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RESEARCH ARTICLE

Role of Essence, Objectives, and Content of Entrepreneurship Education Programs on Their Performance: Moderating Role of Learner Disability in Thailand

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The purpose of this paper was to analyze the role of Essence, objectives, and content of EEP's on their Performance with the moderating role of learner disability in Thailand. Entrepreneurship education programs are developing quickly to facilitate persons to project into an innovative business, raise the amount of "Entrepreneurs" and as well as make an influence on the intention and behavior of entrepreneurs. The present paper applies a quantitative methodology. The researcher of this study selected the sample of the study purposely. The researcher of this paper collected data from educators and students from various universities of Thailand. All the hypotheses of this paper were accepted and has a significant impact on each other. The current research suggests policy makers to be conscious of learner's needs of entrepreneurship education programs performance. This research was limited to the Universities of Thailand. Similar researches in other states and in other universities are required to be carried out by simple random sampling technique to assess entrepreneurship education programs.

Keywords: Entrepreneurship, EEP's, Students, Thailand.

1. INTRODUCTION

In accordance with the researchers, Henry and Lewis [1] and Dehghanpour Farashah [2] education of Entrepreneurship has got its place all over the globe, therefore, a number of states support it to encourage Entrepreneurship. A number of researches demonstrate that "Entrepreneurship" can be educated, taught, or however can be stimulated through teaching or training, which outcomes in decreasing the rate of un-employment and raising the economic development and growth [3, 4]. Thus, it is deliberated as the 1st stage in the activities of entrepreneurship by several stake holders involving "Academicians" and "Policy makers" [3, 5] and researchers [6–8]. The researcher Blenker, Trolle Elmholdt [4] stated that from the side of demand of "EEP's" (Entrepreneurship Education Programs), policy makers depend on providing "Entrepreneurs" whereas learners see it as a chance and opportunity to alter the job marketplaces for self-businesses. However, from the side of the supply of entrepreneurship education programs, scholars depend on creating entrepreneurial communities in order to meet the desires of policy makers and the wants of students. Through inspecting the past researches, it is clear that a number of past researches have concentrated on the side of the supply of entrepreneurship education program [3, 9–12], whereas examining the side of demand [13] shows the needs of the students' to obtain entrepreneurial skills and knowledge [14]. In addition, from institutes, there is a change toward learners in the mission of academies, because students or learners are the key facets of learning the program, who can censoriously evaluate the quality of the program [15–17]. It doesn't mean that institutions of higher education do not impact on learning goals, however assessing policy makers, educators, and students, viewpoints progressively hasten this practice [17]. From the time when entrepreneurship education programs are deliberated as a bridge for learners to get skills of "Entrepreneurship" [4], it is vital to assess the supply side and as well as the demand side of entrepreneurship education program.

The researcher Morris, Webb [9] stated that in accordance with the students of Thailand, absence of a determination of people's professional wants has ensued in a lack of expert "HR" (Human Resource) with practical

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abilities in Thailand. This sort of pattern and as well as not corresponding the fields of universities with the necessity of the worker market in modern era cause a severe issue of un-employment. In addition, nationwide production of Thailand is at a very low-level and a number of corporations are on the edge of shutting, because of the rate of low productivity, absence of "Demand" and the feeble position of competitive of the state in worldwide marketplaces [18]. Therefore, the significance of offering entrepreneurship education program is placed on the program of academies [2]. But, numerous universities and academies are developing the program of entrepreneurship education to increase the propensity of the societies to "Entrepreneurship." In addition, the history of Thailand regarding entrepreneurship education programs, in regard to the state, for example, the United States is at extremely low-level [12, 19]. Thus, entrepreneurship education program can be deliberated as the most dynamic means to enable the transferal of students to self-employment [20]. The (University of Applied Science and Technology), which actually present "Entrepreneurship" as a theoretic subject for all areas of education can considerably play an essential part in this manner. As one of their vital and major goals is to establish a "knowledge based economy" by noticing the needs of labor market and the needs of industry so as to examine the rate of employment and more effectiveness of the community by making "Entrepreneurial" purpose and proposing innovative notions to learners and students [13]. However, it appears that the actions which have been done in the area of entrepreneurship education programs are not adequate to raise the activities of the entrepreneurship [16]. Moreover, the system and the procedures of the universities and academies [12] are focused on the side of supply of entrepreneurship education programs, whereas the learners' wants to take the menace of "Entrepreneurship" in the present economic condition of Thailand has not been deliberated [21]. Therefore, a more comprehensive examination so as to expand and enhance the quality of entrepreneurship education programs is essential to fulfill the needs of the students' needs [2]. Figure 1 shows the entrepreneurship education program offered in Thailand.

1.1. Research Objectives

This research paper includes the following objectives:

- To analyze the impact of Essence of Entrepreneurship Education Programs on Entrepreneurship Education Program Performance;
- To study the mediating role of objectives of Entrepreneurship Education Programs;
- To determine the mediating role of content of Entrepreneurship Education Programs;
- To analyze the moderating role of Learner disability.

2. LITERATURE REVIEW

2.1. Entrepreneurship Education Programs (EEP's)

In accordance with the researchers [3, 5, 9, 10] "EEP's" (Entrepreneurship Education Programs) are programs enhancing entrepreneurial skills and knowledge. The researcher [23, 24] stated that entrepreneurship education programs are developing quickly to facilitate persons to project into an innovative business, raise the amount of

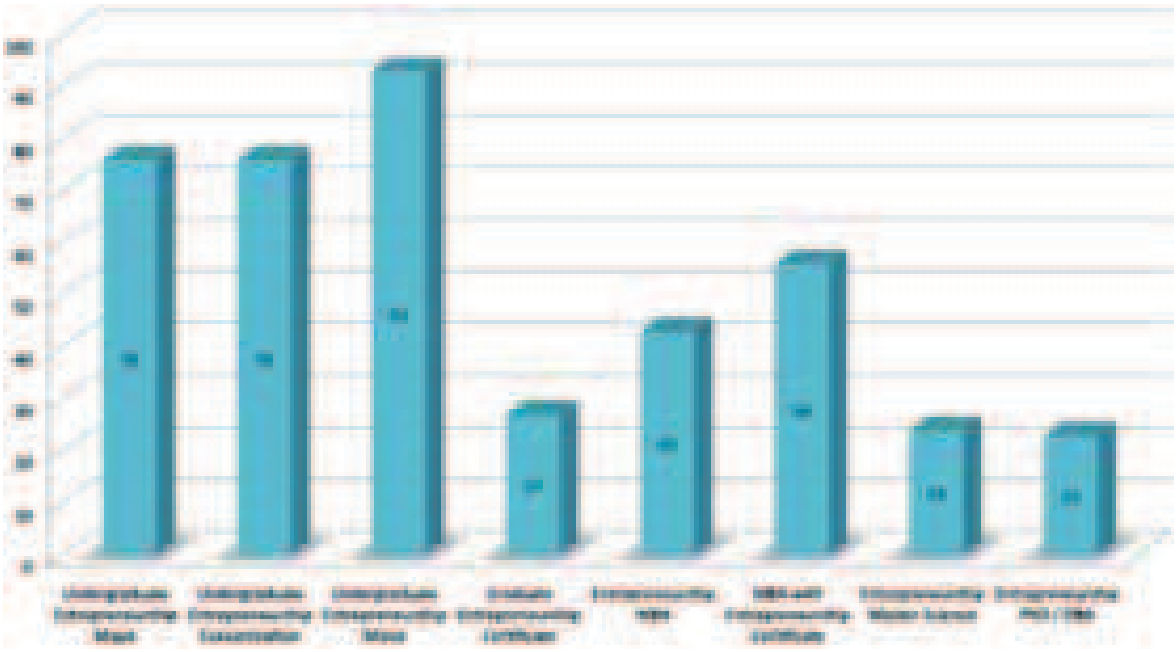

Fig. 1. Entrepreneurship education programs offered in Thailand.
Source: Ref. [22].

"Entrepreneurs" and as well as make an influence on the intention and behavior of entrepreneurs [25]. Entrepreneurship education programs involve a number of components to attain the objectives, however, there is no established model of "ET" (Teaching Entrepreneurship) [26]. Such as, the researcher Matlay [14] stated that entrepreneurship education programs comprise of prospects for learners to follow self-employment. The researcher Ogundele, Akingbade [27] stated that "Content," "Objectives," "Assessment," "Audiences" and "Pedagogies" are elements of entrepreneurship education programs. The scholar Gibb [28] discovered that "Entrepreneurial" academies must teach learners to recognize ecological prospects and opportunities. The researcher Jones and Matlay [29] showed that entrepreneurship education programs comprise of 10 inter-connected systems amongst society, institutes, training process, students and teachers that cause diverse coaching program. The researcher Sánchez [30] demonstrated that entrepreneurship education programs rise the intentions and competences of learners and students. In addition, The researcher Tang, Chen [13] stated that the influence of professors is beyond programs and entrepreneurship education programs. The scholar Jones et al. (2014) stated that deficiency of the theories and foundations of entrepreneurship education program is deliberated as a chance to do a study on "Entrepreneurship Education Program" (EEP's). So as to analyze the influence of entrepreneurship education program, the current research has applied the model which has been shown in Figure 2 and it has been adopted from the mixture of a conceptual model of Refs. [26, 31, 32]. In accordance with the Fayolle [26] in order to become an entrepreneur, entrepreneurship education programs are linked to getting entrepreneurial skills and intention. The researcher Mwasalwiba, Groenewegen [33] claimed that entrepreneurship education programs are linked with forming a business, impacting on community and attaining entrepreneurial abilities. Moreover, the researcher Fulgence [32] stated that the awareness of educators' regarding the essence of entrepreneurship education program has an influence on EPP's performance.

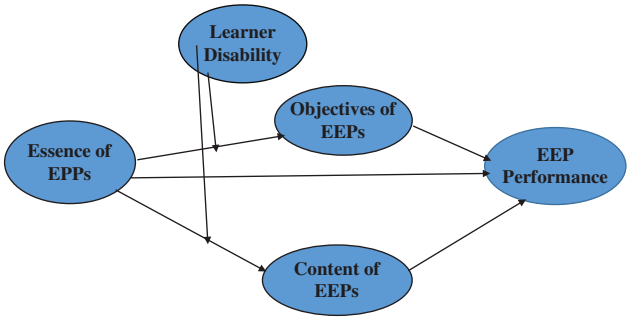

Fig. 2. Framework.

2.2. The Impact of the Essence of Entrepreneurship Education Programs on EPP's Performance

In accordance with the past studies, the education of entrepreneurship makes learners with essential abilities to be self-employed [34], forms entrepreneurial approach, and as well as assist present businesses to be of better-quality [33]. In addition, the essence of entrepreneurship education program has an influence on its content, performance, and objectives [27]. Various methods regarding the essence of entrepreneurship education program lead to different content and objectives which impact on the influence of entrepreneurship education program performance [2].

2.3. The Mediating Role of Objectives of Entrepreneurship Education Programs

In accordance with the researchers Mwasalwiba, Groenewegen [33] and Fayolle [26] the aim of entrepreneurship education program is enhance the skills of persons' for example "Business Management," "Innovation," "Creativity," "Opportunity Recognition" and "Risk Taking" [14] and as well as "Business Formation" [26, 33]. Additionally, they focus on entrepreneurial essence and attitude [26, 33]. In accordance with the researcher the purpose of the entrepreneurship education program is to form entrepreneurial attitude, capabilities, competencies, skills and venture formation amongst the students of Thailand. Additionally, the development of entrepreneurship education program relied on various objectives and has different impacts on entrepreneurship education program performance [32].

2.4. The Mediating Role of Content of Entrepreneurship Education Program

In accordance with the researchers Fayolle [26] and [33] the key contents of entrepreneurship education program are comprised of "Marketing," "Innovation," "Skill of handling resources," "Creativity," "Generating Ideas," "Identifying Opportunities," "Management and growth of business," "Risk Taking," "History of Financial Management and Entrepreneurship," and "Business Plan." Additionally, the content of entrepreneurship education program has a strong and significant impact on entrepreneurship education program performance. So as to attain the objectives of entrepreneurship education program, assessing the performance of these programs is essential to analyze the indicators of the success, for example, getting better the performance of the current business [35–37], novelty in the present business, transfer of technology, inaugurate an innovative business, acquire a perfect result by the learners and as well as an entrepreneurial objective [26, 33] relied on the viewpoints of demand and supply [38]. Academies offering entrepreneurship education program can make learners with the essential abilities to follow opportunities and chances and turn out to be an

"Entrepreneur" [14]. Additionally, there is an association among entrepreneurship education program and activities of learners and entrepreneurial objective [4].

2.5. The Moderating Role of Learner Disability

In accordance with the researcher Dakung, Orobia [39] the disability of the student plays an important role. The researcher Reuel Johnmark, Munene [40] stated that learner disability impacts the performance of the entrepreneurship education program. In addition, the stake holders of the entrepreneurship education program have diverse opinions, choosing the index of assessment of entrepreneurship education program is one of the biggest defies to assess the performance of entrepreneurship education program. The 1st set of them considers that the education of entrepreneurship will result in "Competitive edge [12]," "Self-employment," and "Improvement of marketing," whereas the 2nd set depends on the satisfaction of learners from a better grade on the final-term. Lastly, the 3rd set considers that learners who have appeared in the entrepreneurship education program should attain the abilities to follow their career ambition. So in order to have an effective entrepreneurship education learner ability is much essential. From all the above discussion the scholar of the present study developed the following hypothesis:

H1: Essence of entrepreneurship education program has a significant impact on entrepreneurship education program performance.

H2: Objectives of entrepreneurship education program significantly mediates the relationship between different constructs.

H3: Content of entrepreneurship education program significantly mediates the relationship between different constructs.

H4: Learner Disability significantly moderates the relationship between different constructs.

3. METHODOLOGY

3.1. Research Method

There are different research methods, for example, quantitative, mixed and qualitative. In this study, the researcher of the study used a quantitative study. The method of quantitative is linked with numbers and in this method researchers normally use questionnaires to collect data from research participants. In this study, the researcher of the study used this method because the findings of this papers are also in the form of numbers and the researcher of the study used questionnaire technique to collect data from research participants. Therefore this method has been selected by the researcher.

3.2. Sampling

The experts, educators, and students of entrepreneurship education program are considered as the sample of this study. The researcher of the study collected data from students and educators of the entrepreneurship education program. The writer of this study collected data from almost 281 respondents. So the sample size of the present study is 281. There are different techniques of sampling, in this study the scholar of the research paper used purposive sampling technique. The researcher of the study selected this technique because the writer purposely gathered the data from educators and students of Thailand.

3.3. Data Collection

As the purpose of the study is to assess the entrepreneurship education program from the viewpoints of educators and students of universities. There are different techniques and methods of data collection. However, in this study, the researcher of the study used questionnaire technique. This technique also has some advantages such as this technique is very useful for collecting data from a large sample size. Furthermore, it also has few flaws, for example, costly and time consuming. The researcher of the study self administered the survey questionnaire. The researcher of the study adopted questionnaire of different authors and designed the questionnaire of the present study. The researcher collected data from students and educators of different universities of Thailand. Almost two hundred students and a hundred educators were requested to take part in the survey. The questionnaire of this study was based on (5 Point Likert Scale), where, (1-Strongly Agree) to (5-Strong Disagree).

3.4. Data Analysis

The analysis of this study performed on SPSS software. This software stores the questionnaire electronically. Therefore the researcher of the study used this software.

Table I. Psychometric properties.

Latent variables	No of items	Cronbach alpha	Factor loading
ES	3	0.917	.801, .809, .797
LD	10	0.974	.653, .756, .816, .815, .91.820, .821, .815, .831, .812
OB	5	0.923	.795, .812, .835, .803, .797, .795, .796, .790, .783.
CON	9	0.921	.739, .789, .786, .791, .781
EP	6	0.950	.732, .749, .769, .797, .807, 836

Table II. Convergent and discriminant validity.

	CR	AVE	MSV	CON	ES	LD	OB	EP
CON	0.963	0.744	0.415	**0.863**				
ES	0.733	0.478	0.016	−0.125	**0.691**			
LD	0.965	0.732	0.398	0.578	−0.021	**0.855**		
OB	0.947	0.781	0.415	0.644	0.060	0.631	**0.884**	
EP	0.941	0.727	0.382	0.618	−0.055	0.596	0.607	**0.852**

Table III. CFA.

Indicators	CMIN/DF	GFI	IFI	CFI	RMESA
Threshold range	<3 or 5	>.80	>.90	>.90	<.08
Observed values	2.060	.810	.944	.944	.062

The researcher of the study used different tests such as descriptive statistics test, regression test, and correlation test. The researcher also used AMOS software.

3.5. Ethical Approaches

The investigator of this paper kept in mind the ethical approaches. The researcher assured the research participants that all the information and data they have given to research writer will be kept secret. Moreover before adopting the scale of author scholars the researcher of this paper obtained permission from them. The researcher also obtained permission from research gate-keepers such as the writer of this paper obtained permission from the administration of the university.

4. RESEARCH FINDINGS

This study based in Thailand context and data is collected from the 281 respondents. The findings show that 117 male and 164 females participated in the study. The age of the respondent from 20 years to 25 years have a frequency of 242 respondents, 25–30 years range have 42 respondents, 31–40 years range have 09 respondents and remaining are greater than 40 years. Moreover, 23 respondents are undergraduate, 134 are graduate, 114 are master and remaining 10 have other education.

4.1. Factor Analysis and Reliability Test

The following Table I shows the factor loading of each construct and reliability value which is measured with Cronbach alpha.

The above-mentioned Table I shows the reliability of each construct which is checked by running the test of Cronbach Alpha. Cronbach Alpha presents the internal consistency of each item for each construct. The Cronbach alpha value for all constructs is more than .70 which prove the reliability of the data.

4.2. Convergent and Discriminant Validity

Convergent validity is the validation of items wise for constructs which prove the internal consistency of the data whereas, discriminant validity shows the discriminant of a variable from others, Statistical tool packages used to identify the convergent and discriminant validity of the data finding are above in Table II.

Value of composite reliability and average variance excreted confirm the issue of convergent validity whereas the remaining column shows the discriminate validity of the data. Composite reliability for each constructing has value more than .70 and value of MSV is less than AVE, so it proves the convergent validity and other remaining column shows that every construct has more value for itself rather than others which proved the discriminant validity of the data.

4.3. Confirmatory Factor Analysis

The test of confirmatory factor analysis is used to identify another model of this study is good fit or not. There are 4 to 5 indicators which proved the model fitness and their threshold and observed values are shown in Table III.

The results of above-mentioned Table III presenting that all values are under the threshold range, i.e., the value of CMIN/DF for the current data is 3.168 which is less than 5.0, GFI, .81, which is greater than .80, IFI and CFI are .944 which are greater than .944, and last but not the least RMESA is .06, which is less than .08. So, means that the model of the study is a good fit. Following is a Figure 3 of CFA in AMOS.

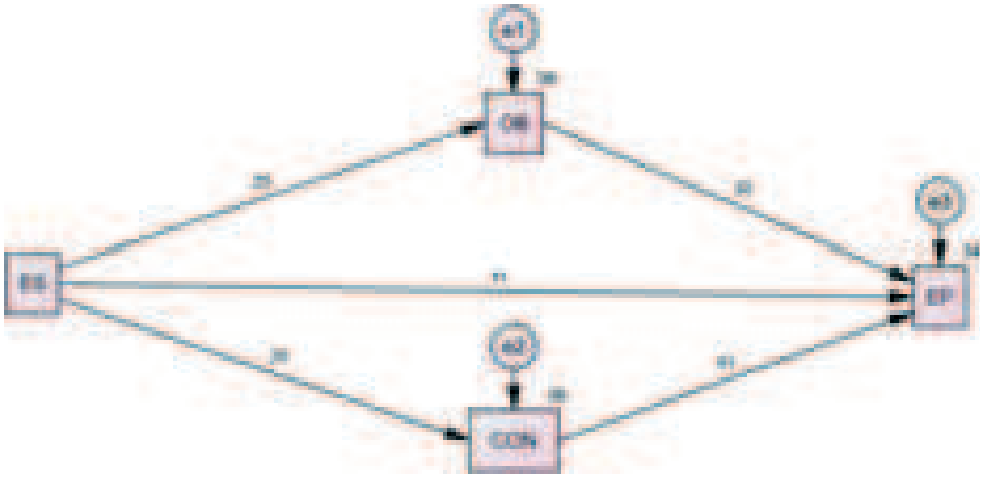

Fig. 3. SEM.

Table IV. Structural model results.

Effects	Hypothesized path	*B*	S.E	*P* value	Conclusion
Linear effects					
Hypothesis 1 (+)	ES→EP	.106	.078	.040	Accepted
Mediation effect					
Hypothesis 2 (+)	ES→ OB→EP	.317	.046	.000	Accepted
Hypothesis 2 (+)	ES→ CON→EP	.414	.046	.000	Accepted
Moderation effects					
Hypothesis 3 (+ ↑)	ES∗LD→OB	.097	.049	.056	Rejected
Hypothesis 5 (+ ↑)	ES∗LD→CON	.244	.046	.000	Accepted

4.4. Structural Equation Modeling

In order to test the study hypotheses structural equation modeling by using AMOS was performed, because SEM has a feature of multiple regression and can test the entire model at the same time in one shot. Table IV presenting the regression weights of each construes on another, and indicate the conclusion of the hypothesis.

This test is chosen by the researcher as it approximates the multiple and interconnected reliance in a particular examination. Above presenting Table IV showing the results of structural equation modelling, ES has positive and significant impact on performance, objective and content also significant mediates between Essence and performance, while the learning disabilities has insignificant moderating role between essence and objective but significant between essence and content. The following Figure 3 show the SEM. Figures 4 and 5 show the moderating effect.

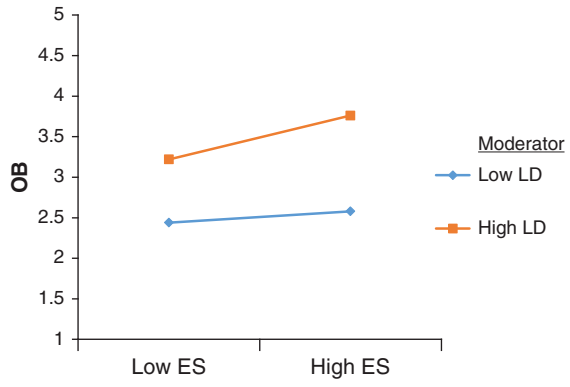

Fig. 4. Moderation impact of LD between ES and OB.

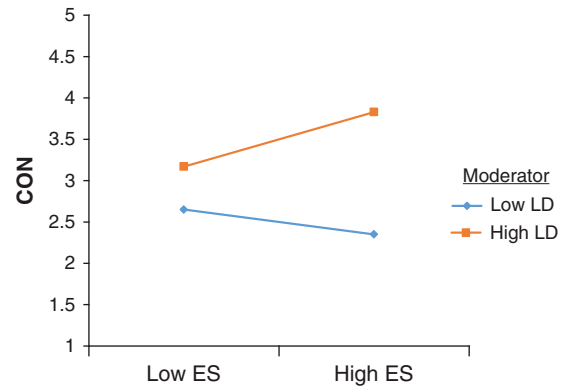

Fig. 5. Moderation impact of LD between ES and CON.

5. DISCUSSION

All the hypothesis of the study is accepted and are supported by past researches. In accordance with the past studies, the essence of entrepreneurship education programs impacts on content, objectives, and entrepreneurship education programs performance. Content, objectives, and performance [2], are in the impact of the essence of entrepreneurship education programs; therefore, the essence of entrepreneurship education programs differentiates content, objectives, and performance of entrepreneurship education programs [32]. In accordance with the scholar Fulgence [32] identifying objectives and inspecting the content of entrepreneurship education programs by instructor's consequences in innovativeness and creativeness in designing proper approaches and enhancing the performance of entrepreneurship education programs. The performance of entrepreneurship education programs must be according to the content and objectives of entrepreneurship education programs. The researcher Farsi, Modarresi [12] stated that the content and objective of entrepreneurship education programs analyze the performance of EEP's. The learner disability moderates the relationship among different constructs. The findings of the study demonstrate that learner disability plays a major role in influencing the performance of entrepreneurship education programs [41–55].

6. CONCLUSION AND IMPLICATIONS

The purpose of this paper was to assess the entrepreneurship education program from the perspectives of educators and students perspective through model illustrated in Figure 2. In accordance with the findings of the study, the essence of entrepreneurship education program impacts on the entrepreneurship education program performance. The universities of Thailand that offer entrepreneurship education program, learners are not pleased with the approaches, whereas instructors think that the essence of entrepreneurship education program has an impact on entrepreneurship education program performance. The belief of students regarding the impact of entrepreneurship education program on the entrepreneurship education program performance demonstrates the significance of improving the performance of entrepreneurship education program. Thus, lectures by the guest speakers and instructors are not adequate approaches to fulfill the needs of students' needs regarding entrepreneurship education program. Therefore, this paper suggests the policy makers to be conscious of the needs of the students from entrepreneurship education program performance,

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also notify instructors of efficient and initiative techniques to improve the influence of entrepreneurship education programs. Therefore, the effective, better and improved approaches of entrepreneurship education program might be useful to raise the influence of entrepreneurship education program performance. Using particular techniques of entrepreneurship education program can't always ensure the influence of entrepreneurship education program performance [20].

Therefore, creative and practical techniques for example, "Interviews with businesspersons," "Problem solving practices," "Games" "Stimulations," "Case Studies," "Projects of Consulting" and an entire range of other experimental tools of learning might play an important part to satisfy the needs of students from entrepreneurship education program techniques. In addition, instructors should have degree or background of entrepreneurship [1], due to this type of instructors can significantly comprehend the impact of essence of entrepreneurship education program on the entrepreneurship education program performance and methods. This paper will enrich the literature regarding entrepreneurship education program in the context of Thailand. This paper will be helpful for the number of educators as from this paper they will know that how much the education of entrepreneurship is important.

7. LIMITATIONS

In this paper, there are few limitations. Such as in this paper the sample size is small. So the investigator of this paper suggests future writers use big sample size. This study was carried out in the context of Thailand, thus, the writer of this paper recommends future scholars to conduct a study in another state. This paper used a quantitative method, so it is suggested to future researchers to use the qualitative or mixed method. In addition, different mediators can also be added to the current framework such as the efficiency of EEP method, so further researches should consider other mediators as well.

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RESEARCH ARTICLE

Driving an Entrepreneurial Mindset and Intentions Through Entrepreneurial Education in Thailand with the Mediation of Entrepreneurial Inspiration

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This research was intended to examine the influence of "EE" (Entrepreneurial Education) on learners' "EM" (Entrepreneurial Mindsets) in higher-education in Thailand. Utilizing a mediating model, the present study focuses "Entrepreneurial Mindset" as a new effect of entrepreneurial learning or education and states the lack of study on the association among entrepreneurship education and entrepreneurial mindsets. Relied on 267 respondents from various campuses in Thailand, this paper demonstrated that the effect of entrepreneurship education on entrepreneurial mindsets is significant. Entrepreneurial education considerably enriched the entrepreneurial inspiration of students, which in-turn, supported the creation of learners' entrepreneurial mindset. At a significant level, entrepreneurial inspiration as well as mediated the effect of entrepreneurship education on EM. The involvement and intention of students' in EE create a significant effect on their EM which favors the role of learning experience in the EE and EE connection. This paper results also contribute to theories of EE and EM and mainly to the comprehension of not just either, though as well as how EE impacts EM in the settings of higher educational institutions. The consequences of the current paper can support to notify the forthcoming assessment and design of the programs of EE.

Keywords: Entrepreneurship, Education, Intention, Mindset, Inspiration, Thailand.

1. INTRODUCTION

A number of economists and strategy designers have shown that "Entrepreneurship" plays a significant part in stimulating commercial innovation and growth [1, 2]. The findings of the earlier studies demonstrate that entrepreneurship of higher level may be attained via "Education." In accordance with the researcher's Neck and Greene [3] and Fayolle [4], the learning and education of entrepreneurship programs has consequently gone through a speedy and worldwide expansion within the system of higher-education from the past few years. The current study investigates a new entrepreneurial education influence through emphasizing "EM" (Entrepreneurial Mindset), which is deliberated as the more profound phenomena of cognitive reflecting "Intellectual Structures" [5]. The researcher Lackéus [6] stated that this structure actually shows the mode of thinking, which makes business persons and entrepreneurs very distinctive in the entrepreneurial doings. According to Kriewall and Mekemson [7], an entrepreneurial mindset allows persons to think, consider and perform entrepreneurially as it reinforces effective forthcoming plans. The basis of entrepreneurial mindset actually lies in intellectual adaptableness, which is essential to attain the required results pursuing entrepreneurial act. According to in spite of its supposed significance, the study of an entrepreneurial mindset is yet emerging. The current researches of entrepreneurial education influence have mostly investigated entrepreneurial inspiration and very little researches have investigated the connection among EM and EM. The deficiency of study into an EM has been highlighted recently by the researchers [5, 8]. The entrepreneurial mindset is strongly linked with prospect and identification that underlies at the central point of "Entrepreneurship" and may direct entrepreneurial accomplishment [9]. Associating the link among entrepreneurial education and entrepreneurial mindset would, therefore, contribute to a thorough comprehension of the extent and scope of entrepreneurial education influence [10]. In addition, it is vague about how the entrepreneurial mindset changes during the course of education. The emotional aspects are perhaps vital for the creation of an entrepreneurial mindset as "Affective" actions play an

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important and significant part in entrepreneurial education and as various designs of learning can produce affective actions that sequentially stimulate entrepreneurial capabilities [6]. Though, emotional variables are infrequent in the study of entrepreneurial education [11]. The researcher stated that a probable "Emotional" mediator among EE and EM is "EI" (Entrepreneurial Inspiration) a gap for the scholars of entrepreneurial education looking for the sentimental drivers of an EM. Furthermore, in higher educational institutions, the efficiency of EE, whereas mainly optimistic, has demonstrated few diverse outcomes [12]. All these opposing results might be because of the intention, for example researches have demonstrated that entrepreneurial intention can impact learners' entrepreneurial inspiration. Consequently, the current works shows the prospect for the present research to also investigate the role of entrepreneurial intention, which shows circumstantial aspects of entrepreneurial education. Contrasted to business learning programs, the area of "Entrepreneurship Education" (EE) is yet comparatively new and not much investigated in the context of Thailand. Yet, it has not emerged as a comprehensively recognized mode of teaching with the finest practices [13]. In addition, all the stake holders of entrepreneurial education might be ignorant of how the programs entrepreneurial education influence the learning outcomes of students. It is thus appropriate and useful to examine the connection among EE and EM within higher education of Thailand. This research highlights the entrepreneurial mindset as an innovative kind of influence and therefore enlarges the entrepreneurial education influence frame-work through checking the direct effect of EE on the EM. The more educational value is added through examining the role of intention and the mediating role of inspiration that will give new visions into the influential aspects of an entrepreneurial mindset and make deeper the comprehension of either and how entrepreneurial education impacts entrepreneurial mindset. The study provides new comprehensions for the instructors, scholars of entrepreneurial education.

1.1. Research Objectives

This paper includes the following objectives:

- To analyze the effect of entrepreneurship education on entrepreneurial mindset;
- To study the effect of entrepreneurship education and entrepreneurial intention;
- To study the mediating role of inspiration between education and mindset;
- To determine the mediating role of entrepreneurial inspiration among EE and entrepreneurial intention.

This paper consist of five sections, first of all, the researcher discussed the introduction of the study, then did the literature review. After that researcher mentioned the methodology of the study and then interpreted the results of the study at the last of the current paper the researcher discussed the results of this paper and concluded the entire study along with research implications and limitations.

2. LITERATURE REVIEW

2.1. Theory

So as to define the connection between learners "Entrepreneurial Mindset" (EM) and "Entrepreneurship Education" (EE), this study follows the "SCT" (Social Cognitive Theory) which exposes connections between cognitive (personal) constructs, ecological aspects, and behaviors in the functioning of human. The researcher stated that social cognitive theory might provide a comprehensible context so as to comprehend EE holistically from the perspective of intellectual mindset. The researcher Winkler [15] implemented the theory of social cognitive into the framework of EE and created a vibrant framework for entrepreneurial education influence investigation, which adds to the examination of how ecological aspects of entrepreneurial education learning impact the cognition of students and consequent entrepreneurial behavior. The researcher Winkler [15] additionally recognized ecological aspects for example educational subjects, educational learning experiences and intellectual aspects for example intention and self efficacy. Assumed that entrepreneurial education might consequence in sentimental altering and shift in mind and that EM is a "Meta-Cognitive Function," Entrepreneurial Mindset is thus a type of intellectual individual construct impacted through ecological constructs within entrepreneurial education. Figure 1 highlighted the research framework of the current study.

2.2. EE and EM

The researcher stated that the concept of mind-set devises from the fields of "Cognitive Psychology." Mind-sets are not inborn as they can be learned and impacted by a person's previous awareness and the connection with the present situation. Bellotti, Berta [16] explained "Entrepreneurial Mind-set" (EM) as the capability to quickly feel, act, and organize, although in extremely ambiguous situations.' The researcher Shepherd, Patzelt [17] described EM as the willingness and capability of persons to quickly feel, proceed, and organize in reaction to a verdict under ambiguity regarding a potential prospect for achievement. According to Packham, Jones [18] as a type of meta-cognition, EM can be developed via training, teaching and can be deliberated as a mind-habit, which necessitates education to form. Relied on the mixed comprehension of those descriptions of EM, there are 4 elements of EM. The first one is (Alertness to Opportunity), the second is known as (Risk Propensity), the third is known as (Ambiguity Tolerance), and the last one is referred to as (Dispositional Optimism). The researcher as well as stated that

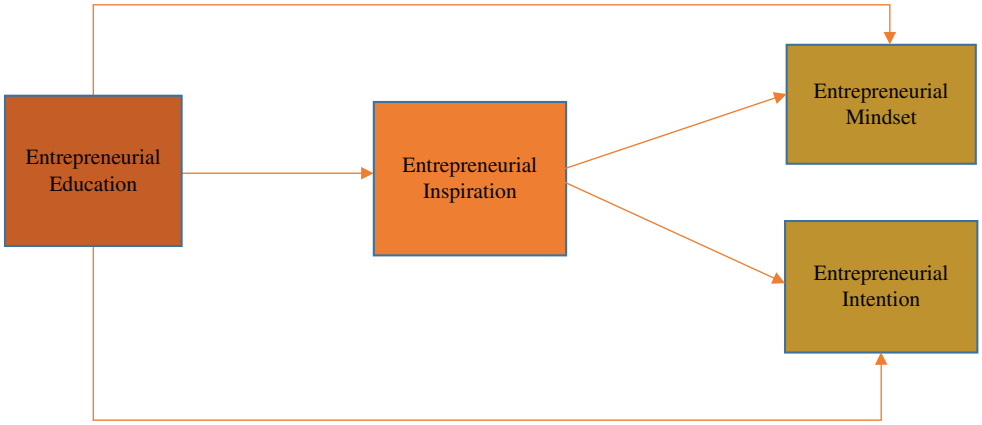

Fig. 1. Research model.

the development of the 4 particular mind-sets are strongly linked with EE. A number of researchers approved that "Alertness" includes a mind-set relied on numerous processes and abilities for example, previous information, skills of information processing and pattern identification. The researcher of the study claim that this information and abilities on which "Alertness" relies might be developed and learned through "Education." In accordance with the researcher Tang, Kacmar [19] seek opportunity and look for alert-scanning signify the growing experience and learning in the developing process of cognition. Thus, EE is one of the factors of (Alertness to Opportunity). The researcher İlhan Ertuna and Gurel [20] identified a significant linkage among joining EE in college and raised the propensity of risk-taking. The researcher Neneh [21] discovered that education might develop aspects such as risk-taking that forms an entrepreneurial mindset. The researcher Sánchez [22] stated that the program of education for the students of engineering and science had an optimistic influence on the entrepreneurial capabilities of learners containing risk-taking. The researcher of the study thinks that "Ambiguity Tolerance" is a vital component of an EM. The researcher Lackéus [6] discovered that entrepreneurial education which is action-based has an influence on the creation of "Ambiguity Tolerance" via particular sentimental actions. Furthermore, the researcher Seikkula-Leino [23] stated that entrepreneurs require to have higher level of (Ambiguity Tolerance) as business events are unanticipated. The researcher stated that if business man or people are very easy-going with uncertainty then they see the situations of ambiguous as challenging and promising, in spite of disappointing and stressful. According to Pollard and Wilson [24], dispositional optimism can be effectually enhanced and measured in the courses of entrepreneurship. This proposes that EE is linked with the EM and it can be presumed that it might be enhanced and raised via targeted learning or education.

H1: *The impact of EE on EM is significant.*

2.3. Entrepreneurial Education (EE) and Entrepreneurial Intention (EI)

The past studies discovered that towards entrepreneurship, "Entrepreneurial Education" (EM) can impact the intention of students [25]. Moreover, the researcher Zhang, Duysters [26] discovered that learners who take part in the programs of entrepreneurship were more probable to commence their own business as compared to other learners. The researcher Sánchez [22] have as well as argued that the students of the university within the field of business whose main domain is "Management" have been exposed to have a more promising careers views in the small arena of business, mainly as the environment of working permits them to play a major role in decision-making. Furthermore, according to Fayolle and Liñán [27] involvement in the program of entrepreneurship considerably raised the perceived viability of beginning a business. The researcher Bae, Qian [25] as well as stated that graduates students in the area of entrepreneurship are much probable to establish ventures and had a greater intention and a much established view of effectiveness. As said by, EE and the support of the University of entrepreneurship had a significant effect on "Entrepreneurial Intentions" and also proposed that deficiency of EE directs to lower "Entrepreneurial Intentions" of learners. The programs of EE are a major basis of "Entrepreneurial Attitude" and general intents to become a forthcoming industrialist.

H2: *EE has a significant effect on EI.*

2.4. The Mediating Role of Entrepreneurial Inspiration (EI) Between Entrepreneurial Education (EI) and Entrepreneurial Mindset (EM)

In accordance with the researcher İlhan Ertuna and Gurel [20] affective expansion associated to emotions, moods, and feelings is a vital source to the course of learning of "Entrepreneurship" that is frequently ignored in the study of entrepreneurship. In accordance with the study of Loon and Bell [28] feelings have been discovered

to moderate the association between cognitive skills and knowledge. The researcher discovered that members in the program of entrepreneurial education covering a trained element and an applied element in the 1st year students, revealed greater inspiration through distinction to non-entrepreneurial education counter parts. Entrepreneurial education is important in the creation of inspiration as entrepreneurial education official subjects or outside activities of the classroom supposedly involves educational triggers that drive learners to be stimulated and inspired towards the aim of becoming an "Entrepreneur." Such as, a view of instructor's in the course of entrepreneurship or contributing to the activities of entrepreneurship might alter learner's cores of loving entrepreneurship as well as minds of becoming more entrepreneurial. "Entrepreneurial Inspiration" (EI) is probably to be a vital variable such as an influence mechanism of entrepreneurial education, and as well as the predictor of another influence actions. This proposes that inspiration might be a mediating construct in the relation between entrepreneurial education and entrepreneurial mindset. EI plays a role of mediation in the association of EE and EM. The researcher Nabi, Liñán [5] examined the inspirational function in the creation of entrepreneurial inspiration in 1st-year learners at the University of UK. The study discovered that practical and theoretical inspiration was closely linked to a rise in entrepreneurial inspiration.

H3: *Entrepreneurial Inspiration significantly moderates the association among EE and EE.*

2.5. Mediation of Entrepreneurial Inspiration (EI) Among Entrepreneurial Education (EE) and Entrepreneurial Intention (EI)

The researcher Karimi, Biemans [29] stated that elective programs of EE had a huge effect on the intention of learners and opportunity identification as compared to required ones. The researcher Bae, Qian [25] stated that learners with an actual attentiveness in a course are much probable to elect into learning an non-compulsory subject, while the concern of learners joining on essential subjects might be difficult to recognize. This may propose that learners who select an optional course of entrepreneurship are more inspired, engaged and interested. The past study discovered that educational boredom adversely influence intention, education, and attainment and optimistic sentiments assist intellectual education [28]. Hence, the non-compulsory subject exerts more impact on learners' knowledge outcomes containing intention. As mind-set and intention is a kind of profound cognitive education result linking to minds and hearts, it could be established through sentimental alteration for example "Inspiration" [30–32]. The study of found that entrepreneurial inspiration mediates the connotation between EE and EI.

H4: *Entrepreneurial Inspiration significantly mediates the connection between EE and EI.*

3. METHODOLOGY

The current research used a method of convenience sampling, extensively used in researches of "EE" [33, 34]. The researcher if this paper gathered data from almost fifteen higher-education institutes in Thailand, selected because the local government of Thailand has applied the reform of EE and Innovation in order to encourage the local expansion in society and economy. Individual, geo-graphical and Institutional distribution was deliberated so as to lessen bias. The sampling institutes have generally presented entrepreneurial components assimilated in the program of under graduate. The fifteen institutes involve six universities, six vocational institutions and three colleges in which "EE" (Entrepreneurial Education) covers optional and required subjects in the class room. Institutes were chosen from various areas of the province of Tak, Eleven of the institutes were from the North, three were from the East, and one institute was situated centrally. The scholar of this paper conducted a survey which is based on a questionnaire so as to collect data. The researcher of the paper tested the questionnaire earlier to the survey by e-mail on twenty learners from various institutes. Respondents in the survey were anonymous and voluntaries. The scholar of the study gathered almost 300 responses from

Table I. KMO and bartlett's test.

Kaiser-Meyer-Olkin measure of sampling adequacy	.960
Bartlett's test of sphericity	
Approx. Chi-Square	8392.954
df	465
Sig.	.000

Table II. Data reliability.

Variable	No. of items	Cronbach alpha
EE	12	.931
EI	6	.902
EM	11	.937
EI	2	.833

Table III. Discriminant and convergent validity.

	CR	AVE	MSV	MS	EE	EI	IN
MS	0.968	0.732	0.489	**0.855**			
EE	0.968	0.716	0.402	0.634	**0.846**		
EI	0.937	0.714	0.489	0.699	0.633	**0.845**	
IN	0.780	0.520	0.017	−0.129	−0.036	−0.079	**0.721**

Table IV. CFA.

Indicators	Threshold range	Current values
CMIN/DF	Less or equal 3	2.357
GFI	Equal or greater .80	.803
CFI	Equal or greater .90	.930
IFI	Equal or greater .90	.930
RMSEA	Less or equal .08	.071

Table V. Structural equation modeling.

Total effect	EE	IN
IN	.711**	.000
EI	.868***	.332**
MS	.891***	.327**
Direct effect		
IN	.711**	.000
EI	.632**	.332**
MS	.658**	.327**
Indirect effect		
IN	.000	.000
EI	.236**	.000
MS	.233**	.000

Note: ***, **, * indicate level of significance at 1, 5 and 10 percent.

the survey. Any questionnaire which was submitted and responded in less than five mins or which were replied with un-qualified names of institutes were rejected. The final size of the sample was 267. All dependent and independent constructs were measured utilizing present tools of measurement or adapted from present measures.

3.1. Empirical Finding

From 267 respondent's data was collected, the target respondents of the study are the students of entrepreneur programs. In this study 110 male and 157 females were participating, mostly respondents are the younger age, 116 respondents have less than 30 years of age. There are 126 respondents are the students of the bachelor program, while 108 respondents studying a master's degree.

3.2. Reliability and Suitability of the Data

The reliability of the data was analyzed with the help of Cronbach alpha while suitability is tested by the KMO test by using SPSS which is shown in Table I.

More than .60 the value of KMO is considered as good fit for data suitability of data for major analysis, now the current value is .96 is more reliable and good fit. Additionally, Table II highlighted the data reliability.

The outputs of the Cronbach alpha test shows that every variable has value more than .70, while the minimum value of Cronbach alpha must b.70 is required, so our data has excellent reliability outcome. Discriminant validity is shown in Table III.

3.3. Discriminant and Convergent Validity

Discriminant validation of the data is required to judge the multicollinearity problem of the data, while convergent validity is obtaining to analysis the internal consistency of the constructs. Discriminant validity is checked by seeing the CR and AVE value if the CR is greater than .70 and AVE more than .50 the validation is okay. The current finding shows that all contracts have more than, 70 CR value and value of AVE is also greater than .50 for all constructs. Other remaining parts of the Table III prove the convergent validity of each construct because all variable has more value for itself as compared to others.

3.4. Confirmatory Factor Analysis

CFA is the test which provides the ultimate indicators to assess the fitness of the research model, the following are the outputs and threshold values of assessing the model fitness, as highlighted in Table IV.

The value for the current study shows that all indicators are accepted, and research model is a good fit.

3.5. Structural Equation Modeling

Following are the results of SEM which indicated the hypothetical effect of the construct as highlighted in Table V.

The effect of entrepreneurial education on intention is positive and significant. The total effect of entrepreneurial education on entrepreneurial mindset is positive and significant which meant that if one unit of EE increased it will

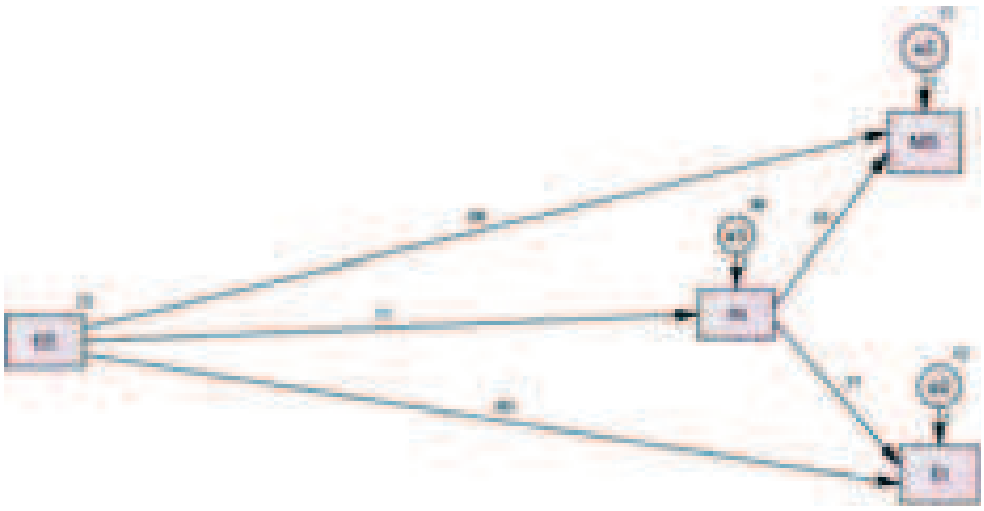

Fig. 2. SEM.

bring 60.5 percent positive impact on the entrepreneurial mindset. However, the direct effect of entrepreneurial on inspiration is insignificant, but the impact of inspiration on mindset is positive and significant. Moreover, the entrepreneurial inspiration also has a positive and significant impact on entrepreneurial intention. Which mean that if one unit of inspiration has been increased it will bring 59 percent positive and significant impact on entrepreneurial intention. The following Figure 2 present the screenshot of SEM when it was run in the AMOS, this Figure 2 shows the impact of each contract on another with standardized beta values (please see Fig. 2).

4. DISCUSSION AND CONCLUSION

The findings demonstrate that EE has a significant impact on the EM and develops student's inspiration. This is coordinated with the discoveries of Ref. [21]. The current study shows that learning is a major and driving predecessor in the development of the mind of learners. The findings demonstrated that entrepreneurial education has an optimistic influence on "EI" (Entrepreneurial Inspiration), which in-turn optimistically impacts 4 particular mind-sets of learners. This is coordinated with the study of Ref. [35]. This study demonstrated that entrepreneurial inspiration might inspire learners to make their mind-set and intentions more entrepreneurial. The researcher in this paper as well as discovered that the entrepreneurial inspiration significantly mediates the connotation between EE and EM. The results of this are coordinated with the study of. The results illustrated that entrepreneurial inspiration significantly mediates the connotation between EE and intention. In short, all the hypothesis of this paper has been approved and all are supported by previous studies. The current study was intended to investigate the influence of "EE" on learners' "EM" in higher educational institutions in Thailand. So as to reach the aim, the model of mediating was constructed to discover the association among entrepreneurial education and entrepreneurial mindset utilizing a study of cross sectional to gather data, which supported the framework and also the measurement model. EE impacts entrepreneurial intention and inspiration, which in-turn rouses learners' entrepreneurial mindset, confirming the role of mediation of "EI." The involvement and intention of students' in EE create a significant effect on their EM which favors the role of education experience in the entrepreneurial education and entrepreneurial mindset connection.

5. STUDY IMPLICATIONS

The consequences of this paper are vital for the strategy designers from higher-education and government institutes. First of all, it approves the importance of entrepreneurial education initiatives by the universities and government, which boosts policy makers of the government to support colleges and universities with more finance to assure entrepreneurial education is reachable to each and every learner. In addition, as entrepreneurial education is supportive to develop learners' intention, mindset and inspiration, it must be assimilated into the comprehensible frame-work of wide-ranging education and learning in the institution of higher education so as to make more entrepreneurial learners for forthcoming learning, living, and work. Furthermore, as inspiration seems to be a vital advantage from entrepreneurial education and a close predictor of an entrepreneurial mindset, the designers or planners of education might concentrate more on inspirational activities within courses [36–50]. In conclusion, extra-curricular activities are very effectual, these must be introduced along with compulsory entrepreneurship learning and education. Consequently, the implementers and developers of university program should pay more consideration to voluntary and active activities associated with entrepreneurship. Moreover, the current paper will enhance the literature on the area of EE, mindset, inspiration, and intention, which would be very helpful for further studies and scholars.

6. LIMITATIONS AND RECOMMENDATIONS

In this paper, the data used was gathered from different institutes where the approaches of teaching were potentially diverse. This permitted for the simplification of results, however further studies might view at the efficiency of various methods of teaching and educational approaches in the state of Thailand. It is recognized that while the conclusions and findings in the current paper have relied on the cross sectional study, a quasi-experimental design or longitudinal research with a focus group will probably provide new perceptions into the association between entrepreneurial education and entrepreneurial mindset.

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RESEARCH ARTICLE

Can Entrepreneurial Motivation Mediate Between Entrepreneurial Education, Training, and Its Intention? An Empirical Study of Thailand

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Entrepreneurs take a huge involvement in national economic development. Emerging person's importance into new business formation signifies a significant advantage, particularly for less emerged nations where entrepreneurial actions are essential in developing an economic expansion. The current economic crisis turned the concentration of policymakers of Thailand to entrepreneurial education as a motivating strength for the generation of new employment examines local or nationwide competitiveness. The study aim is to examine the association between EE and EI, ET and EI, and to find out the mediation impact of EM. In order to inspect the EE, entrepreneurial training, entrepreneurial motivation and entrepreneurial intention in the setting of Thailand, this study utilized a quantitative approach dependent upon the respondents to the questionnaire conducted on a sample of 263 students of the engineering university of Thailand. From the practical standpoint, 4 hypotheses were created and examined utilizing regression analysis results, mediating effects, internal consistency, and reliability of the constructs. The outcomes of the study revealed that all the hypotheses are supported. Finally, implications are provided which could assist the entrepreneurs of Thailand involved in boosting the efficiency of activities objected at increasing the success of the business.

Keywords: Entrepreneurial Education, Entrepreneurial Intention, Entrepreneurial Motivation, Entrepreneurial Training, Thailand.

1. STUDY INTRODUCTION

Entrepreneurial education (EE) is the key facet of the growth of the economy and practical play and provides the prospect of societal climbing to a variety of parts of the population (Chienwattanasook and Jermsittiparsert, 2019). Entrepreneurship motivation plays a substantial role in the economy as a mechanism of improvement and employment generation [1]. The current economic catastrophe turned the consideration of Thailand's policymakers towards entrepreneurial education as a medium for economic improvement and expansion. Current researches demonstrate that small companies make up nearly seventy to ninety five percent of all companies and use more than one-third of the whole private workforce, making entrepreneurship and small business firms as the key features in combating in opposition to societal exclusion and redundancy [2]. Entrepreneurial education has significant roles in a nation's development and economic growth by increasing entrepreneurial motivation and entrepreneurial training [3]. The appearance of entrepreneurial intentions and entrepreneurial motivation is of the greatest significance as the procedure signifies the primary stage in essentially generating a venture. On the whole, entrepreneurial intention signifies a psychological state that is able to turn entrepreneurial activities into definite entrepreneurial motivation. As a result, EE, ET, EM, and EI have attained a noteworthy consideration in various domains of research and practice. Various researches have concentrated on the significance of EE and ET in anticipating individual's intention in different countries and contexts. This has inclined to an emphasis on examining the entrepreneurial motivation determinants by researchers and business practitioners in numerous nations in order to contribute to an improved understanding on how such stimulations grow [4]. Different investigators have attempted to recognize the highly significant factors of EM by examining a variety of patterns of contextual constructs. Liñán, Rodríguez-Cohard [5] have

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observed a significant association between EE and EI. Other than the cognitive structure that signifies the incorporation of individual aspects of EM, ET, EI, and EE correspond to another significant study domain in examining entrepreneurial determinants. From this class, gender disparities in the likelihood of commencing a venture emphasize on the most studied research subject in the literature [6]. Even if in the past research, individuals have been observed to show a highly positive behavior towards entrepreneurship and a greater entrepreneurial intention of starting up a new business or venture, the experimental support is still restricted and not wholly certain [7]. Figure 1 shows the entrepreneurial intention and motivation.

This research offers a variety of contributions. First, the research adds to the general entrepreneurship literature by enhancing the perception of how diverse kind of entrepreneurial characteristics, entrepreneurial training, and entrepreneurial education impact the entrepreneurial intention towards commencing a new business in a developing country like Thailand [8]. Provided that Thailand has a slight academic practice in offering entrepreneurial education, the outcomes of the current study might put in towards regulating the entrepreneurial education and training in compliance with the products or services and target market. In addition, the possible impact of mediation of entrepreneurial motivation on the connection between entrepreneurial education, entrepreneurial training, and entrepreneurial intention have received limited consideration in the developing countries, with this domain being under-studied, particularly in the setting of Thailand [9]. The study is designed as follows. At 1st, the objectives of the study are given. After that review of the literature is provided which offers a brief overview and analysis of the past studies. The literature discusses the association between EE and EM; ET and EM; EE and EI; ET and EI; EM and EI. The analysis of these four constructs permits for the formulation of the study hypotheses. By reviewing the literature, three hypotheses are formulated. After that methodology and discussion of the research are given. At last, the conclusion, implications and further directions are provided.

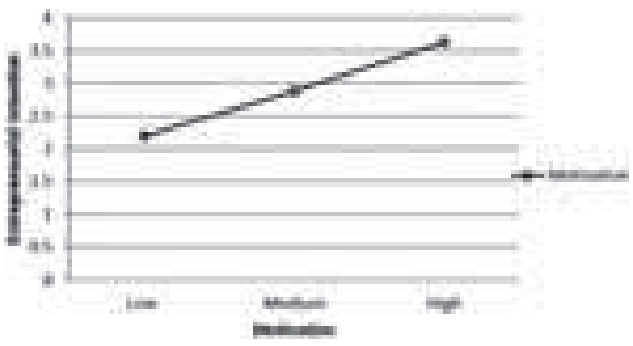

Fig. 1. Entrepreneurial intention and motivation.

1.1. Research Objectives

Following are the research objectives:
(1) To study the link between EE and EI
(2) To observe the connection between ET and EI
(3) To inspect the mediating impact entrepreneurial motivation between the relationship of EE and EI
(4) To examine the mediating impact EM between the association of ET and EI.

2. REVIEW OF THE LITERATURE

2.1. EE and EM

Oosterbeek, Van Praag [1] stated that education of entrepreneurship is the instructors' proposed involvement in the life of learners so as to impact their entrepreneurial capabilities, qualities, and skills, which permit them to endure in the world of business. The researcher Solesvik [2] stated that it might be explained as a learning or education form that goals at appealing and motivating individuals to establish their own business. Hytti, Stenholm [10] indicated that there is a positive significant correlation between EE and EM. As the education of entrepreneurship provides pupils with skills, knowledge, and abilities needed to put on to the setting of establishing a new venture. The students who get the entrepreneurial education are motivated to start or establish a new enterprise. Because entrepreneurial education indirectly impacts the intentions of learners to launch a new corporation through their conducts and attitudes [11]. In addition, the past study of Sánchez [12] indicated that campuses which provide entrepreneurial education to their students will make their students more knowledgeable, risk taker and make them motivated in order to run a successful business [13]. From all the discussion, the researcher of this paper proposes that entrepreneurial education enhance entrepreneurial motivation for students [14].

2.2. Entrepreneurial Training and Entrepreneurial Motivation

A lot of researchers explicitly or implicitly proposed a nexus between entrepreneurial training, entrepreneurial attitudes, entrepreneurial motivation, intention, however with no experiential evidence [10]. Such as the researcher Stefanovic, Prokic [15] indicated that specialized subjects in the domain of training or entrepreneurship of how to establish or set up a new venture might give persons the confidence and motivation, which they required to run their own new enterprise. The researcher Gielnik, Frese [16] argued that students who attend the training sessions of entrepreneurship are more encouraged and more motivated as compared to those students who do not attend training programs of entrepreneurship and study unmotivated. The scholar Rey-Martí, Porcar [17] argued that the EE will improve the viability for entrepreneurship through enhancing the students' knowledge, developing self-confidence and making them more motivated. It as well as develop the

perceived attractiveness for entrepreneurship by demonstrating learners that the training is extremely regarded and acceptable communally and that it can be worthwhile and satisfying work for themselves [18]. The past results of the study of Jusoh, Ziyae [19] demonstrated that entrepreneurial training plays a major role in entrepreneurial motivation. EE will improve the viability for entrepreneurship through enhancing the students' knowledge, developing self-confidence and making them more motivated. It as well as develop the perceived attractiveness for entrepreneurship by demonstrating learners that the training is extremely regarded and acceptable communally and that it can be worthwhile and satisfying work for themselves [20–22]. As the training programs intensifies the motivational aspects of students. So the researcher of this paper proposes that entrepreneurial training has a significant effect on EM.

2.3. EE and EI

The researcher Bae, Qian [23] indicated that entrepreneurial intentions are actually considered as sensible intellectual states, which essentially influence and avert individual consideration, events, and behaviors to an intended entrepreneurial behavior. EE is the 1st step through which a person's entrepreneurial intention is influenced [24]. Additionally, the researcher Zhang, Duysters [25] stated that entrepreneurial behaviors and intentions might be impacted by learning, training, and education. The researcher Rauch and Hulsink [26] stated that the education or learning of a student must be relied on reinforcing his or her intention of becoming a successful business person or an entrepreneur. The researcher Fayolle and Liñán [27] included 2 theories such as the theory of Planned Behavior and the theory of Entrepreneurial Event into the model of EI via adding the other component of entrepreneurial learning attained via education. The planned behavior theory describes the actions of the persons with regard to the intentions through creating a connection between behavior and attitudes. It relies on the foundation that much of the behavior of the person is planned and, thus, projected through intention towards that particular behavior, particularly in instances where the behavior is hard to detect, infrequent and includes irregular times-lags [28]. In simple words, the researcher Piperopoulos and Dimov [29] stated that the universities who provide entrepreneurial education to their students then those students will develop their entrepreneurial intentions and are inclined to establish their own business [30–35].

2.4. Entrepreneurial Training and Entrepreneurial Intention

In accordance with the scholar the ET raises the intentions and increases skills and as well as the knowledge of the students. The researcher Luca and Cazan [36] stated that entrepreneurial intention can be impacted to address a number of different subjective norms and means which are actually obstacles to establish a new business [37–39]. It has been revealed that there is a significant connection between ET and EI and venture creation [40]. For example, it can be viewed by an intensive development of ET in the United States which has raised the EI of learners and increased the number of new companies and businesses [41]. The training of entrepreneurship has demonstrated greater entrepreneurial intentions as compared to the students who do not attend entrepreneurial training programs [2]. The study of Moses, Olokundun [42] as well as indicates that entrepreneurial training can probably assist students to become a good and successful business persons and entrepreneurs Pickernell, Packham [43] because it raises the entrepreneurial intentions among learners which can motivate them to establish a new business [44–50].

2.5. Entrepreneurial Motivation and Entrepreneurial Intention

The researcher Oosterbeek, Van Praag [1] stated that the general belief of the psychological planned behavior theory is that planned behaviors, for example, establishing a new venture, are actually intentional and therefore are projected by intent towards that particular conduct. Furthermore, the researcher Edelman, Brush [51] stated that intention is essentially projected by attitudes such as attitude or approaches towards the conduct and subjective-norms. In accordance with the researcher Lee, Wong [52] the pupils who are motivated will have entrepreneurial intentions. Such as the students who attended the sessions of entrepreneurial training or got the EE are motivated and they have EI to become a successful entrepreneur. Additionally, EM plays a vital role in raising EI. Furthermore, Figure 2 shows the theoretical model of the current study.

2.6. Research Hypotheses

H1: *Entrepreneurial education has a significant and positive connection with EI*

H2: *Entrepreneurial training has a significant and positive link with EI*

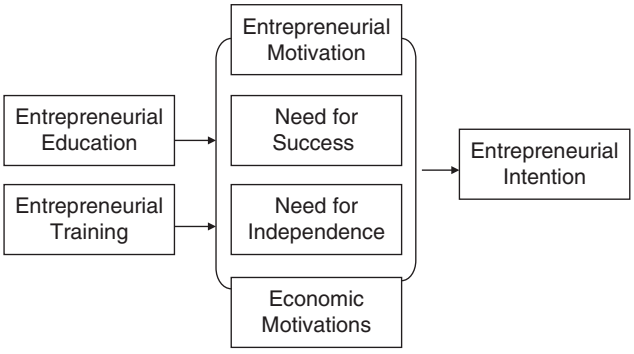

Fig. 2. Theoretical model of the research.

H3: *Entrepreneurial motivation significantly mediates the connection between EE and EI*
H4: *Entrepreneurial motivation significantly mediates the association between ET and EI.*

3. RESEARCH METHODOLOGY OF THE STUDY

The full time students and the regular learners enrolled in various universes in the state of Thailand were the samples of this paper. The survey was used to gather data from the students of the universities. The researcher sent a few questionnaires through e-mail. But because of the incomplete or due to the wrong e-mail I'd in the database of the students, few learners could not receive the survey-based questionnaires. Data were collected from both male and as well as from female students. Total of 300 participants was required by the study but just 263 students participated in the survey. The study goals of the present paper required the examination of particular relationships. The strategy of the survey relied on the self prepared survey designed in English and Thai language. The researcher used the test of Cronbach's Alpha so as to analyze the consistency whereas Bartlett's and KMO test was used for the questionnaire validity. The questionnaire comprised of 2 main parts. The 1st part of the survey was comprised of demographic data and the 2nd part of the questionnaire comprised of items, which are related to each variable. Five points Likert scale was used by the researcher. The participants have to select one option.

4. DATA RESULTS AND ANALYSIS

In order to check the hypothesis status for this study, the collected data from 263 respondent was analyzed by using SPSS and AMOS, the results of demographical findings show that, there are 106 male and 157 females were participating in this study. Mostly respondent falling in the range of 21–30 years of age and 214 respondents have graduation degree, 105 have master's degree and remaining have other degrees.

4.1. Reliability Test

The researcher used KMO and Kaiser-Meyer-Olkin (KMO) to measure reliability of data for factor analysis and then run Rotated Component Matrix KMO. KMO returns values between 0 and 1. A *rule of thumb* for interpreting the statistic. The results of KMO test indicated our data is suitable for factor analysis and factor analysis also good fit. See Table I for KMO and 3 for rotated component metrics. Additionally, Table II highlighted rotated component matrix.

Table I. KMO and Bartlett's test.

Kaiser-Meyer-Olkin measure of sampling adequacy	.948
Bartlett's test of sphericity	
Approx. chi-square	8813.633
df	496
Sig.	.000

Table II. Rotated component matrix.[a]

	Component			
	1	2	3	4
IN1				.850
IN2				.849
EE1		.716		
EE2		.785		
EE3		.836		
EE4		.811		
EE5		.831		
EE6		.834		
EE7		.840		
EE8		.809		
EE9		.822		
EE10		.804		
EE11		.794		
EE12		.732		
EM1	.796			
EM2	.823			
EM3	.792			
EM4	.803			
EM5	.829			
EM6	.839			
EM7	.799			
EM8	.801			
EM9	.794			
EM10	.756			
EM11	.776			
EM12	.676			
EM13	.662			
EM14	.611			
EM15	.621			
EM16	.834			
ET1			.738	
ET2			.764	

4.2. Discriminant and Convergent Validity

Discriminant validity is the degree in which the variable is in fact differing from each other experimentally. It is shown in Table III. On the other hand, Convergent validity is the extant of assurance a researcher has that a characteristic is well evaluated by its measures [53].

Results prove the convergent and discriminant validity of the data, because every contract discriminate from each other, and value of AVE for all variables are greater than MSV.

Table III. Discriminant and convergent validity.

	CR	AVE	MSV	MaxR(H)	EM	EEEE	ININ	ET
EM	0.972	0.682	0.462	0.973	**0.826**			
EEEE	0.967	0.710	0.426	0.985	0.653	**0.843**		
ININ	0.777	0.517	0.020	0.986	−0.125	−0.018	**0.719**	
ET	0.875	0.777	0.462	0.987	0.680	0.629	−0.143	**0.882**

Table IV. Nested confirmatory factor analysis.

Model fit indices	Threshold range	Observed values
Nested model		
χ^2		1214.07
Df		447
χ^2/df	Lesser than 3	2.716
GFI	$\leq .80$	.802
IFI	$\leq .90$	.912
CFI	$\leq .90$	.912
RMSEA	$\geq .08$	.080

Table V. Structural model results.

Effects	Hypothesized path	B	S.E	*P* value	Conclusion
Linear effects					
Hypothesis 1 (+)	EE → IN	.172	.080	.033	Accepted
Hypothesis 2 (+)	ET → IN	.037	.074	.621	Rejected
Mediation effect					
Hypothesis 3 (+)	EE → EM → IN	.102	.027	.010	Accepted
Hypothesis 4 (+)	ET → EM → IN	.072	.026	.010	Accepted

4.3. Confirmatory Factor Analysis

The confirmatory factor analysis (CFA) is "a multivariate arithmetic process which is utilized in order to examine how good the studied constructs signify the figure of variables." Following Table IV shows the findings.

Above Table IV shows the threshold range and observed value. The model above displayed the GFI = 0.802; IFI = 0.912; CFI = 0.912 and RMSEA = .080. Above stated five indicators prove the CFA of the study except GFI, but it is near to range.

4.4. Structural Equation Modeling

By using AMOS structural equation modeling test was performed in order to test the hypothesis of this study, this test at the same time provide the direct and indirect results of regression which is shown in Table V.

Above mentioned Table V shows the structural modeling results and finding indicated that education has 17.2% positive impact on intention, which mean that if one unit of education increased it will bring 17.2% positive impact on intention. Same as training has 3.7% positive but insignificant impact on intention. Hypothesis 3 and 4 shows the indirect effect education on intention via motivation. The finding of the hypothesis 3 indicated that motivation has 10.2% mediating effect between education and intention whereas it has 7.2% mediating effect between training and intention.

The following Figure 3 below is a screenshot of structural equation modeling while running in SEM in AMOS and shows the standardized regression weights between the variables.

5. DISCUSSION AND CONCLUSION

H1: *Entrepreneurial education has a significant and positive association with EI*

The findings of the paper show that EE has a significant positive effect on EI. H1 is accepted. So as to raise the EI of pupils, entrepreneurial education is vital for them. H1 is supported by Ref. [23].

H2: *Entrepreneurial training has a significant and positive association with EI*

The H2 is accepted as well. As the results of the study show that ET has a significant effect on EI. This hypothesis is supported by Ref. [19]. Entrepreneurial training can probably assist students to become good and successful business persons and entrepreneurs because it raises the entrepreneurial intentions among learners which can motivate them to launch a new corporation.

H3: *Entrepreneurial motivation significantly mediates the connection between EE and EI*

The H3 is also accepted. Because the findings indicate that EM significantly mediates the connection between EE and EI. H3 is accepted because the *p*-value is less than .05. Entrepreneurial education enhances entrepreneurial motivation for students and entrepreneurial intention of students.

H4: *Entrepreneurial motivation significantly mediates the connection between ET and EI*

H4 is accepted as well. As the results of the study demonstrate that EM significantly mediates the connection

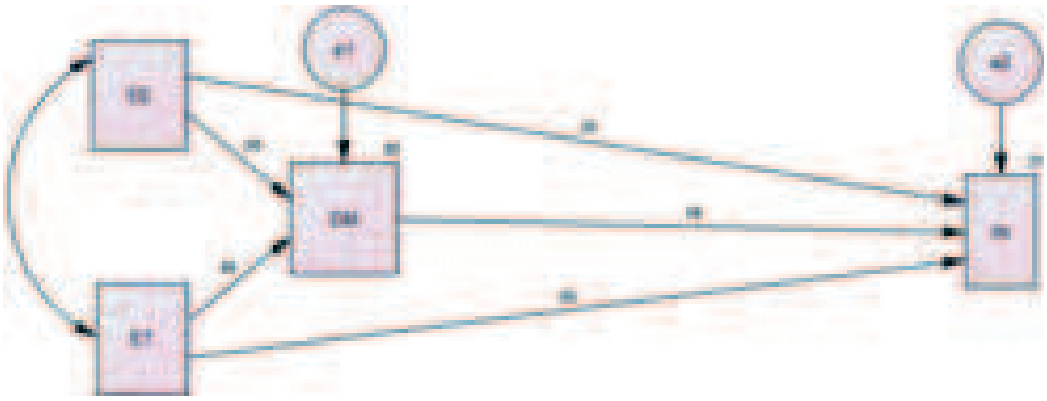

Fig. 3. Structural equation modeling.

between ET and EI. The students who feel motivated want to get self-employed and want to serve an economy by having entrepreneurial intentions [54, 55].

The significance of entrepreneurship in producing wealth in businesses and community has been emphasized by various investigators. Entrepreneurship signifies a dynamic force for the formation of the new venture, creation of work related opportunities, national and regional growth and effectiveness, having significant social and economic advantages. An immense variety of aspects play an important and significant part in the verdict to become a business man or an entrepreneur. The paper aim was to analyze the effect of EE, ET on EI with the mediating role of entrepreneurial motivation. Students were the sample size from which the researcher of this study collected the data. The cross-sectional and quantitative approach has been used in this study. In short, relying on the results of the study, the researcher of this paper claim that entrepreneurial education, entrepreneurial training impacted the student's entrepreneurial motivation and intention. The current research demonstrates that entrepreneurial training and education at various universities must be stimulated more via various tools so as to raise the interest of Thai students' in selecting a career route. H1, H2, H3, and H4 of the study are accepted. All the findings are consistent with the earlier researches.

6. IMPLICATIONS OF THE STUDY FOR PRACTICE

The major practical implication for the developers of the programs of entrepreneurship is that resources and knowledge could raise the probability of achievement for the people who are going to launch a new business. It is a motivation, which increases intention and attitude and as well as raises the probabilities that learners will ultimately attempt the career of entrepreneurship. This indicates that when the aim is to raise the number of business persons from the population of students, then the motivating part of the program has to be purposefully designed. As the findings revealed that motivation was focused by the sights of external specialist and educators, program designers should concentrate on their trainers. The researcher of this paper proposes that educators should also get training not just on how to teach the course of entrepreneurship, however as well as on how to alter minds and hearts. In addition, how correctly can educators motivate and inspire feelings? When we presume that the educator plays a role of leadership within the group of students, we can get more practical guidance from the charismatic leadership and vibrant literature. A charismatic leader is characterized through emotional abilities for example (Emotional-Intelligence). Charismatic leaders were discovered to have a major and strong impact on members via (Emotional Contagion). In short, the writer of the study proposes that employing charismatic educators who can transfer their eagerness for entrepreneurship via non verbal emotion will consequence in motivated learners with greater entrepreneurial intention. The institutes, which want to evaluate the efficiency of their programs should not just capture how much their pupils learn regarding entrepreneurship or either they are pleased with the subjects and training, however as well as either they are motivated from the education and training or not. Furthermore, a feed-back method measuring motivation from training and education is a practical recommendation for higher educational institutes.

7. LIMITATIONS AND DIRECTIONS

The current study has a particular limitation associated with the structure of the size and sample. This study comprised just a few numbers of learners, therefore, the findings obtained can't be generalized at the population level. Further researches should use big sample size and should collect data from more universities from various areas of Thailand. In addition, a more comprehensive examination at the level of Thailand's areas of growth could high-light the areas in which young participants are more probable to establish their own new enterprise so future studies should focus those areas. The quantitative and explanatory study was conducted by the researcher in this paper. Longitudinal research could be used, which capture a vibrant sight of Thai entrepreneurship among students. The researcher of the study collected data from the respondents through questionnaires. The future scholar should conduct interviews from the respondents and should conduct a qualitative study. The future researchers should conduct a study in another state such as in the context of China.

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RESEARCH ARTICLE

Promoting New Venture Creation in Thailand Through Entrepreneurship Education: Role of Entrepreneurial Awareness, Mindset and Skill Development

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The purpose of this paper was to analyze the impact of entrepreneurial education on venture creation along with the mediating roles of entrepreneurial awareness, entrepreneurial mindset, and entrepreneurial skill development. Entrepreneurial Education plays a key role in offering the prospects for graduates to take in the attitude, approach, entrepreneurial mindset and skill development required for the creation of a new venture. For the current paper, the researcher selected the method of quantitative. The researcher of this paper collected data from the Thai students of a few universities. The researcher collected data from those students who were convenient to take part in the study. The findings of this research paper demonstrate that entrepreneurial education is very crucial for students to start a new venture. In this paper, the writer of the paper conducted a quantitative study and collected data from the students of the universities of Thailand. The results of the study depict that all the four hypotheses of this paper were accepted, the universities should provide educational training and education to their students so as to make them aware and develop their mindsets which will assist them in the creation of the venture.

Keywords: Entrepreneurial Awareness, Entrepreneurial Education, Entrepreneurial Mindset, Entrepreneurial Skill Development, Thailand.

1. INTRODUCTION OF THE STUDY

In accordance with the writer entrepreneurial method of teaching and education are implanting entrepreneurial attitudes and skills to encourage the formation of new enterprises and ventures. The search for jobs and the rate of unemployment suggest the system of higher education in Thailand lacks the aspects which are necessary to avoid the higher unemployment rate in the state. Even though the government of Thailand through its academic agencies and observing agencies made the education of entrepreneurship necessary for tertiary institutes. Subsequently, there might exist few gaps between the transformation of this learning into a new business or venture creation and the expansion of entrepreneurship learning and education for learner's [1]. Having considered the significant role of "Entrepreneurial Education" (EE) plays a major role in offering the prospects for graduates to take in the attitude, approach, entrepreneurial mindset and skill development required for the creation of a new venture [2]. The researcher stated that the evident unemployment has been one of the major upsetting issues experiencing all unemployed students in Thailand. According to, a number of universities of Thailand have actually failed to include or provide entrepreneurship tools, training, and making the environment of entrepreneurship inaccessible which would have been a podium for economic development and growth, raised welfare and employment. The researcher [3] stated that essentially few educational institutes create opportunities for 1 or 2 entrepreneurial subjects, communicated by few lectures who actually have no practical know-how or experience regarding entrepreneurship, whereas learners take such type of subjects as a necessity for the completion of a degree. This particular situation, in accordance with the scholar Tracey, Phillips [4], is extremely harmful to the higher educational institutes of the state as it would allow the emerging inhabitants to develop intellectual and become self-employed rather than of being jobless in Thailand. The researcher Lackéus

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and Middleton [5] stated that the course of entrepreneurship must be offered as an explicit component within the program for nonformal and formal learning and education, with nationwide on finest practices to attain this. According to Leitch, Hazlett [6], the practical experience of entrepreneurship should be made broadly available during the course of all training and learning, with necessary learning for all education. This is a stage where a person develops and stimulates the skills of entrepreneurship which might ultimately direct to the creation of new ventures [7]. The researcher Neck and Greene [8] claimed that when this particular action is applied then it would be considered to lessen the current unemployment level which is troubling Thailand thus lessening the segregation, poverty and violence rate among inhabitations of Thai is necessary. According to Nabi and Liñán [9], the concept of entrepreneurship is formed as an elementary notion in total economic alteration. The researcher stated that entrepreneurship education is an elementary well-spring of making the mind of people to improve their entrepreneurial skills [10–16]. Figure 1 shows the relationship between entrepreneurial education, venture creation and entrepreneurial mindset.

1.1. Objectives of This Paper

This paper has four major research objectives:

- To determine the impact of entrepreneurial education on venture creation.
- To analyze the mediating role of entrepreneurial awareness between entrepreneurship education and venture creation.
- To determine the mediating role of entrepreneurial mindset between entrepreneurial education and venture creation
- To analyze the mediating role of entrepreneurial skill development between entrepreneurial education and venture creation.

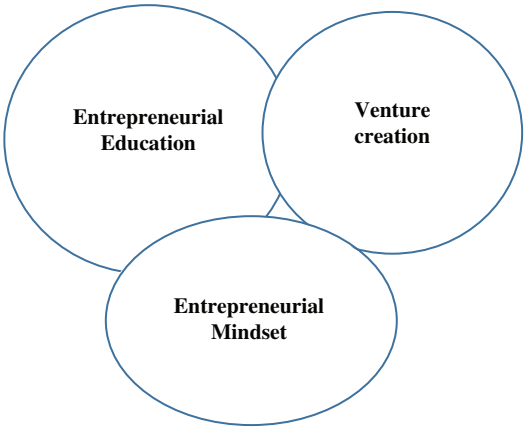

Fig. 1. Relationship between entrepreneurial education, venture creation and entrepreneurial mindset.

2. LITERATURE REVIEW

2.1. Entrepreneurial Education and Venture Creation

In accordance with the writer Ollila and Williams Middleton [3], entrepreneurial education can impact the behaviors and attitudes of a person that would be considered as "Entrepreneurial Intentions." The researcher Sánchez [2] claimed that intention is actually a very essential and vital antecedent of "Venture Creation" (VC). According to the author Tracey, Phillips [4], these intention frameworks draw from the (Planned Behavior Theory), which suggests that "Attitudes," "All the Subjective Norms" towards the "Behavior," and "Perceived Behavioral-Control" are all antecedents of "Intention." The researcher stated in turn that intention is the antecedent of behavior. Furthermore to impacting "Venture Creation," entrepreneurial education can as well as have an influence on the growth, development, and performance new ventures [17]. The scholar Raposo and Do Paço [18] proposes that when students are provided with the appropriate learning and education in the schools and universities then they will be more creative and will contribute to the growth of the economy. In addition, the researcher Lundqvist [19] stated that students who are offered with entrepreneurial education are more interested and willing to create a new venture [16, 20–26]. The findings of the earlier study of Sánchez [2] indicate that entrepreneurial education has a positive significant impact on venture creation. This relationship is also highlighted in the framework of the study (Fig. 2). Thus from the above discussion, the writer of the current paper hypothesized that:

Hypothesis No. 1: *Entrepreneurial Education has a significant impact on Venture Creation*.

2.2. The Mediating Role of Entrepreneurial Awareness Between Entrepreneurship Education and Venture Creation

In accordance with the study of Fretschner and Weber [27], entrepreneurial education and learning can contribute to better "Awareness" and "Consciousness" of the setting of entrepreneurship, thus notifying or adjusting awareness regarding entrepreneurship as the vocation and career. The researcher Lautenschläger and Haase [7] stated that taking

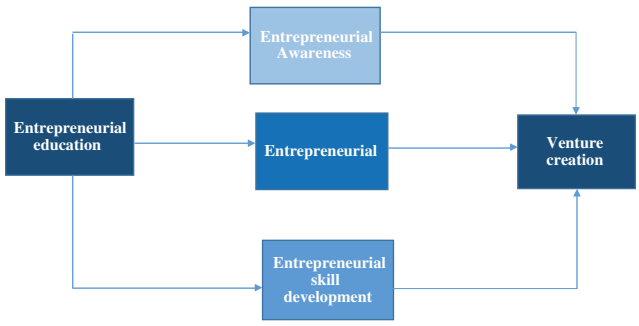

Fig. 2. Theoretical framework.

part in the courses of the entrepreneurial startup frequently leads to raising the extent of "Entrepreneurial Intention," however, this might be because of the bias of self selection of entrepreneurial inclined and minded learners joining in the way. According to Karimi, Biemans [28] the programs of "Entrepreneurial Education" (EE) essentially seems to contribute to high-levels of "Entrepreneurial Awareness" of learners. In addition, Nicolaides [29] argued that when universities teach subjects related to the entrepreneurship then the student becomes more aware regarding entrepreneurial activities. The researcher Chen, Hsiao [30] stated that students who are more aware of entrepreneurial activities are more willing to create a new venture. The researcher Fretschner and Weber [27] in his study observed that when students are provided with effective programs of entrepreneurial education then they will be more aware regarding the importance of entrepreneurship and will start a new business. From the above mentioned discussion, the writer of this paper hypothesized that:

Hypothesis No. 2: *Entrepreneurial Awareness significantly mediates the association between Entrepreneurship Education and Venture Creation*.

2.3. The Mediating Role of Entrepreneurial Mindset Between Entrepreneurial Education and Venture Creation

According to Pfeifer, Šarlija [31] "Entrepreneurial Mindset" (EM) is actually a precursor for "Entrepreneurial actions, conducts, and intentions and signifies a person's world view such as their expectations, motivations, attitudes, and dispositions." The researcher Solesvik, Westhead [32] argued that mind-set is probable to be impacted through "Affective" thinking and through "Non Cognitive" thinking. At another extreme lies innovative business formation, whether in the shape of new "Business Venture" or within the current firm. Furthermore, the researcher Fayolle and Gailly [33] stated that entrepreneurial education can facilitate learners to collect a number of resources, needed to involve in the process of entrepreneurship. It can improve the skills of the human, which can enable the assimilation and gathering of new information and rouse an "Entrepreneurial Mindset" (EM) so as to determine new opportunities for the business, regardless of the exterior ecological setting. In accordance with the researcher Pollard and Wilson [34], entrepreneurial education can stimulate viability and interest towards "Entrepreneurship" and as well as stimulate the intention to turn out to be business proprietors and self employed. The researcher İlhan Ertuna and Gurel [35] stated that the course of entrepreneurship is essential for each and every enrolled learners in their 3rd and 4th years. In accordance with the researcher Elmuti, Khoury [36] learners who actually gone through the sessions of lecture in the planning of business, book keeping, marketing, and risk analysis have a more entrepreneurial mindset. The writer Henry [37] stated that students with an entrepreneurial mindset are more interested in new venture creation as compared to the students who do not have an entrepreneurial mindset. In addition, the researcher Sánchez [2] stated that entrepreneurial education and entrepreneurial mindset plays an important role in new venture creation. The researcher of this paper hypothesized the following hypothesis:

Hypothesis No. 3: *Entrepreneurial Mindset significantly moderates the relationship between Entrepreneurial Education and Venture Creation*.

2.4. The Mediating Role of Entrepreneurial Skill Development Between Entrepreneurial Education and Venture Creation

In accordance with the researcher, Smith and Paton [38] programs of entrepreneurship education are usually considered to be much effective in emerging transferable abilities in contributors, even though this is frequently related with how a certain program of entrepreneurial education is planned and applied. The researcher Elmuti, Khoury [36] stated that the economies with the high-level of adolescence redundancy, there is a mainly strong instance for the education of entrepreneurship intervention intended at lecturing lack of skills and abilities among potential and promising entrepreneurs. The researcher Brixiová, Ncube [39] stated that the requirement for the development of skill, for the workforce is extremely vital in the account of the substantial diminution of human-capital through diseases and battles. In addition, growing technology alteration in an extremely competitive universal economy needs labor force with advanced capabilities and skills to familiarize to new processes and new knowledge. The past researchers of entrepreneurship have already demonstrated that entrepreneurial education has a significant positive influence on entrepreneurial abilities and skills for example "Marketing", "Leadership Skills" and "Business Planning" [2, 40]. Such as, persons with high business-planning skills incline to be well knowledgeable regarding the risks and opportunities of a new venture. People will be more capable to analyze these hazards, manuscript them in printed form, and plan policies to utilize the opportunities and lessen the factors of risks [41]. In the same way, people with better skills of marketing are much probable to form optimistic approaches and attitudes towards earnings prospects and revenue making potentials related to new venture creation [42]. In addition, the improvement and development of entrepreneurial capabilities and skills are vital to competitiveness, efficiency, and innovativeness of ventures. The researcher Whalen and Akaka [43] stated that educational institutes should include comprehensive topics in the program of entrepreneurship for example "Business Planning", "Management", "Taxation and Accounting", "Marketing" and "Business Kinds". As the researches have revealed, the training regarding entrepreneurial skill, when packed together with assistance

in type and in the capital, can assist previous combatants to produce a source of revenue from self employment [44–47]. It can as well as assist more determined entrepreneurial ambitions to grow and operate their own business ventures. From all the above-mentioned discussion the writer of this paper hypothesized that:

Hypothesis No. 4: *Entrepreneurial skill development significantly mediates the relationship between entrepreneurial education and venture creation*.

3. RESEARCH METHOD

In order to understand the importance of entrepreneurial education, and to know the mindset and the level of awareness of people the researcher of this paper conducted a quantitative study. There are different methods of research like quantitative research, qualitative research, and mixed method research. But for this paper, the researcher selected the method of quantitative. This method is basically linked with numbers. The researcher of this paper selected this method because this research also lined with numbers such as the results of this study are in numeric form. Thus the writer of this paper selected this method.

3.1. Research Time Horizon

Time horizon includes various kinds like cross-sectional, longitudinal and time series horizon. A scholar select time horizon in accordance with the time limit of his or her study. In this paper, the current researcher selected cross sectional time horizon. In this time horizon, the researcher will carry out a study just once. And as due to the limitation of the time the researcher of this paper cannot conduct longitudinal and mixed method study. Therefore the researcher of this paper selected cross sectional time horizon.

3.2. The Population of the Study

The educational institutes of Thailand are the population of this paper. It was difficult for the researcher to collect data from each and every educational institute of Thailand. Therefore the researcher of this papers selected sample.

3.3. Sampling

As there are several kinds of sampling but the researcher of the current paper used convenient sampling technique. The researcher of this paper collected data from the Thai students of a few universities. The researcher collected data from those students who were convenient to take part in the study. The total sample size of the study is 316.

3.4. Data Collection Technique

Data collection techniques include various types like a focus group, survey based questionnaire, interviews and so on. In order to gather data from students, the researcher of this paper used the technique of questionnaire. So as to gather data from a large sample size, this technique is very helpful. The researcher of this paper visited three to four universities in Thailand and distributed questionnaires among students. The researcher of this paper adopted the measures of different authors.

3.5. Data Analysis

The researcher of this paper performed data analysis on the software of SPSS. With the help of this software, the researcher of this paper performed a number of various tests like descriptive analysis, regression analysis, and correlation analysis.

3.6. Ethical Approaches

During the entire process of the study, the scholar of the current paper remembered all the ethical and moral approaches which are necessary to conduct research. For example, the researcher of this paper gathered the data from the honest means and reported the results of the study accurately. Moreover, the researcher obtained consent from the management of the university so as to collect data from the students.

4. RESEARCH FINDINGS

This study is working on to investigate the impact of entrepreneurial education on venture creation. After eliminating the rough and complete questionnaire, there is 316 questionnaires are used for analysis. Results indicated that there is 335 male and 81 females participated, out of which 135 respondents have master's degree education whereas the majority of the respondent were young and having age from 21 years 40 years.

4.1. Data Reliability

To check the reliability of the data Cronbach Alpha test was used for each construct, the ideal value for Cronbach Alpha is .80, however, .70 is also acceptable. It is shown in Table I.

Outputs showing that each construct of our study has its value greater than .70. So, the data is normal, and reliability of our constructs are Okay, now, we move for further analysis.

Table I. Reliability test.

Constructs	Items	Cronbach alpha
EE	8	.981
EA	10	.956
EM	6	.845
ES	7	.931
VC	5	.936

Table II. KMO and Bartlett's test.

Kaiser-Meyer-Olkin measure of sampling adequacy	.927
Bartlett's test of sphericity	
Approx. chi-square	14810.024
df	630
Sig.	.000

4.1.1. Data Suitability and Factor Loading

The following Table II shows the factor loading of each construct and suitability value which is measured with KMO and rotated component matrix.

The above-mentioned Tables II and III shows the suitability of data and factor loading, KMO shows that data is suitable for further analysis and rotated component shows that each construct load in its own construct.

4.2. Confirmatory Factor Analysis

Confirmatory factor analysis was applied in order to check the fitness of research model as well as also to analyze the discriminate and convergent validity there are 5 indicators which prove the fitness of model, in the below Table IV indicators and their threshold value is given.

Results of the above-mentioned Table IV prove that the research model for the current study is good if it because all indicators have their value indie threshold rage no statistical tool package was used open the discriminate and convergent validity.

Table III. Rotated component matrix.[a]

	Component				
	1	2	3	4	5
VC1				.907	
VC2				.874	
VC3				.880	
VC4				.877	
VC5				.912	
EM1					.742
EM2					.702
EM3					.730
EM4					.691
EM5					.771
EM6					.660
EE1		.843			
EE2		.920			
EE3		.938			
EE4		.945			
EE5		.937			
EE6		.960			
EE7		.941			
EE8		.944			
EA1	.639				
EA2	.514				
EA3	.922				
EA4	.611				
EA5	.681				
EA6	.958				
EA7	.963				
EA8	.968				
EA9	.966				
EA10	.957				
ES1			.877		
ES2			.796		
ES3			.762		
ES4			.762		
ES5			.935		
ES6			.663		
ES7			.918		

Note: [a]Based on the calculated scores.

Table IV. CFA.

Indices	Range	Output
CMIN/DF	<3	2.141
GFI	>.80	.824
CFI	>.90	.955
IFI	>.90	.955
RMESA	<.08	.060

4.3. Discriminate and Convergent Validity

The results of discriminant and convergent validity are given. Discriminant validity shows the discrimination of each construct from other ones, whereas convergent validity proves the internal consistency of the measurement. It is presented in Table V.

If the CR is greater than .70 and AVE is greater than .50 then the convergent validity of the data was proved. The current findings show that each variable has its CR value greater than .70 and AVE value greater than .50. So, the convergent validity is proved. The other columns show that

Table V. Discriminate and convergent validity.

	CR	AVE	MSV	ES	EA	EE	EM	VC
ES	0.933	0.670	0.112	**0.819**				
EA	0.959	0.713	0.112	0.334	**0.845**			
EE	0.981	0.868	0.100	0.133	0.157	**0.931**		
EM	0.849	0.488	0.218	0.262	0.216	0.316	**0.699**	
VC	0.949	0.789	0.218	0.188	0.113	0.186	0.467	**0.888**

Table VI. Structural equation modeling.

	EE	ES	EA	EM
Total impact				
ES	.134**	.000	.000	.000
EA	.148**	.000	.000	.000
EM	.287***	.000	.000	.000
VC	.177**	.134**	.111**	.305***
Direct impact				
ES	.134**	.000	.000	.000
EA	.148**	.000	.000	.000
EM	.287**	.000	.000	.000
VC	.055	.134**	.111**	.305***
Indirect impact				
ES	.000	.000	.000	.000
EA	.000	.000	.000	.000
EM	.000	.000	.000	.000
VC	.122**	.000	.000	.000

Notes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

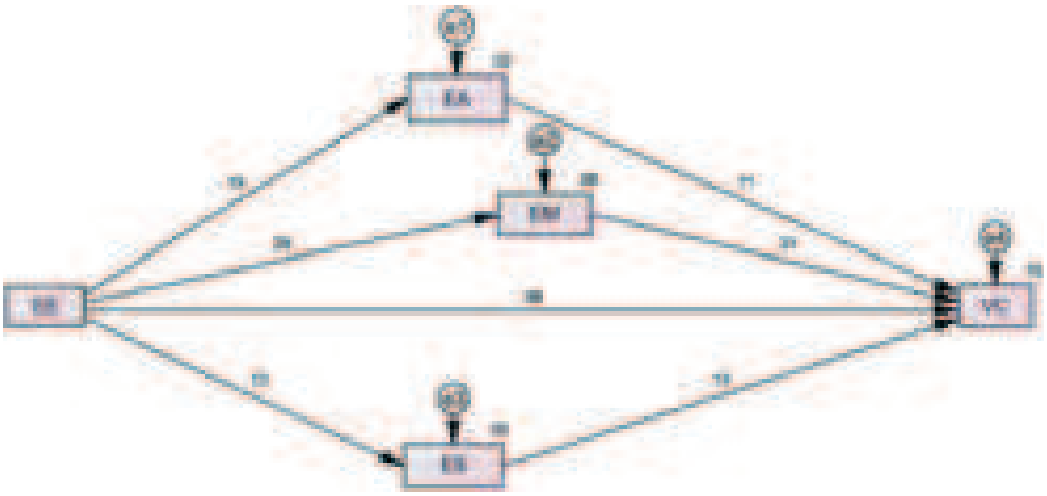

Fig. 3. Structural equation modeling.

each construct has acceptable discrimination from others, so there is no chance of multicollinearity in the data and our data has validation of discrimination.

4.4. Structural Equation Modeling

Structural Equation Modeling basically is the mixture of multiple regression analysis which gives the all results of direct, indirect and total at the same time; the following Table VI shows the output of the current study.

The output of structural modeling showing that entrepreneurial education has 5.5% positive impact on venture creation, but this impact is insignificant, whereas the impact of entrepreneurial education on venture creation is significant through all mediators. Findings shows that through all mediators the indirect effect of entrepreneurial education on venture creation is 12.2 percent. Moreover, the following Figure 3 also showed the standardized effect of each variable on growth intention.

5. DISCUSSION

Hypothesis No. 1: *Entrepreneurial Education has a significant impact on Venture Creation.*

The findings of this paper demonstrate that the impact of entrepreneurial education is significant because the *P* value is less than 0.05. Therefore H1 of this paper is accepted. Students who are offered with entrepreneurial education are more interested and willing to create a new venture. This hypothesis is supported by the study of Ref. [2].

Hypothesis No. 2: *Entrepreneurial Awareness significantly mediates the association between Entrepreneurship Education and Venture Creation.*

The results of this paper depict that entrepreneurial awareness significantly mediates the association between Entrepreneurship Education and Venture Creation. Because the significance value is less than 0.05. Thus H2 of this paper is accepted. When students are provided with effective programs of entrepreneurial education then they will be more aware regarding the importance of entrepreneurship and will start a new business. This hypothesis is in line with the investigation of Ref. [3].

Hypothesis No. 3: *Entrepreneurial Mindset significantly moderates the relationship between Entrepreneurial Education and Venture Creation.*

The outcomes of the study demonstrate that entrepreneurial mindset significantly moderates the relationship between Entrepreneurial Education and Venture Creation. As its significance value is also less than 0.05, therefore, H3 of the study is also accepted. Entrepreneurial education and entrepreneurial mindset play an important role in new venture creation. This hypothesis is consistent with the earlier study of Ref. [34].

Hypothesis No. 4: *Entrepreneurial skill development significantly mediates the relationship between entrepreneurial education and venture creation.*

The study findings indicate that entrepreneurial skill development significantly mediates the relationship between entrepreneurial education and venture creation. Because the value of *P* is less than 0.05. As a result, H4 of the study is also accepted. Persons with high business-planning skills incline to be well knowledgeable regarding the risks and opportunities of a new venture. This hypothesis is in-line with the findings of the study of Ref. [36].

6. CONCLUSION

The purpose of this paper was to analyze the impact of entrepreneurial education on venture creation along with the mediating roles of entrepreneurial awareness, entrepreneurial mindset, and entrepreneurial skill development. The findings of this research paper demonstrate that entrepreneurial education is very crucial for students to start a new venture. In this paper, the writer of the paper conducted a quantitative study and collected data from the students of the universities of Thailand. The results of the study depict that all the four hypotheses of this paper were

accepted. The results of the study show that the mediating role of entrepreneurial awareness, entrepreneurial mindset, and entrepreneurial skill development has a significant impact on entrepreneurial education and venture creation.

7. RESEARCH IMPLICATIONS

This study includes theoretical and practical research implications. The researcher in this paper investigated the impact of entrepreneurial education on venture creation along with the mediating roles of entrepreneurial awareness, entrepreneurial mindset, and entrepreneurial skill development. So this investigation will contribute to the body of the literature. The outcomes of this paper regarding the relationships of variables are very clear which will also contribute to the empirical evidence of the study. In accordance with the findings of the present paper, there is an instant necessity for investment in the programs of training for the students of Thailand. The program of entrepreneurial training should educate students on the importance of entrepreneurial education which would help students to start a new venture after their graduation. The institutes should provide well and better structured consultancies and stronger collaborations and connections with business and industry stake holders. It should as well as encompass training and assistance for the teachers of higher education to take part more dynamically in commercialization and consultancy of study. This will facilitate the staff of the teaching to draw on their own practical know-how, and their institute's entrepreneurial facilities and outputs, so as to improve and enhance the learning of the students'. The government should also invest in programs of entrepreneurial education. The essential spending is not only about the investment of money, however a development of a wide-ranging policy that incentivizes the institutes of higher education towards entrepreneurial activities, motivates inter institutional knowledge sharing and networking, and offers a frame work for continuing quality observing and assessment of entrepreneurial education in the state's institutions of higher education. In addition, the universities should provide educational training and education to their students so as to make them aware and develop their mindsets which will assist them in the creation of the venture.

8. LIMITATIONS OF THIS PAPER AND FUTURE SUGGESTIONS

The researcher of this paper collected data from the students of higher education. Future researchers should collect data from business owners to analyze how they educate their employees regarding the aspect of entrepreneurship. This researcher conducted this study in the country of Thailand, future researches should be conducted in the perspective of a different country. In this study, no moderator has been used by the researcher. Future studies should include other variables and moderating variables such as entrepreneurial training and entrepreneurial intention.

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RESEARCH ARTICLE

Promoting Female Entrepreneurial Growth Intention in Thailand's Tourism Industry: Role of Education Driven Ability, Opportunities and Advisory

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This research proposes to find out the aspects that impact the growth intention (GI) of female entrepreneurs in the sector of tourism of Thailand. The purpose of the current paper is to examine why female industrialists attain growth goals whereas others don't. This research uses quantitative approach and a self-administrated questionnaire was utilized with 200 female tourism entrepreneurs in Thailand. In this study, data analysis was performed through SPSS and regression analysis was run. This study results revealed that that all hypotheses of the study were accepted and are also consistent with the findings of the past studies. This study also showed that female entrepreneurs in Thailand can increase their entrepreneurial capabilities though, the growth of their business is limited by the deficiency of fiscal resources. This study fills the research gap in the domain of feminine tourism industrialists and their growth intention (GI) from the perception of an emerging nation like Thailand.

Keywords: Female, Entrepreneurs, Entrepreneurial Ability (EA), Thailand, Tourism, Growth Intention (GI).

1. INTRODUCTION

Female entrepreneurial activities are increasing day by day in Thailand. Current venture growth shows that females are the key drivers of economic development in several part of the world [1–3]. It is definite that economy of the country grow when greater number of females work. Female entrepreneurial education (FEE) have a significant influence on economic development and affluence Nations with higher number of entrepreneurial movement are linked with greater number of female entrepreneurial activity statistics [4, 5]. This is emphasized by the overall change from large firms to small and medium private owned firms [6]. In Thailand, female entrepreneurial activities has not grown much. However, it is impending to add to socio-economic development in order to raise the status of females in the developing country like Thailand. Lekmat and Chelliah [3] have described that women hold nearly fifty percent of tourisms jobs in Thailand. This shows that Thailand has a huge prospective to grow its tourism sector specifically for females. Development in this sector is predicted to persist at a yearly average rate of five percent in the next 5 years. On the other hand, several of Thailand's tourism resources are under-developed. Thailand lacks satisfactory tourism support services at many of its tourism locations. On the other hand, female-owned tourism firms in Thailand are not competitive and several are involved in small ventures [7]. The Figure 1 below shows the difficulties that female entrepreneurs experience in Thailand.

1.1. Objectives

1. To examine the impact of Female entrepreneurial education (FEE) with the growth intention (GI).
2. To examine the mediating impact of Entrepreneurial ability (EA) between the relationship of Female entrepreneurial education (FEE) and growth intention (GI).
3. To examine the mediating impact of opportunity within tourism environment between the association of Female entrepreneurial education (FEE) and growth intention (GI).
4. To examine the mediating impact of business advisory and support services between the relationship of Female entrepreneurial education (FEE) and growth intention (GI).

The current paper proposes to examine the connection of Female entrepreneurial education (FEE) and the

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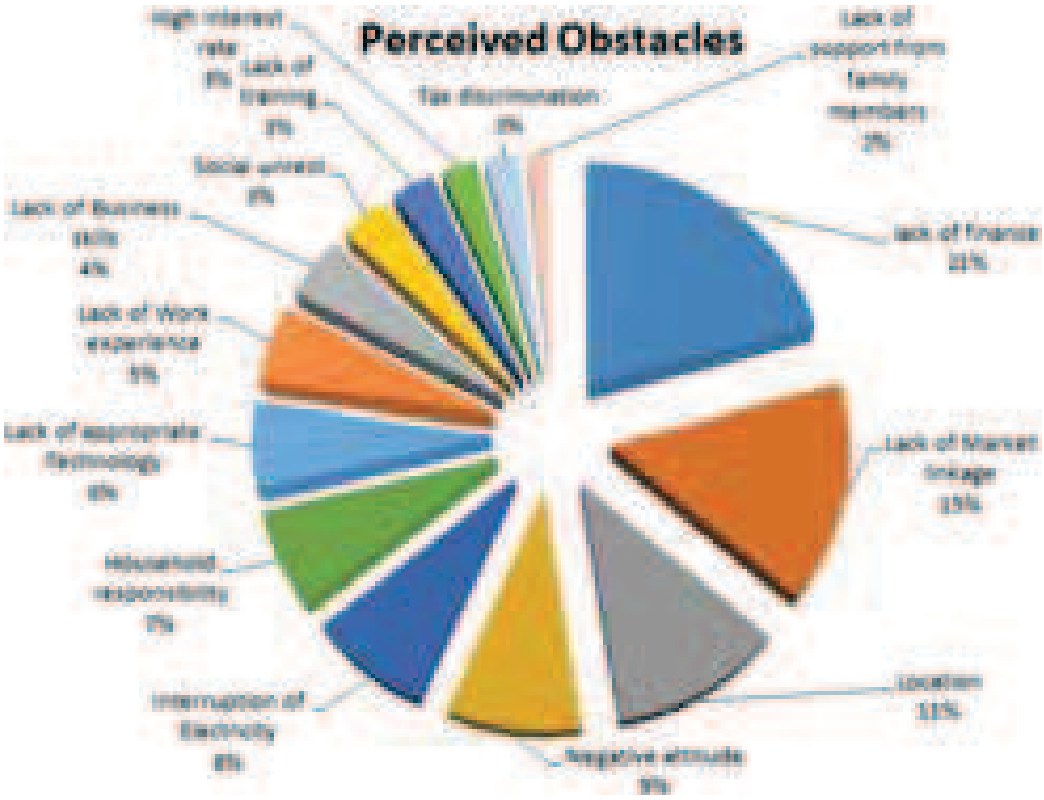

Fig. 1. Perceived difficulties that female entrepreneurs experience in Thailand.

growth intention (GI) with the mediating impact of Entrepreneurial ability (EA), business advisory and support services and opportunity within tourism sector environment. Taking into consideration the impending part of Female entrepreneurial education (FEE) in producing economic development, examining the association of entrepreneurial opportunities for females-owned firms and their (GI) appears to be broadly suggested. The research continues by studying the data in past researches on female entrepreneurial education. This is followed by the literature review on the female entrepreneurial education, growth intention (GI), Entrepreneurial ability (EA), business advisory and support services and opportunity within sector of tourism. At the end, the study concluded and suggested future indications in order to support women entrepreneurs in the search of (GI) in the tourism sector of the emerging nation such as Thailand.

2. REVIEW OF THE LITERATURE

This section covers the following heading: Female entrepreneurial education (FEE) and growth intention (GI), Female entrepreneurial education (FEE) and Entrepreneurial ability (EA), Female entrepreneurial education (FEE) and opportunity in the tourism sector, Female entrepreneurial education (FEE) and opportunity in the sector of tourism, Entrepreneurial ability (EA) and (GI), Entrepreneurial ability (EA) and growth intention (GI), Opportunity within the sector of tourism and (GI), Business advisory and support services (BASS) and (GI), feminist theory and theoretical model of the study.

2.1. Female Entrepreneurial Education (FEE) and Growth Intention (GI)

Female entrepreneurial education (FEE) has been identified as a vital intact source of the growth of economy. Past researches have demonstrated that feminine entrepreneurship has a significant effect on commercial growth in a variety of manners [7, 8]. These are comprised of creation of job, economic growth, novelty, and variety of entrepreneurship in the developing country [9]. Female entrepreneurship is strongly related with the growth intention (GI). Moreover, women owned industries are one of the greatest rising entrepreneurial populations in the entire globe [8]. Particularly, factors of Female entrepreneurial education (FEE) impacts the growth intention (GI) [9]. The feminist theory describes that the substantial feminist custom goes back to primary days of women's liberation and contends for the requirement of societal reform so as to grant females the equal rank and chances as males. Woman's socialization generates various perceptions, objectives, and varieties for females. Earlier studies on female entrepreneurship examined female entrepreneurs to have lower level of education in managing staff, less firm experience, less previous start-up knowledge and ultimately less growth. Brush and Cooper [1]

have identified that females who have insufficient pertinent entrepreneurial education and experience might question their aptitude to handle swiftly the developing firms. It might consequently intentionally restrict the development of their organizations and these may involve to their appropriate growth intention (GI).

2.2. Female Entrepreneurial Education (FEE) and Entrepreneurial Ability (EA)

Entrepreneurial ability (EA) is mainly the capability of a person to recognize and use business opportunities in an efficient way [10]. The aptitude to use Female entrepreneurial education (FEE) is impacted by several of the few aspects as human capital traits which is linked to educational level, administrative capabilities, experience, authentic owner abilities, Entrepreneurial ability (EA), practical knowledge by means of societal, formal as well as in-formal linkages, and the aptitude to organize means for the economic growth [11]. Past papers have demonstrated that humans impacts a company's probability to initiate, persist, develop, and execute. A study by Purwana and Suhud [12] have found out that human-capital of the entrepreneur, especially in the kind of Entrepreneurial ability (EA), administrative abilities, was the highest contributing aspect to the growth as well as performance. Thakur and Walsh [13] have described that fiscal administration, accounting, and promotion were significant abilities for the success of women entrepreneurs. It has also been observed that female Entrepreneurial ability (EA) dependent upon experience in a same venture helps in the survival and growth of entrepreneurs. Entrepreneur's ability is greatly dependent upon the female entrepreneurial growth in order to familiarize to new settings and learn from their capability. Entrepreneurial education increases the ability to identify and use new entrepreneurial abilities [14].

2.3. Female Entrepreneurial Education (FEE) and Opportunity in the Sector of Sector

The character of feminine entrepreneurs is somewhat unkempt in the study of the tourism sector [15]. It is relatively hard to examine the rise of definite main concerns or domains in the research on female's entrepreneurship in the sector of tourism. A few researchers have examined the nature of female's entrepreneurial education and prospects in the entrepreneurship sector of tourism and entrepreneurial events are occasionally declared as one of these tourism sector's opportunities [16]. On the other hand, past researches do not grow on the prospects regarding female entrepreneurship and growth. The opportunity in the tourism industry has been identified as a facet of commercial growth and more job openings, because of the character of the labor intensive of the sector and the fewer access obstacles for persons, specifically, those who are marginalized in the Thailand's economy, for example females [10]. Female entrepreneurs get advantage from working as a home stay tourism business and trading of abilities inclining to enhanced flexibility and position of the female in Thailand. Female entrepreneurial education (FEE) in the new field of tourism is an admirable earning opportunity. These actions by females have the propensity to drive societal as well as economic growth in less emerging countries like Thailand. Opportunities in the tourism sector are seen as offering employment for female entrepreneurs. On the other hand, past researches do not grow on the prospects regarding female entrepreneurship and growth. The opportunity in the tourism industry has been identified as a facet of commercial growth and more job openings.

2.4. Female Entrepreneurial Education (FEE) and BASS

In tourism sector, management and business advisory support for entrepreneurs is able to take on many kinds, for example, obtainability of credits, investment resources and support for entrepreneurs working in few areas, and promotion of entrepreneurship by means of management and BASS and infrastructure growth [17]. BASS and training patterns appear in a variety of plans and events particularly proposed at encouraging and supporting entrepreneurship and business expansion [18]. Female entrepreneurial education (FEE) and growth of staff is broadly acknowledged to be useful for the effective tourism business performance [19]. Has stated that BASS are likely to boost the female entrepreneurial education.

2.5. EA and GI

It has been observed that (EA) are strongly linked with the economy growth have found out that the human-capital of an industrialist, particularly in the kind of Entrepreneurial ability (EA), administrative abilities, was the highest contributing aspect to the growth as well as performance. Fadahunsi [20] have described that fiscal administration, accounting, and promotion were significant abilities for the success of women entrepreneurs. It has also been observed that female Entrepreneurial ability (EA) dependent upon experience in a same venture helps in the survival and growth of entrepreneurs. Entrepreneur's ability is hugely reliant upon the entrepreneurial growth so as to familiarize to innovative settings and learn from their aptitude. It has also been observed that highly educated industrialists are more probable to see growth in their companies. By means of learning by doing, common Entrepreneurial ability (EA) is gained that are appropriate in the growth of all domains and business sectors. By acting so entrepreneurs increase their abilities and possibly enhance their opportunities for the success of the business [21]. It has also been observed that female Entrepreneurial ability (EA) dependent upon experience in a same venture helps in the survival and growth of entrepreneurs. Entrepreneur's ability is hugely reliant upon the entrepreneurial growth so as

to familiarize to innovative settings and learn from their aptitude [22–29]. It has also been observed that highly educated industrialists are more probable to see growth in their companies [30].

2.6. Opportunity Within the Sector of Tourism and GI

Opportunity within the sector of tourism and growth intention (GI) are also strongly related. The opportunities of an industry comprised of the patterns of settings and aspects within and outdoor the tourism sector, which boosts the growth and sustains survival of the venture and influences modifications in the firm. Such opportunities impact the settings that small ventures experience in performing their business and may influence the endurance, growth of the industry of tourism [31]. The environmental aspects and opportunities within the tourism sector is frequently observed as vital for the growth of the business [32–38]. On the whole, it is greatly linked to tourism businesses. The influence of opportunity within tourism sector environment on growth in this sector is yet not widely identified and requires to be researched [39].

2.7. BASS and GI

The growth of all the businesses including tourism sector regardless of size is mainly reliant upon the amount of capital developed at the beginning and for operational events along with the supporting venture extension. The amount of capital accessible to the venture may also be impacted its capital structure, growth as well as effectiveness [40]. Terjesen et al. [41] have also described that access to the BASS anticipates the growth of the industry. Female entrepreneurs are probable to reliant hugely on their business advisory and support services. BASS hugely dependent upon the growth of the entrepreneurship business [42].

2.8. Feminist Theory

The current study used the liberal feminist theory in describing the female entrepreneurial growth intention (GI) in Thailand's Tourism Industry with the role of education driven ability, opportunities and advisors. However, the assumption of liberal feminist theory states that the liberal feminist custom goes back to earliest days of women's liberation and contends for the need of societal reform to provide females the equal position and chances as males. Female's socialization generates various perceptions, objectives, and selections for females and they select their business field consequently. Some researchers Galloway et al. [43], have methodically examined either or not prospective variances linked to discernment or socialization impact entrepreneurial education, entrepreneurial opportunity, business performance, Entrepreneurial ability (EA), BASS and GI [44–46].

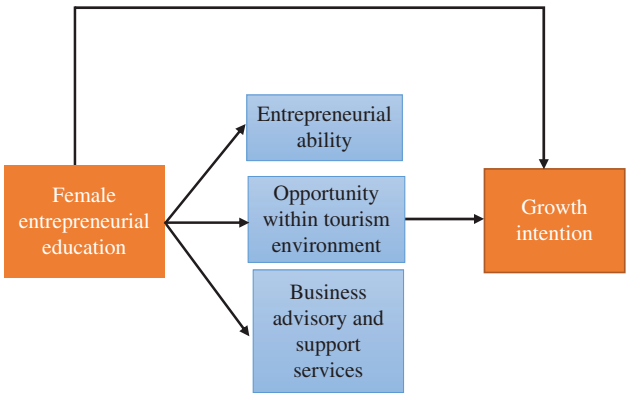

Fig. 2. Theoretical model of the study.

2.9. Hypotheses

H1: Female entrepreneurial education (FEE) has a significant link with (GI)
H2: Entrepreneurial ability (EA) mediates the connection between (FEE) and (GI)
H3: Opportunity within tourism environment mediates the association between (FEE) and (GI)
H4: BASS mediates the connection between (FEE) and (GI).

2.10. Theoretical Model

The theoretical structure of the research is mentioned in Figure 2.

3. METHODOLOGY

This research uses the quantitative method approach and is cross sectional in nature as the data for this study is being collected for one point in time only. The researcher of the study collected data by means of questionnaire survey and questionnaires were self administrated. The items for the survey were designed in multiple-choice response groups. These question items seized the EA of Thailand's female entrepreneurs, growth intention (GI), entrepreneurial opportunities within the tourism sector, and BASS inducements given by the government travel firms of the developing country Thailand. The sampling technique is purposive sampling for this paper and the size of gthe sample for the current research is 334. Therefore, a total of two hundred questionnaires were distributed to privately owned tourism companies in Thailand. The details regarding the contact of the female industrialists was given by the authority of the tourism of Thailand of every local division. The female industrialists of tourism industry in Thailand were contacted at their several industry sites to distribute the survey forms. The indicators for the study were measured by utilizing a 5-point Likert scale extending from (1 to 5) where 1 signifies strongly-disagree and 5 signifies strongly-agree. The reliability analysis demonstrated that all variables are reliable and can be examined further.

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Table I. Reliability test.

Constructs	Items	Cronbach alpha
EE	5	.891
EA	8	.916
OE	11	.925
BAS	2	.903
GI	8	.896

4. RESEARCH FINDINGS

To analyze the empirical effect of female entrepreneurial education on growth intention, data was collected from the tourism sector. After eliminating the rough and complete questionnaire, there is 334 questionnaires are used for analysis. Finding shows that there is no 157 male and 181 females participated, out of which 109 respondents have master's degree education whereas the majority of the respondent were young and having age from 21 years 40 years.

4.1. Data Reliability

To check the reliability of the data Cronbach Alpha test was used for each construct, the ideal value for Cronbach Alpha is .80, however, .70 is also acceptable. It is highlighted in Table I.

Outputs showing that each construct of our study has its value greater than .70. So, the data is normal, and reliability of our constructs are Okay, now, we move for further analysis.

4.2. Confirmatory Factor Analysis

Confirmatory factor analysis was applied in order to check the fitness of research model as well as also to analyze the discriminate and convergent validity there are 5 indicators which prove the fitness of model, in the below Table II indicators and their threshold value is given.

Results of the above-mentioned Table II prove that the research model for the current study is good if it because all indicators have their value indie threshold rage no statistical tool package was used open the discriminate and convergent validity.

4.3. Discriminate and Convergent Validity

In the following Table III, the results of discriminant and convergent validity are given. Discriminant validity shows the discrimination of each construct from other ones, whereas convergent validity proves the internal consistency of the measurement.

Table II. CFA.

Indices	Range	Output
CMIN/DF	<3	3
GFI	>.80	.80
CFI	>.90	.924
IFI	>.90	.924
RMESA	<.08	.08

Table III. Discriminate and convergent validity.

	CR	AVE	MSV	BAS	EE	EA	OE	GI
BAS	0.857	0.749	0.297	**0.866**				
EE	0.984	0.924	0.310	0.470	**0.962**			
EA	0.960	0.752	0.310	0.514	0.557	**0.867**		
OE	0.964	0.713	0.192	0.438	0.421	0.361	**0.845**	
GI	0.940	0.664	0.297	0.545	0.503	0.516	0.438	**0.815**

If the CR is greater than .70 and AVE is greater than .50 then the convergent validity of the data was proved. The current findings show that each variable has its CR value greater than .70 and AVE value greater than .50. So, the convergent validity is proved. The other columns show that each construct has acceptable discrimination from others, so there is no chance of multicollinearity in the data and our data has validation of discrimination.

4.4. Structural Equation Modeling

Structural Equation Modeling is a most prominent technique to analyze primary data [53]. It is basically the mixture of multiple regression analysis which gives the all results of direct, indirect and total at the same time; the following Table IV shows the output of the current study.

The output of structural modeling showing that female education has 15% positive impact on growth intention whereas the impact of education on ability is 61%, direct impact on the opportunity within tourism environment is 52% and direct impact of education on business advisory and support board is 45%. Same as the direct effect of ability on growth intention 22%, the direct impact of opportunity within tourism environment on growth intention is 29% and impact of business advisory and support board on growth intention 20 percent. The indirect in effect of education through all these mediators is 37.5%. Moreover the following Figure 3 also showed the standardized effect of each variable on growth intention.

Table IV. Structural equation modeling.

Total effect	EE	EA	BAS	OE
EA	.612**	.000	.000	.000
BAS	.446**	.000	.000	.000
OE	.517**	.000	.000	.000
GI	.525**	.224**	.203**	.285**
Direct effect	**EE**	**EA**	**BAS**	**OE**
EA	.612**	.000	.000	.000
BAS	.446**	.000	.000	.000
OE	.517**	.000	.000	.000
GI	.150*	.224**	.203**	.285**
Indirect effect	**EE**	**EA**	**BAS**	**OE**
EA	.000	.000	.000	.000
BAS	.000	.000	.000	.000
OE	.000	.000	.000	.000
GI	.375**	.000	.000	.000

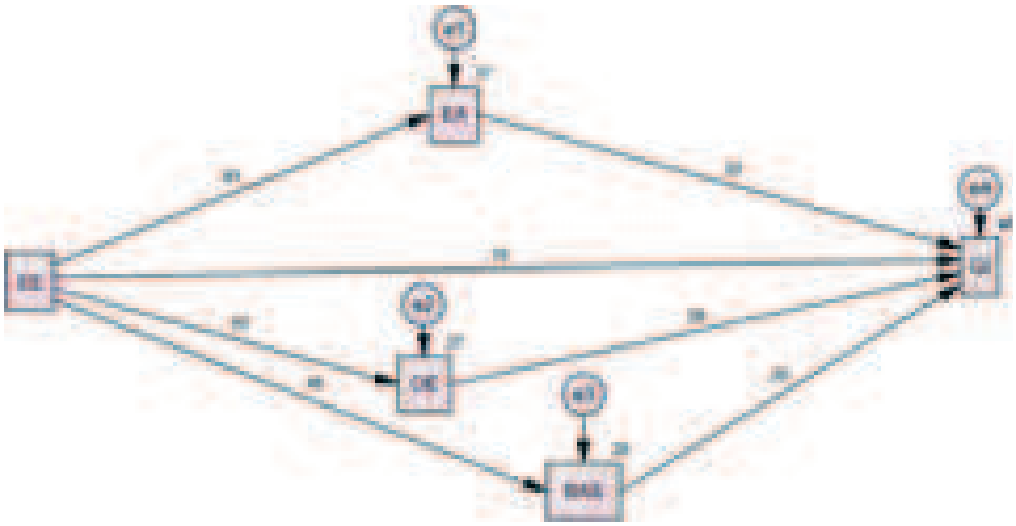

Fig. 3. Structural equation modeling.

5. DISCUSSION

The aim of the paper was to inspect the female entrepreneurial growth intention (GI)s in Thailand's Tourism Industry with the mediating role of entrepreneurial opportunities and business and support service advisory. This research aimed to find out the aspects that impact the growth intention (GI) of female industrialists in the sector of tourism of Thailand. The main goal of the research was to examine why female entrepreneurs attain growth goals whereas others don't. This research used quantitative approach and a self-administrated questionnaire was utilized with 343 female tourism entrepreneurs in Thailand. In this study, data analysis was performed through SPSS and regression analysis was run. This study filled the research gap in the domain of woman tourism entrepreneurs and their (GI) from the perception of an emerging nation like Thailand. The data was examined by means of SPSS software and regression analysis was performed. The result of this study showed that all the 4 hypotheses i.e., H1, H2, H3 and H4 of the research got accepted. The study showed that Female entrepreneurial education (FEE) has a significant connection with (GI); Entrepreneurial ability (EA) strongly mediates the connection between (FEE) and (GI); Opportunity within tourism environment strongly mediates the relationship between (FEE) and (GI) and (BASS) also strongly mediates the association between (FEE) and (GI). The research also showed that female entrepreneurs in Thailand can increase their entrepreneurial capabilities though, the growth of their business is limited by the deficiency of fiscal resources.

6. CONCLUSION OF THE STUDY

This research adds to the framework of existing body of literature on woman entrepreneurs' (GI) in the sector of tourism in the developing country Thailand. This study had 5 variables: female entrepreneurial education, (EA), opportunity in the industry of tourism, BASS, and (GI). The research has examined the level of EA of the feminine tourism industry entrepreneur of Thailand, for example, level of education, industrial experience, and administrative as well as fiscal resources. Therefore, this study will be greatly helpful in understanding some consistent issues that hinder the growth intention (GI) of the female entrepreneurs in Thailand's tourism industry. Thailand is a developing country and has plentiful resources of tourism, this study has discussed the requirement for woman entrepreneurs to utilize the wide-ranging entrepreneurial prospects in the industry of tourism for the growth of the socio-economic status in the country. The research has recognized the requirement for governmental strategies, managerial strategies and business support in regards of commercial finances, BASS, and advertising funds in the tourism sector of Thailand. The deficiency of these aspects is a preventive aspect that limits the (GI)s of woman entrepreneurs in the tourism sector of Thailand.

Implication of the Study

This research has several implications which are given below:

1. Suitable and efficient teaching and promotional inducements that may increase the growth of the tourism business ought to be offered by the administration and targeted to female industrialists of Thailand.
2. Consideration ought to be paid to the growth of tourist spots in a way that the experiences given will induce the travelers to repeat their stays.
3. The woman entrepreneurs in the tourism sector of Thailand ought to utilize the substantial entrepreneurial opportunities within the industry.

4. As tourism industry is a considered as a developing industry in Thailand, it requires consistent, continuous and suitable consideration to grow as anticipated.

Limitation of the Study and Indications

As the sample size of this paper is limited so, future research can perform the same study by taking a big sample size. This research is quantitative in nature so it could not get a deeper analysis of the situation. The future research may perform this study by utilizing a qualitative or mixed method approach in order to get an in-depth responses of the participants. This study can also be performed in any other developing country and future researchers can also compare the results of both the studies.

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RESEARCH ARTICLE

Mobilizing Business Opportunity Identification Through Entrepreneurial Education in Thailand with the Mediation of Entrepreneurial Self-Efficacy and Orientation

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This research emphasizes on mobilizing the business opportunity identification when the level of entrepreneurial education rises in Thailand. The study also focuses on the mediating impact of entrepreneurial self-efficacy and entrepreneurial orientation on the connection between EE and business opportunity identification. The current research is quantitative in nature and data was gathered by self-administrated questionnaire survey. Data of the research was collected from 318 respondents and examined through SPSS software by means of regression analysis. The regression analyses showed that a high level of the EE also leads to greater business opportunity recognition. This study outcomes also demonstrated that self-efficacy and orientation fully mediates the link among both the variables. Entrepreneurial self-efficacy performs as an individual resource that assists entrepreneurs to get high level of entrepreneurial education and business opportunity identification.

Keywords: Business, Entrepreneurship, Education, Self-Efficacy, Opportunity, Thailand.

1. INTRODUCTION

Entrepreneurs generate and recognize business opportunities in frequently dynamic and swiftly transforming contexts [1]. However, entrepreneurial level of education plays an integral part in identifying business opportunities. The entrepreneurial self-efficacy is not fixed but instead changes vigorously with the passage of time [2, 3]. Therefore, the current paper purposes to observe the connection between EE and business opportunity identification with the mediating impact of entrepreneurial orientation (EO) and entrepreneurial self-efficacy (ESE). This research add to the existing body of literature on entrepreneurial education and entrepreneurial opportunity identification by analyzing how vibrant changes of ESE and EO are linked to the business opportunities recognized by the industrialists of Thailand. The earlier studies on the impacts of entrepreneurial education on attitudes have mainly focused on the static patterns of, and personal differences in, worldwide levels of entrepreneurship [3, 4]. In contrast, entrepreneurial level of learning and self-efficacy is not characteristically fixed over time but changes in compliant with their varying contexts. In the same manner, entrepreneurs' impending reaction to entrepreneurial level of learning and self-efficacy, that is, involving in entrepreneurial attitude and identifying business opportunities, might change vigorously with the passage of time [5]. Up till now, it is uncertain whether and how level of entrepreneurial education might impact entrepreneurs' identification of business opportunities. The current study fills this research limitation by examining the association among entrepreneurial education and business opportunity recognition within business persons with the mediation of ESE and EO. In order to analyze the association on how levels of entrepreneurial education might set off opportunity identification, this study emphasizes on two main constructs that might mediate the linkage. Particularly, the study proposes that entrepreneurial orientation works as a reaction to level of entrepreneurial education. Entrepreneurial orientation refers to dynamically involving in entrepreneurial events for example the trialing with latest methods and procedures, re-planning the business services or goods, and looking for new areas and fresh opportunities with regard to the target markets and goods [5, 6]. Earlier literature has shown that entrepreneurial education may give a finest initial point to arouse entrepreneurial orientation and might also support the identification of new business opportunities in the

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target market [6] because it sets down different kind of methods and experimentation. In addition, theory states that high level of entrepreneurial education might persuade a condition of mental entropy by which people identify business opportunities. In the current study, researchers propose to unravel the ambiguous perceptions on the connection between EE, EO, ESE and business opportunity identification. Moreover, the research aims to explore the marginalized situations that differentiate whether within-individual changes in the level of entrepreneurial education are directly or indirectly linked to EO and ESE, and consequently, the identification of business opportunities in Thailand. Particularly, the study illustrates on the theory of social cognitive and involves the notion of ESE as a restricted form to impact within individual associations.

The researcher starts the study by examining the active linkage among EE and EO. After that, the study examines the role of EE and ESE that mediates the linkage among changes in EE and EO. At last, the research examine whether entrepreneurial orientation and ESE acts as a mediators by means of which a variation in the level of EE is linked to the identification of business opportunities.

1.1. Objectives of the Study

The purposes of this research are as following:

1. To find the connection between Entrepreneurial Education and Business Opportunity Identification
2. To identify the mediation role of ESE between the connection of EE and Business Opportunity Identification
3. To identify the mediation role of EO between the association of EE and Business Opportunity Identification.

2. REVIEW OF THE LITERATURE

2.1. Role of EE and Business Opportunity Identification (BOI)

Entrepreneurial education is defined as the mechanism in which attitudes, abilities and characteristics are accomplished and grown that assist people and firms in producing, bearing, and managing the fluctuations and innovations concerning greater degrees of challenges and risks [7]. The study into the direct connection between EE and business opportunity identification are limited [8]. On the other hand, there are some studies that emphasizes on the association between EE and business planning or activity. In the middle of a small figure of frameworks of business opportunity identification occur in the past studies, the most prominent is framework put forward by Ref. [9]. This framework is in fact the foundation from which other researchers derived and practically examined their theoretical models. The past literature review occurred as a result in locating is only one framework that observes a positive relation amongst the entrepreneurial education and business opportunity identification which was given by Ref. [10]. In their study, they stated that the recognition of business opportunities is a capability that is able to be produced as any other distinctive aptitude and that the ultimate approach of attaining this is likely to be an entrepreneurial education.

2.2. Role of EE and EO

EO is one of the major and significant aspects that are highly vital for the entrepreneurs [11]. The level of entrepreneurial education originates from insight mechanisms stranded in individual's understanding of their setting [12]. Individuals typically act reliant upon what they identify [13]. For that reason, in the current research, entrepreneurial orientation is described as a prejudiced factor in respect of perceived in-ability of entrepreneurs to anticipate transformations in the setting [14]. Entrepreneurs are over and over again confronted with unpredictable degrees of rivalry, fluctuations in the market, the challenge of obtaining fiscal resources, and changeable attitudes of stakeholders, all of which might generate conditions of ambiguity [15]. If an entrepreneur have a good education then it will be easy for him or her to anticipate these changes and act accordingly. In particular, this research examines the entrepreneurial education which is the aspect of the context that has revealed to give a significant source for entrepreneurial orientation [16]: technical innovations and demands for the goods or services. Both technology factors and demands for the goods and service have often been seen by entrepreneurial study as the highly vital bases of entrepreneurial orientation. 1st, business persons might be incapable to exactly forecast facets of the technical setting that are quickly and constantly fluctuating [17]. Entrepreneurial education and entrepreneurial orientation have established a major place in theories on entrepreneurship [18], and there is an extended record of studies on its role in the business commencement mechanism [19]. In addition, EE and EO has widely been researched in linkage with the utilization of planning policies, and as a steady mediator relating venture planning and business performance [20].

2.3. Role of EE and ESE

The education of entrepreneurship and ESE are strongly associated as increase in one variable result in a raise in another variable. The notion of self-efficacy is based on the theory of social cognitive [21] which induces the role of human's perceptions in their capability to implement control within their context. Self-efficacy is mainly a person's confidence and anticipation in his or her capability to effectively attain a set of tasks, activities as well as targets [1]. It settles on how people perceive entrepreneurial conditions and react to them as it is directly related to the activities and the perception of acts [22].

The theory of social cognitive has been broadly implemented to the research on the entrepreneurship and the

research of identification of the entrepreneurial opportunity and success of the business [22]. For example, ESE was discovered to establish the entrepreneurial productivity for instance the performance and growth of the business [23]. Likewise, EE directs to the greater level of ESE. Also, few past studies studied the interaction of EE, ESE as well as environmental traits as antecedents of the venture development and success [24]. In accordance to the Ahlin, Drnovšek [23], the environmental munificence, which is the degree to which the context supports the constant development, anticipates the entrepreneurial attentiveness specifically for entrepreneurs with greater levels of entrepreneurial education and ESE. This investigation mainly emphasize on the influence of entrepreneurial education on whether it is directly or indirectly influenced by within-individual modifications in the level of ESE, which might sequentially persuade the results of entrepreneurship [25]. It has been observed that entrepreneurs' self-assurance in their capabilities and higher level of learning to run a venture assists them to alter changes in the ambiguity into self-efficacy [26]. In simple terms, the current study proposes that entrepreneurial level of education is one of the major individual resources that impacts whether entrepreneurs enhance or reduce ESE in the face of varying insights of challenges and risks [27]. The past study shows that high level of ESE and EE demonstrated individual differences in person's capability to efficiently control positive and negative sentiments that occur from the insight of challenging and intimidating business conditions [23, 28, 29]. As a result, the study anticipates that entrepreneurs who are high in entrepreneurial education may more efficiently control their sentiments linked to the insight of ESE. Likewise, EE directs to the greater level of ESE. Also, few past studies studied the interaction of EE, ESE as well as environmental traits as antecedents of the venture development and success. The environmental munificence, which is the degree to which the context supports the constant development, anticipates the entrepreneurial attentiveness specifically for entrepreneurs with greater levels of entrepreneurial education and ESE. This investigation mainly emphasize on the influence of entrepreneurial education on whether it is directly or indirectly influenced by within-individual modifications in the level of ESE, which might sequentially persuade the results of entrepreneurship. For that reason, they have high level of cognitive resources accessible to put forth greater effort and dynamically involve in additional entrepreneurial orientation and modification of their business goods and new ideas [29].

2.4. Role of ESE and BOI

The ESE and BOI has been observed to be directly linked as increase in one variable result in an increase in another variable. BOI is fundamentally a dynamic process of continuous change as well as iteration [30]. Entrepreneurs persistently believe by means of their preliminary business notions and involve in events to structure, build up, increase or amend them [31]. This mechanism might then lead to the modification or the stoppage of entrepreneur's opening goods and services as an effect of the recognition of the innovative opportunities [30]. The idea of self-efficacy is reliant upon the theory of social cognitive given by Bandura in the year (1986) which induces the role of person's perceptions in their ability to implement mechanism within their context. Self-efficacy is a primarily somebody's conviction and eagerness in his or her potential to successfully attain the tasks, accomplishments as well as targets. It settles on how people perceive entrepreneurial conditions and react to them as it is directly related to the activities and the perception of acts [10, 23].

2.5. Role of EO and BOI

The entrepreneurial opportunities are primary to the growth of a fresh businesses, venture performance, and entrepreneurial expansion [23]. On the other hand, variety of perceptions exists on the BOI. In accordance to the standpoint of business opportunity identification, opportunities subsist impartially in the context and are able to be located, for example, all the way through the planned examination for and amalgamation of latest information [3]. In addition, the perception of business opportunity generation views opportunities as prejudiced, such that they are grown and produced by the entrepreneur by means of resourceful and social construction mechanism. Moreover, some studies states that businesspersons are the processors of the information that might utilize a mixture of strategies. The current paper concentrates on the BOI and analyzes how modifications in the entrepreneurial orientation might set off opportunity recognition in regards of the self-perceived figure of venture prospects recognized. Entrepreneurial orientation is a main antecedent for searching individual's surroundings and to process and build up the business goods and services [32]. The recognition of opportunities is highly reliant on the intellectual abilities and mechanisms for example broadly looking for latest market information, a rise in entrepreneurial orientation might offer a practical attitude and an effective commencement point for entrepreneurs in order to recognize the business opportunities [33–35]. Opportunity identification is basically an active procedure of constant modification as well as iteration [36]. Entrepreneurs persistently believe by means of their preliminary business notions and involve in events to form, build up, expand or alter them [37]. This mechanism might then lead to the modification or the failure of entrepreneur's preliminary goods and services as an effect of the BOI [10, 38]. Dependent upon an action regulation structure of entrepreneurship, the effort of entrepreneurs and an active strategy are of main significance for the recognition of the business opportunities [39]. For that reason, the identification of opportunities

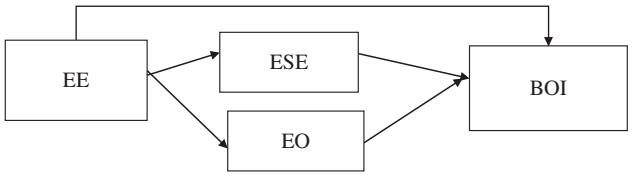

Fig. 1. Theoretical framework.

is highly reliant on the cognitive abilities and mechanisms for example intensively looking for latest market information, data processing, and cautiously exploring market requirements as well as demands [40]. Therefore, structuring on previous research and theory, this study argue that when entrepreneurs enhance their degrees of dynamically examining their contexts by means of entrepreneurs' orientation, they are more likely to recognize the business opportunities [41–46].

2.6. Research Hypotheses

In the light of the above discussed literature review, following hypothesis are made for the current study:
H1: EE has a significant connection with BOI
H2: Entrepreneurial Self-Efficacy significantly mediates the connection between EE and BOI
H3: EO significantly mediates the association between EE and BOI.
Framework:

The theoretical framework of the current research is given in Figure 1.

3. RESEARCH METHODOLOGY

This research follows a positivism philosophy. The positivist model prevails in discipline and anticipates that discipline quantitatively measures the in-dependent realities regarding a particular observable fact [24]. This study used a quantitative method approach which is highly suitable for the present research, as it proposed to gather the data from different respondents to examine and authenticate the theoretical model on EE. This research is cross sectional in nature. Cross sectional approach is utilized because data for the study was gathered at just one time. The data was gathered through SPSS software and different tests was conducted so as to examine the connection among the constructs [47–55]. The data was gathered through questionnaire survey and was self-administrated by the researcher to ensure that the responses are not biased. Purposive technique was used and 318 surveys were distributed amongst the businesspersons of SME's of Thailand. The participants were randomly selected. ESE was measured with 4 questions scale established by Zhao et al. (2005). BOI was measured with 1 question dependent upon the scale utilized by Gielnik et al. [30] and Ucbasaran et al. (2008). Entrepreneurial education was measured with the help of scale of Covin and Wales [38].

4. RESEARCH FINDINGS

To analyze the empirical effect of female entrepreneurial education on growth intention, data was collected from the tourism sector. After eliminating the rough and complete questionnaire, there is 318 questionnaires are used for analysis. Finding shows that there is no 169 male and 149 females participated, out of which 100 respondents have master's degree education whereas the majority of the respondent were young and having age from 21 years 40 years.

4.1. Factor Analysis

To check the reliability of the data Factor Analysis test was used KMO test shows that suitability of the data whereas rotated component matrix shows the factor loading of each item in Tables I, II;

Outputs showing that data is normal, and reliability of our constructs are Okay, now, we move for further analysis.

4.2. Confirmatory Factor Analysis

Confirmatory factor analysis was applied in order to check the fitness of research model as well as also to

Table I. Rotated component matrix.[a]

	Component			
	1	2	3	4
SE1			.843	
SE2			.838	
SE3			.877	
SE4			.869	
EO1	.863			
EO2	.863			
EO3	.843			
EO4	.865			
EO5	.875			
EO6	.840			
EO7	.869			
EO8	.884			
EE1		.855		
EE2		.840		
EE3		.820		
EE4		.818		
EE5		.853		
EE6		.873		
EE7		.843		
EE8		.812		
BO1				.839
BO2				.843

Table II. KMO and Bartlett's test.

Kaiser-Meyer-Olkin measure of sampling adequacy.	.899
Bartlett's test of sphericity	
Approx. chi-square	13388.109
df	231
Sig.	.000

Table III. CFA.

Indices	Range	Output
CMIN/DF	<3	2.131
GFI	>.80	.83
CFI	>.90	.932
IFI	>.90	.932
RMESA	<.08	.061

Table IV. Discriminate and convergent validity.

	CR	AVE	MSV	EO	EE	SE	BO
EO	0.960	0.752	0.323	**0.867**			
EE	0.932	0.641	0.227	0.402	**0.800**		
SE	0.982	0.931	0.323	0.568	0.461	**0.965**	
BO	0.876	0.780	0.267	0.517	0.476	0.474	**0.883**

analyze the discriminate and convergent validity there are 5 indicators which prove the fitness of model, in the above Table III indicators and their threshold value is given.

Results of the above-mentioned Table II prove that the research model for the current study is good if it because all indicators have their value indie threshold rage no statistical tool package was used open the discriminate and convergent validity.

4.3. Discriminate and Convergent Validity

In the following Table IV, the results of discriminant and convergent validity are given. Discriminant validity shows the discrimination of each construct from other ones, whereas convergent validity proves the internal consistency of the measurement.

If the CR is greater than .70 and AVE is greater than .50 then the convergent validity of the data was proved. The current findings show that each variable has its CR value greater than .70 and AVE value greater than .50. So, the convergent validity is proved. The other columns show that each construct has acceptable discrimination from others, so there is no chance of multicollinearity in the data and our data has validation of discrimination.

Table V. Structural equation modeling.

Total effect	EE	EO	SE
EO	.457***	.000	.000
SE	.534***	.000	.000
BO	.510***	.27***3	.115*
Direct effect	**EE**	**EO**	**SE**
EO	.457***	.000	.000
SE	.534***	.000	.000
BO	.324***	.273**	.115*
Indirect effect	**EE**	**EO**	**SE**
EO	.000	.000	.000
SE	.000	.000	.000
BO	.186**	.000	.000

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

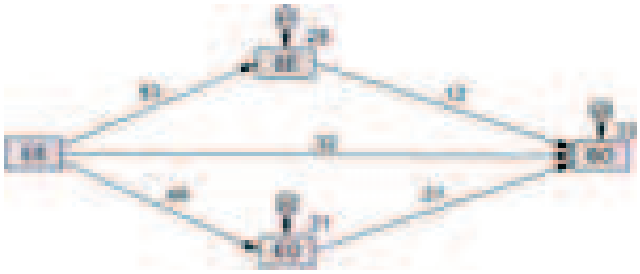

Fig. 2. SEM screenshot.

4.4. Structural Equation Modeling

Structural Equation Modeling is based on two major steps [56]. It is basically the mixture of multiple regression analysis which gives the all results of direct, indirect and total at the same time; the following Table V shows the output of the current study;

The results of SEM show that entrepreneurial education has positive and significance impact on business opportunity identification which means that if one unit of entrepreneurial education increased it will bring 32% positive impact on business opportunity identification. Findings also show that self-efficacy and end entrepreneurial orientation significantly play a mediating role between entrepreneurial education and business opportunity identification. So, all the three hypotheses of the study are accepted. The following Figure 2 show the standardized influence of independent variable on business opportunity identification and influence of mediators.

5. CONCLUSION AND DISCUSSION

The objective of the current research paper was to study the association between EE and BOI with the mediation of EO and ESE. The EO works as a reaction to level of entrepreneurial education. Entrepreneurial orientation refers to dynamically involving in entrepreneurial events. BOI is fundamentally a vibrant practice of incessant change as well as iteration. Entrepreneurs persistently believe by means of their preliminary business notions and involve in events to structure, build up, increase or amend them. The analysis was run on SPSS software and the results demonstrated that all hypotheses of the study are accepted. The results showed that EE has a significant connection with BOI; ESE fully mediates the association between EE and BOI and EO fully mediates the relationship between EE and BOI. Therefore, all the 3 hypotheses i.e., hypothesis 1, 2 and 3 are supported by the past findings. The results of the study contribute too few theories linked to the mediating constructs towards entrepreneurial education.

6. IMPLICATIONS OF THE STUDY

This study offers the following implications:

1. Entrepreneurs should take proper training in order to develop their entrepreneurial skills and grow business effectively.
2. Firms ought to develop an organizational culture and enhance entrepreneurial programs entrepreneurial training sessions.
3. A new learning strategy in EE is needed so as to augment the beliefs and attitudes of fresh and educated entrepreneurs in entrepreneurial activities.
4. Additional measures should be executed in order to support the activities of the entrepreneurship and the culture of the firm in the developing countries like Thailand, by means of reinforcing the support mechanism of stakeholders. This can be comprised of government support, fiscal agencies, (SMEs) also extended members of the family.

7. LIMITATIONS AND FUTURE INDICATIONS

The current research uses the purposive sampling approach in order to determine the size of the sampling. Because of the sampling approach used, the results of the study are restricted to the sampling technique. The sample size of the study was 250 so the population may have underrepresented, as it signifies just a small section of the total population of entrepreneurs in Thailand. So, the result of the research is restricted to the sample population. The current research utilized a cross sectional approach, and not a longitudinal research in order to inspect the influence of EE on BOI with the mediation of ESE and entrepreneurial orientation. So, the results of the research are also restricted to a cross-sectional study approach. Variables like entrepreneurial education and entrepreneurial self-efficacy are likely to alter with the passage of time and might be impacted by various other aspects which are not covered in the current study. The current research used the questionnaire technique that employed a number of questionnaires as a scale of measurement and is quantitative in nature. Future studies may focus in using the other research tools, for example observation, in-depth interviews, to gather the needed information for measuring EE, ESE, business opportunity identification and entrepreneurial orientation.

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RESEARCH ARTICLE

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Role of Human Values in Relationship Between Entrepreneurial Education and Entrepreneurial Career Intentions: An Empirical Study in Thailand

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RESEARCH ARTICLE

Purpose: This study aims to analyze the relationship between entrepreneurship education and entrepreneurial career intentions. This study also provides the mediating role of human factors like openness and self enhancement in the relationship between entrepreneurship education and entrepreneurial career intentions. *Methodology*: This study is based on quantitative methodology in which questionnaires were given to the students of different universities of Thailand studying business courses. Questionnaires were given to 309 students. Questionnaires have been filled to self-administered technique and also through online way. The responses were then analyzed by using statistical tools such as SPSS and AMOS through CFA and SEM. *Results*: The results have shown that entrepreneurial education has the significant positive impact on entrepreneurial career intentions directly and also through the mediating roles of human values like openness and self enhancement. *Implications*: It is an extension to literature related to the role of human factors and their impact on the entrepreneurial career intentions. It also helps the students of Thailand of undergraduate and master level to enhance the ability in them to face and overcomes all the problems related to their business. *Value*: The value of this study is the relationship of the entrepreneurship education with the mediating role of human values like openness and self enhancement and their impact on the entrepreneurial career intentions which was not discussed in the previous studies.

Keywords: Openness, Self-Enhancement, Entrepreneurial Education, Entrepreneurial Career Intentions, Thailand.

1. INTRODUCTION

The past studies shows that entrepreneurship education has become a major element for the students of undergraduate and master level who have the interest to go in the field of the business. The students of Thailand must have the interest to get education about the entrepreneurship, by this they can improve their skills to do the business in efficient way [1]. Entrepreneurship education focuses on the human values like openness and self enhancement and also on the entrepreneurial career intentions for the students who are studying business courses. Business sector of Thailand can be improve if the student of Thailand involves in the entrepreneurial education [1].

Entrepreneurial career intentions in Thailand is not in the proper form. Students who are new in the field of business need to have interest in the entrepreneurial career intentions because the business sector is so poor in Thailand due to the unawareness about entrepreneurial career intentions. For any country entrepreneurial career intentions is playing very important role to maintain the economical level (Barba-Sánchez and Atienza-Sahuquillo, 2017). So this research consists to know about the importance of the entrepreneurial career intentions. Thailand is the underdeveloped country with the income of US$ approx. 7000 per criteria and population rate is 70 million. Thailand should implement the interest of entrepreneurial career intentions in the students of at the end level of undergraduate and master level to increase the efficiency in them (Barba-Sánchez and Atienza-Sahuquillo, 2018; Che and Sundjo, 2018) that they can improve their skills to do any business on medium or small scale. By this they can reduce the poverty rate in Thailand.

Entrepreneurial career intentions have the relationship with the entrepreneurship education and their relationship is due to the mediating role of human values like openness and self enhancement. Human values like openness and self enhancement impacting on the entrepreneurial career intentions separately (Barral, Ribeiro, and Canever, 2018).

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Openness is the human value in which students enhances their communication skills and improves their behavior to communicate with others to do business and makes their business level up. Self enhancement is the human value in which the students develops their self confidence to make the decisions freely (Brush, Ali, Kelley, and Greene, 2017). They becomes independent to do all the activities according to their needs. Mainly theses abilities in a student have the impact on profits and on the poverty and they will have the abilities to create and manage market and to provide the employment opportunities [2].

Here entrepreneurship education not only has the direct relationship with the entrepreneurial career intentions (Dawkins, Jamali, Karam, Lin, and Zhao, 2016) but has the indirect relationship with the entrepreneurial career intentions due to the mediating role of human values like openness and self enhancement. Entrepreneurship education has the impact on the openness and self enhancement and then these human values has the impact on the entrepreneurial career intentions (Entrialgo and Iglesias, 2016).

Previous studies was focusing on the human values like openness and self enhancement and not on the entrepreneurship education. Thailand is facing with the problem of increasing poverty rate due to the growth rate of the population (Entrialgo and Iglesias, 2017; Chowdhury and Shil 2017). The students are not so engaged with the education of entrepreneurship so they don't have the skills to run the business and to reduce the poverty rate of Thailand. Due to the unawareness of entrepreneurship education they cannot produce the employment opportunities and Thailand is still considering as an underdeveloped country (Espíritu-Olmos and Sastre-Castillo, 2015).

This paper is engaged with the deep focus on the missing points of the previous studies. Entrepreneurship education is the main point which is under the discussion of this paper (Fayolle and Gailly, 2015) that have the relationship with the human values like openness and self enhancement and then these values have the relationship with the entrepreneurial career intentions separately. Researchers has recommended to add the concept of entrepreneurship education in this study by this social and economic condition of the Thailand can be improve (Gelaidan and Abdullateef, 2017). Universities of Thailand should enhance the interest of the students for the entrepreneurship.

The main objectives of this research are as follows:

- To analyze the impact of entrepreneurial education on the entrepreneurial career intentions on Thailand business school students.
- To check the mediating role of openness in the relationship between entrepreneurship education and entrepreneurial career intentions in Thailand business school students.
- To determine the mediating role of self enhancement in the relationship between entrepreneurship education and entrepreneurial career intentions in Thailand business school students.

The scope of this study is on the education system of Thailand. Entrepreneurship education is the most important key to achieve the success in any kind of business field in Thailand. So the entrepreneurship education produces the skills in the students of the university to improve the business sector of Thailand (Gorgievski, Stephan, Laguna, and Moriano, 2018; Cossiga, 2018). By increasing the interest in them to get the education of entrepreneurship the students can do the business of their choices. Enhancement in business knowledge increases the interest in the students to know about the jobs. They can find the suitable jobs or they can do their own businesses (Hechavarria et al., 2017).

The similar studies have produce different benefits on theoretical, practical and political dimensions. Definitely this will increase the employment level in the country, reduce the poverty, change the thinking of the people and they will come to get education about business with interest and they can manage and create the market. They will have the knowledge to run the businesses or to do jobs efficiently with the good salary (Holland and Garrett, 2015).

Next section of this paper has contain the literature review, methodology, analyzes and results and discussion and conclusions.

2. LITERATURE REVIEW

2.1. Entrepreneurship Education and Entrepreneurial Career Intentions

Researchers have discussed that the entrepreneurial education has the Impact on entrepreneurial career intentions in such a way that the entrepreneurial education is very important for the students (Hsu, Wiklund, Anderson, and Coffey, 2016) because they have to go to the practical life and they have to face many business issues. They can face these issues only when if they have the complete or well knowledge about the business to run (Ikebuaku and Dinbabo, 2018). Otherwise they will face many problems and they will not aware about how to face these problems and how to overcome these problems. So this study includes that the entrepreneurial education is very important for those students who are very new in business field and have no experience about that field (Jensen, Rezaei, Schøtt, Ashourizadeh, and Li, 2016).

Entrepreneurial scholars has identified that the entrepreneurship education is enhancing the abilities in the students [3] who are very fresh in the field of business in such a way that the students with the ability of good communication will put very good impact in the business sector of Thailand [4]. Theory of entrepreneurship education proofs this whole concept that Self confidence is build up in them due to entrepreneurship education and they can make the decisions freely and confidently and can achieve

their goals that they want [5]. This impact on the human values of the entrepreneurial education is also impacting on the entrepreneurial career intentions. Businesses sector automatically improves by the entrepreneurial education.
Hypothesis 1: Entrepreneurial education has the significant impact on the entrepreneurial career intentions.

2.2. Mediating Role of Openness

Researchers have discussed that entrepreneur education impacts on the human value like openness to enhance the skills and behavior of the people of Thailand on business point of view. Entrepreneurial education enhance the skills of the students of business background to communicate with the others to do business in efficient way. Communication is the most important thing to know about the business of others. Theory of entrepreneurship education proofs that Openness enhances the communication skills and the students will be able to take the decisions professionally in their business (Lechner, Sortheix, Obschonka, and Salmela-Aro, 2018). They will feel comfortable with the people who have impressive communication skills. They can deals with those people easily in different matter of their business. Authors have debated that not only the communication skills in openness but the behavior of the students also becomes effective to interact with the customers more effectively (Liñán, Moriano, and Jaén, 2016) and in this way openness plays mediating role between entrepreneurship education and entrepreneurial career intentions. Customers also feels relax to purchase any item of that business. Theory of entrepreneurial education can proof that the entrepreneurial education has the positive impact on the openness of the students who wants to do business (Ozaralli and Rivenburgh, 2016). They can enhance their beauty of communications with others and enhance the beauty of the behavior and they can make more sales and enhance the profit margin. Theory of entrepreneurship education proofs the concept about the relation of openness with entrepreneurial career intentions. The students of Thailand with no skills should have the knowledge of the entrepreneurship to make themselves a good businessmen and should deal with the different decision making in many possible ways (Piva and Rossi-Lamastra, 2018). Researchers has discussed that in openness the communication skills and behavior of the students improves with entrepreneurship education that enhances the business in such a way that customers have the full believe on that business and increases the sales and by the increasing of sales profit margin also increases. Profit is the big asset of any business or any organization (Shirokova, Osiyevskyy, and Bogatyreva, 2016). Previous studies elaborated that if the situation of the business sector becomes good then this will automatically improve the Thailand's situation in economical point of view and the Thailand will come in the list of the developed countries from the list of the underdeveloped countries (Simmons, Carr, Hsu, and Shu, 2016). So openness puts the great effect on the success of the business of the new student who enters in this field.
Hypothesis 2: Openness has significant mediating role between entrepreneurship education and entrepreneurial career intentions.

2.3. Mediating Role of Self Enhancement

Researchers have discussed that Entrepreneurial education can also impact on the self enhancement on the students of Thailand. Students becomes independent to make their decisions about their business efficiently. Students makes their decisions more comfortably and more efficiently because they are confident in their decisions. Their confident level and their self enhancement build up due to the entrepreneurial education (Tarling, Jones, and Murphy, 2016). Students are free to make the decisions about their business means their freedom level increases due to the entrepreneurial education. Excitement of the students build up to run their business and they feel relax for every kind of difficult decisions and they can face every kind of challenges to run their business efficiently (Tipu and Ryan, 2016). Theory of entrepreneurship education proofs that the students of Thailand after coming in the practical life when they are making their own decision to run their business, they can get success in this field easily (Walter and Block, 2016). They can spend their lives successfully in the society and their social status becomes very powerful. Means to say that the education about entrepreneurship enhances the self confidence of the students that are new in their practical life (Wilson, Kickul, and Marlino, 2007). Self enhancement is basically the human factor that will also impact on the entrepreneurial career intentions. Self enhancement is the mediating variable in this study. This study provides the relation of self enhancement with the entrepreneurial career intentions (Aloulou, 2016). Students that are new in the business field with the knowledge of entrepreneurship have many abilities in them. They can run their business by developing the self confidence in them. They are independent in their all the matters of their business. They can securely make the decisions to run the business and no one can interfere in the decisions of that student (Aloulou, 2016). These all the abilities effects on the entrepreneurial career intentions and by these abilities the new business of that student will be enhance in few days and will automatically impact on the business sector of Thailand. Theory of entrepreneurship education proofs that this human factor is playing the mediating role in this concept and Business sector of Thailand can be improved by the mediating role of self enhancement on the entrepreneurial career intentions (Chang, Yao, Chen, King, and Liang, 2016).
Hypothesis 3: Self enhancement has the significant mediating role between entrepreneurship education and entrepreneurial career intentions.

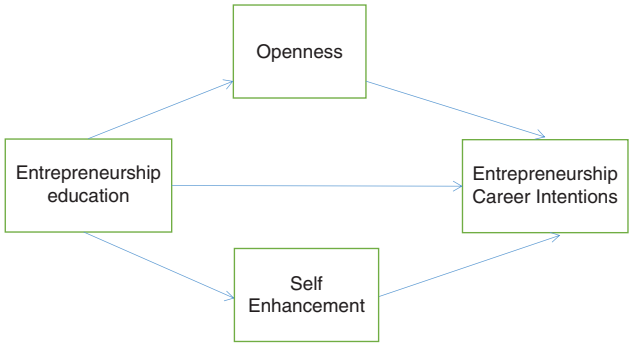

Fig. 1. Theoretical framework.

This study has discussed about the theoretical portion of the role of Human Values in Relationship between Entrepreneurial Education and Entrepreneurial career intentions which is the empirical study in Thailand. Additional theoretical framework is highlighted in Figure 1.

3. METHODOLOGY

Questionnaires were given to 309 students of business courses of different universities in Thailand. The questionnaires were given to the students who were at the end of the undergraduate level or at the master level. About 60% questionnaire were given to the males students and 40% of the questionnaire were given to the female students. The ages of the students were in between 21 to 40. Questionnaire were given to the different courses of the students but majority of them were linked with the course of business sector. Questionnaires have been filled to self administered technique and also through online way. The responses were then analyzed by using statistical tools such as SPSS and AMOS through CFA and SEM.

3.1. Measures

The variable openness was assessed with seven items and the researcher of this study used the scale of Ref. [6]. Females and males were requested to select one option, range from 1-strongly disagree to 5 = strongly agree. This variable includes different questions such as "Thinking up new ideas and being creative are important to him." "He likes to do things in his own original way" or "She likes to take risks. She is always looking for adventures." The variable self-enhancement were as well as assessed with seven items. Such as "It is very important to him to show his abilities. He wants people to admire what he does" and "It is important to her to be in charge and tell others what to do. She wants people to do what she says." The variable entrepreneurial career intention was measured using four items that measure the perceived possibility of an individual to choose an entrepreneurial career and used the scale of Ref. [7]. Following is one of the items of entrepreneurial career intention such as "Do you think that in the future you will create your own company?" The entrepreneurial education was measured with 10 items and the researcher used the scale of Ref. [8].

4. RESULTS

Result of this data collection is showing the significant positive impact of the entrepreneurship education on entrepreneurial career intentions and significant positive impact of mediating role of openness and self enhancement on the entrepreneurial career intentions [9–18].

4.1. Research Findings

To analyze the empirical effect of female entrepreneurial education on growth intention, data was collected from the tourism sector. After eliminating the rough and complete questionnaire, there is 309 questionnaires are used for analysis. Finding shows that there is 164 male and 145 females participated, out of which 95 respondents have master's degree education whereas the majority of the respondent were young and having age from 21 years 40 years [19–27].

Table I. Rotated component matrices.

	Component			
	1	2	3	4
SE1	.862			
SE2	.863			
SE3	.900			
SE4	.888			
SE5	.860			
SE6	.894			
SE7	.899			
OP1			.826	
OP2			.846	
OP3			.843	
OP4			.866	
OP5			.804	
OP6			.841	
OP7			.869	
EE1		.845		
EE2		.831		
EE3		.813		
EE4		.811		
EE5		.846		
EE6		.867		
EE7		.835		
EE8		.806		
CI1				.849
CI2				.817
CI3				.865
CI4				.877

Table II. KMO and ballet's test.

Kaiser-meyer-olin measure of sampling adequacy	.905
Ballet's test of hemispheric	
Approx. chi-square	16996.526
d	325
Big.	.000

Table III. CFA.

Indices	Range	Output
CMIN/DF	<3	2.721
GFI	>.80	.82
CFI	>.90	.927
IFI	>.90	.927
RMESA	<.08	.068

Table IV. Discriminate and convergent validity.

	CR	AVE	MSV	OP	EE	SE	CI
OP	0.959	0.770	0.308	**0.877**			
EE	0.932	0.638	0.198	0.398	**0.799**		
SE	0.989	0.926	0.308	0.555	0.445	**0.962**	
CI	0.922	0.748	0.247	0.497	0.415	0.435	**0.865**

Table V. Structural equation modeling.

Total effect	EE	OP	SE
OP	.456***	.000	.000
SE	.534***	.000	.000
CI	.448***	.322***	.108
Direct effect	**EE**	**OP**	**SE**
OP	.456***	.000	.000
SE	.534***	.000	.000
CI	.243**	.322**	.108
Indirect effect	**EE**	**OP**	**SE**
OP	.000	.000	.000
SE	.000	.000	.000
CI	.205**	.000	.000

Note: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

4.2. Factor Analysis

To check the reliability of the data Factor Analysis test was used KMO test shows that suitability of the data whereas rotated component matrix shows the factor loading of each item. Results of Rotated Component Matric is given in Table I and KMO is given in Table II.

Outputs showing that data is normal, and reliability of our constructs are Okay, now, we move for further analysis.

4.3. Confirmatory Factor Analysis

Confirmatory factor analysis was applied in order to check the fitness of research model as well as also to analyze the discriminate and convergent validity there are 5 indicators which prove the fitness of model, indicators and their threshold value is given and highlighted in Table III.

Results of the above-mentioned Table III prove that the research model for the current study is good if it because all indicators have their value indie threshold rage no statistical tool package was used open the discriminate and convergent validity.

4.4. Discriminate and Convergent Validity

In the following Table IV, the results of discriminant and convergent validity are given. Discriminant validity shows the discrimination of each construct from other ones, whereas convergent validity proves the internal consistency of the measurement.

If the CR is greater than .70 and AVE is greater than .50 then the convergent validity of the data was proved. The current findings show that each variable has its CR value greater than .70 and AVE value greater than .50. so, the convergent validity is proved. The other columns show that each construct has acceptable discrimination from others, so there is no chance of multidisciplinary in the data and our data has validation of discrimination.

4.5. Structural Equation Modeling

Structural Equation Modeling basically is the mixture of multiple regression analysis which gives the all results of direct, indirect and total at the same time; the following Table V shows the output of the current study.

Structural model generally used for hypotheses testing [29]. The results of SEM show that entrepreneurial

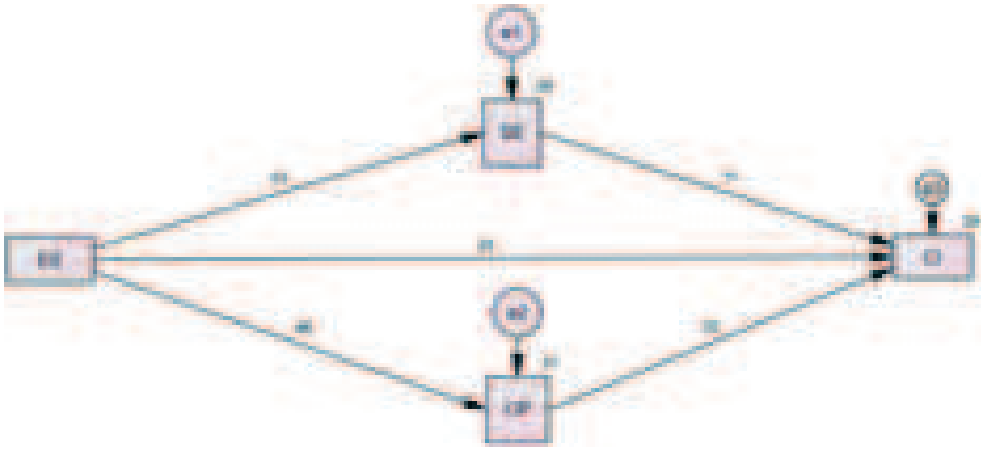

Fig. 2. SEM screenshot.

education has positive and significance impact on entrepreneurial career intention which means that if one unit of entrepreneurial education increased it will bring 32% positive entrepreneurial career intention. findings also show that self-enhancement play an insignificant mediating role between entrepreneurial education and entrepreneurial career intention. However, the role of openness between education and entrepreneurial career intention is significant. So, all the three hypotheses OD the study are accepted. The following Figure 2 show the standardized influence of independent variable on business opportunity identification and influence of mediators.

5. DISCUSSION AND CONCLUSION

This study aims to analyze between entrepreneurship education and entrepreneurial career intentions. This study also provides the mediating role of human factors like openness and self enhancement in the relationship between entrepreneurship education and entrepreneurial career intentions (Hatak, Harms, and Fink, 2015). This study has accepted the first hypothesis which is the entrepreneurship education has the significant impact on the entrepreneurial career intentions. Theory of entrepreneurship education proofs this whole concept that Self-confidence is build up in students due to entrepreneurship education (Khuong and An, 2016) and they can make the decisions freely and confidently and can achieve their goals that they want. So the entrepreneurial education is positively impacting on the entrepreneurial career intentions. Businesses sector automatically improve by the entrepreneurial education (Kim-Soon, Ahmad, and Ibrahim, 2016). Entrepreneurial scholars has identified that the entrepreneurship education is enhancing the abilities in the students who are very fresh in the field of business in such a way that the students with the ability of good communication will put very good impact in the business sector of Thailand and can reduce the poverty (Westhead and Solesvik, 2016).

This paper has accepted the second hypothesis that the entrepreneurship education has the positive impact on the openness of the students of undergraduate or master level. The impact of the entrepreneurship education has the positive impact in such a way that this enhances the skills of communication of the students and also effects on the student's behavior (Entrialgo and Iglesias, 2017) which will help them to communicate with other businessmen in different deals and this will also increase the sales of their business because customers will attract to them due the good communication skills and good behavior. This will create the positive impact on the entrepreneurship career intentions. Theory of entrepreneurship education proofs that Openness enhances the communication skills due to entrepreneurship education and the students will be able to take the decisions professionally in their business (Krueger, 2017). They will feel comfortable with the people who have impressive communication skills. They can deal with those people easily in different matter of their business and can impact on the entrepreneurial career intentions positively (Ozaralli and Rivenburgh, 2016).

This research has also accepted the third hypothesis that self enhancement has the significant mediating role between entrepreneurship education and entrepreneurial career intentions. Entrepreneurship education has the positive impact on the self enhancement and then self enhancement has the positive impact on the entrepreneurial career intentions [2]. Theory of entrepreneurship education proofs that the students of Thailand after coming in the practical life when they are making their own decision to run their business, they can get success in this field easily. They can spend their lives successfully in the society and their social status becomes very powerful (Ashourizadeh et al., 2016). Means to say that the education about entrepreneurship enhances the self-confidence of the students of Thailand that are new in their practical life (Holland and Garrett, 2015). Self enhancement is basically the human factor that is also positively impact on the entrepreneurial career intentions. So this research has concluded that entrepreneurship education has the positive impact on the human values like openness and self enhancement which are playing mediating role and then these human values also impacting on the entrepreneurial career intentions.

6. IMPLICATIONS

This study considered the concept of getting the education about the business to aware the problems that a new person faces in the business sector (Walter and Block, 2016). Entrepreneurial education is too much important for the students who have the interest to go in the field of business. Entrepreneurship education enhances the openness and self enhancement and they can know how to manage all the things related to the business (Wilson et al., 2007) how to improve the situation of the business, how to make the profits by enhancing the sales due to the good communication skills, how to reduce the poverty rate in the country and how to achieve the goals. This study not only includes the personal achievements of goals but this study also includes the goals that has the positive impacts on the business sectors (Simmons et al., 2016). This study includes that how to reduce the poverty rate of the Thailand against the growth rate of the population.

7. FUTURE RECOMMENDATIONS

The previous studies have some missing points regarding to our research. The main point that the previous studies don't have was the entrepreneurial education. Previous studies were just have the concept of the mediating role of the human factors including openness and the self enhancement (Liñán et al., 2016). In this study this missing point is covered. Because without entrepreneurial education human factors cannot impact on the entrepreneurial

career intentions positively. Without entrepreneurial education the students who don't have the experience to run the business cannot build up the confidence level to make the decision freely and they don't have the good communication skills. So this research has the future recommendations for those students who are interested to go in the business field must have the knowledge of business field by entrepreneurial education (Jensen et al., 2016).

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RESEARCH ARTICLE

The Impact of Entrepreneurial Education on Entrepreneurial Activity: With the Moderating Role of Future Time Perspective and Mediating Role of Opportunity Identification

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Purpose: This research is conducted to know the impact of entrepreneurial education on entrepreneurial activity in Thailand, this study also focuses on the moderating effect of future time perspective between entrepreneurial education and opportunity identification. This study is directed to keep opportunity identification as a mediating role between entrepreneurial education and entrepreneurial activity. *Methodology*: Method of quantitative study is used, questionnaire was selected as the research tool, questionnaires were distributed among private and public universities of Thailand and an online survey was also conducted in order to collect data and in order to collect opinions regarding the main idea of this research. *Results*: The results showed that entrepreneurial education has a very important and positive impact on entrepreneurial activity and opportunity identification effectively mediates that relationship between entrepreneurial education and opportunity identification. It can be seen that future time perspective is significantly moderating between opportunity identification and entrepreneurial education. *Implications*: The format and variables adopted in this research are a vital addition to the literature world as almost no research was done keeping these variables all at once whereas, practically this research is helpful for the entrepreneurs and higher education system.

Keywords: Entrepreneurial Education, Entrepreneurial Activity, Future Time Perspective, Opportunity Identification, Thailand.

1. INTRODUCTION

Efficient use of skills by effective human capital requires up-to-date knowledge and skills development in the specific domain [1]. Entrepreneurial education develops the abilities and proficiencies that empower a person to comprehend and grasp the opportunities to manage the system and to earn maximum profit in a planned and hierarchical way [2]. Entrepreneurial education can be looked through in various directions such as it may involve getting ready to take risks and follow the idea of high risk and high return, skills like that need the development of mind towards solving critical problems and simplify the accomplishment of long-term goals [3]. The worn-out definitions of entrepreneurial activity are not enough to define what these activities exactly consist of, entrepreneurial activities can be segregated according to the context as in they might consist of detecting and grasping the opportunities present in the economic structure, an entrepreneur identifies and exploits profit prospects [4]. Entrepreneurial activity is a resourceful human deed in the chase of making worth and merit, through the formation and extension of human activity by ascertaining and utilizing new products, routes and marketplaces.

The link between entrepreneurial activity and entrepreneurial education and its importance is well evident from the past studies and research works, yet, to fill any gaps and to provide better evidence this research paper has indulged into the main idea of their linkage as it is very important for the economic growth of any country to get clear about the determinants of that growth. Entrepreneurial education plays the role of a bridge between an entrepreneur and creation of emerging and profitable businesses. Mainly the scale in order to know efficiency regarding entrepreneurial education in some place is the number of emerging businesses and initiatives taken by the people of that country [5]. Following

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the previous research work entrepreneurship is the most highlighted and emerging sensation for more than the previous 30 years. Since every country has started to focus on its economic development, so has Thailand, interest in economic boost through creating innovative ideas have increased here so much in the past few years that researchers are provoked to study and dig out the determinants that are responsible for this shift of interest, in case of the government of any country, activities promoting entrepreneurship have a highly vital outcome in this environment of high competition, innovation and lack of employment [6].

It is evident from the above discussion that entrepreneurship is of great importance for any country that wants to stay in front in the race of innovation, competition and growing economy, so the place where entrepreneurial activities are important, entrepreneurial education is of great importance as well. Education related to entrepreneurship provides the base for the proper hierarchical achievement of long-term goals through entrepreneurial activities. After all the experimental evidences on entrepreneurial education a lot of researchers and scholars have settled on the fact that opportunity identification is the most dominant of all the characteristics that represent entrepreneurial education and behavior [7]. The present problem needs evidence that how entrepreneurial education will impact entrepreneurial activity, will it enhance it or not furthermore, the present problem is about keeping future time perspective in mind while taking the particular knowledge and focus on opportunity identification, evidences are required to prove the joined impact of entrepreneurial education and opportunity identification on entrepreneurial activity [8]. The main objectives are,

- To find out the impact of entrepreneurial education on entrepreneurial activity.
- To evaluate the moderating role of future time perspective between entrepreneurial education and opportunity identification.
- To evaluate the mediating role of opportunity identification between entrepreneurial education and entrepreneurial activity.

So, the research questions that arise from the above objectives are,

- What is the impact of entrepreneurial education on entrepreneurial activity?
- Is there any moderating role of future time perspective between entrepreneurial education and opportunity identification?
- Is there any mediating role of opportunity identification between entrepreneurial education and entrepreneurial activity?

Competency to predict, anticipate and plot for future is critical as well as very important for organizations and countries striving for excellence [9]. Yet, the present studies are not emphasizing enough on this anticipation, important problems are not being discussed and being planned according to future needs, present should be focused up to some extent but planning according to Future Time Perspective is important as future is going to get worse if the present problems are not addressed properly [10]. So main purpose of this paper is to see if in Thailand FTP, the moderating variable between identification of opportunity and education about starting a new firm is discussed vitally or not and if yes, it shows that if today entrepreneurial education is given by keeping future time perspective in mind then opportunity identification will be focused with proper attention that will bring out the best in entrepreneurial activities in return. In further parts of the paper hypotheses are derived on the effect of taking education in entrepreneurship and their benefits in starting a new business taking opportunity identification as a mediator and keeping in view the moderating role of future time perspective, this section will be called as literature review and theoretical framework. Third section clarifies the research design and tools. Fourth section reveals results and analysis and the fifth section wind ups the results obtained with some limitations and future research indications.

RESEARCH ARTICLE

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1. Entrepreneurial Education and Entrepreneurial Activity

Past studies have suggested that to bring the best possible results out of any entrepreneurial activity, entrepreneurial education is important but none of them discussed both in a very clear way [3]. Hansemark (1998) suggested, customary education only teaches and converts customary knowledge whereas entrepreneurial education alters the way of behaving and objectives. Entrepreneurial education is everything related to growth in economy and promotion of businesses [4]. The Consortium for Entrepreneurship Education (2008) suggests, entrepreneurial education does not only tell a person that in what way he will start and keep a business, it is the thing to inspire innovative ideas and the elevation of sense of self confidence and liberation. Students learn much more than only basic education and how to run a business. These definitions are discussing the prominence related to entrepreneurial training and also covered outcomes but past studies and authors have not directly put emphasis on relationship of entrepreneurial education and entrepreneurial activities, here we cannot see a clear cut discussion on their relationship, hence this paper aims to fulfill such gaps [6].

2.2. Educating About Entrepreneurship is Important for Emerging Firms

The dimensions involved in entrepreneurial activities driven by entrepreneurial education involves the first

driver that entrepreneurs having basic knowledge of entrepreneurship are key factors for boosting economic growth, here entrepreneurial education is considered as a factor that strengthens the entrepreneurial activities and entrepreneur's mind to such an extent where an entrepreneur contributes to the community and to the economy of overall country, it is clearly evident that a task done randomly will always be different from a task done with proper methods, research and education [7]. Here, it is emphasized that getting entrepreneurial education is important in order to get the best out of being and entrepreneur. Starting a business is easy but keeping it, running it and getting profits on regular basis is what establishes it, proper education about what you're going to do provides a base for each step [9]. So, education here acts as a catalyst to achieve goals and to gain most out of the entrepreneurial activities. Business, technical and support services are supported by emerging trend of entrepreneurial education before these activities [11]. Today's employee and a general initiator can be turned into tomorrow's Executive by considering the basic and hierarchical knowledge he needs to become a key player. Last is the dimension of Basic and Higher Education and Research, here the author has considered the increasing trend towards taking higher education in the field of entrepreneurship has contributed so much in the development of sense towards higher education in such an emerging and profitable field as entrepreneurship [12]. After this trend, researchers became provoked and interested in doing research on such emerging and interdisciplinary topic, thousands of researchers and article writers have written and published their work regarding entrepreneurial activities, entrepreneurial education, their determinants, importance and how to improve the existing system. So, both have highly contributed into higher education and research sector [13]. However, present research is still not enough to enlighten the public about the importance of taking entrepreneurial education before taking steps towards entrepreneurial activities. Studies need to be more practical and research workers need to consider that if they really want upcoming generation to take up the task of taking things in proper manner, proper advantages of entrepreneurial education need to be highlighted and demonstrated to general and upcoming generation [14]. The author has not clearly told that how entrepreneurial education helps in development of the other two dimensions filling that gap our paper has to state that like everything needs basic knowledge before getting started, entrepreneurial activities need higher entrepreneurial education in order to increase productivity and increase results of entrepreneurial activities positively [13]. Entrepreneurship emerged and raised its significance to such extent that it captured the interest of young rising blood, researchers, authors and debaters. Most of the time when it is discussed in recent years, it has been discussed alongside with the importance of its basic education.

2.3. KOSGEB Model

The importance and ideas of Entrepreneurial Education in Entrepreneurial activities can be understood by considering the points behind this model that were put forward for best results of entrepreneurial activities [15]:

- Creating flourishing and maintainable enterprises
- Spreading the entrepreneurship philosophy
- Increasing effective entrepreneurship by creating the business upgrading institutions giving entrepreneurial education
- Increasing the number of employments
- Accompanying entrepreneurship based on regional dynamics
- These objectives were set for promoting entrepreneurial education for the up gradation of entrepreneurial activities and to highlight importance of the relationship of these two.

Yet, this model did not describe that how entrepreneurial education is helping in different areas of entrepreneurial activities and it has not effectively segregated each activity and linked it to certain field of related education [16, 17].

However, if entrepreneurial education is taken properly and exactly according to the need of the entrepreneurial activity that one is going to do, higher level of entrepreneurial education brings higher positive results in entrepreneurial activity [18–26]. Through the above research following hypothesis is derived:

H1: *Entrepreneurial education has a positive impact on entrepreneurial activity*.

2.4. Mediating Role of Opportunity Identification

Entrepreneurship is all about creating self-esteem and encouragement to take innovative steps, in this paper opportunity identification is taken as a mediator between entrepreneurial education and entrepreneurial activity, first of all, it is the prime duty of present market players to create opportunities for upcoming young blood, opportunity identification of opportunities and then choosing right one for one's business is the most important step towards effective entrepreneurship [27]. The determinants that decide what kind of opportunity to look for and which one is suitable for one's business are following [28]:

- Entrepreneurial attentiveness
- Asymmetrical data and preceding information
- Social setups
- Personality characteristics
- Nature of opportunity.

Entrepreneurial minds must act attentive and alert for grasping the developing opportunities and in order to maximize entrepreneurial activity in positive way [29]. Proper information is necessary in order to play smart in the market and it depends on the personality characteristics of the person and own interests of the entrepreneur [30].

Consortium for Entrepreneurship (2008) has put great emphasis on opportunity identification as a positive mediator in between education and activities, this states that the skills this education offers include [31]:

- The aptitude to identify and realize opportunities in life
- The skill to avail and grasp opportunities by innovation thinking and to find the necessary requirements
- Capability of creating new ideas and firm
- The proficiency of thinking in innovative and acute way.

Here, entrepreneurial education teaches core manners of opportunity identification, it is because opportunity identification is the main thing that affects entrepreneurial activity in positive way, so if a person has ability of opportunity identification, entrepreneurial activity increases in return [32]. This theory has not elaborated mediating role clearly, moderating role of opportunity identification is taken in this paper, but this theory is not clearly showing any mediating role between entrepreneurial education and entrepreneurial activities [33–38]. Following hypothesis is derived from above theory:

H2: *Opportunity identification plays positive mediating role between entrepreneurial education and entrepreneurial activity.*

2.5. Moderating Role of Future Time Perspective

Minds of entrepreneurs always stay one step ahead and think with future perspective in their minds. Entrepreneurship demands pre-planning, prior information and authentic data at present to perform the best in future, so everything is planned keeping future time perspective in mind [39]. In this study future time perspective is moderating between entrepreneurial education and opportunity identification [27]. In a past study it was stated that entrepreneurship no more works the same old way, it is more than just starting a business nowadays, entrepreneurship needs future time perspective that is planning according to the future situations in present [40]. As the time changed, awareness about future planning and probability planning increased, opportunity identification is considered the emerging most important factor for maximizing entrepreneurial activities and here future time perspective will tell how [41].

As it is seen that entrepreneurial education is becoming compulsory for entrepreneurial activities so the main idea is to take entrepreneurial education keeping future time perspective in mind, keeping it in mind one will come to know the most important determinant that is opportunity identification, when it is learnt in the best possible way, driving a new and innovative business will become a piece of cake [42].

However, there are almost no researches that have taken future time perspective as a moderating role between entrepreneurial education and opportunity identification in case of entrepreneurial activities, so it was the need to time to discuss these gaps in this paper [42]. From the study of above variable, this hypothesis is derived:

H3: *Future time perspective is playing a significant moderating role between entrepreneurial education and opportunity identification.*

Research Model of the study is shown in Figure 1.

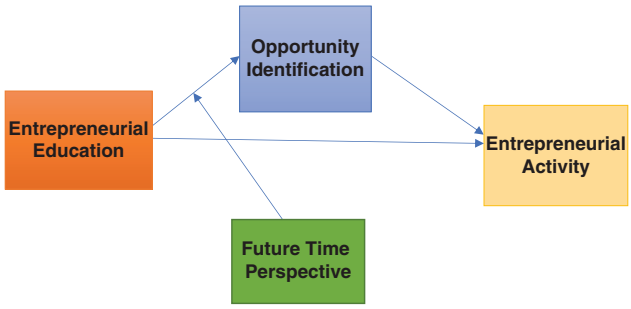

Fig. 1. Research model.

3. METHODOLOGY

3.1. Members and Method

This was a quantitative study in which data was collected by questionnaire method, questionnaires were selected as the data collection tool, and questionnaires were distributed among the students of public and private universities of Thailand. Moreover, online forms were also moved, so information was collected both by an offline method and online method, 289 responses were received.

3.2. Sample

The number of total members was 289, in which population of men was 119 and population of women was 170. The main idea was to select that population who are yet not entrepreneurs and are in the state of wanting to become and entrepreneur because here, intention of the survey was for elaborating the role of education in entrepreneurship on entrepreneurial activity so to define and study the role of mediating variable the transition stage was important.

3.3. Measures

- *Opportunity identification*:

Measures are the scales through which opinions are taken and results are depicted. For the sake to collect data and identify results the scale that was used was from Ucbasaran, Westhead (2008) for opportunity identification [43]. The two factors were, "You have come through (got) how many opportunities to start an innovative business for the last 2 months" Members had to write a full number of the right times they got opportunities and second was that "From those chances which one do you think were reliable to create innovative ideas and firms?"

- *Entrepreneurial activity*:

For the sake of entrepreneurial activity, Caplan Job Stress Questionnaire was used, 2 factors taken were,

"Do you prefer sole proprietorship or partnership?" And respondents were supposed to respond with a yes or no [44].

- *Future time perspective*:

To know about future time perspective, scale of Marlies E.A. Stouthard and Thea T.D. Peetsma was used that had 48 objects in it, 6 for each sub-scale. Reactions were provided on a 5-point scale, members showed their opinion by selecting a number [45].

- *Entrepreneurial Education*:

This was depicted by scale from the paper of Aniefiok Oswald Edet factors included a two-step process in which firstly the interest of the participants was asked whether they wanted to become entrepreneurs or not and in the second step they were asked if they already had tried or not [46].

4. RESEARCH FINDINGS

This study based in Thailand context and data is collected from the 289 respondents. The findings show that 119 male and 170 females participated in the study. The age of the respondent from 20 years to 25 years have a frequency of 236 respondents, 25–30 years range have 42 respondents, 31–40 years range have 09 respondents and remaining are greater than 40 years. Moreover, 23 respondents are undergraduate, 141 are graduate, 115 are master and remaining 10 have other education.

4.1. Factor Analysis and Reliability Test

The following Table I shows the factor loading of each construct and suitability value which is measured with KMO (Table II) and rotated component matrix.

The above-mentioned Tables I and II shows the suitability of data and factor loading, KMO shows that data is suitable for further analysis and rotated component shows that each construct load in its own construct.

4.2. Convergent and Discriminant Validity

Convergent validity is the validation of items wise for constructs which prove the internal consistency of the data whereas, discriminant validity shows the discriminant of a variable from others. Statistical tool packages used to identify the convergent and discriminant validity of the data finding are below in Table III.

Value of composite reliability and average variance excreted confirm the issue of convergent validity whereas the remaining column shows the discriminate validity of the data. Composite reliability for each constructing has value more than .70 and value of MSV is less than AVE, so it proves the convergent validity and other remaining column shows that every construct has more value for itself rather than others which proved the discriminant validity of the data.

Table I. KMO and Bartlett's test.

Kaiser-Meyer-Olkin measure of sampling adequacy	.915
Bartlett's test of sphericity	
Approx. chi-square	5600.550
Df	171
Sig.	.000

Table II. Rotated component matrix.[a]

	Component			
	1	2	3	4
FT1			.809	
FT2			.814	
FT3			.795	
EE1	.679			
EE2	.795			
EE3	.842			
EE4	.860			
EE5	.842			
EE6	.828			
EE7	.848			
EE8	.867			
EE9	.901			
EE10	.864			
EE11	.880			
EE12	.896			
OI1				.858
OI2				.875
EA1		.832		
EA2		.843		

Note: [a]Estimates of the correlations between each of the variables and the estimated components.

4.3. Confirmatory Factor Analysis

The test of confirmatory factor analysis in Table IV is used to identify another model of this study is good fit or not. There are 4 to 5 indicators which proved the model fitness and their threshold and observed values are below.

The results of above-mentioned Table IV presenting that all values are under the threshold range, i.e., the value of CMIN/DF for the current data is 3.168 which is less than 5.0, GFI, .81, which is greater than .80, IFI and CFI are .944 which are greater than .944, and last but not the least RMESA is .06, which is less than .08. So, means that the model of the study is a good fit. Following Figure 2 is CFA in AMOS.

Table III. Convergent and discriminant validity.

	CR	AVE	MSV	OI	FT	EE	EA
OI	0.894	0.808	0.360	**0.899**			
FT	0.733	0.478	0.011	−0.104	**0.691**		
EE	0.973	0.751	0.404	0.565	0.008	**0.867**	
EA	0.897	0.813	0.404	0.600	0.060	0.636	**0.902**

Table IV. CFA.

Indicators	CMIN/DF	GFI	IFI	CFI	RMESA
Threshold range	<3 or 5	>.80	>.90	>.90	>.08
Observed values	1.606	.925	.985	.985	.046

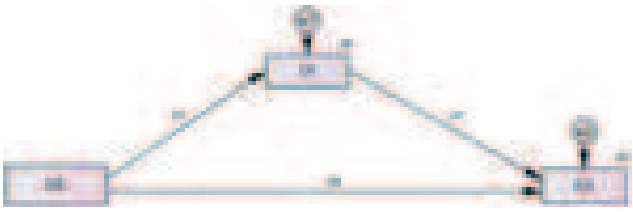

Fig. 2. SEM.

Table V. Structural model results.

Effects	Hypothesized path	*B*	S.E	*P* value	Conclusion
Linear effects					
Hypothesis 1 (+)	EE → OI	.530	.053	.000	Accepted
Mediation effects					
Hypothesis 2 (+ ↑)	EE → OI → EA	.162	.038	.010	Accepted
Moderation effects					
Hypothesis 3 (+ ↑)	EE ∗ FT → OI	.115	.027	.020	Accepted

4.4. Structural Equation Modeling

In order to test the study hypotheses structural equation modeling by using AMOS was performed, because SEM has a feature of multiple regression and can test the entire model at the same time in one shot. Table IV presenting the regression weights of each construes on another, and indicate the conclusion of the hypothesis in Table V.

This test is chosen by the researcher as it approximates the multiple and interconnected reliance in a particular examination. Above presenting Table V showing the results of structural equation modelling, education has positive and significant impact on opportunity identification, and it also has positive and significant direct impact on entrepreneurial. Moreover, the mediating role of opportunity identification between education and entrepreneurial activity, findings shows that it has 16.2 percent significant impact, therefore, H2 also accepted. Future time pass has significant and positive moderating role between education and opportunity identification. The following Figures 2 and 3 show the SEM and Moderating chart.

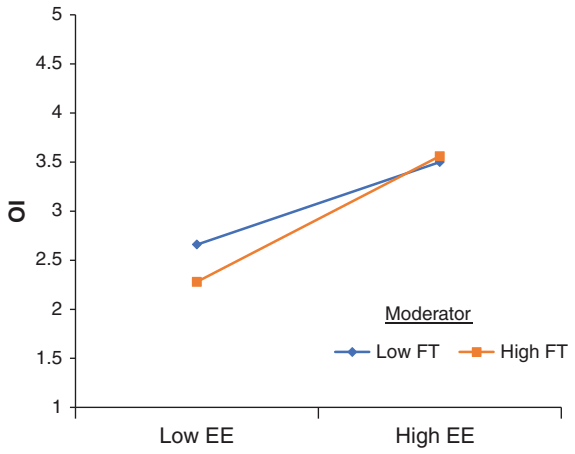

Fig. 3. Moderation impact of FT between EE and OI.

5. DISCUSSION AND CONCLUSION

5.1. Discussion

Aim of this study was to know the impact of entrepreneurial education on entrepreneurial activity with the mediating role of opportunity identification, it also aims to know that how entrepreneurial activity increases with the moderating role of future time perspective between opportunity identification and entrepreneurial education. Discussing each hypothesis proposed one by one.

Hypothesis that, Entrepreneurial education has a positive impact on entrepreneurial activity is accepted because the research results suggest that entrepreneurial activity increases with the increase in effective entrepreneurial education [11]. When entrepreneurship is started with its relevant knowledge its affect will increase and in return efficiency of the firm will increase [12].

Proposed hypothesis 2, Opportunity identification plays positive mediating role between entrepreneurial education and entrepreneurial activity will be accepted [47]. As it is clear from the research results that when opportunity identification is taken as a prime concern while taking entrepreneurial education, the impact of entrepreneurial education increases on entrepreneurial activity, it is also evident from the above theories [48–51].

Future time perspective is playing a significant moderating role between entrepreneurial education and opportunity identification is true. As it is clear from the above-mentioned theories that when education is taken by keeping future time perspective in mind, opportunity identification will be focused, and it will enhance entrepreneurial activity in return.

5.2. Conclusion

The outcomes of this paper recommend that, with the presence of future time perspective as a moderating variable between opportunity identification and entrepreneurial education an entrepreneurship activity increases as entrepreneur will think effectively according to time of the future. By the presence of opportunity identification in between the basic education of how to start a firm with innovative ideas and running the firm and bringing out profitable results has a significant and positive impact overall.

5.3. Implications

Theoretically, this research is important as previous researches have talked about entrepreneurial education and activities but none of them has taken into account future time perspective as a moderating role between entrepreneurial education and opportunity identification and almost none of them has taken opportunity identification as a mediating variable, this research has

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taken all of the four variables together, thus contributing to research world with naive concepts.

Firstly, practically, this research has implications for entrepreneurs as they must decide whether to indulge in the field or not, so they need some proper research on the determinants and factors that they need to study before taking any step. Secondly, this research has implications in the education sector that how they need to better the education system and process to create better entrepreneurs and to teach them according to these factors discussed. Education sector needs proper guidelines on higher education of entrepreneurship to consider the factors mentioned in this paper, when fresh blood will get education according to the modern requirements it will surely bring fruitful results. This research has also contributed to community, bringing innovative ideas and ideas that can change the economic growth level and thinking perspective of all the upcoming entrepreneurs.

5.4. Future Research Indications

This study has filled many gaps, yet this has not discussed all the factors in detail, the detail that how future time perspective helps to increase and improve entrepreneurial activities in the present stage. The same study can be conducted in other countries, other than Thailand to know their mind state and preferences, in this way new dimensions can be discovered and discussed in order to study the same topic in different ways and different demographic setup. Future studies can change the method of data collection and the type of their research. Future studies can also change and discuss different variables.

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Driving Entrepreneurial Success in Thailand Through a Triangle of Entrepreneurship Education, Psychological Capital, and Social Competence

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The main aim of the study is to understand the role of entrepreneurial education in entrepreneurial success and the mediating role of psychological capital and the mediating role of social competences between entrepreneurial education and entrepreneurial success. The success of business rises-out of the overall investments in an enterprise. This is not just narrowed to the tangible in-puts only for example "Financial Capital," however as well as on "In-tangible Resources." The occupation of entrepreneurship is an extremely stressing work including taking risks and frequently challenging the amount of work, therefore necessitating mental contributions such as psychological capital and entrepreneurial education and learning. In addition, the job of entrepreneurship as well as includes doing business with other individuals of various positions involving clients, partners, labor force and investors, therefore necessitating an entrepreneur or business person to show an excessive amount of social competences so as to relate with other individuals. In the current paper, the sample consists of owners and managers of small firms in Thailand. This paper analyzed the data of owners and managers who are working in micro or small businesses. The sample size of this study consists of 292 respondents. The findings of this paper propose that supporting and educating entrepreneurs or business persons to reinforce their social competence and psychological strength is vital. This paper will enrich the empirical evidence and literature body. Additionally, various institutes will know from this paper that how much entrepreneurial education is important for the success of the business.

Keywords: Entrepreneurial Education, Entrepreneurial Success, Psychological Capital, Social Competences, Thailand.

1. INTRODUCTION

In this section, the researcher of this paper discussed the background of this research and stated the research objectives of the study.

1.1. Background of the Study

The scholar Baron, Franklin [1] and Umukoro and Okurame [2] indicated that the jobs of entrepreneurship include forming new enterprises or ventures and developing them into sustainable and successful ventures. All phases of the process of entrepreneurship, still, present intimidating challenges, together with a vibrant competitive work setting and the threats take on. The researcher Margolis [3] argued that these can clearly influence a number of entrepreneurial consequences such as comprising satisfaction, performance and decreasing the potential for continuing in the business or entrepreneurial undertakings. It is mainly an instance for microenterprises in emerging states, where there are greater proportions of non-success. Averagely, just around thirty-four percent of micro entrepreneurs or self-employed entrepreneurs are considered effective as well as successful. While a number of the challenges that entrepreneurs met with are exterior, for example "Economic Circumstances," thus are out-side the situation or control of the business person [4]; unproductive or unsuccessful proprietors of small medium enterprises incline to share alike attributes. This proposes that the abilities of the entrepreneurs' in order to deal with the demands and necessities of entrepreneurship play a crucial and important role in reaching achievement and success (Chienwattanasook, and Jermsittiparsert, 2019). There are 2 vital in-tangible assets accessible to entrepreneurs, which is "Social Capital" and "Psychological Capital" could assist to deal with the stimulating

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part of "Entrepreneurship," thus increasing probabilities of achievement and success [5]. In accordance with the researcher, successful entrepreneurs incline to show high-levels of social and mental competences. This study, thus, investigates the influence of these in-tangible assets to subjective and objective entrepreneurial results. Along with the psychological or mental resources, the capability to comprehend one-self and others is significant for the leaders of business, client management, team work, networking, conflict management and negotiation [6, 7]. These should raise the probability of success and achievement amongst communally competence businesspersons. Social abilities highlighted the researcher involving awareness of the situation, presence, simplicity, and compassion, entrepreneurial education are vital capabilities for the businessperson or for the entrepreneurs; mainly in activities comprising associations with customers, labor force, networks, and suppliers. According to Lans, Blok [8] social capability is as well as associated with the strength of bonds of promising entrepreneurs or businesspersons have with another individual that has implications for difficult tasks of entrepreneurship for example marketing and networking. In spite of the effectiveness of social competences and psychological capital to the business [9–11]. It has been proposed that such in-tangible assets are handled and managed poorly among micro and young ventures, therefore the necessity to constantly high-light the importance of these assets or resources [12]. The main aim of the study is to understand the role of entrepreneurial education in entrepreneurial success and the mediating role of psychological capital and the mediating role of social competences between entrepreneurial education and entrepreneurial success [13–20]. Moreover, Figure 1 highlighted that entrepreneurial education raises the chances of success.

The above Figure 1 shows that the education of entrepreneurship increases the probabilities of entrepreneurial success and as well as raises the chances for new venture creation. As the Figure 1 shows that almost fifty-four percent of entrepreneurship graduates involved in new venture creation while non entrepreneurship graduates percentage is only (17.4 percent).

Fig. 1. Entrepreneurial education raises the chances of success. *Source*: (Alberta Charney Gary D. Libecap).

1.2. Objectives of This Paper

This paper will cover the following research objectives:
(1) To determine the influence of Entrepreneurial Education on Entrepreneurial Success.
(2) To investigate the mediating role Psychological Capital between Entrepreneurial Education and Entrepreneurial Success.
(3) To examine the mediating role of Social Competence Entrepreneurial Education and Entrepreneurial Success.

This paper will be completed in five main parts. First part is about the introduction of the study, in which the investigator of this study mentioned the research objectives. The second part of the study includes the literature review, in which the scholar of this paper discussed the association of variables with each other and developed hypotheses. The third part of this paper consists of research methodology, in which the researcher of the present paper mentioned the methodology of this paper such as a sample, the technique of data collection, data analysis technique, etc. The fourth section of this paper includes the results and analysis, in which the researcher of the study interpreted the major findings of this paper. The last section of this paper includes discussion, conclusion, implications, limitations, and recommendations.

2. LITERATURE REVIEW

In this section, the researcher of this paper mentioned the relationship of entrepreneurial education and entrepreneurial success, the mediating role of psychological capital between entrepreneurial education and entrepreneurial success and the mediating role of social competence between entrepreneurial education and entrepreneurial success [21–27].

2.1. Entrepreneurial Education and Entrepreneurial Success

In accordance with the past study of Hormiga, Batista-Canino [12] entrepreneurial education essentially contributes to the success and growth of an organization, particularly smaller developing enterprises. Generally, developing firms, which were employed or possessed by entrepreneurship former students had more than 5-times the employment and sales growth as compared to those which actually employed as non-entrepreneurship former students [28]. Moreover, bigger organizations paid significantly more to entrepreneurship students than they actually paid non entrepreneurship students [29]. The researcher stated that individuals who studied the course of entrepreneurship are employed in bigger organizations and earned around (23,500 dollars) per annum. So from this review, it has been proposed that entrepreneurial education is very vital for students. The researcher Millan, Congregado [30] stated that institutes that provide entrepreneurial education to their students will make them successful

in their future businesses. The findings of the previous study of Raposo and Do Paço [31] demonstrate that entrepreneurial education is vital for future entrepreneurs and it has a positive significant impact on entrepreneurial success. Moreover, the investigator stated that education of entrepreneurship assists entrepreneurs to overcome the problems of businesses which hinders entrepreneurial success. The theory of self-determination states that an individual who wants to be successful and determined in his or her opinions are much incline to get the entrepreneurial education [32].

2.2. The Mediating Role of Psychological Capital Between Entrepreneurial Education and Entrepreneurial Success

The researchers Haynie, Shepherd [33] indicated in their studies that optimistic intellect is vital to the "Entrepreneurial Mindset" facilitating persons to learn and understand from their personal and practical experiences and amend to the dynamic forces of the business setting so as to attain accomplishment and success. Aspects of "Psychological Capital," such as, "Self-Efficacy," and "Optimism" are vital for performance and enactment in cognitively associated entrepreneurial works comprising opportunities recognition and innovation [34–36]. Thus, from the initiation of the process of entrepreneurship, entrepreneurs or business persons implement "Psychological Resources" [37]. This proposes that "Psychological Capital" is an intellectual investment, which an entrepreneur or a business person will continuously be needed to spend in adequate quantities to attain preferred results [1, 38]. In accordance with the researcher Sarwar, Nadeem [39] the concept of "Psychological Capital" shows the psychological related resources, which persons carry to their job. Relied on the literature of optimistic psychology, "Psychological Capital" includes 4 resources such as "Resilience," "Optimism," "Hope" and "Self-Efficacy" [38, 40]. All these 4 elements of "Psychological Capital" are an acute resource at various phases of the entrepreneurship, thus vital for accomplishment and success. In accordance with the researcher, Gudmundsson and Lechner [41] optimism is also a facet of "Psychological Capital," which is stated to have a significant influence on the capability to create a venture or to do business. Hope is another facet of psychological capital, it includes the expectations of the persons of optimistic consequences or making optimistic characteristics regarding the probability of success in the long term and as well as in the short term [42]. Self-efficacy is actually linked with the situation of challenging objectives and the determination in the enactment of those objectives, therefore it is a beneficial resource for the performance and entrepreneurial growth and performance [43, 44]. People who are higher on expectations and hope are capable to amend policies when confronted with problems, thus, it is vital for encouraging determination and resiliency [45]. Therefore, it is estimated that entrepreneurs or business persons who are greater in-hope attain greater results [46]. Resiliency, it is as well as a psychological resource, which is beneficial in education and blooming in problematic conditions [47]. This is vital for handling the stress of business associated with resource constraints, competition, losses and risks [1]. The person who has psychological resources such as high self-efficacy, hope, resilience, and optimism are inclined to get entrepreneurial education in order to obtain favorable outcomes. People with positive thoughts and hopes tend to learn more entrepreneurial skills and education, which will help them in their business. This paper widens the implementation of "Psychological Capital" to describe an extensive array of entrepreneurial consequences. Generally, an indication shown in this examination proposes that "Psychological Resources" are vital for various entrepreneurial processes and jobs that comprising creating concern in entrepreneurial education, opportunity identification, starting a venture, innovation, creativity, creating and applying business-plans and also inspiration.

2.3. The Mediating Role of Social Competence Entrepreneurial Education and Entrepreneurial Success

In accordance with the researcher Baluku, Kikooma [48] in the domain of entrepreneurship, social competence includes the ability of the entrepreneur's to efficiently interact with persons who are essential to an organization. These involve clients, investors, labor force, suppliers, the society, and as well as other stake holders in the world of business. The researcher Holt and Macpherson [49] stated that social competence involves the capability to comprehend and know other persons, creating good and better impressions, familiarizing to an array of communal conditions and persuasion. These allow entrepreneurs or business persons to construct relational as well as social capital. Social competence could increase the chances of success. In this study, the researcher state that social competence is as well as acute for attaining entrepreneurial consequences involving the satisfaction of the entrepreneur's. The theory of Self-determination proposes that "Affiliation" is one of the key mental and psychological requirements, which drive persistence and inspiration [50]. Particularly, the contentment of the necessity for affiliation, such as other psychological requirements is antecedent for internal inspiration that in-turn is a cause of greater and better job performance. So, the capability to make optimistic associations with stake holders of the business might increase the probabilities of accomplishment and success for business persons. In addition, according to individuals who get entrepreneurial education and have social competence will attain successes in their businesses. As social competences help them to learn the entrepreneurial skills and get entrepreneurial knowledge which will ultimately help them to be successful in their businesses [51].

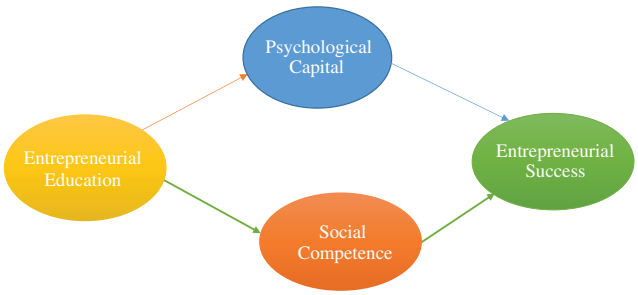

Fig. 2. Model of the study.

2.4. Hypotheses of the Study

This study includes three major hypotheses;

H1: *Entrepreneurial Education has a significant impact on Entrepreneurial Success*

H2: *Psychological Capital significantly mediates the relationship between Entrepreneurial Education and Entrepreneurial Success*

H3: *Social Competence significantly mediates the relationship between Entrepreneurial Education and Entrepreneurial Success*.

2.5. Model of the Study is Highlighted in Figure 2

In the above model, there is one independent and dependent variables such as entrepreneurial education and entrepreneurial success. There are two mediating variables such as psychological capital and social competence.

3. RESEARCH METHODOLOGY

In the current paper, the sample consists of owners and managers of small firms in Thailand. This paper analyzed the data of owners and managers who are working in micro or small businesses. The sample size of this study consists of 292 respondents. From which, 200 were the owners and rest of the respondents were the managers of the firms. The respondents significantly differed in their age groups, such as varying from eighteen to sixty-four years. The data collected through questionnaires. The researcher of this paper collected data from the owners and managers in hard form and as well as in soft form. Such as the researcher of this paper emailed the questionnaire of the study to business owners of different firms and self-administered the survey while collecting data from the managers of the firms. The questionnaire consisted of structured questions. Respondents have to select one option from 1-strongly to agree to 5-strongly disagree. The researcher performed the analysis of the data on SPSS. To test the hypothesis of the study the researcher of this paper run different tests such as direct effects, indirect effects, descriptive statistics and so on.

4. RESEARCH FINDINGS

To analyze the empirical impact of entrepreneurial education on entrepreneurial success, data was collected from the small industries in Thailand. After eliminating the rough and complete questionnaire, there is 292 questionnaires are used for analysis. Finding shows that there is 124 male and 168 females participated, out of which 127 respondents have master's degree education whereas the majority of the respondent were young and having age from 21 years 40 years.

Table I. KMO and Bartlett's test.

Kaiser-Meyer-Olkin measure of sampling adequacy	.959
Bartlett's test of sphericity	
Approx. chi-square	18728.044
Df	703
Sig.	.000

Table II. Data reliability.

Constructs	No of items	Cronbach alpha
EE	8	.957
PC	24	.938
SC	2	.883
ES	4	.912

4.1. Data Suitability and Reliability

To check the reliability of the data Cronbach alpha test was used and KMO test shows that suitability of the data, the following Tables I and II show the outputs;

Outputs showing that data is normal, and reliability of our constructs are Okay, now, we move for further analysis.

4.2. Confirmatory Factor Analysis

Confirmatory factor analysis was applied in order to check the fitness of research model as well as also to analyze the discriminate and convergent validity there are 5 indicators which prove the fitness of model, in the below Table III indicators and their threshold value is given.

Results of the above-mentioned Table III prove that the research model for the current study is good if it because all indicators have their value indie threshold rage no

Table III. CFA.

Indices	Range	Output
CMIN/DF	<3	2.921
GFI	>.80	.801
CFI	>.90	.912
IFI	>.90	.912
RMESA	<.08	.079

Table IV. Discriminate and convergent validity.

	CR	AVE	MSV	SC	EE	PC	ES
SC	0.833	0.750	0.006	**0.866**			
EE	0.955	0.726	0.196	0.044	**0.852**		
PC	0.932	0.844	0.187	−0.065	0.433	**0.919**	
ES	0.916	0.734	0.196	−0.080	0.443	0.401	**0.857**

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Table V. Structural equation modeling.

Total Effect	EE	SE	PC
SE	.025	.000	.000
PC	.405***	.000	.000
ES	.431***	−.092	.260**
Direct Effect	**EE**	**SE**	**PC**
SE	.025	.000	.000
PC	.405***	.000	.000
ES	.328***	−.092	.260**
Indirect Effect	**EE**	**SE**	**PC**
SE	.000	.000	.000
PC	.000	.000	.000
ES	.103**	.000	.000

Notes: $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

statistical tool package was used open the discriminate and convergent validity.

4.3. Discriminate and Convergent Validity

In the following Table IV, the results of discriminant and convergent validity are given. Discriminant validity shows the discrimination of each construct from other ones, whereas convergent validity proves the internal consistency of the measurement.

If the CR is greater than .70 and AVE is greater than .50 then the convergent validity of the data was proved [54]. The current findings show that each variable has its CR value greater than .70 and AVE value greater than .50. So, the convergent validity is proved. The other columns show that each construct has acceptable discrimination from others, so there is no chance of multicollinearity in the data and our data has validation of discrimination.

4.4. Structural Equation Modeling

Structural Equation Modeling basically is the mixture of multiple regression analysis which gives the all results of direct, indirect and total at the same time; the following Table V shows the output of the current study.

The results of SEM show that entrepreneurial education has positive and significance impact on entrepreneurial success which means that if one unit of entrepreneurial education increased it will bring 43.1% positive impact in entrepreneurial success. Findings also show that social competency play an insignificant mediating role between entrepreneurial education and entrepreneurial success. However, the role of psychological capital between education and entrepreneurial success is significant. So, the two hypotheses of the study are accepted, and one rejected. The following Figure 3 show the standardized influence of independent variable on success and influence of mediators.

5. DISCUSSION AND FINDINGS

H1: *Entrepreneurial Education has a significant impact on Entrepreneurial Success*

The results of this paper show that entrepreneurial education has a significant impact on entrepreneurial success. The first hypothesis of the study is accepted and is in line with the findings of. Entrepreneurial education is very important for business students as the education of entrepreneurship will help business students to start their own venture and make it successful.

H2: *Psychological Capital significantly mediates the relationship between Entrepreneurial Education and Entrepreneurial Success*

In addition, the paper findings suggest that psychological capital significantly mediates the relationship between entrepreneurial education and entrepreneurial success. The second hypothesis of the study is also accepted and the second hypothesis is supported by Ref. [52]. The researcher [38] stated that high "Psychological Capital" indicates that a person has a high-level of hope, efficacy, confidence, optimism, and resilience. The present literature demonstrates that all these resources are vital for exploitation and identification of entrepreneurial prospects,

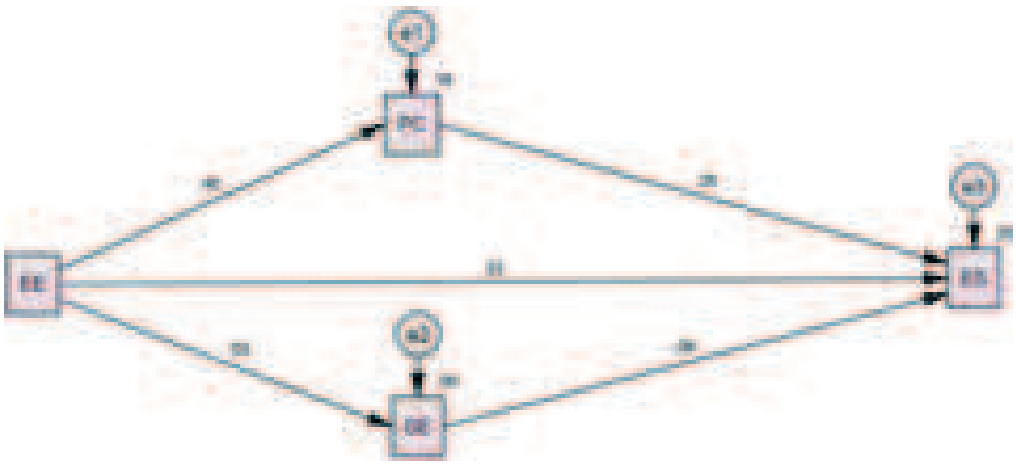

Fig. 3. SEM screenshot.

education, hitching means for investment, taking-risks, creating policies for accomplishing business aims and objectives and also dealing with pressure linked with business [1, 38]. Investing all above-mentioned "Psychological Resources" into a venture, thus, increases the probabilities for success and accomplishment with regard to entrepreneurial education and performance. Business persons with higher "Psychological Capital" are much probable to make constant investments in their companies because of the high hopefulness.

H3: *Social Competence significantly mediates the relationship between Entrepreneurial Education and Entrepreneurial Success*

Furthermore, the study findings suggest that social competence significantly mediates entrepreneurial education and entrepreneurial success. The third hypothesis of this study is also accepted. Individuals who get entrepreneurial education and have social competence will attain successes in their businesses. As social competences help them to learn the entrepreneurial skills and get entrepreneurial knowledge which will ultimately help them to be successful in their businesses.

6. CONCLUSION AND IMPLICATIONS OF THE STUDY

This paper aimed to examine the impact of entrepreneurial education on entrepreneurial success and along with the mediating role of social competences and psychological capital. The discoveries of this paper contribute to the comprehension of the part of intangible resources in the domain of "Entrepreneurship." As the resources confirm the supposition that the success of entrepreneurship doesn't ensue from the "Tangible Resources" only. However as well as from social resources and psychological resources, which a business person takes to the enterprise. Social competence, entrepreneurial education, and psychological capital are particularly essential resources for the success of a business. As education, psychological capital and social competence allow business persons to prosper in spite of the demands and challenges of their business or job. The in-tangible resources, which are actually nested in business persons particular characteristics enable opportunity identification, networking, decision-making, negotiations, dealing with pressure and stress, hitching resources and interaction with various stake holders, which are vital responsibilities of the business persons which will eventually lead to accomplishment and success. In addition, stronger and better social competence, education and psychological capital as well as raise the probability of continuing in the role of entrepreneurship. The capability to stay confident, resilient, optimistic and encouraged, also the capability to efficiently interact with other persons are ways continuing in entrepreneurial actions. Thus, the findings of this paper propose that supporting and educating entrepreneurs or business persons to reinforce their social competence and psychological strength is vital. This study includes implications as well. There are a number of studies on the subject of entrepreneurial education and entrepreneurial success. But no study is available who studied the mediating role of social competences and psychological capital in the relationship between entrepreneurial education and entrepreneurial success. Thus this paper will enrich the empirical evidence and literature body. Additionally, various institutes will know from this paper that how much entrepreneurial education is important for the success of the business.

7. RESEARCH LIMITATIONS AND FUTURE DIRECTIONS

The limitations of this paper should be taken into account by future studies. The scholar of this paper collected data from business owners and managers. Future researchers are recommended to collect data from the students of higher education. Future researchers should use the big sample as in this study small sample size was taken. More variables can be included in the research framework but the researcher investigated a few variables such as entrepreneurial education, entrepreneurial success, social competence, and psychological capital. The researcher of this study suggests future scholars add more variables, for example, entrepreneurial intention. This study was carried out in Thailand. Future researchers should conduct the same study in another country such as in the USA. Future researchers should conduct a longitudinal study and should compare the results of this paper in order to see that either the findings of this paper remain the same or not. Future researchers should write a research thesis in order to give a more comprehensive view of the subject of the present study. Future researchers should conduct qualitative research as this study was used the quantitative method, therefore, the future researcher should use qualitative research approach.

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RESEARCH ARTICLE

A Hybrid of Cognitive Entrepreneurial Training and Education and Their Impact on Business Opportunity Recognition in Thailand: Moderating Role of Entrepreneurial Passion

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Aim of the study: The aim of this paper was to analyze the impact of cognitive entrepreneurial training and education and their impact on business opportunity recognition in Thailand with the moderating role of entrepreneurial passion. This study has four main objectives such as to study the impact of cognitive entrepreneurial training on business opportunity recognition accuracy, to study the impact of entrepreneurial education on business opportunity recognition accuracy, to analyze the role of entrepreneurial passion between cognitive entrepreneurial training and business opportunity recognition accuracy and to analyze the role of entrepreneurial passion between entrepreneurial education and business opportunity recognition accuracy. In the era of rapid development and growth, entrepreneurial education is extremely vital for students. Entrepreneurial passion as well as play an important role in recognizing business opportunities. The process of experiential education facilitates potential business-persons to learn how to identify business opportunities, through developing and building their framework of (Cognitive Opportunity Identification), and through improving their entrepreneurship skills through entrepreneurial learning and education. *Methods*: Quantitative method and cross sectional time horizon have been used by the researcher in this paper. The researcher gathered data from Thai students. *Findings*: The study findings suggest that hypothesis 1, 2, 3 and 4, all are accepted. *Implications*: The programs of entrepreneurial education should provide theoretical understandings to students, facilitating them to make better sense of their pertinent experiences and to transmute them into understanding and knowledge.

Keywords: Business Opportunity Recognition, Entrepreneurial Education, Entrepreneurial Passion, Cognitive Entrepreneurial Training and Thailand.

1. INTRODUCTION

The researchers Fayolle [1] and Neck and Greene [2] claimed in their studies that the education of entrepreneurship offers students with related entrepreneurial competencies, experiences, ways to investigate the universe and ways of thinking. As the education of entrepreneurship concentrates on increasing entrepreneurial cognizance and awareness on emerging a means of thinking [3], and also on creating an entrepreneurial mind-set [4], it needs the implementation of educational methods concentrating on "Cognition." In contradiction of the stable and genetic traits viewpoint, the approaches of cognitive concentrate on the potential of a person to develop his or her mechanisms of cognition by substantial experiences and familiarities, which he or she transmute into knowledge. In addition, a lot of researchers for example Groves, Vance [5] have stated that "Entrepreneurship" is learned best via experiential and entrepreneurial education, as it changes the "Cognitive Systems and Structures" of the students' and as well as the "Ways of Thinking," and outcomes in the identification of real prospects and opportunities [6]. Therefore, in accordance with the researcher Neck and Greene [2] the programs of entrepreneurship concentrating on experiential and cognition education, as a mean to develop an entrepreneurial mind-set, are related to all learning domains and the interests of an individual across the educational institutes. On the basis of the literature of entrepreneurial education and entrepreneurial cognition, the researcher of the study claim that entrepreneurship learning and education objectives, for example,

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increasing entrepreneurial cognizance and awareness, making entrepreneurial mindsets of students, and providing significant entrepreneurial familiarities and experiences with resilient theoretic foundations, which let for the transformation of knowledge, are best attained through developing the programs of education, which concentrates on, (Cognitive Training), for example, the development and enhancement of students "EM" Entrepreneurial Mindsets and the methodologies of (Experiential Learning), for example, significant entrepreneurial experiences, which learners transmute into knowledge (Chienwattanasook, and Jermsittiparsert, 2019). Concentrating on mechanisms of the cognition for example prototypes raises the entrepreneurial cognizance and awareness and consequences in de facto opportunity identification, which is the primary phase and main trigger of the process of entrepreneurship [7]. The past studies on the subject of the education of entrepreneurship demonstrate that particular area experiences, for example, contacting with entrepreneurs, business persons, entrepreneurial activities and case studies are vital to creating an entrepreneurial mindset and as well as entrepreneurial awareness. The researcher stated that the universities that focus on entrepreneurial education and learning, actually assists individuals to transform their experiences of life into knowledge. In addition, the researcher Groves, Vance [5] stated that the programs or courses, which concentrates on experiential learning and entrepreneurial cognition might improve the means in which learners perceive the globe in an entrepreneurial manner and might allow students to efficiently identify the opportunities of the business [8]. The initiatives and programs should be transversal, that is to say, they should have the potential to influence and reach learners across an educational institute, regardless of their study area or scientific back-ground [9]. In accordance with the researcher Costa, Santos [10] there are very little studies regarding the roles of various affective pre-dispositions toward entrepreneurial education. The researcher Cardon and Kirk [11] stated that "Entrepreneurial Passion" is an optimistic pre-disposition toward entrepreneurial education and learning, and has been getting consideration in the literature of entrepreneurial passion. Still, there is inadequate comprehension of the role of "Entrepreneurial Passion" in the creation and development of cognitive systems or structure and entrepreneurial education. Figure 1 highlighted the entrepreneurial passion.

There are very few earlier researchers available on the topic of entrepreneurial passion, cognitive entrepreneurial training, entrepreneurial education, and business opportunity recognition. Therefore the researcher of the study discussed all these concepts and their relationships with one another in the current paper so as to provide a more comprehensive perspective on the topic of entrepreneurial passion. The current paper aims to cover the following research objectives:

1. To study the impact of cognitive entrepreneurial training on business opportunity recognition accuracy;
2. To study the impact of entrepreneurial education on business opportunity recognition accuracy;
3. To analyze the role of entrepreneurial passion between cognitive entrepreneurial training and business opportunity recognition accuracy;
4. To analyze the role of entrepreneurial passion between entrepreneurial education and business opportunity recognition accuracy.

The current study comprised of 5 parts, (1) Introduction, (2) Literature Review, (3) Research Design, (4) Results and Findings and (5) Discussion and Conclusion.

2. REVIEW OF THE LITERATURE

In this part, the investigator of the study discussed the variables of the present study and their associations with each other. At the last of this section, the research model of this study is given.

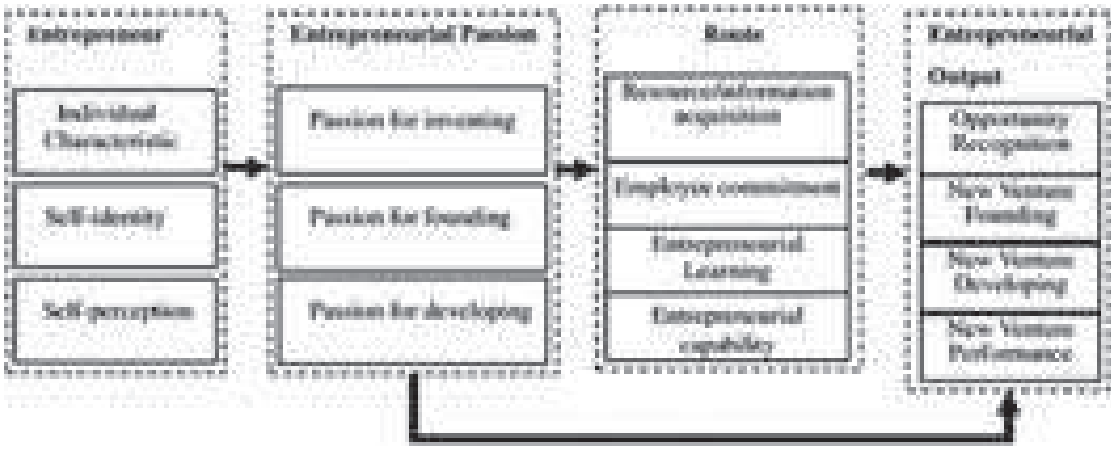

Fig. 1. Entrepreneurial passion.

RESEARCH ARTICLE

2.1. The Impact of Cognitive Entrepreneurial Training on Business Opportunity Recognition Accuracy

The researcher Baron [12] stated that the education and learning of entrepreneurship programs, which depend on the management capabilities only for example writing a business-plan, stimulate the convergence of idea instead of (Thinking outside of the Box) and (Creative Thinking) [13]. In accordance with the researcher Costa, Santos [10], all these contents are much associated with predictability, consistency, and stability instead of the ambiguity and continuous alteration usually linked with the activities of the entrepreneurship. The researcher Baron and Ensley [14] stated that they don't confirm that coaching skills of management to potential business persons are unsuitable, as they all agree that competencies of the management are vital for entrepreneurial accomplishment. Apart from the field of management skills, business-persons and entrepreneurs should perform and do exclusive activities, which actually reveal other entrepreneurial skills [15]. Therefore, the development and improvement of the mechanisms of entrepreneurial cognition are vital to complement the efficient program of entrepreneurship, as these skills and competencies can assists persons to form and create an entrepreneurial mindset, which is essentially unique to the education of entrepreneurship [16]. In this way, the researcher of the current paper claim that the process of experiential education facilitates potential business-persons to learn how to identify business opportunities, through developing and building their framework of (Cognitive Opportunity Identification), and through improving their entrepreneurship skills through entrepreneurial learning and education [15].

(H1): Cognitive entrepreneurial training has a significant positive impact on business opportunity recognition accuracy.

2.2. The Impact of Entrepreneurial Education on Business Opportunity Recognition Accuracy

In accordance with the researcher the education of entrepreneurship is a domain, which actually seeks out to increase awareness regarding entrepreneurship, should concentrates on main facets in the process of entrepreneurship, for example the capability to recognized business opportunity, creativity, making an entrepreneurial mind-set, and comprehending how thoughts and ideas are created and develop over the period of time [17]. Moreover, the higher educational institutes which focus on the programs of entrepreneurial education in order to make students more aware that how they can recognize the business opportunities will make their students more confident in realizing business prospects and opportunities. The researcher of this paper state that encouraging an entrepreneurial mindset concentrating on opportunity recognition and assessment is important to entrepreneurial education. In accordance with the scholar George, Parida [18] entrepreneurship outcomes from the mixture of opportunities and individuals efforts and the process of entrepreneurship is activated by the identification and recognition of opportunity [19]. The findings of the study of Ref. [10] indicated that entrepreneurial education has a positive significant impact on business opportunity recognition accuracy.

(H2): Entrepreneurial education has a significant positive impact on business opportunity recognition accuracy.

2.3. The Moderating Role of Entrepreneurial Passion Between Cognitive Entrepreneurial Training and Business Opportunity Recognition Accuracy

The researcher Chan and Park [20] claimed that "Entrepreneurial Passion" has been attracting researcher's consideration increasingly as a particular entrepreneurial sentimental state. The researcher Cardon, Sudek [21] defined the notion of entrepreneurial passion as a strong, cognizant, and reachable optimistic emotion that consequences from engaging in distinctive entrepreneurial actions, which are vital to the identity of a person. In accordance with the researcher, Biraglia and Kadile [22] entrepreneurial passion is actually not a trait of personality, however a sentimental internal condition, which persons experience while engaging or thinking about in actions, which are generally associated with entrepreneurship. These actions or activities involve discovering new opportunities and solutions, establishing an enterprise, and emerging a business [23–25]. In accordance with the researcher Grégoire, Barr [26] the person's capability to identify opportunities can be enhanced and improved by entrepreneurial passion and through the approaches of experiential education. Moreover, as the opportunity identification relies on the structures of cognition, having pertinent experiences is compulsory to cultivate them. The cognitive entrepreneurial training program in the recognition of opportunity involves the activities and actions, which rouse different processes of experiential learning and seek out to create members' capabilities to identify opportunities, through concentrating on the expansion of their entrepreneurial mind-sets. As the development and improvement of the entrepreneurial mindset take place at the level of cognition, it is suitable to examine how members actually develop and ripen their cognitive systems, which are accountable for opportunity identification at the basic-level of awareness [27]. The students of the university who take part in cognitive entrepreneurial training in the recognition of opportunity will be capable to grow their cognitive capabilities to identify the opportunities of the business much better as compared to the students without such training [28]. In simple words, the researcher Gielnik, Spitzmuller [29] state that members will be capable to recognize the facets of a business opportunity associated with its practicality more correctly than nonparticipants.

Following study has projected that "Entrepreneurial Passion" (EP) is actually an antecedent of "Entrepreneurial Intentions" (EI) [30], a result of entrepreneurial struggle [29], is convertible from the businessperson to workforces [24], impacts angel spending [31], and as well as can impact "Entrepreneurial Cognition" [21]. The researcher Costa, Santos [10] stated that entrepreneurial passion has a significant and vital role in the recognition of the opportunity in the process of learning, which needs, pattern identification, concentration, and innovative problem-solving [21]. The researcher of the current study expects that "Entrepreneurial Passion" will significantly moderate the association between the business opportunity recognition accuracy and cognitive entrepreneurial training, as the association will be resilient for members with higher "Entrepreneurial Passion."

(H3): Entrepreneurial passion significantly moderates the relationship between cognitive entrepreneurial training and business opportunity recognition accuracy.

2.4. The Moderating Role of Entrepreneurial Passion Between Entrepreneurial Education and Business Opportunity Recognition Accuracy

In accordance with the author Fayolle [1], entrepreneurial passion is an attribute which assists entrepreneurs and businesspersons to reach their objectives. The researcher stated that it is essential to entrepreneurship as it produces creative ideas, notions and drives the utilization of "Entrepreneurial Opportunities." Additionally, according to Mitteness, Sudek [31] passion actually plays a vital role in convincing financiers to participate in business ventures. The theory of social learning suggests that human develop the self-confidence to do something when they actually perceive or are directly engaged in the activity. The researcher Bergh, Thorgren [32] stated that for entrepreneurial passion development, learning and education offers a framework within which the students of business can perceive, comprehend, and get engaged in the process of entrepreneurship. In this manner, the education of entrepreneurship might be supportive in constructing self-confidence of the students and a conviction in their capability to recognized business opportunity and to succeed. In accordance with the researcher Chen, Yao [28] if a person is passionate or have entrepreneurial passion, he or she will get entrepreneurial education and as well as will recognize business opportunity accuracy. The researcher Costa, Santos [10] stated that entrepreneurial passion moderates the relationship between entrepreneurial education and business opportunity recognition accuracy [52].

(H4): Entrepreneurial passion moderates the relationship between entrepreneurial education and business opportunity recognition accuracy.

Research Model of the present study is shown in Figure 2.

This study has two independent variables such as (Cognitive entrepreneurial training) and (Entrepreneurial education), one dependent (Business opportunity recognition accuracy) and one moderator (Entrepreneurial passion).

3. RESEARCH DESIGN

The students of the universities were considered as the sample of this paper. The investigator of the present study gathered data from the students who are enrolled in the universities of Thailand. The researcher gathered data from 297 students. The researcher explained the purpose of the study to the research participants. Though there are different techniques of data collection, the researcher of the study used a survey-based questionnaire to gather data from Thai students. In order to gather data from research participants the researcher of this paper obtained permission from the management of the university. The researcher self-administered the whole survey. So as to analyze the data researcher of the current paper used two software such as AMOS and SPSS. the investigator of this paper run a number of different tests to find the results of the study such as structural equation modeling, confirmatory factor analysis, descriptive statistics and so on [33–35].

4. RESEARCH FINDINGS

This study based in Thailand context and data is collected from the 297 respondents. The findings show that 121 male

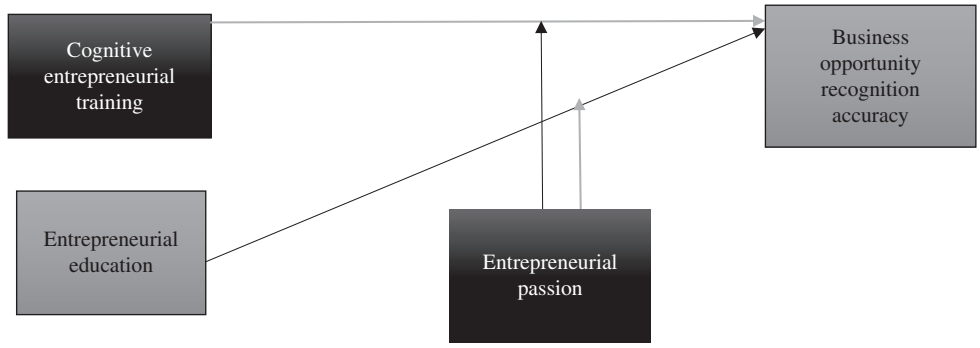

Fig. 2. Research model.

Table I. Rotated component matrix.[a]

	Component			
	1	2	3	4
CET1				.917
CET2				.891
EE1	.743			
EE2	.803			
EE3	.853			
EE4	.851			
EE5	.865			
EE6	.856			
EE7	.853			
EE8	.823			
EP1		.822		
EP2		.832		
EP3		.848		
EP4		.826		
EP5		.839		
EP6		.830		
EP7		.841		
BRA1			.793	
BRA2			.850	
BRA3			.827	

and 176 females participated in the study. The age of the respondent from 20 years to 25 years have a frequency of 238 respondents, 25–30 years range have 45 respondents, 31–40 years range have 12 respondents and remaining are greater than 40 years. Moreover, 24 respondents are undergraduate, 150 are graduate, 113 are master and remaining 10 have other education [36–42].

4.1. Factor Analysis and Reliability Test

The following Table I shows the factor loading of each construct and suitability value which is measured with KMO and rotated component matrix. KMO is shown in Table II.

The above-mentioned Tables I and II shows the suitability of data and factor loading, KMO shows that data is suitable for further analysis and rotated component shows that each construct load in its own construct.

Table II. KMO and Bartlett's test.

Kaiser-Meyer-Olkin measure of sampling adequacy	.935
Bartlett's test of sphericity	
Approx. chi-Square	5639.992
df	190
Sig.	.000

Table III. Convergent and discriminant validity.

	CR	AVE	MSV	EP	CET	EE	BRA
EP	0.955	0.750	0.327	**0.866**			
CET	0.850	0.744	0.086	0.287	**0.862**		
EE	0.959	0.747	0.326	0.560	0.294	**0.864**	
BRA	0.901	0.752	0.327	0.572	0.234	0.571	**0.867**

Table IV. CFA.

Indicators	CMIN/DF	GFI	IFI	CFI	RMESA
Threshold range	<3	>.80	>.90	>.90	<.08
Observed values	2.653	.866	.952	.952	.075

4.2. Convergent and Discriminant Validity

Convergent validity is the validation of items wise for constructs which prove the internal consistency of the data whereas, discriminant validity shows the discriminant of a variable from others, Statistical tool packages used to identify the convergent and discriminant validity of the data finding are below in Table III.

Value of composite reliability and average variance excreted confirm the issue of convergent validity whereas the remaining column shows the discriminate validity of the data. composite reliability for each constructing has value more than .70 and value of MSV is less than AVE, so it proves the convergent validity and other remaining column shows that every construct has more value for itself rather than others which proved the discriminant validity of the data.

4.3. Confirmatory Factor Analysis

The test of confirmatory factor analysis is used to identify another model of this study is good fit or not. There are 4 to 5 indicators which proved the model fitness and their threshold and observed values are below in Table IV.

The results of above-mentioned Table IV presenting that all values are under the threshold range, i.e., the value of CMIN/DF for the current data is 2.653 which is less than 3.0, GFI, .86, which is greater than .80, IFI and CFI are .952 which are greater than .90, and last but not the least RMESA is .07, which is less than .08. So, means that the model of the study is a good fit. Following is a figure of CFA in AMOS,

4.4. Structural Equation Modeling

In order to test the study hypotheses structural equation modeling by using AMOS was performed, because SEM has a feature of multiple regression and can test the entire model at the same time in one shot. Table IV presenting the regression weights of each construes on another, and indicate the conclusion of the hypothesis.

Table V. Structural model results.

Effects	Hypothesized path	*B*	S.E	*P* value	Conclusion
Linear effects					
Hypothesis 1 (+)	CET → BRA	.088	.046	.083	Rejected
Hypothesis 2 (+)	EE → BRA	.509	.051	.000	Accepted
Moderation effects					
Hypothesis 3 (+ ↑)	CET ∗ EP → BRA	.287	.043	.000	Accepted
Hypothesis 4 (+ ↑)	EE ∗ EP → BRA	.032	.043	.558	Rejected

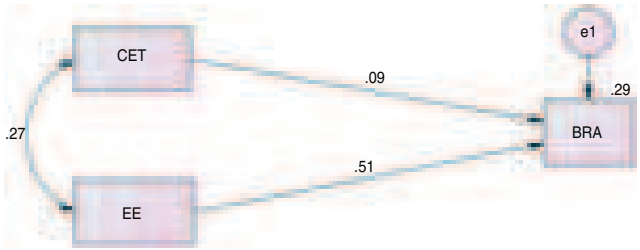

Fig. 3. SEM.

This test is chosen by the researcher as it approximates the multiple and interconnected reliance in a particular examination. Above presenting Table V showing the results of structural equation modelling, education has positive and significant impact on business recognition accuracy, but the impact of cognitive entrepreneurial training has insignificant impact on business recognition accuracy. Moreover, entrepreneurial passion has significant and positive moderating role between cognitive entrepreneurial training and business recognition accuracy, whereas it role between education and business recognition accuracy is insignificant. The following Figures 3–5 show the SEM and Moderating chart [42–50].

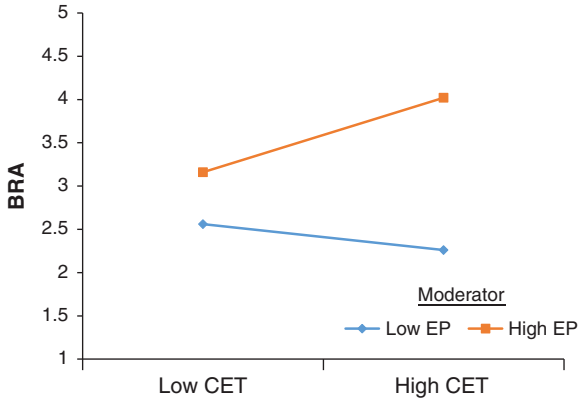

Fig. 4. Moderation impact of EP between CET and BRA.

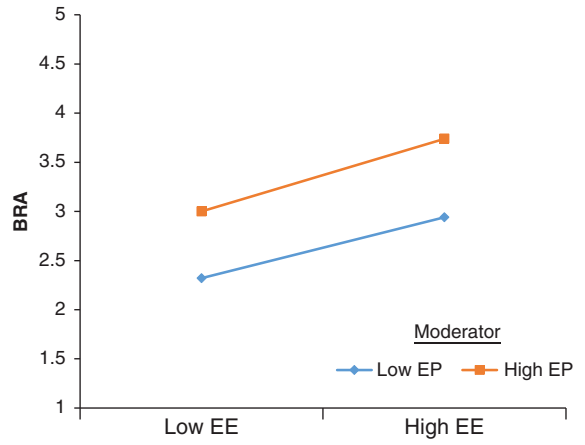

Fig. 5. Moderation impact of EP between EE and BRA.

5. DISCUSSION

In accordance with the results of the present study, all the research hypothesis are accepted. For example, the results of the study show that cognitive entrepreneurial training has a significant impact on business opportunity recognition accuracy because the *P*-value is less than (0.05), thus H1 is accepted. In addition, the results of this paper indicate that entrepreneurial education has a significant impact on business opportunity recognition accuracy as the *P*-value is less than (0.05), hence H2 is accepted as well. Moreover, the findings of the current research paper show that entrepreneurial passion significantly moderates the relationship between cognitive entrepreneurial training and business opportunity recognition accuracy, hence H3 is accepted too. The fourth hypothesis of the study is also accepted as the results of this study show that entrepreneurial passion moderates the relationship between entrepreneurial education and business opportunity recognition accuracy.

6. CONCLUSION OF THE STUDY

This paper aimed to identify the impact of cognitive entrepreneurial training and education and their impact on business opportunity recognition in Thailand with the moderating role of entrepreneurial passion. In the era of rapid development and growth, entrepreneurial education is extremely vital for students. Entrepreneurial passion as well as play an important role in recognizing business opportunities. The process of experiential education facilitates potential business-persons to learn how to identify business opportunities, through developing and building their framework of (Cognitive Opportunity Identification), and through improving their entrepreneurship skills through entrepreneurial learning and education. Quantitative method and cross sectional time horizon have been used by the researcher in this paper. The researcher gathered data from Thai students. The study findings suggest that hypothesis 1, 2, 3 and 4, all are accepted. The students of the university who take part in cognitive entrepreneurial training in the recognition of opportunity will be capable to grow their cognitive capabilities to identify the opportunities of the business much better as compared to the students without such training.

7. IMPLICATIONS

The findings of this research paper have remarkable implications for the practice and theory of entrepreneurial education. The current study will contribute in different ways to expand transversally entrepreneurship across higher educational institutes. This study supports the concept that experiential learning or education is an accurate technique for the education of entrepreneurship. Even though in the educational context, currently, entrepreneurship is extensive concept, and higher educational institutions are viewed as privileged areas in which to grow

entrepreneurial cognizance and awareness, this study call consideration to the point that learner's affective state of mind should take into account when the program of entrepreneurial education is being intended. Particularly when planning programs targeting at an extensive array of learners with various or diverse hopes and backgrounds regarding entrepreneurship, it is vital to evaluate how they sense the activities, which are generally included in becoming a tycoon or entrepreneur. However this may assist improve the impacts of training or learning in (Entrepreneurial Cognition), it may as well as assist learners who might not be familiarized of what is entrepreneurship, or don't recognize "Entrepreneurship" as something, which students experience positively and intensively to reevaluate their inclination to become engaged in such actions and activities. The researcher Kwong and Thompson [51] show that learners looking to establish enterprises instantly after their educations and graduation demonstrate more confidence and passion with regard to achievement however might do not have the significant experience about the industry. The training and education offer learners with mechanisms to examine their environments and surroundings with the entrepreneurial mind-set. The programs of entrepreneurial education should provide theoretical understandings to students, facilitating them to make better sense of their pertinent experiences and to transmute them into understanding and knowledge [8–51]. Furthermore, this paper will enrich the literature on the subject matter "cognitive entrepreneurial training," "business opportunity recognition," "entrepreneurial education" and "entrepreneurial passion."

8. LIMITATIONS AND INDICATIONS FOR FURTHER STUDIES

This study includes a few research limitations and indication for future researches. In this paper, only one moderator has been analyzed by the researcher. Future scholars should add more moderators, for example, entrepreneurial mindset. In addition, in this study, no mediator has been used, so it is suggested to future scholars to add mediator as well. After business opportunity recognition, there is excessive potential in discovering experiential approaches at various phases of the process of entrepreneurship. Afar from the stage of opportunity identification, in accordance with the present researcher experiential learning, might be combined with other recognized practices in entrepreneurial learning and education, for example the approach of lean start-up, to educate learners at later phases of the process of entrepreneurship, for example testing expectations regarding their "Business Opportunities." Moreover, future scholars should conduct the same study in another country to examine whether the findings of the present study match with their findings or not.

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RESEARCH ARTICLE

The Role of Corporate Social Responsibility Initiatives in Determining Customer Satisfaction in Indonesia: An Employee Perspective

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Purpose—This research is examining the overall role of corporate social responsibility activities in companies which ultimately determine the customer satisfaction, based upon employee perspective. The purpose of this study is to evaluate the drivers of CSR and performance outcomes of CSR in the framework of Indonesia. The study uses stakeholder theory, resource based theory, transaction cost economic theory, and signaling theory. *Design/Methodology/Approach*—The data was collected from 401 employees of different firms and banks in Indonesia, through online and face to face questionnaire. The exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) both have been applied to see the overall reliability and validity of measurement and structural model. The structural equation modelling (SEM) is also applied to see the relations and outcomes of variables. *Findings*—The findings suggest the regulatory forces have positive impact on the CSR, which construct under stakeholder theory and so does the competitive advantage forces have positive impact on CSR which construct under RBV Theory. Whereas, efficiency forces negatively impact upon CSR, which construct under TCE Theory. Furthermore, results show that CSR positively influences the customer satisfaction, which describes the role of CSR initiatives from employee perspective is encouraging towards the customer satisfaction. By showing this impact the presence of signaling theory and stakeholder theory. Therefore, the companies should focus on the factors that are affecting the CSR in good manner which is leading them towards the customer satisfaction, as CSR is a main stream line for it.

Keywords: Corporate Social Responsibility, Customer Satisfaction, Efficiency Forces, Regulatory Forces, Competitive Advantage Forces.

1. INTRODUCTION

Corporate Social Responsibility (CSR), is described as the set of standards to which a company subscribes in order to make its impact on society, has the potential to make positive contributions to the development of society and businesses [1, 2]. As the CSR started to generate profits for the corporations, more organizations have been witnessed taking CSR initiations seriously. Gradually, the world has witnessed that the CSR has been spread-out generously and greater number of practices and framework have been adopted by the corporate world whereas, majority of them lies in the West world. The idea of CSR is not a very new concept but it came into being in the ancient times BC (before the Christ), where employees used to be punished severely for working carelessly. When the industrial revolution happened, the concept of CSR became relatively popular and started to have significance in the world of business. It was not considered as an ethic in the 1920's however, it became a new concept which was undervalued. As Dean of Harvard Business School Wallace B. Donham: "Business has not learned how to handle these changes, nor does it recognize the magnitude of its responsibilities for the future of civilization (History of Corporate Social Responsibility and Sustainability).

Furthermore, previous studies have been talking about how CSR is important and in this study the purpose is to define if CSR has an impact on the customer satisfaction and loyalty of the customers [3]. This study demonstrates that marketing has a positive and a stable relationship with CSR. As well as, the customers are the most important and significant stakeholders with respect to

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CSR. By enforcing CSR in to the organizations, the future customer will have a broader perspective and a multidimensional view [4]. In this connection, data from several studies suggest that the implementation of CSR practices on innovations and, at same time to check impact of innovation on CSR practices (Martinez-Conesa et al., 2017). Katamba [5] pointed out in the issue of the establishment of link between corporate social responsibility, learning, competences, managerial discretion and figure out corporate financial performance. The study motivated on corporate social responsibility, an idea not very well respected not actually observed as a means for improved financial performance. CSR need to be reconstruct in a practical way to be meaningful to mangers in their day-to-day pursuits of organizational goals and objectives.

2. THEORETICAL BACKGROUND

2.1. Stakeholder Theory

Stakeholder theory is a theory which has a significant impact on organization management and business ethics and addresses moral values in an organization. Stakeholder theory is now not only used in business ethics fields but in the frameworks of corporate social responsibility as well [3]. For instance, ISO 26000 and GRI (Global Reporting Initiative) also uses stakeholder analysis. This theory has succeeded in different fields such as law, management, and human resource management in challenging the usual frameworks and to put stakeholder's need at the very beginning of any action.

2.2. Resource Based View Theory

Resource based view (RBV) theory is informative for competitive advantage. With the help of this theory, firms can easily identify the key factors that gives them a competitive advantage. It can help the firms in enhancing their sales and expanding their market share and building strong relationships with their customers. Many CSR activities also uses this tactic as it can be a competitive advantage to many firms in expanding their sales.

2.3. Transaction Cost Economics Theory

Transaction cost economics (TCE) theory has a significant impact on businesses. The purpose of the businesses is to make maximum profits and this theory enables them the reasons why do the firms exist?

2.4. Signaling Theory

This theory is useful for defining behavior when two parties are interacting and they have access to different information. It holds an important and prominent position in the fields of management, strategic management, entrepreneurship, and human resource management. This theory shows relevance to these fields and also the use of this study has gained momentum in the recent years.

3. LITERATURE REVIEWS

Chung et al. [4] examine the impact of corporate social responsibility (CSR) on customer satisfaction and loyalty, which ultimately contribute to organizational growth. The findings suggest that CSR is positively and significantly associated with customer satisfaction and customer loyalty that contributes to firm's growth and reputation. The corporate social responsibility factors positively change consumers' perception and firm's image. Ma et al. (2015) empirically find out that Chinese perception on CSR and its expectations are different for local companies and foreign firms. Prior research opine that customer response are not same to CSR, particularly in China (Chung et al., 2015), because people are long term oriented with collectivist values. Therefore, there is a greater customer expectation in local firms as comparison to foreign firms.

Arikan and Guner determined the relationship between CSR, service quality, customer-company identification, customer satisfaction, and customer loyalty. The results indicate that CSR and service quality both integrates with the customer loyalty. Additionally, CSR add more value to firm from customer's perspective, because the customers spends more money in the firms who are incorporated in CSR. It also affects the managers because their customers tend to be more loyal and satisfied because of the CSR activities.

Chaudary et al. (2016) examined the association between corporate performance, CSR capability, customer attachment, and customer perception of CSR activities. The study shows that if the CSR activities are perceiving as culture fit in consumer's perception then there is an emotional attachment between the consumer and that CSR activity and overall with the corporation's performance.

Further, Ağan et al. (2016) examined the impact of CSR on firm performance. The results indicate that CSR is positively associated with financial performance and competitive advantage of the participating firms. The effects of size and sector were also analyzed. It was found that larger firms are slightly more sensitive to CSR as compared to small and medium enterprises. However, heavy industries that are somewhat away from the public eye put little emphasis on CSR. Firms can be encouraged to practice CSR by being exposed to the performance benefits. Figure 1 highlighted the conceptual framework of the study.

4. METHODOLOGY

This research is based upon quantitative approach to fulfill the research purpose, which is to measure and analyze the impact of corporate social responsibility in determining customer satisfaction in Indonesia. This study adopt correlation design or research technique, because it gives opportunity to gather more data than experiments. The targeted population for this research is the employees, as this

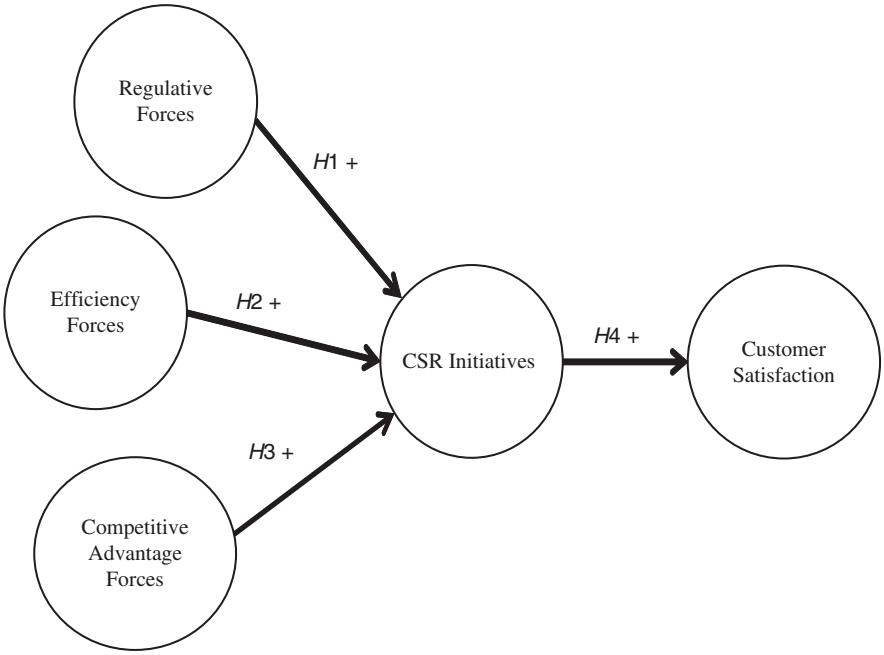

Fig. 1. Conceptual diagram.

research is done to find the employees prospective about CSR in their organization; to find the effect of CSR on firm's progress; whether CSR lead to customer satisfaction; does CSR help in building the long term relation with their customer and the loyal customer? Researcher has targeted employees in order to check whether CSR is important for organization and does it have the effect on the development of the organization as well as customers. The demographics will vary from employees to employees. The purpose is to identify while purchasing how much consumer is influenced by CSR activity of that related product. The data was collected through online and face to face questionnaires from 475 employees, out of which 401 were authentic and rest 74 were missing values and outliers. This study is based upon quantitative research. The variables used in this study were efficiency forces, regulatory forces, competitive advantage forces, CSR, and customer satisfaction. CSR and customer satisfaction are dependent variables whereas, efficiency forces, regulatory forces, and competitive advantage forces are independent variables. The total questions asked in the questionnaire are 20. Questionnaire was adopted from Jean et al. (2016). The questionnaire was based on 5 points Likert-scale measurement tool. For this research investigation, non-probability convenience sampling is applied.

4.1. Statistical Tool

In this research study, we applied reliability analysis which help to assess the consistency from data with the Cronbach's alpha whereas this approach is widely use to estimate reliability. Reliability analysis is performed to examine the consistency of tests on variables. Therefore, the overall reliability of the study was 90.2%, which shows that test is reliable and consistent. In this research, twenty items were loaded that grouped together in five variables are as Regulative forces (RF), Competitive advantage forces (CAF), Customer satisfaction (CS), Efficiency forces (EF) and Corporate social responsibility (CSR) to find out the exploratory factor analysis. The EFA is applied on the research to find out the correlation amongst the observed variables. Moreover, the ideal condition of the factor loading ranges from 0.4 to 0.9 and our factor loading of these variables are supporting. Furthermore, the investigation carried out Path analysis to predict how much independent variable jointly explains the dependent variable in these five factors Regulative forces (RF) supports CSR, Efficiency forces (EF) and Competitive advantage forces (CAF) are also influence positively on CSR whereas Customer satisfaction (CS) has also a positive impact on role of CSR. However, Efficiency forces (EF) is unsupported by CSR.

4.2. Hypothesis

H1: Regulative forces has a positive effect on CSR initiatives.

H2: Efficiency forces has a positive effect on CSR initiatives.

H3: Competitive advantage forces has a positive effect on CSR initiatives.

H4: CSR initiatives has a positive effect on customer satisfaction.

5. ANALYSIS AND FINDINGS

5.1. Respondent Profile

For the purpose of identifying sample size of study, a data from total four hundred and seventy-five questionnaires was collected. These questionnaires were distributed in various organizations and industries, through internet and by manual means. The respondents targeted for the study were working class in respective organizations which operate corporate social responsibilities in their businesses. The purpose to select employees is to identify while purchasing how much consumer is influenced by CSR activity of that related product by the organization. Out of 475 questionnaire distributed data of 401 was considered as relevant to apply on the research due to inappropriate replies. Hence the complete information about the respondents is given in the Table I. The table reports that there were 260 males while 141 females. Furthermore, large part of 156 respondents i.e., 39% involve were aged from 21–30 years and 92 (23%) responses 31–40 years followed by the 18% that's are 72 people ages between 41–50 years whereas 44 belonged to 20 or less year and 36 within 51-onwards age group. Additionally, the majority income level of 46% respondents reported were between RM5,000–10,000 followed by 29% ranging between Rp10,001–15,000, then 16% belonging to Rp15,001–20,000 income level, then 7% of below Rp5,000, and least with 2% from Rp20,000 and above participants. Similarly, in the education level mostly included 192 Graduates, 160 Post Graduates, followed by 32 undergraduates with least selected 3% others and 1% College. Lastly the information collected for respondent designation, reports that majority belonged to 51% on Non-managerial level and 140 respondents (that is 35%) on Managerial level followed by 10% other and 4% Office clerks.

Table I. Profile of respondents.

Demographic items	Frequency	Percentile (%)
Gender		
Male	260	65
Female	141	35
	401	100
Age		
20 or less	44	11
21–30 years	156	39
31–40 years	92	23
41–50 years	72	18
51-onwards years	36	9
Income level (Indonesian rupiah RP)		
Below RM5,000	28	7
RM5,001–10,000	184	46
RM10,001–15,000	116	29
RM15,001–20,000	64	16
RM20,000 and above	8	2
Education level		
Matriculation	–	–
College	4	1
Undergraduate	32	8
Graduate	192	48
Post Graduate	160	40
Other	12	3
Designation level		
Office clerk	16	4
Non-managerial level	204	51
Managerial level	140	35
Other	40	10

Source: Author's estimation.

5.2. Reliability Analysis

The tool used for determining the reliability is through Cronbach's alpha, which determines the internal consistency of data, and shows that how set of items are correlated with each other. Thus, in this research we gauged reliability by using Cronbach's alpha ranging from 0.715 to 0.902. Therefore, alpha coefficient generally ranges from 0.0 to 1.0 and alpha co-efficient that is closer to 1 indicates higher consistency. Suggested that alpha coefficient which is above 0.7 considered reliable and acceptable.

Hence, our test is higher than 0.7 that shows our test is very consistent and reliable. Thus, the results of reliability analysis for all items are presented in Table II.

5.3. Kaiser–Meyer–Olkin and Bartlett's Tests of Sampling Adequacy

For the variety competence of our learning, we worn KMO and Bartlett's test of sphericity test values. In our box, the KMO value is 0.91 which persuade the bare minimum criterion recommended by Kaiser (1974). According to the Kaiser (1974), the KMO value range from 0.70 to 0.79 is well thought-out as high-quality sample. As well, the prob. value of Bartlett'e test of spericity is 0.000 (which is less than 0.05) demonstrating that the correlation between the items at the 5 percent intensity of consequence is sufficient and is adequate for further analysis. The results of KMO and Bartlett's test of sphericity is reported in Table III.

5.4. Exploratory Factor Analysis

When considering validity and multiple reliabilities, factor loadings are measured in order to narrow down the collected data into reduced form. The lowest standard limit taken for this study ranges from 0.4 to 0.9 range in factor loadings. Whereas the researches show that the

Table II. Results of reliability analysis.

Variables	Items	Cronbach's alpha
CS	4	0.858
RF	5	0.715
CSR	4	0.796
CA	4	0.843
EF	3	0.782
Overall	20	0.902

Source: Authors estimation.

Table III. KMO and Bartlett's test.

KMO measure of sampling adequacy	0.905
Bartlett's test of sphericity approx. chi-square	4329.051
Degree of freedom	231
Sig	0.000

Source: Author's estimation.

value is acceptable even if, factor loadings ranges from 0.30 to 0.95 (Yadav, Dokania and Pathak, 2016; Hai, 2018). The related research has loaded twenty items which are grouped together in five variables; (1) Competitive advantage (CA) (2) Customer Satisfaction (CS) (3) Regulative Forces (RF) (4) Corporate social responsibility (CSR) (5) Efficiency forces (EF). Moreover, the factor loading of all these variables satisfies ranges by supporting the criteria range within 0.4–0.9. Further the items EF1 and CSR4 showed factor loadings below 0.4, hence the data of the two items was removed to strengthen exploratory analysis. Table IV shows the results of factor analysis.

5.5. Confirmatory Factor Analysis

It is a great statistical tool that validates the factor structure of observed variables. The main objective of CFA (confirmatory factor analysis) is to investigate and assess the data whether it is suitable for hypothesized measurement structure. Moreover, in confirmatory factor analysis, researchers specify the relationship between measured variables and latent variables. According to the suggested that CFA is measurement tool that is used to decrease measurement error due to among several indicators as per latent variable. We applied AMOS 21 because it helps to do confirmatory factor analysis and in our research there were 20 items were loaded that were best fit in the sample data represented in Table V. In CFA model, the factor loadings that exceed the level of 0.5 create validity.

Table IV. Rotated component matrix.

	Factor loadings				
Items	Competitive advantage	Customer satisfaction	Regulative forces	Corporate social responsibility	Efficiency forces
CA1	.799				
CA2	.746				
CA3	.760				
CA4	.572				
CS1		.591			
CS2		.707			
CS3		.679			
CS4		.660			
RF1			.642		
RF2			.537		
RF3			.719		
RF4			.674		
RF5			.704		
CSR1				.637	
CSR2				.654	
CSR3				.517	
CSR5				.520	
EF2					.536
EF3					.847
EF4					.830

Source: Author's estimation.

In measurement model fitness, some indicators are used to validate how model it has fitted.

$$\text{GFI} = 0.904; \quad \text{AGFI} = 0.88; \quad \text{CFI} = 0.921;$$

$$\text{TLI} = 0.90; \quad \text{RMSEA} = 0.07$$

Comparative fit index (CFI) is acceptable when its value is greater than 0.90 (Hu and Bentler, 1999). Therefore, our model CFI is fit because it is 0.921. The range of goodness of fit index (GFI) and adjusted goodness of fit index (AGFI) greater than or equal to the value of 0.8 is considered acceptable (Jöreskog and Sörbom, 1986; Hye et al., 2014). In our test the value of AGFI is 0.8, which shows the model is fit and accepted at border line. Whereas GFI values are greater than 0.8; that is 0.9 for measurement model and 0.8 for structural model hence accepted according to the standard criteria. According to the Tucker and Levis [6] investigated that Tucker-Lewis Index (TLI) which is indicator and it must be close to 1 which shows model is perfectly fit. Therefore, the value of our test is 0.9 that is very close 1 so this indicator shows model is acceptable and suitable. The Root-Mean-Square Error of Approximation (RMSEA) another fit indicator that helps to estimate the model of covariance structure and it was introduced by Steiger and Lind in 1980. Moreover, our test has shown RMESEA value 0.07 which is adequately and fair fit. RMESEA is evaluated by value of 0.05 or less which indicates goodness of model fit and value which is 0.08 or less which specifies fair model. The value of RMSEA below 0.06 is considered to be good fit (Hu and Bentler, 1995).

5.6. Structural Equation Modeling (SEM)

A structural model of Corporate Social Responsibility in determining Customer Satisfaction in Indonesia was applied to determine the impacts. The study model uses five variables namely, Regulative forces (RF), Efficiency Forces (EF), Competitive Advantages forces (CAF), CSR Initiatives and customer satisfaction (CS). The reason to

Table V. Model fitness.

Goodness-of-fit measure	GFI	AGFI	CFI	TLI	RMSEA
Threshold values	$\geq$0.85	$\geq$0.80	$\geq$0.90	Close to 1	$\leq$ 0.05
Measurement model	0.904	0.88	0.921	0.900	0.07
Structural model	0.899	0.88	0.915	0.9	0.072

Notes: Measurement model-20 items; structural model-20 items.
Source: Author's estimation.

Table VI. Standardized regression weights for the research model.

Hypothesis	Variables	Regression path	SRW	*P*
H1	Competitive advantage forces	CSR ← CA	0.655	0.000
H2	Efficiency forces	CSR ← EF	−0.012	0.667
H3	Regulatory forces	CSR ← RF	0.251	0.000
H4	Corporate social responsibility	CS ← CSR	0.941	0.000

Notes: SRW = Standardized regression weights, dependent variable = EF, CA, RF, *P* or Sig value < 0.10.

conduct the structure model is to test the impacts of the CSR on customer satisfaction.

On the basis of the research hypothesis, the result of the structural model is used to validate the fitness of model GFI = 0.899; AGFI = 0.88; CFI = 0.915; TLI = 0.9 and value of RMSEA is 0.072. These all values are in range between 0 and 1 that is acceptable and shows fitness of model. All values have shown in Table VI. In addition, Bentler (1990) suggest that CFI value should be close to 0.90 to accept the hypothesized model. Thus, our study model shows sufficient information of model fitness to the sample data. Hence, it can be concluded that our hypothesized model is an acceptable model can be considered a useful instrument to determine the initiatives of corporate social responsibilities in customer satisfaction.

Overall, the selected factors, namely RF, CAF have a positive effect on CSR. Whereas, CSR has a significant effect on customer satisfaction. However, Efficiency forces has a negative influence on CSR. EF is referred to efficiency forces and these are the forces that organizations use to minimize the cost and maximize the production. It shows a negative impact on CSR because if the organizations will focus on minimizing their costs they would not get involved in CSR activities then. But if organizations become less cost effective then they can focus on the social responsibilities a corporate has. EF can bring a significant impact of CSR in long-term as customers would be satisfied. Furthermore, CSR and EF is negatively correlated.

6. DISCUSSION AND CONCLUSION

This study explored the motivation of firms involved in CSR activities; why any firm should concentrate on CSR; and how CSR positively influence on organization benefit and society as well. When business goals are interlinked with social responsibility, it is beneficial for the company and customer satisfaction. In Indonesia, most of the firms are lacking in fulfilling the corporate social responsibility and their policies are not up to the mark of taking initiatives for CSR. The factors related to CSR and their impact are taken into account and determined by different methods. In order to conduct the study, the theories which are applied are stakeholder theory, resource base view theory, transaction cost economic theory and signaling theory. Further, to evaluate and analyze the data and its variables (Efficiency forces, Regulative forces, Competitive advantage forces, CSR, Customer satisfaction) outcomes the models that are been used are structural equation modeling, fitness model, reliably analysis, KMO and Bartlett's test [7].

In order to testify this study, the data was collected from employees of different sectors to check their responses if they believed CSR has a significant impact on customer satisfaction or not. However, the question arises if employees can identify or not the significance of CSR on customer satisfaction? Certainly, employees work day and night to increase the productivity of an organization. They can easily identify what factors lead towards customer satisfaction and what does not. The factors that result positively are adopted and the rest are rejected.

Firstly, the results of data reliability by Cronbach's alpha evaluates that all variables are correlated and consistent as the results lies between 0.715 to 0.902 which shows that test is up to the mark. Above 0.7 is considered to be appropriate and thus its acceptable. The results state that variables are positively associated with the corporate social responsibility which company needs to follow. Nunnally (1978) stated that its necessary to use reliability analysis in order to validate the collected data [8–13].

Furthermore, the results by SEM determines that regulatory forces have positive impact on CSR and it is significant. This result is consistent with the stakeholder theory which is proposed by Edward Freeman (1984) states that stakeholders like government bodies and political parties are equally important for the company. Regulatory force is one of the main stream among the driving forces of organization CSR activities and it's been mentioned that stakeholder theory is the one which determines that stakeholders like customers and government impacts on company to conduct such act or policies (Jean, Wang, Zhao, and Sinkovics, 2016). Whereas, if we see the result of competitive advantage forces which is also positive towards the CSR and significant. This result supports the resources based view (RBV) theory. RBV supports that CAF positively influences on CSR, which is discussed that groups of resources are stated as firms (Barney, 1991). Moreover, RBV pointed out that one of the competitive advantage sources are the company's capabilities and their unique efficient resources (Jean, Wang, Zhao, and Sinkovics, 2016). One of the competitive advantage streams are CSR which is definitely hooked up by the forces of competitive advantage [14–21].

The findings also show (in Indonesia) negative relationship between efficiency forces and corporate social responsibility, which elaborates that efficiency forces have a negative impact on CSR hence, it is unsupported. The efficiency forces are interrelated by TCE which suggests

upon the economic and cost minimization. (Williamson, 1975) elaborates that TCE discusses about decrease in production and transaction cost in exchange which companies try to do. Nevertheless, customer satisfaction is one of the most significant factor of any business and its strategy, which is ultimately the stream forces of profit maximization and goodwill of firm's market (Lewin, 2009) [20, 22–26].

By determining the SEM, In Indonesia there is a significant impact of CSR on customer satisfaction, which shows that by getting involved into a CSR activity a company can bring out its good reputation and customer satisfaction which leads towards the consistency of generating income and benefits, company growth and this also leads towards the society's environmental empowerment. Upon this the signaling theory implements as this can be taken as a signal of making reputation among the market and the customers by adopting CSR initiatives. Furthermore, the stakeholder theory also take into account the customers as their important resources [27].

Hence, the results of SEM and CFA which says that measurement and structural model is validate to be fit, determines the overall importance of CSR from the perspective of companies benefit and also the society. It is equally important to balance the company profit and society benefit which is correlated. In sum, we can conclude our research that role of CSR is very important for a company and society both. In Indonesia, the firms with CSR initiatives tends to lead but on the other side most of the firms with are not involved in CSR tends to decline. Firms should focus in determining the variables which are impacting upon CSR and look upon those policies. This research lay down the stream base for the future researchers for more depth research on more variables. By study of this research the role of CSR is clear and crystal in a country and research fulfills its objective and outcomes comes positive relate to CSR role.

7. RECOMMENDATIONS

- Customer satisfaction's SRW (co-efficient value) is 0.941. Which means that CSR has a great impact on Customer satisfaction and it is supported. Organizations should do more often CSR activities so that it increases the satisfaction level of customer.
- Secondly, Competitive advantage force has 0.655 SRW which means that it has a significant impact on CSR and resultantly it is supported. Firms need to merely identify those factors that give them competitive advantage either it be their service/product or technology. When they will define their competitive advantage it will therefore, make a significant impact on CSR.
- Furthermore, the SRW value of Regulative forces is 0.251 which again shows significance and positive impact on CSR and it is supported as well. Government needs to make firms do CSR activities as it is the responsibility of firms to contribute in society. If government legislative bodies impose their laws over companies, they will automatically start doing more CSR activities.
- Finally, Efficiency forces have −0.012 which shows that efficiency forces and CSR are not correlated. Efficiency forces are referred to reducing costs and maximizing outputs. Companies should think in long-term. Doing CSR activities will bring more growth and better outcomes in the form of customer satisfaction and ROI. So investing more in CSR will make organizations efficient in long-term.

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RESEARCH ARTICLE

Influence of International Financial Reporting Standards on Earnings Management: Comparative Study of Pre-Post IFRS Era in Malaysia

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Purpose—The motive of this study is to examine the IFRS (International Financial Reporting Standards) and to investigate the influence of its introduction on earning management in the companies (registered as public listed companies) of Malaysia, as the idea of IFRS is to make the statements of the companies more transparent and comparable. *Design/Methodology/Approach*—100 firms listed on Bursa Malaysia (Stock exchange) were taken for the sampling of data and were investigated to examine the quality of accounting information. In this study, the motive was to evaluate and measure the Earning Management Score (EMS) with respect to the context of Malaysian listed companies. It is based upon cross-sectional study which was introduced by Kothari et al. (2005) and later modified by Jones. The discretionary accruals in this study are evaluated on the basis of the historical estimations of the industry. *Findings*—The findings of this research suggests that IFRS influences the recognition of the losses in financial statements which depends upon the disclosure requirements and also the relevance of the financial data. *Research Limitations/Implications*—Every research is bounded by certain limitations. Similarly, in this study there were also few limitations encountered. Firstly, this study covers only one aspect of IFRS which is observance of the intensity of Earning Management, Therefore the conclusion is drawn towards that respective aspect only. Also, the EM (Earning management) is not only and always apprehended via the accrual models, so in future reference other models can be used as well. Finally, this study was based on cross-sectional approach which assumes that all the firms in the industry tend to have same accruals. Whereas, in reality companies differ from each other in structure, characteristically and in all aspects.

Keywords: IFRS, Earnings Management, Modified Jones Model, Malaysia.

1. INTRODUCTION

After witnessing the downfall of Enron Corporation and Companies like Lehman Brothers, United States was very much aware that there needs to be transparency in the financial reporting systems of the companies. Companies are under pressure to perform well and the earnings of a firm represents the overall organizational performance [1]. Users of accounting information rely on financial statements for decision making decisions, which consequently bring management under pressure towards disclosing better organizational performance. However, in many cases it can lead towards practices such Earnings Management where managers tend to mislead the users of the financial statements to make the firm appear as a better firm in terms of Earnings. Hence, IFRs was introduced and now we can see that almost everyone is converging towards using IFRS. IFRS are the accounting standards of high quality and its purpose is to judge the transparency and comparability of the financial statements in the process of financial reporting (Wu and Zhang, 2018). The idea is to report the real and fair status of the company through the financial statements to the users [2–6]. However, companies when in crisis intentionally mislead people by not giving the real status and faking the financial statements. Similar case happened in Enron, it was going bankrupt whereas according to the financial statements it was the highest earning company at that time and it was among the fortune top 500 companies. The downfall of Enron did not only destruct the organization itself but it destructed US economy which effected the entire world because the stock rate dropped vigorously. So, in order to eliminate the factor of faking financial statements and having loopholes in

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the financial reporting processes, International Accounting Standards Board (IASB) crated IFRS [7].

The objectives of IFRS are not limited only to the improvement of the quality of financial reporting statements but also:

- To diminish the irregularity and EM which can relieve the agency issue.
- To decrease the cross-border listing necessities.
- To create the local GAAPS to adjust to IFRS that is correspondence of local accounting standards.
- To settle on surpassed economic choices with the assistance of full exposures in the financial reports.
- To augment the firm value.
- To make the predictive and confirmatory estimation of the data better, which is progressively important and dependable to the decision making procedures.

Furthermore, this study examined the transparency of financial statements; compare the transparency before and after the implementation of IFRS, and its impact on the earnings management (EM). Therefore, this study had drawn the following questions, which are:

- To examine the practices and impact of EM before the adoption of IFRS amongst the Malaysian companies listed in Bursa Malaysia (Stock Exchange).
- To investigate if the trend in Malaysian firms regarding EM has changed after the adoption of the IFRS.
- To compare the pre and post IFRS adoption eras to explore the behavior of EM is Bursa Malaysia listed firms.

The findings of this study suggest that after the adoption of IFRS, firms listed in Malaysian stock exchange are less involved in accrual-based earnings management. Therefore, it could be argued from the findings that after the implementation of IFRS in Malaysia, the financial reporting quality of listed firms in Malaysia has been improved. Moreover, this study will be relevant to the policy makers and researchers in order to determine the implications of EM practices in Malaysia. Also, it can help in initiating procedures of consideration on IFRS regarding Earnings Management practices in Malaysia and it allows to accumulate the empirical evidences on trends that give rise to EM. Therefore, it gives IASB of Malaysia a framework with respect to Earnings Management.

2. LITERATURE REVIEW

2.1. Theoretical Background

In this research, the theory model that has been used is by Watts and Zimmerman, known as "Positive Accounting Theory." This theory is a discipline that studies and predicts actual accounting practices for the organizations. It explained the normative accounting practices and suggests the optimal accounting standards. It is used to help explore the independent variable i.e., "IFRS," if it has an influence on the level of earnings management (which is dependent variable) or not [8–14]. Furthermore, this study has used Modified Jones model to testify the level of discretionary accruals [15].

2.2. Earnings Management

Earning management can be defined as the process where financial decisions relies on deliberate judgment connected for exchange organizing and financial reporting with the main rationale on meaningful deceit, concealment or data spinning, it gives rise to earnings management. The reason behind it is to deceive the stakeholders and investors and influence favorable outputs from business contracts through controlled accounting figures according to Healy and Wahlen (1999).

Depending upon the real economic consequences, managements of the companies tend to have different strategies and tactics for the manipulation of earnings and such strategies or tactics are known as Profit maximization/minimization (Big Bath Accounting Strategy), and another one known as Income smoothing which is a levelling out technique. Furthermore [16], stated that, irrespective of the interest-related partnership formulation in businesses, entities such as the stockholders, creditors, managers, government and the employees amongst themselves have conflicts over interests [17–23].

Examined that the information related to the prices of stock are instantly confiscated. But this reaction is not always strong and it can be considered as low at times. Moreover, another study suggested that by observing the innate abilities of the agents', markets learn to know their performance and gives more time and weight in judging their performance in the earliest period of their performances once they build up the reputation. Likewise, the performance of a comparative less experienced managers', the market develops the perception and image about that manager's capability because their abilities are uncertain and thus, the performance of the new manager can tell about the performance of the firm. Moreover, a new manager is under pressure to show good performance and is motivated towards it and it can lead towards earnings management resultantly.

2.3. IFRS

In view of the seemingly inexorable rise of IFRS as the global accounting benchmark (Chua and Taylor, 2008) and critics' concerns over its uniform applicability and relevance to different institutional, political, and economic contexts (Cahan, Liu, and Sun, 2008), it is increasingly important to empirically examine the impact of IFRS adoption on accounting quality in countries of different contexts (Liu, et al., 2011). Global adoption of international accounting standards has been increasingly debated. Supporters of International Financial Reporting Standards (IFRS) argue that the use of IFRS increases the quality of financial reporting and benefits investors

(Daske et al., 2008). Opponents argue that a single set of standards may not be suitable for all settings and thus may not uniformly improve value relevance and reliability due to differences among countries (Soderstrom and Sun, 2007). Empirical studies have mixed results on quality change after the adoption of IFRS in different countries. One of the inter-nationality dimensions is that the standard is not closely aligned with the economic or political institutions of any particular nation (Chua and Taylor, 2008), so there are arguments for assessment of IFRS practice on a country-by-country basis (Nobes, 2006).

According to Zakari (2017), IFRS is an International Financial Reporting Standard which was introduced by the International Accounting Standard Board (IASB). IASB is an independent organization which is based in London (United Kingdom) but registered in United States of America (USA). IASB delivers international standard that are applied and adopted worldwide and considered as general rules and standards for the purpose of financial reporting. Furthermore, IFRS is used among 120 countries of the world as a symbol of uniformity, reliability, and comparability of the statements of the finances of the respected companies. The purpose of adopting IFRS is that it can be compared at global and international level with the peers and it gives the opportunity to the investors to compare firms on global level and allows to set the benchmark for the performance of the company (IASB, 2015; Irshad, 2017).

IFRS is extremely important as it increases the quality of accounting standards to the counties in different contexts and allows to set the global accounting benchmark. Furthermore, Wu and Zhang (2018) argued that by using the IFRS, not only the quality of financial reporting increases, but the equity of the investors also accumulate. On the contrary, only accounting and reporting standards cannot establish uniformity and reliability due to the major differences exist among the countries. Furthermore, many empirical studies have shown various and mixed results in different countries on the adoption of IFRS and the quality changes due to IFR. Therefore, one dimension states that one standard set of rules cannot align with the economic and political situations of any nation in particular, it should be assessed on a country to country level (Capkun and Collins, 2016; Jalloh and Guevera, 2017).

According to Amanamah [24], there are several advantages of adopting IFRS, and one of it included the instant betterment in the quality perceived and the financial report status'. Also, the International Accounting Standards Committee (IASC) has documented that the influence of adopting IFRS by the countries needs to be understood. However [25], countered this argument and stated that not necessarily every organization that has adopted IFRS showed improvement in the quality of financial reporting statements. However, Aveen and Charl (2018) examined in his study and stated that there were clear evidences of improvements in the companies' financial reporting statements' prior and posy the adoption of IFRS.

H1: *The degree of earnings management is lower after the adoption of IFRS in Malaysia.*

3. METHODOLOGY

Methodology is the crucial part of every study which is generally based on the nature of research [27]. The data chosen for this study was secondary financial data which was taken from a publication of Bank Negara Malaysia. Seven years data was collected from top 100 listed companies in Bursa Malaysia to test the hypotheses. The sampling method for the study was convenience sampling method because it covered most of the sectors of the industries in Malaysia from Energy to Agriculture etc.

3.1. Earnings Management Models

After the examination, there was a slight change post adoption of IFRS indeed in the quality of the earnings and thus looked at the extent of earnings management and as well as the value of relevance of earnings. In order to evaluate and calculate the earnings management, the absolute values of abnormal accruals were calculated using the Jones model which was later modified by Dechow, Sloan and Sweeney (1995). Following regression were run by year and industry which was based on the General Industry Classification Code (GICS).

$$\mathrm{TACCR}_{it} = \beta_0(1/\mathrm{Assets}_{it-1}) + \beta_1(\Delta\mathrm{REV}_{it} - \Delta\mathrm{RC}_{it}) + \beta_2\mathrm{GPPE}_{it} + \beta_3\Delta\mathrm{OCF} + \varepsilon_{it} \quad (1)$$

Where in Eq. (1) all variables are scaled by lagged total assets; total accruals for the firm "i" in year "t" is represented by TACCR_{it}; the total Assets of the firm i in year $t-1$ are represented by $1/\mathrm{Assets}_{it-1}$; $\Delta\mathrm{REV}_{it}$ is calculated by the difference between the current year revenue and previous year revenue; $\Delta\mathrm{RC}_{it}$ is calculated by the difference between the current year receivables and previous year revenue; GPPE is the gross property, plant, and equipment of the firm i in year t; and ε_{it} is the error term of firm i in year t, which represents the earnings management of firm i in year t.

Congruent with the study of Sadiq and Othman (2017), panel corrected standard error technique (PCSE) was used to test the hypothesis of whether the extent of earnings management is lower after the adoption of IFRS. PCSE is the best estimator in removing heteroscedasticity issue.

$$\mathrm{ABAC}_{it} = \beta_0 + \beta_1\mathrm{IFRS}_{it} + \beta_2\mathrm{SIZE}_{it} + \beta_3\mathrm{PRFT} + \beta_4\mathrm{GRW}_{it} + \beta_5\mathrm{LEV}_{it} + \sum_{it} \quad (2)$$

Here, in Eq. (2) the absolute value of abnormal accrual for the company i in year t is represented by ABAC_{it}.

It demonstrates the absolute abnormal accrual from the Dechow et al. (1995) model; $SIZE_{it}$ is the natural logarithm of total assets for the company i in year t, $PRFT_{it}$ represent organizational performance, which is the return on assets for company i in year t, LEV_{it} represents the ratio of total debt to asset ratio, which is calculated as the sum of total liability divided by the total assets for company i at the end of fiscal year t, GRW_{it} represents the growth of company i at the end of fiscal year t, which is calculated by difference between the current year and previous year sales revenue divided by previous year sales revenue; $IFRS_{it}$ is a dummy variable which is given a value of 1 if the financial statement has to be prepared under IFRS, 0 otherwise; for firm i in year t.

Congruent to the study of Sadiq et al. (2019); Kalabeke et al. (2019) four variables have been included as control variables i.e., the company's size (SIZE), profitability (PRFT), leverage (LEV), and growth (GRW), which altogether can influence the degree of earnings management activities. Furthermore, these variables evaluate the quality of the financial reporting with respect to the level of sophistication of the reporting of the financial statements and in terms of management incentive to manipulate the earnings. For instance, larger companies are supposedly to have better and sophisticated financial statements as compares to the SMEs which are likely to manipulate their earnings. Therefore, the mangers in the SMEs are more likely to manipulate as per the opportunities available. On the other hand, past studies have given evidences on why companies manipulate their earnings and the incentives they get out of it (Roychowdhury, 2006).

4. ANALYSIS AND RESULTS

Post IFRS adoption, a decreasing trend was seen in the Malaysian industries which could be taken as the result of IFRS adoption and strong Corporate Governance. However, there could be various reasons for the overall decrease in trend of Earnings Management, such as, Corporate Governance, the results of the scandals happened at the start of Millennium, adoption of IFRS etc.

After the establishment of the IFRS, the accounting general bodies of Malaysia i.e., MFRS started to enforce their practice without the contradicting the Companies' Ordinance Act 1965. So, the influence of the Earnings Management cannot be directly observed. Correlation analysis is highlighted in Table I.

Table I. Correlation analysis.

Variables	Mean	Med	SD	Min	Max	Q1	Q3
ABACDEC	0.848	0.0789	2.103	0.000	19.891	0.034	0.236
ABACKAS	0.617	0.069	1.673	0.000	15.981	0.024	0.164
SIZE	18.867	18.813	1.512	9.360	24.987	17.967	19.732
PRFT	4.323	4.613	11.131	−163.019	84.562	1.338	8.532
GRW	1.2556	0.890	2.154	−53.890	36.845	0.5222	1.389
LEV	0.389	0.0671	1.289	0.000	9.753	0.0041	0.199

Table II. Pearson correlation matrix.

	Sample for earnings management analysis					
	ABACDEC	ABACKAS	Size	Profitability	Growth	Leverage
ABACDEC						
ABACKAS	0.754**					
SIZE	−0.035*	−0.014				
PRFT	−0.021	0.011	0.288**			
GRW	−0.018	−0.020	0.103**	0.25588		
LEV	0.075**	−0.067**	0.209**	−0.22	−0.024	

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Confirmation analysis showed and confirmed that the ABADCEC is positively and significantly related with the size, profit and growth of the company "*I*". It demonstrates that if the organization has ABADCED and ABACKAS then the organization will perform better and turn out great in terms of size, profit and growth. The leverage was negatively correlated with the profit and growth of the company which means that firms that are high in leverage are poor when it comes to performance. Size of the company was insignificantly correlated with the profit of the company whereas, companies higher in growth were positively correlated with the performance of the company's. Finally profit of the company and growth were found to be significantly and positively correlated with each other. Pearson correlation matrix is presented in Table II.

ABACDEC and ABACKAs is positively and significantly related with the profit of the company. It showed that companies that have ABADCED and ABACKAS performed better as compared to those who don't use it. Growth resulted to be positively related with the profit of the company which supported the statement that high growth tends to perform better than those with low growth. Furthermore, Congruent with the study of Sadiq et al. (2019), leverage was negatively and significantly related to accrual-based earnings management activities, which indicates that high leverage firms tend to get more involved earnings management.

Table III shows the aftereffects of the ordinary least square regressions used to examine the connection between earnings quality, absence of earnings management, and IFRS reception. This regression analysis covered various factors of EM such as the profit, growth, size,

Table III. Regression results of ABAC.

Variables	Constant	IFRS	Size	Profitability	Growth	Leverage
Coeff.	2.667**	−1.789	−0.044*	−0.0033	−0.013	−0.063
T value	6.777	−2.987	−1.905	−1.108	−0.815	−2.482
VIF		1.098	1.091	1.153	1.068	1.088
Adj. *R* square	0.179					
F stats	167.751***					
N	700					

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. *Model*: $ABACDEC_{it} = \beta 0 + \beta 1 LEV_{it} + \beta 2 SIZE_{it} + \beta 3 PRFT + \beta 4 GRW_{it} + \beta 5 IFRS_{it} + \sum_{it}$.

and leverage of the company. The results suggest that IFRS is significant at the β level which means that after the adoption of IFRS in the company, it results in reducing the earnings management in the company overall. However, the Absolute value demonstrates a strongly negative and insignificant relationship between absolute value of abnormal accruals and IFRS adoption.

5. DISCUSSION AND CONCLUSION

The purpose of the study was to identify if there is any influence of IFRS adoption on Earnings Management in Malaysia. To test it, 100 companies were choses which are listed in the Bursa Malaysia (Malaysia Stock Exchange). The data chosen for this study was secondary and it was taken from the website of Bank Negara Malaysia. The data varied and covered almost every industrial sector as the sampling technique used was convenience sampling. The tests were run applying Discretionary Accruals and Modified Jones model. In Earnings Management, Discretionary Accruals represent the employment of the EM. Moreover, results suggested that there has been observed a declining trend in the Malaysian Industrial Sectors after the adoption of IFRS.

In order to reduce the Earnings Management, the trust should be established with the stake holders and it can happen with the help of development of a strong reputation of the organization and offering to bring the profit generation on a stable footing. When it's the time of financial crisis, this trend can often be observed so it requires more research in this area to observe, if there can be any significant changes in Earnings Management in the events of financial crisis. Furthermore, the period of the sample should be longer and also cross country global analysis can offer better analysis and comparison to the future researchers. Besides that, high quality models can be introduced in the future studies in order to detect the Accounting Information manipulation. Also, the existence of CFO in research model would have made a significant impact towards the study. So, in future it can be introduced as well for the predictive research.

In this research, there were few limitations. So in future studies it can be established on the basis of the limitations and it can cover the areas that this study lacks. First of all, the major focus of this study is to learn the influence of IFRS on the observed intensity of Earnings Management. So, the conclusion drawn is merely emphasizing over this aspect solely. Furthermore, Earnings Management is not only examined through Modified Jones Model, so in future the approach can vary as well (Heemskerk and Van der Tas, 2006; Johar et al., 2017). Also, IFRS influences the way losses can be identified in the statements of finances which depends on the discourse requirements and the degree of relevancy towards the financial data. The approach used in this study i.e., cross-sectional approach, assumed that all the companies and organizations lying within an industry have identical accruals. However, this limitation exists because every firm is different than the other with respect to the size, structure, characteristically. Finally, cross-sectional approach is considered to be better than the time series approach however, with the production of a good quality statements for the end users it is comparatively hard to identify if there exists Earnings Management in the company.

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RESEARCH ARTICLE

Innovation and Firm's Success: The Case of Thai-Based High-Tech Firms

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The purpose of this study is to determine the innovation success in Thai-based High-Tech firms with the help of leader's behavior and organizational values with the mediating role of innovation process. This was done quantitatively. Sample size was 200 employees who worked in Thai-based high-tech firm. 5-point Likert scale was used employed for data collection and PLS-SEM version 3 was used to analyze the data. The findings of this showed that leadership role and values of the organization play very significant role in ensuring the innovation success through innovation process in Thai-based High-Tech firms.

Keywords: Leader's Behavior, Organizational Value, Innovation Process, Innovation Success.

1. INTRODUCTION

Currently, all high-tech firms want to be effectively progressive. Almost every firm seek to utilize those factors that make the company successful. Studies acknowledge that the climate of the organization have become the main instrument in ensuring the success of the organization with the help of the utilization of innovative proficiency of the firm (Jermsittiparsert, Sutduean, and Sutduean, 2019). The atmosphere of the organization plays very fundamental role in the firm's success through assuring the continuous innovation further elaborated that "Today innovation is critical for the success of firms and the wealth of nations." Each organizational environment possesses some key factor that foster the innovation. Coleman [1] Number of authors examined the diverse but mutual aspects. For example, Coleman [1] scrutinized people, practices, vision, values as the mutual factors that shape the culture of the organization.

The organizational competency to perform creatively and innovatively is significantly dependent on some factors that adds the value to its success and failure [2]. Quite a lot of research has been done on the understanding of those factors that assure the innovative climate of the firm and such factors are resources, processes, behaviors, values and so on. The firm's success is taken as the level of innovativeness in the possesses in terms of being effectively responsive towards the changing nature of the markets and providing products and services in new and innovative ways. Relating to this, the management guru, Peter Drucker, accepted the role of innovation as pretty much powerful in operating the business successfully.

The competency of an organization as being innovative has turned out to be the most critical ability that firms needed currently [3]. Based on the very important literature related to the capabilities, an "innovation capability" conception dependent upon seven aspects namely, organizational intelligence, management's creativity level, systems and structures of the organizations, climate and culture, management of the organizational technology and so on.

Hence, organization's innovative competency evidently dependent on the proper design and implementation because organizational proficiency in terms of innovative capability has gained the noteworthy attention from the last few years [4]. Number of authors in their study of job-related conceptions and human behavior at the workplace have taken interest in contextual aspects for instance, organizational trust on employees, supportive behavior of management might have considerable and influential impact on the worker's skills and attitude [5]. In accordance with the above stated discussion, this study is aimed to contribute in the literature by investigating that how some organizational factors such as organizational value and leader's behavior encourage the innovation process and how this scenario bring the innovation success within the Thailand-based high tech firms.

1.1. Problem Statement and Background of the Study

In the volatile business environment, organization can only be successful on the basis of their innovative approach.

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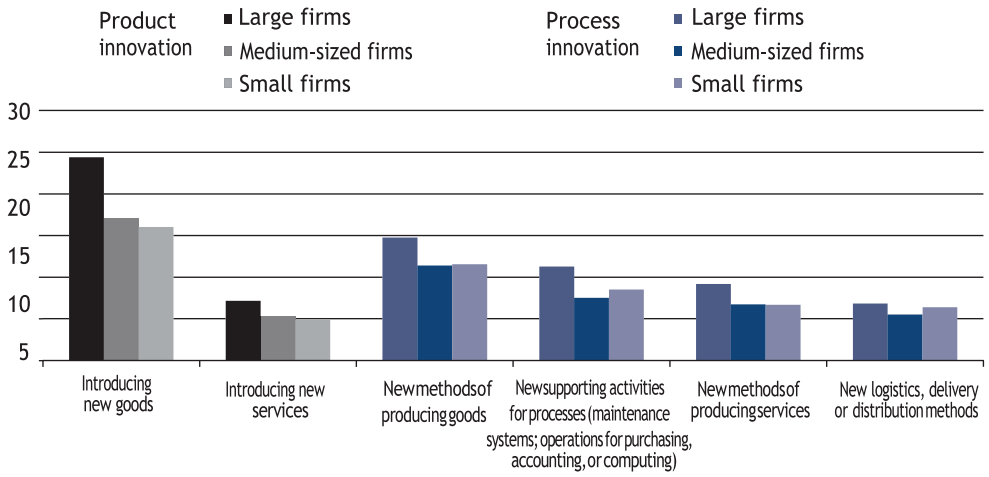

Fig. 1. Innovation process in high tech firms.
Source: UNCTAD, based on data from the national R&D and innovation survey, 2011.

Innovative behavior is highly dependent on the atmosphere of the firm, its processes, values, management's attitude, resources and so on.

In the context of Thai-based firms, globally and Thailand the nature of jobs and work have significantly changed, things have been effected by complex interrelated aspects such as global pressure, change in technology and climate, radical changes in the process of innovation, enhanced fragmentation in production system and the list goes on. In following with this statement, high-tech firms in Thailand are struggling to sustain the competitive edge through innovation. To respond such pressure, Thai-based high-tech firms need to put the investment in human capital, need to develop the innovative methods to run the infrastructure successfully, need to support SMEs and need to be welcoming for the trade with around the globe. The performance of the Thai-based companies regarding the innovation has decreased, by means of the Global Innovation Index, the ratio on innovation of Thailand has been decreased in comparison with some East Asian countries.

From the perceptive of policy makers and researchers, this issue can be resolved. Critical level of innovation can be possible through number of ways, for example innovation can be occur through the cooperation and collaboration with different parties, value chain can also play very significant role in fostering the innovation. This scenario is specifically applicable to ensure the process of innovation of Thai-based high-tech companies [6]. Firms can successfully implement the innovation in the organization, if they keep themselves safe from the inefficient marketing and management policies, weak system etc. [7]. In accordance with the above stated discussion, this study is aimed to contribute in the literature by investigating that how some organizational factors such as organizational value and leader's behavior encourage the innovation process and how this scenario bring the innovation success within the Thailand-based high tech firms. Figure 1 shows the innovation process in high tech firms.

Regarding the outcomes of National R&D and innovation survey 2011 which has been conducted on Thai-Based High-Tech Firms, the main problem that regardless of the size, every company faced was less qualified employees and insufficient info about markets and technology.

1.2. Objectives of the Study

- To examine the effect of leader's behavior on the innovation process of high-tech firms in Thailand
- To examine the effect of organizational value on the innovation process of high-tech firms in Thailand
- To examine the impact of innovation process on innovation success of high-tech Thai firms
- To analyze the mediating role of innovation process between the connectivity of leader's behavior and innovation success
- To observe the mediating impact that innovation process hold regarding the association between organizational value and innovation success
- To examine the link of leader's behavior with innovation success in Thai-based High-Tech firms
- To inspect the connection of organizational value with innovation success in Thai-based High-Tech firms.

2. LITERATURE REVIEW

2.1. Leaders' Behaviors

Organizational behavior states that in what ways employees interact with each other in relation with the innovation. Workers behavior of being innovative and creative is mainly dependent upon the leadership attitude, creativity come up as the fundamental trait of leaders. Among many, the most important skill that make the leadership effective is to create favorable environment which helps the employees to solve the challenging problems in innovative ways.

In the support of creativity and innovation among the workers, leaders must consider their available instruments and resource that employees needed to accomplish the innovative job demands [8]. Organizations who practice innovation hold the clear mission and vision statement which strengthens the innovative attitude of the employees. Leaders are the key aspects that indulge the employees in innovative activities by fully providing the needed resources and atmosphere. Leader would make the way for innovation and creativity by showing his/her complete support.

Among many, the considerable nine practices of leadership and management that specifically encourage the critical thinking and innovative behaviors. These practices are (1) doing outsourcing: recruit creative workforce from the outside, and recognize the talent from within, (2) make available intellectual challenge, (3) make the employees empower and provide them autonomy in the doings of their jobs, (4) ensure the availability of precise resources, (5) attainment of leader's encouragement and connecting innovation to the end result, (6) provide full support from the organization in order to show that how creativity enhance performance, (7) build the positive connection with highly intellectual employees, (8) providing monetary compensation for showing creativity and innovation, (9) design work groups effectively. Innovative organizations make its products, process and services striking. On the same note, more added leadership initiatives that lead towards the innovation are: (1) put emphasis on the practices of transformational leadership if likely, (2) follow the innovative behavior on regular basics, (3) inspire the behavior of risk taking via taking the risk by themselves, (4) focus on cooperation between workers, (5) don't follow the innovative patterns for the sake of its own, (6) participate in production and development, (7) when ideas and products get flop then identify the concealed opportunities, (8) utilize loose-tight leadership approach.

2.2. Organizational Values

Values of the organization describes the organizational competencies. For the workers and decision maker, organizational values are the guiding ideologies. "Meeting the challenge of disruptive change" by Christensen and Overdorf [9], he further described in his scientific paper that values possess the wider sense instead of just emerge as corporate values. Such arrangement of factors would form the worker's judgement about exactly how the customers are the important asset for the organization, in what manner their ordering being formed in comparison with their personal responsibilities.

Organizational values assist the employees in setting their priorities regarding the completion of tasks and idea at any level. Relating to this, at the level of leadership, leaders make judgements about to or not to invest in new products, processes and services. Linking back with the same scientific approach. Christensen and Overdorf [9], the wider the organizational level, the more it suits for senior leadership and management to provide training their employees for being critically judgmental in accordance with their task preferences and directions of the firm.

Organizational values also provide help in developing the firm's mission and vision statement. Companies that follow innovative patterns hold values in terms of active learning, creativity, entrepreneurial, sharing knowledge, dare to take risk, obsession for customer and so on [10]. This is noteworthy to highlight that such values might be different form firm to firm, and with the understanding of organizational values, employees could make it easy to understand that to what extent the firm is sensitive towards the implication of innovation.

The connectivity between organizational values and innovation process is visible in many researches. In accordance with the Ref. [11] once the organization emphasize the values that mainly focus on effective teamwork, immense financial investment in the area of Research and Development enable the employees to work more faithfully and corporately on the way to create new ideas, new solution for the problem through employing innovative processes. In the same way, highlighted in their study that endorsing values for example, ensure the autonomy and participation in decision making, a reduced amount of control and more self-motivated working atmosphere would apparently encourage the innovative processes within the organization.

2.3. Innovation Process

Process brings the solution to problem. Number of activities and everyday jobs establish the process that mutually convert inputs into outputs. Employees of the organization give the input in terms effort, information, material and so on to transform into the end result (output) like innovative products and services [12]. Processes of innovation come up as a second most important aspect relevant to the three main aspects that describe the capabilities of the organization [13]. Processes of innovation throw a significant effect like what a company should do and what should not.

Innovation processes are quite helpful in the functioning of the organization, like such processes help the workers to take bold decision regarding the transformation of organizational resources for the production of innovative goods and services [14]. Innovation processes has two types: (1) First process is formally followed, evidently acknowledged and implemented by the whole organization. (2) Second process is informally followed, and this process based upon the everyday routines and method of performing the job changing all the time [9]. Within the organizational context, the processes that the organizations follow are work as a support system and a guiding principles to employees for the sake of enabling them to adapt them rapidly to meet the demand of changing market effectively. It is pretty much important to consider that

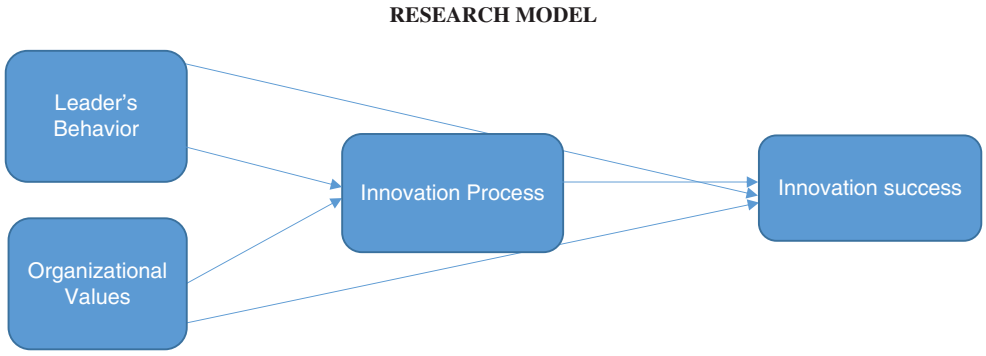

Fig. 2. Framework of the current study.

employees must follow the accurate process relating to the completion of task and project, if not then the process would convert into the bottleneck for the task and project. Workers must consider the process as a back-up approach while taking the decision for the sake of being aside from the serious blunder.

The purpose of Innovation funnel is to bring together the unique ideas and improve the markets products when the concepts and design get clarified via the funnel. On the same note, Innovative funnel is just like a path that has been taken by the ideas from the early stage to final in terms of introducing the product and services to the market. Heading towards the same direction, innovation funnel works as stage gated that turns the ideas and concepts into the reality. Moreover, progressive organizations, successfully utilize their processes of innovation to achieve their end results [15].

2.4. Innovation Success

Organizations who ensure the innovation successfully are those who enable their employees to perform outclass. Performance of the organization is highly dependent upon that how effectively the objectives and goals are achieved by the organization. Organization show impressive performance when its process, employees, policies and procedures are capable to meet short term and long term radical innovation. The innovation on radical basis would pay attention on the emerging new markets and new technology. Organizations perform better and achieve its goals successfully only when the workers are progressive towards their objective related to the growth, this situation lead towards the effective attainment of their goals [16].

Performance also come up as a tool of measurement for inputs and outputs in process and to what extent this is happened. Richard et al. (2009) described that organizational performance represents the three particular domains of organizational outcomes: (1) performances on financial terms such as (ROI, ROA, and profit etc.); (2) performance of product market for example (market share, sales etc.) and lastly returns of shareholder in terms of (overall shareholder return, economics value added, etc.).

Leading towards the firm's success, the one important external point is market orientation. Managers and employee's attitude are also significantly form by the market orientation. The concept of market orientation is the key aspect that lies within the marketing concept. Ozkaya, Droge [17] and is perceived to give long-standing success. Market oriented based firms are heavily relying on innovation just to fulfill the needs and demands of the customers proficiently. Market-oriented firms significantly consider the availability of guidance and support of after sales services. This is considering to be just an effort that firms make to sustain the customer satisfaction at high level and also to endorse the brand loyalty.

Innovation in product is the very important aspect that ensure the long-term growth of the organization [18]. Far-reaching innovative organizations always experience the progressive financial growth through attracting the new shoppers and leaving behind the competitors through processes [19]. Further stated that, performance measurement system is quite necessary to bring betterment within the employee's innovative behavior and capabilities for the sake of being progressive and competitive in the market. Moreover, framework of the current study is shown in Figure 2.

3. RESEARCH MODEL

3.1. Research Hypothesis

H1: Leader behavior is positively linked with innovation process

H2: Organizational value is positively linked with innovation process

H3: Innovation process is positively linked innovation success

H4: Innovation process has a positive mediating effect among the relationship between leader's behavior and innovation success

H5: Innovation process has a positive mediating effect among the relationship between organizational value and innovation success

H6: Leader's behavior is positively linked with innovation success
H7: Organizational value is positively linked with innovation success.

4. RESEARCH METHODOLOGY

The study was done on high-tech firms operated in Thailand. Cross-sectional as a research design has been employed and this study was done quantitatively. All the high-tech firm which operated in Thailand were chosen for this research. The respondents of this study were the management and employees who were linked with the innovative activities in the organization. To get the response, from high-tech firms, survey has been done through email. The link of the survey has been provided through email. Initially, the respondents of this study have been well-versed about the objectives of the study. It has been confirmed that the respondents of this study had a direct connection with the innovative activities. Second, permission has been taken from the respondents for their participation in this study. Employees were not allowed to fill the survey questionnaire unless they had a link with innovation in the organization. Sample size in this study has been taken under the guidance of suggestions. They suggested that sample size would consider to be weak when a lesser amount of participants in terms of less than 50 are involved; sample size based only on 100 participants would also consider weak, sample size of 200 participants would be acceptable; Good sample size contains 300 participants; 500 consider too good and lastly sample size become excellent when covers 1000 participants. As a result, the sample size of this study based on 200 participants. 5-point Likert-type scales was utilized to collect the answers. Two hundred (200) survey questionnaires were disseminated in high-based firms in Thailand. The ratio of the participants in current study is only Seventy-two (72%). Consequently, the occurrence of response rate was 36%. Though, when the response is done through email survey, then the 36% response rate is acceptable. Measurement model is shown in Figure 3.

Table I. Result of measurement model.

	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
IP	0.946	0.961	0.86
IS	0.950	0.964	0.869
LB	0.916	0.938	0.751
OV	0.951	0.962	0.837

Factor loading with all the particular items has been examined in this research. In accordance with the factor loadings of items if achieved superior than the value of 0.5 then convergent validity attained. Relating to this study, values of loading have shown higher than 0.5 in our model. Furthermore, Table I explains composite reliability (CR), Cronbach's alpha and average variance extracted (AVE) for each variable. AVE must touch the value of 0.50 and CR should be come greater than 0.70 [20]. It has shown in Table I that the reliability and AVE of all the constructs is higher than the 0.50 value. In this study Cronbach's-Alpha has been examined at the value of greater than 0.90 to determine the internal consistency. Hence, this shows that the all the variables possess good consistency. The factor loadings items came up with the values which are higher than 0.7 (Hair et al., 2017).

With the help of PLS bootstrapping procedure, path coefficient and *t*-value was determined to measure the

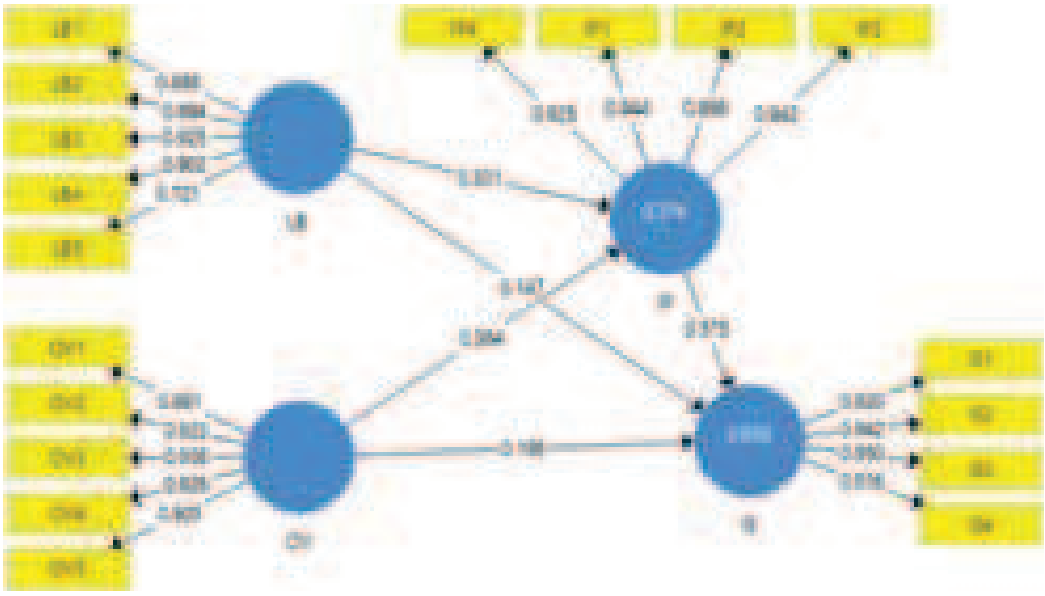

Fig. 3. Measurement model.

Table II. Direct effect.

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	*T* statistics (|O/STDEV|)	*P* values
IP → IS	0.575	0.571	0.067	8.622	0
LB → IP	0.331	0.338	0.053	6.24	0
LB → IS	0.147	0.146	0.054	2.732	0.007
OV → IP	0.364	0.361	0.056	6.453	0
OV → IS	0.196	0.202	0.055	3.567	0

direct association among both exogenous latent construct and endogenous latent construct stated that the function of *t*-values is to observe the significance level of the variables, and the path coefficients (β-values) goes similar with regression analysis. Additionally, t-value would be acceptable at the standard value of 1.96. In our study, five (05) propositions have been analyzed with the direct connectivity, and all five (05) propositions have shown the support. Furthermore, Table II have displayed the direct effect of endogenous latent variable with each other and this table also showed the results that showed the direct influence. In the current study, Table II depicted that *t*-value of all the propositions is higher than 1.96. Furthermore, Table II also evidently simplifies the results of all independent construct on dependent constructs and this table also displayed the outcomes which have direct effect.

In order to determine the indirect effect of each construct, bootstrapping through PLS has been employed in this study. Likewise, number of studies showed that bootstrapping regard as a non-parametric re-sampling procedure and get lot of approachability as this method come up as a very important technique for testing and analyzing the mediation effect in the study [21, 22]. Moreover, in accordance with the citation of F. Hair Jr., Sarstedt [23] to deal with the small sample size, PLS SEM through bootstrapping is the finest option. Though, F. Hair Jr., Sarstedt [23] stated that methods of researchers Preacher and Hayes (2004, 2008) consider as the best to pursue when testing mediation and the following study has adopted this technique [24–26]. Consequently, innovation process has been examined as a mediator in this study. The same, Table III highlighted the mediating effect of innovation process among the relationships between leader's behavior and organizational value with innovation success. The *t*-value of the mediating relationship lies above the value of 1.96 [27–33].

Table III. Indirect effect.

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	*T* statistics (|O/STDEV|)	*P* values
LB → IP → IS	0.19	0.193	0.039	4.931	0
OV → IP → IS	0.209	0.205	0.037	5.712	0

Table IV. Discriminant validity.

	IP	IS	LB	OV
IP	0.927			
IS	0.76	0.932		
LB	0.533	0.562	0.867	
OV	0.547	0.592	0.554	0.915

Table V. Construct cross validated reliability (Q^2).

	SSO	SSE	$Q^2(=1-\text{SSE/SSO})$
IP	1,652.00	1,164.27	0.295
IS	1,652.00	819.901	0.504
LB	2,065.00	2,065.00	
OV	2,065.00	2,065.00	

Much importantly, the values of *R*-square (R^2) has been developed form the PLS and make clear that the paying attention on all constructs collectively possess the tendency of clarifying changes in endogenous latent variable, namely; IP by 37.6 % and IS by 63.6%. As it is shown in Table IV.

The model of predictive relevance (Q^2) was observed with the help of blindfolding technique. Researchers F. Hair Jr., Sarstedt [23] explained that the purpose of Q^2 value is to measure the parameter estimates and to examine that how values are put up on all over the model. Q^2 measured the framework capability (model) to predict the quality of the model and also to predict the relevance of endogenous constructs. Consequently, Table V defines the predictive relevance (Q^2). Table V further exposes that Q^2 determines the predictive relevance of 0.295 for IP and 0.504 for IS that assure the model predictive relevance, as Q^2 is higher than zero.

5. DISCUSSION

Outcome of the current study suggested that innovation success have been significantly ensured through the leader's behaviors and organizational values along with the strong and positive mediating role of innovation process. Statistical analysis exposed that IP and IS, *t*-value is 8.622 ($t > 1.96$) and β-value is 0.572. These results supported H1. It shows that IP and IS has significant positive relationship. Increase in IP enhances the IS. Thus, for 1st objective of this study, it is found that IP is one of the major contributors towards IS. Similarly, LB and IP, *t*-value is 6.24 ($t > 1.96$) and β-value is 0.331. These results supported H2. It shows that LB and IP has significant positive relationship. Increase in LB enhances the IP. Thus, for 2nd objective of this study, it is found that LB is one of the major contributors towards IP [34–41].

Likewise, LB and IS, *t*-value is 2.732 ($t > 1.96$) and β-value is 0.147. These results supported H3. It shows that LB and IS has significant positive relationship. Increase in LB enhances the IS. Thus, for 3rd objective of this

study, it is found that LB is one of the major contributors towards IS.

Similarly, OV and IP, t-value is 6.453 ($t > 1.96$) and β-value is 0.364. These results supported H4. It shows that OV and IP has significant positive relationship. Increase in OV enhances the IP. Thus, for 4th objective of this study, it is found that OV is one of the major contributors towards IP. Moreover, innovation in high-tech firms is most important [47].

Similarly, OV and IS, t-value is 3.567 ($t > 1.96$) and β-value is 0.196. These results supported H5. It shows that OV and IS has significant positive relationship. Increase in OV enhances the IS. Thus, for 5th objective of this study, it is found that OV is one of the major contributors towards IS.

Statistical results supported H6 as the t-value is 4.931 ($t > 1.96$) and β-value is 0.19. In case of mediation of IP, the relationship between LB and IS with t-value 4.931 ($t > 1.96$) and β-value 0.19. These results supported the H6. Thus, IP significantly mediates the relationship between LB and IS.

Statistical results supported H7 as the t-value is 5.712 ($t > 1.96$) and β-value is 0.209. In case of mediation of IP, the relationship between OV and IS with t-value 5.712 ($t > 1.96$) and β-value 0.209. These results supported the H7. Thus, IP significantly mediates the relationship between OV and IS.

6. CONCLUSION OF THE STUDY

In this study, the examination has been made regarding the role of leader's behavior and organizational values on the application of innovation success in Thailand based high-tech firms, with the mediating role of innovation process. The findings of this study suggest that employing the organizational values in terms of creativity, learning, and entrepreneurial attitudes plays very important role in enhancing the innovative capabilities of the employees in high-tech firms based in Thailand. The same the behavior of leadership also throw a positive impact on employee's innovative capabilities and emerged as a strong predictor of ensuring the innovative processes. Consequently, empowering the environment of the organization as a whole enable the leaders/managers to increase the employee's capacity of being innovative, which is very critical to attain the firm's sustainable growth.

7. IMPLICATIONS

Successful innovative organizations are highly dependent on the innovation process (organizational culture) of the firms. Successful and quick implementation of innovative culture within the organization would be highly recommended and helpful for the firms. The research model of this study will be pretty much applicable and helpful in analyzing, understanding and executing the factors which has been discussed in relation with the innovative capability of Thai-based high-tech firms.

Moreover, not just two factors innovation success and innovation process plays important role in determining the firm's innovative capability, but along with these factors, other factors which has been discussed in model are also influence the firm's innovation capability critically. These other factors are leadership behaviors and the values of the organization are also needed to implement the innovation successfully. According to the results of this study, leader's behavior and organizational values have a positive effect on innovation process. Leadership of the organization come up as a key factor that implement the innovation successfully.

8. FUTURE RESEARCH

Innovation is very important aspect for any organization in order to ensure the success in the market. The model in this study can be applicable with different other factors such as companies with different industrial background and startup organizations that operated in the market with less than four or three years. Continuous development in the technologies have changed the nature of work and enable the workers to perform the job more remotely, such advancement throws the direct effect on the innovative culture of the firm. That's why from the perceptive of future approach this model can also be discussed in remote working environment as the part of the firm.

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RESEARCH ARTICLE

The Effect of Service Quality on Customers' Intention: A Case of Internet Service Provider in Malaysia

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Purpose—This study attempts to find the effect of service quality on internet service provider customers' behavior. This study used primary data to examine the relationship between the service quality and the customers' intention. *Design/Methodology/Approach*—The data in this research was collected from general public of Malaysia through survey based questionnaire. The data was analyzed using the PLS-SEM. The chosen population for conducting this research is internet users with the sample size of 305 respondents.

Keywords: Service Quality, Customer Service, Security and Privacy, Information Quality, Switching Intention, Repurchase Intention, Complaint Intention, Network Quality.

1. INTRODUCTION

It is logically oriented that service quality of internet plays a major role in a customer intention, switching intention and behavioral intention. In addition, connection of marketing theory proposes that it is extra helpful for internet service provider to sustain and build up long term relation between customers and suppliers [1]. Retention of consumer is very important in terms of increasing competition. However, acquisitions of clients have a cost of five times more than those related with customer maintenance. Previous research has verified that service quality raise loyalty and retention rates, but poor service frequently results in complaining and switching behavior [2]. Particularly, this has been considered as a most critical issue for service providers. Hsiao et al. (2016) said successful complaint management system can facilitate the maximization of loyalty of customers. It is compulsory for all providers that they separate market into different division. The intention of this investigate are threefold, identifying service quality proportions, second is examine the overall impact of ISP customer's intention to keep on with service dealer, complaint and switch intention, and last one is to investigate the power of ISP customer's usage model on their observation. The matters under analysis the effect of service quality on internet service provider customer behavioral intention. This statement is about how and why service quality of internet played a major role for provider as well as customers. How they interact with each other and what are the dimensions to evaluate service quality. The service quality is determinant of whether a consumer eventually continues or remains with or defects from a provider. It is extensively considered as one of the point factors of determining customer behavioral, complaint and switch. Needs of heavy users were not on point. Providers should be alert with dealing potential threat of secretive response and should grab opportunities which present in restoring the trust of complaining customer. The study explores the dimension of ISPs service quality. Customer retention is very important for any type of business.

Service providers are making sure that they fulfill customers need. They do so by making short survey regarding their customer's needs. People now a day's need speedy and reliable internet connection and at affordable price. In today's market, customer needs fast, reliable and good after sale services for internet service. Overall, the internet service market is increasing day by day in accordance of speed packages and usability packages keeping the customer needs in mind. These different services are changing the customers buying behavior and customer perspective towards service providers [3].

This study identified the impacts of internet service providers on customers and their relationship. Therefore, this study investigate the relationship between variables like network quality, customer service, information quality, security and privacy, service quality, complaint intention, switching intention and re-purchase intention (Jermsittiparsert, Sutduean, and Sriyakul, 2018; Khasabulli et al., 2018). The intention of this research is to investigate the factors influencing customer's usage of ISP, and

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evaluate the dimensions for service quality of internet service dealer and explore the link between service quality and behavioral intention of customer. Finding the best way to implement this is the main focus, and this will have accomplished by focusing and enhancing the service quality then automatically turnover rate decreases. The focus of this study is that what are the dimensions of service quality in internet service and how do they affect the customer perceptions?

The findings of this study highlighted few very important factors through which customers influenced while checking the impact of service quality on internet service provider customer's behavior. Moreover, results show that customer service, network quality, privacy and information quantity are more preferred by customers. Furthermore, it also shows that the customers repurchase intention, complaint intention and switching intentions after using a particular Internet Service by provider. This study will help other researchers in evaluating the impact of service quality and work on those areas where they could not find more information.

2. LITERATURE REVIEWS

2.1. Theoretical Study

2.1.1. Repurchase Intention

Satisfaction of customers is really important for any organization or company (Jermsittiparsert, Sriyakul, Pamornmast, Rodboonsong, Boonprong, Sangperm, Pakvichai, Vipaporn, and Maneechote, 2016; Konain et al., 2018). Kim [4], conducted a research in which they investigated the relationship between customers' satisfaction and their intention to repurchase. It is important for the company to notice the motivating factors for their customers to repurchase any specific product or service. Today's world is customer oriented because there are so many options for people to choose from. A big chunk of these internet users consist of online shoppers or buyers. People buy online because they think it saves them time and effort. Ibrahim and Gomaa (2016) [5] examined the factors which affect the intention of people to buy any service of product again. It was found out that the main reason behind repurchase intention is customer satisfaction so for any service provider it is important to provide a safe and secure environment where their information is safe. Furthermore, service quality, information quality and trust have strong effects on customer satisfaction which leads to customers' intention to repurchase their product or service. Vázquez, Iglesias and Varela (2016) [6], explored which factors affect the complaint behavior and service improvement satisfaction on customer intentions to repurchase online. Firm's reliability, functionality, reliability and usefulness also play important role in repurchasing intention. Many surveys have been conducted to know what factors are important to know by the company and the results showed that it is customer satisfaction which is really important for any company. Customer satisfaction will lead the customers to buy that specific product or service again and this will increase the revenue of the company.

H1: *Service quality has a positive impact on repurchase intention.*

2.1.2. Complaint Intention

Service sector is getting very competitive due to meeting customer expectations, because they are customer oriented. Therefore, businesses do not take any error or malfunctioning for granted. Vázquez, Iglesias and Varela (2016) [6], stated the service recovery satisfaction and complaint behavior of internet is aspects of customer intention. Service providers can obtain a positive outcome by adapting proper complaint handling system and service improving strategy. Aljaberi et al. (2018) discuss that complete customer satisfaction internet banking service quality, and the inspection between service qualities proportions every internet service provider should have a quick recovery system and they should entertain each and every customer in a very positive way because positive word of mouth is also very important for any company's reputation and goodwill. Thaichon, Lobo and Mitsis (2016) inspect the relation of customer's behavioral and physical behavior and the loyalty of customers with their internet service providers if customers are satisfied with their complaints; they will retain and will stick to their brand.

H2: *service quality has a negative impact on complaint intention.*

2.1.3. Switching Intentions

The effect of service quality on customers' behavior is widely possess on customers repurchase intentions. This is because, if the customer are provided all the required services, then they may consider to repurchase the service again. Moreover, it is shown in previous studies that information handling and complaint intentions are also very important element to work. Furthermore, customers motivated towards your service when they see that if they got any problem regarding internet so someone from technical staff come to their home and fix the issue without charging extra amount. As seen, most of the customers prefer those services which give high responsiveness and abilities of solving the problems. In addition, privacy and security are those two factors which are highly concerned the customers. If they do not have the privacy to share whatever they want on the internet, then they may not get motivated from the service. Instead you should give them security to do whatever they want to without their personal information being leaked to anyone. In a nutshell, to maintain the best relationship between customer and service provider, it is by fulfilling those customer needs which are essential for every customer.

H3: *Service quality has a negative impact on switching intention.*

2.1.4. Security and Privacy

Frik and Mittone (2019) [7] suggested the real meaning of internet services is network linked; privacy and security are further dominant in investigating ISPs service quality as compared to service quality of supplementary telecommunication services, like TV and mobile services. The server attached vital report of information, if internet client which crafts customer's private records susceptible, particularly when illegally access is settled. A learning uncover that it can be accomplished that clients recognize ISPs shelter from privacy incursion and cybercrime as needed and main, highlighting the role of privacy and security. Online trading system, privacy leakage information problem is the major problem of this criterion. They necessitate defending it from any type of hazard or threat or risk. Perceived security and privacy has an activist outcome on perceived conviction. Privacy leakage problem is connected with withdrawal on the web to understand operator privacy. Study also found that individual trust is totally based on quality and service of internet Supplier remarkably situation based information for customers take place through offline and online channels. Study reveals that service quality element for ISPs were security, privacy and others.

H4: *Security and privacy has a positive impact over service quality.*

2.1.5. Customer Service

Supporting your customer is compulsory for every business. Customer service is important before and after the purchase of any product or service. Mitsis (2016) stated that if your service is good, then your customer will be loyal to your brand and when the customer is loyal this will improve the performance of your business. Mitsis (2016) stated designing a website in such a manner that it is user friendly and easy to excess is also good for any website company. The type of information provided through internet also matters in creating an image of the internet service provider.

H5: *Customer service has a positive impact on service quality.*

2.1.6. Information Quality

Everyone knows that Information quality is the main or core thing for everything we are thinking about and internet services made it so easy for us to take advantage from it regarding everything we want to know. Asem and Baothman (2017) [7] examined E-tax government from info survey that they should need new criteria for customers to pay tax by providing them very easy services. Thaichon and Jebarajakirthy (2015) worked on customer loyalty and suggested we can easily reduce the customer's

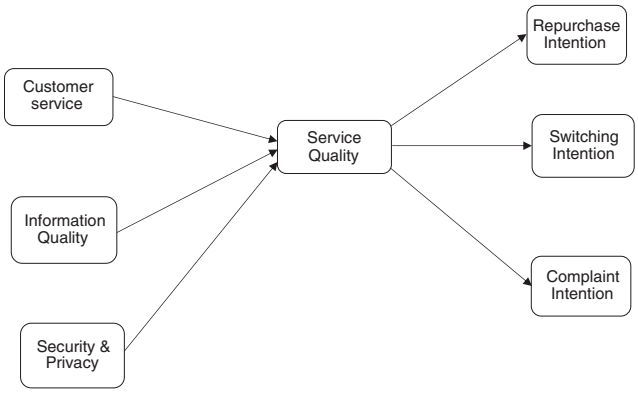

Fig. 1. Conceptual framework.

intension to switch by going on our commitments with them and set a mutative way for the customer to be loyal with us. Lee and Levy (2013) said that information quality factors have a huge impact on customers trust on e-government and understanding IQ characteristics that improve trust would enhance the relationship between citizens and e-government systems, as well as aide in the design and development of such systems.

H6: *Information quality has a positive impact on service quality.*

2.1.7. Service Quality

People these days emphasize more on quality and are conscious, not only in terms of service but in everything that people buy. Considering the variable service quality, it has a huge impact on internet service provider. Ruiz and Rubira (2016) showed the conflict of customer while using internet services and the resulted ATM info is checked that there is a need to complete responsibility of manager to spread full awareness related to the service quality that they are offering. Vezir (2018) evaluated the result which shows that providing good service quality and going straight with the expectation of student's will automatically increase the success of the academy in higher education and it would be their competitive advantage. The last thing is web based technology will be the most adopted technology in the world because of their more and more advantage. Conceptual framework of the study is shown in Figure 1.

3. METHODOLOGY

This study is a quantitative study and is based on corelation study. To test the hypotheses, Partial Least Square Structural Equation Modeling Tool was used to evaluate the hypothesis. The survey was conducted through questionnaires as it is a quantitative approach and the target audience were people who use Internet through TM, or any other mobile internet services. For the pilot study, 50 questionnaires were taken initially and later the research was

upgraded to 300 sample size. The data was collected from any individual who uses internet.

As we have worked on identifying the perception of customers over services provided by the internet by collecting the views of people through few planed questions on Liker scale system. Now the core focus of this chapter is to analyze the reliability, HTMT, Cross loading and other factors of 8 variables in our study that whether our studies are going straight to our planning's or not. The other thing is giving the interpretation of the dependent and independent variable as well. All the respected data were collected from the students of undergraduate, according to the survey, students are using internet for at least two hours and the maximum usage is 5 to 6 hours a day. The relationship between the variables are providing best services will directly satisfy the customer intensions, for complain providers will give the better result, other thing is by providing bad service dissatisfied customer will automatically switch that particular service, if the provider provides the best security and privacy the chances of retaining customer will high. As in the beginning we fill 50 questionnaires to check the reliability of the variables but it's not as par the requirement then we approximately done 350 questionnaires and took with the satisfactory result, moreover, the internal consistency and convergent validity is greater than 0.7 and 0.5 respectively which is a good sign, whereas as the HTMT criteria is less than 0.85. The cross loading difference between variables is greater than 0.1. When analyzing complex models PLS-SEM is particularly suitable [8–12]. Additionally, demographic profile is highlighted in Table I.

Table I. Demographic profile.

	Frequency	Percent
Income level		
Less than 5,000	155	50.8
5,001–10,000	74	24.3
10,001–15,000	38	12.5
Over 15,000	38	12.5
Age		
Less than 25	224	73.4
25–30	64	21
31–35	11	3.6
36–40	6	2
Time spend on internet		
1 hour	33	10.8
2 hours	67	22
3 hours	60	19.7
4 hours	37	12.1
5 hours	25	8.2
More than 5 hours	83	27.2
Gender		
Male	174	57
Female	131	43
Education		
College	71	23.3
Bachelors	183	60
Masters	44	14.4
Others	7	2.3
Type of connection		
Mobile internet	56	18.4
TM	249	81.7

Note: $N = 305$.

3.1. Data Analysis

This table describes the demographic of overall respondents. This study was conducted upon a total number of 305 respondents. In which the results show that 57% of our respondents which are 174 were male and remaining 43% of respondents which are 131 were female. Moreover, among all the respondents 73.4% which are 224 comes under the age of less than 25 years. While 25–30 years range of respondents were 21% which are 64. 31–35 years range of respondents were 3.6% which are 11 and 36–40 years range of respondents were only 2% which are 6 of the total population. Furthermore, the level of education of our respondents were mostly bachelors as they are 60% which are 183 of the total population. While 23.3% which are 71 were college students. Also, 14.4% which are 44 are masters and remaining 2.3% which are 7 were others. However, the income level of our respondents 50.8% which are 155 has the monthly income of less than 5,000. While 24.3% which 74 has the monthly income between 50,001–10,000 and remaining 10,001–15,000 and over 15,000 were 12.5% each which are 38. In addition, the highest percentage who spent most of the time on internet were 27.2% which are 83 their time limit were more than 5 hours. The second highest percentage was 22% which are 67 who use internet 2 hours/day. While 19.7% which are 60 are those who use internet 3 hours/day. 12.1% respondents which are 37 use internet 4 hours/day. And the remaining 8.2% which are 25 use internet 5 hours/day. Whereas, respondents with highest percentage who use broadband as their connection was 45.6% which are 139. On the other hand, respondents who use TM as their internet connection were 249 which makes it 81.7% and the remaining 56 respondents were mobile internet users [13–18]. Moreover, Table II shows the measurement model results.

The above Table II shows the measurement of this study. In this Table II, scale reliability was calculated through composite reliability and Cronbach's α and all the results of both composite reliabilities were higher than 0.7 for each of our constructs. The minimum and maximum value of Cronbach alpha is 0.63 to 0.86 respectively. According to (Henseler et al., 2009; Koumje, 2018) the most acceptable of composite reliability is higher than or 0.7. But RI and CI have less Cronbach's alpha and that is .601 and .6555 but this is also acceptable according to Nunnally (1978). Both minimum and maximum values in the above Table II are acceptable and are reliable for the research. They suggested that the value of Average Variance Extracted (AVE) value is minimum at 0.5 for validity.

Table II. Measurement model.

	Original sample (O)	Cronbach's Alpha	Composite reliability	Average variance extracted (AVE)
CI_3 ← CI	0.711	0.601	0.817	0.695
CI_4 ← CI	0.94			
CS_1 ← CS	0.836	0.742	0.853	0.66
CS_2 ← CS	0.816			
CS_3 ← CS	0.783			
IQ_1 ← IQ	0.809	0.771	0.867	0.686
IQ_2 ← IQ	0.866			
IQ_3 ← IQ	0.808			
NQ_1 ← NQ	0.777	0.754	0.858	0.668
NQ_2 ← NQ	0.839			
NQ_3 ← NQ	0.834			
RI_1 ← RI	0.91	0.655	0.849	0.738
RI_2 ← RI	0.805			
SI_1 ← SI	0.811	0.72	0.84	0.637
SI_2 ← SI	0.81			
SI_3 ← SI	0.774			
SP_1 ← SP	0.779	0.758	0.86	0.672
SP_2 ← SP	0.841			
SP_3 ← SP	0.838			
SQ_1 ← SQ	0.837	0.712	0.838	0.634
SQ_2 ← SQ	0.788			
SQ_3 ← SQ	0.762			

Table III. Factor loading.

	CI	CS	IQ	NQ	RI	SI	SP	SQ
CI_3	**0.711**							
CI_4	**0.94**							
CS_1		**0.836**						
CS_2		**0.816**						
CS_3		**0.783**						
IQ_1			**0.809**					
IQ_2			**0.866**					
IQ_3			**0.808**					
NQ_1				**0.777**				
NQ_2				**0.839**				
NQ_3				**0.834**				
RI_1					**0.91**			
RI_2					**0.805**			
SI_1						**0.811**		
SI_2						**0.81**		
SI_3						**0.774**		
SP_1							**0.779**	
SP_2							**0.841**	
SP_3							**0.838**	
SQ_1								**0.837**
SQ_2								**0.788**
SQ_3								**0.762**

In the above Table II all the values are above 0.5 which are acceptable for achieving conversion validity.

It is explorative analysis, and it does not need to distinguish between dependent and independent variables. The threshold value for factor loading should be more than 0.7. After running this test the maximum and minimum values are 0.91 and lowest is 0.711. It states that all the values lie above the threshold value of .7 which is acceptable [19–26].

Data reliability has been realized through statistical test of reliability. The questionnaire consisted of 27 items. There were four dependent variables and three independent variables. The reliability test was done through SPSS. Limitations suggested that the value of Cronbach alpha should be more than 0.7. The Cronbach alpha value of our variables was more than 0.7 which is acceptable.

The first variable is independent that is "customer service." It consisted of four items and the Cronbach alpha value of this variable is 0.742. The third independent variable is "information quality" which consists of three items. The Cronbach alpha value for this variable is 0.771. The fourth independent variable is "security and privacy" and this variable consists of three items. The Cronbach alpha value for this variable is 0.758. The first dependent variable is "service quality" which has three items. The Cronbach alpha value of this variable is 0.712. The second dependent variable for this study "complaint intention" which has four items. The Cronbach alpha value for this variable is 0.601. The third dependent variable is "switching intention" which consists of three items. The Cronbach alpha value for this variable is 0.72. The fourth dependent variable is "repurchase intention" which consists of three items. The Cronbach alpha value for this variable is 0.655. Moreover, Table III highlighted factor loadings.

All the bold values mention the highest number of its variable and all variables differences is greater than .1 horizontally. The validity of measurement model examines the indicators of cross loading because all are reflective [27]. The condition of .7 and more than .7 is met on study of loading. HTMT value are shown in Table IV.

The Table IV HTMT shows the correlated criteria that every variables value should be less than .85 (Henseler, Ringle and Sarstedt, 2015). Monotrait is greater than hetrotrait as shown in the result, all variables result is less than .85 which is acceptable according to reference. It include the values of .2 to .7 which is significant. The reason of test is to check the compatibility and reliability of variables.

This Table V shows the correlation matrix between all variables. Bold values shows the square root of average variance extracted (Table V). And all are greater than .5 (Fornell and Larcker, 1981; Ladvánszky, 2018). Bold or highlighted values is more than the values of their column which is significant.

Table IV. HTMT.

	CI	CS	IQ	NQ	RI	SI	SP	SQ
CI								
CS	0.241							
IQ	0.319	0.654						
NQ	0.246	0.684	0.686					
RI	0.24	0.572	0.56	0.495				
SI	0.516	0.279	0.357	0.241	0.404			
SP	0.323	0.718	0.69	0.533	0.501	0.43		
SQ	0.368	0.709	0.647	0.621	0.557	0.268	0.603	

Table V. Fornell and larcker.

	CI	CS	IQ	NQ	RI	SI	SP	SQ
CI	**0.834**							
CS	−0.186	**0.812**						
IQ	−0.24	0.495	**0.828**					
NQ	−0.183	0.514	0.531	**0.817**				
RI	−0.134	0.404	0.406	0.357	**0.859**			
SI	0.343	−0.21	−0.279	−0.188	−0.284	**0.798**		
SP	−0.248	0.54	0.531	0.411	0.368	−0.327	**0.82**	
SQ	−0.272	0.517	0.484	0.46	0.392	−0.206	0.452	**0.796**

3.2. Structural Model

Structural model is based on hypotheses testing [28]. This model analyzes the holistic view of our results and hypothesis. Focusing the relationship between all dependent and independent variables. Analyzing the hypothesis, if we talk about hypothesis 1, it is all about if providers have better service quality, repurchase intention level increases. In H2, service quality played a negative impact on complains intention but its mean it is good because less complaint from customer means we have a better service in terms of quality. According to H3, the better service the less switch intention of customer means having a good quality by internet service provider automatically attract customers. While in H4, Security and the privacy played a key role for the betterment of service quality and study shows the positive impact of S and P on SQ. H5 represents independent variable impact of customer service on dependent variable that is service quality. However, H6 hypothesis represent what level of information provided by ISP. Relevancy level of information provided by ISP automatically relates the satisfactory level of service quality.

It shows how all the independent variables combined and explain the dependent variables of the study. *R*-square. The threshold value of R^2 considered as weak as it is lie on less than .25 (Hair et al., 2013). It is shown in Table VI.

Path-coefficient results are given in Table VII. Every *P* values of this Table VII should be less than 0.05 (Hair et al., 2007). This *O* shows that how much unit change will occur in the dependent variables if independent variables are changed by one unit. CS, IQ, NQ and SP are independent variables in this study. Whereas SQ, CI, RI and SI are dependent variables. One unit change in CS will bring 0.26 unit change in SQ. One unit change in IQ will change SQ by 0.193 unit. SQ will be changed by 0.166 unit if NQ is changed by one unit. One unit change in SP will bring 0.141 unit change in SQ. One unit change in SQ will bring −0.272 change in CI. RI will be changed by 0.392 unit if SQ will be changed by one unit. One unit change in SQ will change SI by −0.206 unit. CS, IQ, NQ, SP and RI are related positively. CI and SI are related negatively with SQ. Customer service is an independent variable; it has a positive impact on service quality. Further, information quality network quality and security and privacy also have positive impact on service quality. Meanwhile, all independent variables have positive impact on SQ. However switching, complaint and repurchase intention is depending on service quality, the result shows that service is good it will automatically effect on complaint and switching intention of customer, and the result of both decreases and repurchase intention increases. It shows that service quality has a negative impact on complaint intention and switching intention because when service quality increases customers tend to complaint and switch less. That is why service quality has a negative impact on complaint intention and switching intention.

Table VI. *R*-square.

	Original sample (O)	*T* statistics (|O/STDEV|)	*P* values
CI	0.074	2.445	0.015
RI	0.153	3.714	0.000
SI	0.043	1.624	0.105
SQ	0.367	7.674	0.000

Table VII. Path-coefficient.

	Path coefficient (O)	*T* statistics (|O/STDEV|)	*P* values
CS ← SQ	0.26	4.944	0.000
IQ ← SQ	0.193	2.541	0.011
NQ ← SQ	0.166	2.587	0.010
SP ← SQ	0.141	2.099	0.036
SQ ← CI	−0.272	4.807	0.000
SQ ← RI	0.392	7.366	0.000
SQ ← SI	−0.206	3.334	0.001

4. CONCLUSION

This research was based on consumer behavior towards service quality of internet service provider. The variables which are used in this research are switching intention, complaint intention, service quality, network quality, customer service, and information quality; repurchase intention and security and privacy. In this 21st century, every transaction is done through internet. People are buying and selling things online. Internet is now vastly used for communication purpose. So having a good internet connection is a blessing these days. People want consistence quality of internet service and when they do not get the services they want, people get dissatisfied and they complain about it. This study was conducted to know the influence of independent variables over dependent variables. This study also assisted in determining the effect of each variable on the other one. The researchers selected 305 people as a participant which included both male and female. Among the participants few were students and few were doing jobs. The maximum age of the participants was 40. The methodology used in this survey was questionnaire survey. The instrument was adapted from the base paper. Face validity and content validity was done on the questionnaire. The questionnaire was validated by two experts

of their fields. The questionnaire consisted many questions related to the variables. The researchers used 5-point liker scale. The reliability was checked by SPSS. Further significance of the questionnaire was done by SEM (Structural equation model).

5. RECOMMENDATION

By evaluating the different dimensions of the study using seven limited variables we will recommend that, providing best services and going straight with the commitment towards customers will directly retain the customer and create positive word of mouth. Creating awareness program or campaign related to internet services will directly catch the people who are not aware of the merits and demerits of internet service provider. Providing hundred percent clear information related to internet service provider will create more interest or target more users. According to hypothesis 1, the service provider should have engaged with their customers in every aspect in order for better service and take feedbacks from their customers, this will increase the interest of their customers and customers will feel satisfy, so that the customer will repurchase it. According to hypothesis 2 the service provider should have better strategy of feedbacks for their customers in order to overcome complains. Furthermore, hypothesis 3 states that the service provider should increase the quality of their internet service and should have engaged with the customers and their feedbacks just to satisfy their customers otherwise the customer will switch the service provider. According to hypothesis 4 which shows that now a day's customer loves their privacy more than anything which is based on internet so the service provider should give a high security and privacy to their customers, because this will satisfy their customers. Furthermore, hypothesis 5 states that if the customers service representative is very much friendly and kind with the customers and act according to them then the customer will be feel satisfy and will be loyal to them. According to hypothesis 6 the internet service provider should provide a quality information to their customers so that it creates a positive impact on customer's mind regarding their service quality.

While analyzing the result of this study, the readers should understand the limitations this study. Of course, every study has its limitations. Similarly, this study was based on internet service provider. It may not be applied on every type of service providers. On the other hand, the finding of this study may not be applicable to generalize to all contexts. Initially we have conducted the survey under Malaysia specifically in Selangor region (Klang Valley to be precise) but we may go for other foreign sources regarding internet services.

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RESEARCH ARTICLE

Job Performance of Malaysian Academic Institutes with the Mediating Role of Entrepreneurial Leadership

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The purpose of this study is to investigate the job performance of Malaysian academic institutions in the presence of managerial competency, self-efficacy and learning orientation with the mediating role of entrepreneurial leadership. This is a quantitative study and random sampling technique was used. 200 sample size was taken from the Universiti Utara Malaysia and Universiti of Technology Malaysia. For the data collection 5-point Likert scale was used and PLS-SEM version 3 was used to analyze the data. Findings of this study showed that managing competency, self-efficacy and learning orientation put a very positive effect on the job performance of Malaysian academic institutes along with the role of entrepreneurial leadership which has also emerged pretty much significant in ensuring the higher level of job performance.

Keywords: Managerial Competency, Self-Efficacy, Learning Orientation, Entrepreneurial Leadership, Job Performance.

1. INTRODUCTION

Any country's economic and social life get supported by the level of innovation and research performance as institutes of higher learning mainly work on innovation and research and enable the human capital to further bring advancement. Explained that country's progress is highly dependable on the level of education, as education play very important role in the development of the idea of the nationalism, it also provides help in economic growth, bring enhancement in ethics and morality, foster workforce preparation and lastly bring radical advancement in science and technology. Within the higher education system, educational institutes have a very important role in the development of high-level specialists, scientists, professionals and researchers, as it is the requirement of the country to be well-informed in favor of national innovation systems. In accordance with the educational marketplace, development in the education has come up as an important goal to be fulfilled [1]. In this situation, the important goal for the most of the governments is to make sure that their universities are evidently providing the advanced scientific knowledge and ensuring the intellectual development. Based on the report of World Development 1998/99, there are four core aspects to guide the nation regarding the changeover to a knowledge-based nation to ensure the dynamic knowledge infrastructure, having systemic national innovation system, provide a strong support from human resource and lastly having the suitable institutional and economic control.

2. PROBLEM STATEMENT

Around the globe, jobs are changing its nature so the academic jobs are. Worldwide academic stress is the emerging concept in all universities. This situation clearly indicates that academic staff no longer enjoy less stressed working environment, as the worldwide competition, rapid changes in technology have dramatically changes the nature of jobs and this situation make the work pretty much demanding that affect the performance of the employees.

In the context of Malaysia, stress level has been observed at higher level in Malaysian public academics due to the rapid changing in the education sector [2]. As the objective of Malaysian research universities (MRUs) (1) is to be known as highly innovative; (2) establish the centers of excellence in the different targeted area of the nations; (3) to generate outclass research outcomes; (4) to create high impact factor research publications; (5) to attract the graduate students in large numbers; (6) to provide a supportive and healthy environment for research discussed Ministry of Higher Education in 2004. Moreover, to boost research and development capabilities of Malaysian universities, the direct plan regarding development and research expenditures has been introduced under the 5th to 10th Malaysia Plan which is shown in Figure 1.

However, besides this Malaysia spend round about RM600 million to boost the level of research capabilities

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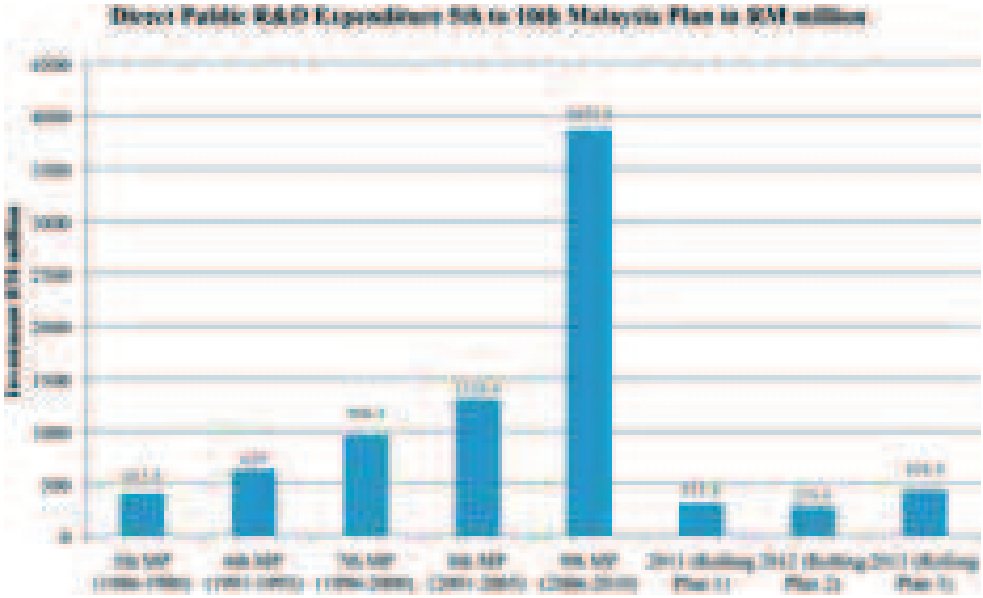

Fig. 1. Direct public R&D expenditure 5th to 10th Malaysia plan in RM million 1986 2013.

of their research universities, but their world ranking is still far behind and need to be improved [2]. Based on this problem our study is aimed to investigate the level of job performance of Malaysian academic staff and how their job performance can be enhanced with the number of positive organizational factors which are managerial competency, self-efficacy, learning orientation and entrepreneurial leadership [3–5].

2.1. Research Objectives

- To determine the relationship of managerial competency with entrepreneurial leadership in the context of Malaysian academic institutes
- To spot the connectivity of self-efficacy with entrepreneurial leadership in the context of Malaysian academic institutes
- To scrutinize the link between learning orientation and job performance in accordance with the Malaysian academic institutes
- To examine the effect of entrepreneurial leadership on job performance in the context of Malaysian academic institutes
- To inspect the impact of managerial competency on job performance in accordance with the Malaysian academic institutes
- To examine the impact of self-efficacy on job performance in the context of Malaysian academic institutes
- To observe the mediating role of entrepreneurial leadership among the relationship between managerial competency and job performance
- To observe the mediating role of entrepreneurial leadership among the relationship between self-efficacy and job performance.

3. LITERATURE REVIEW

3.1. Managerial Competency and Job Performance

Plomp, Tims [6] explained that within the organizational setting there are behavioral constructs that determine the employees' job performance successfully and such variables regard as 'competencies.' Mitchelmore and Rowley [7] further explained that the main concept lies in the competencies is to discover the traits of the individuals that evidently contribute in the success or failure in performance at the job. Number of researchers further confirmed that employees' specific level of competencies predicts the firm high performance in future [8]. Significant important managerial competency models illustrated in the literature suggest that skills of leadership in terms of business skills, interpersonal skills, intra-personal skills and so on plays very critical role in assuring the successful managerial performance [9]. Managerial Competencies (MC) have been employed as the predictor of the performance besides measure for performance. Managerial performance has a tendency to work at both levels, enhance the performance and predict the performance. Bucur [10] also assumed that involvement and prediction concerning the advancement in managerial performance may achieve the greater advantage for the managerial competencies [11–18].

Managerial competencies from the perceptive of human resource management has been identified as a very strategic tool that helps in achieving the strategic aims of the firm (Jermsittiparsert & Sriyakul, 2014). Managerial competencies are the reflection of behavior that is very necessary to obtain the required level of manager's performance, in aligning with proficient firm management, and recognized as an important aspect for competitive advantage and achievement. Skills, knowledge, aptitude and activities are including in managerial competencies, along with

individual competencies which are also important in assuring the high level of management performance [19]. Management competency framework has been developed by to ensure the further development and coaching of university academic staff. This framework of management competency is based on the varied literature review regarding the context of South African tertiary education setting that depicts that in order to perform competencies at better level plays very integral role [20–26].

3.2. Self-Efficacy and Job Performance

Self-efficacy has been observed with performance, and likewise in the field of entrepreneurship quite a lot of studies determined the link of self-efficacy with performance [27]. Leadership as an instrument helps managers to higher their performance expectation level and enhanced self-efficacy which as a result bring the outclass level of performances [28]. In accordance with the work setting number of studies have evidently stated that self-efficacy has an important role in increasing the performance of the employees [28]. Literature clearly explained the role of self-efficacy with the required performance outcomes. Employees with higher level of self-efficacy showed the positive performance and also showed confidence that helps them to achieve another level of excellence in their work performances [29]. Olusola [30] examination's result brought two things. The first thing showed the intrinsic motivation, job satisfaction and self-efficacy forecast the performance of the job of industrial workers, and the second thing was that the level of employees' performance which is highly predicted by these constructs. Conducted a meta-analysis that investigated the researcher's outcomes in relation with the association between self-efficacy, job-related performance of the employees and employee motivation. The end result of this meta-analysis has showed that the self-efficacy and level of employees' performance go hand in hand.

The association of Self-efficacy with performance influence the employees action that they seek and the level of effort they instill to fulfill those action to achieve the greater level performance [31]. Self-efficacy can positively and negatively affect the aims of the employees that they set for themselves. Employees with higher level of self-efficacy tend to become high performer, and with the passage of time they continuously develop themselves and competently perform the job at the best level in comparison with those who possess low level of self-efficacy.

3.3. Learning Orientation and Job Performance

Both active learning and high-order learning are always considered as the predictor of higher performance of the employees [32]. Learning enable the organizations to cope with the highly volatile business environment and to respond proficiently towards the transformation [33]. Earlier studies illustrated that learning orientation significantly affect both gains via firm's performance and innovation [34]. Organizations who quickly develop their learning capabilities in comparison with their competitors are ultimately perform high and successfully sustain their presence in the market [35]. From the perceptive of small and medium enterprises, learning orientation showed the significant and positive association with the financial performance of the firm and also constructively connected with the non-financial performance. In order to increase the productivity level of small and medium enterprises, the enhanced level of learning orientation is connected with sustainable innovation that outperform the competitors with the higher level of performance [36]. Although, researchers started to examine the association of learning orientation with the different measures of performance [37], and such researchers confirmed the positive and significant association among the employees' performance and learning orientation. Empirical outcomes further stated that performance and innovation capability of the firm has greatly and positively affected by the learning orientation. Hughes, Morgan [38] leading the same higher level of performance is the predictor of learning orientation and firms with the high learning orientation perform at higher levels in comparison with those firms who possess decreased level of learning orientation. This is specifically correct mostly in unstable and strong competitive environments [39]. Earlier researches have shown that learning orientation positively affect the both, performance of the firm and the innovation capability of the organization [40, 41].

3.4. Mediating Role of Entrepreneurial Leadership

Entrepreneurial leaders provide encouraging environment to employees, they also indulge the employees in competent activities, stimulate the employees to be creative and innovative, with these things entrepreneurial leaders assure the organizational performance development [42]. Though, there is a certainty lies about the implementation of entrepreneurial leadership to get the increased institutional performance. It is further anticipated that an organizational performance has positively linked with entrepreneurial leadership. One point of view about the organization with proficient growth level might be the implication of its entrepreneurial leadership style [43, 44]. The reason behind the entrepreneurial leader's ability to ensure such type of performances is the requirements of the firms as now a day's firms have to cope with the instable business environment [45]. Consequently, the basic need is to make the followers motivated and ask them to dump the existing conservative and focus on the career-secure practices that benefit both the entrepreneurial and employees' innovative activities (Gupta et al., 2004). Despite the fact that the role of entrepreneurial leadership in ensuring the higher level of organizational performance is the well-studied phenomena, but the unique point is that this leadership also serve in educational institutions and help them to enhance their performance [46, 47].

Additionally, literature on the role of entrepreneurial leadership in boosting the performance level in educational institutes is still negligible Pihie and Bagheri [48], and the current study is focusing on the role of entrepreneurial leadership in fostering creativity, innovativeness, leadership succession, firm's growth and performance [49]. However, explained the mediating role of entrepreneurial leadership in accordance with the competitiveness level of SMEs in the UK and the findings of his study showed that the partial effect of mediation along with the casual relationship among entrepreneurship process and social capital was established. For that reason, entrepreneurial leadership has emerged as a very important type of leadership as educational institutes need to be more entrepreneurial to make the performance outclass and also to develop the capacity for long-term survival and adaptation [45]. Leading the same, entrepreneurship leadership also proved itself as it can act as a mediator in any construct's relationship in the context with the job performance. Additionally, framework of the study is given in Figure 2.

3.5. Research Hypothesis

H1: Positive connectivity has been observed between managerial competency and entrepreneurial leadership
H2: Positive link has been observed between self-efficacy and entrepreneurial leadership
H3: Positive link has been observed between learning orientation and job performance
H4: Positive connectivity has been observed between managerial competency and job performance
H5: Positive association has been observed between self-efficacy and job performance
H6: There is a significant association between entrepreneurial leadership and job performance
H7: Positive mediating role of entrepreneurial leadership has been observed among the association between managerial competency and job performance
H8: Positive mediating role of entrepreneurial leadership has been observed among the association between self-efficacy and job performance

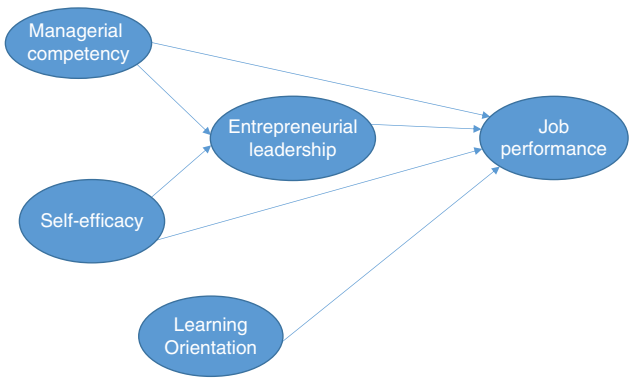

Fig. 2. Framework of the study.

4. RESEARCH METHODOLOGY

Research methodology is an important part of the research study, research methodology usually depends on research objectives and nature of the research. So, by following research objectives and nature of the study quantitative techniques with cross-sectional design was used to achieve these objectives of the study. Data was gathered from Malaysian Academic Institutes Universiti Utara Malaysia and Universiti of Technology Malaysia. Lecturers of these academic institutes were selected as respondents.

In these institutes, permanent Lecturers were taken, since they have the huge responsibility to put the organization in the way of progress. Mundfrom, Shaw [50] stated in their studies about how much sample size should be taken. The argued that "Sample having less than 50 participants will observed to be a weaker sample; sample of 100 size will be weak; 200 will be adequate; sample of 300 will be considered as good; 500 very good whereas 1000 will be excellent." So, in this study 200 sample size were taken Survey scale was applied to collect the response from the permanent Lecturers of these academic institutes. Random sampling technique was used to collect the responses.

Respondents were taken by using random sampling. As the random sampling is appropriate technique in collecting the data. Hence, 200 questionnaires were given to the Lecturers of these academic institutes through random sampling. Response rate were 100% since face to face interaction were made to collect the response. Moreover, 7-point Likert applied to examine the data. The 7-point Likert scale was made since that it made better response rate and also response quality with falling respondents' "frustration level." Furthermore, Smart PLS 3 has been used in analyzing the data. Figure 3 shows the structural model through PLS.

5. DATA ANALYSIS

The data analysis of this current study relied on two parts, measurement model assessment is the first part. Structural model assessment is the second part, in this part hypothesis have been examined. Effect size, R-squared and quality of model has also been measured in this send part. However, the first part Measurement Model Assessment based on factor loading, CR and AVE. As far as factor loading is concerned, its values should be >0.05, so, all the item if they are less than 0.05 must be erased. Mentioned about the alpha value "$\alpha > 0.9$-Excellent, $\alpha < 0.8$-Good, $\alpha < 0.7$-Acceptable." The values of CR should be greater than .07. Table I shows the measurement model results.

Additionally, to get the convergent validity, AVE should be greater than 0.5 which refers to the internal consistency. Figure 2 displays the model of measurement assessment. Table II displays the results. It is obvious that all the values are acceptable range. Factor loading is more than 0.6, Cronbach alpha and CR also more than 0.6. Moreover,

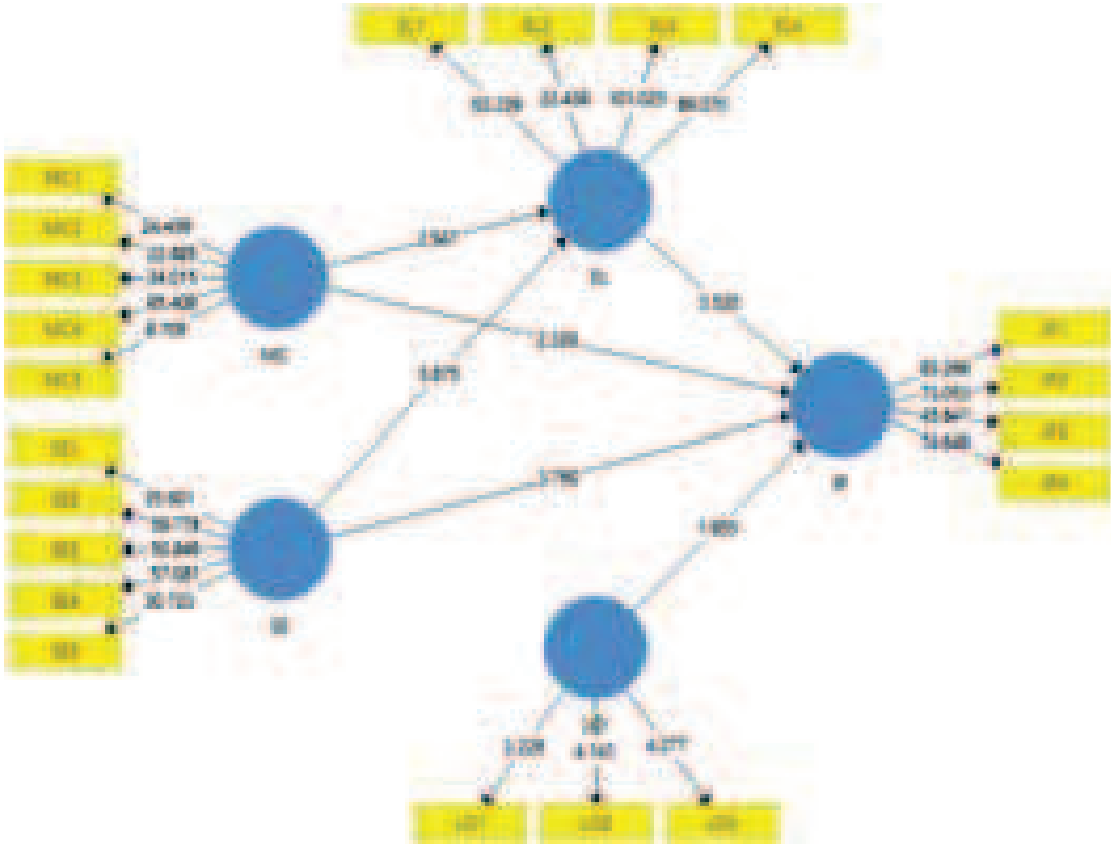

Fig. 3. Structural model.

values of AVE is greater than 0.5 which refers to the CV. Figure 4 shows the measurement model through PLS.

The second part which is for hypothesis testing. This part tests both direct and indirect hypothesis (Mediation). However, first direct hypothesis has been tested which have been exhibited in Table II and indirect effect in Table III. In order to accept or reject these direct hypotheses based on t-value which must be greater than 1.96 to accept the relation. So, in this Table III all the t-value >1.96, its mean all the relations are significant. So, all the hypothesis H1, H2, H3, H4 and H5 have been accepted.

The value of discriminant validity is to be achieved through attaining cross loadings and the square root of AVE. The values of cross loading were measured, but the square root of AVE was measured. The criteria of Square root of average variance extracted (AVE) is shown in Table IV.

Table I. Result of measurement model.

Construct	Cronbach alpha	CR	AVE
EL	0.944	0.96	0.857
JP	0.957	0.969	0.886
LO	0.843	0.892	0.736
MC	0.903	0.928	0.723
SE	0.951	0.962	0.835

Besides, hypothesis testing this part exhibits the variance or difference explained by R^2 in endogenous constructs. In this study, R square of the construct EL is 38.4%, it shows all exogenous construct is likely to describe 67.5% and 67.5% is of JP, it shows all exogenous construct is likely to describe 67.5%. It is shown in Table V.

Quality of model is measured through cross valid redundancy or Q^2. This test could replace to goodness-of-fit. In Table VI which shows that Q^2 value of both EL and JP are greater than zero which shows to achieve a good quality of model.

6. DISCUSSION

Outcome of the current study suggested that the effects of entrepreneurial leader ships on job performance in

Table II. Direct hypothesis.

Relationship	Beta	Sample mean	STDEV	T statistics	P values
EL → JP	0.403	0.407	0.119	3.372	0.001
LO → JP	0.133	0.126	0.067	1.984	0.048
MC → EL	0.276	0.273	0.104	2.644	0.008
MC → JP	0.177	0.179	0.078	2.273	0.023
SE → EL	0.417	0.426	0.105	3.962	0
SE → JP	0.364	0.355	0.105	3.456	0.001

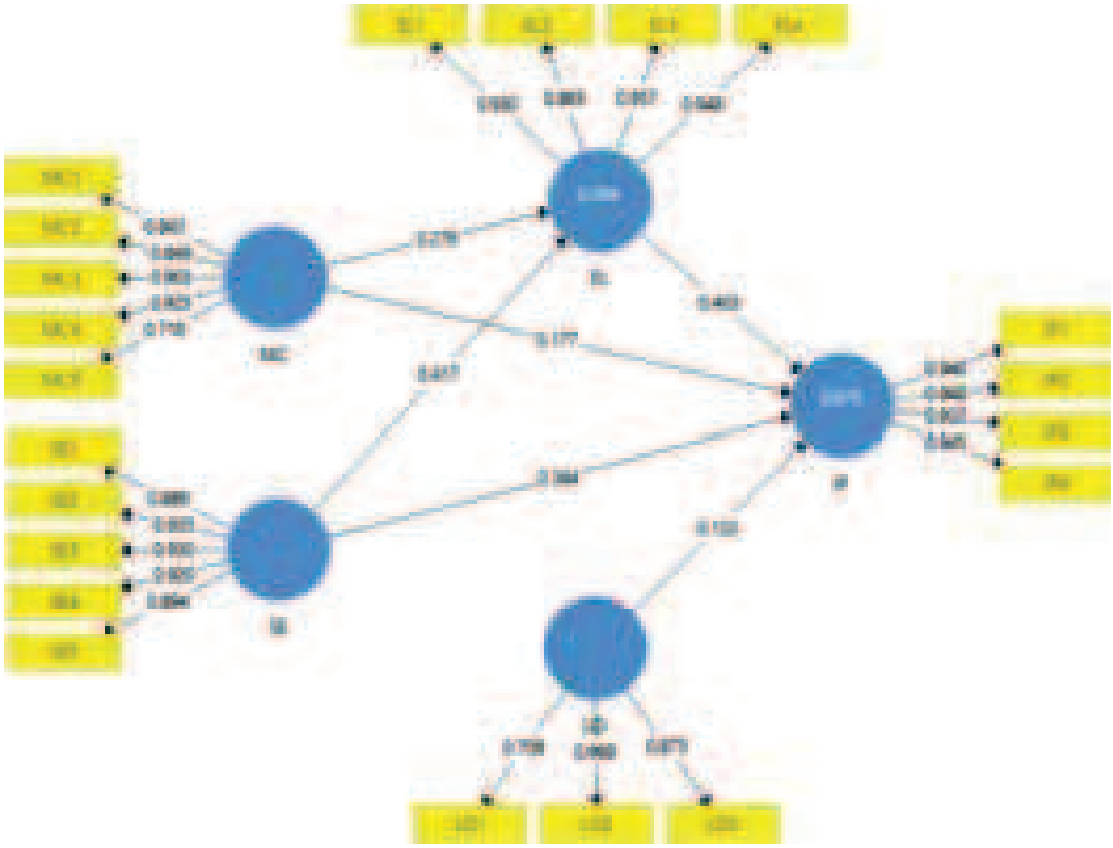

Fig. 4. Measurement model.

the presence of managerial competency, self-efficacy and learning orientation. Statistical analysis exposed that EL and JP, value of t is 3.372 which is >1.96 with beta value is 0.403. So, results favored H1. It shows that EL and JP has positive association. Increasing in EL enhances the JP. Thus, for 1st objective, EL is one of the main contributors to JP. Similarly, LO and JP, value of t is 1.984 which is >1.96 with beta value is 0.133. Thus results favored H2. It shows that LO and JP has positive association. Increase in LO enhances the JP. Thus, for 2nd objective, LO is one of the main contributors to JP.

Similarly, MC and EL, value of t is 2.644 which is >1.96 with beta value is 0.276. Thus, results favored H3. It shows that MC and EL has positive association. Increase in MC enhances the EL. Thus, for 3rd objective, MC is one of the main contributors to EL.

Likewise, MC and JP, value of t is 2.732 which is >1.96 with beta value is 0.147. Thus, results favored H4. It shows that MC and JP has positive association. Increase in MC enhances the JP. Thus, for 4th objective, MC is one of the main contributors to JP.

Similarly, SE and EL, value of t is 3.962 which is >1.96 with beta value is 0.417. Thus, results favored H5. It shows that SE and EL has positive association. Increase in SE enhances the EL. Thus, for 5th objective, SE is one of the main contributors to EL.

Similarly, SE and JP, value of is 3.456 which is >1.96 with beta value is 0.364. Thus, results favored H6. It shows that SE and JP has positive association. Increase in SE enhances the JP. Thus, for 6th objective, SE is one of the main contributors to JP.

Table IV. Discriminant validity.

Construct	EL	JP	LO	MC	SE
EL	0.926				
JP	0.711	0.941			
LO	0.047	0.18	0.858		
MC	0.518	0.631	0.253	0.85	
SE	0.578	0.694	−0.043	0.582	0.914

Table III. Indirect hypothesis.

Relationship	Beta	Sample mean	STDEV	T statistics	P Values
MC → EL → JP	0.111	0.113	0.057	1.935	0.004
SE → EL → JP	0.168	0.175	0.072	2.331	0.02

Table V. R square.

Constructs	R square	R square Adjusted
EL	0.384	0.373
JP	0.675	0.664

Table VI. Construct cross-validated redundancy.

Constructs	SSO	SSE	Q^2
EL	476	335.803	0.295
JP	476	218.245	0.542
LO	357	357	
MC	595	595	
SE	595	595	

Numerical results favored H7, value of t is 1.935 which is >1.96 with beta value is 0.111. In the situation of mediation of EL, the association between MC and JP with value of t is 1.935 which is >1.96 with beta value 0.111. These results favored H7. Therefore, EL mediates the association between MC and JP.

Numerical results favored H8, the value of t is 5.712 which is >1.96 with beta value is 0.209. In the situation of mediation of EL, the association between SE and JP with value of t is 2.331 which is >1.96 with beta value 0.168. These results favored H8. Therefore, EL mediates the association between SE and JP.

7. CONCLUSION OF THE STUDY

The current study has been provided extra suggestion and evidence to the enhancing management of knowledge about the mediating effect of entrepreneurial leadership on the association between self-efficacy, managerial competency and learning orientation and the performance of job in Malaysia academic institutes. Findings of the current study show that in order to enhance the high level of performance in Malaysian Universities, management must ensure the capability of staff by enabling them to complete the task competently. Learning orientation also observed to be positively linked with the enhancement of the job performance. Besides, result of this study also showed that highly self-efficacious are evidently seen with the higher job performance and the role of entrepreneurial leadership has also observed pretty much significant in ensuring the higher level of job performance of Malaysian academic staff through managerial competency and self-efficacy.

8. FUTURE RESEARCH

The limitations which are recognized in the current study made the foundation of future guideline for the next study, the first limitation is to conduct the current study in Malaysia, so next similar study should be conducted in other Asian region or other than educational institutes to valid the results and findings. The second limitation is not to investigate other variables which might enhance the variance measured by the current framework. Furthermore, next study might take into account numerous situation in which performance could be enhanced or less. The third limitation is to conduct a study as a cross sectional due to cost and time reasons. In future, longitudinal work might be made to have deeper analysis and behavior of academic institutions for a long period.

Fourthly, suggestions moderating variables, the next study may examine the likely use of other leadership styles as a mediating variable. Likewise, this study suggests for next studies to examine the conceivable use of behavior factors like openness to experience, extraversion and emotional stability as moderating or mediating variables.

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RESEARCH ARTICLE

Impact of Atmospheric Stimuli on Revisit Intention: Some Evidence on Stimulus-Organism-Response Model: A Case of International Five-Star Hotels in Indonesia

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The prime objective of the current study is to investigate the impact of the atmospheric stimuli on revisit intention. In addition to that, the study has examined the mediating role of perceived image in the relationship between atmospheric stimuli and revisit intention. Finally, the moderating role word of mouth in the relationship between perceived image and revisit intention has been examined. The study has broached the issues related to sensory marketing. Sensory marketing is a new concept which is evolved more in the last two decades. It is part of experiential marketing. Sensory marketing is considered as revolutionary area in the field of marketing in which emotions and perceptions are evoked by the marketers by targeting five senses of human. The expectations can be exceeded by the organization for the customers by targeting more than one sense. When external factors are used to stimulate the human senses, a memorable experience is created, which help in building a positive image in the mind of customers, which later on has an impact on the retention of customers as well. However, the current study has filled this gap. However, this study is among the pioneering studies on this issue Employing the survey-based methodology; the SEM-PLS technique is used to test the hypothesized relationships. So,the current study has used SEM-PLS as a statistical tool to answer the research questions raised in this study and research objectives envisaged in the current stud, and the data is collected from the tourist in Indonesia. The findings of the study have provided support to the theoretical foundation and proposed hypothesis of the current study. The current study will be helpful for policymakers and practitioners in understanding the issues atmospheric stimuli on revisit intention. In author knowledge, this is among very few pioneering studies on this issue.

Keywords: Atmospheric Stimuli, Revisit Intention, Perceived Image, Word of Mouth, Indonesia.

1. INTRODUCTION

Competition is mounting in almost every industry due to globalization. It is very important for organizations to satisfy the customers by using different strategies. By this way, a business can attain a larger market share. One such strategy is to develop such an environment by which organization can attract and retain more customers [1]. The environment in which a customer is getting a service or buying a product plays a significant role to satisfy the customer, build a positive image of the organization and develop the intention to revisit.

In the last few years, sensory marketing has emerged as a tool by which organizations can build a positive image among the customers and develop the intention to revisit. In sensory marketing, organizations can use all or some of the few sensory stimuli to stimulate the senses of customers, namely gustative, tactile. Olfactory, auditory and visual [2]. As marketing is very competitive, so traditional marketing is not relevant any more. Organizations cannot only use visual and auditory sensory stimuli to attract and retain customers for a long period of time. There is a need to give more individualized attention and personal experience to be given by the organizations.

In the current globalization, it is very important for organizations to attract and retain customers for a longer period of time. Retention of the customer is dependent upon the experience which the customer get while getting a service or buying a product. Now a days, customers prefer to have

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a memorable experience while they are buying a product or having a service. On the other hand, it is important to understand the senses of human so consumption process of human can be understood. Human senses play a significant role in the decision making process of a customer.

Sensory marketing is a new concept which is evolved more in the last two decades. It is part of experiential marketing. Sensory marketing is considered as revolutionary area in the field of marketing in which emotions and perceptions are evoked by the marketers by targeting five senses of human. The expectations can be exceeded by the organization for the customers by targeting more than one sense. When external factors are used to stimulate the human senses, a memorable experience is created which help in building a positive image in the mind of customers which later on has an impact on retention of customers as well [3]. Due to sensory marketing, the concept of traditional marketing is totally changed. People like to pick the product from the store on the basis of their experience, which is offered to them during their consumption. A number of organizations are adopting sensory marketing strategies to take a competitive advantage over other organizations. Sensory marketing plays a critical role in developing loyalty and intention to rebuy the product from the same company. Moreover, it plays a critical role in developing a positive brand image as well [4].

In the area of marketing, revisit intention among the customers is the most important topic [5, 6]. Additionally, customers mentioned that when the customers are satisfied, their intention to revisit is increased and they also develop positive word of mouth as well [7]. On the other hand, the scholar mentioned that great experience plays a critical role in developing a positive attitude in the mind of the customer. Moreover, experience also has an impact on positive image development in the mind of customers [8].

As a customer is satisfied when he/she gets the positive evaluation after experiencing the service or consuming the product, thus the experience has a positive impact on developing a positive image and revisit intention among customers regarding the product. Scholars have also mentioned that positive image in the mind of customers also impacts the revisit intention. On the other hand, researchers also argued that emotions would be evoked in case of good experience by the customers which in turn will have the impact on customers intentions as well [9]. In the past, there are very few studies that have focused on revisit intention of the customers impacted by the sensory stimuli which have an impact on the corporate image of the organization as well [10].

Scholars have argued that word of mouth has a very critical and significant role in the success of the organization. Positive word of mouth is generated when customers are satisfied with the experience they get from consuming a product or service. Results from a number of studies have proved that positive word of mouth has a significant relationship with the image of the organisation and revisit intention as well.

The concept of environmental stimuli, also known as atmospherics, was introduced by Kotler [11] in which the scholar explained the impact of sensory stimuli like touch, taste and visual stimuli of intention to re-use. Later Mehrabian and Russell [12] developed the theory known as SOR which explained that environmental stimuli have the reaction in the form of Organism (O) which lead to response (R) as the outcome. The Mehrabian and Russell [12] model were tested in a number of industries like such as hotels, restaurants, casinos, sports stadiums, and events.

Therefore, the purpose of this study is to examine the impact of three sensory stimuli, namely, visual stimuli, touch stimuli and sound stimuli on revisit intention and image. Furthermore, the moderating role of word of mouth on the path of revisit intention and image will be examined as well. This study will be underpinned by the SOR model developed by Mehrabian and Russell [12].

2. LITERATURE REVIEW

2.1. Revisit Intention

Baker and Crompton [13] defined revisit intention as the intention of visitors to visit the location again in the near future and also willing to travel towards the same destination as well. For the same reason, it is important for the service provider to provide required services to the client so the experience can bring satisfaction to him/her [14–21]. Once a person is satisfied with the services of a service provider, he or she will be willing to return to the destination [22]. One of the most important antecedent and factor of revisit intention is the experience of the customer, which give him satisfaction [23]. Customer experience is one of those factors that are critical for a customer to have the intention to revisit the location. Customer satisfaction and the development of positive image regarding product or service providers plays with a significant role in developing repurchase or revisit intention [24–26]. Moreover, positive image is developed along with satisfaction when customer expectations are met by the service provider regarding the needs of customers [27].

2.2. Overall Image and its Relationship with Revisit Intention

The definition of overall image in the eyes of customers is defined as the image in the eyes of the customers regarding the organization on the basis of their experience. The corporate image of an organization is considered as an important function of experience which is based on experience over a period of time [28]. It is also considered as the function of satisfaction or dissatisfaction of the customers. Researchers mentioned that organizations having a high level of positive corporate image influence the satisfaction of consumers. On the other hand, a number of researchers mentioned that experience also influences the

image of the organization, which is based on the quality of services [29–35].

On the other hand, Aydin and Özer [8] argued that the perception of the customers also has an influence on the image of the corporation. The services being provided impact the perception, which has also impact on the corporate image as well. Organizations having a positive image has more likelihood to retain the customers. Researchers also noticed that the corporate image has a strong influence on persuading a customer to develop revisit intention. Thus it is an important factor to develop revisit intention. Moreover, the positive image of the organization helps them to attract and retain more customers and persuade them, especially for revisit intention. So to maintain revisit intention, it is critical to the develop positive image in the perception of customers.

Researchers have also defined the image and the overall perception in the mind of the customers [36] it is recognized as one of the most important factors and antecendant that influence the choice of destination and behaviour regarding a service [37–39]. Additionally, a tourist who develops great experience and develops positive image regarding a destination will have a high intention to visit the place again in the near future. Image regarding the destination will impact the post purchase decision regarding the destination as well. The perceived value and future behaviour intention are also influenced by the image of the destination, which influences the revisit intention among customer. The tourist who has a positive image regarding a product is more likely to visit the destination again. Moreover, it is more likely that traveller will revisit the destination again in future [39].

H1: *Overall Image have a positive impact on the revisit intention*

2.3. Sensory Marketing

In the current era, the field of marketing is advancing with the passage of time. Researchers have mentioned that organizations should focus on giving customers a more memorable experience by using the senses of human known as sensory marketing. On the other hand, Binkert, Beckmann [40] mentioned that products and services should focus on human senses by giving the experience of more than one sense at a time by using senses namely smell, sound, touch, taste and sight.

In Past human senses are ignored by marketers for a long time. In the recent era, the focus of most marketers is using human senses to give customers a memorable experience, which in turn has an impact on consumer behaviour. All these five senses are a big gift to a human being, and by using more than one sense, organizations can give a memorable experience to the customers. The sensory marketing has an impact on the consumption process and future decision making process regarding a product.

As mentioned by Krishna [41], human perception is impacted through the senses of human, which later impact consumer decision making. The researcher also noted that sensory marketing could be used by the organizations to trigger the senses of human unconsciously. Organizations can also use sensory marketing in the form of shape, smell, taste or color to influence the perceived quality on the attributes of the products. These stimuli's plays a critical role in cognitive process and development of positive brand experience. Humans senses play a critical role in the development of positive image in the mind of customers and help the customers to make a decision regarding the product.

Researchers state that memories based on the senses of human have a strong influence on the relationship between consumer and brands [42]. As mentioned by Krishna [41], human senses are involved in the evaluation of a product or service, which in turn has an impact on the perception and emotions of customers. These perceptions and emotions impact the behaviour of the customer. To impact the customer's senses, organizations use stimuli which impact the perception of the customer regarding the product features or organization. The perceived quality of the product is also influenced by the stimuli like shape, smell, taste and colours [41]. These perceptions play a critical role in shaping the perception of customers as they are based on the experience of the customers, which is evaluated by the customers. Therefore, the main objective of sensory marketing is to strengthen the relationship of customer and organization by adopting those strategies that aim to target human senses. These sensory marketing strategies impact the buying process and decision making process as well. So, it is important that marketers use combination of more than one sensory stimuli for their marketing strategies

2.4. Touch Stimuli in Sensory Marketing

Touch is the largest sensory organ of human. Customer can contact physically with the product through the skin. More than 25% share is of touch sense in the process of brand building. The attitude, behaviour and evaluation of the product are positively impacted by touching the product by the customer. Researchers also suggest that customers are encouraged to use the electronic equipment's when they touch their screens. It is important to understand that the eye cannot alone judge and evaluate the product alone [43]. All the things that a customer touch like weight, temperature and material positively evaluate the product or service [43, 44].

The attention of the customers is influenced by the auditory and visual stimuli which force the customer to touch the product. As a result, the behaviour of the customer is impacted if the evaluation of the product is positive. Thus,the customer gets closer to the services or products if he or she is able to touch it [43].

2.5. Taste in Sensory Marketing

Scholars have mentioned that more than 31% of the brand building of the products is through the flavours of the

product. As the market is very competitive and there exists immense competition, therefore it is important for the organizations to provide good taste which influences with the behaviour and intentions of the customers. Companies should use palate in an effective way to persuade customers to use the product or service. The way food is served to the customers, and their taste plays a significant role in product evaluation [45]. Marketing experts can attract the customers towards the product through its taste. The sales of the food business have increased by focusing on this strategy.

Researchers concluded in their study that by adopting sensory marketing, organizations could achieve loyalty among customers by providing a great experience. It is because the point of difference is created by the customers in terms of quality of services by providing unique colour selection, odor, smell, pleasant smell, good sound and music and surprising taste. By this way, organizations can provide unique value to the customers through memorable experience which customer can recall and do not consider price when the customer has to reuse the services or product again [46].

2.6. Visual in Sensory Marketing

The researcher mentioned that shapes, size, brightness and colors are the visual dimensions of the product and services; these visuals dimensions impact the intention to use the product. A color like blue is considered cool that plays a significant role in evoking emotions among the customers. Due to emotions and positive evaluations, the customer is willing to pay more to use the product. Additionally, arousal and pleasure are correlated with the environment of the customer [12]; resultantly customers are attracted to use the product. Behavior and emotions of the customers are also impacted by design, decore and color of the product [2, 47]. Physical environment like wall decore, layout, furnishing, signage, color and light can be controlled by organization to effect the behaviour of the customer.

3. Sensory Marketing (Visual, Taste & Touch) and Revisit Intention

Mehrabian and Russell [12] in their SOR model, mentioned that environmental stimuli create a response which can be approach or avoidance outcome. The approach behaviour shows the positive outcome of the environmental stimuli, whereas avoidance is the negative outcome. The environmental stimuli which plays important role in developing positive outcome are soft fabrics, bright light, fresh scent, good taste which will in turn develop the recommending the experience (Sherman et al., 1997), Desire to stay more, revisit intention [2], spending more money and time, consumer willingness to buy. Behavioural intention to re-use or revisit a destination is the strong predictor for the behaviour of customer. Based on the above discussion, we hypothesis that

Based on the Above Discussion, and Figure 1 we can hypothesize that

H1: Visual Stimuli have a positive impact on behavioural intention of consumers

H2: Taste Stimuli have a positive impact on behavioural intention of consumers

H3: Touch stimuli have a positive impact on behavioural Intention of consumer

3.1. Sensory Marketing (Visual, Taste & Touch) and Image

Empirical study was conducted by the scholar to examine the impact of sensory marketing on brand image of restaurants. Scholars found that visual, taste and touch stimuli are more significantly related to the image of the restaurants as compared to other two sensory stimuli, namely sound and smell. Based on this discussion, we can hypothesize that:

H4: Visual Stimuli have a positive impact on Image

H5: Taste Stimuli have a positive impact on Image

H6: Touch stimuli have a positive impact on Image

H7: Overall image positively mediate the relationship of visual stimuli and Revisit intention

H8: Overall image positively mediate the relationship of taste stimuli and Revisit intention

H9: Overall Image positively mediate the relationship of touch stimuli and Revisit intention

3.2. Word of Mouth, Revisit Intention and Image

Word of mouth is the sharing of information among the potential customers of a product or service regarding features of product or service. The purchase decision of customers is significantly impacted by the positive word of mouth. Past literature has not given much attention as negative word of mouth is not much studied in relation to image and post purchase decision. Positive post purchase

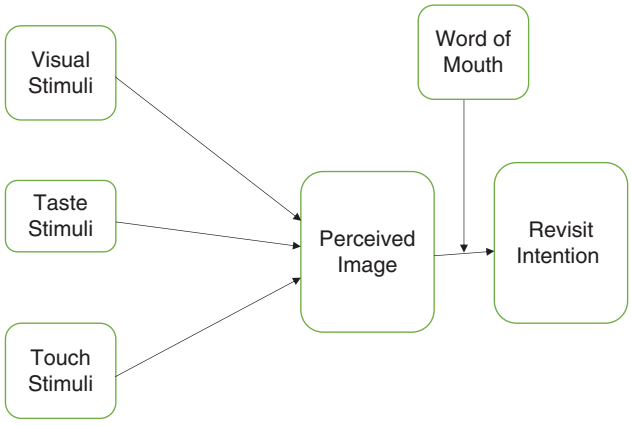

Fig. 1. Research framework.

decision of customer is based on the customer's experience which they get through the consumption process [48].

H10: Word of mouth positively impact the Image

H11: Word of mouth positively impact the revisit intention

H12: Word of mouth moderate the relationship of the overall image and revisit intention

H13: Overall image positively impact the revisit Intention.

4. METHODOLOGY

The study has employed the survey-based methodology. For research analysis, the research has made use of SEM Approach, which refers to Structural Equation Modelling. This approach is now to be effective as the approach of simple and multiple regression analysis in which the variables assessed without errors. Factor analysis and multiple regressions are involved in SEM and it has greater effectiveness in estimation of variables concurrently. In this research, cluster-sampling technique was used for collection of data. Presented five-technique approach through which sample size can be calculated. This technique has been implied for the calculation of this research. The total population for the study has been estimated after which the sample size is calculated using the table presented by Krejcie and Morgan [49]. For this study, the size of population came out to be 312. The response rate is 63 percent. The scale of image, revisiting purchase intension and word of mouth is adopted from Durna, Dedeoglu [50], of taste and touch from Wiedmann and Lenzen [51]. Also, the scale of visual is adopted from Ref. [52].

5. RESULTS

SEM approach is greatly employed in social science studies because of its ability to estimate multiple relations simultaneously. Much emphasis has been given on approach based on co-variance and AMOS by the researchers in previous years. However, a good substitute is PLS-SEM because of its unique estimation features and methodology. There are several reasons for optioning SEM in this research. The first and foremost reason is its effectiveness in resolving the research problems that cannot be tackled by multiple regressions. PLS approach is considered useful when prediction is required by structural modeling for the constructs. In this research, PLS-SEM has been used because of its flexibility for sample size and its ability to estimate multiple relations simultaneously.

Formative and reflective constructs are involved in model. The aim of the study is to make prediction among the variables. The use of PLS method has been supported by because of the use of measurement and structural model in it.

The relation between the observed and unobserved variables is shown by the measurement model. It is highlighted in Figure 2. Variations occur in all the model items while the measurement model is estimated. It is expected that there is a strong relation among the variables and are put together to develop a construct.

The validity of measurement model is also important, which reflects the representation of constructs by the observed variables. Therefore, strong correlation is expected to exist between variables and is combined to form a construct. For this, CFA analysis is done. In this analysis, the constructs having first and second order are measured. Separate analysis has been done for all the elements using formative, reflective, and structural modelling during the process of estimation. Factor loadings are given in Table I.

Four distinct methods to be used in research for estimation of reliability. These include test retest, coefficient of Cronbach's alpha, split half and alternative form. Test retest, split half and alternative method is not sufficient for the reliability estimation rather they given weak estimation. Low score value are estimate due to changes in subject and higher expenses are involved in these tests. The division of items generates the coefficient of reliability. Therefore, these methods have not been adopted in this research study. The method selected in this research is Cronbach's alpha, which is employed to check the reliability. The weaknesses of the other three methods are overcome in this approach. The use of this method is extensive in the social science research studies.

For measuring the reliability, the study has chosen Cronbach's alpha coefficient. The level of measuring the proposed item to be intended is referred as the validity of content. For items, a detailed literature review has been studied. Factor analysis has been used to load the items to their constructs in a correct way. In Table II, the measures of content validity have been shown. It is reflected that item loadings has been done in a significant manner to the related constructs. It is evident through Table II that the content is valid. The degree of convergence by a set of variables in the estimation of a particular concept is referred as convergent validity. Composite reliability, convergent validity, and AVE can be developed through use of simultaneous tests of factor loadings.

According to the criterion of criterion, a power estimation that is adopted widely is of discriminant validity. The degree of relation among the reflective variables and constructs is estimated in discriminant validity. The variables included in the research model are operationalized through discriminant validity. The estimation of discriminant validity is based on this aspect. It is expected that the reliability value index is 0.70 or greater than this. Therefore, the value of cross-loadings and outer-loadings are same. The correlation is assessed by the cross loadings among the constructs. This research study has found the discriminant validity between the constructs and variables as presented in the Table III.

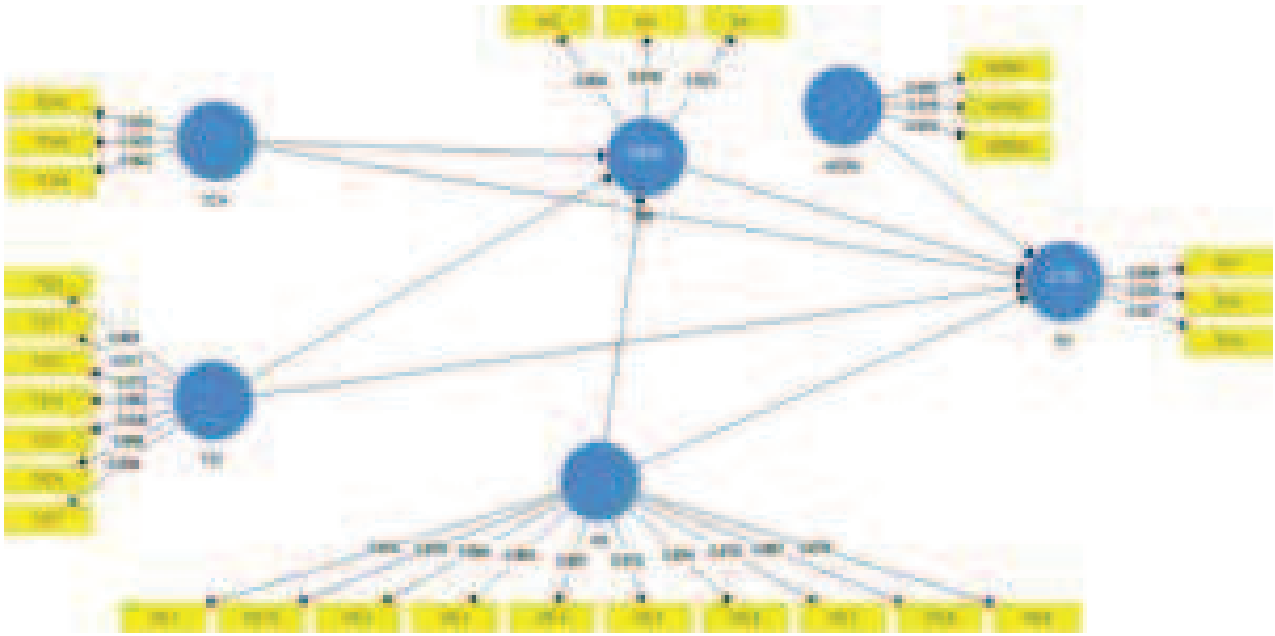

Fig. 2. Measurement model.

After the estimation of reliability and validity, the next step is to measure the structured relation among the variables. The relations can be measured simultaneously using the SEM-PLS method among the variables constructed in contrast to other approaches. The direct and indirect variable effects are analyzed in the structural model. The following is the structural model of the study. Structural model is shown in Figure 3.

The level of significance for *p*-value is below 0.05. The *p*-value is less than 0.05 for all the hypotheses. This reflects that the hypotheses are accepted while no hypothesize is rejected. The mediating influence on the association of agile supply chain and external performance of supply chain by customer responsive has been shown in Table IV. It is indicated by the moderation results that the values of t and p are significant for both hypotheses. The t-test is greater than 2.62 and *p*-value is lesser than 0.05, which

Table I. Outer loadings.

	IM	RV	TCH	**TST**	**VIS**	**WOM**
IM2	0.904					
IM3	0.916					
RVI1		0.906				
RVI3		0.934				
RVI4		0.927				
TCH2			0.954			
TCH3			0.920			
TCH4			0.942			
TS22				0.905		
TST1				0.911		
TST3				0.872		
TST4				0.883		
TST5				0.826		
TST6				0.868		
TST7				0.854		
VIS 1					0.910	
VIS 10					0.879	
VIS 2					0.844	
VIS 3					0.904	
VIS 4					0.891	
VIS 5					0.910	
VIS 6					0.854	
VIS 7					0.819	
VIS 8					0.867	
VIS 9					0.879	
WOM1						0.950
WOM2						0.919
WOM3						0.924
IM1	0.925					

Table II. Reliability analysis.

	Cronbach's Alpha	rho_A	CR	(AVE)
IM	0.902	0.903	0.939	0.837
RV	0.912	0.913	0.945	0.851
TCH	0.932	0.933	0.957	0.881
TST	0.949	0.950	0.958	0.765
VIS	0.966	0.967	0.971	0.767
WOM	0.923	0.924	0.951	0.867

Table III. Discriminant validity.

	IM	RV	TCH	TST	VIS	WOM
IM	**0.915*****					
RV	0.531	**0.922*****				
TCH	0.657	0.625	**0.939*****			
TST	0.661	0.616	0.918	**0.875*****		
VIS	0.895	0.580	0.735	0.691	**0.876*****	
WOM	0.646	0.851	0.705	0.680	0.716	**0.931*****

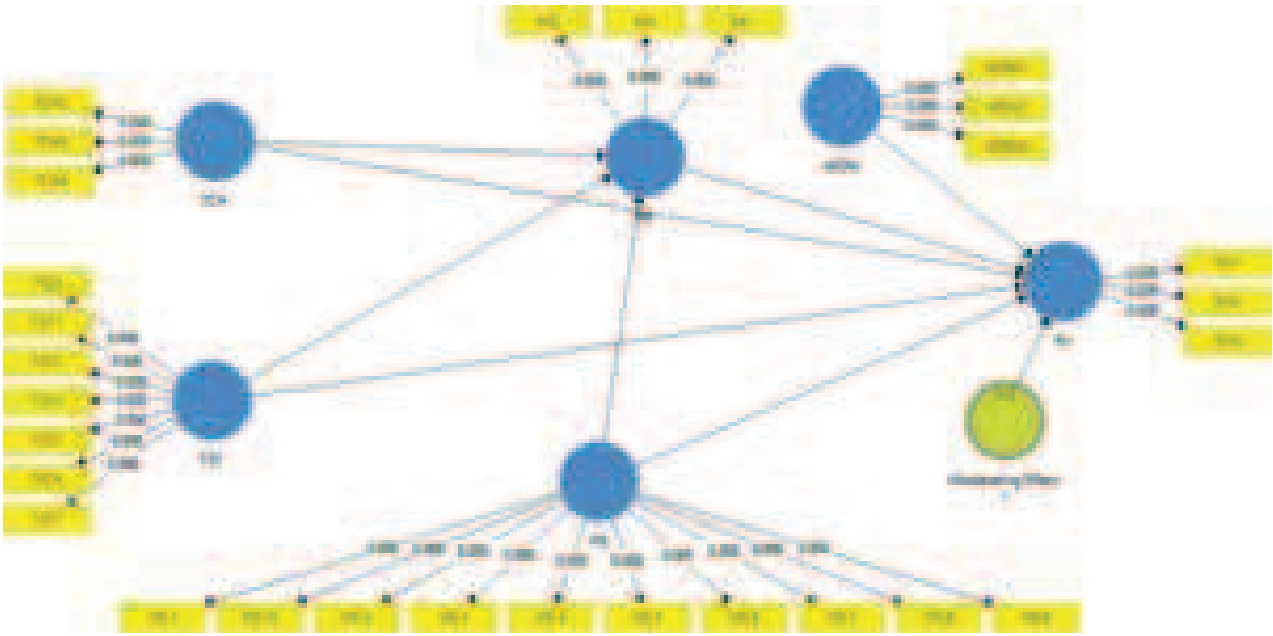

Fig. 3. Structural model.

lead to the acceptance of all the hypothesis. Mediation effect is given in Table V.

The level of moderation is measured to analyze the direct influence of variable on the mediating variable. Moreover, bootstrap method has been used to assess the relationship significance. A sample of 1000 observations has been used for bootstrap analysis. Moderation results are given in Table VI.

R2 is the coefficient of determination that explains the amount of variation in the dependent variable through the exogenous variables. The value lies in the range of 0–1. When it is closer to 0, this means the coefficients are insignificant and when the value is closer to 1, it means the variables are significant. When the value is 0.75, it reflects substantial predictive power and it is moderate when the value is 0.50. However, the predictive power is weak when it is 0.25. The in this research, the R^2values are 0.814 and 0.732 that reflects 81.4 and 73.2 percent of the variation, as shown in Table VII.

Table IV. Direct relations.

	(O)	(M)	(STDEV)	T Statistics	P Values
IM→RV	0.055	0.061	0.100	4.550	**0.000**
TCH→IM	−0.248	−0.247	0.095	4.601	**0.009**
TCH→RV	−0.041	−0.042	0.100	5.406	**0.000**
TST→IM	0.275	0.279	0.095	4.907	**0.004**
TST→RV	0.158	0.163	0.104	5.525	**0.000**
VIS→IM	0.888	0.883	0.046	4.363	**0.000**
VIS→RV	−0.081	−0.084	0.058	4.384	**0.000**
WOM→RV	0.848	0.847	0.068	5.444	**0.000**

Table V. Indirect results (mediation).

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
TCH→IM→RV	−0.014	−0.014	0.026	4.532	**0.000**
TST→IM→RV	0.015	0.018	0.029	4.510	**0.000**
VIS→IM→RV	0.049	0.053	0.088	4.554	**0.000**

Table VI. Indirect results (moderation).

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
Moderating Effect 1→RV	0.058	0.060	0.055	5.051	**0.000**

Table VII. R-Square.

	R Square
IM	0.814
RV	0.732

6. CONCLUSION

Authors of the study have argued that word of mouth has a very critical and significant role in the success of organization. Positive word of mouth is generated when customers are satisfied with the experience, they get from the consuming a product or service. Results from a number of studies have proved that positive word of mouth has significant relationship with image of organisation and revisit intention as well. The purpose of this study is to examine the impact of three sensory stimuli namely, visual stimuli, touch stimuli and sound stimuli on revisit intention and image. Furthermore, moderating role of word

of mouth on the path of revisit intention and image will be examined as well. This study will be underpinned by the SOR model developed by Mehrabian and Russel. The main objective of the current study is to investigate the impact of the atmospheric stimuli on revisit intention. In addition to that the study has examine the mediating role of perceived image in the relationship between atmospheric stimuli and revisit intention. Finally, the moderating role word of mouth in the relationship between perceived image and revisit intention has been examined. The study has broached the issues related to sensory marketing. Sensory marketing is a new concept which is evolved more in last two decades. It is part of experiential marketing. Sensory marketing is considered as revolutionary area in the field of marketing in which emotions and perceptions are evoked by the marketers by targeting five senses of human. The expectations can be exceeded by the organization for the customers by targeting more than one sense. When external factors are used to stimulate the human senses, a memorable experience is created which help in building positive image in the mind of customers which later on has impact on retention of customers as well. However, the current study has filled this gap. However, this study is among the pioneering studies on this issue Employing the survey-based methodology, the SEM-PLS technique is used to test the hypothesized relationships. So, current study has used SEM-PLS as statistical tool to answer the research questions raised in this study and research objectives envisaged in the current study. The findings of the study have provided support to the theoretical foundation and proposed hypothesis of the current study. Current study will be helpful for policymakers and practitioners in understanding the issues atmospheric stimuli on revisit intention. In author knowledge this is among very few pioneering studies on this issue. According to the findings stimuli's plays a critical role in cognitive process and development of positive brand experience. Humans senses plays a critical role in development of positive image in the mind of customers and help the customers to make decision regarding the product. Researchers states that memories based on the senses of human has strong influence on the relationship of consumer and brands.

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The Effect of Shopping Mall Image on Consumer Behavior in Indonesia

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This study investigates the effect of shopping mall image on customer behavior in Indonesia. We hypothesized that shopping mall image strongly effect consumer behavior, to be specific, the probability of buying, coming back to the shopping mall and spreading positive word of mouth WOM. Be that as it may, congruity-reflected by 'self-image congruity' and 'social-image congruity'—had no impact on. We ascribe this unforeseen finding to Indonesians scoring low on Hofstede's components of Individualism and Indulgence. The survey conducted showed that there was high self-image congruity among consumers just as congruity with different customers, however most of them were reluctant to let it be known influences their shopping conduct-seemingly, that would act as self-indulgent and show an absence of restriction with deference to controlling their wants.

Keywords: Shopping Mall Image, Consumer Behavior, Congruity, Indonesia.

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1. INTRODUCTION

The retail organizations which are build up in numerous nations and societies around the world, are known as Shopping centres (SC), or essentially malls [1]. It is indicated by the International Council of Shopping Centres [2] that there are around 127 thousand SCs which are presently operating in 40 countries around the globe. In the second quarter of twentieth century, SCs were introduced as an effective answer to help urban communities' development towards the suburbs, labeled as a commercial centre overseen as a solitary property, 'made in the U.S.A.' In the mid of 1960s, when the SC idea was presented in Europe, at the point, two barriers were faced by them that did not have any existence in USA at the time. The constrains in urban planning limitations inflicted by government and establishments was the first restriction, and therefore the development of the out-of-town shopping (malls) has been impeded by arranging confinements. The already well-established and traditional shopping streets also posed itself as a second challenge [3]. Later on, SCs were bit by bit set up in rising nations, during the late 1990s, where shopping avenues offered solid challenge, and social and cultural contrasts demonstrated to be a test to SC designers.

The concept of store image reflects a consumers' view about the practical functions and psychological characteristics of the store. The tangible aspects which are observable are the functional characteristics which may include stock arrangement, quality and value, deals and post-deals administrations, physical offices-, for example, climate security, accommodation of area and facility of parking. The intangible aspects which are not that directly observable are the psychological characteristics that may include store atmospherics and the picture of the general population that disparage the store [3]. Thus, the consumers' view of both tangible and intangible characteristics of shopping mall is reflected in the concept known as mall image that are normally found in retail stores, for example, the shopping centres.

Serious competition among shopping centres has intimated shopping centre supervisors to make separation between their shopping centre and that of close-by contenders. They begin to do this via cautiously understanding what their objective purchasers' fairly estimated valuations are, thus, what drives their shopping conduct. More than 40 years prior it was perceived that clients at retail store look for something other than utilitarian benefits, for example, cost and comfort. Kesari [4] remarked: Shopping malls have tried to gain loyalty of shoppers by appealing to their social motives as well as providing

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access to desired goods. Malls are becoming giant entertainment centre.

A failure to recognize factors by the management that at last influence shopping practices that could prompt in making a mall image that isn't harmonious with the consumers' self-idea. One technique to make an ideal shopping mall image is by overseeing characteristics inalienable to the shopping centre. Malik and Hanafi (2018) recommend these traits incorporate marketing, openness, administration, atmospherics, amusement, sustenance, and security. These traits are controllable and can serve to fulfill utilitarian needs; yet Malik and Hanafi (2018) recommend clients look to fulfill non-practical needs as well, which originate from affiliations one has with the shopping centre.

Lu and Xu [26] defined Self-image congruency as the match between a shopper's self-idea and their picture of a given shopping centre. Their investigation included looking over vehicle proprietors, and they found that the more noteworthy the mental self-image congruency, the more prominent was the devotion towards the brand. A similar thinking can be connected to why a client chooses to visit and shop at a specific shopping centre. Here, we investigate the relationship between the shopping mall image and the consumer behavior in the setting which is a top of the line shopping centre in Indonesia.

The second largest city of Indonesia is Surabaya and as indicated by the Association of Shopping Mall Management in Indonesia, it has around 33 shopping centres more or less, extending from low value quality level shopping centres to premium, rich shopping centres. Normally, this calls for serious competition, and mall managers are reacting by seeking after strategies of differentiation. The management objective of one of the new shopping centres in Surabaya, Indonesia, which was set up in 2011, was to build up a rich shopping mall image via cautiously thinking about the shopping centre's structure, the choice of retailers just as offering outstanding hospitality all under one rooftop, where shoppers can express their cutting edge way of life. In any case, there are unanswered inquiries regarding the viability of the picked methodology on customers' practices. Consequently, the aim here is to give understanding into how view of the shopping centre (its image and how consistent it is with one's self-idea) influences purchaser's shopping practices, specifically the probability of obtaining, coming back to the shopping centre, and escalating constructive word of mouth (WOM).

2. LITERATURE REVIEW AND HYPOTHESES

The constructions of various shopping malls have been witnessed in Indonesia in recent years, with a rough number of almost around 200 malls from an unofficial source. Among these, some of the malls possess a national image whereas some of them have been constructed keeping in mind the necessity of specific zones of a city. Shopping centres considerably affect the customers' way of life [4], in light of the fact that they are seen as a spot for exchange as well as viewed as social and networking centres [5]. For sure, construction of the enormous number of shopping centres with their specialized and non-specialized characters, for example, huge and little stores, cinemas, carnivals, drive-thru eateries, social gatherings, bistros, etc., appears for their role in an individuals' way of life. Then again, the customers' value and process of decision-making changes with the capacity to give information, which is easily accessible and the options to purchase online. These occasions place customers in a prevalent position and make them progressively inaccessible. Consequently, considering the enormous number of shopping centres and developing web based shopping mall, one of the essential objectives of administrators in this competitive market is keeping up their present customers or drawing in new customers. In a competitive market, it is very crucial to keep up the market share with loyal consumers.

The beginning position taken thus is that there is a connection between the shopping mall image, which is the latent construct and consumer behavior. However, what are the indicator variables that are positively correlated and observable that would serve to reflect the latent construct which is shopping mall image? recommended that there are characteristics of a shopping centre that assume a huge role in forming the image of the shopping centre; be that as it may, there is not any particular set of properties on which researchers have settled upon. The point of view given by Rahman et al. (2016) that there are seven shopping centre traits will be taken here. These items inherently link up to the basis of being inter-linked which is in-line with reflective measurement models; they share a common subject matter, and subsequently including or laying off one of the variables would not change the significance or theoretical area of the latent construct shopping mall image. A favorable position of grasping is that, it gives granularity without being overpowering from an exact sense, and every one of the traits are characteristic for the shopping centre and controllable by the authorities. We recognize that components influencing the consumer encounter, for example, the presence of crowds or the perceived crowd which influence customer satisfaction can be eliminated.

Taking help from Malik and Hanafi (2018), seven indicator variables will be taken here for the study. The variables are as under:

Merchandising, which alludes to the items that are sold at the shopping centre, Ayadi [6] express that merchandising consist of variety of product such as quality, valuing, and design or style. Rahman et al. (2016) remarked that a few shopping centres are so centreed around getting to be spots of diversion "almost to the point that their traditional retail occupants seem like an afterthought."

Accessibility is the ease with which the consumers get in, enter and move about inside the shopping centre. There are two parts of accessibility as per, macro accessibility and micro accessibility. Macro accessibility incorporates street conditions, street patterns, regular and counterfeit obstructions, and separation from home or office. Micro accessibility incorporates limit of parking, blockage, and the simplicity of perusing and finding stores inside a shopping centre. The location of shopping centre and its distance from the purchasers are the most important criteria for customers. A shopping centre which is promptly open to customers is probably going to be assessed progressively positive. This idea is examined by different analysts under a similar title or under different titles, similar for convenience [7].

Services, according to Malik and Hanafi (2018) have three types which are personal service, amenities service and communal service.

Atmospherics incorporates the configuration, fragrance, music, lighting, and so forth, factors that make full of quality that has effect. All in all, these all collectively are responsible for the ambiance inside the shopping centre. As far as positivism paradigm is concerned in view of atmospherics, which converge on the stimulus-organism-response (S-O-R) approach [5] in three different ways, may get reaction from a customer: excitement, predominance, and charm. As indicated by this methodology, the stimulus (S) is the atmosphere, influencing shopper intrinsic reactions (organism) and bringing about the social reaction (R). Notwithstanding the different components of the inner atmosphere of a retailer, for example, music and colors influence customers' view of a store. In fact, the atmosphere of the mall can be ordered in three interior components: social classes (for example, representative nearness, kind of consumer and closeness), physical classifications (for example lighting, format, and structure), and surrounding highlights, (for example, smell and music). The atmosphere of the mall likewise impacts different parts of mall image, for instance, impression of physical properties by customers altogether influences item quality, cost, and administration quality.

Entertainment facilities inside the mall consist of two dominant categories i.e., permanent entertainment which includes movie theatres, stations for karaoke and beauty and spa centres; and the second category consist of occasional entertainment which includes different types of exhibitions, fashion shows and seasonal displays [8–16].

Food or food stalls inside shopping centres urge consumers to remain longer and seem to animate motivation of impulse purchasing [17].

Security, which refers to the safety of customers inside the shopping mall as well as when they are entering and leaving the mall.

El Hedhli et al. [7] opine that when consumers have positive view of a store's characters, it expands customers' repurchase expectations just as their shopping recurrence at the store. In addition, Malik and Hanafi (2018) expressed that positive assessments of store characteristics builds consumer loyalty and consumer satisfaction. Consumer loyalty refers to consumers deliberately continuing associating with or acquiring certain items over the long period of time [18–24]. There is a contrast between present long period and short period consumer loyalty.

The short period loyal consumers may show dedication yet switch effectively when they discover other better alternatives; whereas on account of long period loyalty, the client will remain steadfast despite the fact that there might be possibly better alternatives accessible [25]. Faithful clients display standard purchasing conduct over a given timeframe. We can refer here loyalty as customers' aims to consistently visit and shop at shopping centre in Surabaya despite the fact that there are other top of the line shopping centres in Surabaya. Keeping in mind these insights, the following hypotheses can be given forward:

H1: Shopping mall image significantly effects consumer behavior; where shopping mall image, a latent construct is reflected by shopping mall attributes and the likelihood of buying, again visiting the shopping centre and escalating the positive WOM reflects consumer behavior.

The shopping malls that have congruent image with the customers' self-idea are tended to be more visited by and shopped at by the customers, which stems from the conviction one holds about themselves just as from the reactions (suppositions, decisions) by others when associating with them. Oyserman et al. (2017) recommends that self-idea is the person's point of view about his/her life that grows naturally through communications with others. Lu and Xu [26] characterize mental self-image congruency as "the match between consumers' self-concept (actual self, ideal self, etc.) and the user image (or 'personality') of the given product, brand, store, etc. In this manner, when a consumer buys an item or become a frequent visitor of a store, especially one of a hedonic sort which is probably going to be very much present at an upscale shopping centre, all things considered, one of the inspirations fulfilled can be understood through a symbolic interactionism perspective which emphasizes the importance of products in setting the stage for the multitude of social roles that people play. Shopping represents a social act where symbolic meanings, social codes, relationships, and the consumer's identity and self may be produced and reproduced [27]. At the point when items are congruent with their self-idea, then they become faithful to those items. Shopping centre directors should subsequently try to comprehend their objective market's self-idea and equipped with that information make a shopping centre image that is consistent with it. Self-image congruency will expand customers' dedication. The following hypotheses can be put forward:

H2: Congruity significantly effects consumer behavior; where congruity is reflected by self-image congruity and congruity with other consumers and the

likelihood of buying, again visiting the shopping centre and escalating the positive WOM reflects consumer behavior.

3. METHODOLOGY

A mall intercept survey was used to conduct this research study. A total of 200 respondents filled the survey at one of the well-renowned shopping mall in Surabaya, Indonesia. The survey consists of two sections. The first section consists of demographic information of the respondents which include age, gender, and education, occupation and monthly income; whereas the second section consists of the items that were reflective of the indicator variable which is discussed below.

The three latent constructs were reflected by collecting twelve measures.

Shopping mall image (referred to now as 'shopping') is the first construct. It comprised of the perceptions of the customers of the seven below described indicator variables:

- Merchandising (SMA1) which is the quality and the product arrangement which is sold by different stores in a shopping mall;
- Accessibility (SMA2) is the ease with which the customers have the access to the mall and the comfortable way in which they can enter and leave the mall;
- Service (SMA3) is the presence of different service facilities that are offered inside a shopping mall;
- Atmospherics (SMA4) is the general vibe that includes the environment and the ambience which is experienced by the shoppers within the shopping mall;
- Entertainment (SMA5) is the assortment of different entertaining activities within a shopping centre;
- Food (SMA6) which is the availability of different choices of eatables present in a shopping mall;
- Security (SMA7) is the safety of the shoppers that they feel when they visit the shopping mall and during their whole visit.

'Congruity' is the second latent construct that incorporates two reflective indicator variables: self-image congruity (SC1) which apparent congruity between the people's self-idea and the shopping centre image, and social self-congruity (SC2) which is the congruity between the consumers' self-image and their view of different clients at the shopping centre. Third and the last construct is consumer behavior (hereby now referred to as 'loyalty') and incorporates three indicators: purchasing repetitively (CL1) which is the consumers' objective to repurchase items at the shopping centre; word-of-mouth (CL2) which is the recommendation of the shopping mall given by consumers to other consumers; and future shopping expectations (CL3) which is the consumers' aims to keep going to the shopping centre.

A 5-point likert scale was used to measure all the reflective indicator variables. SPSS v.19 was used to carry out the analysis with the help of correlation analysis.

4. RESULTS AND ANALYSIS

4.1. Descriptive Analysis

Predominately, 71% of the women consumers visit the mall used in the study. The education of the consumers ranges from senior high school to university graduates in majority. Students, entrepreneurs, government officers and people from professions and executives were in major occupations of the consumers. The average income of the consumers ranged from Rp 1 up to Rp 10 million (~$1000 AUD) per month [28–32].

4.2. Model Estimation

By doing a comparison of the reflective indicator store with the latent variable score, convergent validity was estimated. It is evident from Figure 1 that all the reflective indicator score possess the value which is more than 0.5, which is the cutoff value. This shows that the research model presented here fulfills the least requirement of the convergent validity. Among all the variables of shopping mall attributes, merchandising has the least reflective indicator score which is 0.584. This suggests that this characteristic has a very little contribution to the overall construct of shopping mall image but caution should be exercised here since merchandising was correlating with four of the other six variables ($p < 0.05$). The two congruity reflective indicator scores is more than 0.83, also showing that both the congruity measures also fulfill requirements of convergent validity. The two congruity variables were also correlated to each other ($p < 0.05$). Word-of-mouth which is a reflective indicator for consumer loyalty has the lowest score with the value of 0.585, which shows that consumers' objective to repurchase items at the shopping centre and revisiting the shopping mall has more effect to drive the latent construct of consumer loyalty. WOM is correlated with revisiting the shopping mall ($p < 0.05$) but with a p-value greater than 0.05, WOM is not correlated to consumers' objective to repurchase items at the shopping centre. AVE must be above 0.5 to achieve convergent validity [33]. The value of AVE (average variance extracted) was more than 0.5, thus the discriminant validity is good for research model. The value of R-square was 0.574 for the inner model. Moreover, Figure 1 highlighted the factor loadings.

For all the reflecting indicator variables for 'shopping' have the mean value which is greater than 4.29/5, which indicates that all these characteristics of shopping mall have an effect on performance of the mall and in the presence of the characteristics shopping mall functions well. In the same manner, the reflective indicator variables for the consumer loyalty have a mean which is greater than 4.26. As shown in the Figure 1, the value of gamma

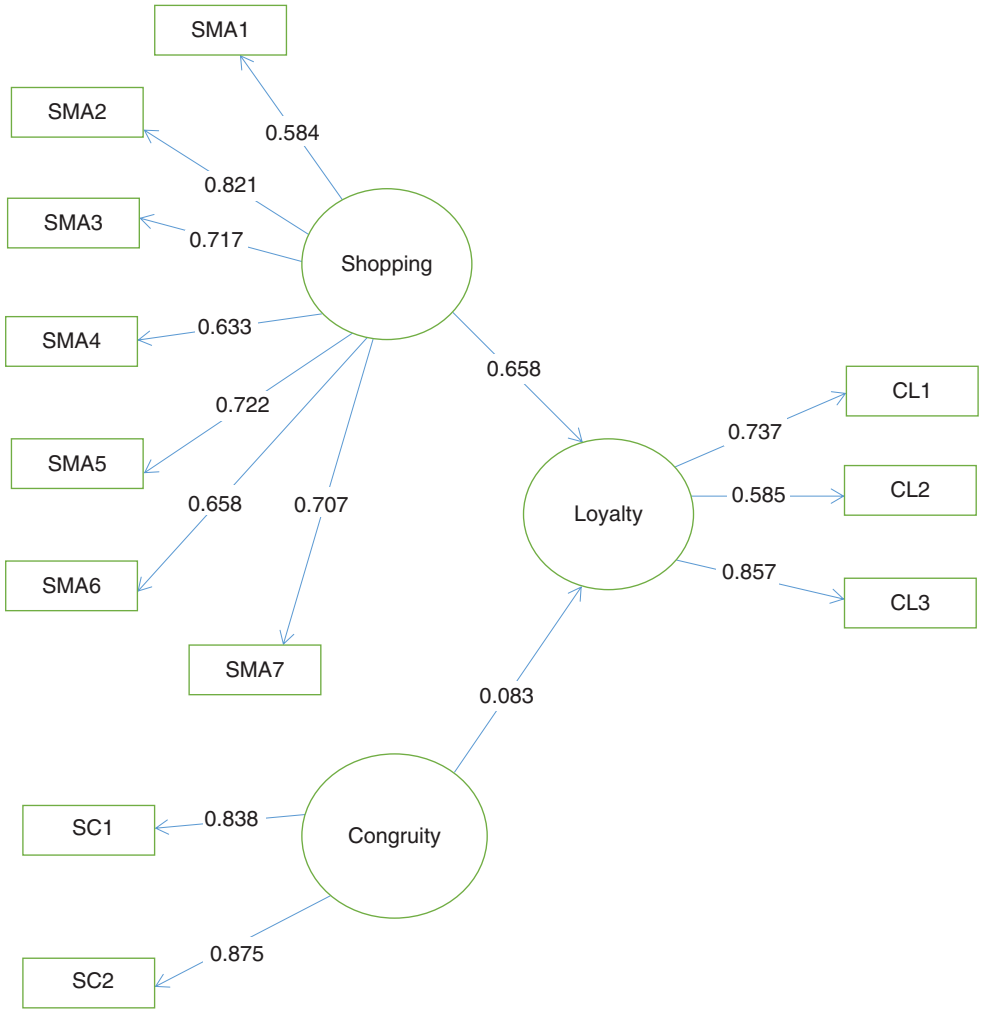

Fig. 1. Factor loadings.

coefficient is 0.658 (t-statistics = 6.949, $p < 0.01$), ultimately it can be said that shopping mall image referred as 'shopping' significantly effects consumer behavior referred here as loyalty as given in hypotheses 1. Table I shows descriptive statistics and correlations for the study variables of 'Shopping Mall Image.' Moreover, Table II shows descriptive statistics and correlations for the study variables of 'congruity.' Table III shows descriptive statistics and correlations for the study variables of 'consumer behavior.'

Table I. Descriptive statistics and correlations for the study variables of 'shopping mall image.'

Variables	*M*	SD	SMA1	SMA2	SMA3	SMA4	SMA5	SMA6	SMA7
SMA1	4.39	0.36	–	–	–	–	–	–	–
SMA2	4.35	0.52	0.876**	–	–	–	–	–	–
SMA3	4.29	0.36	0.795**	0.859**	–	–	–	–	–
SMA4	4.38	0.90	0.589	0.759**	0.456	–	–	–	–
SMA5	4.32	0.67	0.689**	0.824**	0.854**	0.856**	–	–	–
SMA6	4.47	0.91	0.745**	0.844**	0.544	0.651	0.742**	–	–
SMA7	4.31	0.48	0.564	0.798**	0.845**	0.788**	0.832**	0.534	–

Note: **Correlation is significant at 0.05 level (2-talied).

Taking the mean values for congruity variables, 3.67 was the mean for self-image congruity while 4.10 was the mean for social image congruity. By taking the help of The Hofstede Centre, a possible explanation for this can be given. According to Hofstede Centre, Indonesia has a low score of 14 on Individualism and also a low score of 38 on Indulgence. Taking into account the Hofstede's analysis, more stress should be placed by Indonesia on adjusting to the desires of society and that of large number of people to which they have a sense of belonging (Indonesians rarely shop without anyone), that is why the social-image congruity has a mean score of 4.10 which is relatively higher. In the meantime, it can be seen through the indulgence score that they are limited by social

Table II. Descriptive statistics and correlations for the study variables of 'congruity.'

Variables	*M*	SD	SC1	SC2
SC1	3.67	0.36	–	–
SC2	4.10	0.90	0.852**	–

Note: **Correlation is significant at 0.05 level (2-talied).

Table III. Descriptive statistics and correlations for the study variables of 'consumer behavior.'

Variables	*M*	SD	CL1	CL2	CL3
CL1	4.38	0.85	–	–	–
CL2	4.26	0.81	0.581	–	–
CL3	4.28	0.75	0.864**	0.769**	–

Note: **Correlation is significant at 0.05 level (2-tailed).

standards, and they should attempt to control their wants, which could clarify the generally lower mean for mental self-image congruity (3.67). The value of gamma coefficient is 0.083 (t-statistics = 0.856, $p > 0.05$), which shows that congruity does not have a significant effect on customer behavior, thus we fail to accept hypotheses 2. This shows that consumers are willing to show that they have high self-image congruity along with congruity with other consumers but at the same time they are unwilling to accept that it has any effect on their loyalty to the mall—which can be argued as self-indulgent and points towards the absence of self-control in come to have a control over their wants.

5. DISCUSSION AND CONCLUSION

A model which can be accepted generally does not exist that can explain what components are responsible to drive the consumers' value despite the fact that consumers have utilitarian needs to fulfill-components characteristic to the shopping centre-just as non-practical desires, which come from affiliations one has with the shopping centre. In that capacity, two latent constructs are present in the inner model of Figure 1: the primary marked 'shopping' attempts, to catch utilitarian needs, and the second, 'congruity,' to catch nonfunctional desires. As for the previous we quantified the seven shopping centre traits presented by Sing and Prashar (2013) to mirror the latent construct 'shopping'—these traits are characteristic to a shopping centre and controllable by the administration. The connection among 'shopping' and 'loyalty' was critical, subsequently which supported H1.

All seven indicator variables reflective of shopping mall image had mean value more than 4.29/5, which shows that efforts have been put it by management to deliver these characteristics. As the factors are relied upon to have inter-item relationship and the consideration or removal of a measure isn't intended to modify the applied concept of the latent construct of interest, shopping centre image it will be wrong to come to any conclusion with respect to the general commitment of one reflect or variable contrasted with the others. In any case, while a correlation was expected from these items, some exceptions can also be made: no correlation existed between merchandise and atmospherics or security and also no correlation was seen between food and service and atmospherics ($p > 0.05$ for all correlations). The only correlated variables out of all seven items were accessibility and entertainment recommend that entertainment is often "neglected" along with food and security when it comes to molding the shopping mall image.

There was no significance of gamma coefficient between 'congruity' and 'loyalty' which failed to support H2. This result was not expected. Almost 40 years ago, suggested that "[M]any retailers would benefit from defining their business as being part of the social-recreational industry." An empirical support was provided by Malik and Hanafi (2018) about the shopping experience at department store that concluded that "our insights suggest expending effort that boosts one's status or self-esteem could be a viable differentiation strategy as it would create social value." In this study, we can see that a significant correlation exist between two indicator variables reflecting the 'congruity.' when one of the variable measured congruity between the people's self-idea and the shopping centre image, and the other measured congruity between the consumers' self-image and their view of different clients at the shopping centre, however the relationship between 'congruity' and 'loyalty' had no significance. The mean value for these two indicator variables were 3.67/5 and 4.10/5, respectively, but regardless of such high means, it had not translated into loyalty. It can be suggested that the reason behind this could be the low ranking of Indonesians in Individualism and Indulgence. Conceding that they like to enjoy shopping and satisfy wants through utilization would appear to run counter to these hidden social inclinations. In any case, we firmly caution against reasoning that congruity and shopping practices have no relationship. Till to-date research has been saturated with a Western point of view that recommends there is a social measurement to retail chain shopping that ought not to be disregarded.

In any case, maybe the absence of a huge relationship is progressively trite: there are other top of the line shopping centres in Surabaya, Indonesia, and these shopping centres might just additionally rate high on congruity, consequently loyalty is not driven by congruity, yet rather attributes of the shopping centre that shape its image. We along these lines urge further research to investigate this potential relationship and to dissect these various perspectives. A culturally diverse correlation could reveal insight into the Hofstedian view, and an intra-city shopping centre examination could uncover the role, assuming any, of congruity and consumer loyalty among Indonesian customers.

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RESEARCH ARTICLE

The Mediating Role of Customer Satisfaction in the Relationship Between Atmospherics on Customer Behaviour: Stimulus Organism Response Model Approach in the Spa Industry of Thailand

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The main purpose of the current study is to examine customer satisfaction, atmospheric and customer behaviour using SOR model. In addition to that, the study has examined the mediating role of customer satisfaction in the relationship between Atmospherics on Customer Behaviour. In recent Past, the main focus for the organizations was to identify the factors that can help in enhancing the loyalty of the customers. Additionally, their focus is also on delivering superior services by which they can keep the customers loyal. The study is of the view that the organizations make these efforts with desires to keep these customers retain, which will help them in increasing the profits and revenues. However, the current study has filled this gap. However, this study is among the pioneering studies on this issue Employing the survey-based methodology; the SEM-PLS technique is used to test the hypothesized relationships. So, the current study has used SEM-PLS as a statistical tool to answer the research questions raised in this study and research objectives envisaged in the current study. The data is collected from the SPA customers in Thailand. The findings of the study have provided support to the theoretical foundation and the proposed hypothesis of the current study. The current study will be helpful for policymakers and practitioners in understanding the issues work customer satisfaction, atmospheric and customer behaviour using SOR model. In author knowledge, this is among very few pioneering studies on this issue.

Keywords: Customer Satisfaction, Atmospheric, Customer Behaviour, SOR Model.

1. INTRODUCTION

It is a very important forfirms to create loyalty for the customers. For this reaso, a large number of research is conducted in the past regarding keeping the customer loyal (Wang and Chaipoopirutana, 2015; Wangchan and Worapishet, 2019). Organizations can minimize their operational costs and maximize revenue and profit by keeping the customers loyal. It is more likely that loyal customers will be engaged with positive word of mouth regarding the services and products [1]. Moreover, it is less costly to serve loyal customers because it requires less information for them to be informed regarding the product or services [2].

In recent past, the main focus for the organizations was to identify the factors that can help in enhancing the loyalty of the customers. Additionally, their focus is also on delivering superior services by which they can keep the customers loyal [3]. Organizations make these efforts with desires to keep these customers retain, which will help them in increasing the profits and revenues.

It is important to note that the loyalty of the customers is dependent upon the satisfaction of the customers [1]. For the same reason, the main focus of past research has remained on the factors that can satisfy the customers, so the companies can retain them. Therefore, its been found that the physical environment in which product is sold, or service is provided plays a critical role to make and keep the customer satisfied [4–6].

As a contrast to the product buyers, the experience of cues in the services industry is less by the customer [7]. In most of the occasions, the physical environment like ambient conditions, spatial layout and décor etc. are just

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the cues which are tangible in the service industry. Therefore, for the organizations, the physical environment is one of the most important factors that keep the customer satisfied and made them loyal as well [8]. In the past, a large number of researches is conducted to examine the impact of word of mouth on a number of variables related to consumer behaviour such as word of mouth and customer satisfaction [9]. However, the impact of word of mouth as a moderator between customer satisfaction and consumer behaviour as loyalty is tested very rarely. It is very important to examine this relationship because satisfaction and loyalty created through word of mouth provide the life time value to customers [2]. And their impact on profitability is proven in past researches. Therefore, it is very important to examine the moderating impact of word of mouth on the relationship of customer loyalty and customer satisfaction [10–24].

Despite the fact that the physical environment is one of the important components of factors that keep the customer satisfied. Moreover, it is also one of the important factors that explain the mechanism to keep the customer loyal as well. In the past, there is very little research conducted regarding the formation of loyalty as customer behaviour through customer satisfaction. Moreover, there is very less research conducted in terms of multiple components of physical and their relationship with customer loyalty to a specific service provider or product manufacturer. Moreover, this relationship is less evaluated through the formation of customer satisfaction by the physical environment, which leads towards the formation of customer loyalty. This research will be one of the few types of research that have tried to explore this relationship. This relationship is important to explore because the role of the physical environment in creating customer satisfaction and loyalty is not clear yet. Therefore, the combined impact of all these variables on the creation of customer loyalty is important to be explored.

Stimulus Organism Response model, is also known as SOR model, According to SOR model, the external environmental stimuli (S) of the SOR is the experience of the customer, which create emotions known as Organism (O). As a result, both these Stimulus (S) and Organism (O) create a response, which is the outcome of the model. In this study, Cleanliness, Layout and Decor are the environmental Stimuli (S) which create emotions as satisfaction known as an organism (O) of the model. As a result of the physical environment (S) and customer Satisfaction (O), the outcome is customer loyalty (R). In this study, the SOR model is being used as the underpinning theory.

So, the main objective of this research is to examine the impact of physical environment like ambient conditions, cleanliness and special layout as antecedents of customer satisfaction, which would lead to the creation of customer loyalty. Additionally, the direct impact of the physical environment on the creation of customer loyalty is examined as well, including the moderating role of customer word of mouth on the relationship of customer satisfaction and loyalty.

2. LITERATURE REVIEW

2.1. Customers Loyalty

Researchers have suggested that there exists, attitudinal and behavioural dimensions of the loyalty [25]. Consistent repurchase and frequency of repurchase deal with behavioural loyalty. Whereas, attitudinal loyalty refers to the psychological commitment towards the brand. Thus, loyalty is the consequence of repeat purchase and frequency of purchase of a specific product or using certain services from a certain service provider. By this way, the customer develops the favourable attitude.

In the recent past, researchers have mentioned that it is disadvantageous to use overall customer loyalty to assess the behaviour of the customers. It is because the behavioural dimension of loyalty does not treat the decision making process, and it does not differentiate the behaviour of repeat purchase [26]. Moreover, using a behavioural dimension to measure the loyalty include improper multiplication of behavioural and attitudinal attributes. Moreover, for industries like hospitals and restaurants, attitudinal loyalty should be used to measure the loyalty of the customers [27]. It is because unlike manufacturing industry, repeat purchase of customers is not similar in the hospitality industry. But, to comply with Loyalty, this study used the combined impact of attitudinal and behavioural loyalty to measure the loyalty of customers.

2.2. SOR Model and Physical Environment

As mentioned by the environmental psychologists, the behaviour of human is strongly influenced by the physical environment associated with him/her. The theory proposed that human act in two different ways to the environment in which he or she is acting. These actions or outcomes of human are known as approach and avoidance outcome. The approach is the positive outcome of the Stimulus and Organis, whereas avoidance is the negative outcome of the physical environment, also known as Stimulus and Organism. The examples of a positive outcome are the desire to stay and loyalty etc. whereas, the negative outcome is the switching behaviour of the customers.

The main objective of the organizations is to minimize the avoidance behaviour and maximize the approach behaviour of the customers [28]. A number of studies have been conducted in past which highlight the importance of the physical environment in influencing the behaviour of the customers [29]. Researchers have proved empirically that in the presence of an innovative and pleasant atmosphere of the customer, the approach behaviour is improved. The success of organizations is associated

with the environment of the organization provided to customers [30]. It is because customers unconsciously or consciously sense the physical environment at the place where they are involved in product buying or service acquiring process.

In the context of services, physical surroundings like music, layout, artifacts and décor, plays a critical role in shaping the behaviour of the customers. These factors play a critical role in creating satisfaction among the customers and helping the customers to make them loyal as well. As mentioned by Kotler [31] that in a few situations, the atmosphere in which product or service is being provided is more important as compared to the features of product or services itself. These atmospherics plays a critical role in shaping the behaviour of the customer and purchasing decision as well. If the physical design of any product or service is designed in a creative way by the product manufacturer or service provider, it will help the organization in achieving specific objectives of marketing. Moreover, the customer will get a positive experience and will develop a positive attitude as well.

There are a number of terms used by the researchers regarding the physical environment of the service or product. Bitner [28] used the term services cape in order to describe the term man made environment or the built environment. Moreover, terms like physical surroundings and social environments are also being used in literature as well. In the same way, in this study, the physical environment means the manmade environment or the physical conditions or settings which can be controlled by any service provider or product manufacturer.

In a number of studies, essential physical factors are identified by the researchers which include ambient conditions, artifacts, decore, cleaning and spatial layout particularly in the service industry [32, 33]. In most of the researches, the factors that have been discussed are cleaning, ambient conditions and spatial layout. These factors are considered as the dimensions of the physical environment, which make a serious impact on consumer behaviour [33].

2.3. Spatial Layout

It refers to the physical environment within a service setting with the purpose of making an environment which will be able to fulfil the wants and needs of the customers. Therefore, within physical surroundings, the spatial layout is very important [28]. The spatial layout means the arrangement of objects within specific service settings or product manufacturer which fulfil the needs of the customers. These products may include equipments and furniture within specific settings [7]. If the layout is efficient and well planned, it will fulfil the needs of the customers and make the customers more comfortable [34]. In the service sector, spatial layout is very important for the customers as it is related to the movement of the customers and their sitting as well. The layout which is effective make the customers satisfied and keep them engaged with the specific service provider as well.

Based on the above discussion, we can hypotheses that:
H1: *Spatial Layout have a positive impact on the Loyalty of Customers*
H2: *Spatial Layout have a positive impact on customers satisfaction*.

2.4. Ambient Conditions

Basically, ambient conditions refer to the characteristics of intangible background. These characteristics have a subconscious impact on the perception and behaviour of the consumer [7]. The elements of ambient conditions include temperature, air quality, music, scent, noise and lighting etc. They are considered as the background characteristics of the environment. In the presence of ambient conditions in the physical environment that are suitable for the customers, they are pushed to continue the products or services of a specific service provider of product manufacturer. In the presence of a pleasing environment, adequate lighting, low level of noise, temperature and pleasant music has a very positive impact on the experience of the customers. In such ambient conditions, customers positively evaluate the products and remain satisfied with the value provided. By this way, the service providers also retain the customers on the long term basis.

Based on the above discussion, we can hypothesis that:
H3: *Ambient Condition have a positive impact on the Loyalty of Customers*
H4: *Ambient Condition have a positive impact on customers satisfaction*.

2.5. Cleanliness

Researchers have defined cleanliness as the absence of bad smell, stains and dust. Researchers observed that the demands of human regarding sanitation are related to the hierarchy needs. This means that the human wants to remain dirt free and like the environment that is clean. Within the context of the service sector, the cleanliness is considered very important and is mentioned by a number of researchers. Additionally, researchers mentioned that the product which is clean make good sense to the customers. Researchers also mentioned that cleanliness is important to make customer satisfied and to be evaluated positively by the customers to predict the future purchase decision of product or services thus it helps in shaping the future behaviour of the customer as well [35].

Based on the above discussion, we can hypothesis that:
H5: *Cleanliness has a positive impact on the Loyalty of Customers*
H6: *Cleanliness has a positive impact on customers satisfaction*.

2.6. Customer Satisfaction

There are given several definitions for a clear explanation of customer satisfaction, and the initial definitions considered it as a cognitive procedure of customer. But in recent research, the paradigm of consumer satisfaction has exceeded the cognitive interpretations for recognizing the emotional nature of satisfaction. According to Ref. [36], customer satisfaction is defined as the response of product consumer, to evaluate the perceived difference of expected and actual performance of any product as observed by the customer when it is consumed. Similar views are given by Oliver and Swan [37] regarding the definition of customer satisfaction.

Moreover, the overall evaluation of customer satisfaction in service industry includes the fulfilment of customer's expectations and performance of the company in comparison with the ideal service provider [38]. Clients who construct a relationship with their service providers during their experience have greater satisfaction, they feel their better interactive worth regarding friendship, respect, and communication with the company employees and thus, get satisfied with the specific company services. (Jermsittiparsert, Sutduean, and Sriyakul, 2018; Jermsittiparsert, Sriyakul, and Sangperm, 2019).

2.7. Word of Mouth

Word of mouth is oral communication among the communicator and receiver. It is also regarded as the person to person communication, which is regarded as non-commercial by the receiver [39]. Researchers defined the word of mouth in which information, comments and opinions are conveyed to the customers in a non-marketing matter. In this study, the definition of the word is adopted by Carpenter, Walker [40] so the word of mouth of customers can be measured.

Word of mouth is the extent to which customers informs its colleagues, relatives and friends regarding a product or service about the level of satisfaction achieved after using that product. The relationship of word of mouth is considered very different by different researches in a number of studies. For example, scholars claimed that more than 50% of the customers who targeted to collect the data told that they were satisfied with the experience of the product or service. Additionally, the study conducted by reported that more than 70% of the customers told that they were satisfied with the experience. The same observation. According to the theory of asymmetrical effects, the positive responses of the events are effected by the negative events.

Word of mouth is very important in the service sector. This claim is well documented by a number of researchers [41, 42]. Vital information is provided by word of mouth regarding a specific product or service. This information helps the customers to decide regarding the use of the product or services. By this way word of mouth help the organization to minimize the switching of the brand. Moreover, it also assists the firm in target and attains new customers. According to equity theory, if the organization is able to spread positive word of mouth and recommendations by fairly responding to the failure of the services, it would help them to attain the customers [43]. Several researchers have suggested that there are benefits as well to spread the negative word of mouth as in some situation perceive the unfair response to the failure of services [44]. A few researchers also claim that there exists a positive relationship between word of mouth and customer satisfaction.

2.8. Customer Loyalty and Satisfaction

Researchers have reported that loyalty of the customers will increase if they are satisfied, which means that the satisfaction of the customers will be positively impacted by the satisfaction. Moreover, also had the same view who believed that repurchase and loyalty would have a positive impact on satisfaction. As a result, the switching behaviour will be minimized, and customers will continue to use the product or service of the same company. Additionally, the same results were mentioned in the research, who pointed out that loyalty of brand was positively impacted by the customer satisfaction.

H7: *Customer satisfaction has a positive impact on the loyalty of the customers.*

2.9. Satisfaction and Word of Mouth

Word of mouth is basically informal communication between customers and suppliers of the products regarding its characteristics. The word of mouth of the product can be negative or positive. Word of mouth is received by the potential buyer of the product or service user before using or experiencing the product. There are several studies conducted to discuss regarding the impacts of word of mouth. Past literature has discussed its impact on loyalty and customer satisfaction a lot. As mentioned in the traditional theory, the decisive position is occupied by the customer satisfaction in terms of its impact on consumer behaviour. The customer who is satisfied has more positive information regarding the product or service. The satisfied customer is more likely to produce positive word of mouth regarding the product as well. After the consumption of the product by the customers, there occur sharing the evaluation experience and compare them as well. When the value of the product does not meet the expectations, it will impact the satisfaction and will cause dissatisfaction in the customer. On the other hand, if the expectations are met by the product, it will cause the positive word of mouth as the customer is satisfied. Therefore, customer satisfaction has an important influence on word of mouth.

Researchers believed that more word of mouth would be produced as a result of satisfaction and as compared to unsatisfied customers [37]. A positive relationship between

customer satisfaction and word of mouth is mentioned in a number of studies. As scholars reported a positive relationship between these variables and a very strong relationship as well. Additionally, negative word of mouth will be produced due to the dissatisfaction of the customers. Moreover, they reported a linear relationship between satisfaction and word of mouth [45]. On the other hand, Ref. [9] reported a U-shaped relationship among these variables. In case of the low or high level of satisfaction, the level of word of mouth regarding the characteristics of the product also varies. In some cases, the average word of mouth is produced as a result of the dissatisfaction of customers.

H8: *Customer Satisfaction has a positive impact on word of mouth*.

2.10. Word of Mouth and Loyalty: Word of Mouth as Moderator

A number of studies have used the concept of word of mouth in their studies. The relationship of word of mouth with loyalty is causal among the companies and consumers. The loyalty and word of mouth are not limited to products or services only; in fact, this impact can also be seen in the form of organizations and consumer relations. The positive word of mouth of the firm will have a positive impact on the loyalty of the customer. As mentioned by the scholar base of word of mouth is commitment. If the customer is loyal to a service of the product, it will spread positive word of mouth, which will lead to more engagement of the customers. Negative word of mouth will push potential customers to use other brands. The benefit of positive word of mouth is the recommendations to the potential buyers to use the products or services. Based on the above discussion, we can hypothesize that

H9: *Word of Mouth has a positive impact on loyalty*

H10: *Word of mouth moderate the relationship between Loyalty and Customer Satisfaction.*

2.11. Customer Satisfaction as Mediator

There are a number of empirical studies conducted in past that highlight the relationship of customer satisfaction and future purchase decision with cleanliness such as Stern [35]. Moreover, customer satisfaction has a direct impact on loyalty as well. On the other hand, ambient conditions have a positive impact on customer satisfaction and loyalty [7]. Moreover, Layout also has a positive impact on customer satisfaction and loyalty as well.

This discussion fulfils the condition of Barron and Kenny [46] of mediation. Based on this discussion, we can hypothesize that:

H11: *Customer satisfaction mediate the relationship between layout and loyalty*

H12: *Customer satisfaction mediate the relationship between Ambient Conditions and loyalty*

H13: *Customer satisfaction mediate the relationship between cleanliness and loyalty*.

3. METHODOLOGY

The currents study has adopted the surveys-based methodology and researcher adopts several tools and procedure for the analysis of data, hypotheses testing and refining theories, which is referred as research methodology. In this research study, inferential and descriptive statistics were used for analyzing data. The method of PLS-SEM (Partial Least Squares Structural Equation Modeling) was used to analyzing data. The questionnaire was coded after collection of data and entered to SPSS v18 (Statistical Package for the Social Sciences). Following were the steps involved in the data analysis in this research. In the initial step, the data was screened to identify errors. The frequency test was run for every variable to evaluate the expected missing value through use of means. Demographics were described and compared through descriptive statistics. The final step was the use of PLS-SEM. This is also regarded as the second-generation approach of SEM. It has become an efficient and effective approach for analyzing the cause and effect association among the unobserved constructs [47]. The scale of layout, customer satisfaction, customer loyalty, and ambient condition are taken from the study of author Cleanliness from Harris and Ezeh [48], and of Word of Mouth Kim, Han [49]. The total questionnaire received were 456 and the response rate is 59 percent.

4. RESULTS

The choice of PLS-SEM method has been based on its ability to perform better estimation as compared with the first generation and regression models to estimate mediation effects and co-variance. This study has adopted PLS-SEM approach based on the rationale of choosing a suitable approach for measurement model and structural model assessment, shown in Figures 1 and 2, respectively. The research model is complex and PLS-SEM can estimate it efficiently. According to Haenlein and Kaplan [50], it is a suitable approach having a greater number of unobserved independent variables defining a less number of unobserved dependent variable. It can be referred as a multivariate analysis, which can be executed in strategic management, marketing, and other researches of social sciences. In PLS-SEM, there is no limitation of interaction approach adopted is testing moderation as compared with other techniques of measuring covariance. In this way, this approach is suitable alternative for estimating the influence of moderation. Moreover, it is allowed through this approach to incorporate the chains of effects including mediation and some other complicated relations [51]. In this research, SmartPLS v3.0 has been used for estimation of outer model (including convergent validity, reliability and discriminant validity) and inner model (including effect size, coefficient of determination, path coefficient significance and predictive relevance). Outer loadings is shown in Figure 1 and Table I.

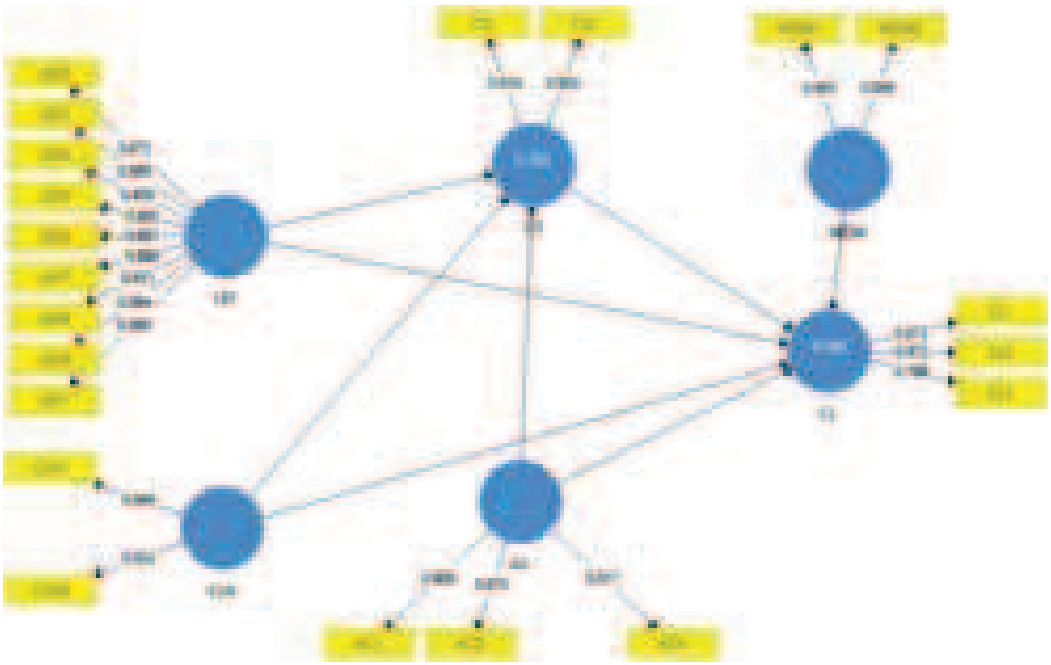

Fig. 1. Measurement model.

The initial step in the PLS-SEM approach is to estimate the outer model, which is also called measurement model. The measurement of the component enabling the determination of item loading and the way they are related with respective constructs. It is confirmed through the estimation of outer model that the survey items measure what they aim to do. This ensures validity and reliability of the model. The two main criteria involved in PLS-SEM approach are validity and reliability, which estimate the outer model [52, 53]. It is the reliability and validity, which draws the results about the type of association among the constructs. The individual item reliabilities indicate the suitability of the suitability of outer model. Internal consistency and indicator reliability is involved in composite reliability. The use of AVE is linked with the individual constructs and convergent validity. The discriminant

Fig. 2. Structural model.

Table I. Outer loadings.

	AC	CL	CLN	CS	LEY	WOM
AC1	0.909					
AC2	0.873					
AC4	0.917					
CL1		0.872				
CL2		0.872				
CL3		0.788				
CLN1			0.946			
CLN4			0.933			
CS1				0.910		
CS2				0.903		
LEY2					0.872	
LEY3					0.888	
LEY4					0.859	
LEY5					0.900	
LEY6					0.881	
LEY7					0.888	
LEY8					0.851	
LEY9					0.884	
WOM1						0.943
WOM2						0.948
LEY1					0.886	

validity has been estimated based on criterion of criterion and the outer loadings indicator. The consistency of results of similar test items is measured through internal consistency. It estimates whether the proposed measuring items for constructs give the similar values or not. By estimating CR, the study has assessed the internal reliability consistency. The equal construct loading indicator is not assumed in CR as compared with Cronbach's alpha. The value must lie within the range of 0–1. The standard value should be equal or greater than 0.60. The value equal or greater than 0.70 is considered sufficient. The value in the range of 0.6–0.7 is considered average. However, the value in the range of 0.70–0.90 is considered more than sufficient. Alpha, CR and AVE is shown in Table II.

The convergent validity is related to the association among the same construct's measures, which are not linked theoretically. The degree of association among the same construct measures is reflected by convergent validity. The standard value of 0.50 or above is used to identify the convergent element in construct estimation. It is indicated by 0.50 value that AVE is sufficient. Half of the variance of indicators is explained by the latent construct and this indicates a sufficient level of convergent validity.

Table II. Reliability.

	Cronbach's alpha	Rho_A	Composite reliability	(AVE)
AC	0.883	0.885	0.927	0.810
CL	0.799	0.798	0.882	0.714
CLN	0.868	0.875	0.938	0.883
CS	0.783	0.784	0.902	0.822
LEY	0.963	0.964	0.968	0.772
WOM	0.882	0.883	0.944	0.894

Table III. Reliability.

	AC	CL	CLN	CS	LEY	WOM
AC	0.900					
CL	0.758	0.845				
CLN	0.871	0.741	0.940			
CS	0.671	0.685	0.649	0.907		
LEY	0.679	0.771	0.685	0.879	0.879	
WOM	0.884	0.724	0.879	0.659	0.665	0.946

The discriminant validity is related to the extent of differentiation among the constructs. The constructs measurement not linked theoretically with each other are referred as discriminate validity. The criterion is the suitable approach for the estimation of discriminant validity. The method of examining cross-loadings is considered advanced as it can have more constructs indicating discriminant validity. It is shown in Table III.

An important criterion for the estimation of contribution of indicator is through outer factor loading. This research adopted outer factor loading for estimation. The standard value of 0.50 or above was used for the examination of outer loadings. It was stressed by that the value in the range of 0.40–0.70 should be examined carefully. The item should be deleted when the value of AVE and CR increases. The structural model is estimated after the indication of absence of collinearity issue. The basic criterion for structural model assessment in PLS-SEM is the path coefficients significance, effect size (f^2) coefficient determination (R^2), and predictive relevance (Q^2). Structural model is given in Figure 2 and results are given in Tables IV–VI.

This research adopted method of bootstrapping. This was used to estimate the path model of association between the dependent and exogenous variables in a direct way without the incorporation of mediating variable. The t-values and path coefficients were included in bootstrapping and PLS-SEM algorithm. The path model was later estimated incorporating the mediating factors. It is focused whether the mediator influence the relation of dependent and independent variables significantly or not. It is not required to confirm the influence of mediation. The two path coefficients significances are multiplied and divided by standard error, which estimate the indirect significance effect.

Table IV. Direct relationships.

	(O)	(M)	(STDEV)	T statistics	P values
AC → CL	0.279	0.278	0.111	2.513	0.012
AC → CS	0.168	0.170	0.100	3.688	0.000
CLN → CL	0.152	0.153	0.110	4.379	0.000
CLN → CS	−0.041	−0.036	0.101	4.403	0.004
CS → CL	−0.149	−0.150	0.093	3.597	0.000
LEY → CL	0.429	0.429	0.086	5.005	0.000
LEY → CS	0.793	0.786	0.057	3.909	0.000
WOM → CL	0.035	0.037	0.101	3.344	0.000

Table V. Indirect relationships (mediation).

	(O)	(M)	(STDEV)	*T* statistics	*P* values
AC → CS → CL	−0.025	−0.027	0.024	3.042	0.000
CLN → CS → CL	0.006	0.006	0.018	3.344	0.000
LEY → CS → CL	−0.118	−0.118	0.074	3.595	0.000

Table VI. Indirect relationships (moderation).

	(O)	(M)	(STDEV)	*T* statistics	*P* values
Moderating effect 1 → CL	−0.060	−0.059	0.028	3.119	0.034

Table VII. *R*-square.

	R square
CL	0.706
CS	0.783

The results were presented using a systematic analysis of structural model. All the 12 hypotheses were tested in a comprehensive way. The estimate of direct association among the dependent and independent variable was done in the inner model assessment. PLS-SEM Algorithm was used to examine PLS-SEM Algorithm and path coefficient. The significance of relationship has been estimated through bootstrapping process of PLS-SEM in the Smart-PLS 3.0. The number of cases used were the original number of cases i.e., 5000 for bootstrapping samples [52]. The focus of the first model is on estimation of direction association between the dependent and independent variable. The second model involved the incorporation of a mediator between the relation of dependent and independent variable (Hypotheses 7–9). After this, the association between the dependent and mediator was estimated.

Under multivariate analysis, the coefficient of determination shows that the predictor variables explain the endogenous variable. Thus, the magnitude of R^2 explains the predictive power of explaining endogenous variable in the model. Furthermore, following the sample was reapplied in order to declare the models' predictive validity. Partial Least Square technique is used as it is an appropriate and very well software for reusing the sample technique [47–51, 53, 54]. In the current study the *R*-square values are above the threshold values. *R*-square is given in Table VII.

5. CONCLUSION

Despite the fact that physical environment is one of the important components of factors that keep the customer satisfied. Moreover, it is also one of the important factors that explain the mechanism to keep the customer loyal as well. In past there is very little research conducted regarding the formation of loyalty as customer behaviour through customer satisfaction. Moreover, there is very less research conducted in terms of multiple components of physical and their relationship with customer loyalty to specific service provider or product manufacturer. Moreover, this relationship is less evaluated through the formation of customer satisfaction by physical environment which lead towards the formation of customer loyalty. This research will be one of the few researches that has tried to explore this relationship. This relationship is important to explore because the role of physical environment in creating customer satisfaction and loyalty is not clear yet. Therefore, the combined impact of all these variables on creation of customer loyalty is important to be explored. The prime objective of the current study is to examine the customer satisfaction, atmospheric and customer behaviour using SOR model. In addition to that the study has examined the mediating role of customer satisfaction in the relationship between Atmospherics on Customer Behaviour. In recent Past the main focus for the organizations was to identify the factors that can help in enhancing the loyalty of the customers. Additionally, their focus is also on delivering the superior services by which they can keep the customers loyal. The study is of the view that the organizations make these efforts with desires to keep these customers retain which will help them in increasing the profits and revenues. However, the current study has filled this gap. However, this study is among the pioneering studies on this issue Employing the survey-based methodology, the SEM-PLS technique is used to test the hypothesized relationships. So, current study has used SEM-PLS as statistical tool to answer the research questions raised in this study and research objectives envisaged in the current study. The findings of the study have provided support to the theoretical foundation and proposed hypothesis of the current study. Current study will be helpful for policymakers and practitioners in understanding the issues work customer satisfaction, atmospheric and customer behaviour using SOR model. In author knowledge this is among very few pioneering studies on this issue. According to the results the main objective of the organizations is to minimize the avoidance behaviour and maximize the approach behaviour of the customers. A number of studies have been conducted in past which highlight the importance of physical environment in influencing the behaviour of the customers. Researchers have proved empirically that in presence of innovative and pleasant atmosphere of the customer, the approach behaviour is improved. The success of organizations is associated with the environment of the organization provided to customers. It is because customers unconsciously or consciously sense the physical environment at the place where they are involved in product buying or service acquiring process.

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RESEARCH ARTICLE

Sensory Marketing Cues and Behavioural Intention: An Application of Stimulus Organism Response Model in the Hospitality Industry of Thailand

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The main focus of the current study is to investigate the impact of sensory marketing cues, namely visual cues sound cues, and smell cues on the behavioural intentions. The second focus of the study is to investigate the mediating role of customer satisfaction in the relationship between sensory marketing cues and behavioural intentions. Lastly, the moderating role of trust in the relationship between customer satisfaction and behavioural intentions. This study is among the pioneering studies on this issue Employing the survey-based methodology; the SEM-PLS technique is used to test the hypothesized relationships. So, the current study has used SEM-PLS as a statistical tool to answer the research questions raised in this study and research objectives envisaged in the current study. The findings of the study have provided support to the theoretical foundation and the proposed hypothesis of the current study. The data is collected from the internal tourist in Thailand. According to the findings of the study, feelings have an effect on various marketing parameters like selection priority of store, store files, satisfaction from product, service and shopping, need based shopping, pleasure-based shopping, time spent in store and decision-making style of the customer. Moreover, customers preferred to use the products based on their feelings, mental satisfaction and emotions related to the product.

Keywords: Sensory Marketing Cues, Trust, Customer Satisfaction, Behavioural Intention, Thailand.

1. INTRODUCTION

In the current era, the service sector has encountered fast development and has turned into the main sector because it is the fast-developing area in the development of first world economies. Given the worldwide idea of the market, competing firms are continually trying to extend their organizations' perception in the eyes of the customer. The service sector has great importance than it is considered ever. Therefore, both researchers and managers are vigorously trying to understand how customers perceive the quality of services and how these perceptions affect customer satisfaction and behavioral intentions.

The success and profitability are closely linked with customers' satisfaction and loyalty. Scholars stated that the average number of customers have to purchase at least four times from a service provider. Therefore, the service provider will be able to generate a profit from a customer. Then, how customers, can be motivated to repurchase the same business?

According to researcher senses, emotions and experience of customers are developing as important factors of marking as well as an alternative to traditional marking methods. Therefore, marketers around the globe are struggling to cope with these changes in a number of different ways. Gauthier, Champagne [1] stated that feelings have an effect on various marketing parameters like selection priority of store, store files, satisfaction from product, service and shopping, need based shopping, pleasure-based shopping, time spent in store and decision-making style of the customer [2–9].

Moreover, customers preferred to use the products based on their feelings, mental satisfaction and emotions related to the product. In the current scenario of marketing, choosing and selecting a product on the bases of senses and emotions known as sensory marketing. Researchers

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Krishna and Schwarz [10] analysed the effects of scattered on the behaviour of consumers. Sensory marketing involves the senses of consumer and affects their perception, judgment and behavior. The motivation behind Sensory advertising is to send messages to the correct part of the mind, incitement of the purchaser detects, lastly making a bond among client and item and prompting instigate him to buy. Researchers stated a key difference between reasons and emotions, customers' actions are based on their emotions, but they make decisions on the bases of reasons. Besides this, consumers can visualize the product and express it in the form of their emotions. The perceptions and behaviour of the customers can be engaged effectively by the firms by using sensory stimuli and marketing strategies effectively. If the stimulants being used by the marketers are consistent with the senses of the customer, it will have more impact on customer and audience. If the marketers have a correct understanding of sensory stimuli, it will have a favourable impact on perception and consumer behaviour of the customers [11].

The main objective of sensory marketing is engaging the customers and to persuade them to give preference in terms of using services and buying products, among others. It is important to understand by the managers that more than one sense should be used. This type of marketing should be used by marketers on the basis of consumers. If the customer gets a positive experience, it will return in the loyalty of the customer towards the product.

Terms *taste*, *touch* and *sight*, have been a part of the marketing area for a longer time, but term *sensory marketing* has appeared primarily after application of other senses (smell and hearing). According to this, we can define term sensory marketing as a relatively young sphere of marketing, because using these tools appeared on the European and international market at the turn of the 20th century [12–14].

Scholars like Inkpen and Currall [15] define trust "an organization has work for external partners such as customers, suppliers, and joint venture partners." Meanwhile, basically, trust depends on the top management and spokesperson of the organizations who involves in the dealings with other organization [15].

The trust between the stakeholders and the organisation depends upon the boundaries and parameters of the organization [15]. Trust can be used by the marketers to enhance the relationship with the stakeholders, specially with customers [16]. It will help the organization in the development of marketing channels, Joint venture, Partnerships and International Cooperative alliances [15]. In most of the trust of the cases depends on the previous experience. However, past experience of customers cannot determine that the supplier will act in the same way, although if the supplier acts in the same way as expected by the customer, the customer interest will increase. There three attributes of trust, namely, benevolence, integrity and competence [17, 18].

Therefore, the aim of this paper is to evaluate three sensory cues, namely sight, sound and smell and examine their impact on customer satisfaction and behavioural intention to re-use the services or products in future. Moreover, the moderating role of trust will also be examined on the path of customer satisfaction and behavioural intention.

2. LITERATURE REVIEW

2.1. Repurchase Intention

Repurchase intention means that intention of an individual to by again a specific product or services while considering the individuals' current circumstances. Repurchase intention also refers to the intention of customers to continue the relation with a supplier or service provider [19].

Both practitioner and researchers agreed that repurchase intention of customers is crucial for the success of service and manufacturing business because repurchase intention has an influence on cost savings, which ultimately effect the profitability of the business. Contrary to it, if information technology, retailing and marking used together to create business value, it will be more effective for stakeholders [20]. Numerous studies revealed that customers have to buy at least four times from an outlet to make the business profitable. Hence, the intention has great importance in determining the customer's behaviours.

2.2. Customer Satisfaction

There are two perspectives of customer satisfaction, cumulative-perspective and transaction-perspective. Cumulative-perspective indicates the over purchasing experience of customers without focusing on any specific purchase [21]. While transaction-perspective refers to the recent purchase experience of the customer [22]. Researchers claimed that cumulative-perceptive of customer satisfaction is suitable to evaluate the service quality of the firm as well as to identify the post purchase behaviour of customers. In current research customer satisfaction refers to the consumption perception of customers about value-added services.

2.3. Customer Satisfaction and Behavioural Intention

Researchers have revealed in a number of studies that customer satisfaction positively and strongly influence the post purchase intention of the customers (Jermsittiparsert, Siam, Issa, Ahmed, and Pahi, 2019), where the impact of customer satisfaction is considered to be the largest among other factors. Researchers have defined customer satisfaction as the attitude and feeling of a customer in terms of pleasure, which results in the evaluation of performance upon the usage and consumption of the product [23–29]. Researchers have theorized the satisfaction of the customer, which impact the future intention in both indirect and direct ways if product or service is evaluated

positively [30]. In the end, satisfaction plays a significant role in the development of the intention of customers to use a specific product or service again in future. Therefore:
H1. *Customers' satisfaction positively affects their repurchase intentions*.

2.4. Trust

The term trust can be defined in different ways. Researchers Beldad, De Jong [17] introduce an interdisciplinary concept of trust covering the actions of e-commerce customers. These researchers provide concepts of trust, namely, institution-based trust, disposition of trust, trusting intention and trusting belief. Accordingly, the current research used trust as a trusting belief. In other words, it alludes to the conviction that one can depend upon a guarantee made by another and that the other, in unexpected conditions, will act toward oneself with altruism and in a kind manner. In most of the trust of the cases depends on the previous experience. However, past experience of customers cannot determine that the supplier will act in the same way, although if the supplier acts in the same way as expected by the customer, the customer interest will increase. There three attributes of trust, namely, benevolence, integrity and competence [17, 18]. Competence refers that customers (turster) expect that the supplier (trustee) has the abilities and power to fulfil the truster expectations [17]. While, benevolence means that, supplier want to do their best for their customers (truster) without any self-benefits [18]. Integrity refers that customer (truster) believes that the supplier (trustee) provide true information and make a detailed agreement with full information and will fulfil the agreement ethically [17]. However, Researcher stated that trust must go beyond the expectations, because if the trustee is predicted to ignore the expectations of others for egocentric purposes, then no one will trust on such trustee. Hence, the current research adopts the trust characteristics presented by Ref. [18].

2.5. Trust and Customer Satisfaction

It is important for organizations to satisfy the customers before getting their trust. In other words, trust has a significant impact on the customer satisfied. The customers who trust the product are those who are satisfied [31]. Researchers have mentioned that trust is key for marketers to gain satisfaction. The customer who trusts the product is also satisfied by the characteristics and features of the product or service [32]. Moreover, researchers found that satisfaction is an important antecedent of trust. On the other hand, scholars found a positive correlation between satisfaction and trust. This satisfaction and trust are positively correlated with each other. Based on this discussion, we can hypothesise that
H2: *Brand satisfaction positively correlates with trust*.

2.6. Trust and Behavioral Intention

Past literature has a lot of evidence that there exist linkage between behavioural intention and trust of the customers which is mediated by many other variables [33–35]. On the other hand, customers also have a strong intention to repurchase a product or service who have already trust the product or service.

Based on the above discussion, we can hypothesize that:
H3: *Trust has a positive impact on the Behavioural Intention*.

2.7. Trust as Moderator

Past Studies posits inconsistent relationships between Customer Satisfaction and Behavioural Intention to re-use the product or service again in future. Moreover, there exists a direct relationship between Trust and Behavioural Intention and Trust and Customer Satisfaction.

Based on these relationships, we can hypothesise that:
H4: *Trust Moderate the relationship between Customer Satisfaction and Behavioral Intention*.

2.8. Sensory Marketing

Senses have greater importance in human life as humans are able to understand everything through their senses. Rujescu, Ingason [36] stated that adding more senses in a product design enhance the brand experience. Senses are among the vital section of human life. Product experience is a multi-dimensional user-product interaction, which includes the uses of emotional aspects. Researchers claimed that customers' sensory experience about a product drives the customer's attraction towards that product. Human senses are directly linked with memory and have the power to tap the emotions. Scholar argued that effective use of senses and their effect on customers' understanding leads to the increase in brand experience, preference, more interest and loyalty. Sensory branding helpful in understanding the relationship between brand and customer. In 2001 researchers first time introduce the term emotional branding, and it has been continuously investigated by other researchers. Scholars portrays it as the intentional structure and use of the collaboration between the senses so as to invigorate a consumer's association with a brand and to cultivate an enduring passionate association that upgrades brand steadfastness.

2.9. Sight Cues

Visual cues are the strongest sensory organ of the human body that plays more than 80% role in brand building of a product or service. More than 75% of the advertisement being done, target the visual sense of customers. For this reason, marketers try to develop images which attract the customers and are appealing visually as well. Designing, packaging, colors and logos are an example of sight stimuli designed by the marketers to attract the customers [37].

The most important component of sight is the eye of a human. Through the eye, a human can create a two-dimensional image of the object, which is visible. This object turns into a visual image. This image is turned into a 3D image by the brain, and we are able to see it. This is called sight sensation. This sense of sight is used by us most frequently. Infact it has been used by us on a daily basis every second till we are awake. Human rely mostly on sense of sight; infact it's the most important sight and sense for human as well. For this reason, marketers have worked a lot to create a catchy and attractive image which can be recalled by the customers on the basis of experience.

2.10. Smell Cues

A customer can close the ears, can cover the ears, can refuse to taste but cannot refuse to smell a product because its in air and a customer breath it [38]. More than 45% of the brand building process is done through the sense of smell or by using smell cues by the marketers. Sense of smell plays a significant role in evoking emotions of a customer and have a significant impact on the behaviour as well. Smell and Odor are used by a number of retailers to have a positive impact on the behaviour of customers [39]. One of the most important sense to develop loyalty and have an impact on purchase decision, the smell is one of the most important factors and impact the limbic cortex system.

Also mentioned that the sense of smell plays a critical role in influencing the emotions and emotional experience has a great impact on the memorable experience. This experience is the positive image of a customer in the memory of the customer. The short term marketing activities can be successful if sound cues are used tactically and effectively by marketers.

2.11. Sound Cues

Ears are the organs of the body by which sound enters in the body; thus, a sense of sound is created. Ears of human are able to diagnose to maximum 28000 to minimum 16 cycles per second. A large number of companies have used sound as an important part of their marketing strategy, which can improve the image of their brand. A service provider can get a competitive advantage if the sound is used in a very conscious way, and the customer can distinguish it . The judgement of a person is impacted by the sound. Moreover, it has a major influence in terms of purchase decision and behaviour of the customers. The role of hearing is 41% in building the brand of a specific product or service.

Organizations can use sound like an efficient and effective way to communicate with the customers and impact the behaviour of shopping as well [38]. Moreover, the researcher showed in their study that positive emotions are evoked in the customers in music is properly used in store and retail outlets. Moreover, music in the store can play a significant role in increasing sales and impacting their intentions to purchase.

2.12. Sensory Marketing, Customer Satisfaction and Behavioral Intention

There are a number of studies that have proven statistically that there exists a relationship between sensory marketing tools and customer satisfaction. The most significant impact in of the visual tool according to which customers are attracted 36% by the visual tools of sensory marketing. These tools include all stimuli of physical appearance like light, décor, coloring, layout, cleanliness. Second most significant impact is of auditory tools of sensory marketing, which impact customer satisfaction by 29%. It is a significant impact but not as strong as visual stimuli. The tactile tool of sensory marketing has 19% impact on the sense of the satisfaction of the customer. It means that if customers have the chance to touch the product, then there is 19% more chance that they will get satisfied as compared to other tools being used by the business. On the other hand, 42 percent of the customers gave importance to the gustatory tools being used by the organizations.

In a study conducted by the researcher, researchers proved empirically that Visual, smell and hearing cues of the sensory marketing significantly impact the Behavioral Intention of the consumers. Therefore, we can hypothesize that:

H5: *Visual Cues have a positive impact on the Behavioral Intention*.

H6: *Sound Cues have positive Impact the Behavioral Intention*.

H7: *Smell Cues have positive Impact the Behavioral Intention*.

H8: *Visual Cues have positively impact Customer Satisfaction*

H9: *Sound Cues have a positive Impact on Customer Satisfaction*

H10: *Sound Cues have a positive Impact on Customer Satisfaction.*

2.13. Customer Satisfaction as Mediator

In the studies conducted by scholar, Its evident that Customer satisfaction is significantly impacted by sight, smell and sound cues. Moreover, Smell, visual and sound cues also have an impact on behavioural intention. Additionally, the author mentioned in their study that customer satisfaction has a significant relationship with Behavioral Intention. All these relationships meet the conditions of mediator by Baron and Kenny [40]. Therefore we hypothesize that:

H11: *Customer Satisfaction mediate the relationship between Visual Cues and Behavioral Intention.*

H12: *Customer Satisfaction mediates the relationship between Sound Cues and Behavioral Intention.*

H13: *Customer Satisfaction mediate the relationship between Smell Cues and Behavioral Intention.*

3. RESEARCH FRAMEWORK

Based on the above literature, we have developed the following framework, as shown in Figure 1.

4. METHODOLOGY

In order to address the objectives and research questions of the current study, a survey method is used. A primary research technique is employed taking the questionnaire as a tool for data collection. The structural equation modelling for analysing the structural relation is selected. SEM is a combination of multiple regression and factor analysis and observes the structural relation between the latent and measured constructs as well as the direct and indirect connection between the constructs. Selection of sample size is an important aspect of Structural Equation Modelling. In the process of choosing an appropriate sample size, a sample of 315 is selected for this research. However, in order to avoid response-bias, the sample size has increased to 610. The overall response rate came out to be 62 percent having 384 well addressed questionnaires. Therefore, keeping in view the research capabilities and objectives, SEM-PLS employed for analysing the structural equation modelling. Many contemporary studies have viewed SEM not only as a statistical procedure but also as a process which involves few stages: (1) conceptualizing the model (2) parameter identification (3) model specification (4) estimation of model (5) modification of model and (6) evaluation of parameters. These steps are necessary when carrying out SEM analysis. They are hereby explained in succession. The first stage of any SEM analysis should be for the researcher to conceptualize the model, this entails pointing out which relationships are hypothesized to exist among observed and latent variables. A theoretical model is based on the underlying theory that gave rise to the variables being investigated and should be focused on literature and knowledge on the subject matter. Ideally, in SEM applications, the operationalized theories assume the form of the measured variable path analysis model, that is hypothesized structural or causal relationships among variables that are directly measured. The scale of trust is adopted from the study of Satisfaction from Eggert and Ulaga [41], of repurchase Intention (Behavioral Intention). Eggert and Ulaga [41], of visual, sound and smell from Wiedmann, Labenz [42].

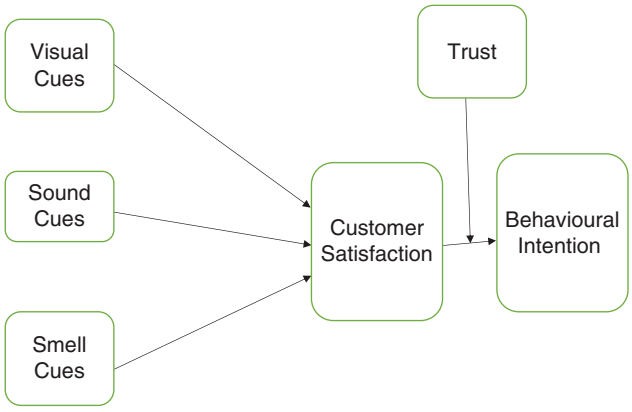

Fig. 1. Theoretical model.

5. ANALYSIS

This analysis was used to establish the nature of the relationship between the independent and dependent variables in this study. Thus, it was used to explain the influence of the independent variables on the dependent variable as theorized in this study. Before testing of hypotheses, the partial Least Square-Structural Equation Modelling is employed to analyse the outer model. A method by Anderson and Gerbing [43] was followed to assess the model. The measurement model of the current study is shown in Figure 2.

It is also very useful in checking the validity of the instrument that will be utilised in the study. Two major forms of factor analysis exist in the area of social science research. The exploratory factor analysis is often used to determine the structure of the items while the component factor analysis is also used to reduce the number of the items. They include exploratory and principal component factor analyses. In this case, the study used the component factor analysis with a varimax rotation as suggested by Kolawole and Torimiro [44], all items loading the acceptable limit are all accepted while those not loading the minimum standard are dropped. Thus, items that lacked to load meet the minimum acceptable limit are not used for further analysis in this study. In addition to this, the study equally ensured that the result of the factor analysis indicates an Eigen value greater than 1. The outer loading values are shown in Table I.

Convergent validity is the extent to which a set of variables intersect to estimate a particular concept. Analyzing the convergent validity requires the simultaneous testing of three criteria, i.e., composite reliability, factor loading, and the average variance extracted. Firstly, the assessment of loadings for all items indicated that all factor loadings are above 0.5, with a significance level of 0.01 percent, showing an acceptable level according to the literature. Secondly, the composite reliability is tested, which refers to the extent to which a group of items invariably explains the latent variables. The Table II contains the values for composite reliability and Cronbach Alpha. The range of Cronbach alpha came out to be 0.890–0.964, and range of composite reliability was 0.759–0.971, which was higher than the recommended range, i.e., 0.7. It is highlighted in Table II.

Fig. 2. Measurement model.

Table I. Outer loadings.

	CS	RPI	SC	SMC	TR	VC
CS1	0.923					
CS2	0.885					
CS3	0.930					
CS4	0.909					
RP2		0.858				
RPI1		0.904				
RPI3		0.911				
SC1			0.910			
SC2			0.862			
SC4			0.926			
SMC1				0.892		
SMC2				0.923		
SMC4				0.908		
SMC5				0.898		
TR2					0.894	
TR3					0.905	
TR4					0.884	
TR5					0.925	
VC1						0.937
VC2						0.917
VC3						0.911
TR1					0.894	

Table II. Reliability analysis.

	Cronbach's alpha	rho_A	Composite reliability	(AVE)
CS	0.933	0.935	0.952	0.832
RPI	0.870	0.871	0.921	0.795
SC	0.883	0.898	0.927	0.810
SMC	0.926	0.927	0.948	0.819
TR	0.942	0.942	0.955	0.811
VC	0.911	0.911	0.944	0.850

The results proclaimed and confirmed the convergent validity. Furthermore, the AVE is also obtained for the outer model in order to assess the convergent validity. It explains the average variance extracted for a set of items in comparison with the shared variance, involving measurement errors. In addition, it determines the variance that the indicators cover in comparison with the variance which is assigned with the measurement errors. If the value of the average value extracted reaches the level of 0.5, then it indicates the adequate convergence of this group of items to determine the required construct. The range of AVE for the present study came out as 0.510–0.919, exhibiting a good validity of the measures.

Developing a discriminant validity is essential to declare the construct validity for the outer model. Therefore, testing of discriminant validity is crucial before the hypotheses testing. A discriminant validity measures the level to which the items of the model differentiate from their constructs. Similarly, the discriminant validity indicated that a number of 111 items had employed different constructs that exhibited no overlapping. Moreover, the shared variance of the measures that exist among each construct must be higher

Table III. Discriminant validity.

	CS	RPI	SC	SMC	TR	VC
CS	0.912					
RPI	0.878	0.891				
SC	0.651	0.703	0.900			
SMC	0.695	0.717	0.911	0.905		
TR	0.881	0.882	0.664	0.674	0.901	
VC	0.626	0.648	0.898	0.885	0.672	0.922

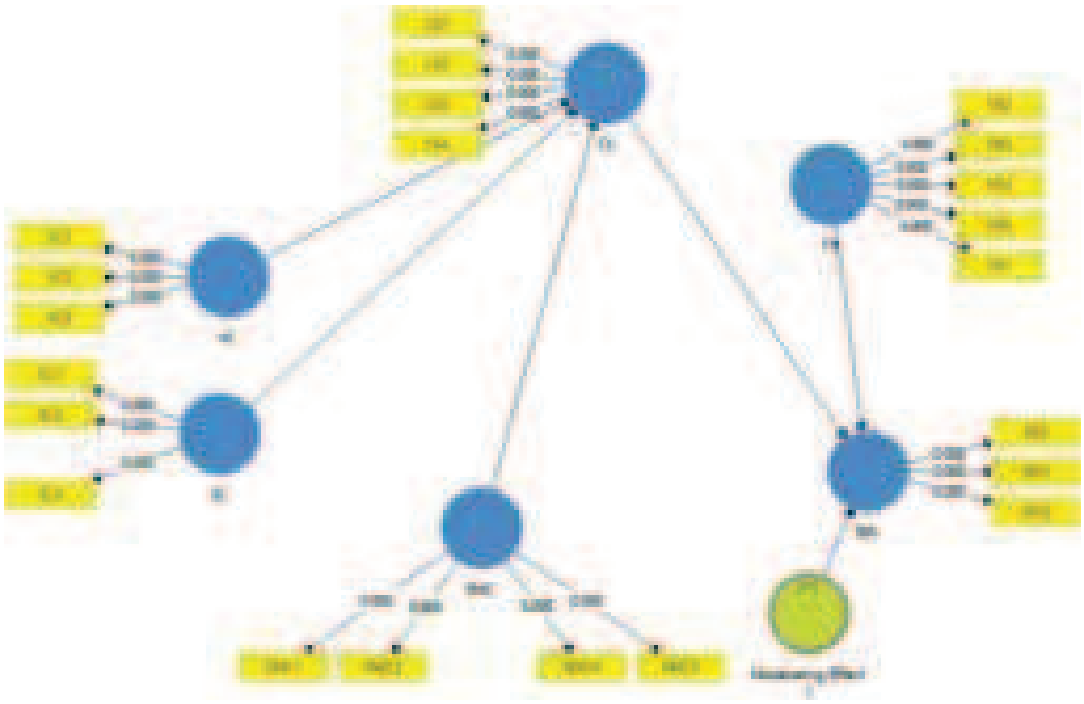

Fig. 3. Structural model.

than the shared variance between the different constructs. The square root of the average variance extracted was then replaced for all the constructs with diagonal elements of the correlation matrix, as mentioned in the Table III. The diagonal elements of the matrix turned out to be greater than the elements of rows and columns, thus, verifying the discriminant validity as presented in Table III.

In light of the measurement of construct validity for the outer model, therefore it is assumed that the results of hypotheses testing must be valid and highly reliable. After the goodness of fit test for the outer model, the hypotheses were tested to assess the nature of the association between the variables. Figure 3 shows the structural model.

The hypotheses testing for the present study is made through PLS Algorithm, employing smart PLS technique.

Table IV. Direct relationships.

	(O)	(M)	(STDEV)	*T*-value	*P* values
CS → RPI	0.489	0.487	0.107	4.554	0.000
SC → CS	0.101	0.094	0.134	4.755	0.000
SC → RPI	0.050	0.049	0.071	4.702	0.000
SMC → CS	0.597	0.608	0.111	5.375	0.000
SMC → RPI	0.292	0.295	0.083	3.534	0.000
TR → RPI	0.385	0.387	0.111	3.467	0.001

Table V. Mediation.

	(O)	(M)	(STDEV)	*T*-value	*P* values
SC → CS → RPI	0.597	0.608	0.111	4.375	0.000
SMC → CS → RPI	0.292	0.295	0.083	3.534	0.000
VC → CS → RPI	0.385	0.387	0.111	4.467	0.001

The results of the direct hypothesis are shown in Table IV.

The mediating effect of customer satisfaction in the relationship between SC, RPI, and SMC, RPI and VC and RPI is shown in Table V.

The moderating effect of trust in the relationship between customer satisfaction and behavioural intention is shown in Table VI.

Under multivariate analysis, the coefficient of determination shows that the predictor variables explain the endogenous variable. Thus, the magnitude of R^2 explains the predictive power of explaining the endogenous variable in the model. Furthermore, following Geisser [45], the sample was reapplied in order to declare the models' predictive validity. Partial Least Square technique is used as it is an appropriate and very well software for reusing the sampling technique [49–50]. *R*-Square value is shown in Table VII.

Table VI. Moderation.

	(O)	(M)	(STDEV)	*T*-value	*P* values
Moderating effect 1 → RPI	0.085	−0.086	0.023	3.727	0.000

Table VII. *R*-square.

	R square
CS	0.485
RPI	0.831

6. CONCLUSION

sensory marketing, the concept of traditional marketing is totally changed. People like to pick the product from the store on the basis of their experience, which is offered to them during their consumption. A number of organizations are adopting sensory marketing strategies to take a competitive advantage over other organizations. Sensory marketing plays a critical role in developing loyalty and intention to rebuy the product from the same company. Moreover, it plays a critical role in developing a positive brand image, as well. The prime objective of the current study is to investigate the impact of sensory marketing cues, namely visual cues sound cues, and smell cues on the behavioural intentions. The second focus of the study is to investigate the mediating role of customer satisfaction in the relationship between sensory marketing cues and behavioural intentions. Lastly, the moderating role of trust in the relationship between customer satisfaction and behavioural intentions. This study is among the pioneering studies on this issue Employing the survey-based methodology; the SEM-PLS technique is used to test the hypothesized relationships. So, the current study has used SEM-PLS as a statistical tool to answer the research questions raised in this study and research objectives envisaged in the current study. The findings of the study have provided support to the theoretical foundation and the proposed hypothesis of the current study. According to the findings of the study, feelings have an effect on various marketing parameters like selection priority of store, store files, satisfaction from product, service and shopping, need based shopping, pleasure-based shopping, time spent in store and decision-making style of the customer. Moreover, customers preferred to use the products based on their feelings, mental satisfaction and emotions related to the product. Both practitioner and researchers agreed that repurchase intention of customers is crucial for the success of hospitality the business because of repurchase intention has an influence on cost savings, which ultimately effect the profitability of the business. Contrary to it, if information technology, retailing and marking used together to create business value it will be more effective for stakeholders.

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RESEARCH ARTICLE

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Entrepreneurial Intentions of Graduation Students in Thailand: Moderating Role of Characteristics of Entrepreneurship Education Programmes

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RESEARCH ARTICLE

This study investigated the entrepreneurial intentions of master students in Thailand and also examined the moderating role of Entrepreneurship Education Programmes (EEP). Data were collected from the final year students of master in business administration (MBA). Top ten universities of Bangkok were selected on the basis of convenient sampling for the data collection on the basis of ranking given by the ministry of education in Thailand. PLS-SEM was used to analysis the data of the study. Results discovered that entrepreneurial behavior, subjective norms, and perceived control behavior (PCB) have a positive role regarding entrepreneurial intentions. Results also revealed that the characteristics of EEP also moderate the relationships in a positive way. This study suggested to the policy makers that they should developed such characteristics in the students that they convert their attention towards the entrepreneurship.

Keywords: Entrepreneurial Intentions, Entrepreneurship Education Programs, Entrepreneurial Behaviour.

1. INTRODUCTION

The increasing trend of training and education provided to the student regarding entrepreneurship has been observed in the modern countries of the world. The initiative of this trend taken by the United States of America (USA) in the 1970s. This EEP not only increases the interest of the university students regarding entrepreneurship education and careers but also increase the awareness of public authorities regarding its importance in the development of the economy [1]. The increasing level of EEP and the resources allocated to these initiatives have played a positive role and generated interest of fund providers, students, and universities regarding the efficiency and effectiveness of these initiatives (Chienwattanasook, and Jermsittiparsert, 2019). Moreover, the nature of EEP is different in various education institution and countries across the world in terms of pedagogical approaches, target audience, objectives, and format. Thus, there is a need to make a framework that is common for all types of institutions for the evaluation, improvement, and comparison of these programs across the world. But at the first stage, such as in developing countries, only need to apply effective EEP in the education institutions of the country [2]. Therefore, a strong and effective EEP is needed in the developing countries of the world to enhance their economies because EEP enhances the interest of students and institution regarding entrepreneurial education. As a result, trained, educated and skilled entrepreneur enter in the market and develop new and effective enterprises that enhance the economy of the country [3].

Thus, EEP has the direct as well as indirect impact of the economic development, and many of the researchers investigated the EEP and its issue of complexity but still it is an exploring area for the developing countries such as Thailand. There is a need for developing countries where the entrepreneurship is ignoring by the universities and the public authorities due to lack of facilities and funds. To develop the economy of the developing country, there is much need to increasing the trend of entrepreneurship in the country. Same in the case of Thailand, entrepreneurship is a very ignoring area in the field of education as well as the field of practical entrepreneurship. The reason behind it the lack of funds and facilities that must be provided by the universities or public institutions due to which they cannot develop the interest of student towards entrepreneurship. Now it is necessary for the developing economies that they launch the EEP that enhanced the interest of authorities and students regarding the entrepreneurship education. Therefore, this study investigated the entrepreneurial intentions of the master

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student in Thailand with the help of the factors already exist in the environment, such as entrepreneurial behavior, subjective norms, and perceived control behavior. Moreover, this study also examined the moderating role of EEP on the relationship of these factors and entrepreneurial intentions of the students.

2. LITERATURE REVIEW

The literature about the variables that are used in the study and their relationships with each other are mentioned in this section, along with the hypotheses of the study.

2.1. Entrepreneurial Intentions

It refers to the interest and intentions of the students towards entrepreneurial education and also includes the interest of people to join the practical field of entrepreneurship. Moreover, it also refers to the willingness of university students to join the entrepreneurship not only for education purpose but also for the practical experience after getting an education [4]. Furthermore, entrepreneurial intentions mean that students get admission in the field of entrepreneurship and carry this field for future experiences in the practical field. Similarly, the entrepreneurial intention is the development of student's inclination about entrepreneurial education by showing its benefits and also by providing the facilities and funds. Likewise, a study by Zhao, Seibert [5] defined that the entrepreneurial intentions are the development predisposition in the students of the university that they take an interest in the entrepreneurial subject and also join entrepreneurship as a practical field. Thus, entrepreneurial attention is necessary for the improvement of the economy of the country, and this study takes this variable as the main construct of the study [6–23].

2.2. Attitude Towards Entrepreneurial Behaviour

It refers to the attitude of the people regarding entrepreneurship education and the practical field of entrepreneurship. Moreover, it also refers to the behavior of the people about entrepreneurship education and the practical field of entrepreneurship [24]. Similarly, "entrepreneurial behavior underlies the inclination to undertake invention and innovation, including the creation of something new as well as the distribution and adoption of the new throughout society" [25]. Moreover, it also means the behavior of the students and their parents about entrepreneurship education and the practical field of entrepreneurship. Likewise, entrepreneurial behavior means the interest of the students and their parents about entrepreneurship education and the practical field of entrepreneurship. Furthermore, a study by Lüthje and Franke [26] defined the entrepreneurial education as "a preference for changing the status quo over maintaining it based on relatively greater satisfaction generated by novel information over redundant information." Thus, entrepreneurial behavior is necessary for the capture the intension of the students towards entrepreneurship, and this study take this variable as the predictor in the study.

2.3. Subjective Norms

It refers to the personal belief of the people to do or not to do anything being a part of society. Moreover, it also refers to the "perceived social pressure to perform or not perform a particular behavior. Social rules for how people should and should not use technology" [27]. Furthermore, it means the student's norms to join or not join the subject of entrepreneurship. Similarly, it also defined as "the personal belief that others have expectations that one should behave in a certain way. The belief influences one to behave that way" [28]. Thus, subjective norms are necessary for the capture the intention of the students towards entrepreneurship, and this study take this variable as the predictor in the study.

2.4. Perceived Behavioral Control

It refers to the student's perceptions regarding their abilities that they perform in the given behavior. Moreover, "PBC refers to people's perceptions of their ability to perform a given behavior. Drawing an analogy to the expectancy-value model of attitude, it is assumed that perceived behavioral control is determined by the total set of accessible control beliefs such as beliefs about the presence of factors that may facilitate or impede the performance of the behavior" [29]. Similarly, PCB defined as the observation of the students about their abilities to do anything in a given set of behavior. Likewise, Godin, Valois [30] defined the PCB as the "person's perception of the ease or difficulty of performing the behavior of interest." Thus, PBC is necessary for the capture the intention of the students towards entrepreneurship, and this study take this variable as the predictor in the study.

2.5. Entrepreneurship Education Programmes (EEP)

EEP refers to the programs that facilitate and develop the interest of the students regarding the education of entrepreneurship. These programs give the facilities regarding the entrepreneur education and also provide the facilities to develop new business [31]. Moreover, "entrepreneurship education and training programs around the world, improving the field of entrepreneurship education and training." Similarly, EEP is the programs that motivate the students towards the entrepreneurship by providing the facilities, knowledge, and training to the university student that they become a successful entrepreneur [32]. Likewise, a study by Souitaris, Zerbinati [33] conducted on the training and education programs of entrepreneurship. Moreover, they defined that "EEP in a wide sense as any pedagogical programs or process of education for entrepreneurial attitudes and skills, which involves developing certain personal qualities."

They also defined that EEP develops an interest in the student about entrepreneur education and entrepreneurship. Thus, EEP is necessary for the capture the intention of the students towards entrepreneurship, and this study take this variable as the moderator in the study.

2.6. Attitude Towards Entrepreneurial Behaviour and Entrepreneurial Intentions

The attitude of the people regarding entrepreneurial behavior has moved their intentions towards entrepreneurial education and entrepreneurship [34]. Moreover, it is human psychology that they must join the field and education that suit to their behaviors. They did not go beyond their behavioral attitudes. If the people have attitudes regarding entrepreneurial behavior, then there are strong chances of diversion of intentions towards the entrepreneurship. Similarly, a study by Sondari [35] conducted on entrepreneurial behavior and examined that if the entrepreneurship attitudes exist in the behavior of the people, then they have strong intentions towards the entrepreneurship education and entrepreneurship. Likewise, entrepreneurial intentions are affected by the strong attitude about entrepreneurial behavior in a positive sense [36]. The previous literature showed that attitudes of the people regarding entrepreneurial behavior have a positive association with their intention of entrepreneurship. Thus, this study is going to investigate the association among the attitudes regarding behaviour of entrepreneurship and entrepreneurial intention of the university students in Thailand. Therefore, this study developed the hypothesis is as follow:

H1: There is a positive association between attitude towards entrepreneurial behavior and entrepreneurial intentions.

2.7. Subjective Norms and Entrepreneurial Intentions

The subjective norms of the society and people both also affected the intentions of the people about entrepreneurship. Moreover, the personal beliefs of the student and their parents both can modify the intentions of the students regarding entrepreneurship [37]. In addition, the entrepreneurial intentions of the students can be affected by the social norms of the society and the individual itself. Positive norms about entrepreneurship can move the intention of the students towards the entrepreneurship, but on the other hand, negative norms about entrepreneurship have an adverse impact on the entrepreneurial intentions of the students. Additionally, subjective norms of the student have affected the selection of the subject at education level and also affected the selection of practical field after the education [38]. A study also investigated the positive association between subjective norms and entrepreneurial intentions. The previous literature showed that subjective norms have a positive association with their intention of entrepreneurship. Thus, this study is going to investigate the association among the subjective norms and entrepreneurial intention of the university students in Thailand. Therefore, this study developed the hypothesis is as follow:

H2: There is a positive association between subjective norms and entrepreneurial intentions.

2.8. Perceived Behavioral Control and Entrepreneurial Intentions

The intentions of the entrepreneurial cab are affected by the behavioral control of the student. Moreover, the PCB of the student and their parents both can modify the intentions of the students regarding entrepreneurship [39]. Furthermore, PBC of the student has affected the selection of the subject at the education level and also affected the selection of practical field after the education. In addition, PCB of the people has a positive association with the intentions of entrepreneurship [40]. The previous literature showed that PBC has a positive association with their intention of entrepreneurship. Thus, this study is going to investigate the association among the PBC and entrepreneurial intention of university students in Thailand. Therefore, this study developed the hypothesis is as follow:

H3: There is a positive association between PCB and entrepreneurial intentions.

2.9. Moderating Role of Entrepreneurship Education Programmes (EEP)

EEP can enhance the intention of the students about entrepreneurship and also the ability to moderate the relationship between the attitudes regarding entrepreneurial behavior and intentions of entrepreneurship [41]. Moreover, EEP provides the facilities to the students that it modify the attitudes and behavior of the students towards entrepreneurial education and also the selection of the entrepreneurship field after the study. In addition, EEP may tune-up the association among the attitudes of the students about entrepreneurial behavior and student's intention about entrepreneurship. The previous literature suggested that EEP may play a moderating role between the entrepreneurial behavior and intention of entrepreneurship. Thus, this study is going to investigate the moderating role of EEP between the attitudes of entrepreneurial behavior and intention of entrepreneurship of the university students in Thailand. Therefore, this study developed the hypothesis is as follow:

H4: EEP moderates the association between attitudes of entrepreneurial behavior and entrepreneurial intentions.

EEP can enhance the intention of the students about entrepreneurship and also the ability to moderate the relationship between the subjective norms and intentions of entrepreneurship. Similarly, EEP changes the minds of the students and also their subjective norms about entrepreneurial intentions [42]. Moreover, EEP provides

the facilities to the students that it modifies the subjective norms of the students towards entrepreneurial education and also the selection of the entrepreneurship field after the study. In addition, EEP may tune-up the association among subjective norms of the students about entrepreneurial behavior and student's intention about entrepreneurship [43]. The previous literature suggested that EEP may play a moderating role between the subjective norms and intention of entrepreneurship. Thus, this study is going to investigate the moderating role of EEP between the subjective norms and intention of entrepreneurship of university students in Thailand. Therefore, this study developed the hypothesis is as follow:

H5: EEP moderates the association between subjective norms and entrepreneurial intentions.

EEP can enhance the intention of the students about entrepreneurship and also the ability to moderate the relationship between PBC and intentions of entrepreneurship. Likewise, the behavior of the students can be changed by the EEP and also change their intentions about entrepreneurship [44]. Moreover, EEP provides the facilities to the students that it modify the attitudes and behavior of the students towards the entrepreneurial education and entrepreneurship field. In addition, EEP may tune-up the association among the attitudes of the students about PBC and student's intention about entrepreneurship [45]. The previous literature suggested that EEP may play a moderating role between the PBC and intention of entrepreneurship. Thus, this study is going to investigate the moderating role of EEP between the PBC and intention of entrepreneurship of university students in Thailand. Therefore, this study developed the hypothesis is as follow:

H6: EEP moderates the association between PBC and entrepreneurial intentions.

3. RESEARCH METHODS

This study used deducted approach because the main purpose of the study is to predict the dependent variable with other variables. It also selects the top ten universities of Bangkok on the basis of convenient sampling for the data collection on the basis of ranking given by the ministry of education in Thailand. Out of these ten universities; five universities are under private control, and five universities are under government control. The students of MBA are the respondents of the study. Around 600 students are studying MBA courses in these universities. A survey adopted questionnaire was distributed among the students for data collection. Five-point Likert scale was used to answer the items of the questionnaire.

3.1. Measures

All the variables used by the study are uni-dimensional, and several items such as entrepreneurial intention used as the main variable and have three items. While, the attitude of entrepreneurial behavior, subjective norms, and perceived behavior control used as predictors and has thirty-two items, six items, and six items, respectively. Moreover, EEP used as a moderating variable in the study and has five items. Five-point Likert scale was used to answer the items of the questionnaire.

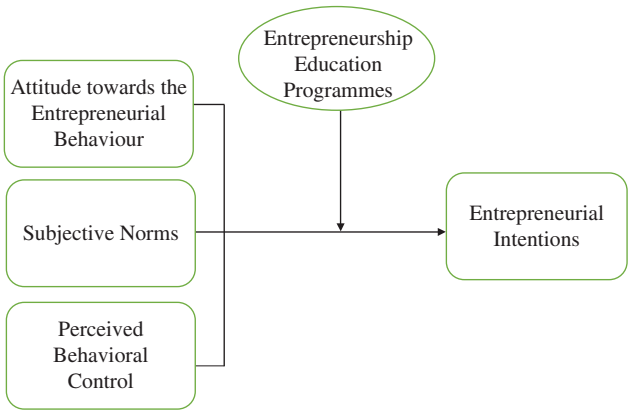

Fig. 1. Theoretical framework.

3.2. Data Collection Procedure

The top ten universities situated in Bangkok was selected by taking the ranking list from the ministry of education in Thailand. The students of MBA final year was selected as the respondents of the study who take entrepreneurship specialization. Total 600 students are studying MBA with entrepreneurship specialization in these top ten universities of Bangkok. A survey adopted questionnaire was distributed among the students for data collection by personal visit the universities. After fifteen days, only 475 questionnaire returned from the respondents. Out of them, fifteen questionnaire were not responded correctly and eliminated from the analysis. Finally, the remaining 460 valid responses were used for analysis that represented approximately 76.66% response rate. Additionally, framework of the study is given in Figure 1.

4. RESULTS

Table I of the study showed that the convergent validity of the data is perfect because all the loading of the items is greater than 0.60. The value of Alpha is also greater than 0.70 for all the contracts, and composite reliability (CR) is also greater than 0.70, and AVE of all the variables are also greater than 0.50.

Tables II and III of the study showed the discriminant validity of the constructs. The old criteria are Fornel Larcker, and according to these criteria, discriminant validity has no issue because the first value is greater than the rest of the values.

Table IV of the study also showed the discriminant validity of the constructs. The new criteria are

Table I. Convergent validity.

Constructs	Items	Loadings	Alpha	CR	AVE
Attitude towards entrepreneurial behavior (ATEB)	ATEB1	0.673	0.941	0.945	0.531
	ATEB10	0.663			
	ATEB11	0.699			
	ATEB12	0.666			
	ATEB14	0.714			
	ATEB15	0.567			
	ATEB18	0.642			
	ATEB19	0.626			
	ATEB2	0.617			
	ATEB20	0.624			
	ATEB21	0.600			
	ATEB22	0.613			
	ATEB25	0.643			
	ATEB26	0.756			
	ATEB27	0.711			
	ATEB28	0.690			
	ATEB29	0.703			
	ATEB3	0.651			
	ATEB30	0.699			
	ATEB5	0.683			
	ATEB6	0.598			
	ATEB7	0.592			
	ATEB9	0.628			
Entrepreneurship education programmes (EEP)	EEP1	0.743	0.700	0.813	0.523
	EEP2	0.773			
	EEP4	0.754			
	EEP5	0.611			
Entrepreneurial intentions (EI)	EI1	0.895	0.657	0.810	0.590
	EI2	0.668			
	EI3	0.724			
Perceived behavior control (PBC)	PBC1	0.888	0.874	0.906	0.617
	PBC2	0.837			
	PBC3	0.682			
	PBC4	0.759			
	PBC5	0.827			
	PBC6	0.701			
Subjective norms (SN)	SN1	0.921	0.923	0.943	0.767
	SN2	0.929			
	SN3	0.879			
	SN5	0.772			
	SN6	0.870			

HTMT ratio, and according to these criteria, discriminant validity has no issue because the values are less than 0.85. Additionally, measurement model is shown in Figure 2.

Table II. Fornel larcker.

	ATEB	EEP	EI	PBC	SN
ATEB	0.656				
EEP	0.222	0.723			
EI	0.572	0.172	0.768		
PBC	0.679	0.145	0.515	0.786	
SN	0.606	0.238	0.432	0.481	0.876

Table III. Cross loading.

	ATEB	EEP	EI	PBC	SN
ATEB1	**0.673**	0.089	0.501	0.722	0.348
ATEB10	**0.663**	0.078	0.333	0.43	0.357
ATEB11	**0.699**	0.126	0.361	0.483	0.36
ATEB12	**0.666**	0.142	0.425	0.448	0.329
ATEB14	**0.714**	0.143	0.384	0.49	0.365
ATEB15	**0.567**	0.208	0.242	0.235	0.36
ATEB18	**0.642**	0.207	0.253	0.29	0.431
ATEB19	**0.626**	0.165	0.241	0.293	0.381
ATEB2	**0.617**	0.167	0.321	0.494	0.641
ATEB20	**0.624**	0.163	0.266	0.285	0.336
ATEB21	**0.6**	0.069	0.326	0.28	0.257
ATEB22	**0.613**	0.052	0.33	0.365	0.339
ATEB25	**0.643**	0.105	0.31	0.304	0.333
ATEB26	**0.756**	0.156	0.403	0.435	0.449
ATEB27	**0.711**	0.182	0.337	0.393	0.488
ATEB28	**0.69**	0.143	0.379	0.38	0.413
ATEB29	**0.703**	0.166	0.303	0.435	0.442
ATEB3	**0.651**	0.141	0.522	0.646	0.406
ATEB30	**0.699**	0.185	0.328	0.39	0.436
ATEB5	**0.683**	0.156	0.497	0.702	0.411
ATEB6	**0.598**	0.211	0.41	0.382	0.445
ATEB7	**0.592**	0.182	0.391	0.381	0.41
ATEB9	**0.628**	0.169	0.409	0.469	0.418
EEP1	0.197	**0.743**	0.117	0.131	0.216
EEP2	0.167	**0.773**	0.15	0.049	0.186
EEP4	0.147	**0.754**	0.136	0.144	0.19
EEP5	0.133	**0.611**	0.079	0.115	0.066
EI1	0.582	0.206	**0.895**	0.52	0.362
EI2	0.28	0.033	**0.668**	0.29	0.167
EI3	0.387	0.109	**0.724**	0.328	0.433
PBC1	0.596	0.153	0.428	**0.888**	0.477
PBC2	0.563	0.052	0.388	**0.837**	0.413
PBC3	0.507	0.157	0.373	**0.682**	0.28
PBC4	0.589	0.104	0.482	**0.759**	0.381
PBC5	0.49	0.136	0.388	**0.827**	0.413
PBC6	0.419	0.077	0.34	**0.701**	0.275
SN1	0.496	0.207	0.377	0.408	**0.921**
SN2	0.532	0.172	0.389	0.439	**0.929**
SN3	0.619	0.282	0.398	0.47	**0.879**
SN5	0.595	0.209	0.336	0.43	**0.772**
SN6	0.417	0.172	0.388	0.362	**0.87**

Table V showed that positive association between the entrepreneurial intentions and all predictors such as attitude towards entrepreneurial behavior, subjective norms, and PBC. Moreover, EEP also significantly moderate the relationships among attitude towards entrepreneurial behavior and entrepreneurial intentions, subjective norms and entrepreneurial intentions, PBC, and entrepreneurial intentions.

Table IV. HTMT ratio.

	ATEB	EEP	EI	PBC	SN
ATEB					
EEP	0.280				
EI	0.656	0.222			
PBC	0.704	0.193	0.644		
SN	0.653	0.282	0.535	0.532	

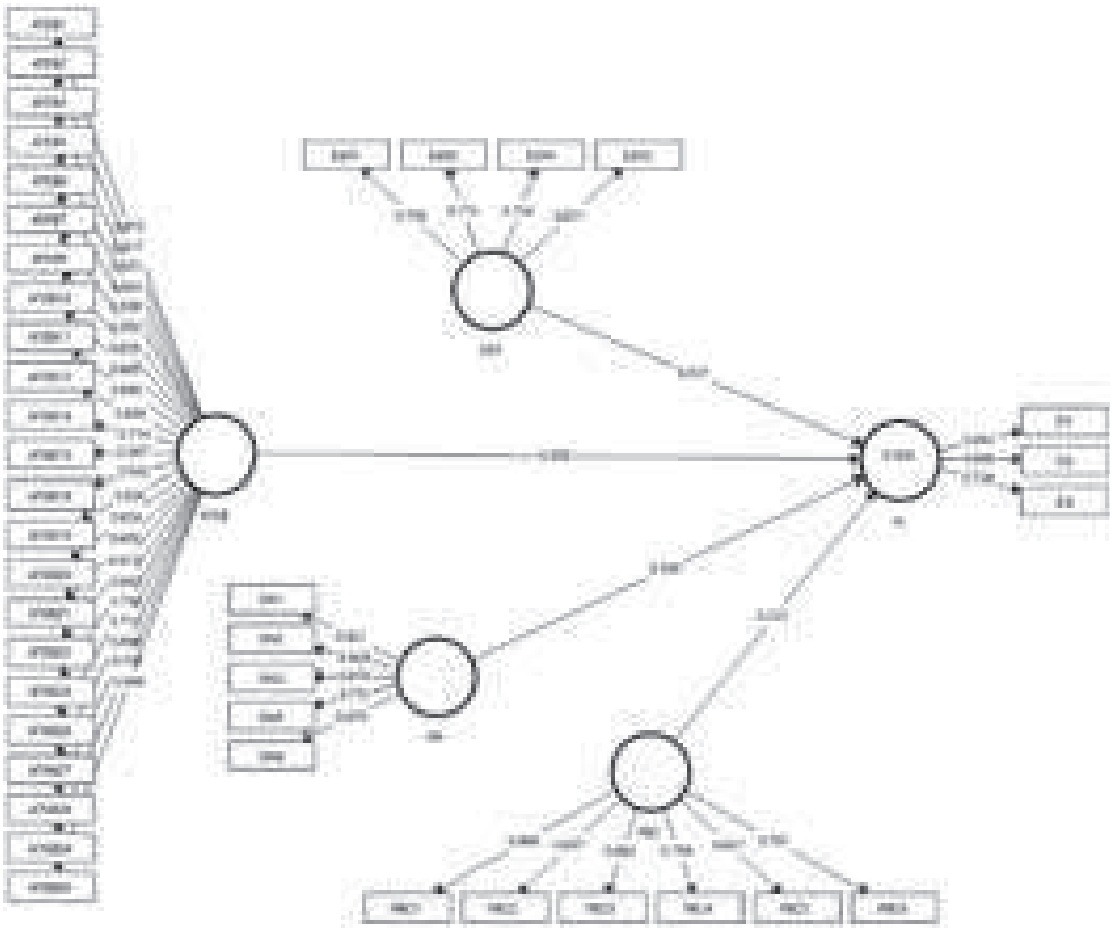

Fig. 2. Measurement assessment model.

Table V. Path analysis.

	Original sample (O)	Sample mean (M)	Standard deviation	*T* statistics	*P* values
ATEB → EI	0.347	0.358	0.068	5.145	0.000
EEP → EI	0.033	0.044	0.048	5.152	0.000
PBC → EI	0.224	0.224	0.062	3.593	0.000
SN → EI	0.103	0.095	0.064	2.654	0.000
Moderating effect 1 → EI	0.018	−0.023	0.086	3.145	0.000
Moderating effect 2 → EI	0.009	−0.001	0.071	4.125	0.000
Moderating effect 3 → EI	0.003	0.009	0.067	4.223	0.000

5. DISCUSSIONS

Entrepreneurship is the global requirement nowadays, especially in developing countries such as Thailand. Thus, this study examined the entrepreneurial intentions of MBA students of the top ten universities in Bangkok. Results showed that the attitude of the students about entrepreneurial behavior moves the intention towards entrepreneurship. These results are matching with results of Kusmintarti, Thoyib [46] who also examined the positive association between them. Moreover, Results exposed that subjective norms about entrepreneurship also move the intention towards entrepreneurship. These results are similar to the results of, who also investigated the positive association between them. Furthermore, Results indicated that perceived behavior control move the intention towards entrepreneurship. These results are also matching with results of Walker, Jeger [47] who also examined the positive association between them.

The results also revealed that EEP mediates the association among the attitude of the students about entrepreneurial behavior and intention towards entrepreneurship. Similarly, a study by Smith, Collins [48] also found that the EEP programs have the ability to modify the behavior of the students towards entrepreneurship. In addition, the results also discovered that EEP also mediates the association among the subjective norms and intention towards entrepreneurship. Likewise, a study by also examined that the EEP programs have the ability to modify the subjective and social norms of the students towards entrepreneurship. Additionally, by following most prominent SEM technique [50], results also exposed that EEP mediates the association among control behavior and intention towards entrepreneurship. Similarly, also found

the EEP programs have the ability to modify the PBC of the students towards entrepreneurship.

Finally, this study concluded that entrepreneurial intentions could be affected by entrepreneurial behavior, subjective norms, and the control behavior. These elements are important for entrepreneurial activity [51]. Moreover, it also concluded that EEP is also have the ability to positively change this relationship by providing the facility and knowledge to the student about entrepreneurship. It also suggested to the policymakers that they should arrange many EEP with continues interval that motivate the students towards entrepreneurship. It also suggested to the new researcher that they add more factors in their study that affected the entrepreneurial intentions of the students. It also recommended that future researchers must add other universities and cities of Thailand under investigation. Finally, it also suggested that comparative study of different universities and countries is also an emerging topic for future researchers.

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RESEARCH ARTICLE

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The Attitude of Graduation Students Towards the Entrepreneur Education: A Case Study of University Students in Thailand

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This study investigated the attitudes of graduation students regarding entrepreneur education in Thailand. Data were collected form the Master of Business Administration (MBA) students of three public and three private universities in the city of Bangkok of Thailand by applying convenient sampling. PLS-SEM was used to analysis the data. The results revealed that the students how to have the ability to take the extensive risk, have self-efficacy regarding entrepreneur and have feasibility in terms project startup have a positive attitude towards entrepreneurship than the students who did not have these facilities. This study provides the guideline to the police makers, universities, and the government of the country that provides these type of facilities to their students that they take much interest in the entrepreneur education.

Keywords: Entrepreneurship, Entrepreneur Education, Public Universities, Private Universities.

RESEARCH ARTICLE

1. INTRODUCTION

Currently, the major requirement for the MBA programs in the Asian countries that they should adopt the dramatic changes in global business. Essentially, they should adopt the management competencies that are the major requirement for success as a future manager of the business. However, the quality of higher education, especially MBA programs, is the widespread concern nowadays not only for the Asian countries but also for the whole world. In most of the Asian countries, particularly Thailand, to obtain the degree of MBA is too easy and that is the reason, most of the academic researcher often criticized the education and training that are provided to the MBA students [1]. Conversely, most of the scholars acknowledged that economic growth is associated with particular types of entrepreneurship [2, 3]. Thus, there should be a need that more academic entrepreneurs are employing than non-academic entrepreneurs. The academic entrepreneurs make a bigger investment than the non-academic entrepreneurs in the business. Furthermore, the firms of academic entrepreneurs perform better than the firms of non-academic entrepreneurs.

Academic entrepreneurs are considered more experienced than non-academic entrepreneurs in the business. Moreover, academic entrepreneurs have a verity of knowledge regarding business matters than non-academic entrepreneurs. These are the reasons; the academic entrepreneurs affect the economy of the world. Based on all above-mentioned characteristics of academic entrepreneurs, most of the policy makers declare that the advancement and sensitization depend upon the outcome of the educational institutions (Chienwattanasook, and Jermsittiparsert, 2019). Resultantly, a comprehensive range of efforts regarding entrepreneurship education has been taken by the education institutions of the world.

Entrepreneurship education brings advancement and innovation to meet the global challenges that are currently existing in the business environment. Educated entrepreneurs have enough knowledge regarding business concerns, and after getting reasonable experience, they become able to improve the activities of the business and meet the global challenges that are essential nowadays for the businesses. Therefore, the researcher and policy makers recommended that the education of entrepreneurship is essential nowadays for survival in the global market. Thus, this paper investigated the MBA programs in terms of their student's attitude towards the entrepreneurship and also investigated the facilities that are provided to the MBA students regarding entrepreneur education.

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2. LITERATURE REVIEW

Review of literature regarding the variables and their relationships that are used in the study are mentioned in this section.

2.1. Attitude Towards Entrepreneurship

It refers to the interest of students regarding entrepreneurship education while studying in the university and its implementation after university. Previous literature acknowledged that the education, knowledge, and skills regarding entrepreneurship that is provided by the educational institution in their students play a vital role in the building of entrepreneurial capacity [4]. There is a reasonable expansion has been observed in the programs of entrepreneurship globally in recent years. Although only participation is not enough in the building of strong entrepreneurship for the businesses [5]. Moreover, it is the belief of the researcher that education is the best instrument that students must equip with essential skills and knowledge that must require in the working environment. It is an emerging area and needs an ongoing debate about the important components of entrepreneurship education is necessary. Furthermore, a study by Jack, Dodd [6] mentioned that entrepreneurship education is a very difficult area for the students in terms of complexity, contingency, and variability. The main outcome of the entrepreneurship education is to develop the skills and knowledge in the students that is necessary for the establishment of a successful business. However, there are three prime goals of entrepreneurship education such as "develop a wide understanding of entrepreneurship, acquire an entrepreneurial mindset as well as how to start and operate an enterprise effectively." It requires innovation, as innovation has central role in any activity [7]. Existing knowledge regarding entrepreneurship education needs to improve further to develop a successful enterprise in Thailand. Moreover, it continues the question that entrepreneurship education is successful for providing reasonable knowledge to the students and it is beneficial for the business or not. Thus, this study also take the attention of students regarding entrepreneurship as a main construct and going to analysis the factors that are affecting the student entrepreneurship attentions.

2.2. Risk Preference

It refers to the ability of the students to take the risk regarding the entrepreneurship education and after that to implement that knowledge to the practical environment [8]. Moreover, there are two types of students according to risk preference exist in the university. One is risk-averse, and second is a risk taker. Risk-averse students are those who do not prefer to take an extra risk or avoid the risk. Risk taker students are those who prefer to take extra risk. The students who are risk taker are more interested in entrepreneurship education than the students who are risk averse [9]. Similarly, a study by Fairlie and Holleran [10] conducted on risk preference and entrepreneurship education and mentioned that risk preference refers to the student's willingness to take a risk in terms of selecting the appropriate subject not only for the education purpose but also for their future practical requirements. Likewise, the selections of the subject also depend on the choice of the student, and this choice varies by the students risk preference [11]. Furthermore, risk preference is the risk-taking the ability of the students that they in the selection of the field of study and this ability also brings them to the future practical environment [12]. Therefore, risk preference is important for the selection of the subject or the field of study. Thus, this study also takes the risk preference of the students as a predictor that may affect the attention of the students in selecting the entrepreneurship education [13–37].

2.3. Entrepreneurial Self-Efficacy

Self-efficacy refers to the beliefs of the people regarding their capabilities that produce a high level of achievement and performance that influence the events and affect the lives [38]. It determines how people think, feels, behaves, and motivate themselves for any type of activity in their life. The people who have a durable sense of self-efficacy can enhance personal well-beings and human accomplishment in better and many ways [39]. Moreover, the people who have excessive assurance regarding their capabilities can also approach problematic tasks and taking them as challenges rather than threats. Furthermore, self-efficacy defined as the confidence of individuals regarding their capacity to behave necessary that produce designated performance [40]. Similarly, entrepreneurial self-efficacy refers to the ability and confidence of the students regarding the matters of entrepreneur education and entrepreneurship [41]. Likewise, a study by Izquierdo and Buelens [42] conducted on entrepreneurial self-efficacy and defined that entrepreneurial self-efficacy refers to the confident of the student for the selection of entrepreneur education and the ability of the student that they survive in the entrepreneurship field in the future. Therefore, entrepreneurial self-efficacy is important for the selection of the subject or the field of study. Thus, this study also take the entrepreneurial self-efficacy of the students as a predictor that may affect the attention of the students in selecting the entrepreneurship education.

2.4. Feasibility of Start-Up Project

Feasibility of a start-up project is referred to the confidence, knowledge, and experience of the people that make confident to them that the project, they are going to start is feasible in all respect. There are no chances of failure in the project that they are going to start [43]. Moreover, the feasibility of beginning the project means the confidence of the people that starting a project is feasible, and

the lack of chances of failure. Similarly, the feasibility of any project gives the confidence to the investor regarding the safety of their investment in that particular project. Similarly, feasibility regarding entrepreneur education and entrepreneurship give the confidence to the students that they select the field of entrepreneurship [44]. Likewise, a study by Archibald, Di Filippo [45] conducted on project feasibility and mentioned that the feasibility means easiness of doing something and feasibility of project means easiness of start and run the project. While in terms of entrepreneurship the feasibility means that the easiness of being getting education about entrepreneur and then easiness in the practical field of entrepreneurship [46]. Therefore, the feasibility of a start-up project is important for the selection of the subject or the field of study. Thus, this study also take the feasibility of start-up project of the students as a predictor that may affect the attention of the students in selecting the entrepreneurship education.

2.5. Risk Preference and Attitude Towards Entrepreneurship

The decision of students regarding the selection of entrepreneur education and selection the field of entrepreneurship depends upon the risk preference [47]. The students who are risk-averse by nature or university develop this characteristic in their nature are not interested in joining the field of entrepreneurship. On the other hand, the students who are a risk taker by nature or university develop this characteristic in their nature are very keen to join the field of entrepreneurship. Moreover, a study by Barbosa, Kickul [48] conducted the study on entrepreneur education and found that the attention of students towards entrepreneur education depends upon their risk preference. More risk associated students are attached to the field of entrepreneur education and entrepreneurship. Similarly, risk preference is the major element that are very prominent in the selection of the field of study and the practical field experience. A lot of risks attached to the entrepreneurship field, and only those are survival that is a risk taker and handle the risk perfectly [49]. Likewise, a study by Brachert, Hyll [50] found that risk attitudes of the students are the major element of selection the entrepreneur education and entrepreneurship field. The students whose attitudes are risk averse cannot join entrepreneurship while the students whose attitudes are risk taker are very keen to join entrepreneurship field. Therefore, risk preference is important for the selection of the subject or the field of study. Thus, this study also checks the link between risk preferences of the students with the attention of the students in selecting the entrepreneurship education. On this basis, the current study developed the following hypothesis:

H1: There is a positive association between risk preferences and attitude towards the entrepreneurship of the students in Thailand.

2.6. Entrepreneurial Self-Efficacy and Attitude Towards Entrepreneurship

The self-efficacy of students regarding entrepreneurial also has a positive impact on the attitudes of the students towards the entrepreneurship [51]. The students who have confidence about the entrepreneur education and entrepreneurship also have a positive attitude in the selection of entrepreneurship field, while the students who have less confidence about the entrepreneur education and entrepreneurship also have less attitude in the selection of entrepreneurship field [52]. Similarly, a study by Neck, Neck [53] investigated that entrepreneurial self-efficacy is an important element in the selection of entrepreneur education and entrepreneurship. Most self-efficacy students are more confident, and high confidence leads the risk taker and the student who takes more risk always select the entrepreneur education and entrepreneurship. In contrast, lack of self-efficacy in the students are creating low confidence, and low confidence leads the risk-averse, and the student who takes low risk are very hesitated in the selection of entrepreneur education and entrepreneurship. Likewise, self-efficacy of students regarding entrepreneurial has a positive association with the attitudes of the students towards the entrepreneurship. This positive association shows that the institutions must create the self-efficacy in the students regarding entrepreneurial that they join the entrepreneur education and after getting the education they will play their role in the field of entrepreneurship [54]. Therefore, entrepreneurial self-efficacy is important for the selection of the subject or the field of study. Thus, this study also checks the link between entrepreneurial self-efficacy of the students with the attention of the students in selecting the entrepreneurship education. On this basis, the current study developed the following hypothesis:

H2: There is a positive association between entrepreneurial self-efficacy and attitude towards the entrepreneurship of the students in Thailand.

2.7. Feasibility of Start-Up Project and Attitude Towards Entrepreneurship

The feasibility of the starting of any project can increase the attitudes of students and other people towards that project [55]. Similarly, if the students have the feasibilities regarding the entrepreneurship, they take more interest in the education of entrepreneurship. While, if the students feel that there is no feasibility of any business in the future, then they hesitate to join the entrepreneur education [56]. Likewise, a study by Laukkanen [57] examined that the confidence of the students regarding the selection of entrepreneur education can be enhanced by providing the feasibility of the starting the projects in the practical field of entrepreneurship. Moreover, feasibility regarding starting the projects provides confidence to the students in the selection of the entrepreneur education and entrepreneurship [58]. Thus, feasibility regarding starting

the projects has a positive association with the selection of entrepreneur education and entrepreneurship [59]. Therefore, feasibility regarding starting the projects is important for the selection of the subject or the field of study. Thus, this study also checks the link between feasibility regarding starting the projects of the students with the attention of the students in selecting the entrepreneurship education. On this basis, the current study developed the following hypothesis:

H3: There is a positive association between feasibility regarding starting the projects and attitude towards the entrepreneurship of the students in Thailand.

3. RESEARCH METHODS

This study selected the three public sectors and three private sector universities that are situated in Bangkok based on convenient sampling approach. The survey questionnaire was used to collect data from the respondents. MBA students of theses selected universities are the respondents of the study. There is a total of 300 MBA students studying in these selected six universities. Five-point Likert scale was used to answer the questions of the adopted questionnaire. The deducted approach of the research was used because the purpose of this study is to test the hypotheses that are developed in the previous section.

3.1. Measures

This study used the attitudes of students towards entrepreneurship as the dependent variable. It is a uni-dimensional variable and has five items [60]. Moreover, risk preference, entrepreneurial self-efficacy, and feasibility of a start-up project used as predictors in the study. All of the predictors are uni-dimensional variables and have six items, twenty items, and six items, respectively [60]. Five-point Likert scale was used to answer all the items of the study.

3.2. Data Collection Procedure

This study selected the three public sectors and three private sector universities that are situated in Bangkok based on convenient sampling approach. There is a total of three hundred MBA students studying in these selected six universities. The questionnaire was distributed to the students by personal visit to their classes. Three hundred questionnaire were distributed to the students, but two hundred and fifty responses were returned from the students. Out of these two hundred and fifty responses, thirty responses are not meet the standard and eliminated from the analysis, and remaining two hundred and twenty responses were used for analysis. The response rate was around 73.33%. Moreover, framework of the study is shown in Figure 1.

Research Framework

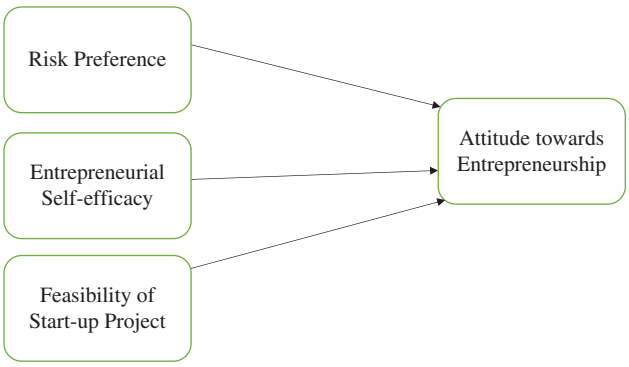

Fig. 1. Theoretical framework.

4. RESULTS

PLS-SEM was used to check the validity of the constructs and to test the relationship among the variables. Two types of model were used in the study. The first model is for the assessment of measurement, and the second model is for the structural assessment, highlighted in Figures 2 and 3, respectively. In the first model, we check the convergent as well as discriminant validity of the constructs. In the second model, we test the hypotheses that are developed in the previous section. There are four measures to test the convergent validity, namely; outer loadings, Cronbach's Alpha, Composite Reliability (CR), and Average Variance Extract (AVE). Table I shows that the outer loadings of all the items are greater than 0.50, that means convergent validity is perfect. Moreover, the value of Cronbach's Alpha is also greater than 0.70 of the constructs that also shows no issue with convergent validity. The value of CR is also greater than 0.70 that means no problem with convergent validity. Lastly, the value of AVE is also greater than 0.50 than shows convergent validity is perfect. Table I regarding convergent validity is given below.

There are two ways to check the discriminant validity of the constructs, namely; Fornel Larcker and Heterotrait Monotrait Ratio (HTMT). The thumb rule for Fornel Larcker is that the value of the constructs should be greater than the values of other constructs. Table II shows that the values fulfill the criteria as mentioned above, that means no problem with discriminant validity. Table III also shows discriminant validity by using cross-loadings.

The Fornel Larcker criteria are very old, and most of the researcher discourage it and consider HTMT ratio criteria is more reliable than Fornel Larcker. The thumb rule for the HTMT ratio that it should be less than 0.85, and Table IV shows that the values are meet with the criteria.

Table V given below shows the relationship between the understudy variables. All the independent variables (Risk preference, entrepreneurial self-efficacy, and feasibility of start-up projects) have a significant positive association with the attention of entrepreneurship education. The beta value of all the variables have a positive sign that shows a

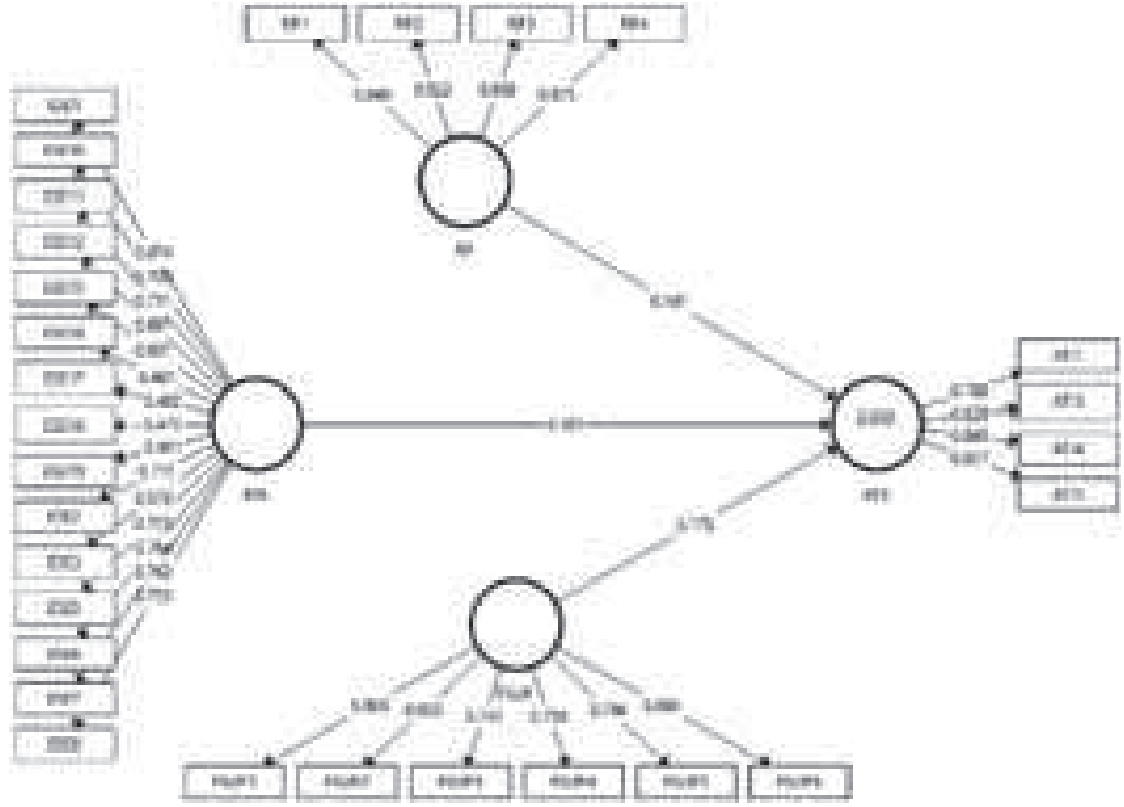

Fig. 2. Measurement assessment model.

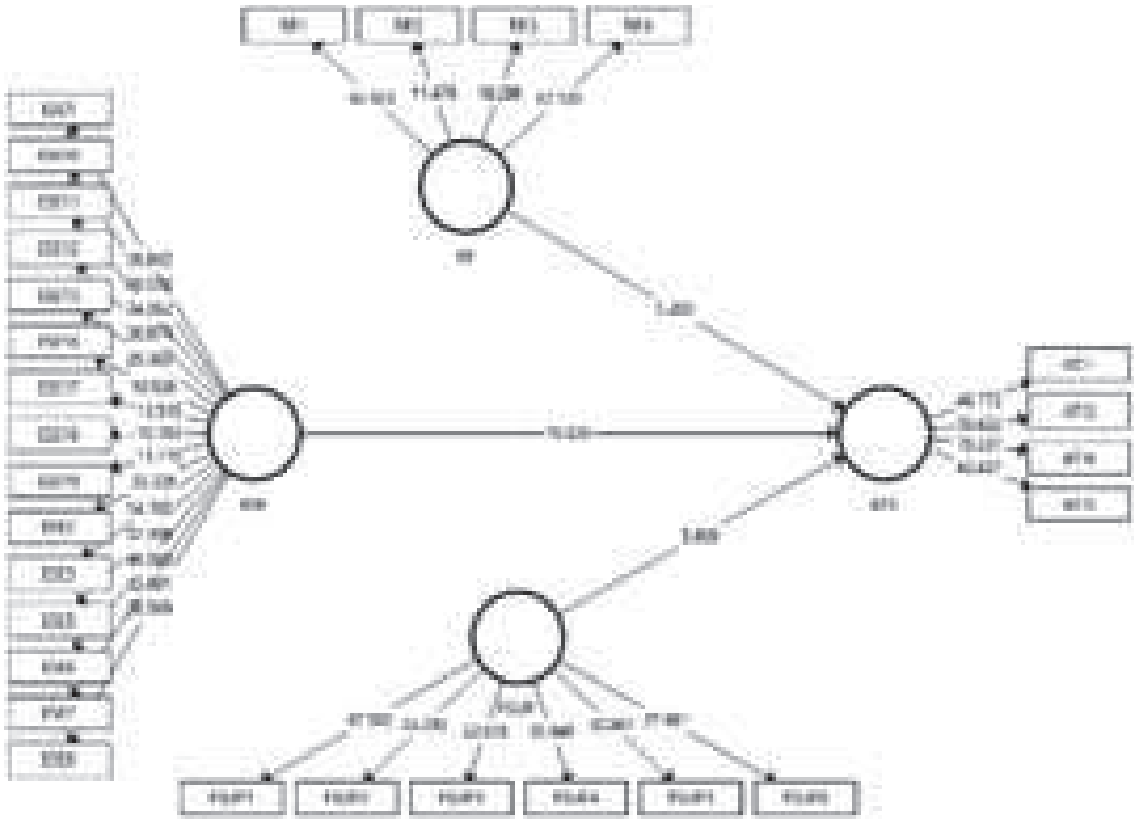

Fig. 3. Structural assessment model.

Table I. Convergent validity.

	Items	Loadings	Alpha	CR	AVE
Attention towards entrepreneurship (ATE)	ATI1	0.788	0.840	0.893	0.676
	ATI3	0.829			
	ATI4	0.845			
	ATI5	0.827			
Entrepreneurial self-efficacy (ESE)	ESE1	0.674	0.903	0.915	0.525
	ESE10	0.700			
	ESE11	0.711			
	ESE12	0.691			
	ESE15	0.691			
	ESE16	0.481			
	ESE17	0.482			
	ESE18	0.473			
	ESE19	0.481			
	ESE2	0.711			
	ESE3	0.570			
	ESE5	0.723			
	ESE6	0.764			
	ESE7	0.762			
	ESE8	0.733			
Feasibility of start-up projects (FSUP)	FSUP1	0.803	0.863	0.895	0.588
	FSUP2	0.820			
	FSUP3	0.731			
	FSUP4	0.759			
	FSUP5	0.794			
	FSUP6	0.684			
Risk preferences (RP)	RP1	0.846	0.724	0.823	0.547
	RP2	0.522			
	RP3	0.658			
	RP4	0.875			

Table II. Discriminant validity.

	ATE	ESE	FSUP	RP
ATE	0.822			
ESE	0.758	0.652		
FSUP	0.583	0.623	0.767	
RP	0.46	0.452	0.314	0.739

positive relationship, while the P value of all the variable is less than 0.05, and T statistics are greater than 1.64, that means relationships are significant. Table V regarding the relationship between the variables is given below.

5. DISCUSSION

Currently, the business environment needs a strong, knowledgeable, and experienced entrepreneur for the establishment of new business entities globally. For this purpose, there is a need to develop the attention of students towards the entrepreneurship. Thus, this study takes into account the major factors that are influences the attentions of the students regarding selecting the field of study. Firstly, this study test the risk preference impact on the attention of students regarding entrepreneurship. Results revealed that excessive risk-taking students are joining the entrepreneurship education with more interest than risk-averse students. These findings are similar to Hatos, Hatos [61] who also found that risk preference has a positive influence on the attitudes of the students towards selecting the entrepreneur education.

Table III. Cross loadings.

	ATE	ESE	FSUP	RP
ATI1	**0.788**	0.596	0.479	0.335
ATI3	**0.829**	0.635	0.453	0.374
ATI4	**0.845**	0.632	0.498	0.422
ATI5	**0.827**	0.629	0.49	0.38
ESE1	0.506	**0.674**	0.578	0.311
ESE10	0.465	**0.7**	0.369	0.296
ESE11	0.493	**0.711**	0.377	0.239
ESE12	0.484	**0.691**	0.373	0.243
ESE15	0.473	**0.691**	0.408	0.226
ESE16	0.288	**0.481**	0.164	0.109
ESE17	0.252	**0.482**	0.132	0.087
ESE18	0.323	**0.473**	0.179	0.134
ESE19	0.309	**0.481**	0.187	0.122
ESE2	0.576	**0.711**	0.439	0.357
ESE3	0.367	**0.57**	0.476	0.247
ESE5	0.601	**0.723**	0.544	0.397
ESE6	0.592	**0.764**	0.443	0.38
ESE7	0.669	**0.762**	0.527	0.445
ESE8	0.674	**0.733**	0.548	0.468
FSUP1	0.521	0.562	**0.803**	0.27
FSUP2	0.378	0.43	**0.82**	0.212
FSUP3	0.418	0.427	**0.731**	0.252
FSUP4	0.481	0.509	**0.759**	0.238
FSUP5	0.346	0.394	**0.794**	0.183
FSUP6	0.476	0.483	**0.684**	0.26
RP1	0.383	0.423	0.291	**0.846**
RP2	0.197	0.109	0.049	**0.522**
RP3	0.256	0.201	0.092	**0.658**
RP4	0.453	0.47	0.367	**0.875**

Secondly, this study also checks the entrepreneurial self-efficacy impact on the attention of students regarding entrepreneurship. Results revealed that more confident students are joining entrepreneurship education with more interest than less confident students. These findings are similar to Hallak, Assaker [62] who also found that self-efficacy has a positive influence on the attitudes of the students towards selecting the entrepreneur education. Additionally, time allowed, and management support also effect on entrepreneurship activities [62]. Thirdly, this study also tests the feasibility of a start-up project impact on the attention of students regarding entrepreneurship. Results revealed that feasibility regarding the future business could develop an interest in the students to join the entrepreneurship education with more interest. These findings are similar who also found that feasibility of start-up business after getting an education has a positive influence on the attitudes of the students towards selecting the entrepreneur education.

Table IV. Heterotrait monotrait ratio (HTMT).

	ATE	ESE	FSUP	RP
ATE				
ESE	0.831			
FSUP	0.67	0.653		
RP	0.557	0.479	0.335	

Table V. Path analysis.

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	*T* statistics (|O/STDEV|)	*P* values
ESE → ATE	0.585	0.586	0.03	19.32	0.000
FSUP → ATE	0.175	0.174	0.03	5.909	0.000
RP → ATE	0.141	0.142	0.027	5.2	0.000

Finally, this study concluded that self-efficacy, feasibility regarding starting business projects after getting education and risk taker students are keener about getting entrepreneurship education and also join entrepreneurship practically after getting an education. It also suggested to the future researcher that they will add more factors that are affecting the attentions of the students regarding selecting the entrepreneurship education. This study also suggested to the policy makers and the universities that they should add these factors in the education of entrepreneurship that will help to boost up the attention of students towards entrepreneur education. Future researchers can also expand the scope of their study by adding more universities in their study. This study is also helpful for the students of entrepreneurship or the student who want to join this field in the future.

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Factors Affecting the Entrepreneurial Intentions Among University Students of Thailand

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Due to today economic conditions, entrepreneurship is one the emerging source for the economic growth and prosperity. Now the individuals diverting their intentions to entrepreneurship, for this reason this has examined the role of entrepreneurial education, internship quality and elements of TPB (attitude, social norms, perceived behavioral control) affect the entrepreneurial intentions. Students were considered for data collection who have done internship during their study time period. Data were collected by using convince sampling technique by using questionnaires. Smart-PLS has been used for the data analysis. The findings of the study show that all variables are significantly and positively associated with entrepreneurial intentions. The result shows that entrepreneurial education, internship quality, attitude, subjective norms, and perceived behavioral control are positively significantly related with entrepreneurial intentions. The findings of the study shows that only financial resources are not enough to start a new business, behavioral factor also affect the entrepreneurial mind set. Among all the variables perceived behavioral control emerge to be a strongest predictor of entrepreneurial intentions. Whereas subjective norms predicted the entrepreneurial intentions with smallest effect size and explained only 5% variance in entrepreneurial intentions. Practical implications and future directions are provided at the end of the study.

Keywords: Entrepreneurial Intention, Education, Attitude, Perceived Behavioral Control, Subjective Norms.

RESEARCH ARTICLE

1. INTRODUCTION

For meeting the challenges of today world, entrepreneurship consider as foundation of the economic growth. Due to increasing number of economic challenges like inflation, economic downturn, unemployment, there is need to diverting the intentions of individuals towards the entrepreneurship (Chienwattanasook and Jermsittiparsert, 2019). Education related to entrepreneurship is among the key factors that take the academic attentions for introducing entrepreneurial behaviors [1]. Entrepreneurship intention means that intention to start own business rather than employment. Entrepreneurship can be best tested by intentions [2, 3]. It can be enhance by the entrepreneurial education. The main object of the entrepreneurial education is to guide the students to screen the opportunities in the entrepreneurial business. Entrepreneurial education can enhance the confidence level of individual about starting a new business or change an exciting one.

The internship quality of students is best predictor of entrepreneurship intentions. Internship quality of students gives practical knowledge to the students. They can perform better and handle the complex situation. The internship quality improves the decision making power of individuals, development of diverse skills, and provides the practical training in the work settings. In this way, individual are more involve in entrepreneurial activities [4]. Individual's intentions to become an entrepreneur are influenced by the TPB elements (attitude, social norms, and perceived behavioral control) affect the entrepreneurial intention. These individual personality factors like beliefs, attitude, social norms, perceived behavioral control, affect the motivation and intentions of individuals to become an entrepreneur [5–7]. Following Figure 1 is showing the entrepreneurial aspects in Thailand over the years.

Present study is aimed to investigate the intentions to become an entrepreneur in the substance of entrepreneurial education, internship quality, attitude, subjective norms and perceived control behavior. The main purpose of this study is to enhance the entrepreneurship in the economy to reduce the unemployment, economic downturn and inflation. The development towards the entrepreneurial intentions is indispensable for economic development. Following are the research questions: (1) has entrepreneurial

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Fig. 1. Entrepreneurial behavior and attitude aspects in Thailand.
Source: Global entrepreneurship monitor (2018).

education significant effect on entrepreneurial intentions? (2) Can internship quality influence the entrepreneurial intentions? How the attitude, subjective norms, and perceived behavioral control effect the entrepreneurial intentions? Consequently, by answering these questions the study will give in depth anticipation about entrepreneurial intentions. This study could demonstrate better for the policy makers and organizers to express course of action as regards the improvement of entrepreneurial intention since deviation of mind may produce and endorse the own business actions and self-employment [8–28].

The rest of the paper is as follows: literature review of all variables that affect the entrepreneurial intentions such as entrepreneurial education, internship quality, attitude, subjective norms and perceived behavioral control. Further, after discussing the literature of variables the research

framework, methodology of the study and findings of study and practical implication and future direction will be discussed.

2. LITERATURE REVIEW

2.1. Entrepreneurship Intention

Entrepreneurship intension denotes the tendency of the individuals to start a new business or bring a fundamental change in the exciting one. It enlightens the experience, actions and attentions of entrepreneur's about the business [1, 3, 29]. Entrepreneur intentions defined by many scholars, following are their definitions. Entrepreneurship intension can be defined as intensions of undergraduate engineering students to involve in entrepreneurial activities after graduations. Intentions can do potentially predict the entrepreneurship [2, 3]. Entrepreneurship intention means an individual desires to start some entrepreneurship events [30].

Further, Zhang, Duysters [31], described that education about entrepreneurship is one the best driver of entrepreneurship intentions. In addition, previous literature directed that the person have high intention to start new enterprises that have high level of entrepreneurship features. Entrepreneurship intensions can be impelled by several features such as education, knowledge, past experience, personality attributes, age, genders, and skills [32–36]. Moreover, Fitzsimmons and Douglas [37], described that above mentioned features induced the entrepreneurial intentions into individuals.

2.2. Entrepreneurship Education

Entrepreneurial education can be defined as any program or process of education that create and enhances the entrepreneurial skills and attitude [38]. According to Morris, Webb [39], the information about entrepreneurship standards and beliefs can be presented by entrepreneurship education. It may be served as important source of relevant knowledge of entrepreneurship [40]. Moreover, for seeking the entrepreneurs, most of the educational institutes increase the awareness about entrepreneurial education [41].

Similarly Bae, Qian [1], described that entrepreneurial education provoking greater awareness in student for taking decisions about their future either they had to focus on entrepreneurship or employment, this education helped the students who had not prior experienced about running a new business. The function of entrepreneurship education in the group of entrepreneurial manners is fascinating expanding academic responsiveness [1, 42, 43]. The education about entrepreneurship developed the thinking skills and positive attitude that lead towards the entrepreneurial activities 2006. So, it will enable the students to realize, identify and chase opportunities for starting their own businesses.

2.3. Internship Quality

Internship is an extremely central technique for apprentice entrepreneurial training because this type of practical knowledge provides skills development and practical application through training in organizational settings [4]. Now a day, researcher gives much attention to the impact of internship program on career choice [44]. Exciting research also explored that confidence of students boost up by internship programs, internship is important for students to get more learning opportunities [45, 46]. Career development of students closely link with internship quality if the students [47]. Such as, Gault, Redington [46] students internship program have positive and significant impact on their successive career development. Entrepreneurial intentions developed in students that have better internship experience in business world. One of the most important business competency developed in students by internship program is decision making power in problematic situations [48].

In addition, internship program provided the full knowledge about the real business situations, enhances the problem solving skills and developed the decision making power [46]. The quality of internship can be determined by managerial support, feedback, training and having a chance to learn new things etc. [47, 49, 50]. The internship quality can be improved by feedback and critical instructions from management [51, 52].

2.4. Attitude, Perceived Behavioral Control and Social Norms

Attitude, perceived behavioral control and social norms are one the important determinants to evaluate the intention [5]. Allport [53], considered the attitude as emotional condition of individuals about something. Attitude is related with perception, emotive and thinking process of individuals. PBC is concerned with the thinking related to a certain task itself and its complexity and how much easily it can be done [6]. Furthermore, perceived behavioral control permits the persons to do the job corresponding to their abilities [7]. As well as, described that perceived societal pressure about particular things to carry out or not to carry out known as subjective norm. Subsequently, individual considered that what society contemplate and require about specific subject matters.

2.5. Factors Affecting Entrepreneurial Intentions

Nowadays, entrepreneurship intentions are key factor for economic development. Different factors affect the entrepreneurial intentions. According to Yi [4], described that Internship quality has considerable influence on entrepreneurial intentions. The internship during the degree positively influence student's career. The students who have internship programs during degree time period have performed better in entrepreneurial intentions [46]. Moreover problem solving skill developed at

internship time period, that skill prominently related with entrepreneurial capabilities [48].

Moreover, the recent literature about entrepreneurship determined that entrepreneurship education has positive relationship with entrepreneurial intensions [54]. For solving the employment problems and enhances the economic development there is need to develop the government policies and entrepreneurial education, that focusing the students entrepreneurial intentions for their career development [55]. Such as in previous years China has adopted different techniques to develop the students with entrepreneurial mindset for cultivating entrepreneurial intentions.

Conversely, Tkachev and Kolvereid [56], demonstrated that attitude is positively linked to individual entrepreneurial intentions. The individuals willingly start a new innovative business, if he/she believes that these initiatives take along positive consequences. Furthermore, the study done at UAE apprentices concluded that female students are motivated and interested to start a own business as compare to the male students [57]. Similarly, Dabic, Daim [58], defined that the attitude as the important contributor that affect the entrepreneurship motivation. Another study elaborated that entrepreneurial education must be given to the students in school life. In this way the students can better understand the opportunities for starting their own business and also can developed the entrepreneurial attitude in future. The younger person has more attitudes to perform as an entrepreneur [59].

The study reported that perceived behavioral control has direct and indirect influence on entrepreneurial intentions. Also Dinc and Budic [60], examined that perceived behavioral control has significant positive effect on entrepreneurial intentions. The study concluded that perceived behavioral control in young person's lead to failure of entrepreneurial achievements because of their wrong judgment [61].

To become an entrepreneur, subjective norm is one of the significant and stable factors that affect the student entrepreneur intentions [62]. The students who have high level of positive subjective norms highly motivated to become an entrepreneur. If there is availability of employment in society, the society less motivate the person who has entrepreneur abilities but if there is less employment opportunities the subjective norms motivate individual to start their own business [63]. According to Ref. [64] recognized subjective norm as the major element that miscarries the individuals to alter their intentions of developing an entrepreneur into actions.

2.6. Conceptual Framework and Hypotheses

Figure 2 shows the theoretical framework of the study. The purpose of current study is to examine the entrepreneurial intentions and factor that affecting the entrepreneurial intentions. Thus, in the light of available conceptual and empirical evidence it is hypothesized that:

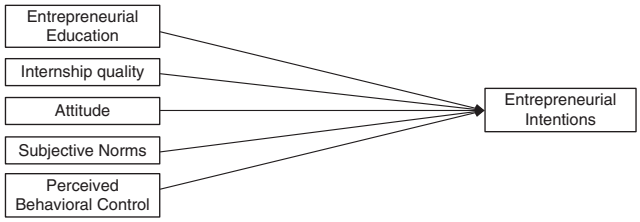

Fig. 2. Theoretical framework of the study.

H1: There is significant relationship between entrepreneurial education and entrepreneurial intentions.
H2: An Internship quality has significantly relationship with entrepreneurial intentions.
H3: There is significant relationship of attitude with entrepreneurial intentions.
H4: There is significant relationship of subjective norms with entrepreneurial intentions.
H5: There is significant relationship of perceived behavioral control with entrepreneurial intentions.

3. METHODOLOGY

The purpose of current study is to examine the antecedents of the entrepreneurial intentions of students. Entrepreneurial education, internship quality and the three elements of theory of planned behavior (attitude, subjective norms and perceived behavioral control) were considered as potential factors which derive the entrepreneurial intentions.

For the present study data were collected from the students who were in the final semester of their degree. The students who were doing the degrees in IT and have done internship during their degree were selected for the data collection. By using the convenience sampling data were collected from the above mentioned students as all of them shared similar characteristics and convenience sampling is more suitable were sample has similar characteristics as of the population.

Different sample size selection techniques have been proposed by previous researchers. According to one sample size technique the sample size should represent at least 20% of the population [65]. Whereas other technique [66] says that sample size should be 200 to 400 for SEM. The current study has used the Krejcie and Morgan [67], table for sample size selection. The total students were 700 students who had done internship during their degree. So as per the table the sample size for the study was 248.

Data were collected by using the questionnaire having two sections: one for demographic profile of the respondents and other for the variables under study (Entrepreneurship intentions, entrepreneurship education, internship quality, attitude, subjective norms and perceived behavioral control). Measures for the variables were adopted from the previous studies the details of which

Fig. 3. Measurement model.

Table I. Confirmatory factor analysis.

Constructs	Items	Loadings	Alpha	CR	AVE
Attitude	Att. 1	0.830	0.861	0.898	0.640
	Att. 2	0.848			
	Att. 3	0.728			
	Att. 4	0.764			
	Att. 5	0.823			
Entrepreneurship education	EE1	0.810	0.849	0.898	0.688
	EE2	0.850			
	EE3	0.836			
	EE4	0.821			
Entrepreneurial intentions	EInt1	0.781	0.776	0.850	0.554
	EInt2	0.822			
	EInt3	0.843			
	EInt4	0.833			
	EInt5	0.283			
Internship quality	Int. Q 1	0.729	0.841	0.894	0.679
	Int. Q 2	0.839			
	Int. Q 3	0.835			
	Int. Q 4	0.887			
Perceived behavioral control	PBC 1	0.882	0.890	0.925	0.755
	PBC 2	0.778			
	PBC 3	0.916			
	PBC 4	0.893			
Subjective norms	SN 1	0.925	0.878	0.924	0.803
	SN 2	0.849			
	SN 3	0.912			

are as follows: Entrepreneurial intentions were measured by adopting 6 items scale [68]. Entrepreneurship education was measured by adopting 4 items scale. Internship quality was measured by adopting 4 items scale [47]. Attitude, subjective norms and perceived behavioral control was measured by adopting 5, 3 and 4 items respectively. For data collection the email was sent to the deans of the respective departments for data collection. After their approval questionnaires were distributed among 248 students. Out of which 190 responses were valid and used for further data analysis. The results of the study are presented in the next section. Factor analysis is based on measurement model which is highlighted in Figure 3 and results are presented in Table I.

4. FINDINGS

CFA was performed to assess the scale validity [73–74]. First of all convergent validity is verified. It is established on two criteria namely; composite reliability and average variance extracted. The value for the CR should be greater than 0.8 and value for AVE should be greater than 0.5. As per the Table I all the values for the CR and AVE are greater than 0.8 and 0.5 respectively (Hair et al., 2010). The third criterion for the convergent validity is the factor loadings which should be greater than 0.5. As per the

Table II. Discriminant validity.

	Att.	EE	EInt	Int. Q	PBC	SN
Att.						
EE	0.631					
EInt	0.615	0.738				
Int. Q	0.505	0.657	0.652			
PBC	0.63	0.648	0.857	0.548		
SN	0.189	0.331	0.398	0.349	0.313	

Table I and in below Figure 3 all the values for factor loadings are greater than 0.5. Thus convergent validity is established.

For the internal consistency of the scale Cronbach's Alpha has also been reported in the Table I. For the value for the Cronbach's Alpha it was argued that its value should be greater than 0.7. As per the Table I Alpha values for Attitude, entrepreneurship education, entrepreneurship intentions, internship quality, perceived behavioral control and subjective norms are 0.861, 0.849, 0.776, 0.841, 0.890 and 0.878 respectively. All the values for Alpha are greater than 0.7 which affirms the internal consistency of all the scales. Moreover, Table II shows the discriminant validity.

After the convergent validity is established the next test was performed to assess the discriminant validity. It measures the magnitude of a complete scale to which it do not represent the other variables. There are two known techniques used for the discriminant validity namely: "Fornell-Larcker Criterion" and "Hetrotrait-Monotrait Ratio of Correlations." Later one is latest technique being used. According to HTMT approach variables correlations should be less than 0.85. As per Table II all the correlation values are less than 0.85. Which establishes the discriminant validity.

4.1. Structural Equation Modeling

Structural equation modeling has been used to test the hypothesized relationship for the present research study and results are shown in Table III. SEM is applied in this study as it assesses the properties of the scales used for the measurement of theoretical constructs and test the hypothesis.

Table III shows the results regarding the test of hypothesis. As per Table III attitude is significantly and positively associated with the entrepreneurial intentions. The relationship is valued at 0.087. It means that the positive attitude of students will positively influence their intentions towards entrepreneurship. 1% change in attitude will bring about 8% change in intentions towards entrepreneurship. When the student's attitude becomes more positive he/she will be more entrepreneurship oriented. The effect size of attitude is small but the results are significant. When the students are provided with entrepreneurship education their entrepreneurial intentions are likely to increase as they will gain new knowledge, skills and abilities. This argument is support by the results of current study as per the results the relationship between entrepreneurship education and entrepreneurial intentions is significant and valued at 0.204. The more a student is educated regarding the entrepreneurship the greater will be his/her entrepreneurial intentions. If the entrepreneurial education will increase it will also result in more entrepreneurial intentions. Slight increase in the entrepreneurship education will bring about 20% change in entrepreneurial intentions.

The next hypothesis tested the relationship between internship quality and entrepreneurial intentions. Internship is basically with pay or without pay training session of students during their degree as per their request to the company. They do internship with the primary objective to gain some sort of practical knowledge. The results of the study pointed out a significant relationship between internship quality and entrepreneurial intentions. The positive relationship is valued at 0.144. It can be interpreted that when the students have good quality of internship they learn the way things are being done. Thus leading towards strong entrepreneurial intentions. Furthermore, perceived behavioral control and entrepreneurial intentions are strongly associated. It means that when students perceive that they can control their behaviors and evaluate their abilities they become more intended towards the new venture under entrepreneurship. The relationship value between the variables (perceived behavioral control and entrepreneurial intentions) is 0.484. Which asserts that the stronger the individual perceptions regarding his behavioral control the greater his/her will be entrepreneurial intentions. Simple speaking 1% change in perceived behavioral control can bring about 48% change in entrepreneurial intentions. Finally the results also reported a positive significant relationship between subjective norms and entrepreneurial intentions. The relationship is significant however the relationship value is smallest of all the relationship values reported in Table III. Which asserts that subjective norms impact the entrepreneurial intentions but not with big effect size. All the hypothesis are supported and accepted by the study.

Table III. Path coefficients.

Hypothesis relationships	Beta	SD	t	p	Decision	R^2	f^2	VIF
Att. → EInt	0.087	0.031	2.798	$p < 0.05$	Supported	0.624	0.012	1.691
EE → EInt	0.204	0.032	6.463	$p < 0.05$	Supported		0.058	1.906
Int. Q → EInt	0.144	0.031	4.684	$p < 0.06$	Supported		0.035	1.588
PBC → EInt	0.484	0.031	15.594	$p < 0.07$	Supported		0.350	1.782
SN → EInt	0.057	0.024	2.333	$p < 0.05$	Supported		0.008	1.142

Fig. 4. Structural model.

Below Figure 4 is showing the path coefficients for the study research model.

5. DISCUSSION

The present study investigated the predictors of entrepreneurial intentions and considered the entrepreneurial education, internship quality and the factors theory of planned behavior such as attitude, subjective norms and perceived behavioral control as potential predictors. Entrepreneurial education has significant and positive relationship with entrepreneurial education. Prior research also provides evidence that entrepreneurship impact the intension of entrepreneur [54]. Internship quality also has positive effect on entrepreneur intention. So, hypothesis one and two is accepted in this study. Internship quality of final semester students boost their confidence level, because he/she have field knowledge in different work settings and can understand the work settings complexities in better way. The person who have good internship experience can take better decision for long term organizational benefits [4, 48]. The theory of planned behavior factors also have positive and significant relationship but perceived behavioral control have greater influence on entrepreneurial intention and subjective norms have less stronger relation with entrepreneurial intention as compare to others [61, 63, 64]. In this way the third hypothesis is also accepted.

This study not only consider the financial resources for starting a new business, it also considered the entrepreneurial knowledge, internship experiences and individual attributes like attitude, belief and behavior also effect the entrepreneurial intentions. It provides better knowledge for government to create exclusive internship facilities, creative ways for getting education about entrepreneurship for students. In this ways students self-confidence increase and they confidently start a new own business. Findings are significant in respect to their contribution and considerable insights for the instructors, institutions providing education (specifically entrepreneurship) and the practitioners. The educational institutions should invite the successful entrepreneurs to have a talk session with students, they should arrange training session on how to become an entrepreneur and they should engage students in small entrepreneurship projects so the students may get benefit from their experience and learning at institution. Consequently choose the entrepreneurship as their ultimate objective and go for the new ventures.

In future research can be performed between two different sectors like internship institutions and universities for getting better information about entrepreneur intentions. Further, longitudinal studies also can be executed to

examine whether students with entrepreneurial intentions will in fact inaugurate their own businesses after finishing the degrees. For collecting data this study used the convenient sampling technique that create problem in generalization. The sector of this study is only students of Thailand further studies can do on other countries to do the comparative analysis. This study only considered the theory of planned behavior factor in future researchers can consider the other behaviors.

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Role of Personality Traits and Education Towards the Entrepreneurial Intentions of Students

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Positive personality traits have been linked with various positive outcomes such as job performance, job satisfaction etc. However emotional intelligence and creativity have been scarcely linked with the entrepreneurship. Bering in mind the importance of entrepreneurship, present study has investigated the impact of emotional intelligence, entrepreneurial education and creativity on the entrepreneurial intentions. Data were collected from the students who were in their last semester of their degree. Smart-PLS was used for data analysis. The results of the study revealed that emotional intelligence has significant positive impact on the entrepreneurial intentions of students. Furthermore, results also showed a significant positive relationship between creativity and entrepreneurial intentions. Finally results also showed a positive relationship between the entrepreneurial education and entrepreneurial intentions. All the hypothesis was supported by the results of the study. Study findings concluded that students who are emotionally intelligent, creative and when they are provided with the quality education regarding the entrepreneurship, their intentions tend to be more inclined towards the entrepreneurship. Future directions are limitations are provided at the end of the study.

Keywords: Entrepreneurship, Education, Entrepreneurial Education, Emotional Intelligence, Entrepreneurial Intentions.

1. INTRODUCTION

Entrepreneurship has become an important aspect in today business life. It leads towards the innovation in business which consequently creates job. It is seen as a productive strategy through which the employability issues can be dealt. Having such an importance research in the domain of entrepreneurship intentions remains an attractive area of study. Undeniably it is one of the major driver for the innovation. Thus it cannot be overlooked in both fields business and academia. It do encourage the economic growth and entrepreneurs have proved this fact such as Bill Gates and Steve Jobs are one of the well-known entrepreneurs around the globe, pointed out student entrepreneurship as vital component of the broad entrepreneurship. It has gained greater attention over the recent years.

Regarding the student entrepreneurship there are number of universities which has paid greater attention towards it. Jansen, van de Zande [1], argued that universities are heading towards the entrepreneurship and they are changing their conventional orientation by collaborating with the public and private industries and maintaining a competitive advantage. This phenomenon is not limited to the male only. The role of the women is also changing in the current world as they are getting education and entering into the field of business (Jermsittiparsert, 2016; Chotiyaputta, 2018; Chotiyaputta and Yoon, 2018). Till now there is little research has been carried out specifically for the women entrepreneurs. Focusing on the urgency of the topic, the purpose of the present study is to explore the factors that influence the entrepreneurial intentions of women. Present study will address the following research questions:

(1) Do emotional intelligence effect the entrepreneurial intentions of women?

(2) Do entrepreneurship education effect the entrepreneurial intentions of women?

(3) Do creativity effect the entrepreneurial intentions of women?

Regarding the women entrepreneurship Rauth Bhardwaj [2], has argued that the proportion of female entrepreneurs are on rise over the years and will show an extraordinary trend in upcoming years which makes it a considerable phenomenon to be studied. Regarding the research trends Yadav and Unni [3], reported that only 185 research publications have been published from 1900 to 2016 specifically on the women entrepreneurship, also argued that till now it remained as a less studied area in research. Having such an importance present study has considered the women entrepreneurial intentions and factors that can effect it.

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Emotional intelligence has been selected as a potential factor that can influence the women entrepreneurial intentions. It is also in the line with the previous call for research in the domain of personal characteristics which can influence the intentions. Moreover still there is scarcity of research on the topic of emotional intelligence and creativity. Similarly the other factor which serves as a potential stimulus for the entrepreneurial intentions is the education. The role of education is indispensable in routine life and it also has a significant impact in motivating an individual to be entrepreneur [4–13].

In recent years the research has grown specifically in the domain of the intentions and its drivers. This phenomenon has also received a greater attention in the entrepreneurship. As it helps to make prediction regarding a certain behavior (entrepreneurship). Education regarding the entrepreneurship can potentially change the mind set of an individual and thus resulting in more entrepreneurs [14]. Previously it has been argued that the educational institutions play a vital role in the entrepreneurship development [15]. Most importantly, argued that in present scenarios for the consistent supply of entrepreneurs in academia and practice it has become necessary to study the factors that lead the individuals towards entrepreneurship and stimulate a will power for new startup and become an entrepreneur [16–24].

The present study offers valuable insights into different factors that can potentially influence the intentions. This will help to predict the behavior regarding the entrepreneurship. It is worthy to mention that this study has considered the women entrepreneurship which will help the policy makers to redesign the policies to make easy the way of women entrepreneurship. The later sections of the present study will elaborate the previously available empirical and theoretical evidence, methods adopted for the study, findings and conclusion.

2. LITERATURE REVIEW

2.1. Entrepreneurial Intention

Before defining the entrepreneurship intentions it is worthy to mention some point of views regarding the intentions itself. Intentions play a vital role in decision making, choice of an alternative and behavior [25]. It is argued to be the mind set of individuals which leads them for a particular behavior [26]. Before performing a behavior intentions are regarded as key driver to it. When someone decides to be independent and go for a paid employment options, by nature of decision it is voluntary [27]. Thus, entrepreneurial intentions can be proposed as individuals' intentions for a new startup. In addition it is a process of decision making consequently resulting in decision to go for a new business [28].

Entrepreneurial intentions is an important area within the domain of entrepreneurship as it is the basis which develops a behavior or on the basis of which a behavior can be predicted. Many researchers are paying greater attention towards the entrepreneurial intentions as they consider it to be an important factor for a new startup [29]. Theory of planned behavior is most widely used to explain the underlying mechanisms for the entrepreneurial intentions [30]. Entrepreneurial intentions have been defined as "a state of mind that people wish to create a new firm or a new value driver inside existing organizations" (as stated in).

Different factors have been identified which do influence the entrepreneurial intentions such as individual beliefs [31], skills, knowledge and ability, self-efficacy [32], parents [33], risk taking [34] etc. Present study has considered emotional intelligence, entrepreneurship education, and creativity as a potential predictors for the entrepreneurial intentions. Moreover, Figure 1 is representing the research framework for the present study. Following is the conceptualization and relationship details among the variables.

2.2. Emotional Intelligence

Emotional intelligence has emerged in the recent decades. Salovey and Mayer [35], introduced the concept of emotional intelligence later on it gained popularity with the works of renowned scholar. It has been defined by different researcher over the course of time. Emotional intelligence is "the ability to monitor one's own and others' feelings and emotions, to discriminate among them and to use this information to guide one's thinking and actions." Later on emotional intelligence was categorized in four widely used dimensions. According to a recent definition of the emotional intelligence it lies when the information is processed by a human mind and then it is integrated with the cognition [36].

Emotional intelligence is foremost component of an individual personality. It helps to make wise choices over the bad ones. It is regarded as a one way to handle the emotional state of displeasure and assists to gain much confidence to deal with such negative feelings. Moreover, it was also added that students who do not score high at emotional intelligence often they are deficient in passion to take decisions regarding career because of their inability to maintain the good social networking. Consequently, it keeps them away from getting information for career decision making [37].

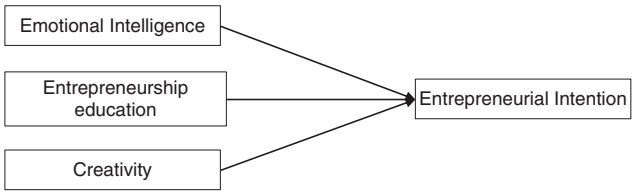

Fig. 1. Following figure is representing the research framework for the present study.

Emotional intelligence plays a vital role in entrepreneur's decision making and problem handling in this regard it was argued that highly emotionally intelligent people consider them more competent and capable of handling disappointments and hurdles. Same goes for the emotionally intelligent entrepreneurs. If someone as an individual is capable of handling the emotions better and can regulate the feelings will be good entrepreneurs [38].

Kanonuhwa, Rungani [39], conducted a study regarding the important role of emotional intelligence in entrepreneurship. They concluded that emotional intelligence and entrepreneurship are directly associated. Further results also pinpoint that emotional regulation is the strongest predictor of the entrepreneurial intentions among all the dimensions of the emotional intelligence. Another study [40], has also reported a direct positive relationship between emotional intelligence and entrepreneurial intentions. Hence, based on the literature review and empirical evidence available it is proposed that:

H1: *Emotional intelligence is significantly associated with the entrepreneurial intentions*.

2.3. Entrepreneurship Education

Entrepreneurship education has become an essential and among the key factors that can lead an individual towards the entrepreneurship. It can potentially mold the thinking of an individual. Entrepreneurship education has a potential to provide the youth with knowledge and skills to develop a character, approach and vision. Entrepreneurship education has been proposed by different researchers in different ways such as it is completely different concept from enterprise education. The earlier is for the individuals who in search of opportunities whereas the later one deals with developing an approach of self-dependence [41]. Entrepreneurship education denotes to the specialized employment of the knowledge, capabilities, approach and skills. It goes beyond just teaching merely how to be an entrepreneur. It deals with the creation of environment which do focus on traits and behaviors related to entrepreneurship [42]. It is basically regarded as a process by which people are provided with the capability to identify commercial opportunities, self-esteem, knowledge and abilities for action [43]. Such education has adopted the latest techniques to educate the students and provide them with the latest skills, knowledge and abilities in every field of life [44]. More importantly it changes the thinking pattern, let the individual to think out of the box and attain the goals and objectives set for themselves. In this regard, argued that it equips the individuals with analytical and problem solving abilities which makes smooth their way towards a new start up. It also lead the individuals towards better self-recognition and self-management [44]. Researchers have attempted to address the relationship between entrepreneurship education and entrepreneurship intentions but still this relationship is under research from various perspectives [45]. Therefore, it guarantees for more study on the underlying relationship. Karimi, Biemans [46], conducted a study in six Iranian universities regarding the impact of entrepreneurship education on entrepreneurship intentions and opportunity recognition. They concluded that entrepreneurship education has direct positive relationship with the entrepreneurship intentions. Similarly, in their qualitative study concluded that entrepreneurship education provides the individuals with more analytical and critical thinking which consequently lead them towards the new startup. Thus it is hypothesized that:

H2: *Entrepreneurship education is positively and significantly associated with entrepreneurial intentions*.

2.4. Creativity

Creativity is a vital facet of a human being. It enables him/her to think out of the box and do something extraordinary. Undeniably it is a complex phenomenon, it as "one of the main cognitive tools used by human beings in proactive behavior." It is actually the expression of the ability of any individual which states the extent to which someone can go beyond the realities. Simply it can be said as an ability to create new and useful idea regardless of any domain [47]. More recently it has been purported as a process which generates ideas, solve the problems and application of an existing idea within provided circumstances. Creativity has become an important domain in an organization because of its contribution in the organizational success [48]. As defined earlier entrepreneurship is doing something new and entrepreneurship is a behavior. Thus it can be concluded that when an individual is equipped with a creative mind he/she will be more intended towards the entrepreneurship. Figure 1 is representing the research framework for the present study:

Previously available empirical evidence has also reported a positive relationship between creativity and entrepreneurial intentions. Hence, based on the literature review and empirical evidence it is hypothesized that:

H3: *Creativity is positively and significantly associated with entrepreneurship intensions*.

3. METHODOLOGY

Purpose of this study is to explore the effect of different personality and institutional factors on the entrepreneurial intentions. Emotional intelligence and creativity are considered as personality factors and entrepreneurship education has been considered as institutional factor. Students were selected as a respondents for the present study. Only the students of the last semester of their undergraduate and post graduate students were selected as they were about to complete their education, enter the practical life onwards and have to make choice regarding the job and business.

There are different parameters for determining the sample size. According to Barlett, Kotrlik [49], sample

should represent at least 20% of the whole population. Oke, Ogunsami [50], argued that 200–400 sample size good enough to for a SEM. There are some sample size digits given as per the population size [51]. Conclusively all the parameters suggests that sample size should be 200+. So current study has adopted Krejcie and Morgan [51], table for the sample size determination and 300 sample size was determined.

After the sample size is selected the next thing is to design the measuring instrument for the data collection. For the data collection questionnaire was used having two sections. One of them represented the demographic information of the students (gender, age, study field, degree level and entrepreneurial education) and other one contained the questions related to the variables namely; emotional intelligence, entrepreneurship education, creativity and entrepreneurial intentions. All the measures were adopted from the previous studies the details of which is as follows: Emotional intelligence was measured by adopting 16 items scale [52]. Creativity was measured by adopting 5 items scale [53]. Entrepreneurial intentions were measured by adopting 6 items scale [29]. Entrepreneurship education was measured by adopting 4 items scale.

For data collection initial request was sent to deans of the respective universities for data collection after the permission the data were collected. By employing the convenience sampling data were collected from the students of the universities in Bangkok. Convenience sampling is used when population shares the same characteristics. 300 questionnaires were distributed out of which 200 questionnaires were valid which resulted in approximately 66% response rate. The results of data are presented in next section of this research study. Confirmatory factor analysis is shown in Table I.

Table I. Confirmatory factor analysis.

Constructs	Items	Loadings	Alpha	CR	AVE
Creativity	Cty1	0.817	0.827	0.876	0.549
	Cty2	0.829			
	Cty3	0.726			
	Cty4	0.441			
	Cty5	0.756			
	Cty6	0.805			
Entrepreneurial education	EE1	0.810	0.849	0.898	0.688
	EE2	0.850			
	EE3	0.836			
	EE4	0.821			
Emotional intelligence	EI1	0.712	0.864	0.896	0.553
	EI12	0.786			
	EI13	0.776			
	EI14	0.694			
	EI15	0.833			
	EI2	0.735			
	EI7	0.655			
Entrepreneurial intentions	EInt1	0.788	0.776	0.850	0.554
	EInt2	0.828			
	EInt3	0.837			
	EInt4	0.826			
	EInt5	0.282			

4. FINDINGS

For validity of the measure confirmatory factor analysis was performed. According to the parameters of the convergent validity there are three figures needs to be verified whether they are in acceptable range or not. The three parameters are; Factor loadings, Composite reliability and Average variance extracted. According to Hair et al. (2010) to establish the convergent validity values for CR, AVE and Factor loadings must be greater than 0.5, 0.8 and 0.5 respectively. Table I is representing the values of CR, AVE and factor loadings for the variables namely entrepreneurial intentions, entrepreneurial education, emotional intelligence and creativity. As per Table I all the values for the factor loadings, CR and AVE are within their acceptable range. Thus, it affirms the convergent validity of scale.

4.1. Discriminant Validity

After the convergent validity is established the next test was performed to assess the discriminant validity of the scale. It measures the magnitude of a complete scale to which it do not represent the other variables. Previously "Fornell-Larcker Criterion" was used for discriminant validity. According to which correlation of the variable must be higher with itself as compared to other variables. Whereas in Smart-PLS latest technique is used for the discriminant validity according to which all the correlations among the variables must be less than 0.85. As per the Table II below all the values are less than 0.85. Thus it affirms the discriminant validity of the scale.

4.2. Structural Equation Modeling

Structural equation modeling has been used to test the hypothesized relationship for the present research study. Below Table III is showing the results for the study.

Table III is presenting the hypothesis tests for the study. As per the results in Table III creativity and entrepreneurial intentions are positively and significantly associated. The value of the relationship is 0.259. It asserts that 1% change in creativity of an individual will change his/her entrepreneurial intentions by 26%. The more the creative mind of someone the greater will be the intentions towards the entrepreneurship. The results are significant. Thus, it provided support to the hypothesis creativity is positively

Table II. Discriminant validity.

	Cty	EE	EI	EInt
Cty				
EE	0.661			
EI	0.578	0.718		
EInt	0.670	0.738	0.697	

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Table III. Path coefficients.

Hypothesis relationships	Beta	SD	t	p	Decision	R^2	$f2$	VIF
Cty → EInt	0.259	0.033	7.956	$p < 0.05$	Supported	0.499	0.086	1.548
EE → EInt	0.307	0.038	8.145	$p < 0.05$	Supported		0.100	1.881
EI → EInt	0.274	0.035	7.808	$p < 0.05$	Supported		0.089	1.689

and significantly associated with entrepreneurial intentions. Furthermore the results showed a positive relationship between entrepreneurial education and entrepreneurial intentions. The relationship is valued at 0.307, which asserts that entrepreneurial education brings significant change in the entrepreneurial intentions. In general interpretation 1% change in the entrepreneurial education brings about 30% change in the entrepreneurial intentions. The more the students are provided with entrepreneurship education the greater their intentions will move towards the entrepreneurship and finally resulting in a new venture. The study proposed a hypothesis that there is significant positive relationship between entrepreneurial education and entrepreneurial intentions. The hypothesis is supported by the results. Finally as per the Table III above mentioned there is also positive relationship between emotional intelligence and entrepreneurial intentions. The relationship between these variables is valued at 0.274. The results are significant. Which asserts that when the individual is emotionally intelligent he/she will be more inclined towards the entrepreneurship. He/she will have more strong intentions towards the new venture. In the light of results reported in Table III all the hypothesis are supported and accepted.

5. DISCUSSION AND CONCLUSION

Entrepreneurship is one of the major contributor towards the economy of any country. It also drives the employment at small scale which has resulted in increased attention towards this particular area. With the increasing number of entrepreneurship ventures and small scale businesses it has gained attention from the researchers and undeniably it cannot be ignored by both the academics and practitioners. In this regard entrepreneurial intentions are being studied extensively, especially the antecedents of the entrepreneurial intentions. Despite the growing research still there are few studies available which has explored the personality characteristics and education role in driving the entrepreneurial intention of business graduates. The present study aimed to examine the impact of emotional intelligence, creativity and entrepreneurship education on the entrepreneurial intentions. Thus, this study addresses the gap mentioned in the literature.

Education regarding the entrepreneurship makes student able to gain knowledge which is prerequisite for the risk taking and starting a new business. Further for the development of an entrepreneur mindset and promotion of such approach education is necessary and plays a vital role. Having in mind such importance of education on entrepreneurship, present study hypothesized that entrepreneurship education is significantly and positively associated with the entrepreneurial intentions. The study results revealed a positive relationship between entrepreneurship education and intentions. Which further asserts that when students are provided with necessary education on entrepreneurship they will be more motivated towards the new startups. As education provide them with necessary knowledge, skills and abilities to be used in such scenarios. Personality of a person plays a vital role in determination of the career choice and all the matters. Emotional intelligence is one and major part of the personality. The present study hypothesized that emotional intelligence is positively and significantly associated with entrepreneurial intentions. The results of the present study also supported this notion with the positive and significant relationship statistically. The more the person is emotionally intelligent the better is his/her thinking pattern regarding the things around. Entrepreneurship is about doing something new which ask for creativity and unique approach. Bearing in mind the importance of the creativity, the present study has hypothesized that creativity is significantly associated with the entrepreneurial intentions. The results of the study reported a significant positive relationship between creativity and entrepreneurial intentions. Which affirms that if an individual can think creatively he/she can go for a new venture. All the hypothesis H1, H2 and H3 are supported by the results and thus accepted. The findings of the present study are in line with the previous studies.

From the results it is obvious that the impact of entrepreneurial education is strongest among all other variables. From a generic point of view if an individual is provided with good education opportunity to study and learn the entrepreneurship it will add to the skills of him/her, which will be used by him/her to establish a new venture. All other variables are also equally important but the education emerged to be strongest of all. It can be said that the education specially designed for the entrepreneurship not only lead towards the entrepreneurship but it will also enhance the emotional intelligence and creativity of students. Based on the findings of the present study it is concluded that personality factors such as emotional intelligence and creativity can influence the entrepreneurial intentions of the students. Consequently leading them towards the establishment of new ventures. The education also plays a vital role in shaping and molding the mind set towards the entrepreneurship. The present

study has some implications which are as follows: as study has proved that emotional intelligence and creativity lead towards the entrepreneurial intentions, thus it is an insight for the education course makers to design such courses which promotes the entrepreneurial intentions among the students. Special training sessions on entrepreneurship and talk series with entrepreneurs must be arranged by the institutions for the students. There should be some extracurricular activities which can build the emotional intelligence and lead the students towards the creative thinking. Although the research study has attained all its objectives since there is no perfection, present study also carries some limitations which can be considered as potential area for future research. First of all the study is cross-sectional which do not capture the over the time causal relationship between variables. So future studies may conduct research to examine the current research during the last semester and after the degree completion. Further it might be useful to introduce the qualitative methodology or mix methods in future studies.

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RESEARCH ARTICLE

Employee Turnover Intentions: The Role of the Supervisor's Support and Job Autonomy with Job Satisfaction Acting as a Mediator: A Case of Paramedical Staff in Thai Government Hospital

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The prime objective of the current study is to explain the relationship between employee turnover intentions, supervisors support, job autonomy and job satisfaction. Furthermore, the mediating role of job satisfaction in the relationship between job autonomy, employee turnover intentions and supervisors support are examined. We have used the SEM-PLS as a statistical tool to achieve the objectives of the current study. The data is collected with the aid of an adapted questionnaire. The operation managers and finance managers of Indonesian manufacturing firms are chosen as the final sample of the current study. The current study focused on job satisfaction, and it is argued that job autonomy is a key determinant of job satisfaction, as greater autonomy will lead to more satisfaction and lower the turnover. Meanwhile, the findings of the study have revealed the fact that supervisor support is also a key factor. The results of the study are providing support to the proposition of agency theory and resource-based theory. Overall the findings of the current study are in line with the proposed findings. The paramedical staff of Thai government hospital is chosen as the sample of the study.

Keywords: Employee Turnover Intentions, Supervisors Support, Job Autonomy and Job Satisfaction, Thailand.

1. INTRODUCTION

Employees are the basic asset for the organizations in the current competitive business environment. The survival and performance of the organization are determined by the commitment of employees. The needs, goals and objectives of the organization are expected to be met by the employees working in the organization. Therefore, a number of the organization have high expectations from the capabilities of employees. From the point of view of the organization, employee retention is crucial as the advancement of technology. It's the fact that organizations are competing with each other to hire a skilled employee so they can develop and sustain competitive advantage over the others [1].

Turnover of employees is the major concern for the organizations as it out the financial burden over the firm. When an organization lose an employee, it cost the two hundred percent of salary annually in the process of recruitment, hiring and training the employee as a replacement. Thus, the profit of the business, employee morale is impacted significantly due to estimated turnover cost. Additionally, a lot of time is lost to train a new worker [2].

The performance of the business is not only negatively impacted by the turnover of the employee, but it also impacts the operations and causes service delays. Additionally, the morale of the employees is also negatively impacted by employee turnover, and other employees are inspired to quit the job. Employees leave their current job for a number of reasons, including inadequate training, benefits or pay, unfairness, lack of career progression, and resource depletion. One of the major antecedents of turnover intention is voluntary employee turnover [2]. Another factor which the major cause of employee turnover is the intent of the employee to leave

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the firm. Employee perceives this stressor as the cause of hinder in its learning and growth [3].

When the employee leaves the organization, it has an undesirable impact on the competitive advantage and success factors of the organization. Researchers mentioned that a high level of turnover of the employees impacts the stability, consistency and quality of services provided by the organization to the customers. As a result, customers not get satisfied with the services or products being provided [4]. As there is a shortage of expertise in the job market, so the turnover of the employees can be fatal for the firms because they have to bear the high cost to train the employees causing a reduction in the production of the organization [5]. Therefore, it is important to highlight the factors causing turnover intentions in the organization [6–23].

It is important to mention that job satisfaction is the attitude of the employees, which is caused by summation and balancing of many dislikes and likes experienced by the employee. These experiences are connected with the evaluation of the job. It is critical for an organization to ensure the satisfaction of employees to be successful [24]. There are a number of factors which are important for job satisfaction. All of these factors are critical as feelings of a person regarding the job is impacted by it. These factors include work itself, productivity, safety, communication, work condition, co-workers, supervisors, benefits, promotion and pay. Every factor mentioned has an individual impact on job satisfaction. There are a number of benefits of job satisfaction, including termination, turnover, absenteeism, grievances and complaints [25–38].

Therefore, the focus of a number of studies is the satisfaction of employees from the job. Among the factors effecting the satisfaction level of employee regarding the job is job autonomy, which is considered very important. It is considered that employee having a high level of job autonomy will bring more satisfaction to the employee. It is because the employee feels freedom regarding the schedule of the job and efforts being made for it.

Furthermore, the attitude of the employee is impacted by the experience an employee gets from the support from the supervisors. As a result, it impacts job satisfaction, as well. Researchers have perceived organizational support as the basic component of the organization. Importantly, in perceived organizational support, the employee feels that the organization value his/her contribution to achieve goals and care for his/her well being [39].

Therefore, this can be hypothesized that the supervisor support and job autonomy might help to improve employee's job satisfaction leading to reduce the intention of turnover. Based on these arguments, the purpose of research is to examine the relationship between job autonomy and supervisor support leadering the job satisfaction of the employee, which will later impact the turnover intent of the employee. The findings of the research will help in identifying the reasons causing the employees to leave their jobs. The information gathered will help organizations to take the initiative to stop the turnover resulting in maximizing the profitability. This model will help the organization to adopt certain procedures and policies so the work environment can be improved and turnover a be reduced. In this study, employee turnonver is the dependent variable, whereas perceived organizational support and job autonomy are the independent variables. This relationship is mediated by job satisfaction.

2. LITERATURE REVIEW

2.1. Turnover Intention

The term turnover intention is often used in Human Resource Management. It is crucial for an organization to constantly monitor the turnover rate amongst its employees. There are various visible and invisible costs of high employee turnover rates, such as recruitment, induction and training expenses (visible) and effect on the morale of the remaining staff (invisible).

Researchers have defined turnover intention as the probability of employee that he/she will leave the job permanently in the near future. The intention of employee turnover is the willingness of an employee to leave the employer and quit the job. The term intention is the basis of quitting the job. It is defined as the process in which employees have decided to leave the job and organization.

There are basically two categories of turnover as involuntary or voluntary turnover. Few researchers have classified turnover to dysfunctional or functional turnover. In every one of these categories, there occurs variation among the impact on the organization [40]. The most damaging turnover for the organization is the dysfunctional turnover. Thus, when the employee will intent to leave the organization, this intention will definitely lead to voluntarily quit the organization causing long-term harm to it.

Among the predictors of turnover intentions, job satisfaction is the major predictor [41]. Researchers have reported that job satisfaction is not sufficient predictor of turnover intention. Whereas, there should be other variables studied that may impact the turnover intention of the employee. Most of the times, the employees who tend to leave the job are the most skilled one. If such employees leave the job, the organization will lose the knowledge, talent, skills and experience of the employee, which will impact the efficiency of the organization [42]. Therefore, according to studie, most of the human resource department personnel emphasized on internalizing and embracing basic aspects of HRM practices in retaining talents [43].

2.2. Job Satisfaction

Researchers have stated that job satisfaction is a collection of beliefs and feelings of employee related to the job. It also refers to the general attitude of the worker towards

the organization and job. Organizations are more concern about the satisfaction of the employees towards the job because the employee who is satisfied is more intended to have less absenteeism [44].

Different theories and factors related to the satisfaction of the job are being examined by a number of researchers and theorists. These factors include the organizational environment, gender, age, organizational commitment, performance and cohesion. There are a number of factors associated with satisfaction of job, including promotion opportunities, working condition, work itself and its nature, relationship with supervisor, and co-worker relation. All these facets impact the satisfaction level of employees and thus must be reviewed in the studies.

Researchers have pointed out that job satisfaction is very important for organizations because it is an indicator of psychological wellness of employee [45]. There are a number of theories reported that can help researchers to explain job satisfaction. Such theories include Social reference group theory, two factor motivational theory, discrepancy theory, equity theory and need theory of fulfilment.

Scholars have found different ways to satisfy employees. The managers were accordingly facilitated by the managers of human resource so they can attract, motivate and retain the employees working in the organization. Level of job satisfaction impacts the productivity, performance, commitment and absenteeism of the employees directly. Moreover, the cost to hire new employees is reduced, and the retention level of workers is improved as a result of job satisfaction. On the other hand, when the employees are dissatisfied, it impacts in increasing the cost of hiring selecting and training. Its also reduce the revenue, efficiency and production of an organization. So job satisfaction is one of the most important aspects of the organization that needs to be studied [46].

2.3. Job Autonomy

Researchers have considered the autonomy of job as essential characteristics of management of any organization and it is studied by a number of researchers since a few decades. Job autonomy is defined as inborn freedom and choice in the job to perform a number of tasks [47].

Most of the studies have confused the concepts of control and autonomy. Therefore, it is important to distinguish between them. Control means shaping tasks and projects, working circumstances and means of work. On the other hand, autonomy means having free choice from interaction and continuous observation with the manager. In other words, autonomy is also referred to as sanctioning the action of one person at a very high level [48].

If professionals are telaneted, they have the high possibility to be successful. Such professionals have the ability to perform well and compete in their profession. These professionals use knowledge to support their work. They also have autonomy in the decision making process of their work. Responsibility regarding the outcomes of work is also included in the autonomy, which is resulted in a high level of motivation and high efficiency. Past researches have emphasized that autonomy impact the goal setting, work pace and work method.

2.4. Supervisor Support

The role of management and supervisors is key to facilitate and support the employees in delivering services in a better way and achievement of satisfaction regarding the job. Support from the supervisor means instrumental and emotional support provided by the managers, which are required for the employee to keep a balance between family and job responsibility. Due to this support, hope, purpose and predictability of employees are increase while working at work place [49].

Researchers found that there exists a significant gap between the performance of employee, satisfaction, and supervisor support strategies. Organizational profitability can be increased as a result of strategies adopted by organizations regarding perceived supervisor support. Researchers have reported that the profitability of the organization is decreased in the absence of perceived supervisor support. The absence also results in increased turnover and also the factors like wellbeing, quality of life and interpersonal relationships are also impacted [50].

Researchers agreed that supervisors and managers must play an active role in making employees satisfied and make them engaged in their jobs.

2.5. Turnover Intention and Job Satisfaction

In the studies related to behavioral and social science, job satisfaction is studied extensively since a few decades. These studies focused on examining the factors considered and antecedents of job satisfactions, its dimensions, and relationship among turnover, performance and job satisfaction. Past studies have reported a negative relationship between turnover intention and job satisfaction [51]. The finding is also supported by many other studies regarding turnover [52]. A same negative relationship was found by Refs. [53–56] among the variables.

2.6. Relationship of Job Autonomy with Job Satisfaction and Turnover Intention

Past literature indicates a number of factors that impact the job autonomy and job satisfaction of the employee. Researchers found that autonomy of work was the most motivating factor for an employee to make them satisfied from the job. These employees categorized that work itself was the most important factor due to which they were satisfied with their jobs [57]. Researchers have found that job satisfaction and autonomy of jobs are significantly linked to each other. Furthermore, for professional development, work autonomy is considered as important element of satisfaction. Researchers have also found that job

satisfaction is positively influenced by flexibility and job autonomy [58].

Past studies show there exists a negative relationship between turnover intention and job autonomy [59]. When employees are at work, and if they feel empowered, they contribute actively to achieve goals. In case of dissatisfaction, the turnover of an employee is increased. Therefore, intention to leave the organization is negatively impacted by job autonomy [60].

2.7. Relationship of Supervisor Support with Job Satisfaction and Turnover Intention

From the past literature, its evident that there exists a positive relationship between supervisor support and job satisfaction [61]. In this study, its hypothesized that supervisor support will positively impact job satisfaction. A good environment will be created because of supervisor support to its team members, which will result in a positive attitude among the team members towards the job. In this scenario, employees will gain knowledge from the guidance of their supervisors, which will motivate them to work, resulting in job satisfaction [39].

Turnover of employees is influenced by the supervisors, which impact the attitude and perception of the employee towards the organization. Researchers found the different impact of supervisor support on turnover and attitude of the employee toward their job. As a result, the employees of organizations tend to work hard to achieve their assigned goals and objectives [62]. Therefore, managers of the organization should consider turnover intention as a potential outcome of neglection from supervisor and lack of supervisor support impacting the decision to stay or leave the organization. If the perceived supervisor support is increased, the turnover intention among employees will be reduced [63].

Researchers have found an effective negative impact of supervisor support on turnover intention. Its reported that employee retention is increased as the perceived supervisor support is increased [64]. Percieved supervisor support is a critical factor that can help in creating strategies to reduce turnover. The actions of supervisors help a lot to reduce the turnover among the organizations and the intention to leave organization among employees [65].

On the other hand, perceived supervisor support can have a negative impact on the employees. It is because the interaction among employee and supervisor is increased, which make supervisor the primary focus and employee always look towards the manager for help. As a result of supervisor support, employees feel obligated in the adoption of some roles like helping the other workers of organization within the organization [66]. Additionally, theoretical model of the current study is highlighted in Figure 1.

Fig. 1. Theoretical framework.

2.8. Research Hypothesis

Following hypothesis are developed from the previous framework:

H1: The job autonomy is in a significant relationship with the employee turnover intentions.

H2: The supervisor's support is in a significant relationship with the employee turnover intentions.

H3: The job autonomy is in a significant relationship with job satisfaction.

H4: The supervisor's support is in a significant relationship with job satisfaction.

H5: The job satisfaction is in a significant relationship with the employee turnover intentions.

H6: Job satisfaction mediates the relationship between job autonomy and employee turnover intentions.

H7: The job satisfaction mediates the relationship between supervisor's support and employee turnover intentions.

3. METHODOLOGY

To achieve the objective of the current study, the author has employed the survey-based methodology, and the data is gathered through a self-administered questionnaire. The email and personal courier are used to collect reach the respondents, which are the operation managers of manufacturing firms. Initial data is analyzed via SPSS 20.0, which is among one of the robust and advance research software for the data analysis in the social sciences. Later the SEM-PLS is used to for data analysis and the data has undergone these analyses, namely (a) the descriptive analysis, (b) the reliability, and the validity analysis, and (c) the regression analysis. Meanwhile, testing of hypothesis is done using Structural equation modeling regression analysis. The results from these tests help to indicate the direction and strength of the association between the independent and dependent variables, as well as to identify the most influential variable in the model.

Several authors have observed and realized the problem of non-response bias in research studies, which can occur due to multiple reasons. For instance, respondents may have limited or no time for filling the survey, the sensitivity of certain questions involved in the questionnaire, fear of top management, lack of interest or cooperation by the respondents, unable to provide desirable information, or failure to reach or target desirable respondents. In order to deal with non-response bias, researchers need

to ensure the appropriate selection of desirable and interested respondents.

In addition, while designing the survey, questions must be very well structured and free from any ambiguity. After undergoing the process of data collection, the questionnaires that are incomplete must be excluded from the dataset.

In the process of data analysis, the primary step is to check the validity of the instruments involved in the study. For this purpose, Confirmatory Factor Analysis is employed. In this context, a suggested rule of thumb states that the values for factor loadings must be above 0.50 [67]. Therefore, the sample size for the current study is estimated to be 276, which will be used to estimate the accepted factor loading value for the relation among factor loadings and sample size. Since the sample size for the present study is 276, the factor loadings for all items turned out to be above 0.40. According to the authors, the sample size that lies within 30–150 is considered as normal. Also, the large sample size assures data normality. This indicates the normality of data improves with the increase in sample size. Furthermore, the normality test is done to check whether the sample data is well modeled.

Table I. Outer loading.

	ET	JA	JS	SS
ET1	0.906			
ET2	0.873			
ET3	0.882			
ET4	0.828			
ET5	0.880			
ET6	0.861			
JA1		0.895		
JA2		0.895		
JA3		0.904		
JA4		0.883		
JA5		0.926		
JS1			0.882	
JS2			0.895	
JS3			0.879	
JS4			0.275	
JS5			0.745	
SS1				0.890
SS2				0.908
SS3				0.902
SS4				0.927

4. RESEARCH ANALYSIS AND DISCUSSION

Structural Equation Modeling operates for identifying the extent to which the determination of structural model is in line with the sample data and how appropriately fits the data. It particularly observes the structure of relation among the existing observed variables. On the other hand, observed variables explain the latent variables as well as make inferences about them. Where latent variables are the unobserved variables that requires more and more constructs for defining them. Furthermore, a maximum likelihood approach is used for the advanced evaluation of the model.

An association between two or more independent variables is known as multicollinearity. Multicollinearity test is also conducted, exhibiting an inter-association among all variables involved in the model. The independent variables are expected to be associated with the dependent variable to some extent, but the existence of high correlation among variables can result in the existence of multicollinearity. Collinearity refers to a condition where some of the independent variables are found to be highly correlated with each other. Therefore, it is suggested to avoid multicollinearity as it can bring misleading results

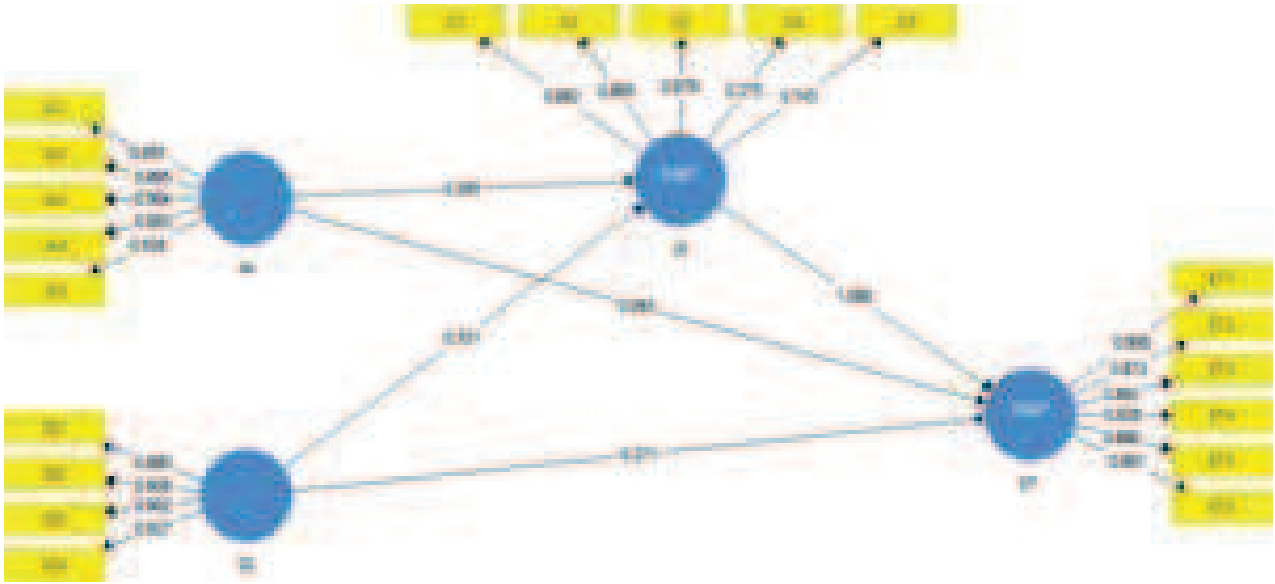

Fig. 2. Measurement model.

Table II. Reliability.

	Cronbach's alpha	rho_A	Composite reliability
JA	0.955	0.955	0.965
SS	0.917	0.919	0.939
JS	0.949	0.950	0.961
ETI	0.924	0.921	0.923

Table III. Fornell-Larcker criterion.

	ET	JA	JS	SS
ET	0.872			
JA	0.680	0.901		
JS	0.791	0.886	0.772	
SS	0.651	0.892	0.903	0.907

and influence the process of data analysis, resulting in the impractical interpretation of the findings. For the present study, multicollinearity test is conducted through regression analysis and found no multicollinearity. Measurement model together with the confirmatory factor analysis examine the estimates from the CFA. Confirmatory Factor Analysis is also used to assess whether the constructs of both proposed and measured model show consistent results. Measurement model of PLS is given in Figure 2.

Factor analysis is a powerful and commonly used measure to check the validity of construct that can be established through summarizing the data, in order to increase its visibility, manageability, straight forwardness, and to identify suitable items for every dimension. In addition, it also specifies two problems that need to be focused while conducting factor analysis. Firstly, the sample size must be adequate, i.e., above 150 and secondly, the inter-association between items. For factors analysis, the Barlett's test for Sphercity must be significant at $p < 0.5$. Factor loading is given in Table I. Moreover, reliability is highlighted in Table II.

Reliability test involves several dimensions. Cronbach's alpha test is generally considered as a measure of scale precision. The results of Cronbach alpha indicates that all constructs have a value higher than 80%, which is considered to be good according to researchers. Furthermore, multiple regression analysis is employed for testing of hypothesis.

Table IV. Direct results.

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
JA → ETI	0.081	0.092	0.113	4.72	0.000
SS → ETI	0.126	0.125	0.035	6.517	0.000
JS → ETI	0.079	0.081	0.023	3.973	0.000
JA → JS	0.786	0.143	0.035	7.237	0.000
SS → JS	0.091	0.093	0.023	3.775	0.000

Table V. In-direct effect through mediation.

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
JA → JS → ETI	0.018	0.024	0.04	3.60	0.002
SS → JS → ETI	0.029	0.032	0.08	4.63	0.002

Table VI. Variance explained.

	R square
ET	0.647
JS	0.847

Discriminant validity is also obtained for the current study by comparing the item and cross loadings. Discriminant validity determines the extent of distinctiveness and visibility of the measures of constructs. Table III shows the discriminant validity.

Afterwards, structural equation model is estimated using path diagram, which is an effective technique of measuring the indirect and direct association between the observed constructs. Therefore, SEM is preferred for this research and for the hypotheses testing and results are shown in Table IV.

Furthermore, hypothesized structural model is developed for assessing the relation between the latent constructs. However, path coefficients are also obtained to observe the association between the variables and to conclude about the proposed hypotheses. After assessing the structural model, the fitness of model is checked through Goodness of Fit test. It determines if the proposed model is appropriate for hypothesis testing. Finally, the measurement model is then converted into the structural form for identifying the association between exogenous and endogenous constructs [60, 68]. The Table IV shows the findings of direct hypotheses, depicting the significant acceptance of all direct hypotheses.

Moreover, Table IV highlights the mediating effect of KS in the relationship between the ET and SCM. These results of moderation show that for both mediation hypothesis, the t-value is above 1.96 and p-value is below 0.05 which accept H6, H7, and H8. Indirect effect results are demonstrated in Table V.

The present study involves multivariate analysis, in which the predictor variables explain the variation in the R^2 of the endogenous variable which is shown in Table VI.

5. CONCLUSION

Employees with high turnover intentions to leave an organization have undesirable effects on organizational success factors and competitive advantage. The prime objective of the current study is to explain the relationship between employee turnover intentions, supervisors support, job

autonomy and job satisfaction. Furthermore, the mediating role of job satisfaction in the relationship between job autonomy, employee turnover intentions and supervisors support are examined. We have used the SEM-PLS as a statistical tool to achieve the objectives of the current study. The data is collected with the aid of an adapted questionnaire. The operation managers and finance managers of Indonesian manufacturing firms are chosen as the final sample of the current study. Prior studies have revealed the fact that turnover is a key determinant of the organizational performance, as it drains the minds of the organization, increase the human resource cost and reduce the competitive advantages. The current study focused on job satisfaction, and it is argued that job autonomy is a key determinant of job satisfaction, as greater autonomy will lead to more satisfaction and lower the turnover. Meanwhile, the findings of the study have revealed the fact that supervisor support is also a key factor. The results of the study are providing support to the proposition of agency theory and resource-based theory. Overall the findings of the current study are in line with the proposed findings. The findings of the study highlight the fact that lower turnover intention enhances the number of experienced individuals, and the support of the supervisor or colleague matters a lot.

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RESEARCH ARTICLE

Predictors of Entrepreneurial Intentions: Mediating Role of Self-Efficacy

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Entrepreneurship is an important factor which lead towards the self-employment and while doing this can potentially reduce the unemployment. Which has become a giant problem globally. Considering the importance of the issue present study has attempted to analyze that how do the entrepreneurship education and emotional intelligence lead towards the entrepreneurial intentions. Additionally, self-efficacy was considered as a potential mediator. Data were collected from the engineering students by using the convenience sampling. Statistical analysis was performed by using Smart-PLS. The results of the study reported a positive relationship between entrepreneurship education and entrepreneurial intentions of the students. Relationship between emotional intelligence and entrepreneurial education was also supported by the study results. The relationship between self-efficacy and entrepreneurial intentions was proved to be strongest of all by the study results. Finally the study results have supported all the mediation relationships between the variables. Practical implications and future research areas are provided at the end.

Keywords: Emotional Intelligence, Entrepreneurial Intentions, Entrepreneurship, Self-Efficacy, Engineering.

1. INTRODUCTION

Entrepreneurship emerged to be an important topic in current research. Researchers have paid great attention towards it as it contributes towards the economic growth of a country. It helps to tackle the unemployment and reduce the burden of the state to provide the jobs to every citizen of the country. It is stated that the entrepreneurship activities in a country significantly predicts its economic activities and growth. However the level of entrepreneurship activity fully relies on the number of entrepreneurs in a country. The number of entrepreneurs can be increased by providing the education specially designed to polish and build the entrepreneurial abilities among the students (Chienwattanasook and Jermsittiparsert, 2019). The entrepreneurship asks for its promotion within a country to have better outcomes. It is also stated that undeniably no country has the required number of entrepreneurs, so there is need to promote this domain to meet the need of the country [1]. One method through which it can be achieved is the education. Bearing in mind the importance of the topic present study has considered the role of education towards the entrepreneurship intentions. Thailand is also encountering the unemployment especially in youth due to increase technology adoption in the Thai industries. Following Figure 1 is showing the increasing trend for the Thai youth unemployment:

Other than education there are several other variables which also do contribute towards the entrepreneurial intentions such as personality factors. In recent years, emotional intelligence has become an important factor to be studied in different research areas. It is the mental ability to know, utilize, understand, and cope with the feelings of oneself and others as well. It helps to deal with the emotional states effectively and can potentially help to solve the problems as well. It has been studied with different outcomes over the years. Previously researchers have reported it to be associated with the positive psychological states and job outcomes such as job performance, satisfaction, commitment and problem solving, etc. Numerous research is available on the role of emotional intelligence towards positive outcomes. However, there is less research available regarding the contribution of emotional intelligence to the entrepreneurship. Similarly, another study has also argued that entrepreneurship is extensively researched topic. However, there are few efforts on record, which has tried to explain the relationship between emotional intelligence and entrepreneurship intentions [2].

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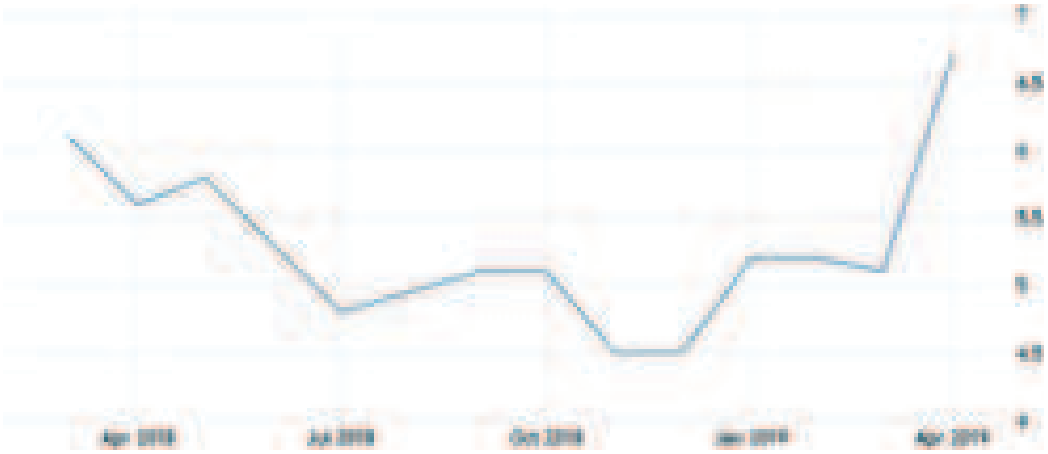

Fig. 1. Increasing trend for the Thai youth unemployment.

Considering the literature absence and research gaps the present study attempted to explore the influence of emotional intelligence and entrepreneurship education on entrepreneurial intentions. Furthermore, self-efficacy is considered as a mediator between the mentioned relationships. So following are the research questions:

1. Is there any relationship between emotional intelligence and entrepreneurship intentions?
2. Do the entrepreneurship education influence entrepreneurial intentions?
3. Do self-efficacy contributes to entrepreneurial intentions?

The topic of the present study has a valuable contribution to literature as well. Because it is related to the current debate on the unemployment rates in the developing economies globally which makes it a topic of concern. Further, it is also related to university education reforms. It also contributes to the questions regarding the effectiveness of education at the university level. The education may not be a driver for entrepreneurship, but it can be considered one of the major ones. Undergraduate unemployment is the current issue being faced by different economies. By addressing this issue current study will provide insights that what can be done to promote the entrepreneurship and promote the self-employment. Undeniably the jobs offerings are significantly less than the number of graduates. The next sections of the present research will present a detailed discussion on the previously available empirical and conceptual literature; the research methods adopted results, and discussion and future research areas.

2. LITERATURE REVIEW

2.1. Entrepreneurship Intentions

Entrepreneurial intention is an individual's deliberation to exhibit his/her entrepreneurial behavior or get him/herself engaged in entrepreneurial activities leading toward the self-employment resourcefulness or going for a new business venture. Furthermore, these do denote internal courage, determination, and sense of independence. Also, it has more to become an entrepreneur instead of expression. Entrepreneurial intentions have been proposed as a state of mind of an individual which are focused on starting a new business venture or starting something new within an existing business [3–17]. These do serve as a vital driver during the process, which is related with the opting the new venture [18].

2.2. Emotional Intelligence

Salovey and Mayer [19], introduced the emotional intelligence, and popularized the concept. It has been defined over the years by different researchers. It has been defined as "the ability to monitor one's own and others' feelings and emotions, to discriminate among them and to use this information to guide one's thinking and actions." [19] Later on, different dimensions were also proposed for emotional intelligence which is as follows: perception, appraisal, and emotional expression; emotional facilitation of thinking; consideration and analysis of information related to the emotions, application of knowledge related to the emotions and their regulation. Cartwright and Pappas [20], defined the emotional intelligence it lies when the information is processed by a human mind, and then it is integrated with the cognition. There are entirely different approaches have been adopted by researchers to study and conceptualize emotional intelligence such as ability, integrative, and mixed model approach [21–33].

As per the specific ability approach, certain abilities and competencies are regarded as a major aspect of emotional intelligence. Certain abilities have been proposed by different authors who do represent the four branch model [20]. However, the integrated approach is different in which each area is developed from childhood. The third approach is the mixed model which states that it is a collection of intangible abilities, skills, and aptitude, which potentially influence the ability of an individual to get success in tacking the demands of an environment [3–5, 7–9, 34–37].

Previously conducted studies have provided empirical evidence regarding the role of emotional intelligence with positive work outcomes. Emotional intelligence has been previously linked with work performance [38], job satisfaction, commitment, and involvement at a job [39]. Possibly emotional intelligence can predict the favorable work outcomes across the different areas, and it has been proved by the previous studies as well. In this regard, a study was conducted to explore the relationship between emotional intelligence and positive work outcomes. As per the previous study emotional intelligence considerable predicted the work outcomes. The relationship direction was positive.

Emotional intelligence influence entrepreneurial behavior in multiple ways. It does influence the self-assessment of an individual. Therefore the individuals having higher perceptions about emotional intelligence tend to show higher patience for the stress. Further, highly emotionally intelligent individuals tend to have affection, proactive, and they are also highly creative, which adds to the entrepreneurship behaviors. The authors explored the how do organizational support and emotional intelligence impacts the entrepreneurial behaviors. The findings reported that both variables have a positive influence on entrepreneurship behavior. The authors recommended that the actions may be filtered through the emotional capabilities of employees [40]. However, Ahmetoglu, Leutner [41] raised a question regarding the link between emotional intelligence and entrepreneurship behavior as the personalities are different, so there should be some different mechanism which leads towards the entrepreneurship.

Similarly, Haider, Gill [42], conducted a study regarding the entrepreneurship behavior of individuals. They proposed a conceptual framework in which emotional intelligence and perceived organizational support were linked with the entrepreneurship. They suggested to replicate the research model and support the model with the statistical evidence. Based on the previous conceptual and empirical evidence, it is proposed that emotional intelligence will predict entrepreneurship behavior.

Self-efficacy is a motivational paradigm that can potential predict the behaviors in several ways. There are four sources which do affect the self-efficacy, namely; performance accomplishments, vicarious experience, persuasion, and judgments of one's physiological states [43]. Emotional intelligence comes under the physiological states, reported that some of the dimensions of emotional intelligence have significantly predicted the self-efficacy. In this regard, Lee, Wong [44], argued that it can influence entrepreneurial intentions.

Furthermore, a previous study also provided evidence which states a relationship between emotional intelligence and entrepreneurship intentions. Therefore, it is argued that emotional intelligence can predict the entrepreneurship intentions, and the self-efficacy of an individual will strengthen the relationship. Thus, it is hypothesized that:

H1: *Emotional intelligence is significantly and positively associated with self-efficacy.*

H2: *Self-efficacy is significantly and positively associated with entrepreneurial intentions.*

H3: *Emotional Intelligence is significantly and positively associated with entrepreneurial intentions.*

H4: *Self-efficacy significantly mediates the relationship between emotional intelligence and self-efficacy.*

2.3. Entrepreneurship Education

The association between entrepreneurship education and entrepreneurial intentions is an under-researched topic in entrepreneurship [45]. A comparative study reported that entrepreneurship intentions of business students in Poland increased over time due to the course they studied regarding the entrepreneurship. However, the results of the study were not significant. Similarly, another study reported a positive association between enterprise education and students' entrepreneurial intentions in Poland [46]. Therefore, it can be concluded that when the student gets the education related to entrepreneurship, it provides them with good knowledge about the entrepreneurship, which further translates into their behavior. It is also worthy of mentioning the findings of another study which was carried out in 4 countries and provided comparative findings regarding entrepreneurship education. Study concluded a positive association between entrepreneurship education and self-employment. A recent meta-analysis has also supported the arguments of the previous studies [47, 48].

Self-efficacy theory states that the individual's potential self-efficacy is influenced by the sources of information. It asserts that four major factors are influencing it, which are as follows: performance accomplishments, displaced exposures, verbal encouragement, and physiological states [43]. As per the definition, emotional intelligence has to do with the emotions, so it falls under the umbrella term of physiological states. Furthermore, researchers [49], stated that education related to entrepreneurship could potentially provide all of the mentioned areas or any of them. When students are learning the courses regarding the entrepreneurship, they execute different projects of practical nature, which consequently enhances their self-efficacy because of the viable accomplishments they have gained. They do have time to get together, observe or talk about the stories of the entrepreneurs who have gained success. Thus, it serves as a source of learning for them. It is worthy of mentioning that they can be stimulated about entrepreneurship as it is attainable goal, and positive emotions can be developed [50]. In the light of available evidence, it is concluded that entrepreneurial education can significantly add to the students' self-efficacy.

The mediating role of the self-efficacy has been examied and verified by the previous studies. In this regard,

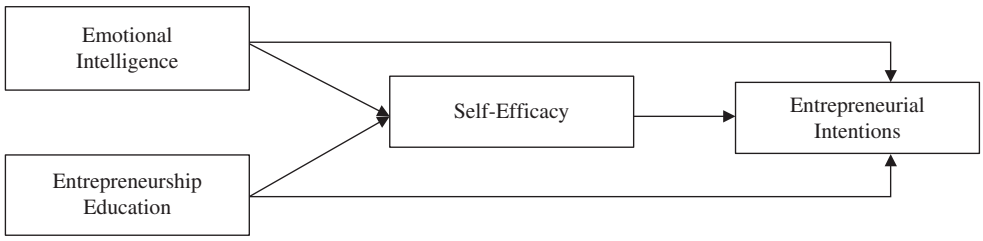

Fig. 2. Theoretical framework.

Nowiński, Haddoud [50] conducted a study to examine the role of entrepreneurship education towards the entrepreneurial intentions, and they tested the mediation role of self-efficacy by collecting data from students. They reported a positive mediation role of self-efficacy between the relationship of entrepreneurial education and entrepreneurial intentions. Previous studies have reported a significant positive relationship between entrepreneurial education and self-efficacy [44]. Similarly, previously, self-efficacy has also been associated with entrepreneurial intentions [50]. Based on the literature review, it is hypothesized that:

H5: *Entrepreneurship education is significantly and positively associated with self-efficacy.*

H6: *Entrepreneurship education is significantly and positively associated with entrepreneurial intentions.*

H7: *Self-efficacy significantly mediates the relationship between entrepreneurship education and self-efficacy.*

Following Figure 2 is showing the theoretical framework for the present study.

3. METHODOLOGY

The present study investigated the influence of emotional intelligence and entrepreneurship education on entrepreneurial intentions. Further, the study has also considered the role of self-efficacy in the relationship.

The nature of the study is quantitative. For data collection students of engineering, studies were selected as potential respondents. The reason behind the population is that all the candidates will not get the job, so they have to move towards the other options. All the students are from the universities in Bangkok, Thailand. Convenience sampling is used for data collection, as all the respondents are from the same discipline and study line. It is used and appropriate, where the respondents share the same characteristics.

After the population selection, the next was to decide about the sample size for the study. It can be determined by using different criteria provided by different researchers in the past. According to one sample size technique, the sample size should represent at least 20% of the population [51] whereas the other technique uses a table for sample size determination. According to Krejcie and Morgan [52], the table sample size is pre-calculated. Just there is a need to select the sample size as per population. However, the present study has selected the latest technique, which says that for SEM, there should be 200 to 400 respondents. Sample size determination technique provided by Oke, Ogunsami [53] has been adopted as the current study population belongs to construction engineering students.

As per the nature of study self-administered survey has been used for data collection, which was made of two sections. One of the section consisted of the demographic profile of the students, whereas the second section consisted of the variables, namely; emotional intelligence, entrepreneurial intentions, self-efficacy, and entrepreneurship education. All the questionnaires were adopted from the previous studies, the details of which are as follows: emotional intelligence has been measured by using 16 items scale [54]. Entrepreneurship education was measured by four items. Entrepreneurship intentions were measured by six items [55]. Self-efficacy was measured by adapting ten items scale [56]. Point 5-Likert scale has been used for all the variables measures. The next section of the study explains the results of the current study.

4. FINDINGS

First of all, a confirmatory factor analysis was performed to assess the convergent validity of the scale. For convergent validity, there are three criteria to be checked, namely; factor loadings, composite reliability, and average variance extracted. Values for the factor loadings should be more than 0.7. However, generally, the factor loading values can be up to 0.5. The values for the composite reliability and average variance extracted should be greater than 0.8 and 0.5, respectively (Haier et al., 2010).

As per Table I, all the values for the factor loadings are greater than 0.5 and 0.7, which falls within the acceptable range. Similarly, composite reliability values of entrepreneurship education, emotional intelligence, self-efficacy, and entrepreneurial intentions are 0.821, 0.907, 0.913, and 0.893, respectively. Furthermore, the value of average variance extracted for the entrepreneurial intentions, entrepreneurship education, emotional intelligence, and self-efficacy is 0.676, 0.542, 0.522, and 0.542, respectively. Alpha values should be greater than 0.7. Alpha values for the entrepreneurial intentions, entrepreneurship education, emotional intelligence, and self-efficacy are 0.840, 0.707, 0.885, and 0.893. All the values for the CR

Table I. Confirmatory factor analysis.

Constructs	Items	Loadings	Alpha	CR	AVE
Entrepreneurial intentions	E. In1	0.789	0.840	0.893	0.676
	E. In2	0.828			
	E. In3	0.845			
	E. In4	0.827			
Entrepreneurship education	EE1	0.797	0.707	0.821	0.542
	EE2	0.831			
	EE3	0.78			
	EE4	0.486			
Emotional intelligence	EI1	0.705	0.885	0.907	0.522
	EI2	0.746			
	EI3	0.712			
	EI4	0.638			
	EI7	0.679			
	EI12	0.759			
	EI13	0.749			
	EI14	0.704			
	EI15	0.796			
Self-efficacy	SE1	0.703	0.893	0.913	0.542
	SE2	0.743			
	SE3	0.617			
	SE4	0.771			
	SE5	0.802			
	SE6	0.811			
	SE7	0.776			
	SE8	0.744			
	SE9	0.629			

and AVE are within the acceptable range, which establishes the convergent validity of the scale. Following is the Figure 3 of confirmatory factor analysis.

After the convergent validity is established, then the discriminant validity of the scale was assessed. It was calculated to know the degree to which scale does not reflect the other variables in the questionnaire. There are two criteria for the assessment of discriminant validity. One is "Fornell-Larcker Criterion," and the other one is "Hetrotrain-Monotrait Correlation Ratio." The present study has adopted the latest technique, and according to the HTMT, the correlation between all the variables should be less than 0.85. As per Table II, all the correlation values for the variables are less than 0.85, which establishes the discriminant validity.

Table II. Discriminant validity.

	E. In	EE	EI	SE
E. In				
EE	0.723			
EI	0.680	0.632		
SE	0.840	0.758	0.727	

4.1. Structural Equation Modeling

After the scale reliability, convergent and discriminant validity is established, then structural equation modeling was performed to test the hypothesis. SEM is used as the sample size of the present study is small, and when the sample size is small, it is advised to use the PLS-SEM. Results are shown in Table III.

Table III is showing the hypothesis tested between the variables. As per the statistical findings, emotional intelligence is found to be significantly and positively associated with the self-efficacy. The relationship is valued at 0.451. When the students are emotionally intelligent, they do have a sense of awareness of their surroundings, and they can manage themselves. They tend to be

Fig. 3. Measurement model.

Table III. Path coefficients.

Hypothesis relationship	Beta	SD	*t*	*p*	*R*2	*f* 2	VIF
EE → E. In	0.129	0.032	4.084	$p < 0.05$	0.601	0.025	1.687
EE → SE	0.395	0.031	12.927	$p < 0.05$	0.540	0.251	1.348
EI → E. In	0.145	0.031	4.654	$p < 0.05$		0.029	1.79
EI → SE	0.451	0.027	16.527	$p < 0.05$		0.327	1.348
SE → E. In	0.584	0.034	16.969	$p < 0.05$		0.394	2.173

Table IV. Indirect effects.

Hypothesis relationship	Beta	SD	*t*	*p*
EE → SE → E. In	0.231	0.021	10.787	$p < 0.05$
EI → SE → E. In	0.263	0.022	11.982	$p < 0.05$

more positive about themselves. Their self-efficacy tends to increase. Which further will result in positive outcomes? With the increase in emotional intelligence, the individual self-efficacy tends to increase. The results showed a positive influence of self-efficacy on the entrepreneurial intentions of the students. The relationship is significant and valued at 0.584. The relationship between the self-efficacy and entrepreneurial intentions is strongest of all, which ultimately affirms that the positive approach of an individual leads him/her towards entrepreneurship. It can also be asserted that the highly positive individuals are more inclined towards the entrepreneurship as compared to other ones. When the education is designed and provided to students regarding the entrepreneurship, it will help them gain a positive attitude towards the entrepreneurship. The results of the study presented a positive relationship between entrepreneurship education and self-efficacy. The relationship is significant and valued at 0.395. Thus, it is interpreted that a 1% change in entrepreneurship education will bring about a 39% change in the self-efficacy of the students. The also provided a signification relationship between entrepreneurship education and entrepreneurship intentions. The value of the relationship is 0.129. Even though the value of the relationship is low, it asserts that when the individual is provided with the education, it provides him with more knowledge and widens his/her point of view and thinking which leads towards the entrepreneurship.

Moreover, the study has also reported a positive relationship between emotional intelligence and entrepreneurship intentions. The association is valued at 0.145. However, in comparison to education, the effect size of emotional intelligence is more on entrepreneurship intentions. The results have supported the Hypothesis H1, H2, H3, H5, and H6. These hypotheses are accepted in the light of above-presented results.

Table IV is showing the results for the mediation. As per the Table IV, the self-efficacy mediation between entrepreneurship education and intentions is positive and significant. The value of overall influence of entrepreneurship education on intentions is 0.231. It is greater than the direct effect, so the results have confirmed that with the education when the students are also highly positive, they will be more intended towards the entrepreneurship. Further, the results also showed a positive mediation between emotional intelligence and entrepreneurial intentions. The overall effect size has increased due to the self-efficacy.

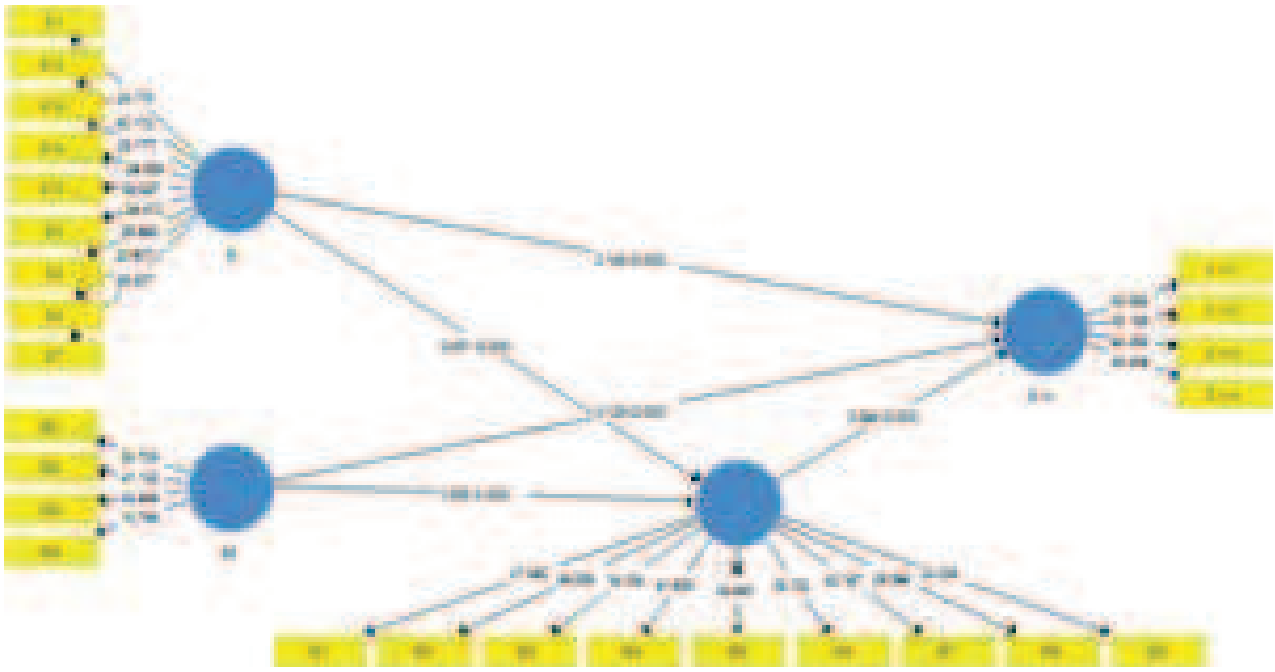

Fig. 4. Structural model.

Based on the results hypothesis, H4 and H7 are accepted. Following in the Figure 4 of the SEM.

5. DISCUSSION

The present study has explored the relationship between emotional intelligence, entrepreneurship education, entrepreneurial intentions and self-efficacy. Study proposed that EI is significantly and positively associated with SE. Results revealed a favorable relationship between the variables, on the basis of which it can be stated that when the individual is capable to control him/herself and the emotions of the persons around him, he/she can go for entrepreneurship due to the ability to manage and regulate the emotions. Thus will have more intentions to go for entrepreneurship as well. Study considered the self-efficacy as potential mediator and proposed that self-efficacy is a significant predictor of the entrepreneurial intentions. It can be stated that individuals having higher levels of self-efficacy and positive self-evaluation about themselves are more inclined towards the new business ventures. The results of the study has also supported these arguments and provided a positive interrelation between self-efficacy and entrepreneurial intentions. The results of the study also supported the hypothesis that self-efficacy is significant mediator between emotional intelligence and entrepreneurial intentions. Thus, in the light of the results presented in the above section following hypothesis (H1, H2, H3 and H4) are supported and accepted.

The other construct was the entrepreneurial education which also do contributes towards entrepreneurial intentions. Thus, the research study proposed a significant association between entrepreneurial education and intentions. The provision of good education and specific teaching related to the entrepreneurship their intentions to become an entrepreneur will increase. Results also supported this notion. Further, a relationship between entrepreneurial education and self-efficacy was also proposed by the study. Self-confidence and positive self-assessment both serve as a motivator to become and entrepreneur. In this regard self-efficacy has been included as a potential mediator. Students having proper education and positive assessment about themselves will be highly motivated to start a new business venture. The results of the study has also supported this argument and proved a positive relationship between entrepreneurial education and self-efficacy. Finally study proposed that self-efficacy significantly mediates the relationship between entrepreneurship education and entrepreneurial intensions. Statistical figures are in support of direct and indirect association of entrepreneurship education and intentions. Interestingly self-efficacy proved to be the stoutest forecaster among all the variables related to entrepreneurial intentions.

Even though the study has achieved its objective and answered the research questions, still there are some limitations which can serve as a potential future research area. The study has small sample size which makes it difficult to generalize it. Future studies with large sample size should be carried out. Longitudinal research should be designed to get the clearer picture of the casual relationship between the variables. Besides the theoretical contribution the present study offers some practical implications for the practitioners, policy makers and institutions as well. From the broader point of view the states can provide the necessary funding and support to the entrepreneurial initiative by the students. A training institute can be established with a prime objective to facilitate and train the students regarding the new business startups. Further a national course can be introduced as a compulsory subject for the entrepreneurship promotion. From the institutional point of it is recommended that they must encourage students for the small business ventures. The course work should be designed which do lead the students towards the entrepreneurship. The student should be provided with the latest skills which can be implemented in their business ventures. Students must be supported and provided necessary means to go for an entrepreneurship workshop. Further the students must be provided with some sort of career counseling which can potentially broaden their way of thinking. The trainings and workshops should be focused on increasing their psychological skills, they should be presented different situational circumstances which will enable them to think.

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RESEARCH ARTICLE

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Energy Balance Analysis—An Impact of Temperature Variation in Unified Hydrogen Based Opto-Source

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The present analysis is towards carbon-free energy transition in power-generating station. In the evolution towards sustainable energy-system, green-source with hydrogen-energy plays a vivacious role as a clean and safe energy carrier in the production of electricity. A unified hydrogen based opto-source (UHOS) with riven bias inverter (RBI) is projected in this manuscript. The planned context integrates the technical and economic feasibility for better energy balancing system (EBS). The impact of Temperature variation is also analyzed along with energy managing scheme (EMS).

Keywords: Unified Hydrogen Based Opto-Source (UHOS), Riven Bias Inverter (RBI), Economic Feasibility, Energy Balancing System (EBS), Energy Managing Scheme (EMS).

RESEARCH ARTICLE

1. INTRODUCTION

The vitality emergency in India prompted serious research in electrical vitality age and transformation innovation by utilizing sustainable sources. Sze Sing Lee, Member, et al. [1] built up his examination on single stage split source with Modified inverter topology and ad improved pulse width modulation. This is accomplished by interfacing the inductor over the Switching gadgets. The exchanging gadgets are worked under crucial recurrence in extension design. To acquire distinctive dimensions of voltages Multi-Level design with split source idea is proposed. Diverse topologies of SSI are Diode Clamped SSI (DC-SSI) and Flying Capacitor SSI (FC-SSI). The Flying Capacitor SSI (FC-SSI) is proposed in this paper so as to avoid the utilization of two secluded DC source. In correlation with two-level SSI, FC-SSI has an additional favorable position as far as information inductance prerequisites utilizing a similar exchanging recurrence, Voltage worry over the leading switches and Complete Harmonic Distortion (CHD) in yield voltage [2].

The Model Predictive controller is proposed in this paper to control the Split source inverter to play out a discrete-time model to gauge the fast approaching conduct of the info and yield flows for each exchanging state, at that point a control activity is characterized by limiting a legitimate cost work [3]. With the utilization of Energy stockpiling gadgets like Battery Energy Storage System (BESS), Fuel Cell or Super capacitor, the power transformation framework in lift inverter presents second request music on DC side of the lift converter [4]. This prompted interior warming of vitality stockpiling gadgets and debasement of capacity gadget lifetime. In this proposed paper a novel information current criticism technique is intended to lighten the low-recurrence current swell in the lift converter without expanding other recurrence segments [5]. The Multi-Level Inverter topology with BESS for remains solitary lattice applications. This power reversal topology requires less control in contrasted with ordinary topology [6]. To eradicate the selected low-order harmonics and to govern the desired fundamental component, nonlinear system equations are represented in fitness function through the manipulation of modulation index and the genetic algorithm (GA) is employed to find the optimum switching angles [7]. Impedance source organize in power transformation framework assumes an imperative role in voltage, stage, and recurrence change [8]. This paper concentrated the examination on different converter topology including VSI, CSI, Buck-help, Uni-directional and Bi-directional converter [9]. The investigation of impedance connects different converter topology results in a decrease of various power transformation stages and in the framework control chain [10].

The different Impendence organized this topology is outfitted in this paper and the consequence of the correlation is given for the accompanying components (1) Boost factor (2) Voltage weight on exchanging gadgets (3) No. of S.C switches required (4) No. of capacitors and inductors required and its highlights are examined. Additionally,

Conversion usefulness and exchanging setup study was done and are ordered [11]. The modulation topology

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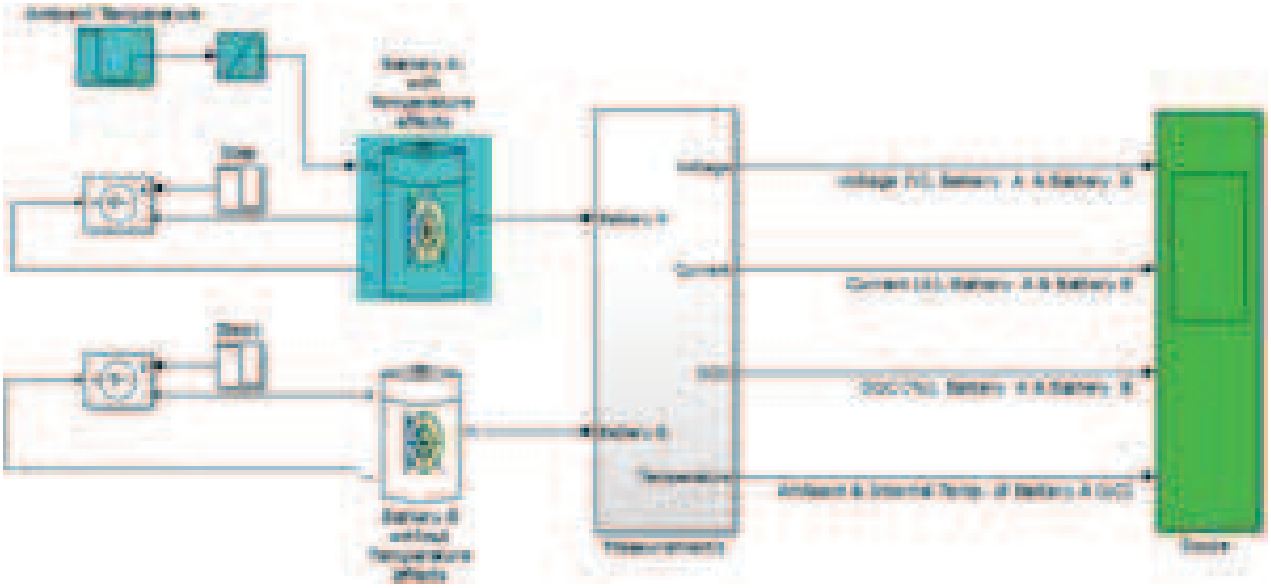

Fig. 1. Hybrid battery-energy storage system model.

combined with a half and half channel, which accomplishes low-recurrence swell decrease in DC have notwithstanding when the framework recurrence changes. A new-flanged hybrid filter is proposed to retain the DC current swell in single-stage PWM inverter and the control of this is figured by instantaneous power analysis. In this paper, the swell in DC current and power was evaluated under various methods of activity under different working force factor.

The anticipated idea furnishes great separating execution with decreased expense and structure adaptability without trade off in by and large effectiveness [12]. CSI and VSI are the two distinct topologies that are centered on the structure of intensity transformation framework. CSI strengthen the capacity while the later topology is utilized just for buck ability. With the utilization of inexhaustible source, the yield voltage shifts persistently. Because of the high variety of yield voltage buck-support setup is must with an extra stage. This paper proposed the modulation procedure for the planned inverter topology [13]. The cons confronted are (1) trouble in the plan of attractive segments, (2) high swell current which diminishes the stack lifetime. The proposed in this paper centered the exploration towards the converter configuration in parallel mode and interleaving methods. With the utilization of interleaving methods in parallel converter sharp ascent and fall of current, swell current is evaded.

Thermal administration is simple in low power applications as decentralized warmth scattering framework is executed in parallel converters. Parallel converters with

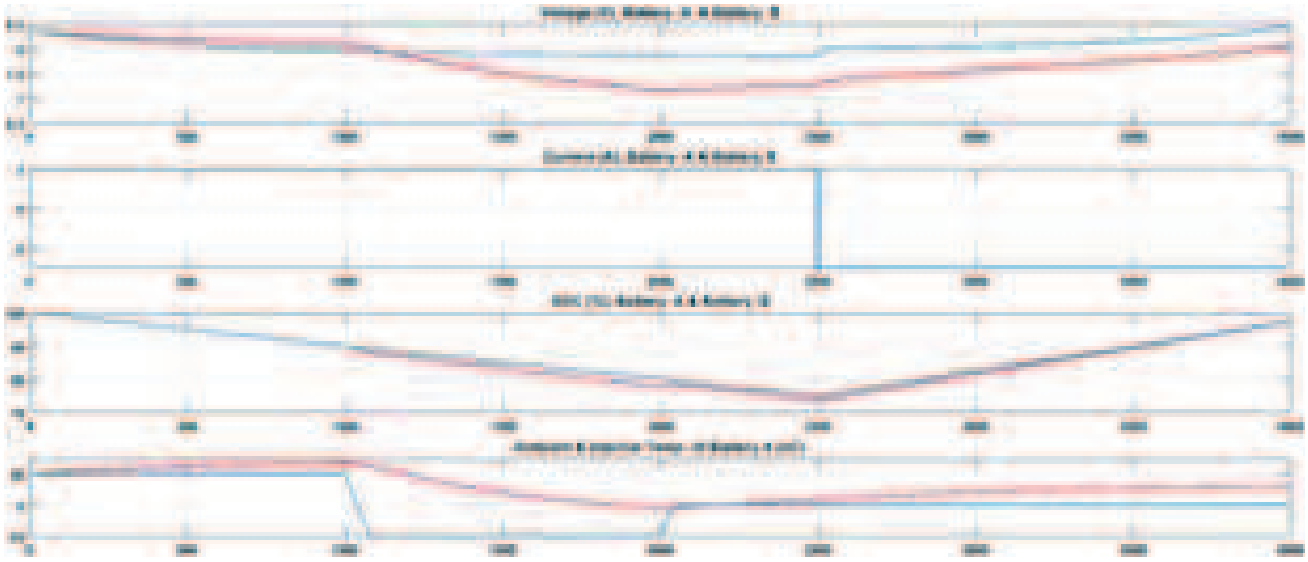

Fig. 2. Hybrid battery-energy storage system model characteristics.

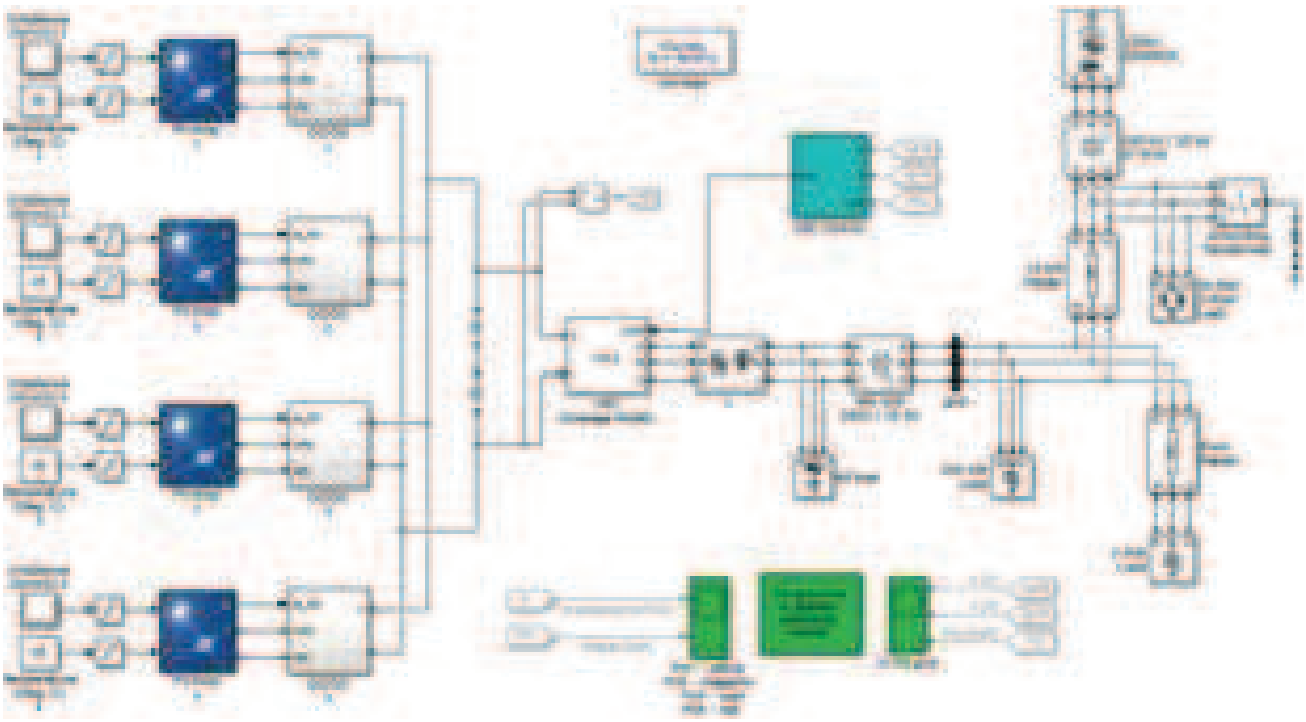

Fig. 3. Smart solar system–simulation diagram.

interleaving calculation are utilized for high power applications [14]. Superior power module based converter is proposed for lattice associated organize. In network associated islanding method of activity the planned superior converter controls both genuine and responsive power. The PQ control calculation dependent on SOGI is structured dependent on second-request summed up integrator which gives quick flag molding. Additionally, the execution and attributes of energy unit associated with power transformation framework are checked [15].

2. SIMULATION AND TEST RESULTS

2.1. Battery Impact on Temperature Variation

The simulation diagram of Hybrid Battery-Energy Storage system model is shown in Figure 1. The hybrid Battery model consists of a battery that considers temperature

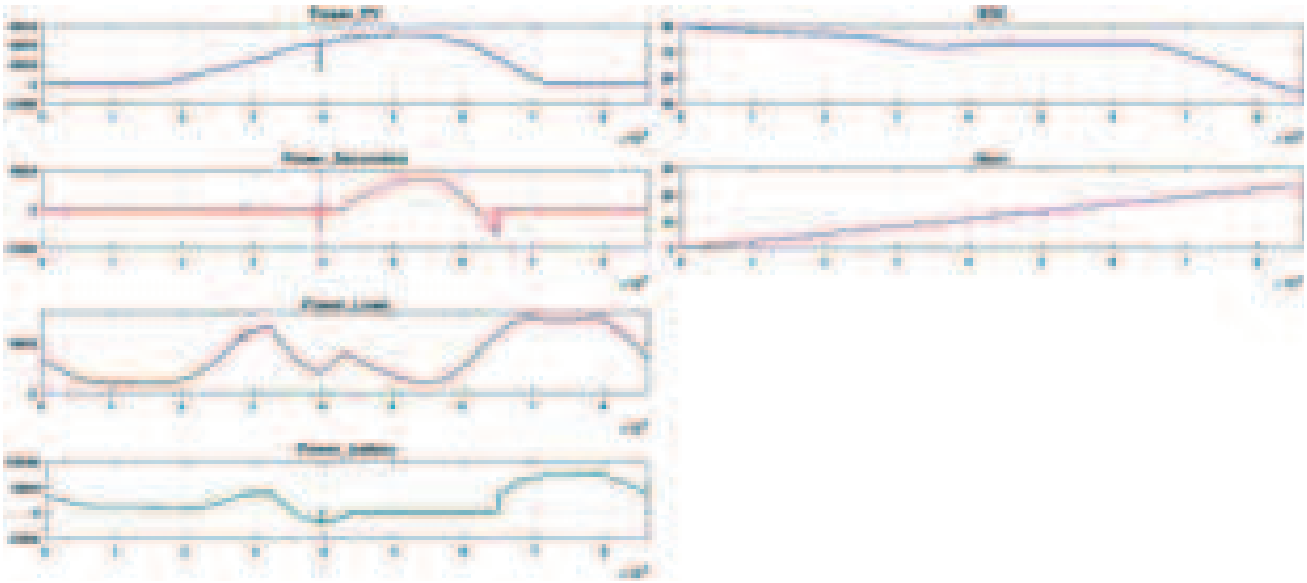

Fig. 4. Opto-electric source hourly simulation–energy balance.

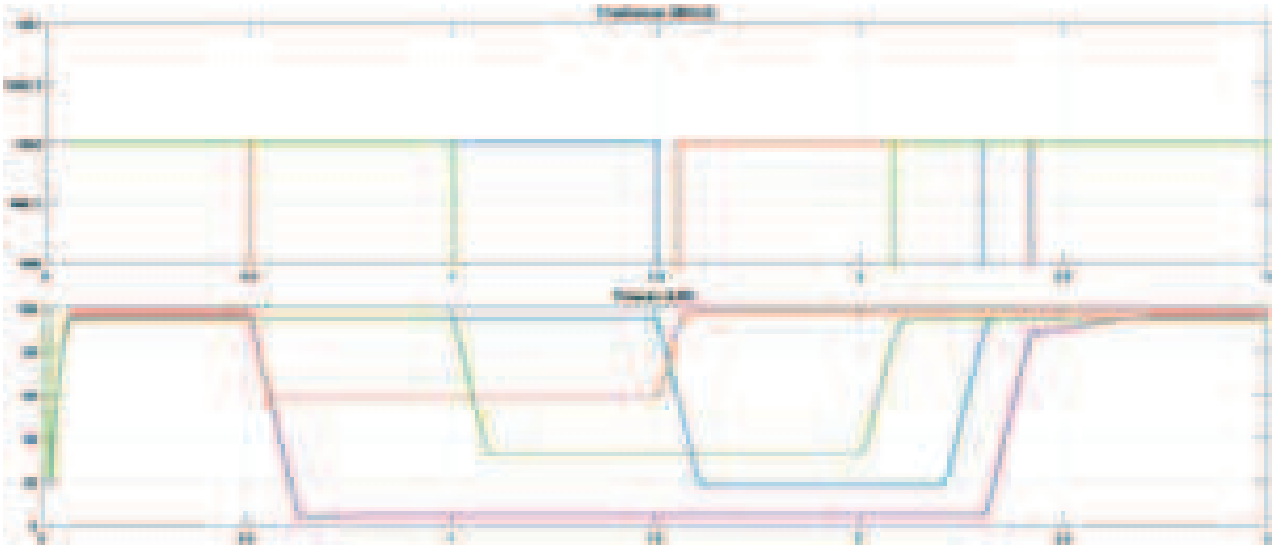

Fig. 5. Opto-electric source simulation output–mean power.

effect and neglecting the effect of temperature variation. The effect of temperature variance occurs from two facts (i) due to solar insolation variation (ii) Internal loss of heat with charging and discharging current. The battery used is hydrogen based integrated with opto-source.

The power drawn from solar is variable with reference to time-factor. Hence the power from solar has to be connected to the Battery energy storage system. Since the power drawn from opto-electric source varied upon the environment condition, the impact of T_{cell} or the T_{ambient} on the voltage capacity and resistance of the battery model is encountered during charging and discharging process of the battery model. The storage-battery model used can either be temperature dependent/in-dependent model. The simulation model compares the performance characteristics of Battery-model, in which the temperature dependent model produces result close to the reality as indicated from the Figure 2.

The simulation result of Hybrid Battery-Energy Storage system model Characteristics is shown in Figure 2. it is observed that the battery starts to discharge at a T_{ambient} (ambient temperature) $= 20$ °C at $I_{\text{discharging}}$ (Charging Current) $= 3$ Amps. During discharging time loss of heat occurs in battery model and at $t = 1000$ sec the internal temperature of the battery model increases to a steady state value of 30 °C. This causes the output voltage of Battery-A to upsurge with diminution in Battery-B output voltage. SOC of Battery-A declines owing to battery capacity fall.

The techno-economic analysis of smart Opto-system is based on depiction of system mechanisms, simulation of power-flow on hourly basic, rate of energy calculation based on sizing and financial report of system components.

The complete simulation for techno-economic analysis of smart opto-system is shown in Figure 3. The designed system has solar panel that works with different insolation and temperature variation. The variation in solar power is tracked on hourly basic. Peak-power from opto-electric source is tracked by using EPPT (Extreme Power Point Tracker) algorithm. The tracked power charges the battery model and the surplus energy available in battery due to opto-source is converted to electricity by means of Riven Bias Inverter (RBI). The transformed power is supplied to grid for various consumers to stabilize the annual energy consumption.

The simulation done on hourly basic defines the energy balance and is represented in Figure 4. Higher the insolation, large amount of power generated from opto-source and majority of load consumes power from solar rather utilizing the grid source.

Promising conclusion arrived from techno-economic calculation is energy managing scheme (EMS) that is accountable for upholding power balance in battery integrated opto-electric system. Lingering load defines the power generated by Opto-source. If the lingering load is negative the power generated by Opto-source is more and hence the riven bias inverter supplies power to the load and absorbs power from load in vice-versa condition. Thereby energy balancing is attained.

The operation of individual PV array is simulated for different insolation with respect to time variance is shown in Figure 5.

3. CONCLUSION

A unified hydrogen based opto-source (UHOS) with riven bias inverter (RBI) is presented in this paper. Techno-economic analysis makes the system more technically feasible in the aspect of energy balancing and energy management system. The variation in power is managed by means of integrated battery charging and discharging progress and internal heat loss. Technical feasibility is

attained by means of digital control technique. By using this unconventional digital control procedure supply-demand is upheld in stable condition.

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RESEARCH ARTICLE

Multilevel Secure Digital Image Steganography Framework Using Random Function and Advanced Encryption Standard

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One of the crucial aspects of processes and methodologies in the information and communication technology era is the security of information. The security of information should be a key priority in the secret exchange of information between two parties. In order to ensure the security of information, there are some strategies which are used, and they include steganography and cryptography. With cryptography, the secret message is converted into unintelligible text, but the existence of the secret message is noticed, nonetheless, steganography involves hiding the secret message in a way that its presence cannot be noticed. In this paper, a new secure image steganography framework which is known as an adaptive stego key LSB (ASK-LSB) framework is proposed. The construction of the proposed framework was carried out in four phases with the aim of improving the data-hiding algorithm in cover images by using capacity, image quality, and security. To achieve this, the Peak Signal-to-Noise Ratio (PSNR) of the steganography framework was maintained. The four phases began with the image preparation phase, followed by the secret message preparation phase, embedding phase and finally extraction phase. The secure image steganography framework that is proposed in this study is based on a new adaptive of least significant bit substitution method, combination random function, and encryption method. In the proposed work, the secret bits are inserted directly or inversely, thereby enhancing the imperceptibility and complexity of the process of embedding. Results from the experiment reveal that the algorithm has better image quality index, peak signal-to-noise ratio, and payload used in the evaluation of the stego image.

Keywords: Security System, Steganography, Spatial Domain, AES, Huffman.

1. INTRODUCTION

As sensitive information is increasingly being transmitted over public network, the security of such sensitive information has become a challenge, as well as an interesting area of research in the past decades. For this reason, the use of cryptography, which is a process through which sensitive information is encrypted into scrambled messages is employed as a solution to this challenge of information security [1]. Nevertheless, cryptographic methods are accompanied by a major problem which is the senseless form of encrypted messages, which attracts the attention of attackers because of how suspicious the message looks. If the attackers suspect the presence of an information, they can make use of effective cryptanalysis systems to modify or decrypt the messages. One way through which this problem can be solved is through the use of methods that enable information hiding, and one of such methods is steganography which is capable of protecting sensitive information when it is being transmitted, while security breaches are minimized [2].

Steganography which is regarded as an art of science for hidden communication, is a special branch of concealing information. The aim of using steganography is to hide a secrete message within a cover image in a way that its presence cannot be detected by an attacker; it is only the sender and the receiver of the message that are aware of the existence of the message [3]. The key rudiments of steganography include a message, a carrier object, hiding mechanism and a stego key that can provide better security. The carrier object is the object in which the message is embedded and this could be DNA, protocol, image, text, audio or video. The use of steganography can be employed in a broad spectrum of applications like secure distribution of secrete military data and other intelligence agencies, fortifying the security of mobile banking, security of online voting, telemedicine system for patient monitoring and covert communication between two communicating entities [4, 5].

Payload is described as the amount of secrete data which can be concealed within a cover object successfully

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without creating visual artifacts in stego images. In order to measure payload, bits per pixel (bpp) is used. If each pixel is used in hiding 1 bit of data, then the payload of a steganography algorithm will be 1bpp or 12.5%. The size of the payload is directly proportional to the strength of steganography algorithm and vice versa [1]. In steganography, the word robustness refers to the resilience of a steganography algorithm against diverse kinds of statistical and simple attacks. If the data that is hidden in a cover image cannot be easily modified or extracted using image processing operations, then the steganography algorithm used is regarded as robust. The issue of robustness is crucial in when watermarking techniques are used because of copyright protection [6]. The concept of imperceptibility is synonymous to undectability, which can be measured using diverse metrics of image quality assessment like structural-index metric (SSIM) and peak-signal-to-noise-ratio (PSNR). The imperceptibility of a method of steganography is high if it is able to produce images that can barely be distorted after data has been intentionally concealed in a manner that it cannot be easily detected by the use of human visual system (HVS) [7, 8].

Based on the data embedding mechanism, there are two classes of image steganography techniques, which include transform domain and spatial domain. With spatial domain, the pixels are directly modified with larger embedding capability and minimal image quality degradation. The robustness of these images is low because it is impossible to totally recover the embedded data if the stego images are subjected to manipulation and simple attacks like compression, cropping, filtering, addition of noise, rotation and translation, which is its shortcomings. Some spatial domain methods include LSB substitution methods [9–11], pixel-value-differencing methods [12], tri-way-pixel-value-differencing method [13], gray-level modification methods [14], edges-based embedding methods [15], and pixel-pair-matching method [16].

On the other hand, the transform domain techniques are based on the use of transformed coefficients to conceal message, thereby reducing the vulnerability to different kinds of attacks. In this category, some of the widely known techniques include discrete wavelength transform method [17], discrete Fourier transform method [18], integer contour transform method [19], and discrete cosine transform method [20]. In comparison to the spatial domain, the transform domain methods are better in terms of robustness, thereby enhancing the suitability for watermarking purposes like protection of copyright [21]. However, such methods are limited in terms of high level of computational complexity, lower payload, inability to maintain an acceptable level of balance between quality of image, efficiency, payload, and security, which in turn makes them not a favorite alternative for real-time security applications. Bearing this in mind, the framework that is developed in this study is done based on the spatial domain and giving priority to just methods within the spatial domain.

In the last ten year, so many spatial domain steganography methods have been proposed by researchers, and one of the widely known ones is Least Significant Bit (LSB) replacement. With this scheme, a replacement of the host mage with message is done, and thus, yielding a comparatively good quality marked images. Nevertheless, it allows comparatively easy detection using steganalysis methods because of its simplicity and the imbalanced pixel modification [22]. In order to reduce this limitation, the use of LSB-matching (LSBM) scheme [23] is employed in making an addition or a subtraction of a numerical one to the pixels of the host image based on the secrete message. This in turn minimizes the probability of message detection, but with distortion of marked images. The LSBM scheme was modified and named LSBM revisited (LSBMR) [9], in which the correlation between a pair of pixels is considered as a means of hiding two bits at the same time, thereby minimizing the rate of distortion for marked images to 0.325 from 0.5 bpp or 6.25% EP. In order to further reduce the detectability of marked images, Luo et al. [23], combined the LSBMR with edge-based data hiding mechanism. In their study, the areas of cover image were selected adaptively for hiding message based on the requirements. Regardless of the benefits offered by these schemes, they are vulnerable the problems like: (a) directly using the host image to embed sensitive information without encryption, thereby enhancing the operation of attackers in terms of extracting the secret messages more easily by cracking the embedding algorithm, (b) the use of ineffective embedding algorithms can produce visually distorted stego images, which in turn increases the probability of detection by human visual system, and (c) imbalance between quality of image, computational complexity, payload and security, thereby making them inappropriate for use in real-time and top-secret security applications. In this paper, the use of ASK-LSB mechanism alongside with chaotic method is employed in developing an efficient framework in spatial domain, with the aim of addressing the aforementioned problems. This paper makes the following key contributions:

1. Propose an effective secure steganography framework which combines the benefits of chaotic method and steganography with the aim of achieving a better balance between the quality of image, payload and security, thus, enhancing the suitability of the proposed framework for use in real-time and top-secret level security applications.
2. Using Advanced Encryption Standard (AES) algorithm before the process of data embedding to encrypt sensitive information. The aim of this is maintaining a high level of security for secret information.
3. Identifying the random pixel that can be used in embedding secret information, while Henon map function is

utilized in enhancing the resilience of the system against the attempts of trackers to uncover which pixel to embed first or the sequence of pixels.

4. The embedding of the secret information is done in a random region within an image through the use of an adaptive stego key LSB (ASK-LSB). This way, the visual quality of the stego images is enhanced while the extraction of data is made difficult, thereby reducing the detectability by HVS.

This paper is made up of different sections as follows: Section 2 presents discussions on the conventional LSB steganography, random map function and chaotic method. In Section 3, the processes of embedding and extraction in the proposed scheme are described in details. Section 4 presents the results of experiments and analysis conducted in this study with the aim of evaluating the performance of the proposed scheme in terms of resisting statistical and visual attacks. Lastly, Section 5 presents the conclusion of the study.

2. RELATED WORK

2.1. Least Significant Bit Substitution

Least significant bit (LSB) substitution is a conventional and simple method used to insert secret information within a cover image [4]. While this process is ongoing, it is possible to overwrite the binary representation of the secret data. With regards to the gray-scale images whose pixels possess just a single value ranging from 0 to 255 and the bit depth of 8 bits, the bits of the secret information cannot be converted into binary bits because they are used directly to substitute the cover object's image. Pertaining the colour images that possess 3 routes (RGB) and the bit depth of 24 bits, the cover object (image) is initially divided into 3 channels before the secret information is embedded in each of the channels. Finally, the three paths are merged so as to produce the stego image. The modification of the LSB bits does not allow the HVS to detect the stego-image. Due to the fact that a distinct kind of the LSB substitution method is utilized in the proposed scheme, a mathematical expression of the method is provided with adequate details. The aim of this mathematical expression is to provide deeper insight on the central idea of the scheme in Section 3. Diverse embedding percentage (EP) of LSB which include 6.25%, 12.5%, 18.75% and 25% which means 0.5, 1.0, 1.5 and 2 bpp respectively are used based on the capacity that is to be embedded. Through the use of a simple instance, a comprehensive explanation of the central idea of the LSB-based steganography is provided: it is assumed that P is a grayscale image consisting of 8 pixels $[P = P_1, P_2, P_3, P_4]$ with the next values for their decimal and an associated binary substitutions as given in Figure 1.

Where M denotes the secret text, in a manner that $M =$ 'A' with the binary form $X = 01000001$. For X to be embedded within a certain cover image P, a replacement of the pixels' LSB $[P = P_1, P_2, P_3, P_4]$ is made with the bits of M (01000001), and the pixel which is obtained after the secret message has been embedded is denoted by $[P = P_1', P_2', P_3', P_4']$ with their decimal and associated binary values as given in Figure 1.

The LSB in the pixels $[P = P_1', P_2', P_3', P_4']$ are the pixels that have been modified and are the products of the process of embedding. This an example of 12.5% EP which means 1bpp in each LSB, which can be expanded to different EP. This way, the imperceptibility of the stego image is reduced, thereby making it easy for the HVS to detect the stego-image. Here, image quality is compromised for data capacity. If a larger amount of data is concealed, degradation occurs in the image quality [7]. With the use of LSB methods, high data capacity is achieved. Figure 2 presents diverse stego images of Lena in different embedding percentages [21].

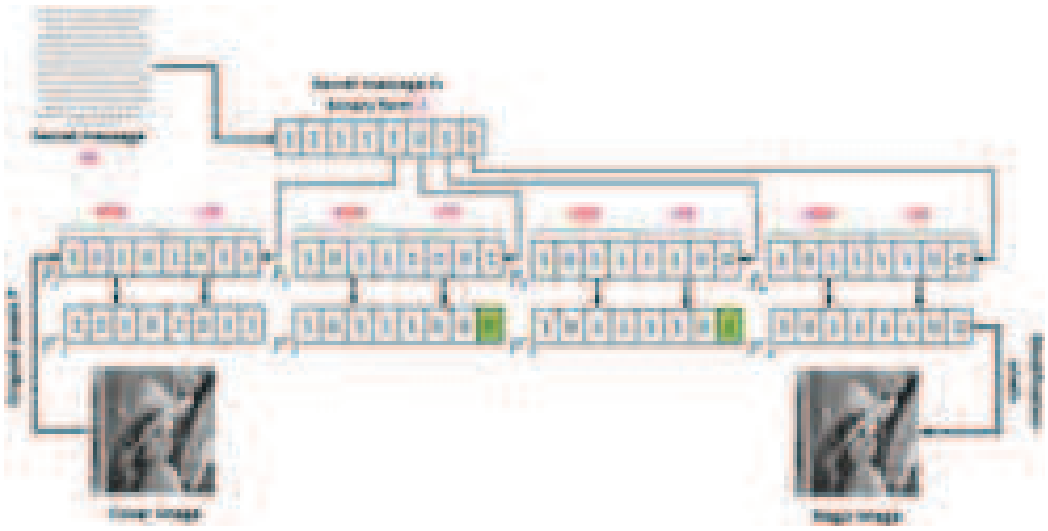

Fig. 1. LSB substitution procedure.

Fig. 2. Degradation in the quality of Lena stego image by hiding data in different EP [21].

Through the random addition of 1 to the gray levels of the host image, the pixels of the image are slightly modified using the LSB-Matching. This is done if there is no correspondence between the secret bit and the LSB of a given pixel, with the values of the pixels maintained within the range of 0–255. There is no difference between the process of extraction in LSB and LSB-M, i.e., to use a shared secret key to obtain a traversing route, as well as to extract the LSB of each pixel to obtain the real embedded bits. A pair of pixels (P_i, P_{i+1}) is used by LSB-MR [24] as a unit of embedding which is modified into (P'_i, P'_{i+1}) in a manner that the given criteria is satisfied.

$$\left\{\mathrm{LSB}(P'_i) = S_i \mathrm{LSB}\left(\left|\frac{P'_i}{2}\right| + P'_{i+1}\right) = S_{i+1}\right\} \quad (1)$$

Where P_i and P_{i+1} denotes the embedding unit while the two secret bits are represented by S_i and S_{i+1}. With this correlation, the LSB and LSB-M like irregular artifacts are not produced in stego images. More so, with the use of LSB-MR, the rate at which the pixels are modified in can be minimized in contrast to LSB and LSB-M method. The process of extraction involves the generation of a traversing path using a stego key as well as a quasi-random number generator, and afterwards the extraction of two bits from each of the units of embedding is performed.

When the LSB-based approaches are used, high quality stego-images can be obtained. However, it is easy for attackers to compromise and hack these images because of the simplicity of these techniques. In a study carried out by Ref. [25], attempts were made to improve the security and distribute the message within the entire host image. To achieve this, these researchers investigated the simulation of images through the use of text, and they used LSB to hide information. According to them, the aim of their study is to provide three levels security in which (1) the secret message is complemented, the complemented secret message is hidden within a cover image pixels that are selected randomly through the use of puesdo random number generator and inverted bit LSB method. Based on the results of their study, their proposed approach outperforms the conventional LSB as well as the inverse LSB with lower MSE and higher PSNR.

Hashim et al. [6] in their study, proposed a secure image steganography based on Huffman coding, odd/even distribution, and henon map. In comparison to other extant methods, the implementation of the proposed system was found to be less complex. In order to improve the system's security, the use of the henon map algorithm was employed, the imperceptibility of the stego-image is enhanced by using odd/even distribution. Prior to the process of embedding, the secrete message is embedded using Huffman coding. There are two major reasons why this method is considered effective: the first is it is capable of checking the correspondence between secret bits with LSB and mapping so as to ascertain odd and even word during the process of embedding, and the second one is the segmentation of the secret message with the aim of tracking and mapping every bit within the stego image. Based on the results, the performance of their proposed method is better than that of in terms of PSNR.

Based on the review of literature, most of the existing methods of steganography are unable to produce high quality stego-images, and this makes the image vulnerable to detection by human vision system. Furthermore, it was observed that with some of the methods, data is embedded directly into the image pixels plainly, which in turn makes the extraction of the embedded data easy if the steganography algorithm is compromised. Consequently, the hidden secret can be easily accessed by the attackers, and therefore, cannot be used as an authentic information in top-secret security systems. Therefore, the current study focuses providing solutions to these problems by proposing a scheme with eight levels of security; this scheme with the eight layers are discussed in the subsequent sections. Through the provision of these levels, the proposed scheme provides one of the best mechanisms for ensuring the authenticity of visual contents of secret communication of private messages.

2.2. Random Map Function

One of the major reasons steganography is developed is to afford an environment which is secured, where data can be transmitted over the network by secret messages in form of stego-images. The increasing concern on the security of data is one of the main motivations of this research. Many studies have been carried out in the area of steganography with the aim of developing novel methods through which message can be secured using steganography [25]. For the purpose of enhancing data privacy, many of such studies have used the random technique because of its higher efficiency and ease of use. The following are the advantages of randomized algorithm:

i. Rapid and ease, or even both for diverse problems.
ii. Easy implementation.
iii. Rapid with high probability, and/or
iv. Produces optimum output with very high probability.

In the literature, it has been found that several authors have leveraged the advantages of the random maps function, with each having its shortcomings and strengths. Based on behaviour, there are diverse kinds of random maps in existence, and they include, NUBASI [26], Arnold scrambling [27], LDA [28], Henon map [29] and Knight

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Tour [30]. In normal random maps, the number is selected using single parameter, with the initial condition of this function being (single) is 10^{15}, while the possibility of discovering these numbers is 250 [31]. one random map is used for the allocation of pixels with the aim of maintaining the proposed ASK-LSB.

3. THE PROPOSED FRAMEWORK

This section provides a graphics description of the proposed framework which is proposed in this study alongside its key modules. Through this graphic representation of the framework, the innovation of the framework is further explained so that the readers are able to have a clear image and deeper insight of the proposed scheme. The proposed scheme based steganography, is accompanied by multi layers of security for grayscale and colour images while different from other methods of steganography that are unable to provide a good level of security while maintaining the quality of image at a low cost and reasonable payload, in the sense that it is capable of maintaining balance among quality of image, security, payload and computational complexity. With these capabilities, the use of the proposed scheme can be employed in the transmitting high level secret sensitive information between military agencies, electronic banking, healthcare centers, and other agencies, a private communication that require high level of privacy. Figure 3 below presents a graphic description of the proposed scheme.

This framework is made up of four major sub-stages which include:

(1) Image preparation, involving the random selection of pixel based on multi-layers of security. (2) Preparation of secret data, involving the compression and encryption of secret data prior to the embedding stage. (3) The third stage involves adaptive hiding of prepared the secret data within cover images through the use of a data embedding algorithm; this process enables the production of the stego images that can be transmitted to the concerned users. (4) Lastly, the use of extraction algorithm is employed in extracting the secret data from the stego image that has been delivered at the receiver terminal, afterwards, the data can be used accordingly. A brief description of these four major stages is given in the following sections.

3.1. Image Preparation

One of the rudiments of the embedding method is to identify the pixel required for hiding the secret message with high level of precision. It is not just enough to identify the embedment location, but it is also important to have knowledge of the subsequent location. Again, another important step is to find the complete trajectory so that the proposed algorithm cannot be tracked by anyone other than the receiver or communication partner. It is based on this that steganography designers always aim to use pixel paths that cannot be predicted by a third party who is not part of the communication. Bearing this in mind, the use of multi-layer security together with Henon Map Function

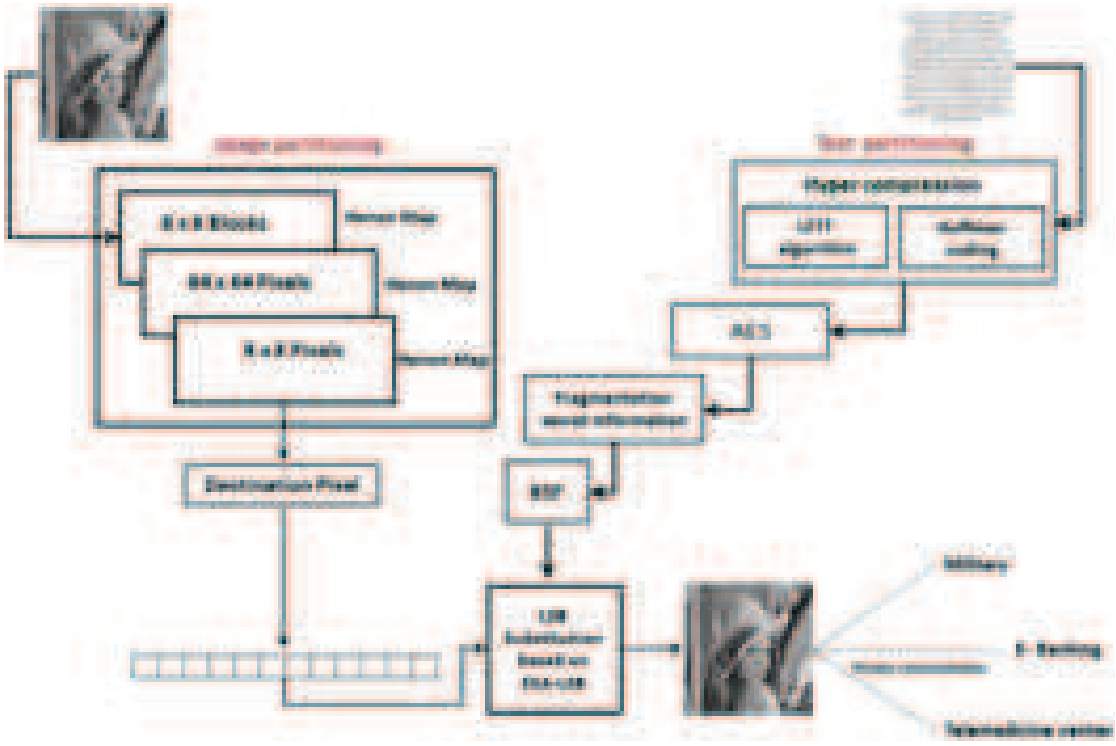

Fig. 3. Block diagram of the proposed framework.

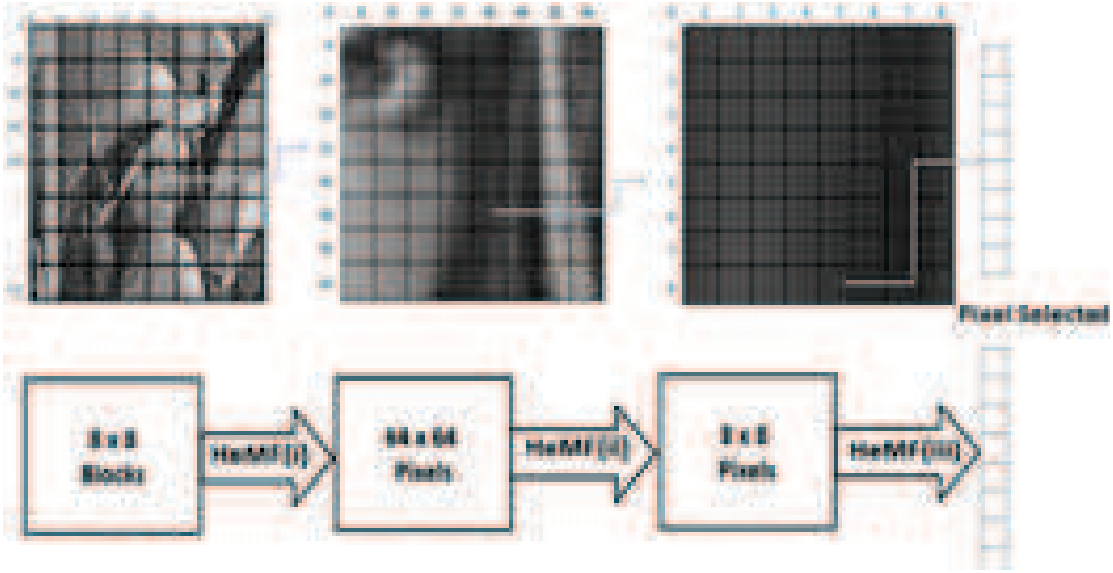

Fig. 4. Proposed framework for Random pixel selection.

algorithm is employed in this framework as shown in Figure 4, so as to enhance the accomplishment of the goal of providing security with high level of precision in the selection of pixels. Image preparation procedure is carried out using Henon Map Function (HeMF) algorithm. With this algorithm, the cover image can be divided into blocks and sub-blocks until pixels have been obtained. These are overlapped with each other in order to guarantee the total embedment of the inserted data, and to make sure that is almost impossible to detect the pixels path. With this, the security of the proposed framework is guaranteed.

The robustness of the system against the operations of attackers is enhanced through the selection of pixels in three stages. This way, the attacker is unable to identify the pixel that was first embedded or even the sequence of pixels.

3.1.1. Henon Map Function (HeMF) Process

Henon map function alongside two random parameters are used in achieving the second and third layers of security. With normal random, the use of single parameter is employed in selecting the number; the initial condition for this function (single) is 10^{15} and probability of finding these numbers are 2^{50}. The complexity of random selection of the pixels can be increased by using two control values for the selection of the pixels for two stages, which are sub-block and pixel selection. An example of a dynamic system that demonstrates chaotic behaviour is the Henon map function. There are two control parameters possessed by the Henon classical function which include $a = 1.4$ and $b = 0.3$ as the chaotic function. This function is majorly dependent on a and b parameters, and this function can be depicted as coordinate point (X_n, Y_n) in the plane. The following equation is reflective of new points:

$$\begin{cases} x_{n+1} = 1 - ax_n^2 + y_n \\ y_{n+1} = bx_n \end{cases} \tag{2}$$

Basically, the use of three major vectors (HeMF(i), HeMF(ii), HeMF(iii)) are employed in tracking each pixel while the process of embedment is ongoing (for secret key). Based on the HeMF(i) stage, the first block which is made up of (64×64) pixels (stored in HeMF(i) vector) is produced. Afterwards, the block is moved to the HeMF(ii) stage so as to facilitate the production of a block of (8×8) pixels (stored in HMF(ii) vector) at this stage. To carry on with the HeMF(iii) stage for the selection of pixel which is stored in the HeMF(iii) vector, the following procedure is repeated for each pixel:

$$\begin{aligned} R_i &= (K_{i1}, K_{i2}, K_{i3}, \ldots, K_{i(n-1)}) \\ K_{ij} &= (P_{ij}^{(1)}, P_{ij}^{(2)}, P_{ij}^{(2)}, \ldots, P_{ij}^{(n)}) \end{aligned} \tag{3}$$

Where $j = 1 - (n - 1)$, $n = 64$, R is level 1 block, K is level 2 block, P is level 3 pixel.

3.2. Secret Message Preparation

There are two main stages that secret message passes through, and they are compression and encryption. After the message is compressed, then it is goes through the next stage which is the stage of encryption. The use of alphabetical letters is employed in randomly generating the secret messages in diverse lengths.

3.2.1. Hybrid Compression Algorithms

Two lossless data compression algorithms have been used in the proposed method that couples the LZ77 algorithm and the Huffman coding.

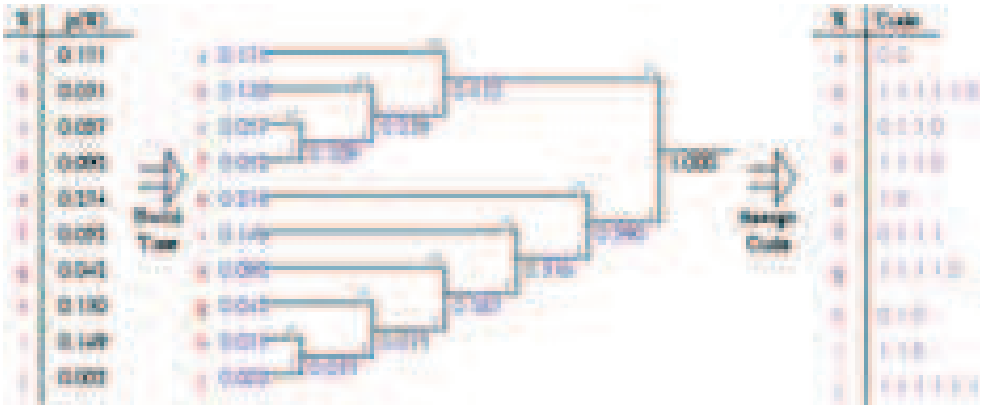

Fig. 5. Mechanism of Huffman coding algorithm [34].

3.2.1.1. LZ77 Algorithm. LZ77 is a lossless data compression algorithm [32] brought out by Abraham Lempel and Jacob Ziv in 1977 and 1978. Universally, the procedure requires no knowledge about data statistics to be compressed in comparison with Huffman coding. Data is compressed one time with no data loss with the achievement done by the involvement of strings that are similar. A window with a two parts separation is used for movement of the text, which consists of earlier coded information and residue of the remaining uncompressed text. The process entails first finding equality between the section to be compressed and what has already been read, and rather write an equivalence of 1 at the output, indicating read accomplished, instead of re-scripting what is equivalent. Addition of the uncompressed character to the couple is accomplished as per the equivalence, which is because of the time limit. Moreover, uncording in the read text is as a result of chances of it not being compressed later. This result in less time wastage during the search for equivalence.

3.2.1.2. Huffman Compression. Huffman coding is a particular kind of prefix code always used in lossless data compression. David A. Huffman developed an algorithm when he was a Ph.D. student at MIT, and published a paper in 1952 known as "A Method of the Construction of Minimum-Redundancy Codes" [33].

The general algorithm can be described as:

Input: Alphabet $A = \{a_1, a_2, \ldots, a_n\}$ which represents alphabet symbols with size n.

Set $W = \{w_1, w_2, \ldots, w_n\}$ which represents positive symbol weight such as $w_i = weight(a_i), 1 \leq i \leq n$.

Output: Code $C(A, W) = (c_1, c_2, \ldots, c_n)$ which are the binary codewords such as c_i is the code words of $a_i, 1 \leq i \leq n$.

The main *goal* is

Let $L(C) = \sum_{i=1}^{n} w_i \times length(c_i)$ is the length of code C with the condition that $L(C) < L(T)$ for any code $T(A, W)$.

Huffman is used to compress the secret message but impossible to use for compression of the image itself as it may affect the hidden data inside it, limiting the process to only secret data streams as shown in Figure 5.

We can conclude that Huffman coding algorithm is helpful in steganography system to increase payload capacity and when applied to the secret message before embedding. At the same time the system is made more robustness against histogram and statistic attack.

3.2.2. Advanced Encryption Standard (AES)

Advanced Encryption Standard (AES) is still a robust balanced algorithm. It is a balanced encryption algorithm providing support for data chunks of 128-bit and different key lengths of 128, 192 and 256 bits. In AES, only a single key is used to perform both enciphering and deciphering by the transmitter and beneficiary. The key has to be kept secure and authentic which is by it being kept a secret between the two parties.

In AES, loaded data is displayed in 4×4 arrays of bytes called a State, which is a composition of four rows and four columns with a total of 16 bytes. AES utilizes a round function that entails four different byte-oriented transformations [35]. Figure 6, shows the AES algorithm.

3.2.3. Bit Swapping Function (BSF)

In the proposed framework, subsequent to the selection of the pixels, they are organized into a sub window of 8×8 pixels. Afterwards, each pixel's LSB is used to obtain (64 bits), which will now be ready for embedding. At this point, there are 64 bits obtained from the image, and these 64 bits will be substituted with 64 bits from the secret message. More so, at this stage the use of the bit swapping function (BSF) is employed in checking the correspondence between the bits inside the original image and the secret message bits. In an event that the number of corresponding bits is less than that of the mismatched bits, then the secret message is inverted and embedded, if not, secret bits should be embedded directly. The seventh security layer is achieved using the BSF. Algorithm 1 explains the function of bit swapping.

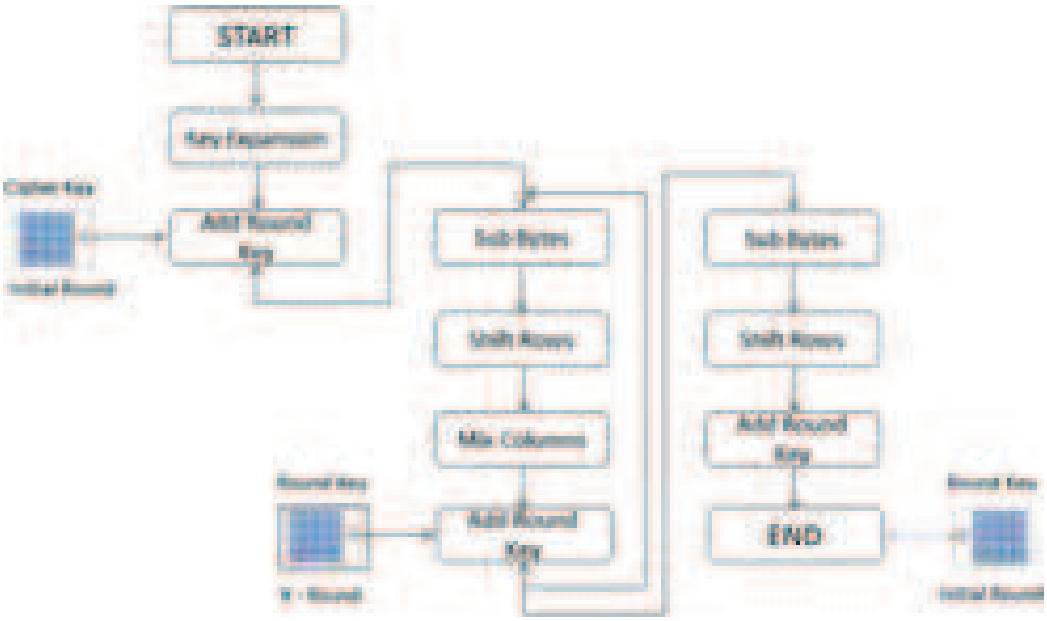

Fig. 6. Mechanism of AES algorithm.

ALGORITHM 1 (BIT SWAPPING FUNCTION).
1. If Bit matched > Bit mismatched then
2. Embed directly from secret message to image pixel using algorithm 2
   Else
3. Invert the secret message then embed using step 17 in algorithm 2
4. End if

The embedding algorithm and BSF that is incorporated in the proposed framework is illustrated in Figure 7.

3.3. Embedding Algorithm

It is the responsibility of the embedding algorithm to hide the secrete message within a cover image. The embedding algorithm is able to conceal the encrypted and compressed message within the LSB layer adaptively with the aid of the stego key. In Algorithm 2, the key steps involved in the proposed embedding mechanism are illustrated. Here, marking every pixels into block map is the most crucial procedure; this procedure is referred to as embedding block.

ALGORITHM 2 (EMBEDDING ALGORITHM).
Input: Cover image (I^m), Stego key (K^S), Secret Message (M^s).
1. Initialize $I^m \leftarrow$ Cover Image, $M^s \leftarrow$ Secret Message, $K^S \leftarrow$ Stego key
2. Apply hybrid algorithms on M^s to get the compression bit stream (M^{CBS})
3. Apply AES using algorithm1on M^{CBS} to get encrypt secret information (M^{ESI})
4. Let L = length of M^{ESI}
5. Segment the M^{ESI} into groups each with 64 bits.
6. Select an appropriate cover image I^m from dataset of cover images (DS^{CI})
7. Generate random number 1 and arrange it according to HeMF(i) vector
8. Select one block of (8×8) blocks via HeMF(i) vector
9. Generate random number 2 and arrange it according to HeMF(ii) vector

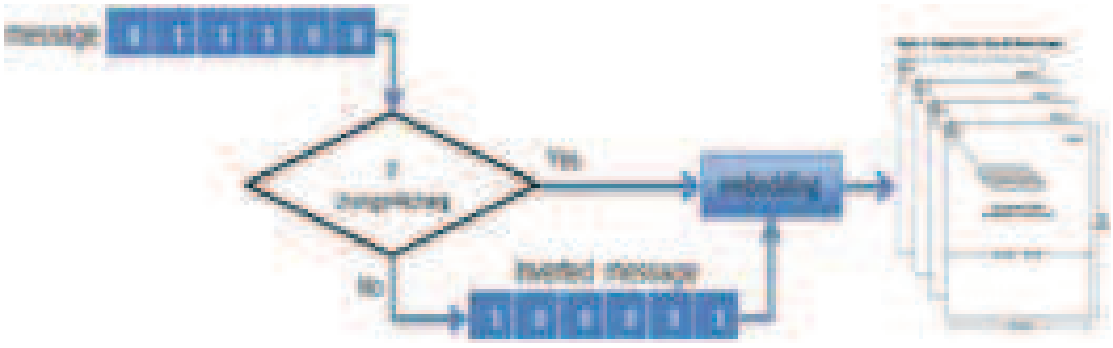

Fig. 7. Bit swapping function approach [36].

10. Select one sub-block of (64×64) pixels via HeMF(ii) vector
11. Generate random number 3 and arrange it according to HeMF(iii) vector
12. Select the destination pixel via HeMF(iii) vector
13. Generate EM vector and arrange it according to (1,0)
14. Mark the LSB of each pixel and M^{ESI} group
15. Apply BSF based on algorithm 1
16. Loop from I = 1:N
17. Select M^{ESI} bit (0 or 1)
    a. If $M^{\mathrm{ESI}} = 0$ and 2-LSB layer is 0, Do no change in 2-LSB layer.
    b. If $M^{\mathrm{ESI}} = 0$ and 2-LSB layer is 1, Embed in 1-LSB layer via replace 0 to 1-LSB layer.
    Else if 1-LSB layer is full, Embed in 2-LSB layer.
    c. If $M^{\mathrm{ESI}} = 1$ and 2-LSB is 1, Do no change in 2-LSB layer.
    d. If $M^{\mathrm{ESI}} = 1$ and 2-LSB is 0, Embed in 1-LSB layer via replace 1 to 1-LSB layer.
    Else if 1-LSB layer is full, Embed in 2-LSB layer.
18. $I = I + 1$
19. Repeat Step 16 until all the secret bits are embedded, and the stego image is obtained.

Output: Stego Image (I^S)

A clearer picture of the central idea of the proposed embedding algorithm is presented in the procedure shown in Figure 8. Let P be a cover image with pixels $[P_1, P_2, P_3, P_4]$, and secret message preparation which comes from (Section 3.2) $M^{\mathrm{ESI}} = (00111010)_2$. For the avoidance of confusion, some of the intermediate steps are skipped, and more attention is paid to the central idea.

The second objective which this study seeks to achieve through the proposed scheme is to embed the secret message inside the LSB layer, so that the image quality can be maintained like that of the original image.

The embedding process can be used using the following assumptions:

In case that the second bit of P_1 is 0 in LSB and the first bit of M^{ESI} is 0, so no changes will be made in the second LSB layer. In the case of second pixel P_2, if the second bit is 1 in the LSB layer and M^{ESI} bit is 0, hen replacement will be made in the first layer of LSB which is 0. In the case of third pixel P_3, if the second bit is 1 in the LSB layer and M^{ESI} bit is 1, then no changes will be made in the second LSB layer. In the case of fourth pixel P_4, if the second bit is 0 in the LSB layer and M^{ESI} bit is 1, then hen replacement will be made in the first layer of LSB which is 1. Consequently, the stego image produces the following pixels $[P_1', P_2', P_3', P_4']$. Here, the embedding outcome is indicated by the green colour, while the randomly selected pixel is indicated by blue colour. Furthermore, the colour yellow indicates the secret bits. These LSBs are converted during the process of data embedding.

3.4. Extraction Algorithm

The extraction of the concealed secret data from the stego image is carried out using the extraction algorithm. For the secret data to be extracted successfully, different parameters are utilized. Some of these parameters include decompression for both LZ77 and Huffman coding, decrypt the Advanced Encryption Standard (ASE), Henon map function (HeMF), Bit Swapping Function (BSF), and stego key of data embedding framework. The security feature of

Fig. 8. Simple example of embedding for the proposed framework.

the proposed framework is complemented by these parameters, thereby making it difficult for attackers to extract secret data. The key steps involved in the proposed mechanism of extraction are presented in Algorithm 3.

ALGORITHM 3 (EXTRACTION ALGORITHM)
Input: Stego image (I^S), Stego key (K^S).
1. Initialize $I^S \leftarrow$ Stego Image, $K^S \leftarrow$ Stego key
2. Apply random number 1 using HeMF(i) vector
3. Select one block of 64 blocks from HeMF(i) vector
4. Apply random number 2 using HeMF(ii) vector
5. Select one sub-block of (64×64) pixels from HeMF(ii) vector
6. Apply random number 3 using HeMF(iii) vector
7. Select the stego pixel from HeMF(iii) vector
8. Apply EM vector and arrange it according to (0,1)
9. Mark the LSB of each pixel
10. Loop from I = 1:N
11. Reverse the step 17 of embedding process from algorithm 2
12. Repeat step 11 in algorithm 2, until extract all secret bits from stego image
13. Reverse the step 15 from algorithm 1
14. Decrypt the resultant bits using the reverse operation of ASE.
15. Decompression from the resultant bits of step 2 using hybrid compression
16. Re-construct the original data from the achieved bits.
Output: Secret message (M).

4. EXPERIMENTAL RESULTS AND DISCUSSION

In the experiments performed in this study, the use of MATLAB tool alongside eight standard grayscale images that are contained in Figure 9 was employed. The images with size (512×512) were obtained from USC-SIPI image database [37]. The results are obtained considering the full capacity of each image for the respective techniques. The different stego-images for the proposed technique with embedding percentage (EP) = 18.75% are contained in Figure 10. The proposed framework has been evaluated using parameters such as PSNR, EC, bits per pixel (BPP) and Normalized Cross Correlation (NCC). In order to check the robustness of the proposed scheme against attack, BER and Chi-squared statistical attack were used.

4.1. Analysis Based on EC, PSNR, BPP, and NCC

The embedding capacity EC is defined as ratio of the number of message bits to the number of cover pixels [39]. This is directly related with the number of pixels used in the scheme that is proposed in this study as different number of message bits are embedded by one pixel.

$$C = \frac{\text{The number of message bits}}{\text{The number of cover images's pixels}} \tag{4}$$

In the current study, diverse payload capacities were used, and presented as a percentage so as to be in accordance with that of recent studies in this field. For more clarification the following is given:

- 16384 Bytes which is equal to 6.25% for a given image 512×512, meaning that every two pixels = 16 bits, so 1/16 = 6.25% when 1 bit of two pixels is embedded.
- 32768 Byte which is equal to 12.5% for a given image 512×512, meaning that every pixel = 8 bits, so 1/8 = 12.5% when 1 bit of one pixel is embedded.
- 49152 Byte which is equal to 18.75% for a given image 512×512, meaning that every two pixels = 16 bits, so 3/16 = 18.75% when 1.5 bit of one pixel is embedded.

The reason these percentages are used in this study is that diverse payloads were used in previous studies, and we need to have uniform tools so that we can obtain fair

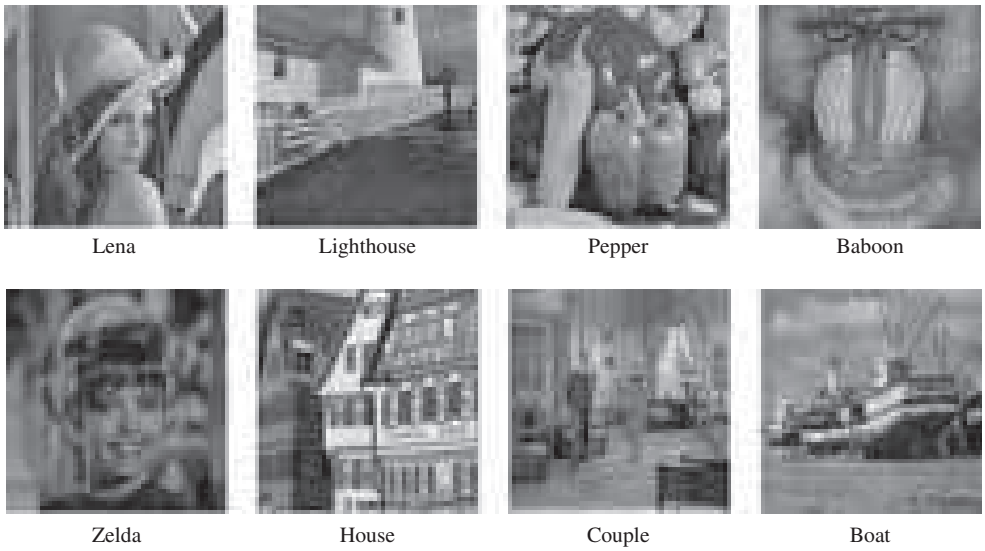

Fig. 9. Cover images used in the proposed scheme.

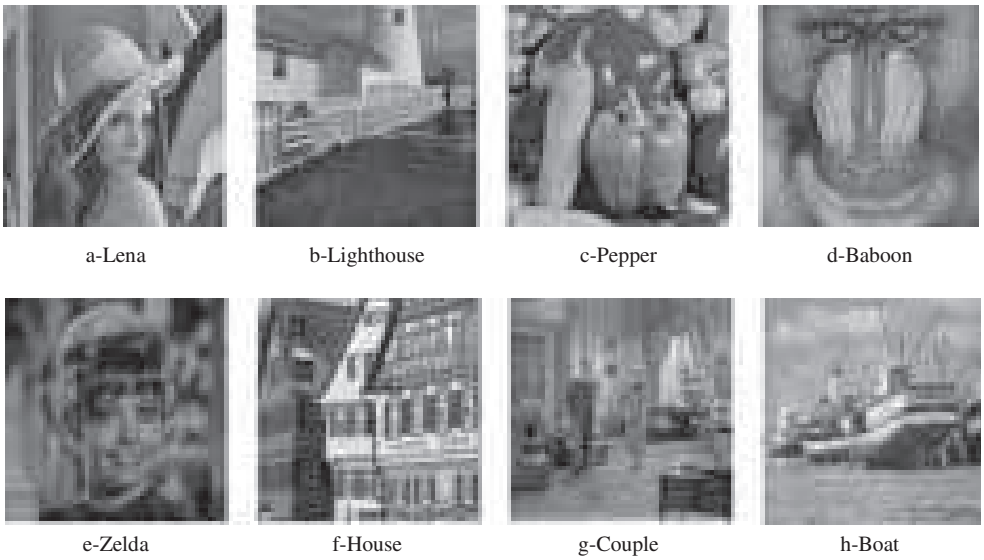

Fig. 10. Stego-images (a–h) for the proposed framework for EP = 18.75%.

results. In Figure 11, the embedding percentages utilized in the proposed framework are presented.

Human Visual System (HVS) or Human Audio System (HAS) is an invisibility property, so no perceptible artifacts should be left if humans cannot differentiate carrier with or without hidden message [39]. The method for image quality evaluation is determined by peak signal to noise ratio (PSNR), which is calculated after the process of embedding to compare between original and stego images. The process of embedding data is considered to be imperceptible to the human vision system (HVS), if the result of PSNR calculation is equal or greater than 30 db [40]. By applying the following equations PSNR can be calculated.

$$\mathrm{PSNR} = 10\log_{10}\left(\frac{255^2}{\mathrm{MSR}}\right) \tag{5}$$

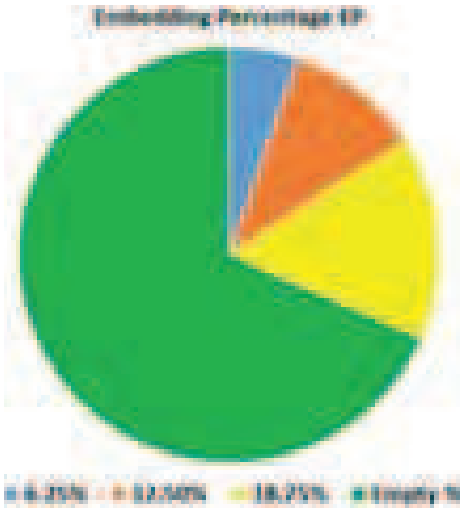

Fig. 11. Different embedding percentages (EP).

Where, MSE is mean square error, which is calculated by the following equation:

$$\mathrm{MSE} = \frac{1}{mn}\sum_{i=1}^{m}\sum_{j=1}^{n}(x_{ij} - y_{ij}) \tag{6}$$

Where, m and n are the images' sizes while x and y are the cover and stego images respectively. During the implementation of the proposed framework two important stages were carried out on this study, namely the training and testing stages. In conventional processing of image, the imperceptibility of the stego image is measured using PSNR measures [40]. By applying the PSNR measures which mentioned above, the fidelity of the stego image is evaluated against the original carrier image. In other words, the level of distortion in the stego image is measured against the carrier image; this is measured in decibel (dB). If a higher score of PSNR is obtained, it means that the quality of the image is high, thereby minimizing the probability of detection using the HVS. Through the training phase, PSNR is become less when the MSE is large, means mismatched increased between the original image and stego message. Whenever, MSE is large

Table I. Results of existing frameworks and the proposed framework for 6.25 % EP.

Image 512×512	EC (bits)	BPP	[6]	[42]	Proposed framework
Lena	131,072	0,5	71,60	42,41	72,80
Baboon	131,072	0,5	71,51	32,01	72,77
Barbara	131,072	0,5	N/A	41,78	72,56
Pepper	131,072	0,5	71,57	N/A	72,62
Couple	131,072	0,5	N/A	N/A	72,80
Boat	131,072	0,5	71,56	37,81	72,62
House	131,072	0,5	N/A	45,25	72,77
Average	131,072	0,5	71,56	39,852	72.70

Table II. Results of existing frameworks and the proposed framework for 12.5% EP.

Image 512 × 512	EC (bit)	BPP	[41]	[30]	[6]	[42]	Proposed framework
Lena	265,144	1	51,27	51,13	66,63	35,39	66,64
Baboon	265,144	1	51,27	51,15	65,85	24,32	66,68
Barbara	265,144	1	N/A	51,10	N/A	33,49	66,64
Pepper	265,144	1	51,28	N/A	67,69	N/A	66,62
Couple	265,144	1	N/A	N/A	N/A	N/A	66,64
Boat	265,144	1	51,27	51,13	66,61	31,20	66,66
House	265,144	1	51,28	51,15	N/A	36,90	66,63
Average	265,144	1	51,27	51,13	66,69	32,26	66,65

the result will be not good in term of PSNR because it works in a reverse as mention in equation (PSNR). This problem has been solved in testing stage and the result has been shown the better result from other methods. The BPP gives the average number of bits that can be hidden per pixel [33]. The experimental results for the proposed framework, and the techniques of Kumar and Chand [41], Yang [42], Mohammed et al. [6], Muhammed et al. [30], are presented in Tables I–III and VI. More so, those techniques and proposed framework have been compared in terms of PSNR, EC and BPP, respectively.

The PSNR of the proposed framework for embedding percentage EP = 6.25% is 72.70 dB, for EP = 12.5% is 66.65 dB and for EP = 18.75 is 61.13 db. Similarly, the EC of the proposed framework is 131,072, 265,144 and 393,216 bits for EP = 6.25%, 12.5% and 18.75 respectively.

In the studies carried out by Kumar and Chand [41], Muhammed et al. [30] and Mohammed et al. [6], PSNR of their techniques were 51.27 dB, 51.13 dB and 66.69 dB respectively. As seen from the Table II of comparison, the proposed framework outperforms that of Kumar and Chand [41], Muhammed et al. [30] and Mohammed et al. [6] in terms of PSNR when EP = 12.5% with equal EC. The scores of the PSNR of the proposed work when EP = 6.25% and 12.5% are presented in Tables I and II. Based on the results, the marked images of the proposed framework are of better quality, thereby confirming its effectiveness. Likewise, the PSNR and EC of the proposed framework for EP = 18.75% is better than that of Yang [42], Muhammed et al. [30] and Mohammed et al. [6], respectively.

Table IV shows the average time used in embedding data, as well as the average PSNR on USC-SIPI dataset images. Variations in the average embedding time was observed, varying from 0.1 seconds to 0.16 seconds for different payloads. The proposed scheme modifies maximum of two least significant bits, and so the quality of image does not deteriorate. Variations in the calculated average PSNR was observed within the range of 72.82 at 6.25% of EP to 61.13 at 18.75% of EP.

Table IV. Average execution time and PSNR on USC-SIPI images.

Embedding payload (%)	Bit per pixel (BPP)	Average time (second)	Average PSNR
6.25	0.5	0.1210	72.70
12.5	1.0	0.1366	66.65
18.75	1.5	0.1544	61.13

4.2. Robustness Evaluation for the Proposed Scheme Against Bit Error Rate (BER)

The robustness of the proposed scheme was evaluated using traditional quantity, which is bit error rate (BER). Robustness refers to the ability of the secret bits to resist attacks, which are referred to as hereunder.

The value of PSNR is inverted so as to obtain the bit error rate using the following equation:

$$\mathrm{BER} = \frac{1}{\mathrm{PSNR}} \tag{7}$$

The portion of the original cover image's qubits that is converted during the process of steganography is determined by the BER. In the case whereby the PSNR is 50 db, the BER would be 0.02, i.e., alterations have been made to 2% BER-P of bits during the process. Table V present the results of the calculated BER in the simulation of the current study, while Table VI present the results obtained for other frameworks proposed in previous studies.

Table III. Results of existing frameworks and the proposed framework for 18.75% EP.

Image 512 × 512	EC (bits)	BPP	[43]	[30]	[6]	Proposed framework
Lena	39,216	1,5	30,20	44,58	47,38	61,10
Baboon	39,216	1,5	24,32	44,59	47,36	61,12
Barbara	39,216	1,5	27,49	44,54	N/A	61,13
Pepper	39,216	1,5	N/A	N/A	47,39	61,18
Couple	39,216	1,5	N/A	N/A	N/A	61,16
Boat	39,216	1,5	25,80	44,61	47,20	61,12
House	39,216	1,5	30,54	44,56	47,37	61,12
Average	39,216	1,5	16,76	44,57	74,34	61.13

Table V. Bit Error Rate (BER) for the proposed scheme in our simulations when EP = 6.25%, 12.5% and 18.75%.

	Proposed scheme (6.25%)				Proposed scheme (12.5%)				Proposed scheme (18.75%)			
Image (512 × 512)	PSNR	EP (%)	BER	BER-P	PSNR	EP (%)	BER	BER-P (%)	PSNR	EP (%)	BER	BER-P (%)
Lena	72,80	6.25	0,013736	1,37	66,64	12.5	0,015006	1.50	61,10	18.75	0,016366	1.63
Baboon	72,77	6.25	0,013741	1,37	66,68	12.5	0,014997	1.50	61,12	18.75	0,016361	1.63
Barbara	72,56	6.25	0,013781	1,37	66,64	12.5	0,015006	1.64	61,13	18.75	0,016358	1.63
Pepper	72,62	6.25	0,013770	1,37	66,62	12.5	0,015010	1.50	61,18	18.75	0,016345	1.63
Couple	72,80	6.25	0,013736	1,37	66,64	12.5	0,015006	1.49	61,16	18.75	0,016350	1.63
Boat	72,62	6.25	0,013770	1,37	66,66	12.5	0,015001	1.49	61,12	18.75	0,016361	1.63
House	72,77	6.25	0,013741	1,37	66,63	12.5	0,015008	1.50	61,12	18.75	0,016361	1.63
Average	72.70	6.25	0,013753	1,37	66,65	12.5	0,015003	1.50	61.13	18.75	0,016343	1.63

Table VI. Bit Error Rate (BER) for different existing frameworks when EP = 12.5%.

Image	[41]			[30]			[6]			[42]			Proposed framework		
(512 × 512)	PSNR	BER	BER-P	PSNR	BER	BER-P	PSNR	BER	BER-P	PSNR	BER	BER-P	PSNR	BER	BER-P
Lena	51,27	0,019504	1,95	51,13	0,019557	1,95	66,63	0,015008	1,50	35,39	0,028256	2.82	66,64	0,015006	1,50
Baboon	51,27	0,019504	1,95	51,15	0,019550	1,95	65,85	0,015186	1,51	24,32	0,041118	4,11	66,68	0,014997	1,49
Barbara	N/A	–	–	51,10	0,019569	1,95	N/A	–	–	33,49	0,029859	2,98	66,64	0,015006	1,50
Pepper	51,28	0,019500	1,95	N/A	–	–	67,69	0,014773	1,47	N/A	–	–	66,62	0,015010	1,50
Couple	N/A	–	–	N/A	–	–	N/A	–	–	N/A	–	–	66,64	0,015006	1,50
Boat	51,27	0,019504	1,95	51,13	0,019557	1,95	66,61	0,015012	1,50	31,20	0,032051	3,20	66,66	0,015001	1,50
House	51,28	0,019500	1,95	51,15	0,019550	1,95	N/A	–	–	36,90	0,027100	2,71	66,63	0,015008	1,50
Average	51,27	0,097517	1,95	51,13	0,01955	1,95	66,69	0,014994	1,49	32,26	0,031676	3,16	66,65	0,015086	1,49

The BER and BER-P of the proposed framework for embedding percentage EP= 6.25% is 0,013753 and 1.37%, for EP = 12.5% it is 0,015003 and 1.50% and for EP = 18.75 it is 0,016343. The BER and BER-P of the frameworks proposed by Kumar and Chand [41], Muhammed et al. [30], Mohammed et al. [6] and Yang et al. [42] are 0.01957, 1.95%, 0.01950, 1.95%, 0.01950, 1.95% and 0.01950, 1.95% respectively. Based on the results of the current study, the proposed scheme produced better BER and BER-P than others frameworks when EP = 12.5% with equal EC, and when EP equal different percentage.

5. CONCLUSION

In this paper, a new secure image steganography framework which is known as an adaptive stego key LSB (ASK-LSB) framework is proposed, based on four phases with the aim of improving the data-hiding algorithm in cover images by use of the capacity, image quality and security. The secure image steganography framework that is proposed in this study is based on a new adaptive least significant bit substitution method, random function, AES algorithm, and hybrid compression techniques. The use of the adaptive LSB substation method is in embedding the secret message within the carrier image, depending on the stego key. The random function makes the system worthy against unauthorized personnel trying to disclose which pixel to embed first or the sequence of the pixels. The application of the encryption procedure to the secret message is for the generation of a binary equivalent random sequence secret message that hinders attack to the secret message. Different payload capacity has been used with the current study and is reflected as a percentage to correspond with the researches in recent studies. In the proposed work, the secret bits are inserted directly or inversely, which enhances the complexity and Imperceptibility of the embedding process. This algorithm has provided multi-layers of security working together to augment protection from attacks. The hiding algorithm has been proposed to fight two types of attacks: visual and statistical attacks.

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RESEARCH ARTICLE

Electronic Payment Systems: Architecture, Elements, Challenges and Security Concepts: An Overview

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In this paper, the major aim is to investigate the heightened awareness regarding various electronic payment systems-related concepts in terms of their advantages, problems, and security issues. The payment processing system providers use *software as a service* (*SaaS*) model and with this model, they form a single payment channel to numerous payment methods for their clients. Users often give away their personal information such as names, card details, and so on whenever they go online to make any firm of payment. An online payment system is referred to a system that facilitates electronic money exchange. This form of payment typically involves the deployment of the Internet, computer networks, and other digital stored value systems. Collecting any form of payment over the internet implies that the user has accepted an online payment and must have shared some confidential information with the service provider. This paper embarks on a thorough review of all aspects of online/electronic payment with emphasis on the analysis of numerous studies on electronic payment systems. The latest studies have been explored to gain insight on the electronic payments systems.

Keywords: Electronic Payment, Information Hiding, Steganography, Cryptography.

1. INTRODUCTION

The exchange of goods and services between 2 persons start before the advent of written history; but as the exchange of goods become more difficult between persons, they began to represented values in an abstract manner, starting with the barter system to the use of certified notes, payment orders, cards (debit or credit), and recently the electronic or e-payment systems [1]. The customary payment methods are well-known to have certain issues such as false signatures, cash falsification, and bounced cheques. However, a well-planned e-payment system can address these security issues and provide an added advantage of usage pliability [2, 3]. E-payment systems have received much recommendation due to their ease of money exchange, security, and faster access to capital resources [4–6]. The conventional cash payment systems have become more expensive compared to the recent strategies due to the recent impacts gained by minor financial transactions in most economies. Furthermore, interne cash processing can have less value compared to the smallest cash estimation in the manual world [7]. As the web keeps impacting our daily lives, people are getting used to online transactions when buying or selling products [8]. However, the increased dependence on web-based transactions for cash-related activities has come with issues that cannot viably be solved by the traditional payment methods. For this reason, financial experts have begun to investigate different e-payment systems with emphasis on the issues associated with digitalized and e-payment systems [3]. Each online transaction is processed through payment gateways which serve as a point for accessing different financial organizations. The payment details between different parties and financial institutions are validated through these payment gateways [8]. In this paper, a detailed description of the increased awareness on electronic payment systems (EPS) was provided. This paper is arranged as follows: Section 2 provides various definitions and aspects of EPS while Section 3 and Section 4 cover the advantages and popularity of EPS. In section [6], the problems associated with payment system is provided while the important security issues of EPS are presented in section [7]. A review of the related works to EPS is presented in section [8] while section 8 concludes the paper.

2. ELECTRONIC PAYMENT SYSTEM (EPS)

With the increase in the exchange of goods among different business partners over the Internet, the conventional

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cash-based payment system has been gradually relegated [9] as most people prefer an electronic payment system to the cash-based method. These e-payment systems are considered as a method of making payments for services over the Internet [10, 11]. An EPS can be described as a form of inter-organizational information system (IOS) dedicated for making money-related transactions between customers and different organizations. There may be a need for complex interactions between technologies, the environment, and the partners to ensure an effective EPS. The specific features of EPS/IOS also makes it technologically, organizationally, and relationally different from the traditional internal-based information systems [12–14]. This highlights the need for the cooperation among different technologies to make an effective system [15].

Over the years, there has been an increase in the global annual non-cash transactions facilitated through mobile and e-payment systems except for the year 2012 when there was a decline in the annual growth rate from 8.6% in 2011 to 7.7% in 2012 [16]. However, the year 2014 witnessed an increase in the global electronic payment to 8.9%, reaching 387.3 billion, representing the most significant increase since the World Payments Report was first published. This increase was mainly due to the quickened development in newly emerging financial markets. A projected higher worldwide development of 10.1% was anticipated for the year 2015 and predicted to take the global non-paper exchange volume to 426,300,000,000 [17]. Individuals and groups use e-payment systems as a convenient and secure way of making cash payments over the internet and consider the channel as the gateway to technological advancement in global economy [18]. It has also become the major facilitator of e-commerce on which success in electronic business depends upon. E-payment systems have also reduced resourcefulness ad fraud rate in the global payment system [11, 19].

2.1. History of EPSs

Historically, e-payment dates to 1918 when the United States (U.S.) Federal Reserve Bank first moved currency via telegraph. However, this technology was not widely adopted in the US until the incorporation of their Automated Clearing House (ACH) in 1972. Since then, the popularity of the system became high, enabling the U.S. commercial banks and its central treasury to introduce it as an alternative to the conventional cheques payment [11].

The advent of credit cards also date to 1914 when customers were issued with cards by department stores, oil companies, Western Union and hotels to facilitate payment for goods and services. Forty years later, credit cards are being widely used and have become more acceptable as a payment option. Before the 1990s, credit cards were issued as paper-based payment options but later, they were transformed to electronic systems. The increase in the rate of credit card usage has led to a rapid growth in the industry and has ushered in the introduction of a debit card system. Both credit and debit cards are currently used globally for the payment for goods and services [10, 20].

2.2. Definitions of EPS

The EPS is a complex term that portrays various methods of electronic payment delivery. Its multipurpose nature provides and increased imprecision of e-payment characterization in the literature. In terms of capabilities, e-payment can be considered as e-banking, e-cash, internet banking, m-payment, online banking, and so on. All things considered, researchers have recently strived to provide a comprehensive definition of e-payment [5]. The EPS is described by Ref. [9] as a form of financial commitment which brought a customer and a seller to the same platform via electronic means. Furthermore, Ref. [15] considered e-payment as a form of inter-relation between people and associations powered by institutions that provides electronic financial transactions [12–18].

According to Ref. [21], e-payment is any form of internet-based money exchange. Similarly, Ref. [22] stated that an e-payment system is an electronic way of making payments for web-based services. In another explanation, e-payment is any form of payments/exchange made electronically [23]. Another researcher [24] considered e-payment as an online monetary exchange between two persons. Additionally, Ref. [25] defined e-payment as money-related exchanges facilitated via electronic means. Another definition of e-payment is any form of payment that involves exchange of electronic information such as credit and debit card detail other than payment with cash or cheque [26].

As per Ref. [27], e-payment is a fiscal claim exchange by a payer on a worthy and useful party. According to Ref. [28], e-payment involves payments made through electronic transfers, an automated clearing house, or through a commercial card system. E-payment was defined by Ref. [29] as any form of money exchange via any electronic channel. Another definition of e-payment according to Ref. [30] is payments made through electronic signals linked to credit or debit bank accounts. E-payment, as per Ref. [31], is any form of non-money payment with the exception of a paper cheque. E-payment is defined by Ref. [32] as any electronic exchange that could be considered as a form of payment for goods and services made via e-payment channels that gives clients a remote access to their financial accounts via electronic systems. Generally, EPS can be defined as any form of monetary exchange between buyers and sellers via online platforms with the help of a digital financial instrument [33].

2.3. Types of E-Payment Systems

Several types of EPS have been developed within the global financial system, such as electronic cheques, electronic fund transfers, e-cash, credit and debit

card [11, 34]. Online payment can generally be classified into two types; (i) based on the Internet Banking Payment Gateway (IBPG) involved, and (ii) based on the external payment platform. In the first type, it is a sort of a direct payment as the client is aware of the online payment via an e-business platform which is linked to a banking platform. For the second type, it involves the transfer of fund from the purchaser's account to the seller's account by an external payment system. The IBPG connects a banking process system with the Internet; it is specifically designed for the management and authorization of payment. It links the purchaser with the seller and the bank. The IBPG-based online payment method cannot be realized without the involvement of payment gateways [35].

A study by Ref. [36] classified EPSs into four groups that deserves mentioning; these groups are electronic cash, small payments, online credit card payment, and electronic cheques. The study further highlighted that each of these systems is associated with specific advantages and drawbacks. They stated that each of these groups can be assessed from their technological, economic, social and institutional/law aspects. In reality, only two specific kinds are payment systems exists [3, 37].

2.3.1. Based on Electronic Transaction

There are four modes of internet-based payment systems:

(i) *Cyber cash*

This is an online service in which a client's credit card information is processed, charged, and deposited in the dealer's account via electronic means. In this form of cash transfer, the cyber cash serves act as the payment gateway through which the payment is made. The system depends on digital signatures to ensure the security of the payment process [37]. Although e-money is a more extensive concept that involves all internet-based fund transfer, cyber cash mainly emphasizes on all systems of cash exchange processed through the Internet. A clear distinction between e-money and cyber cash may be difficult to establish since cash money is derived from e-money and is progressively converging into it [38].

Secure electronic transaction (SET)

This secure electronic money transfer system is an online payment system that guarantees a secure internet-based money exchange. It was created by Master Card and VISA as an open technical platform for business [39]. SET ensures a secure card-based fund transfer over the Internet. It uses digital certificates to confirm the legitimacy of a vendor or a cardholder [37].

(ii) *First virtual holdings*

This is one of the early Internet-based payment platforms that depend on external confirmation techniques to facilitate online payments. This payment system is of particular interest because it does not depend on any form of encryption. It is only used for the selling of data over the Internet, as against the exchange of goods and services. This system uses an automated telephone system to gather the payment information of the participants. Being that it does not depend on cryptographic techniques and digital signatures, it mainly depends on a careful monitoring of sales and purchases to reduce fraud [40]. As an open system, a principal aspect of this payment system is that some data are not meant to go online since they are essentially related to the financial information of the clients. This system uses a first virtual PIN issued by a first virtual organization for exchange purposes instead of using credit card numbers. Being that these PIN numbers serve as ID, they can be transmitted over the Internet without charging the client's account since an affirmation email must be received from the client to approve any form of payment [37].

The use of cards as a mode of payment has seen tremendous growth since the year 2010; this is evidenced in the decline in cheque-based transactions in the last 13 years. Debit cards accounts for the highest share among the card-based system as almost 45.7% of the global non-cash money transactions are through debit cards, presenting it as the fastest growing (12.8%) payment option in the year 2014. These figures allude to the better security and convenience of the card-based system compared to other payment options [17].

Electronic payments can also be made via mobile platforms; various Android-powered smart-phones can provide online payment platforms. Regarding EPS, these mobile applications can also work well on Desktop computers. Clients can also utilize mobile phones in various platforms to facilitate financial transactions. With the use of mobile internet, clients can transmit PIN numbers or use WAP to make electronic payments over the internet. For E-payment, the debit or credit card transaction performed by a client can be authenticated by a vendor by attaching a device to their mobile phones. In the U.S., a conglomerate of late publicized Power Swipe, which is physically connected to a Nextel telephone, weighing 3.1 ounces, and comprised of a reader for magnetic stripe, goes through a connector for charging the battery of the handset and an infrared port for printing [41].

(iii) *Net bill*

This is a payment system that depends on the Internet to facilitate online secure transactions. As a micro-payment system, its server maintains buyers and sellers accounts, enabling clients to make payments for products. Information exchange in this system involves exchange of bits with the customers and could be performed in any internal structure such as the search results of a database inquiry, a page of text, or a software program. Customers are billed based on the number of items they use; unlimited access can also be provided to members [42]. A software with financial tools checks the receipts of the products. In so doing, net bill electronic payment system facilitates the communication between the money tool in the software and the dealers' server [37].

2.3.2. Internet-Based Payment System

There are four basic methods of Internet-based payment systems:

(i) *Debit card*

The debit card is the most utilized e-payment platform; its technique combines the concept of Internet banking with Automatic Teller Machine (ATM) card [43]. With the debit card, holders make a direct payment for goods through the bank. Debit cards gives holders the opportunity to save money in their bank accounts for later withdrawal at the point of sales. Ideally, there are two types of debit cards; these are online and offline debit cards [37].

(ii) *Smart card*

A smart card is a plastic card equipped with microchip on which funds can be pre-loaded and later used to make instant payments. The smart card is also called a chip card [44]. The business data of an individual can be stored on smart cards just as a chip card can be used to store cash. The smart card is usually authorized with a PIN which the service provider gives to the user. These cards store data in an encoded form to ensure information security; they have a high processing speed. Examples of smart cards include VISA and Mondex cash cards [45].

(iii) *Credit card*

This is other form of EPS where cards are issued to the clients by the monetary organization for making online payments [44]. Credit card is the most commonly used e-payment system. Compared to the other e-payment systems, credit card is not proper to be used for the payment of small values [43].

(iv) *E-cash*

E-cash was introduced as an alternative to credit cards for online purchases [43]. It is an electronic payment system where certain cash measures are kept away from the customer's gadget and made open for online transactions. E-cash can also be described as cash in digital form; it uses a pre-installed e-cash software on the client's PC to facilitate transactions [44]. A major attribute of e-cash is its low cost which endears it t clients for small-scale transactions [43, 46].

3. ADVANTAGES OF EPS

A review conducted by the Federal Reserve Financial Services Policy Committee for the first time showed that in the U.S., electronic payment exchanges have exceeded cheques payments. The total number of electronic exchanges in the U.S. in 2003 was equivalent to USD 44.5 billion, while an equivalent of USD 36.7 billion was recorded in cheque payments [1]. Evidently, there is a recognizable pattern among buyers; purchasers are noted to be willing to transact electronically via an automated medium while doing their transactions.

The review conducted by Ref. [48] indicates that the advent of the web has set e-payments on an exponential rate of development. Customers can easily purchase goods on the Internet and send an unencrypted credit card information over the system. This raises the susceptibility of the transactions to frauds. However, the advent of e-payment systems has introduced several secure payment systems, making customers to be more concerned about the security of their personal details. As per Ref. [48], there are remarkable financial benefits of e-payments in addition to their security and ease of operation. An expansion of these advantages can contribute immensely to the financial improvement of a country.

The introduction of computerized e-payments helps to develop bank deposits which in this manner, has increased accessibility to business credits (a major driver of financial achievement). The security and advantages e-payments confers them full scale financial advantages [48]. The influence of introducing e-payments is likened to using the gears on a bicycle. The introduction of an efficient e-payment system into an economy will move the performance of the economy to a greater level. The addition of a well-controlled business and consumer credit will improve the rate of economic development even further.

EPS can help in unmasking shadow economies and bring out hidden exchanges into the banking system; this will bring uprightness, confidence, and cooperation into the economic system. Additionally, Ref. [48] specified that a relationship exists between the increase in demand deposits and the increase in the volume of point of sales. In the banking sector, automated e-payments serve as a gateway and as a powerful driver for growth. Such payments mop cash from the circulation and into bank accounts, providing low cost funds that can support the banks' investment lending. With this process, there is a greater accountability and transparency, leading to a better economic performance and a greater efficiency.

Comparatively, e-payment is more beneficial to the buyer [49] because most times, a buyer is required to provide his account information such as the card number and the delivering address only once. The information provided by the client is saved in the database of the retailer's server. On his next visit to the page, the client will only be required to sign in with a personalized username and password. A transaction can simply be completed by simply clicking a mouse as the client only has to only confirm the purchase.

Furthermore, e-payments are believed to cut down organizational expenses [49] as the cash spent on paper and postage is saved. Organizations can also enhance clients preservation via an e-payment system. Customers are more likely to return to an e-commerce platform where their information is already saved.

As per [48], e-payments can reduce the cost of transactions and facilitate higher consumption and GDP, boost financial transparency, and increase government efficiency. Furthermore, governments have a significant role to play in creating an ideal environment for these benefits can be

consistently achieved through their economic development plans [48].

Similarly, Ref. [50] stated that the use of e-payment systems can ensure several advantages to both clients and sellers due to the reduction in costs, higher security, ease of use, and reliability. A noteworthy advantage is that EPS empowers bank customers to resolve their daily money related-issues without going to the bank, thereby, saving time and cost of handling financial transactions [51].

As stated by Ref. [52], the cost of a country's payment system can account for about 3% of its GDP. Being that most e-payment systems cost about 33% to 50% of the paper-based non-money payment, e-payments can clearly reduce the social cost of a payment platform if computerized [51]. Paper-based mistakes and expenses can be reduced via mechanizing and reshuffling e-payments via self-serve channels such as point-of-sale (POS) and ATM systems.

A survey by the Visa Canada Association in collaboration with the Global Insight discovered that e-payment systems confers transaction proficiency to purchasers, banks and the economy. Since 1983, e-payments have contributed about $C 107 billion to the Canadian treasury, and accounts for about 25% of the $C 437 billion accumulated in the Canadian economy over the said period. About $C 60 billion of the increment in Personal Consumption Expenditures was accruable from e-payments over the same period, with credit card contributing a major sum ($C 49.4 billion) compared to debit cards ($C 10.4 billion) [53].

4. THE COMMONLY USED E-PAYMENT SYSTEMS

In the world today, the major impact of the Internet is the ability to move businesses from place to place over a website. This is why people can easily buy items from the Internet via several payment gateways. Payment service provider are organizations that facilitates marketing-related online services; they regulate electronic payments by monitoring financial exchanges between sellers and buyers [1]. Some of the common payment methods are bank transfers, credit card, and real-time orders. Among the popular online payments systems are Braintree, Stripe, Authorize.Net, PayPal, Dwolla, CheckOut, Worldpay, Samurai, Eway, Feefighters, American Express Serve, Icepay, Intuit GoPayment, Amazon Payments, Skrill (previously Moneybookers), V.me by Visa, WePay, Google Wallet Checkout, Square, etc. [54].

5. PROBLEMS OF E-PAYMENT SYSTEMS

Despite the advantages of EPSs, they are still prone to several challenges in today's world. The identified problems associated with EPS according to previous studies grouped into infrastructure-related, regulatory related, legal-related, and socio-cultural-related issues [1].

5.1. Infrastructure-Related Issues

For an effective deployment of any e-payment system, infrastructure is critical. The establishment of appropriate infrastructure for e-payments is a problem [55]; to have a successful e-payment system, there is a need to ensure a strong financial and infrastructural backing. Several areas in most of the developing nations have no banks or access to the basic infrastructure that drives e-payments. As such, a study by Ref. [56] revealed that Nepalese have no access to electricity and telecommunication and it is not possible to implement an e-payment system.

5.2. Regulatory and Legal-Related Issues

An effective implementation of e-payments requires the existence of national, provincial or global laws and standards. Most of these components have guidelines on tax evasion, monitoring of e-money institutions, and commercial banks; the central banks must regulate the payment systems and ensure the protection of both buyer's information. According to Ref. [55], there are legal issues associated with the global nature of e-payment; for instance, it may be tedious to establish the related laws to debated cases and the competence of certain jurisdictions. The execution of an e-payment system requires the establishment of legitimate administrative structures that builds trust and confidence.

5.3. Socio-Cultural-Related Issues

The social-cultural differences and the use of various forms of cash (credit cards in North America and debit cards in Europe) have significant impacts on the establishment of a globally-relevant EPS [55]. As stated by Ref. [55], the differences in the security level required and the productivity among various individuals complicates the issue. The buyer's confidence in the conventional payment system makes it more challenging to embrace new ideas. New ideas may have no influence in the global market until customer's privacy is ensured and security is confirmed [55]. Such new ideas must also be up to standard to attract people's trust irrespective of whether it is a simpler method or less expensive compared to the established methods [53].

5.4. Security of EPSs

Data and information security is paramount in all information systems [56]. Data security in terms of the methodology, practices and technology involved to ensure data security is presented in Figure 1.

i. Unintended alteration or change (integrity).
ii. Unapproved access (confidentiality).
iii. Easily accessible to the approved clients based on demand (availability).

These security features are necessary in an e-payment system; an insecure EPS will lose client's trust which is necessary to ensure acceptance. As stated by Ref. [57],

Fig. 1. Depiction of information security (CIA).

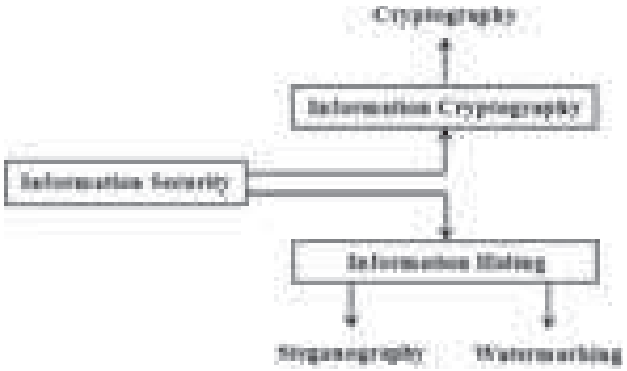

Fig. 2. Categorization of information security.

there are security issues with e-banking and e-payment systems since they depend on basic ICT platforms which are prone to several economic and business vulnerabilities.

5.5. Security Demands in EPSs

There are certain requirements which must be met by any electronic payment system, such as:

(a) *Integrity and Authorization*

The integrity of a system may be described as its accuracy, validity, and completeness based on business qualities and desires. Integrity in payment systems implies that a client will never be billed unless his approval is confirmed. Furthermore, sellers must not accept any payment unless the client approves it [58].

(b) *Confidentiality*

Confidentiality is defined as the security of sensitive materials from unauthorized declaration. Few organizations have confidentiality as a part of their dealings. In this setting, confidentiality implies the secrecy of data information related to any form of transaction. Commonly, clients are interested in the security of their transactions [59]. When there is a need for anonymity, there may be a need to divulge such information to a certain group of the participants.

(c) *Availability and Reliability*

Availability guarantees the existence of data frameworks and information when they are needed; it requires a regular communication of the amount of time a framework can be used efficiently. All aspects of the system must be ready to make or get payments whenever there is a need [59].

(d) *Enhancing EPS Security*

As per Refs. [55, 60–63], the commonly used strategy for ensuring the security of EPS is by using hiding-based electronic systems such as encryption, steganography, watermarking, and digital signatures as explained in Figure 2. On application, these innovations have reduced money theft and forgery. Here, a brief explanation of the mentioned security methods that secures electronic payments is presented.

(e) *Information security*

The advent of the Internet revolutionized e-payment; meanwhile, there is a challenge of securing information over open connections. To solve the information security problems, several techniques have been advocated in the area of security systems as depicted in Figure 2. Cryptograph or information encryption is a process of scrambling information in a manner that it becomes unattractive to an intruder. Meanwhile, electronic payment information may sometimes be difficult to encrypt. Therefore, there is a need for an invisible mode of communication which keeps the existence of a secret information from anyone. This is the reason an information hiding technique is required. There are two subdisciplines in information hiding, steganography and watermarking [64]. Both methods ensure the hiding of secret message and are related to each other through with different objectives. Steganography primarily aims at the hiding of the existence of secret communication and the protection of the secret information. Contrarily, watermarking aims at protecting the secret data integrity with or without hiding the existence of secret information from invaders. Watermarking applications mainly aims to protect the content's intellectual property. Table I portrays the basic features of information encryption and information hiding techniques.

(f) *Cryptography*

This is a conventional approach towards ensuring the privacy of transactions between two parties during an e-payment process [65–67]. Cryptography refers to the art of secret writing in which a plaintext is encrypted into a ciphertext with a key before being transmitted through an insecure channel. The ciphertext can only be decrypted to the plaintext version using a valid key [68], without which it will be impossible to retrieve the plaintext. Cryptography is a significant tool in ensuring a secure communication over an insecure channel because it confers privacy, confidentiality, non-repudiation, authentication, and key exchange. A cryptographic system is depicted in Figure 3 [69]. Data security can be ensured using two types of cryptographic schemes. These schemes are mainly used to achieve certain aims such as public/secret key cryptography and hash functions. The type of encryption algorithm used determines the length and type of the secret keys to be used [69].

Table I. Basic features of information hiding techniques.

	Information hiding		
Comparison criteria	Cryptography	Watermarking	Steganography
Objective	Content protection.	Carriers' copyright protection.	The existence of a secret data is concealed.
Features			
Perceptual security	No security as it can be easily identified (visible).	The security is dependent on the intended application. (Visible and invisible).	Difficult to be identified (invisible).
Communication security	The communication security is dependent on the key confidentiality.	The confidentiality of the technique determines the communication confidentiality.	The confidentiality of the technique determines the communication confidentiality.
Robustness	It is robust against the complexity of the ciphering framework.	It strongly resists the alteration or removal of the secret information.	It is robust against the detection of the presence of secret information.
Key requirement	A key must be used.	A key can be used.	Key usage depends on the application.
Type of output	The output is either the ciphertext or the plaintext depending on the medium.	Output could be an image, text, or video depending on the medium.	Output could be an image, text, or video depending on the medium.
Limit of security	Secure until the decrypted ciphertext loss its watermark.	Secure until the integrity of the watermark is lost.	Secure until the existence of the secret information is revealed.
Medium or carrier	Any digital data can serve as a carrier.	Any digital file can serve as a carrier.	Any digital data can serve as a carrier.
Imperceptibility	It has a high imperceptibility.	It has a high imperceptibility.	It has a high imperceptibility.
Applicability	Has a universal applicability.	Has a universal applicability.	Has a universal applicability.
Capacity	It has a high embedding capacity, but long messages can raise its chances to be decrypted.	The capacity is dependent on the hidden data size.	The capacity varies since the hiding capacity of different steganographic technologies is usually low.
Detection method	It has an untargeted detection method.	It has a targeted detection method.	It has an untargeted detection method.
Complexity of detection and extraction processes	The detection process is easy while the extraction process is complex.	Both processes are complex.	Both processes are complex.
Output data testing parameters	The use of parameters is optional.	The use of parameters is optional.	Both structural and statistical methods are employed.
History	It is a modern technique.	It is a modern technique.	It is an ancient method with a digitalized modern version.
Drawbacks	Its problems include key management and the complexity of the encryption schemes.	Its drawback is related to its robustness.	It has the challenges of embedding capacity, robustness, and high imperceptibility.
Techniques	The available techniques are the symmetric and asymmetric techniques.	The available technique is the spatial domain.	The available technique is the spatial domain.

A. Symmetric/secret key cryptography: This form of encryption is also called shared key, single-key, or private-key encryption. Private Key technique is used to encrypt data on all sides and must be used to decrypt the encrypted data. The sender encrypts the original data or plaintext with a key and transmits the secret key to the sender for the retrieval of the plaintext. This secret key is only available to the authorized persons during the encryption/decryption, Symmetric process depicted in Figure 4 [69]. Although this technique provides a good level of transmission security, there is still a problem of the secret key distribution. Exposing the secret key to an unauthorized person will ruin the encryption process. The DES algorithm is a perfect example of a symmetric key framework [69].

B. Asymmetric/public key cryptography: This technique can also be called an asymmetric or public key cryptosystem. In this technique, two mathematically-related keys are used for a separate encryption and decryption of data. When a private key is used in this technique, it is difficult to obtain the data and for this technique to proceed, all the keys are needed. The encryption key is publicly stored and as such, is referred to as a public key; the decryption key is secretly stored and as such, is referred to as a private key, Figure 5 explains the process of Asymmetric cryptogra-

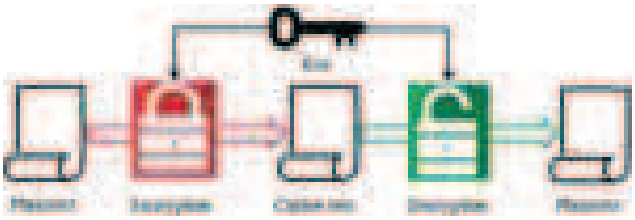

Fig. 3. A general Scheme of cryptography.

Fig. 4. Symmetric cryptography process.

phy process. The RSA is an example of an asymmetric key framework [69].

(g) *Steganography*

This is an act of concealing and transmitting secret e-payment information through a reliable channel in a bid to hide the presence of the secret data. It ensures that there is no evidence of the existence of such message. It keeps the existence of the secret information in the cover message from the public, thereby, keeping the information safe and free from any retrieval attempt. An overview of a steganographic system is depicted in Figure 6 [69]. The secret data can be embedded in a cover media using a stego-system encoder without the need for an algorithm. Anything that can be represented as a bit, such as a plaintext, a ciphertext, or an image can be embedded using this method. Having embedded the secret data in the cover object, the resulting carrier is called a stego-object which is transmitted to the intended destination via a suitable channel. Upon receipt of the stego-object, a decoder system is used with a similar stego method to retrieve the original data [69]. There are different types of steganographic methods based on the digital carrier used as follows (Fig. 7).

Fig. 5. Asymmetric cryptography process.

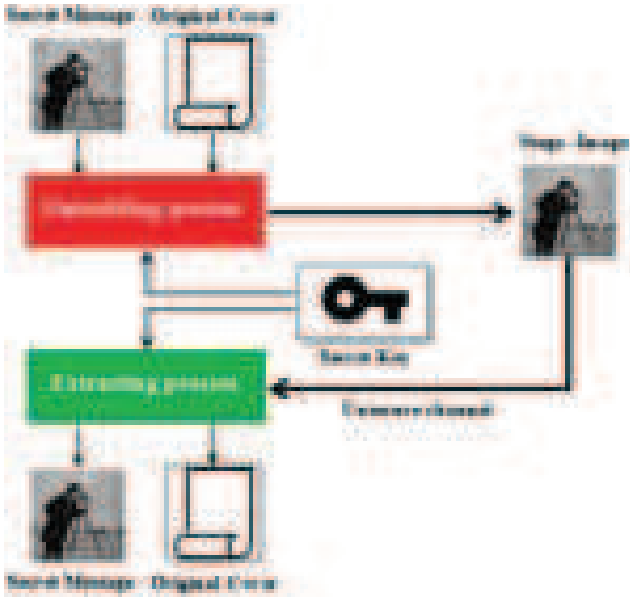

Fig. 6. The principle of steganography.

A. Text steganography: In this method, text files serve as the cover object. The secret data is embedded in every *n*th letter of each word in the text file. There are currently many available methods in this category, such as Format-based method, Linguistics method, and Random and statistical method [70].

B. Image steganography: Here, attractive cover objects are used to embed the secret data. The secret data is embedded using message pixel intensities; images are mainly used as the cover object due to the presence of several bits in a digital image representation [71].

C. Audio steganography: Audio files are used in this method to hid secret message. Some of the commonly used cover objects are WAV, AU, and MP3 sound formats. Some of the methods used in audio steganography are Low Bit Encoding, Spread Spectrum, and Phase Coding [72].

D. Video steganography: Files in video formats are used in this technique to hide secret data. Some of the commonly cover objects in this method are AVI, H.264, MP4, and MPEG video files [73].

E. Network or protocol steganography: Here, network protocols like TCP, UDP, ICMP, IP etc. are used to hide data in the cover object. In the OSI layer network

Fig. 7. Steganography digital carrier.

model, there are secret channels which can be explored for steganographic purposes [74].

F. DNA steganography: This method exploits the randomness feature of DNA to conceal secret data. It is a recent technique used for the numerical mapping of DNA sequence and has been explored for secret data embedment [75].

6. RELATED WORK

An algorithm for the detection of fraud in credit cards called BLAH has been proposed by Ref. [76]. This algorithm is a combination of BLAST and SSAHA frameworks. These frameworks are proficient algorithms for sequence alignment and detection of frauds in credit card. The system called BLAHFDS detects fraudulent transactions using a profile and deviation analyzer. These analyzers detect fraud using BLAH as a tool for sequence alignment. The proposed model was suggested for the generation of synthetic transactions to analyze the performance of BLAHFDS. This system presented a good fraud detection performance with a high accuracy. It also resented a fast processing speed but cannot detect cloned credit card or duplicated transactions. Fraud in other sectors such as telecommunication can be countered using BLASTSSAHA hybridization approach.

An FDS which combines the result achieved from the present and past behavior of a user has been proposed by Ref. [77]. There are four elements in this fraud detection system (FDS), which are Rule-based filter, Transaction history database, Dempster–Shafer adder, and Bayesian learner. The doubt level in each transaction is extracted by the Rule-based Filter based on its variation from the normal spending pattern. The Dempster–Shafer adder combines all the doubtful transaction obtained by the Rule-based filter to establish a primary belief. The Hidden Markov Model (HMM) is a common statistical tool used to solve several problems.

Ashphak et al. modeled the sequence of operations involved in credit card transaction processing using HMM. They considered the relationship between the transition probability and the hidden state and observations [78]. Sasirekha et al. suggested an Intrusion Detection Systems (IDS) which combines anomaly, misuse, and decision-making models to achieve a decreased rate of false positive alarms and a better detection accuracy. The HMM approach can be used to build an integrated IDS to detect attacks in credit card system based on the anomaly detection module. The behavior of the card holder is considered as attributes and suspicious transactions are detected from the user's spending profile. Suspected illegal transactions are then forwarded to a misuse detection system.

In another study [79], the author stated that trust is very important in online e-commerce environment as it determines customers preparedness to participate in an online transaction system. Digital certificates and signature are commonly used in controlling or avoiding risks of fraud and for securing online-based transactions [79]. In other study [80], the author explained e-commerce for goods and services during online transactions. It was observed that protection policies that ensures security and re-liability over companies providing services are the barriers to online shopping services. However, consumer's responses towards online purchase includes concern over sharing of sensitive personal information, unsolicited contacts from the online shopping system, and tracking of shopping activities [81]. Besides system security, consumers are also concerned about illegal bridging devices that are technologically protected to acquire consumers personal, financial or transaction-related personal information. Concern is also raised for information sharing with online payment retailers, as well as fraud due to a purposeful non-delivery of goods already paid for which are among the potential threat to online shopping. Improved security model for online purchase could minimize customer's misbehavior with the introduction of online transactions [82]. Disposing of the customers banking details and card details during and after online transactions should be avoided as it is prone to illegal use and misuse. Once an information is revealed, an attacker can misuse it for other purposes. Online payment system could be improved by introducing policies that are technically sound, incorporate legal, rigorous standards for security of data or information, and with the issue of certificate from trusted third parties [82]. In another study [83], the author enhanced the security of online shopping system to encourage consumer's engagement in online shopping or e-commerce as well as to create awareness among Libyan economic units. Consumers feel confident and relaxed while using online medium if their capital and personal information are properly protected and secured [83]. In addition, online portals should include elements that encourage trustworthy relationship between customers and online portals in order to improve the purchase of goods and attract customers. The portals should also ensure that every transaction is based on agreements that must be fulfilled [84]. The protection of the customer's data and security can bring awareness and trust to Libyan economic units.

The impact of information security for e-businesses was discussed by Eben with emphasis on the potential losses and security threats that could result from these vulnerabilities. The security of e-business consists of 6 dimensions which are confidentiality, integrity, legitimate use, auditing, availability, and non-repudiation. The study advocated for the designing of a systematic and comprehensive security policy that will ensure business security [85]. Cheng, Hamid, and Cheng [86] suggested 5 perceived security risks as physical, performance, time, psychological, and financial loss. Physical risk includes cash or card loss while performance risk includes the risk of additional

charges when used. Psychological risk involves risks that will affect the perceived image of the user when such payments are made; time loss risk involves risks due to a prolonged process time compared to an alternative mode of payment. Financial risk involves activities that will invoke non-refundable financial loss if performed. Srinivasan [87] believed that the success of e-businesses depends on several factors. He stated that e-businesses must strive to develop trust over a period. According to the author, some of the factors that contributes to gaining customer trust include product or service offerings, appeal of the Website, branding, trusted seals, and quality of service. Trust can be considered in many perspectives, such as information content, product, transaction, technology and institution. In this paper, the author analyzed trust from the transaction point of view and highlighted measures that e-businesses must take to build customer trust. It is not easy to measure factors that contribute to trust because it is developed over time. People always rely on their past experiences to trust a business; they also depend on third party reviews and recommendations. The study concluded that e-businesses can be accessed from anywhere at any time but there are certain factors that impedes building and maintaining trust. The major problem of this study is that it failed to focus much on the ways a company can improve online security during transactions. Perea y Monsuwé et al. suggested a framework for the improvement of researcher's understanding of the attitude of consumers toward online transactions in the US and Europe. The framework deploys the Technology Acceptance Model (TAM) constructs as a basis and extended its external factors and applied it to the online shopping context. The review portrayed that customer's attitudes toward online transactions are not only affected by usefulness and ease of use of the platform, but also by external factors such as consumer traits, product characteristics, situational factors, past shopping experiences, and trust in online transactions [88]. Abdul et al. assessed the impact of security and trust on the consumer's willingness for online transactions among the urban Moroccans. This study examined customer's preparedness to shop online by considering demographic factors, trust and security related factors. From the logistics regression analysis performed, customer's willingness to participate in online shopping was found to be reliant on trust, security, age, awareness and piracy factors. The study also found that most of the respondents are willing to shop online. The result of this study was undoubtedly important to both online vendors and the government for a better understanding of online shoppers. The outcome of the study also encouraged decision-makers to develop better online shopping facilities with the technological competitive advantage for both online shopers and vendors [89]. The economic impact of e-banking in Bangladesh was studied by Baten and Kamil; they also studied the benefits and scope of e-payments in Bangladesh [90]. Furthermore, Salehi and Alipour studied e-banking in an emerging economy with the aim of seeking to provide empirical evidence from Iran [91]. James investigated the acceptance of e-banking in Nigeria using Statistical Package for Social Sciences (SPSS). The study outcome e-banking acceptance to depend mainly on the age, income, educational status, perceived benefits, perceived risks, and perceived ease of use [92].

7. CONCLUSION

The significance of electronic payment systems in global trade and commerce is quite evident from the changing modern trends. Their scope ranges from one dollar transactions to several million dollar transactions. This study gives a wide knowledge of electronic payment systems and payment security considerations. A secure electronic payment system for online shopping is proposed by using information security systems like steganography or cryptography or by a combination of both techniques to protect customer's data and minimize misuse or fraud at the merchant's side. Considering the previous studies, it is possible to gain valuable knowledge about the pros and cons of the currently available electronic payment systems and the available security mechanisms for electronic payment systems. This paper also analyzed electronic payment systems from different security perspectives with the aim to provide a better customer understanding and satisfaction.

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Wireless Body Area Sensor Network: Tutorial Review

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Sensor networks that utilises wireless technology can be broken down into many smaller fields, one of it is known as Wireless Body Area Sensor Network (WBASN). Its inception is the product of advanced progress made in sensor networks that utilises wireless technology. Immense progress amassed in terms of technology has culminated in the creation of user-friendly technology that could be worn and minute-sized electronic parts. Consequently, this area of study has achieved huge interest prevalently as the result of its wide and diverse range of implementations, especially in the medical sector that deals with wellbeing and care. Current day scenario observes the existence of minute sensors that are enabled to be posited on the human anatomy for purposes of documentation on an assortment of physical constants to reciprocate appropriate responses. Hence, it forms a perceptive and vigilant scheme that can provide a prompt notification towards acute and complex health incidences, and can be utilised for diagnostic purposes to treat diseases. In view of the topic being of broad and current interest, the objective of this study is engaged in the presentation of a multiplex component of cutting-edge WBASN. This involves the transmission structures, applications in WBASN, programming core, concerns on security, and routing conventions that is adept in its use of energy. We endeavour to encapsulate the most up-to-date progress and expounded on the scientific mechanics of radio that is available that is related to this kind of network. Prospective perspectives and problems will be deliberated pertaining this aspect.

Keywords: Healthcare, Sensor, Telemedicine, WBASN, MEMS, Network.

1. INTRODUCTION

The exhilarating and accelerated progress in the advancement of prevalent areas in science and technology that has not been foreseen prior to this is actualised and is an integral component of our current daily lives. An exemplar of current innovations is an invention termed as sensor which is minute in size that is an enabler for the monitoring of various characteristics such as object motion, luminous concentration of light, temperature, magnetic therapy, vibrational movements (seismic) and others [1]. They are enablers of intra and inter-types of transmission with other gadgets, are created for the compilation of documented information to be deposited in a repository for further program execution if required. These forms of communications may be emplace accordingly in wireless or wired modality in view of the parameters such as communications could take place via wired as well as wireless mode due to the expansion in the system or systems of connections.

The world is currently witnessing an impressive progress in the fundamental technology that underlies the micro-electro mechanical systems (MEMS) technical knowledge which resulted in minimal-powered and minute sensor nodes towards the formation of wireless sensor network (WSN).

Typically, the necessity for infrastructure is obsolete, and in several cases nearly obsolete with a negligible number of infrastructure comprising sensor nodes on a spectrum from a small number to a few thousands, the network sensors could run in an integrated manner for tracking objectives. The WSN is classified into two categories; structured or unstructured. The sensors are assigned in a chaotic non-systematic manner spanning the area of interest (AoI) in the unstructured WSN. Meanwhile, the sensors are assigned to specific sites in the structured WSN.

An expansive application environment exists for the mentioned WSNs [2]. Due to their minuscule size, these

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networks can be executed on insignificantly low source of energy. Practically, Figure 1 Illustrates the configurations of sensor networks which are task-specific such as evaluation, monitoring, uncovering, and categorisation of information. WSNs' numerous functions that constitute fields pertaining to transport [3], smart grid [4], wellbeing care in health [5], smart bridges [6], meticulous agriculture based on accuracy, appliances and functions related to industry [7, 8], security [9], environment surveillance and city topological monitoring. Plausibly, the inception of wireless body area sensor network (WBASN) was credited to Van Dam in 2001. However, prior to the period, Zimmerman in 1996 had emphasised on the methods whereby devices that can be moved around, be operable within the human environment as a consequence of the rising interest in such devices. At the beginning, the particular networks were known as personal area network (PAN); it later developed a new terminology and is known as body area network (BAN).

With the current evolution on its terminology, it is presently known as WBASN with its vast association with variant kinds of networks and gadgets which are enablers of tracking processes which could be controlled from a distance WBASN function is the tracking system in healthcare. Figure 2 illustrates the scenario of WBASNs. It should be noted that from there to three terms related to this field of study which is WBASN, WBAN, and WBSN. These terms refer to similar types of networks with equal sets of functional sensors used to trace and evaluate physical human constants. At times in contextual-based situations, the references to the terms are transposable in this study.

WBASN minute sensors can be in dual forms; as invasive (that may be implanted in the human anatomy) or non-invasive (that can inserted or affixed to the human skin). They do not cause disruption to human actions; contrarily they are able to document the physical constants whilst the human is undergoing any particular actions.

As an example, the blood pressure, heartbeat or temperature of a patient could be tracked whilst participating in normal day-to-day activities. It enables a participant in a game to be examined from afar, or a combatant in the army to be monitored whilst in a practice session or in the war zone. Consequently as the result of the WBASNs being human-specific in terms of their functions,

Fig. 1. Wireless sensor network applications.

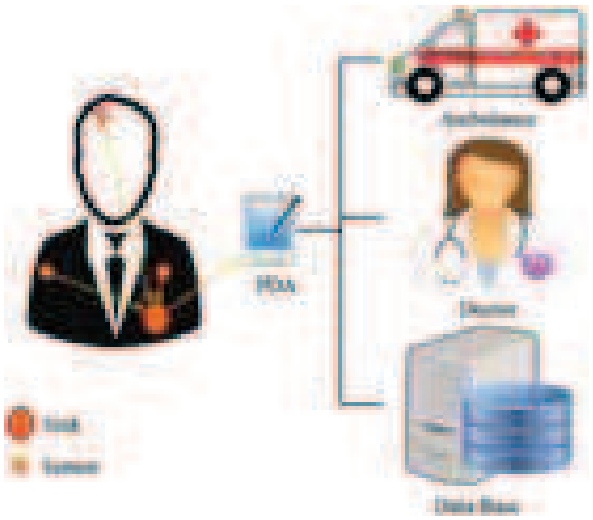

Fig. 2. Wireless body area sensor network in medical health care.

thus the uninterrupted tracking of the physical condition constants is possible. Veritably, they are minute in size in comparison with the normal sensors. They execute three essential undertakings: sensing, processing, and communicating transmitters.

During the execution of sensing undertaking, tracking and examination of the constants are carried out as per their configuration. During the undertaking of processing, a sensor transacts compiled information for differentiation and repository use prior transmission to the sink. Meanwhile, during the communication undertaking, the processed information is transferred to the sink for extensive communication or processing. Table I illustrates a directory of invasive and non-invasive sensors that are responsible for the execution of three essential undertakings as specified.

Figure 2 illustrates the numerous sites on the human anatomy whereby the physiological condition constants are evaluated. The administration of drugs or medicines into the body can be implemented via actuators that are positioned proximate to the sensors. As an example, the blood sugar level in the case of a patient who has diabetes can be tracked; and 4 in the event of a reduction in the sugar level, the actuator will be triggered to inject a specific insulin volume into the body. The provision

Table I. Invasive and non-invasive sensors.

Invasive and non-invasive sensors	
Non-invasive sensor	Glucose sensor, electrocardiogram (ECG), electroencephalogram (EEG), electromyography (EMG), temperature, oxygen, pH value, pulse oximeterze, blood pressure
Invasive sensor	Pacemaker, implantable defibrillators, wireless capsule endoscope, electronic pill for drug delivery, deep brain stimulator, retina implants

of assistance by WBASNs to individuals with disabilities could also be made possible by the embedding of sensors. This mesh of micro sensors could be embedded underneath the eye or artificial retina for those with visual disabilities where the sensors will transform the electrical cues into othalmic mode. In addition, paralysed individuals whose legs or lower torso have lost their sensory ability can be affixed with sensors to identify where their lower limbs or torso are located. It has been understood that WBASN has an immense imminent effect in the field of medicine.

In actuality, it was discovered by us whilst executing this study that there exist an abundance of researches done in e-healthcare. A majority of the methods that are in the forefront involve the utilisation of WBASN as the crucial aspect along with the use of sensors or sensing gadgets. Thus, the user-friendliness and minuteness possessed by the sensor nodes within the matrix are of the utmost significance. Traversing the span of time, it has been observed the inverse usage of integrated systems of circuit and electronic gadgets as compared to the heightened increase in the utilisation of spinoff of the devices. Momentous progress in electronics such as MEMS and nano-electro-mechanical systems (NEMS) has enabled these achievements.

As the result of the decrease in the size of the sensors, they are more convenient to be worn and are also easier to be carried and moved around. In addition, the size reduction is added advantage as the sensors' portability is enhanced. High-tech mechanisms in these sensors make more perceptive and agile that improves the effectiveness of their performance. Additionally, utilising micro or nano energy levels, prevalent practice of utilising these cutting-edge types of energy forms have made the running of the sensors more efficient at lower energy utilisation. The ensuing sections are the following: "WSNs versus WBASNs" describes the essential distinctions between WSN and WBASN, next, "WBASN communication architecture" discloses the transmission method in communicating in WBASN architecture, then "WBASN Energy-efficient routing protocols" section reveals the efficiency of energy-routing protocols, after that section "Applications of WBASNs" explicates the numerous kinds of WBASN functions, and "Security threats" unfolds the security concerns. Ensuing these sections, "Radio technologies and notable protocols," describes radio mechanics, followed by "Programming frameworks for WBASNs," which discusses the structures in programming and "some ongoing projects," annotates significant ventures in progress. Other ensuing sections are: "Future scope and challenges, which defines the forthcoming demarcation in research study and embarks on study concerns and the concluding section" "Conclusion and future studies" forms a closure to the study in the probable imminent research orientation in this field of study.

2. WBASN VERSUS WSN

There are various problems encountered by WBASNs which are distinct from those encountered by the conventional WSNs. It is a known fact that human anatomy possesses limited environ which behaves according to the interior environ in addition to the exterior environ.

Notably, tracking the conditions in the human anatomy requires a great level of accuracy reliability and precision, with any flawed interpretations culminating in misdiagnose or the making of erroneous judgments on crucial physiological matters.

The sensors are mobile and their orientations are influenced by human positions and motion, which was not

Table II. The main distinctions between WBASN and WSN.

Issues	Wireless body area sensor network	Wireless sensor network
Monitoring	Human body physiological parameters	Environment monitoring
Scale	Up to centimeters to a few meters	Meters to kilometers
Channel	Medical channel, ISM (industrial, scientific, and medical), body surface	ISM
Number of nodes	Fewer, limited in space	Many nodes are needed so that wide area is covered
Accuracy of result	Through node accuracy and robustness	Through node redundancy
Task of node	Multiple	Dedicated task
Size of node	Small is preferred	Small is preferred, but not important
Network topology	More variable due to body movement	Very likely to be fixed or static
Data rates	Non-homogeneous	Homogeneous
Replacement of nodes	Replacement of implanted nodes difficult	Performed easily, nodes even disposable
Node lifetime	Days/months	Months/years
Power supply	Inaccessible and difficult to replace in an implantable setting	Accessible and likely to be replaced more easily and frequently
Power demand	Lower	Large
Energy scavenging source	Motion (vibration), thermal heat	Wind energy and solar energy
Biocompatibility	Very important	Not important
Security level	Higher, to protect patient information	Lower
Impact of data loss	More significant	Compensated by redundant nodes
Wireless technology	Low-power technology required	Bluetooth, ZigBee, general packet radio service (GPRS), wireless local area network (WLAN)

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covered by the conventional WSN. Table II illustrates the main distinctions and the problems encountered by WBASN and WSN. For the furtherance of managing and resolving the explicit WBASN issues, numerous research surveys were carried out in the past ten years. In order to make reference easier, we have compiled a few significant research endeavours in this study. Through the transition of time, these survey endeavours became out-dated which is the norm for any extended progressing scientific knowledge. Furthermore, these previous endeavours were issue-specific and were executed for specific purposes or subject matter. Thus, this current survey endeavours to compile the latest knowledge and data, and to exhibit the up-to-the-minute headways made to remedy the shortcomings such as resolving the programming structures and concerns on multi-sensor fusion.

3. WBASN COMMUNICATION ARCHITECTURE

Figure 3 shows the human physiological parameter. The WBASN monitoring system communication architecture is displayed in Figure 4. It illustrates the sensor sites on the human anatomy. They can be in the form of electroencephalogram (EEG), electrocardiogram (ECG), electromyography (EMG), or evaluation sensors for blood pressure. The sink or base station (BS) acts as the personal server (PS) and will receive the documented information transmitted by the sensors. The total documented information compiled in the sink will then be transferred to the external environ which might consist of physicians, a centre for medicinal purposes or medical database to be information handling and computation in addition to diagnosis of the incidence.

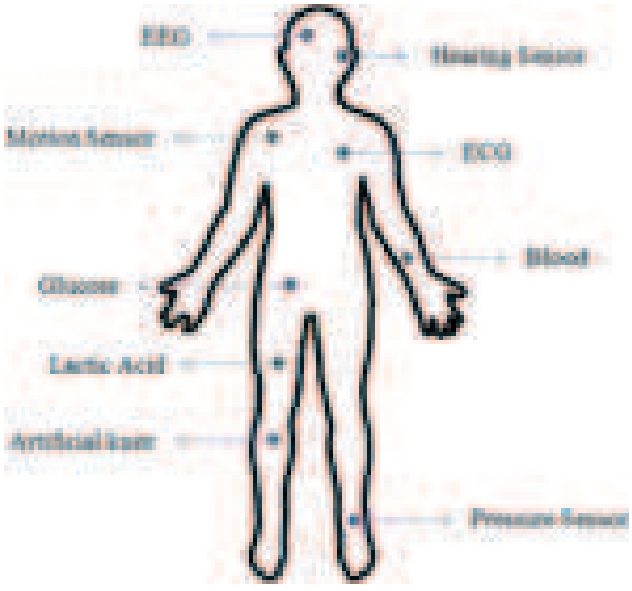

Fig. 3. Human physiological parameter.

Figure 4 displays the transmissions executed in WBASN architecture, which is segregated into three tiers:

(1) Tier 1-intra-WBASN communications, (2) Tier 2-inter-WBASN communications, and (3) Tier 3-beyond-WBASN communications. Notably, in stances during the movements of an individual, the whole anatomy is in motion. Thus, the sensors locations concerned in this case may alter, signifying that WBASNs are not stationary

Tier-1: intra-WBASN communications

Here, there could be wired or wireless forms of transmissions as forwarded by Zimmerman. During intra-WBASN communications, only two parts are involved; the sensors and the sink. The communications scope is within the parameters of 2 m, within the radius of the human anatomy. This tier is highly crucial to note the parameters of the interactions that are restricted by the location that should fall within the communications radius. Hence due to this factor, the scope of distance is small. In this tier, ZigBee68 and Bluetooth69 mechanisms are utilised for transmission purposes. The sink of PS, which is posited within this tier will receive the readings transmitted by the sensors pertaining the physical condition of the subject (person). The responsibility of the sink is to handle the compiled information and transfer the information to Tier-2.

Tier-2: inter-WBASN communications

Here, bilateral transmission occurs between the sink and the multiple access points (APs). Multiple eventualities could arise such as the deployment of APs by an infrastructure, or the positioning of APs in optimum positions in a volatile environ that will enable the excellent address of emergency scenarios. Tier 2 purpose is to enable the interconnection amongst the various kinds of networks for ease of receptiveness and reachability such as mobile phone network or the Internet to the WBASNs. It can also utilise 3G/4G, Cellular, ZigBee, wireless local area network (WLAN), and Bluetooth technologies.

Tier-3: beyond-WBASN communications

The Tier-3 has been created to be utilised by metropolitan area networks (MANs). Here the sensors have an outreach capability to a receiving party such as a healthcare provider, who has access to the transmitted information via the internet or alternative networks. Tentatively, the receiver of the information could be a physician or a nurse. In addition, the information could also be deposited into the patient's database and hence the database is a crucial part of Tier-3. Within the database contains the patients or users profile inclusive of the individual's case history.

Here, notification through a message with regards of the patient's state of health could be relayed to the physician in cases of health deterioration symptoms, and the information in the database could be utilised for appropriate steps to be executed prior to the patient reaching the treatment centre. The content of Tier-3 is indispensable, due to the medical environ and database which includes the medical history and profile of the patient/user.

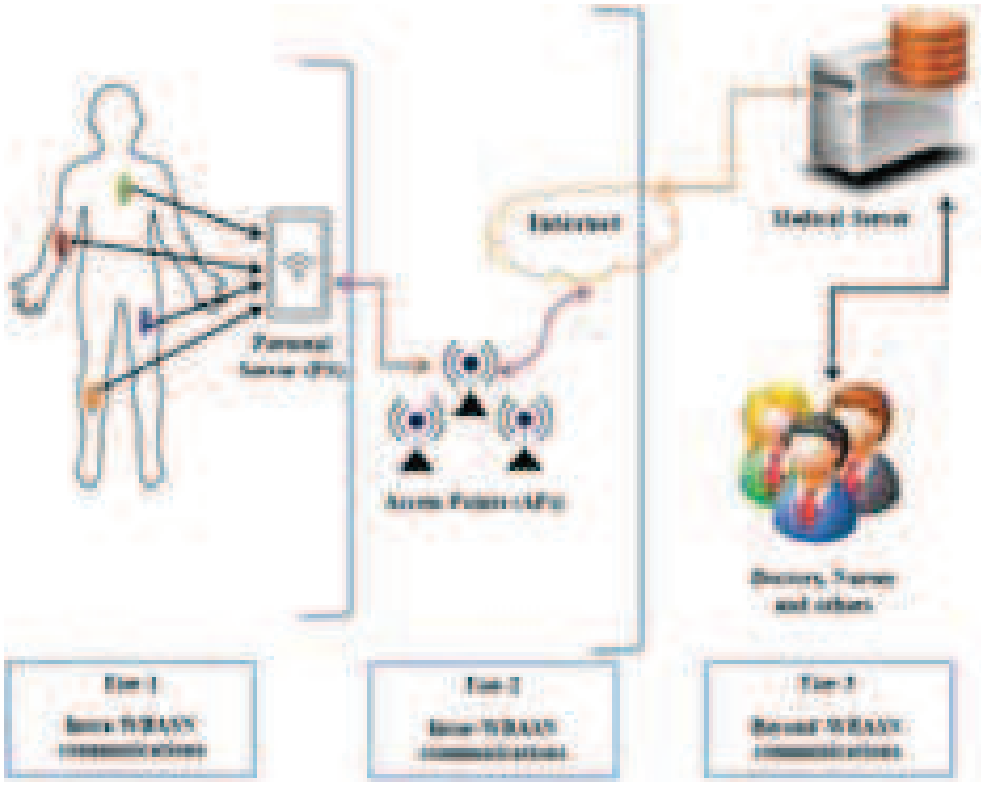

Fig. 4. Communication tiers in a wireless body area sensor network.

Hence, an alert could be relayed to the physician or users in medical crisis conditions via the internet or short message service (SMS). Moreover, it enables the restoration of essential patient data which could be utilised for treating the patient.

Nonetheless, the Tier-1 sink typically utilises the general packet radio service (GPRS)/3G/4G rather than an AP as means of transmission. Figure 4 illustrates in cases when the environ spans over the WBASN boundaries, similar techniques could be expanded to realise a surrounding that enables the connection of myriads of thousands of gadgets to boost the e-health amenities, accommodating extensive distances and remote care provisions for patients very far away. This colossal visionary aspiration is coined as *Internet of Medical Things*. WBASN can be the core of *Internet of Medical Things*. On the other hand, taking into consideration the parameters of WBASN, that falls within the confines of Tier-2 and the basic part confined to Tier-1, which is the area of focus of this study. Whatever that is further than WBASN (further than Tier-2) is over the limits of WBASNs operational capabilities. Therefore, effective ways and techniques could be executed further than the WBASN environ, and suitable techniques are chosen to address numerous concerns such as scope of application, data rate, security, privacy issues and effective energy utilisation. In general, it is necessary for gadgets to possess a multi-polar communications channel that they can communicate collectively between each other. Gadgets such as sensors, and communication devices like mobile phones, actuators, devices to indicate time, radio-frequency identification (RFID) tags, or other gadgets should be able to execute this function.

4. APPLICATION OF WBASN

Undoubtedly, the value of life has been enhanced by applications such as WBASNs. Their utilisation capabilities span from medical to non-medical uses, several examples of the uses of WBASNs in the care of wellbeing are the advanced identification of ailments, and tracking and assistance of after surgery responses. However, movement or gesture identification for gaming purposes, or the help given for driving purposes are some examples of non-medical uses of WBASNs. In actuality, there is a wide range of their uses for example in pervasive universal care of wellbeing, in the army, sports pursuits, amusement and recreational industry as well as myriads of other fields that include human activities.

Table III displays the various utilisations of WBASNs.

4.1. Medical Applications

In real world context, WBASN has a huge prospective in transforming the system in the care of wellbeing industry through its user-friendly diagnostics and real-time tracking mode. Based on a research done by World Health Organization (WHO), it is estimated that by year 2050, the world inhabitant would increase to approximately 2.1 billion comprising those who are above sixty years old.

Table III. Various types of WBASNs.

WBASN field	Application types		Example of applications
Healthcare	Medical	Wearable	Electrocardiogram (ECG) Electroencephalogram (EEG) Electromyography (EMG) Saturation of peripheral oxygen (SPO2) Blood pressure (BP)
		Implantable	Diabetes control
	Non-medical		Motion detection Secure authentication
Military and defense	Medical	Wearable	Asses solider fatigue Detect life threatening situations
	Non-medical wearable	Wearable	Fire detection Poisonous gas
Sports	Medical	Wearable	Heartbeat, temperature, blood pressure, motion sensor
Entertainment	Non-medical	Wearable	Real time streaming: Video streaming by camera, audio streaming by headsets Consumer electronics: MP3 player, microphone, camera Gaming purposes, virtual reality, ambient, intelligence areas, personal item tracking and social networking

Thus, the rise in the number of the aged will intensify expansive wellbeing concerns. In accordance to a WHO report, 17.7 million fatalities in 2015 are due to cardiovascular disease (CVD). This accounts for thirty-one percent of fatality rate worldwide.

Furthermore, the number exceeds four hundred and twenty two million individuals who are afflicted with diabetes. By year 2030, it is predicted to be the 7th reason to induce mortality.

Other fatality causing diseases are Cancer, Parkinson's disease, respiratory disorder and others which are long-termed and prolonged. The prevention of these diseases can be implemented if timely detection is enabled. Hence, WBASN are utilised to boost the quality of wellbeing care procedures to increase in its efficiency in the discovery of diseases at its onset. Consequently, appropriate cause of action will be executed for medicinal purposes. There are several categories of WBASN medical functions which are at the subordinate level, which are; those that can be worn, embedded, or WBASN control from afar. Each will be individually explicated further in the ensuing paragraphs.

4.2. Wearable WBASNs

The visible development that is quantifiable and the progress in tracking gadgets emphasise the necessity for minute-sized gadgets which are operable on varying frequency spectrum. These gadgets should not be heavy to make them easy to wear. There are several real-world uses of wearable WBASN.

4.3. Assessing Soldier Fatigue

An example of one such usage of WBASN wearable is in the evaluation of exhaustion in soldiers. Exhaustion can be at the physiological or psychological level. Physiological exhaustion constitutes muscular inability to sustain optimum physiological functional state.

WBASN is utilised to monitor the physiological functioning abilities of soldiers whilst they are engaged in combatant practices or in the war zone. It could be executed amidst the practice periods of the police forces, fire brigade personnel's and crisis management squad. Any individual could be assessed in terms of physiological fitness form. The examination could assist towards the achievement of improved bodily functions by providing adequate respite to the individual, and by substituting his position to some other individual.

4.4. Sports Training

Within the period of practice, sports participants' or the athletes' achievements can be examined, and from their performance they are chosen. The recorded data will be kept as an information input to be used at a later date, to help the participant achieve a higher level of competency as a result of knowledge secured from the data.

4.5. Sleep Monitoring

One of the essential and crucial human requirements is sleep. Sound sleep is critical in preserving the psychological and physiological wellness. In instances when a human being suffers from sleep deprivation, numerous disorders and deaths will arise out of it. Consequently, this may culminate in neurological disarray termed as narcolepsy which influences the management of sleep and of being awake, being asleep during driving or during work, in addition to the probability of contracting CVDs. Indeed, a substantial portion of the global inhabitants are suffering from sleep disarray.

4.6. Polysomnography (PSG)

This method is a diagnose for the tracking of sleep disarray syndrome. It records and keeps the sleeping information for further examination by physicians. For the investigations of sleeping disorders, WBASN architectures were suggested and its other function is in the removal of complicated wiring network via the use of PSG sensor nodes. As an example, Rajagopal and Rodriguez-Villegas has suggested the utilisation an architecture that utilises minimal power to assess the sleeping phases through the application of automatic sleep staging algorithm (ASSA) on an individual core node and analog signal processing (ASP) architecture on sensor node. A prototypical bio potential

sensor was created in De Vicq to track the phases in sleep without wires.

4.7. Asthma Monitoring

Asthma is a widespread ailment that afflicts the majority of individuals and can cause death if left untreated. Pollutants contained in the atmosphere and climatic changes are the major causes of asthma affliction. The timely intake of 'terbutaline' by asthmatic patients is crucial in order to suppress the allergic reaction. For individuals who suffer from allergic reaction or asthma, with the assistance of WBASN sensors, the tracking of allergens or the attributing elements that is the onset of allergy are enabled.

This is indeed beneficial for individuals suffering from allergic reaction or afflicted with asthma. Asthmatic patients are advantaged by the usage of the asthma monitoring system as it facilitates them in the initial identification of critical and dangerous conditions that escalates asthmatic attacks.

4.8. Fall Detection

Fall-Mobile Guard was recommended by Fortino and Gravina, that is considered as innovative real-time non-intrusive gadget that can be worn to track the incidents of fall and with the ability to alert through an alarm mechanisms. It engages an inertial sensor node that can be worn at the waist and is outfitted with a tri-axial accelerometer. It is also affixed with an individual mobile phone that is capable to identify and discern the various kinds of collapses. It is beneficial for the aged who are fragile and weak, although they are still mobile as they are liable to fall at any given time or place caused by their age or by ailments (example swooning).

The authors have forwarded that there are two essential blocks used in processing, namely; (1) threshold-based trigger that is implemented on the wearable sensor and (2) posture classification that functions on the mobile device.

4.9. CVDs

It is amongst the deadliest cause of fatality worldwide. The top most lethal ailment which is commonly termed as heart attack by the general public is Myocardial infarction (MI). Through the tracking and detection of aberrant occurrences on daily monitoring vigilance, the impact of MI can be minimised by the utilisation of WBASN mechanism. An essential function of WBASNs is the initial identification of medical abnormalities and manifestations. Patients suffering from heart problems are analysed through the usage of the Holter monitor for a duration of twenty four to forty-eight hours, Initial detection of MI in real-time scenario through the use of WBASN are suggested by Hadjem et al. The provision in Khan et al. of a different type of WBASN solution that can be worn to track coronary in actual time is mentioned. Delano and Sodini stated the creation of an ECG monitor that could be worn and that is an enabler in the provision of a prolonged period information compilation and scrutiny. In addition, Gravina and Fortino, authors of current day automated procedures in the identification of rapid cardiac defense response (CDR). The mechanism of CDR operates on the level of the instinctive nature beings to respond physiologically to the occurrence of precarious situations or perils. It is a reaction that acts to protect as it is the foundation for behavioural adaptation.

Within this study, the authors forwarded device applications that could be worn for the purpose of body sensor network (BSN). It is considered as an innovative technique that is a wholly automated tracking device of CDR configuration. In actuality, with the utilisation of this kind of sensors could guarantee a timely medicinal crisis remedy to be applied due to the fact that the sensors are able to relay the information on the occurrence of the incident.

4.10. Implant WBASNs

There are millions of the world's inhabitant who are suffering from CVDs and many other prolonged diseases such as acute joint ailments, diabetes, hypertension and others. Gadgets and appliances that can be embedded and are enablers of communication without the use of wires have a huge potential to be utilised for analysis purposes, and as an alarm system to alert the needed caregivers and parties in saving lives. There are a multitude of gadgets and appliances that have been implanted in the human anatomy such as pacemakers, gadgets that stimulates the nerves, implanted cardiac defibrillators (ICD), pumps for medicine, and pumps for psychiatric medication.

4.11. Cancer Detection

One of the principal causes of fatalities worldwide is cancer. WBASN can be incorporated with sensors that are enablers of the tracking and examination of cancer cells. For example, with no necessity of resorting to a biopsy, these types of sensors have the capability to identify tumorous growth.

4.12. Diabetes Control

Diabetes is an ailment where the body is unable to make use of insulin. According to a study, diabetes is the 8th principal cause of fatalities. It is foreseen that by 2030, diabetes sufferers would escalate to 438 million individuals that will constitute 7.8% of the entire world populace at the said period.

4.13. Remotely Controlled Medical Sensor Devices

There is an immense potential on the uses that WBASNs could contribute towards the remote tracking and examination of care of wellbeing. The development and utilisation of the emergent Information and Communications Technology (ICT) is the main objectives of and emphasis by

ambient assisted living (AAL). The provision of assistance for the aged in the running of their daily routine forms the central aims of AAL.

4.14. AAL

AAL's core objective in WBASN is the provision of assistance that will alleviate the pain points and the improvement in the quality of lives of the aged cohort for the enabling of them to be more autonomous and be able to care for themselves with the assistance of the latest technical procedures. It will offer an improved and enriched living surrounding. Several functions of AAL utilised in healthcare centres such as hospitals that are devoted towards serving on a long period of care duration, dwellings and residential homes that operate on the smart system concepts such as flats and houses. These AAL functions deem AAL as fitting in the provision of support for the elderly.

4.15. Telemedicine Systems

In order to ease the lives of users and to provide them comfort, WBASNs which are equipped with elements that are connected to them, have been recommended. It is appropriate to be implemented in telemedicine applications and healthcare that uses mobile applications as a platform.

4.16. Patient Monitoring

The tracking of physiological actions is incrementally considered as important due to the fact that they are connected to the condition of health. The mechanisms of WBASN are enablers of internetworking communications that are linked with myriads gadgets.

4.17. Non-Medical Applications

The implementation and functions of non-medical WBASNs are the following:

Biometrics

Gadgets and appliances that utilises WBASN as a basis for non-medical usage can be observed in the banking quarters, utilised to lock and open smartphones or computers and other types of industries that needs securing. Cues that are connected to biological imprint and characteristics are used for authentication identification purposes. Biological cues such as ECG, voice-generated, body motions, facial skin thermal reading, rate of breathing and others are appropriate and compatible to be utilised with these types of applications.

Entertainment applications

There are great potentials in the utilisation of WBASN applications in the sports and entertainment industries. Activities such as movements during training sessions or while in a sedentary position on a sleeping divan or a couch and others can trigger the sensors. As examples, certain musical content are activated by a person's stance, or certain types of video could be activated on the television whilst exercising and others.

Emergency (*non-medical*)

The essential aims of WBASN applications are grounded on the aspiration to provide an enhanced and comfortable lifestyle value to the users. Nonetheless, most the WBSAN are applicable to particular applications only so as to fulfil the needs of the technology involved. Certain applications are utilised internally within the body while others are utilised externally on the body as illustrated in Table III.

5. SECURITY THREATS OF WBASN

Multitudinous and varying kinds of hazards and assaults exist that makes the possibility of the WBASN information to be seized and altered or infringed. Figure 5 display the threats which are classified as active or passive. The assaults are essentially eavesdropping, message corruption, modification of the data, replaying and impersonation attacks. Due to the fact that the data are health related, in the event of the data being intercepted or hijacked, the information might be utilised for actions which might be detrimental.

Table IV displays the assaults on WBASN.

5.1. Eavesdropping

The radio frequency utilised by WBASN are of the open signal source type which is used for the relaying of the protocol data unit (PDU), utilised for the compilation of source data and the destination head. Eavesdropping may occur at the point when the data is being transferred from an intermediary node to another, whereby the attacker will intercept and eaves drop the packet, thus crack the confidentiality.

5.2. Node Compromise (NC)

A Node Compromise is considered an active attack when there is failure in the node and privacy is compromised, and this happens as the following:

(i) Direct:

Through this kind of attack, the attacker utilises specific devices to get hold of private information of high level confidentiality by capturing it at a node.

(ii) Indirect:

Node Compromise is the utmost damaging type of attack for WBASNs. In an Indirect Node Compromise attack, the sensitive information is intercepted from a node by an attacker by not hijacking it. It is however executed through the analysis of the secret information compiled from other compromised notes or alternatively from the protocol data unit (PDU). Through this mechanism, a compromised data that is newly transformed and is under the command of the attacker will execute assaults that are more damaging. In general, the WBASN set up in venues with no vigilant or high defence mechanisms in place such

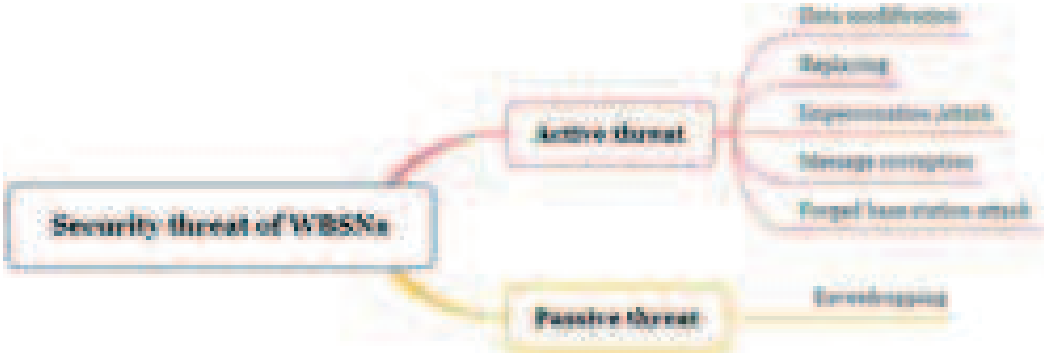

Fig. 5. Security threats in WBASN.

as in war zones and healthcare *modus operandi*. Thus there is no guarantee of continuous network vigilance in such situations. This gives the attackers opportunities to launch a compromise attack on the sensor nodes. Apparently, launching a node compromise is simple as the sensor nodes are constructed by utilising cheap gadgets with no high level of protection.

5.3. Message Corruption

Message corruption is a more sophisticated type of eavesdropping. The attacker will eavesdrop and also erase part of or the whole data which will result in message corruption. These types of data cannot be admitted for processing.

5.4. Data Modification

Both message corruption and data modification involve the alteration of data; however there is a small differentiation. In a particular data modification attack part of the modified data that is modified or some part of the message that is substitute or erased is still admitted for processing in reaching the destination. This will result in wrong and erroneous diagnosis.

5.5. Impersonation Attack

This type of attack involves the execution of imitating by the attacker, that goes undetected as it mimics an authorised party in the system, or the attacker impersonates another authorised party and intercepted the information, and the attacker will initiate unauthorised utilisation of the captured information.

Table IV. Attacks against WBASN.

Attack assumptions	Risks	Requirements
Capabilities	Impersonation	Authentication
Computational	Data modification	Data integrity
Broadcast capabilities	Replaying	Protection
Listening capabilities	Eavesdropping	Freshness

5.6. Replaying

The mode of attack by replaying method is to resend the messages repeatedly, so as to deplete the source of energy which will cease the functioning of the sensor. This type of attack goes undetected as the data that goes to and fro are legitimate, and on the recipient's end it seems authentic and the replays will escape suspicions.

5.7. Forged BS Attack

In forged BS attack, the attacker imitates the PS taking advantage of the compactness of the network size. Compilation of private data through the impersonation method by deceiving the valid sensor nodes that it is the real PS. In fact, it is imperative for WBASN to have a protected and secured relaying of information, as information pertaining to a patient should be given the provision of confidentiality, legitimacy and incorruptible fidelity. There should be a security measure that allows only approved entities to retrieve any information. Thus, authorisation is equally of importance, however in WBASN scenario, the priority is placed on the lightness of weight of security elements to enable them to be operatable on wearable or sensors that are embedded. Via the nature of this concern on light weightness, several security methods that are light and secure transmission models for security networks are there for the offering to satisfy this concern. It can be installed on WBASN configuration without any difficulties regardless of models that are dependent or not dependent on servers.

The security hazards of WBASN and their related security services are shown in Table IV. Various attacks of known cyber-attacks are irrelevant such as the sinkhole attack, Hello flood attack or the wormhole attack due to the confined and limited area that contains nodes in the WBASN as compared to the normal WSN.

5.8. Data Privacy

Data privacy involves the consent in the use of data to users who are given authority to do so. Exposure of private information pertaining to medical conditions of an individual to any third party without any authority is

hazardous. In order to maintain the private information in WBASNs methods that does not utilise cryptography are implemented. Phantom routing protocol is utilised to enhance the location of the privacy source expansively. The source location is expanded via the initiation of the phantom source by attaching the transmission overhead contrast with single-path routing and flooding.

5.9. Data Confidentiality

Data confidentiality is attained through the non-revelation of the patient's critical information and affording shield from various networks. The encryption technique is applied in order to maintain confidentiality of data in transmission pathways via a shared key and data protection is constructed to relay a patient's confidential information restricted only amongst the coordinator and WBASN nodes.

6. ENERGY-EFFICIENT ROUTING PROTOCOLS FOR WBSN

There are several essential distinctions between WSNs and WBASNs as stated in the section WSNs versus WBASNs. A distinctive feature of WBASN is the size of their sensors is more diminutive as compared to those of the conventional WSNs. Thus, accordingly the energy consumed by the WBASN sensors requires a lower power (used in well-being care and medical purposes). Due to this, considerations pertaining WBASN routing protocols are forwarded and a summary of significant routing protocols that uses energy effectively are suggested for WBASN.

In Quwaider and Biswas, a protocol is described by the utilisation of a single-hop mode of transmission for the relaying of information from the nodes to the sink. It reduces the amount of delays; however distant nodes use a greater amount of energy than the near ones. Nadeem suggested the Cost Function (CF) consideration factor, which involves the selection of nodes as parent or child notes according to the CF value considerations. The CF value is calculated according to the energy content of sensor nodes and their distance from the sink. The parent node is chosen for the node with the lowest CF value and the balance will be the child nodes. Thus, the sequence of order is that the sensor nodes with the crucial information will transmit the information straight to the sink, due to their close proximity to the sink.

Seo et al. has suggested the multi-hop communication that involves the sink and the nodes.

Nevertheless, the arrangement has its disadvantages as nodes closer to the sink will use larger amount of energy. Additionally, there will be more delays. Through a study engaged by Javaid et al., it was recommended that the transmission of crucial information will be transmitted straight to the sink by the source node.

In the event that the information is normal, the nodes will follow the multi-hop arrangement. It is a protocol that is sensitive to heat, thus upon the identification of a heated point along the channel, there will be a re-routing. Tauqir et al. has recommended an alternative protocol that involves sensors with similar parameter of the body. They deliberate that during the transmission of information from the compiled information by the sensors, energy is utilised and heat is given off. Consequently, the body tissues will be seriously harmed. Thus, with these considerations, they have created a protocol in the order of sequence, that the transference of information and processing of information be executed when the threshold is arrived at, and the other sensors are to track the parameters vigilantly and constantly. Information will be sent to the sink by the sensor nodes through the assistance of the relay nodes in order to decrease the energy usage. The positioning of the relay node will be on the chest and it possess greater energy in comparison to the others. This is due to the fact that data aggregation is executed and the sink receives the relayed information. Braem et al. recommended a protocol in which case, child node data is transmitted to the parent nodes for a greater reliability attainment of the network a reduced amount of delay. However the power balance is unresolved. Ahmed et al. recommended an energy-efficient protocol, where the attributes of single-hop and multi-hop schemes arrangements are utilised with the objectives of decreasing the path loss in order to extend network lifetime [10–14].

In this study, CF is signified by the choice of forwarder node. The calculation of the CF value is based on how far away are the sensor nodes from the sink. Thus, the forwarder node will be chosen out of the node that demonstrates a greater balance of energy left-over and are nearer to the sink. The left-over energy will keep the balance of energy in check. Uddin et al. discussed on the path loss of a node in motion, which is assessed, and a WBASN energy model is recommended. It is founded on the basis that path loss along with the received path power of the propagation model.

Formed on the basis of fixed and energetic sensor nodes, a propagation precursor is recommended. A path loss is configured as when a sensor node is in motion along with the body motions in a standard dispersion. From Coronato et al., the research discusses an architecture that is situational, with the objectives of decreasing stereotyped afflictions pertaining to movements of children who are afflicted with autism spectrum disorder. Here, aberrant signs are distinguished. The effects of varying values for (relative permittivity) and (conductivity) of human body tissues at a frequency of 2.45 GHz were computed on the basis of a 3-D model recommended in Kurup et al. The validity of recommended model isuntil the value of 8 cm for dipole antennas. The execution in order to identify the differences of path losses of heterogeneous and homogeneous human tissues is carried out. The study done by the authors provided some insights on transmission of a high

frequency nature, specifically on the dispersal of energy and its impact on the human physique.

The forwarder node receives information from the sensor nodes in Sandhu et al. The responsibility of the forwarder node is to convey information to the sink. Amongst all the other types of sensor nodes, the forwarder node is chosen for its greater energy from the rest of the nodes. This combination of the forwarder entails minimal distance in transmitting information, between the sensor node and the sink for the purpose of energy conservation. An interference-aware network is recommended in Chen et al. for the purpose of tracking the health condition of many patients. Actually, disturbances in communications without wires would induce greater energy usage. In Braem et al. endeavours are made to enhance the effective energy usage via suitable propagation models. Specific relay devices are inserted as hotspots deterrent, resulting in a longer network lifetime. An optimum scheme is recommended in Elias and Mehaoua, that suggests the placement of relay and routing of data with the objectives of prolonging network lifetime. Seo et al. recommends heuristic adaptive routing algorithm towards achieving effective energy usage. It decreases energy usage and for the purpose of emergency data, ensuring Quality of Service (QoS). A wide-area network is recommended for the utilisation in the management of medicinal field in Wang. Certain of this system characteristics requires minimal power, simple to arrange, and possesses currency with a stable data.

In Javaid et al., the protocol endorses the movements of nodes. Here, the information is transmitted from an individual sensor to other sensor and is recognised as forwarder node. It is chosen on the basis of CF which is protocol-determined. The suggested CF chooses the forwarder that has the minimum CF value. Once more, in Khan et al. suggests the path loss reduction scheme where the precise placement of sensors is recommended. In addition, Khan et al. suggests the utilisation of eight sensors related to physiology that will operate effectively. A couple of the sensors are devoted in documenting crucial information and transmit their cues immediately to the sink by utilising the single-hop communication. Some others utilises the multi-hop scheme for transmission. Proximate sensors to the sink are calculated for remaining threshold energy and examined to ascertain a forwarder sensor amongst the other sensors. The duty of the forwarder node is in the compilation of information from sensors and ensuing the execution of appropriate aggregation, transmitting the information to the sink. Favourable results were obtained from a simulation that was executed [15–23].

Majumder and Gupta, recommended new algorithm pertaining to routing. It utilises three variables: request queue length, the quantity of hops, and the power level. The variables are used by this protocol for the purpose of transmission and the algorithm deters obstructions and engorgement. Yang et al. recommended an innovative and a medium access routing protocol that uses energy effectively. It utilises a hybrid scheme via time division multiple access (TDMA) arrangement with carrier-sense multiple access with the collision avoidance (CSMA/CA). Towards the improvement of the effective energy usage, the authors recommended ascribing the transmission overhead and designed awaiting order state for the sensor nodes. To address the challenges of enhanced data dissemination with delay and the cost of network management, Samanta and Misra suggests a structure that will keep the management cost of network to a minimal. It endeavours to obtain an optimal QoS and the optimum rate of successful message delivery over a communication channel of the network. The recommended framework has kept three aspects to a minimal: (1) Costs incurred for the distribution of data, (2) management that deals with intrusion and disturbances, and (3) connectivity that is dynamic. Lee and Kim suggested a routing protocol known as aSymMAC. A non-symmetrical energy balanced model was recommended between the coordinator (sink) and the nodes (coordinator signifies BS or the sink node). The objective of this model is to attain an effective energy usage. Moreover, it tries to resolve two essential concerns: (1) Conveyance of crucial information to the sink and (2) the condition of energy levels of sensor nodes in comparison to the sink (i.e., BS).

The arrangement was assessed by Institute of Electrical and Electronic Engineers (IEEE) 802.15.6. The effectiveness of energy usage is a critical network concern that utilises sensors in its central functioning modus operandi [24–28].

Nevertheless, in deliberating about the needed rate of data that will be higher for the upcoming e-healthcare systems and its applications, which will lead to the higher level of total energy usage, this specific concern will be not so pertinent in terms of WABSN due to the following.

Generally, it is the norm for the emergent e-healthcare systems and methods to utilise novel architectures such as cloud, IoT (Internet of Things), and CPS (cyber-physical system) in terms of WBASN for usage, with myriads of choice for transmission (such as for the purpose of data uploading, downloading, load balancing). This would heightened the quantity of processing tasks needed and in time, would incur a higher level of energy usage. On the other hand, when taking into consideration the WBASN boundary, notwithstanding the external (outside of WBASN) or related networks and technological applications, the information related to a patient or a user remains the same as needed for the care of wellbeing service. Specific techniques are implemented for the reading of physiological variables of the such as rate of the pulse or heartbeat rate and others. Hence, the information falls under permissible boundaries when compiled internally and from the WBSN. Thus, generally WBASN is minimally unaffected by the exterior factors in accordance

to its original internal function (please refer to Tier-1 in Fig. 4).

Eventually, considering that variant technologies require improved rate of data which leads to a higher energy usage, in actuality, the direction that is being observed is the evolution of improved technologies of batteries and garnering of energy technologies and of gadgets with enhanced means while maintaining the size of the gadget or even reducing it. The essential concern is that, even though the rate of data is considered as eminent, and could lead to a higher level of energy usage, however in the case of WBASN there are other more significant considerations. It involves the effective routing protocols which controls the quantity of communications and amount of data received which ascertains the degree of energy usage. The network processing functions would reduce due to the fact that information pertaining human activity are compiled regularly, the data quantity would be in check in spite of the fact that in certain conditions, certain intermittent and inconsistent data are generated as the product of erratic modifications of human pursuits.

Through the deliberations of the protocols and concerns referred, which in varying degree tackles the concerns on of energy in WBASN environment, the ensuing section will consider the various utilisations of WBSNs, which includes several non-medical purposes as well [29–34].

7. RADIO TECHNOLOGIES AND NOTABLE PROTOCOL

This section will resent radio technologies that are related to WBASN use such as as Bluetooth, ZigBee, Bluetooth low-energy technology (Wibree), ultra-wideband (UWB), and others.

7.1. Bluetooth

Bluetooth is a technology that does not use wire and runs on minimal energy which has been incorporated in many gadgets. It is a standard for communication of information that is constructed for communications without the use of wires between compact, minute-sized gadgets that can be moved around (portable). Its operation functions is at the Bluetooth operates at ISM (industrial, scientific, and medical) frequency band of 2.4 GHz. Voice and information can be communicated via Bluetooth. Table V illustrates the frequency, rate of data, and the scope which the Bluetooth is functional.

Table V. Bluetooth specification.

Technology	Data rate	Frequency	Maximum range
Bluetooth IEEE 802.15	723 kbps	2.4 GHz	10–100 m

7.2. ZigBee (IEEE 802.15.4)

The ZigBee standard is the IEEE 802.15 Task Group 4 (TG-4) that entails data with a minimal rate of wireless personal area network (WPAN) standard. ZigBee use is synonymous with automated systems related to the domestic residences. It possesses two physical bands 2.4 GHz and 868/915 MHz having data rates of 250 kbps for 2.4 GHz, 20 kbps for 868 MHz, and 40 kbps for 915 MHz. At a subsequent stage, it was upgraded and elevated in its quality to display a low duty cycle (\0.1%), with a minimal power usage (prolonged battery life that can last for years). ZigBee functions in the networking purposes of two gadgets, and is akin to Bluetooth. It is considered as beneficial due to it being quiet cheap in cost and its usage of power low is minimal. It is deemed as an option to Bluetooth.

7.3. Bluetooth Low-Energy Technology (Wibree)

Prior to this, it was regarded as a lower grade development associated with Bluetooth; however it developed its name and is known as Wibree. Its construction was initiated for the purpose of linking minute gadgets to terminals that are mobile without the use of wires.

Its performance capability has been benchmarked to the provision of a data rate that reaches until 1 Mbps. It is deemed as the more superior selection for WBASN applications where there is a requirement for minimal power usage, and this is possibly attained via the utilisation of a cycle operation that is low-duty in nature [35–44].

7.4. UWB and IEEE 802.15.6

With a frequency assignment of 3.1–10.6 GHz, USB mechanisms are predicted to be utilised in WBASNs due to the capacity such as anti-multipath capabilities, large bandwidth that is offered, and minimal power usage. Its construction was incepted for the purpose of enabling transmissions that are of close proximity range and adhered to the standards by IEEE 802.15.6 Task Group 6 (TG-6). It possesses a frequency range of 3.2448–4.7424 GHz in low-band and 6.24–10.2336 GHz in high-band of 499.2 MHz channel bandwidth.

7.5. ANT

With the purpose solely for PANs, ANT protocol was constructed. ANT operates on elements that functions on energy levels that are minimal. Cost factored in at a cost effective price and functioned at 2.4 GHz ISM band. An umpteenth number from tens up to several hundreds of interlinking nodes is probable in ANT protocol which enables it as deemed to be a quality selection for pragmatic networks. In comparison to other protocols, ANT's hardware energy usage is ten times lesser than that utilised by Bluetooth's hardware. Factors that enable ANT to run on an effective energy usage mode are that typically it is maintained in a sleep mode at extremely low energy

level, where it will function at the briefest time span in the occurrence of conveyance, where after the transmission, it will return to its sleep mode that is extremely low-powered again. As a whole, it offers a data rate of 1 Mb/s.

7.6. RuBee (IEEE 1902.1)

Stander protocol IEEE 1902.1 was adhered to by RuBee. A robust security level, battery life that lasts for a long period of time, a transmission distance that is effective, and stable functioning mode are aspects that enables RuBee to be deemed as the appropriate choice for WBASNs. A frequency of low value which is under 450 kHz sourced its operability. Based on a dual-way protocol that does not use wires, which utilises magnetic signals that are long-waved with the intent of transmitting and/or accepting data. Data are not long and can reach until 128 bytes. Running at a frequency that is not weakened by any metallic or liquid environment, RuBee's extraordinary capability is being able to function and be deployed in whatsoever environment which RFID failed to address.

7.7. Sensium

Sensium is an enabler for care of wellbeing providers to track their patients condition constantly at a minimal cost. At a minimal data rate for on-body devices, Sensium offers a platform that functions on an extremely minimal energy usage. Personal computers (PCs), computers, personal digital assistant (PDA), mobile phones or laptops are some appliances that can act as servers for the numerous information transmitted by the sensors. These can be utilised to transmit the information to other receivers. Sensors are maintained on two types of modes, either on sleep mode or on standby mode, waiting for their designated interval of time to transmit information. It is able to make connections with smartphones free of wires.

7.8. Zarlink

It is an appropriate choice for devices embedded for medical purposes. Cyclic redundancy check (CRC) error detection is merged with Reed-Solomon coding scheme in order to obtain a link. The link is deemed as extremely secure and dependable. In actuality, the inaugural camera capsule that is appropriate to be ingested utilises radio-frequency (RF) chip by Zarlink. It is especially constructed for examination purposes within the gastrointestinal tract, where two images in movie format is transmitted instantly. Its minimal usage of current and the fact that it is maintained in a sleep mode constantly are the essential rationale for the utilisation of Zarlink Transceiver.

7.9. Wave and Insteon

AA-Wave and Insteon technologies are both registered mesh networking technologies created for automated residences. Z-Wave functions on 2.4 GHz ISM band. Meanwhile Insteon utilises power lines and functions on 900 MHz ISM. In addition, Z-Waveis associated with the next-generation wireless networking arrangement that enables networking to be done internally or be utilised for long distant command and administration. It utilises radio waves that are dependable and that utilises minimal energy, and are able to move through walls of buildings.

8. CONCLUSION

WBASN is considered an emerging technology with a huge prospective to transform the applications used in healthcare henceforward. In this study, outlined and gave an overview on numerous features and concerns pertaining to WBASN. We endeavoured to encapsulate the latest developments in this particular field in addition to several general debates and statements which were displayed for the general audience and readership of this subject matter. On the occasion the availability of anticipated outcomes of numerous current projects in progress (with many more forthcoming) come to fruition, the robustness of WBASN would be strengthened in its practicality in terms of applications, such that it would have an immediate effect on the healthcare industry that is made available to the general populace and in turn will make our daily lives more comfortable and easy. For forthcoming studies, a fascinating and intriguing orientation entails the investigation of edge computing based/assisted BSN systems. Through the accrual of published papers pertaining edge computing, these current progress have a resultant influence on the BSN and WBASN. Table V highlighted the bluetooth specification.

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RESEARCH ARTICLE

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Preparation and Analytic of Intelligence Big Data for Smart Systems

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It is already true that smart system involving big data has drawn massive attention from researchers in analytic, decision makers, intelligence in smart city or system. As the speed of Information Technology (IT) and internet developing, become necessary to come up smart system meets all requirements of modern life. Smart system make the life of human beings more comfortable and easy. However people can get so much interest and highly useful benefits from using big data in smart system. A proposed new scientific paradigm is born in this study to get the advantage and avoid the disadvantage of existing smart systems. Some Important structure illustrated in this study including triad main issues that control any smart system such as big data that responsible to make avenues to success smart system. Valuable insight comes from big data should analytic and control under process before manipulate in intelligence phase to get right decision in regimes. There is no doubt that competition in the future in field of big data will open the horizon to evolve the smart system. This paper is aimed to illustrate a close up view about using the modern technologies that currently evolve with amazing acceleration like intelligence and big data utilities. Challenging of these three issues big data, intelligence and analytic are adopted to find the opportunities of integrate smart system that dealing with hazardous government data clouding in such system. State-of-the-art discussed in this paper and useful recommendation been put up within conclusion to overcome the problems regarding designing smart system.

Keywords: Smart System, Big Data, Intelligence, Analytic of Big Data, Artificial Intelligence.

RESEARCH ARTICLE

1. INTRODUCTION

Analytics of big data have become increasingly importance in the business communities and academic field especially in past two decades. More system studies aim to highlighting significant of this development. For more declaration can looking to the survey of 4000 Information Technology (IT) which are professionals within different countries about 93 in additional to 25 industries, the Tech Trends Report produced from IBM in 2011 that identify subject of business analytics considered as one of the major four technology trends [1]. From this study we can see important of system analytic during (IT), at the same time right analytic of such business lead to increase the financial return that income from certain business. A report produced by McKinsey Global Institute at the same year predicted that USA alone in 2018 will face shortage in analytical skill, and that what happened exactly later [2]. Analytic of any data and in particular big data have become nowadays the important in term of frontier for innovation. One of the important issue in analytic of big data that related to the service marketing as we can noted in Asia region (Excluding Japan) that grow in Compound Annual Grow Rate (CAGR) in the period of 2016 to 2019 [3] around US$3.2 Billion reflected by 16.3% in CAGR. Artificial Intelligence (AI) nowadays become is indispensable and core business for business process, infrastructure optimization in additional to blend industries [4], in this regard Gartner predicts growth around 30% of new revenue that including AI in industry to helping the system by 2021.

Analytic of intelligent big data consider as emerging technology and science that's depend on AI, and industry marketing broadly aim to across organization and factories. However, there are two issues have not been take significant attention in both industries and academia fields such intelligent big data foundation and a managerial point of view for intelligent big data analytics. Actually, this is the era of big data [5], and big data analytic considered as innovation of revolutionizing, development in additional of management the business. This term of big data analytic, look like opportunities of creating big market.

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Big data consider now is the next generation to warehousing the data and business analytic; actually is a phenomenon with rapid pace of change and innovation. The term of big data will reach the next generation and tell them where it is born and what is the early day and how it called age of big data analytics and how the infancy of it was [6]. In recent years smart manufacture or (in general) systems got increased attention by industries and academia. This attention is important to give and provide advantage for companies of make the factories more easy and sustainable; the smart manufacturing and big data analytic provide hidden knowledge with useful information in term of relation lifecycle and parameters used in the process of industries. Artificial intelligent has been known for more than six decades [7] with the rise power processing of super computer, become necessary new big data technology appears working together with intelligent managements of data. Rapid growth of AI will helping to increase the attention of big data in smart application and systems. Any information system managed by AI can easy to be compatible with the hug or big data processing. Merging analytic of big data with AI generate the age of fast computing at the same time open the horizon to improve smart processing to make bygone era of slow computing being eroded [8].

2. RELATED WORK

With increasing of internet and fast development in data processing, internet become the main resource in the world and fast management and processing are required in such environment. First we have to open our mind of the important knowledge so can imagine why we interesting in analytic big data; National Security Agency reported that the internet processes 1826 petabytes (PB) of data every day [9]. While the data produced per day in 2018 was 2.5 quintillion bytes [10]. Generated data actually will increased double every two years, reported previously by International Data Corporation (IDC) [11]. However, 90% of whole data at the world generated in the last two years, as it is Google Company processes over 40000 searches every second that's mean 3.5 million searches every day [10]. 300 million photo uploaded by Facebook every day in additional to 510000 comments with 293000 status updated [12]. From given information we can illustrate the massive amount of information that generated and deal with every day it is staggering knowledge indeed, these huge data or can called big data need special control and management with analytic required for these great resources. Then advance technique to control and analyze big data to make smart environment with large datasets, most of the time fast response or make decision of such datasets important to operate smart system such as health care or electronic health records [13]. Business Intelligence and proposed its tool produced by Ref. [14], these tool used to organized the business and test the performance of the system, however tools like Tableau, Pentaho and micro strategy analysis used in evaluate Business Intelligence (BI). Health care industry take the share of big data analytic to improving and developing in disease detection and prevention [15, 16]. In the same issue many algorithms used in medical treatment, considering time complexity, Cuckoo, Firefly and PSO algorithms used to prove the efficiency in health care big data system [17]. Complex domains such as defense, cyber and security in military fields also used with artificial intelligence to allow reduction of the big data and prediction the future events [18, 19]. Many researches apply big data with artificial intelligent to check the validity of information in earth science that need GPU computing for the clouding data [20, 21]. Energy consumption is the main issue in many economic systems to that using big data to control efficiency of such system also can provide creation, maintenance and development to the system when using AI [22]. Tremendous studies apply big data on machine learning make the basic of intelligence systems in many fields recognition, network, robotics and security [23, 24]. As conclusion for that need to improve the analytic of big data in smart system that need control in intelligence decision to stand on the advantages of previous works and overcome the disadvantage of them.

3. INGREDIENTS OF THE SYSTEM

Proposed study consists of three main terms, which are very important to understand, these terms some time called ages according to their applications. First term is big data which consider as the hug information waiting the process [25] that data in term of excessive will cause double problem to human that's mean increasing the data not easy to process or manipulate need special caring indeed [26], big data generated daily in many fields from different sources such as government, social network, financial, academy and health matter. Due to cloud computing proliferation the data growth incredibly, also cover many smart devices. Before revolution of big data institutes or companies were not able to store the data on one place for long time even manage these data efficiency is difficult. When the rise of internet and developing in network many people become able to store their big data in the clouding unit, in additional to using parallel processing the efficiency of management the big data become easier. The second term in this study is analytic that consider the root of any problem and responsible for making decision. Analytic data is different from analytic of big data that related with a foundation of big data. Big data analytic can be consider as the collection process analyzing and organizing. There is a strong relation between analytic of big data and intelligent system of sharing the resources organizing the knowledge and controlling the other information among multi-sub processes. Analytic big data can be defined also as emerging science and technology which including multidisciplinary

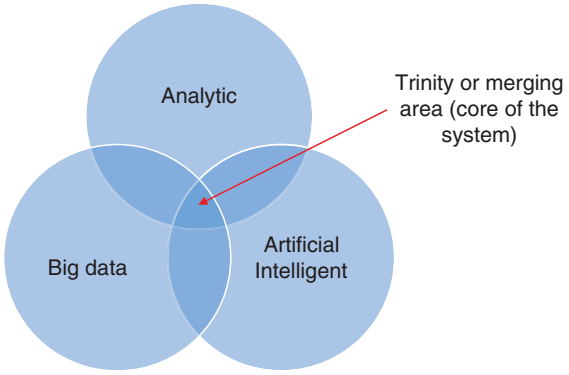

Fig. 1. Component of the system.

information and IT, operation research, mathematics, and decision making in big data [27]. The third and last term here is Artificial Intelligence (AI) that is the rise of thinking machines. This term become famous since 1990 for normal data and IT communication, in 2000 intelligent knowledge enter the field of business and industries regarding management [1]. By the nature of big data it is useless to process and analyses with traditional method so with the development of IT and storing of the big data at the clouding area it is inevitable to use technique of AI in the big data analytic [28]. To illustrate the ingredients of the system can show in Figure 1.

For more clearance have to explain more deep details for each term in such system to know the modern technique, strategy, organization and sharing knowledge between them. Next section will consider this issue in detail.

4. BIG DATA

There is a different between big data and traditional data, term of big data can be defined as a large grow amount of the data which include different formats via considering structure of the data. It is a complex mixture of data need powerful technique of processing with advanced algorithms. So that traditional techniques cannot stand even not efficient working with big data application [29]. Define the big data according to main three characters some time called 3 Volumes consist of:

Volume: By generating large volumes to digital data continuously and comes from huge number of devices and applications (social network, sensors, phones, and IT). Some researchers estimate 2.5 exabytes generated every day we can imagining that every three years this number increased three times. All these big amount need special techniques to deal with, and expected amount of generated data will be in 2020 about 40 Zeta bytes that's mean double 400 times.

Velocity: Fast generating data allowed in this target, fast way comes from different sources such as YouTube and big financial company. As the fast generating of such data need actually fast response by extract the useful information and related idea from the coming data then processing it. For this reason dealing with big data is not easy like normal data.

Varity: Generated big data comes from different sources with fore sure multiple formats such as images, video and document. Many factors limit the distributed big data because of large database include shared and not, completed or not completed data, local or private. These issues must handle with new technique appropriate with the term of big data.

Other classifications suggested by the researchers in literature but the most interesting one is [29] when distributed the issues in big data into 5 Volume's as shows in Figure 2.

Volume consider as the huge amount of data that generated from the resources every second then should involve in the scale and size of the dataset. Practically cannot consider the data less than Terabyte as the big data due to the processing performance effective when the huge data taken. This size still just belong to big application such as financial, health care, military and social media [30].

Variety refers to any construction belong to big data that fall in different forms which including semi-structured, structured and unstructured data. For the structure data taken the relational of data inside with the priority and be in good organized stored inside in easy manner. While unstructured data most of the time be randomly then not easy to analyze like multimedia. The data in term of semi-structure controlled by the user so that contained link and indexing to the data like SQL database then can easy to reach to the data element anywhere. Some difficulties faced when changing the form from one structure to other like from unstructured to structure data accessing will be not easy when manipulation the data. The challenging occur when analyzing unstructured and semi-structured data the data will be under observation that already come from different sources (heterogeneous) with deference in representation and type of data.

Fig. 2. The 5 Volume' big data characteristics.

RESEARCH ARTICLE

Velocity: Which involve the speed of accessing data representing by (near real time, batch, streaming and real time) for the data to be under the process. In this regard emphasizing on the meeting the speed of the data with produced on. Internet of Things (IoT) is the best example of this due to many resources such as sensors produce the data at the same time, this proper when many online singles need to process at the same time and any delay at the process will cause the danger of injury to the patient. Same issue when the big data fail to deliver on the exact time in real time system this cause encounter problem indeed.

Veracity: Reveres to data quality within huge data in term of inaccurate data item. Actually this is very important issue in big data as we can notice that IBM Company reported that inaccurate or ambiguous data cost the economy per year around 3.1 trillion US dollars [31]. Due to these kind of data (inaccurate and uncertain) are classified as bad, good and undefined. Because of increasing the variety of data with resources the accuracy becomes difficult to connect in big data. As example in big data for this issue is processing medical reports over the wide area in certain country so the data some time become inaccurate due to different environment.

Value: Refers to the benefits and context of making decision in big data, while other former issues considered big data challenging. As example for this Volume' Google Company collect million locations over the world coming from smart phones and need to analyze on the Google map directly, other example when Amazon analyze costumers over the web and arrange the product and sealing in massive amount of data per hours also find the static plan with prediction actually is crazy processing.

Big data provide huge amount of data coming from different resources in this study we focusing on the three main things big data, and its availability in the system, processing of this data with time consuming in this producing data. Also focusing on the analytic of this data to speed up the processing of providing the information. Finally focusing on which smart system used of this data. Generally the system can be better understanding when shows the flowchart of figure so Figure 3 can illustrate that.

5. STRUCTURE OF THE SYSTEM

The term system refers to any organized process with input and output. The main part in our system is the smart environment that support human life which effected by the people and also effect the people as well. In practical word increasing the size of population it is necessary reflected on the big data size that dealing with Ref. [32]. Massive data comes from growth the population so in this regard

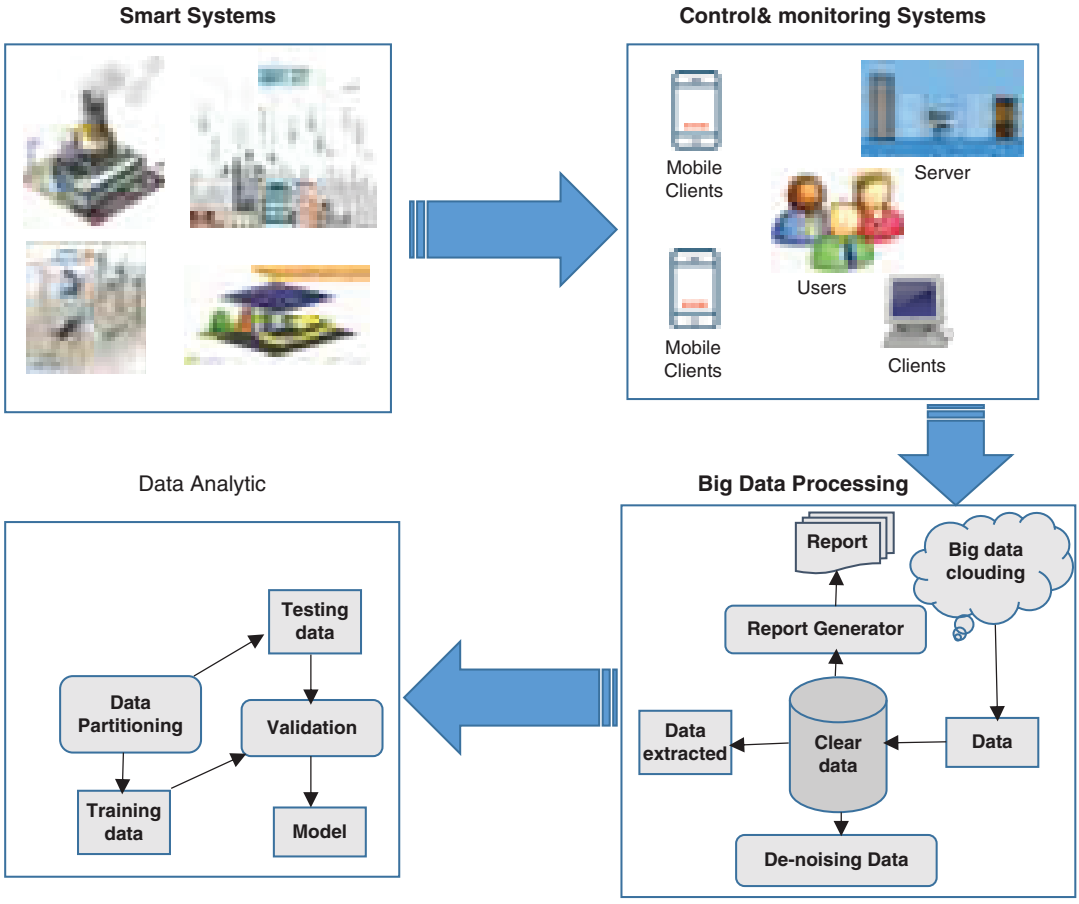

Fig. 3. Architecture of smart system.

the amount of data increased rapidly and increased accordingly. Congestion of the traffic generated day by day and increased rapidly make this issue as a main challenging need to manage and solve to avoid inequality of the social. Increasing the urbanization lead to raises people economic, social different technical and sustainability of the city environment as shown in Figure 3 the first block (smart system or city) applications of smart system in the city like big factory, wind power generator need to develop faster and take the extending efficiently so can handle volume of growing people in this regard variety of big data come to solve this issue of helping civilized people. The aim of proposed system is to helping to develop and circulate application of smart system to be good enough for smarting city to spreading keep up growth of massive or big data of getting better results.

Smart systems normally generate huge data every day as a result of dealing with smart technology from this point can see the key advantage of such application in smart city which is the variety of generated data massive data with different format. This difference come from different platform such as education, marketing, manufacturing, healthcare system, and energy with traffic issue. This data actually collected and managed via big monitoring system and high power server (Fig. 3 second block) real time collected data from many devices at the same area like mobiles and clients in many places all manage by server units located at the same area. Monitoring in many factories or platforms need also traffic management by server in additional to manage the data itself because of that server should be near at the same location or at least inside the infrastructure of the city the massive generated data take effort to manage and manipulate till reach the destination server for that some time sub-servers or mini-servers used in certain area. So that management tool is necessary to hold this amount of data to be effected and useful, the management of data involves architecture execution, development, policies, and lifecycle control. Many tools used to helping smart city applications that process the data from different sources and of course with different format. Advance features is needed for data managements to recognize variety formats of data and different sources such as managing, classifying, structuring and structure controlling. Scalable tools for handling big data should be provided in smart city for off line applications in the system [33, 34].

Applications of big data that control smart system require to perform analytic for generated data which need massive processing abilities. Thus, both reliable software and platform of hardware in needed. However, high performance software and hardware and capabilities should be provided for smart system to optimize hardware usage [35]. Different data used in such application need to be trained with the person that support it to increase the capability of the team with high level knowledge [36]. There are a big team dealing with massive data and many department like reporting of each intensive data to make plan for the future routing of same data. Most of the data collected from external models and clouding one to store in certain host data base to be classified and de-noised separately. Later extracted data from this main hole of big data become ready for farther processing in the next stage of analytic (Fig. 3 third block).

One of the most important part in big data and smart system is Big Data analytic, many opportunities with potential transformative data in term of different sectors brings to main big data. It also poses unexpected challenges in harnessing such large amounts of data, extracted features with its relation in additional to data explored require advance analysis data for understanding. In certain organization analyzing the data allow the user to extract valuable information used to asses and may affect the business both positively and negatively. Many systems used big data need real time analysis so the data driven from these application need fast response such as social network, astronomy, smart transport system, finance and biomedicine. For this reason more efficient technique and advanced performance algorithms for data mining are required here to achieve accurate results and observation in order to future prediction. There are many reasons make big data still in challenging due to the complexity nature of big data which contain the 5 Volume's in additional to the performance of analyzing heterogeneous data comes from real time with scalability [37, 38] (Fig. 3 fourth block). Analytic of big data starting with partitioning incoming data or extracted data then produce test or train data both of them need to validation to get model for certain path of the data at certain time.

6. ANALYTIC OF BIG DATA

Big data analytic represent the process of organizing, analyzing and collecting big data for discover and visualize the knowledge, intelligence within big data [15, 39]. Interesting define of big data analytic is combining technology and science that include multidisciplinary of Information Technology (IT), mathematic, machine learning and decision making. Three main components of big data analytic are descriptive, predictive, and prescriptive analytic of big data. We can say:

$$\text{Big data analytic} = \text{big}[\text{descriptive} + \text{predictive} + \text{prescriptive}]\text{data analytic} \quad (1)$$

Three factors control the equation of big data analytic which are:

- Big data descriptive analytic refers to discover nontrivial data, new and explain entities of characteristic with its relationships through existing data. This solve the problems of what and when the data comes from Ref. [40].

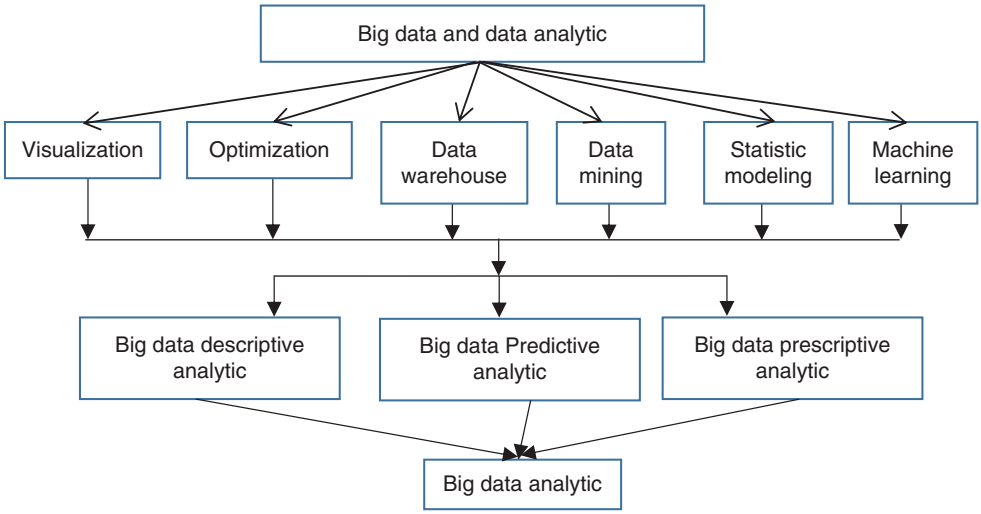

Fig. 4. Category of big data analytic.

- Big data predictive analytic defined as forecasting trends to solving the question such as what will happened in future data and why happen in additional to the question of what is going to happen. Its usually make models predicted in the future and events that depends on existing [40, 41].
- Big data prescriptive analytic used to solve the problem of what should I do and why and what should happen by uncertainly out coming data [42].

There are many elements that big data and data analytic consist of, then producing the three factors of big data to perform big data analytic as shown in Figure 4.

In Figure 4 data analytic represented as the method used to manipulate the data or knowledge in order to learn or predict some issue. In other word data analytic considered as technology to examining the conclusion that comes from data to describe something.

Fundamental of big data analytic includes mathematical, computer science, engineering and information technology. Big data analytic technique include mainly techniques of both mathematical and modeling. Analytic of big data refers to how to learn the data inside the system from this point any smart system or intelligent method should be related to big data analytic. While the human resources produce a huge data every day then have to analysis the data and built new paths or routs every day. In smart system three dimensions used measure any intelligence issue which are expectability, temporality and relativity. Also these can be consider as characteristics of intelligence. Degree of intelligent can be measured for every smart system as equation 2 below:

$$\text{degree of intelligence} = \text{temporality} + \text{expectability} + \text{relativity} \quad (2)$$

Due to the equation on the smart city have performance, advantage and service then it is useful for our purpose. From above can be conclude intelligence got strong relation with big data analytic then big data with analytic can give accurate system of big data intelligent as shown in equation below:

$$\text{big data intelligence} = \text{big data} + \text{big data analytic} \quad (3)$$

In that context increasing of both or either on the big data or analytic will help to get useful system in big data intelligence. The term intelligence can be consider as technique or method in whole big data scheme, and the most important here which is developable is ability to control this technique. This technique is not in contact with remote used even the used cannot control it due to it is not providing any service directly to the user. But there are many services attached with the big data to be able of gaining services to end user (terminal). These services allow to the whole scheme to be effective by the end used or vice versa. The big data analytic services in general controlled by

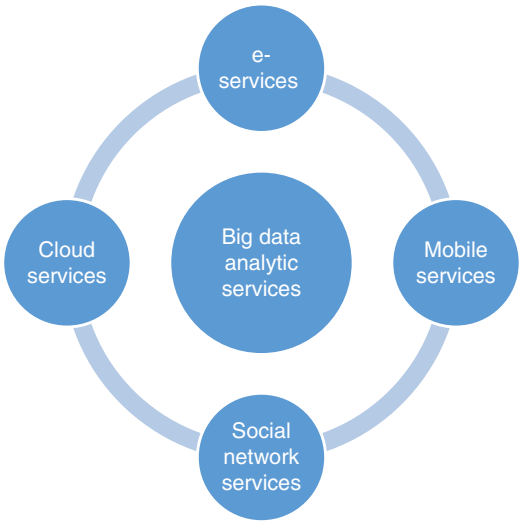

Fig. 5. Effectives of big data analytic services.

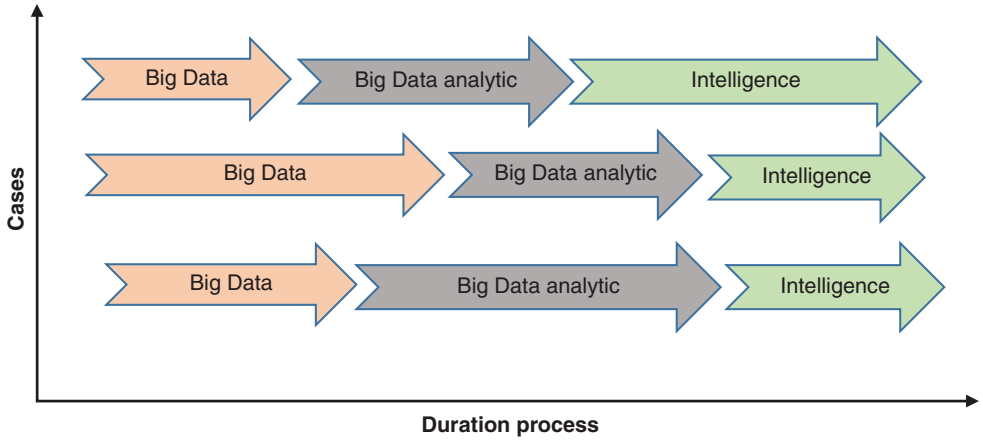

Fig. 6. Three main factors that control any smart system.

many services such as Cloud services, social network services, mobile (or client) services, and e-services as shown in Figure 5.

7. INTELLIGENCE OF BIG DATA

The term intelligence basically refers to ability of the system of learning, understanding and thinking. In this regard Artificial intelligence be focus on automation intelligence of the human the ability of learning in the system can be called Machine Learning (ML) [43]. Intelligent is an operation such as addition, subtraction, repeating and division any one can know it. The three factors can be achieved for big data intelligence that make the system smart as:

- Intelligent of data management and process that including management of both data base and new term called warehouse.
- Data mining and sharing the knowledge in optimization case.
- Control the knowledge in both visualization and optimization.

Then increase the intelligence to the system by many ways such as factors mentioned above or by controlling it by the machine and IT, lead to make smart environment.

Table I. Example of smart city or system including big data project.

Component of smart city	The project and application of big data	Location
Mobility and transportation	Accelerated time of simulation for traffic that using smart traffic light with signal, three factors take in the consideration which are city map, cars and generated smart signals. Some requirements should be there in such application like network sensors, mathematical model such GUI and traffic light.	_
Health care	Ministry of health and welfare that use integrated network managements analyze many types of public data collected from different resources such agencies and mange welfare that provide the government of comprehensive information.	South Korea
Public safety	Many ministries like ministry of agriculture, food, Fisheries and public administration and security. Also big data related to the animal disease and immigration reports in additional to industries.	South Korea
	Infection disease and national security with other national concerns. (RAHS) refers to Risk Assessment and Horizon Scanning program in Singapore launched this project. Manage of national threats that effect the country such as terrorist attacks, financial crisis and infectious disease.	Singapore
Education	National Education Network is a system consider as integrated project that used network infrastructure service, and learning service with intelligence thinking with diction support.	Thailand
Government administration	Mange the big data with high performance in real time system that can handle massive data within few seconds online dealing with management and economic in additional to health care using Hadoop and warehousing. IBM considered the smart system project to get helping from big data to predict the vacant housed and properties.	USA
National resources	Horizon Scanning Centre established in 2004 by the UK government to enhance ability of the government so can handle multi-disciplinary and cross department challenging. The produced project then in 2011 deal with climate and its effective on the food, water, international stability, and regional tensions.	UK

The main issue in smarting the big data is utilize the information technology and networking system to the big data.

8. DISCUSSION

This paper actually discussed how the three factors affect the smart city like big data, analytic of big data and intelligence that manage the flow data inside the system. Aim of this study is to focusing on state of the art of respected big data that consider the main issue in smart city or any system. For each technique we summarize the effecting of each on smart city and how developing that may help to support the system. Due to big data used in such system then will considered the core or heart of it, so management of the data during transferring or arrange it within the system will recognize the efficiency if it. Difference among the three factors inside the system would control the success of smart system because of unbalancing among them may fault the system as shown in Figure 6.

Table II. Benefits of using big data in smart city.

Components smart city in field of:	The benefit of big data
Healthcare	• Healthcare provider with practitioner for analyze, gather and utilize all information for the patients in additional of used in insurance company. • Complex processing of analyzing and monitoring the patient health issues. • Increase the information that collected daily health issue such using smart devices and sensors of blood pressure and sugar test and so on.
Energy	• Control the facility of making decision to provide level of electricity and what the actual demand to the citizen. • Allow real-time processing that give efficient analysis to collected big data.
Transportation	• Real time monitoring of traffic light and immediate investigation. • Reduce the congestion of the road by prediction the alternative path for adjusting the flow. Opening new road according to collected data through congestion and change paths of mapping on-lining touch with drivers. • Optimization of shipping movement during delivery to reduce wasting time supplying.
Environment	• Agriculture is important so when controlling the weather can help this factor in the country and can tell the people in advance about any danger may happen all based on good prediction within big data system.
Safety	• Provide timing of any geographic map with detail and easy determining any change can happen suddenly. • Can help to predict about any possible happening related to the safety of people like earthquake and any disasters, so prediction is needed in advance.
Education	• Helping in space environment by analysis the picture taken from the space so dealing with astronomy indeed. • Provide resources for university and institutes and helping the students to track their projects.
Governance	• Integration inside the government and agencies supported here and combining their process. This will resulting more accurate and effective systems by sharing the data. • Helping for economic growth by making decision within huge data that related to the project. • Help government to control the people in many fieldssuch education, social care, health, policing, and housing.

For three example cases represents the duration for each factor in the system. Second case which is the top refers the amount of big data is more than analytic and intelligence that lead to less efficiency of the system. When the analytic take more process at the big data also make the system slow and time consuming. Smart issue (intelligence) increase the validity of the system that control the flow of the data in and out of the system while maintaining the flow of the system. Intelligence can extend until certain point that will be useless and waste the system sources. In this case balancing among these factors is necessary and required indeed.

Here is in Table I example of smart city of system can actually give the comprehensive idea regarding this issue.

In Table I we reviewed many examples to application that involve the big data that considered as map to establishing smart city. Several of them added interesting components so can enhance smart city and most achieved different access level. The purpose of reviewing these experiences in smart cities of actual implementation give knowledge and benefits for smart city components and these benefits can be summarize in Table II through different applications that included in smart city.

9. CHALLENGING OF USING BIG DATA IN SMART SYSTEM

Using big data in smart system or city can face many challenges in development and design the applications that using big data. Two features involved in smart city which are dynamic and developing environment, hence it is necessary to reduce or at least avoid these challenges in smart system through its application. Many issues can affect the application of big data in smart system and its performance such as accessibility, accuracy, real time analytic and representations these actually limits the benefits of big data. The challenges can be address as follow:

• *Dara source and its features:* different sources already generate different data in various formats. Some of these formats is unstructured such as image, video, server logs and many data formats. So in this case have to category these data in structured format.

• *Data with information sharing:* another challenging which is sharing data and information among different

sites and department within system and some data controlled by government and has some privacy may not be available in certain time. Sharing some data can facing some difficulties so application have to draw the right path and ensure that collecting big data availabilities.

• *Quality of the data:* during analyzing the current data some time getting errors that is normal with any system in big data should reporting this error to be corrected in the next stage.

• *Privacy and security:* in this regard some data produced from government and have degree of security then when maintaining the data must consider the security level of the data. Keeping produced data through the system secure and protected against attacks and unauthorized people with big data security divided into two types security of generated data and network security so responsibility here is double when comparing with other system.

• *Population of smart system:* people and smart or intelligent system affected each other. Increasing the number of population will effect on the big data. During growing of people of course the data will increase according to that and as a result huge data will arise within life of the system. This increasing lead to traffic congestion and this actually jeopardize all resources of the system, so have to control this issue which inevitable of it.

• *Cost:* any system controlled by the cost and it is sensitive issue in big data application. In smart system analyzing generated data in real-time is expensive in additional to intelligent manipulation of the data such as monitoring, recording information and correct generate new paths for real-time generated data is expensive. Maintenance of the system and handling the fault of it also cost too much.

10. CONCLUSION

There are two concepts developed nowadays which are smart system and big data, therefore integrate two of them is useful to build applications of smart system. These applications helping to effective the government, smart management of the resources belong to the government, increase life quality. Three main terms discussed in this study that give importance to who interesting and need to come up with new system which are big data, analytic, and intelligence. Structure of the whole system presented with explain the similarity and difference between smart system and city. Factors that affect the big data should considered when design the system, some discussion related examples for using big data in smarting cities with systems in different countries. Benefit of big data in such proposed system illustrate to get advantage when design smart system including big data.

For future researches, will evaluate proposed system and algorithms with different criteria analysis such as time consuming, parallel processing time, and speed of fetch data to and from clouding big data. Due to smart system, considered as infancy time when comparing with other systems then benchmarking of such system with existing is a bit difficult because of incompatibility of standards criteria that measure the system.

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An Adaptive Noise Removal Framework for Medical Images

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RESEARCH ARTICLE

Improvements of restorative imaging frameworks for acknowledgments and desire for the illnesses have shown gigantic outcomes all through the latest couple of decades. The pervasive imaging helpful imaging methodologies, for instance, MRI or other alluring separating procedures can recognize the regions with irregularities in any bits of the human body. MR imaging frameworks, being the most common system open and can be associated for various disorder disclosures, are extensively gotten. It is entirely expected to understand that the commotion types can be various on account of the methodology of catch or limit of the past patient records and various bits of the MR pictures can be impacted by various noise types. Moreover, tremendous quantities of the parallel consequences of this investigation region are scolded for loss of information as loss of information in therapeutic data or picture dealing with is deadly. Thusly an adaptable technique for recognizable proof and removal of all commotion types is the enthusiasm of the bleeding edge helpful science. This work presents a novel procedure for perceiving and removing the commotions from MR pictures without the information disaster. The after effect of this framework centres towards making the remedial picture dealing with better for better human life in future.

Keywords: White Noise, Impulse Noise, Gaussian Noise, Structural Noise, Adaptive Noise Removal, Image Information Index.

1. INTRODUCTION

In the domain of the medical research and other industrial exposures, the MR images are widely accepted due to the non-aggressive nature of the capture devices. The images get easily affected by noise during the capture and must be removed during the pre-processing of the images in order to obtain an accurate medical analysis.

The initial image restoration methods were a good success as re-written by Shao et al. [1] and are well accepted by the research community. Nevertheless, the generic image demonising methods are not appropriate for medical image pre-processing, especially for MR Images, as demonstrated by Mohan et al. [2]. Thus various attempts on modifying the traditional methods to make these approaches suitable for MR images continued.

Few popular mechanisms are must be touch based in order to analyse the outcomes. Firstly, the work demonstrated by Liang et al. [3] shows the normalization of the variance of the images. This method claims to de-noise the MR images based on the variance available and compared with the total variance of the image. The initial notable work of Perona et al. [4] designed the foundation of the medical image processing using the diffusion filtration process. Further, this algorithm was improved by Krissian et al. [5].

These mentioned approaches were successful in removing the noise from the image. However, motivated by the information preservation, the work by Awate et al. [6] is also notable. Nevertheless, these parallel outcomes from various researchers have ignored the multi noise effects on single medical image. Thus, a novel framework to detect and remove all types of noises is the demand of practitioner, education and research.

Henceforth, this work presents a novel framework to detect and de-noise all types of noises from the MR images and also preserves the information in the medical images. The rest of the work is furnished such that, the types of noises and the effects on the MR images are discussed in Section 2, the Section 3 elaborates further on the parallel research outcomes, the problem formulation for image de-nosing and information preserving is furnished in Section 4, in the Section 5 the proposed framework

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for automatic noise detection and removal is elaborated, the driving algorithm for this framework is listed in the Section 6, the results obtained from this framework is elaborated in the Section 7, further the comparative analysis is discussed in Section 8 and in the Section 9 the work presents the final conclusion.

2. NOISES IN THE MEDICAL IMAGES

Due to the extensive capture process of MR images, it is often observed that the images are affected by various types of noises. The noises in the image make the medical analysis difficult and erroneous. Thus the removals of the noises are one of the most important phases in medical image pre-processing. Nevertheless, the bottleneck of this process is to detect the noise types and deploy suitable removal method. Hence, the understanding of the medical image noise types is most important. In this section of

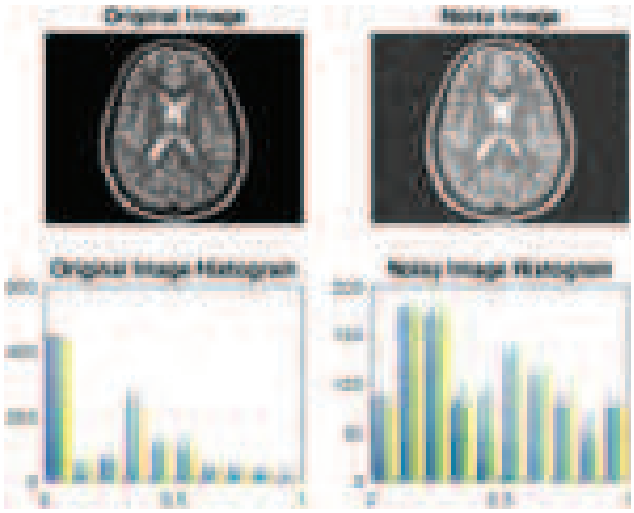

Fig. 1. Sample-1 for Gaussian noise.

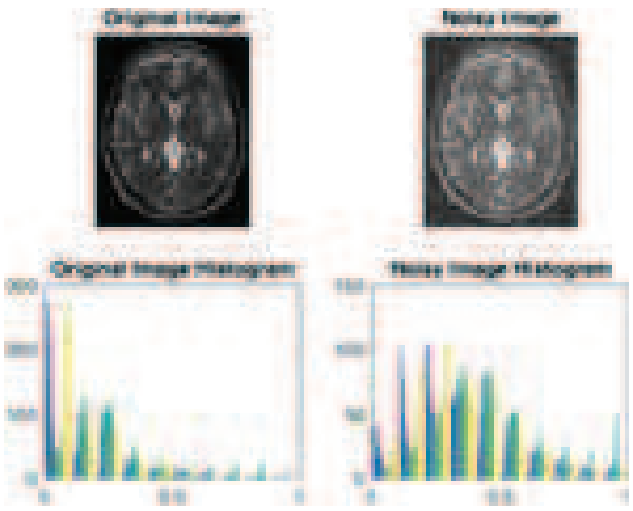

Fig. 2. Sample-2 for Gaussian noise.

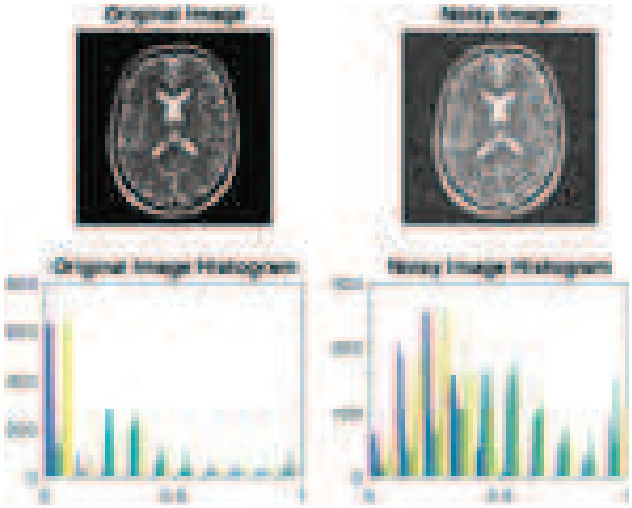

Fig. 3. Sample-3 for Gaussian noise.

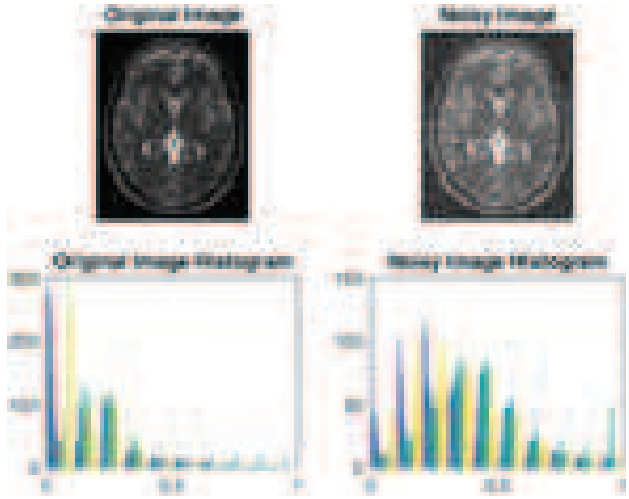

Fig. 4. Sample-4 for Gaussian noise.

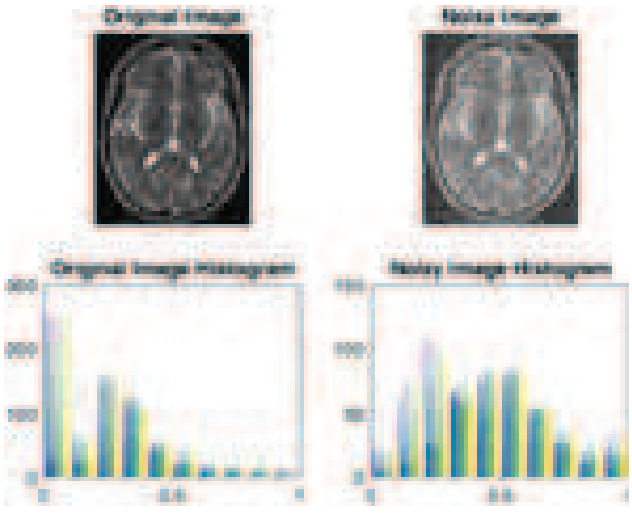

Fig. 5. Sample-5 for Gaussian noise.

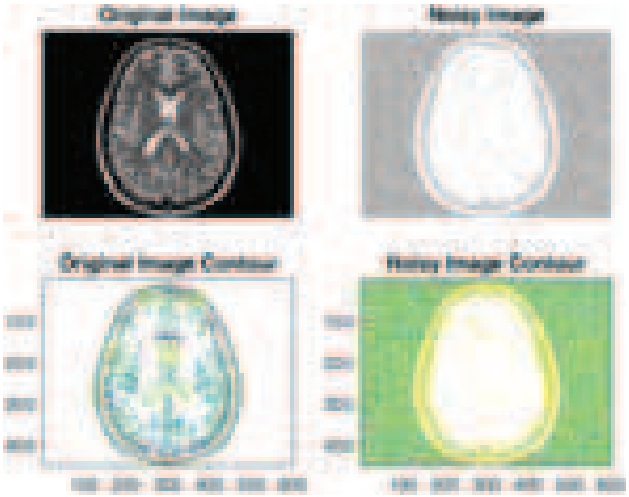

Fig. 6. Sample-1 for white noise.

the work, the types of noises in the medical images are elaborated.

2.1. Gaussian Noise

The Gaussian noise model or the Gaussian noises are usually included in the images during the capture process of the MR images. During the capture process, of the over radiation of the magnetic objects, this noise can be included in the medical images.

The following samples are collected to demonstrate the effect of Gaussian noises in the MR Images (Figs. 1 to 5).

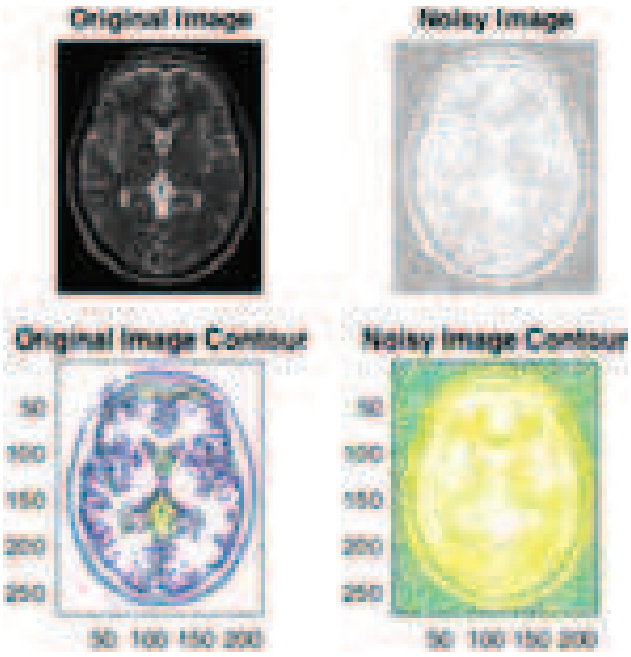

Fig. 7. Sample-2 for white noise.

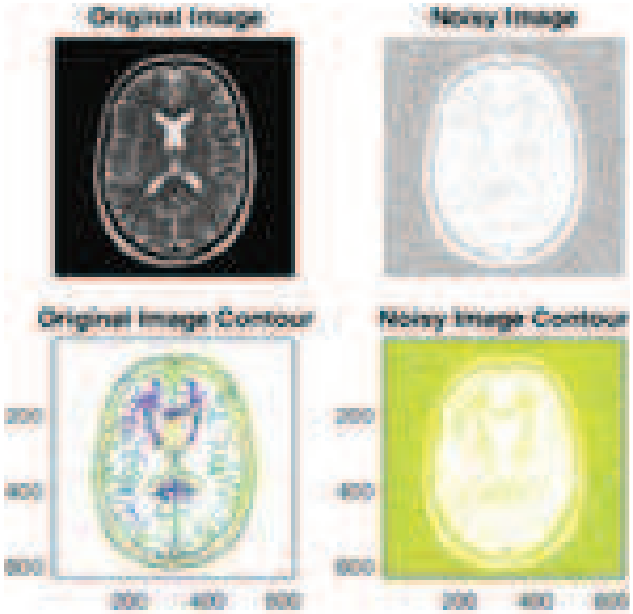

Fig. 8. Sample-3 for white noise.

2.2. White Noise

The white noise in the medical images is the noises with very high peak values. The Gaussian noises are also similar to the White noise expect the amplitude of the noise signal is very high in case of the white noises.

The following samples are collected to demonstrate the effect of White noises in the MR Images (Figs. 6 to 10).

2.3. Impulse Value Noise

Another type of noise, which affects the medical images are the impulse noise or the salt and pepper noise. This

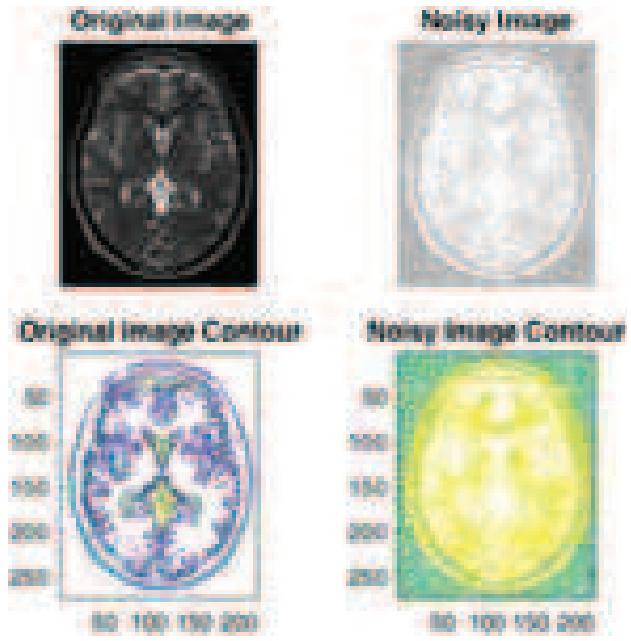

Fig. 9. Sample-4 for white noise.

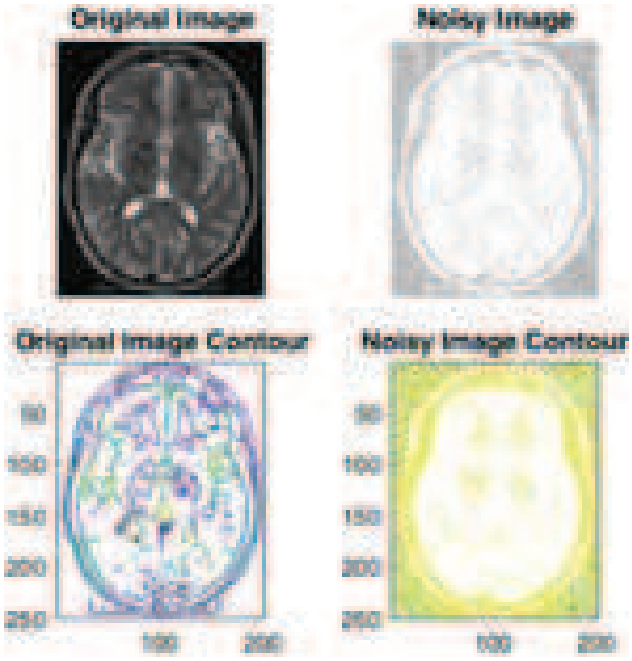

Fig. 10. Sample-5 for white noise.

noise type is eventually gets incorporated during the mis-handling of the medical records during storage for a long time. Nevertheless, the noises cause significant dispute in the medical data processing.

The following samples are collected to demonstrate the effect of Impulse Value noises in the MR Images (Figs. 11 to 15).

2.4. Structural Noise

The final type of noises can be present in the MR images is the Structural noises. The primary cause of inclusion of structural noises in the MR images are the interference of other magnetic devices in the premises. Nevertheless, the noises cause significant dispute in the medical data processing.

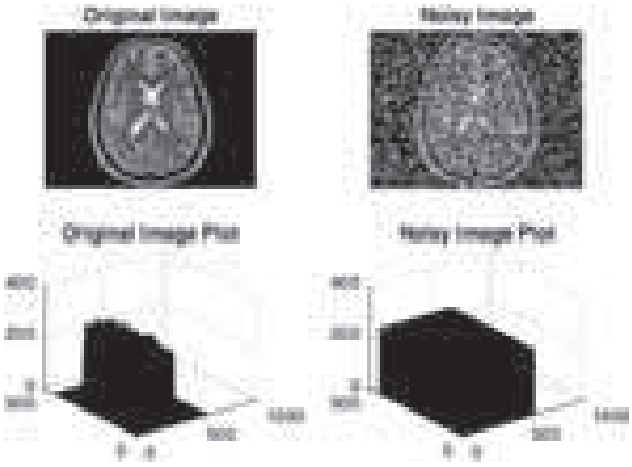

Fig. 11. Sample-1 for impulse value noise.

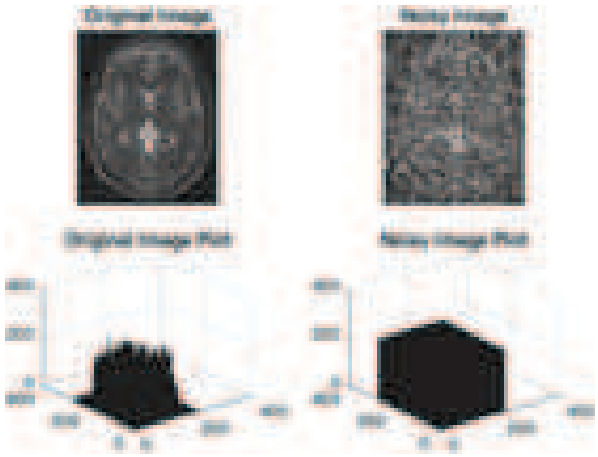

Fig. 12. Sample-2 for impulse value noise.

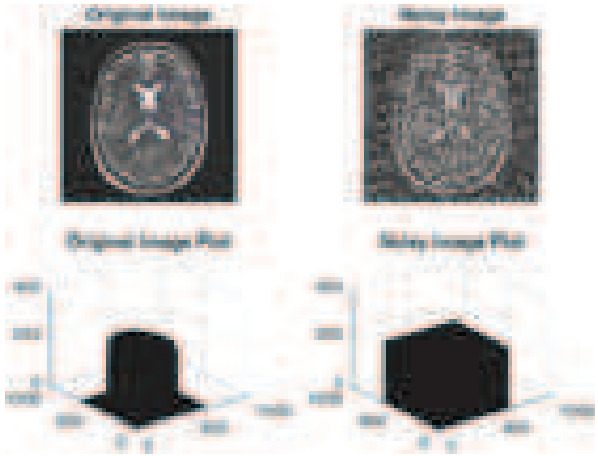

Fig. 13. Sample-3 for impulse value noise.

The following samples are collected to demonstrate the effect of Structural noises in the MR Images (Figs. 16 to 20).

Further, this section of the work summarizes the types of noises with the respective causers (Table I).

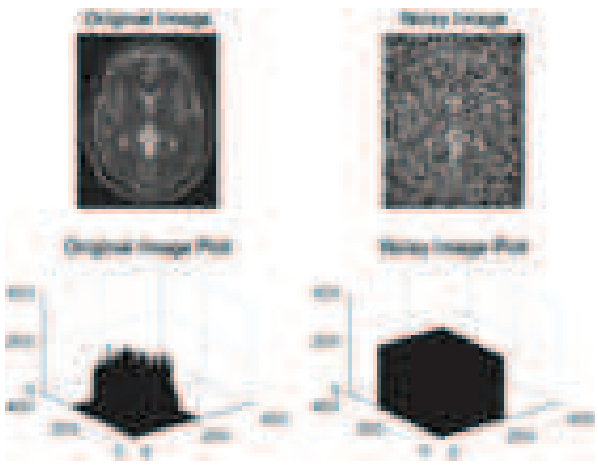

Fig. 14. Sample-4 for impulse value noise.

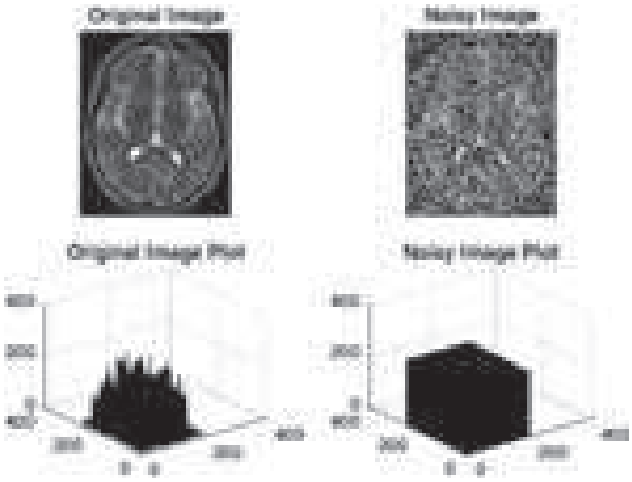

Fig. 15. Sample-5 for impulse value noise.

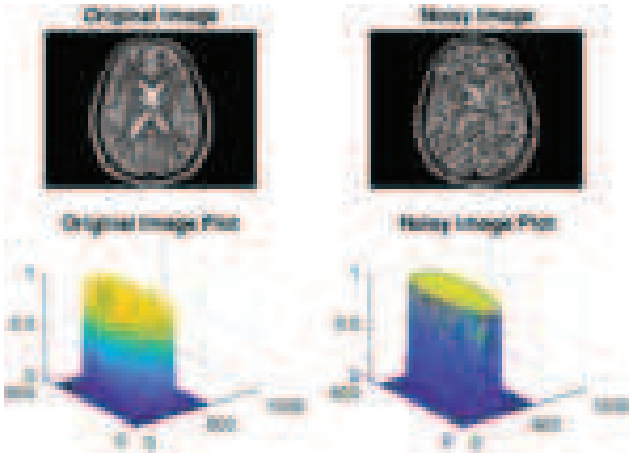

Fig. 16. Sample-1 for structural noise.

With the understanding of the noise types, which can be available in the MR images, in the next section of this work, the parallel research outcomes in order to remove the noises are elaborated.

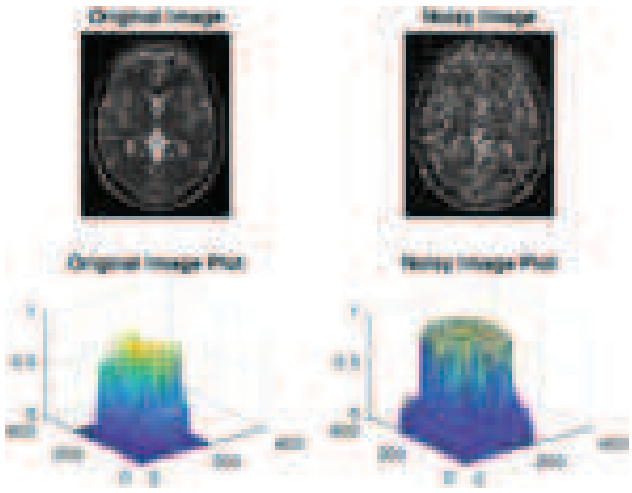

Fig. 17. Sample-2 for structural noise.

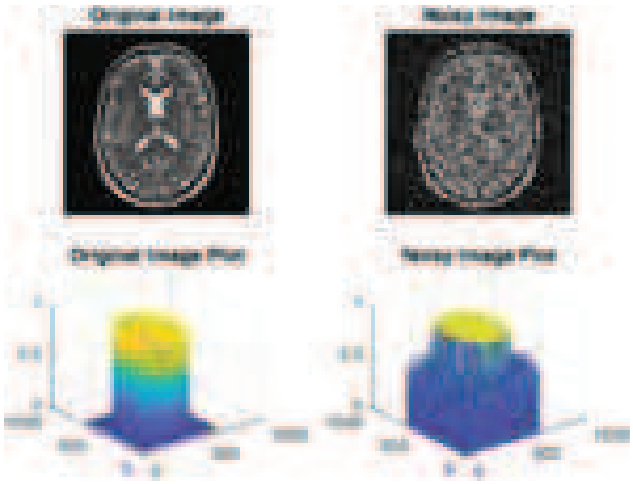

Fig. 18. Sample-3 for structural noise.

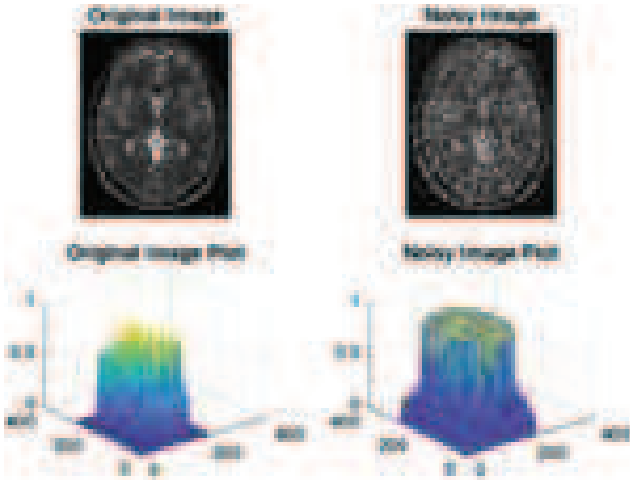

Fig. 19. Sample-4 for structural noise.

3. OUTCOMES FROM THE PARALLEL RESEARCHES

In the recent past, many medical practitioners have criticized about the noises present in the medical images and distressing the final medical analysis results. Hence de-noising the medical images, especially the MR images, has become the major targeted domain for research.

In this field of research, a number of notable outcomes are contributed by various researchers. A few of the recent and high notable measures are discussed here.

The restoration or the de-nosing of the noisy medical images has faced a constant challenge of losing information which is vital in medical information analysis. The initial contributions towards this direction were made by Nowak et al. [7] and Zaroubi et al. [8]. The primary principles behind these outcomes are Wavelet based transformation methods. These solutions were well accepted for the lossless mechanisms of the images. However the DWT methods are often less accurate for the image de-noising purposes.

RESEARCH ARTICLE

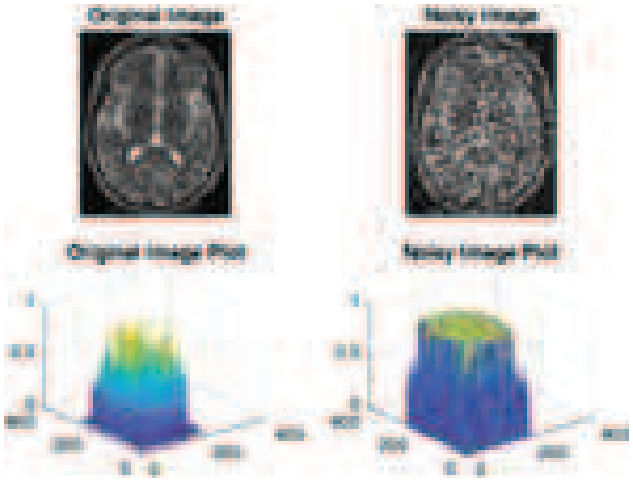

Fig. 20. Sample-5 for structural noise.

Henceforth, another set of researchers have proposed to incorporate mean variance of the local and non-local terms. The significant observations on their proposed method were enlisted by Buades et al. [9] and Coll et al. [10]. Nonetheless, these methods were not perfectly applicable to handle the noises in MR images. Thus, the research attempts by Gal et al. [11] and Manjón et al. [12] fine-tuned the previously proposed methods.

The research continued towards this direction and various other research attempts proposed multiple enhancements of this model of noise removal. The outcome by Manjón et al. [13] made yet another attempt to improve the NLM model. Identifying the scope for further improvements over the NLM model, Coupé et al. [14] proposed a segment or block-wise method of applying NLM method. Nevertheless, these attempts were made on two dimensional MR images. But the demands for applying the similar approaches on 3D MR images were growing continuously. Thus, Manjón et al. [15] proposed another NLM method for 3D MR images. This approach was criticized by various other researchers due to the assumptions made in the algorithms. Hence, few more improvements over this method took place. Guleryuz et al. [16] discussed about the weighted averaging policies and Yaroslavsky et al. [17] discussed about the transformation domain solutions with NLM.

Table I. MR image noise analysis.

Noise type	Characteristics	Cause of occurrence
Gaussian noise	Irregular distribution of the noisy image	Magnetic effects
White noise	Irregular correlation of the noise image with the normal image	High amplitude magnetic effects
Impulse value noise	Irregular peak value of the noisy image signal	Improper storage of the images
Structural noise	Shifts the signal orientations of the noisy image	Interference of other devices

With the success of Yaroslavsky et al. [17], other researchers have also tried proposing various other combinational approaches to solve the de-noising problem. Dabov et al. [18] proposed a collaborative filtering method. Kolda et al. [19] proposed a tensor based method. Rajwade et al. [20] proposed a method by adjusting the orders for the decomposition equations. This approach was further enhanced by Zhang et al. [21]. The NLM methods were also criticised for little high time complexity. This problem was resolved by Maggioni et al. [22] and demonstrated for volumetric images.

In another dimension of the research, few of the researchers have considered working with 4D MR image data and analysis of fourth dimension space. Kilmer et al. [23] has initiated the research for tensors. The immediate improvements and the applicability were proposed by Braman et al. [24]. Further, Hao et al. [25] proposed the enhancement of tensor methods using decompositions of MR images. The most recent widely accepted method t-SVD was proposed by Zhang et al. [26]. Nonetheless, 4D analysis not highly popular in the medical imaging domain yet, thus this work limits the research in 2D and 3D medical image analysis.

Thus, with the detailed understanding of the parallel research outcomes, this work formulates the problem with mathematical modelling in the next section.

4. FORMULATION OF THE PROBLEM SCOPE

The de-noising is the primary purpose of this research. Nevertheless, information preservation is also the objective. Thus proposing a lossless method for de-noising the medical images is the primary objective. In order to formulate and objective the problem, in this section of the work, the problem is mathematically modelled.

Firstly the accumulated images in the grayscale, must be calculated for pixel information.

$$\text{Pixel}_1[\,] = \frac{\text{No. of Pixels } (I)}{\Delta\text{Scale}} \tag{1}$$

And

$$\text{Pixel}_2[\,] = \frac{\text{No. of Pixels } (I')}{\Delta\text{Scale}} \tag{2}$$

Equations (1) and (2) here the pixel_1 and pixel_2 denotes the image pixels for normal and noisy image respectively.

Equations (3) and (4) further, the colour types are to be identified from the images,

$$\text{ColorType}_1 = \text{ColorScale}(I) \tag{3}$$

And

$$\text{ColorType}_2 = \text{ColorScale}(I') \tag{4}$$

Equations (5) and (6) also, it is important to obtain the bit depth of the images.

$$\text{BD}_1 = \frac{\text{total\_bit}(I)}{\text{Pixel}_1[\,]} \tag{5}$$

And

$$\mathrm{BD}_2 = \frac{\text{total\_bit}(I')}{\mathrm{Pixel}_2[\,]} \tag{6}$$

Equations (7) and (8) finally the image information index must be calculated,

$$\mathrm{INI}_1 = [(\mathrm{Pixel}_1)(\mathrm{ColorType}_1)(\mathrm{BD}_1)] \tag{7}$$

And

$$\mathrm{INI}_2 = [(\mathrm{Pixel}_2)(\mathrm{ColorType}_2)(\mathrm{BD}_2)] \tag{8}$$

Equation (9) thus, the information index for the images bust be nearly equal after and before de-nosing.

$$D_1 = \frac{\mathrm{INI}_1}{\mathrm{INI}_2} \to 1 \tag{9}$$

Equation (10) Further, the signal to noise ratio must be high in order to ensure better de-noising of the image.

$$D_2 = \mathrm{SNR}\left(\frac{I}{I'}\right) \to \mathrm{High} \tag{10}$$

Hence, the problem is to make D_1 as close as 1 and D_2 as high as possible.

Henceforth, with the complete formulation of the problem, the objective of the solution is fairly achievable. In the section of the work, the proposed framework is elaborated.

5. PROPOSED FRAMEWORK

With the primary goal of detecting and de-noising the unknown type of noises, the framework is elaborated in this section (Fig. 21).

The proposed adaptive framework detects the noise types by running histogram, contour, surf and mess analysis on the sample image, further compares the correlation with the noisy image. The correlation influences the hypothesis testing, where the null hypothesis denotes the invariance of the sample and noisy image distribution. The detected noise type triggers the appropriate de-noising algorithm.

The solution is not accepted from this framework, unless the image information index (I3) is up to the acceptable mark.

Finally, at the end of this framework process, the de-noised image is returned.

It is natural to realize that, this proposed framework is capable of detecting the noise generally available in the MR images and de-noising is most suitable for these types of images.

Henceforth, in the light of the proposed framework, the driving algorithm behind the framework is discussed in the next section of this work.

6. PROPOSED ALGORITHM

This section of the work, elaborates on the proposed adaptive de-noising algorithm.

Algorithm (Adaptive De-Noising).
Step 1: Accept the MR Image
Step 2: Perform the grayscale conversion
Step 3: Apply segmentation of the image
Step 4: Consider the noise range from 0.1 to 0.9.
Step 5: For each segment
  a. Consider the null hypothesis "No Variance"
  b. Consider replication of the noisy image
  c. Add Gaussian noise with variable adaptive ratio
  d. Apply Histogram Correlation on original and replicated image
  e. Calculate p value
  f. If p is low,
    i. Then discard null value
    ii. Repeat step-c to funtil noise range
    iii. Add White noise with variable adaptive ratio

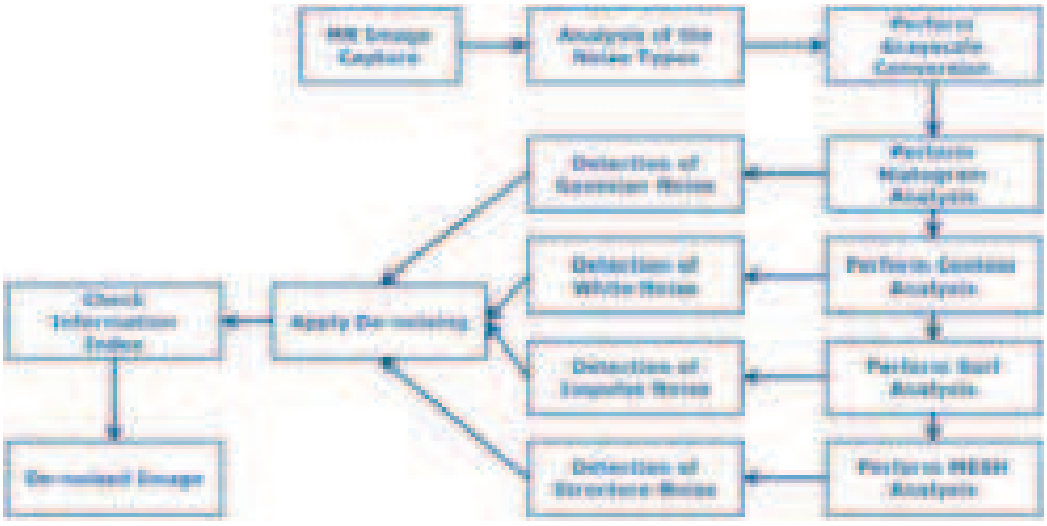

Fig. 21. Proposed adaptive noise removal framework.

Table II. MR image noise analysis and removal.

Image sample sequence	In build noise type	Correlation values				Detected noise type (Based on correlation)	SNR after de-noising	Image information index (Ratio)
		Gaussian (Histogram)	White (Contour)	Impulse (Surf)	Structural (MESH)			
Image001	Gaussian	0.8496	0.4369	0.3135	0.3992	Gaussian	9.1854	0.85
Image002	Gaussian	0.8838	0.3673	0.3827	0.3437	Gaussian	12.8716	0.824
Image003	Gaussian	0.8591	0.3128	0.3542	0.4027	Gaussian	8.1774	0.98
Image004	Gaussian	0.8288	0.3311	0.4757	0.3643	Gaussian	7.0569	0.831
Image005	Gaussian	0.8931	0.4981	0.4987	0.4115	Gaussian	8.8981	0.838
Image006	White	0.3334	0.8076	0.337	0.3021	White	5.5516	0.816
Image007	White	0.3911	0.8203	0.3563	0.3038	White	5.8452	0.835
Image008	White	0.3966	0.8319	0.3533	0.3755	White	6.521	0.802
Image009	White	0.3675	0.874	0.3292	0.3258	White	7.7055	0.888
Image010	White	0.3721	0.8176	0.3214	0.3152	White	5.4366	0.811
Image011	Impulse	0.3442	0.3915	0.8545	0.3492	Impulse	5.0657	0.92
Image012	Impulse	0.3213	0.319	0.911	0.3853	Impulse	7.734	0.816
Image013	Impulse	0.3018	0.3901	0.893	0.3736	Impulse	5.6171	0.938
Image014	Impulse	0.326	0.3129	0.8646	0.3325	Impulse	6.4833	0.924
Image015	Impulse	0.3634	0.3855	0.9388	0.3036	Impulse	6.0578	0.819
Image016	Structural	0.3189	0.3267	0.3597	0.7948	Structural	8.1916	0.968
Image017	Structural	0.3199	0.356	0.305	0.8463	Structural	6.4943	0.894
Image018	Structural	0.3369	0.3004	0.3428	0.7208	Structural	7.4729	0.866
Image019	Structural	0.3823	0.3139	0.3482	0.7514	Structural	6.6184	0.831
Image020	Structural	0.3092	0.3527	0.3067	0.8048	Structural	5.8452	0.961

iv. Apply Contour Correlation on original and replicated image
v. Calculate p value
vi. If p is low,
   1. Then discard null value
   2. Repeat step—iii to vi until noise range
   3. Add Impulse noise with variable adaptive ratio
   4. Apply Surf Correlation on original and replicated image
   5. Calculate p value

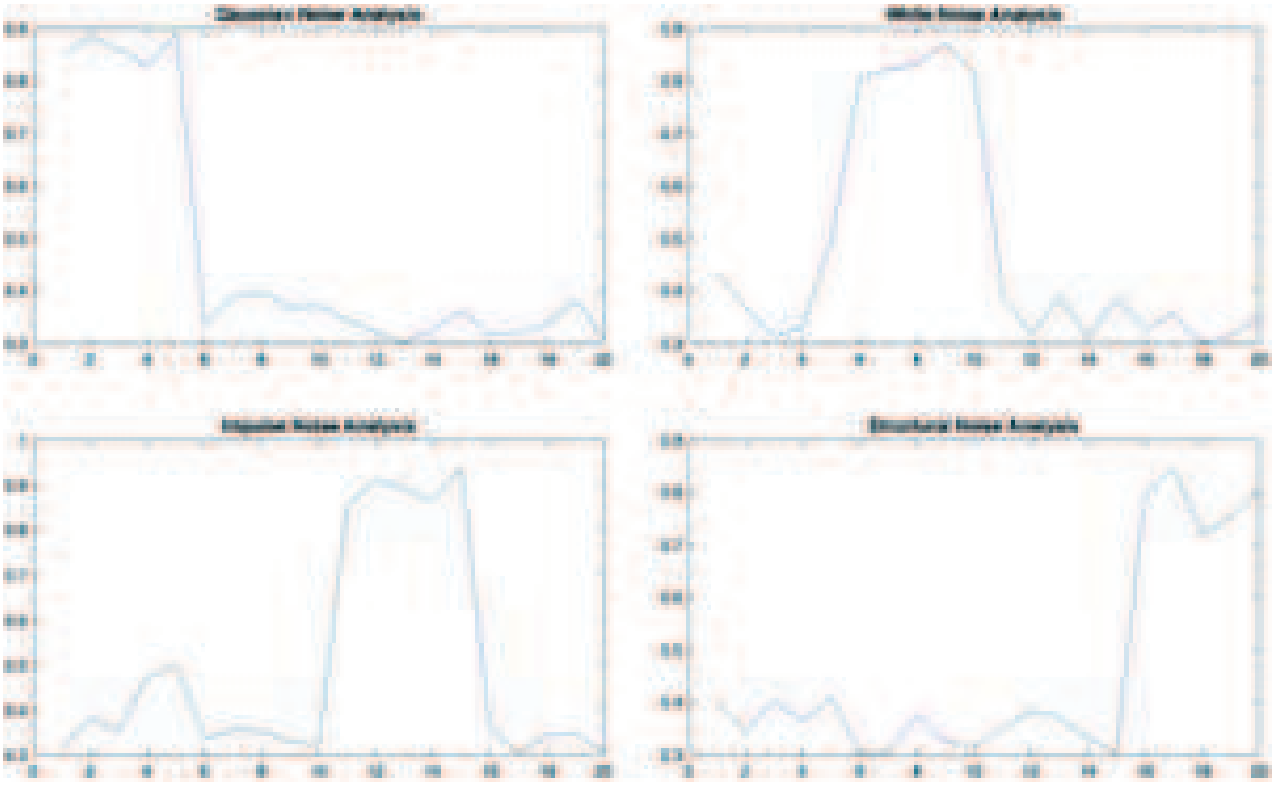

Fig. 22. Analysis of the noise types.

6. If p is low,
   A. Then discard null value
   B. Repeat step—3 to 6 until noise range
   C. Add Impulse noise with variable adaptive ratio
   D. Apply Surf Correlation on original and replicated image
   E. Calculate p value
   F. If p is low,
      01. Then discard null value
      02. Repeat step—C to F until noise range
      03. Add Structure noise with variable adaptive ratio
      04. Apply MESH Correlation on original and replicated image
      05. Calculate p value
      06. If p is low,
         1. Then discard null value
         2. Repeat step—03 to 06 until noise range.
   G. Else
      01. Identify the noise type
      02. Apply de-noising process.
7. Else
   A. Identify the noise type
   B. Apply de-noising process.

vii. Else
   1. Identify the noise type
   2. Apply de-noising process.

g. Else
   i. Identify the noise type
   ii. Apply de-noising process.

Step 6: Generate the de-noised image
Step 7: Check for Image Information Index (III) ratio

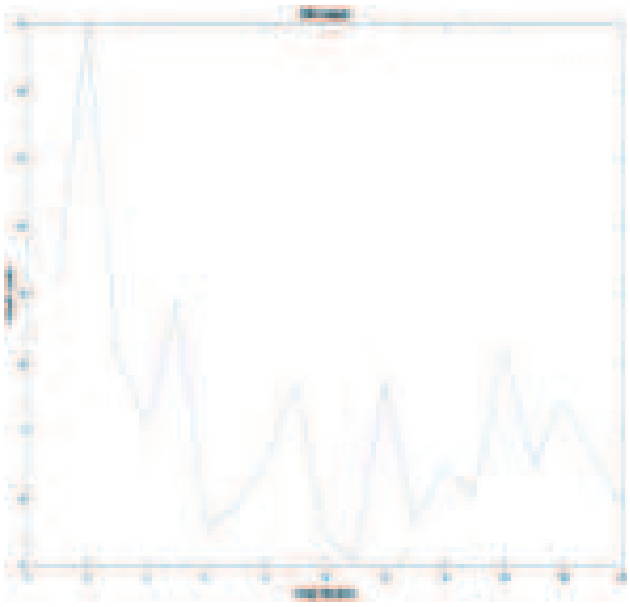

Fig. 23. SNR analysis.

Step 8: If III ratio >0.85.
   a. Then accept the de-noised image.
Step 9: Else
   a. Start from Step—5 with different segment of image.

The novelty of the algorithm is the adaptive testing for all the image segments for all possible noise combinations with variable noise peak values.

The results obtained from the framework and the algorithm is discussed in the next section of the work.

7. RESULTS AND DISCUSSION

The algorithm running in the framework is applied on the popular and bench marked BRATs dataset.

The data set contains four different noise types as proposed by this work as well. Thus the detection of the noises and removal of the noises are classified in four different sub sections here.

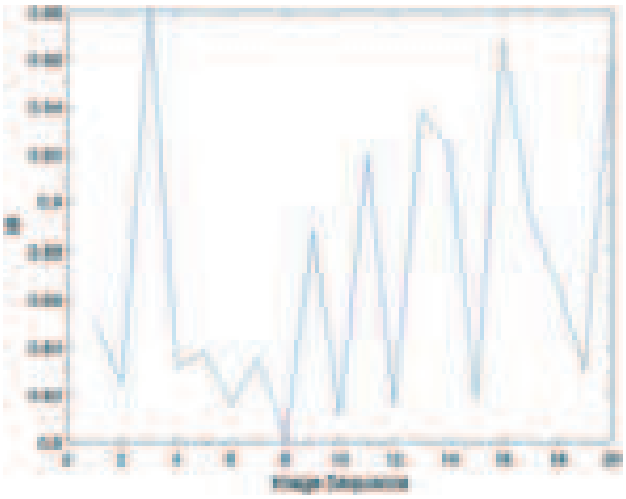

Fig. 24. Image information index analysis.

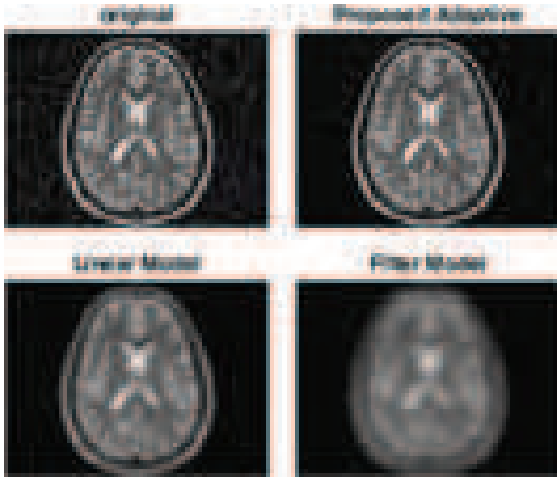

Fig. 25. Sample-1 image information index.

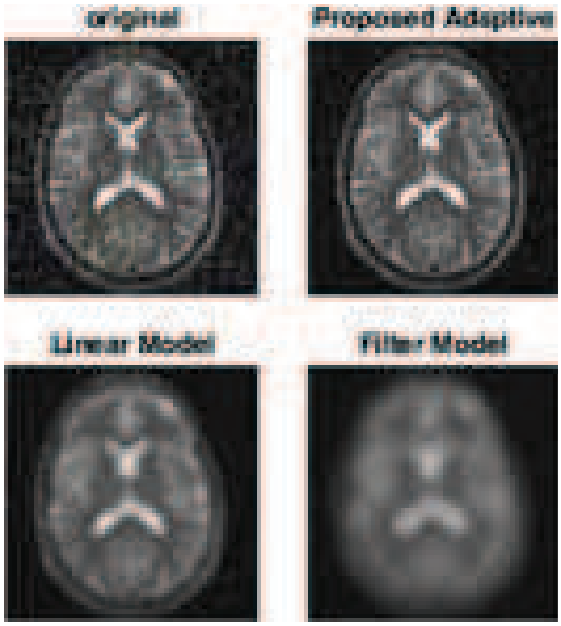

Fig. 26. Sample-2 image information index.

The algorithm is applied for the various noisy images. Though, during the testing process of the algorithm, the initial noise types are not disclosed. The results from the-framework are discussed here (Table II).

Thus, it is natural to understand that, the proposed method is significantly accurate in detecting the noise types. Further, it is also notable that the reductions of the noises are also highly satisfactory. Also, the proposed method significantly maintains the information in the images after de-noising as well.

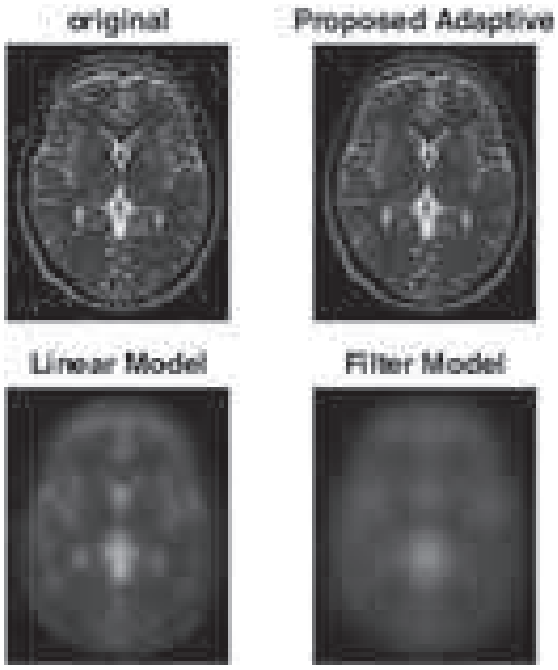

Fig. 27. Sample-3 image information index.

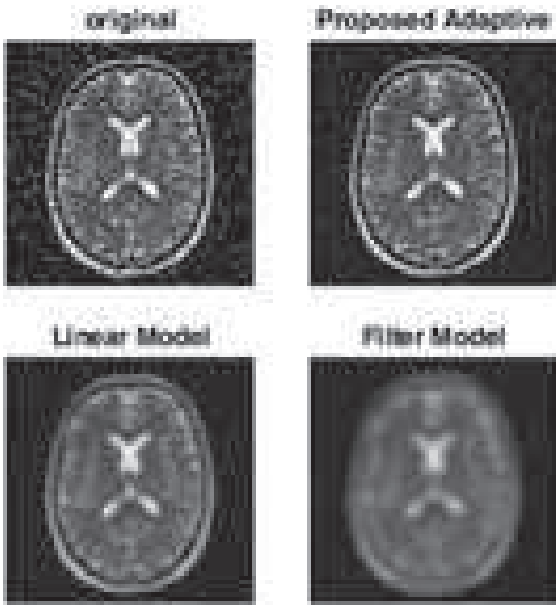

Fig. 28. Sample-4 image information index.

In certifiable photos, the most noteworthy spatial-recurrence detail comprises generally of varieties in brilliance instead of varieties in tint. Since any clamour decrease calculation should endeavour to expel commotion without giving up genuine detail from the scene shot, one dangers a more prominent loss of detail from luminance commotion decrease than Chroma commotion decrease basically in light of the fact that most scenes have minimal high recurrence Chroma detail in any case.

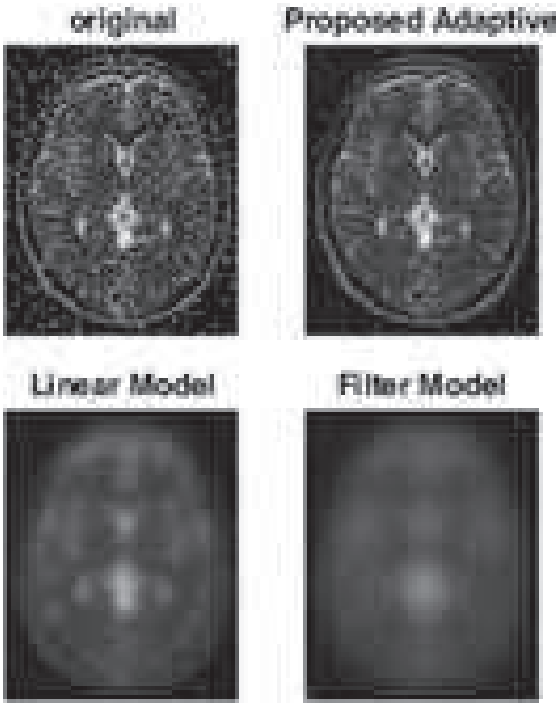

Fig. 29. Sample-5 image information index.

Table III. Framework comparative analysis.

Framework name, title and author	Image input type	Noise types	Algorithm nature	Image information preservation	Applicability to medical image processing
Nonlocal transform-domain filter, Maggioni et al. [22]	2D MR Images	Gaussian	Non-local transformation	No	Yes
Third-order tensors, Kilmer et al. [23]	2D MR images	Gaussian	3rd order matrix	No	Yes
Facial recognition using tensor-tensor, Hao et al. [25]	Grayscale images	Impulsive	Tensor–tensor decompositions	No	No
The virtual skeleton database Kistler et al. 2013	3D MR images	Gaussian, impulsive	Mapping	No	Yes
Heuristic optimization, Shao et al. [1]	2D MR images	Gaussian, impulsive	Learning	No	Yes
Higher-order singular value decomposition, Zhang et al. [21]	3D MR images	Gaussian	Decomposition	No	Yes
BM3D-MRI, Ender M. Eksioglu et al. [28], 2016	3D MR images	Gaussian, impulsive	Block matching	No	Yes
Bitonic, E. Ben George et al. 2012	2D MR images	Gaussian	Tracking	No	Yes
Shearlet sparsity, A. P. Yazdanpanah et al. [30], 2017	3D MR images	Gaussian, impulsive	Variant	No	Yes
Adaptive noise removal framework (proposed)	2D MR images	Gaussian, impulsive, white and structural	Segmentation, learning, adaptive	Yes	Yes

The results are analysed graphically as well (Fig. 22).

Here, it is to identify that, the correlation values are high as the noise type tested matches with the actual noise types in the images.

The signal to noise ratios is also visualized graphically (Fig. 23).

Finally, this work graphically analyses the image information index ratio (Fig. 24).

Also, few of the results are visualised graphically (Figs. 25 to 29).

It is natural to realize that, not only removal of the noises, this proposed framework maintains the high ratio of the information as well.

Table IV. SNR and peak SNR comparative analysis.

	Kilmer et al. [24]		Maggioni et al. [22]		Proposed adaptive framework	
Image sequence	Peak SNR (dB)	SNR (dB)	Peak SNR (dB)	SNR (dB)	Peak SNR (dB)	SNR (dB)
Image001	15.3476	4.4039	14.3247	3.0742	19.3346	9.1854
Image002	17.8544	4.2874	17.2669	3.3779	25.4197	12.8716
Image003	14.2928	3.6619	13.3012	2.3208	17.9486	8.1774
Image004	14.9156	1.7651	14.6295	1.2118	19.1239	7.0569
Image005	14.6393	4.0861	14.2734	3.5121	18.7468	8.8981
Image006	13.1742	0.519	12.8682	0.1089	16.9117	5.5516
Image007	13.0338	0.8564	12.692	0.1373	16.7845	5.8452
Image008	15.6117	2.121	15.3387	1.5034	19.1069	6.521
Image009	13.7449	2.5531	13.419	1.8377	17.9261	7.7055
Image010	13.4877	3.8684	14.4681	3.9177	24.9619	5.4366
Image011	14.3829	3.2445	13.9209	0.5903	17.7972	5.0657
Image012	13.5999	2.8611	13.6972	2.1115	23.4541	7.734
Image013	13.0836	0.9983	14.4024	2.1286	20.0622	5.6171
Image014	14.1494	2.4277	14.1394	3.1938	21.6170	6.4833
Image015	14.3136	2.5273	13.7927	1.5764	18.5933	6.0578
Image016	13.0162	1.783	14.4526	3.6841	17.9318	8.1916
Image017	13.969	2.5694	13.7022	1.966	23.9176	6.4943
Image018	13.5636	3.0659	14.6022	1.7719	18.7966	7.4729
Image019	14.4915	3.5392	14.292	1.9834	21.4106	6.6184
Image020	13.0338	0.8564	12.692	0.1373	16.7845	5.8452

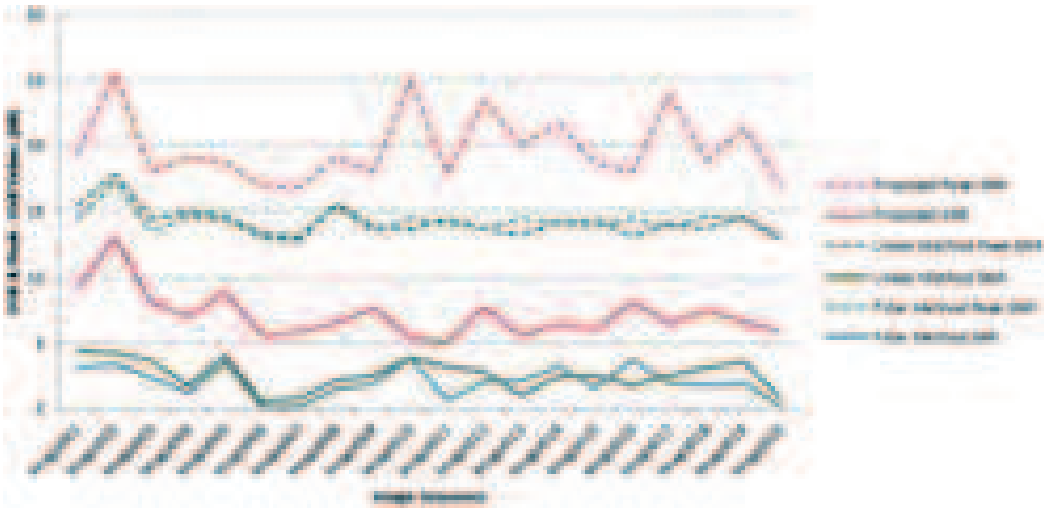

Fig. 30. SNR and peak SNR analysis.

8. COMPARATIVE ANALYSIS

With the highly satisfactory results obtained from the proposed framework, in this section of the work, in order to prove the improvements over the existing studies, the comparative analysis is presented. The comparative analysis is carried over comparisons of the framework characteristics, SNR and Peak SNR analysis and time complexity analysis [28–34].

8.1. Framework Characteristics Analysis

Firstly, the comparative analyses on popular and widely accepted parallel outcomes are carried out with the proposed framework (Table III).

Thus, it is natural to realize that, the proposed framework is significantly improved the capabilities for denoising [34–42].

8.2. SNR and Peak SNR Analysis

Secondly, the comparative analyses on popular and widely accepted parallel outcomes are carried out with the proposed framework for SNR (Table IV).

Table V. Time complexity comparative analysis (ns).

Image sequence	Kilmer et al. [24]	Maggioni et al. [22]	Proposed adaptive framework
Image001	0.8172	0.212	0.13
Image002	0.014	0.024	0.0212
Image003	0.0194	0.0643	0.0033
Image004	0.009	0.0229	0.0032
Image005	0.0285	0.0885	0.0048
Image006	0.0263	0.089	0.0037
Image007	0.0253	0.0885	0.0023
Image008	0.0144	0.0514	0.0024
Image009	0.0173	0.0546	0.0023
Image010	0.0802	0.0744	0.0149

The comparison is graphically analysed (Fig. 30).

Further, it is realistic to understand that the signal to noise ratio is better than the other parallel outcomes.

8.3. Time Complexity Analysis

Finally, the comparative analyses on popular and widely accepted parallel outcomes are carried out with the proposed framework for time complexity (Table V).

The comparison is analysed graphically as well (Fig. 31).

Thus, it is natural to comprehend that the time complexity of the proposed algorithm is relatively less than the other approaches or methods or algorithms.

Henceforth, up on confirming the improvements over the existing methods or frameworks or the algorithms, this work presents the final conclusion on the next section.

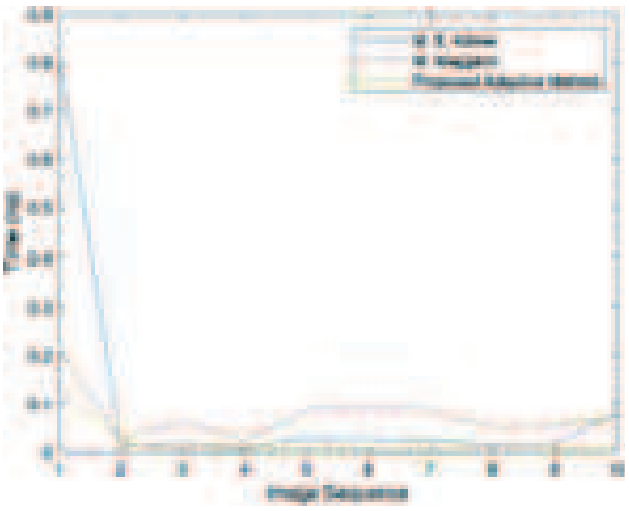

Fig. 31. Time complexity analysis.

9. CONCLUSION

In the field of therapeutic picture taking care of, the modified or manual examination solely depends upon the got pictures and the proximity of noise in the pictures can make the assessment wrong, which can be life threating. Along these lines, de-nosing the pictures are a prime task during the pre-taking care of stages for remedial picture planning. Different parallel research results have shown higher pace of noise removal. Before long, protecting the information during the de-noising system is comparably urgent. Colossal quantities of the parallel investigates fail to suit this need. In like manner, the current pervasive procedures are proposed to de-noising unequivocal kind of commotions. The adaptable method shows higher commotion ejection rate with lesser time multifaceted nature. Furthermore, the information protecting limit of this proposed estimation is in like manner higher. Thusly, the proposed adaptable estimation is exhibited to be an improved denoising figuring for MR pictures in order to make a prevalent remedial assessment and makes the profitable human life progressively secure.

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RESEARCH ARTICLE

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Convolution Neural Networks for Binary Classification

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Convolutional neural networks (CNNs) are similar to "ordinary" neural networks in the sense that they are made up of hidden layers consisting of neurons with "learnable" parameters. These neurons receive inputs, perform a dot product, and then follows it with a non-linearity. The whole network expresses the mapping between raw image pixels and their class scores. Conventionally, the Softmax function is the classifier used at the last layer of this network. However, there have been studies conducted to challenge this norm. Empirical data has shown that the CNN model was able to achieve a test accuracy of ≈99.04% using the MNIST dataset. MNIST dataset consists of 60,000 training images and 10,000 testing images. This experiment was inspired by following the experiment on MNIST dataset. The dataset we used in this experiment is collection of images consisting of cats and dogs. These images are gathered from different sources over internet. This dataset consists of 10,000 images of each class i.e., Cats and Dogs. The overall accuracy of training and validation set is 96.85%. The said results may be improved if data pre-processing techniques were employed on the datasets, and if the base CNN model was alternatively more sophisticated than the one used in this study.

Keywords: Artificial Intelligence, Artificial Neural Networks, Classification, Image Classification, Machine Learning, Softmax, Supervised Learning.

RESEARCH ARTICLE

1. INTRODUCTION

A number of studies involving deep learning approaches have claimed state-of-the-art performances in a considerable number of tasks. Convolutional Neural Networks are very similar to ordinary Neural Networks. They are made up of neurons that have learnable weights and biases. Each neuron receives some inputs, performs a dot product and optionally follows it with a non-linearity. The whole network still expresses a single differentiable score function from the raw image pixels on one end to class scores at the other. And they still have a loss function e.g., Cross Entropy on the last i.e., fully-connected layer and all the tips we developed for learning regular Neural Networks still apply. Convolutional neural networks play a major role in image classification [1, 2].

CNN's are profound educational models for visual imagery analysis. It is affected with how we beings look at the globe around them. As shown in Figure 1.

Before we go to CNNs to evaluate how computers look. The light receptors in your eyes send signals to the main visual cortex through the optic nerve to process the insertion in an item. What you see in the primary visual cortex is meaningful.

In this reminder and labeling method, the profoundly complicated hierarchical structure of neurons and brain connections play a significant part. In layers of growing complexity, the human brain analyses pictures. The first layer differentiates fundamental characteristics such as lines and curves. At greater concentrations, the brain acknowledges that, for example, a train or a dog is a mixture of edges and colours. In a limited area of the visual field only, individual cortical cells react to stimuli, known as the receptive field. The receptive fields of various neurons partly overlap, covering the entire field of vision.

1.1. How Do Computers See?

A picture is only a set of values for a computer. It's typically a pixel (RGB) three-dimensional matrix. An abstract picture representation of 6×6 RGB, for instance, would look like that. As shown in Figure 2.

CNN uses weight matrixes called filters (features) for processing pictures that detect particular characteristics, including vertical edges, horizontal edges, etc. Also, the filters can acknowledge more complicated characteristics as the picture advances through each layer. The CNN's ultimate aim is to find out what is happening in the scene.

Research and creation of devoted Deep Learning (DL) equipment is of great concern. Binary weights, i.e., weight

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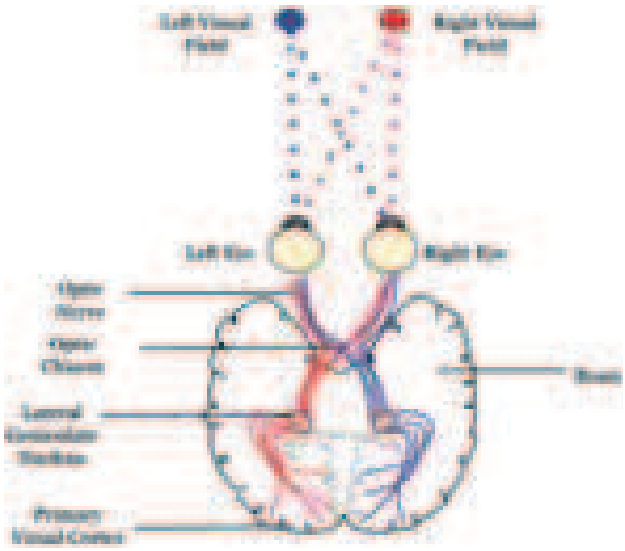

Fig. 1. Visual structure of human brain.

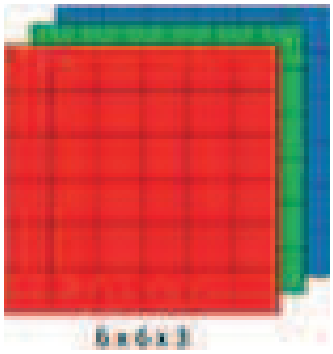

Fig. 2. A 3D abstract image representation in RGB pixels.

limited to only two possible values (e.g., −1 or 1) [3, 4], would give specific DL components excellent advantages, replacing many multiple-accumulation activities with easy accumulations, as multipliers are the most space-hungry and power-starved elements to implement a digital neural network [5, 6].

2. RELATED WORK

Deep neural networks are often over parametrized and their designs are highly redundant. Inadequate computing and memory use is typically the result [12]. Several techniques for addressing effective training and inference in profound neural networks have been suggested. Compact blocks can save on memory and computer expenses on each layer of a profound network. The Network architecture examined the substitution of the fully linked layer with worldwide average pooling [7], GoogLenet [8] and Residual-Net [9], which achieved state-of-the-art results on several benchmarks. The breakdown of the 3rd channels with two 1 to 1 has been used in Ref. [10] and has led to cutting-edge object recognition performance. In Ref. [11] 3 to 3 turns are replaced by 1 to 1 turns for a very compact Neural Network that can reduce the numbers of parameters by 50 times while achieving high precision. Measuring the MNIST and CIFAR-10 datasets by the measuring of a network with L2 error reduction was accomplished better [13]. Several techniques are aimed at linearizing weight and activation in neural networks. Because of the damaging property of binary quantization, extremely quantized (i.e., binary) networks have been thought to be very poor [14]. We're working in comparable ways as we quantify the network parameters. Only during inference in the Extended Back Propagation are the binary parameters used. The probability concept behind the EBP was expanded by Binary Connect [15].

3. METHODOLOGY

The Pytorch Deep learning framework of Facebook AI is used in this experiment to perform the deep learning algorithms. The collection of cats and dogs is the data here used in this experiment. These pictures are collected over the Internet from various sources. This dataset includes 10,000 pictures, cats and dogs, for each class. All photographs of the RGB pictures are their dimensions (initial dimensions' $\times 3$), 3 being the image depth that depicts a R-red G-green B-blue colour picture. But the image is still cut to the depth 224×224, so the image sized as $224 \times 224 \times 3$ is preserved. The dataset considered as 8000 training images and validation images for 2000. As shown in Figure 3.

3.1. Convolutional Neural Networks

There are always four significant steps towards constructing a new Convolution Neural Network as in step 1 Convolution is prepared; the step 2 will be performed pooling; step 3 calculated as flattening and in step 4 will perform full connection to produce results.

Convolutional Neural Network (CNN) is a class of deep feed-forward artificial neural networks which is commonly used in computer vision problems such as image classification. The distinction of CNN from a "plain" multilayer perceptron (MLP) network is its usage of convolutional layers, pooling, and non-linearities such as tanh, sigmoid and ReLU. The convolutional layer consists of a filter, here in our experiment $3 \times 3 \times 3$ (3 pixels for width and height, and 3 because the images are in colour). Intuitively, the Convolution layer is used to "slide" through the width and height of an input image, and compute the dot product of the input's region and the weight learning parameters. This in turn will produce a 2-dimensional activation map that consists of responses of the filter at given regions. Consequently, the pooling layer reduces the size of input images as per the results of a Convolution filter. As a result, the number of parameters within the model is also reduced—called down-sampling. Facebook uses neural nets for their automatic tagging algorithms, Google for their photo search, Amazon for their

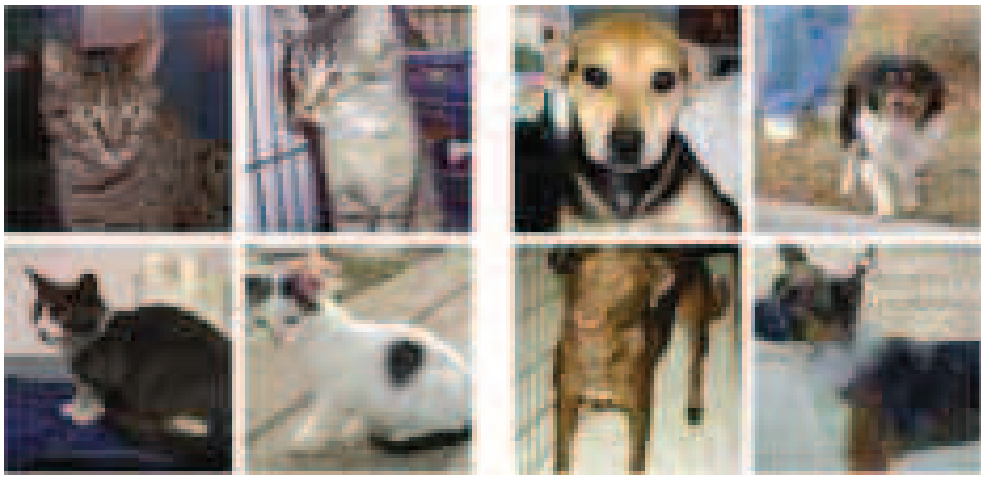

Fig. 3. A sample input images of cat and dog.

product recommendations, Pinterest for their home feed personalization, and Instagram for their search infrastructure. As shown in Figure 4.

3.2. Inputs and Outputs

When a computer sees a picture, a pixel value will be displayed. When an image is taken as an input. The number array is $32 \times 32 \times 3$ (3 relates to RGB values) depending on the resolution and size of the picture. To get the point right, let's say that we have a JPG-shaped colour picture and its size is 480×480. The array is $480 \times 480 \times 3$ representative. A value of 0 to 255 describing the intensity of pixels is provided to each number is shown in the Figure 5. These are the only inputs accessible to the computer, while meaningless to us when performing picture classification. The concept is to offer this range of numbers to the computer, and to provide numbers describing the probability of a certain class of the picture. As shown in Figure 5.

3.3. ReLU

We will use ReLU Activation Function, which returns 0 for each adverse value in the picture while returning the same value for every favourable value, without going into further information. As shown in Figure 6.

Fig. 4. Architecture of CNN.

The Rectified Linear Unit (ReLU) activation function produces 0 as an output when $x < 0$, and then produces a linear with slope of 1 when $x > 0$. The equation for calculating activation function is $f(h\theta(x)) = h\theta(x) = \max(0, h\theta(x))$. The sigmoid functional graph is shown in the following Figure 8 and we can find the slope of the sigmoid curve at any two points.

Finally, an activation function is used to introduce computational non-linearity. Without this, only linear mappings can be learned. The ReLU feature is the widely used feature these days (see Figs. 7 and 8). ReLU is used in tanh and sigmoid because the convergence of stochastic

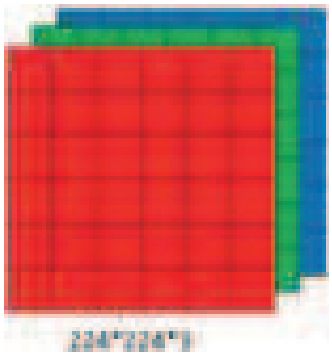

Fig. 5. The intensity of pixels.

Fig. 6. The activation function output of $[32 \times 32 \times 12]$.

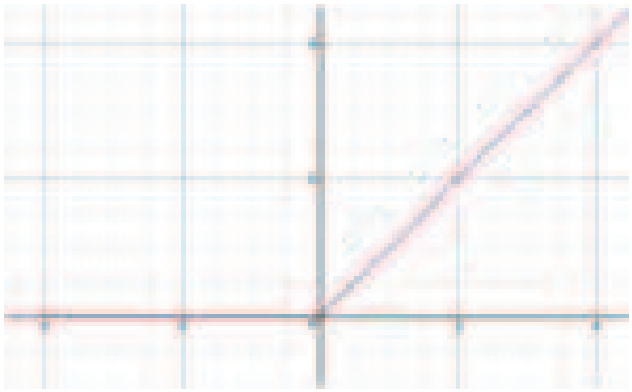

Fig. 7. ReLU activation function graph.

gradient descent was discovered to be significantly accelerated in compared to two other features. In addition, ReLU is incorporated simply by threshold the matrix values at zero in comparison with the extensive calculations required by tanh and sigmoid. The equation of Sigmoid is calculated as $s(x) = 1/(1+\exp\hat{}(-x))$.

3.4. MaxPooling

The objective of this layer is to provide spatial variability, merely to allow the system to recognize an object as an object, although its appearance is somehow different. Pooling layers conduct a spatial down sampling procedure (width, height) that leads to outputs for pooling size (2, 2) such as $[16 \times 16 \times 12]$.

Pooling layers' section would reduce the number of parameters when the images are too large. Spatial pooling also called subsampling or down sampling which reduces the dimensionality of each map but retains the important information. Maxpooling retains the maximum rectified value from the feature maps Figure 9.

3.5. Fully Connected

We flatten the output of the last convolution layer into a completely linked layer and link any node of the layer with the other node of the following layer. Neurons in a fully linked layer are fully linked to all prior layer activations as

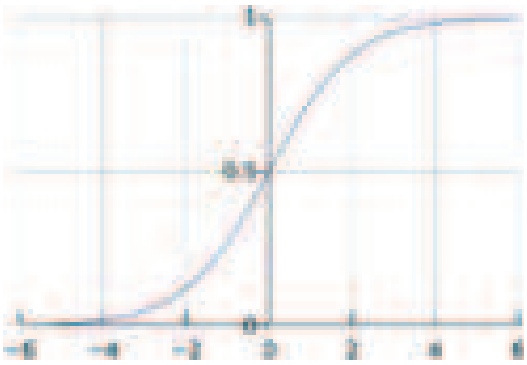

Fig. 8. The sigmoid activation function is differential.

Fig. 9. MaxPooling.

seen in periodic Networks and operate in the same manner. The layer in the last CNN will calculate a volume magnitude $[1 \times 1 \times$ NUMBER OF CLASSE$]$ for the class probability values.

In this paper, we implement a base CNN model with the following architecture:

1. INPUT: $224 \times 224 \times 3$
2. CONV3: 3×3 size, 32 filters, 1 stride
3. ReLU: $\max(0, h\theta(x))$
4. POOL: 2×2 size, 1 stride
5. CONV3: 3×3 size, 32 filters, 1 stride
6. ReLU: $\max(0, h\theta(x))$
7. POOL: 2×2 size, 1 stride
8. FC: 128 Hidden neurons
9. FC: 2 Output Classes (because this is a Binary Classification).

4. EXPERIMENTAL RESULTS

This test uses the Facebook AI Pytorch Deep Learning Paradigm to execute profound training algorithms. Training Set consists of 8000 images and Testing Set consists of 2000 images which are used for validation of the model. Dimensions of images are mostly random but however we resize and randomly crop them to $224 * 224$ to make them fit to our model and the image size is adopted from Resnet model as that size makes a standard to train with pre-trained models in case if needed. All experiments in this study were conducted with Intel Core (TM)i5-4210M CPU@3.20 GHz $\times$ 4, 12 GB of DDR3 RAM, and NVIDIA GeForce (TM) 940MX 4 GB DDR5 GPU.

This Table I below demonstrates the procedure of dropping, whereby "noise" is removed at test time.

Table I. Test error rates of DNNs trained on the MNIST and CIFAR-10.

Method	MNIST (%)	CIFAR-10 (%)
No regularizer	1.30 ± 0.04	10.64
BinaryConnect (det.)	1.29 ± 0.08	9.90
BinaryConnect (stoch.)	1.18 ± 0.04	8.27
50% dropout	1.01 ± 0.04	
Maxout networks	0.94	11.68
Deep L2-SVM	0.87	
Network in network		10.41
Deeply-supervised nets		9.78

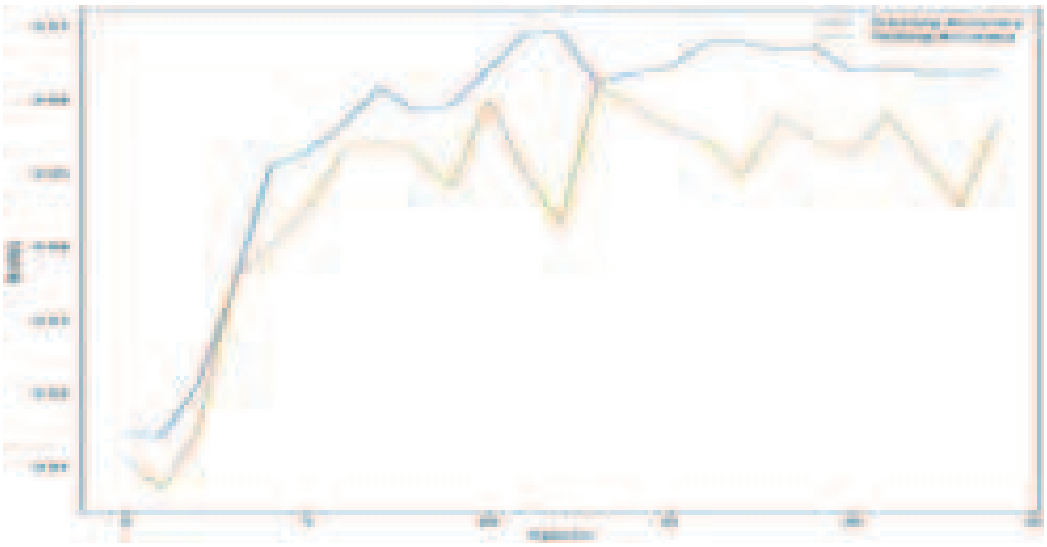

Fig. 10. Accuracy of proposed model.

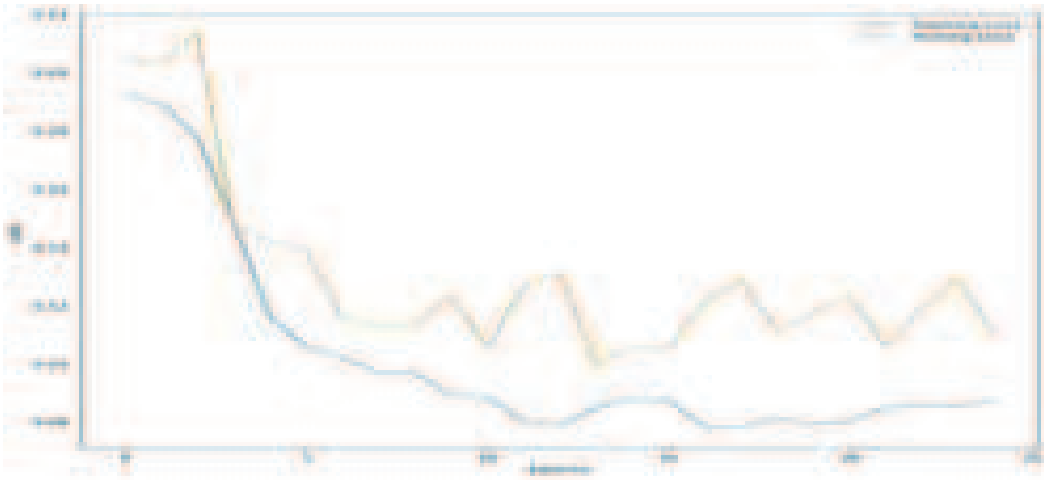

Fig. 11. The loss function.

4.1. Data Analysis

There are two parts in this experiment named Training part and Testing part. By evaluating its effectiveness and precision, we assess our technique. The effectiveness of our binary convolution versus Standard convolution is measured by calculating the computational acceleration (in regard to range of high accuracy operations) attained. This precision is significantly higher than that of rivals in binary neural networks. We also present an ablation survey, in which we assess the main aspects of our approach; the calculation of scaling variables and our binary CNN block structure. We show that our measuring technique is essential to achieve high precision. The hyper parameters batch size is considered in the experiments 128, the cross entropy loss function is used for our proposed model, and Adam optimization algorithm has been used for finding the out results.

The training precision of the model was 96.85 percent after training for 25 epochs. The clean-up of the information and the addition of more information into the model can further improve it. While the model was not so bad, it is useful for this sort of model to classify more classes that allow us to create facial identification systems, classifiers etc. is shown in Figures 10 and 11.

Every iteration of training will randomly resize the pictures from 256 to 480 pixels in small dimensions and then select a random sequence of 224×224 for training. We operate a 58-epoch training algorithm with lots of 256 pictures. The apprenticeship rate begins at 0.1 and the apprenticeship is 0.01 at epochs number 30 and 40.

5. CONCLUSION

For neural networks we assessed easy, effective and precise binary estimates. We train a neural network that learns

to discover binary weight values, reducing the grid size by $\sim 32\times$ and allowing very profound neural networks to be loaded into mobile, memory-restricted systems. In this article, we attempted to analyse neural network characteristics. A simplified model that classifies the two objects. The classification of higher-class information can be further investigated. This may not be the latest model, but it will produce better outcomes if this model is further targeted.

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Template Protection Using Multi Biometric Web Modulo Graph

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RESEARCH ARTICLE

To develop a complete biometric authentication system, security is highly needed. Even though there are several methods for storing fingerprint templates, they are compromised by the attacker leaving it as an unprotected system. In this paper, a novel method is proposed for protecting biometrics through an user defined graph named Web Modulo Graph. Feature vectors are extracted from the Left Fingerprint, Right Fingerprint and Palm Print during the enrollment process. The captured information from the biometrics are combined and stored in Web Modulo Graph where the insertion and traversal of feature vectors are unknown to the attacker. So even if the database or the graph structure is stolen by the attacker the correct sequence cannot be obtained. In this case, guessing the correct sequence is not almost possible as user defined graph is used and the system can achieve this with an Equal Error Rate (EER) of 4.8%. After various analyses, the proposed system is found to have high computational hardness.

Keywords: Template Security, Biometric Cryptosystem, Multi Biometrics, Transforming Feature Vectors, User Defined Graph.

1. INTRODUCTION

In the modern world security should be considered as a foremost thing [1]. The evolution of security starts with the concept of password protection. But the password protected system faced lot of security problems, so biometry concept came into existence. In the case of biometrics, once the data is cracked it is lost forever. Although there are many biometric recognition techniques, Fingerprint based authentication is considered to be the most secured authentication system. Moreover Fingerprint approach is used because of its stability and distinct nature. Fingerprint security becomes an important issue, because of the wide spread use of fingerprint based authentication systems. Many techniques which are existing uses key for fingerprint protection. But if the key and fingerprint get stolen these techniques are failed to give security. This biometric template approach is classified into Feature Transformations and Biometric Cryptosystems. Key Generation and Key Binding are the two schemes which come under Biometric cryptosystems. In key generation scheme, binary keys are generated from biometrics. Whereas in key binding scheme, with randomly selected keys the obtained biometric data are combined and the information are stored.

Instead of using a single Fingerprint, the multi-biometric model improves better security. This is called as Multi Biometric Cryptosystem (MBC) which is very securing than single biometric system which is proved experimentally.

When single biometric is used, and the attacker is able to retrieve it, then the biometric gets lost forever. Whereas in multi-biometric, there are less chances to hack all the biometrics we have obtained. The two fingerprints are combined in the image level and used in encryption.

Figure 1 depicts the process involved in biometric security and it also shows the present situation of our fingerprint security. The attacker is able to capture the raw data that is the stored biometric and can obtain the feature vector stored. From the captured data he is able to calculate the matching score and thereby get the biometric. So we have to use an algorithm which should be impossible for the hacker to crack it to get the biometric.

2. RELATED WORK

To protect individual template there is a method proposed by Abishek et al. where they store the secure sketch. From the template using biometric cryptosystems method, secure sketch is obtained. A new fingerprint recognition scheme where assembled geometric moment sets and Zernike features which is nothing but the moment features is used

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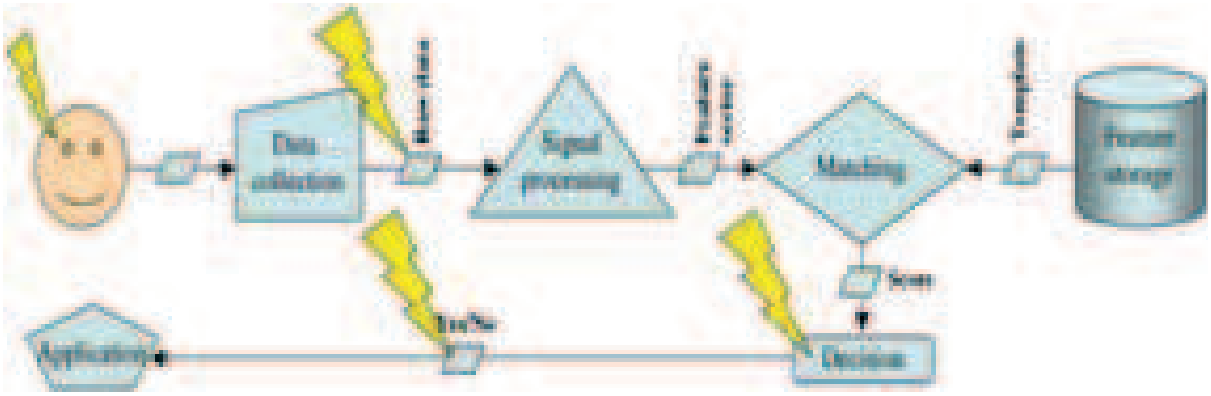

Fig. 1. Possible attacks on biometric system.

and is proposed in. Using geometry and Zernike moment analysis, local and global properties from the features are extracted based on subROIs. From original image and frequency domain, Geometric moments and Zernike can be calculated. The system is however less robust than 4.

Reconstruction techniques are proposed in by Kai Cao et al. which tells the need of secured templates by improving the interoperability of templates and fingerprint synthesis. In this method a reconstruction algorithm is proposed, which utilizes the prior knowledge of fingerprint ridge structure by which the reconstructed fingerprint image can be improved which do not look like a real fingerprint.

A hierarchical matching based on template synthesis is proposed by Uz et al. in which combines several enrollment feature sets into a high quality super-template sets. Javier et al. [4] introduced a method named Liveness detection method which detect particular properties of fingerprint traits to identify real and fake traits. But it failed to find efficiently when different types of synthetic traits are given.

Tomko et al. did a Pioneering work in fingerprint biometrics. However, usability and security issues are not covered to the standard level. The coding and embedding issues are considered in Ref. [6]. There they proposed two techniques—joint-coding and embedding technique such as permuted subsegment embedding technique and the GRACE technique. But the system cannot withstand for high resistance.

Sheng Li et al. [10], the user information are embedded with binary thinned fingerprint image. During authentication phase, the embedded user data is obtained from the stored template to verify the person's authenticity with the fingerprint. It is found that, during data embedding no boundary pixel is formed which results in a marked thinned fingerprint image.

It is observed that the performance of fingerprint identification is not compromised. Even if the online database is attacked, the hacker will be unable to obtain the templates which are stolen. Thus the user's privacy is protected with the stolen templates.

A new adaptive detection method was proposed by Shan He et al. [6]. In that detection method, according to the detection statistics the threshold are adjusted automatically. This reflects the underlying collusion pattern. Under various collusion scenarios, it overcomes non-grouped orthogonal fingerprinting and this system provides consistent performance improvement. During colluder detection there is chance for the false alarm.

A fuzzy vault scheme was proposed by Juels and Sudan et al. [8]. It involves concealing biometric data and identification of a polynomial done with the help of polynomial reconstruction. Polynomial reconstruction is done using a Reed–Solomon ECC.

Sutcu et al. obtained binary strings through transformation of combined templates (face and fingerprints). This method used fuzzy commitment scheme which takes the concatenated binary strings as an input.

A fingerprint security method is proposed by combining spiral and continuous components from two fingerprints by Asem Othman et al. [13]. This method provides virtual identities and used to generate cancellable fingerprint template and also it provides a new identity for authentication. Due to mixed fingerprints, performance has to be enhanced as compared with [15].

A new hashing approach is proposed by Teoh et al. [7]. Here hashing is used to compute between inner products. This is employed between the fingerprint features and a key. Here the key is generated as a pseudo random number. In this approach the key is assumed that is not stolen or shared and that explains its accuracy.

Cai Li et al. [9] proposed a method to add security to fingerprint-based multi biometric cryptosystem using a method known as decision level fusion. To protect each single biometric trait they employed hash functions during their construction. Since hash functions are used, the hash function should be time efficient. And a bad hash function might become a vulnerability and easy target.

Ratha et al. [14] proposed a method which uses non invertible transforms on the minutiae to generate cancellable fingerprint templates. A key is used to guide

these non invertible transform which causes a reduction in matching accuracy.

Another secured approach is used in Ref. [11] by Sheng li and alex.c .kot, where a key is used to hide user's identity on a thinned fingerprint image. The user's identity can be stolen when the user identity and the thinned fingerprint are compromised.

Ross and Othman et al. in Ref. [15] proposed a method where two images of noise type are produced by the decomposition of fingerprint image. The images are stored in separate databases with the help of visual cryptography scheme.

The sheets are overloaded during authentication which creates a temporary image. Thus in this scheme, the user's identity can never be stolen by the attacker. But this approach is practically impossible as it needs two separate databases.

Another scheme is introduced in Ref. [5] for indexing multi-biometric databases. In this scheme, fixed-length codes are generated. Match scores are computed with the help of biometric and reference images which are fixed. From the computed match scores, index score is obtained. But it may not achieve state-of-the-art indexing performance for some biometric modalities but can be easily ported for use on multimodal databases.

Farooq et al. [3] designed fingerprint templates which are cancelable and they are represented using binary strings. As binary strings representation is used it fulfills the registration requirement. Hence it is infeasible to recover minutiae data by inverting.

Another scheme is proposed in Ref. [2]. Here a new identity is created by combining the minutiae positions extracted from a fingerprint and with the points obtained from the voice. Experimental analysis showed that the Equal Error Rate of this method was 5.2%.

In this paper, the storing of biometrics is done using Web Modulo Graph which is user defined. So the insertion and traversal of the feature vectors remain abstracted. In this way security can be achieved for the enrolled Biometrics.

The organization of the paper is as follows. The proposed Multi biometric privacy protected cryptosystem with Web Modulo graph is explained in Section 3. Section 4 analyses the results followed by conclusions and future work [7].

3. PROPOSED WEB MODULO GRAPH

The architecture diagram of the proposed multi biometric cryptosystem using Web modulo graph is shown in Figure 2. As already mentioned, biometrics from Left, Right fingerprint and Palm prints are taken during enrollment. From the extracted biometrics, feature vectors are extracted and it is encrypted and stored in Web Modulo Graph.

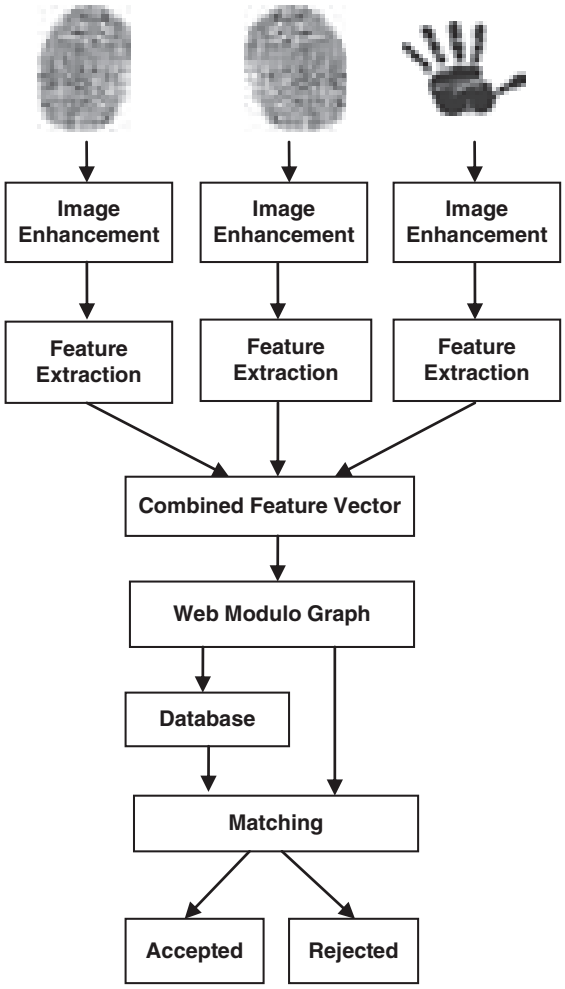

Fig. 2. Overall architecture diagram of the proposed system.

3.1. Image Enhancement

Before preprocessing any fingerprint image, its quality and noise has to be checked for obtaining true feature vectors and for better matching results. After enhancement, there are certain techniques used in preprocessing fingerprints.

Binarization is the process of transforming the 8-bit Gray fingerprint image to a 1-bit image and assigns two values 0 and 1 for ridges and for furrows. This process is done using Recursive Otsu method. Thinning in fingerprinting is the process of reducing the amount pixels in an image and producing a new simplified image with the minimum number of pixels possible.

Minutiae Detection is done by obtaining crossing number of a pixel. Post-processing stage is useful in removing spurious minutiae. Spurious Minutiae is nothing but the already presented minutiae or added by the previous steps. Structural post-processing and Minutiae filtering are mainly used steps.

3.2. Web Modulo Graph

The description of the graph is as follows. Figure 3 depicts the structure of web modulo graph. For Insertion, modulo

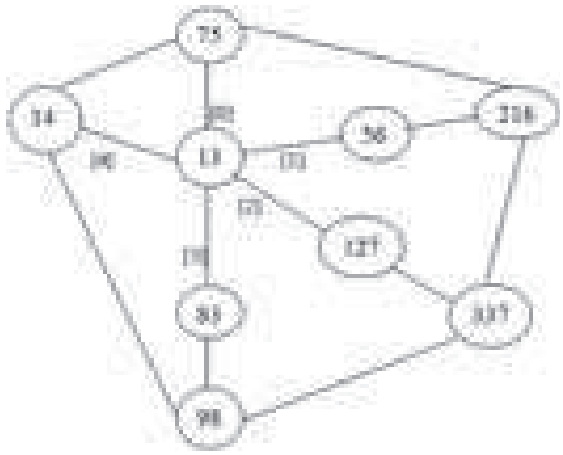

Fig. 3. Web modulo graph with input and output.

operation is performed on the feature vector obtained from preprocessing done on biometrics. Modulo 5 is used on the feature vector. Based on the modulo values the values are going to be inserted.

First value of feature vector is always considered as root node and inserted first. Five edges are formed from the root node as modulo 5 is used. The edge values are assigned as [0], [1], [2], [3] and [4]. Based on modulo value the feature vector is inserted from the root node. The edge value and modulo value should be same for insertion of feature vector as corresponding node. This process is repeated for all feature vector values. For traversal root node is considered first and retrieved. Then the input sequence is reversed and modulo 5 is performed on the input sequence. The graph is traversed based on the reversed sequence and while traversing the first node which lies on the edge is obtained. And hence the obtained sequence will be in shuffled order. In Figure 3, The input sequence is:
13, 83, 56, 75, 98, 127, 14, 216, 337
After performing modulo 5 on the input sequence the obtained sequence will be,
3, 3, 1, 0, 3, 2, 4, 1, 2.
Based on this obtained sequence, feature vector is inserted in the graph. Initially, 13 is inserted as root node.
Input: 13, 83, 56, 75, 98, 127, 14, 216, 337
Output: 13, 127, 56, 14, 337, 83, 75, 216, 98

Figure 4 depicts the formation of edges after the insertion of root node. The second value 83's modulo result is 3, so this gets inserted in 3rd edge. Figure 5 shows the insertion of second feature vector value. i.e., 83. The third feature vector value is 56 and the modulo result will be 1, so it gets inserted in 1st edge. The similar process is repeated for the input sequence.

Algorithm 1 Insertion Algorithm.

Step 1: for I to $n2$
Step 2: if (root[feature[i]%5]==0)
Step 3: mod[0][feature[i]%5]=feature[i]
Step 4: pos[0][feature[i]%5]= i

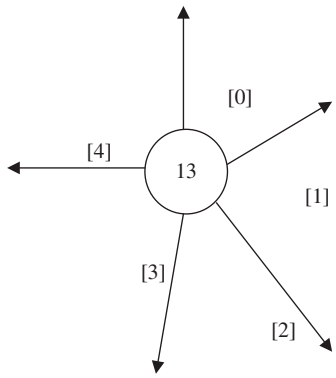

Fig. 4. Formation of edges with values.

Step 5: fields[feature[i]%5]=feature[i]
Step 6: root[feature[i]%5]=1
Step 7: adj[0][i]=1
Step 8: if (fields[feature[i]%5]!=feature[i])
Step 9: fields[feature[i]%5]=feature[i]
Step 10: feature[i]%5]][feature[i]%5]=feature[i]
Step 11: pos[k[feature[i]%5]][feature[i]%5]= i
k[feature[i]%5]++

Algorithm 2 Traversal algorithm.

Step 1: K[i] = 0
Step 2: for $i = n2$ to 0
Step 3: **print** od[k[feature[i]%5]][feature[i]%5])
Step 4: k[feature[i]%5]++

3.3. Matching and Scoring

The output vectors from the graph are stored into a database. The database is created and there is a table for each of the biometrics. One for the right fingerprint, the other for the left fingerprint [3] and the third for the palm prints. The output from web-modulo graph is put into their corresponding databases. Thus the templates are stored into database after a one-way encryption i.e., hashing as encrypted feature vectors.

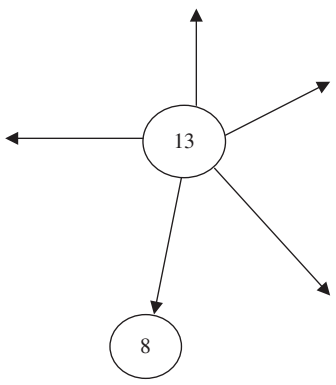

Fig. 5. Insertion of feature vector.

During the time of validation, the query fingerprint and palm print go through the steps to obtain output. The match score will be calculated between all the entries in the database. The sequences are searched for a match. The print is said to be a match. If the result is below a threshold value, the fingerprint is a bogus one or it is not in the database. The threshold value is determined based on equal error rate (EER).

4. PERFORMANCE ANALYSIS

In a biometric system, an Equal Error Rate (EER) is a point at which both the FAR (False Acceptance Rate) and FRR (False Rejection Rate) are equal. In a graph with *x*-axis as threshold and *y*-axis as Error rate, the FRR and FAR are two entities, the interception of the intersection of the two entities along the *x*-axis gives the threshold value and the interception of the intersection of the two entities along the *y*-axis gives the EER. It is otherwise called as Crossover Error Rate (CER). The overall EER of the system should be low for higher accuracy of the system.

The FAR should be very low and the FRR should be very low too. If FAR is tried to decrease there is a chance for FRR to increase. In that case, the correct person might be rejected assuming that the person to be a wrong one. If FRR is tried to decrease the FAR might rise. Thus the measures are inversely proportional.

An optimal threshold value is the equal error rate at which both the FAR and FRR are low.

The threshold value must be adjusted to attain this value. Thus by testing and running a large data set the threshold value is determined. the proposed system's threshold value was found to be 0.69 with an error rate of 4.8%. The threshold value was fixed after running the system with 2002 DB1 and 2004 DB1.

Figure 6 depicts the FAR and FRR and optimal threshold value. For the proposed system the optimal threshold value is found to be 0.69.

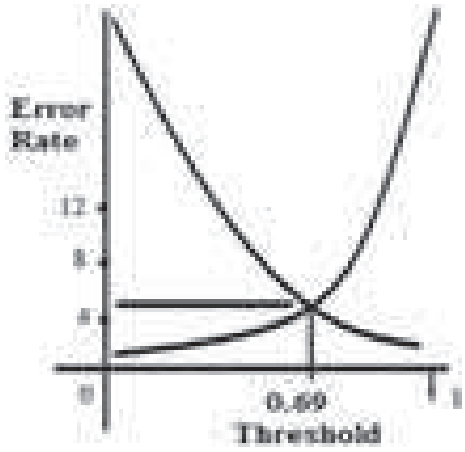

Fig. 6. FAR versus FRR and optimal threshold value.

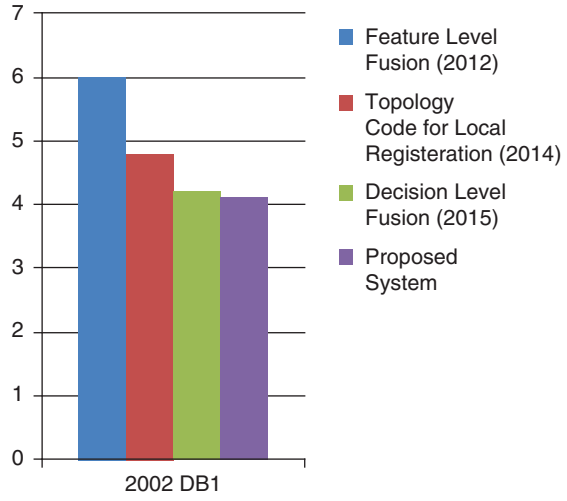

Fig. 7. Performance of proposed system against existing system in 2002 DB1.

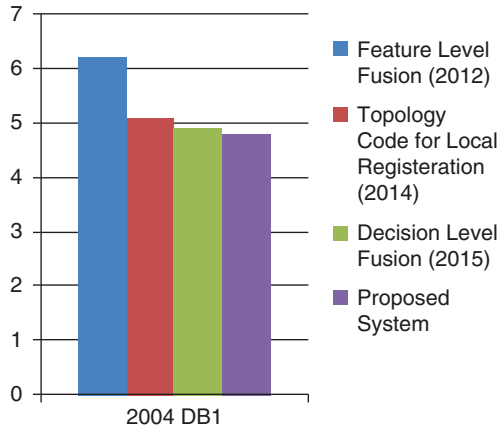

Fig. 8. Performance of proposed system against existing system in 2004 DB1.

Figure 7 depicts the comparison of error rate with existing systems for the database 2002DB1.

In Figure 7, the ERR of the existing methods, Feature level fusion stands at 6%, Topology code for local registration stands at 4.8%, Decision level fusion stands at 4.2%. The EER of the proposed system is 4.1%. Thus the EER of the proposed system is better than previous systems.

The proposed system is also checked with 2004 DB1. Figure 8 shows the comparison of Error rates between proposed and existing systems.

The EER of the existing methods, Feature level fusion stands at 6.2%, Topology code for local registration stands at 5.1%, Decision level fusion stands at 4.9%. The EER of the proposed system is 4.8%. Thus, the EER of the proposed system is better than previous systems.

5. CONCLUSION

For any biometric cryptosystem, the two foremost important factors are security and matching accuracy plays vital

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role. Based on the analysis, we can conclude that the proposed system has high computational hardness as compared with other existing systems. As graph data structure is used, the system is limited with the running time. Comparing with the existing Single Biometric Cryptosystems (SBC), proposed system shows lesser EER. Experimental analysis shows that the proposed system has better security and authentication accuracy.

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RESEARCH ARTICLE

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Solar Powered Multi-Controlled Smart Wheelchair for Disabled: Development and Features

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RESEARCH ARTICLE

As per the report presented by the World Health Organization, it is well aware that 15% of the total world's population is physically challenged. Accessibility of health care services is limited to people with physical disabilities. The utilization of battery powered wheelchairs with excellent navigational capabilities is one of the extraordinary strides towards the incorporation of severely physically and mentally challenged people. Motion, movement and localization are significant issues for the blind, paraplegic and handicapped people who are accompanied by eminent tiresome work. There exist different systems to override the problems described, allowing the end-user to perform safe movements and complete certain daily life tasks. Considering the said issues as a motivation, this work presents the design and development of Solar Powered Multi-Controller Smart Wheelchair. The developed smart wheelchair uses eye blink sensor to steer the wheelchair for quadriplegia patient along with Joystick and Keypad module for several kinds of disabilities. In addition, more liberty is provided to the disabled person by using additional sensors such as heartbeat sensor and a temperature sensor which continuously monitors the health condition of the patient. Additionally, a urine level indicator is also used to avoid inconvenience to the patient. If the patient falls down along with a wheelchair, a fall detection system in the wheelchair detects the same. All the detail can be shared with hospital staff and the patient's guardian during a contingency condition, so that the staffs and guardians can take immediate actions. The safety of the patient and the wheelchair with respect to the incorporation of solar power is highly given priority during this system design.

Keywords: Disable, Multi Control, Paralysis, Solar Power, Smart Wheelchair.

1. INTRODUCTION

Disability is normal among the human diversity. They might be temporary, fluctuating or even permanent, from birth which could create substantial or minimal impact on the life of a person. Various disabilities include mobility, communication, visual or learning and they could result after accident, illness or genetic conditions or sometimes congenital. Disabled people have the same right as every other human in making decisions about their lives and wish to be active members of the community. Disability is only signified as one's individual identity. Some people identify strongly with their disability who are emotionally broken making their survival still worse. While, others see it as just a part of what makes them unique in the society and cope up their survival. However, is their though process, their survival in meeting the daily needs always poses challenges in terms of dependencies on their caretakers. Wither these issues as a motivation, this work is carried forward to develop a smart wheelchair.

Development of the next-generation smart wheelchair for people suffering from paralysis and who are handicapped, will help them to come over their self-mobility constraints which is considered as the main objective of this work. Any kind of paralysis like Monoplegia, Paraplegia, Quadriplegia, ALS, etc., affected people can be possibly assisted by this smart wheelchair. Irrespective of the type of paralysis, this system helps the person to move on their own and reduce the dependency on others [1]. The motivation for developing a smart wheelchair with the solar panel for battery recharging comes from many reasons, but the most prominent is to remove the dependency and to provide better convenience. For a disabled person, it is hard to perform day to day activities, but this developed technology will help them to sustain in a self-dependent

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manner and conserve the time their dependencies. In most of the cases of disabilities, the patient is emotionally and psychologically disturbed due to the inferiority complex during his/her dependency on others for basic daily needs. To ensure better a mental health, this smart wheel chair serves as a helping hand to uplift him/her.

As per the recent studies, the number of suicides of the paralyzed people is increasing and nearly 1 in 50 people live with paralysis which accounts approximately 5.4 million people across the globe [2]. High attention is required in understanding the reason behind the disabled people for committing suicides. The pain, misery, depression they face in their daily lives make their lives miserable. Considering this concern, a smart and automated wheelchair is designed using various sensors and microcontroller technology which will help them reducing the dependency on their caretakers.

2. LITERATURE REVIEW

Several literatures were taken into consideration before starting to design this wheelchair model. Table 1 provides a detailed survey on the development of wheelchair [3].

3. SPECIFICATIONS OF THE WHEELCHAIR MODEL

3.1. Arduino Uno

It is an open-source based micro-controller developed by Arduino.cc i.e., it can be configured by the user according to the application, based on Atmega328. It is introduced to minimize the effort on the input side and maximize the output. Microcontrollers are an important part of electronic and automation industry, which are widely used in the embedded system to make the user's task much easier and time-saving. It consists of several electronics parts such as USB interface, 6 analog pins, a total of 14 digital (I/O) input and output pins which are used for external circuit connection 6 out of which provides PWM output, and Atmega328 microcontroller which also supports the serial communication through Tx and Rx pins. It also has a 16 MHz crystal oscillator, a power jack and a reset button. It operates at a voltage of 5 V. Arduino Uno allows the user to implement his/her idea to the real world.

3.2. Eye Blink Sensor

The main component used in the eye blink sensor is an IR sensor which tracks the changes in the infrared light illuminated to the eyelid area using a phototransistor and differential circuit. This sensor has an operating voltage of 5 V and operating current of 100 mA. There are three different wires connected to the IR sensor, black, red and brown. The black wire is grounded, while brown wire act as an output and red wire provides positive supply. Output data level is Transistor-Transistor Logic level and is connected to the Arduino Uno. In this model, when both the eye is open wheelchair moves forward, it turns to left if the left eye is opened, turns right when the right eye is opened and to stop wheelchair both eyes should be closed in Figure 1.

Since, the eye blink sensor used is IR based, therefore the variation in the eye will vary as each time eye blink. The output is set as high if the eye is open otherwise it is set as low for a closed eye, which helps to monitor the opening or closing position of the eye. This output is given to the logic circuit to indicate the alarm. This sensor is connected to a 5 V regulated DC power supply. To test the sensor, we have to connect it to +5 V (which is red wire) and GND (which is black wire) using two connecting wires and output wire is left open. When the eye is closed, led is off and the output is at 0 V, if we put eye blink sensor wearable glasses on the eyes within a 15 mm distance range, led blinking can be noticed on each eye blink. The output is active low for the closed eye and is forwarded directly to the microcontroller for interfacing purposes.

3.3. Joystick

In this model, the analog joystick is used to control the movement of the wheelchair with respect to the movement of the joystick. It provides analog voltages in two dimensions i.e., X and Y to the corresponding position of the joystick. These values of voltages are used to find the position of the cursor according to the joystick position in Figure 2.

Since it produces an analog output, therefore, an ADC is required to convert the data into a digital output which is done with the help of ADC converter preinstalled on Arduino. By connecting the x-out and y-out pins to the PA0 and PA1 of the Arduino which are the ADC channels, the value of output voltages can be measured. ADC gives 10-bit output. In programming certain values in x-axis and y-axis is set so that if any movement of the joystick is there within that range then according to it wheelchair will move.

3.4. Keypad

In order to interface a single key to the microcontroller, only a single GPIO pin is required. So, to interface more keys like 9, 12 or 16 then all GPIO pins of the microcontroller are required. In order to save GPIO pins, the matrix keypad arrangement can be used. By using matrix keypad instead of 16 GPIO pins only 8 GPIO pins of microcontroller required.

The keypad is the combination of more than a single button with suitable inbuilt resistance to the overall act as a switch. The rows and columns are placed as shown in Figure 3. Whenever a key is pressed, then a particular row and column touch and produces a digital output. Otherwise, there is no contact between rows and columns. The basic working concept of the keypad is that it takes

Table I. Literature review.

S. No.	Model/project name	Year	Sensors used	Significant features
1	Automated-guided wheelchair	1992	Magnetic stripes, infrared	Magnetic stripes were laid so that the chair follows it. Infrared was used to detect obstacles [4]
2	Wheelesley	1995	Ultrasonic, infrared, hall sensors, computer vision	Ultrasonic sensors along with infrared were used to detect obstacles. Hall sensors were used in the bumper of the chair [5]
3	SCENARIO	1997	Ultrasonic, laser, dead reckoning	This chair was having internally stored maps for independent navigation. Ultrasonic and bump contact were used to avoid obstacles. Dead reckoning was used to determine the current position based on the previous one [6]
4	Rob chair	1998	Ultrasonic, joystick, infrared, voice recognition	Joystick, voice along with keyboard were used to control the wheelchair. Four Ultrasonic and twelve infrareds were used to detect the obstacles in the best way possible [7]
5	Rolland I wheelchair	1999	Ultrasonic, laser, dead reckoning	Occupancy grid was used as a local map. 27 ultrasonic sensors were used. The laser was used as a range finder [8]
6	Tin man KIPR wheelchair	1999	Ultrasonic, infrared, dead reckoning	In tin man 1 there were three modes of operations: Human controlled with obstacle avoidance, move towards a given heading, and move towards a predicted position. Tin man 2 was capable of wall following, doorway passing along with docking [9]
7	Luoson III	1999	Joystick, ultrasonic, compass, dead reckoning, computer vision	Comes with direct control, assistative control, and autonomous control. Ultrasonic to avoid hindrance [10]
8	Tetra Nauta	1999	Infrared, computer vision	Navigation of the wheelchair using landmarks as painted on the floors. Landmarks used were radio beacons (tower). The goal was to keep very severe mobility restricted users to be interactive [11]
9	Voice cum auto wheelchair	2000	Infrared, dead reckoning, voice recognition, computer vision	Using dead reckoning wheelchair travels to fixed points based on internal map saved. Infrareds were used to detect the hindrance [12]
10	Maid wheelchair	2001	Ultrasonic, infrared, gyroscope, dead reckoning, GP2D02 distance sensor	It is an electrically powered wheelchair. Ultrasonic, two infrared and distance sensors were used to ensure safety [14]
11	SIAMO	2001	Voice module, motion sensors, ultrasonic, infrared	Modes of control include voice recognition, breath expulsion, joystick, electro-oculography, and head motion. To detect obstacles in the path ultrasonic and infrared was used. Display and voice synthesizer was used to interact with the patient [15]
12	VAHM (Véhicule Autonome pour Handicapé Moteur)	2001	Ultrasonic, infrared, computer vision, dead reckoning	First VAHM was constructed on robot base, had features like wall following and obstacle avoidance. Second VAHM includes features like free-space search, direction following, maps with grids were used for path planning [16]
13	Mr. HURI	2002	Voice and face recognition, camera, ultrasonic	Take inputs to form voice commands. Controlled using the facial gesture. Sonar technology to avoid aobstacle [17]
14	NavChair	2002	Ultrasonic, dead reckoning	Use of Motoric and thinking abilities of the patients was reduced as the chair provides control decisions. Sonar was used to detect the hindrance. Some other features include wall following and doorway crossing [18]
15	WAD	2002	Infrared, dead reckoning	An improvised version of a CRUISER power wheelchair, from invacare 7. Using infrared sensors, obstacle avoidance is achieved. Both the repulsive and attractive dynamic approach is used for avoidance [19]
16	Watson	2003	Laser, modified power chair	The laser is used to avoiding hindrance. Gaze and facial gestures were used to control the wheelchair [20]
17	Smart chair	2003	Infrared, laser, dead reckoning, computer vision	Navigate through the hallway. • Three-point turn. • Avoid hindrance. • Navigate through a doorway. • Turn while avoiding an obstacle. • Head towards a specific goal [21].

RESEARCH ARTICLE

Table I. Continued.

S. No.	Model/project name	Year	Sensors used	Significant features
18	SWCS (Smart Wheelchair Component System)	2004	Drop off, infrared, ultrasonic	The drop-off sensor is used to detect stairs, pits, and holes. Control using switches and joysticks [22]
19	SMART CHAIR	2005	Infrared, camera, laser, encoders	Incorporates detail motion plans, reactive behaviours, and user inputs. Control inputs from three different sources were continuously used in order to provide a safe path towards the destination [23]
20	LIASD-wheelchair	2009	PID, ultrasonic, encoders, wireless internet camera server	Uses sensor network, radio networks, wireless mesh networks. Uses multi-mode communication for motion. This wheelchair moves autonomously as per environment changes [24]
21	mWheelness	2013	Magnetic sensor, accelerometer, proximity sensor	Uses three-tier system namely, inertial and heart sensors at Tier 1, Tier 2 includes a smartphone, and Tier 3 includes a mHealth server. Its display and communicate patient's data regarding heart activity in different situations [25]
22	IOT based wheelchair	2014	Accelerometer, DTMF decoder, level indicator, touchpad, ultrasonic	• Joystick, chin control, voice control. • Control through head motion. • Can be controlled with the mobile call. • Controlled through the internet [26].
23	Controlling wheelchair using eye blink sensors	2014	Eyeblink sensor, accelerometer, bluetooth	Eyeblink sensor, head motion is used to control the wheelchair. Home automation is also included in this chair [27]
24	Solar power assisted wheelchair	2014	Solar PV	Quality function deployment approach was used. The mechanism was provided in order to switch between manual control mode and an electric control mode [28]
25	iChair	2015	Head tracking mouse, gryphon shield	• Helpful for people with ALS. • Localization, object detection. • Object classification, event prediction, and self-navigation [29].
26	Wheelchair based on patient monitoring	2015	Ultrasonic, temperature, heartbeat sensor, GSM	• Includes different controls like eye-ball gesture, voice, and joystick [30].
27	SWS (Smart Wheelchair System)	2017	GPS, LIDAR (light detection and ranging)	This system integrates 3D LIDAR/imaging. Includes a mapping system which generates a map of different landmarks [31]
28	Advancement in a solar power wheelchair	2018	Ultrasonic, radio frequency module, GSM, solar PV	Ultrasonic is used to detect the obstacle. GSM is used to send the messages in emergency conditions. Powered with solar energy [32]
29	PLC based wheelchair with IOT	2018	HMI, smartphone, PLC	Wireless wheelchair control includes the HMI over the Ethernet port. Speed and direction are arranged and displayed over the touch screen. HMI Remote Viewer application provides the remote access, which displays the speed and direction on a smartphone, with the help of wireless communication [33]

input from the user whether to switch on the particular button that gives the required output. To detect which key is pressed, all rows are being grounded by providing 0 to the output latch with the help of a microcontroller, and then it reads the columns.

3.5. Heartbeat Sensor

In order to continuously monitor the patient health heartbeat sensor is used in this project. This sensor let's caretaker to continuously monitor the heartbeat of the patient, which is displayed on an open source app connected via Bluetooth. This helps to monitor patient condition even from a separate room and thereby reducing the work effort and load on the caretaker. It is integrated on a PCB type board which monitors the heart rate of a patient using a light emitting diode, light dependent resistor, and microcontroller in Figure 4.

The IR led emits infrared light which is reflected by the finger surface. This reflected radiation produces a current, which passes through the resistor to get a proportional voltage. Since its output is in analog therefore, it is further converted into digital by the inbuilt converter and the measured heartbeat is displayed on the screen via Bluetooth. It has an input voltage of 5 V and can measure up to a range of $\geq$30/min.

3.6. Temperature Sensor

LM35 is the temperature sensor used in this model. It has an integrated circuit which measures the temperature which is proportional to an electrical output. When voltage

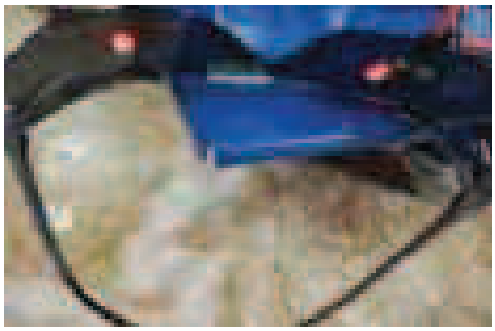

Fig. 1. Eye blink sensor.

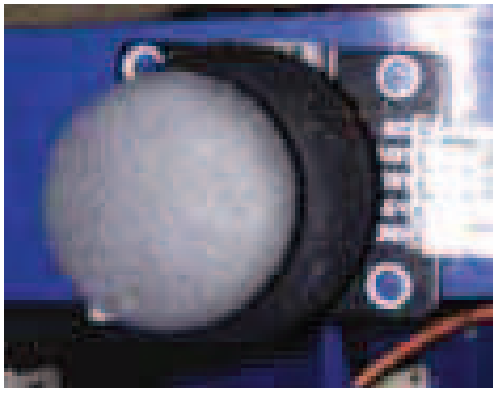

Fig. 2. Joystick module.

output across it is increased by 10 mV, there is a 1 degree Celsius rise in temperature in Figure 5.

Its output is an analog signal. Therefore, it is connected on the 6 channel of the Arduino Uno, which further converts the signal into a digital output. It can measure temperature up to a range of −55 °C to +150 °C.

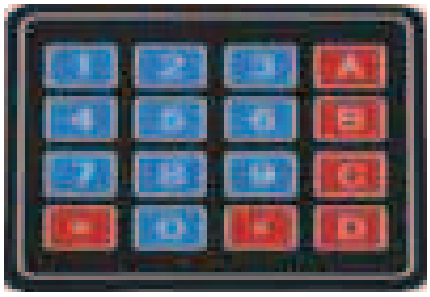

Fig. 3. Keypad module [33].

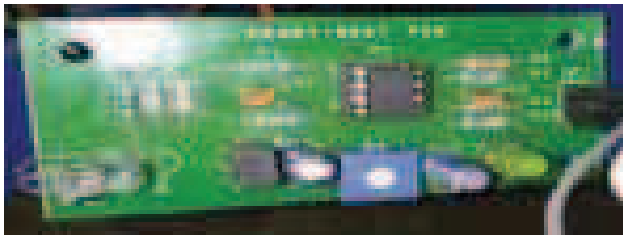

Fig. 4. PCB heart beat.

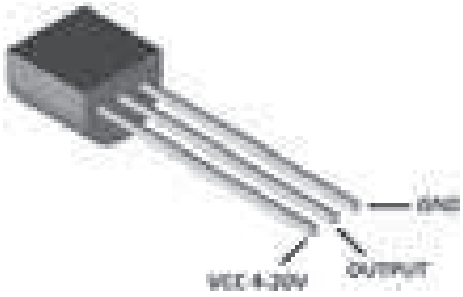

Fig. 5. LM35 sensor.

3.7. Ultrasonic Sensor

Ultrasonic sensors mainly are used for object detection. In this model, we have used it for two different purposes, the first one for obstacle avoidance and secondly for Urine level detection. The used ultrasonic module has a range of 2 cm to 450 cm, has a resolution of 0.3 cm, the effectual angle of <15 degree and quiescent current in it is <2 mA.

It has an operating voltage level of +5 V. It consists of a transmitter, a receiver and control circuit. The transmitter transmits eight 40 kHz ultrasonic waves by triggering IO for at least 10 us high-level signal in Figure 6. If there is an object in the path of waves then it will bounce back to the module and is received by the receiver. Travelled distance by waves can be calculated by considering the travelling time of waves and the known speed of sound.

3.8. Bluetooth Module

This is designed to establish wireless communication. HC-05 is the most common and easy serial port communication module with a sensitivity of 80 dBm, integrated antenna, operates at 1.8 V and its transmission power of 4 dBm RF. This module is paired with an open source Bluetooth mobile application to share data/information in Figure 7.

Since in Arduino serial communication is done using UART to send gathered data to the mobile application through Bluetooth. Data is sent in binary pattern i.e., either 1 or 0 or we can also say that output is either at low voltage or at high voltage. In Arduino, there is an inbuilt software serial library which helps to define the pins for Transmitter (Tx) and Receiver (Rx).

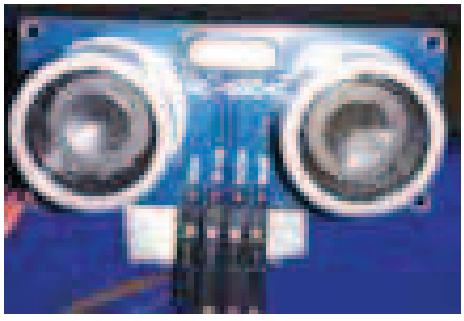

Fig. 6. Ultrasonic module.

Fig. 7. Bluetooth module.

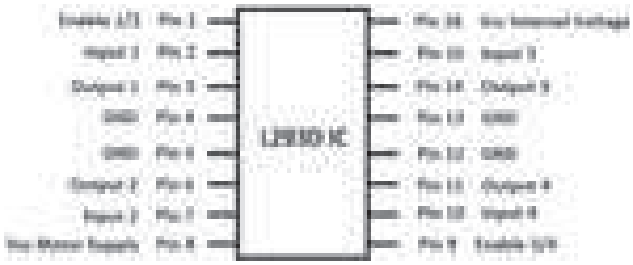

Fig. 8. Pin diagram of L293d.

3.9. Motor Driver

This motor driver operates on dual H bridge circuits which acts as a current amplifier. Basically, it takes low current command from the microcontroller and produces high current to drive the motors in Figure 8.

Pin 1 and 9 should be enabled in order to control the motors. Logic Input is given at the pin 2 and 7 and pin 15 and 10 with the help of Arduino UNO. Motors are connected at Output pin 3 and 6 and pin 14 and 11. Whatever logic, high or low given to the input pin, the corresponding output pin is going to receive the same. But the difference is that it is going to be amplified Below the Table II help to understand the logic control involved. M1 is a term used for Right motor and M2 for left motor. Positive and Negative are used to describe terminals of the DC motor.

Left and Right motor face each other therefore respective logic are used in order to maintain the same direction of wheelchair movement. In order to turn the wheelchair right, right wheel should be at rest and left wheel should move, therefore M1 is kept off and vice-versa for the left turn where M2 motor is kept off. To stop the wheelchair, all the terminals should be kept low.

3.10. DC Motor

12 V dc motor used is Center Shaft Geared Motor because its shaft extends through the centre of its gearbox

Table II. Logic representation to control the motors.

Terminal status/ the direction of motion	M2 positive (pin 3)	M2 negative (pin 6)	M1 positive (pin 14)	M1 negative (pin 11)
Forward	Low	High	High	Low
Backwards	High	Low	Low	High
Left	Low	Low	High	Low
Right	Low	High	Low	Low
Stop	Low	Low	Low	Low

Fig. 9. Inside of DC motor.

assembly. Lithium grease is used to seal and lubricate the Gearbox which can be seen in the Figure 9 above.

3.11. Solar Panel

Solar panel used is of 10 W power. This device comes with a reverse diode connection in order to ensure that energy is not flowing from the battery to the panel in Figure 10.

3.12. Solar Charger Controller (SCC)

PWM based solar charge controller is used in this project. Its ensure that constant voltage is maintained in order to charge the battery. In the PWM controller, current from solar PV array changes according to the needs and requirements of the battery. Directly charging the battery with the solar array is difficult as the voltage regulation is present in Figure 11.

The technology used in modern quality battery charges, the same technology is used in PWM solar chargers as well. In order to avoid overheating and gassing of the battery, the PWM algorithmic program reduces the charging

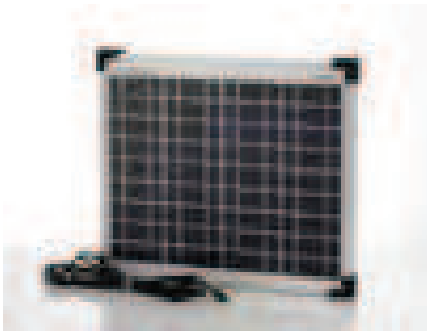

Fig. 10. Solar panel.

Fig. 11. Solar charge controller.

current whenever a battery voltage reaches the regulation set point. But it is ensured that the maximum energy should be transferred to the battery in the shortest time. As per the result, higher charging efficiency is achieved, along with rapid recharging, and a tip-top battery at full capacity. Also, 20% to 30% more energy is recovered from the solar array as compared to the normal retrieval of energy.

4. DESCRIPTION OF THE WHEELCHAIR MODEL

System-wise explanation is provided in this section. The project is divided into four systems as stated earlier. Different profile picture of the smart wheelchair can be seen below in Figures 12 and 13.

4.1. Patient Monitoring System

This part of the project involves one of the two Arduino Uno and let it be known as Arduino1. Sensors like Heartbeat, the temperature sensor, urine level detector along with a Bluetooth module, emergency push buttons, and a buzzer are connected to the Arduino1. This Arduino is powered with the help of a 12 V battery. Whenever a finger is placed on a heartbeat sensor, it will take 10 seconds to calculate your heartbeat per minute. Actually, its algorithm is in a way that it will calculate beats for 10 sec then it will add to average value to get nearby results. The temperature sensor should be placed in the armpit or the groin region to get an accurate result. The Urine level detector consists of an ultrasonic sensor which is placed on the top of a urine bag or a cup. Urine cup used in this project is of around 10 cm deep. Whenever the urine level rises above 5 cm, the warning message will be sent

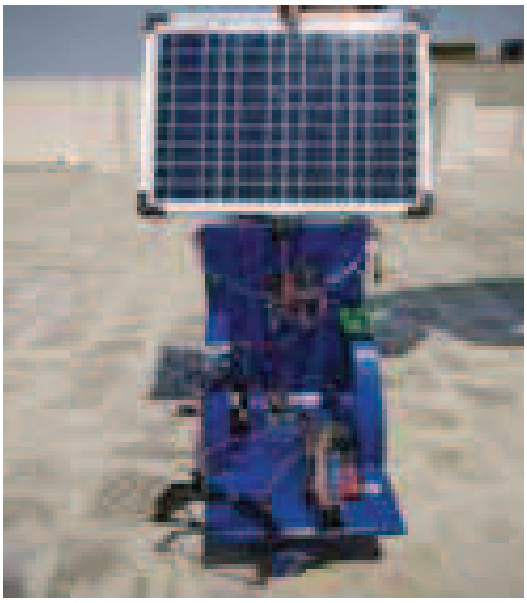

Fig. 12. Front side view of the developed smart wheelchair.

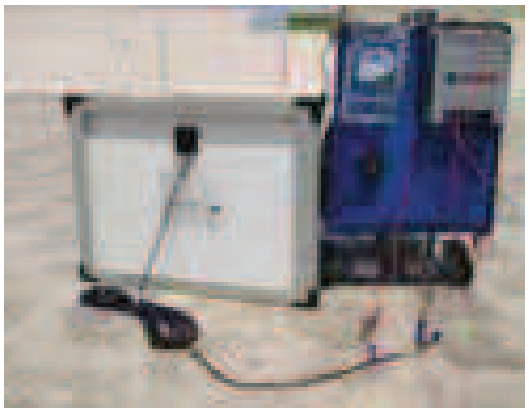

Fig. 13. Back side view of the developed smart wheelchair.

to the observer. If a patient seeks any help, then he/she can press the emergency button which will generate an emergency message on the mobile app along with a buzzer sound. All the sensors value will be sent to the Arduino1 and then with the help of Bluetooth communication, it will be transferred to the Mobile App. UART technology is used by Arduino to connect to the Bluetooth and for data transferring.

4.2. Wheelchair Control System

This system consists of second Arduino (Arduino2), Two 12 V Motors, Motor driver, eyeblink sensor, joystick module, and a keypad module. Input is taken from different control module by Arduino2 and respective output generated is transferred to the L293d motor drive which further connects the different terminals of the motors. First, the Keypad module is used to select between the different modes of control. Key 'A' to select eye control mode, key 'B' to select joystick control mode, key 'C' to select keypad control mode, and key 'D' to deselect the particular mode used. In eye control mode, if your both eyes are open then forward motion. If both are closed then a wheelchair will stop. If left eye is open and right is closed then the wheelchair turns left and vice-versa for a right turn.

In joystick control, to move a wheelchair in a particular direction, move the joystick in the respective direction to have a desirable result. In Keypad control, when pressed '2' the wheelchair goes forward, backwards if '8' is pressed, '4' to turn left and '6' to turn right the wheelchair. Press '5' to stop the chair.

4.3. Wheelchair Safety System

In this system, the sonar technology based ultrasonic is connected to the Arduino1 microcontroller. Two emergency Pushbutton is placed on either side of the developed wheelchair which is also connected to Arduino1. When any obstacles come within the range of 55 cm (decide as per the size of the prototype), then the buzzer goes on. And alert the patient. Also, if the wheelchair is fallen down

either side, then also buzzer goes on with an alert message 'EMERGENCY' appear on the mobile app.

4.4. Wheelchair Power System

This system constitutes a solar panel, solar charge controller, and lead-acid rechargeable battery. Solar Panel and the battery are connected through a solar charge controller. Solar Charge Controller has six terminals to which battery, load and solar panel connects. Six terminals are battery positive negative, load positive negative and solar PV positive negative. There are 3 lights on the solar charge controller, one is green which represent Load on/overcharge, red represents battery low, and yellow represent SPV charging. If a wheelchair is running only on the battery, then the green light will glow. If SPV charging is present then both green and yellow light will glow. If the battery is disconnected while SPV charging, then also both green and yellow light glows and the wheelchair still is in running condition. If the battery is low or has an ageing factor then the red light will glow. If the short circuit will occur at load end then the green light goes off. If solar polarity connections are reversed then yellow light will goes off.

5. RESULTS AND DISCUSSION

After development, remodelling and testing the project in different situations and conditions, detailed system wise results are provided in this section. Comments on obtained data, observed behaviour, working accuracy, and reliability are also incorporated.

Fig. 14. Heartbeat and temperature data obtained on mobile application.

Fig. 15. Figure illustrating urine cup about to fill and its alert message.

5.1. Patient Monitoring System

Below figures show the data obtained through a mobile application which can be seen by the caretaker. Figure 14 shows the temperature and heartbeat of the human body.

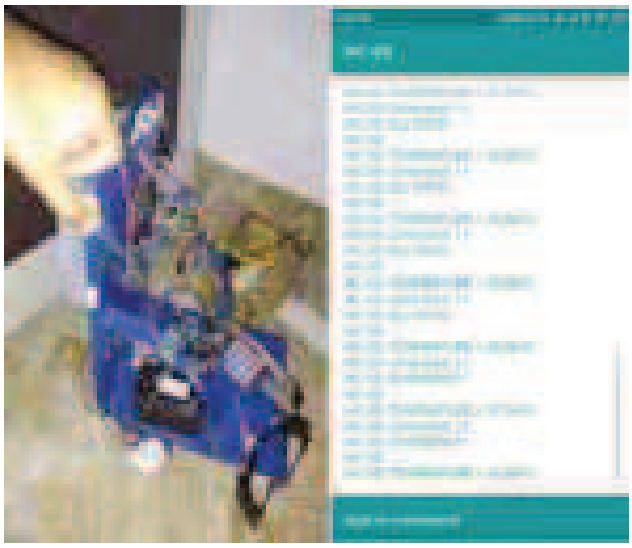

Fig. 16. Figure illustrating emergency push button is pressed and its result.

Fig. 17. The figure representing both the eyes are open.

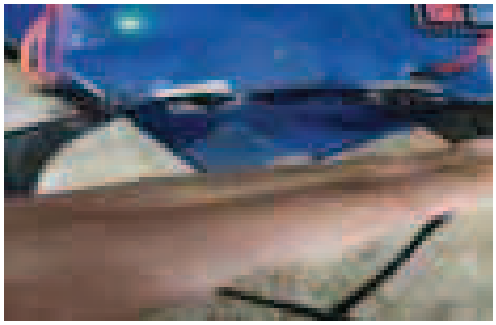

Fig. 18. The figure representing both the eyes are closed.

Fig. 19. The figure representing the right eye being closed and left being open.

If these parameter rises up or goes down because of fever, heart attack, etc., then observer comes to know about it and quick aid can be provided to the patient. Figure 15 shows that "urine bag about to fill" message when the urine cup/bag is about to be filled. Figure 16 shows that whenever an emergency push button is pressed then "EMERGENCY" message appears on the mobile application along with buzzer sound. The accuracy of the heartbeat sensor

Fig. 20. The figure representing the left eye being closed and right being open.

Fig. 21. Representation of joystick control.

Fig. 22. Representation of keypad control.

is about 60–70%, the temperature sensor is about 0.5 °C at 25 C and urine level detector sensor is about 90%.

5.2. Wheelchair Control System

5.2.1. Eye Control

In the Eye control method, eyes being open is represented by both glowing red lights in the eyeblink sensor as shown in Figure 17. Similarly, eyes being closed is represented by both the red lights being off as shown in Figure 18.

If to make a left turn, the left eye should be open and the right eye should be closed as represented in Figure 19 and in order to make the right turn vice-versa as shown in Figure 20.

The accuracy of this sensor is about 50–60%. Therefore, to represent controls better, hands are used. Using the

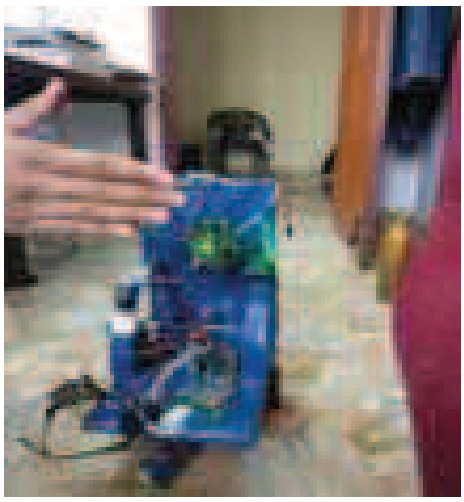

Fig. 23. Representation of obstacle detection.

Fig. 24. Representation of fall detection.

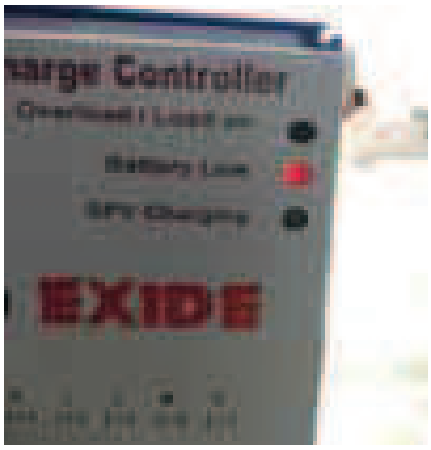

Fig. 25. Battery low status represented by SCC.

Joystick module, it is very easy to control the wheelchair and its accuracy is around 90% in this system in Figure 21. Keypad Control also provides good results with around 90% accuracy in Figure 22.

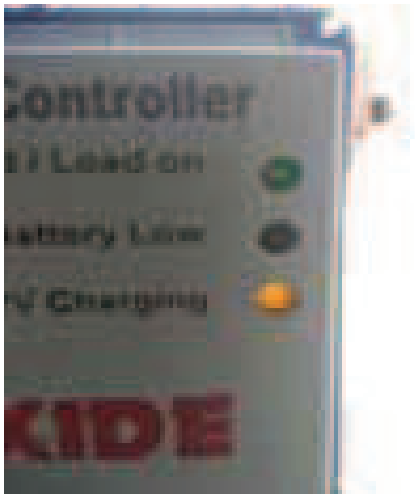

Fig. 26. Load connection along with solar charging represented by SCC.

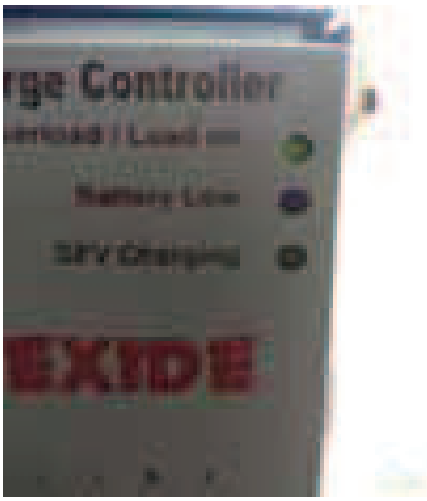

Fig. 27. Load connection only with battery represented by SCC.

5.3. Wheelchair Safety System

The obstacle is perfectly detected by the ultrasonic sensor and it alerts the patient quite well with the help of a buzzer in Figure 23.

Fall of the wheelchair as represented in Figure 24 is quite very well detected with the help of the push buttons which are placed on both sides of the chair. The care-taker will be aware of the emergency message as shown in Figure 16 along with buzzer sound.

5.4. Wheelchair Power System

Our designed prototype uses a battery which can be recharged using solar and electric power. Results are obtained on the basis of different situations in case of solar power recharging.

Figure 25 represents SCC when the battery is low and solar charging is not available, only a red-light glow.

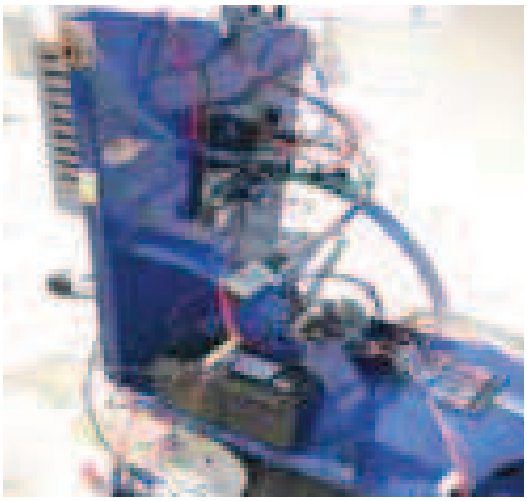

Fig. 28. Representation of wheelchair with battery terminals are disconnected but solar terminals are connected.

Figure 26 represents SCC status when the load is connected along with solar charging. Both green and yellow light glows.

Figure 27 represents SCC when the load is connected and only supplied by the battery. In such cases, only a green light glows.

Figure 28 represents that when the load is connected but it is only supplied by solar power. In such cases also both green and yellow light glows as shown in Figure 26.

6. CONCLUSION

This work explains a smart wheelchair which can be controlled via multiple modes, can monitor the health condition of a patient like his/her heartbeat, body temperature and can also recharge the battery through the solar panel interfaced on the wheelchair. The essential parameters of the patient can be observed using a smart wheelchair. So, a person with a different disability like paraplegia, quadriplegia or person who is unable to walk properly can use this wheelchair according to their convenience. Since this system does not involve any complex algorithm to operate the wheelchair, therefore it can be used by any with ease. There are several cases of a patient who either have paralysis or any type of disability which make them unfit to do any type of movement on their own. These types of disabilities can be tackled simultaneously with the help of this wheelchair and it can make the patient less dependent on the caretaker and more self-dependent. Alert system is also interfaced on the wheelchair which makes caretaker aware of the situation so that proper steps can be taken in any health-related issue. To provide better movement of a wheelchair in a crowded places system with three wheels are used. In some areas where the distribution of electricity is not proper, so to recharge the battery used to operate the wheelchair a solar panel is installed on a wheelchair. The ultrasonic sensor is interfaced on a wheelchair for obstacle avoidance along with fall detection system and urine level indicator. All these features are available to the user at minimal cost and will be very reliable and helpful to them.

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