8th International Conference on Recent Challenges in Engineering and Technology

(ICRCET-2020)

Singapore

30th - 31st January, 2020

Institute For Engineering Research and Publication (IFERP)

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Editorial:

We cordially invite you to attend the **8th International Conference on Recent Challenges in Engineering and Technology (ICRCET-2020)** which will be held at **Copthorne Kings Hotel, Singapore** on **January 30th-31st, 2020**. The main objective of **ICRCET** is to provide a platform for researchers, students, academicians as well as industrial professionals from all over the world to present their research results and development activities in relevant fields of Recent Challenges in Engineering and Technology. This conference will provide opportunities for the delegates to exchange new ideas and experience face to face, to establish business or research relationship and to find global partners for future collaboration.

These proceedings collect the up-to-date, comprehensive and worldwide state-of-art knowledge on cutting edge development of academia as well as industries. All accepted papers were subjected to strict peer-reviewing by a panel of expert referees. The papers have been selected for these proceedings because of their quality and the relevance to the conference. We hope these proceedings will not only provide the readers a broad overview of the latest research results but also will provide the readers a valuable summary and reference in these fields.

The conference is supported by many universities, research institutes and colleges. Many professors played an important role in the successful holding of the conference, so we would like to take this opportunity to express our sincere gratitude and highest respects to them. They have worked very hard in reviewing papers and making valuable suggestions for the authors to improve their work. We also would like to express our gratitude to the external reviewers, for providing extra help in the review process, and to the authors for contributing their research result to the conference.

Since November 2019, the Organizing Committees have received more than 60 manuscript papers, and the papers cover all the aspects in Electronics, Computer Science, Information Technology, Science Engineering and Technology. Finally, after review, about 21 papers were included to the proceedings of **ICRCET-2020**.

We would like to extend our appreciation to all participants in the conference for their great contribution to the success of **ICRCET-2020** We would like to thank the keynote and individual speakers and all participating authors for their hard work and time. We also sincerely appreciate the work by the technical program committee and all reviewers, whose contributions made this conference possible. We would like to extend our thanks to all the referees for their constructive comments on all papers; especially, we would like to thank to organizing committee for their hard work.

Rudra Bhanu Satpathy
Chief Executive Officer
Institute for Engineering Research and Publication (IFERP)

Acknowledgement

IFERP is hosting the **8th International Conference on Recent Challenges in Engineering and Technology** this year in month of January. The main objective of **ICRCET** is to grant the amazing opportunity to learn about groundbreaking developments in modern industry, talk through difficult workplace scenarios with peers who experience the same pain points, and experience enormous growth and development as a professional. There will be no shortage of continuous networking opportunities and informational sessions. The sessions serve as an excellent opportunity to soak up information from widely respected experts. Connecting with fellow professionals and sharing the success stories of your firm is an excellent way to build relations and become known as a thought leader.

I express my hearty gratitude to all my Colleagues, Staffs, Professors, Reviewers and Members of organizing committee for their hearty and dedicated support to make this conference successful. I am also thankful to all our delegates for their pain staking effort to travel such a long distance to attain this conference.

Sincerely,

Rudra Bhanu Satpathy

8th International Conference on Recent Challenges in Engineering and Technology (ICRCET-2020)

Singapore

30th-31st January, 2020

Keynote Speakers

Organized by

Institute For Engineering Research and Publication (IFERP)

Dr. Senjuti Goswami

Senior Professor & Course Leader
Amity Global Institute
Singapore

Message

I am extremely happy to note that IFERP- Institute For Engineering Research and Publications is organizing the **"*8th International Conference on Recent Challenges in Engineering and Technology*"** during **30th & 31st January 2020, Singapore**. I am also happy to know that the institute is bringing out a Souvenir on this occasion.

I hope this conference will provide an opportunity to all the participants to interact with each other & discuss on the issues related to the current research and latest advancement and Recent Challenges in Engineering and Technology. The deliberation at this conference will, I am sure, enable Academicians, Practitioners, Consultants, Research Scholars, Industry leaders and other Experts to exchange ideas and suggest measures for meeting the evolving challenges and the exchanges will hopefully benefit the community.

I wish the conference a great success.

Dr. Senjuti Goswami

Dr. Lampong Klomkul

Director for Research,
Information and Academic Services Division, ASEAN Studies Centre,
Mahachulalongkornrajavidyalaya University, Bangkok, Thailand

Message

I would like to thank to the organizing committee of IFERP inviting me as a keynote speaker with the latest emerging topic. I am believe "**8th International Conference on Recent Challenges in Engineering and Technology**" will give a lot of benefit to the participants in discussing on latest finding in engineering sciences and technology. I am particularly happy to be present in this conference and to exchange views and share experiences with participants, colleagues and friends, representing my Universities and Research group together with members of relevant international participants. I would like to welcome you to this conference and look forward to your participation.

Dr. Lampong Klomkul

ICRCET-2020

8th International Conference on Recent Challenges in Engineering and Technology

Singapore
30th-31st January, 2020

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30th-31st January, 2020 - Singapore

Analyzing Industrial Intranet technology effect on the performance of oil and gas companies in Nigeria

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Abstract:

Industrial intranet connects the entire industrial assets of the organisation to a specific internal network. The network can permit only specific persons to access them. This in turn restrict the company's industrial assets data to be available on the internet. Oil and gas industry is a highly complex business environments and companies forced the employees to make fast and effective decision with regard to industrial assets. With the help of industrial intranet, oil and gas companies can access the industrial assets information in a speedy way. Besides, efficient storage of information, interactive collaboration and technical compatibility. Above stated attributes exhibits in industrial intranet have influenced the companies to utilize it to overcome constraints like redundant information or unnecessary duplication, disorganized documents, obsolete information, and decaying links. In addition, it offers not only information on how to complete the processes on time but also tools and services required to accomplish the task on time. Therefore, industrial intranet become strategic business tools for oil and gas companies in Nigeria. The present aims is to investigate the impact of industrial intranet using task technology fit elements within oil and gas companies in Nigeria and to develop a framework for effective utilization of industrial intranet for the organization. The findings would insights on how industrial intranet could improve the individual performance of oil and gas companies in Nigeria.

Keywords:

Industrial intranet, task characteristics, technology characteristics, task and technology fit and performance

I. INTRODUCTION

Technology plays a crucial role in assisting and facilitating the work processes especially in oil and gas industry . The utilization of technologies assist the companies in investigating large quantity of structured and unstructured data from various sources and generate it as a real time insights. Nowadays, oil and gas companies faces complex in accessing huge volume of data. Emergence of technology paves the way for the companies to create an impact especially in terms of new level of connected intelligence to oil and gas operations. As per the survey made by Accenture, big data analytics, industrial intranet and mobile devices occupying as a top digital investments for oil and gas companies.

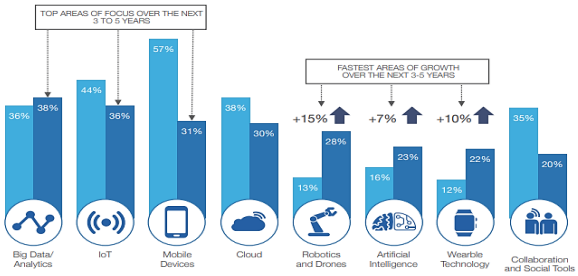

Fig 1: Digital investments

Hence, the above stated new technological advancements forced the oil and gas companies to make an important changes in operations to make it more viable in the low price environment. (williams, 2019)Oil and gas industry pioneered with new models, digital investments and compliance solutions which makes the industry to be turnaround in the recent days (Halvorsen, 2018). Cheap sensors, widening connectivity and ever greater computing power is already ruining the industry. Modern offshore drilling platforms already have nearly eighty thousand sensors for predicting 15 petabytes of data during an assets life time . Hence increasing assets utilization is a critical area while developing the oil and gas industry. Therefore it is vital to improve the utilization rates which in turn provides a prospects to lower the costs and drive the efficiency of the sector. Oil and gas companies prefers industrial intranet is to upsurge the production in the oil field, stimulate the throughput in the refinery and upsurge asset utilization is a foremost goal for the technology investment in oil and gas industry. Besides, the companies make an investment in industrial intranet of things to inform an impactful decision on real time assets information. This is primarily because of eradicate the complexities involved in connecting every continent and time zone around the world. Therefore, oil and gas companies connect their field assets and equipment with industrial intranet i.e one common corporate intranet using sensors which provides an

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automated monitoring and diagnostics to the concerned department. This in turn makes the environment to gain connectivity using industrial intranet, simplify the entire supply chain which creates an impact on individual side. Hence the study, makes an effort to make a probe on how industrial intranet ruined the oil and gas companies, fostering the employee opinions on accepting the technology using task and technology fit theory.

II. OBJECTIVES OF THE STUDY

The objective of the study is to explore the opinions of the employees with regard to the acceptance of technology adopted for monitoring industrial assets in Nigeria

III. THEORETICAL FRAMEWORK

The present study incorporates task technology fit theory, which is an expansion of information system success model of Delone and Mclean (1992). The model developed by Delone and Mclean (1992) pointed out the most significance of task technology fit in improving the performance of the organization**.** Goodhue & Thompson, 1995 stated that the performance outcome primarily dependent on how level of fit exists among information system and tasks to be performed. He framed a model which exhibited in the below diagram.

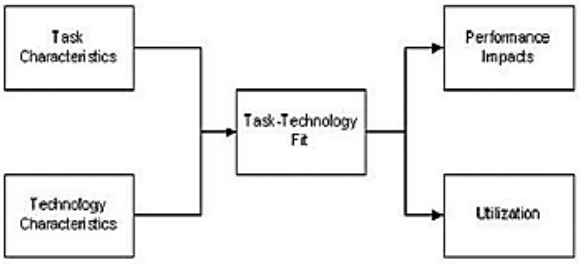


Fig 2: Task and technology fit theory

The primary application of adopting the theory is stating that a high technology fit results better performance for the organization. The first and foremost dimension in the theory is the fit among technology and task attributes. Task technology fit referred as the ability of an information provider to assist task matching technology capabilities in accomplishing task demands . With the help of theory, it is perceived that new technology likely to have a positive influence on individual performance. If it uses continuously, then it matches the task that the user perform. Goodhue and Thompson (1995) developed a measure which has eight attributes. Quality, locatability, authorization, compatibility, training, production timeliness, system reliability and relationship with the users. Hence the researcher applied the original task technology fit theory to identify the impact of technology in oil and gas companies in Nigeria.

Task characteristics

It refers to the individual activities in transforming the inputs into outputs. The primary intention is to satisfy the users with their information needs. (Goodhue, 1995). The present study consider the task attributes using sensors and actuators. Though there are various dimensions like task non routines, task interdependence, time criticality, the researcher applies task equivocality and task interdependence (Goodhue, 1995) because the aspects of monitoring achieved using technologies are the task characteristics for the study.

Technology characteristics

Goodhue (1995) defined technology as the tool that is either hardware or software used by individuals in carrying out their tasks. The aspects of technology tools may influence technology utilization and users' perceptions (Goodhue, 1995, 1998). The task-technology fit model considers the importance of fitting the functionality and attributes of technology used to the demands imposed by individual needs

Task and technology fit

It is defined as for an information technology, how IT have an impact on individual performance and how the technology utilized and the extent to which the technology must be a fit with the task it assists. As per Goodhue(1993), the researcher investigate the sensors and actuators of industrial intranet within the user task domain of IT supported decision making. The researcher considered the eight appropriate dimensions like quality, locatability, authorization, compatibility, ease of use, production timeliness, system reliability and relationship with the users. Goodhue (1993)

Performance impact

It refers to how an individual belief about their task execution capabilities and how it changes after using smart sensors and actuators interventions. High task technology fit has an impact on individual performance (Goodhue, 1995).

IV. CONCEPTUAL FRAMEWORK

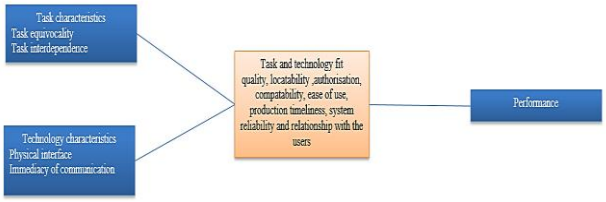


Fig 3: Conceptual framework

V. RESEARCH METHODOLOGY

Research methods represented to the extent that comprehending research issues for the better understanding of research outcome. To investigate the research issues, the researcher considers the sampling frame to be the

organization who applies industrial intranet in Nigeria. The top level managers selected because they have the power to influence the technology to gain competitive advantage in the market . Hence identification of top level managers based on criteria set forth by (Badpa et al 2018) The targeted population to be managers attached to maintenance department who are monitoring industrial assets through intranet. About 50 self-reporting questionnaires sent to HR departments of the respective organization and only 35 sent back. Hence the response rate to be 70% which is noticeably high and the representative of population studied enables generalization of results to be obtained .

VI. ANALYSIS

The section exhibits the demographic profile and attributes of industrial intranet uses in the oil and gas companies in Nigeria.

Particulars	Frequency	Percent
Age		
25 years and above	11	31.4
26 to 35 years	7	20.0
36 to 45 years	7	20.0
Above 45 years	10	28.6
Gender		
Male	35	100
Female	0	0
Education qualification		
Bachelor degree	10	28.6
Masters degree	14	40.0
Doctoral degree	11	31.4

It is observed from the table that 31.4% of respondents belong to the age category while an identical 20% of respondents between the age category of 26-35 years of age and 36-45 years of age and 28.6% of are above 45 years of age. With regard to gender, 100% of respondents are male. Concerning education qualification, 28.6% of having a bachelors degree, 40% of having masters degree and 31.4% of having doctoral degree.

Kind of industrial intranet having in organization

Particulars	Frequency	Percent
One common corporate intranet	**16**	**45.7**
Location based versions	**11**	**31.4**
Different intranet for different units	**8**	**22.9**
Total	**35**	**100.0**

It is observed from the table that 16 respondents stating 45.7% of using one common corporate intranet while 11 respondents stating 31.4% of using location based versions and 8 respondents stating 22.9% of using different intranet for different units.

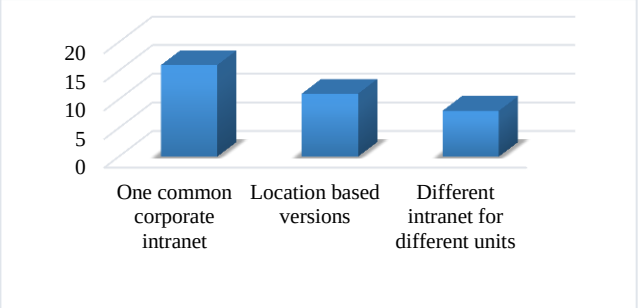


Fig 4: kind of industrial intranet having in organization

What type of contents does your industrial intranet offer it to users

Particulars	Frequency	Percent
Industrial assets information	8	22.9
Internal company news	4	11.4
Work instructions, guidelines and process descriptions	8	22.9
Interactive sessions	4	11.4
Links	7	20.0
others	4	11.4
Total	**35**	**100.0**

It is clear that 8 respondents stating 22.9% of stating industrial intranet offers industrial assets information to the users, 4 respondents stating 11.4% of providing internal company news to the users, 8 respondents stating 22.9% of providing work instructions, guidelines, process development to the users, 4 respondents stating 11.4% of providing interactive sessions and other information to the users and 7 respondents stating 20% of offering substantial link to the users.

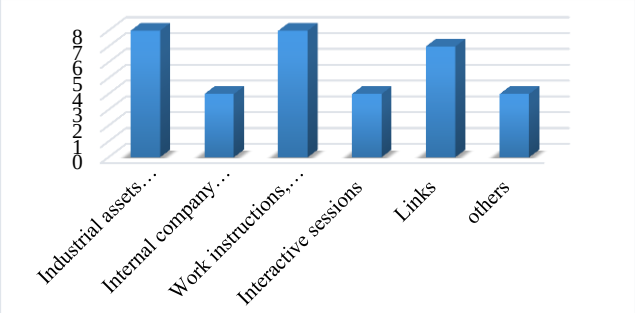


Fig 5: type of contents does your industrial intranet offer it to users

News information published on the industrial intranet

Particulars	Frequency	Percent
Many times a day	11	31.5
Daily	10	28.5
Weekly	9	25.7
Less frequently	5	14.3
I don't know	0	0
Total	**35**	**100.0**

It is observed from the table that 11 respondents stating that 3.5% of getting information many times a day while 10 respondents stating that 28.5% of getting it daily, 9 respondents stating that 25.7% of weekly and 5 respondents stating that they are getting less frequently.

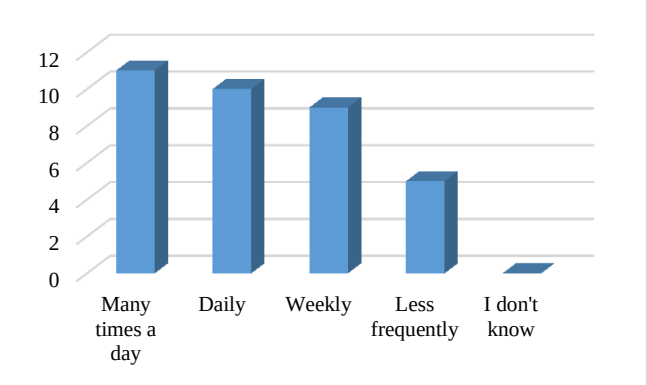


Fig 6: news information published on the industrial intranet

Kind of sources of information getting for monitoring industrial assets

Particulars	Frequency	Percent
Emails	10	28.6
Weekly summaries of industrial assets	8	22.9
Team meetings	8	22.9
Forums	5	14.3
Others	4	11.4
Total	**35**	**100.0**

It is observed from the table that 10 respondents stating 28.6% of getting emails, an identical 8 respondents stating 22.9% of getting weekly summaries and through team meetings. Respondents of 5 members stating that 14.3% of through forums and 4 respondents stating that 11.4% of through others.

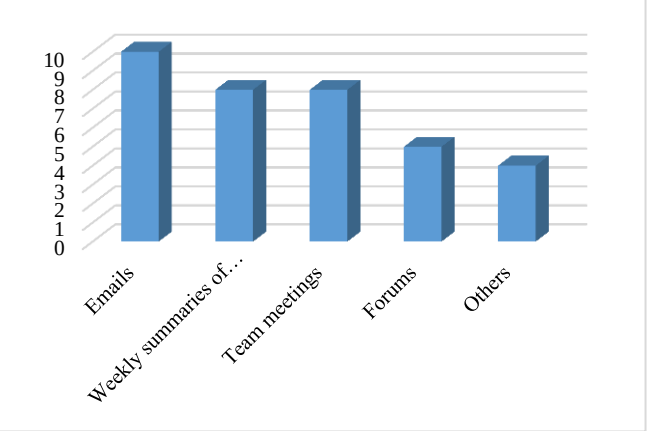


Fig 7: kind of sources of information getting for monitoring industrial assets

How important industrial intranet for monitoring industrial assets of oil and gas companies in Nigeria

Particulars	Frequency	Percent
Highly important	11	31.4
Important	8	22.9
Neutral	10	28.5
Unimportant	3	8.6
Highly unimportant	3	8.6
Total	**35**	**100**

It makes clear that 11 respondents stating 31.4% of stating industrial intranet is highly important while 8 respondents making 22.9% of stating it as important, 10 respondents making 28.5% of stating it as neutral and an identical 3 respondents making 8.6% of stating it as unimportant and highly unimportant.

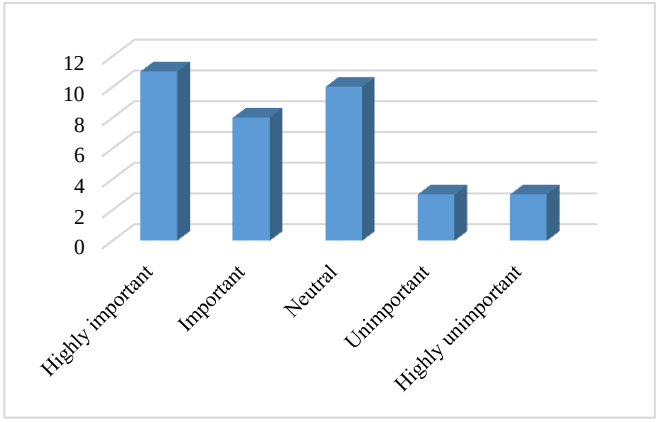
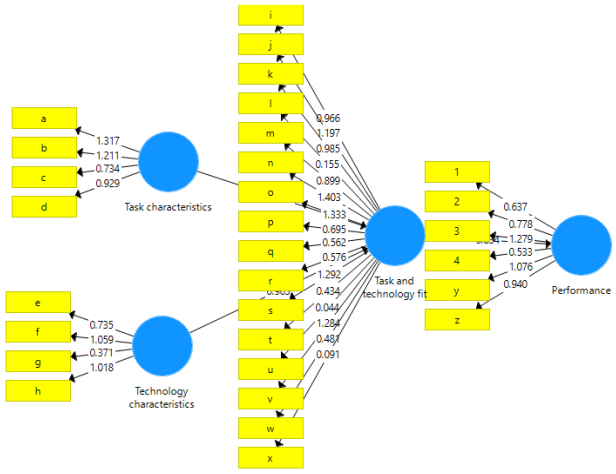


Fig 8: Important of industrial intranet for monitoring industrial assets

PLS-SEM



Evaluation of outer measurement model

The primary intention of assessing the model is to calculate the reliability followed by internal consistency and validity of the observed variable with the unobserved one. The present study evaluate the consistency using construct

reliability test whereas convergent for assessing the validity. The study investigates the outer loadings and the values are higher than 0.7 and hence it found to be acceptable whereas lesser than 0.7 found to be discarded.

Construct reliability and validity

Particulars	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Performance	**0.876**	**0.869**	**0.527**
Task and technology fit	**0.842**	**0.836**	**0.526**
Task characteristics	**0.926**	**0.935**	**0.619**
Technology characteristics	**0.924**	**0.915**	**0.661**

Cronbach Alpha and composite reliability primarily used to check the internal consistency evaluation in the construct reliability. From the above table, it makes clear that cronbach alpha and composite reliability secures values to be higher than 0.80. The values exhibited that scales were reasonably reliable and at the same time latent variables value greater than the minimum threshold level of 0.70. To prove this, AVE calculated and the values are higher than 0.50 . Hence convergent validity is confirmed for the above stated model. Finally, the results clearly depicted that the good convergent validity seen and at the same time internal consistency found to be good.

Fornell larcker criterion test

Particulars	p	TTF	TC	TEC
Performance	0.477			
Task and technology fit	0.584	0.355		
Task characteristics	0.370	0.624	0.565	
Technology characteristics	0.118	0.482	0.118	0.511

Where (P represents performance, TTF represents task and technology fit, TC represents task characteristics and TEC represents Technology characterstics)

From the above table, it makes clear that the squared correlation compared with the correlations from other varirables using Fornell larcker criterion test. The values depicting that it is smaller than the squared root of average variance and hence it implies satisfactory discriminant validity.

Evaluation of inner structural model

The measurement is showing valid and reliable and the next step is to assess the inner structural model using coefficient of determination followed by path coefficient, t statistics value and effect of size. These are considered to be the key standards especially for evaluating the inner structural model.

Measuring the effect size

Measuring effect size is the impact of each construct on the endogenous latent variable. When an independent variable deleted from the path model, it alters the value of the R square and defines whether the removed variable has an impact on endogenous latent variable .F square values of 0.35 represents strong effect, 0.15 shows moderate effect and 0.02 represents weak effect. From the below table, it makes clear that task and technology fit, task characteristics and technology characteristics secured values of 0.517, 0.737 and 0.383 respectively. Hence, all the exogenous variable has a strong effect on the value of R square.

Exogeneous latent variable	Effect size f^2	Effect
Task and technology fit	**0.517**	**Strong**
Task characteristics	**0.737**	**Strong**
Technology characteristics	**0.383**	**Strong**

Standardised root mean square residual

It is an index of the average of standardised residuals among the observed and the hypothesized covariance matrix . Generally, SRMR applied to measure the estimated model fit. The below table depicts that SRMR is 0.001 which is lesser than 0.08 and hence the model has found to be good fit for the study . Besides, chi-square value to be 710.638 and NFI equal to 0.030 was also measured.

Particulars	Estimated Model
SRMR	0.001
d_ULS	11.611
d_G	6.926
Chi-Square	710.638
NFI	0.030

Measuring the value of R square

The value measures the overall effect size and variance which is explained in the endogenous construct for the structural model which measure the model predictive accuracy. In this study, inner path model is 0.741 for the performance and 0.558 for the task and technology fit. Hence the two attributes constructs substantially 55.8% of variance in the task characteristics and technology characteristics and task and technology fit have 34.1% of variance in the performance. Henseler et al and Hair et al has stated that R square value of 0.26 to be weak, 0.50 as moderate and 0.75 to be substantial. Therefore the present study has a performance value is substantial whereas task and technology fit has a moderate effect.

Particulars	R Square	R Square Adjusted
Performance	0.741	0.321
Task and technology fit	0.558	0.530

Latent variable correlation

	P	TTF	TC	TEC
Performance	1.000			
Task and technology fit	0.584	1.000		
Task characteristics	0.370	0.624	1.000	
Technology characteristics	0.118	0.482	0.118	1.000

With the help of the measurement models and structural model, it is highly determined because hypothesis are statistically significant and hence it is accepted. The results of the study stated that all variables of task and technology theory support the performance impact in oil and gas companies in Nigeria.

Estimation of path coefficient and T statistics

PLS path coefficient and standardised coefficient results from regression analysis are similar. With the help of β value, hypothesis testing conducted. If β value is greater, then the substantial effect on endogenous latent variable to be higher. To test the significance of the path coefficient and T statistics value, bootstrapping carried and exhibited the results below. Hence the variable task and technology fit participated relatively to the greater value of 34.1% in the dependent variable whereas task and technology characteristics participated relatively greater value of 55.8% of the dependent variable.

Particulars	Standard ised beta	T Statistics	P Values
Task and technology fit -> Performance	0.584	0.834	**0.00**
Task characteristics -> Task and technology fit	0.575	1.900	**0.05**
Technology characteristics -> Task and technology fit	0.414	0.963	**0.03**

Technology characteristics influenced task and technology fit ($\beta = 0.414$, $T = 0.963$, $p < 0.005$). Hence it is highly supported. With regard to task characteristics and task and technology fit ($\beta = 0.575$, $T = 1.990$, $p < 0.005$). Thus ,it is statsically significant. Considering task and technology fit and performance, ($\beta = 0.584$, $T = 0.834$, $p < 0.005$). Finally, the results stated that task and technology fit significantly influenced the individual performance in oil and gas companies in Nigeria. Finally, the greater beta coefficient ,the strong effect of exogenous latent variables on the endogenous latent variables.

VII. FINDINGS AND DISCUSSION

From the survey outcome, it makes clear that industrial intranet widely implemented in oil and gas maintenance department which is used in major oil and gas companies in Nigeria. Industrial intranet considered to be the most significant sources of information which clearly exhibits the operation of industrial assets of the organization. Maximum number of respondents stated that only one industrial intranet widely used based on their purpose of the organization. Industrial intranet provides industrial assets information, work instructions, guidelines and process description to the user. Most of the industrial information intimates to the user via emails and weekly summaries. This in turn makes the employees to take necessary action even before stoppage of machineries in the production line. Hence, many employees stated that industrial intranet is vital for maintenance department to monitor the assets of oil and gas companies.

However, PLS-SEM depicts as an effective technique for investigating the complex models, validate it accordingly. Here, the conceptual paths of task and technology fit theory estimated using SEM based PLS techniques. The results of the study revealed that task characteristics have a positive influence on task and technology fit ($\beta = 0.575$, $T = 1.990$, $p < 0.005$) followed by technology characteristics have a positive influence on task and technology fit ($\beta = 0.414$, $T = 0.963$, $p < 0.005$) and at last task and technology fit have a positive influence on performance ($\beta = 0.584$, $T = 0.834$, $p < 0.005$). Hence, the findings of the present study consistent with the Goodhue results. Finally, the study found that there is a positive association between task technology fit and performance and hence the companies are more likely to utilise industrial intranet for maintenance department the high productivity achieved

VIII. CONCLUSION

It is observed from the study that only one common intranet is available for each oil and gas companies which provides an update information on industrial assets information to be in cloud data base. Top management level of people have the power to access industrial intranets in the organization. Most of the information is available to the users in the form of emails and weekly summaries of the industrial assets of the equipment. However, the study challenged for the researcher to fix original task technology fit theory to be applicable for industrial intranet especially for oil and gas companies. With the help of correlational approach, it makes clear that variables are highly correlated to one another. Finally, task characteristics and technology characteristics have an impact on task and technology fit followed by task and technology fit have an impact on individual performance of oil and gas companies in Nigeria.

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Blockchain in Payment of Agriculture Subsidies in Malaysia

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Abstract:

Nowadays, blockchain technology are being implemented in many sectors and industries. Initially, this technology was only used for cryptocurrency which is built with cryptographic protocols that make transactions secure and difficult to fake. Most technologies around the world are expected to use blockchain in the future, as this technology is efficient for online transaction compares to the traditional ways. Agriculture subsidies is one of the areas that blockchain technologies can be applied. The most common problem with current agriculture subsidies in Malaysia is lack of banking infrastructure, which can leave a certain section of subsidy-eligible farmers deprived of their rights. Lack of data for ascertaining eligibility and lack of tools to track utilization of funds has also come up as the biggest threats and these are part of the agriculture subsidies problem. This paper aims to solve the problems stated above by applying Ethereum smart contract on the subsidy's payment for the financial for agriculture site, thus preventing lack of infrastructure and data.

Keywords:

Blockchain, Ethereum, Smart Contract, Agriculture Subsidies

I. INTRODUCTION

Agricultural subsidies can be defined as incentive, which is paid to agrobusinesses, agricultural organizations and farms. This is due to managing the supply of agricultural commodities, supplement their income, and influence the cost and supply of such commodities. To develop the country's agriculture sector, as well as to increase productivity and income of agrobusiness and farmers, the public sector which is the agriculture-based ministry (government) has been given some allocation which also can be called as agricultural subsidy [1]. The private sector also play an important role as a subsidizer to the farmers. They can change the way decision-makers view agriculture and poverty reduction programmes. Involvement from them is powerful in promoting the use of sustainable agricultural practices to support small-scale farmers, as well as allowing equal access to land, technology and markets [2]. Strong complementarity between private and public sectors is important. The public investment started pouring in for the promotion of agricultural marketing infrastructure when the private investment came [3]. The subsidizer which is from public sector and private sector can be called as funder.

The main benefit of agricultural subsidies is that it can boost up the agricultural sectors. Farmers and agrobusiness are the one affected from the subsidy given by the public and private sector. Farmers in some country sees that these subsidies can help them to scale agricultural insurance to a certain extent, but without it, costs to maintain the agricultural business remain too high and most products are financially unsustainable [4]. These subsidies stimulate additional production of government-favoured commodities by raising incentives to use scarce land and farmer talent on some products [5]. The specifics of the government program determine the degree of production stimulus.

Real farm programs and agricultural businesses are usually much more complex and with the help from the government as well as private sectors, these programs can become easier and the time can be shortened. These subsidies also very important for operating and development expenditure in agricultural sectors. This is to increase the development allocation in order to ensure the country's agriculture and livestock would continue to be developed sustainably, food supply would be adequate and could be obtained at a reasonable price [1]. The other benefits from these subsidies is that it helps the industrial buyers and processors to have a reliable source of cheap raw material [6]. Many of the raw materials for the agricultural sectors are expensive and not affordable by the farmers. With the subsidies given, it helps them to buy those things and create more crops.

However, these agriculture subsidies still have many flaws that needed to be improved although they have several advantages. One of the main issues that have been in agriculture subsidies is who they subsidized. The problem with farm subsidies is that they don't subsidise farmers and agribusinesses. What happen is that land prices rise to

reflect the subsidies being paid from time to time. This is appalling for those who wish to become farmers but great news for those who owned the land [7]. The control from the government also became a serious issue. Government controls what products receive subsidies, and which do not, and this could create a large problem to those who did not receive these subsidies [8]. The subsidies should be comprehensive and meaningful because there are a lot of riskier occupations in agricultural sectors. Some other issues from these agriculture subsidies that are also highlighted by some researcher includes: (1) the subsidies offered have more to do with other things compare to the financial need, (2) discriminate other farmers which is farmers that specialize on crops or agricultural products and also some cases which are farmer that decides not to grow crops are discriminated and not eligible for subsidies [8].

Smart contract will produce a lot of convenience not only to the farmers, but also to the funders or investor (public and private sectors). By implementing this thing in the agriculture subsidies, we can create a place for the person to share or invest in the agricultural sectors and the program will spread the money to the farmers fairly and automatically. The system also can track the amount of money release to every farmer. Either the money will be given to the farmers or return to the owner, it depends on the outcome.

II. LITERATURE REVIEW

First, Blockchain is fairly new technology and there are a few researches and studies created for that thing. Blockchain can be defined as a public ledger of all Bitcoin transactions that have ever been executed. It is constantly growing, and the miners constantly add new blocks to it for every 10 minutes to record the most recent transactions. The blocks are added in a linear, chronological order [9]. The blockchain also can be called as a growing list of records which is called blocks. These blocks are linked using cryptography and each block contains a cryptographic hash [10]. Blockchain become the important part of the internet and this technology is secure as it uses hashing for every block. The word blockchain comes from the word's "block" and "chain".

In this context, it is about digital information which is the "block" stored in a public database which is the "chain" [11]. For a block to be added to the blockchain, four things must happen: (1) a transaction must occur, (2) the transaction must be verified, (3) the transaction must be stored in a block, and (4) the block must be given a hash. The transaction in the blockchain is happened when the action triggered by the participant and the data is entered the chain in intervals known as blocks. Each block is time stamped and transactions verified. This method of storing data in duplicate creates a chain of transactions that are simply called as blockchain [12]. Each of the block that has been inserted cannot be deleted or modified.

Blockchain also uses consensus algorithm in order to achieve reliability. It is a decision-making process for a group, where the decision that works best for the rest of them are constructed and supported by every individual in the group [13]. This algorithm target is to reach a specific goal by any means, reliable and fault tolerant compare to the byzantine. There are many different types of consensus algorithm and among the popular one is Proof of Work (PoW) and Proof of Stake (PoS). Various industries around the world including agricultural sectors are being disruptive by its implementation as the blockchain has many advantages.

Smart contract is one of the features in the blockchain and it can be defined as self-executing, written into code, and built as complex if-then statements. The definition of smart contracts also comes from Nick Szabo, an American computer scientist who invented a virtual currency. He stated that the smart contract is a computerized transaction protocols that execute terms of a contract. Meanwhile, this contact a self-executing contracts between buyer and seller with the terms of the agreement and directly written into lines of code. The code and the agreements contained exist across a distributed and/or decentralized blockchain network [14]. Ethereum, EOS and Tron are such platform that supported smart contracts and all these threes are what most people use [15]. By posting transactions on blockchain network, users can create a smart contract.

Payment is one of the areas that blockchain can be implemented. Nowadays, most of the payment payments are using online payment, and this blockchain payment platform is one of the popular platforms in the blockchain. However, there are not much or none of this technology is used for the agriculture subsidies. Most of the payment platforms are used for business or personal which is good but need an enhancement of the usage. It can be used in other sector as well like as agricultural and construction sectors. Example of the popular blockchain payment platform is BitPay. This modern payment platform also has a lot of advantages compare to the traditional way.

The blockchain payment systems provide a more secure and transparent for the customers rather than traditional way which the authority like a bank is able to control all our actions through the system [16]. There aren't any bosses in blockchain payment system. The community, all together, rules the platform. This make a lot easier for the users to contribute and take the money within the requirement needed. The costs also reduced which leads to a lower commission fee. The systems provide an easier and faster cash-out process without any settlement rate and once it is in the system, it becomes secure. As in the Malaysia, there is no undergoing development/ready to use system of blockchain based on payment yet especially in agricultural sectors. Table 1 show the features of Bitpay.

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Table 1. Features of bitpay

Features	Explanation
Platform	• Cryptographically Secure API • Two-Factor Authentication
E-Commerce	• Shopping Cart Plugins • Embeddable Invoices
Billing	• Cross-Border Payments • Email Invoicing
Retail	• Multiple User Capability • Gratuity Options
Support	• Email Availability • Dedicated Account Management

III. METHODOLOGY

A. Proposed System

The system builds by using React.js as front end and Node.js as backend. Remix language used for smart contract development. First, users have to login to their e-wallet by using Fortmatic in the main page. This is important to stay put with the system. The system has a dApp that are integrated with web3.js that will simply make the Fortmatic to be integrated with the Ethereum network. Users also can interact with smart contract by using web3.js.

When an investor or funder creates new fund/payment in the system, new contract is deployed in the Ethereum network. The funders can simply track the record of their fund which is where and when it goes. The other part from this system is the fund can be collected by the other users which are in this case is agrobusinesses. But they must meet a few requirements that need from the system and the funders in order to collect the money.

The system is connected to Ethereum network using Frost, which is an open API for developing integrations, registering works, and integrating the system. This system uses proof-of-authority blockchain called Kovan network in order to solve the problem of spam attacks on Ethereum network. Figure 1 shows the diagram of system architecture of the system and figure 2 shows the transactional flow of Ethereum in the system.

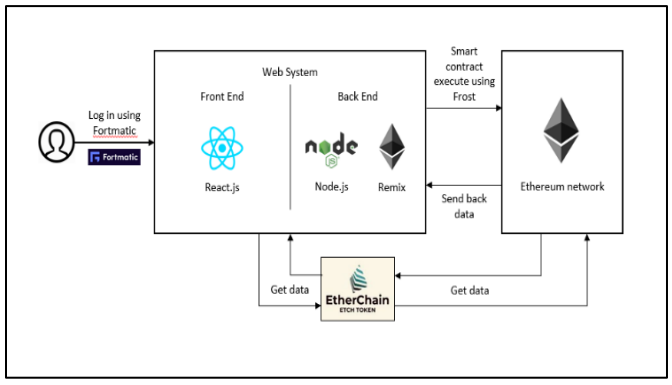

Fig.1 System architecture of the system

B. Algorithms

The algorithms are :

- Investor/funder donate to smart contract.
- Smart contract holds the money collected.
- Investor/funder can see the details of the transaction of the contracts.
- The money will be sent to the farmer once it follows all requirements and agreed by the investor/funder.

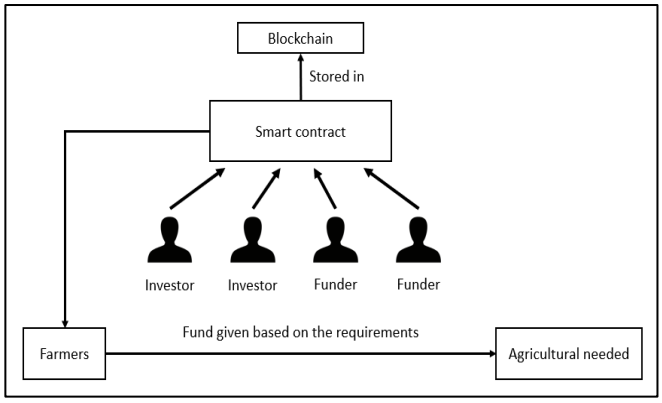

Fig.2 Transactional flow of Ethereum network in the system.

C. Sequence Diagram

The sequence diagrams are:

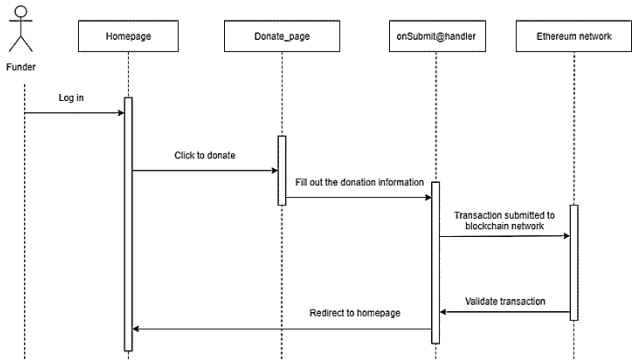

Fig.3 Donation from funder sequence diagram

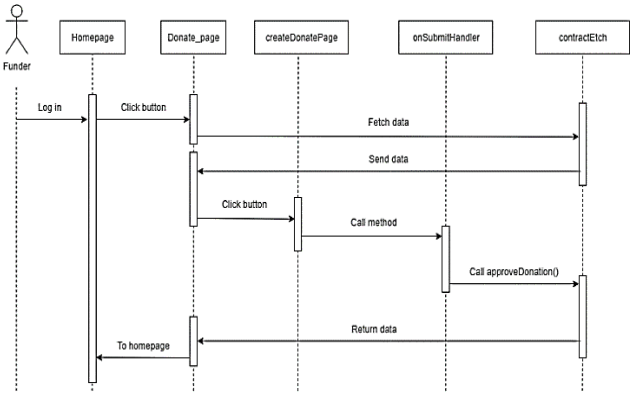

Fig.4 Create new fund sequence diagram

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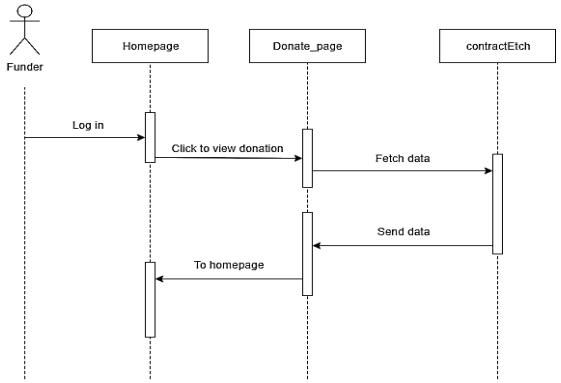

Fig.5 Approve fund sequence diagram

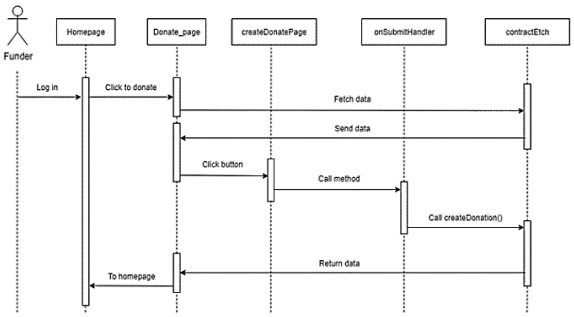

Fig.6 Check fund sequence diagram

D. Graphical User Interfaces

The graphical user interfaces are:

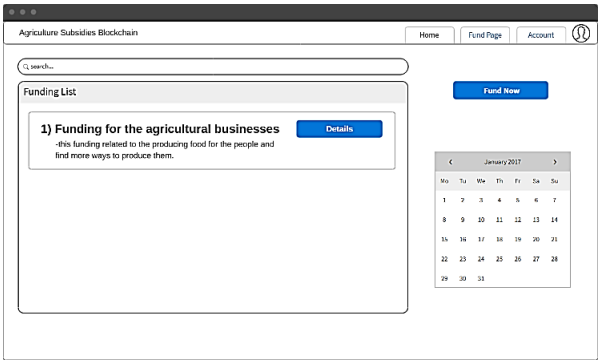

Fig.7 Homepage

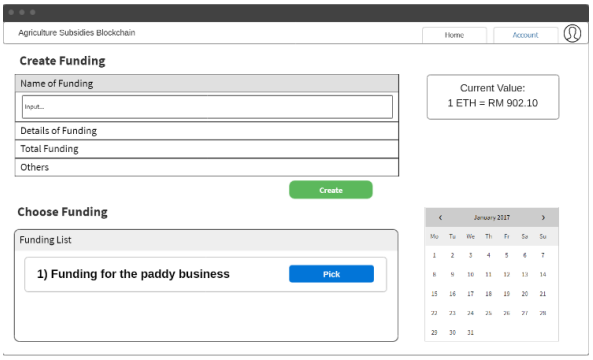

Fig.8 Create Fund Page

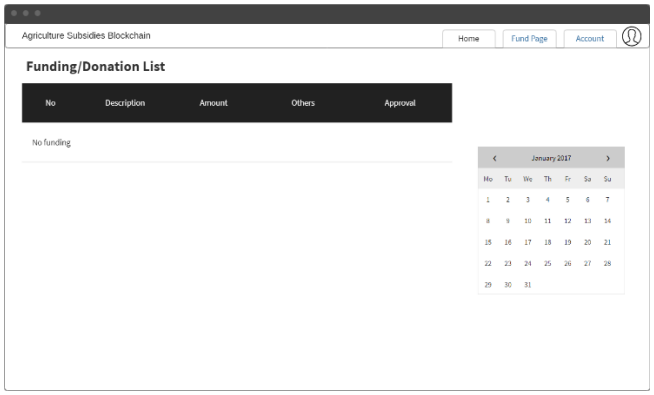

Fig.9 Funding/Donation List with approval (empty fund)

IV. CONCLUSION

Implementation of blockchain technology to this kind of payment (agricultural subsidies) creates more chances for farmers to live on these days. Farmers really need this as there will be more transparent on distribution of the money. The funders also do not need to rely on the third party anymore as this system will handle their money that they will give to the agricultural businesses. The system also can track where their money is and where it has been spent. But, blockchain have a long way to go in Malaysia. In the future, the implementation of ERC-777 into the smart contract will be plan as this thing provide more benefits which are: (1) reduce friction in crypto transaction, (2) lower transaction overhead. This also can reduce fraud cases by rejecting incoming token from a blacklisted address.

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The Study of Modified Bonechar Synthesis to Apply in the Treating Alum Water in Kien Giang Province

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Abstract:

In this research, bone char was synthesized going from bovine bone waste which collected at cooking shop of noodle soup with beef in Vietnam country, called as Vietnamese bone char (VNBC). In VNBC synthesis, the results of synthesis process were found the VNBC product sample with the optimal calcination condition to be at temperature of 600°C, corresponding to the time of 90 minutes. Further, the characteristics of VNBC product sample were analyzed with the specific surface area of 76.404 m^2/g, and pore diameter of 87.48 Å measured by BET method. The surface morphology with the particle size measured by SEM method was 70 nm. The composition compounds of VNBC contained calcium carbonate-hydroxyl apatite with the formula was $Ca_5(PO_4)_3(CO_3)(OH)$ measured by FT-IR and XRD methods, respectively. In application, VNBC uses as adsorbent to treatment the alum water sample collected at Kien Luong region of Kien Giang province were considered. The results of VNBC adsorbent to treat alum water solutions measured by UV/VIS method obtained the conditional indicators after alum water adsorption are in agreement with the cleaned water of Vietnamese standard. These results suggested that VNBC are able to use making a potential adsorbent in the treatment of alum water resource becoming clean water resource in Vietnam.

Keywords:

Bovine bone waste; VNBC synthesis; Adsorbent; alum water

I. INTRODUCTION

The use of meat or fish making food for human has been disseminated in all over the world. This means that the slaughterhouses have to produce an enormous amount of bovine or fish bones. This growing amount of bone residue among other waste materials from meat and fish processing industries considered such as one of the pollutants to environmental challenges that the food industry is facing today. In detail data after slaughtering, one animal is able to produce about 18 weight % bone residues of its total live weight, which considered as slaughterhouse waste source[1-3]. Further, the chemical compositions from bovine bones were consisted with a compound both organic (30%) and inorganic (70%) in which proper mechanical properties of bones as stiffness depended on their mineral parts. The model compound into mineral phase of bones is a biological apatite called as nonstoichiometric hydroxyapatite [4, 5]. This nonstoichiometric hydroxyapatite was used in enamel and dentine with the Ca/P molar ratio exceeds 1.67. Based on its chemical and structural minerals, bovine bone is not only a biocompatible, osteoconductive, non-toxic, noninflammatory and nonimmunogenic agent, but also bioactive to apply greatly in biochemistry[1,5].

In previous bone residues, inefficient management of these bones are creating an effective variety of problems to the endanger public health and the environment in general. When bones are waste in land, this bone wastes created a pollution of surface and underground waters and air quality[6, 7]. As a result, it is caused the affective health of residents living within the vicinity of the abattoirs, destroyed water bodies making affectively to fish yield thus [8,9]. In addition, bone wastes are also ideal breeding grounds for disease causing organisms (pathogens) to development. It is usually disposed by burning since treatment, effected thus to which further pollutes the air and endanger human lives.

Adsorption is a phenomena to known that as the consist in the transfer of an adsorbate from a gas or liquid phase to an adsorbent, in which it existed a bonding through intermolecular forces. In adsorption, the quantity of adsorbate in a surface area unit is small. Because of this, normally porous adsorbents with a great internal surface area are selected. On the other hand, it has two types of adsorption phenomena that can be know such as physical and chemical. Physical adsorption, easily reversible, is the result of Van der Waals intermolecular forces (physical interaction) between adsorbent and adsorbed substance (adsorbate). This interactions is weak, thus the energy when

the molecule physisorbed is about the same order of magnitude as the condensation enthalpy[10-12]. Whereas, chemical adsorption is the result of the chemical interaction between the adsorbent and the adsorbate to form the chemical bonds. Hereafter, the chemical bond force is able to vary so that chemical compounds cannot be formed in the usual way. However, the adsorption forces of chemisorption is normally a lot higher than of physisorption. During chemisorption, the heat is always released, and as an exothermic process, which commonly is similar to a chemical reaction heat. In addition, it is the same substance that at low temperatures experiences essentially for physical adsorption, sometimes exhibited for chemical adsorption at higher temperatures, and can be both processes simultaneously[13-15]. In application, the adsorption process has a widely application in environmental treatment. Specially, liquid–solid adsorption systems are based on the ability of certain solids as adsorbents to preferentially concentrate specific substances (adsorbates) from solutions onto their surfaces. This rule can be used for the removal of pollutants, such as metal ions and colored organics from wastewater. To adsorbents producing used for adsorption process, a number of low-cost agricultural wastes such as mud tire rubber, and ash are investigated. Other potential minerals and materials for instance bentonite and bone char as potential adsorbents have been tested also, respectively. Many previous studies have been reported during the last ten years to find the low-cost, and efficient adsorbents for the removal of metal ions or color compounds in wastewater [16-20].

Actually, bone char has been successfully synthesized and used for fluoride removal in Tanzania and Thailand [21,22]. The effectiveness of bone char as an adsorbent has been performed using batch experiments with contained heavy metal ions and color solutions under different conditions, for example, variable pH, temperature, chemical and thermal activation, adsorbent dosage [17,18,23]. However, the synthesis process of bone char and its application in wastewater treatment containing metal ions and color solutions at Vietnam (VNBC) are still new research. Bone char is a material obtained by carbonizing animal bones. It is consisted mainly compound of hydroxiapatite and carbonate with its zero charge point between pH value of 8 and 9. Bone char has been used for thousands of years in many fields such as fertilizer, pigment, cosmetics, and varnish. Recent studies have used bone char to adsorb radioisotopes of antimony and europium ions from radioactive wastes. Researchers claimed that sorption is due to cation exchange of metal ions onto hydroxyapatite [14,16,22-25]. Therefore, the goal of this study is to find the process of VNBC synthesis from bovine bone waste. Simultaneously, VNBC product then is measured by analysis methods to determine the surface properties. Finally, we try to apply VNBC product as an adsorbent to remove the organic colors in solution. In the detail this works, the samples of bovine bone waste are treated and calcinated then in conditional without oxygen at different temperature and time to find the optimal condition burning. The optimal VNBC sample, then are chosen and measured surface properties by analysis methods. The effects of conditional temperature and time to adsorption capacity on VNBC are also investigated.

Kien Giang is a coastal province in the Mekong Delta in southern Vietnam, with most of the province's area in the former Rach Gia province. Kien Giang has a city, a town and 13 districts, a total of 145 communal units including 12 towns, 15 wards and 118 communes. Kien Giang has four main land areas: sweet alluvial areas in the west of Hau Giang, areas affected by alum inundated in Long Xuyen quadrangle, saline areas in Ca Mau peninsula and mountainous areas, islands in Phu Quoc and Kiên Hải districts. In particular, agricultural land, accounting for 64.2% of natural area, forest land accounts for 122.8 thousand hectares, special-use land of 35.4 thousand hectares and residential land of 10.1 thousand hectares. In addition, the province has over 70,000 hectares of unused land and unstable production with more than 25 thousand hectares of mixed gardens. Forests in Kien Giang are few, mainly protection forests. Kien Giang has a monsoon tropical climate, hot and humid all year round. Kien Giang is not directly affected by the storm but the amount of rain due to storms accounts for a significant proportion, especially at the end of the rainy season. Weather conditions of Kien Giang have the basic advantages that other provinces in the Mekong Delta do not have such as: lost natural disasters, no cold, no direct landing storms, abundant light and stable temperature are during the year. It is very convenient for many kinds of plants and animals to grow. In Kien Giang province, the level of acidity is quite high, ie low pH, people call it alum water because of the sour taste. Acid in alum water is sulfuric acid, which is formed when alkaline pyrite (FeS_2) soil comes into contact with air. Acid sulfate soil was formed due to geological tectonic process. In the rainy season, rainwater washes out acid sulfate soils, carries a lot of iron, aluminum sulfate and organic humus acid, contains lots of H ions and acidic hydrolysates such as $AlCl_3$, $Al_2(SO_4)_3$, $FeCl_3$, $Fe_2(SO_4)_3$, $FeSO_4$. Through the pollution of acid sulphate soil, most of the regions from Ha Tien to alleviate alum water affect the living process of the people here, especially the consequences of alum water cause such as causing stomach pain, water containers are corroded, bathed with blisters, opaque yellow water containing a lot of iron alum causes poor aesthetic feeling, clear blue water contains a lot of alum, low pH, if Use will damage tooth enamel, digestive system because water is too acidic. Iron content greater than 0.3 mg/ L, manganese greater than 0.1 mg/ L stains clothes and household containers, high aluminum content will make water colored and deposition in containers, causing neurological disorders, causing osteoporosis in the elderly and affecting the kidney's ability to filter blood; high sulfate content causes unpleasant taste for broth. The data show

that the composition and image of alum water collected in Kien Giang province shows the time according to the table 2 below.

Base on current situation of the bovine bond waste and alum water sources at Kien Giang province of Viet Nam that need to be solved. Therefore, the important applications of bone char can be seen that the construction of bone char synthesis process and its application in treating alum water are necessary to deploy. Thus, studies need to be developed, experimented, as well as knowledge to run on a small scale first needs to be done. To do this, the first is to build the process of synthesizing bone char and its product application then in environmental treatment of alum water with the scale of applied research in the laboratory, this is the main works in the project, which we did.

II. MATERIAL AND METHODS

Many samples of the bovine bone wastes collected from cooking shop of noodle soup with beef, and experiments to VNBC synthesis are performed at the Faculty of chemical engineering, Industrial University of Ho Chi Minh City of Vietnam. In all experiments and measurements are that the first step, we fixed each time (time constant) to calcine the bovine bond samples to VNBC products with the changed temperature from 500-800 ^{0}C, and trying to then adsorption capacity of VNBC products with alum water. Hereafter, the highest adsorption capacity product is found to correspond with optimal temperature burning. In second step, by repeating similar experiments in the first step, temperature (temperature constant) is fixed but to find optimal time burning. Finally, VNBC product in synthesis process having an optimal temperature and time burnings were found, and measured the surface characteristic by analysis methods.

Samples of alum water were collected in the district of Kien Luong district, the pH was 2.5. The samples were taken at the last March 2019, analyzed then to determine the chemical composition of initial alum water sample which it listed in Table 1.

Table 1. Data for chemical composition of alum water before treatment

No.	Indicators	Number of samples analyzed	Concentration (mg /L)
1	Độ pH	3	5.2
2	Fe^{3+}	3	4.0
3	Al^{3+}	3	1.3
4	Pb^{2+}	3	0.05

In performance of alum water treatment by VNBC products, the concentrated alum water after adsorption on VNBC was analyzed by UV-VIS spectrophotometer. Herein, this method consists in forming alum water complex which are measured with photometric measurement of absorbance at a wavelength of 550 nm and 650 nm, respectively.

To determine the surface characteristics of optimal VNBC product such as compound components and phase composition are analyzed by X-ray Diffraction (XRD) method with graphite monochromator using Cu-Kα of 1.54, combined with FT-IR analysis spectrophotometer in the range of middle infrared from 400 to 4000 cm^{-1}. In addition, the effect of calcination temperature on the microstructure of optimal VNBC sample is analyzed also using scanning electron microscope (SEM). The calculations of adsorption capacity analysis methods are used in this work to be in line with previous experiments[26, 27]. Many results of synthesis process and analysis are performed respectively in following below,

III. RESULTS AND DISCUSSION

III.1.The process to VNBC synthesis

The samples of bovine bone waste are collected from cooking shop of noodle soup with beef, washed with hot water at temperature (T) from 50 to 60 ^{o}C, done then the fat clean with weak soap solution. The samples are washed continuously with hot water at 50-60 ^{o}C, and dried at 105 ^{o}C. Finishing wash, bovine bone wastes are calcinated into furnace to VNBC product, and grinded then to the small pieces of 1 mm particle sizes. The process of VNBC synthesis is at Figure 1 in following:

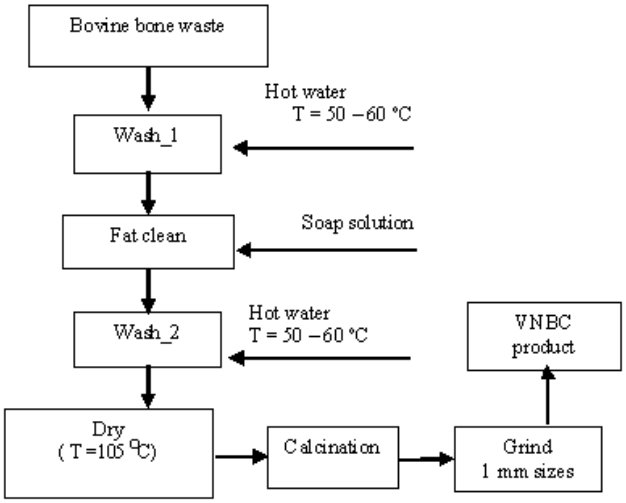

Figure 1: VNBC synthesis process

The most important step of synthesis is bone calcinated into furnace at the condition of without oxygen. The principle and structure of calcinated furnace with laboratory model in charring of bone is designed similarly to previous study[28]. By doing this, the performance of synthesis steps from bovine bone waste to VNBC product was obtained experiments at laboratory as shown in Figure 2.

Figure 2: The images of VNBC synthesis process in laboratory. It is denoted that Figure (a) as bovine bones collected from cow slaughterhouse, Figure (b) as bovine bones collected from cooking shop of noodle soup with beef, and Figure (c) as bovine bones synthesized to VNBC, respectively.

III.2.The experiments on burned temperature effects to BC synthesis

In this works, we have done experiment that, each a bovine bone samples (BBs) after cleaning is weighed with initial m_1 mass (in gram, g), and then burned into furnace at conditional without oxygen at 60 minutes, where it is changed the temperature burning (T_b) from 400 to 800 ^oC. After burning, VNBC product is weighed to determine the m_2 mass (g) in each BBs. The results of burned temperature effect and recover efficiency as the ratio of m_2 divided m_1, namely E (in percentage, %) of VNBC products at different temperature are obtained in Table 2, respectively.

Table 2. The effects of burning temperature to VNBC synthesis.

BBs Sample	T_b	m_1	m_2	E
500- 60	500	11.16	8.12	72.76
600- 60	600	10.04	6.95	69.22
700- 60	700	10.15	7.01	69.06
800- 60	800	10.56	7.30	69.13

We observed in Table 2 that E is 69.22 % at T_b of 600^{o}C. Thus, in this works, use of the BB600-60 sample is chosen as VNBC product at optimal condition of 600 ^{o}C temperature in synthesis process. Further, VNBC products are charred bone does not add color, taste or smell to the water which it is in line with bone char products in previous experiments[15, 22, 23, 28, 29]. This is able to help us have a confident method in VNBC synthesis, also potential applications of product in next time research.

III.3. The experiments on burned time effects to BC synthesis

In similarly, each a bovine bone samples (BBs) after cleaning is weighed with initial m_1, then calcinated at conditional without oxygen at the temperature of 600 ^{o}C, whereas it is changed the times burning ($Time_b$) from 60 to 180 minutes. Hereafter, VNBC product is weighed to determine the m_2. The results of burned time effect of VNBC products at different temperature presented in Table 3, respectively.

Table 3. The effects of burning time to VNBC synthesis.

BBs Sample	$Time_b$	m_1	m_2	E
600- 60	60	19.50	14.70	75.38
600- 90	90	18.94	14.27	75.34
600- 120	120	23.32	17.25	73.97
600- 150	150	23.09	16.74	72.50

It is an observation from Table 3 that the recover efficiency of 75.34 % at time of 90 minute to choose as optimal sample with time. Because, the results of conditional calcination depending on recover efficiency follow us to conclude that the sample of BB600-90 is the most optimal one. This is to say that synthesis process to VNBC product at optimal condition of temperature as 600 ^{o}C, corresponding with the time of 90 minute. Thus, we are used then this sample to treat alum water and measure the surface characteristics of VNBC product at conditional optimization in next step, in following.

III.4. Adsorption capacity of VNBC in alum water treatment

In alum water treatment, in each experiment, a ratio of experimental sample of weighed (gram,g) VNBC product and alum water volume (in ml) contained the chemical composition above (see in Table 1) as 1:10 is mixed together. Sample is shaken then at 60 minute with 250 revs per minute, which the time of sample changed from 30, 60, 90, 120, and 150 minutes, respectively. After those time, samples are filtrated to obtain alum water after asorption by VNBC, measured then pH values and chemical composition by UV-VIS method to determine concentration (in ppm) of chemical compositon in alum water after adsorption. In addition, we also present the concentration of chemical composition in clean water standar in Viet nam. The resulted experiments of five samples (sample 1-5) are found and listed in Table 4, as follow.

Table 4. Chemical composition of alum water after treatment by VNBC product

No.	Indicators	Standard of clean water in Vietnam (ppm)	Concentration after adsorption					
			Initial sample	Sample 1	Sample 2	Sample3	Sample 4	Sample 5
1	pH	6,0-8,5	5.2	6.5	6.25	6,8	6.7	6.8
2	Fe^{3+}	5.0	4.0	3.3	3.2	3.7	3.8	3.9
3	Al^{3+}	2.5	1.3	1.2	1.1	1.2	1.2	1.1
4	Pb^{2+}	0.5	0.05	0.03	0.01	0.04	0.02	0,02

It is observed the chemical concentration after adsorption of alum water sample in Table 4 that the increased pH value is reasonable to compare with sample of clean water standard. To explain for this increase of pH value is clearly that hydroxyl group in the structural VNBC neutralized with H^+ in alum water, this cause makes pH increase. Further, all concentration ions in alum water such as Fe^{+3}, Al^{+3}, and Pb^{+2} is more decreased respectively after adsorption in comparison with clean water sample. Simultaneously, at the time of 60 minute on sample of 2, the

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adsorption capacity of VNBC is the most one because the concentration after adsorption as being lowest, which it followed us to conclude that adsorption time of alum water is the optimal condition of 60 minute. In addition, these results are to say that VNBC being a strong adsorbent with heavy metal ion in alum water. Therefore, our resulted study is giving a positive in alum water treatment by synthesized VNBC product, which can be applied in industry.

III.5. The resulted characteristic surface of optimal VNBC

III.5.1. BET analysis

This analyzed techniques were based on the combination between theoretical BET [31,32] to determine the pore diameter and specific surface area of adsorbents exhibiting a wide range of pore sizes, and described appears to be applicable to porous solids of any nature. By this method thus, the optimal VNBC sample is plotted contour by BET method to what measured results, presenting in Figure 3.

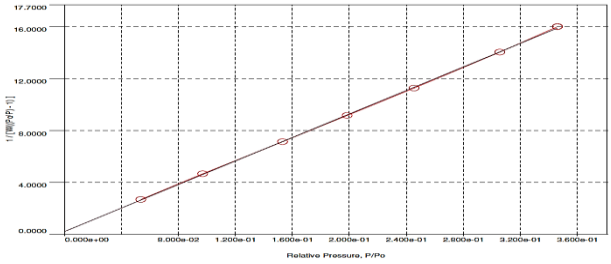

Figure 3. Chart of BET results of VNBC calcined at 600°C for 90 minutes

The resulted BET of VNBC calcined at 600 °C for 90 minutes, the graph can give the following,

Slope = 45.358
Correlation coefficient R = 0,999920
C constant = 204.803
Surface area = 76,404 m²/g

The measured results is observed from Figure 3 that optimal VNBC sample has a specific surface area to be 76.404 m^2/g with pore diameter of 87.48 Å (8.75 nm), this is able to say that VNBC such as mesoporous material has a good adsorption capacity to which it has many potential applications in industry. The resulted BET analysis of specific surface area in present work is varying interval with BET analysis in previous invesstigation [27], this may be due to the differnce of method or different animal bone which effect to synthesis process.

III.5.2. SEM analysis

SEM analysis is confirmed that VNBC product at optimal condition to demonstrate a diversified propensity for crystal agglomeration on the surface. Inhere, the surface morphology and crystal size of optimal VNBC sample (BB600-90) is measured by SEM method, shown in Figure 4.

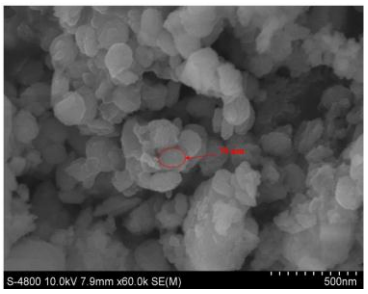

Figure 4. Resulted SEM of optimal VNBC sample with the scale of image is noted 500 nm

It is an observation at Figure 4 that the microcrystal of VNBC sample contributed to be uniform and small particle size. To be more clearly, a scale of VNBC at 500 nm is taken with image to give a crystalline size is 70 nm. Resulted SEM image in this study is in line with previous experiment [27], this means that VNBC synthesis method has a suitable.

III.5.3. FTIR analysis

The basic of FTIR analysis is to identify the characteristic of functional groups on adsorbent surface such as VNBC in present work. The resulted FTIR spectra is measured, and shown in Figure 5.

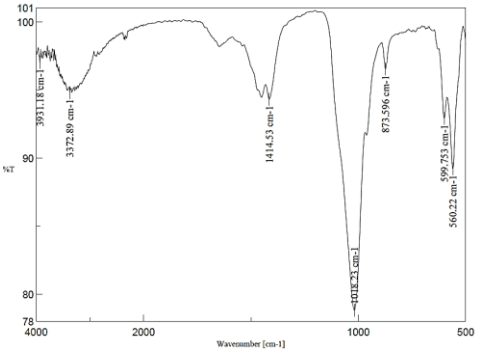

Figure 5. FTIR results of bovine bone after calcined at optimal condition of BB600-90 sample

FTIR analysis of bone char products from animal bones in previous experiment [27,30,33] have been reported that, in transmittance mode, shown the presence of carbonate group at around 1410-1450 cm^{-1} and 873 cm^{-1}, carbon group at C-C (1200 cm^{-1}), C=C (1650 cm^{-1}), and C≡C (2150 cm^{-1}), with hydroxide group at around 3500-3200 cm^{-1}, respectively. For phosphate group at 1030-1090 cm^{-1} and 1950-2200 cm^{-1}, 962 cm-1 and 560 cm^{-1}. Herein, we observe FT-IR at figure 5 that the bands corresponding to the vibrations of C–H and C–C bonds of organic compounds is absent which this confirmed that a total organic matter was removed after the synthesis process. It is only weak band of C=C bond at 1652 cm^{-1} which we predicted that the VNBC sample existing with carbon black composition. Continuously, the presence of characteristic

bands of phosphate group (PO_4^{3-}) is resulted that the sharp peaks existing the wave number of 560 cm^{-1} assigned to bending mode of phosphate and 599 cm^{-1} for the presence of hydroxyl group (OH). The most intensive bands of 1018 cm^{-1} is corresponded to stretching vibrations of P–O bonds, whereas the wave numbers of 3372 cm^{-1} came from the symmetric stretching vibration of H–O bonds. In addition, the low-intensity bands at 1414 and 873 cm^{-1} is observed for sample corresponding to the vibration mode of carbonate group (CO_3^{-2}). These follow us to conclude that the optimal VNBC sample is contained the structure of carbonate hydroxyl apatite compounds.

III.5.4. XRD analysis

To determine the phase composition, the optimal VNBC sample is measured using XRD analysis. The analyzed results of VNBC sample at optimal condition presented in Figure 6.

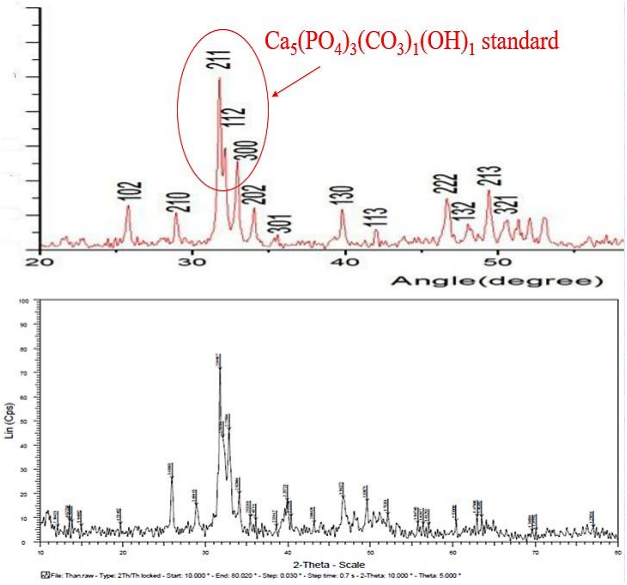

Figure 6. The resulted spectrum of optimal VNBC sample measured by XRD of bonechar samples burned at 600^{o}C for 90 minutes

We observed the XRD spectrum in Figure 6 that, the peaks of VNBC sample (black solid line) is overlapped with the peaks of standard $Ca_5(PO_4)_3(CO_3)_1(OH)_1$ sample (red solid line) at diffraction angle (2θ) from 30 to 35^0, this confirmed that VNBC sample existing the composition of $Ca_5(PO_4)_3(CO_3)_1(OH)_1$ compound (calcium carbonate-hydroxyl apatite. The XRD analysis in this work is an agreement with previous studied [15,27,29,30] to which confirm again that the method of VNBC synthesis process is successful.

IV. CONCLUSIONS

From the resulted investigations, we draw some conclusions in following,

1. In VNBC synthesis, many samples of bovine bone are performed in laboratory which optimal VNBC product sample found at Temperature of 600 °C, corresponding with the time of 90 minutes.
2. The use of VNBC product as an adsorbent is examined to treat alum water in Kien Giang province. The results of VNBC adsorbent to remove heavy metal in alum water is found and obtained with five experimental samples after adsorption which is reasonable with the Vietnamese standard of clean water sample. This is required that used VNBC as adsorbent to treat alum water resource in Vietnam.
3. Many analyses on optimal VNBC sample were measured to determine the surface characteristics. In these analysis methods, SEM can be helpful to describe the morphology of VNBC at nanoscale level with a crystalline size of 70 nm. FTIR and XRD technique given us to find out that crystalline nature of VNBC, existing the calcium metal is bound with PO_4^{-3}, CO_3^{2-}, and OH^- groups, to which structural crystal was $Ca_5(PO_4)_3(CO_3)(OH)$ compound (calcium carboxyl-apatite). Furthermore, BET technique can be used to distinguish the types of pore material and adsorption capacity of adsorbents. Hence, the resulted specific surface area of 76.404 m^2/g with pore diameter of 87.48 Å (8.75 nm) measured to what VNBC sample in this study is a good adsorbent and as a mesoporous material having potential applications in industry.
4. This study is the first step to design successfully the process of VNBC synthesis, also apply it to be an adsorbent in alum water solution treatments. Many other applications and kinetic model of VNBC will be studied continuously in next research.

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Securing Privacy in Data Mining: A Survey of Techniques

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Abstract:

Since two decenniums the expansion of dominant data mining tools and their use on data available over the internet in electronic form has posed threats to individual's privacy and data security. It is believed that legitimate privacy involvement is with spontaneous connection to an individual's records, especially connection to keen information. Awkward or devoid discovery control can be the basic reason of privacy controversies. Methods that involve securing data privacy while increasing the data usefulness are termed as privacy-enhanced data mining (PEDM) methods. To deal with privacy troubles, plentiful data security-intensifying techniques have been worked upon. In this survey, a scheme of classification for privacy-enhanced data mining techniques is given which categorizes various techniques according to the data distribution. This classification scheme divides the privacy-enhanced data mining techniques into two groups; centralized privacy-enhanced data mining techniques and distributed privacy-enhanced data mining techniques. Thus based on the data distribution user can apply the technique according to the need of the application.

Keywords:

Privacy, data mining, privacy-enhanced data mining techniques, centralized privacy-enhanced data mining techniques, decentralized privacy-enhanced data mining techniques

I. INTRODUCTION

Data mining has enticed further recognition in the modern period, perhaps owing to the fact that the commerciality of its spacious ambit of applications in nearly all fields. Han, M. Kamber, and Jei defined data mining as the procedure where interesting patterns and hidden information is disclosed from the tremendous volume of data [1]. Regardless of the fact that the information turned up by digging huge data mines is very profitable, the public has expressed genuine apprehension regarding the other side of the fence; specifically, the privacy threats caused by data mining [2]. Privacy concerns exist when an individual's data is gathered, stored in digital form, and accessed by any third party for mining to reveal application-specific results. In this scenario, an individual's privacy may be infringed due to distrustful miners. To overcome the threat to data security many techniques have been developed in the last two decades. Traditional data security techniques have been applied to preserve an individual's privacy for example, in databases multilevel security model is employed which permits access to users according to the various security levels; data items are encoded using the encryption, anonymous databases, and blind signatures. Numerous other data security techniques are being studied by researchers under a newly emerging subarea of data mining known as privacy-enhanced data mining (PEDM). It is also termed as privacy-preserving data mining or privacy-sensitive data mining.

II. CLASSIFICATION OF PRIVACY-ENHANCED DATA MINING TECHNIQUES

Privacy-Enhanced Data Mining (PEDM) techniques have been worked upon to extricate the information from a huge dataset while preserving privacy. In this complete process, of not disclosing an individual's private information, the challenge in the task is to balance the two contradictory facts that are to increase data utility and preserve the data integrity. C.C. Aggarwal and

P.S. Yu in his research concluded that there is a natural degradation of data quality if privacy-enhanced data mining techniques are applied to extricate information [3]. There is a paradox between information loss and privacy. Anyhow, the benefits of data mining cannot be disregarded because everything comes with a price. Thus, there is a need to study the privacy-enhanced technique to ensure data-security and user-privacy [4].To allow effective mining results PEDM techniques are designed in a way that will not degrade data quality and will guarantee a certain level of privacy.

A number of taxonomies for PEDM methods or techniques are proposed by many authors over the past decade. In this survey, we list all the preliminary PEDM techniques and describe them one by one in detail. Current

studies on PEDM techniques can be classified into two main categories- Privacy-enhanced Distributed Data Mining Techniques and Privacy-enhanced

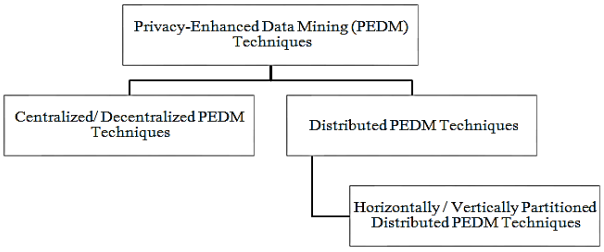

Figure 1: Classification of PEDM Techniques

Centralized / De-centralized Data mining Techniques. Most of the PEDM techniques come under these two categories as shown in figure 1. The following sections will describe each of the PEDM technique in detail.

III. CENTRALIZED/ DECENTRALIZED PEDM TECHNIQUES

The techniques that come under this category are listed in figure 2 and are explained in the following subsections:

3.1 Modification

3.1.1 Randomization

Additive Noise: In this method the noise is appended to the actual data value such that the new data value obtained is given as new_data_value = old_ data_value + e, where e is the noise [5].

Multiplication Noise: In this method the noise is multiplied to the actual data value such that the new data value obtained is given as new_data_value = old_ data_value * e, where e is the noise [6].

3.1.2 Perturbation

Geometric Data Transformation: A family of data transformation techniques were introduced by Oliveira and Zaiane [7] for privacy-enhanced. Basic operations performed in geometric data transformation method are:

Scaling: In view of this approach the value of the attribute is changed by adding the noise term to each attribute to obtaining the confidential data. The noise is constant and can be either negative or positive. This approach is termed as Additive Noise Perturbation.

Translation: In view of this approach the attribute is changed by multiplying the noise term to each attribute to obtaining the confidential data. The noise is constant and can be either negative or positive. This method is known as Multiplicative Noise Perturbation.

Rotation: This method works entirely indifferent manner. The noise term in this method is the angle θ. The attribute is rotated at an angle θ with respect to the origin and the new perturbed attribute is obtained by the equation V'= R*V. R represents the rotation matrix, V is the actual attribute vector and V' is the perturbed attribute vector. To achieve better accuracy and confidentiality we can apply this method more than once.

Probabilistic Data Transformation: Agrawal and Srikant [8] introduced a method that replaced the actual values of the individual data by the new values obtained by adding arbitrary values using probability distribution to the old data attributes in a decision-tree classifier.

3.1.3 Blocking

In view of this approach the attribute value is replaced with an enigmatic symbol to hide the sensitive rules.

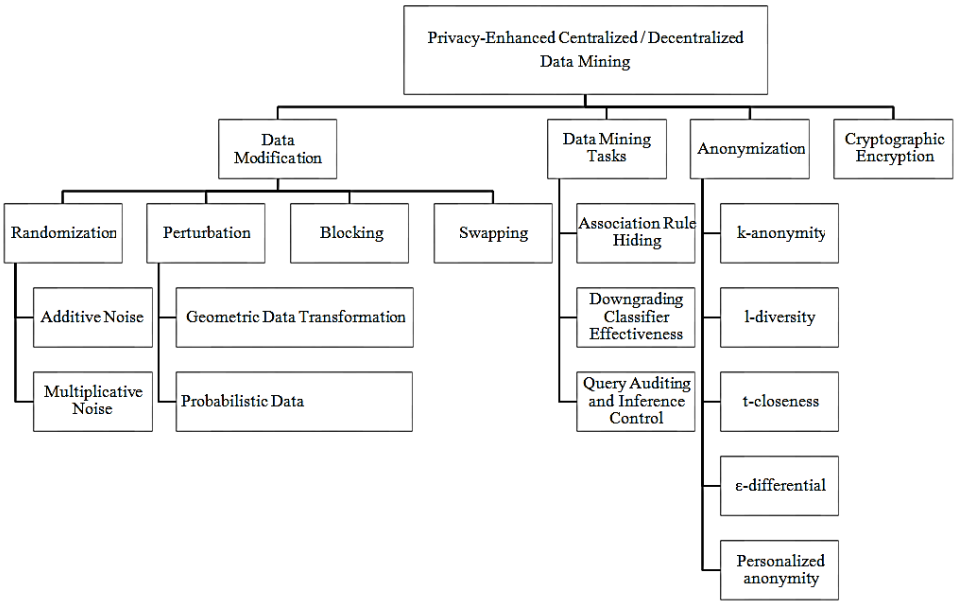

Figure 2: Centralized / Decentralized PEDM Techniques

The first blocking based algorithm was proposed by Saygin et al. [9]. By introducing a question mark the basic definition of support and confidence to find the sensitive rules was completely changed by Saygin. The work of Saygin was continued by Wang et al. [10], who introduced a blocking-based sanitization algorithm. Amiri et al. [11] introduced another method based on aggregation and disaggregation sanitization approaches.

3.1.4 Swapping

This is a type of data transformation technique in which data values are swapped within the dataset thus resulting in the randomization effect. Thus faking the information and preventing away to prevent any leakage of personal information.

3.2 Data Mining Tasks

Based on data mining tasks to be performed various PEDM techniques can be applied accordingly. Here is a list of most frequent data mining tasks.

3.2.1 Association Rule Hiding

Atallah et al. was the first researcher who introduced the notion of association rule hiding in [12]. In this perception, the non- sensitive rules are exposed whilst the sensitive rules are kept obscure. The attribute values are transformed using non-optimal solutions so that the sensitive rules are secluded in this course. Although to some extent non-sensitive rules are not completely discovered. Nonetheless, distinct means, to find specific resolutions have been worked upon [13], [14].

3.2.2 Downgrading Classifier Effectiveness

The capability of a classifier to produce more efficient results is degraded to preserve the obscure sensitive information from attackers. [15], [16] accords illustrations of a membership inference attack, where an attacker demonstrates whether a record belongs to the original dataset. Therefore to preserve the sensitive information some researchers worked it out and applied techniques to degrade the classifier efficiency [4], [17].

3.2.3 Query Auditing And Inference Control

Occasionally individuals can yield a connection to the novel dataset, supporting entirely demographic queries to the data. More sporadically, an individual's record cannot be aggregate from the dataset. Query auditing is divided into the following advents: Query Inference Control and Query Auditing. Inference Control: In this regard, either the novel data value or the result of the query are altered; and in Query Auditing, there is a disapproval of some queries in a sequence of multiple queries. Few novel methods are stated in [18] and [19].

3.3 Anonymization

PPDP categorizes anonymization methods into four models. The anonymity models are applied on the tables which constitutes four types of attributes viz. Identifier (ID), attributes which specifically pinpoint a particular; Quasi-identifier (QID) attributes which partially determines an individual; Sensitive Attribute (SA), attributes that are supposed to be obscure; Non-sensitive Attribute (NSA), the leftover attributes excluding the ones mentioned above.

The attacker can identify an individual's record by linkage attack and probabilistic attack. There are three types of linkage attacks i.e. record linkage attribute linkage and table linkage. These linkage attacks and probabilistic attack structures the elemental anonymity models i.e. k-anonymity protection model, l-diversity protection model, t-closeness protection model, epsilon-differential protection model [20].

3.3.1 k-Anonymity

This model was brought in by Samarati and Sweeney. The model works in two phases where first it eliminates the record identifier and then anatomizes the quasi-identifier. The basic principle of k-anonymity is that it distinguishes each record from k-1 records [21]. The value of k is directly proportional to the level of complexity to de-anonymize records. A k-anonymity model forbids record linkage attacks.

3.3.2 l-Diversity

The work of Samarati and Sweeney is carried out further and a new model is introduced termed as the l-diversity model. This model broadens the k-anonymity standard by creating correlative classes in a table [22]. The level of diversity of delicate attributes is enhanced by applying the l-diversity standard to each correlative class. As per the l-diversity principle, the equivalence class consists of l different values for items corresponding to sensitive attributes. There are various instances of the l-diverse principle [23]. This type of model forbids record linkage attribute linkage attacks.

3.3.3 t-Closeness

To forbid attribute linkage attack and probabilistic attack, Li et al. [24] developed a model named as t-closeness privacy model. This model obligates the dispersions of the susceptible items in each equivalence class to be analogous (distance be less or equal to t) to dispersions in the original table. Based on the different distance functions available there are various versions of the t- closeness model [14], [24]. Few variants of the t-closeness model are Earth Mover's Distance, Kullback-Leibler distance, etcetera.

3.3.4 ε –Differential

The perception of differential privacy was given by Dwork [25]. In his work, the author gave the theory to estimate the dissimilarity on an individual privacy revelation. Based on this theory he designs a privacy model known as the ε-differential privacy model and concluded that the analysis result is not afflicted by a particular record.

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The main drawback of this model is selecting the pertinent value of ε [26].

3.3.5 Personalized Anonymity

Xiao and Tao were the first who gave the concept of personalized privacy preservation by introducing a mechanism that generalized the idea of personalized-anonymity [27]. The main objective of this model is to designate the intensity by an individual to hide the susceptible data.

3.4 Cryptographic Encryption

The work on cryptographic encryption was carried out by Brickell and Shmatikov [28]. The author developed a protocol that was established amidst of end-user and a server for structuring a decision tree. The decision tree is constructed based on the input provided by the end-user. The server constructs a decision tree without knowing anything about output. In this way, the privacy of the data was preserved using cryptographic encryption techniques.

IV. DISTRIBUTED PEDM TECHNIQUES

The techniques that come under this category are listed in figure 3 and are explained in the following sections:

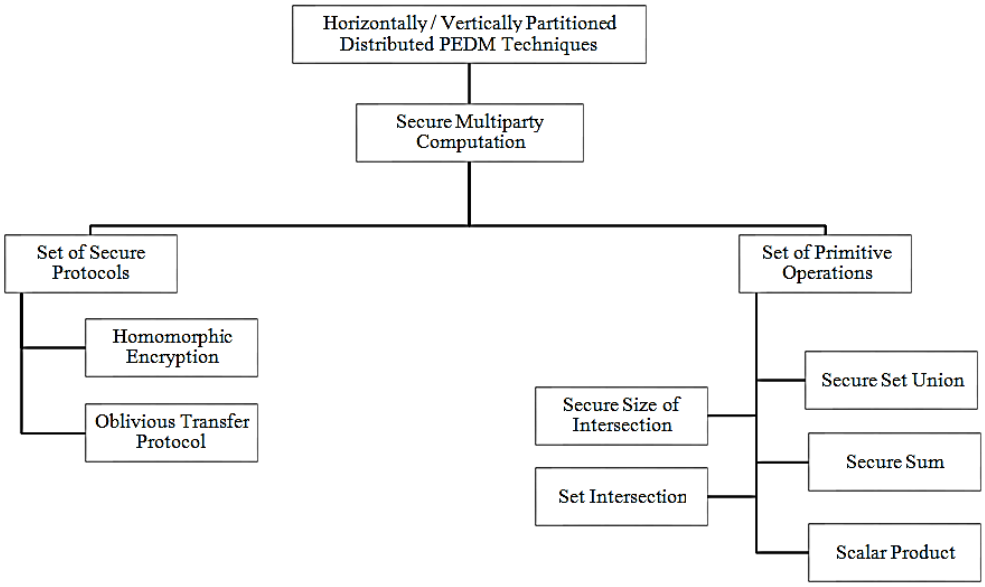

Figure 3: Distributed PEDM Techniques

4.1 Secure Multiparty Computation

In a distributed computation scenario multiple users are not ready to share their data but wish to compute the result using other party's data. This problem, in general, is known as secure multi-party computation (SMC). Time and over many protocols have been worked upon to find a solution to the secure multiparty computation such that no user learns anything about other user's data and his data remains hidden while performing the computation. Depending on the users involved in SMC, a party may be categorized as Semi-honest Attacker, who pursue to figure out others' confidential information; Malicious Attacker focuses on retrieving others' information thus experiences an abortion of computation; Collusion, one or more parties combine to figure out other parties data.

Privacy-enhanced distributed data mining is established on the SMC scheme. SMC is categorized broadly into two parts viz. Set of Secure Protocols and Set of Primitive Operations. The following sections describe each of the categories in detail.

4.1.1 Set of Secure Protocols

The set of secure protocols forbids information leakage when the computation is being performed among various entities. They can be further divided into two types as listed below:

Oblivious Transfer Protocol (OTP): Almost all SMC methods employ oblivious transfer protocol. This protocol is applicable only when two parties wish to perform a computation over a distributed channel. One out of two oblivious- transfer protocol is frequently put into action and was introduced by S. Even et al. [29]. The author in his work implemented the protocol and described that the sends don't learn anything from the computation although the receiver learns one of the bits out of two-bit input.

Homomorphic Encryption: The perception of the homomorphic encryption was firstly popularized in distributed privacy by Rivest et al. [30], and gave the name to the technique as privacy homomorphism. The technique initially supported a few algebraic operations and was thus known as partially homomorphic encryption [31]. To

support any algebraic operation Gentry [31] introduced the first fully homomorphic encryption system in the year 2009.

4.1.2 Set of Primitive Operations

To maintain privacy in distributed environment data mining algorithms are incorporated with a set of primitive operations. The first few primitive operations were introduced by Clifton et al. [32]. Some of the first primitive operations which are frequently used in distributed privacy are as follows:

Secure Sum protocol: Secure sum protocol is the basis of all the protocols in a set of primitive operations. It follows the simple algebraic operation to perform its computation. The multiple users share their inputs and the computation starts from any arbitrary user which is known as master user. The major drawback of this protocol is that if the master is a distrustful user then the privacy breach is definitely to happen. However, these limitations have been worked upon [33], [34].

Secure Set Union: The secure set union is applicable where there is a need to mine frequent patterns [14]. The itemsets are contributed among users for computations and union of sets is formed without disclosing information about the provider of the set. The protocol is applied by C.Clifton et al [33].

Secure Size of Intersection: This protocol adopts commutative encryption to hide the identity of the original user of the itemset. The primitive operation used in this protocol is set intersection. The dataset is encrypted in any order before sharing and the major benefit of using this protocol is that the datasets do not need decryption.

Scalar Product: This protocol resembles the secure sum protocol as it also adds haphazardness to the input to avoid predictability. This protocol applies to two parties only [33]. The input of the same size is shared between two users and the scalar product, which is the primitive operation, is calculated. The output is computed by removing the haphazardness [33], [35].

Set Intersection: As the name suggests, in this protocol the primitive operation to be performed is set intersection. M. J. Freedman et al. termed this protocol as private matching [36]. The output in this protocol is the set intersection performed between the inputs shared by two users over a distributed channel. The computation is performed such that the result is not known to the other user. An adept resolution is introduced by M. J. Freedman et al. [36] that adopts the theory of partially homomorphic encryption.

V. LIMITATIONS

At present, numerous data mining methods are accessible to preserve privacy. The classification of various privacy-enhanced methods is provided on the basis of data distribution. Though much research has been done in the previous few decades but has not proved to be optimal. Even though it encompasses privacy as well as preserves information loss, it fails at the efficiency of problem-solving time utilization. Therefore focusing on the aforementioned shortcoming, further work can be done to improve its applicability. Also, previous works do not account for the full-time definition of "privacy" and fall short to accomplice the demand for personalized privacy. To suffice the fundamentals of personalized privacy, it is mandatory to work in that direction, that is, towards personalized privacy. K-anonymity, a privacy-enhanced technique, has failed to overthrow cyber-attacks and is inclined to phishing, major havoc on privacy.

VI. CONCLUSION

Many private and public organizations, institutions and other authorities frequently collect data for various purposes which are categorized as "sensitive data" as it is personal. To manage the collected sensitive data, and extricate the information, there is a need to preserve the sensitivity of data without degrading its utility. Various privacy-enhanced techniques have been studied and classified by a number of researchers. A highly efficient and effortless classification scheme has been formulated in this survey to make the cumbersome process easy. The above work, therefore, establishes a structured, logical, coherent and systematic way of managing the proposed techniques so far. It can also act as a fundamental tool for further analysis of the familiar PEDM techniques.

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Automated pH Regulator for Freshwater Prawn with Analog pH Meter Pro

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Abstract:

In Malaysia, farmers faced the problems of prawn diseases which cause billions of USD in damage, along with the loss of prawn production. Farmers begin to wipe out from the prawn industry and investors are unwilling to finance in prawn production. There will be a risk that it will decrease the productivity of Malaysia prawn production due to the prawn affected by diseases. Research shows that an uncontrolled pH level in the prawn tank causes the prawn to be stressed and lower the prawn immunity system. As a result, diseases such as Early Mortality Syndrome (EMS), White Spot Syndrome Virus (WSSV), and Taura syndrome virus (TSV) can easily attack the prawn. The existing water quality monitoring system lacks a complete solution from monitoring the pH level until autonomous remedial action taken to control the pH level. When developing the system, no autonomous remedial action being taken to control when the pH level is out of range. Automated pH Regulator For Freshwater Prawn with Analog pH Meter Pro help farmers to monitor and control pH level in prawn tank. Logged data is stored in a personal computer for reference to prawn health. This paper proposes a conceptual framework with three (3) stages that consist of monitoring pH level with threshold data to determine pH level, provide autonomous remedial action to control the pH level in prawn tank and logged data into a personal computer for reference. By having an Automated pH Regulator For Freshwater Prawn with Analog pH Meter Pro, immediate action can be carried out in order to save the prawn life from diseases.

Keywords:

Automated pH regulator, Analog pH Meter Pro, Diseases

I. INTRODUCTION

Prawn farming is a vital industry in Malaysian aquaculture as it is a highly profitable business and constitutes 75-80 percent of total annual household income [1]. By 2020, the Malaysian government has set production targets of aquaculture 214,000 tonnes valued at RM6.5 billion [2].In Malaysia, there are currently about 11, 580 prawn pond operating, covering a total of about 7,309 hectares. Rendering to Bohari Leng, Sarawak Marine Fisheries Department deputy director, lands located at Loba Stoh, Santubong, Telaga Air in Kuching, Selalang, Belawai in Sarikei and Tanjong Manis in Mukah have the potential to be turned into prawn farms and capable to generate RM 1 billion in revenue annual [3].

In recent years, the production of cultured prawn has markedly decreased as a result of serious viral disease outbreaks. In Malaysia, the outbreaks of Early Mortality Syndrome (EMS) resulted in a drop in prawn species named 'L. vannamei' production from 70,000 metric tonnes in 2010 to 40,000 metric tonnes in 2011 [4].The Global Aquaculture Alliance [5] has estimated that losses to the Asian prawn culture sector amount to USD 1 billion and they lost about 80% of their products in some regions.

According to an industry expert, Mohamad Nazri bin Puasa [6] uncontrolled pH level causes the prawn to be depressed and has a low prawn immune system to protect itself against diseases. As a result, diseases such as Early Mortality Syndrome (EMS), White Spot Syndrome Virus (WSSV) and Taura syndrome virus (TSV) began to attack prawn. EMS diseases are transmitted orally, colonizes the prawn gastrointestinal tract besides produces a toxin that causes tissue destruction and dysfunction of the prawn digestive diseases in the prawn post-larval, juvenile and adult stages of prawn called 'Penaeusvannamei'.

In order to minimize the risk of the disease attacks, it is important to come out with an Automated pH Regulator For Freshwater Prawn with Analog pH Meter Pro that can monitor pH level and provide autonomous remedial action to control the pH level. Deplorably, there is a lack of complete solution from monitoring the pH level until autonomous remedial action taken to control the pH level. The techniques of monitoring pH levels by conducting colorimetric tests consume a lot of time and effort [7]. Occasionally, information might reach to farmers but there is a late response from the farmers to control the pH level, result in prawn die. This paper aims to purpose architecture and develop a prototype for Automated pH Regulator For Freshwater Prawn with Analog pH Meter Pro that can monitor the pH level of the water in the prawn tank and provide autonomous remedial action to control pH level.

In the real world application, the proposed system will be using an Analog pH Meter Pro that is placed in the prawn tank to measure pH level. The sensor is connected to Arduino UNO R3 that will analyze the current pH level with threshold data, trigger DC motor to pump pH Up or pH Down when the pH level is not in between an optimal range of 6.5 to 8.5 and display the information on LCD 16x2. As proof of concept, the project is scaled down to only lab-scale setup experimentation. A proposed prototype that consists of Analog pH Meter Pro, Arduino UNO R3, LCD 16x2, DC motors and pump tubing are tested in a lab-scale aquarium tank. Analog pH Meter Pro will detect pH level changes and send it to Arduino UNO R3 to analyze current pH level with threshold data and send pH level reading to LCD. Any changes beyond the optimal pH level will trigger DC motor to pump pH Up or pH Down to the prawn tank. The logged information of date, time and pH level will be stored in the personal computer database.

The following sections of this paper will discuss the literature review, design and project modeling, results and discussion, and conclusion and recommendation.

II. LITERATURE REVIEW

It is addressed in the Introduction that this paper focuses on performing a small scale study of monitoring and controlling the pH level of water in the prawn tank. This section discusses how this paper is related to the work of others and what can be improved based on the identified gaps in the literature.

Diseases of prawn due to the uncontrolled pH level

In the process of prawn hatching and breeding, pH is an important parameter to be measured and controlled. pH refers to the hydrogen ion concentration or how acidic or basic as water is and pH is defined as –log[H+].pH value range from 0-14; pH 7 is neutral, pH<7 is acidic, and pH>7 is basic [8]. pH greater than 8.5 and pH lower than 6.5 is unsuitable for prawn organisms. Figure 1 below displays the tolerable range of pH level for prawn to live [9].

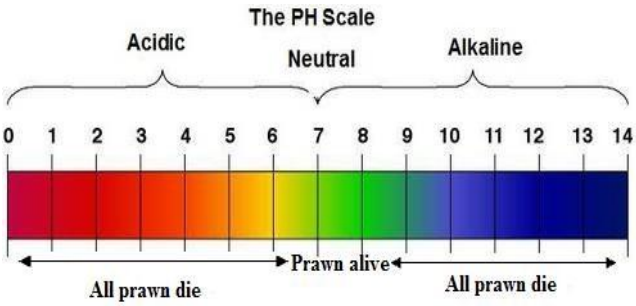

Figure 1: Impact of pH level scale to prawn Table 1: pH level impact on prawn health

As shown in Table 1 prawn organisms are extremely sensitive to pH level. pH level below 6 .5 and above 8.5 causes to prawn feel stressed and reduces the immune system to protect against the virus [10]. The optimal pH level range for prawn to continue living is from 6.5 until 8.5.

1. Early Mortality Syndrome (EMS)

In Malaysia, EMS which is caused by a high pH level has first appeared at the farm in early January 2011 in five ponds stocked with postlarvae from the same hatchery about one month earlier [5]. Within two months, the diseases had spread throughout the farm. Typical mortality in the affected ponds was 70% to 80%, and all ages and sizes of prawn were affected. EMS case was detected in July in Johor, where 100% of all prawn in seven ponds died due to virus infection. For Malaysia's billion-dollar-plus yearly prawn industry, these drops in prawn production could prove catastrophic. The country's prawn exports are already in a less-than-ideal state, having suffered steady declines since their peak in 2009[11]. With a 26.7% year-on-year drop in production between 2010 and 2012, the industry is ill-positioned to withstand further shocks.

2. White Spot Syndrome Virus (WSSV)

Increased severity of widespread WSSV infection is the most serious threat to stable aquaculture production. In the case of Malaysia, the outbreak of this disease was almost the same as the Thailand situation that was WSSV disease occurring as a serious problem [12]. A lot of farms have given up prawn culture due to the heavy loss incurred by WSSV. WSSV outbreaks were found in Penang, Kedah and Sarawak State, and information of the occurrence of viral disease was obtained. Almost all prawns in the ponds were dead by this disease. These dead prawns were showing many clear White spots on their carapace. Pathogenic viruses are the cause of WSSV.

3. Taura syndrome

Taura syndrome is caused by the Taura syndrome virus, a small picorna-like RNA virus that belongs to the genus Apara virus in the family Dicistroviridae. The disease outbreaks caused catastrophic losses with cumulative mortality rates of

60 to > 90 % in pond cultured prawn [13].TSV is a particularly virulent pathogen of prawn 'P. vannamei' and can infect several other prawn species including P. monodon, P. aztecus, P. duorarum, L. setiferus, L. stylirostris, Marsupenaeus japonicas, M. rosenbergii, Metapenaeusensis, F. chinensis and L. schmitti.

Therefore, there is a need to improve monitoring pH levels of water in the prawn tank and provide autonomous remedial action to neutralize the pH of water in the prawn tank. It is essential to control the pH level in the prawn tank as a precaution step to protect prawn against diseases such as EMS, WSSV and TSV. Unhealthy prawns will cause billions of USD in damage along with the loss of prawn production.

Related Works

1) Mobile Sensor Node for Real-Time Monitoring of pH Level in Domestic Water Resources

This paper presents a technique implemented based on wireless sensor networks and mobile technologies to measure pH value in water in a domestic environment in real-time. It is real-time measurements taken using three water samples indicate that the system performed with high accuracy. It provides a user-friendly graphical interface to visualize relevant information on the screen of a mobile phone [14].

2) Efficient Design and Deployment of Aqua Monitoring Systems using WSNs and Correlation Analysis

This paper navigates data of aqua monitoring to a database at the receiver station through the GSM. The graphical user interface was designed by using VB and .NET and in such a manner that the observations are forwarded to the farmer as a message in their respective local languages to their mobile phones. That alerts them in unhygienic environmental conditions for adopting suitable measures [15].

3) Automated Water Quality Monitoring System Using GSM Service

This paper focuses on evaluating data collected through three bases: Oxygen dissolved in the water, Level of pH in water, the temperature level of the water. It has the capability to conduct the tests automatically with the help of a timer present in it. It sends the degradation of water quality in the pond via SMS (Short Messaging Service) [16].

4) Monitoring System of Aguiculture With Automatic Control System Using ARM 7

The paper focuses on controlling the real-time aquaculture environment factors and over problem has been rising to play automatic sound alarming with Levels. These levels follow Automatic ON / OFF water pumps & Air pump water levels far distance. This project can accomplish lower labor intensity; improve efficiency as well as an automatic controller system [17].

Gaps Found in the Literature and Way Forward

Although it was clearly shown that Automated Water Quality Monitoring System Using GSM Service or Wireless Sensor are both beneficial, it is nevertheless inefficient due to the fact that they are lack of autonomous remedial action to control the pH level. A better system is one that controls pH to that which is needed. This is accomplished by automatically pump pH Up or pH down by using a pump to prawn tank. This type of control system is referred to as an Automated pH Regulator. Moreover, the solution of paper is inefficient as it does not have logged data. Therefore, an alternative to monitor pH level is by referring to logged data that is stored in PC. The logged data will inform farmers about the date, time and pH level. According to Mohamad Nazrin bin Puasa [6], the logged data is essential to farmers to identify the causes of prawn death and monitor prawn health.

Comparative Study on pH measurement

Table 2 shows the comparative study on pH measurement Table 2: Comparative Study between pH measurements [17-18]

Criteria	Spectrophotometric pH	Potentiometric pH
Advantages	Calibration free Very precise	Less expensive
Disadvantages	Expensive	Frequent calibration Less precise
Hardware	Spectrophotometer, temp-control device, optical cells Indicator, no standard	pH electrode, mV meter, temp-control device, buffer standards
When to use	Monitoring in situ and laboratory carbon system changes	Needed for pH-stat. Better for monitoring very rapid pH changes

Based on a comparative study in Table 2, spectrophotometric pH measurements are more precise and less calibration than potentiometric pH measurements but potentiometric measurements are advantageous for many types of studies for which less precise measurements are adequate[18]. As such, the use of pH electrodes, mV meter, temp-control device and buffer standard is likely to continue measurement as a very common practice in laboratory and field investigation. Based on the comparison in Table 2, potentiometric pH has the advantage to be used as a because it is less expensive and better for monitoring very rapid pH changes.

Comparative Study on microcontroller devices

Table 3: Comparative Study on Arduino UNO R3, Raspberry Pi [19]

Criteria	Arduino UNO R3	Raspberry Pi
Processor	ATmega32B	ARM 1176JZF-S
Operating System	None	Linux
Integrated Development Environment	Arduino IDE	Scrath, IDL, Anything with Linux Support
Memory	2KB	256MB
Price	Inexpensive	Expensive

Based on the comparison between Arduino UNO, Raspberry Pi and Beagle Bone in Table 3, Arduino UNO is chosen as the microcontroller as it provides the simplicity of programming as it operates on ATmega32B that allows direct access and control to the programming of the

microcontroller [19]. Arduino does not require any specific operating system as compared to Raspberry Pi which uses Linux to write and run the code. Arduino environment is easy-to-use for beginners and flexible enough for advanced users and it is inexpensive.

III. DESIGN AND PROJECT MODELLING

As illustrated in Figure 2, the Automated pH Regulator For Freshwater Prawn with Analog pH Meter Pro consists of data processing, data presentation, and data response.

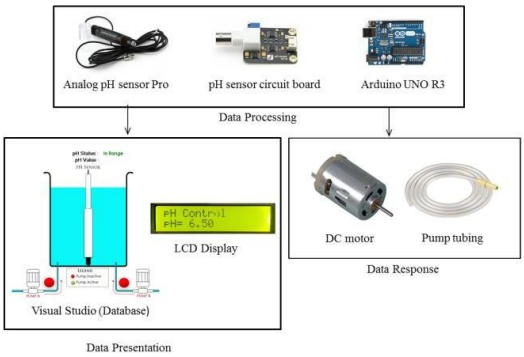

Figure 2: System Architecture for Automated pH Regulator For Freshwater Prawn with Analog pH Meter Pro

Analog pH Meter Pro is attached to the pH sensor circuit board will record the pH level and send the information to Arduino UNO R3. Arduino UNO R3 will analyze the information and trigger DC motor to pump pH Up or pH down when the pH level is not within the optimal range. Any changes in the pH level will be logged in the personal computer. The activity diagram in Figure 3 shows the algorithm flow of the code that has been programmed into the microcontroller via the Arduino Software IDE.

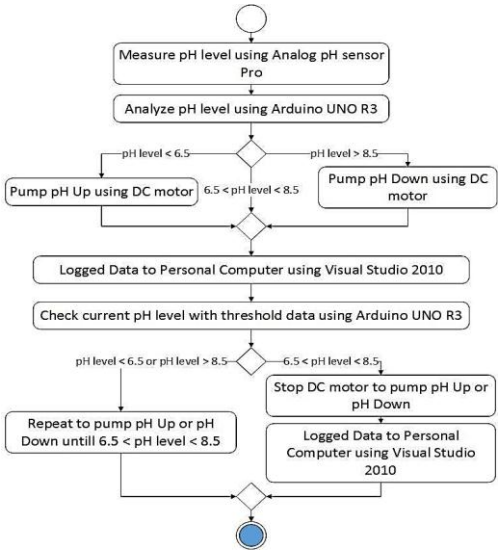

Figure 3: Activity Diagram for Automated pH Regulator For Freshwater Prawn with Analog pH Meter Pro

IV. RESULTS AND DISCUSSION

A. Accuracy of pH level Testing

The purpose of conducting this test is to determine the accuracy of pH collected from the pH meter pro. The test is executed in an indoor environment with the default setup shown in Figure 4.

Figure 4: Default Experiment Setup

The accuracy of the pH level collected from the pH meter pro is determined by comparing its measurements with manual measurements using pH meter. According to the measurements recorded from the graph in Figure 5, out of the 30 trials that have been performed, it appears that the highest pH level measured by the Analog pH meter pro is 10.9, while the actual pH level recorded 10.7.

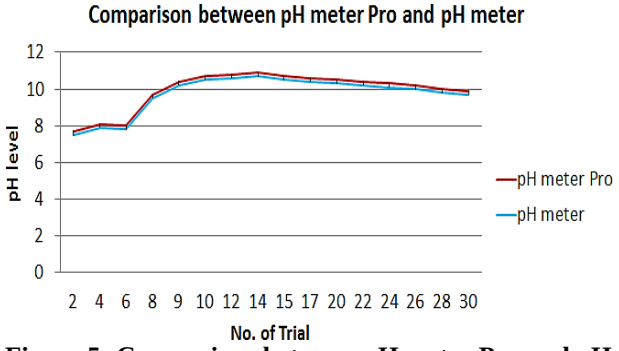

Figure 5: Comparison between pH meter Pro and pH meter

In conclusion, the results proved that there is a good correlation between the pH level recorded with pH meter and the actual distance measured with a pH meter. It is proved it is relevant to use pH meter pro as its measurement is less than 0.1cm of error.

B. Time taken to control pH level testing

The purpose of conducting this test is to calculate the average time taken to control the pH level. Test 2 is performed in an indoor environment as shown in Figure 6.

Figure 6: Experiment Setup for Automated pH Regulator For Freshwater Prawn with pH Meter Pro

Table 4 shows a list of values gathered from the experiment, in which the value represents the following parameter. It is important to get a good estimation of time frames to ensure a healthy environment for the prawn to live.

Table 4: Time Taken to control pH level

No of trial	pH level	Time taken (s)
1	2.1	3.2
2	5.1	2.27
3	4.4	2.58
4	2.8	2.79
5	5.8	1.21
6	3.9	2.62
7	2.5	2.99
8	3.1	2.7
9	6.1	0.88
10	6.4	0.04
11	8.8	1.64
12	8.7	1.16
13	9.4	2.52
14	9.1	2.23
15	9.5	2.56
16	10.2	2.77
17	10.6	2.91
18	8.6	0.05
19	8.88	1.67
20	9.3	2.46
Average Time Taken		2.24

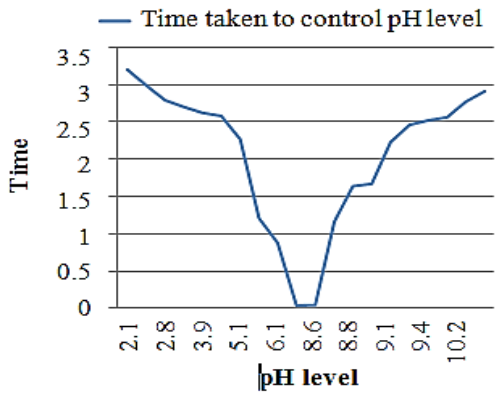

Figure 7: Graph for Time Taken to control pH level

From the testing, Figure 7 shows that the graph of the time taken to control the pH level. The difference between those values is due to the different strengths of the pH level.

C. Performance Testing

The purpose of conducting this test is to measure the stability Automated pH Regulator For Freshwater Prawn with Analog pH Meter Pro system. This is done to ensure the system can perform well in measuring the pH level accurately as well as logged data immediately. A similar setup to the setup of an experiment in Test 2 is used.

The stability of the system is measured by looking at the consistency of data collected by the pH meter pro.

Date	Time	pH_Value
27/1/2016	20:50:01	7.7
27/1/2016	20:50:02	7.7
27/1/2016	20:50:03	7.7
27/1/2016	20:50:46	8.1
27/1/2016	20:50:47	9.7
27/1/2016	20:50:48	10.4
27/1/2016	20:50:49	10.7
27/1/2016	20:50:50	10.8
27/1/2016	20:50:51	10.8
27/1/2016	20:50:52	10.8
27/1/2016	20:50:53	10.8
27/1/2016	20:50:54	10.9
27/1/2016	20:50:55	10.9
27/1/2016	20:51:11	10.8
27/1/2016	20:51:12	10.8
27/1/2016	20:51:13	10.8
27/1/2016	20:51:14	10.8
27/1/2016	20:51:15	10.7
27/1/2016	20:51:16	10.7
27/1/2016	20:51:17	10.7
27/1/2016	20:51:18	10.7
27/1/2016	20:51:19	10.6
27/1/2016	20:51:20	10.6
27/1/2016	20:51:21	10.6

Figure 6 : Output Display on Personal Computer

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Based on the results, the system is already stable in recording pH levels accurately and logged the data.

V. CONCLUSION AND RECOMMENDATION

In the nutshell, Automated pH Regulator For Freshwater Prawn with Analog pH Meter Pro will enable the farmers to improve the productivity of the prawn hatching and breeding process. By having a desirable pH level, prawn will be in healthy condition to continue living. It can also reduce the risk of diseases attacking the prawn. Diseases such as Early Mortality Syndrome (EMS), White Spot Syndrome Virus (WSSV), and Taura syndrome virus (TSV) causes billions of USD in damage, loss of prawn production, farmers wiped out and unwilling investors to finance in prawn production. Automated pH Regulator For Freshwater Prawn with Analog pH Meter Pro has a complete solution from monitoring the pH level until autonomous remedial action taken to control pH level. It helps the farmers to take care of the pH level quality in the prawn tank for twenty-four (24) hours.

For further recommendation, more parameters are needed in order to obtain more accurate results such as temperature, light intensity, and salinity. The proposed solution can also be further enhanced by allowing the system to detect the water quality suitable for various kind of aquaculture as the current system can only monitor the water quality suitable for the prawn tank.

VI. ACKNOWLEDGMENT

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Academic Journey of Mathematics Students: Some Experiences to Share

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I. BACKGROUND AND MOTIVATION

Learning mathematics has historically been viewed by many as very difficult subject and sometimes impossible to comprehend. Students have a feeling of intense frustration or helplessness about their ability to learn math. Mathematicians are used to the fact mathematics is widely misunderstood. One misunderstanding is mathematics does not have relevance in ordinary life. Most people believe that the calculator negates any reasons to learn mathematics at all with exceptions of telling time or counting your change after a transaction (Harackiewicz, 2013).

It is commonly accepted that math is difficult, obscure, and of little interest to certain people. The study of math carries with it stigma and people who are talented in math are often treated as though they are quiet normal. Mathematics has importance over and above the application of basic numeracy skills. It is also the prime vehicle for developing student's logical thinking and higher-order cognitive skills. Mathematics also plays a major role in a number of other scientific fields, such as physics, engineering and statistics. In this connection, a positive attitude towards mathematics among students is an important goal of mathematics education in many jurisdiction (Thompson, 2010).

From the International Mathematics Olympiad, details showed that the Philippines ranked 79th out of 82 countries in 2003 and 80th out of 85 countries in 2004. Based on the possible maximum points of 225, China got the highest score of 220 points, Vietnam 126, Thailand 9, and the Philippines 16 points (DepEd, 2003). It is alarming that Filipinos are found lacking in the ability of basic mathematics. The Department of Education is trying to pursue an educational system that has quality and excellence, efficiency and effectiveness, as well as significance and receptiveness in all school levels (Adono and Yap, 2010).

Generally, it is an alarming observation among Filipino students that they excel in knowledge acquisition but are considerably low in lessons requiring higher order thinking skills. This sorry state is evident in the performance of students in national and international surveys on Mathematics and Science competencies. Traditional methods of mathematics instruction have done little to change this trend. For many students, the inability to learn mathematics prohibits college graduation. One solution to the growing problem of low student achievement in mathematics may be found in the construct of mathematical identity.

Public policy leaders recognize a need for more students to graduate with degrees in science, technology, engineering, and mathematics, at the same time, many college students, most studying in non-STEM fields, struggle to learn the mathematics they should have learned in high school so they complete their college level general education mathematics courses. Although mathematics is a foundational skill in today's technological economy, the majority of Americans consider themselves bad at mathematics, many to the degree of math phobic in the U.S., this attitude is socially acceptable. Whether driven by myth or reality, this cultural acceptance has led to a shortage of quantitatively literate citizens (Steen, 1999; Stigler, Givvin & Thompson, 2010; Varma, 2010).

The Mathematics Framework for Philippine Basic Education contains resources that will help curriculum developers, teachers, school administration and policy makers to design and implement mathematics curricula that empower students to learn and cause them to better understand and use mathematics in their everyday life. The strategies consider only Grades 1-10 however, because of the progressive nature of the concepts, curriculum development could easily be extended to cover K-12. Various mathematics educators have suggested that students are unable to use school-learned methods and rules because they do not fully understand them. Educators relate this lack of understanding to the way that mathematics is taught. Traditional methods of mathematics instruction have done little to change this trend. For many students, the inability to learn mathematics prohibits college education. One solution to the growing problem of low student achievement in mathematics may be found in the construct of mathematical identity (Edward, 2010).

There are various factors that cause the students' low performance in mathematics here in the Philippines most especially in public schools. Few to mention are the less attention of parent involvement in child's learning, intense poverty, lack of funds for learning facilities and materials,

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inappropriate teaching techniques employed by teachers, uneven teacher-pupil ratio inside the classroom, and the students who are unprepared to learn (Eballe, 2012).

Moreover, mathematics anxiety also results in poor performance rather than the reverse. To some point of view, these problems are also the basic and common problems that the students at Lorenzo S. Sarmiento Sr. National High School might be experiencing.

Furthermore, past studies mentioned mainly on student's unsatisfactory performance and misconceptions in mathematics. However, I have not come across any study that specifically discusses the factors that may have been the cause of it. Furthermore, this study will provide relevant concepts that would possibly create breakthroughs in the teaching of mathematics in the academic community.

II. OBJECTIVE

The purpose of this phenomenological study was to explore the academic journey of grade 10 mathematics students of Lorenzo S. Sarmiento Sr. National High School, Poblacion, Mawab, Compostela Valley Province, determining the specific factors and variables that explains the varied levels of their success and failure in mathematics.

At this stage in the research, low performance in mathematics is a social issue and a phenomenon that actually exist in the field of education. The mathematics students have so much to share as they learn mathematics each day. The academic track they pursue will give us an idea how they learn and experience their academic journey in mathematics. They will share experiences that are both positive and negative. Others share experiences of what kept them motivated w Introduction

This phenomenological study would add to the growing body of knowledge about the usefulness of the Social Cognitive Theory in investigating social issues such as of students' experiences in mathematics at rural areas. Through this study, I would be able to acquire salient information that would help us understand how human beings create meanings about a social phenomenon such as students' experiences in mathematics at rural areas. It also aims to capture students' perception in mathematics especially in remote schools, and how these students cope with the common problems they encountered in helping other students in developing one's skills in mathematics. It also seeks future directions for teachers how to facilitate learning inside the classroom with students struggling in mathematics even if they put themselves into risks or hardships.

This study also visualizes documenting the different experiences of the seven students in in-depth interviews, seven students in the first focus group discussion and another seven in the second focus group discussion, both the best and undesirable experiences they encountered at Lorenzo S. Sarmiento Sr. National High School. Moreover, the intent of this study is to seek, listen, and understand the stories of the participants as they willingly share their experiences during the interview. In addition, this study aims to gain additional knowledge in the field of research concerning students' experiences in learning mathematics.

This study sought to answer the following questions:

1. What are the students' academic experiences in mathematics?
2. How do students cope with the challenges in learning mathematics?
3. What are the students' suggestions/insights toward mathematics?

III. STATEMENT OF CONTRIBUTION

I am confident that this phenomenological study would add to the usefulness and significance of determining the specific factors and variables that explains the varied levels of success and failure in mathematics experienced by the students of Lorenzo S. Sarmiento Sr. National High School, Poblacion, Mawab, Compostela Valley Province. It is through this study that I was able to obtain information about the students' academic journey in learning mathematics, their best and undesirable experiences, their emotion, hardships, achievements, dedication and commitment, as well as the different problems they met while learning mathematics and to how they cope with these unfavorable experiences. Furthermore, students' beliefs and attitudes towards mathematics teaching and learning play an important role in mathematics education.

The goal of this study is to provide a basic and comprehensive framework for creating a better learning system for mathematics students of all abilities. I am confident that the result of this study would add to the knowledge about the usefulness of Social Cognitive Theory as a lens of investigating a social phenomenon. The results of this study will benefit the school administrator as this study will present fresh insights into the effectiveness of the current system of educating students in mathematics and offers new ideas that can contribute to higher learning and understanding of mathematics. In addition, the result of this study will serve as a reference and resource for the academic staff of the school system with a focus on the secondary schools for planning and devising new techniques and strategies to improve students' achievement. Another is that, this study will give classroom teacher awareness of each student's strengths and weaknesses which will guide them and determining the appropriate strategies to be used in the classroom to improve students' mathematical ability. Moreover, this study will enable students to learn in a more efficient, effective manner creating a new level of understanding, preparing them for their future careers. Lastly, this study would somehow assist other researchers in the future who are interested to conduct a study related to academic journey of mathematics students and will serve as a basis for further study on teaching-learning activities.

IV. METHODS

This paper aimed to explore students' academic journey in learning mathematics. This study is qualitative in nature. This phenomenological study described the lived experiences (Creswell, 2009) of the mathematics students. It focused into what common experiences the participants had encountered in learning mathematics, the phenomenon under investigation. I used phenomenology because a group of individuals such as grade 10 and grade 11 students personally experienced the same phenomenon which is learning mathematics. They were able to explore such single idea (Creswell, 2012) about students' academic experiences into more composite descriptions based on "what and how" they experienced the phenomenon (Moustakas, 1994; Creswell, 2012).

The qualitative study involved interviews with students of Lorenzo S. Sarmiento Sr. National High School, Mawab, Compostela Valley, Philippines, the observable fact under investigation. Using descriptive method, the study explored their success and failure in mathematics that each have experienced along their academic journey and the processes through which those shared experiences were created. On the other hand, Burns and Grove (2007) illustrate qualitative research as concerning more on human experiences conducted in natural settings where information are processed through observed phenomenon. I used phenomenology of my study because it is centered on the people's lived experiences (Carpenter, 2007).

Bracketing is necessary in phenomenological study which means the researcher must identify first what he wants to discover (Ariola, 2006). Bracketing is the researcher's awareness on the possibility that their values, beliefs, and decisions may influence the setting of the research (Porter, 1993; Jootun, McGhee & Marland, 2009). As part of this study, I am cautious and observant at all times, being aware on the pre-obtainable beliefs on the study. I sought to it that I could fully capture the participants' experiences as they shared it to me during the interview. I heightened my awareness on the phenomenon that the participants had given during the interview however, I made sure to set aside my own views and personal experiences only of the participants by identifying its real fundamental nature (Creswell, 2012).

As suggested by Creswell (2012), sources of qualitative data include profoundly interviews, personal observations, and reliable documents. In the study, I used specific strategies in obtaining information such as substantial interviews using video recorder, taking down notes, and focus group discussion. I gave focus on the emotional details of the participants to create a significant output and significance of the study.

Themes of the phenomena from the seven participants of the individual interview and with fourteen members of the focus group discussion were described using thematic analysis, which is widely used in qualitative analytic method (boyatzis, 1996; Roulston, 2001) because of its flexibility. Participants from 5 to 25 individuals who experienced the phenomenon is deal for in-depth and multiple interviews. Thematic analysis as a foundational method for qualitative analysis (Holloway and Todres, 2003) provides a flexible and useful research tool which can potentially provide a rich, detailed yet complex account of data (Rouston, 2001).

V. RESULTS/DISCUSSIONS

In this section, the experiences of the informants of the study, both best and undesirable experiences are presented, which were gathered through in-depth interviews and focus group discussions. With the following research questions, data production from the participants was directed.

1. What are the students' academic experiences in mathematics?

During the in-depth interviews and focus group discussion, the translation of this question was done, from English to vernacular language. This is to further understand the question. There were ten major themes emerged from the data collected on the experiences of the study participants such as Understanding the Lesson, Getting Zero in a Test, Intimidation by the Teacher, Teacher Factor, Financial Aspect, Social Media/Sites/Gadgets, Negative Peer Influence, Classroom Environment, Home Environment, and Attitude.

2. How do students cope with the challenges in learning mathematics?

Same as in question #1, translation of this second question was also done, from English to vernacular language to further understand the question. There were six major themes emerged from the data collected on the coping mechanisms of students such as Optimism, Paying Attention, Good Study Habits, Interest, Perseverance, and Support System.

3. What are the students' suggestions/insights toward mathematics?

Same as in question #1 and #2, translation of this third question was also done, from English to vernacular language to further understand the question. There were eight major themes emerged from the data collected on the students' suggestions/insights toward mathematics such as Perception in Mathematics, Listening to the Teacher, Mindset, God Study Habit, Role Modelling, Encouragement, and Participation.

From the result of the study taken from the responses of both the in-depth interviews and the FGD (focus group discussion) participants, most of them experienced frustrations and aggravating circumstances in learning mathematics. The mathematics academic experiences researched in this thesis clearly pointed out the positive and negative aspects of learning mathematics. The positive research results revealed that students excelled in learning mathematics if the teacher was motivated and interested in

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explaining the math lessons. Also, teachers who made time after class to instruct students to question if they were confused. Students who were planning on higher education in fields that required high math achievement were highly motivated to learn. Students who practiced good study habits and had like-minded friends excelled. The formation of study groups among friends was found to be highly effective. The overall environment at the school played an important part. If the teacher and classmates were serious about learning, it led to greater concentration and focus resulting in mathematics understanding.

VI. CONCLUSION

The findings of this research and overall study conclude that there are five factors involved in the varying degrees of students' success and failure:

1. Effective teachers and academic environment. This includes school system, curriculum, and a positive and engaged student body.
2. The research revealed that students based on their degrees of learning aptitude were more likely to succeed in learning mathematics at a high level when the family and academic environments were conducive to achievement.
3. The barriers encountered with unsatisfactory achievement were based on sub-par family and academic environments.
4. Based on the research, the key factors are comparable. Academic excellence breeds success. Academic mediocrity breeds mediocrity. Academic failure breeds failure.
5. The quality of teachers, student body, family environment, and support system were instrumental in the student achieving at the highest level of success in mathematics based on their aptitude and overall intelligence.

Based on my research, I have come to a conclusion that results of these analyses including the interviews and focus group discussions set forth a blueprint for the Administrators at the Department of Education to hire only the most qualified and motivated teachers whose skills and passion will directly lead to higher academic success at the institutions they are part of.

Teachers will be most effective in their roles when they create positive student-teacher relationships. Teachers may believe student learning and behavior is out of their control. To a degree this is true. No student can be forced into any particular behavior. However, uncooperative students will often respond to an opportunity to be cooperative when teachers offer respectful and caring attempts to build positive relationships. It follows that positive and constructive student-teacher relationships are the responsibility of the teacher. These relationships begin when teacher uses a positive and energetic approach to the teaching of mathematics. Kindness and respect must permeate all interactions with students. These behaviors make students comfortable in the classroom where they are willing to engage with the teacher and other students. When students believe the teacher cares about their learning and is willing and available to help them learn, positive student-teacher relationships can be formed.

Furthermore, meaningful mathematics instruction engages students with mathematics through appropriate mathematical tasks that cause students to reason mathematically, communicate their thinking to others, and engage in reciprocal critique of mathematical ideas.

In as much as this study is bounded only within Lorenzo S. Sarmiento Sr. National High School, the following future research are recommended:

First, since the findings of this study are not generalizable beyond the twenty-one participants, future research may be conducted on student's academic journey in mathematics with another group of participants in order to strengthen the validity of the findings of this study.

Second, future research may be conducted in some other places of Region XI and other regions in the Philippines to add more information and insights from other students learning in mathematics.

Third, future research may be conducted to investigate whether students' experiences positively or negatively influence their personality.

Fourth, future research may be done by conducting a re-interview with some of the participants to find out if their views and insights on their experiences in mathematics have not changed overtime.

Fifth, a different research may be conducted investigating how principals or school administrators respond to the complaints or undesirable experiences using Social Cognitive Theory as a lens in investigating a social phenomenon.

The findings of this study were collated from the students' academic experiences. The ongoing research on this study should become a part of the annual review of the effectiveness of the present curriculum to confirm the findings of this study. Student interviews and feedback on their level of learning and comprehension at their high school should be evaluated by the Department of Education Administrators and taken into consideration while planning the next year's curriculum.

VII. CONCLUDING REMARKS

Every society's foundation for continued growth, health and prosperity is based on the quality of their educational systems. Effective, dynamic and creative leadership from the Administrators at the Department of Education are the key component for excellence. They must be "hands on" and continually review the effectiveness of every national high school's Mathematics Department to ensure the student body are in an environment where they can become the best they can be based on their overall abilities. They have an obligation to observe, critique and advise the teachers under their control. Remember, "A young mind is a

terrible thing to waste." Good teachers deserve to be on a fast track to advancement and put in advisory roles. The most successful students deserve a scholarship for higher education based on their academic circumstances.

In conclusion, International Research has determined that traditional methods of teaching while being effective for the top third of elementary, high school and college students, ultimately is not completely effective for the other two-thirds. Traditional methods of mathematics instruction have done little to change this trend. New academic research reveals that the majority of students in a classroom environment respond positively to dynamic teachers who teach using alternative learning techniques and are willing to teach small groups after class. Improving the success students experience in their academic journey and their future careers can be accomplished by continued research on actual student feedback, specifically on what teaching methods and techniques are effective and which are ineffective. This will provide important insights to the Department of Education administrators' responsibility and task of developing a learning system that enables students to realize optimal mathematics mastery.

Finally, the Philippines and its growing economy is the new "Asian Tiger". There are a plethora of international and domestic companies and corporations in need of employees who are adept in Mathematics. Careers in Information Technology, Computer Science, Bioscience, Engineering, Financial Services and Architecture are available for qualified candidates who have excelled in mathematics. "High Achievement in Mathematics Equals High Achievement in Life."

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Natural Resource Management using Participatory Process of Youth Volunteer in Community

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Abstract:

The purposes of this research were 1) to study the state of area, water and community potential, 2) to develop and propose the method of natural resource management using participatory process of youth volunteer in community. Action research and quantitative research were used and research tools were interview form and questionnaires. Data were collected from in-depth interview, focus group discussion and quasi-experimental design. Qualitative data from 31 key informants was analyzed by using content analysis whereas quantitative data collected from 134 samples was analyzed by using descriptive statistics. Results indicated that 1) the area and water in community has only one source of water, and it was not enough for utilization. They could not save the water during flooding season. Therefore, the leader of the community tried to find the best way to preserve water using technique of adding water to underground and making life dam in order to slow down water. 2) Five steps of natural resource management process using participatory process of youth volunteer in community consisted of (1) pre-research plan, (2) planning, (3) action plan, (4) implementation, and (5) follow up. Results of post-test and follow up showed higher score than pretest at significant level of .05.

Keywords:

Natural Resource Management, Participatory Process, Youth Volunteer

I. INTRODUCTION

Natural resources continue to be the critical issues of Thailand. Over several decades, natural resources have been utilized vastly for development. Therefore, natural resources have been constantly depleted while the natural environment has weakened in quality. As a result, conflicts over the utilization of natural resource between the government and different groups of people have tended to increase. In addition, the management of natural resources and the environment remains centralized, which has no linkage with the local level. All these factors have contributed to the existing state of natural resources such as forest areas are decreasing, soil becomes unfertile, biodiversity is threatened, coastal ecosystems are destroyed, water resources cannot meet consumption demand, and environmental problems escalate simultaneously with the growth of the economy and urbanization as in [1].

According to the issue of water, water management is an issue that has been discussed a lot over the past especially year 2010, Thailand suffered from the lack of rain and flooding in the same year. This issue is often discussed in the management of water especially of the country's main water line. Another level of water management also brought for the discussion was at the community level. In the area, they have rarely been researched much. It is different in each area since 2005, it caused a shortage of hard water areas in Rayong province which was the site of heavy industrial area of the country. Then, it caused the problem related to the social issues greatly between different sectors especially in the industrial sector during that period of time.

In the last 30 years, the urban areas of Thailand are often faced with frequent floods. Most were born in communities located in areas at risk of flooding especially on the east coast and south of the country because it is located near the ocean. In big cities like Bangkok, Hat Yai and Chiang Mai, they suffered of flooding as well specially during the rainy season. This is because the amount of water over the detention and drainage systems are not working well enough, which refers to the flood disaster caused due to water causes. Be a flood or flash flood caused by more heavy rain continued for a long time and sometimes causing landslides that can be caused by a tropical cyclone with force. A trough of low pressure is intensifying climate variability, sea earthquake bolster levees break, it could cause a flood. For that kind of flooding, it can be divided

into three types [2] as follows: 1) flash flood caused by heavy rain on the mountains or watershed and flood plain down quickly because trees absorb water slowly and the water flow to be gathered more quickly at low-water areas. The greater speed of water and power can result to increase the water level by the rapid water evacuation and cannot move away within urgent time, 2) the flooding caused by the water that flood higher than normal flood and then caused the traffic disruption, 3) the waves are huge ocean waves caused by the force of the wind and caused by a tropical cyclone is moving toward the shore. The storm surge washed on shore and the tropical cyclone with tropical storm strength levels up, and then causing large waves lapped the shore. The area at risk has a chance of storm surges hit coastal areas including the South East Coast from Phetchaburi province to Songkhla province, and the Eastern province from Chonburi to Trat.

When the state of emergency that requires utilization of emergency assistance. It is noteworthy that the teenager became a major force gathered themselves to help those afflicted by their aptitudes and capacity. There are also several youth groups gathered to serve society as normal, reading to the blind, and hearing to the forest to collect garbage in the sea, or teaching street children in order to use the free time to benefit and how they can be useful to others in society. If an adult leader or volunteer to take care of these young volunteers work closely to make these systems more and more are moving in the same direction including counseling and resolve issues that arise in the event. The tremendous power of teens can transform into benefits for society and those who need help in trouble will include the early development of these youths.

One Buddhist proverbs have said that (Thai Tipitaka 25/54/69) “children are defense of human beings, and children are defense humanity well must be a quality children as in [3], both public and private sectors have realized the importance of youth which will grow into a major force in the development and initiative the country. It was a collaboration to create activities and programs to a variety of pulling power that teens are more developed and where they are located by allowing them to participate in these activities and projects in terms of being a volunteer. Learning system volunteerism in real situations is to find their strengths and build on it including the development of their own commentary story has appeared on the "volunteer" is a very interesting story of young man who devoted his energy to public works such as building roads, bridges, plant trees to create a residence hall walking, and clean public places. He has done 7 good action consisted of 2) take care mother and fathers, 2) conduct good manner to adult, 3) speak politely, 4) do not say sneaky to others, 5) willing to sacrifice lifelong, 6) says a faithful lifelong, and 7) do not angry through the life. The result of this painstaking send him a truly good idea or to be Indra (Thai Tipitaka 25/258/376). According to volunteer work like this, Buddha said that the praise that "these are plantations, reforestation, build bridges, classified as drinking water, ponds and marshes, provide shelter blessed are those will have good life all day and night "(Thai Tipitaka 25/246/47). This is to show that the Buddha encouraged people to work that benefits others and the public that is called “volunteer work”.

His Majesty King Bhumibol Adulyadej heeds the significance of the forests for the country, a major variable in their survival being water. As such His Majesty has presented ideas on a successful, beneficial, and interesting tool to revive the forest land known as the “check dam” which serves the purpose of retaining moisture. A check dam is a structure built to block the path of water and normally obstructs small brooks in areas of headwater or sloping land. When water currents are strong, the dam delays the water flow and retains sediment to stop it from running into the lower watershed portion. This is a superb method of conserving soil and water. His Majesty presented ideas to build moisture-preserving check dams to create a water cycle for the forests. Surveying for highland near mountain peaks is done and the dam must be designed to retain sufficient water amounts for two months since water retained for long periods after the rainy season will sustain the strong and fast-growing plants interspersed throughout dry forest area as in [4].

Local government organization is the organization that is close to people in order to alleviate the suffering people of the area as much as possible. Water shortage is a problem that is deteriorating day by day, more and more every year. The government, under the leadership of General Surayud Chulanont has announced that a "water" as a national agenda in 2007 (Department of Water Resources. 2007) to ensure and set the water management systems. This leads to the solution of national water resources sustainably. The management style and currently trending in the right direction towards a holistic water management can consider the ecological dimension and the greater community. It focused on the developing of water management model that integrates knowledge and understanding. The process relies on the participation of the public sector or the local community. At the administrative organization of Nong Kham Sub-district realizes the importance of this issue. It supports projects to prevent conflicts and reduce the conditions that lead to violence. Water shortage in the area Nong Kham Sub-district always recurs every year, especially during the months of January to May, which affects farmers in the area as well. Building check dams is another alternative that can help to fix the problem of water shortage and moisture to the forest.

Therefore, researchers have realized the importance of volunteerism to develop and cultivate virtue of youth and the development process of the youth volunteer activities. According to the model, the development potential and stimulate moral good that is in these children leads their interests and aptitudes. Another important purpose is that to

produce young people who do not hesitate to serve society as well as in society with wisdom. Researchers believe that people who volunteer to work for others; it is highly possible to bring the Buddhist doctrines related to social work, to serve others, and to take a share in the lifestyle in order to live together peacefully in society including the value of self and society that being known and rewarded. As the reason, researchers are therefore interested in studying "natural resource management using the participatory process of youth volunteer in the community."

II. RESEARCH OBJECTIVES

The objectives of this research article were 1) to study the state of area, water and community potential, and 2) to develop and propose the method of natural resource management using participatory process of youth volunteer in community.

III. RESEARCH METHODS

A. Research Design

Action research [5] and quantitative research were used and research tools were interview form and questionnaires. Data were collected from in-depth interview, focus group discussion and quasi-experimental design. Qualitative data from 31 key informants was analyzed by using content analysis whereas quantitative data collected from 134 samples was analyzed by using descriptive statistics. The researchers developed a model of water management with the participation of youth volunteer in parallel study between (a) the focus of the learning community, and (b) scientific research in order to use for the database to the public. The process of implementation were consisted of 1) documentary study from primary sources including Buddhist scriptures [6], and the secondary sources include scripture commentary, research books, articles and other related documents, 2) an area study of understanding community youth volunteer and stakeholders about the purpose of the operation and the target, 3) recruited young volunteers who are the target audience and subscribe, 4) participants meeting in the community to find problems and the need to solve the problem together, 6) preparing materials, 7) doing, and 8) data processing at every stage of the compilation, analysis and presentation summarizing the findings.

B. Research Process

Research process of this research has developed into 4 steps consisted of to analyze concept, created research tools, conduct the experiment, and to assess experimental results. Steps were shown in Fig. 1.

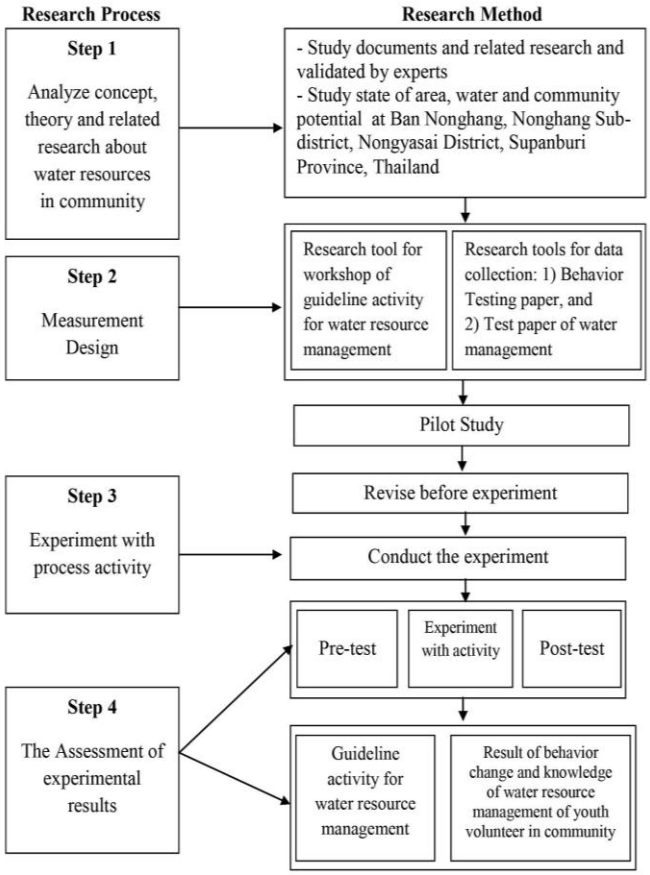

Fig.1 Research process for the development of water resource management of youth volunteer in community

IV. RESULTS

Results indicated that 1) the area and water in community has only one source of water, and it was not enough for utilization. They could not save the water during flooding season. Therefore, the leader of the community tried to find the best way to preserve water using technique of adding water to underground and making life dam in order to slow down water. 2) Five steps of natural resource management process using participatory process of youth volunteer in community consisted of (1) pre-research plan, (2) planning, (3) action plan, (4) implementation, and (5) follow up. Results of post-test and follow up showed higher score than pretest at significant level of .05.

Results of the study can be presented natural resource management using participatory process of youth volunteer in community. A Model of CF: UAU-4P was developed from area study and was effective process for youth volunteer to collaborative and tried to be part of natural resource management as shown in Fig.2.

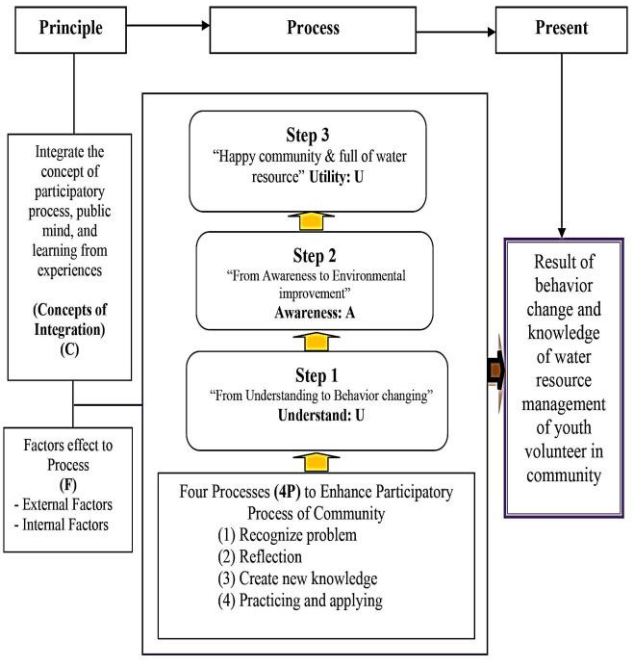

Fig.2 A Model of CF: UAU-4P for Natural Resource Management using Participatory Process of Youth Volunteer in Community

From Fig.2 can be explained to A Model of CF: UAU-4P for natural resource management using participatory process of youth volunteer in community that consisted of 6 aspects. The first aspect is concepts of integration (C) that integrates the concept of participatory process, public mind, and learning from experiences. The second aspect is factors effect to process (F) consisted of external factors and internal factors. The third aspect is the process from understanding to behavior changing (U). The fourth aspect is the process from awareness to environmental improvement (A). The fifth aspect is utility that is the process of happy community and having water resource for utilization (U). The sixth aspect is four Processes (4P) to enhance participatory process of community consisted of (1) recognize problem, (2) reflection, (3) create new knowledge, and (4) practicing and applying. Then, youth volunteers have been developed to be behavior change and knowledge of water resource management in community. In addition, these six aspects can be developed as a grounded theory in order to develop for further study using causal relationship model (SEM) applying mixed methods research related to research design of L. Klomkul as in [7]-[8] as shown in Fig.3.

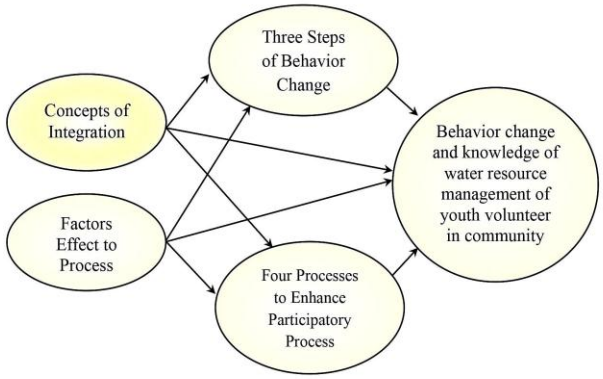

Fig.3 A Model of Behavior Change and Knowledge of Water Resource Management of Youth Volunteer in Community

V. DISCUSSIONS

The results of the review of the community in the field of conservation indicated that water resources management in the past had the relationship between the community and the water resources in the community. Youth volunteer in the community is to raise awareness and the wisdom of the past to selected areas which are abundant and the children were living. However, if the weather changes like flood, drought and occupation, these things make the community aware of the importance of conserving water resources in the community. It is also talking to local communities in the management of water resources such as dams, digging canals, and cleaning of the canals and around that area. So when faced with floods in the rainy season that runs from the watershed with no trees to block. As a result, the mass of water that has plenty of erosion along the river bank, in some places, the water eroded the road junction of Ban Nong Hang School. It occurs a big hole or sometimes the break the street. The amount of water is very acute and water overflowing from the canal to the river bank, and then damage in the community. The impact due to the volume of water that much, but could not keep it grounded and make overflow spilling out riverbank damage in the community.

When a problem like this people in the community are so common quest for knowledge about how to treat people in the early practices by telling the elders in the community and a review of the experience that they had engaged in activities that lead to practices that are consistent with community life. They are learning to share local knowledge to the conservation of water resources in the community. Many communities have used such mechanisms. Regulation of water use wisdom to engage the community integrating with schools, community groups, youth leadership and volunteerism, and external support. Each engine is built from a real community feel resulting in the recognition and participation in the practice particularly the Nong Kham. The parish is a leader with vision and offers something new to the community. As a result, information, knowledge and innovation from various

external agencies with the training philosophy of sufficiency economy can adopt the lifestyle. It also provides training on water management scholars from a network such as a dam. The activities in rural schools and the sections of the community send young volunteers and officials of the district administration to learn how to make a dam at Huay Hin Dam. When they have learnt knowledge, they came the public hearing stage and to find a common agreement in the order to build a dam and to the management of water resources in the community. This is the way to promote the environment and water resources, land and forest areas around water sources in the community. This is consistent with the strategic plan as in [9] to develop and increase water resources utilization. The supply of clean water for consumption is sufficient to cover all the villages by empowering the retention of existing water resources. Restoration improved water sources digging ponds on farms and developing networks linking water resources and water distribution. Development of new water sources in the area more suitable and acceptable to the public and lead to groundwater with surface water in areas with sufficient water capacity under the management of the demand for water-efficient. In addition, the work of the community through a participatory process is not only youth volunteerism in the community; there was also the participation of the community and officials of the district administration, teachers and parents in efforts to make banks groundwater. The work is due to the importance of filling water into the soil. To replace the amount of water pumped up from underground through groundwater pumping.

The participation of the community for youth volunteering participation has made decision to make groundwater bank instead of improving live weir because after a survey for the first time on June 3 that appeared over two weeks, heavy rains in the area. Causing a mass influx of water caused erosion around the elephant ears and glutinous rice. The area also stepped behind the dam. It was the erosion of the sand lot. As a result, damage the youth volunteers cannot be solved in a short time, so they decided on the conservation of resources and through other means, which is to make groundwater bank. Then share the plan and find space to store water underground. The area is water that was marshy water throughout the year or swampy areas. The survey found that there are two areas that should be done underground banks that related research to [10]. This paper indicated that Groundwater banking is the use of aquifers to store water to balance seasonal or longer-term variations in supply and demand. The large storage capacity provided by aquifers can be a valuable tool for conjunctive use of surface water and groundwater as well as other elements of integrated water resources management. Successful groundwater banking requires favorable hydrogeological conditions to efficiently recharge, store, and abstract large volumes of water. Additionally, groundwater banking is also highly dependent upon water management and operational policies.

Since it is an area with a water feature was marshy water throughout the year or a swampy area in front of the teachers' houses including and in the water beside the cafeteria. It was found that when the area did not have groundwater banks, both 2 areas that used to have underground water overflowing in the area. As a result, there are no problems with flooding, no smell, and no eggs of mosquitoes. This is the participatory process of engaging the local community leaders, government officials, researchers and the consequences can be filled with water to the ground. This activity can make collaboration joint planning and encourage all people who have been involved in the management of water resources in the community together. This is consistent with researcher as in [11] said that the process involved in rural development as having three dimensions and 2 contexts. The dimensions of involvement include the first dimension (What) consisted of 1) participation in decision-making, 2) participation in the implementation, 3) the involvement of beneficiaries, and 4) to participate in the evaluation. Participation in decision-making does not mean that the decision alone to take a decision in conjunction with the operations as well as in the organization. Defining development activities and decisions, and also is associated with the public about the benefits and evaluation. For context, participation means that the nature of the project by considering the nature of the import benefits and formed to define the environment of the project or event such as historical factors, physical and natural factors. The second factor is social factors that contribute to someone (Who, Whom), including the composition of those who took part with residents in different stages, such as community leaders, government officials, and organizations that provide grants consider the demographic, social, economic, guests took part in gender, age, education, occupation, income levels in society, length of stay. The third dimension, the engagement, however, (How) is subdivided into 1) the nature of participation, such as a willingness to participate, and the reward or being forced to participate, 2) forms of participation such as to participate directly or through the organization of community. 3) The size of the part, such as the frequency and duration of participation, 4) the effects of participation. This may be the power or authority of the organization, or is it only interaction as in [11].

The procedure of checking during the learning community indicated that this research is correlated to the research [12] showed that the process of learning process in 5 steps consisted of the process of gathering "people, thinking, acting, share lessons, results from actions". If the cycle of learning communities of any spin faster or are highly dynamic, it shows that the community has the power to learn from the educational and information needs of the community. Schools are required to take advantage of the water that is considered the main factors of life, affect the

cognitive development of the school and the community. This is the natural resources management using participatory process of youth volunteer in the community.

VI. VI. RECOMMENDATIONS

A. Recommendations for Practices

1. Strengthening the mechanisms to manage water resources in the community is the learning process of people in the community in order to drive other mechanisms to achieve more efficiency. Each of these communities has different dynamics. If they learn and share to each other, they will result in an adjustment to protect problems appropriately.

2. The most effective of water resources management in the community should be cooperation from the internal and external communities. The support from various organizations both public and private is absolutely necessary for the strengthening initial phase of water resource management in community.

3. Leadership is very important towards using local wisdom for conserving water resources in the community because people in the community have confidence and trusts a group of activists and leaders. Therefore, leaders should make the learning process to enhance knowledge for people in the community in order to make them full of confidence and to express themselves with reasonable. For those who are unable to attend the meeting, leader should open channels for them to attend the meeting as well.

B. Recommendations for Further Research

1. The samples tested in this study were aged around 10-13 years. For the next research, it should be done with a group of students from the age of 15-18 years to develop methods and guidelines for sustainable water resource conservation and to create new knowledge to further research.

2. This research was designed and completed by using short experimental. So, this should be set to repeat the experiment with a group of students at other ages.

3. This research conducted specifically on water resource management. Therefore, it should conduct research on various types of national resources in order to guide the conservation of local resources by encouragement people in the community to join in participatory process of preservation the natural resources with sustainable development.

4. Result of this research was developed by mainly qualitative research and grounded theory is emerged as a relationship model between variables. Therefore, it should conduct further research by analyzing structural equation model by extending the sample size of sample group, and to validate the developed model using LISREL program.

VII. CONCLUSION

In conclusion, the findings from the analysis of both quantitative and qualitative showed that a change in the student participants in both cognition and changing behaviors in a better direction. After receiving training for a period of 2 days and 2 nights, results found that they were increase cognition in natural resource management. The results of in-depth interviews with community leaders reflected that community members who participated in the project have changed their behaviors and showed collaboration efforts in the activities. Students who attend the event have shown good value of integration activities and volunteering. The efforts have also resulted in different activities such as volunteer activity in the community to paint the walls and clearing grass along the roadside around the village. In summary, the participation of young volunteers in the community on water resources management in the community consisted 3 phases to encourage behavior change and knowledge which understanding, awareness and utility. In addition, results of this research can develop for further study by using structural equation model in order to find out the effect size between variables in the model including variations of endogenous latent variables. Then, the developed model can generalize to other communities.

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Approach to String-Like Pulse in Traditional East Asian Medicine by Ultrasound device

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Abstract:

Objective: Pulse diagnosis is one of the most fundamental and important diagnostics in traditional Korean medicine. Pulse condition is difficult to master, because of writing only by text in the past. Although researches and machines for objectification of pulse have been developed in these days, it is hard to master pulse condition yet. Pulses are defined by several aspects; such as pulse location (superficial and deep pulse), pulse rate (slow and rapid pulse), pulse length (long and short pulse), pulse strength(forceful and forceless), pulse smoothness(stagnant and smooth pulse), pulse tension(tension and relaxation), pulse thickness(string and enlarged pulse) and so on. Some of them we could express pulse form visibly, especially with string pulse and enlarged pulse because those have pulse shape like thick or thin. So we study pulse actualization with especially string pulse out of two. Also we focused on what the place of inch-bar-cubit is just on the radial artery. That means that measuring the change of radial artery thickness by some given conditions would show the actualized pulse definition with visual evidence not only with practitioners' fingertip sensation.

Methods: The string pulse is straight and narrowed like a string with a bow which is referred to traditional medical classic such as Nanjing, Maijing and other text for diagnosis. It could be explained by thickness of radial artery. According to medical classics, what string pulse mainly represents fatigue on human body. That means if somebody had fatigue on his or her body the pulse would be changed into string pulse from normal. Therefore, we check thickness of radial artery by ultrasound after causing artificial fatigue. 1) Measure the thickness of radial artery after 30 min break for making sure the normal pulse. 2) Make subject to grab handgrip for 1 min to make him or her in fatigue stage. 3) Measure again the thickness of radial artery. 4) Compare the values of radial artery thickness between before and after grabbing.

Results: After causing artificial fatigue, thickness of radial artery is decreased after the experiment. The thickness of RA of Subject A had been changed from 1.8mm to 1.6mm and Subject B from 2.0mm to 1.6mm.

Conclusion: This change from experiments above shows that RA was influenced by even short term stimulation like grabbing handgrip. Also that explains that just like artificial fatigue could make string pulse condition, real fatigue would cause making string pulse on his or her wrist. So with that way, we could define or diagnose patients' fatigue status with ultra sound results not only with oral explanation. In this study, we verify that string pulse condition could be actualized with ultrasound. As the first study for actualization only with string pulse, there is more need to experiment actualizing with other pulses.

Keywords:

Pulse condition, string pulse, ultrasound, pulse actualization, fatigue

I. INTRODUCTION

Wrist pulse diagnosis (palpation), one of the typical diagnostic methods of traditional East Asian medicine[TEAM], is a medical examination method that examines a change in a disease and a patient's condition by checking changes of a patient's wrist pulse.

In the past, traditional medicine doctors defined pulses based on the fingertips by combining the rate of pulses, rhythm, size, etc. and described them in the literature using the expression as 'pulse condition'. However, the literary description for pulse condition is very difficult to grasp the reality. In TEAM, the person who diagnoses the disease with pulsation among the four methods is called the lowest level of doctor. On the contrary, it was recognized as a relatively easy technique compared to inspection, listening and smiling examination, Inquiry. As mentioned above, palpation is a typical diagnostic method of TEAM. At the same time, it is a technique that should be understood first, but palpation as a diagnosis is gradually disappearing because it is difficult to understand for who wants to learn at traditional medicine educational institutions.

To overcome this, numerous traditional medicine doctors and several researchers have made various attempts to actualize the pulse. Among them, efforts were made to visualize the shape of pulses based on the fingertips. For example, Yun(2000)[1]'s Device and uBio[2]'s Device that

[1]Youngjun Y. Palpation Device and Palpation Wave Analysis. SNU Dissertation. 2002:4-12;24-25.
[2] https://ubios.modoo.at/ (search date: Jan 8th, 2020)

grasps the pulse wave such as ECG of western medicine. But this was not enough to materialize the pulse.

The most visible part of the wrist pulse can be determined by the thickness of the wrist pulse because the wrist pulse in TEAM is basically radial artery[RA]. So grasping the size among the changes in the artery is a good indicator for visualizing and objectifying the pulse. In other words, measuring the thickness of the pulse using an ultrasonic device rather than the subjective sense of the fingertips and visually expressing it will be an easy way to identify the pulse condition. Among them, in particular, string-like pulse is straight long and thin, feeling like palpating the string of a musical instrument. The body is mainly described as the thickness of the wrist pulse. Therefore, this article could be a trial to visualize the wrist pulse through measuring the thickness of the wrist pulse, based on the expression for string-like pulse described in the literature.

II. HYPOTHESIS

According to TEAM theory, hypothesis could be framed.

- Fatigue of body could make the string-like pulse
- Fatigue artificially made would change the normal pulse to the string-like pulse
- String-like pulse is in straight and thinner status comparing with the normal pulse
- Shape of wrist pulse is basically same as shape of radial artery
- If the thickness of the radial artery is reduced after artificially generated fatigue, it could be considered as a string-like pulse corresponding to fatigue.

III. METHODS

1. Advance preparation

Subjects will be allowed to rest for 20 minutes after arriving at the laboratory. After the subject is in a comfortable position, the thickness of the radial artery of the subject is measured using ultrasound. Ultrasound is a GE Pro A model and the measuring instrument is a 5 cm long linear probe.

2. Artificial fatigue

Subjects will be stimulated with the grip meter for 2 minutes. The grip meter is a model of the Lavicen gripmeter ks-301.

3. Measuring

The ultrasound will be used to measure the thickness of the radial artery of the subject after making artificial fatigue.

4. Analysis

The thickness of the radial artery will be compared before and after the test.

Figure 1. Pro A, GE

IV. RESULT

After tests with subjects A, B, and C, the thickness of the radial artery of the subjects was compared using ultrasound.

Figure 2. Lavicen gripmeter ks-301

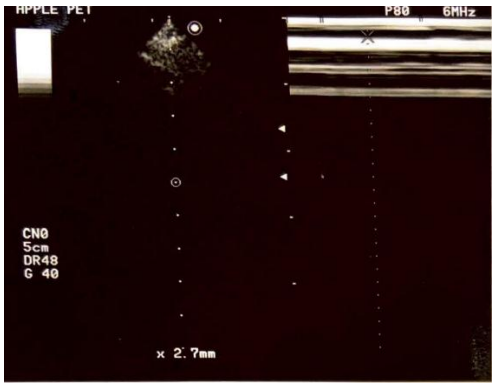

Figure 3. Thickness of Subject A's RA before test: 1.8mm

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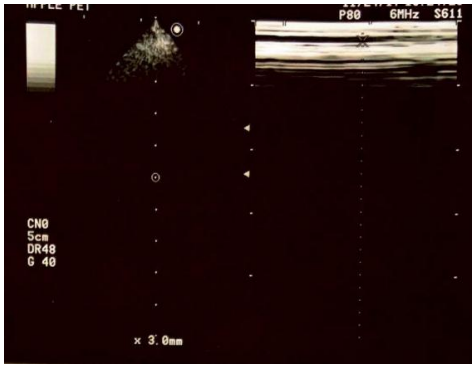

Figure 4. Thickness of Subject A's RA after test: 1.6mm

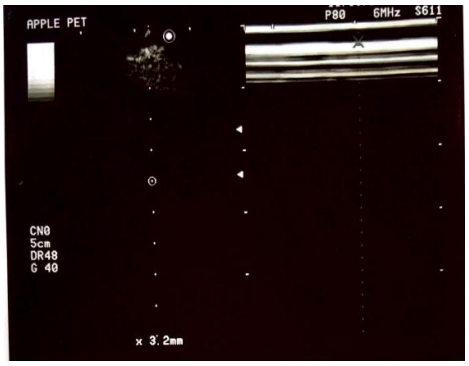

Figure 5. Thickness of Subject B's RA before test: 2.0mm

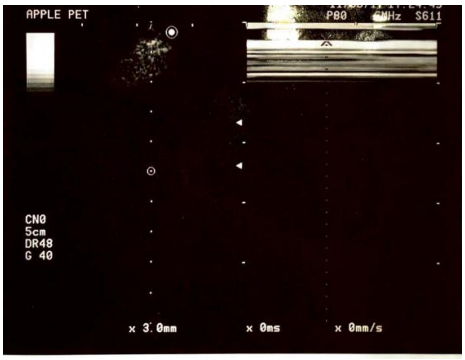

Figure 6. Thickness of Subject B's RA after test: 1.8mm

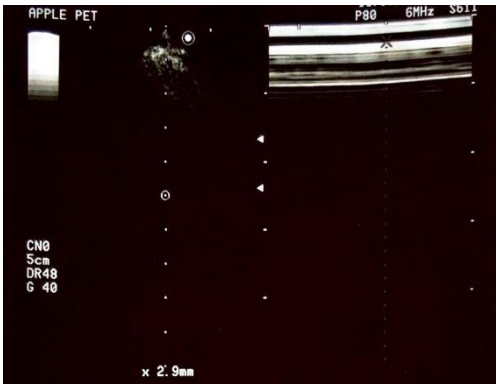

Figure 7. Thickness of Subject C's RA before test: 1.2mm

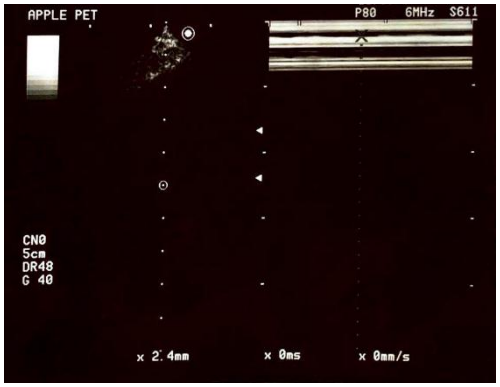

Figure 8. Thickness of Subject C's RA after test: 0.8mm

Through the test, Subject A had a decrease in the thickness of the RA from 1.8mm before the test to 1.6mm after the test. Subject B had a decrease in the thickness of the RA from 2.0mm before the test to 1.8mm after the test. Subject C had a decrease in the thickness of the RA from 1.2mm before the test to 0.8mm after the test.

V. CONCLUSION

Palpation is one of the most basic and important diagnostic methods of TEAM. However, since the objectification is difficult, there is a recent tendency that the utilization of palpation is lowered. Although there are many studies that classify opinions about the palpation that doctors mentioned in the old books, there have been no studies that actually embody the shape of palpation. Existing researches have been conducted by converting the changes of blood vessels into waveforms and analysing waveforms[3]. This method is effective as an objectification method, but it is difficult to recognize them directly by using them in the TEAM. Although devices have recently been developed to represent the shape of wrist pulse, these devices could not represent the shape of wrist pulse intuitively.

The purpose of this study is to verify that palpation changes can be expressed visually. After looking at the palpation mentioned in the classics, the shape of wrist pulse was sorted out, and the artificially developed disorder was linked to specific wrist pulse, string-like pulse. The fatigue could make the string-like pulse on human body so if doctor examined the string-like pulse, doctor could diagnose that the patient was in fatigue status.

VI. ACKNOWLEDGEMENT

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An assumption of UAV swarms utilizing ocean surface gradient wind field to acquire energy for air cargo transportation

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Abstract:

Using UAV swarms to carry out freight transportation has begun to carry on the application exploration stage, many areas began to use UAV in the field of express transportation. However, due to the limitation of UAV in the range capability, this manner can be just used in the short-distance mode of transport. In this paper, in view of the widespread existence of wind gradient at sea, we propose an idea that using UAV swarms for air cargo transportation at the advantage of sea level gradient wind field to obtain energy. By this method, UAV swarms can fly from one location to another during unpowered long voyages, like albatrosses that migrate on a large scale on the sea surface. According to the characteristics of UAV flight route under different position conditions, we propose a dynamic gliding route that combines a variety of flight tracks to realize unpowered flight under different wind field conditions. The characteristics of sea level wind gradient field and the green transportation mode of dynamic gliding provide a new method for the exchange of goods between marine freighters and the transmission of goods on the sea.

Keywords:

UAV swarms, Dynamic soaring, gradient wind field, cargo transportation

I. INTRODUCTION

A major handicap associated with small- and micro-Unmanned Aerial Vehicles (UAV) is the limited on-board energy capacity (either as chemical fuel or as batteries). The reduced endurance and range which results greatly reduces the utility of such vehicles[1, 2]. However, significant energy is available from the atmosphere.

Recent developments in UAVs show two trends; at one end of the spectrum, large uninhabited aircraft are gaining capabilities for high altitude flight, long endurance, and are increasingly able to cover great distances. At the other end, uavs are getting smaller while retaining many of the abilities previously held by significantly larger airplanes. These small aircraft offer advantages such as portability, difficulty for adversaries on the ground to detect or destroy, and comparatively low cost, while also eliminating the need for established ground facilities (airstrips, etc.). Smaller vehicles, however, pay a price in smaller available payloads, severely decreasing their utility for many missions. Additionally, any energy stored on-board, in the form of batteries or chemical fuel, decreases the mission payload capabilities further. Ultimately a trade-off must be made between increasing the energy storage on a small uav and thus its range, or carrying a larger mission payload[3].

Dynamic soaring is a flying technique used to gain kinetic energy without effort by repeatedly crossing the boundary between air masses of significantly different horizontal velocity[4].

For centuries, biology has provided fertile ground for hypothesis, discovery and inspiration. NASA has paid great effort to explore the potential to increase range and endurance by extracting energy from the ambient atmospheric velocity field[5].

Nature is a good source of inspiration as lots of energy-saving strategies are exploited by birds[6].

Ornithologists propose the theory of dynamic soaring firstly, because they are intrigued by the phenomenon that birds such as albatrosses, falcon and jackdaw can fly long distances, even around the world, almost without flapping their wings. Until now, many researchers still pay their attention on how albatrosses fly around the world without flapping their wings[7] and how the changes in wind pattern alter the distribution and lift-history traits of albatross[8]. They find that dynamic soaring is an effective method to enable a bird to harvest energy in the form of increased altitude or speed from the atmosphere and greatly extend flight duration and distance[9].

This idea is then widely accepted by scholars in aviation, and the most interesting topic for them is which one is the optimum flight path for an aircraft to extract the

maximum energy from wind shear. Many commercial software are developed to determine trajectories for dynamic soaring in specific conditions, and lots of valuable results are obtained, such as Zhao et al present the optimal patterns of dynamic soaring for glider in wind shear by the software named NPSOL[10], Sachs analyzes the minimum strength of wind shear required for albatrosses to perform dynamic soaring by the software named ALTOS[11] and Deittert et al generate the optimal trajectories of UAVs in the condition of the minimal and maximal strength of wind shear for the optimal cross-country travel by the software named AMPL[12], other examples can be seen in[13-18].

Nowadays, dynamic soaring have been used to extend operational lifetime of small UAVs, and many researchers try to realize the autonomous dynamic soaring of UAVs. Some pioneering works have been done, such as Lawrance et al have designed a guidance and control strategy for a gliding UAV to perform the autonomous dynamic soaring[19], Kahveci et al have developed an adaptive control scheme based on linear quadratic control for UAV in autonomous soaring application[20], Lawrance et al and Langelaan et al have separately designed methods to estimate wind field for autonomous dynamic soaring[21, 22].

In this paper, in view of the widespread existence of wind gradient at sea, we propose an idea that using UAV swarms for air cargo transportation at the advantage of sea level gradient wind field to obtain energy. By this method, UAV swarms can fly from one location to another during unpowered long voyages, like albatrosses that migrate on a large scale on the sea surface. According to the characteristics of UAV flight route under different position conditions, we propose a dynamic gliding route that combines a variety of flight tracks to realize unpowered flight under different wind field conditions. The characteristics of sea level wind gradient field and the green transportation mode of dynamic gliding provide a new method for the exchange of goods between marine freighters and the transmission of goods on the sea.

II. THE BASIC TRAJECTORY OF DYNAMIC SOARING

Now, the idea of dynamic soaring is widely accepted by scholars in aviation, especially for UAVs which may be controlled automatically to extract energy from wind shear to greatly extend flight duration and distance[9]. Zhao[10] and Sachs *et.al.*[16] have shown the two patterns of dynamic soaring for UAVs: the one is bend type (or named as travelling type), the other is oval type (or named as loiter type), the typical behavior of two patterns is to roll 'belly-to-wind' to a steep angle of bank[23], as shown in Fig.3.

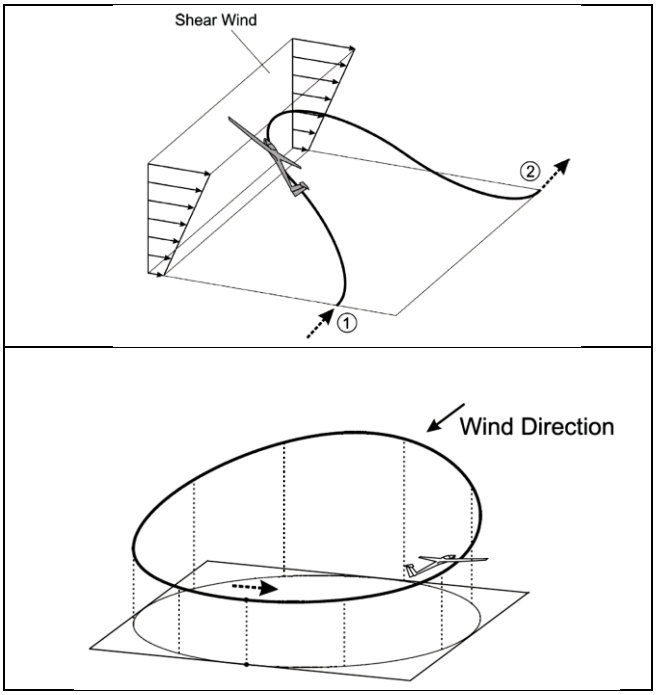

Fig. 1 Bend and oval type of trajectory[16]

Instead of perusing battery performance, researchers find that dynamic soaring can supply more energy for long-endurance mission UAVs without adding additional weight on the UAV. Recently, energy extraction from wind shear has attracted more and more attentions of researchers all around the world[3, 13, 24-26]. Since wind shear is persistently distributed in the boundary layer above the ocean surface and upper atmosphere from altitude of 15 to 20 km[27], incorporating with the rapid technologies development of UAVs, dynamic soaring may become a new way to explore the energy from nature and the energy extracting from wind shear possibly becomes a new kind of renewable and sustainable energy source. The motivation of this paper is to explore a new method that transport the cargo above the sea surface by UAV swarms at the advantage of sea level gradient wind field to obtain energy.

III. THE MODEL OF AIRCRAFT FLYING IN WIND SHEAR

A mathematical model that consists of the equations of motion for three-dimensional flight of aircraft is always adopted to analyze the aircraft flying in wind shear. There are mainly two types of model to describe an aircraft flying in a spatially and temporally varying wind field—the Sachs' equations of motion [11, 16, 17, 28] and the Zhao's equation of motion[10, 12, 14, 29]. Bower G.C. [30] has discussed the advantages and disadvantages of the two sets of equations of motion. Zhao's model is considered to be more intuitive by using airspeed, flight path pitch angle, and heading angle as state variables. Based on this reason, the Zhao's model is adopted in this paper, and a linear wind shear is supposed to be always blowing along *x*-axis. The

definitions of forces and angles used in the model are shown in Fig.2.

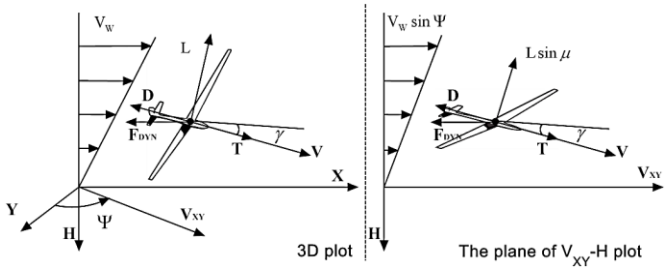

Fig. 2 Forces acted on aircraft

The left figure of Fig.2 is the 3D plot of aircraft and the right figure is the plot on the plane of V_{XY}-H, where the V is airspeed, X and Y are positions, μ is bank angle, L is lift force, D is drag force, T is the thrust, F_{DNY} is the dynamic soaring force which will be further interpreted in the following, the V_{XY} represents the projection of velocity of aircraft on XY-plane, Ψ is the azimuth measured clockwise from the y-axis and γ is the flight path pitch angle.

The differential equations of motion for aircraft is given as follows, where the speed of aircraft is modeled in a wind relative reference frame and the position of aircraft is modeled in an earth fixed frame.

$$m\dot{V} = T - D - mg\sin\gamma - m\dot{V}_W\cos\gamma\sin\Psi \tag{1}$$

$$mV\cos\gamma\dot{\Psi} = L\sin\mu - m\dot{V}_W\cos\Psi \tag{2}$$

$$mV\dot{\gamma} = L\cos\mu - mg\cos\gamma + m\dot{V}_W\sin\gamma\sin\Psi \tag{3}$$

$$\dot{h} = V\sin\gamma \tag{4}$$

$$\dot{x} = V\cos\gamma\sin\Psi + V_W(h) \tag{5}$$

$$\dot{y} = V\cos\gamma\cos\Psi \tag{6}$$

The lift and drag force are expressed as follows

$$L = \frac{1}{2}\rho S_W C_L V^2 \tag{7}$$

$$D = \frac{1}{2}\rho S_W C_D V^2 \tag{8}$$

Where, the ρ is the air-density, S_w is the reference area of aircraft, C_L and C_D are the lift coefficient and drag coefficient, respectively. The drag coefficient C_D depends on the lift coefficient C_L, yielding

$$C_D = C_{D0} + kC_L^2 \tag{9}$$

Where, the C_{D0} is the parasitic drag coefficient and k is the induced drag factor.

For the Eqs. (1)-(3), because the airspeed-frame of aircraft is not an inertial frame relative to the wind-frame when aircraft is flying in wind shear, there is a fictitious force F_{DYN} acted on aircraft, as described in Ref.[12], which is expressed as follows

$$F_{DYN} = -m\dot{V}_W \tag{10}$$

Its projection onto the direction of airspeed is expressed as follows according to the definition in Eq.**Error! Reference source not found.** and Eq.(4)

$$(F_{DYN})_V = -m\dot{V}_W\cos\gamma\sin\Psi = -\beta mV\sin\gamma\cos\gamma\sin\Psi \tag{11}$$

Eq.(11) reveals that an aircraft can extract energy from wind shear if only the product of sinγ and sinΨ is negative when β is positive or the product of sinγ and sinΨ is positive when β is negative. So an aircraft can always extract energy from wind gradient, whatever the gradient of wind shear is positive or negative.

IV. AIRCRAFT DESIGN FOR CARGO TRANSPORTATION

Since the aircraft can extract energy from wind shear to increase its altitude or airspeed, it is possible to use the adding energy for power production. Barnes and MacCready[31] have outlined one of this aircraft, as shown in Fig.10. This aircraft would incorporate a windmill and an energy storage system. The former one is a dual-role machine, power mode and thrust mode, which can be used for electrical power production when the strength of wind shear is great enough and to propel the aircraft when the wind is lull, the later one is used to store the electrical energy when the windmill works in the power mode and to supply the electrical energy when the windmill in the thrust mode.

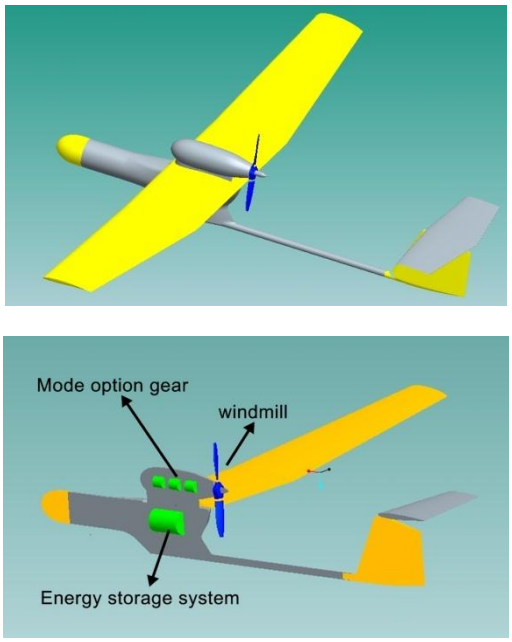

Fig. 3 The concept of regenerative soaring aircraft

The equation of motion for the energy stored in the on-board battery is given by Eq.(12)

$$m\dot{V} = -D - \eta_{gen} D_{gen} - mg\sin\gamma - m\dot{V}_W \cos\gamma \sin\Psi \quad (12)$$

where the D_{gen} is the drag of windmill worked in the power mode, the η_{gen} is the energy conversion coefficient of windmill.

V. CHALLENGES

Although the results are encouraging, the optimal solutions may not be achievable in practice because information about the ambient wind field is currently limited. More work is needed to determine a guidance heuristic that will approximate the optimal solutions given the limited atmospheric information currently available on board the vehicle.[5]

However, those studies have focused on regular horizontal gusts and have neglected the problem of determining closed loop control laws. Given the scope of current knowledge, the technology to apply dynamic soaring to UAVs is immature[32].

(1) Structure and Design

Gliding birds continually change the shape and size of their wings, presumably to exploit the profound effect of wing morphology on aerodynamic performance. Lentink D. has shown that choosing the most suitable sweep can halve sink speed or triple turning rate[33].

(2) Navigation

Navigation about dynamic soaring[34, 35],

One of the ways to extend range and speed in autonomously guided UAVs is to incorporate dynamic soaring techniques within the navigation algorithm[36, 37]

The higher gradient allows for correspondingly greater energy extraction, resulting in much higher speeds for the aircraft. Models repeatedly cross the shear layer by flying in a circular path, penetrating a fast-moving headwind after flying up the back side, turning to fly with the wind, diving down through the shear layer into the stagnant air, and turning again to fly back up the back side of the hill. Because of the speeds involved, significant structural reinforcement in the fuselage and wing is important. Because of this, dynamic soaring models are commonly built using composite materials.[38]

(3) Control

A receding horizon controller which computers a sequence of pitch rate commands with the goal of maximizing energy gain over a fixed horizon is derived. An energy based reward function is used to maximize energy gain with only local knowledge of atmospheric wind conditions[39].

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Effect of Coanda Jet Direction on Characteristics of a Finite, Swept Circulation Control Wing

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Abstract:

The present paper reports on a numerical investigation into the effect of the jet direction (normal to the trailing edge or parallel to the freestream flow) in a circulation control (CC) device on aerodynamic behavior of a finite, swept circulation control wing. In this work, HyperFLOW software is adopted to solve the Reynolds-averaged Navier–Stokes (RANS) equations coupled with the Spalart-Allmaras turbulence model, treating the Coanda jet slot as a velocity inlet condition computed. Turbulent flow over a NA64A010 airfoil with and without circulation control at a range of attack angles is simulated as a baseline of the aerodynamic characteristics. And a finite wing with a sweep angle of 53 degrees, extruded from the NA64A010 airfoil, witnesses the 3D effects of Coanda jet in the normal to the trailing edge direction and freestream direction. Furthermore, a comparative analysis illustrates that Coanda jet normal to the trailing edge performs better in lift augment and providing nose-down moment than the jet parallel to the freestream. In general, the current analysis provides a support for practical application of circulation control technology.

Keywords:

Circulation Control, Active Flow Control, Swept Wing, Jet Direction, 3D effects

I. INTRODUCTION

Circulation control (CC) is a kind of technology to utilize the fluidic injections and the Coanda effect at the trailing edge to modify the lift generated and provide control moment. There are various kinds of benefits compared with traditional mechanical control surface, 1) reduction in part count and weight which directly reduces overall cost; 2) less requirement for maintenance; 3) potential increase in Cl_{max} by a factor of 4; 4) improvement of maneuverability, stability and control characteristics; 5) reduction of sensitivity to Reynolds number owing to primarily inviscid performance; 6) enhancement of short take-off and landing, and stealth ability. However, its drawback is also apparent that trailing edge thickening for placing a CC device seems to increase base drag in cruise. Besides, it is inevitable to decrease in thrust (estimated 5%) due to the bleed flow requirement from the engine compressor 1. In addition, the complexity of control methodology hinders the practical application of CC technology. All these features attract great interest in deliberating the characteristics of CC system.

The investigation on blown jet airfoils utilized in aerodynamics can trace back to the 1930s, and possibly earlier 2. As a pioneer, Henri Coanda discovered the phenomena of circulation control in a near-fatal plane crash 3. Early formal research into circulation control focused on its high-lift feature on fixed-wing aircraft for short take-off and landing [4, 5]. WVU CC demonstrator designed at West Virginia University and the US Navy A-6A were built and flown to show the effectiveness of CC system. This period witnessed the parameters of the ratio of coanda radius to slot height and non-dimensional velocity were illustrated to have much influence on characteristics of circulation control technology. After 2000, more experimental investigations on circulation control wing provided basis of computational work to validate the ability and issues of CFD methods in simulating flow control. There are general aviation circulation control (GACC) wing designed by NASA in 2002 [6, 7], NCCR 1510-7067N airfoil put forward in a circulation control workshop held by NASA and ONR in 2004 8 and CC-E0020EJ circulation control airfoil designed at the Georgia Institute of Technology (GTRI) in 2007 9.

On the other hand, current and future generic unmanned combat aerial vehicle(UCAV) configurations will have wings with a low aspect ratio and a medium to high leading-edge sweep angle for high agility and low radar signature

cross section, and a high aspect ratio and a medium to low leading-edge sweep angle with high lift-to-drag ratio for high altitude long-endurance ability. At low speed, the aerodynamic characteristics of a swept wing are significantly driven by sweep angle. The flow around a swept wing dominated by a vortical flowfield, which onsets from leading edge and develops in streamwise at low angles of attack. As a result, many researchers deal with the flow physics of the vortical flowfield of the swept wing. Andreas Schütte gave a deep insight into the onset of the vortical flow and aerodynamic behavior. And one can refer to 10 for more details.

There are a few experimental or numerical researches focusing on the details of circulation control applied in a swept wing. Wood 11 applied circulation control to swept wings to examine the effects of the sweep angle on a circulation control wing. This experiment presents no first-order effects of sweep on mixing between the Coanda jet and the boundary layer within the parameter range tested. G. Hoholis 12 took it a step further, and numerically investigated a circulation control as a roll effector on a generic unmanned combat aerial vehicle. The circulation control performs well at low angles of attack but loses roll control at higher angles due to the flow separation. In the aforementioned two works, the coanda jet is perpendicular to the trailing edge of the swept wing by default, forming a particular angle with the freestream, which is different from the 2D circulation control research. Therefore, the effect of jet direction on the performance of circulation control applied in a swept wing will be investigated in this paper.

This paper reports numerically investigates the effect of Coanda jet direction (normal to the trailing edge and parallel to the freestream flow) on aerodynamic behavior and flow physics of a finite, swept circulation control wing. The first part validates that the CFD solver HyperFLOW can reliably predict the aerodynamics and flow structures for such applications. The second part presents the simulation of NA64A010 airfoil with and without circulation control at a range of attack angles for a baseline of aerodynamic characteristics for the 2D case. The third part investigates the effect of the jet direction on aerodynamic behavior and flow physics of a finite 53° swept wing with NA64A010 section, following by a brief conclusion for this work.

II. VALIDATION OF CFD METHOD

In this work, HyperFLOW, a structured/unstructured hybrid CFD software, is adopted to solve the RANS equations coupling with the one equation Spalart-Allmaras turbulent model in its negative formulation. The basic numerical method in HyperFLOW is well-known cell-centered, second-order accuracy, finite volume method. It has been validated to have good accuracy and grid convergence performance in complex configuration high Reynolds subsonic and transonic turbulent flow simulation on unstructured/hybrid grids, referring to [13, 14]. The flow problems presented in this paper have a high Reynold number and a low Mach number which is suitable for HyperFLOW to deal with.

The CC-E0020EJ circulation control airfoil has been designed at the Georgia Institute of Technology (GTRI) for CFD validation purposes. This airfoil has a chord length of 8.6 inches, an elliptical forebody, a 20%-thickness-to-chord-ratio straight afterbody. Remarkably, the trailing edge is a semi-circular Coanda surface with a 0.812 inches radius, which has a upper and a lower CC slot with the same slot height 0.02 inches and slot lip 0.01 inches. Among three test cases in reference [15], we choose the mid blowing case (freestream and Coanda jet condition listed in the **Table I**) to validate the ability of HyperFLOW in simulating the circulation control flow.

Table I. Freestream and jet conditions in mid blowing case

	Mid blowing case
Ma_∞	0.10057
Re_∞	487,000
NPR	1.22330
C_μ	0.115

In this paper, we adopt the velocity inlet condition at jet slot corresponding to the specified blowing coefficient. The blowing coefficient is defined as following:

$$C_\mu = \frac{\dot{m}u_j}{q_\infty c} \qquad (1)$$

In which, the $\dot{m}$, u_j, q_∞, and c are massflow rate, jet velocity, dynamic pressure, and chord length. Assuming the pressure and temperature at the slot are the same as the freestream parameters, u_j can be induced according to the isentropic flow equations and the definition of $\dot{m}$:

$$u_j = \sqrt{\frac{C_\mu q_\infty c}{h\gamma p_j}}\sqrt{\gamma R T_j} \qquad (2)$$

In the mid blowing case, the non-dimensional slot velocity u_j is set to 4.94 in the parameter file of HyperFLOW. Two hybrid grids are also constructed to check for grid independent solutions, in which the coarse grid including 14561 quads and 6346 Tris, and the fine grid involving 74124 quads and 14698 Tris. For both grids, the first cell spacing is 8.6×10^{-5} inches, and the first cell spacing around the coanda surface and at the slot exit was half of that. More details about the number of nodes and grid topology for these two grids are presented in **Table II** and **Figure 1**, respectively.

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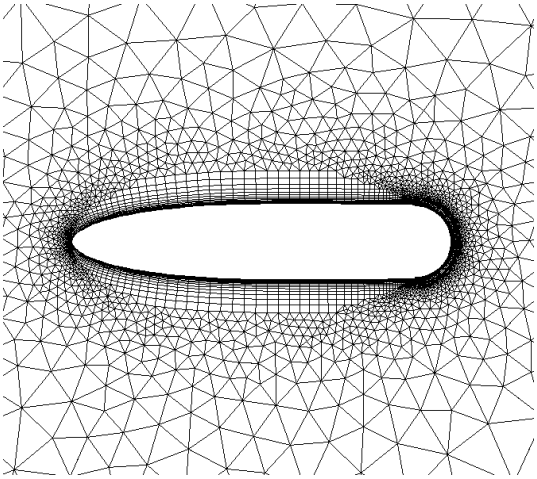
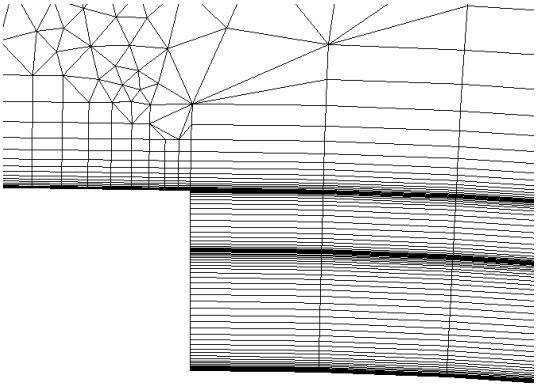
Table II. Details of the nodes configuration of the two grids for the validation case

Number of nodes	Coanda surface	Jet slot	Airfoil surface (excluding Coanda surface)
Coarse	121	41	241
Fine	481	81	481



(a) Overveiw



(b) View zoomming in the upper slot

Figure 1. Topology of the coarse grid for the validation case

As we can see that the fine and coarse grid predicate the similar Cp distribution on the surface of the airfoil (see **Figure 3**). Two curves match the experiment data in general, while the discrepancy might be due to the velocity boundary condition treatment. Most reference use pressure inlet boundary condition to simulate flow in the plenum chamber together with the outer flow. However, this work pays more attention to the effect of jet direction on aerodynamic characteristics and flow structures of the swept wing (see **Figure 2**). The CFD ability capturing the overall trends could just meet our requirements in general. Therefore, computational meshes with a similar fineness and topology to the coarse mesh will be constructed in the following cases.

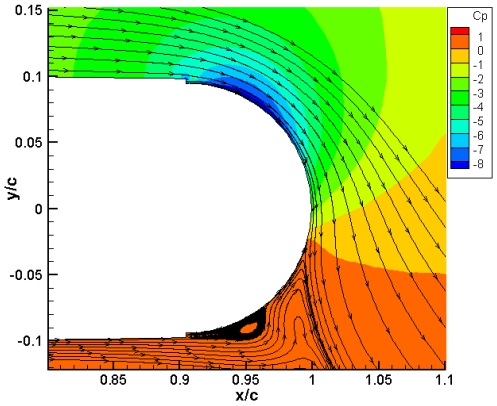


Figure 2. The pressure coefficient contour with streamlines in the vicinity of the trailing edge

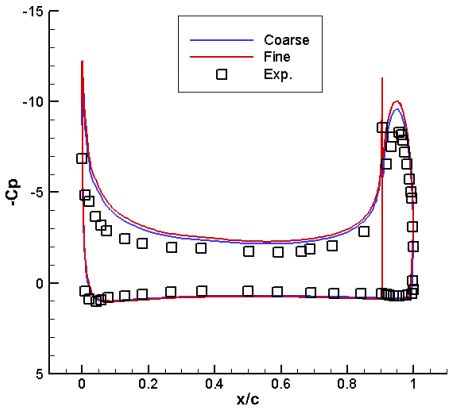


Figure 3. Cp distributions on the solid surface on two grids compared with the experiment data12

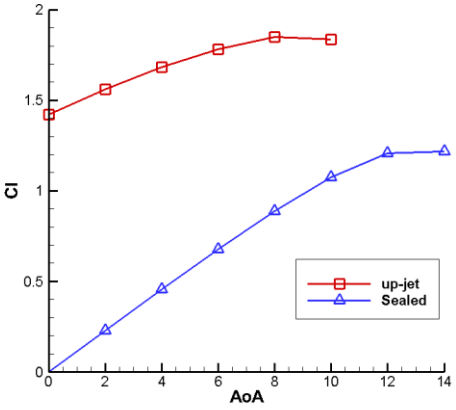
III. 2D CHARACTERISTICS OF CIRCULATION CONTROL

The NACA-64A-010 airfoil is taken as a good balance between the characteristics of common applied airfoils for military applications and the enough thickness for the placement of a CC system. The Coanda radius and slot height were chosen based on the work done by Stephen Michie at the University of Manchester 2, which demonstrated that a 0.5%-radius-to-chord-ratio Coanda surface could successfully augment lift, and minimize the induced drag from CC system. Therefore, this ratio is kept in our work, causing that 5% of chord at the trailing edge have to be removed to rebuild the Coanda surface. Besides, the slot height and slot lip are 10% and 5% of the Coanda radius, respectively. The first cell spacing was 1×10^{-5} with the other details as the same as the coarse grid of the validation case.

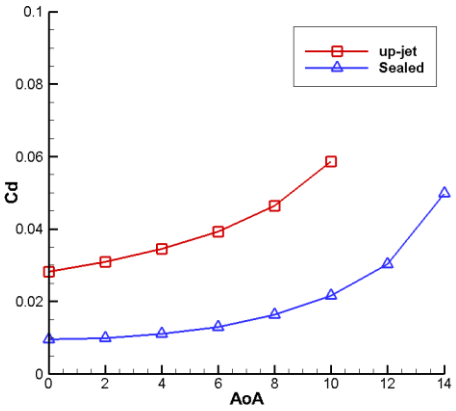
The freestream have a Mach number of 0.2, and a Reynolds number of 4.363×10^{-6} based on the chord length 0.95. The attack angle simulated ranges from 0 to the stall angle. As for the jet condition, the blowing coefficient is set to 0.01684, corresponding to the non-dimensional jet

velocity 4. These parameters come from the reference 12.

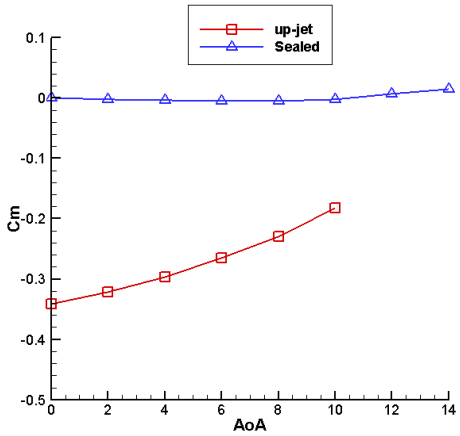
Figure 4 presents aerodynamic coefficient of NACA-64A-010 airfoil with and without circulation control system. The label "up-jet" means the upper slot of the CC system works, while "Sealed" suggests that the upper and lower slots are both sealed. Apparently, the CC system significantly augments lift coefficient at a attack angle varying from 0 to 10. And the slope of CC line is slightly lower than that of the sealed-slot line. However, the CC system indeed induces more drag force and provides a significant nose-down moment at a given attack angle. In addition, the airfoil with circulation control stalls at a smaller angle of attack (smaller than 10°), which illustrates that it is easier to get stall with a CC system aiming at lift augmentation or pitch maneuver. The **Figure 5** depicts the full stall stage of CC airfoil and the steady separation zone of normal airfoil at AoA=14.



(a) Lift coefficient

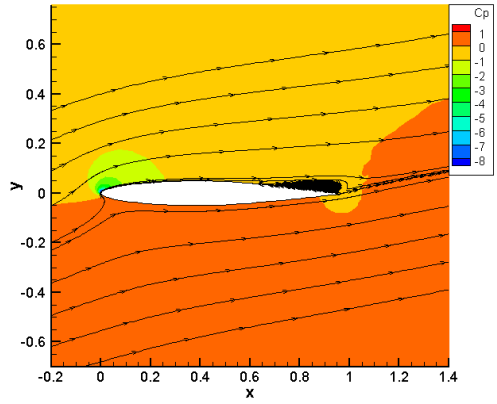


(b) Drag coefficient

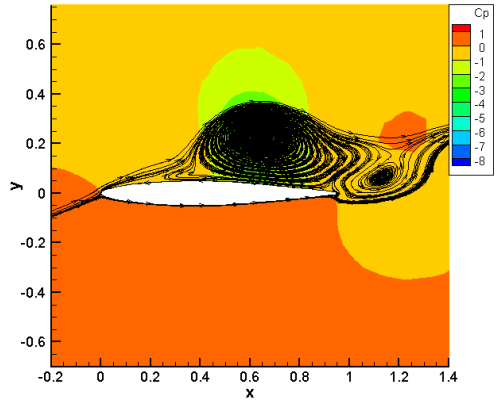


(c) Pitch moment coefficient

Figure 4. Aerodynamic behavior of NACA-64A-010 airfoil with and without circulation control (C_μ=0.01684)



(a) Slots sealed



(b) Upper-slot jet

Figure 5. Flow physics of NACA-64A-010 airfoil at 14 degree attack angle with and without Coanda jet (C_μ=0.01684)

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IV. EFFECT OF COANDA JET DIRECTION

The finite wing has a 53° sweep angle which is a typical UCAV configuration, such as the SACCON and MULDICON in AVT, one of the Boeing X-47 and Eurofighter Typhoon. What's more, this swept wing's profile is as the same as the former 2D circulation control airfoil, with an aspect ratio of 3.26 and a span of 3m. In other words, the Coanda surface and slots extend from root to tip of the wing. However only the mid part of the slot from 1m to 2m in spanwise works, preventing the wing tip vortices from interrupting the interaction of Coanda jet and upper-surface boundary layer. **Figure 6** outlines the main geometry parameters including the position of MRP.

The spanwise profile grid of this swept wing is the same as the 2D grid in the former section. Prism and hexahedral cells are assembled to resolve the boundary layer. There are about 250 nodes along spanwise making the total number of cells 5 million. **Figure 7** displays the grid near the trailing edge of the wing root.

The Coanda jets parallel to the freestream or normal to the trailing edge have been taken into account. In addition to the non-dimensional jet velocity of 4 inheriting from the 2D case, there is another parallel-to-freestream case with jet velocity of 6.65, sharing the same massflow rate with the normal-to-trailing-edge case with u_j=4. **Error! Reference source not found.** lists 4 cases with varying jet conditions and their descriptions.

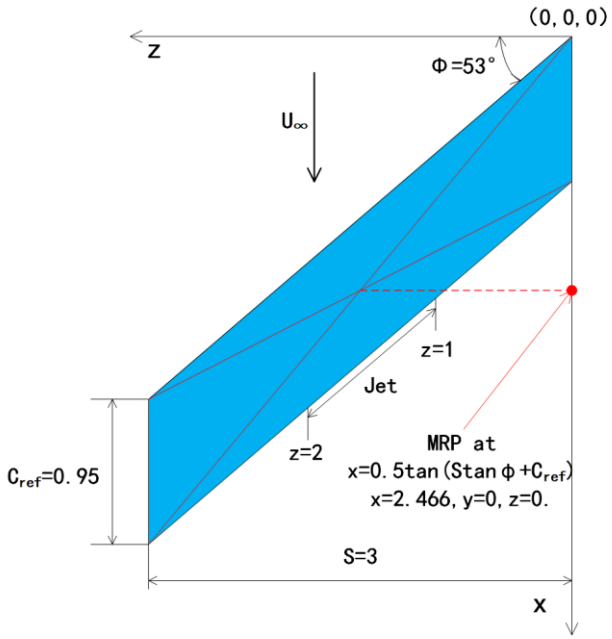

Figure 6. Configuration and main geometry parameters of the swept CC wing

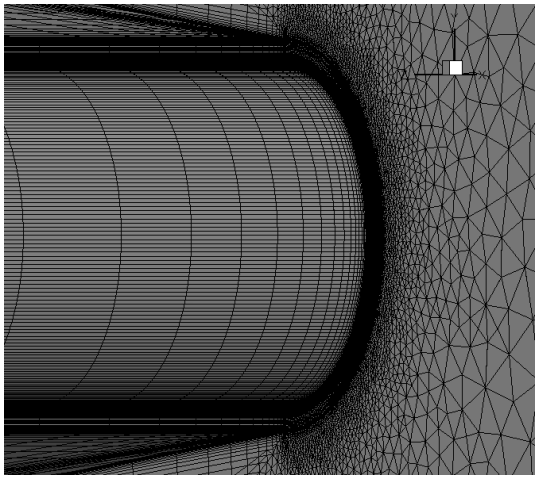

Figure 7. Surface grid near the trailing edge of the wing root

The following section will discuss how jet direction affects the aerodynamics behavior of the finite swept wing at an attack angle from 0 to 12, and attempt to explain the flow physics of the effect. **Figure 8** shows the effect of 4 jet conditions on aerodynamics force and moment coefficients. It is obvious that the lift, drag and pitch moment coefficients climb steadily with the increasement of the angle of attack in 4 cases. As for pitch moment , the symmetry profile wing without a coanda jet is equilibrium by itself at zero attack angle, and shows a higher nose-up trend as angle increasing. It should be noted that the coanda jet induces conspicuous nose-down moment, which is eliminated gradually and even turned to nose-up moment at a AoA larger than 8 with the increasement of attack angle.

Table III 4 different jet conditions and descriptions

Jet condition label	Description	u_j	Estimated C_μ
Parallel-to-freestream-Uj=4	The jet from the upper slot is parallel to the freestream with the non-dimensional velocity of 4; The lower slot is sealed.	4	0.0034
Parallel-to-freestream-Uj=6	The jet from the upper slot is parallel to the freestream with the non-dimensional velocity of 6.65; The lower slot is sealed.	6.65	0.0093

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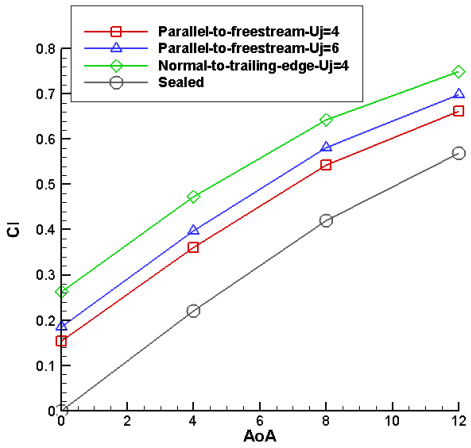
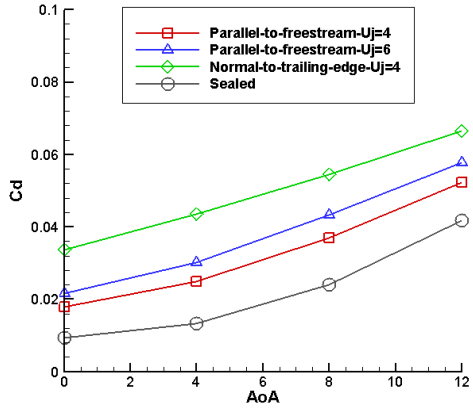
Normal-to-trailing-edge-Uj=4	The jet from the upper slot is normal to the trailing edge with the non-dimensional velocity of 4; The lower slot is sealed.	4	0.0056
Sealed	The upper and lower slot are both sealed.	0	0

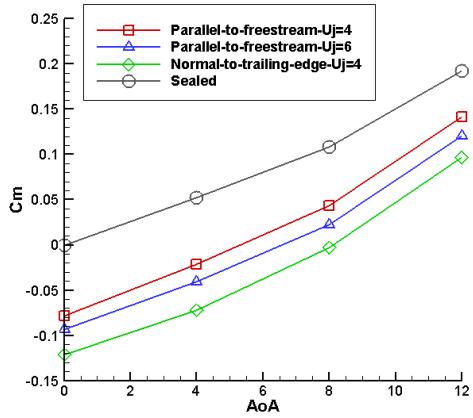
In each line graph, aerodynamic performances differ from 4 jet conditions. The Coanda jet improves the lift coefficient significantly, in which the jet normal to the trailing edge provides the best lift augmentation, following by the jet parallel to freestream with $u_j = 6.65$ and $u_j = 4$. The similar trends are also observed in drag coefficient graph. Jet increases the drag apparently, in which the level of drag increment of jet in normal-to-trailing-edge direction ranks 1st, following by that of jets in freestream direction with $u_j = 6.65$ and $u_j = 4$. According to the former discussion, it implies that effect levels of jet directions to the origin aerodynamics of the swept wing ranking from top to bottom are jet in normal-to-trailing-edge with $u_j = 4$, jets in freestream direction with $u_j = 6.65$ and with $u_j = 4$. With this assumption, the feature of the pitch moment curves is understandable to a certain degree. Upper slot jet at trailing edge tends to provide nose-down moment which is consistent with the conclusion of 2D cases. That jet in freestream direction ($u_j = 4$) with lowest effect on the flow field, ought to produce least pitch moment, and vice versa.



(a) Lift coefficient



(b) Drag coefficient



(c) Pitch moment coefficient

Figure 8 Aerodynamic behavior of swept wing in 4 jet conditions

V. CONCLUSION

In this work, we numerically investigate the effect of Coanda jet direction (normal to the trailing edge and parallel to the freestream flow) on flow physics and aerodynamic behavior of a finite, swept circulation control wing. HyperFLOW shows the ability to capture the main features of the circulation control benchmark. A 2D NA64A010 airfoil and a finite, 53 degrees swept wing with different Coanda jet conditions are simulated and analyzed. Numerical experiments indicate that the circulation control system in 2D and 3D significantly improve the lift feature with a certain degree of drag augment, and provide extra nose-down moment. The Coanda jet normal to trailing edge shows superior performance in aerodynamics behavior, compared with the jet parallel to freestream with the same jet velocity or the same massflow rate. In the future, the collaboration of multi Coanda jets will be considered to improve the efficiency and effectiveness of the circulation control system.

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Watermarking Scheme for using YCbCr Based On 2-Level DWT

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Abstract:

Multimedia data for both personal and commercial purposes is now accessible to everyone due to the rapid development of the Internet. Consequently, the issue of copyright protection has surfaced and has triggered the development of several techniques for multimedia copyright protection. Such techniques include digital watermarking in which the important information contained in the host media is concealed by embedment in carriers such as images, videos, or audios. In this paper, the adaptive color image watermarking technique is proposed for the satisfaction of both imperceptibility and robustness demands. There are two main stages involved in this technique – coding/embedding and decoding/extraction. Prior to the coding stage, imperceptibility and robustness are preserved by first converting the host image from RGB to YCbCr color space before selecting the Cb component to apply the DWT embedding technique. Once more, the selected quadrant of the hosted image is decomposed using DWT before extracting the watermarked image. The robustness and efficiency of this technique were proved by exposing the watermarked image to six types of attacks, namely Median filter, Gaussian noise, Sharpening filter, Salt & Pepper Noise, JPEG Compression, and Rotation. The results of the study were benchmarked against other methods that deploy DST on the same images. From the benchmarking process, the proposed algorithm was found to withstand the six types of attacks earlier mentioned and achieved a better performance compared to the DST approach. The quality of the watermarked image was also preserved in the proposed method.

Keywords:

Watermarking, Discrete wavelet transform, YCbCr image, discrete slant-let transform

I. INTRODUCTION

Over the last few years, multimedia communication has become a major tool for information transfer due to the evolution of communication technologies. However, this has resulted in copyright protection issues due to the easy access to multimedia data and its content by everyone [1]. Consequently, several novel protection mechanisms such as watermarking and steganography techniques have been developed to solve this problem. Steganographic techniques involve the hiding of information in a carrier such that its presence cannot be visually perceived. Watermarking, on the other hand, is a technique where the information is concealed in a carrier such as an image, video, or audio in a manner that cannot be visually or audibly detected. It confers protection and robustness to different forms of attacks, including those that involve image operations (such as rotation, Salt & Pepper Noise, cropping, filtering, Gaussian noise, and JPEG Compression) [2]. In the case of multimedia watermarking, it is a form of digital watermarking in which another information is embedded into the watermark. The two main stages of watermarking techniques are embedding and extraction [3]. The embedding stage involves passing the host multimedia through several encryption frameworks based on the type of application or domain. For the extraction stage, the hidden data is retrieved upon fulfilling the copy protection requirements. Figure 1 depicts the whole process in a watermarking system

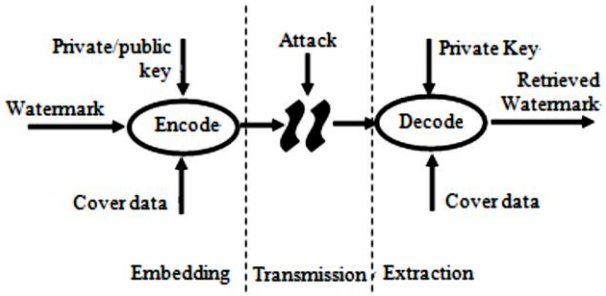

Fig. 1 the whole processes in a watermarking system

II. RESEARCH METHODOLOGY

The method employed in this paper involves the conversion of the RGB color image to the YCbCr color space before converting it into four sub-bands using DWT technique to ensure its imperceptibility and robustness after watermarking. The two important stages in this process are the embedding and extraction stages, both involving several steps that will be explained later. During the embedding process, the cover image is first converted to the YCbCr

color space before getting the four sub-bands using DWT techniques. Next is to choose the best band on which the watermark image will be embedded [5]. The next stage involves the use of an extraction method to extract the hidden image. An important step to note in this process is to ensure how to embed the watermarked image within the cover image to guarantee its robustness, capacity, and imperceptibility. Being that the major concern is copyright protection, watermarking is an important method of achieving this feat. Another important thing to consider is to ensure the quality of the watermarking in terms of imperceptibility (can be achieved by controlling the size of the secret image [8]. This involves the conversion of the watermarked image from (0-255) level to (0-15) level, then, changing to I-D array. The aim of the extraction process is to restore the integrity of the original image without compromising its quality and ensuring no observable differences between the watermarked and the cover images. Lastly, the result of this scheme is checked for high robustness by benchmarking against the Salentlet transform.

III. EMBEDDING STAGE

The processes involved in the proposed watermarking method in this study are shown in Figure 2. These processes were adopted to ensure that the main goals of watermarking (imperceptibility, capacity, and robustness) are considered during the embedding process.

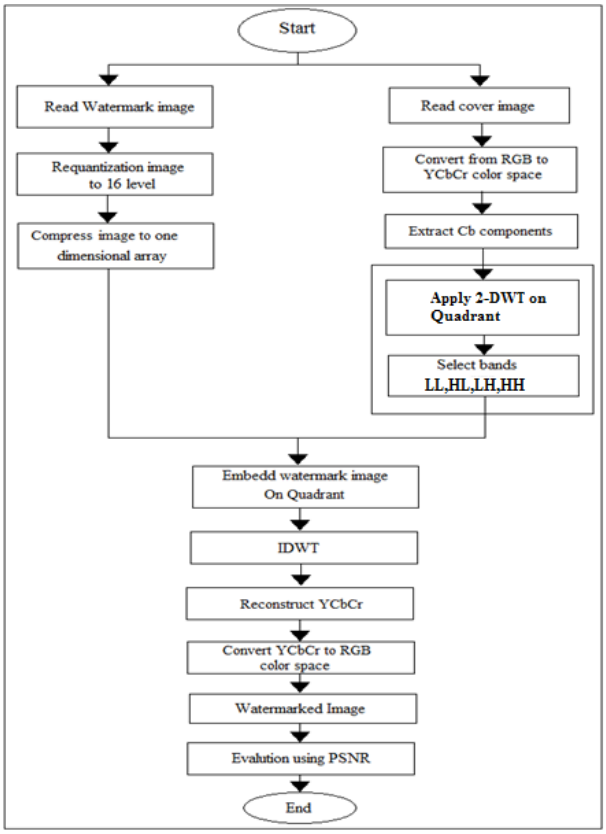

Fig. 2 the processes of the proposed approach

A. Image Requantization

The size of the embedded data is very important in information hiding as it is one of the factors that influence the hiding capacity and PSNR ratio. The efficiency of any hiding technique can be increased by reducing the size of the hidden data [18]. Images can be transformed from 256 level into different levels using image requantization which involves compressing an image in the subsequent stage. The requantization process can be represented by the equation below [10]:

$$I_{new} = \frac{I_{old} - Min}{Max - Min} * Range_{new} + Start \quad (1)$$

Where,

I new = obtained value after image stretching.

I old = original image size prior to stretching.

Range new = targeted value to convert the image value to.

Max and Min = maximum and minimum pixel values prior to stretching

majorly, image stretching is employed when there is a need to convert values from one range to the other. The values in this work were converted from (0-255) range to (0-15) range as discussed in the next subsection. Only 4 representation bits are required for values of this range, as depicted in Figure 2 which depicted the conversion of a Lena image into 2 ranges.

Fig. 3. Lena image requantization in the a) 0-255 and b) 0-15 ranges

B. Image compression

From the previous phase, the values of the image pixel have been converted into a new range. Therefore, these converted values require only 4 bits from each byte to be represented, meaning that in each image byte, 50% of the byte will be empty. Hence, getting 50% of the size of a same requires combining each byte into a 1-D array.

C. RGB conversion into YCbCr

Owing to the higher imperceptibility of the YCbCr color space compared to the RGB color space [7], the YCbCr color space is mainly used by researchers. In this color space, Y represents the components' luminance while the blue and red chrominance components are represented by CbCr. For the RGB color space, R, G, and B represents the red, green, and blue channels, respectively. The process of RGB color space transformation into the YCbCr spectrum is shown in Equation 3.2 [11].

$$\begin{bmatrix} Y \\ Cb \\ Cr \end{bmatrix} = \begin{bmatrix} 16 \\ 128 \\ 128 \end{bmatrix} + \begin{bmatrix} 65.481 & 128 & 24.966 \\ -37.0.797 & -74.203 & 112 \\ 112 & -93.786 & -18.214 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \quad (2)$$

The YCbCr mainly differ from the RGB color space by representing bright colors with 2 or more color signals while RGB represents colors as R, G, or B.

D. DWT for the Cover Image

The DWT is a method for hierarchical decomposition of an image [12]. It is based on wavelets (small waves) which differ in frequency and have a limited lifespan. Signals are split during DWT processes into high and low-frequency regions; the high-frequency regions are mainly used for watermarking processes due to the lower sensitivity of the human eye to changes in edges [13].

Having read the watermarked image and having converted the level to (0-15), the DWT algorithm is used to partition the cover image into 4 sub-bands (LL, HL, LH, and HH) and the best bands are subsequently selected for watermarked image embedment.

E. Watermarked Image embedment in the Cover Image

The embedding process involves hiding a secret or private image in a carrier without significantly altering the quality of the carrier. The embedding process is represented in Equation 3, where WI represent the watermarked image, H represents the carrier image, and b represents a suitable scaling factor (0.005), and W is the watermarked image (binary) [14,15].

$$WI = H + b * W \quad (3)$$

F. Wavelet Reconstruction (IDWT)

An inverse DWT (IDWT) is applied to revert the image to its spatial domain in a process that will produce one watermarked quadrant.

G. Reconstruction YCbCr

The quadrants are finally recombined to get the watermarked image in the YCbCr color space as illustrated in Figure 5.

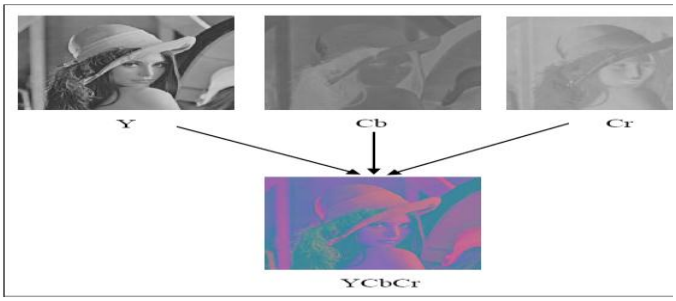

Fig 5. YCbCr reconstruction

IV. EXTRACTION STAGE

In this stage, the watermarked image of the cover image is separated without significantly altering the quality of the watermarked and cover images. Figure 6 depicts the watermarked image extraction process from the cover image.

Later, the cover image will be converted from the RGB color to YCbCr as earlier described to extract the Cb. Then, DWT will be applied to extract the pieces of the watermarked image (as discussed later). After splitting the image into 4 bands, the HH sub-band is then selected to retrieve the watermarked image [16] using the formula below, where WI represent the watermarked image, H represents the value of the host image, b represents a suitable scaling factor (0.005), and W is the watermarked image (binary)

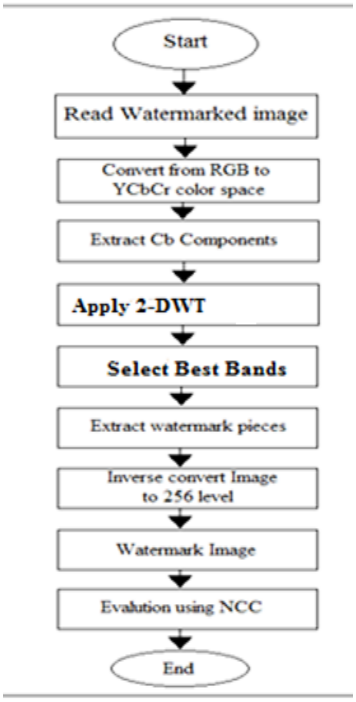

Fig 6. The watermarked image extraction process

$$W = (WI - H) / b \quad (4)$$

After retrieving the pieces of the watermarked image, the requantization process will be reverted to convert the watermarked images' level back to the original range (0-255

V. ROBUSTNESS MEASURE

Equation 5 can be used to determine the similarity between the original image and the extracted watermarked image.

$$NCC = \frac{\sum_x \sum_y (W_{xy} \times W'_{x,y})}{\sum_x \sum_y (W_{xy})^2} \quad (5)$$

Where, W x y and W ' x y represents the value of the pixel at position (i, j) of the original image and the extracted watermarked image, respectively, such that $1 \leq (x, y) \leq 32$.

VI. MEASURE OF IMPERCEPTIBILITY

The peak-to-signal-noise ratio (PSNR) measures the variations in the original and watermarked image qualities; higher PSNR values indicate higher image quality. The PSNR can be calculated as follows [15].

$$PSNR = 10 \times \log_{10}\left(\frac{MAX^2}{MSE}\right) \quad (6)$$

Where m is the watermarked image size and n is the host image size, I (i, j) is the host image pixel value, K (i, j) is the pixel value of the watermarked image, MSE represents the mean square error for (I, K).

VII. ATTACKS

The results after applying various attacks on Lena and Baboon images are presented in this section. Some of the applied attacks include Sharpening, JPEG compression, Median filter, Gaussian noise, Salt & Peppers, and Rotation.

A. Gaussian Noise Attack (GNA)

This is one of the commonly used statistical attacks deployed in watermarking processes. Its probability density function is proportional to that of the normal distribution. Gaussian noise is the most commonly used attack in applications, where it serves as an additive white noise to produce additive white Gaussian noise.

B. Salt & Peppers Attack (S&PA)

This attack involves the deposition of black and white pixels on an image at different density ratios (0.01, 0.02, and 0.03 %). It is clearly observed on the affected image as a small randomly spread noise.

VIII. PERFORMANCE TESTING AND EVALUATION

The results of the proposed method are evaluated in this section based on 2 criteria (PSNR and NCC). First, the watermarked image will be tested based on the results of the embedding process of the watermark image in Y, Cb, and Cr components depending on the PSNR. The watermarked image after applying the proposed method is shown in Figure 7 while Figures 8 and 9 presented the extracted watermarked image after exposure to two attacks (Gaussian Noise and Salt & Pepper). Tables 1 and 2 presented the results of the watermarked image (with respect to the NCC and PSNR) after the blue colors have been selected and the proposed embedding technique applied on each of the LL2, LL3, and LL4.

Fig 7. The watermarked image before and after attacks

TABLE I. The watermarked images' PNSR after selecting the blue (B) colors

Channel	The selected band		Image after watermarking	PSNR (db)
B	LL2	Y		50.080
B	LL2	Cb		45.020
B	LL2	Cr		44.180
B	LL3	Y		51.550
B	LL3	Cb		50.560
B	LL3	Cr		51.780
B	LL4	Y		59.780
B	LL4	Cb		55.210
B	LL4	Cb		49.230

Fig. 9. Extracted watermarked image after exposure to GNA

TABLE III The NCC values for the two attacks

GNA result				S&PA result		
Ratio	0.010%	0.020%	0.030%	0.010%	0.020%	0.030%
Measure	NCC	NCC	NCC	NCC	NCC	NCC
Lena	0.9620	0.99750	0.99690	0.99620	0.97210	0.95710

IX. RESULTS DISCUSSION AND CONCLUSION

Digital watermarking is was developed to solve at least 3 existing multimedia communication problems, including protection of copyrights, establishing the integrity and authenticity of information, and tracing the unlawful distribution of patented contents. These are the major issues

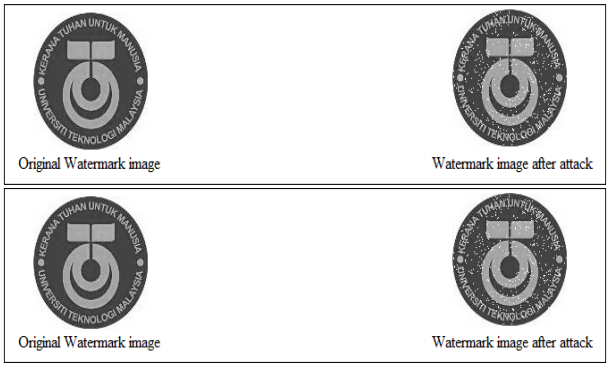

Fig. 10. Extracted watermarked image after exposure to Salt & Pepper attack

that emanate from wide data distribution over digital networks. Researches have proved that numerous types of attacks exist against watermarking techniques, and experiments have shown previous watermarking approaches to be prone to several types of malicious attacks. As such, the embedded watermarks in digital media must be extracted in order to identify the ownership. Furthermore, some attacks may be complicated for most watermarking methods to handle. Therefore, there is a need for a universal watermarking scheme which can withstand different types of attacks and, concurrently, meet the conventional and embedding capacity requirements. This paper reported a new embedding method which is based on the conversion of RGB images into the YCbCr color space. Here, each color of an image is transformed into the Y, Cb, and Cr components, resulting in RedYCbCr, GreenYCbCr, and blueYCbCr. To extract the frequency components, a two-level DWT is applied after converting the image on each YCbCr color. For the embedding process, the BlueYCbCr component is the best component. The DWT process gives rise to four frequency sub-bands (LL, LH, HL, and HH). All the bands were selected in this paper to embed the watermarked image in order to test the strength of the proposed algorithm. The performance of the system was determined based on the PSNR and NCC values, where the blue channel of LL4 frequency achieved the best PSNR value of 59.78dB, while the NCC of the similarity between the original image and the watermarked image was 0.9969 %. The system achieved an NCC ratio of 0.03% after exposure to Gaussian attack and 0.03% after exposure to Salt & Pepper attack. The final performance of the proposed algorithm was benchmarked against that of Slant-let algorithm earlier reported in the literature [4]. Though there was some difference of about 0.82dB, this is still important when dealing with cryptographic techniques to ensure the accuracy, robustness, and reliability of the transmitted information. Thus, the proposed algorithm in this study is a better image embedding algorithm compared to the Slant-let transform.

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User's perception on corporate annual reports: evidence from Sri Lanka

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Abstract:

The purpose of this study is to examine how users of Sri Lanka's corporate annual reports perceive the usefulness and relative importance of the company's annual report in Sri Lanka. A self-administrated questionnaire was distributed to individuals representing the seven groups identified. Descriptive methods, the Kruskal-Wallis (K-W) test, the Mann-Whiteny (M-W) test and One-way ANOVA test were used to achieve the objectives of this study. The results of the study reveal that most respondents strongly agree that annual reports published by the listed companies in Sri Lanka are considered as an important major source for their decision-making process; however, the timely release and availability of these annual reports to the public are becoming a great of concern. The study also reveals that the company information contained in the annual reports is not sufficient for the purposes for which it is used. Finally, these finding reveal that, compared to the developed economy, Sri Lankan users rely more on the information contained in the corporate annual reports than the other sources of information. Further, with developing economy in Sri Lanka and other developing countries, an annual report is likely to provide a more holistic view of a company's picture going further than what is statutorily required.

Keywords:

Perception; Corporate Annual Reports; Corporate information; Sri Lanka

I. INTRODUCTION

The disclosure of the corporate report receives a great deal of interest in empirical studies and this area of study is growing on a large scale widely (Beattie, 2005). Binh (2012) argues that annual reports are usually an important means of obtaining accountability in the corporate sector and are often a means by which sectors can improve stakeholder's perceptions about their accountability.

Shehata (2014) says that many financial scandals around the world were due to the lack of proper disclosure of the company in annual reports. Because of the variety of financial scandals worldwide, Arif and Tuhin (2013) claim adequate disclosure in annual reports are now necessary in the corporate world in order to ensure transparency and accountability and also assist various interest groups in their rational decision making. Disclosure is considered as an important indicator of the quality of accounting (Robson and Marston, 1997). Murray (1976) states that the quality of corporate disclosure affects the ability of capital markets to assess a company's value. In addition, the quality of disclosure has a major impact on investors' ability to make better investment decisions (Singhvi and Desai, 1971).

Subsequently, researchers are much interested in determining the types of information and the level of disclosure that will meet the user needs and the variables that will significantly influence their decisions and the factors that affect corporate disclosure practices. Companies have multiple channels and tools to communicate with their stakeholders. Likewise, investors and other stakeholders use different sources of information for their decision making. Companies use different sources to publish information to the public: Corporate Annual Reports (CARs), magazines, newspapers, periodic bulletins, Web sites, special publications, direct communication with the company and so on. Many research have attempted to determine the source (s) on which users rely on their decisions and to what extent.

In developed countries, a wide range of researches have explored user's perceptions and their views on the importance of different information sources and the usefulness of corporate annual reports. Some of these focused on a specific group of users, such as financial analysts, individual investors or investment analysts. Some studies explored the perception of more than one user group and examine possible differences between these groups with regard to the usefulness or importance of information disclosed in annual reports for their decision making. The closer consideration at these studies revealed that although there have been many studies on annual reports of companies in countries with developed capital markets,

studies on emerging capital markets are rare. The results of studies on developed capital markets cannot be applied to emerging capital markets because there are significant differences in economic, cultural, political and social factors between these two different markets. The conclusions of the studies conducted in developed capital markets cannot be applied to emerging capital markets, as there are large differences in economic, cultural, political and social factors between these two different markets. (Perera, 1989; Jaggi, 1975), the corporate annual report's users in emerging markets perceived not much about the way the users view those reports. One of the most significant features of previous studies on this aspect is that most of these studies were limited to exploring the information needs of a very small group of users, and in most cases one or two (Malone et al, 1993).

II. REVIEW OF LITERATURE

In business activities, investors need reliable and timely information to make effective and effective investment decisions. This type of financial information can be obtained through many sources, one of the most important sources is annual report of companies. Mandatory disclosure and voluntary disclosure are two types information that are commonly disclosed in corporate annual reports (CARs). Mandatory disclosure refers to compliance with mandatory standards. If the disclosure element is mandatory, it is often assumed that the information element will certainly be disclosed; otherwise, the company will receive a qualified audit report or other regulatory sanctions. Voluntary disclosure means as disclosure in excess of mandatory requirements, which are the free choice of management to provide accounting and other information deemed relevant to the decision-making needs of users of their annual reports (Meek et al., 1995).

In the developed countries such as the United States and the United Kingdom, several studies have been undertaken to explore user perceptions of the usefulness of information disclosed in corporate annual reports. Only a few studies have been conducted in developing and emerging countries, like Sri Lanka. These studies tested perceptions of different groups of users of annual reports. Some of them focused on one group of users such as individual investors. (e.g., Anderson and Epstein, 1995; Epstein and Freedman, 1994; Bartlett and Chandler, 1997; investment analysts); or (Bauman, 1989) financial analysts (Streuly, 1994).

Some studies, conducted in emerging countries, explore the perception of more than one user group and test potential differences among these groups' usefulness or relevance of information that is disclosed in CARs to make decisions. These user groups may include institutional investors, individual investors, investment analysts, financial analysts, creditors, executives / managers and government officials, or academics. (Mirshekary and Saudagaran , 2005), (Naser Abdelkarim et al., 2009), (Zoysa and Rubkin, 2010), (Nassir Zadeh,2011), and Alzarouni et al. (2011). Most of the studies show that most respondents rated annual reports as the primary information source for different user groups and the most often used source for their decision making. The financial statements have been classified as the most significant section in the corporate annual reports. Some of these studies reveal a high level of agreement among user groups on the relative importance of information elements in the corporate annual reports, but some others indicate a lack of consensus.

Annual reports are considered to be the most important source of corporate information for individual investors in Saudi Arabia, and also users of the corporate annual report ranked the income statement and statement of financial position as the most important disclosure section in the corporate reports in Saudi Arabia. (Abdulsalam, 1990); (Al Mahmoud, 2000) and (Al Razeen and Karbhari, 2007). Investors, government authorities, bankers and financial analysts perceive the annual reports of companies as an important and useful source for making investment decisions and categorized the company's statement of financial position, the auditor's report, the statement of cash flows, the statement of income and the notes to the financial statements as the main sections of the corporate annual reports of listed companies in Qatar. Users of annual reports of Kuwaiti listed companies strongly agreed that the annual reports of Kuwaiti listed companies are used as an important primary source of information for their decision making (Mishari

M. Alfraih and Abdullah M. Almutawa, 2014). A study was conducted on the user's perception of corporate annual reports in Sri Lanka and found that most group of users use the annual reports to obtain stock transaction information. (De Zoysa, A. and Rudkin, K., 2010)

Findings of this study support recommendations that may help to increase confidence in capital markets and enhance stakeholder's confidence. The results of the study would also be useful for regulatory authorities, company boards, policy makers and market participants. At the international level, the results yield interesting conclusions to those in other emerging markets, particularly those developing countries that share similar social, political and economic environments.

III. OBJECTIVES OF THE STUDY

There are three main objectives of study: First, to study the perceptions and views of users of corporate annual reports of Sri Lankan listed companies and measure the relative importance of the components in these reports. Second, to ascertain whether the different user groups have different views or similar views of some selected aspects of annual reports. Third, to investigate the usefulness of certain voluntary items of information in corporate annual reports as perceived by external user groups.

IV. RESEARCH HYPOTHESES

To achieve the research objectives, the following hypotheses were developed based on the literature surveyed discussed in the above section.

H1: There is no significant difference among different user groups in the perceived purposes of using annual reports.

H2: There is no significant difference among different user groups in the perceived importance of various sources of information.

H3: There is no significant difference among various user's perceptions in relation to the adequacy of the information provided in the annual reports.

H4: There is no significant difference among different user groups in relation the frequency of information provided in the annual reports.

H5: There is no significant difference among different user groups in the importance they attach to various sections in a corporate annual report.

H6: There is no significant difference among user groups regarding the perceived usefulness of information content in annual reports in the decision-making process.

H7. There is no significant difference among user groups regarding the perceived usefulness of information content in annual reports in the decision-making process.

H8. There is no significant difference among user groups regarding the perceived problems that restrict the use of annual reports in their decision-making process.

V. RESEARCH DESIGN

In order to obtain data information for the analysis of the objectives in this study, developed questionnaire were handed over to 125 respondents. However, only 100 respondent submitted the questionnaire back.

Table 1. Distribution of Respondents for group of participants

User	Sample	Response
Accountant in Company/Govt.	25	22
Manager/Executive in a Company */Govt.*	10	8
Banker	25	20
Assessor/Tax Officer	10	7
Lecturer/ Researcher	15	11
Investors	25	22
Financial analysts	15	10
Total	125	100

Reliability of data

In this research researcher used Cronbach Alpha to test the reliability of the measures used in the instrument. In order to test reliability, a Cronbach coefficient alpha was used as it is the most common method used for assessing the reliability for a measurement scale with multi-point items. The coefficient, which reflects homogeneity among a set of items, varies from 0 to 1. (George and Mallery , 2003) Provide the following rules of the thumb: >.9- Excellent, >.8- Good, >.7-Acceptable, >.6- Questionable, >.5 Poor and <.5- Unacceptable.

Table 2. The Cronbach's Alpha Table

Variable	Cronbach's Alpha	No of Items
Sources of information	0.813	9
Importance of different parts of annual report	0.818	10
Understanding	0.959	10
Usefulness of annual report	0.840	8

The Cronbach's Alpha Table (Table.1) actually shows the reliability of data or questionnaire. In other words, Cronbach's Alpha is the indicator for the testing the actual data, that it is reliable or not. In this research Alpha value is good. The researcher takes all variables and check the Cronbach's Alpha test for source of information, importance of different parts contained in corporate annual report, usefulness and understanding of annual report were 0.813, 0.818, 0.840 and 0.959, respectively which indicates the data is reliable and able to be used for study.

Validity of data

Validity refers to the extent to which an instrument measures what it is supposed to measure and a measuring instrument is valid when it does what is intended to do. Dunn (2001) defined the validity as the degree to which an observation or a measurement corresponds to the construct that was supposed to be observed or measured. Validity can be measured through different forms such as content validity, criterion – related validity, and construct validity (Opatha, 2003). Following Tables show the results of Kaiser-Mayer-Olkin (KMO) measures of sampling Adequacy of the data.

Table 3. KMO and Bartlett's Test (Source of information)

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.773
Bartlett's Test of Sphericity	Approx. Chi-Square	262.637
	Df	36
	Sig.	.000

Table 4. KMO and Bartlett's Test (Importance of different part of annual report)

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.799
Bartlett's Test of Sphericity	Approx. Chi-Square	300.648
	Df	45
	Sig.	.000

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Table 5. KMO and Bartlett's Test (Understanding)

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.585
Bartlett's Test of Sphericity	Approx. Chi-Square	829.992
	Df	3
	Sig.	.000

Table 6. KMO and Bartlett's Test (Usefulness of annual report)

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.823
Bartlett's Test of Sphericity	Approx. Chi-Square	329.243
	Df	28
	Sig.	.000

Kaiser Meyer-Olkin Measure of Sampling Adequacy recommends accepting values greater than 0.5 (Parveen & Khan, 2014) and the value generated is 0.500 which falls in the range of being mediocre. So the validity of data is confirmed.

Respondents' Demographic Aspects

As shown in Table 7, the occupation was used to decide the different user groups for the sample of this study. According to the sample the main user groups were Accountant and Investors. It is around 22 percent per group out of the sample. The next two main user groups were Banker and lecturers/researchers each of which represents around 20 percent and 11 percent. Around 10 percent were represented by the Financial Analysts Finally, a small percentage represented the Tax officers and Managers for the sample.

The respondents in this study were 59 percent male and 41 percent females. Out of the respondents 100 percent were Sri Lankan. There was no time to gather data from foreign investors who deal with the CSE.

Most participants (69 percent) had a bachelor's degree or higher. The mean value of this category is 3.93, higher than the diploma level. However, respondents' profiles revealed that all respondents (100 percent) had at least an advanced level qualification (A / L), indicating that they had a higher level of education. Over 80 percent of the respondents in the sample had studied accounting at some level. 81 percent of the respondents were empowered with accounting and financial qualifications. There were very few users, around 5 percent, who have gained accounting/professional knowledge of accounting through tax examinations conducted by Department of Inland Revenue and banking examinations conducted by the Bankers' Association of Sri Lanka. Mean value of this professional qualification category shows sound accounting knowledge and professional background of the sample. The level of experience of the user's group was high, with 93 percent of them having more than one year's of working experience and 36 percent having more than 5 years' of working experience in their current capacity.

The experience level of the user's group is high, 93 percent of respondents having more than one year's of working experience and 36 percent having more than 5 years' of working experience in their current capacity.

Due to the time limitation, the researcher did not make much effort to find out individual and institutional investors. But due to the nature of different user groups they had purchased shares from the listed companies. The analysis of the sample revealed that 54 percent respondents owned shares in listed companies with a 2.2 mean value. In addition to that some user groups such as partners in audit firms, managers/executives, bankers and financial analysts had also purchased more than 50 percent shares out of their sample.

Table 7. Respondent's socio economic profile
Table 7. Respondent's socio economic profile

Demographic Characteristic	%	Mean	S.D
Occupation		3.83	2.099
1 Accountant in Company/Government	22.0		
2 Manager/ Executive in Company/Government	8.0		
3 Banker	20.0		
4 Tax officer	7.0		
5 Lecturer/Researcher	11.0		
6 Investor	22.0		
7 Financial Analysts	10.0		
Gender	0.59	0.494	
1 Male	41.0		
2 Female	59.0		
Nationality		1.00	0.00
1 Sri Lankan	100.0		
2 Non Sri Lankan	0.0		
Education Qualification	3.93	0.700	
1 G.C.E.(O/L)	-		
2 G.C.E.(A/L)	4.0		
3 Diploma	14.0		
4 Bachelor's Degree	69.0		
5 PGD/Master's Degree	11.0		
6 Doctorate	2.0		
7 Other	0.0		
Accounting Knowledge/ Qualification	3.71		1.604
1 G.C.E (O/L, A/L)	4.0		
2 Diploma	15.0		
3 Bachelor's Degree	36.0		
4 CA/CIMA Parts, MAAT/SAT	22.0		
5 PGD/Master's Degree/Doctorate	7.0		
6 ICMA/CIMA/ACCA Membership	11.0		

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7 ICA/FCA Membership	0.0	
8 Other (Please Specify)	5.0	
Present Profession Experience	2.42	0.86
1 Less than One Year	7.0	
2 1-5 Years	55.0	
3 5-10 Years	29.0	
4 10-15 Years	7.0	
5 15-20 Years	2.0	
6 Over 20 Years	0.0	

Share Purchased	2.20	1.287
1 None	46.0	
2 One Company	14.0	
3 2-5 Company	16.0	
4 6-10 company	22.0	
5 11-20 Company	2.0	
6 Over 20 company	0.0	

Table 8. Purchased share (Occupation cross tabulation)

			Occupation							Total
			Accountant	Manager	Banker	Tax officer	Lecturer /Researcher	Investors	Financial Analysts	
Purchased share	None	Count	14	3	5	4	6	6	8	46
		% within Purchased share	30.4%	6.5%	10.9%	8.7%	13.0%	13.0%	17.4%	100.0 %
		% within Occupation	63.6%	37.5%	25.0%	57.1%	54.5%	27.3%	80.0%	46.0%
	One Comp:	Count	0	0	1	3	2	8	0	14
		% within Purchased share	0.0%	0.0%	7.1%	21.4%	14.3%	57.1%	0.0%	100.0 %
		% within Occupation	0.0%	0.0%	5.0%	42.9%	18.2%	36.4%	0.0%	14.0%
	2-5 Comp:	Count	0	5	8	0	3	0	0	16
		% within Purchased share	0.0%	31.2%	50.0%	0.0%	18.8%	0.0%	0.0%	100.0 %
		% within Occupation	0.0%	62.5%	40.0%	0.0%	27.3%	0.0%	0.0%	16.0%
	6-10 Comp:	Count	8	0	6	0	0	6	2	22
		% within Purchased share	36.4%	0.0%	27.3%	0.0%	0.0%	27.3%	9.1%	100.0 %
		% within Occupation	36.4%	0.0%	30.0%	0.0%	0.0%	27.3%	20.0%	22.0%
	11-20 Comp:	Count	0	0	0	0	0	2	0	2
		% within Purchased share	0.0%	0.0%	0.0%	0.0%	0.0%	100.0 %	0.0%	100.0 %
		% within Occupation	0.0%	0.0%	0.0%	0.0%	0.0%	9.1%	0.0%	2.0%

VI. ANALYSIS AND RESULTS

The analysis of results is described under the following eight sections: The purpose of using annual reports, sources of information, adequacy of information, level of frequency of using annual reports, importance of various sections in the annual report, understanding of different users on the annual report, usefulness of the annual report and factors restricting the use of annual reports.

Purpose of using annual reports

The company's annual reports are used by various parties to obtain information for various reasons, such as investment, management decisions, lending, research and

education. Respondents were asked to specify their main objectives of using the company's annual reports to determine whether there were any significant differences in the use of annual reports among the seven user groups.

Table 9. Mean ranks of respondents- Purpose of using annual report

	Purpose of using Annual report	N	Mean Rank
Occupation	To decide whether to acquire , hold or sell shares	23	78.39
	To grant loan/trade credit to a company	5	26.50
	To advice a client	22	36.73
	To make decision for a client or employer	19	38.03
	To evaluate income tax liability	6	54.00
	To make decision in managing the company	14	40.50
	To know about the company for academic purposes	11	63.00
	Total	100	

This suggests that the purposes of using annual reports are different vary widely among different user groups. The 78.39% of respondents indicated that they use the annual reports to buy, hold or sell shares and it can be considered that the mostly users use the annual for the purpose to buy, hold or sell shares. This finding also is consistent with a study conducted in Bangladesh (Karim, A.K.M, 1995).

Annual reports for making decision

Three users groups ((INV, ACC and FA) stated that they use annual reports mostly for decision making purposes, while another three users groups (MAN, BAN and TAX) use annual reports for decision-making purposes was their second priority.

Table 11. Descriptive statistics (Annual reports for decision making)

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Accountant in a Company/Govt.	22	4.27	.456	.097	4.07	4.47	4	5
Manager/Executive in a Co./Govt.	8	4.00	.000	.000	4.00	4.00	4	4
Banker	20	3.95	.686	.153	3.63	4.27	3	5
Tax officer	7	3.57	.787	.297	2.84	4.30	3	5
Lecturer/Research	11	3.09	.302	.091	2.89	3.29	3	4
Investors	22	4.50	.512	.109	4.27	4.73	4	5
financial Analysts	1	4.20	.422	.133	3.90	4.50	4	5

In general, the most of the user groups mostly use the annual reports to decide to buy, hold or sell share and thus it indicates that most user group are involved in share trading. (Kareem, AKM, 1995) found that the second most preferred reason for using annual reports was to acquire, hold or sell shares in his private capacity, where 63.00 percent of the respondent's second most widely used purpose was identified as "general review / academic purposes." (Hypothesis 01) There is no significant difference between different users' perceptions of the purpose of using annual reports.

	Occupation
Chi-Square	38.180
Df	6

Table 12. Test Statistics a,b

Asymp. Sig.	.000

a. Kruskal Wallis Test

b. Grouping Variable: Purpose of using annual report

The Kruskal Wallis test results (x2 = 38.180, df = 6, p = 0.000) showed that users ' perception of the purpose of usin g annual reports was significantly different among user groups (P < 0.05). The hypothesis was therefore supported w ith the findings. The results are shown in Table 12.

Source of information

In addition to the corporate ateannual reports, different user groups can use several other sources such as accounting advisory services, stock market publication, communication with company management, Information provided on the internet, friends' advice on investment decisions to obtain information to make their financial or

non- financial decisions. The importance users attach to different sources of information may significantly vary among different user groups depending on the information needs of users.

In order investigate the significance of information sources and their perceived differences for each of the seven user groups, with the guidance of the study of De Zoysa and Rudkin (2010), the respondents were requested to choose the importance they attach to nine possible sources of information which can be used to obtain a financial and non- financial information.

Table 13 shows that the most important information source is the annual report having the highest mean score 4.66. Therefore, it can be reinforced that the annual report is the primary information source for various user groups in Sri Lanka. In addition to the annual reports, accounting advisory services were considered the next major source of information in the overall ranking (average score of 4.26). The publications on the stock market are considered the third most important source of information with a score of 4.19 and communications with the company's management are the fourth by various user groups. However, considering mean value of all the sources of information except advice of friends had a great to moderate importance. Other sources of information was considered as the leased importance source of information for all different user's group with a men score 1.74.

The Kruskal Wallis test was conducted to determine if statistically significant variations between user groups existed in relation to the information sources mentioned in the questionnaire. The test showed that statistically significant differences ($P < 0.05$) existed between the different user groups with respect to six Advisory service of accounting, Stock market publication, communication with company management, Information provided on the internet, Personal knowledge about the company and other) of the nine information sources listed in the questionnaire other than the annual corporate reports. It is also revealed that different user groups had different views on corporate annual reports as a source of information. The opinion relating to three out of nine sources of information among different user groups had similar views.

Table 13. Perceived reliability of sources of Information

	Mean	Std. Deviation	Rank	Kruskal Wallis Test	
				X2	Significance
Information Sources					
Company annual report	4.66	0.572	1	7.269	0.297
Advisory Service of accounting firms	4.26	0.747	2	29.296	0.000
Stock market publication	4.19	0.787	3	34.055	0.000
Communication with company Management	3.89	0.737	4	37.625	0.000
Information provided on the Internet	3.25	0.687	5	31.963	0.000
Personal knowledge about the company	3.14	0.652	6	58.677	0.000
Newspaper reports and other media reviews	2.73	0.529	7	12.831	0.46
Advice of friend	2.45	0.500	8	1.061	0.983
Other	1.74	0.613	9	30.480	0.000

Based on the ranking of information sources, Four of the seven user groups (EXE, BAN, LEC, and INV) ranked annual reports as their primary source of information while ACC and FA ranking them as the second most important source of information. Only one user group (TAX) ranked two other sources as their primary information sources ahead of annual reports, making the annual report the third most important source. The above table of rankings also shows that although more businesses are disclosing more information on the internet, most users still do not find it to be a very useful source of information for the reasons mentioned above.

This result is consistent with the findings of (Lane, M., Van der Vyver, G., Delpachitra, S. and Howard, S, 2004), which found that while the internet and e-commerce capabilities in Sri Lanka have become comparatively sophisticated. Sri Lanka's basic Internet infrastructure is either non-existent or unstable and quite expensive. (Lane et al., 2004). Likewise, "press reports and other media reports" have not been considered particularly important, despite recent efforts by the Securities and Exchange Commission to provide periodic information on corporate affairs through these media. The findings of this research are consistent with the study (Abu Nassar, M. Rutherford, PA, 1995) which examined the most widely used financial information sources in Jordan. They found that the most favored source of primary financial information was the annual report for four groups of users namely academics, stockbrokers, institutional shareholders and individual shareholders.

Table 14. Means of respondents relating to sources of information

Information Source	Occupation							
	Accountant in a Company /Govt.	Managers	Banker	Tax officer	Lecturer/Resea:	Investors	financial Anly:	Total
Advice of friends	2.41	2.38	2.45	2.43	2.55	2.50	2.40	2.45
Advisory services of accounting firms	4.59	4.63	3.85	4.14	3.36	4.45	4.70	4.26
Newspaper reports and other media reviews	2.82	2.50	2.45	2.86	2.64	2.86	3.00	2.73
Company annual report	4.41	4.75	4.6	4.86	4.64	4.82	4.80	4.66
Communication with company management	3.36	3.75	4.30	3.57	4.18	3.64	4.8	3.89
Stock market publications	4.68	4.25	3.80	3.86	4.64	3.64	4.80	4.19
Personal knowledge about the company	3.73	2.63	2.55	3.00	3.82	2.86	3.4	3.41
Information Provided on the internet	3.23	3.63	3.65	2.57	2.73	3.00	3.80	3.25
Other	1.64	3.00	1.65	1.43	1.55	1.77	1.50	1.74

Adequacy of information

With the study guidance on the adequacy of information in annual reports for different users (De Zoysa, A. and Rudkin, K., 2010), respondents were asked to indicate whether the annual reports they used contained sufficient information for their purposes.

It was revealed that only 39.0% of respondents considered the information contained in annual reports to be adequate and 53.4 percent of all respondents previewed the information contained in annual reports to be inadequate or partially adequate. The analysis showed that the information is insufficient to the users for the purposes of using them because because it was perceived by over 50% of respondents as partially adequate or not at all adequate.

The Kruskal-Wallis test analysis (Table 15) showed that (Hypothesis 03) there were statistically significant differences ($p<0.05$) of perception within different user groups relating to the adequacy of information. The test therefore revealed that all different user groups had similar perceptions of the adequacy of the information contained in the corporate annual reports.

Table 15. Adequacy of Information

		Frequency	Percent
Valid	Yes	39	39.0
	No	12	12.0
	Partially adequate	49	49.0
	Total	100	100.0

Descriptive Statistics	Adequacy
Mean	2.10
Std. Deviation	0.937
Test statistics a'b	
Chi- Square(x2)	21.980a
Df	2
Asymp, Sig	0.000
Kruskal Wallis Test	
Groping Variable: Occupation	

When closely analyzing the results (refer Table.16), it is revealed that the tax officer did not give an indication that of the totally inadequate information contained in annual reports. However, when comparing the banker group with tax officer group 17.9 percent of the tax officer group had agreed that the information contained in annual reports was sufficient for their use. Therefore, according to Table.17, the first rank was obtained by the investor group and the second rank was obtained by the group Lecturer although they agreed totally with the statement given relating to the adequacy of annual report information.

Table 17 shows that, there is no significant difference of mean value among various user groups. Therefore, mean value of the different user groups also revealed that all groups had similar views relating to the sufficiency of information contained in annual reports. Tax officer group was the group which obtained the least mean value as shown in Table 17.

Table 16.: Adequacy of information (Occupation cross tabulation)

			Occupation							Total
			ACCOUNTANT	MANAGER/EXE:	BANKER	TAX OFFICER	LECTURER/RESEARCHER	INVESTORS	FINANCIAL ANALYSTS	
ADEQUACY OF INFORMATION	Yes	Count	8	3	8	7	3	6	4	39
		% within Adequacy of information	20.5 %	7.7%	20.5%	17.9%	7.7%	15.4%	10.3%	100.0%
	No	Count	4	0	3	0	2	1	2	12
		% within Adequacy of information	33.3%	0.0%	25.0%	0.0%	16.7%	8.3%	16.7%	100.0%
	Partially adequate	Count	10	5	9	0	6	15	4	49
		% within Adequacy of information	20.4%	10.2%	18.4%	0.0%	12.2%	30.6%	8.2%	100.0%
	Total	Count	22	8	20	7	11	22	10	100
		% within Adequacy of information	22.0%	8.0%	20.0%	7.0%	11.0%	22.0%	10.0%	100.0%

Table 17. Mean ranks of respondent (Adequacy of information)

	Occupation	N	Mean Rank
Adequacy of information	Accountant in a Company/Govt.	22	50.09
	Manager/Executive in a Co./Govt.	8	55.00
	Banker	20	49.03
	Tax officer	7	20.00
	Lecturer/researcher	11	55.18
	Investors	22	59.34
	Financial Analysts	10	47.50
	Total	100	

Frequency of using annual reports

Table. 18 indicates that very often (usually / always) the proportion of respondents who used annual reports was 37 percent. In comparison, the less frequent users (rarely / sometimes) are 58 percent, with annual reports maximum users being 95 percent. Only 5 percent of users have never made decisions using annual reports.

Further analysis was performed to test the fourth hypothesis. The fourth hypothesis was "there is no significant difference between perceptions of different users regarding the frequency of information provided in annual reports." The results of the Kruskal-Wallis test (x2 = 79.200, df = 4, p = 0.000) showed that the perception of users with regard to the frequency of use of annual reports was significantly different (P <0.05) between user groups, so the hypothesis was not supported with the results.

Table 18. Frequency of annual report

		Frequency	Percent
Valid	Never	5	5.0
	Rarely	11	11.0
	Sometimes	47	47.0
	Usually	35	35.0
	Always	2	2.0
	Total	100	100.0

Descriptive Statistics	Frequency
Mean	3.18
Std.Deviation	0.845
Test statistics a'b	
Chi- Square(x^2)	79.200[a]
Df	4
Asymp, Sig	0.000
Kruskal Wallis Test	
Groping Variable: Occupation	

When considering the mean values of different user groups relating to frequency of using annual reports (Table 19), it was found that managers and financial analysts were the most regular users of annual reports.

Table 19. Mean Rank of respondents- Frequency of using annual report

	Occupation	N	Mean Rank
Frequency of using annual report	Accountant in a Company/Govt.	22	58.64
	Manager/Executive in a Co./Govt.	8	60.50
	Banker	20	46.90
	Tax officer	7	28.14
	Lecturer/Researcher	11	42.18
	Investors	22	48.73
	financial Analysts	10	60.50
	Total	100	

Therefore, financial analysts in Sri Lanka use annual reports to make decisions. The second most user group was accountants. They are the consultants for the investors. So, it is assumed that they use annual reports frequently to advice their clients. Among the sample groups, Tax officers were considered as the least frequent user group for annual reports.

Importance of different part of annual report

Table 20 summarizes the average mean values for the perceived importance of different sections of the corporate annual report to user groups, the standard deviations and significant differences in mean values.

The ten sections of the annual report have been considered remarkably important for decision-making by different user groups in Sri Lanka. The Statement of financial position was the most significant section of an annual report having a mean score of 4.39 as perceived by different users. The next most significant section was the income statement having a 4.13 mean score. The mean scores relating to the Statement of cash flow , notes to the financial statements and auditor's report were also very close to scale 4. This suggests that these sections were also more significant as perceived by users.

The results show that the value added statement, and directors' report were rated as moderately significant This means that user groups are likely to rely on these reports for information that is either not included in the financial statements or less complication for decision making. Different users perceived that directors' report were the least important section in the annual report. Although director's report was ranked at the bottom of the list, it was very close to a moderately significant level.

Table 20. Perceived significance of annual report sections

Annual Report Section	Mean	Std. Deviation	Kruskal Wallis Test	
			X2	Significance
Statement of financial position	4.39	0.643	28.940	0.000
Statement of profit and loss account	4.13	0.646	27.740	0.000
Statement of cash flow	4.02	0.752	5.180	0.075
Accounting Polices	3.28	0.668	21.40	0.000
Notes to accounts	3.57	0.517	51.380	0.000
Movement in shareholder's fund	2.60	0.550	43.220	0.000
Auditors' Report	3.08	0.631	32.960	0.000
Directors' Report	2.43	0.498	1.960	0.162
Value add Statements	2.29	0.456	17.640	0.000
Statistical data/ summary of operations/Historical data	2.68	0.634	27.860	0.000

The results of the Kruskal Wallis test revealed that the observed differences among different user groups were significant at 1 percent ($p < 0.01$) with respect to eight sections out of ten sections of the annual report. But eight out of ten sections including the above two were significantly different among user groups at 5 percent significant level ($p<0.05$). (Hypothesis 05) This suggests that the different group of users of corporate annual reports in Sri Lanka hold different views on the significance of the eight parts of the corporate annual report to their decision making process.

However, since the p-values calculated for the Kruskal-Wallis test for two sections of the annual report (statement cash flow and director's report) were greater than 5 percent (P> 0.05), there is no significant difference, in terms of statistics, among the user groups with respect to the importance of these attached two sections of an annual report.

Table-21 showed that six out of seven user groups ranked Statement of financial position as the most important section in the annual report, while financial analyst ranked the income statement as the most important section but the bankers ranked their importance totally different from other user groups.

Table 21. Means of Respondents relating to significance

	Occupation							
Annual Report Section	Accountant in a Company/Govt.	Managers	Banker	Tax officer	Lecturer/Resea:	Investors	financial Anly:	Total
Statement of financial position	**4.64**	4.25	4.45	3.86	**4.55**	4.09	**4.70**	4.39
Statement of profit and loss account	3.95	3.88	3.90	3.43	**4.82**	4.18	**4.80**	4.13
Statement of cash flow	4.27	4.38	3.75	3.00	4.73	3.50	**4.80**	4.02
Accounting Polices	3.45	3.50	3.05	2.71	3.55	3.14	3.60	3.28
Notes to accounts	3.50	3.75	3.25	3.71	3.55	3.64	4.00	3.57
Movement in shareholder's fund	2.41	2.50	2.7	2.57	2.64	2.50	3.00	2.60
Auditors' Report	3.14	3.88	3.30	2.57	2.55	3.00	3.00	3.08
Directors' Report	2.36	2.50	2.40	2.43	2.27	2.41	2.80	2.43
Value add Statements	2.18	2.38	2.50	2.43	2.09	2.36	2.00	2.29
Statistical data/ summary of operations/Historical data	2.50	2.38	2.55	2.57	2.36	3.32	2.60	2.68

Understanding

Table 22 provides a summary of the average mean value of the perceived understandability of each section to the seven user groups. Significant differences are also reported among user groups regarding their views on the understanding of these sections. The user groups understand all the sections of the annual report. The statement of financial position and the statement of cash flows were the most understandable sections of the annual report.

The results of the Kruskal Wallis test revealed that there were statistically significant differences in the perception of user groups at the level of 1 percent ($p < 0.01$) for ten out of the ten sections of the annual report. When considering the 5 percent significant level ($p<0.05$), two out of ten sections were significantly different among user groups. (Hypothesis 06) This suggests that the different group of users of corporate annual reports in Sri Lanka hold different views relating to the understandability of the two parts of the corporate annual report in their decision-making process.

The results of the Kruskal Wallis test also exposed that although user groups' perceptions in relation to their understandability of eight sections of annual reports were significantly different, they shared similar perception ($p> 0.05$) on their understandability of annual reports.

Table 22. Perceived Understandability of annual report sections

Information Sources	Mean	Std. Deviation	Rank	Kruskal Wallis Test	
				X2	Significance
Statement of financial position	4.78	0.418	1	15.865	0.014
Statement of profit and loss account	4.60	0.492	4	1.160	0.976
Statement of cash flow	4.74	0.441	2	13.768	0.032
Accounting polices	4.55	0.500	5	11.706	0.069
Notes to accounts	4.73	0.489	3	11.892	0.064
Movement in shareholder's fund	4.73	0.489	3	11.892	0.064
Auditors' Report	4.55	0.500	5	11.706	0.069
Directors' Report	4.60	0.492	4	1.160	0.979
Value add Statements	4.73	0.489	3	11.892	0.064
Statistical data/ summary of operations/Historical data	4.55	0.500	5	11.706	0.069

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Usefulness of annual report

As shown in Table 23, group of users chosen an average mean value on the usefulness of corporate annual report above 3.5 to five out of the eight given statements, revealing a strong agreement on the usefulness of the information contained in the annual report. Average mean score was less than 3.5 for the seventh and eighth statements. It seems that all user groups gave priority (mean score 5.09) to obtain information about the company's performance over the other seven statements. The table shows that using information for liquidity purposes came second (mean score 4.60) in importance, the third most favored reason (mean score 4.11) for overall information content is relevant.

Kruskal-Wallis test indicated that the differences among the user groups in relation to usefulness of information content in annual reports were significant at the 5 percent significant level ($p<0.05$) for five out of the eight statements listed in the questionnaire. (Hypothesis 07) This proposes that the usefulness of information content in annual reports vary significantly for five statements across different user groups. The test also revealed that the different users had similar views ($p>0.05$) in obtaining information about the company's liquidity, management of the company and other.

Table 23. Perceived usefulness of information content in annual report

	Mean	Std. Deviation	Rank	Kruskal Wallis Test	
				X2	Significance
Overall information Content is relevant	4.11	0.723	3	53.403	0.000
To obtain information about the company's liquidity	4.60	0.492	2	11.922	0.064
To obtain information about the company's performance	5.09	3.957	1	41.300	0.000
To obtain information about the future potentials of the company	3.80	3.091	5	15.495	0.017
To obtain information about management of the company	3.67	0.587	6	5.568	0.473
To evaluate income tax liability	4.06	5.168	4	20.884	0.002
To evaluate the information for academic purposes	3.40	0.936	7	61.693	0.000
Other	1.71	0.457	8	9.394	0.153

Table 24 shows the perceived usefulness of information content in annual reports by each user group. Seven user groups namely accountants, manager, bankers, lecturers, Investors and Financial analysts indicated that the most important statement is 'to obtain information about the company's performance while three user groups, the Accountant, Tax officers, Lecturer perceived that the most important statement is 'overall information content is relevant'. Assessors/ tax officers perceived that the statement 'to obtain information about the liquidity' to be the most useful statement for their purposes. The lecturers group perceived the information contained in annual reports to be useful for both company's performance and academic purposes.

Table 24. Means of respondents relating to usefulness of annual report

Information Source	Occupation							
	Accountant in a Company/Govt.	Managers	Banker	Tax officer	Lecturer/Resea:	Investors	financial Anly:	Total
Overall information Content is relevant	4.73	3.75	3.40	4.57	4.55	3.73	4.50	4.11
To obtain information about the company's liquidity	4.41	5.00	4.75	4.57	4.55	4.50	4.70	4.60
To obtain information about the company's performance	4.86	5.00	5.00	4.14	4.55	6.45	4.10	5.09
To obtain information about the future potentials of the company	3.32	3.00	3.60	3.57	3.73	4.91	3.70	3.80
To obtain information about management of the company	3.68	4.00	3.50	3.71	3.82	3.55	3.80	3.67
To evaluate income tax liability	3.18	3.63	3.50	3.86	5.45	5.59	2.70	4.06
To evaluate the information for academic purposes	3.86	2.75	2.84	3.43	4.55	2.64	4.40	3.40
Other	1.76	1.50	1.50	1.86	1.91	1.73	1.80	1.71

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Factors restricting the use of annual reports

The survey showed that the delay in the publication of annual reports was identified by the vast majority of respondents (28 per cent) as the main limiting factor in the use of annual reports in Sri Lanka. This item has been classified as the primary restriction factor by user groups. This indicates that users generally agree on how serious this limitation is. The use of annual reports was constrained by the apparent difficulty in obtaining them, with 23 percent of respondents citing it as the second major determining factor. Analysts and financial investors viewed this as the most serious constraint, ranking it before "delay in publication."

The results of the Kruskal-Wallis test showed p-values greater than 5 percent (p >0.05) for all Six factors. This result suggests that (Hypothesis 08) there is no significant difference of opinion between user groups with regard to the factors that limit their use of annual reports. This result is consistent with a study done by (Mirshekary 1999) who also found the delay in publishing is primary reason that restricts the use of annual reports in Iran.

Table 25. Descriptive Statistics- Factor restricting the use of annual repots

N	Minimum	Maximum		Mean	Std. Deviation
Factor Restricting the use of annual repots	99	1	6	3.23	1.583
Valid N (list wise)	99				

Table 26. ANOVA- Factor restricting the use of annual repots

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.337	6	1.390	.539	.778
Within Groups	237.320	92	2.580		
Total	245.657	98			

Source: Survey Data 18

Table 27. Test Statistics a, b- Factor Restricting the use of annual repots

Chi-Square	3.834
Df	6
Asymp. Sig.	.699

a. Kruskal Wallis Test

b. Grouping Variable: Occupation

VII. CONCLUSION

The main objective of this study was to examine perceptions about the usefulness of corporate annual reports in Sri Lanka's emerging market, through a questionnaire covering a wide range of group of users. The majority of users group agreed that they frequently use annual reports, indicating the important role that the annual reports play in their decision-making functions. The results of the survey reveal that the main purpose of using the company's annual reports in Sri Lanka is to obtain the information necessary to make decisions related with the acquisition, holding or sale of shares. The statement of financial position and the income statement were unanimously selected as the most important section of the annual report, followed by the statement of cash flow.

Nonfinancial sections of the report, such as the directors' reports and value add statements, were rated less important. It can therefore be stated that non-financial sections contained in the annual reports mostly do not provide useful information to assist users in making decisions. Moreover, companies are disclosing more information on the internet, users had given less priority on the importance of a company's web site as a source of information, implying that this source does not provide current information to Sri Lankan users of annual reports. Concerning the level of voluntary disclosure, most of user groups do not feel satisfied with the quantity of information provided by corporate annual reports. User groups indicate a desire for more information than listed companies currently disclose, to improve their decision making and the usefulness of corporate annual reports. This suggests an urgent need for the disclosure gap between users and preparers to be filled.

These finding reveal that, compared to the developed economy, Sri Lankan users rely more on the information contained in the corporate annual reports than the other sources of information. Further it reveal that an annual report is likely to provide a more holistic view of a company's picture going further than what is statutorily required in Sri Lanka.

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Comparison of CO Adsorption on Undoped and Ti Doped ZnO Surface: A Density of Functional Study

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Abstract:

In this works, we have employed the density functional theory (DFT) calculations with the generalized gradient approximation to investigate the carbon monoxide (CO) adsorption on undoped and Ti (Titanium) doped ZnO $(10\bar{1}0)$ surfaces. In performances, the positions of atomic zinc (Zn) on ZnO $(10\bar{1}0)$ surfaces were substituted by atomic Ti to find the model of Ti doped ZnO $(10\bar{1}0)$ surface, namely Ti-D-ZnO. Continuously, the CO adsorption on undoped ZnO surface and Ti-D-ZnO model were examined to compare together, respectively. Further, the effect of Ti dopant on CO adsorption sites and bonding energies were studied also using density of states (DOS) and electron density difference (EDD) contour plots. The results of adsorption energy pointed out that CO adsorption on Ti-D-ZnO was more stable than the undoped ZnO surface. Interestingly, we found that the Ti doping can significantly modify the chemistry and improves the adsorption properties of ZnO surface.

Keywords:

undoped ZnO surface; Ti-D-ZnO, DFT, CO adsorption, DOS

I. INTRODUCTION

CO adsorption on metal oxide systems (M_mO_n) has been extensively performed for theoretical investigations [1-4], which this is the first step towards more complex processes in hetero-catalysis like methanol synthesis, reduction of CO, water gas shift, and other reactions in fuel cell fields. In addition, the adsorption of gas phase (adsorbate) on semiconducting metal oxide surface such as ZnO (adsorbent) has been known to be the best materials for making gas sensors because its advantages as low cost, small dimensions, and great compatibility with microelectromechanical processing [1]. Considering the adsorption mechanism of this gas sensor formation are that the charge transfer occurrence between the adsorbed gas species and the surface of semiconducting metal oxides, which this charge transfer will either increase or decrease the concentration (or mobility) of the major carriers in the metal oxides under operating conditions. Thus, one of this target working is performed to consider the adsorption ability of CO on metal oxides, included both ZnO and modified ZnO surfaces.

On the other hand, metal-oxide adsorbents are attracted considerable attention owing to their potential applications in industry and academic research. In the last years, several experimental and theoretical studies on metal oxides have been performed to increase their performance and reduce the energy required for their practical use [2,5,6]. Among the oxide adsorbents, zinc oxide (ZnO) has become a frequently studied material in surface science because of its wide range of applications such as a basic material for varistors, as a chemical sensor in gas-detecting systems and as a adsorbent to catalyze for many important chemical processes on the industrial scale (e.g., de-/hydrogenation and methanol synthesis/conversion) [7-9]. Among of four main ZnO surfaces, the non-polar $(10\bar{1}0)$ surface has been the focus of several experimental and theoretical studies due to its most abundant and stable nature [8-10]. The surface is obtained by cutting the crystal perpendicular to the hexagonal Zn and O layers. Atomic planes perpendicular to the $(10\bar{1}0)$ direction consist of equal numbers of zinc and oxygen ions and can be formed as rows of zinc-oxygen dimmers. These dimmers are then bonded to dimmers in the next layer [10,11]. In many these potential reasons, one of present work, the ZnO $(10\bar{1}0)$ surface is used thus to adsorb the CO molecular in gas phase.

Moreover, recent theoretical studies [12-18] showed that the adsorbed properties of the oxides could be improved by replacing a small fraction of the cations at their surface with other cations [15, 17]. In general, one such treatment substitutes some of the cations, M, at the surface of an

oxide, M_mO_n, with a different cation, D, to form a single-phase compound having the chemical formula $D_xM_{m-x}O_n$. In this frame work, disnormally called a dopant, M_mO_n is the host oxide, and $D_xM_{m-x}O_n$ is doped oxide. With the large number of possible D-oxide pairs, it is hoped that some useful adsorbents may be found in this class of compounds.

Previous studies [12,17-19] reported that the doped oxides are difficult to characterize experimentally due to several reasons. For instance, in the methods prepared to form doped oxides, unfortunately, they may be formed one of several alternatives i.e., a fine physical mixture of two oxides, forming an oxide clusters of D supported on the oxide M_mO_n, or very small neutral clusters of the metal D supported on the oxide M_mO_n, or a doped oxide in which all dopant atoms are hidden in the bulk of the material. To overcome the experimental difficulties, we use theoretical methods to qualitatively explore various possibilities and predict the best adsorbent candidates. In the present work, we have investigated the effect of Ti atom doping on ZnO surface layer to determine the Ti-D-ZnO surface model. Here, Ti atom was chosen because it allows to study the dopants which have a larger oxidation state than the Zn ions. To be specific, Ti can switch from the oxidation state of +4 to +3 and are able to compensate the disruption caused by doping, whereas Zn only has a +2 oxidation state and thus lacks this flexibility [15]. Hence, the Ti doped ZnO surface may improve some adsorption reactions compared to that of undoped surfaces. In detailed examinations, we concentrate on the calculated CO adsorption energies to find the most stable sites of CO adsorption on both undoped ZnO and Ti doped ZnO $(10\bar{1}0)$ surface. A comparison adsorption enrgies in CO adsorption reaction between undoped ZnO surface and Ti doped ZnO surface are also performed. In additions, we also investigated the nature of the surface –CO bonding through scrutiny of density of states (DOS) and electron density difference (EDD) contour plot.

II. COMPUTATIONAL DETAILS

All DFT calculations were performed with the Vienna ab initio Simulation Package (VASP) [20-22]. The electron-ion interactions are treated with the projector augmented wave method [23] in which all the electrons except the valence ones are kept frozen. Exchange-correlation energy was calculated using the GGA-PW91 function [24]. All reported results for a given species on the surface were obtained for its lowest-energy conformer. Normal-mode analysis was performed to verify the nature of several stationary points.

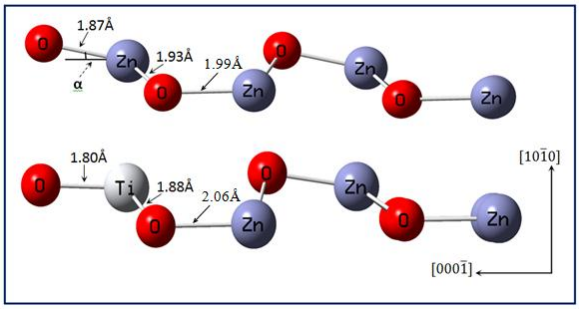

Fig. 1. The side-view of the (2x2)-ZnOsupercell of the optimized undoped (top) and Ti-doped (bottom) systems. Only first two outermostlayersin the direction $(10\bar{1}0)$ are shown.

A (2×2)-ZnO $(10\bar{1}0)$ surface super-cell with six layers was used for all calculations, where the top three layers were relaxed and the bottom three layers were fixed. The Ti dopant is in the substitution position as depicted in Fig. 1, replacing one Zn atom for every 4 Zn atoms in the first two surface layers of ZnO in the $(10\bar{1}0)$ direction. A plane-wave cutoff energy of 380 eV and a (4×2×1)k-point grid set by Monkhorst-Pack [25] were used for all periodic calculations, except for ZnO bulk calculations where a (4×4×4) k-point grid was used. A vacuum space of 15 Å was introduced in the $(10\bar{1}0)$ direction to avoid the interactions of adjacent slabs.

We have calculated the chemisorption energy, E_{ads}, as the energy difference between the total energy of the chemisorbed molecular system and the sum of the total energies of the free elaxed molecule and the surface. In the case of CO adsorption on either undoped or Ti doped surface, the chemisorption energy is then given by

$$E_{ads} = E_{CO/surface} - (E_{CO} + E_{surface})$$

Where, E_{ads} is the adsorption energy of the adsorbate on the considered surface (either clean ZnO or Ti-D-ZnO); $E_{CO/surface}$ is the total energy of the optimized CO on the surface; E_{CO} is the total energy of the isolated CO molecule; and $E_{surface}$ is the total energy of the surface.

III. RESULTS AND DISCUSSION

III.1. Undoped and Ti doped ZnO Surfaces

It is well known that the stoichiometric undoped ZnO $(10\bar{1}0)$ surface is auto-compensated since it contains an equal number of zinc and oxygen atoms per unit area, and only one bond per atom is broken when the surface is created [7,10,26]. The step-edge Zn and O atoms have one dangling bond per atom [9,11]. The atomic planes, which are perpendicular to the $(10\bar{1}0)$ direction, consist of equal numbers of Zn and O ions and can be considered as rows of Zn-O dimmers. Fig. 1 (top) presents the optimized undoped ZnO $(10\bar{1}0)$ surface where the Zn-O bond length in the first and the second outermost layers are 1.87 and 1.99 Å, respectively, and the inter-layer Zn-O distance between the

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two layers is 1.93Å. After structural reconstruction, the surface geometry distortion from the bulk structure is reflected in the tilt angle (α), which is found to be changed by about 10^{o}. It has been noticed that the calculated structural parameters for undoped ZnO $(10\bar{1}0)$ surface is in agreement with the previous results [10,11]. Previously, it has been reported that, the dopant must replace a Zn atom at the surface of the oxide or in the first layer below the surface [12,13,15]. Also, the dopant may occupy either in an in-terstitial position or form a single neutral atom on the surface during synthesis. In this study, the position of doped Ti, replaces Zn atom on the surface which is shown in Fig. 1(bottom). In Fig. 1, it has been observed that the oxygen atom bonded with Ti moves outwards, resulting in a shortening of Ti–O bond length (1.80Å) compared to the corresponding Ti-O bond length (1.98 Å) of TiO_2 in the bulk. This indicates that, the oxygen atoms which are neighboring to the dopant in the ZnO $(10\bar{1}0)$ surface become less active after doped with Ti.

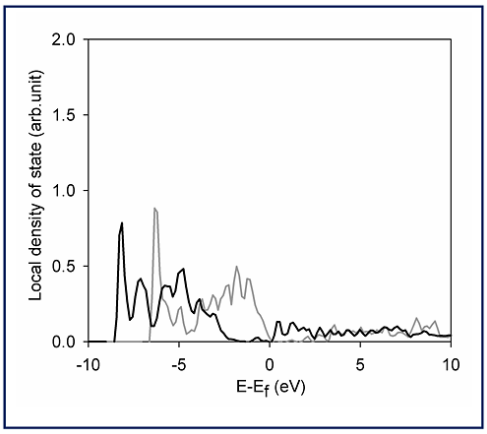

Fig. 2. Local density of states (LDOS) for neighboring O atoms bonded to Zn of undoped ZnO surface (grey line) and to Ti of doped ZnO surface (black line).

To understand in more detail about doping, we analyzed the local density of states (LDOS) of O atoms of undoped and doped surfaces and the plotted LDOS is shown in Fig. 2. It can be seen that, the peaks which are corresponds to the interaction between neighboring O atoms and Ti doped surface has been shifted negatively *i.e.* moves away from the Femi level region, in comparison with the interaction between neighboring O atoms and undoped surface. This indicates that the neighboring O atoms of ZnO $(10\bar{1}0)$ surface become less active after doped with Ti, which agrees with the earlier results of Pala*et.al.*[12, 15, 17].

III.2. CO adsorption on undoped ZnO surface

The CO adsorbed on the undoped surface either by C atom (C down) or O atom (O down) [2,3,18,27]. It is well known that, the surface area in the vicinity of the topmost O ion is purely repulsive for both the "C down" and "O down". Previous study [27] indicates that the "C down" orientation was found to be the most stable one. We also performed different orientation of CO adsorbed on undoped surface and found that the C down is the most stable conformer. Therefore, we considered "C down" orientation for all the other calculations in this study. The most stable configuration for the CO adsorbed on undoped surface is shown in Fig. 3 (top), and the calculated parameters are listed in Table 1. The other less stable configurations of CO adsorbed on the undoped ZnO surface and their corresponding adsorption energies are presented in the Fig. S1 (supplemental material). The calculated adsorption energy of CO adsorbed on the undoped surface is 0.33 eV. The C-Zn distance and tilt angles (β and γ) are found to be 2.13 Å and 33º, respectively, which agree with the previous results [27]. The C-O bond length is slightly elongated (0.02Å) after adsorption on the surface, which may be due to the electron donation to the surface. It is interesting to note that, the tilt angle (α) changes from 10 to 0°when CO absorbed on the undoped surface. This is due to the formation of the bond between CO and Zn atom, which counter-balances the force pulling Zn atom towards the $(10\bar{1}0)$ direction, this causes the elongation of Zn-O bond length (from 1.93 Å to 1.99 Å) between topmost layer and sub-layer after CO adsorption.

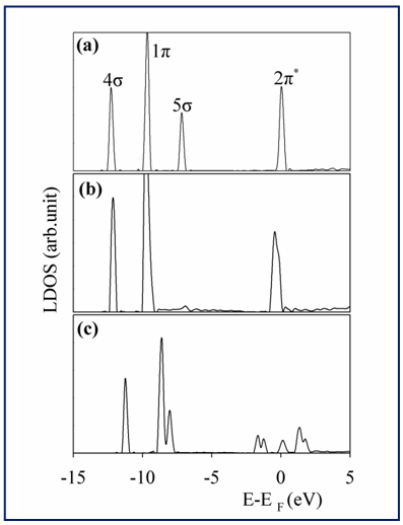

Fig. 3. Local density of states (LDOS) of (a) free CO molecule in a gas phase; (b) and (c) CO adsorption on undopedand Ti doped ZnO surface.

The plotted local density of states (LDOS) for CO molecule in gas phase and CO adsorbed on the undoped surface are illustrated in Fig. 4(a) and 4(b), respectively. By analyzing the Fig. 4 (a) and (b), it has been found that, the 5σ states are vanished after the adsorption of CO on the undoped surface. Further, we noticed the broadening of the $2\pi^{*}$ states after adsorption, which indicates the interaction between CO and surface. To study this in detail, we plotted the partial density of states (PDOS) for s, p, and d orbitals

of Zn atom before and after CO adsorption on the ZnO surface and shown in Fig. S3 and S4 (supplemental material), respectively. From the PDOS of 4s and 4p orbitals of Zn atom, we found that, there is a partial electron occupation through increased electron density and also shifting of peaks after CO adsorption, which indicates that CO has a broad electron distribution on the surface and it forms strong dative bond. It can be seen from Fig. S4, the d orbitals of Zn atom located away from the Fermi level (about 8 eV), which implies that the back donation of electrons from the surface to CO will be less. In addition, after CO adsorption, an increase in electron density has been noticed in the $3d_{z2}$, 3dyz, and 3dxz orbitals (Fig. S4), which is due to formation of the dative bond. These results indicate that, the CO molecule interacted with ZnO surface via formation of dative bond (i.e., the electron donation from C atom to Zn atom). To gain more information about the charge distributions of CO adsorbed on ZnO $(10\bar{1}0)$ surface, we plotted the electron density difference (EDD) contour plots and shown in Fig. 5(a). It has been observed that the electron density near C and Zn atoms are increased, which confirms the formation of dative bond between these two atoms. The decrease in electron density near C-O bond clearly demonstrates the electron donation from CO to the surface.

III.3. CO adsorption on Ti doped ZnO surface

As like, undoped surface, we considered only C down orientation to interact with the Ti doped ZnO surface. The most stable configuration of CO adsorption on the Ti doped ZnO surface and the calculated adsorption energy are shown also in the Fig. 3 (bottom) and Table 1, respectively. The other less stable configurations and corresponding adsorption energies are summarized in the supporting information as Fig. S2. It has been noticed that, the dopant bond lengths (O-Ti) are elongated after CO adsorption, which is likely due to the formation of the bond between CO and Ti atom, which counter-balances the force pulling Ti atom towards the bulk. However, this force is ignored because the tilt angle (α) of reconstruction surface doped with Ti atom does not change much. The adsorption energy for CO absorbed on the Ti doped ZnO surface is found to be -0.86 eV, which is much larger than that of the undoped ZnO surface. The calculated C-Ti distance and the tilt angles (β and γ) are found to be 2.10 Å and 24°, respectively. Also, C-O bond length is found to be 1.16 Å, which is longer than the gas phase CO molecule (1.13Å). These results indicate the interaction of CO with the doped surface is stronger than the undoped surface.

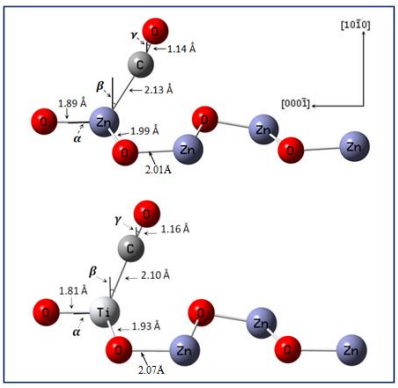

Fig. 4. The most stable structures of CO adsorption on the undoped(top) and the Ti-doped (bottom) ZnO $(10\bar{1}0)$ surface.

Table 1. The calculated bond distances (d in Å), bond angles (in degrees) and binding/adsorption energies (E_{ads} in eV) for CO adsorption on undoped and Ti doped ZnO $(10\bar{1}0)$ surfaces. The bond angles (α, β and γ) are defined in Figure 3.

Parameters	Undoped	Ti-doped
d_{C-O}	1.14	1.16
d_{Zn-C}	2.13 (2.17)[a]	/
d_{Ti-C}	/	2.10
α	0	0
β	33 (30)[a]	24
γ	33 (30)[a]	24
E_{ads}	-0.33 (-0.36)[a]	-0.86

[a] *Taken from Ref. [27]*

In order to study the bonding nature of the CO on Ti doped ZnO $(10\bar{1}0)$ surface, we plotted LDOS of CO before and after adsorption and shown in Fig. 4(c). By examining the individual quantum states at 5σ and $2\pi^*$ of CO molecule, the shifting of 5σ states reveal the electron donation of C atom in CO molecule to the surface, whereas the splitting of $2\pi^*$ states indicate the electron back donation from the surface to CO molecule. These interactions cause the bond formation between CO and Ti doped ZnO surface. To explain these interactions in detail, we plotted PDOS for s, p, and d orbitals of Ti atom before and after CO adsorption on Ti doped ZnO surface and shown also in Fig. S3 and S4 (supplemental material), respectively. From the PDOS of 4s and 4p orbitals of Ti atom, Fig. S3 (b-b_1), it has been noticed that, there is a partial electron occupation through increased electron density and shifting of peaks at energy region from -5 to -10 eV after CO adsorption, resulting that CO has a broad electron distribution to make surface becoming good hybridization with adjacent O atoms. From Fig. S4 (b-b_2), it has been observed that, the d orbitals of Ti atom are located very near to the Fermi level, hence the

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back donation of electrons from the surface to the CO becomes more compared to the undoped ZnO surface.

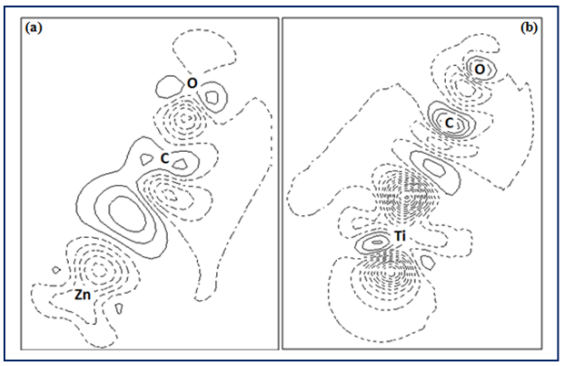

Fig. 5. Electron density difference (EDD) contour plots of CO molecule adsorbed on (a) undoped and (b) Ti-doped ZnO $(10\bar{1}0)$ surface. The solid and dashed lines represent increasing and decreasing electron densities

Further, EDD analyses have been performed for the bonding of CO on Ti doped ZnO $(10\bar{1}0)$ surface and shown in Fig. 5(b). From this figure, we can find an increase in electron density between C and Ti atoms and decrease in electron density between the C and O atoms, which indicates the strengthening and weakening of C-Ti and C-O bonds, respectively. In addition, the back donation of electrons from Ti increases the electron density at anti bonding π orbital of CO molecule. As a result, it makes decrease in the bond order of CO molecule, which causes the elongation of CO bond length compared to the undoped surface (see Table 1).

IV. CONCLUSIONS

We have carried out a systematic periodic plane ware DFT calculations on CO adsorption on undoped and Ti doped ZnO $(10\bar{1}0)$ surface. All of important structural parameters of both undoped and doped surfaces were obtained by optimization. The adsorption of CO causes significant structural changes in CO, undoped and doped surfaces. We found that, the presence of dopant increases the absorption ability of CO on the ZnO surface. The interaction of CO with undoped and Ti doped ZnO surface has been studied in detail and explained using LDOS, PDOS and EDD plots. The calculated results show that interaction of CO with the doped surface is stronger than the undoped surface.

V. ACKNOWLEDGMENT

We thank to the Industrial University of Ho Chi Minh City for supporting this research financially. We are also grateful to the National Center of High-Performance Computing for donating computer time and facilities.

Appendix A. Supplementary material the Fig. S1 and S2 show the less stable configurations of CO adsorbed on the undoped and Ti doped ZnO surfaces, respectively. Fig. S3 and S4 present partial density of state (PDOS) analysis of orbitals (s, p, and d) bonded on undoped and Ti doped ZnO surface. This material is available free of charge via the Internet at http://www.sciencedirect.com/.

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8th International Conference on Recent Challenges in Engineering and Technology (ICRCET-2020)

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Scientific Development of Sustainable Mitti Cool Refrigeration System

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Abstract:

This project outcome based paper is a Scientific Development of Mansukh Bhai's all-natural clay refrigerator. The Al-4Ti master alloy was fabricated by aluminum (Al) and sponge titanium particle in a resistance furnace at different cooling rates added with clay to improve cooling effect .Mityi cool doulbe layer packing, first with fine grade sand with sponge titanium aluminum & second layer with paper pulp (recycled)- small sponge cubes.Solar PV cell with a D.C motor used to pass of air through multi clay tubes makes the system renewable energy sourced. This increase more cooling effectiveness adding a multi bucket cooling chamber instead of single one. Conventional Refrigerators has its own share of problems pertaining to environmental safety, usage and maintenance in rural parts of developing countries. This sustainable project is a one man stand to serve & satisfy economical, social& environmental conditions.

Keywords:

Evaporative Cooling; Environment; Refrigeration; Sustainable

I. INTRODUCTION

Mitticool is a natural refrigerator made entirely from clay to store the vegetables, fruits and also for cooling water, milk, eatable items for 2-3 days.It provides natural coolness to the stored material without requiring any electricity or any other artificial form of energy andcan be used to store freshly without deteriorating the quality and the original taste of the fruits and vegetables. This is a very outstanding alternative for the rural people who cannot afford the conventional refrigerator due to high cost.

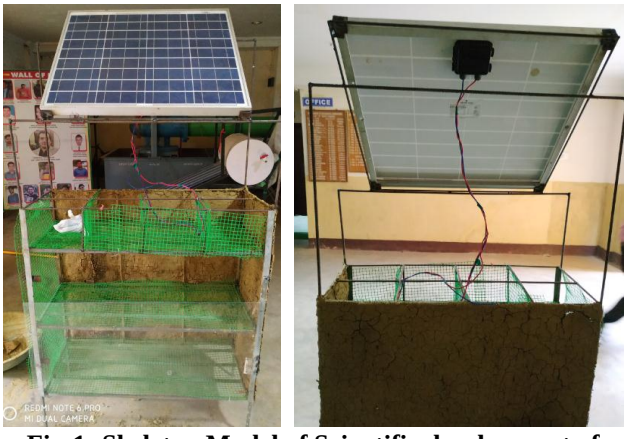

Fig-1: Skeleton Model of Scientific development of Mansukh Bhai's Mitti Cool Refrigeration System

The new design resembles the modern electrical refrigerator at first glance, but it is smaller in size. It has separate provisions for storing water and food. The upper chamber is used to store drinking water and the bottom chamber is provided to store fruits and vegetables. Usually a tap is provided to draw drinking water. The food storage chamber is covered with a glass pane. [1]

II. OPERATIONAL PRINCIPLE

Scientific development of Mansukh Bhai's Mitti Cool Clay Refrigeration System is a scientific transformation of Mansukh Bhai Prajapati's Mitti Cool Clay Refrigerator (a National President awardee)

The scientific modification includes as following details;

1. Solal PV panel to ensure renewable and cheap electricity
2. 3 layers added to the conventional mitti cool wall to improve porosity & cooling effect.
3. Mixure of Al+Ti powder added to improve further cooling effect.
4. Water jacket is devided in to interconnected sub-sections to increase the area and thereby increasing the cooling effect.
5. Adequate insulations provided to structure to avoid heat interchaswnge.
6. Blow of air (high speed AC fan) through number of small diametric tubes provided for natural cooling.

7. A DC pump motor installed to provide water through the tubes for more cooling.
8. An DC/AC inverter & 12V DC battery provided to run the high speed AC fan and DC pump motor.

III. PARAMETERS AFFECTING EVAPORATION

A. Ambient Temperature:

The ambient temperature plays an important role in evaporative cooling. The higher the temperature, the higher will be the rate of evaporation, ensuring better cooling of the storage space.[2]

B. Ambient Relative Humidity:

Relative humidity is a measure of water content already present in air. When the relative humidity of air surrounding the refrigerator is less, more water can be evaporated and as a result cooling will be better. Theoretically, it is observed that with decrease in ambient relative humidity for a given temperature, the temperature of the storage space come down. [3]

C. Geometry and Surface Area of Refrigerator:

The amount of evaporation taking place is directly proportional to area available for evaporation. Hence increase in the area for evaporation around the storage space enhances the cooling process. [3]

D. Thermal conductivity of Material used to hold water:

The material used to hold water between the pots should have a thermal conductivity as low as possible to obtain lesser temperature in the storage space for a given ambient temperature and relative humidity. Theoretical as well as experimental studies have also confirmed that the material used should be of low thermal conductivity. [3]

E. Thermal conductivity of material exposed to evaporation:

The material in contact with the ambient air should maintain lower thermal conductivity as well. But theoretical results have shown that though the temperature of storage space decreases with decrease in thermal conductivity, the effect is minimal. [3]

F. Hydraulic Conductivity of material:

Hydraulic Conductivity of porous material in contact with ambient air should be higher, but not too high to allow seepage. Theoretical analysis shows that the effect of hydraulic conductivity is also minimal on the cold temperature obtained at storage space.

IV. PHOTO VOLTAIC (PV) ENGAGEMENT

Based on the principle of photovoltaic effect, solar cells or photovoltaic cells are made. They convert sunlight into direct current (DC) electricity. But, a single photovoltaic cell does not produce enough amount of electricity. Therefore, a number of photovoltaic cells are mounted on a supporting frame and are electrically connected to each other to form a photovoltaic module or solar panel. Commonly available solar panels range from several hundred watts (say 100 watts) up to few kilowatts. They are available in different sizes and different price ranges. Solar panels or modules are designed to supply electric power at a certain voltage (say 12v), but the current they produce is directly dependent on the incident light. As of now it is clear that photovoltaic modules produce DC electricity. But, for most of the times we require AC power and, hence, solar power system consists of an inverter too.According to the need of power, multiple photovoltaic modules are electrically connected together to form a PV array and to obtain as much power as is necessitated.. There are various types of PV systems according to their implementation.

1. PV direct systems: These systems supply the load only as long as the Sun is present. There is no storage of the generated power and, hence, batteries are absent. An inverter may or may not be employed depending on the type of load.[4]
2. Off-grid systems: This type of system is commonly used at sites where power from the grid is not reliably available. An off-grid solar power system is no way connected to electric grid and comprises of a battery and inverter as its primary components.[4]
3. On-grid systems: These solar power systems are tied with grids so that the excess power required by the consumer (investor organization) can be accessed from the grid .In case there is an excess power generated, then the rest power after fulfilling the consumer's demand is fed to the grid. The same amount of power can be recovered from the grid as compensation as and when there is a demand of the consumer. The system may or may not use a battery which is treated optional.

   The Mitti cool Refrigerator makes use of the electric energy both in the form of AC as well as DC. The system is provided with solar power supply and generates power when Sun is present. . The DC power from solar is converted to AC by inverter from where the AC energy can directly feed to the AC fan motor to run. In case solar power is not available (in the absence of Sun) a battery of 12V DC is available as back-up and again the inverter will be able to supply the same AC Power to enable the AC fan motor to run continuously. [4]

   Similarly, the 12V DC is always available with the battery and can provide the uninterrupted power supply to run the DC pump motor.

Schematic Diagram of Scientific Development of Mansukh Bhai's Mitti Cool Refrigeration System with electrical layout illustrated in figure 2 & 3.

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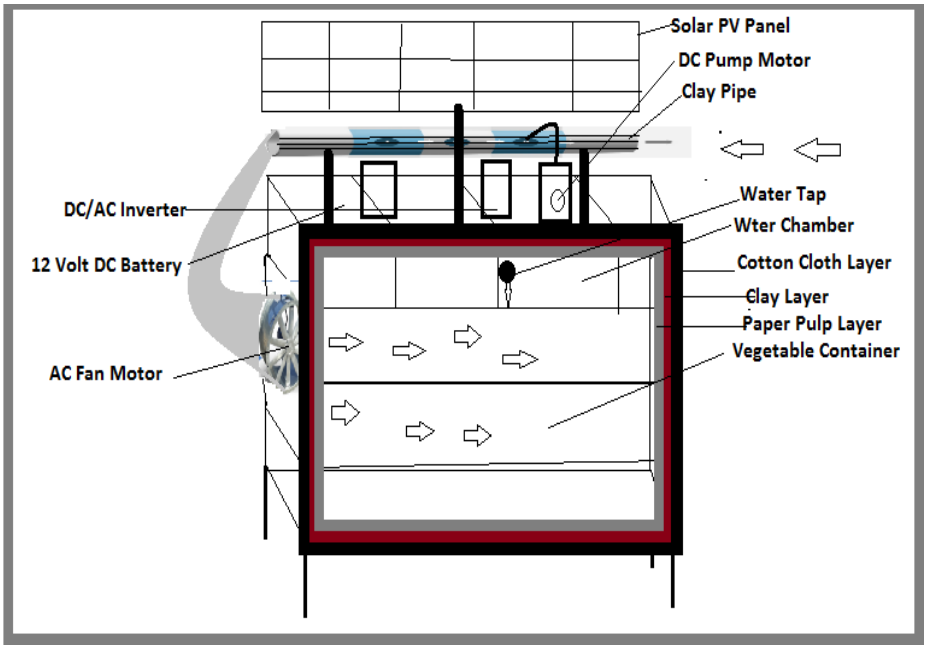

Fig 2: Schematic Diagram of Scientific Development of Mansukh Bhai's Mitti Cool Refrigeration System.

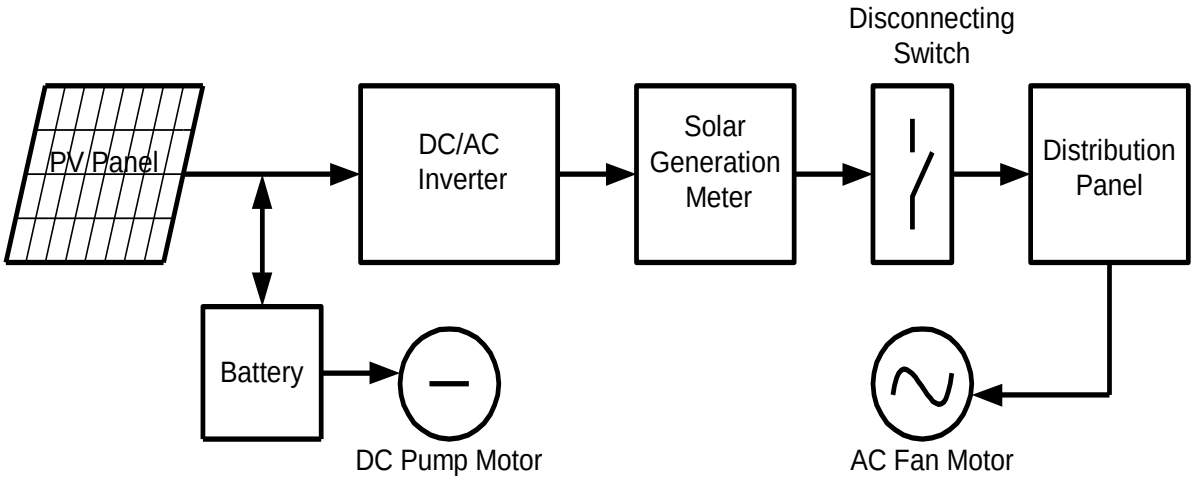

Fig 3: Electrical Layout of Scientific Development of Mansukh Bhai's Mitti Cool Refrigeration System.

This scheme has been proved to have better utility than the later in terms of economy, environmental friendly, efficiency,sustainability and more adoration by the rural people.The previous system developed by Mansukh BhaiPrajapati was comprised of three cabins consisting of onewater jacket and two vegetable containers.Clay slurry grinded and walls formed through molding of clay. It allowed drying inside a close air tight room maintaining temperature 70 to 80 degree centigrade to avoid cracks. The cooling concept was based up on "Evaporation makes cooling". If its allowed to dry in open atmosphere cracks will be developed& its will close the ventilations of clay walls and consequently hindering the cooling system. Presently, the chamber and the container walls are constructed out of four layers viz; first layer of a simple wire gauge of insulated steel material, second of a clay of mud variety,mixed with a chemical called Aluminum Titanium exhibiting the property of high grade of cooling, the third with paper pulp materials required for absorbing the moisture content of the muddy soil and the fourth layer being a cover of cotton cloth for bettr absorbing quality of moisture and for assisting towards the cracking resistance properties. Finally a layer of Paint is added to for making the system to sustain for long duration. Water droplets are allows to pass through clay small diametric tubes exhibit more cooling with a separate DC motor and high speed suction AC fan.

Fig 4: Construction of Scientific Development of Mansukh Bhai's Sustainable Mitti Cool Refrigeration System

Fig 5: Final prototype of Scientific Development of Mansukh Bhai's Mitti Cool Refrigeration System

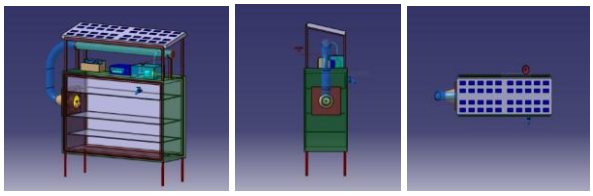

Fig 6: Solid Modeling of Scientific Development of Mansukh Bhai's Mitti Cool Refrigeration System

V. KEY ADVANTAGES

- The product is technically 100% sustainable & cost effective for all grade of consumers
- This product gives a message to human society for using renewable energy sources rather than conventional sources and includes no recurring costs.
- As the total manufacturing cost is limited to 2000 to 3000 Indian Rupees, the product is affordable & socially adored.
- There is no side effect produced on human body due to chemical effect as the total system made out of natural resources.
- It can preserve water, food, vegetables and milk as electrical/electronic refrigeration can do without deteriorating the quality for 2-3 days.
- Provides a cheap and eco-friendly option to store drinking water, food, vegetables and milk.
- Does not require any conventional electricity and therefore no recurring costs.
- Very good alternative for the rural people who cannot afford the conventional refrigerator.

VI. LIMITATIONS OF MITTICOOL

- Mitt cool's performance is totally dependent on external temperature and humidity. It performs well in dry and hot climate. So it will not function everywhere, as evaporative cooling only works well in dry climates.
- This whole unit is brittle,as it is made up of baked clay and needs careful handling.

VII. CONCLUSION

The scientific modification on Mitti cool refrigerator is proved to be a sustainable, economical, environmental friendly & social adorable development.It is worth while to note that the feasiblity & acceptability of modified one is appreciated by end consumers of different level of customers due to more cooling effect, renewable sourcing ,more durable & realiable in all directions.It is also suggested that the orientation and locate on of the cooler be varied in order to determine the effect of orientation on performance.

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The Compliance of Medical Equipment Design Technology against Indonesian Medical Regulatory Board

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Abstract:

The government policy on Indonesian National Health program demands adequate supply of medical devices in terms of the number and type of equipment. Currently, there are about 90% of the medical devices are obtained through imports and 10% are sourced locally. In 2035, the Health Ministry has projected to reduce their dependency to imported devices up to 35% through a localization program which to be accelerated by domestic industry. During the implementation effort, the progress is rather slow due to technology limitation coupled with acute shortage of expertise in the area of medical device products. This technology is scarce but it is a foothold for the development of safe and effective as intended use and shorter time to market. In this study the medical device's design technologies are examined to established the regulatory requirement and specifications. A paper review on medical devices technology and regulatory were done to formulate a systematic approach to identify the design requirement to meet the required standards. The main requirements are functionality, usability, safety and conformity against standards.

Keywords:

Medical Devices, product design technology, design requirements, regulatory requirement, systematic approach

I. INTRODUCTION

Medical Devices is defined as "any instrument, equipment, tool, material, or other item, whether used alone or in combination, including software needed for the proper application intended by the manufacturer to be used by humans for the purpose of diagnosis, prevention, monitoring, treatment , or reduction of disease, replacement, or modification of anatomic or physiological processes, and conception control. "[4]. Medical devices are an excellent resource for improving diagnosis and management of disease.

The Government of Indonesia in 2015 [1] in the National Industrial Development Master Plan (RIPIN) has determined that Medical Devices are the mainstay industry that will be developed from 2015 - 2035. The selection of medical devices is inseparable from the Indonesian government's policy on National Health Insurance (JKN) which triggered an increase in demand for medical devices to exports and imports over the past 4 years, can be seen from the average growth of Indonesia's medical device exports reaching 7.7%, while import growth for medical devices reached 12.7% [2].

Of the demand for domestic medical devices 90% of them are met through imports, only 10% are supplied from domestic industries. The target of RIPIN medical devices is towards independence of the domestic medical device industry in 2035, so as to ensure that the target can be achieved the President of the Republic of Indonesia issues presidential instructions to accelerate the growth of the medical device industry [3]. The president's instruction was followed by a decision of the minister of health with the action plan for the acceleration of the medical device industry as a technical guide for its implementation [4].

In the RIPIN, the types of technology of medical equipment have been formulated to be developed to ensure the independence of the medical device industry as shown in figure1.

No	Industry Priority	Technological Needs Developed		
		2015-2019	2020-2024	2025-2035
(1)	(2)	(3)	(4)	(5)
2	**Industry Pharmaceutical, Cosmetics And Medical Devices**	1. Product design	1. Product Design	1. Product Design
		2. Micro scale Measurement	2. Micro and nano scale measurements	2. Micro and nano scale measurements
		3. Electromagnetics	3. Electromagnetics	3. Electromagnetics
		4. Microelectronics	4. Micro-nano-bio electronics	4. Micro-nano-bio electronics
		5. Biomedical technology	5. Biomedical technology	5. Biomedical technology
		6. Automation and robotics	6. Automation and robotics	6. Automation and robotics
			7. Micro-nano-bio material	7. Micro-nano-bio material
			8. Pneumatic	8. Pneumatic
			9. Nuclear	9. Nuclear

Figure 1. Technology Needs for Medical Devices [1].

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From Figure 1 can be seen that the technology of product design in every phase of development is always programmed, this indicates that the need for innovation in medical devices must indeed be mastered properly from the upstream. This means that the mastery of medical device innovation technology in Indonesia is still very weak, and efforts to accelerate are constrained by limitations in the mastery of technology in designing medical devices. This technology is a foothold in the development of medical devices that are safe and effective as intended use, and can be marketed in a short time.

Deepening is needed so that this product design technology is truly mastered because medical devices that are not well designed when placed on the market and have failed, and if the product class is class II or class III, there is a high possibility of "fatal failure" that can occur resulting in death in patients and in medical personnel or damage to health facilities and the environment.

Medical devices are products that are strictly regulated in their use ranging from premarket to postmarket. In Europe it is regulated to use MDR regulations, the US FDA, Indonesia AMDD etc., so that before a medical device is placed on the market the medical device must already have a marketing authorization [5] which guarantees that the product meets (in accordance with) regulatory requirements.

Medical devices are products with a very broad spectrum of products ranging from contraceptives, contact lenses, hospital beds, operating tables to pacemakers, each of which has a different level of security class. So for the successful mastery of product design technology, it is necessary to deepen its technology upstream, which is related to the product requirements from various aspects ranging from technical functions, operational ease to security aspects and the calculation of the risk of failure.

The purpose of this research is to provide the design requirements needed in the medical devices product development process so that the process can be done quickly and correctly, it is hoped that the resulting product can be immediately placed on the market and can meet the design criteria that have been set to provide assurance that the medical devices that is designed is can be used safely,effectively, good quality and useful according to its intended use.

II. METHODOLOGY

To obtain the design requirements for the design of medical devices, the methodology used is a literature review including product development standards, product safety standards, good manufacturing practices (GMPs), and product regulation. By using a systematic approach to information from the literature, it is then formulated and compiled into the main requirements for the design of medical devices.

III. LITERATURE STUDY

3.1 Systematic Approach

This design process methodology is referred to as the systematic approach methodology [10]. This approach can be illustrated as a black box (fig 2), which is connected directly to input and output. In general, input and output systems can be classified as energy, materials and signals, and in the box, function words are written, which are function statements that must be solved as expected outputs from this approach.

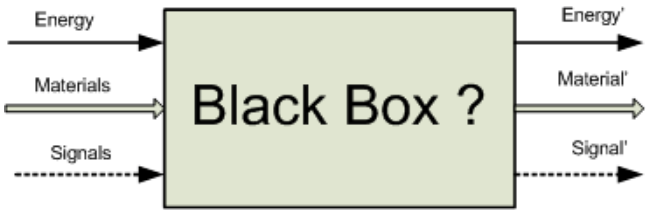

Figure 2. Energy, material and signal conversion. Solution not yet known; tasks or functions that are explained based on input and output, Pahl and Beitz [10]

Start with the overall function and then use it to structure the function, as shown in figure the function structure is a detailed description of each specific function that is arranged to fulfill the overall function. Each special function must be unique that can complete the function as the focus as possible and the right solution can be proposed accurately as needed by the design requirements. If a function in the structure of a function cannot be defined as a unique function, it must be used again into sub functions consisting of unique functions

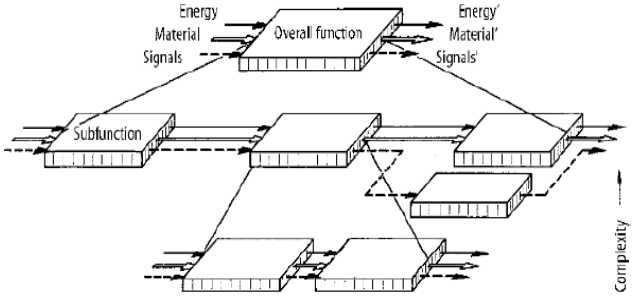

Figure 3. Building the structure of functions by breaking down the overall function into sub- functions, Pahl and Beitz [10]

3.2 Types of Medical Devices

With such a broad spectrum of products, these medical devices are classified into various types of medical devices, namely:

1. Medical devices: frombandages, tongue depressors, thermometer,contact lens, stetoskop, splints, first-aid kits, breathalysers, heart valves and imaging quipmentAs defined in Medical Devices Directive (MDD) 93/42/EEC [9]and PMK No. 62 2017[5].

2. Medical devices In-Vitro: reagents, control standards, test-kits, equipment intended for the in-vitro examination of human specimens e.g. blood grouping reagents, pregnancy test kits, Hepatitis B test kits.As defined in In-Vitro Diagnostic Medical Devices Directive (IVDD) 98/79/EC [10] and PMK Nomor 62 tahun 2017[5].
3. Medical devices Active Implantable: aktiv (i.e. termasuksumber energi) implantsataupartial implants e.g. heart pacemakersAs defined in Active Implantable Medical Devices Directive (AIMDD) 90/385/EEC [13] and PMK No 62 2017[5].

3.3 Medical Device Product Development Process

The development of medical devices is a long process from premarket activities, clinical trials, registration of medical devices to the ministry of health, to the activities of placing products on the market which are then followed by postmarket activities. Isa T Santos [11] described this process as shown in Figure 4 and in the context of the product life cycle shown in Figure 5.

Figure 4. The process of developing medical device products [13]

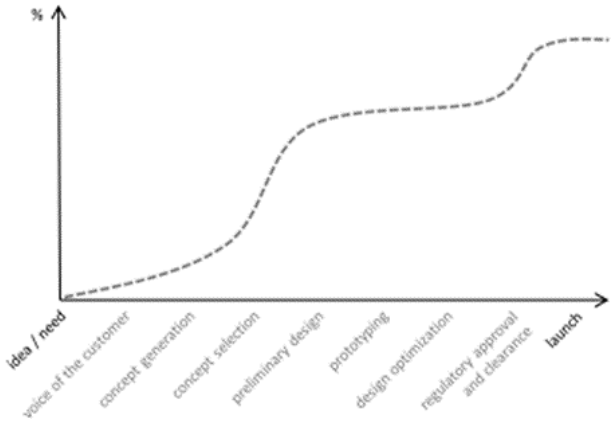

Figure 5. Life cycle of medical device products [13]

To get certainty that medical devices can fulfill the useful function of some developers of medical equipment products using the "water fall" model as shown in Figure 6. In this model at each stage of the process a review is carried out, the design output is verified as being compatible with the design input, and the product is validated compliance withuser requirements.

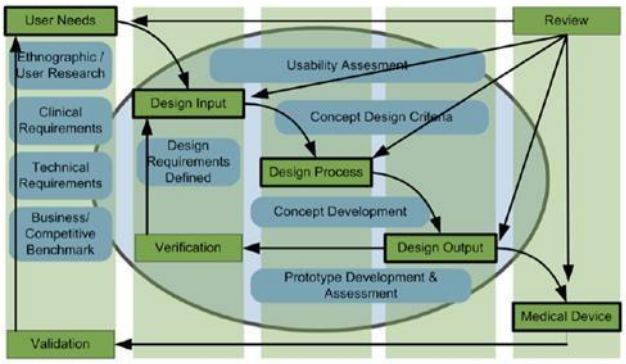

Figure 6. Water Fall model in the process of developing medical device products.

3.4 Indonesian Medical Devices Regulation

Industry and medical device business egulations in Indonesia in the form of schemes ranging from pre-market to post-market are shown in figure 7. While the rules that become the basis of reference are the regulations of the minister of health, namely:

a. Permenkes No. 1189 / VIII / 2010 Concerning Certificates of Production of Medical Devices and Household Products [4]
b. Permenkes No. 1191 / VIII / 2010 Concerning Distribution of Medical Devices and Household Health Products [6]
c. Regulation of the Minister of Health of the Republic of Indonesia Number 62 Year 2017 Concerning Circulation of Medical Devices, In Vitro Diagnostic Medical Devices and Household Health Supplies [5]
d. Permenkes Number 20 Year 2017 Regarding Good Manufacturing Practices of Medical Devices and Household Health Supplies[7].

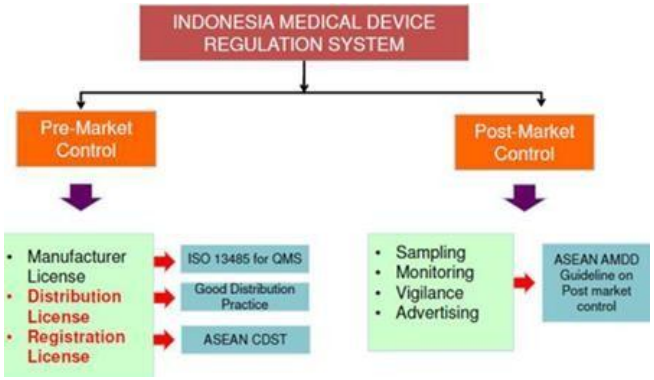

Figure 7. Schematic of Medical Device Regulation System

3.5 Safety Requirements for Medical Devices

Safety requirements for medical devices in the medical device industry generally follow the scheme of the IEC in this case using the structure of the IEC 60601-Series Module [12] as shown in figure 8.

This scheme consists of collateral standards in part 1 of generic standards and special standards in part 2 in the form

of product standards. In part 1 in the collateral standard ISO 14971 [13] is placed relating to risk management which is used to accommodate the issue of failure that must be managed adequately from the concept stage to production with the intention to eliminate the occurrence of failure due to failure of the product in showing its best performance.

	Part 1 Generic		Part 2 Particular	
	IEC 60601 -1 General Requirements		Device	Standard
Colateral Standard	IEC 60601 -1-2	Electomagnetic Compatibility	X-ray	IEC 60601-2-54
	IEC 60601 -1-3	Radiation Protection	Interventional X-ray	IEC 60601-2-43
	IEC 60601 -1-6	Usability	Mammography	IEC 60601-2-45
	IEC 60601 -1-8	Alarm	Dental intra-oral	IEC 60601-2-65
	IEC 60601 -1-9	Environment	Dental extra-oral	IEC 60601-2-63
	IEC 60601 -1-10	Physicological Close Loop Controller	Computed tommography	IEC 60601-2-44
	IEC 60601 -1-11	Home Health Care Environment	X-ray Tube assembly	IEC 60601-2-28
	IEC 60601 -1-12	Emergency Service Environment	MRI	IEC 60601-2-33
		ISO 14971 Risk Management	Hospital Bed	IEC 60601-2-52

Figure 8. Module Structure of IEC 60601-Series medical device safety requirements

3.6 Indonesian Medical Device Industry Opportunities and Challenges

The current existence of the medical device industry can be represented by the Association of Indonesian Medical Device Manufacturers (ASPAKI). ASPAKI data [15] states that the condition of the medical device industry in Indonesia is:

- Number of manufacturers of medical devices 275 companies
- The number of ASPAKI members is 85 companies
- Large Medical Devices Market is US $ 4.5 bn
- Manufacturing capability of US $ 1.45 bn
- Import US $ 3.65 bn
- Export US $ 0.8 bn

Products manufactured by domestic medical device manufacturers are [15]:

- Hospital furniture
- Sphygmomanometer, Stethoscope, Nebulizer
- Electromedic (infant incubator, nebulizer, O2 concentrator, dental chair, dll.)
- Disposables (syringes, urine bags, infusion set, masker, dll.)
- Medical Apparels (operating gown, bed sheets)
- Consumable (reagensia, anti septic, band aid)
- Others

3.7 Literature Compilation is related to Product Design activities.

From the literature study to the relationship of literature with aspects of product design and development activities shown in table 1. Sources of literature used include regulations on medical devices, safety standards, standards for good manufacturing practices (GMPs), publications in the form of articles or studies on medical devices.

Table 1. Literature Design and Development of Medical Device Products

Author	Titles/Years	Issue
ISO 9001: 2015	Quality management systems, 2015	General Quality management systems
ISO 13485 :2016	Medical devices - Quality management systemsRequirements for regulatory purposes, 2016	Quality management systems of Medical Devices, year 2003
PMK No20:2017	Cara Pmbuatan Alat Kesehatan yang baik (CPAKB), 2017	Good Manufacturing Practices of Medical Devices Indonesian version
ISO 14971: 2007	Medical devices Application of risk management to medical devices, 2007	It specifies a process identify hazards associated with medical devices
Europea n Counsil Drective 93/42/E EC	Medical Device Directive , 1993	Concerning medical devices
PMKN o. 1189 / VIII / 2010	Produksi Alat Kesehatan Dan Perbekalan Kesehatan Rumah Tangga, 2010	Regulation of Production Certification of Medical Devices and Household Products
PMK No62 : 2017	Izin Edar Alat Kesehatan, Alat Kesehatan Diagnostik In Vitro Dan Perbekalan Kesehatan Rumah Tangga.	Regulation of Circular Permit for Medical Devices, In Vitro Diagnostic Medical Devices and Household
Isa C.T. Santos	Product development methodologies: the case of medical devices, 2013	propose new- product development methodology to assist the medical device industry to optimize their processes and develop relevant solutions.
Christo pher Don Simms	An analysis of the management of packaging within New Product Development: An investigation in	examine how the development of a new product's packaging is managed and integrated into the new product development

	the UK food and drinks sectors	(NPD) process of firms;
Santos. Et al	Medical devices specificities: opportunities for a dedicated product development methodology	identified and the most relevant legislation is reviewed providing the foundations for a dedicated product development methodology.

IV. DETERMINATION OF DESIGN REQUIREMENTS

4.1 Overall Function

From the purpose of this study, the overall function of the activity can be described as shown in Figure 9. In this picture the input relation to the blacbox in the form of product classification, regulation system adopted, safety standardization and clinical investigation must be transformed into product requirements grouped in aspects of function, safety standards, regulation and clinical.

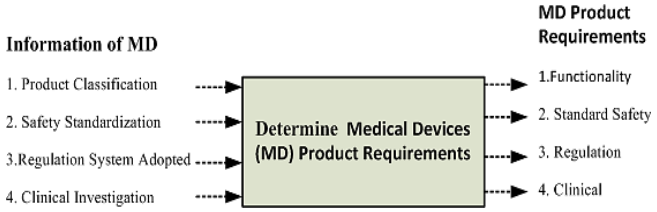

Figure 9. Overall Function of Research Activities

4.2 Function Structure

From the overall function in Figure 9 based on the input, set the functions of activities required to be able to determine the overall requirements for the design of medical equipment products consisting of activities:

1. Determine Functionality and intended use for the product
2. Determine Standard Safety of the product
3. Determine Product Compliance with standard
4. Determine regulation requirements of the product
5. Determine Requirement of Product Registration
6. Determine clinical investigation requirements of the product
7. Determine total design requirement of Medical Devices Product

The output of this activity is:

- S_1=Functionality/Intended use
- S_{21}=Standar Safety
- S_{22}= Testing
- S_{31}= Regulation(general)
- S_{32}=Product Registration
- S_4 = Clinical Trial
- S_{all} = Overall MD Design Requirements The relation of input and output according to the function of the activity is arranged into the functional structure of the activity to obtain information on the design requirements of the product design activities for medical devices as shown in Figure 10.

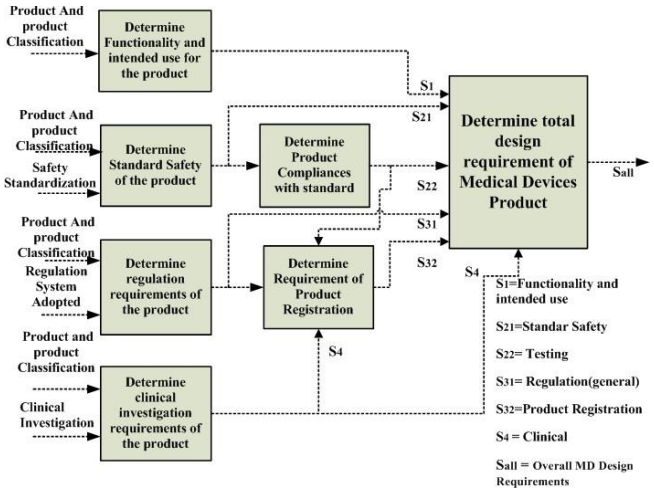

Figure 10. Functional Structure of Activities

4.3 Activity Analysis Determining Design Requirements

4.3.1 Determine Functionality For The Product.

To get the output of this activity, the input namely product and product classification, must be determined in advance for that reference to use products based on their categories [3] and classification of medical devices based on the risk of their use [5].

For product categorization globally it is usedmerger of two system the Universal Medical Device Nomenclature System (UMDNS) developed by ECRI (formerly the Emergency Care Research Institute) in the United States[16][17] and the Global Medical Device Nomenclature (GMDN), which is owned by the European StandardsOrganization [18].

The Medical Devices category includes [3]: Implant, Electromedics, Disposables & Consumables, Diagnostic reagent, Instrument Diagnostic, Hospital Furniture, PACS, POCT, Radiology dan Software & IT.

Risk Based Medical Equipment Classes [5] :

a. Class A raises low risk;
b. Class B raises low risk to moderate risk;
c. Class C raises moderate to high risk; and
d. Class D poses a high risk

After the product type and risk class are determined, design requirements are determined based on the functionality and use of the product (S1). The functionality is described from the intended use of the medical device.

4.3.2 Determine Standard of Safety of the product

The safety aspect of medical devices widely uses the IEC 60601 is a series standard as explained in chapter 3.5.The general standard IEC 60601-1 - Medical electrical

equipment - Part 1: General requirements for basic safety and essential performance - gives general requirements of the series of standards 60601 is a widely accepted as standard safety for medical electrical equipment. In many country the compliance with IEC60601-1 has become a requirement for the commercialization of electrical medical equipment.

Requirements of 60601-1 may be overridden or bypassed by specific language in the standards for a particular product. Collateral standards (numbered 60601-1-X) define the requirements for certain aspects of safety and performance, e.g. Electromagnetic Compatibility (IEC 60601-1-2) or Protection for diagnostic use of X-rays (IEC 60601-1-3) part 1 figure 8. The Collateral standard which is used in every medical devices is:

1. ISO 14971 : 2007 Risk Managements
2. IEC 60601-1-6 Medical electrical equipment - Part 1-6: General requirements for basic safety and essential performance - Collateral standard: Usability

The basic concept of medical devices is safe and effective as intended use. Safety guarantee in use is in risk management starting from premarket to post market. The product must be able to meet the safety requirements, namely risk analysis for the possibility of failure in the use of the medical device. To overcome the possibility of failure in use, it is required to apply ISO 14971 Standard. Effectiveness in use must be ascertained and the design of medical devices must have formulated usability according to IEC 60601-6 (S21).

4.3.3 Determine Product Compliance with standard

This requirement in series 60601 is a special requirement according to the type of product to be designed. In series 60601 (fig 8 part the standard examples are:

- IEC 60601-2-52 Medical electrical equipment - Part 2-52: Particular requirements for the basic safety and essential performance of medical beds
- IEC 60601-2-54 Medical electrical equipment - Part 2-54: Particular requirements for the basic safety and essential performance of X-ray equipment for radiography and radioscopy
- IEC 60601-2-65 Medical electrical equipment - Part 2-65: Particular requirements for the basic safety and essential performance of dental intra-oral X-ray equipment
- IEC 60601-2-66 Medical electrical equipment Part 2-66: Particular requirements for the basic safety and essential performance of hearing instruments and hearing instrument systems

In the case of Indonesia, compliance with this standard has been regulated in Law No. 20 of 2014 [5] in this case the product conformity reference is to use the Indonesian National Standard (SNI), for example for patient bed products the standard is SNI IEC 60601-2-52 [16]. This standard is a standard that is adopted in full fromstandar series 60601 part 2 special standar IEC 60601-2-52 Medical electrical equipment - Part 2- 52: Particular requirements for the basic safety and essential performance of medical beds.

In the case of conformity to standard requirements, after the type of product has been determined, design requirements (S22) based on the product standard are selected from the 60601 series or other standards and testing needs to be carried out including:

- Load and condition tests on components or parts throughout the realizationprocesses: test of materials, storage, production, assembly, package, andtransportation
- Integration tests among components
- Influence of environment on components throughout the realization processes:storage, production, assembly, package, and transportation
- Test of processes: performances and results
- Feasibility and applicability of processes (design rule check); ensuring that theprocesses are feasible and applicable for realization by analyzing the events ofthe process and the progress of the production—usually done by simulationsoftware
- Tests that are necessary to qualify a medical device for use (ones which provethat the medical device answers the intended use): safety tests, functionalitytests, and delivery of the medical device to users for test use
- Clinical evaluation investigations
- Assembly and examination of prototypes
- Acceptance test to decide whether the medical device is ready before release
- Retests for validation when changes where implemented

4.3.4 Determine Regulation Requirements Of The Product

Regulatory requirements relating to design for medical devices widely used are good manufacturing methods for medical devices as stated in ISO 13485 standard and for Indonesia cases this standard has been adopted as Minister of Health regulation number 20 of 2017 Regarding Good Manufacturing Practices of Medical Devices and Household Health Supplies.

Requirements relating to design activities from the regulatory aspect (S31) of ISO 13485 [11] are in clause 7.2, customer-related processes consisting of 3 sub-clauses, namely: 7.2.1 Determination of Requirements Related to the Product; 7.2.2 Review of Requirements Related to the Product Requirements; 7.2.3 Customer Communication;

Product requirements define the customer's expectations of the product; the customerformally communicates their needs through defined communication channels and transfer product specifications, including performance requirements.

- Possible types of customer requirements include(S31) :Product-related requirements such as functionality, quality, performance, safety,intended use

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- Technical specifications of materials, parts, components, processes, the use
- The Compliance of Medical Equipment Design Technology against Indonesian Medical Regulatory Board of certain equipment, and the qualifications of personnel
- Packaging and identification
- Transport and delivery specifications and schedules
- Storage and protection
- Certifications for standards

4.3.5 Determine Requirement of Product Registration

Every medical device product placed on the market must have been registered by the National Body which has the authority to register the product so that the product can be circulated in a country. Depending on the regulations used in a country such as FDA, SFDA, MDR, AMDD etc from this system the product registration requirements are set. For cases in Indonesia the product registration requirement (S32) is use the Regulation of the Minister of Health of the Republic of Indonesia Number 62 of 2017 [5].

4.3.6 Determine clinical investigation requirements of the product

Clinical studies, once rare for devices other than Class III devices, are becoming much more frequently required and performed. Since 1991, Office of Device Evaluation (ODE) for the Center for Devices and Radiological Health (CDRH) of the FDA[20] has taken actions for imposingmore stringent requirements on clinical studies used tosupport device PMA applications. Clinical studies are alsobeing required more often to support performance claims in510(k) premarket notifications. The ODE focus on requiringcarefully designed clinical trials is based, in part, on the FinalReport of the Committee for Clinical Review, also known as theTemple Report.

For any clinical study of a device conducted under an IDE, the sponsoris required to submit an investigational plan, including a protocolfor the proposed study to ODE. The plan should describe three fundamentalclinical trial areas: study design, study conduct, and dataanalysis (S4). Each of these three elements needs to be carefully thought outin advance, long before the first patient is recruited into the study [20].

4.4 Design Requirements.

The design requirements used as input requirements for the design and development of medical devices products from chapter 4.3 have been analyzed for types according to the design aspects used, namely S1, S21, S22, S31, S32 and S4, the details of the requirements are not always exactly as presented on the analysis but the content is flexible following the type of product being designed.

Saal is overall design requirements are a compilation of all the requirements of each activity, which are:

$$S_{aal}=S_1+S_{21}+S_{22}+S_{31}+S_{32}+S_4$$

V. CONCLUSION

From this study it can be concluded that to make the design of medical devices that are safe, good quality and effective the design inputs needed are necessary to pay attention to aspects: Functionality and intended use of the product; Standard Safety; Product Compliance with standard; regulation requirements; and clinical test.

Using a systematic approach methodology each aspect of design input can be broken down into design requirements and all of the design requirements are compiled into Saal's overall design requirements.

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Comparative Analysis of Blind Spectrum Sensing Techniques over Fading Channel

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Abstract:

A spectrum is a scarce and precious natural resource and a matter of concern with the rapidly growing wireless communications. However, studies show that licensed spectrum is underutilized. Cognitive radio system allows unlicensed users (secondary users) to access licensed spectrum band (spectrum hole) of primary user when they are not occupied. To do this the secondary users need to continuously monitor the licensed user's activity to find the unused band. Spectrum sensing is the key tasks for cognitive radio which prevents the unwanted interferences with authorized users to recognize available radio spectrum and enhance the usage of spectrum. Spectrum sensing is also a tough task because of shadowing, fading, and time-varying nature of wireless channels. This thesis investigated the difference in performance of energy detection and eigenvalue based blind spectrum sensing technique (without having prior knowledge) by implementing it over different environmental models and compares the Receiver Operating Characteristics (ROC) curves. Evaluation and analysis of performance is done by using Monte Carlo method with MATLAB software. The implementation gives detail comparison between blind spectrum sensing technique performances over fading channel and multiple network nodes. In particular, the result show the minimum required energy level for optimal detection (with acceptable interference) over fading channel and also how effectively cooperative spectrum sensing overcome the hidden primary user problem for both scheme and channels.

Keywords:

Cognitive radio, energy detection, eigenvalue based detection, blind spectrum sensing, fading channels, spectrum hole

I. INTRODUCTION

From the beginning of wireless communications a use of available radio spectrum has always been a matter of concern due to the fact that spectrum is a limited and valued natural resource. Then again a static spectrum allocation policy adopted by government of many countries has caused underutilization of spectrum because a huge segment of licensed radio spectrum is not efficiently used [1]. conventionally, licensed spectrum is owed over relatively long time periods and is meant to be used only by licensees [2]. A government organization is responsible for allocating spectrum bands to operators. In Ethiopia, the ministry of communication and information technology (MCIT) is responsible for this exercise; as federal communications commission (FCC) is for USA. This approach is termed as the fixed spectrum allocation (FSA) scheme and with this the radio spectrum is divide into bands allocated to distinct technology based services, e.g. mobile telephony, radio and TV broadcast services. The FSA supervision structure guarantees that the radio frequency spectrum is entirely licensed to an approved party (primary user (PU)) without interference [3].

The current fast growth of wireless communications has made the difficulty of spectrum utilization ever more challenging. On one side, the rising diversity (voice, short message, Web, and multimedia) and demand of high quality-of-service (QoS) applications have resulted in congestion of the allocated FSA spectrum bands leading to considerably reduced levels of user satisfaction. The challenge is particularly critical in communication-intensive situations such as in case of people gatherings or in a substantial emergency. On the other side, main licensed bands such as those allocated for television broadcasting have been found to be hideously underutilized which resulting in spectrum wastage. For instance, the study report of Federal Communications Commission (FCC) shows that the spectrum utilization in the 0–6 GHz band varies from 15% to 85%. In Ethiopia case, the national radio frequency spectrum allocation table from ETA shows that the spectrum in the 960M–3GHz band as vastly underutilized [4,5]. This makes the benefit of cognitive radio vital to let loose licensed bands to unlicensed users which is known as dynamic spectrum access (DSA). Consequently, the IEEE has created a working group IEEE 802.22 to build up an air interface for opportunistic secondary access or DSA through the cognitive radio technology [6].

Cognitive radio as an original concept was first proposed by Joseph Mitola III and Gerald Maguire [1] where offered as an expansion of software defined radio

increasing flexibility of individual wireless services with radio domain model and computational intelligence. CR as a result is an exciting and new way of thinking about wireless communications. In fact it is by now being considered as one of the proposed technologies for the fifth-generation (5G) wireless systems which aim to provide a higher data rate transmission, satisfactory capacity, cost efficiency and highly complicated services.

CR aims to advance spectrum utilization and efficiency of spectrum handling by opportunistically accessing the licensed spectrum without interfering the licensed users [7]. To avoid the problem caused by using the spectrum at the same time with the licensed users, CR needed to find out the existence of primary user (PU) by sensing the spectrum. It knows how to communicate if the spectrum is idle. However, when PUs back again, CR users must stop their communication immediately to avoid creating interference to the PUs. Hence, spectrum sensing is key for CR. The better CR knows about the PU's existence the better it can communicate and utilize the spectrum. There are numerous types of spectrum sensing techniques for CR such as energy detection, eigenvalue based detection, matched filter and Cyclostationary. This thesis focuses on studying the performance comparison of blind spectrum sensing techniques which are energy detection and eigenvalue based detection by applying them over fading channels. Blind spectrum sensing involves estimating the presence of a signal only based on the received signal at the receivers and minimize the error vector; this requires no knowledge of a PU signal.

There are several ways to detect the spectrum holes: transmitter detection, cooperative detection and interference based detection. Transmitter detection methods consist of matched filter, eigenvalue based detection, cyclostationary and energy detection [8]. These techniques are further classified as [9] coherent, semi-coherent or non-coherent (blind); that is either having complete, partial or no prior knowledge of the transmitter respectively. Spectrum sensing is a key issue of cognitive radio technology since it needs to detect the existence of primary users correctly [8]. Among them, the blind spectrum sensing methods energy detection and eigenvalue based detection has been broadly applied since it does not involve any apriori knowledge of primary signals and has lesser complication than the other schemes. Cooperative schemes include centralized, distributed and relay-assisted sensing methods. Whereas transmitter and also cooperative detection methods identify spectrum to avoid interference to primary transmitters [10].

Radio propagation characterization and modeling are very important for the communication systems. Without proper knowledge of channel models a wireless system would never be developed. The mobile radio propagation channel introduces fundamental limitations of the performance of any wireless communication systems [11, 12]. In digital communication theory the frequently assumed model for a transmission channel is the additive white Gaussian noise (AWGN) channel though for many communication systems the AWGN isn't a satisfactory model. In exercise, the fading channel model is normally applied. Good examples of such channels are the Rayleigh and Nakagami-m channels.

The study considered in this work is to obtain the detection probability of an energy detector and eigenvalue based detector to determine the signal-to-noise ratio (SNR) region over Rayleigh and Nakagami-*m* fading channels which shows the consequence of fading nature of wireless channels. More so, the impact of employing cooperating secondary user nodes over fading channels is also considered. In its simple form, the propose of blind spectrum sensing is to find primary transmitters operating at a given time by using local observations without prior information from the transmitter [4]. With energy detection technique, the secondary user examines the signal strength generated from the primary user to exploit the whitespace within the channel and eigenvalue based detector determines the presence or absence of the primary signal based on the covariance matrix of the received signal.

In [13] Tevfik Y'ucek and H'useyin Arslan outlined that one of the challenges of spectrum sensing for cognitive radio is the hidden primary user problem which can be caused by many factors as well as severe multipath fading or shadowing observed by secondary users while scanning for primary users transmissions. Here, cognitive radio device causes unwanted interference to the primary user (receiver) as the primary transmitter's signal could not be detected because of the locations of devices.

The work in [8] stated the uncertainty of noise imposes fundamental limitations on the performance of the energy detector. Below a particular threshold SNR a reliable detection cannot be achieved by increasing the sensing duration. This SNR threshold for the detector is known as SNR wall. From experimental studies with the help of the primary user signal information (which needed prior information); the SNR wall was mitigated but it was not possible to eliminate it completely. Moreover, the energy detector cannot differentiate the primary user signal from the noise and other interference signals which may result to a high false alarm. The proposed approach in case of no information from primary user to set optimal detection with very low false alarm probability should be by evaluating the performance while considering the energy attenuating channel behaviors.

In the research paper [14], they proposed new methods based on the eigenvalues of the covariance matrix of the received signal. It shows that the ratio of the maximum or average eigenvalue to the minimum eigenvalue can be used to detect the presence of the signal. Based on some latest random matrix theories (RMT) [15, 16] they quantify the distributions of these ratios and find the detection thresholds for the proposed detection algorithms. The probability of false alarm and probability of detection are also derived by

using the RMT. The proposed methods overcome the noise but it has not considered a practical channel [16, 17].

In reference [11] the author shows comparison between AWGN and fading environments. The Gaussian model is popular in the parameter optimization problems e.g., optimizing the operating threshold or the power allocation so as to achieve the maximal throughput or minimal error rate. This model often gives a more convenient cost function which may result in a convex optimization problem. However, based on the Gaussian model the analysis of the average detection performance of blind detectors over different fading scenarios is not well practiced in the open literature.

Most of the existing analytical comparison results are limited to the additive white Gaussian noise (AWGN) channel and performance over other fading scenarios are investigated in this work. Moreover, the designing of the detectors is based on consideration of fulfilling fundamental sensing requirements proposed in IEEE 802.22 WRAN (missed-detection and false alarm probabilities ≤ 0.1) [6].

The remaining sections of the paper are organized as follows. In Section II addresses the system model and presents an overview of energy detection and eigenvalue based detection including channel models. Section III reviews performance analysis and detection threshold over Rayleigh and Nakagami-m fading channels. In Section IV, provides the simulation results and discussion of single node and cooperative spectrum sensing of energy detection and eigenvalue based detection over Rayleigh and Nakagami-m fading channels. Finally, Section V, the conclusion and suggestions for future work were presented.

II. SYSTEM MODEL

Analytically, when the decision on the availability of a primary user is to be made, it is reduced to an identification problem [18]. This is formalized as a hypothesis test as:

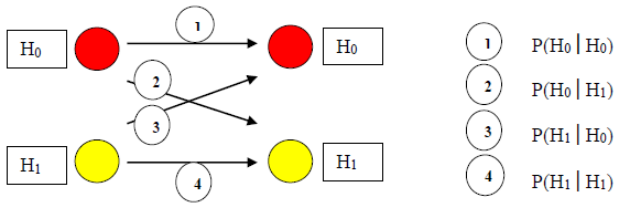

Figure 1: Hypothesis test with possible outcomes and their corresponding probabilities.

From Figure 1, four possible cases can be defined for the detected signal; Case 4 is known as a correct detection, whereas cases 2 and 3 are termed as false alarm and missed detection respectively. The goal of the signal detector is to achieve correct detection all the time. However, this cannot be accomplished absolutely in practice because of the statistical nature of the problem. Therefore, signal detectors are designed to function within minimum error levels. A prominent issue for spectrum sensing is missed detection; as it implies interfering with the primary system and also the false alarm rate has to be kept as low as possible to enable the system exploit possible transmission opportunities. The performance of the spectrum sensing technique is influenced by the probability of false alarm PFA = P ($H_0 \mid H_1$) an important metric for spectrum sensing. Equation (1) shows that a reliable method to differentiate a signal from noise is required.

$$x(k) = \begin{cases} n(k) & H_0 \\ h(k)s(k) + n(k) & H_1 \end{cases} \quad (1)$$

Where x(k) represents the sample to be analyzed at instant k, h(k) denotes the channel gain at each instant k, s(k) represents the signal to be detected and n(k) is the additive noise at the CR receiver, modeled as an independent and identically distributed zero-mean complex Gaussian noise that is independent of s(k) (of variance $\sigma w2$) that is n(k)~$\mathcal{CN}$(**0**,$\sigma w2$**I**) where **I** denotes an identity matrix. H_0 is the null hypothesis; representing a sensed state with an absence of the licensed user signal. H_1 denotes the existence of a licensed user signal within the spectrum under consideration.

To evaluate the performance, a decision threshold (η) is set and compared to the test statistic (Y) generated. The detection rule is determined as:

Y > η primary user present

Y < η primary user absent

A. Energy Detection

This is the most popular detection technique and has "the least computational and implementation complexity" [19]. Apriori knowledge of the primary user signal is not required for signal detection [8, 20]. Calculating the received signal's energy gives the test statistic which is compared to a predetermined threshold. The threshold is determined from noise energy and its accuracy is a key to the performance of the energy detector. If the received signal's energy at the cognitive radio is greater than the set threshold, the alternate hypothesis H_1 is validated and the primary user is concluded to be present. If the energy is lower, the null hypothesis H_0 is validated thus signifying the presence of a spectrum hole. The binary hypothesis is presented in Equation 1.

The optimal Neyman-Pearson test is to compare the log-likelihood ratio to a threshold. That is

$$P(x) = \log\left(\frac{p(x|H_1)}{p(x|H_0)}\right) \underset{H_0}{\overset{H_1}{\gtrless}} \eta \quad (2)$$

By removing all the constants that are independent of the received vector (k) we obtain the optimal Neyman-Pearson test.

$$Y = P_c = \|x\|^2 = \frac{1}{N}\sum_{n=0}^{N-1}|x[k]|^2 \underset{H_0}{\overset{H_1}{\gtrless}} \eta_c \quad (3)$$

Where $|\cdot|$ denotes the Euclidean norm of a complex vector and N number of samples taken. In fundamental nature the energy detector measures the received energy

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during a finite time interval and compares it to a predetermined threshold.

B. Eigenvalues Based Detection

The key idea behind Eigenvalues based primary signal detection is that the primary signal received at the CR user is usually correlated. Such correlation can be utilized by the CR user to differentiate the primary signal from white noise [21]. Specifically, Eigenvalues based detector determines the presence or absence of the primary signal based on the covariance matrix of the received signal. Suppose that the received signal is given by

$$x(k) = hs(k) + n(k), \quad 0 \le k \le N-1 \qquad (4)$$

Then the sample covariance matrix of the received signal can be estimated as

$$\hat{R}_x = \frac{1}{N}\sum_{k=L-1}^{N-1} x[k]x^H[k] \qquad (5)$$

$$\text{Where,} x[k] = (x[k], x[k-1], \dots, x[k-L+1])^T \qquad (6)$$

It can be shown [29] that $\hat{R}_x$ converges in probability at

$$R_x = E\{x[k]x^H[k]\} = HR_s + \sigma_w^2 I_L \qquad (7)$$

Where R_s is the L × L covariance matrix of the primary signal vector

$$s[k] = (s[k], s[k-1], \dots, s[k-L+1])^T \qquad (8)$$

σ_w^2 is the noise power, and I_L is an L × L identity matrix.

Let λ_{max} and λ_{min} denote the maximum and minimum eigenvalues of R*x* respectively. Define u=(λ_{max}, λ_{min}); then according to (7)

$$u = \begin{cases} (\sigma_w^2, \sigma_w^2), & H_0 \\ (\rho_{max} + \sigma_w^2, \rho_{min} + \sigma_w^2), & H_1 \end{cases} \qquad (9)$$

Where ρ_{max} and ρ_{max} are the maximum and minimum eigenvalues of R_s respectively. Because of the correlation among the sampled primary signals $\rho_{max} > \rho_{min}$. Therefore, if there is no primary signal

$$\frac{\lambda_{max}}{\lambda_{min}} = 1 \qquad (10)$$

Otherwise

$$\frac{\lambda_{max}}{\lambda_{min}} > 1 \qquad (11)$$

Based on the above calculations and [29], the eigenvalue-based detection algorithm can be formulated as follows.

1. Estimate the covariance matrix of the received signal according to (5).
2. Calculate the maximum and minimum eigenvalues of the sample covariance matrix as $\hat{\lambda}_{max}$ *and* $\hat{\lambda}_{min}$ respectively and compute the decision statistics
3. Obtain the final decision

for $Y = \frac{\hat{\lambda}_{max}}{\hat{\lambda}_{min}}$ *if* $Y > \gamma$ primary user present

if $Y < \gamma$ primary user absent

C. Channel Models

Since signals take more than a path between a transmitter and receiver, they are generally modeled by fading distributions that account for uncertainties encountered in the channel. Among these are Rayleigh and Nakagami fading models. These channel models serve as tools for studying both multipath and path loss features of a typical environment where spectrum sensing is to be employed.

For Rayleigh fading, the signal is not received on a line-of-sight path; directly from the transmitting antenna [22]. This fading model considers urban multipath features, including effects of the ionosphere and troposphere. More so, it describes the statistical time varying nature of the received envelope of a flat fading signal or the envelope of an individual multipath component [23]. When this model is employed then attenuation of the signal is Rayleigh distributed making the SNR at every node exponentially distributed [24].

In Rayleigh fading channel, the instantaneous SNR follows the probability density function (PDF) given by

$$f_\gamma(\gamma) = \begin{cases} \frac{1}{\bar{\gamma}}\exp(-\frac{\gamma}{\bar{\gamma}}), & \gamma \ge 0 \\ 0, & otherwise \end{cases} \qquad (12)$$

Where γ and $\bar{\gamma}$ is respectively the instantaneous and average SNR [25].

The Nakagami fading distribution is a convenient model for analyzing the performance of digital communication systems over generalized fading channels. This fading distribution is assumed in the analysis of many terrestrial wireless communication systems since it is flexible, embraces scattered, reflected and direct components of the original transmitted signal. For urban multipath environments the Nakagami-m fading model has been shown to be very suitable [24].

In Nakagami-m fading channel, the instantaneous SNR follows the PDF given by

$$f_\gamma(\gamma) = \frac{m^m \gamma^{m-1}}{\bar{\gamma}^m \Gamma(m)} \exp\left(-\frac{m\gamma}{\bar{\gamma}}\right), \quad \gamma \ge 0 \qquad (13)$$

Where, m is the Nakagami-m parameter which describes the severity of fading; m < 1 suggests severe fading, while m > 1 indicates less severe fading [26]. Rayleigh fading channel is a special case for Nakagami-m fading channel where m equals to 1. Also, in the limit where m → +∞, Nakagami-m fading channel converges to an AWGN channel [27].

III. PERFORMANCE ANALYSIS AND DETECTION THRESHOLD

Sensing the performance of the energy detector is specified by the following general metrics: The probability of detection (P_D), the probability of false alarm (P_{FA}), the probability of missed detection (P_M). A large PD denotes exact sensing; which translate to small chance of interference. Hence, a false alarm event occurs when the detector assumes H_1; when the right decision is H_0. When a false alarm event occurs the SU would not exploit the free spectrum thus missing a chance to utilize the free channel. Again, P_M implies declaring of H_0 when H_1 is true which lids to an increase in the chance of interference between the PU and the SU. In essence, the spectrum sensing method should record a high probability of detection (low miss detection probability) and low probability of false alarm.

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The probability of detection is the probability that H_1 is selected when a signal is present. Probability of detection P_D and false alarm P_{FA} for a given threshold (η), are represented respectively by [27];

$$P_D = P(Y > \eta|H_1) \quad (14)$$

$$P_{FA} = P(Y > \eta|H_0) \quad (15)$$

Where, η is the decision threshold expressing the P_D and P_{FA}.

A. For energy detection

Since a Chi-Squared or a central Chi-Squared distribution is defined as a summation of squares of independent standard normal random variables(RVs) with zero mean and unit variance we used it to test for significant difference between the expected and observed result under the null hypothesis H_0 [27]. Again, A Non-Central Chi-Squared Distribution is defined as a summation of squares of independent Normal RVs with mean μ and variance σ2 which is test or decision statistic (output of the detector) under the case of H_1.

Therefore, the decision statistic for the measure of the energy of the received waveform $Y = \frac{1}{N}\int_0^T x^2(k)dk$ distributed with d=B_wT degrees of freedom is under hypothesis H_0 ; $Y \sim x^2_{2d}$ and under hypothesis H_1 ; $Y \sim x^2_{2d}(\psi)$. Where, ψ is non-centrality parameter which is $\psi = 2\gamma$ and γ is defining the SNR.

The probability density function (PDF) for a chi-squared distribution; for this case Y is [27]; $f_Y(y) =$

$$\begin{cases} \frac{1}{2^d\Gamma(d)} y^{d-1} e^{-\frac{\psi}{2}}, & H_0 \\ \frac{1}{2}\left(\frac{y}{\psi}\right)^{\frac{d-1}{2}} e^{-\frac{\psi+y}{2}} I_{d-1}(\sqrt{\psi y}), & H_1 \end{cases} \quad (16)$$

Where Γ(.) is the gamma function and Iv(.) is the *v*th-order modified Bessel function of the first kind.

Appling (13and16)

$$P_{FA} = \int_\eta^\infty f_Y(y)dy = \frac{1}{2^d\Gamma(d)}\int_\eta^\infty (\frac{y}{2})^{d-1} e^{-\frac{y}{2}}dy \quad (17)$$

After, substituting $\frac{y}{2} = k, \frac{dy}{2} = dk$ and changing the limits

$$P_{FA} = \frac{\Gamma(d,\frac{\eta}{2})}{\Gamma(d)} \quad (18)$$

Where, Γ(d,*x*) is the incomplete gamma function, defined by $\Gamma(d,x) = \int_x^\infty (k)^{d-1} e^{-(k)}dk$ [28]. Since the signal power is unknown, the false alarm probability P_{FA} is set to a constant and the value of η in real communication systems is influenced by the system requirements.

From (16), the probability of detection is obtained by the cumulative distribution function (CDF);

$$P_D = 1 - F_Y(y) \quad (19)$$

The CDF of Y is obtained (for an even number of degrees of freedom *2d* in this case) as; $F_Y(y) = 1 - Q_d(\sqrt{\psi}, \sqrt{y})$.

$$P_D = Q_d(\sqrt{\psi}, \sqrt{k}) = Q_d(\sqrt{2\gamma}, \sqrt{k}) \quad (20)$$

Where, $Q_d(.,.)$ is the generalized Marcum-Q function.

If the signal amplitude follows a Rayleigh distribution, the SNR follows an exponential PDF [27]; Thus, to obtain the Probability of Detection for Rayleigh channels (20) is averaged over (12)

$$P_{D_{Ray}} = \int_D^\infty P_D f_\gamma(\gamma)d\gamma \quad (21)$$

Again, The probability of detection over Nakagami channel is determined by averaging the detection probability for a given SNR over the Nakagami distribution from(13).

$$P_{D_{Nak}} = \int_D^\infty P_D(\gamma) f_\gamma(\gamma)d\gamma \quad (22)$$

B. For Eigenvalues Based Detection

RMT has proved to give methods to improve channel capacity for fading, wideband, multiuser and multi-antenna channel features of wireless communications [15]. RMT takes a closer look at the Eigenvalues distribution large square matrices. It enables to characterize the existence of a signal by analyzing the distributions. The end results of RMTs are also used to set threshold values to draw decision for signal detection. Some important Random Matrices used in wireless communication including Wishart Matrices [29, 15].

For signal detection two hypotheses: (1) hypothesis H_0: there exists no signal (only noise); (2) hypothesis H_1: there exists both the signal and additive white noise. The binary hypothesis test can be replaced by:

$$H_0: x(k) = \eta(k), \quad k = 0,1, \ldots \quad (23)$$

$$H_1: x(k) = \sum_{\tau=0}^N h(\tau)s(k-\tau) + \eta(k) \quad (24)$$

Where $x(k)$ denotes the discrete signal at the secondary receiver, $s(k)$ is the primary signal seen at the receiver, $h(k)$ is the channel response, N is the order of the channel and $\eta(k)$ are the noise samples.

Considering a sub-sample L of consecutive outputs and defining

$$\hat{x}(k) = [x(k), x(k-1), \ldots, x(k-L+1)]^T \quad (25)$$

$$\hat{\eta}(k) = [\eta(k), \eta(k-1), \ldots, \eta(k-L+1)]^T \quad (26)$$

$$\hat{s}(k) = [s(k), s(k-1), \ldots, s(k-N_1-L+1)]^T \quad (27)$$

Yielding

$$\hat{x}(k) = H\hat{s}(k)\hat{\eta}(k) \quad (28)$$

Where *H* is *L* × *(N+L)* matrix, defined as

$$H = \begin{bmatrix} h(0) & \cdots & h(N) & \cdots & 0 \\ & \ddots & & \ddots & \\ 0 & \cdots & h(0) & \cdots & h(N) \end{bmatrix} \quad (29)$$

Let us consider the statistical properties of the transmitted signal and noise by assuming the noise as white and that the noise and the transmitted signal are correlated.

Let $\boldsymbol{R}$ be the covariance matrix of the received signal, that is,

$$\boldsymbol{R} = \frac{1}{N_s}\sum_{k=M}^{M-1+N_s} \hat{x}(k)\hat{x}^H(k) \quad (30)$$

Where, N_s is the number of collected samples. If N_s is large based on the assumptions made earlier, we can verify that

$$\boldsymbol{R} \approx \mathbb{E}[\hat{x}(k)\hat{x}^H(k)] = HR_sH^H + \sigma_w^2 I_L \quad (31)$$

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Where, R_s is the statistical covariance matrix of the input signal; $R_s = \mathbb{E}[\hat{s}(k)\hat{s}^H(k)]$, σ_w^2 is the variance of the noise and I_L denotes an L × L identity matrix

When the primary signal is absent, $\boldsymbol{R}$ turns to, the covariance matrix of the noise defined as

$$R_\eta = \frac{1}{N_s}\sum_{n=l}^{l-1+N_s} \hat{\eta}(k)\hat{\eta}^H(k) \quad (32)$$

$R\,\eta$ is nearly a Wishart random matrix [30]. In recent years, researchers have found the distribution of the largest eigenvalue and smallest eigenvalue for real and complex Wishart random matrices as described in the theorems [31, 32]. 1. Assuming real noise and defining the quantities.

$$Q = \frac{N_s}{\sigma_w^2}$$

$$\mu = (\sqrt{N_s - 1} + \sqrt{ML})^2 = (\sqrt{K} + \sqrt{P})^2 \quad (33)$$

$$v = \left(\sqrt{N_s - 1} + \sqrt{ML}\right)\left(\frac{1}{\sqrt{N_s - 1}} + \frac{1}{\sqrt{ML}}\right)^{\frac{1}{3}}$$

$$= \left(\sqrt{K} + \sqrt{P}\right)\left(\frac{1}{\sqrt{K}} + \frac{1}{\sqrt{P}}\right)^{\frac{1}{3}} \quad (34)$$

2. Assuming that the noise is complex

$$Q = \frac{N_s}{\sigma_w^2} R_\eta$$

$$\mu' = (\sqrt{N_s - 1} + \sqrt{ML})^2 = (\sqrt{K} + \sqrt{P})^2 \quad (35)$$

$$v' = \left(\sqrt{N_s - 1} + \sqrt{ML}\right)\left(\frac{1}{\sqrt{N_s - 1}} + \frac{1}{\sqrt{ML}}\right)^{\frac{1}{3}}$$

$$= \left(\sqrt{K} + \sqrt{P}\right)\left(\frac{1}{\sqrt{K}} + \frac{1}{\sqrt{P}}\right)^{\frac{1}{3}} \quad (36)$$

Based on the theorems, we have the following results

$$\lambda_{max} \approx \frac{\sigma_w^2}{K}(\sqrt{K} + \sqrt{P})^2 \quad (37)$$

$$\lambda_{min} \approx \frac{\sigma_w^2}{K}(\sqrt{K} - \sqrt{P})^2 \quad (38)$$

Where, $K = N_s - 1\ and\ P = ML$ and N_s is the number of collected samples, L is the length of the covariance matrix and M is the number of receivers that is one.

Assuming $\lim_{K\to\infty} \frac{P}{K} = a\ (0 < a < 1)$, then the quantity $\frac{\lambda_{max}(Q) - \mu'}{v'}$ converges with probability one to the Tracy-widom distribution of the second order.

The Tracy-Widom distributions were found by Tracy and Widom as the limiting law of the largest eigenvalue of random matrices [33]. There is no closed form expression for the distribution functions. Fortunately, there are tables for the functions and matlab functions are also available on numerical computation [31]. Using the theories, we can now derive the decision threshold for the optimal detection method. Let γ represent the decision threshold, then the probability of false alarm of Energy with minimum eigenvalue (EME) detection is

$$P_{FA} = P(\lambda_{max} > \gamma\lambda_{\min})$$

$$= P(\frac{\sigma_w^2}{K}\lambda_{max}(Q) > \gamma\lambda_{\min})$$

$$\approx P(\lambda_{max}(Q) > \gamma(\sqrt{K} - \sqrt{P})^2)$$

$$= P\left(\frac{\lambda_{max}(Q) - \mu}{v} > \frac{\gamma(\sqrt{K} - \sqrt{P})^2 - \mu}{v}\right) \quad (39)$$

Hence, we should choose the threshold such that

$$\frac{\gamma\sqrt{M}(\sqrt{N_s} - \sqrt{ML})^2 - \sqrt{M}N_s}{\sqrt{2N_s}} = Q^{-1}(P_{fa}) \quad (40)$$

When there is a signal, the sample covariance matrix $R_x(N_s)$ is no longer a Wishart matrix and the distributions of its eigenvalues are unknown. To obtain a precisely closed form formula for the P_D we need to approximate [14].

Since N_s is usually very large, we have the approximation

$$R_x(N_s) \approx \mathbb{H}R_s\mathbb{H}^\dagger + R_\eta(N_s) \quad (41)$$

Note that $R_\eta(N_s)$ approximates to $\sigma_\eta^2 I_{ML}$. Hence, we have

$$\lambda_{max}(R_x(N_s)) \approx \rho_1 + \lambda_{max}(R_\eta(N_s)) \quad (42)$$

$$\lambda_{min}(R_x(N_s)) \approx \rho_{ML} + \frac{\sigma_\eta^2}{\sqrt{N_s}}\left(\sqrt{N_s} - \sqrt{ML}\right) \quad (43)$$

Based on (43) and derivations on [14], an approximation for the P_d of EME as

$$P_d = P\left(Y(N_s) > \gamma\lambda_{min}\left(R_x(N_s)\right)\right)$$

$$\approx P\left(\frac{T_r\left(R_\eta(N_s)\right)}{ML} > \gamma\left(\rho_{ML} + \frac{\sigma_\eta^2}{\sqrt{N_s}}\left(\sqrt{N_s} - \sqrt{ML}\right)\right) - \frac{T_r(\mathbb{H}R_s\mathbb{H}^\dagger)}{ML}\right)$$

$$= Q\left(\frac{\gamma\left(\rho_{ML} + \frac{\sigma_\eta^2}{\sqrt{N_s}}\left(\sqrt{N_s} - \sqrt{ML}\right)\right) - \frac{T_r\left(\mathbb{H}R_s\mathbb{H}^\dagger\right)}{ML} - \sigma_\eta^2}{\sqrt{\frac{2}{MN_s}}\sigma_\eta^2}\right) \quad (44)$$

From the formula, the P_d is related to the number of samples N_s and the average and minimum eigenvalues of the signal covariance matrix (including channel effects).

C. Cooperative spectrum sensing

In real communication environments the hidden terminal problem, deep fading and shadowing, etc., would deteriorate the signal detection performance of cognitive users. To address this issue multiple cognitive radios can be coordinated to perform spectrum sensing. Several recent works have shown that cooperative spectrum sensing can greatly increase the probability of detection in fading channels [34, 35].

Let N denote the number of users sensing the PU. Each CR user makes its own decision regarding whether the primary user present or not and forwards the binary decision (1 or 0) to fusion center (FC) for data fusion.For simplicity we have assumed that the noise, fading statistics and average SNR are the same for each CR user. We consider that the channels between CRs and FC are ideal channels (noiseless). Assuming independent decisions, the fusion problem where k out of N CR users are needed for decision can be described by binomial distribution based on Bernoulli trials where each trial represents the decision process of each CR user. With a hard decision counting rule, the fusion center implements an n–out-of-M rule that decides on the signal present hypothesis whenever at least k out of the N CR user decisions indicate . Assuming uncorrelated decisions, the probability of detection at the fusion center [36] is given by

$$P_d = \sum_{l=k}^{N}\binom{N}{l} P_{d,i}^l (1 - P_{d,i})^{N-l} \quad (45)$$

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Where, $P_{d,i}$ is the probability of detection for each individual CR user as defined by (21),(22) and (44).

In this study ,assume if all of the local decisions sent to the decision maker are one, the final decision made by the decision maker is one. The fusion center's decision is calculated by logic AND of the received hard decision statistics. Cooperative detection performance with this fusion rule can be evaluated by setting *k*=*N* in (45).

$$P_{d,AND} = P_{d,i}^{N} \quad (46)$$

IV. SIMULATION RESULTS

In this section, we simulate based on the previous chapter concept and interpret the simulation results using the MATLAB2017a for both energy detection and eigenvalue based detection spectrum sensing techniques. On the performance comparison over the Rayleigh and Nakagami-m fading scenarios for a single and multiple (cooperative) nodes compared. On the other hand, simulations in this work are executed using Monte Carlo (MC) method which is a stochastic techniques based on the use of random numbers. The parameters used for simulation are given

Table 1 simulation parameters

Parameters	Type /value	Remark
Channel	Rayleigh and Nakagami-m fading	In case of Nakagami-m (m=0.5)
Detectors	Energy detection and Eigenvalue based detection	ED and EME algorithms
Performance Metrics	P_D , P_{FA} and P_M	$P_{FA} \leq 0.1$(based on IEEE 802.22)
Sample Size	1000000	
Number of Transmitters and Receiver	1,1	In case of CSS ([2,5,10]),1
Number of Monte Carlo	10000	
Temporal smoothing factor(L)	8	
Noise	White Gaussian	Assumption
SNR range	[-10,10]dB	SNR=$\frac{\left[\left(E(\|x(k)\|-\|\eta(k)\|)\right]\right.\text{^}2)}{E(\|\eta(k)\|\text{^}2)\rangle}$
Cooperative network	Center fusion-AND Rule	
Number of nodes for CSS	[2,5,10]	

Figure 2 shows the Probability of Detection Curves for ED and EME spectrum sensing with single CR users in the presence of Rayleigh and Nakagami m=0.5 fading channel. The results are taken for SNR vary form -10dB to 10 dB to imitate low SNR condition. The probability of false alarm is fixed to 0.1 which is the maximum allowed according to the IEEE standard. As shown in the figure at a very low SNR over Rayleigh environment. ED cannot detect and in case of Nakagami channel ED has poor detection. However, EME achieve more than 80% detection in both fading channel cases. But the performance of ED increases rapidly while the SNR value increase. It can be seen that a transition from -4dB to 2dB leads to performance improvement of 65% (Rayleigh) and 26% (Nakagami). Perhaps the same improvement for EME scheme allows more than 95% detection. EME reaches its full detection performance at 2dB (Rayleigh) and 5dB (Nakagami). But we need more than 10dB to achieve full detection performance of ED under Nakagami and it reaches its peaks at 6dB (Rayleigh).

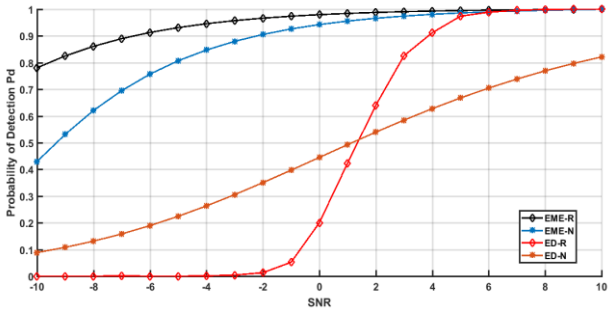

Figure 2: Detection performance comparison over varying SNR over Rayleigh and Nakagami-m fading channel

The simulation result shows us how Sever the effect of fading channel on ED and how EME perform better in comparison to ED. We also notice Nakagami fading has much effect on both ED and EME than Rayleigh flat fading.

Obtained curves from figure 3and 4 presents the performance of the detection probability Pd of ED and EME in terms of the signal noise relation in the receiver. Probability of detection for different false alarm probability of (Pf = 0.1 and Pf = 0.05) were calculated by using 10000 Monte Carlo sample over Rayleigh and Nakagami fading channels. The curves show us the tradeoff between probability of false alarm and probability of detection which is the increased probability of false alarm raise probability of detection in both fading channels. The simulation result of EME over Rayleigh shows more than 10% variation of detection performance between 0.1 and 0.05 probability of false alarm.

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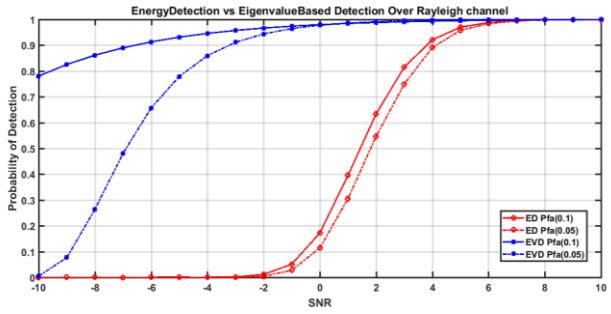

Figure 3: Detection performances between 0.1 and 0.05 probability of false alarm over Rayleigh fading channel.

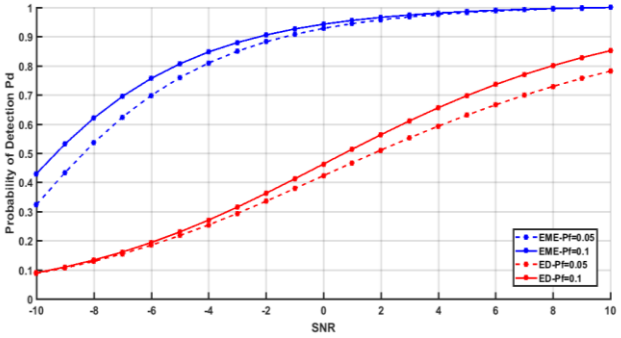

Figure 4: Detection performances between 0.1 and 0.05 probability of false alarm over Nakagami-m fading channel.

Figure 5 and 6 describes the detectors through complimentary ROC curves for different values of probability of false alarm and Number of Cognitive Radio. From the figure we can see curve of 2, 5 and 10 cognitive radios cooperative spectrum sensing in Rayleigh and Nakagami-m fading channel with AND rule fusion. The curves show that the increment of the Number of Cognitive Radio improves the performance of ED and EME method in both Rayleigh and Nakagami-m channels.

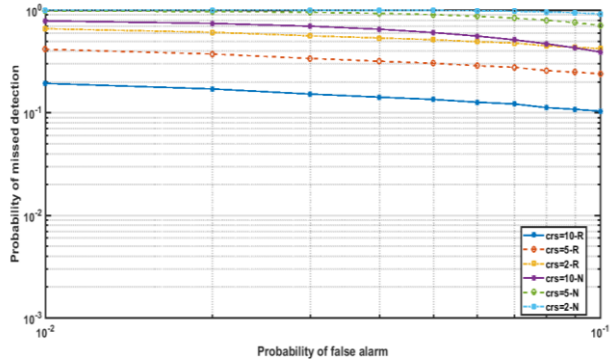

Figure 5: Complementary ROC curves for Energy Detection over Rayleigh& Nakagami-m fading channel.

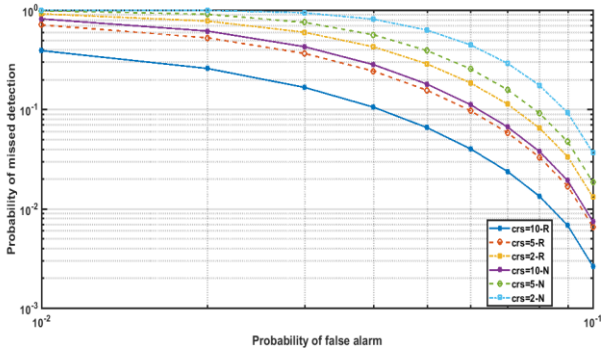

Figure 7: Complementary ROC curves for Eigenvalue based Detection over Rayleigh& Nakagami-m fading channel.

Figure 7 depict the performance comparisons of ED and EME schemes cooperative spectrum sensing for different number of CRs (5,10) and fading channel (Rayleigh and Nakagami). Performance of EME is much better for higher value of false alarm in relative to ED (for all number of CRs). From the figure we note almost equivalent performance between only 5 numbers of CRs of ED and 10 CRs of EME at PFA=0.01. The performance achieved by the method summarized in table 6.2, it's seen that performance of ED is better to overcome the effect of the fading channels by using less number of network nodes than EME for low PFA values.

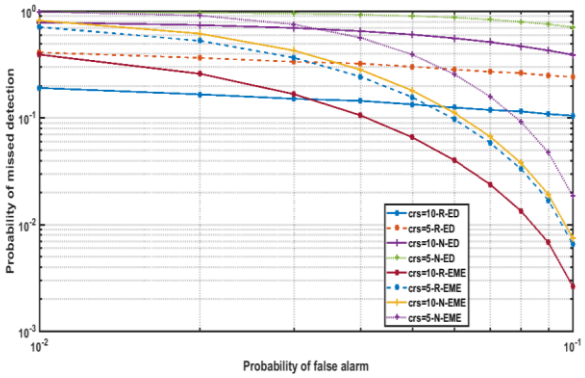

Figure 8: Performance comparisons of ED and EME schemes cooperative spectrum sensing

V. CONCLUSION AND FUTURE WORK

In this thesis, the performance comparison between the two energy detection and eigenvalue based blind spectrum detection schemes over fading channel are investigated. Even though cognitive radio must be able to detect very weak primary signal, fundamental limitations arise during detection at low SNR. Blind spectrum sensing techniques are preferable in a sense that they can detect only type of signal and does not require any knowledge about the signal to be detected. Spectrum is a very essential but scarce resource to new high data rate requiring wireless communication technology.

To utilize the available spectrum efficiently, use of an intelligent radio platform (cognitive radio) is vital. A fundamental prerequisite for this technology however is the ability of unlicensed (SU) users to detect unused spectrum from licensed user (PU). The process is known as spectrum sensing. The study provides useful information about the behavior of the energy detection and eigenvalue based detection techniques over Rayleigh and Nakagami fading environments. Employing Probability of detection curve and ROC (complementary Receiver Operating Characteristics) curve receiver performance is quantified for both signal user detection and a network of cooperative detection nodes.

The simulation results indicates that performance of ED and EME improvement over Rayleigh fading channel compared to Nakagami fading channel for various average values of SNR. Comparing signal detection ED curve with EME curve at low SNR, ED face a sever challenge to detect over fading environment while EME performance satisfactory detection in both Rayleigh and Nakagami fading channel. More so, as SNR increases the EME reach its full detection easily and ED performance increase gradually.

On the other hand the performance comparison of cooperative spectrum sensing of ED and EME are analyzed. It shows that CSS for different number of nodes provide different performance improvement, the better the number of nodes in the network the better the performance achieve for both schemes and both fading channels. Furthermore, results signify a better performance of EME at higher probability of false alarm than ED. However ED curve shows higher performance to overcome effects of multipath and hidden node challenges in lesser probability of false alarm values. ED Outperform EME since it needs only 5 CRs nodes of EME at low probability of false alarm (PFA = 0.01). In general, our comparative study justifies poor performance of ED at low SNR over fading channel and ED is much better than EME to achieve the desired performance with reduced false alarm value in case of cooperative networks.

It would be interesting to find out the performance of the detection techniques by implementing a real-time platform using software defined radio such as open source toolkit GNU radio. In addition, Researchers can use the platform to sense multiple bands instead of a single band. In order to find an optimal sensing technique, future studies focuses on combining these two schemes in a cascade model and evaluation of the performance over practical medium.

VI. ACKNOWLEDGMENT

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Design Thinking for Futuristic Skills Development Using Project-Based Learning (PBL) Approach: A Preliminary Study

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Abstract:

The teaching and learning methods adopt Project-Based Learning (PBL) to provide industry required skills to the graduates. It plays a vital role for problem solving and determine innovative solutions. However, Design thinking(DT) strengthen the innovation to enhance the solutions dynamically. The futuristic skills seek for integrated Technology based innovation for design, develop and apply to social needs which integrates critical thinking, problem solving, communication and leadership skills. The Saudi Arabia vision 2030 is focused on integrating the skills for the national development. The DT is the conceptual tool identifying the skills required by the graduates through PBL pedagogy. This paper signifies DT role for futuristic skills, to integrate futuristic skills practices in PBL approach and preliminary results are discussed.

Keywords:

Design thinking; Project Based Learning; Futuristic skills; teaching learning pedagogy

I. INTRODUCTION

Project Based Learning (PBL) is an alternative to traditional education for learners to facilitate cooperative teamwork, develop communication and group skills, encourage peer teaching, involve timely feedback, and support self and peer assessment on an ongoing basis [13]. On the other hand, Design Thinking (DT) plays a critical role in educating a learner who can create a better society by innovating product and services that solve real world wicked problems [8]. By incorporating both concepts in a 21st Century Learning and Innovation Skills framework, this paper reveals that most of the gaps the learners encountered during their traditional learning activities could be resolved with a help of assessments that have been designed to measure creativity in specific fields such as project-based learning and design with thinking.

This paper is structured as follows: Section 2 outlines skills and practices required for the 21st century and the main concepts of PBL and DT in the learning process. Section 3 describes the methodology, Section 4 describes learning model of PBL with DT in the learning process, while in Section 5 comparison and result discussion is done and Section 6 concludes the paper.

II. BACKGROUND OF STUDIES

The advent of digital transformation, knowledge itself is growing ever more specialized and expanding exponentially, which ultimately requires the skills [5] such as digital age literacy, inventive thinking, effective communication, and high productivity that 21st-century learner's need to thrive in today's global economy. According to [7, 11], the traditional education generally not succeed to comply with 21st-century requirements which involves the external requirements of the workplace and needs of an individual learner as internal requirements. Listening, sharing, leading, collaborating, and being flexible is as important as scientific knowledge. So, in the context of knowledge building based on the development of skills, the instructors, being teachers or trainers, should be able to monitor the level of knowledge the learners continuously adapt during the learning process according to the goals usually achieved by learner's acting as a group.

A survey reported in [9] has attempted to shed light on the current research on the 21st Century Critical Learning and Innovation Skills which involves:

1. Critical thinking
2. Creativity
3. Collaboration
4. Communication

5. Information Literacy
6. Media Literacy
7. Technology Literacy
8. Flexibility
9. Leadership
10. Initiative
11. Productivity
12. Social Skills

Best Practices for Implementing 21st Century Skills [6] requires to

- Focus on real-world problems and processes
- Support inquiry-based learning experiences
- Provide project approaches to learning
- Focus on teaching students how to learn

According to future work skills [Table 1], various six drivers such as computational world, super structured organizations, extreme longevity, new media ecology, globally connected world and the rise of smart machines and systems have relevance to the development of each skill.

Ministry of higher education has planned and revamped these futuristic skills to implement and integrate to meet the vision 2030 of Saudi Arabia. Also, has asked its stakeholder to find the challenges for these skills to be incorporated in the higher education system. For this all the stake holder were invited and take part in the transformation process. In view of that the (PBL)project-based learning applying (DL)design thinking assure that the graduating students are acquiring the futuristic skills.

III. METHODOLOGY

The methodology describes the concept of PBL , DT activities and its mapping process for futuristic skills development of under graduate students.

3.1: Project Based Learning

Traditional Project Based Learning is a hands-on learning approach for the learner to experience learning in a different manner. So PBL shifts the focus of instruction from teacher-driven to learner-centered which is the necessary skill for the future [10].Projects are offered as one among the learning tool with specific learning objectives to develop imagine, explore, thinking skills for learning to know and practice specific tasks which are aligned with learning outcomes, but it doesn't fulfill the graduates to adopt contemporary techniques in their work environment. Therefore, and integrated approach is demanded by the industry .The higher educational stake holders are attempted to various possible combinational practices to ensure the required industry skills to the graduates according to their selected programs. This work attempted to integrate the project-based learning process with specific functional activities according to the phases presented in figure 1.

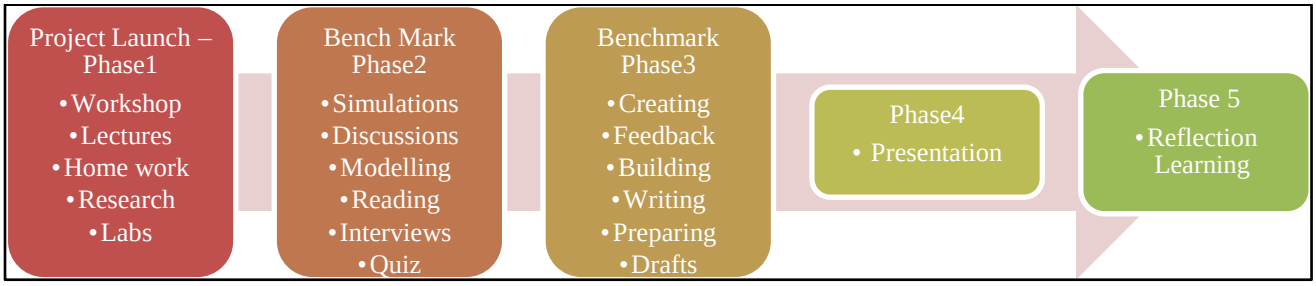

Figure. 1. Project Based Learning Phases

The project launch is the process to visualize the conceptual framework of an idea into a realistic implementation which includes analysis , design ,development ,deployment and maintenance which leads to solve real time scientific issues. The phases of the project and activities of each project are unique which ensure the acquisition of specific skills according to the domain nature, Herewith the general description of activities and its related skills provided. The first encompassed with activities , workshop lectures, research, homework and labs. This unit provides the conceptualization of conversion of ideas into a framework which requires thinking, investigation, acquisition of facts, distribution of responsibility, identification of knowledge and sampling the protocols which needs the basic cognitive abilities and its related skills such as thinking , creativity ,collaboration and communication which are supported by literacy, flexibility leadership, productivity and innovation initiatives. Based on the benchmark of phase one the unit two activities simulation, discussion, modelling, reading ,interviews and quiz are required to represent the conceptualization of the project; however, it requires information literacy, media literacy and technology literacy to simulate an idea based on the discussion which represents the model. The reading process initiate and innovative thoughts which aides to provide an interview leads to the decision making. It enables the conversion of cognitive thoughts into a conceptual model ,this model is bench marked with the existing other models and confirmed for the further development. The next phase of the project includes creation, building, drafting and feedback these processes are focused to build the project and produce conceptual idea into realistic process which involves productivity , social skills and flexibility to build the product based on the

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model. According to the presentation of the model the learning efficiency will be reflected. Therefore, the PBL approach is appreciated for acquiring the futuristic skills. The PBL approach needs suitable conventional mechanism therefore DT is identified, mapped and evaluated with set of learners that are described in the next session.

3.2. Design Thinking (DT)

The DT focused to improve learning and development skill for the 21st century learners via learner center approach, thinking about the innovative solutions, Providing Intuitive Learning Technology, Questioning, Testing, and Developing. However, it is a model to deal with "be creative on demand" requirements for learners and provide valuable solutions for the learning problems of the 21st Century.

Dt provides a testable innovative solution prototypes based on redefining the problem, using iterative process in a non-linear approach. The non-linear approach provides an approach to start the process and end the same ,at any functional point namely Empathize, Define, Ideate, Prototype and Test shown in figure 2. these functional points could be executed repeatedly until securing an innovative solution via redefining the problem. These solutions are testable with an appropriate prototype. Therefore, DT could be considered as a tool for skill development process at higher educational level. The functional points and its relationship described in the *figure 2.*

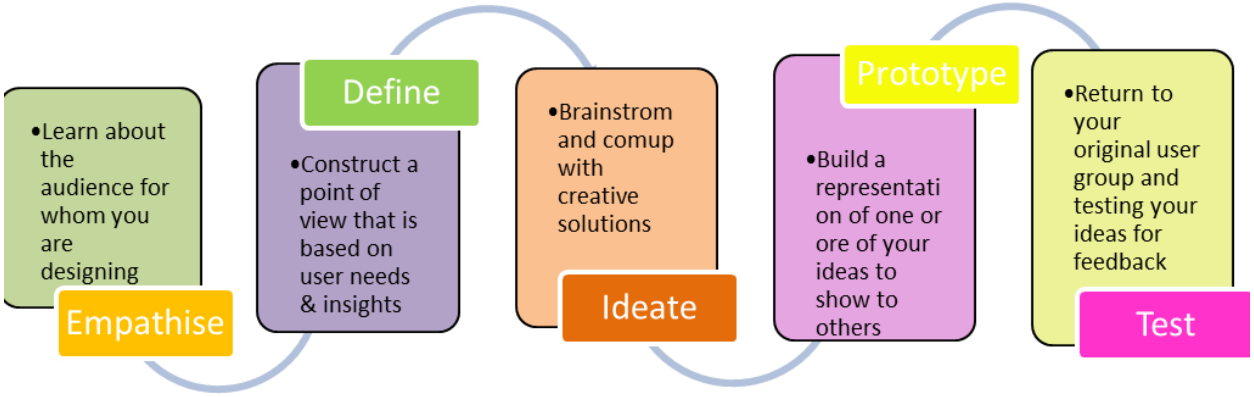

Figure. 2. Learning model of Design thinking

IV. PBL WITH DT LEARNING MODEL

The PBL accomplish with various teaching and learning tools, but the initiation of innovative thoughts requires unique thinking which is differing from others. therefore, to enhance the learning skills through PBL the DT approach integrated and evaluated as part of this work.

PBL with DT learning model helps to:

- Engage students with the help of inquiry process to exploring their world
- Organization subjects around a real-world problem to solve.
- Students to do research, plan, design and create a product
- Perform collaborative student work on projects, guided by the teacher.
- Present a choice to the currently used model of learning.

Design thinking mainly focuses on empathy or understanding for users. The practice of DT seems to be developing in the business domain but missing in instructional design university programs, professional training, and workplace practices. So, DT has the potential to combine with PBL to come up with better design solutions which will promote innovative learning experiences.

The skills and its integration of learning process mapped and presented in table 1 based on grouping of futuristic skills.

Table 1: Association of 21st Century Futuristic Skills' with Design Learning

Skills	Futuristic skills	(DL)Design Learning
S1	Critical thinking	D1-Empathise
	Creativity	
	Collaboration	
	Communication	
S2	Information Literacy	D2-Define
	Media Literacy	
	Technology Literacy	
S3	Flexibility	D3-Ideate
	Leadership	
S4	Initiative	D4-Prototype
	Social Skills	
S5	Productivity	D5- Test

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The set1 skills are denoted as S1 which consist of critical thinking, creativity, communication and collaboration contributing to DT Empathize denoted as D1. The set2 representing information, media and technology literacy is denoted as S2 contributing D2 Define phase. The Ideate(D3) of DT supported by flexibility and leadership skills represented as set3 (S3). The initiative and social skills which are supporting to Prototype D4 of DT stated as set4(S4) and the Productivity skill supported for Test(D5) is presented as set5(S5). The PBL approach and its effective enhancement for skill development using design thinking phases mapped and presented in *table 2*.

Table 2: Mapping between PBL and DT:

	DT	D1	D2	D3	D4	D5
PBT	Activities	Empathize	Define	Ideate	Prototype	Test
P1	Project launch	✓		✓		
P2	Project Analysis		✓	✓		
P3	Project Design		✓		✓	
P4	Project Development			✓	✓	✓
P5	Project Implementation				✓	✓

According to the associative mapping between PBL and DT phases its corresponding skill sets are mapped and presented as per learning process in table 3. For an e.g. The PBL phase 1(Project Launch) activity which is aligned with DT of Empathize ensure the skill S1(Critical thinking, Creativity, Collaboration, Communication).

Table 3: Skills Acquisition in PBL with DT

	DT	D1	D2	D3	D4	D5
PBT	Activities	Empathize	Define	Ideate	Prototype	Test
P1	Project launch	S1		S3		
P2	Project Analysis		S2	S3		
P3	Project Design		S2		S4	
P4	Project Development			S3	S4	S5
P5	Project Implementation				S4	S5

V. RESULT AND DISCUSSION

As per the mapping of table 3, all the skill sets are fulfilled while applying DL activities in PBL phases, these skills set process are evaluated with learners while they are doing their projects .The evaluation process is categorized as Beginning, Developing ,Accomplished and Exemplary with the range value of 1 to 4. The sample learner evaluation is presented in table 4.

Table 4: Evaluation on futuristic skills while starting in (PBL) to (DT)

	DT	D1	D2	D3	D4	D5	
PBT	Activities	Empathize	Define	Ideate	Prototype	Test	***Total***
P1	Project launch	1		1			2
P2	Project Analysis		2	1			3
P3	Project Design		1		2		3
P4	Project Development			2	2	2	6
P5	Project Implementation				2	1	3
Total		1	3	4	6	3	17

The *table 4* values are representing the futuristic skill measures at the beginning the PBL based learning .While the learners are following the PBL based approach the skills are acquired by the learner it is observed at the end of the project with the same measuring process. The measured values of the same learners at the end of the process presented in *table 5*.

Table 5: Evaluation on Futuristic skills Ending in (PBL) to (DT)

	DT	D1	D2	D3	D4	D5	
PBL	Activities	Empathize	Define	Ideate	Prototype	Test	**Total**
P1	Project launch	2		3			5
P2	Project Analysis		3	2			5
P3	Project Design		2		3		6
P4	Project Development			3	3	3	9
P5	Project Implementation				3	2	5
Total		2	5	8	9	5	30

As per the comparison between *table 4 & 5* the learners total skill development point increased from 17 to 30 the highest variation occurs in the design phase from 4 to 8

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which shows that the design skills are high developed in the DT approach integrated with PBL process. All the remaining phases also shows the positive growth for both DT and PBL process. For each student the starting measure and the measure which occurs in the end of the project present in *table 6 & 7*.

Table 6: Skills Score Before PBL approach with DT activities

Skills Score Before PBL						
	D1	D2	D3	D4	D5	Total
S1	3	2	3	1	3	12
S2	1	1	2	3	1	8
S3	1	2	2	1	2	8
S4	3	2	3	3	1	12
S5	3	1	3	1	1	9
S6	3	3	3	1	2	12
S7	2	1	1	3	3	10
S8	2	3	2	1	2	10
S9	1	1	3	3	3	11
S10	2	2	1	1	3	9
S11	3	2	2	3	1	11
S12	3	1	2	3	1	10
S13	1	2	2	2	3	10
S14	2	3	1	3	3	12
S15	1	3	1	1	1	7
S16	3	1	1	3	3	11

Table 7: Skills Score After PBL approach with DT activities

Skills Score After PBL						
	D1	D2	D3	D4	D5	total
S1	2	3	3	4	2	14
S2	2	4	2	3	3	14
S3	4	3	2	4	4	17
S4	4	4	3	4	2	17
S5	2	2	3	4	2	13
S6	3	4	2	3	4	16
S7	2	2	2	2	3	11
S8	3	3	2	4	2	14
S9	3	4	2	2	4	15
S10	3	3	3	4	4	17
S11	2	4	4	2	2	14
S12	3	2	2	3	3	13
S13	2	3	3	4	3	15
S14	3	3	4	3	2	15
S15	2	4	4	2	2	14
S16	2	3	3	4	4	16

As per the comparison between skills scores of *table 6 & 7* its proved that PBL approach integrated with DT activities developed the skill of the learners. The variation of learning skills of each individual student group presented in the chart figured.

The Skill development progress presented as follows :

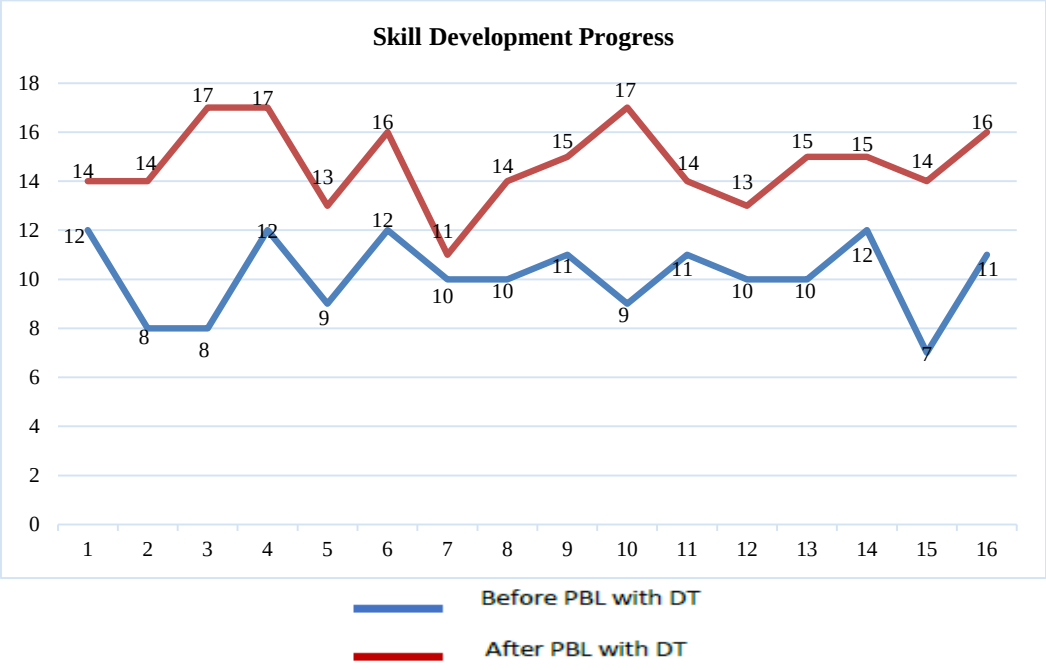

Figure 3. Individual student skill development

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According to the chart the 3rd student and 15th student gained highest level of skills through PBL with DT activities, the 1st and the 7th student have acquired the skill at minimal level but the charts shows that all the student s are improved their futuristic skills from minimum 1 skill point to the maximum of 9 skill points , it proves that the PBL with DT is one among the prefect tool for acquiring the futuristic.

VI. CONCLUSION

As per the experimental research of 14 students from the Computer Science background evaluated the futuristic development process via Project Based Learning integrated with Design Thinking Activities .The project phases and Design Thinking activities are mapped and associated with futuristic skills. The performance measures are assessed before starting the learning process and end of the learning process using the PBL approach as the results the futuristic skill measures are increased for all the learners which are proved based on the acquired results. The PBL and DT activities are tested with limited samples of students in a single domain specific learner. Though the results are positive it should to be tested with more samples and multiple domain of learners as a future work.

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Improving Efficiency of Grain Processing Industry Using Value Stream Mapping (VSM) – A Case Study

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Abstract:

Lean manufacturing technology has been widely recognized for continuously improving productivity and also the quality of the product. This paper deals with lean implementation in the grain processing industry. Value Stream Mapping (VSM) is one of the key lean tools which can be used to identify opportunities for improvement in a production flow process. All the process information related to the processing of grain is collected and a current state VSM is developed showing the current operating status of the rice mill. Then the '5 whys' method is employed and the root causes are determined using Fish bone diagram (Ishikawa diagram). A total of five root causes are determined which form the major problems in the rice mill. These five causes are then solved and a future value stream map is then developed showing the increase in overall efficiency of the process. This study will serve as a guide for the implementation of future lean activities and the betterment of the rice mill when done on a large scale.

Keywords:

Value Stream Mapping, Fishbone diagram, Cycle time

I. INTRODUCTION

Firm's efficiency and competitiveness are two important challenges in today's global market that have motivated many manufacturing firms to plan novel manufacturing management strategies [1].

Due to the challenges and competitiveness prevailing in industries to meet for Quality and customer satisfaction, the companies are in need of process improvement in all aspects of their operations.

Process improvement methodology such as Lean manufacturing, Six Sigma, Value Stream Mapping, Total Quality Management, and so on as has become popular competitive tool, but its successes depends on the nature of organizations [2] and employees' flexibility toward change. Several authors have identified the benefits of applying these process improvement methodologies. For example, [3] applied lean manufacturing to the design process in construction papers. The study indicated that lean efforts increased value adding activities in total work by 31%, reduced unit production errors by 44% of and waiting times 58% in production cycle. [4,5] point out the benefits of applying six sigma for healthcare quality and in health care industry. The study found that Six Sigma has the potential to significantly improve healthcare quality and process, including a decrease patients waiting time in the emergency room, optimize the scheduling time for equipment testing, design a new and remodel existing facilities, and enhance staff to better understand the patient experience, process performances and staffing inter-relationships.

Value Stream Mapping (VSM) is considered one of the most essential (Belekoukias et al., 2014), with Womack (2006) considering it "the most important tool lean thinkers will need to make sustainable progress in the war against muda". VSM is a simple and visual process-based tool which enables the documentation, visualization and comprehension of material and in-formation flows in processes, in order to identify wastes and assist in their elimination (Nash and Poling, 2011). Over the last years, the application of VSM has not only increased within manufacturing plants and supply chains (Forno et al., 2014) but also in process industries and the service sector (Jeyaraj et al., 2013).Taking VSM as a basis, Lai et al. (2008) proposed a framework for combining life-cycle environmental input analysis, total cost analysis, and an energy consumption analysis. Kurdve et al. (2011) used an adaptation of VSM, which they also called E-VSM, at Volvo Penta Vara and Volvo Construction Equipment Braås. Folinas et al. (2014) offered a systematic approach for measuring the environmental performance of a sup-ply chain in the agrifood sector based on VSM. Brown et al. (2014) examined in detail three case studies to demonstrate the breadth of applicability of the Sustainability-VSM tool and the aptness and limitations of the tool in assessing and

visualizing sustainability performance in different manufacturing system configurations. Faulkner and Badurdeen (2014) presented a comprehensive methodology to develop Sustainable Value Stream Mapping by identifying suitable metrics and methods to visually present them.

Although, there are many different studies reports the successful process improvement methodologies used to enhance organizations and companies processes throughout the past decade, lean manufacturing is considered to be one of the most well-known methodologies approach for improving organizational performance because the methodology is simple to apply and also easy to monitor. Lean manufacturing is focused on continuous eliminating non-value added activities and maximizing value added activities through reducing costs and increase the quality of an organization processes. Normally, non-value added activities add costs to the process without enhancing the value. Non-value added activities can called as waste in lean manufacturing. Non-value added activities or waste refer to any activity that does not add value to the process and to activities that a customer would be unwilling to pay for [14]. Waste can be categorized into seven areas: waste due to overproduction, unnecessary waiting, unnecessary transportation, over processing, excess inventory, unnecessary movement, and defects. By eliminating waste in process makes operations significantly improve in low cost more efficiency. Several lean manufacturing tools and techniques were applied such as visual control, 5S, value stream mapping, and Kaizen. One popular tool for lean manufacturing methodology is called Kaizen. Kaizen came from Japanese word that consists of "Kai" and "Zen". "Kai" means change whereas "Zen" means good or for the better. General, Kaizen means continuous improvement by involving every employee from the top to the assembly line who is part of the process. The main purpose of this paper is to explore the impact of applying lean manufacturing in a case study of the company's sheet metal stamping process. The beginning of the research is to study the current situation in the company's sheet metal stamping process through individual interviews of employees and observing problems in the study area. The next section determines the most frequently occurring waste and determines causes using Pareto and the cause and effect diagram. The next section observes how the implementation of lean manufacturing could bring value to the case study company's process. Lastly, the conclusion that consider of lean manufacturing implementation in the company performance is presented.

There are five steps to implement lean thinking in a company: 1) define value from the perspective of the customer, 2) determine the value streams, 3) Achieve Flow, 4) Schedule production using Pull, and 5) seek perfection through continuous improvement. Value stream includes all the specific activities (both value-added and non-value-added) needed to bring a particular product by implementing three important management skills of any business that are problem solving, information management and physical transformation [6]. Lean manufacturing applied tools and approaches such as Just-In-Time (JIT), Total Productive Maintenance (TPM), Cellular Manufacturing and 5S [8]. Moreover, lean accounting, as a coordinated approach, along with lean thinking provides administrators with reliable, accurate and timely information for decision-making. Hence implementation and control, of the lean system as new approach becomes for strategic management approach

The goal of this paper is to apply one of the most significant lean manufacturing techniques called Value Stream Mapping (VSM) to improve the production line of a color industry as a case of study

II. LITERATURE REVIEW

Jafri MohdRohania, SeyedMojibZahraee (2015) have Value stream mapping (VSM) was first found in Monden's 1993 "Toyota Production System" book about circulation kanbans with symbols that resemble VSM. Since then VSM has been used in many sectors. Lean value stream mapping (VSM) is a commonly used method that has been applied successfully in many domains. Despite its success VSM does have shortcomings when it is used to analyse complex processes where the value produced varies for different stakeholders and is largely intangible. Traditional VSM also lacks a practical way of modelling elements that are present in multiple steps of the value stream and a systematic approach to generating different type of improvement ideas.

Teemu Toivonen et al, (2016) Lean fundamental principles was implemented to construct VSM for identification and elimination of wastes by using team formation, product selection, conceptual design, and time-frame formulation through takt time calculation. Based on the future VSM, final results showed that by implementing some lean thinking techniques, Production Lead-time (PLT) decreased from 8.5 days to 6 days, and the value added time decreased from 68 minutes to 37 minutes.

Jafri Mohd Rohani & Seyed Mojib Zahraee, (2015) Manufacturing data were collected from a cover glass manufacturer in China during December 2015. The purpose of this study is to evaluate the performance of the current facility design using E-VSM method, and present several strategies to reduce the energy consumption and production costs. Furthermore, a case study of cover glass manufacturing facility is presented to show that the implementation of environmentally lean strategies resulted in the reduction of both the production costs and emissions.

Yuchu Huang & Masayoshi Tomizuka, (2017) Lean principles were adapted for the process sector for application at a large integrated steel mill. Value stream mapping was the main tool used to identify the opportunities for various lean techniques. We also describe a simulation model that was developed to contrast the "before" and "after" scenarios in detail, in order to illustrate

to managers potential benefits such as reduced production lead-time and lower work-in-process inventory.

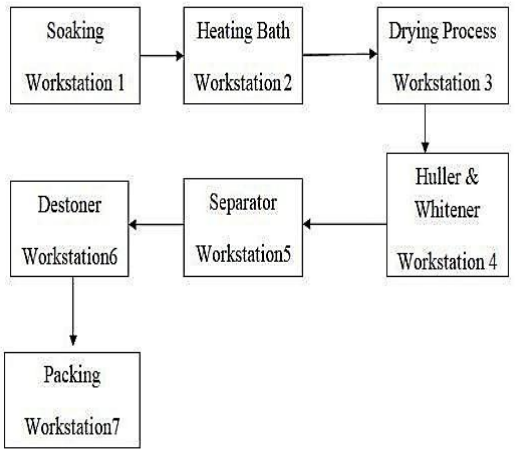
Fawaz A.Abdulmalek et al, (2007)VSM process symbols are used to discuss lean implementation process in the production industry. The existing status of the selected manufacturing industry is prepared with the help of VSM symbols and improvement areas are identified. Some modifications in current state map are suggested and with these modifications a future state map is prepared.

Bhim Singh et al,(2010)VSM is different than conventional recording techniques, as it captures the information at individual stations about station cycle time, up time or utilization of resources, set-up time or change over time, work in process inventory, man power requirement and the information flow from raw material to finish goods. It covers both value adding as well as non-value-adding activities.

Bhim Singh, Suresh K. Garg et al, (2010) Overall Equipment Effectiveness (OEE) is a hierarchy of metrics which focus on how effectively manufacturing equipment is utilised. The results are stated in a generic form which allows comparison against benchmark defined for the industry. Comparisons can also be made in between shifts, products, machines, departments, lines and plants etc.

III. STUDY OF CURRENT PROCESS

Understanding the process- This is the initial stage in the improvement process. The basic concepts and process at each processing line should be carefully noted by visual observation for proper understanding of the process. The following observations should be made for productivity improvement- Working methods, Tools used, Process flow, Number of workstations & their purpose, Sequence of operation, Number of operations at each workstation. The basic rice milling process is shown below.



Time study- The quality of the product lies in the accurate time measurement of each activity. It is important to learn how to measure and record time. Time reflects the method of action. Hence, we need to study the working condition of each process. When measuring work time to prepare standardized work, work units to be measured vary depending on operations. In standardized work, it is necessary to measure both manual and auto or machine time.

Value stream mapping (VSM) is an effective tool for the practice of lean manufacturing. VSM approached the entire process flow in a three-step methods in which first producing a diagram showing the actual material and information flows or Current State on how the actual process operates. This is created while walking down the production line. Secondly, a Future State map is produced to identify the root causes of waste and through process improvements that could give great financial impact to the process, a lean process flow. These improvements are then carried out, the implementation Plan as part and partial details and action needed to gain the paper objectives in process kaizen (continuous improvement) and poka-yoke [19].

VSM Implementation and Kaizen: A detailed study on the current state map for Wheel cylinder assembly unit is made . A set of kaizen activities initiated and implemented in effort to optimize the productivity of the assembly line. The assembly process is monitored and during the monitoring phase, continuous evaluation on any discrepancies or imperfections on product are being addressed immediately. Necessary counter measures are made to ensure the effectiveness of the new Future state VSM and line productivity stability is achieved.

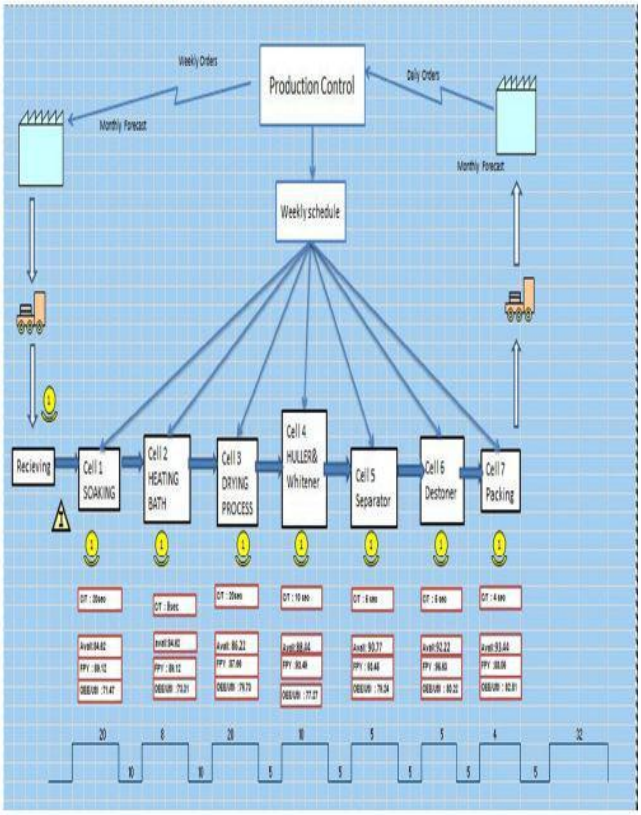
IV. OPERATION TIME FOR EACH PROCESS

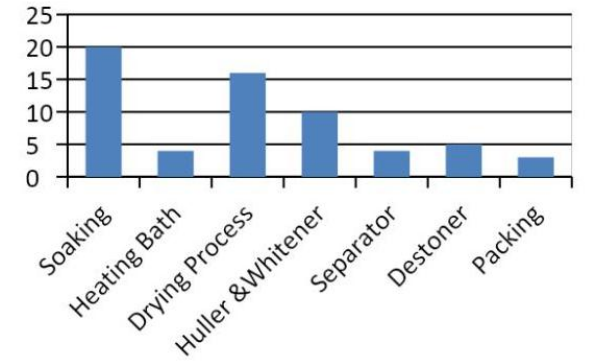
S. No	Process	Work station	Operator	Cycle time
1	Soaking	WS 1	O 1	20
2	Heating Bath	WS 2	O 1	8
3	Drying Process	WS 3	O 2	20
4	Huller &Whitener	WS 4	O 3	10
5	Separator	WS 5	O 4	5
6	Destoner	WS 6	O 5	5
7	Packing	WS 7	O 6	4

V. FISH BONE DIAGRAM

Ishikawa diagram shown below states the causes and effects of each of the major problems experienced in the industry. Addressing these problems can reduce the cycle time and increase the efficiency to a considerable amount therefore increasing the production of the rice and reducing the damaged goods.

VI. CURRENT STATE VSM





VII. AREAS OF IMPROVEMENT

From the Current state VSM, the following observations has been made for further improvements in the assembly unit

a. Soaking & Heating Bath:

The current state VSM and operation table for the process carried out gives an idea about the possible areas of improvement in the process flow.

In the workstation 1 & 2, the SOAKING &HEATING BATH are performed separately which leads to more cycle time and also motion waste occurs due to the movement of the worker from workstation 1 to workstation 2.Also the intensity of the heat that acts on the paddy after the soaking process is very less and hence is not effective.

b. Drying Process:

In workstation 3, the DRYING PROCESS, the time consumed for this process is very high as the work can be done only during sunlight, The number of workers involved in this process is also a large amount as they need to help in speeding up the drying process and this results in high wages being paid.

c. Packing:

In workstation 7 PACKING, the main cause is increased packing and stitching time as it takes a lot of time for a person to do the job and the excess of labour will lead to unnecessary costs.

VIII. PROCESS IMPROVEMENT METHODOLOGY

One of the main pillars of lean methodology is Kaizen. Kai means change and Zen means good. Kaizen is more than just a methodology for continuous improvement. The primary objective of Kaizen is to improve productivity, reduce waste, eliminate unnecessary hardwork and humanize the workplace. With Kaizen, workers at all levels of the organization are engaged in constantly watching for and identifying opportunities for change and improvement. The causes identified using fishbone diagram are rectified by using Kaizen in the following workstations

Workstation 1 &2: Soaking & Heating Bath

Less intensity of heat after the soaking process is improved using a simple air blower. The blower is connected to a motor and it is used to speed up the heating process which reduces the cycle time to a large extent. Wastes due to transportation from one workstation to other is also reduced by implementing 5S principles and it has shown a greater improvement in OEE from an avaerage of 70.53 to 74.23 for two workstations

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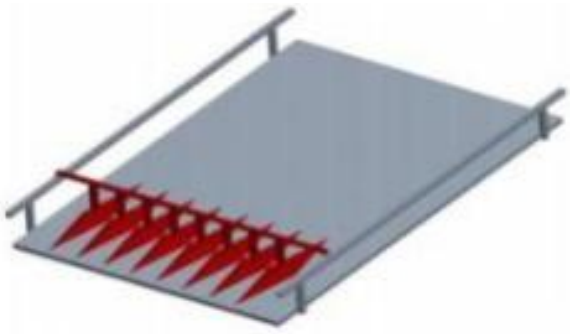
Workstation 3: Drying Process

The main cause of higher time consumption and this is solved by fixing MS plate as shown below onto a slab and kept under direct sunlight to absorb heat. The rice is thrown onto the bed and a lever connected to a motor is used to operate the part which moves to and fro acting as the replacement for workers moving over the slab and thus heating all the rice in a quicker and less expensive manner. This has reduced the cycle time from 20 seconds to 16 seconds.

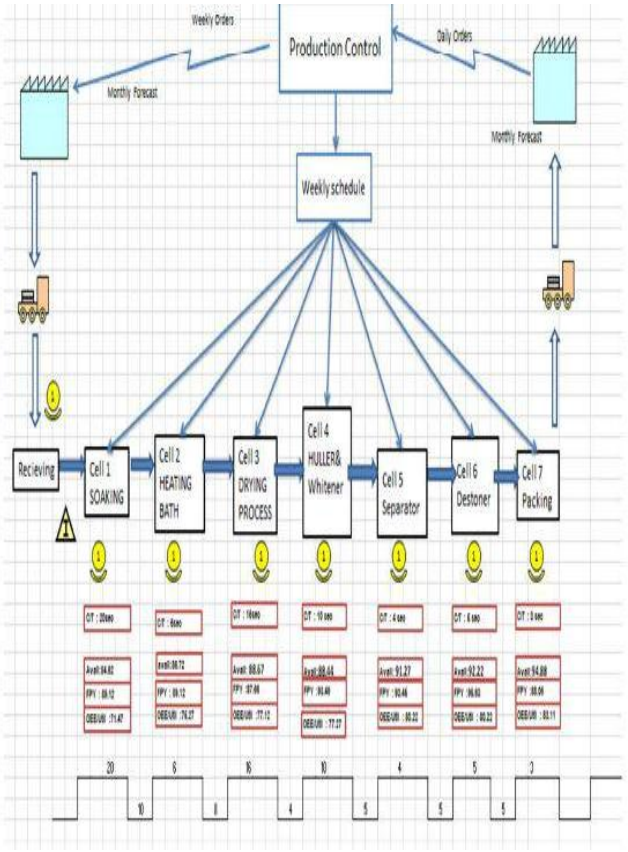


Workstation 7: Packing

The root cause here is the increased time consumption as the worker needs to hold and pour the rice into the bag and then tying it up with the help of a string or rope. This difficulty is reduced by means of a packing machine setup where the rice falls down from a hopper and a bag is placed in the opening. Once the bag is filled a lever is pushed to clamp the bag into place and it is held in that position which makes it easier to stitch the bag. The bag is then dropped by releasing the lever. This has resulted in reduced cycle time from 4 seconds to 3 seconds and increased availability of the machine.

IX. FUTURE STATE VSM

A future state map identifies improvement to be made to the value stream that will shorten the overall lead time. To create an effective future state map, the following must be considered: Takt time versus current cycle times. Takt time is the rate of customer demand measured in time. That is the number of working minutes available per day divided by the number of units of product the customer requires per day on average. In general takt times should be calculated on a monthly basis although there are certain exceptions to different applications Cycle times is defined as how often a part is completed by a given process within the value stream. A bar chart is useful for comparing takt time with cycle times for all processes within a value stream.



This future state value stream map consists of the changes made to the current processes which has been refelected reflecting on the output obtained and increased efficiency. The OEE thus calculated has been used to draw the future value stream map

Revised Operation Time Table

S.no	Process	Workstation	Operator	Cycle time
1	Soaking	WS 1	O 1	20
2	Heating Bath	WS 3	O 2	4
3	Drying Process	WS 4	O 3	16
4	Huller &Whitener	WS 5	O 4	10
5	Separator	WS 6	O 5	4
6	Destoner	WS 7	O 6	5
7	Packing	WS 8	O 7	3

DISCUSSION

The results thus obtained, clearly shows that the OEE has increased for 4 workstations and the Takt time for the entire unit has also been improved.The revised Operation table for grain processing shown above indicates that using VSM, the cycle time for the following workstations has been improved

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Workstation	CT before VSM	CT after VSM
WS 2	6	4
WS 3	20	16
WS 7	4	3

CONCLUSION

The goal of this paper was to develop both a current and a future value stream map in the grain processing industry to determine and eliminate the wastes that did not add value to the final product. It was also aimed at reducing the cycle time and improve OEE so as to increase the overall efficiency of the industry. Based on the future value stream map, the final result showed that with the help of principles like Kaizen, JIT and OEE we can reduce the downtime and the cycle time of the process to a considerable amount. More investigation can be done by conducting more in depth research of VSM integrated with computer simulation to verify the proposed VSM method..

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Analysis and prediction of Chronic Kidney Disease using Machine Learning Algorithms

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Abstract:

Health is Wealth: Today the world has taken a step forward where each individual is concerned about what he is consuming on a daily basis and analyses the after effects of the food. Every individual is more concerned about his/her everyday food habits and tries to adapt himself to what nature provides him. We are moving towards a technology oriented living where computers in general and data science and analysis in particular plays a major role in every field. A recent survey from World Health Organization (WHO) tells us that the growth of ageing population may increase by 50% in the forth coming decade. Here, in this paper we mainly concentrate on kidney related issues, and try to predict the presence of chronic kidney disease based on certain parameters available from UCI dataset using decision tree based approach.

Keywords:

Health, chronic kidney disease, machine learning, decision tree

I. INTRODUCTION

WHO survey states that between 2020 and 2050 the number of aged people is supposed to double from 11% to 22% across the globe [1]. Chronic kidney disease is a conditions that causes damage to our kidneys and decrease their ability to function normally and does not keep us healthy thereby affecting our day-to-day routine. When kidney disease worsens, wastes may accumulate to high levels in our blood and makes us feel sick and lazy. Complications such as high blood pressure, anemia, weak bones, and nerve damage may occur leading us to totally get bedridden. Early detection of malfunctioning of kidneys and treatment can help chronic kidney disease from getting worse. When the same condition progresses, the situation may lead to failure of kidneys where they may have to be replaced or the patient may be put to dialysis for his lifetime. Though kidney disease is common among all ages, survey reports reveal that the percentage of people affected by kidney failures generally fall under the above 55 category. This usually makes the person immobilized and deprives him from doing his daily activities.

To detect chronic kidney disease the authors implemented (LDA) Linear Discriminant Analysis and (CSP) common spatial pattern filter[3]. [4] Different classification techniques were applied on patient's record available and the authors proved that adial basis function gives better results worked on Naïve Bayesian and k-nearest neighbour algorithms and used it to predict the disease. They proved according to their test results that k-nearest neighbour shows more accurate results than naïve Bayesian. [9] the authors are using Datasets to store medical records. They used support vector machine and Bayesian network to predict kidney disease and select the efficient one among them. [11] SVM and KNN classifiers are compared by the authors and based on their accuracy and execution time for CKD prediction they proved KNN classifier is better.

II. PROPOSED MODEL

Figure 1 shows the proposed model for the analysis to be carried out. The data-set with patient data is considered for pre-processing, which includes removing duplicated, filling up of empty locations. This paper focuses on decision tree and C4.5 algorithm the data set was not completely filled because the algorithm works well for discrete values. The next step after pre-processing is to train the dataset and construct a decision tree for each individual data. After training the dataset, this is now used to test the remaining set of values and the result shown indicates whether a patient is affected by Chronic Kidney Disease (CKD) or not (NCKD).

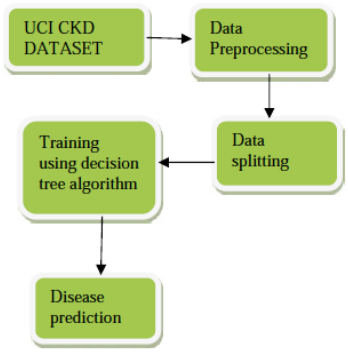

Fig: 1

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III. DATA DESCRIPTION

Parameter	Description
age	age (n)
bp	blood pressure (n)
sg	specific gravity
al	albumin
su	sugar
rbc	red blood cells
pc	pus cell
pcc	pus cell clumps
ba	bacteria
bgr	blood glucose random (n)
bu	blood urea (n)
sc	serum creatinine (n)
sod	sodium (n)
pot	potassium (n)
hemo	hemoglobin (n)
pcv	packed cell volume (n)
wc	white blood cell count (n)
rc	red blood cell count (n)
htn	hypertension
dm	diabetes mellitus
cad	coronary artery disease
appet	appetite
pe	pedal edema
ane	anemia
class	class

Table 1

The dataset for this experiment was taken from the UCI source and it contains patient data with 24 attributes, most of them are clinical and the rest are physiological. Some of the attributes are numerical and some are nominal. The numerical values are indicated in the table by (n) (Table: 1)

IV. IMPLEMENTATION

The implementation begins with the collection of raw data and pre-processing it. The data is then sampled and split into training data and testing data. Training data-set is cleaned up and is trained by using the learning algorithm. The results obtained are optimized. The data is then validated for the correctness of its classification. Lastly, the evaluation of the test data set is performed and classified using the decision tree created for the training data set.

Data from the test data set will be entered and for every input decision tree will be generated by calculating entropy and information gain values as per the rules of c4.5 algorithm explained in the section below. From the root to the leaf node the place at which the incoming node is to be placed will be calculated and it depends upon the homogeneity of the node. Prediction process usually occurs at the leaf node in a decision tree. The results obtained on the classification of CKD and NCKD is listed in Table: 2 and Fig: 2.

V. C4.5 ALGORITHM

C4.5 algorithm builds a decision tree for every input from the training dataset using the concept of information entropy. The training dataset consists of already classified samples.

In each node of the tree the algorithm classifies that particular attribute of the data that effectively splits the samples into subsets that deepen onto one class or the other. The splitting criterion is the normalized information gain (difference in entropy). The attribute that has the highest normalized information gain is chosen to make the decision. This process progresses recursively on the partitioned subsets as well.

This algorithm to start up should have a few base cases.

- All chosen samples in the list belongs to the same class. In this case a leaf node is created stating that the node belongs to the base class.
- The node does not provide any information gain. In this case a node is created higher up in the decision tree meaning to choose that class.
- Instance of previously-unseen class is encountered. In this case also a node is created higher up in the decision tree meaning to choose that class.

Algorithm:

The general algorithm for building decision trees is:

- Start the process
- Check each attribute for the above base cases
- Find the normalized information gain of the attribute
- Create a decision node that splits on the normalized information gain
- Repeat on the sub-lists by splitting up on the normalization gain and add those nodes that satisfies the criteria as a child node

VI. RESULTS

classification	% classification TP	% classification TN
CKD	99.25	0.75
NCKD	98.75	1.25

Table: 2

The results obtained clearly indicate that the algorithm proposed in this paper classifies the given data to a convincing extent. With more parameters to be processed and introducing a higher level of precision may show considerable improvement in the results of classification.

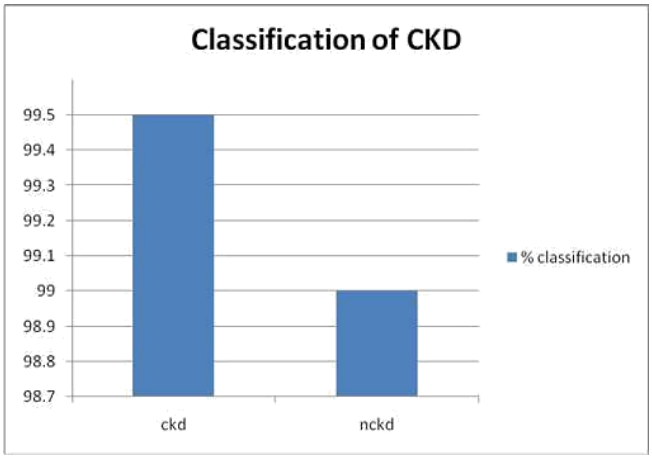

Fig: 2

VII. CONCLUSION

Computer vision especially machine learning works absolutely good in predicting health statistics of humans obtained by clinical diagnosis. Prevention is better than cure, yes but prediction of disease earlier is better to treat people in an effective manner and can save the patient by helping him to get back to his normal routine after a prediction. Many advances in machine algorithms aids us to do this prediction accurately. In this paper, c4.5 learning algorithm is used to predict patients with chronic kidney failure (ckd) disease and patients who do not (nckd) suffer from the disease. The results obtained from applying machine learning algorithms for these types of predictions seems to be convincing and better implementation of computer vision into medical diagnosis help us to do more research of this kind in future

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Red Mud Brick Using Lime and Coir Fibre

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Abstract:

In earth construction the most affordable means for residential is with the least demand of resources. Investigation is carried out to find at which suitable proportion of materials. In India, about 10 million tons of red mud residue are being generated annually posing serious environmental problems. Neutralized red mud can be used for construction purpose. Coir fiber has tensile strength, ability to resist cracking, spalling and increases the durability. Laterite soil needs minimum stabilization and it is durable, reduces CO2 emission and it is a good thermal insulator. Stabilization of soil becomes essential to attain adequate compression strength. In this research project coir fiber, red mud along with lime is used as stabilizers in laterite soil for improving the strength, durability of brick and thus to provide affordable housing. By implementing this technique in effective manner, bricks can increase the lifetime of structures, reduce moisture and used as an alternative building material.

Keywords:

Stabilizers, Red mud, coir fiber, lime and laterite soil

I. INTRODUCTION

Human society has been using shelter since the days of Egyptian and Mesopotamian cultures. Before the arrival of the commercial age, and the invention of mechanical heating and cooling, bio-climatic means were exclusively used to achieve moderately comfortable climates inside buildings [17]. They have significantly less embodied energy, contribute fewer CO2 emissions and help to promote the local economy and labor. Sand content in a range of 65% to 80% leads to a satisfactory stabilized earth brick. Material selection plays a vital role in determining the environmental performance of a building. This requires consideration of the resources and energy consumed during manufacture as well as the influence on operational aspects such as indoor air quality and the overall energy efficiency of the building. Soil is a mixture of stones, gravels, straw and lime. Soil can be made into bricks by mixing with water, placing the mixture into the mould. Straw sometimes used as a binder within the bricks, it will distribute the force throughout the bricks, decreasing the chance of breakage. Through the stabilization process, the plasticity of soil is reduced, it becomes more workable, and its compressive strength and load bearing properties are improved [13].The fibers provide a better coherence between the mud layers.

The compressive strength of fiber reinforced mud brick has been found to be more than that of the traditional fibreless mud brick, because fibers are strong against stresses [3].The Red mud generated by this method is extremely alkaline with hydrogen ion concentration usually lies between ten and thirteen. Due to its hazardous corrosive nature, it is posing a very serious and alarming environmental problem [18]. For thousands of years, it was common in most parts of the world to build walls using earth bricks. Kusum Delval and Kishandarvah suggested that the red mud can be used as a geotechnical material for varies purposes. In future, one can also work with the red mud by stabilizing by adding lime, fly ash, gypsum [6]. From the literature survey, it is observed that red mud can be used by neutralizing it so that toxic can be removed and can increase compression strength. The use of lime reduces moisture and absorb CO2from atmosphere. Lime is used to impart strength in the long term. The use of coir fiber improves strength and durability. Stabilization of soil becomes essential to attain adequate compression strength of bricks.

II. SCOPE OF THE PROJECT

Relevance of the project includes providing a low-cost building material. Especially in the tropical areas, stabilized earth bricks are a better alternative considering cost as a factor. Since India is a tropical country, earth brick provides a better living environment, it does not allow too much heat from entering the building. The waste of red mud being disposed in the ground can reduce pollution.

III. OBJECTIVE

The objectives of this project are,

- To study about laterite soil and know about the properties.

- To study about the effect of altering important materials such as lime, red mud, and coir fiber content on the properties and performance on stabilized mud blocks.
- To meet the economic requirements of the local situation by reducing dependence on outside sources and ensuring low cost alternatives.

IV. PROPERTIES

4.1 Red Mud

In the bayer method of extraction of aluminum oxide from bauxite, the insoluble product generated after bauxite digestion with caustic soda at elevated temperature and pressure is known as red mud [15]. Red mud is principally composed of fine particles of mud. Red mud contains silica, aluminum, iron, calcium, titanium and sodium. The use of the red mud increases the tensile and compressive strength of the bricks. Hydrochloric acid has been used for neutralization process, because it enriches the silicon oxide and aluminum oxide content of red mud eliminates harmful sodium oxide.

Table 1: Physical Properties for Red Mud

S.No	Tests	Values
1.	Specific gravity	3
2.	Liquid limit	45.5%
3.	Plastic limit	32.3%
4.	Plasticity index	10.2%
5.	pH	7

4.2 Laterite Soil

Laterite is a soil rich iron, and aluminium. Laterite soil needs minimum stabilization, its durable and reduces CO_2 emission. They are the products of intensive and long - lasting tropical rock, which is intensified by high rainfall.

4.2.1 Sand

Sand is nothing but grains of quartz varying in size from 0.75mm to 2.0 mm. It is hard and chemical inert. Laterite soil has 86% sand.

4.2.2 Clay

Clay particles are finer than 0.002mm.The physical character of clay are very much dependent on presence of moisture. Laterite soil has 4% clay.

4.2.3 Gravel

Gravel is a loose aggregate of rock fragments. They are classified by particle size of 2 -20mm. Laterite soil has 10% gravel.

Table 2: Physical Properties for Laterite Soil

S.No	Tests	Values
1.	Specific gravity	2.80
2.	Liquid limit	46.02%
3.	Plastic limit	34.77%
4.	Plasticity index	11.25%

4.3 Lime

Lime is a cementing material for construction. Lime is formed by burning calcined at 900℃. Lime is used for stabling soil. Lime provides benefits to bricks in both plastic and hardened state. It can be used in building, as they are vapour permeable and hence reduces risk of moisture. They have the property of self-healing if micro cracks develop. Lime absorbs CO_2 from atmosphere and plasticity reduction.

Table 3: Physical Properties for Lime

S.No	Tests	Values
1.	Specific gravity	2.5
2.	Fineness	10%
3.	Standard consistency	30%
4.	Initial setting time	120 minutes
5.	Final setting time	24 hours

4.4 Coir Fibre

Coir fiber is a natural fibre that is obtained from the husk of coconut. It is the fibrous material found between the hard, internal shell and the outer coat of coconut. Coconut fiber has regarding 48th of lignin that adds strength and elasticity to the cellulose primarily based fiber walls. Coconut fiber diameter ranging between 0.29 mm and 0.83mm, length between 6mm and 24mm and approximate mean aspect ratio of 150.

V. EXPERIMENTAL SETUP

5.1 Collection of Samples

Laterite soil was collected from hill region and red mud from aluminium waste. Hydrated lime is used as a binder. The samples were properly dried.

5.2 Mould

Mould was prepared with dimensions 210mm x105mm x 75 mm size and the mould was prepared with wood.

5.3 Proportions of the Materials

The various proportions of stabilizers used for bricks are,

Table 4: Material Proportions

ID	Laterite Soil (%)	Red Mud (%)	Lime (%)	Coir (%)
C1	100	0	0	0
C2	80	8	10	2
C3	80	10	7	3
C4	80	12	4	4
C5	80	14	1	5

5.4 Compressive Strength

Compression strength test was conducted on the red mud bricks (210x105x75mm) with varying proportions of red mud, coir fiber and lime. Compressive strength of each red mud brick was tested in the compression-testing

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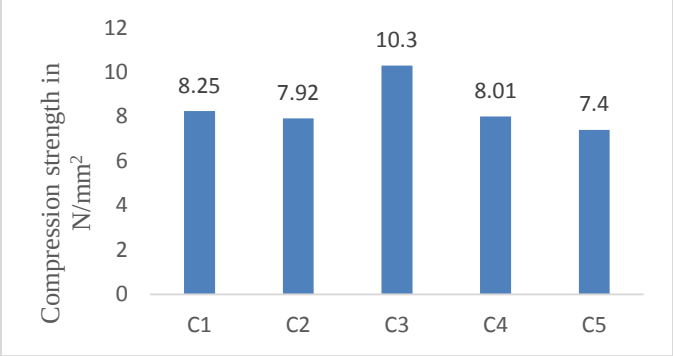
machine. The maximum compressive strength value obtained was 10.3 N/mm^2 for the red mud brick with 10% red mud, lime 7% and 3% coir fiber. Results of compression test are shown in Table 5as per IS 1077-1992. For red mud brick with coir and lime showed more compressive strength but when the percentage of stabilizer (red mud) increased to 12 %, the strength is less.

Table 5: Results of Compression Test

S.NO	Identification Mark	Area in mm	Strength in N/mm^2	Average in N/ mm^2
1.	C1	210x105	8.5	8.25
		210x105	8.2	
		210x105	8.05	
2.	C2	210x105	8.06	7.92
		210x105	7.83	
		210x105	7.87	
3.	C3	210x105	10.5	10.3
		210x105	9.4	
		210x105	10.3	
4.	C4	210x105	8.1	8.01
		210x105	7.9	
		210x105	8.04	
5.	C5	210x105	7.5	7.4
		210x105	6.91	
		210x105	7.8	



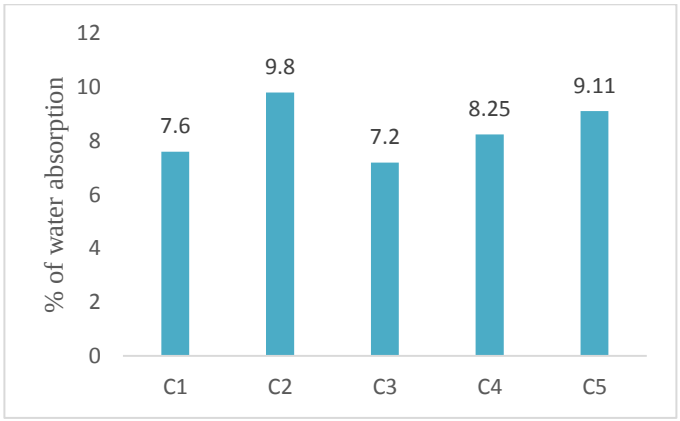
Graph 1: Compression Strength

5.5 Water Absorption

As per IS 3495(Part-2)1992 specification the most allowable share of water absorption is 15%. Results of water absorption test are given in Table 6.Adding 10% red mud satisfy the water absorption criteria. The brick with 10% red mud, 7% lime and 3% coir fiber showed reduced water absorption rate of percentage.

Table 6: Results of Water Absorption Test.

S.NO	ID mark	Weight of dry brick (W_1)	Weight of wet brick (W_2)	Amount of water absorption (%)	Avg (%)
1.	C1	3550	3801	7.2	7.6
		3490	3786	7.95	
2.	C2	3880	4285	10.4	9.8
		3914	4279	9.2	
3.	C3	4000	4300	7.52	7.2
		3950	4220	6.83	
4.	C4	3820	4136	8.27	8.25
		3933	4257	8.23	
5.	C5	3850	4294	8.94	9.11
		3838	4188	8.23	



Graph 2: Water Absorption

5.6 Efflorescence Test of Bricks

The alkalis present in bricks cause efflorescence on the surface of brick. Brick is immersed in water for 24 hrs. It is then taken out and allowed to dry in shade. The absence of white deposits on its surface indicates absence of soluble salts. Observation is made with naked eyes and classified as slight.

VI. CONCLUSION

The experimental investigations on the strength characteristics of red mud brick with lime and coir fiber significantly improved the strength. With 10% red mud, 7% lime and 3% coir fiber the compression strength obtained is 10.3 N/mm^2 and the water absorption of 7.2%. Since by adding more of red mud in the bricks the strength of bricks decreases and can be concluded that red mud should not be more than 10%. From the above detailed study on Red mud brick that made can be used for constructions and satisfies the IS criteria.

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Application of Artificial Neural Network to Predict the Lightfastness of Prints on Paper

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Abstract:

The purpose of this study is to describe the lightfastness of printed samples on the paper substrate due to long-time exposure by applying artificial neural networks. The lightfastness of prints is an important characteristic for determining their print stability. The fastness properties of prints are very important to check the print durability and image stability. It is the ability to retain the color strength of prints. It may be useful for verification of printed expiry date and authenticity or validity of the product. Nowadays, customers are very much influenced by good packaging and convinced to buy the products due to the displayed information. Packaging acts as a silent salesman and hence it is of immense importance for product manufacturers. Moreover, any kind of deterioration in package print quality will affect the product sale adversely. Little work has been done to study the fastness properties of gravure prints. In this work, paper printed in the gravure printing process has been taken as the sample as it has extensive usage in food, confectionery and medicine packaging etc. The paper samples are continuously exposed in artificial lightfastness tester BGD 865/A Bench Xenon Test Chamber (B-SUN) for assessing the light fastness of Cyan, Magenta, Yellow and Black ink on paper. The spectral curves and colorimetric values(L*, a*,b*) of prints are obtained by using ocean optics spectroradiometer (DH2000BAL) before and after exposure. An Artificial Neural Network model is proposed to predict the fading behavior of the prints. The optimal model gives excellent prediction with the minimal MSE for each color and a correlation coefficient of 0.98-0.99. As a comparison, a kinetic model is also employed. The results show that ANN has a higher prediction capability comparing to the kinetic model.

Keywords:

Artificial Neural Network(ANN), CIELab Data, Gravure Printing

I. INTRODUCTION

Flexible package printing is drawing wider attention in the printing world. As this technology continues to rapidly progress into mainstream markets, many questions have been asked about the permanence of prints. Gravure printing is a traditional printing technology that is extensively used for flexible packaging because it is suitable to print on many kind packaging- substrates especially paper, paper board, film and foil etc. The lightfastness of prints is the ability of the print to retain its color strength and fading resistance upon exposure to light. Prints with poor lightfastness have a negative effect on sellers of various goods. In case of food, confectionary or medicine products that may require long stability so that the print surface does not change its color or fades away, as it may create confusion about the authenticity and freshness or validity of the product. On the other hand, it may be possible to check if a product is exposed to sunlight which is not supposed to be exposed (for example, medicines that have to be kept in dark and cool environment and whether the printed expiry dates are authentic).

The study of fading requires careful planning with regard to the operating conditions of the materials required for performance characteristics. Since the packages are stored in different indoor lighting conditions, there is a possibility of fading which may reduce their marketability. The durability of color quality plays an important role in the packaging when they are exposed to sunlight or any artificial light for a long period of time. The stability of the printed image is affected by light exposure, water, heat and different kinds of chemicals. This paper will focus only on the lightfastness which provides image stability of prints on paper. Nowadays paper is preferred as a substrate in food, confectionery and medicine packaging due to its reusability and eco-friendly properties. The temperature and relative humidity can affect the rates of fading. Different models may describe fading rates of print. It represents either a hypothetical mechanism or can be empirically derived during laboratory experiments.

A. Related Work

A lot of praiseworthy studies were carried out to discuss the effects of light on paper substrates, dyes, pigments, and photographs [1]-[7]. These studies explained whether the content of lignin has any significant effect on this phenomenon. The extensive utilization of densitometry or spectrophotometric measurements for the estimation of the

degree of printed sample degradation is explained [8], [9]. H.Wilhelm and M. McCormick-Goodhart [10]-[12] discussed the image permanence studies for prints in detail, and also focused to analyze the effect of temperature, humidity, illumination, and air pollutants on the light stability. Reciprocity failure in high intensity accelerated light stability tests were also considered when making the display-life prediction. B.Rat et al. [13] examined the colorimetric properties of heat and moisture treated prints to ensure the information permanence under different illuminant conditions. Several studies explained the gradual decline of the gamut volume of prints to evaluate the effects of artificial weathering of prints. Therefore, the relative gamut volume change of prints on paper due to the influence of light might be expressed as a single number, thus conveniently quantifying the process of dye fading [14]-[17].

J. Izdebska et al. [18] and A. Borbély et al.[19] discussed the effect of artificial aging on the selected properties of flexible package printing materials so that one can select the proper substrate and inks on the basis of its lightfastness that is used in the flexible packaging industry. J. Lucas [20] proposed what types of tools can be used for testing lightfastness. Aydemir and Yenidogan discussed that the standard blue wool scale is used to characterize the light fastness properties of printed ink where the pigment selection is seemed to be an influencing factor on the lightfastness of printed material [21]. The color degradation was analyzed by applying the first-order kinetic model by Medley [22], Ahmed et al [23], and Mandal et al.[24]. O. Haillant [25] reported the photofading mechanism of colored materials where the photochemical behavior of organic or mineral colorant molecules and resin were examined due to exposure of real or artificial light conditions. It was also mentioned that chain scissions and reticulation reactions were generated through the photooxidation of the polymer matrix, which could influence the mechanical properties and cause appearance changes. Y. Shashoua et al. [26] discussed the effect of the natural and accelerated aging process on the cellulose nitrate to determine the lifetime of the adhesive. The colorimetric properties and UV/visible spectrums were evaluated to determine the effects of aging on the films.

Recently, an artificial neural network was developed to predict the light fastness of fabric samples. An artificial neural network model was designed to predict the Lab and wash fastness values of nylon by Balci et al. [27]. Many previous studies used a feed-forward neural network model to estimate an accurate reaction rate [28]-[31]. Few studies applied the ANN model to predict ΔE from the measured color coordinates of before and after dehydration process determining the color change of fruit or pumpkin [32, 33].

Though several studies focused on the lightfastness of paper substrate, most of the studies are on offset or digital prints. Little work has been done on the lightfastness of gravure printing. Considering the huge impact of fading on the marketability and authenticity of prints especially in food, confectionery and pharmaceutical packaging industry, the gravure printing process is chosen. In our previous work, the kinetic model and Artificial Neural Network (ANN) model is proposed to determine the fading behavior of prints on the foil and film substrate with time respectively [24,35]. In the current study, an Artificial Neural Network (ANN) model has been designed for the prediction of the fading behavior of prints on paper.

B. Objective

The goal of this study to evaluate the effect of light on prints produced by the gravure printing process on paper substrate. Lightfastness of a print is considered as the long-term permanence of the package of the item and maybe an indirect estimation of the expiry date of a product also. Some studies have applied the kinetic model to describe the color degradation of prints. Little work is done on predicting the fading behavior of prints by using the Artificial Neural Network model (ANN). So, the study has focused to assess the quality degradation of the print with time due to its exposure of light by designing an ANN model and to show the efficiency of the ANN model.

II. EXPERIMENTAL MATERIALS AND METHODS

Gravure printing is drawing wider attention in the packaging world because it is suitable to print on many kind packaging- substrates especially paper board, film, and foil, etc. It is the major printing process used for food, confectionery, cosmetic and pharmaceutical packaging due to its simplicity, quality, productivity and ability to print at very high speeds. Therefore, the experiment is carried out on the paper substrates which are printed by the gravure printing press. This printing unit comprises electronically engraved four color printing cylinders, blower, and heater. The prints are allowed to dry at 50°-60°C temperature. The experiment is performed on 100% solid patch of Cyan, Magenta, Yellow and Black inks of 152 lines per inch resolution. The printing speed is set at 60meter/min speed. The printing speed and pressure are kept constant during the printing of the samples. The ambient temperature and humidity are 17 ± 3°C and 35±5% inside the press. Multiple samples are tested for this experiment and the experiment is performed on five samples for each color patch to check the repeatability from each run. Samples are collected from five different runs.

A. Lightfastness Test

BGD 865/A Bench Xenon Test Chamber **(**B-SUN**) wa**s used for determining the lightfastness of prints. ASTM D3424-01standard, Test method 3 was followed to perform the test as per for evaluating the lightfastness of prints [37]. The artificial lightfastness tester is used for determining the lightfastness of paper prints. The test samples were cut at 150×70 mm sizes and positioned in the sample holders for the lightfastness test. The test samples were continuously

exposed under the 1.8 KW accelerated xenon light source. The test prints were exposed in the artificial xenon chamber as per the ASTM G155 procedure.

The irradiance level on the print sample was 0.35 W/m^2. Nm (± 0.02 W/ m^2. nm) at 340 nm. The artificial lightfastness tester has a black panel thermometer consisting of a PT100 sensor and a metal panel painted by a black coating which is used to monitor temperature and humidity inside the chamber. The uninsulated black panel temperature was set at 55 ± 2°C and the relative humidity was set to 40±5%. The test was performed by exposing the test print samples for a different time interval. The samples were continuously exposed to xenon light tester up to a total of 170hrs under a controlled environment to support repeatability.

B. Measurement

The fresh test prints were taken for exposure in lightfastness tester and the reflectances of the samples were collected at regular intervals. All the data were measured on each test and reference sample prior to exposure and after each exposure. As per the ASTM D3424 standard, for visual estimation, the samples were kept in the viewing booth under the D50 light source. For instrumental evaluation, Ocean Optic Spectroradiometer (DH2000BAL) was used in the experiment with Tungsten Halogen and Deuterium light source. After print, the spectrophotometric curves and the L*, a* and b* values were measured using Ocean Optic Spectroradiometer. After each artificial light exposure, the spectrophotometric curves of the exposed samples at different time intervals were taken using an ocean optic spectroradiometer using 2° standard observer. For each sample, five readings were measured and the average of five readings was collected. Furthermore, the data collection process was completed at 17°C-23°C. In this experiment, initially spectral data and L, a, b data were collected first at 15 minute time interval for one hour. Then it was taken on an hourly basis till 24 hours. Then it was taken at 5 hours and later on at 10 hours interval till 160 hours. But after 160 hrs, the Magenta and Yellow color on the print samples did not remain. The data was repetitively taken for 5 runs. The five individual datasets were prepared for the proposed model so that the accuracy of the model may be checked.

The CIELab values were measured to determine the color changes of the unexposed and exposed prints shown in (1) and (2). The CIELab reprsents the lightness, L*, a value that is characterized by the lightness of prints; a* is a measure of the degree redness to greenness and b* is a measure of the degree yellowness to blueness. The changes in lightness and the shift in redness to greenness and yellowness and blueness were also observed. The a* and b* values are used to define the chroma of prints in (2). Then these coordinate values of color were applied to estimate the color differences (ΔE_{00}) of Cyan, Magenta, Yellow and Black prints using the unexposed and exposed sample's data at individual time interval [36]. These results are plotted to determine the correlation between color change as expressed in ΔE_{00} and time intervals.

$$\Delta L^* = L^*(t) - L^*(0) \quad (1)$$

$$C* = \sqrt{a*^2 + b*^2} \quad (2)$$

Where, L*(0)- the lightness of unexposed print, L*(t) represents the lightness after exposure with time t.

The differences in lightness, chroma and color difference are important parameters to describe the fading effect on prints**.**

III. THEORY

A. Overview of Artificial Neural Network

In this study, a feed-forward artificial neural network is preferred to develop the ANN model. Neural Network Toolbox of MATLAB (Mathwork, 2011) software is used to develop the proposed model [34,35]. In this proposed model, a multilayer feed-forward network has been applied for modeling to predict the light fastness behavior of prints over time. The schematic presentation of the proposed ANN network is shown in Fig. 1. The development of an artificial neural network model generally comprises three stages-preparation of the data for the training and then the training of the neural network with the selected data. Here, an objective function is applied to minimize the errors in predicted and target values. The final step is the testing in which the trained network is tested with the unknown dataset and consequently the accuracy in the predicted pattern is determined.

In this study, the artificial neural network (ANN) model is designed with three layers –the input layer, hidden layer and output layer shown in Fig. 1. The input layer consisted of two input parameters which were wavelength and different time intervals. This hidden layer is consisted of

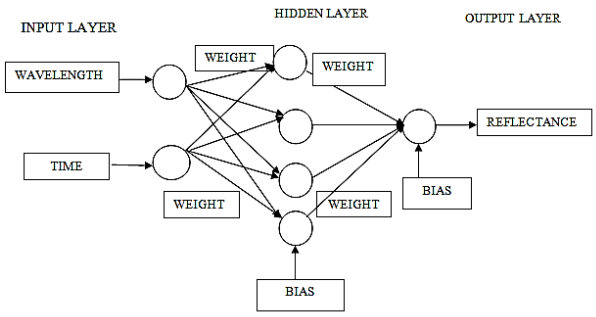


Fig. 1: Structure of feed-forward ANN

Variable number of neurons. The output layer is consisted of one output parameter i.e. the reflectance value at different exposure time. In this ANN model, a hyperbolic tangent activation function defined in (3)and a pure linear function have been applied in the single hidden layer and in the output layer. The tangent transfer function is selected as the activation function defined in (4) due to lower

calculated mean squared error values than the sigmoid function and a linear function [32].

$$tanh = \frac{e^{x}-e^{-x}}{e^{x}+e^{-x}} \quad (3)$$

$$MSE = \frac{1}{P}\sum_{p=1}^{P}\left(D_p - O_p\right)^2 \quad (4)$$

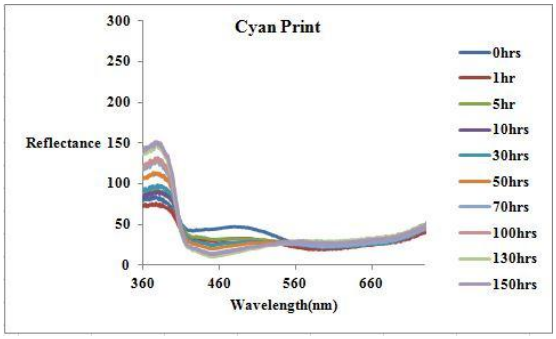
In order to avoid over-fitting and to get the best network, the training data set of the proposed ANN model was divided into three subsets including the training, cross-validation (CV) and test data set [33]. The 70% of the data in training set was used to train the network, and 15% of the data used as cross-validation which were applied to monitor the neural network performance during training and the test set included 15% of the data used to verify the accuracy of the network and compared the performances of various network structures. This proposed ANN model was trained with Backpropagation Levenberg-Marquardt (BP) algorithm to minimize the error during neural network training. In this model, 'trainlm' function is applied in the Matlab tool to train and test the ANN. The training procedure was continued until the minimum MSE of the validating sets was obtained. The trained sets were utilized to determine the fading behavior of different unknown times which were not previously fed to an artificial neural network. The evaluation of the performance of the ANN depended on MSE and the highest correlation coefficients between the experimental values versus predicted values (R^2). It helps to ensure the accuracy of the neural network to produce the outputs which are closer or equal to the experimental values.

In this study, the ANN model was tested twice for predicting the lightfastness of prints. Firstly, the proposed ANN model was trained up to 70hrs time data to predict the lightfastness of 120hrs and 150hrs. Then the model was trained up to 90hrs time data to predict the lightfastness of 120hrs and 150hrs. In the second case, 50 hours of data were not fed and it was also used for verification. The prediction for 150 hr data was shown only in Fig. 5 when the model was trained up to 90hrs time data. MSE and correlation coefficient R^2 are also determined for this set. However, the data were available for 120hrs time data also. The values were more or less similar. So the study may claim that the ANN model works as a predictive model. In the second case, the model also predicted the lightfastness of 50hrs which might act as the behavioral model.

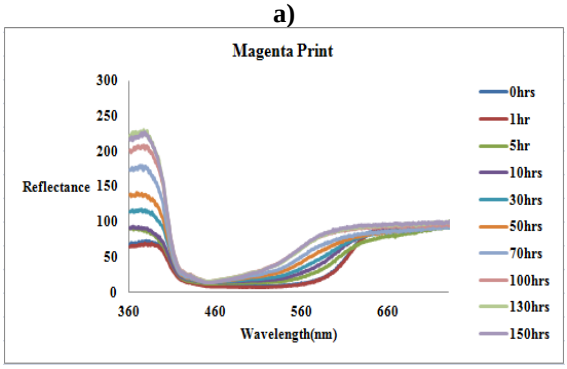
IV. RESULTS AND ANALYSIS

A. Spectral distribution of prints with time

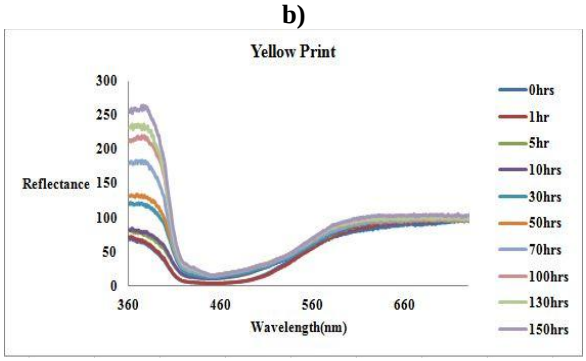
Fig. 2 a), b), c) and d) represents the spectral reflectance of Cyan, Magenta, Yellow and Black prints done on the paper substrate. Fig. 2a) shows the spectral reflectance distribution of Cyan paper print in which the reflectance value of cyan print is increased in the blue zone with further exposure. The reflectance spectra of magenta ink printed on paper are plotted in Fig. 2 b) where it is found that the reflectance value is continuously increasing in 360nm-410nm and The reflectance value is also increased in the spectral range of 510nm-610nm zone with time. It is found in Fig. 2c) that the yellow ink on paper has shown variance in the spectral region 360–450nm. There are no significant changes in Black paper print which are plotted in Fig. 2d).



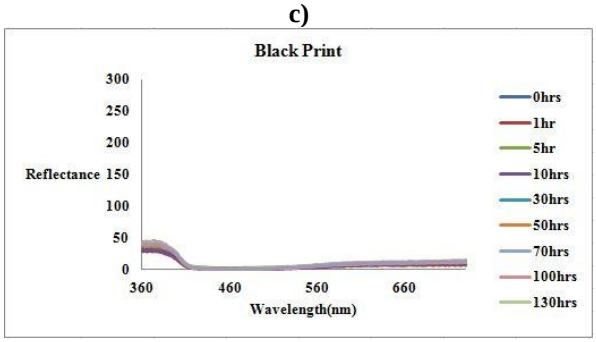
a)



b)



c)



d)

Fig.2: Spectral data of fading on a) Cyan Print b) Magenta print c) Yellow print and d) Black print on the paper

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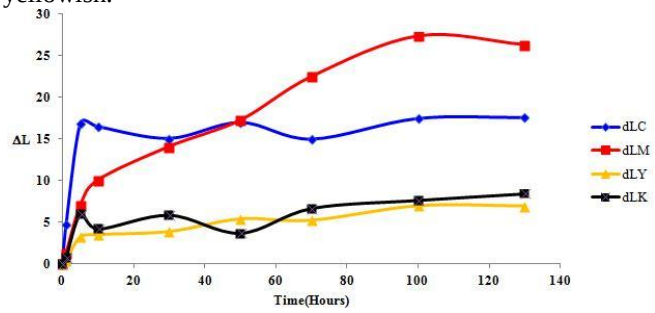
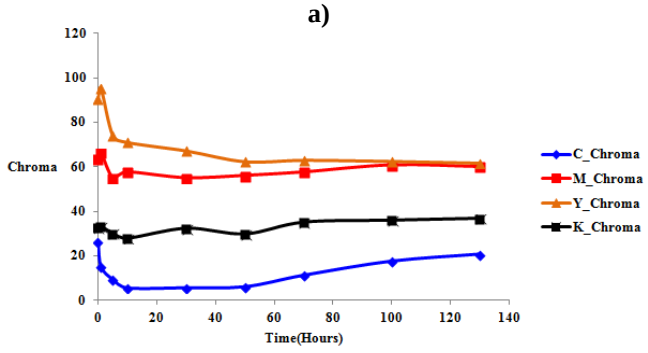
B. Effect of Light exposure on Colorimetric Properties of Paper Prints

The variation of lightness L and chroma at different times are plotted for each color print paper substrate shown in Fig. 3a) and Fig. 3b) respectively. Fig.3a) shows that the ΔL value for Cyan print slightly decreased with time. The significant changes in ΔL value is shown in Magenta and Yellow print. The lightness values of Magenta print and Yellow print are gradually increased with time due to artificial light exposure. It clearly indicates the fading with time. In contrast, the ΔL value for Black Print is initially increased but then a little reduction is seen with time.

The change in chroma for the paper substrate is presented in fig. 3b) where a strong reduction in chroma is seen for Yellow and Magenta prints on a paper substrate which turns grayish. It is also seen that the differences in chroma for Cyan prints and Black prints are little increased during artificial xenon light exposure which turns slightly yellowish.



a)

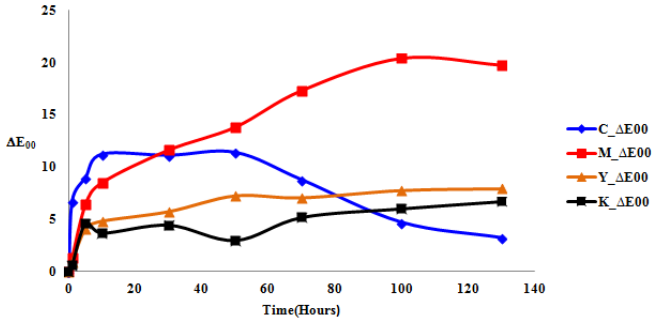


b)

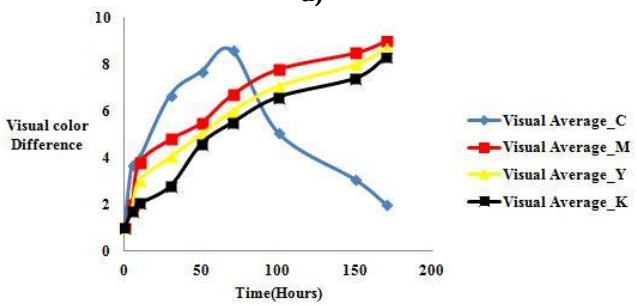
Fig. 3: Changes in a) L value b) Chroma of Cyan, Magenta, Yellow and Black print on Paper substrate after exposing to xenon light source

The color stability after the artificial lightfastness test can be monitored with the color difference ΔE_{00} and obtained results are shown in Fig.4a) It shows the overall color difference ΔE_{00} for each color prints on the paper substrate after artificial light exposure. The ΔE_{00} value for Magenta print in Fig.4 shows the faster fading. The greatest values are obtained for Magenta prints. Fig. 4 also shows a slight increase in Yellow and Black prints. The Cyan print on paper shows a faster increase at the beginning of exposure and then decreased with time.

Moreover, the color difference is also analyzed by visual observation of the fifteen observers for each color shown in Fig,4b). The findings is similar with the experimental results.



a)



b)

Fig. 4: a) Color difference b) Visual Color Difference of Cyan, Magenta, Yellow and Black print on Paper substrate after exposing to xenon light source

C. Comparison of ANN Model and Kinetic Model

In the present study, the optimum number of neurons in the hidden layer is chosen by trial/error method based on minimizing the difference between estimated ANN outputs and experimental values. After several repetitions, it is seen in Table 1 that the proposed ANN model with 10 neurons has produced minimum MSE for the prediction of lightfastness properties of prints. This ANN model is examined with 5 datasets to predict the repeatability of the fading behavior of print packages over time. The designed neural network model has been trained best with MSE value 0.2934, 0.5692, 0.6329 and 0.1456 for each color. The proposed ANN model for testing data has shown the best prediction accuracy illustrated in Fig. 5a), b), c) and d) for Cyan, Magenta, Yellow and Black prints, respectively, in which the comparison of the ANN output (predicted) data and the experimental data of the network trained with R^2 0.99 for each color is shown. The calculated correlation coefficient values(R^2) for estimation of lightfastness properties of Cyan, Magenta, Yellow and Black prints show a good agreement between predicted and experimental values. Therefore, the configuration of the ANN model including 10 neurons in the hidden layer is efficiently recommended for the prediction of lightfastness properties of prints with time.

A regression model was also developed with the same data which were applied to the proposed ANN model training. The performances of both Kinetic and ANN modeling were analyzed based on the correlation of determination (R^2) and mean square error (MSE).Fig. 3 also depicts the predicted reflectance for 150hours exposure applying the ANN model and regression. The result presents that the ANN model has higher modeling and prediction capability on the light fastness effect of prints due to fading than the kinetic model. The correlation coefficient for the least square model is very less for Cyan, Magenta, Yellow and Black respectively and the ANN model is 0.99 for Cyan, Magenta, Yellow and Black respectively.

Table I: ANN model performance for prediction of fading behavior of Cyan, Magenta, Yellow, and Black Print on Paper for different number of neurons in a hidden layer

Print	No. of Hidden neurons	MSE
Cyan	3	3.3198
	5	2.028
	7	1.0864
	10	**0.2934**
Magenta	3	3.7902
	5	2.3859
	7	0.9101
	10	**0.5692**
Yellow	3	2.6027
	5	1.3737
	7	1.1259
	10	**0.6329**
Black	3	0.2392
	5	0.1867
	7	0.1499
	10	**0.1456**

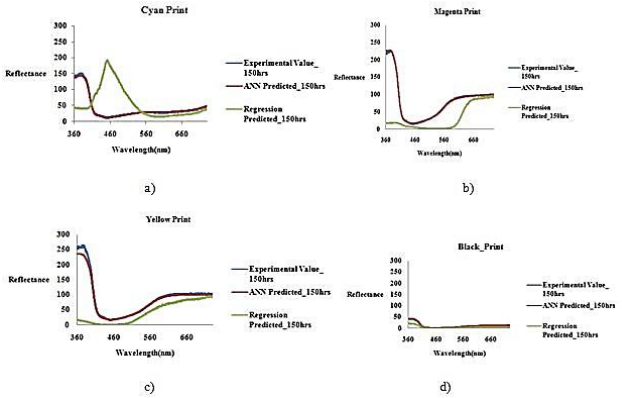


Figure 5: Experimental Value Vs Predicted Value after 150hours accelerated exposure by ANN model and Regression model for a) Cyan b) Magenta c) Yellow d) Black print on Paper

D. Discussion

The colorant molecules have a great influence on the lightfastness properties of prints. This study has focused on the lightfastness of paper prints which are printed by gravure inks. The gravure inks are formulated with pigment, resin, solvent, and additives [39]. During the artificial light exposure, not only the colorant molecules but also the resins undergo various chemical processes, which result in fading. Though the colorants and the resin affect each other during the artificial light exposure due to this chemical evolution but the effect of the ingredients cannot be investigated individually. The increase of b* value can be occurred due to the presence of chromophores which appear by the degradation of paper components such as cellulose, hemicellulose, and lignin during artificial light exposure [38]. A.M. Emsley and M. Ali[40] have reported that the discoloration of paper prints causes the degradation of cellulose. The presence of moisture, oxidative agents and microorganisms is playing important role in this process and especially the presence of acidic substances. Therefore, it is suggested that the printing substrate may be selected for

printing that has low concentrations of heavy metals to achieve greater optical stability of paper prints because the photocatalytic activity and absorbency in UV area is characteristic for heavy metals, which lowers the brightness and increases the yellowness [38]. It is also discussed that short term irradiation of paper initiates light induced oxidation reactions, which continues even after the paper is stored in the dark [41]. The discoloration can be described by yellowing or browning to darkening, depending on the wavelength range of absorption [25]. It is stated by O. Haillant that the fading due to the influence of light may be defined as yellowing or photo-oxidation. In the present investigation, Fig. 3a) claims that the yellowing occurs for Cyan and Black prints. According to J.Lucas [20], the real fading problems in four-color process inks occur in Magenta and Yellow. Fig. 3also depicts that fading occurs in Magenta and Yellow prints due to oxidation which occurs due to the photochemical behavior of the compounds of the ink. It is stated that due to oxidative reaction the pigments or dye molecules get exited under oxidation process which results in the discoloration of prints [4] and [25]. O. Haillant has also reported that fluorescent colorants have poor lightfastness as these types of colorants typically undergo photooxidation from their first singlet excited state. In the present study, Magenta and Yellow prints claim the presence of fluorescence. The greatest color difference ΔE is achieved for Magenta print. Yellow prints present a slightly smaller color difference comparing to Magenta. The fading behavior of Magenta and Yellow prints may be described by the co-photooxidation of resin and pigments [25].

Based on the result, the color change after a certain period of exposure may be predicted by applying the Artificial Neural Network model. Hence the L* a*b* values of printed packages may help to predict the real age of a

package. It may be applied for verification of printed expiry date and authenticity or validity of the product.

V. CONCLUSION

The current study was performed to predict the fading behavior of paper samples printed by the gravure printing process. Artificial Neural Network modeling was designed to predict the fading rate on printed samples. This study compared the performance of the ANN model and kinetic model for their prediction capabilities using the experimental values of spectral reflectance. The artificial Neural Network (ANN) model claims a better prediction of the fading rate than the regression model for each color.The three-layered ANN was designed with one hidden layer and the input layers representing two variables time and wavelength. On the basis of prediction outputs, it is possible to predict the lightfastness performance of prints. The most optimal ANN model was obtained with evaluative criteria (MSE and correlation coefficient R^2). A very good correlation was revealed between the actual reflectance spectra and predicted reflectance spectra with high R^2 and minimum MSE. These results may be used for verification of printed expiry date and authenticity or validity of the product.

The present study is done at controlled temperature and humidity inside the artificial xenon light chamber. So, the future study will be performed to examine the impact of temperature and humidity on the degradation of Cyan, Magenta, Yellow and Black prints on foil by varying those parameters and then it will guide to develop an artificial neural network model to predict the color stability due to the effect of temperature and humidity.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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