PROCEEDINGS
ICTA 2017

INTERNATIONAL CONFERENCE ON TECHNOLOGY AND APPLICATIONS

The Role Of Technology in Sustainable Development In The Era Of The ASEAN Economic Community

Bhayangkara University Of Surabaya

Bhayangkara University Of Surabaya

July 29, 2017
Surabaya, Indonesia

Cooperation partners

International Office

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PROCEEDING

INTERNATIONAL CONFERENCE ON TECHNOLOGY AND APPLICATIONS

Surabaya, July 29, 2017

Presented by:

ENGINEERING FACULTY

BHAYANGKARA UNIVERSITY OF SURABAYA

INDONESIA

INTRODUCTION

Assalamu'alaikum. Wr. Wb.

All praise is due to Allâh, the Lord of the Worlds. All praise and gratitude we pray to the presence of Allah SWT who has bestowed His grace and guidance so that this proceeding can be fulfilled properly. The proceedings contain of papers from national and international that have been presented and discussed in the International Conference on Technology and Applications held by the Engineering Faculty, Bhayangkara University Of Surabaya on Saturday, July 29, 2017. The topic of this conference is "The Role of Technology in Sustainable Development in The Era of the ASEAN Economic Community ".

This proceeding is arranged to collect and share ideas and research results related to innovation in technology development. In addition, the topic is chosen with a wide scope and international scale so that many related stakeholders can participate in this conference. Nevertheless the target of the topic is more focused on the results and efforts of the researchers / professionals in contributing to support the growth of national and international industries, especially in the field of industrial technology, engineering and informatics. In the accomplishment of this proceeding, we realize that there is a lot of support from various parties. Therefore, the committee expressed his gratitude and gave the highest appreciation to:

1. Rector of Bhayangkara University Of Surabaya, Drs.EdyPrawoto, S.H., M.Hum., Who has provided support and facilities in this activity.
2. Dean of Engineering Faculty, Bhayangkara University Of Surabaya, Dr. Bambang Purwahyudi, S.T., M.T., for all the support and motivation in this activity.
3. All guest speakers, Prof. Taufik, Dr. Boonyang Plangklang, Dr. Gautam Kumar Jha.
4. Mr / Mrs. / Students all the committee who have taken the time, energy, and thought for the success of this event.
5. Mr / Mrs all lecturers and officials contributing articles articles of research and scientific thinking in this international conference.

We realize that this proceeding certainly has many shortcoming, therefore, we expect all suggestions and criticism for the improvement of proceedings in next year's issue. Finally we hope this proceeding can be beneficial for all related participant.

Wassalamualaikum. Wr. Wb.

Surabaya, July 12, 2017
Chairman of Committee

M. Mahaputra Hidayat, S.Kom, M.Kom

RECTOR'S OPENING SPEECH AT

INTERNATIONAL CONFERENCE ON TECHNOLOGY AND APPLICATIONS 2017

Honorable Delegates, Respected Chairs, Distinguished Guests

Ladies and Gentlemen,

It is my great pleasure and honor to welcome you all at the opening ceremony on the International Conference on Technology and Applications 2017 on the topic of "The Role of Technology in Sustainable Development in the Era of the ASEAN Economic Community". I am very happy and grateful that many distinguished scholars, academician, engineers have come from both local and abroad to share their knowledge and experience and to explore better ways of educating our current and future generations on the role of technology in sustainable development.

To our keynote speakers, welcome and thank you for spending your valuable time with us to deliver the keynote speeches. Especially to Prof. Taufik, who came all the way from America. This International Conference is intended to disseminate information to the general public on the latest developments in the area of Sustainable Technology. It would provide a common forum for researchers, scientists, engineers and practitioners not only in Indonesia but throughout the world to present their latest research findings, ideas, developments and applications of Sustainable Technology.

We live in a world which is increasingly integrated economically, and is affected by global challenges such as climate change, food security and environmental degradation. The recent financial and food crises have reminded us that the world is changing quickly and dramatically. The challenges of providing a growing population with appropriate food, water, shelter, and livelihoods, without further degradation of the environment are being taken up worldwide. In the current set of proposed Sustainable Development Goals (SDGs) before UN Member States, there are goals and targets which relate to economic growth, infrastructure, energy, and strengthening capacities to create new technologies to help facing the challenges ahead. ICTA is one of the answers given by UBHARA to help achieving those Goals.

We know that these challenges call for big partnerships to tackle them head-on. The Community of endeavor represented here today must be part of these partnerships. Through meetings like this one, global knowledge and insights can be shared and applied to building the better, fairer future the world's people want and deserve. By harnessing humanity's knowledge and technologies, and by ensuring access to new technologies, we can fulfil our destiny of being the first generation able to eradicate extreme poverty, and the last generation able to prevent catastrophic climate change.

I hope that over the next hours you will have a most productive and stimulating discussion. I sincerely wish that this conference will be a great success not only as a chance to share knowledge and experience in sustainable development but also as the beginning of a long and fruitful cooperation and friendship among fellow educators and presenter devoted to the most meaningful and worthwhile task of protecting our environment and natural resources by teaching and training our younger generations, who will shape our future.

Before I end my speech, allow me to quotes from Albert Einstein that said "Play is the highest form of research". For our foreign guests and guests from other parts of Indonesia, please enjoy our lunch and meals that we have prepare for you. I wish you all a happy and enjoyable stay in Surabaya. Thank you very much.

Rector Bhayangkara University Of Surabaya

Drs. Edy Prawoto, S. H., M. Hum. Brigjendpol (purn.)

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RUNDOWN ICTA
JULY 29, 2017

Time	Program	Remarks
07.00 – 08.00	Registration	
08.00 – 08.30	Opening Ceremony	
08.00 – 08.05	Sparkling Surabaya Dance	
08.05 – 08.10	Indonesia Raya Anthem	
08.10 – 08.20	Opening Speech by the Chief of Commitee	
08.20 – 08.30	Opening Speech by the Rector of UBHARA	
08.30 – 09.00	MOU Signing	
08.30 – 08.40	UBHARA and JNU	
08.40 – 08.50	UBHARA and UPHSD	
08.50-08.55	Photo Session (Presenters and VIP Guests)	
08.50 – 09.00	Security Session by Best Western Papilio	
09.00 – 09.30	Coffe Break	
09.30 – 12.30	Main Session	
09.30 – 10.10	Presentation by Prof Taufik	Moderator : Ahmad Faza Azmi, ST, MT
10.10 – 10.25	Q and A Session	
10.25 – 10.30	Summary of Presentation	
10.30 – 11.10	Presentation by Dr. Gautam Kumar Jha	Moderator : Rifki Fahrial Zainal, ST, M.Kom
11.10 – 11.50	Presentation by Dr. Boonyang Plangkang	
11.50 – 12.15	Q and A Session	
12.15 – 12.20	Summary of Presentation	
12.20 – 12.30	Token Givings	
12.30 – 13.30	Lunch Break	
13.30 – 15.30	Paralel Session Participant separated into four groups	
15.30 – 16.00	Coffe Break	
16.00 – 16.30	Closing Ceremony	
	Photo Session	

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RISK ANALYSIS ON PILE FOUNDATION OF HIGH

RISE BUILDING IN SURABAYA

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ABSTRACT

Project is a dynamic activity; it will be a lot of risk that will occur in a project due to its dynamic nature. If the risk is not well controlled, it wf32ill lead incompatibility to project specifications, in terms of cost, quality, and time. Therefore, it needs risk management. The application of risk management on construction project has been done considerably. However, most of managed risk are still general. The aim of this research is to specifically review the risks involved in a building, particularly high rise building construction in Surabaya which has pile foundation. Risk identification performed in this research is to determine the level of risk probability and impact on cost performance. The results of the first stage questionnaire were analyzed by the risk matrix method to determine the risk rating. Furthermore, this research also attempts to provide risk responses to the experts regarding of down structure field. The result of the second stage questionnaire were analyzed to decide the risk response policy. The high risk factor on pile construction are the disrepair of retaining wall and the large of foundation shifting, one of the causes is the changing of soil characteristic around the foundation with the type of A2 response, it means that the project is accepted and the risk is controlled by the careful planning.

Keywords: *Foundation, Risk identification, Risk response, Risk Management, Pile*

1. INTRODUCTION

Project is an activity that has a certain period of time with limited resources allocation [1].Hence, project is a dynamic activity*,* the dynamicity will lead uncertainty that causes the risk in project. Every project has different risk of each activity. Therefore, Risk management has an important role on the construction building project. Construction risks in general are phenomena that affect the project objectives of cost, time and quality. Each stage of the project is related to the various risks and uncertainties that affect both quality and quantity [2]. Risk management is managing the risk from the start to the completion of the project, started with active risk identification, then assessing those risk level, so that the management priority is obtained. Finally, determining the completion steps in order to minimize the risk as much as possible. Thus, it is necessary to do the risk identification for each activity of the project.

Risk management on building construction projects has already done considerably. However, it still refers to general aspects or general risk on the project. Whereas, every project has different activity that cause the general risk could not be applied in the specific project. The building construction project done in Surabaya city are mostly a mall and apartment projects, the mall and apartment construction project can be regarded as a high risk project considering the workload quality and the high structure that will be constructed. The construction process of this project takes long period with high complexity, causing to various risks, starting from the general risk to the specific risk. In the construction project, the very influential working stage on the deviation of project goal is the foundation work. The foundation is the lowest structural part of the building that passes building load to the ground or the rocks located underneath. The pile foundation is used to carry the building load located above water or soft soil to the ground, in order to pass the load to a relatively soft soil until a certain depth so that the building foundation is capable of providing sufficient support to the load [3]. If it is not properly managed, the foundation work is very

risky to the project goal, in terms of cost, quality, and time. The foundation work is also the work that is done earliest. If this foundation work experience the delay process. The delay could also be happening due to inability to manage the risk. In the other hand, the risks that may appear in the foundation work is cost expansion.

According to the background described above, the aim of this research is to determine various risk and risk response regarded as high risk on foundation work in Surabaya. This research is focus on the risk identification based on the contractor point of view and the response done toward risk factor regarded as high risk. This research expect that the practitioners could determine the risk on foundation work before construct the building. Thus, the risk can be reduced. It is also expected that the practitioners can responses the risk properly based on the expert experience.

2. METHODOLOGY
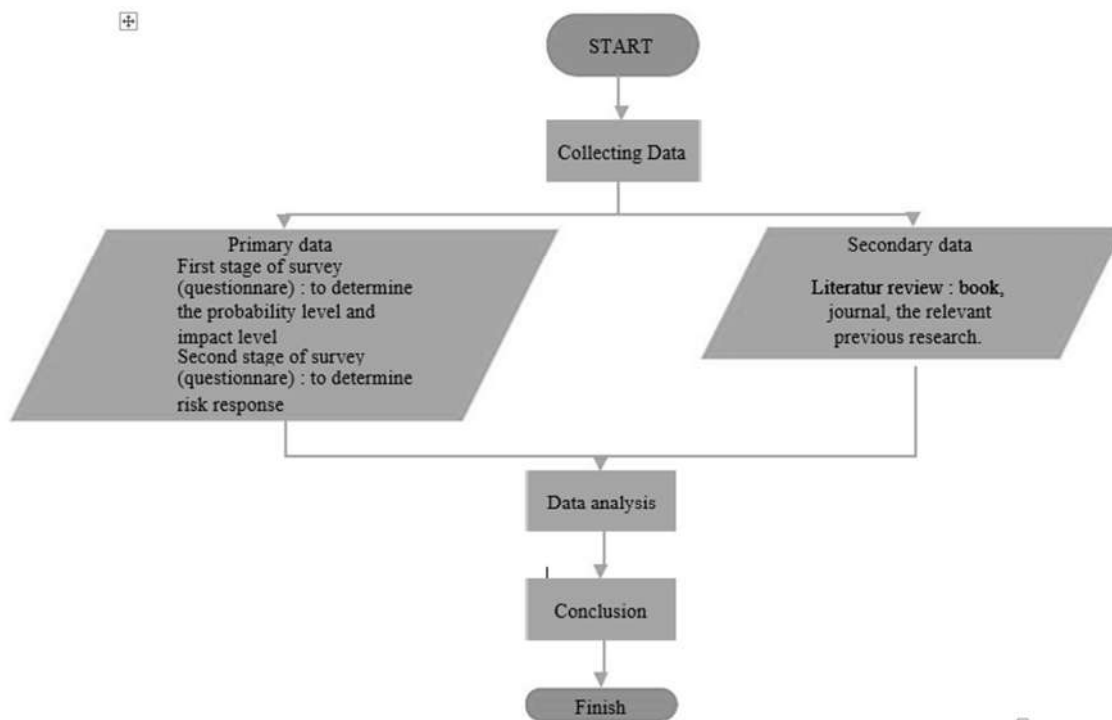
Figure 1. General Flowchart for this research

2.1. Collect Data

Data collecting is done by spreading the questionnaire to the determined project as the research location. Data collecting is done to determine the information needed in obtaining the research purpose, the purpose is showed in hypothesis form that is temporary response toward research question. So that, the response still need to be examined empirically. Thus, it needs data processing. According to the scope of the research, the analysis is only done on Construction project of Tujungan plaza 6 Surabaya, Marvel City Apartment, Gunawangsa Tidar Apartment, Ciputra World Soho and Apartment. The number of respondent in this research is determined by using purposive sampling technique. The purposive sampling technique is determination sampling technique by certain consideration or selection of subject group adjusted with the criteria based on the research purpose. Based on the sampling technique, 3 respondents are determined from each project: Project Manager, Site Manager, and field executive. Because, the three determined respondents have many experience in implementing project. The data used in this research are as follows:

1) Primary data
   Primary data were collected from respondents by directly distributing questionnaires to the projects that were or have been done the soil research, retaining and foundation work. The form of questionnaires used in this study is a stratified questionnaire, stratified questionnaire is the respondent's answer accompanied by a stratified statement. which shows the scale of attitudes covering the range from the

lowest to the highest towards the statement. Respondents in the research are Project Manager, Site Manager and field Executive. The method used to process the data obtained from the questionnaire is the risk matrix method.

2. Secondary Data
   Secondary data is a data or information generated from literature studies, such as: books, journals, and relevant previous studies.

2.2. Data Analysis

The data analysis in this research done by descriptive quantitative survey, the survey is specified by the scale on respondent response. The measurement of respondent perception is done by using Likert Scale then it is processed to determine risk identification.

2.2.1. Risk Identification

Based on the processed data, risk identification is obtained as the following table.

Table 1. Risk Identification for pile foundation

Code	Risk factor	Source
X13	The failure for determining foundation assembly point	[4]
X14	Waiting period until the concrete is ready to use for long-term period	[4]
X15	If it requires cutting in its implementation, it will be difficult and will take a long period	[4]
X16	The disrepair of the retaining wall	[5]
X17	The previous work is late	[5]
X18	The fault of foundation design	[6]
X19	The Fault of determining the foundation dimension	[6]
X20	The cost is high	[4]
X21	The foundation shifting is large	[4]

2.2.2. Risk Analysis

Measuring respondent perception cannot be directly processed because the value is still qualitative, so it must be quantified by giving a scale on respondent answer, by specifying the code to facilitate the data processing mathematically [7]. There are two types of risk analysis, as follows:

1. Qualitative risk analysis
   Qualitative data can simply be interpreted as not number data. In qualitative data, the data cannot be performed as mathematical operations [5] Qualitative data can be divided into two, nominal and ordinal data. The nominal data is the lowest data in the data measurement level. While ordinal data is higher than the nominal data.
2. Quantitative Risk Analysis
   Quantitative data can be interpreted as the form of numbers. Thus, various mathematical operations can be performed on quantitative data [5].

In this research we first conduct quantitative risk analysis to determine the most dominant risk. Each expert is given a question based on table 1. The experts will give a value of 1-5 for how much risk

factors that may occur and also how much impact is on the same scale. Then the expert answer is averaged with the formulation below:

$$Index\ value = \frac{(F1x1)+(F2x2)+(F3x3)+(F4x4)+(F5x5)}{5} \qquad (1)$$

Which:

F1 = respondents answer frequency that answer scale 1

F2 = respondents answer frequency that answer scale 2

F3 = respondents answer frequency that answer scale 3

F4 = respondents answer frequency that answer scale 4

F5 = respondents answer frequency that answer scale 5
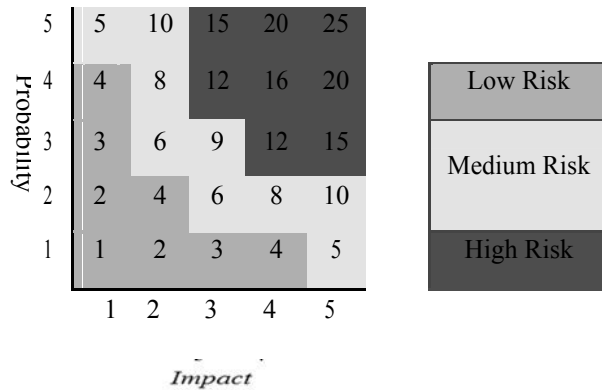
Figure 2. Matrix table of risk category

After this process, we will obtain probability and impact value in each risk factor. It will be compared to figure.2 to determine risk category.

The entry process of matrix table is done by substituting the result of risk index formula to determine probability and impact scale. The result of risk index formula is analyzed using matrix table with *Probability x Impact* (P x I) formula.

After substituting those results, it is continued by multiplying the scale on the probability and impact column as follows:

Table 2. Risk analysis based on impact toward the cost

CODE	P	*I*	P x *I*	Risk Categories
X13	2.6	3.1	8.06	Medium
X14	2.8	2.6	7.28	Medium
X15	2.6	3.8	9.88	Medium
X16	5	5	25	High
X17	3	3.2	9.6	Medium

X18	2.8	3	8.4	Medium
X19	2.6	3.8	9.88	Medium
X20	3.2	2.5	9	Medium
X21	3.6	4.8	17.28	High

Sources: Processing data (2016)

The result of multiplying *Probability x Impact* (*P x I*) on Table 2 become the reference to determine risk factor that may cause the dominant impact toward the cost. Based on Table.2 we will obtain 2 risk categories that is dominant enough, that are the disrepair of the retaining wall and the large of foundation shifting. Furthermore, in the response risk, we will focus on the most dominant risk factor.

2.2.3. Risk Response

To determine risk response, qualitative risk analysis were done by giving the expert question. The experts is interviewed based on the most dominant risk factor. Then, they will answer how to reduce the risk based on their experience. Based on risk factors obtained through analysis the risk factor regarded as high risk rating, questioner's distribution of stage 2 is done to determine the reason factor and to determine the response toward risk factor. Here is the response policy toward risk factor according to [7]:

1. The Project is rejected (T1).
2. The Project is accepted, but the risk is certified by the owner (T2).
3. The Project is accepted, and the risk is redirected to other parties in the company guided (A1).
4. The Project is accepted, and the risk is controlled by company it is self with the careful planning (A2).
5. The Project is accepted, and the risk is accepted as the cost, it means that if the risk occurs, it has been calculated in budget (A3).

3. RESULT

Based on the processing data, it can be obtained that the very dominant risk factor is the disrepair of retaining wall (X16). Therefore, it is necessary to do the risk response to determine how to anticipate by the expert experience. Table 3 will explain how to do the risk identification toward the response.

Table 3. Risk Response for high risk

Risk Identification	Cause Analysis	Responce Policy					Reponse
		T1	T2	A1	A2	A3	
The desrepair of retaining wall (X16)	The soil stability is poor				√		Accurately investigating the soil first.
	Earthquake					√	Predicting the earthquake level and build the cooperation with BMKG.
	Soil data is not accurate			√			1. Turn over the occurred risk to delegated sub-contractor. 2. monitoring the soil while investigation process.
	Error calculation of horizontal force in the soil			√			Turn over the occured risk to specialist sub-contractor.
	The fault of geogrid installation			√			Turn over the geodrid installation to specialist sub-contractor.
	The sloping surface due to Compacation using to heavy equipment			√			Turn over the work to the specialist subcontractor
	Design fault of SPT				√		Periodically monitoeringmust be done on planing/ design stage

	Design fault of retaining wall			√			1. Redesign. 2. Trun over the work to the expert.
	The fault of geogrid utilization				√		The gegroid installation planing must be ajusted with field needs.
	Load –carrying capasity is poor				√		1. Soil reparation by geotextile installation. 2. Properly investigating the soil in order to accurately determining the real load-carryingcapasity.
The large of foundation shifting (X 21)	Flood					√	1. Control tub installation for flood water reservoirs. 2. Must have BMKG estimation data.
	The changing of soil characteristic around the foundation				√		Accurately invertigating the soil.
	The soil stability is poor				√		The repairation of soil stability by the variuos of geotextile as requirement.
	DPT is poor				√		1. Protection installation in the form of sheet pile. 2. Monitoring periodically. 3. The construction method that has been discussed with the expert.
	Load-carrying capasity is poor				√		1. Soil repairation by geotextile installation. 2. Properly investigating the soil in order to accurately determining the real load-carrying capacity.
Risk identification	The huge earthquake that cause the foundation shifting					√	1. Strengthen foundation design to reduce the foundation shifting. 2. Must have eartquake estimation data from BMKG.

Table 3 explain what must be done by practitioners based on expert experience and response once the risk occur. It can be known that when descrepair for retaining wall occur due to the fault of geogrid utilization, the expert still accept the project and the risk is controlled by company its self with the careful planning (A2 response), the expert suggest the company to do geogrid installation planing and it was adjusted with field needs. Another reason for derepair of retaining wall is design fault of retaining wall, in this case, the expert still accept the project, however the risk is redirected to other parties in the company guided (A1 response). And the expert suggest the company to do redesign of retaining wall and turn over the occurred risk to expert.

4. CONCLUSION

The conclusion of the research is:

Response type of risk factor regarded as high risk is determined by last stage questionnaire distribution. Research variables regarded as high risk have the same probability and impact multiplication. One of them is pile foundation project with research variable of the disrepair of retaining wall that have several cause analyses, they are: the poor soil stability, design fault of SPT by response type A2 which means the project is accepted and the risk is controlled by the careful planning.

Most all the risk policy is A1, A2, and A3. It means that the experts agreed to accept the project, and the risk is redirected, controlled and accepted with additional cost based on the work type.

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CLASTERING TYPE OF BEST GRAMEDIA PUBLISHER SELLER PAPER USING SHRINKING SHARED NEAREST NEIGHBORS METHOD

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ABSTRACT

Over time in the business world of book publishing has increased the number of publishers is very significant. This has triggered a very tight competition to grab the attention of customer for the next operational activity. The publisher must be able to guess which type of book the customer candidate will be interested in. Given these problems, the publishing industry is still having trouble determining what kind of books will attract potential readers. So this situation hampers publishers to be able to create the kind of book that the readers want. Then to make it easier to determine and know the best seller type book group is the author uses one way that is by using SSNN method.

SNN-based data shrinking algorithm (SSNN) uses the concept of data movement from the shrinking data algorithm to increase the accuracy obtained. The concept of data movement will strengthen the density of adjacent graph so that cluster forming process can be done from neighboring graph components that still have adjacency relationship. In this trial using data order gramedia property and using 1200 test data which is divided into 4 groups of test data. Produces clusters that generate the amount of data per genre on each cluster. And generate the children's book genre as a genre of best seller books.

Keywords: book, SSNN, best seller, genre

1. INTRODUCTION

Competition to grab the attention of customer for the operation of book publishing operational very significant lately. Thus to make it easier to determine and know the type of best seller book is the author uses one way is to use the SSNN method. The Nearest Neighbor (SNN) Shared algorithm is an algorithm that forms a graph of consideration that uses the similarity between data points based on the number of closest neighbors held jointly. The cluster is obtained from the representative points selected from the adjacent graph. The representative point is used to reduce the number of clustering errors, but also reduce accuracy. SNN-based data shrinking algorithm (SSNN) uses the concept of data movement of the shrinking data algorithm to increase the accuracy obtained. The concept of data movement will strengthen the density of adjacent graph so that cluster forming process can be done from neighboring graph components that still have adjacency relationship. Thus can be determined what type or genre wanted by customer.

2. METHODOLOGY

2.1 Data Mining

Data mining is a process that uses Static, Mathematical, Artificial intelligence, and machine learning techniques to extract and identify useful data information and related knowledge from large databases.[1]

Data mining is a series of processes to explore the added value of a data set of knowledge that has not been known manually. In the big journals of data mining is also called Knowledge Discovery In Database (KDD) is an activity that includes the collection, use of historical data to find regularities, patterns or relationships in large data sets.[2]

2.2 Clustering

Clustering is a grouping method based on the size of proximity (resemblance). Clustering is different from group, if group means group same condition if not yes definitely not group. But if the cluster does not have to be the

same but the grouping is based on the proximity of an existing sample characteristic, one of them by using the euclidean distance formula. The application of this cluster is very much, because almost in identifying problems or decision-making is always not exactly the same but tend to have similarities only.[3]

2.3 *Algorithm Shrinking based Shared Nearest Neighbor (SSNN)*

SSNN algorithm is a development of SNN algorithm. The cluster accuracy is improved by increasing the density of the graph of the customer formed in the SNN algorithm. Then to strengthen the density is to use the concept of data movement toward the cluster center of the data algorithm Shrinking.

Because, this repair algorithm will make the data points seem to shrink toward the cluster center, then this algorithm is named SNN algorithm based data shrinking or *Shrinking based Shared Nearest Neighbor (SSNN)*. [3]

If the data points in the neighboring graph are moved toward the cluster center, the neighboring weights for the data points in the same cluster will become larger and the neighboring weights for the data points in the different clusters will become smaller. To be able to apply the concept, the neighboring graph will be formed in several iterations. The number of nearest neighbors used for the formation of an adjacent graph increases in each iteration. Overall, the SSNN algorithm consists of steps:

1. Calculate the similarity value of the data set.
   To calculate the value of similarity (distance):
   Formula   :

$$\text{Calculating distance} = \sqrt{\sum(x - x_1)^2}$$

   explanation   :
   x : First set of data sets.
   x_1 : The next set of data sets.

2. Form a list of the nearest neighbor k each data point
3. Form adjacent graph from the list of nearest neighbor's k
4. Calculate the value of proximity and disconnect the adjacency weight less than the closeness value
5. Repeat steps 3 and 4 until the closeness value is greater than the proximity threshold value6. The cluster form of the adjacent graph component still has the weight of neighboring relationships.

Steps 1 to 3 are still the same as the SNN algorithm, but in step 2 the list of nearest neighbors is formed for the entire data point in the data set because it is required for the establishment of an adjacency graph in several iterations. Steps 3 and 4 are done in several iterations to apply the concept of data point movement toward the cluster center.

The SSNN algorithm enters the sequence of the nearest neighbor in the list of nearest neighors in the calculation of the weight of the neighboring relationship so that the value of the neighboring weights will have a more accurate value.

For example, there are two data points i and j, then the neighboring weights of i and j are:

$$\text{weight } (i, j) = \sum(k+1-m) \times (k+1-n)$$

   explanation :
   K = The size of the list of nearest neighbors
   m and n = The position of the nearest neighbor listed in the nearest neighbor list i and j.

The k value will increase in each iteration according to *the Move Points (MP)* parameter to be able to adjust the change of adjacent graph. The density value of each data point is calculated based on the total weight of the neighbor relationships owned by each data point.

Data points in the same cluster have adjacent density values. The SSNN algorithm uses the condition as a proximity value to determine the weight of the adjacent neighbor relationship to be disconnected and ignored in the adjacency graph formation process in the next iteration. In other words, the weight of neighbor relationships that are not close to their density values will be disconnected and ignored. The process of calculating the value of proximity in each iteration serves to overcome the shortcomings of the basic SNN algorithm that is too dependent on a threshold value of the neighboring weights.

The iteration process will be stopped if the proximity value has reached a closest or nearest neighbor threshold value that is used is greater than the amount of data in the data set. The restrictions are made to prevent the occurrence of cluster splits.

The neighboring graph obtained at the end of the iteration will have a strong density so there is no need for a process of determining representative points. The cluster can be directly formed from an adjacent graph component that still has the neighboring weights. Related data points will be included in the same cluster, so cluster forming process can be done in a shorter computation time.

3. RESULTS

3.1 Test Results 1

The first test used the top 40 data from the first quarterly test data. Generates 10 Clusters that generate 1124 data of nearest neighbor data. This first test shows that the genre of Children Books is superior among other genres of books. This can be seen in Table 6.9 where in the test each cluster has a varying number, the test that produces 10 clusters shows the first cluster is the most superior among other clusters. In the first cluster we can see that the owner of the largest amount of data is Children's Book. In addition, when viewed from the total number of genres in the 1st trial that has the highest amount of data Children's Book with calculations Children's Book 759 data, Cooking 33 data, Diet & Health 33 data, Economi & Bussines 35 data, Enterteinment 33, Fiction & Literature 99 data, Reference & Dictionary 33 data, Self-Improvement 66 data and Social Science 33 data. We can thus conclude that in experiment 1 it generates the Children's Book genre as the most genre of books in interest or best seller book genre.

Tabel 1. Results of testing genres 1

Genre / Cluster	Children's Books	Cooking	Diet & Health	Economi & Bussines	Enterteinment	Fiction & Literature	Reference & Dictionary	Self - Improvement	Social Sciences	Total
1	144	3	2	0	3	8	3	5	2	170
2	82	2	1	35	8	5	8	2	1	144
3	108	2	2	0	3	20	3	4	2	144
4	55	3	28	0	3	34	3	28	2	156
5	103	3	0	0	3	6	3	6	26	150
6	72	2	0	0	3	5	3	21	0	106
7	76	2	0	0	3	4	3	0	0	88
8	62	16	0	0	3	6	3	0	0	90
9	27	0	0	0	2	11	2	0	0	42
10	30	0	0	0	2	0	2	0	0	34
Total	**759**	**33**	**33**	**35**	**33**	**99**	**33**	**66**	**33**	1124
Total Data	**1124**									

3.2 Test Results 2

In test 2 it still uses the top 40 results in quarter 2. The result of trial 2 yields 10 clusters, the number of clusters is almost the same as the test result 1 but has the smallest number of neighboring data is smaller that is 942 data. Of the 10 clusters retrieved trial 2 still has the best cluster of cluster 1. In cluster 1 has the largest amount of data than the other clusters. In the cluster again shows that the genre of Children Books is the most superior among other genres of books. In addition, the results of the total number of clusters of each genre also show the genre of Children's Book which has the highest number of Children's Book 637 data, Cooking 63 data, Diet & Health 60 data, Economi & Bussines 30 data, Fiction & Literature 60 data, Medical 32, Religion & Spirituality 30 data and Social Science 30 data. Thus it can be concluded again that the genre of Children Book is a genre of bestsellers. More detailed calculations can be seen in table 2.

Tabel 2 Results of testing genres 2

Genre / Cluster	Children's Books	Cooking	Diet & Health	Economi & Bussines	Fiction & Literature	Medical	religion & spirituality	Social Sciences	Total
1	98	5	4	4	26	0	4	4	145
2	65	2	3	2	3	1	1	1	78
3	20	32	2	1	2	1	1	1	60
4	47	1	9	8	9	30	11	11	126
5	48	1	2	1	2	0	1	1	56
6	86	2	4	2	4	0	2	2	102
7	67	2	27	3	5	0	2	2	108
8	78	2	3	3	3	0	2	2	93
9	84	3	3	3	3	0	3	3	102
10	44	13	3	3	3	0	3	3	72
Total	**637**	**63**	**60**	**30**	**60**	**32**	**30**	**30**	**942**
Total Data	942								

3.3 Test Results 3

The third test uses the top 40 data from the 3th quarterly test data. Test 3 produces 8 clusters, fewer clusters than the previous test, test 3 produces 1264 data of nearest neighbors. Of the 8 clusters obtained in trial 3, the first cluster is the most superior among the other clusters, because it has the highest amount of data among other clusters. In the genre of cluster 1, the Children's Book genre has the largest amount of data among other genres. Not only that, if calculated as a whole in test 3 or quarter 3 this genre of Children's Book again has the most amount of data than the other genres: Children's Book 875 data, Diet & health 35 data, Economi & Bussines 70 data, Enterteinment 38 data, Fiction & Literature 106 data, Self- Improvement 70 data and Social Sciences 70 data. Thus it can be concluded that the genre of Children's Book back into the genre of best seller books in this trial. More detailed test results can be seen in table 3.

Tabel 3 Results of testing genres 3

Genre / Cluster	Children's Books	Diet & Health	Economi & Bussines	Entertein ment	Fiction & Literature	Self – Improvement	Social Sciences	Total
1	218	5	13	0	38	46	60	380
2	67	2	5	38	40	4	4	160
3	195	3	7	0	7	6	6	224
4	40	25	27	0	2	4	0	98
5	195	0	11	0	4	6	0	216
6	70	0	2	0	2	4	0	78
7	61	0	3	0	2	0	0	66
8	29	0	2	0	11	0	0	42
Total	**875**	**35**	**70**	**38**	**106**	**70**	**70**	**1264**
Total Data	1264							

3.4 Test Results 4

The fourth test uses the top 40 data from the 4th quarterly test data. Test 4 produces 8 clusters, test 3 yields 1272 data of nearest neighbors. Of the 8 clusters obtained in pilot 4, the first cluster is the most superior among the other clusters because it has the highest amount of data among other clusters. In cluster 1, there is a considerable composition of the Children's Book genre in the genre of the others. Then if the total count is calculated in 4, the Children's Book genre has a large amount of data in the amount of other genres. Thus it can be concluded that the genre of Children's Book is a bestseller genre or best seller on trial 4. Detailed test results are found in table 4.

Tabel 4 Results of testing genres 4

Genre Cluster	Children's Books	Cooking	Economi & Bussines	Fiction & Literature	Medical	Reference & Dictionary	Self - Improvement	Total
1	339	55	6	5	6	13	18	442
2	203	5	4	2	4	5	7	230
3	136	4	20	2	2	4	6	174
4	55	3	3	26	21	3	29	140
5	84	2	2	0	2	2	2	94
6	104	4	0	0	0	4	4	116
7	36	2	0	0	0	2	2	42
8	28	2	0	0	0	2	2	34
Total	**985**	**77**	**35**	**35**	**35**	**35**	**70**	**1272**
Total Data	**1272**							

4. Conclusions

From the results of research that has been done can be concluded as follows:

1. The use of this method is quite easy because to normalize we can determine its own requirements.
2. SSNN method can be used to cluster genre on best seller book determination.
3. The results of this experiment indicate that in this period the genre of Children book is a genre of bestseller or most desirable.

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RELATIONSHIP BETWEEN DATA REDUCTION AND PERFORMANCE IMPROVEMENT OF CLASSICATION WITH K-SUPPORT VECTOR NEAREST NEIGHBOR

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ABSTRACT

K-Support Vector Nearest Neighbor (K-SVNN) as a Nearest Neighbor-based method can be used for data reduction. Reduction is done by giving parameter K as nearest neighbor used. Besides data reduction, K-SVNN can also improve the performance of prediction accuracy. The author tests the value of K that is the percentage of the amount of data. The K used varies from 10% to 100%. This study was conducted to observe the relationship between data reduction and performance improvement. Performance improvement is measured by Fisher Discriminant Ratio (FDR). From the results of research proved that in some data sets, data reduction with K-SVNN can increase the FDR value, while some other data sets can't. The K value that gives the highest FDR value is 30% to 50% with data reduction up to 4.49%.

Keywords: *K-Support Vector Nearest Neighbor, data reduction, performance, improvement, classification, Fisher's Discriminant Ratio*

1. INTRODUCTION

K-Support Vector Nearest Neighbor (K-SVNN) is a method based on Nearest Neighbor to perform classification task [1]. This method successfully reduces the training data used during the training process but still strives to maintain accuracy. The results of the experiments performed show that the yielded reduction performed for K = 7 is up to more than 49% but the accuracy obtained can still survive, even raise 1% compared to other methods with the highest accuracy. One of the expected goals of K-SVNN is that it can reduce the prediction time used, as given by Prasetyo [1]

The comparison of K-SVNN with Decision Tree (DT) and Naïve Bayes (NB), in terms of time spent on training and prediction, K-SVNN is longer than DT or NB [2]. This is because K-SVNN must calculate the distance between each data with all other data, whereas DT and NB do not do that but other work where consumption time is less. The result of comparison of K-SVNN with DT and NB on prediction accuracy was K-SVNN better than DT and NB. This becomes something interesting, because on the one hand, K-SVNN tries to reduce training data but still can keep accuracy obtained. Comparison of other methods of ANN Back-propagation (ANN-EBP) and Support Vector Machine (SVM) have also been done [3]. The comparison results show where the K-SVNN accuracy tends to be superior to ANN-EBP and SVM, although for the Vertebral Column and Wine data sets, K-SVNN is lower than SVM. As for training time, K-SVNN is superior to other methods. For predictive time is shorter than ANN-EBP but longer than SVM. Comparison with four data sets proves that K-SVNN has a relatively higher performance than ANN-EBP, DT and NB methods, but lower than SVM and K-Nearest Neighbor [4]. The research that has used K-SVNN as preprocessing is Prasetyo [5], In his research, K-SVNN was used for data reduction before applying the ANN-EBP classification method. Tests performed on five data sets gave results that the performance on the Wine data set was poor. In this study, the author tries to prove the use of K-SVNN on some data sets with a choice of K that is proportional to number of data.

From the exposure provided by [2, 3], K-SVNN has performance that competes with other classification methods. Sometimes lower and sometimes higher for both accuracy, training time and prediction time. This study performs empirical testing on the effect of data reduction practice with predictive accuracy obtained. Previous

research has done a reduction with certain selected K, [1] use K=7, [2, 3] use K=13. The number of data from the test data sets is not the same, so in this study the authors used the percentage to measure the effect. The results of this study can prove whether K-SVNN can provide benefits of data reduction training and increased accuracy based on certain percentage reduction choices. The data set feature strength measurements in the authors' prediction using Fisher's Discriminant Ratio [6, 7].

The exposure of this paper is divided into four parts. Part 1 provides preliminary background of the author doing research and research related to the study. Section 2 presents the methodology of the study and design of systems. Section 3 presents the results and discussion. And section 4 presents the conclusions of the research and suggestions for next research.

2. METHODOLOGY
2.1 Research Methodology

Research methodology conducted by authors is presented in Figure 1. The input given is training data and K value of K-SVNN. Training data used by authors is part of the data set with a certain percentage. While K is a choice of K that can be set independently by user.
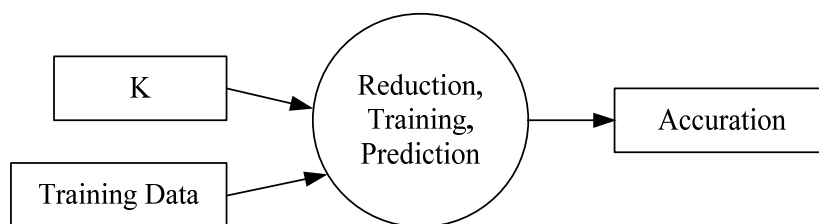
Figure 1. Research methodology

The authors use percentage as K value of K-SVNN. K serves as a determinant of reduction parameter, where K is the number of nearest neighbors involved in K-SVNN calculations. The data sets used by the authors have unequal number of data, then for proportional needs in the reduction authors use value of K with the percentage according to the number of data from the dataset. For example, for K = 10% of the data, then for data set with the number of data 200 will use K = 20, while for the data set with the amount of 500 data will use K = 50. In this study the authors use 10 variations of K, that is 10% , 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, and 100%. For K = 100% gives a 0% reduction result, so the FDR obtained must be the same as the K-NN method without data reduction.

The result of K-SVNN test with 10 variations of K as the author's way to know the correlation between the amount of reduction made to the prediction accuracy obtained. With reduced amount of training data due to reduction whether it can keep accuracy, decrease or increase. As in previous studies that the reduction done on the train data is able to keep the accuracy of predictions obtained. This study can prove the behavior.

To know the strength of training data of the results of the reduction at the time of prediction, the authors use Fisher's Discriminant Ratio (FDR) [6, 7]. FDR value is calculated on each feature, then calculated the sum of FDR value on each dataset. The sum of FDR value is calculated on the 10 K variations of K-SVNN specified in this study. Furthermore, the authors do the analysis on the results obtained.

3. RESULTS
3.1 Testing Result

The author tests on 5 public datasets downloaded from UCI Machine Learning Repository, they are: Iris (150 records, 4 feature), Vertebral Column (310 records, 6 features), Glass (214 records, 9 features), Wine (178 records, 13 feature), and Diabetic Retinopathy (1151 records, 18 features). Especially for Diabetic Retinopathy data sets, we don't use the first feature because value of the data variance same to 0. This caused the value of variant in one of the classes is zero. System testing using 5-fold, of which 80% is used as training data and 20% used as testing data.

The results of the tests that the author did on the data set Iris presented in Table 1. The reduction rate obtained proportional. It can be observed in the Reduction column, its value decreases as the value of K increases. The FDR value obtained for feature 1 continues to decrease as the value of K decreases. This result indicates that the 1st feature is proportional to the value of K but inversely proportional to the size of the reduction experienced. For features 2, 3 and 4 FDR values rise and fall along the value of K and the reduction experienced. The ability to separate classes can be seen in the Sum of FDR column, where Sum of FDR values are obtained by summing up all

FDR features. But the highest value of Sum of FDR is obtained only when 0% reduction or no reduction is done. This behavior indicates that for Iris data sets it is not suitable for reduction with K-SVNN.

Table 1. Result of FDR from Iris data set

No	K (%)	Reduction (%)	FDR of Feature				Sum of FDR
			1	2	3	4	
1	10	67.33	0.09	0.01	2.33	2.55	4.98
2	20	50.00	0.18	0.02	2.68	3.33	6.22
3	30	42.00	0.37	0.08	3.01	3.79	7.25
4	40	39.33	0.43	0.12	3.24	3.91	7.70
5	50	36.00	0.53	0.16	3.22	4.08	7.99
6	60	34.00	0.61	0.18	3.19	4.20	8.19
7	70	21.33	1.00	0.01	2.11	3.01	6.14
8	80	4.00	1.43	0.03	2.83	3.71	8.00
9	90	0.67	1.51	0.04	2.99	3.86	8.40
10	100	0.00	1.53	0.05	3.01	3.89	**8.48**
11	Without reduction		1.53	0.05	3.01	3.89	**8.48**

The results of the testing that the authors do on the data set Vertebral Column is presented in table 2. The FDR value given for feature 1 is also straight proportional to the decrease in value of K and inversely proportional to the amount of reduction experienced. Features 2 to 6 have FDR values that vary increase and decrease throughout the K value and reduction options experienced. The highest value of Sum of FDR is obtained by K = 50% with a value of 2.61, higher than without reduction of 2.10.

Table 2. Result of FDR from Vertebral Column data set

No.	K (%)	Reduction (%)	FDR of Feature						Sum of FDR
			1	2	3	4	5	6	
1	10	16.77	0.26	0.20	0.18	0.12	0.44	1.08	2.27
2	20	9.68	0.28	0.20	0.21	0.13	0.40	1.20	2.41
3	30	6.45	0.32	0.24	0.24	0.15	0.37	1.22	2.54
4	40	4.52	0.34	0.26	0.25	0.14	0.35	1.20	2.54
5	50	2.58	0.35	0.28	0.26	0.14	0.35	1.23	**2.61**
6	60	1.61	0.35	0.29	0.27	0.13	0.31	1.17	2.52
7	70	0.97	0.36	0.30	0.28	0.12	0.30	1.17	2.53
8	80	0.65	0.36	0.31	0.28	0.12	0.28	1.14	2.50
9	90	0.32	0.36	0.32	0.28	0.12	0.27	1.14	2.49
10	100	0.00	0.36	0.31	0.28	0.12	0.28	0.75	2.10
11	Without reduction		0.36	0.31	0.28	0.12	0.28	0.75	2.10

The results of the testing that the authors do on the data set Glass presented in Table 3. FDR values provided for features 1 and 9 straight proportional to the decrease in value of K. While features 6 and 7 inversely proportional. Features 2, 3, 4, 5, 7, and 8 have varying FDR values increase and decrease throughout the K value and reduction options experienced. The ability to separate classes has the highest Sum of FDR value obtained by K = 30% with a value of 6.40, higher than without a reduction of 5.62.

The results of the testing that the authors do on the data set Wine presented in Table 4. FDR values provided for feature 1 straight proportional to the decrease in value of K. Features 6 to 9 has a very small FDR value, zero in all options K used, this proving that the feature is not informative used in the classification. While other features have FDR values that vary increase and decrease throughout the selection of K value and reduction experienced. The ability to separate classes has the highest Sum of FDR value obtained by K = 40% with a value of 6.94, higher than without reduction of 6.89. This good result is different from the results of the research presented by Prasetyo [5] where the accuracy performance becomes poor when using K-SVNN for data reduction. Higher results in the study are global with FDR value.

Table 3. Result of FDR from Glass data set

No.	K (%)	Reduction (%)	FDR of Feature									Sum
			1	2	3	4	5	6	7	8	9	
1	10	38.79	0.00	0.36	2.64	0.72	0.09	0.10	0.08	0.50	0.06	4.56
2	20	7.94	0.01	0.56	3.60	1.17	0.06	0.09	0.05	0.75	0.09	6.38
3	30	2.34	0.02	0.55	3.83	0.97	0.08	0.09	0.04	0.72	0.10	**6.40**
4	40	1.87	0.02	0.55	3.64	0.98	0.09	0.09	0.03	0.73	0.10	6.22
5	50	1.40	0.03	0.55	3.31	0.98	0.09	0.06	0.01	0.76	0.11	5.90
6	60	1.40	0.03	0.55	3.31	0.98	0.09	0.06	0.01	0.76	0.11	5.90
7	70	0.93	0.03	0.56	3.16	0.96	0.09	0.06	0.01	0.65	0.11	5.63
8	80	0.93	0.03	0.56	3.16	0.96	0.09	0.06	0.01	0.65	0.11	5.63
9	90	0.93	0.03	0.56	3.16	0.96	0.09	0.06	0.01	0.65	0.11	5.63
10	100	0.00	0.05	0.50	3.28	1.01	0.05	0.00	0.00	0.60	0.12	5.62
11	Without reduction		0.05	0.50	3.28	1.01	0.05	0.00	0.00	0.60	0.12	5.62

The results of the testing that the author did on the data set Diabetic Retinopathy presented in Table 5. Actually, the FDR value provided by all the features in the table is low, almost zero all. The Sum of FDR value obtained in the data set without reduction is 0.92, while with reduction, Sum of FDR value varies above it, the highest is 0.98 with K 40%.

The FDR value given for feature 1 is straight proportional to the value of K. Features 6 to 9 has a very small FDR value, zero in all K options used, this proves that the feature is not informative used in the classification. While other features have FDR values that vary increase and decrease throughout the selection of K value and reduction experienced. The ability to separate classes has the highest Sum of FDR value obtained by K = 40% with a value of 6.94, higher than without reduction of 6.89.

3.2 Analysis

The graph of the results of the fifth test of the data set is presented in Figure 2. In the figure, the authors give the "x" mark to the highest Sum of FDR value. Data reduction on K-SVNN with certain K options turned out to provide high FDR value support as well. In the data sets tested by the authors, four of them provide a high FDR value when K is 30% to 50%.
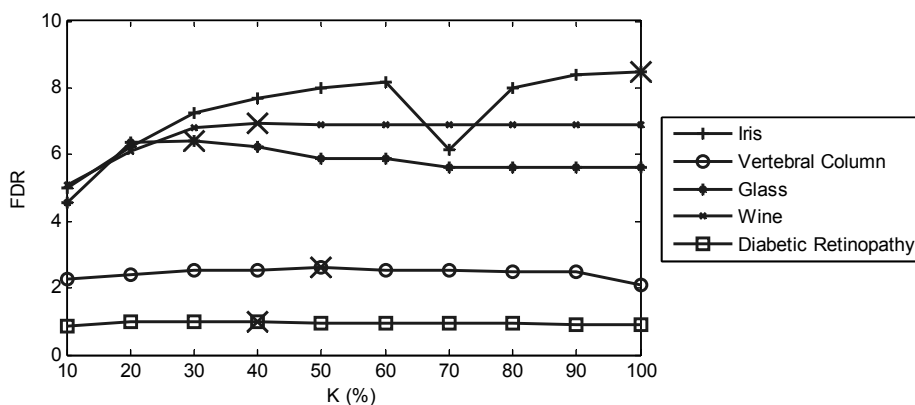
Figure 2. FDR value

At the highest FDR value, the reduction given to the K value is up to 4.49% as obtained in the Wine set data, while the smallest reduction is 0.26% as in the Diabetic Retinopathy data set. The graph of reduction rates obtained at the highest accuracy of the five data sets is presented in Figure 3.

For Iris data sets, the use of K-SVNN for data reduction does not increase the FDR value of all K options used. The value of FDR obtained is even lower than without reduction. Thus, for Iris data sets it is not appropriate to use K-SVNN for data reduction.

Table 4. Result of FDR from Wine data set

No.	K (%)	Reduction (%)	FDR of Feature													Sum of FDR
			1	2	3	4	5	6	7	8	9	10	11	12	13	
1	10	49.44	1.39	0.01	0.29	0.02	0.20	0.03	0.00	0.01	0.00	2.05	0.13	0.01	0.93	5.09
2	20	20.22	1.73	0.15	0.25	0.08	0.29	0.00	0.01	0.00	0.00	2.14	0.23	0.06	1.17	6.10
3	30	11.24	2.05	0.22	0.27	0.06	0.36	0.01	0.00	0.00	0.00	2.26	0.27	0.07	1.25	6.81
4	40	4.49	2.23	0.23	0.24	0.07	0.26	0.00	0.01	0.00	0.01	2.24	0.32	0.09	1.25	**6.94**
5	50	1.69	2.30	0.20	0.28	0.07	0.18	0.00	0.00	0.00	0.01	2.23	0.29	0.09	1.22	6.88
6	60	1.12	2.32	0.20	0.28	0.07	0.18	0.00	0.00	0.00	0.01	2.25	0.27	0.09	1.23	6.91
7	70	0.00	2.33	0.20	0.29	0.07	0.18	0.00	0.00	0.00	0.01	2.18	0.30	0.09	1.23	6.89
8	80	0.00	2.33	0.20	0.29	0.07	0.18	0.00	0.00	0.00	0.01	2.18	0.30	0.09	1.23	6.89
9	90	0.00	2.33	0.20	0.29	0.07	0.18	0.00	0.00	0.00	0.01	2.18	0.30	0.09	1.23	6.89
10	100	0.00	2.33	0.20	0.29	0.07	0.18	0.00	0.00	0.00	0.01	2.18	0.30	0.09	1.23	6.89
11	Without reduction		2.33	0.20	0.29	0.07	0.18	0.00	0.00	0.00	0.01	2.18	0.30	0.09	1.23	6.89

Table 5. Result of FDR from Diabetic Retinopathy data set

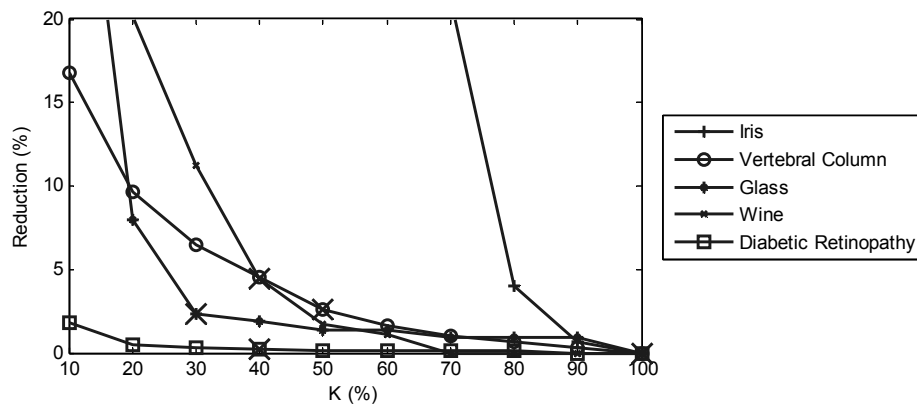| No.	K (%)	Reduction (%)	FDR of Feature																			Sum of FDR
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1	10	1.82	0.01	0.17	0.14	0.10	0.07	0.05	0.03	0.00	0.00	0.00	0.01	0.04	0.06	0.08	0.08	0.00	0.00	0.00	0.87
2	20	0.52	0.01	0.19	0.16	0.12	0.08	0.05	0.03	0.01	0.00	0.00	0.02	0.05	0.07	0.09	0.08	0.00	0.00	0.00	0.97
3	30	0.35	0.01	0.19	0.16	0.12	0.08	0.06	0.03	0.01	0.00	0.00	0.02	0.06	0.07	0.09	0.08	0.00	0.00	0.00	0.97
4	40	0.26	0.01	0.19	0.16	0.12	0.08	0.06	0.03	0.01	0.00	0.00	0.02	0.06	0.07	0.09	0.08	0.00	0.00	0.00	**0.98**
5	50	0.17	0.01	0.19	0.16	0.12	0.08	0.06	0.03	0.01	0.00	0.00	0.02	0.04	0.05	0.09	0.08	0.00	0.00	0.00	0.95
6	60	0.09	0.01	0.19	0.16	0.12	0.08	0.05	0.03	0.01	0.00	0.00	0.02	0.04	0.05	0.08	0.07	0.00	0.00	0.00	0.94
7	70	0.09	0.01	0.19	0.16	0.12	0.08	0.05	0.03	0.01	0.00	0.00	0.02	0.04	0.05	0.08	0.07	0.00	0.00	0.00	0.94
8	80	0.09	0.01	0.19	0.16	0.12	0.08	0.05	0.03	0.01	0.00	0.00	0.02	0.04	0.05	0.08	0.07	0.00	0.00	0.00	0.94
9	90	0.00	0.01	0.19	0.16	0.12	0.08	0.05	0.03	0.01	0.00	0.00	0.02	0.04	0.05	0.08	0.07	0.00	0.00	0.00	0.92
10	100	0.00	0.01	0.19	0.16	0.12	0.08	0.05	0.03	0.01	0.00	0.00	0.02	0.04	0.05	0.08	0.07	0.00	0.00	0.00	0.92
11	Without reduction		0.01	0.19	0.16	0.12	0.08	0.05	0.03	0.01	0.00	0.00	0.02	0.04	0.05	0.08	0.07	0.00	0.00	0.00	0.92

Figure 3. Reduction

Overall, the use of K-SVNN for data reduction does not necessarily increase the FDR value as a data capability parameter in separating classes. The FDR value here is still common among the classification methods. Need further testing on the classification method in order to obtain predictive accuracy.

4. CONCLUSION

The conclusions can be given from the results of this study as follows:
1. K-SVNN can be applied to the data set for data reduction while increasing the FDR value as a measure of the ability to separate classes.
2. In the five data sets used by the author, four of them can be applied K-SVNN for data reduction and one data set cannot. This means that in the data set used for classification it is necessary to test a number of K values of K-SVNN in order to know the effect of K-SVNN against it.

The suggestions are given as follows:
1. It is necessary to test the optimal choice of K on the classification method in order to know the performance increasing of the reduction performed.
2. The results of this study are limited to five data sets, need to be proved with other data sets to obtain a higher quality performance.

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DOUBLE FUZZY-PI CONTROLLER BASED SPEED CONTROL OF PERMANENT MAGNET SYNCHRONOUS MOTOR

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ABSTRACT

In high performance industrial application, Permanent Magnet Synchronous Motor (PMSM) becomes the main competitor for AC motor. PMSM has some advantages such as high efficiency, small size, high power density, large torque to inertia ratio, and low maintenance. PMSM is also very popular compared to DC motors in applications of machine tools, servo and robots, electric vehicle, and ship propulsions. Speed control of PMSM widely uses the conventional proportional integral (PI) controller, but PI controller has difficulty in speed changes, parameter variations and load disturbances. This paper presents double fuzzy logic controllers to tune the parameters of PI controller applied in the speed control of PMSM. Double fuzzy-PI (DFPI) controller is verified using simulation process for normal and disturbance conditions. DFPI controller has better performance compared to the conventional PI controller during change of operating condition. Simulation results of DFPI controller show that PMSM quickly achieve the speed reference, has small steady state error, no overshoot and reduce the speed oscillation during load disturbance condition.

Keywords: *Permanent Magnet Synchronous Motor, Speed Control, PI, Double Fuzzy Logic*

1. INTRODUCTION

Permanent Magnet Synchronous Motors (PMSM) are becoming the main competitor to other types of AC motors in high performance motor drives applications. PMSM have some advantages such as high efficiency, small size, high power density, large torque to inertia ratio, and low maintenance. PMSM are also very popular compared to DC motors in applications of machine tools, servo and robots, electric vehicle, and ship propulsions [1,2]. Some criteria of high performance motor drives applications are insensitivity to parameter variation, fast speed responses, and quick speed achievement to a speed reference during load disturbance occurs. The conversional proportional integral (PI) controller has been widely employed as speed controller for PMSM drives. In order to obtain the best results of speed control, the axial reactance parameters of the d-q PMSM should be correctly known. However, the conversional PI controller has difficulty in speed changes, parameter variations and load disturbances [1-6].

To solve these disadvantages of PI controller, various artificial intelligent (AI) techniques have been applied in motor drives systems to control the speed of motor. Fuzzy logic controller (FLC) can be considered to improve the performance of conventional PI controller. FLC can provide nonlinear control action by selecting the appropriate parameters. In this way, the success key of designing an FLC is to define well its parameters such as knowledge base, rule base and scale factor (3-9). Nowadays, a method of control at the base of double fuzzy controller and a proportional integral (PI) controller has been developed [10, 11].

This paper presents the usage of AI methods especially double fuzzy logic (FL) to tune the parameters of PI controller applied in the speed control of PMSM. The effectiveness of the proposed systems is verified by simulation process using SIMULINK-MATLAB. Therefore, performance of Double Fuzzy-PI controller is compared with the conventional PI controller during change of operating condition based on the performance of induction motor.

2. SPEED CONTROL OF PMSM

Block diagram of PMSM drives system used in this paper is shown in Figure 1. PMSM is connected to pulse width modulation (PWM) inverter using current control. PMSM currents are decomposed into i_d and i_q components. These components represent flux and torque components in d-q coordinate system.
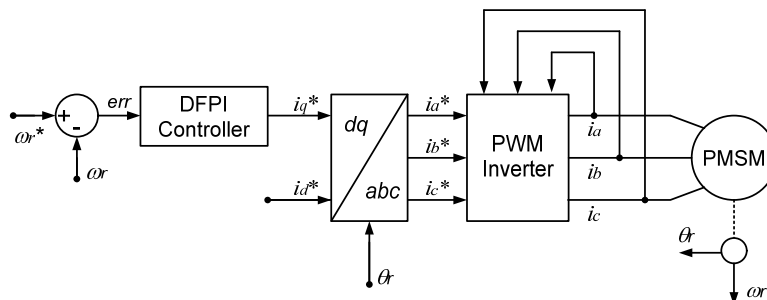
Figure 1. Block Diagram of PMSM Speed Control with DFPI Controller.

3. MATHEMATIC MODEL OF PMSM

The d-q model of the wound rotor synchronous machines is simply adapted to learn the dynamic performance of PMSM [1,2,4]. Back e.m.f. produced by permanent magnet is equal to produced by excited coil. Therefore, the d-q model of PMSM in the rotor reference frame can be seen in Equation (1).

$$\begin{bmatrix} u_d \\ u_q \end{bmatrix} = R_s \begin{bmatrix} i_d \\ i_q \end{bmatrix} + \frac{d}{dt}\begin{bmatrix} \phi_d \\ \phi_q \end{bmatrix} + \omega_r \begin{bmatrix} -\phi_q \\ \phi_d \end{bmatrix} \tag{1}$$

where u_d, u_q, i_d, i_q, ω_r, R_s, ϕ_d and ϕ_q are stator voltage and current in d-q frame, rotor speed, stator resistance, flux linkage in d-q frame, respectively.

Dynamic behaviour and electromagnetic torque of PMSM can be expressed in Equation (2) and Equation (3).

$$\frac{J}{p}\frac{d\omega_r}{dt} + \frac{f}{p}\omega_r = T_{em} - T_L \tag{2}$$

$$T_{em} = \frac{3}{2}p\left\{\phi_f i_q + (L_d - L_q)i_d i_q\right\} \tag{3}$$

where J, p, f, L_d, L_q, T_{em}, and T_L are rotor inertia, pole number, reactance linkage d-q frame, electromagnetic torque and load torque, respectively.

4. DESIGN OF DOUBLE FUZZY PI (DFPI) CONTROLLER

Fuzzy logic controller (FLC) is one of most popular artificial intelligence (AI). FLC is used to solve nonlinear control problem or whenever the system model is unknown or difficult to build. The FLC is built from three steps: fuzzification, control rules evaluation and defuzzification. The fuzzy rules are obtained through knowledge of the process systems which automatically extracted from sample process [3-11]. Figure 2 show the control algorithm of PMSM speed based on a double fuzzy PI controller. The speed of PMSM is compared with the reference to obtain the error speed shown by Equation (4).

$$e(t) = \omega_m^*(t) - \omega_m(t) \tag{4}$$

where $e(t)$, $\omega_m^*(t)$ and $\omega_m(t)$ are error speed, reference speed, and motor speed respectively.
The change of error speed is given by Equation (5).

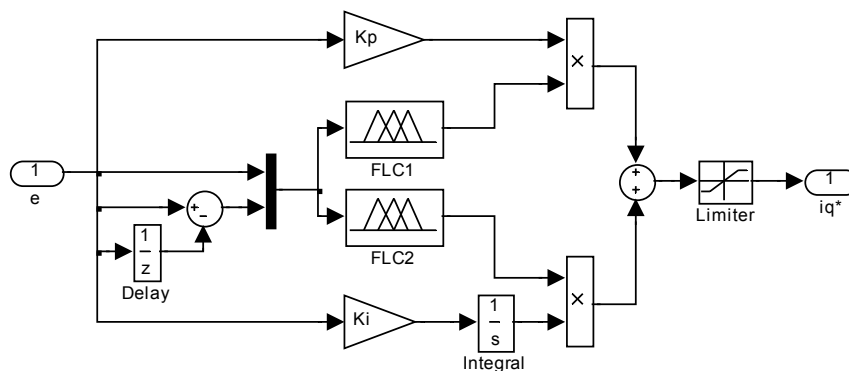$$de(t) = e(t) - e(t-1) \tag{5}$$

Figure 2. *The DFPI Controller for speed control of PMSM*

In this paper, FLC has five membership functions (MF) for two inputs and an output. Two inputs and an output are error (e), change of error (de) and promotional parameter (K_p) or integral parameter (K_i) respectively. The membership functions are built to represent its input and output value. The fuzzy sets of two input signals are as follows: ZE = Zero, PB = Positive Big, PS = Positive Small, NB = Negative Big and NS = Negative Small respectively. Whereas, the fuzzy sets of an output signals are as follows: S = Small, MS = Medium Small, M = Medium, MB = Medium Big and B = Big, respectively. Figure 3 and Figure 4 show the fuzzy sets and corresponding triangular MF description of two input signals and an output signals. The rule base of the FLC is shown in Table 1. Table 1 show that there may be 5 x 5 = 25 possible rules.
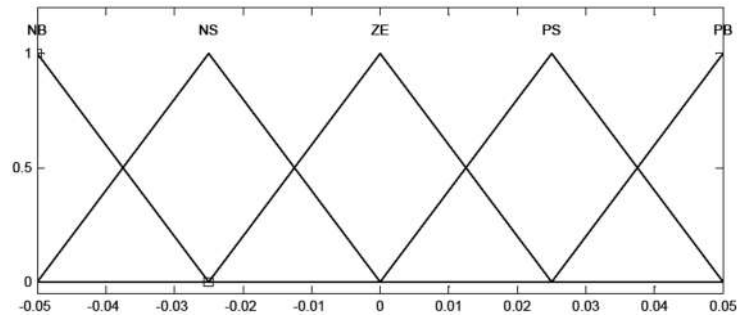
Figure 3. *Membership Functions for inputs of FLC*
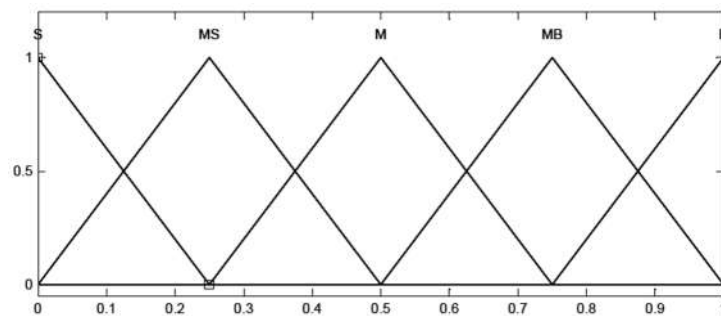
Figure 4. *Membership Functions for output of FLC*

Table 1. *Rule Base of FLC*

error (*e*)	change of error (*de*)				
	NB	NS	ZE	PS	PB
NB	S	S	S	MS	M
NS	S	S	MS	M	MB
ZE	S	MS	M	MB	B
PS	MS	M	MB	B	B
PB	M	MB	B	B	B

5. RESULTS

The effectiveness of the proposed Double Fuzzy-PI (DFPI) controller is clarified by simulation process. Simulation process is conducted in conditions of normal and disturbance. The parameters of permanent magnet synchronous motor (PMSM) used in this simulation is as follows: motor power of 1 HP, nominal voltage of 220 V, stator resistance of 2.875 Ω, direct inductance of 0.0085 H, quadrature inductance of 0.0085 H, 4 poles, inertia moment of 0.0008 kg.m^2, friction coefficient of 8x10^{-5} N.m.s, motor flux of 0.175 Weber. Figure 5 shows simulation model in SIMULINK-MATLAB.
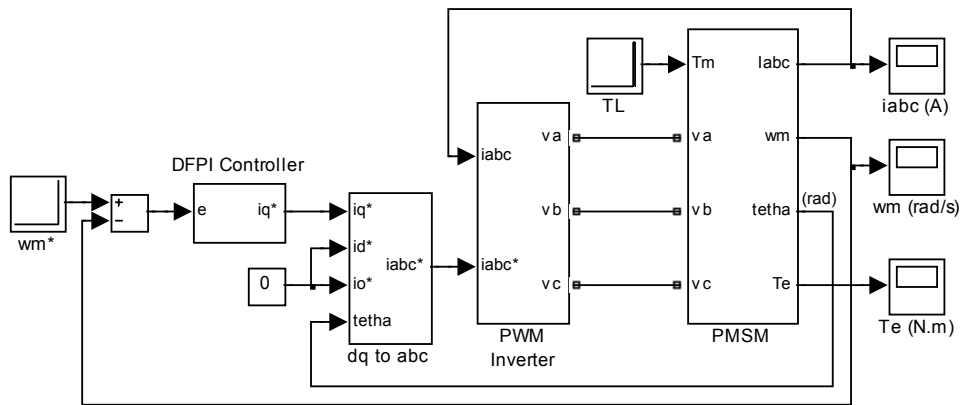
Figure 5. Simulation PMSM model using SIMULINK-MATLAB

Figure 6 shows speed response of PI controller and DFPI controller for speed reference of 700 rad/s. DFPI controller yields settling time of 0.008 s, no overshoot and small steady state error of 0.5 rad/s. Whereas, PI controller yields settling time of 0.013 s, overshoot of 4.1 % and also small steady state error of 1.1 rad/s. From their simulation results show that DFPI controller provide the improvement of performance compared to PI controller.
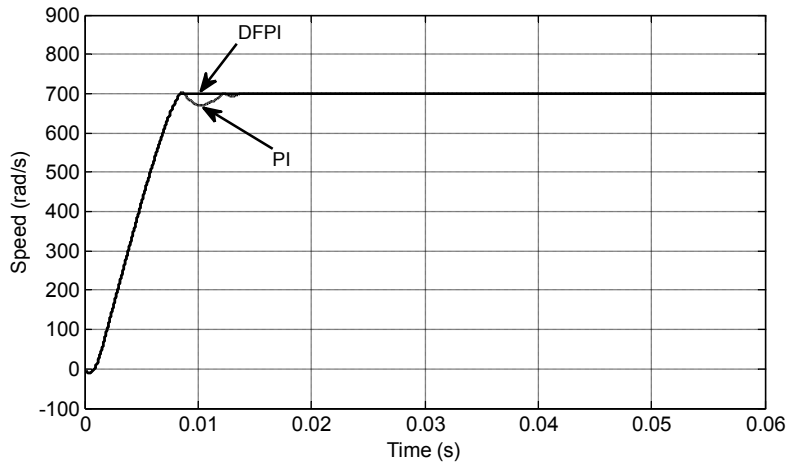
Figure 6. Speed response for speed reference of 700 rad/s.

Figure 7 shows comparison of the electromagnetic torque response between PI controller and DFPI controller. PI controller needs the greater electromagnetic torque than DFPI controller. These electromagnetic torques are used both controller to rapidly reach the speed reference, however PI controller causes speed oscillation.

Current of PMSM for PI and DFPI controllers are shown in Figure 8 and Figure 9. Both figures show that the change of electromagnetic torque causes the change of PMSM current.
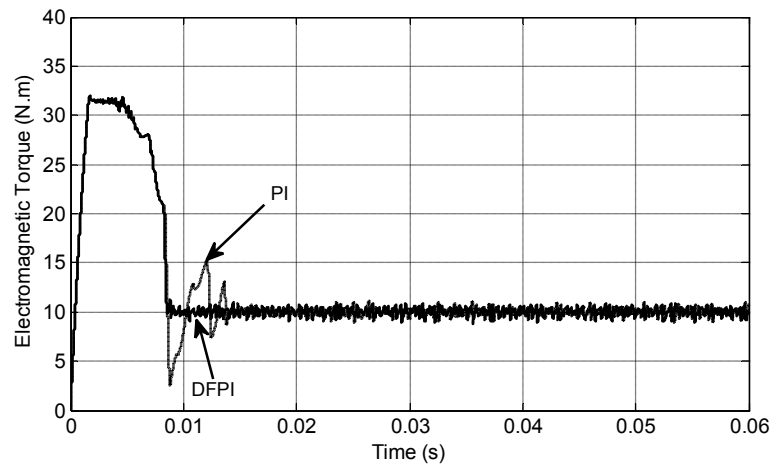
Figure 7. *Electromagnetic torque responses for PI and DFPI controllers.*
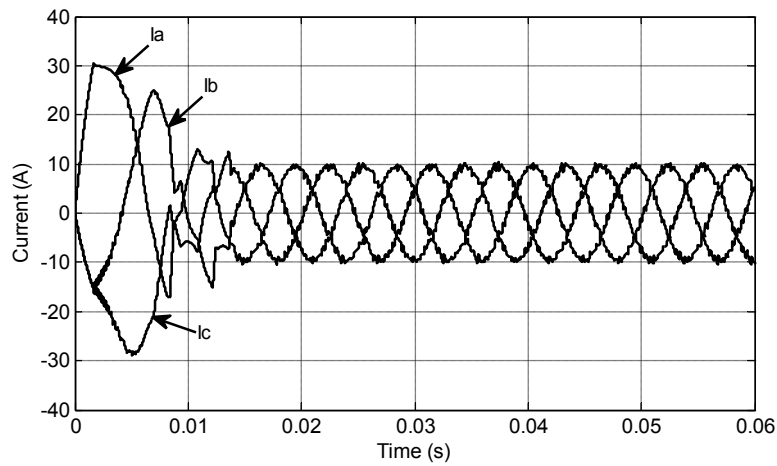
Figure 8. *Current of PMSM with PI Controller*
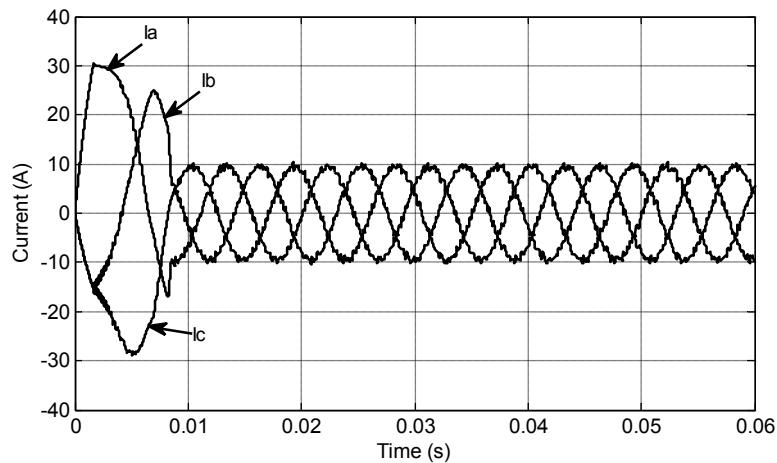
Figure 9. *Current of PMSM with DFPI Controller*

For disturbance conditions, the load torque of PMSM suddenly changes from 10 N.m to 15 N.m at t = 0.04 s and also returns again to 10 N.m at t = 0.041 s. The change of load torque affects the electromagnetic torque of PMSM shown in Figure 10. PI controller requests the greater electromagnetic torque than DFPI Controller. Disturbance also causes change of PMSM speed shown in Figure 11. Simulation result shows that speed error for PI controller is better than DFPI controller but PI Controller still produce speed fluctuation.
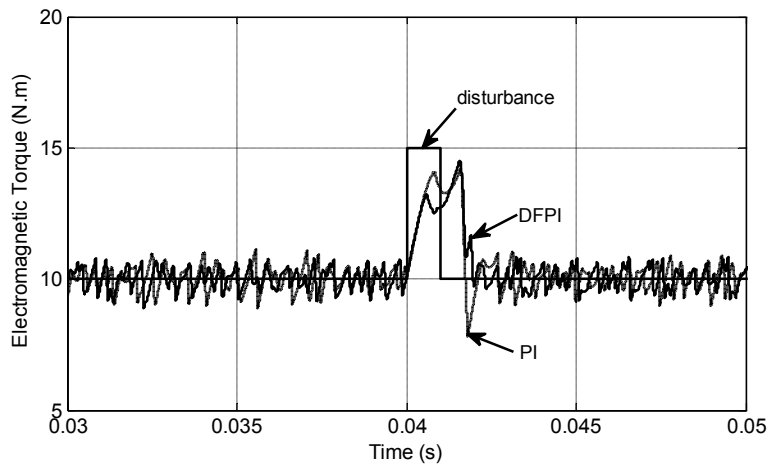
Figure 10. *Electromagnetic torque of PMSM for disturbance condition*
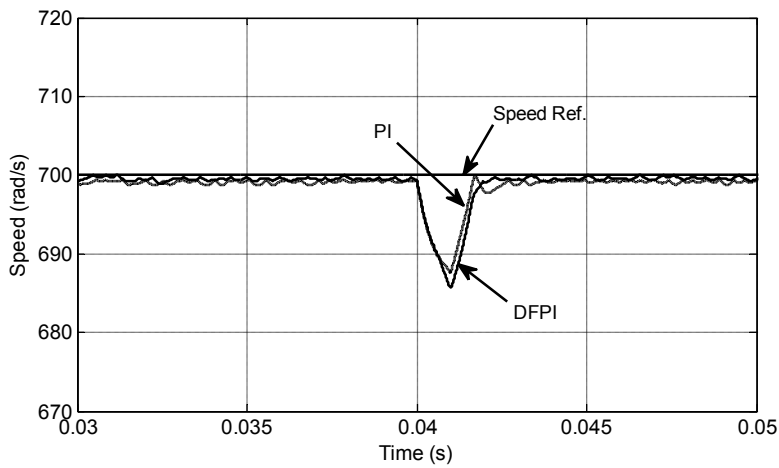
Figure 11. *Speed responses for disturbance condition*

Figure 8 and Figure show PMSM current of PI and DFPI controllers during disturbance condition. Both figures show that the disturbance causes the change of PMSM current. Simulation results show that PMSM current for DFPI controller is better than PI controller.
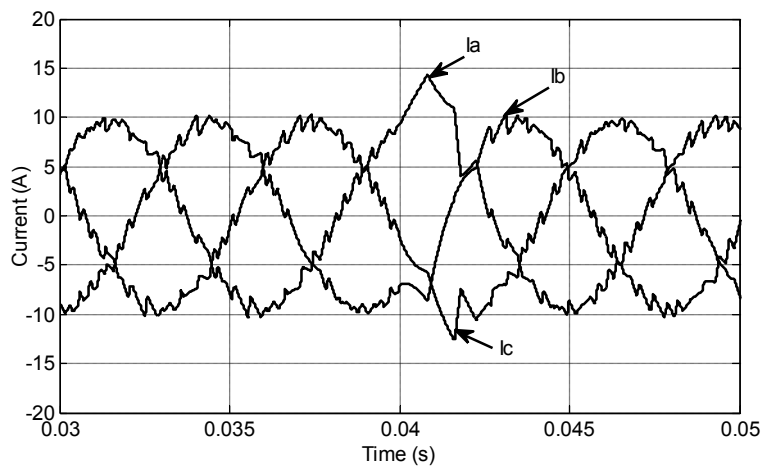
Figure 12. *Current of PMSM for PI Controller*
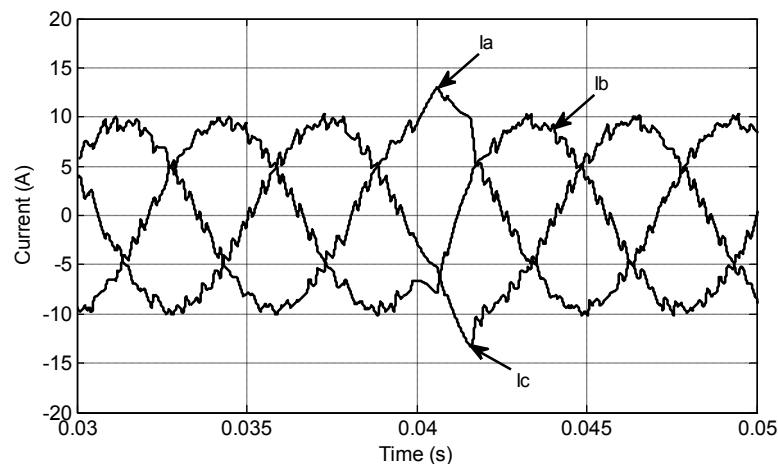
Figure 13. *Current of PMSM for DFPI Controller*

6. CONCLUSION

Double fuzzy proportional integral (DFPI) controller applied in speed control of PMSM has been presented and discussed. Double fuzzy logic technique is used to adjust the parameters of PI controller (*Kp* and *Ki*). Double fuzzy logic can improve the performance of PI controller when there are changes of PMSM parameters. DFPI controller proposed is verified by simulation process. Simulation results show that DFPI controller produces better performance compared to PI controller. DFPI controller rapidly achieves the speed reference, has small steady state error, no overshoot and decreases speed oscillation during load disturbance condition. The settling times of PI and DFPI controllers are 0.008 s and 0.013 s respectively. Whereas, steady state errors of PI and DFPI controllers are 0.5 rad/s and 1.1 rad/s respectively.

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SIMSOYA3D: A DATA-DRIVEN'S SIMULATOR OF SOYBEAN'S GROWTH MODELING USING TRAINABLE PARAMETRIC L-SYSTEM AND ANFIS ALGORITHM

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ABSTRACT

The purpose of this study was to design and build a system that is able to predict plant's growth patterns as a function of the nutrients obtained from fertilization pattern. The simulator is represented in 3-dimentional to perform animated models. As the object of research is Soybean (Glycine max (L.) Merrill).

The output parameters are long growth trunk / branches (L), a wide cross section of the leaf (W), and branch growth (B), as a function of changes in the fertilizing elements Nitrogen (N), Phosphate (P) and potassium (K), as input parameters of the system. Modeling done on the vegetative phase of the soybean crop.

The training phase of ANFIS are to obtain the values of Parametric L-system's constantas as a change of N-P-K you L-W-B values. In the implementation phase, using obtained constantas, the user's inputed datas could processed bythe Trained Parametric L-system to perform simulation of growth's function, and finally to perform 3-dimentional's animated models.

The test results on the system to grow plants pattern proves that ANFIS method is quite adaptive to variation of N-P-K values changes, and able to predict the output values of L-W-B. The visualization of 3D-animated models as the results of Trainable Parametric L-system has proven to be influenced by variations in the composition of input parameters(N-P-K values). Overall, the system has been running as expected. column as it is here, below the author information.

Keywords: *Parametric L-system, ANFIS, Plant growth simulation, Data driven modeling, 3D Plant growth animation*

1. INTRODUCTION

The purpose of this study was to design and build a system that is able to predict plant's growth patterns as a function of the nutrients obtained from fertilization pattern. The simulator is represented in 3-dimentional to perform animated models. As the object of research is Soybean (Glycine max (L.) Merrill). The modeling of plant growth patterns is combination of multidisciplinary scientific include: botany, agronomy, plant physiology, meteorology, soil science, and mathematics and computer science and has been used widely in agriculture, including to support the decision-making system [8]. Plant growth is categorized in two phases, namely vegetative phase (which includes the growth of roots, stems / branches, and leaves), and generative phase (characterized by the growth of flowers and fruit) [1]. The research of the characteristics of plant growth models are dynamic and very complex, so it is very difficult to approach using mathematical equations and conventional geometric [12]. The modeling of plant growth includes the natural process of biological systems of plant life, following the influence of environmental characteristics. For that purpose, artificial intelligence system approach, such as neuro-fuzzy method, is used. According to [4], neuro-fuzzy system is the mechanism of fuzzy inference system mapped into the architecture of artificial neural network. In the field of graphical computing, mathematical formulation of the plant growth structure that is widely applied is Lindenmayer system (L-system). The result of L-system is a string in L-system's grammar.

To display in 3-D graphically, the L-system result needs to be translated into the formation of 3-D coordinates using Turtle Geometry [9] [10]. With displayed in 3-D, the representation of the plant growth model as the function of environmental factors is expected to be more easily understood [3].

2. RESEARCH METHODS

The research began by identifying the parameters that influence plant growth, both internal and external, as the input and output of the system [8]. It can be concluded that the parameters such as nutrients, water, oxygen, and sunlight generally affect the growth of the trunk and branches and increment of leaves number [3].

2.1 System Architecture and User Interfaces

The final result of system's user interface is shown in Fig. 1. The architecture of plant growth simulation system that was built in this research is shown in Fig. 2, which describes the usage steps of plant growth simulation system. The flowchart of the system is shown in Fig. 3.
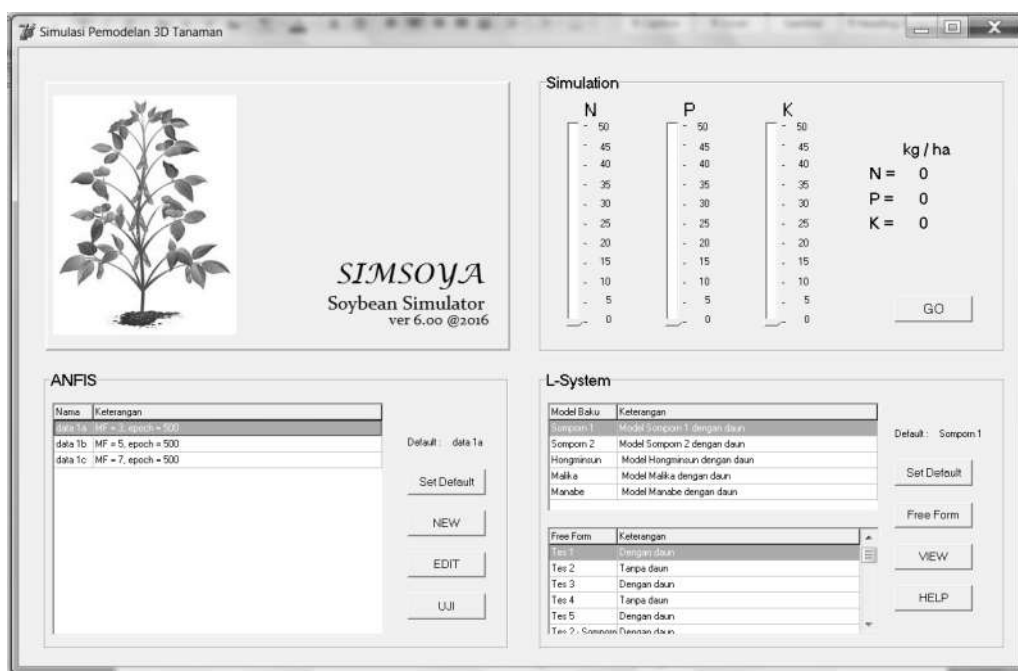
Figure 1. The user interfaces of plant growth simulation system
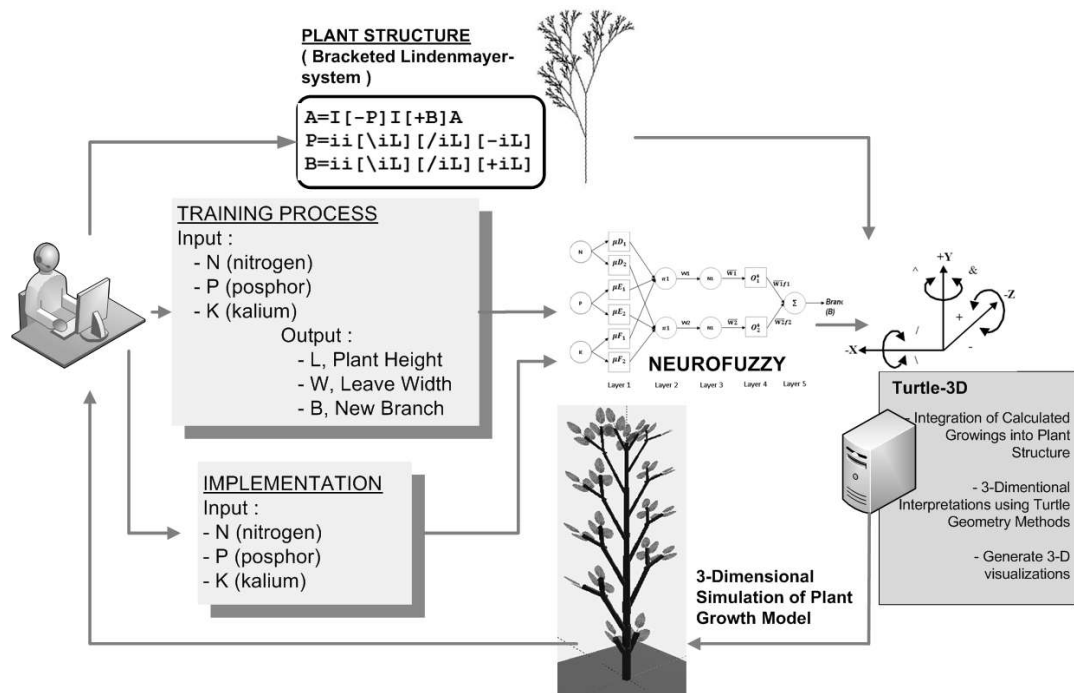
Figure 2. The architecture of plant growth simulation system

2.2 Parametric L-system

2.2.1 Parametric L-system with Turtle Geometry Representation

The L-system design in this research is based on the Parametric L-system method that represented visually in 3-D using Turtle Geometry. As explained in [1] and [9], to display the 3-D visualization of L-system string, the Turtle Geometry method has two steps, which are:

1) Interpret the Parametric L-system string by adding direction symbols which corresponds to Turtle Geometry method.
2) Using the matrix formula of Turtle Geometry to calculate the 3-D coordinates of the points in displaying the plant visually, such as the direction and position of the trunk, branch, twigs, and leaves.

In the first step, several direction symbols, such as shown in Table 1 and Figure 3, is added on the L-system string. Then in the second step, the main concept is to represent the orientation of the current position in a space with three vectors which shown the direction on X, Y, and Z axis. Those three vectors are orthogonal unit vectors. The rotation of the turtle, which represents the plant growth, is expressed by (1) – (3). Using (1) – (3), the coordinates of the next positon of each iteration in interpretation result of Parametric L-system string of plant structure can be calculated [3].

Table 1. Rules of Turtle Geometry

$$R_X(\theta) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & Cos(\theta) & -Sin(\theta) \\ 0 & Sin(\theta) & Cos(\theta) \end{bmatrix} \quad (1)$$

$$R_Y(\theta) = \begin{bmatrix} Cos(\theta) & 0 & -Sin(\theta) \\ 0 & 1 & 0 \\ Sin(\theta) & 0 & Cos(\theta) \end{bmatrix} \quad (2)$$

$$R_z(\theta) = \begin{bmatrix} Cos(\theta) & Sin(\theta) & 0 \\ -Sin(\theta) & Cos(\theta) & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad (3)$$
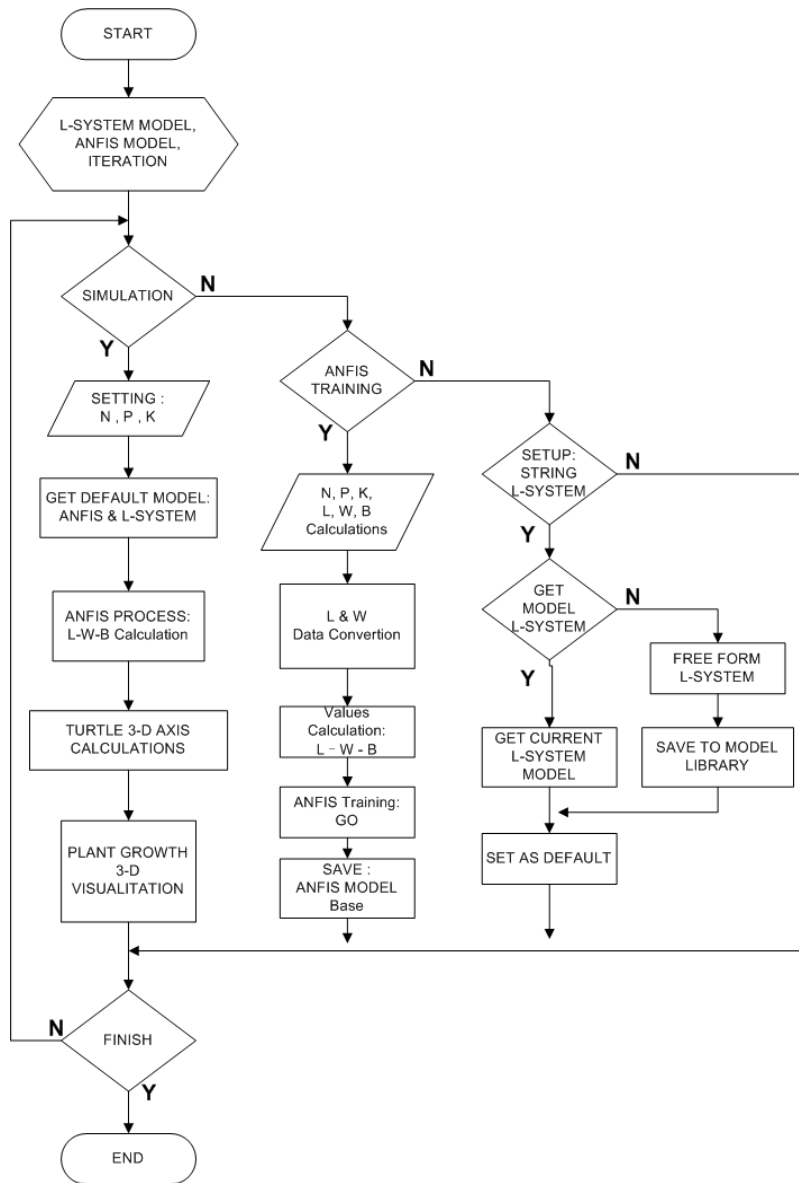
Figure 3. The flowchart of plant growth simulation system

2.2.2   Standard Model of Parametric L-system for Soybean Plant

Based on [1], the Parametric L-system rules with Turtle Geometry representation when applied to the plant modeling simulation has a frame of reference as follows:

> *{*
> *Axiom*
> *Production Rules*
> *End Rule*
> *}*

where Axiom is the determinant of growth starting point at each iteration starts, Production Rules are strings production which will produce the effect of plant growth simulation, and End Rule is the string to end the re-writing process. As the standard model in this research, some models of Production Rules that has been produced by earlier researchers are used, as shown in Figure 5 where :

> A = apex, the tip of the plant in an iteration,
> P = re-writing rule for internode (I) that leads to the left, and
> B = re-writing rule for internode (I) that leads to the right.

Symbol	Meaning
I	Add internode (trunk segments)
i	Add short-internode (branch segments)
L	Add leaf
[	Change position to create new branch
]	Back to the position before creating new branch
+	Turn left according to X axis with angle α using rotation matrix $R_H(\alpha_X)$
-	Turn right according to X axis with angle α using rotation matrix $R_H(-\alpha_X)$
&	Pitch down according to Z axis with angle α using rotation matrix $R_U(\alpha_Z)$
^	Pitch up according to Z axis with angle α using rotation matrix $R_U(-\alpha_Z)$
\	Roll left according to Y axis with angle α using rotation matrix $R_L(\alpha_Z)$
/	Roll right according to Y axis with angle α using rotation matrix $R_L(-\alpha_Z)$

Figure 4. THE LIST OF PARAMETRIC L-SYSTEM WITH TURTLE GEOMETRY REPRESENTATION

No.	Reference Model	Standard Model of L-system for Soybean Plant
1.	Model [8]	*somporn1* *{* *Axiom=I[+iL][-iL]A* *A = I[-P]I[+B]A* *P = IIII[\pL][/pL][-pL]* *B = IIII[\pL][/pL][+pL]* *Endrule* *B = IL* *P = IL* *A = IL* *}*
2.	Model [9]	*Hongminsun* *{* *Axiom=I[+iL][-iL]A* *A = I[+P]A* *Endrule* *P = P[\iL][/iL][-iL]* *}*
3.	Model [3]	*Malika* *{* *Axiom=I[+iL][-iL]A* *A = I[-P]I[+B]A* *P = I[\pL][/pL][-pL]* *B = I[\pL][/pL][+pL]* *Endrule* *B = IL* *P = IL* *A = IL* *}*
4.	Model [10]	*Manabe* *{* *Axiom=F* *F = FF-[[-F][+F][+F]]+[[+F][-F][-F]]* *Endrule* *F = I* *}*

Figure 5. Standard model of Parametric L-system for Soybean plant

2.2.3   Free-form Model of Parametric L-system for Soybean Plant
In this free-form mode, Parametric L-system models have a common frame of reference with the standard model. The difference is based on the free-grammar context which is the characteristics of the Parametric L-system that provides the flexibility of defining strings Production Rules, then the Production Rules string may use any letter symbols freely. Which means, the user can define the L-system strings specifically to their own needs. The free-form options are provided to assist the research process and further development of this research.

2.3   Neuro-Fuzzy (ANFIS) Model
2.3.1   Plant Growth Prediction Using ANFIS
The system is designed to be capable of providing predictions of the growth rate of soybean plants as a function of the N-P-K nutrients composition applied in plants. Function was created as predictor by utilizing the advantages of neuro-fuzzy method (ANFIS). Some advantages of method neuro-fuzzy method (ANFIS) are as follows:
-    Able to generate and associate,
-    Able to tolerate uncertainty,
-    Able to resolve the issue of non-linearity, and
-    Can be operated in real-time

Those advantages are utilized in this system to build a pattern model of correlation between the changes of input value N-P-K with the changes of output value L-W-B. Through the simulator system designed in this research, by varying the composition of the input value N-P-K, the changes in the growth amount of soybean plants produced by the simulator can be predicted.

2.3.2   ANFIS Architecture
To perform the modeling of soybean growth patterns, it takes ANFIS structure that can accommodate the needs of the growth parameters which are:

-    3 inputs (for fertilizer N, P, K), and

-    3 output (for L, W, and B)

Fundamentally, the ANFIS structure is only possible for one output. Then to accommodate the system which has 3 outputs, three identically structured ANFIS are used, each for output L (growth of trunk / branches / twigs), output W (growth of leaves width), and output B (growth of the branching) as shown in Fig. 6. The number of nodes in the first layer (membership function) can be varied, but to simplify the system, in this research we used the same number of nodes in the first layer.
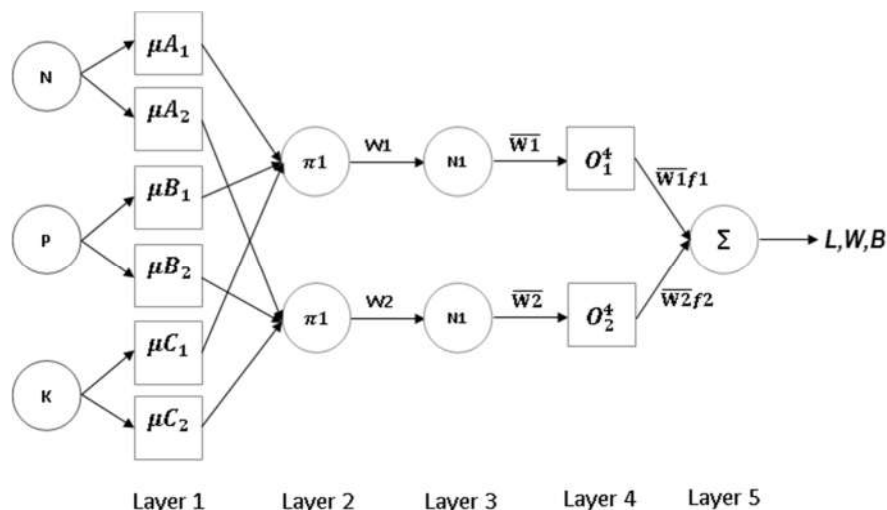
Figure 6. The ANFIS architecture for soybean growth simulation

2.3.3 ANFIS Algorithm

To obtain the model of soybean growth patterns, the data that has been inputted into ANFIS structure will be processed using the training process of ANFIS. In ANFIS training process, determination of the parameters to stop the training process is required. The parameters are:

- Error system < 0.01
- Epoch variable, with default value is 500.

The training process will stop if the epoch has reached the stopping value, although the error value of the system has not reached the stopping value yet. If that happens, then the re-training process is needed with increasing the epoch value until the error value reached the stopping value that has been determined (less than 0.01).

2.4 The Merging of Parametric L-System Model with Neuro-Fuzzy Model

Once the L-system string of the plant structure had been obtained, we calculate the coordinates of trunk, branches, twigs, and leaves position. This require the calculation of the final coordinates (x2, y2, z2) of an object based on:

- The coordinates of start position (x1, y1, z1),
- The length or distance to the end position (l), and
- The directions (α degrees) towards the end position.

In 3-D L-system modeling using GL Scene, coordinates of trunk and branch segments are calculated at their segment's midpoint. To determine the L-system coordinates of the trunk and branch, calculation using Turtle Geometry is used.

3. RESULTS AND DISCUSSION

Data used in the experiment is secondary data, which means that the data has been obtained by the previous researches of soybean plant, among others was obtained from [1], [3], and [5]. The experimental results of the ANFIS system are shown in Table 2. The experimental results shows that the average error of the system decreases with the increasing number of the membership function (MF). A decrease in the average error value of a system means the increase of ANFIS system performance.

The example of experimental result of the system in 3-D animation which are dynamic and adaptive to the changes of N-P-K input are shown in Fig. 7. All the simulations result in Fig. 7 was performed in 3 iterations and has a same L-system string as follows:

```
{
Axiom : I[+iL][-iL]A ;
Rule : A=I[-P]I[+B]A ;
  P=ii[\iL][-iL] ;
  B=ii[/iL][+iL] ;
End Rule : A=I[L][+iL][-iL] ;
  P=I[+iL][-iL] ;
  B=I[+iL][-iL]
}.
```

Table 2. Experimental Results

#	Num of ANFIS MF's	Average *Errors* (%)		
		L	W	B
1	3	13.4	18.4	18.8
2	4	10.4	9.4	12
3	5	7.4	7.5	10.6

(a) Differences in L values (b) Differences in W values

(c) Differences in B values
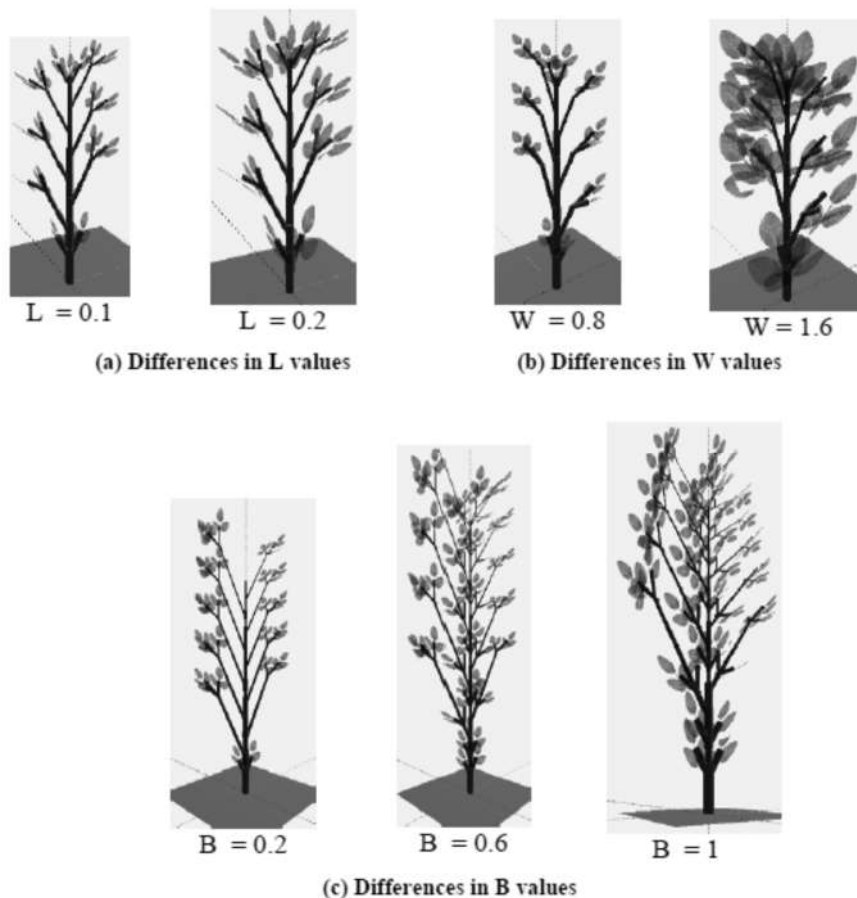
Figure 7. Simulation results with the difference in L-W-B values

4. CONCLUSION

In this research, a system that can help to model and visualize the growth of soybean plants based on the variation of the given NPK nutrition has been built. ANFIS method can be applied to calculate the input data which are the quantities of N-P-K nutrients and produce the output which are the growth of branch (L), growth of leaf's width (W), and the increase of branch number (B). The final result of L-system string with its visualization has proven to be influenced by the changes in N-P-K values composition. The visualization method with Turtle Geometry has proved able to interpret L-system string into 3-D visualization and adaptively accommodate the differences in N-P-K quantity patterns based on the input-output data in the ANFIS training process.

Based on the experimental results, the increment in number of membership function has correlation with the average error value of the system, as well as the ANFIS training time. The average error value is decreased when the number of membership value is increased, in this research the minimal average value of this system is reached when the number of membership function is 5. The minimal error values for the L, W, and B are 7.4%, 7.5%, and 10.6% respectively.

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CLASSIFICATION OF ACTIVE SELLING DETERMINATION FOR BOOK PRODUCTS USING C4.5 ALGORITHM (CASE STUDY: PT.KOMPAS GRAMEDIA NON GAM DIVISION)

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ABSTRACT

Along with the growth of business in the era of globalization and advances in the field of information technology that quickly provide a considerable influence in the field of industry and services. It also brings a big change in the level of competition between companies, so the perpetrators of the company must always create a variety of techniques to keep growing and in demand to be able to take the right decision in increasing sales. Therefore, a classification system of determining the active selling of book products using Algorithm C4.5 is established. From the results of 2 testing results obtained that the book product active selling has a little percentage of the non-active selling.

Keywords: Classification, Active selling, Algorithm C4.5.

1. INTRODUCTION

Along with the growth of business in the era of globalization and advances in the field of information technology that quickly provide a considerable influence both in the field of industry and services. It also brings a big change in the level of competition between companies, so that the perpetrators of the company must always create a variety of techniques to continue to grow so that in demand to be able to take the right decision in increasing sales. To be able to do so, the company needs a lot of information sources to be in further analysis. The purpose is design and build systems to classify active selling products and giving the result value obtained from the calculation with algorithm C4.5 from criteria that have been specified.

There are some literature review in between Jefry. (2013), Implementation Algorithm C4.5 In Application To Predict Number Of Students Repeating Subjects In STIMIK AMIKOM Yogyakarta, STIMIK Amikom Yogyakarta, Yogyakarta, Page 1-14 and Swastina, Liliana (2013), Application of Algorithm C4.5 For Student Determination, STIMIK Indonesia, Banjarmasin, Page 93 – 98.

2. METHODOLOGY
2.1 System Planning
2.1.1 Flowchart
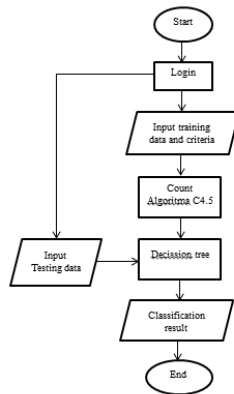
Figure 2.1 *Flowchart Process Algorithm C4.5*
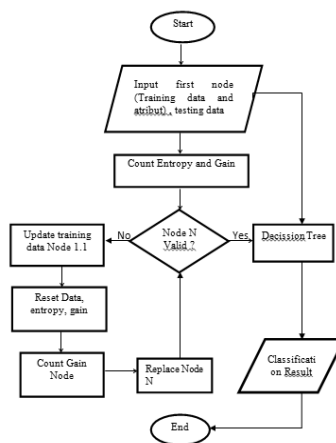
Figure 2.1 *Flowchart Process Algorithm C4.5*

For the design of the application system in accordance with the system flowchart Figure 2.1 and flowchart program Figure 2.2, then for example calculation Algorithm C4.5 Classification determining the active selling for the product book sample data table 2.1 is as follows:
Here is the training product data book used:

Table 2.1 Training Data

Publisher	Years of publish	Type	Price	Tax	Sale
Very salable	Medium	Scientific	Cheap	Cheap	Few
Very salable	Medium	Scientific	Cheap	Cheap	Few
Very salable	Very long	Non fiction	Cheap	Expensive	Many
Less Saleable	Medium	Fiction	Cheap	Cheap	Few

Less Saleable	Medium	Scientific	Cheap	Cheap	Few
Medium	Very long	Non fiction	Cheap	Expensive	Many
Medium	Old	Non fiction	Cheap	Expensive	Many
Very salable	Old	Non fiction	Cheap	Expensive	Many
Very salable	Medium	Fiction	Cheap	Cheap	Few
Less Saleable	Medium	Fiction	Cheap	Cheap	Few
Very salable	Old	Non fiction	Medium	Expensive	Few
Very salable	New	Non fiction	Medium	Expensive	Few
Very salable	Very new	Non fiction	Cheap	Expensive	Few
Less Saleable	Medium	Fiction	Cheap	Cheap	Medium
Very salable	New	Non fiction	Medium	Expensive	Few

1. Calculating the value of entropy and gain

$$Entropi\ (S) = (-\left(\frac{110}{200}\right)\log 2 \left(\frac{110}{200}\right)) + \left(-\left(\frac{90}{200}\right).\log 2 \left(\frac{90}{200}\right)\right) =$$
$$= \frac{-\left(\frac{110}{200}\right)\ln\left(\frac{110}{200}\right) + \left(-\frac{90}{200}\right)\ln\left(\frac{90}{200}\right)}{ln2} = -0.9930$$

There : ln2 = 0.693

Table 3.1 Results of Data Calculation Training

Total cases	Sum (Yes)	Sum (no)	Sum Of Entropy
200	110	90	0.9930

Table 4.9 Attribute Analysis, Value, Number of Value Events, Entropy and Gain

Node	Attribut	Value	Sum (Value)	Sum (Yes)	Sum (No)	Entropy	Gain
1	Publishers	Very salable	29	0	29	0.0000	
		Medium	30	30	0	0.0000	
		Less salable	141	80	61	0.9871	
							0.2971
	Years of Publish	Very Long	15	15	0	0.0000	
		Old	20	20	0	0.0000	
		Medium	20	0	20	0.0000	
		New	112	75	37	0.9155	
		Very New	33	0	33	0.0000	
							0.4803
	Type	Fiction	114	60	54	0.9982	
		Non Fiction	50	50	0	0.0000	
		Scientfic	36	0	36	0.0000	
							0.4240
	Price	Cheap	158	85	73	0.9960	
		Medium	25	25	0	0.0000	
		Expensive	17	0	17	0.0000	
							0.2061
	Tax	Cheap	27	0	27	0.0000	
		Expensive	173	110	63	0.9463	
							0.1744
	Sale	Few	117	70	47	0.9721	
		Medium	43	0	43	0.0000	
		Many	40	40	0	0.0000	
							0.4243

Because the largest gain value is the attribute of the Year of Publish. Then Year of Publication becomes the root node (root node). Then in the Very Long Issue Year it has 15 cases and all of them have No answer (Sum (Total) / Sum (No) = 15/15 = 1), Year of the Length has 20 cases and all have no answer (Sum (Total) / Sum (No) =

20/20 = 1), Publish Year Medium has 20 cases and all have answers Yes (Sum (Total) / Sum (Yes) = 20/20 = 1), Year Very New has 33 cases and all have Answer Yes (Sum (Total) / Sum (Yes) = 33/33 = 1). Thus the Year Is Very Old, Old, Medium and Very New to be leaf or leaf.
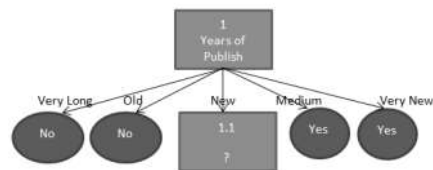
Figure 3.3 Decision Tree Node 1

Based on the formation of the decision tree node 1 (root node), Node 1.1 will be analyzed further. For simplicity, Table 4.7 is filtered by retrieving data that has Year Rising = New then do iterated like node 1 until each leaf / leaf has all classes.

3. RESULTS
3.1 System View
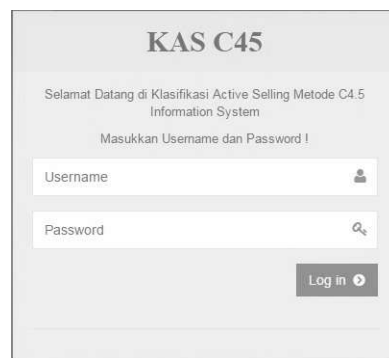
Figure 4.1 Login
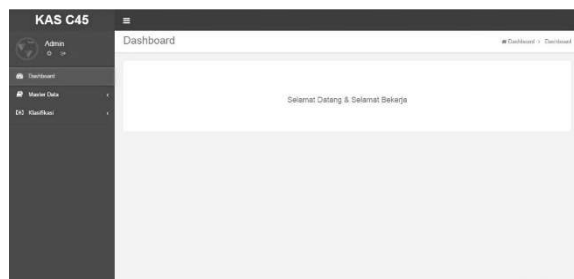
Figure 4.2 Dashboard
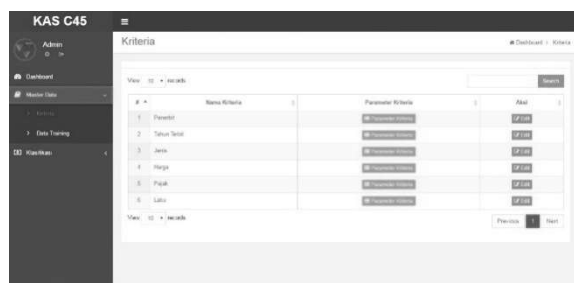
Figure 4.3 Criteria
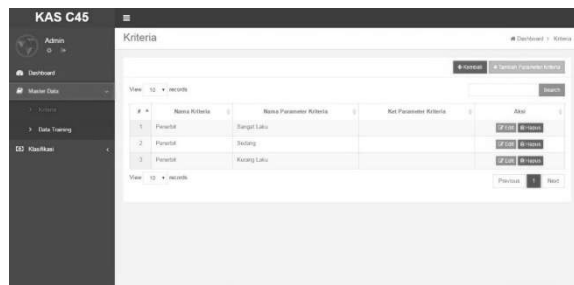
Figure 4.4 Parameter Criteria
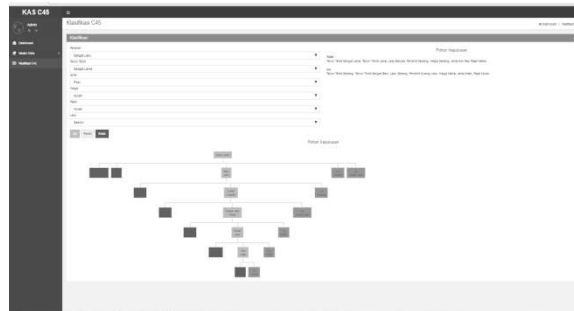
Figure 4.4 Form Classification C4.5

3.2 System Testing

Testing the system will be done two times the testing process of testing A and B that have different data composition by using different criteria parameters according to the class of the decision tree and data testing the same. The amount of data testing used in the testing process there are A there are 300 data and test B there are 150 data

Table 5.1 Test Result A

.

No	Test	Active Selling	Not Active Selling
1	First	52	-
2	Second	-	248

In the table above can be seen the acquisition of percentage of testing criteria of different parameters as follows:

From testing A with 300 test data obtained the value of active selling 52 data and there are 248 data instead of active selling, then:

$$\text{Active Selling} = \frac{The\ amount\ of\ test\ result\ data}{Amount\ of\ data\ performed} = \frac{52}{300} = 0.17 * 100 = 17\%$$

$$\text{Not Active Selling} = \frac{The\ amount\ of\ test\ result\ data}{Amount\ of\ data\ performed} = \frac{24\ 8}{300} = 0.83 * 100 = 83\%$$

Meanwhile, to know the level of accuracy and error in the test A, from the data 300 test data obtained predicted value of 216 data output in accordance with the actual data output and there are 84 data whose output is not in accordance with the actual data output.

$$\text{Accuration} = \frac{Amount\ of\ data\ predicted\ is\ correct}{Amount\ predicted} = \frac{21\ 6}{300} = 0.72 * 100 = 72\%$$

Error $= \dfrac{Amount\ of\ data\ predicted\ is\ wrong}{Amount\ predicted} = \dfrac{84}{300} = 0.28 * 100 = 28\%$

From the calculation can be concluded that the system has an accuracy of 72% and error rate of 28%.

3.3 Discussion of Test Results

From the calculation can be seen that the test A percentage of active selling 17% and non 83% active selling and on test B the percentage of active selling 11% and non 89% active selling. Comparison of classification results can be seen in the graph below.
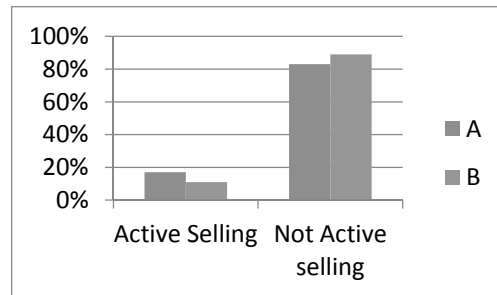
Figure 6.5 Comparison graph

From the comparison chart can be concluded that after done 2 times the test phase with the composition of different test data then the active book product selling less than the book product instead of active selling.

4. CONCLUSION
4.1 Conclusion

The conclusion that can be from this research that is;
1. The system of determining the active selling of book products has been successfully implemented by using Algorithm C4.5 with the calculation of accuracy and trial.
2. From the test results conducted two times using different criteria parameters, it can be seen that in the test A book product active selling obtained percentage of 17% and non-active selling book products obtained 83% percentage and on test B book product active selling earn percentage 11% And non-active selling book products earn 89% percentage.
3. From the calculation of accuracy and error on the test A accuracy of 72% and error 28% while in the B test accuracy of 79% and error 22%
4. Determination of parameters greatly affects the final result.

4.2 Suggestions

From research that has been done writer, there are some suggestion which can be given by writer for further research is as follows:
1. The system is in the provision of random parameter criteria, it is expected in subsequent research parameters of the criteria to be optimized so that the data will be evenly classified against the group.
2. The addition of system features to make it easier for the admin or user in using the system.

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MAZE SOLVING RETURN TRIP FOR MOBILE ROBOT USING DEEP FIRST SEARCH METHODE

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ABSTRACT

This paper is the result of research on wheeled robot strategy in completing task by using deep first search (DFS) method for return trip. This DFS method serves to map the path through which the robot and process it as a return trip route. By this method the robot is able to recognize the intersection, obstacle, and field door conditions. So that the robot can know the way that has traveled through the robot from the point of departure (home) to the room (R1-R4) where the target is located. The results obtained are robots capable of completing tasks in less than 60 seconds.

Keywords: *mobile robot*, *Deep First Search*, *return trip*

1. INTRODUCTION

A mobile robot declared a successful return trip after performing the task if the time taken in a return trip quickly. So that needed a change strategy for return trip. The robot strategy to perform a return trip is to map the shortest path from the start point to the point of finding the target and process the data as a route for the return trip. The robot must know the start / home start position and recognize every right turn that has been passed if the robot uses the right-hand wall scan. That way the robot can determine the shortest path for the return trip after successfully performing the task.

Deep First Search is one of the methods used to find a way out of a labyrinth. With this method the micromouse robot can explore the labyrinth and find the shortest path to the finish. In searching for a way out of a labyrinth where the formed field can be represented in binary form and in each plot there are a maximum of 4 possibilities: top, right, bottom and left.

Deep First Search method can be applied to the robot as a robot solution to be able to perform a return trip. In Deep First Search Method the route formation is done by storing each condition encountered by the robot and removing unnecessary conditions. The two processes are repeated over and over until the target is met. Once the target is met then the route will be formed and the route will be reversed so that the shortest route from the target point to start. Deep First Search method is suitable for microcontroller because it does not require large memory.

2. METHODOLOGY

2.1. Deep First Search (DFS) Method

DFS is one of the methods used to find a way out of a labyrinth. With this method the micromouse robot can explore the labyrinth and find the shortest path to the finish. In searching for a way out of a labyrinth where the formed field can be represented in binary form and in each plot there are a maximum of 4 possibilities: top, right, bottom and left.

DFS method can be applied to the robot as a robot solution to be able to perform a return trip. In DFS Method the route formation is done by storing each condition encountered by the robot and removing unnecessary conditions. The two processes are repeated over and over until the target is met. Once the target is met then the route

will be formed and the route will be reversed so that the shortest route from the target point to start. Deep First Search method is suitable for microcontroller because it does not require large memory.

2.1. Deep First Search (DFS)

The DFS method will depict the robot track from home to target based on the intersection that the robot has passed into a tree. The target or finish point of the DFS search tree is the white line of the room with fire. Robot will process the data of the search tree to be reversed and used as a reference for the return trip. The field used in this study is shown in Figure 1.
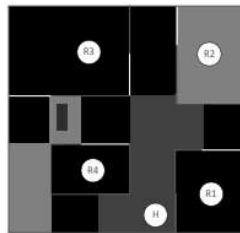
Figure 1. Field used

The field has four rooms named as R1, R2, R3, R4 and has a start position located at point H along with a dog obstacle located along the corridor with a rectangular image. From the field above, the robot travel scheme of four rooms can be described in accordance with Figure 2 below.
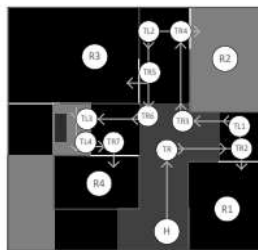
Figure 2 robot travel scheme

Flowchart of main program of the wheel robot and DFS program is represented on figure 3 and figure 4, respectively.
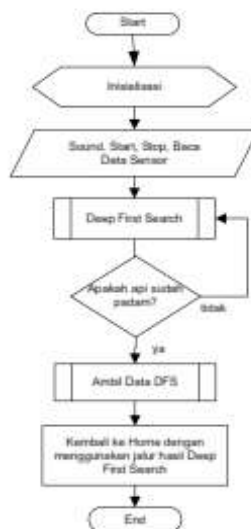
Figure 3. Main Program of wheel robot
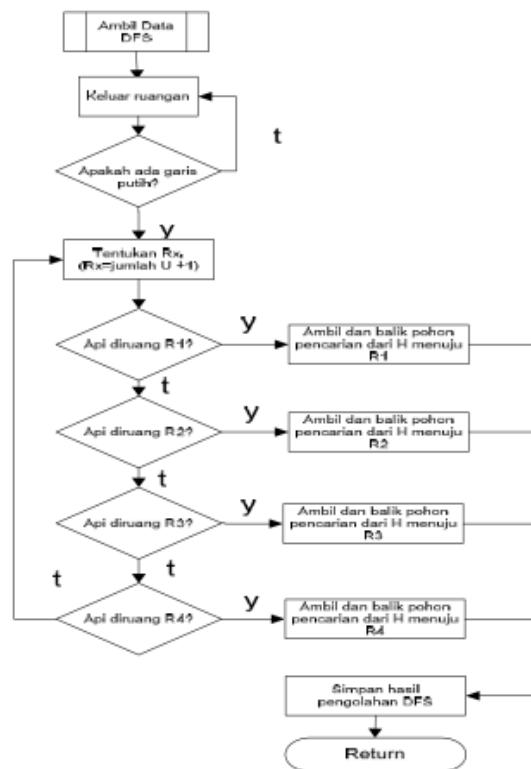
Figure 4 Sub Program of the DFS

After the start button is pressed, the robot executes the DFS process until the robot finds the white line of the room which is in it there is target. If the white line is found then the robot will enter the room and perform the task. And the robot will update the data after the execution of the task is completed. The updated data initializes that the robot must exit the room and compile the DFS result data from the home point into the room. Data from the search tree results will be used to exit the room and make a return trip.

2.2. DFS From Point H To Room R1

DFS is used in room R1 where the target is placed. For a robot travel scheme image from point H to point R1, the robot journey can be seen in the search tree diagram in figure 5.
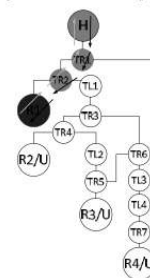
Figure 5 Tree Diagram Search target in R1

2.3 Deep First Search From Point H to Room R2

DFS is used in room R2 in which the target is fired. For a robot travel scheme image from point H to point R2, the robot journey can be seen in the search tree in figure 6
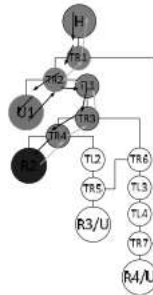
Figure 6 Tree Diagram Search target in R2

2.4 Deep First Search From Point H to Room R3

DFS is used in room R3 in which the target is fired. For a robot travel scheme image from point H to point R3, the robot journey can be seen in the search tree in figure 7.
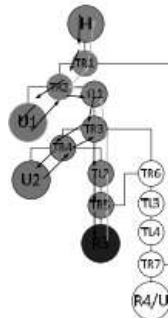
Figure 7 Tree Diagram Search target in R3

2.5 Deep First Search From Point H To Room R4

DFS is used in room R4 in which the target is fired. For a robot travel scheme image from point H to point R4, the robot journey can be seen in the search tree in figure 8.
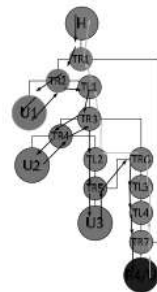
Figure 8 Tree Diagram Search target in R4

3. RESULTS
3.1. Deep First Search Method Room R1

In this experiment the robot is placed at point H and the target in room 1. Here is a table of DFS experiments on room R1.

Table 1 Result of return trip experiment data from room R1 to Home point

Exp.	Return trip time (second)	Return trip success	Exp.	Return trip time (second)	Return trip success
1	9	Yes	6	9	Yes
2	9	Yes	7	10.5	Yes
3	8.5	Yes	8	10.5	Yes
4	10	Yes	9	9	Yes
5	11	Yes	10	9	Yes

In this test robots have virtually no difference between the DFS method and the back home method using left-sided scans.

3.2 Testing Method Deep First Search Space 2

In this second test the robot is placed at point H and the target for DFS is the return trip from room 2. The experiment is done many times as many as ten times trial. Here is a table of DFS experimental results in room R2 for the return trip from R2 to the starting point of the robot H.

Table 2 Result of return trip experiment data from room R2 to Home point

Exp.	Return trip time (second)	Return trip success	Exp.	Return trip time (second)	Return trip success
1	17	Yes	6	20	Yes
2	20	Yes	7	20	Yes
3	22	Yes	8	20	Yes
4	19	Yes	9	18.5	Yes
5	22	Yes	10	19	Yes

From the data Table 2 can be seen that the robot managed to return trip without entering the existing room. There is a significant time difference between the DFS method and the robot method which rely solely on the right or left wall scan alone in the return trip.

3.3 Tests of Deep First Search Methods of Space 3

The robot is placed at point H and the DFS target is the return trip from the room 3. In this experiment the robot is placed in a rather oblique facing direction (the direction of the wind). The following is a DFS trial data table for return trip in room R3.

Table 3 Result of return trip experiment data from room R4 to Home point

Exp.	Return trip time (second)	Return trip success	Exp.	Return trip time (second)	Return trip success
1	24	Yes	6	22	Yes
2	21	Yes	7	23.5	Yes
3	25	Yes	8	22	Yes
4	110	No	9	23	Yes
5	90	No	10	23	Yes

From the data Table 3 robots can make a return trip without entering the room around but in some experiments robot failed to make a return trip because of errors in the ultrasonic sensor, and also because there was an error on the sensor readings. While in the last experiment the robot managed to make a return trip.

3.4 Testing Method Deep First Search Space 4

Testing in this room is the last room. Number of experiments performed ten times. The robot is placed at the same starting point at point H and the DFS target is the return trip from room 4 to point H. Here is a table of five DFS experiments on the R4 robot.

Table 4 Result of return trip experiment data from room R4 to Home point

Exp.	*Return trip* time (second)	*Return trip* success	Exp.	*Return trip* time (second)	*Return trip* success
1	7	Yes	6	7	Yes
2	7	Yes	7	8	Yes
3	8	Yes	8	8	Yes
4	6	Yes	9	8	Yes
5	7	Yes	10	7	Yes

From the data Table 4 robots can make a return trip Quickly towards point H.

4. CONCLUSION

Deep First Search provides some advantages that make it a good choice for many maze solving problems that have some similarities when the Benefits include:

1. Requires relatively small memory, because only the nodes in the active path are stored in memory.
2. Deep First Search can find a solution without having to test more in the space state, it is needed in completing the return trip task.
3. The experimental results, the mean time required for the return trip of space 1 is 9.55 seconds, from space 2 is 19.75, from space 3 is 22.94, and from space 4 is 7.3 seconds

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THE IMPLEMENTATION OF COMPETENCY CERTIFICATION EXPERTISE AND SKILLS OF CONSTRUCTION LABORS IN SURABAYA CITY

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ABSTRACT

Labors carrying out construction work must have skills certificates and job skills. However, these requirements cannot be fulfilled maximally by certifying stakeholders. This study aims to examine in depth the performance of the stakeholders involved in the implementation and benefits of certification expertise and skills of construction labors in the city of Surabaya. Data collection using questionnaires distributed to 60 contractors and professional associations. Analysis of data using qualitative and quantitative methods. The results concluded that the information, requirements and implementation of certification in Surabaya is good enough. Some things that must be considered are: or major qualification skills and the timing of verification and validation process at professional association level is too long. The cost of certification is too expensive and there is no uniformity of cost from the professional association of the organizers. The owner of certification expertise and skills of construction labors is guaranteed to be easy enough to get a job and gain career levy according to skill, easy enough to earn higher salary and gain skills but not guaranteed regular salary increase. The existence of certification expertise and skills of construction labors for contractors has not been fully utilized for the following requirements: establishing new companies, participating in tenders and implementing government or private projects. Professional associations already have and use the guidelines and standard operating procedures in accordance with applicable government regulations and have been certifying with service is quite satisfactory.

Keywords: certification, skill, expertise, contractor, Surabaya city.

1. INTRODUCTION
1.1 Background Issues

The number of construction service companies in Indonesia currently has reached about 141,000 companies, with a total construction workforce of about 6.5 million. The quantity of construction labor has not been matched by a sufficient number of qualities of professional competence [2]. Various efforts have been made both by the government through the Ministry of Public Works, the National Construction Services Development Board (NCSDB) and Professional Associations through training and various coaching. One of the efforts to improve the quality of the skill and skill of the construction laborers is by the quality assurance system in the form of construction labors certification (Regulation of Minister of Public Works of Republic of Indonesia No. 07 / PRT / M / 2010) [3]. But these efforts have not produced significant results until now.

Under the Law of the Republic of Indonesia Number 2 of 2017 on Construction Services [1] and Government Regulation of Republic Indonesia Number 70 of 2012, every construction labors is required to have a certification expertise and skills of construction labors [4]. Based on the previous study, the data shows that the distribution of construction work group consists of experts about 8%, skilled group of about 30% and the rest is a group of manual laborers. If the current construction workforce amounts to about 6.5 million, then about 3 million people must have a certificate. In fact, performance of the certification of experts and skilled personnel is still apprehensive. To date there are only 107,562 certified construction labors (about 6.46%). The number consists of 29,417 people who have a expertise certification of construction labors, and 78,145 people who have a skills certification of construction labors (NCSBDN, 2014) [5].

Based on the description, the resources and the ability of construction services business, especially in the case of human resources is still very low both in terms of quality and quantity. Therefore it is necessary synergistic programs for the stakeholders involved to accelerate the implementation of certification expertise and skills of

construction labors. This research seeks to reveal the performance of the stakeholders involved in the certification expertise and skills of construction labors in Surabaya City.

1.2 Previous Research

Table 1 describes some previous studies, among others, by Pratiwi and Wibowo (2010) [6]; Widiasanti (2013) [7] and Jelanatik et al. (2014) [8]. The table describes the research approach, population and research respondents, measured variables and analytical tools used.

Table 1. Previous Research

Title	Performance Evaluation of Stakeholders in Construction labors Skills Development With Performance Prism Method	Review of the Effectiveness of Certification Mechanism of Construction Experts Through NCSDB Labors Certification Unit	Analysis of Factors Affecting Construction Labors to Have Certification Expertise and Skills of Construction Labors at Contractor in Bandung
Researchers	Pratiwi dan Wibowo [6]	Widiasanti [7]	Jelantik, Alit, Salain & Nadiasa [8]
Year	2010	2013	2014
Research Approach	Strategies, Processes and Capabilities	Research Descriptive	Qualitative Research (case study)
Population	Ministry of Public Works, Manpower & Transmigration and NCSDB	Authorities in the implementation of certification expertise and skills of construction labors at Contractor	Some small, medium & large qualification contractors
Variable measured	Stakeholders Performance	Certification Mechanism of Construction Experts	Factors to have certification expertise and skills of construction labors at Contractor
Analyzation	Performance Prism Analysis	Description Analysis	Factor Analysis

Source: Various references

1.3 Problem Formulation

Based on the background description of the problems described above, then the formulation of the problem in this study are:
1) How far the results of the certification expertise and skills of construction labors at Contractor for construction in Surabaya City?
2) To what extent is the added value gained for certification expertise and skills of construction labors at Contractor in Surabaya?

1.4 Purpose and Objectives

Based on the description of the problem background and the problem formulation described above, the purpose and objectives of this study are:
1) To examine and analyze in depth of the certification expertise and skills of construction labors at Contractor for construction in Surabaya City.
2) To examine and analyze the added value obtained of the certification expertise and skills of construction laborers at Contractor for in Surabaya City.

1.5 Research Benefits

Based on the description of the background of the problem, the formulation of the problem and the purpose and objectives described above, then the expected benefits of the results of this study are:
1) For the Surabaya City Government: is to provide informative contribution related to problems and barriers to the implementation of the certification expertise and skills of construction labors at Contractor in Surabaya City.

2) For the parties directly involved in the implementation of the certification expertise and skills of construction labors at Contractor as input and evaluation for further implementation.

1.6 Scope and Limitations of Research

This research was conducted in Surabaya City by involving the parties involved directly or indirectly in the implementation of the certification expertise and skills of construction labors in the city of Surabaya. The parties involved are among others; Contractors of minor, medium and large qualifications (subcualication : K1, K2, K3, K4, M1, M2, B1 and B2) [9], professional association of contractors, located and operating in Surabaya City and other parties involved [10] .

2. RESEARCH METHOD

2.1 Research approach

This research uses a research approach with a qualitative paradigm, because it observes social phenomena that occur in the environment of construction services. Qualitative research is a research that emphasizes the understanding of the problems in social life based on factual conditions or natural settings are holistic, complex and detailed. This research also has a category of action research because it will produce a policy that will be submitted to decision makers [11].

2.2 Population, sample and respondent

The population in this research is construction service company (contractor), professional association and construction service construction team in Surabaya City. Sampling is done because the population is unlimited, so sampling technique is required. In this research use purposive sampling and random sampling. Purposive sampling to determine the sample of existing professional associations in Surabaya, while random sampling is used for sampling of construction service companies who have taken care of the certification expertise and skills of construction labors. Respondents of the study were determined by purposive as many as 100 companies, consisting of 65 contractor companies and 35 professional association companies

2.3. Instruments and research data

The research instrument is questionnaire. The research variables and indicators are set out in accordance with relevant government laws and regulations as well as the provisions of procedures for certification from the National Construction Service Development Board (NCSDB). Questionnaires were distributed through three stages: first stage was distributed 100 questionnaires and 38 answers back. The second stage was reprinted as many as 50 questionnaires and returned 17 answers. The third stage was reprinted as many as 25 questionnaires and returned 10 answers. The number of answers to the questionnaires returned by the contracting company is 65 answers, while the worth to be analyzed from the collected amount is 60 company answers.

2.4 Research variables and indicators

The research variables consist of 5 variables and 35 indicators. The research variables include; (A). The performance of the certification expertise and skills of construction labors (consisting of 16 indicators, (B) The owners of the certification expertise and skills of construction labors (consisting of 5 indicators), (C) The benefits of of the certification expertise and skills of construction labors for construction companies (consisting of 5 indicators) and (D) Benefits of the certification expertise and skills of construction labors for professional associations of construction companies (consisting of 9 indicators)

2.5 Data Analysis

Data analysis was performed using mean and mean deviation standard calculated from data of each group of respondents' answers, using formula [12]:

$$\overline{X} = \frac{\sum fi.Xi}{\sum fi} \dots\dots (1) \text{ and } \overline{Y} = \frac{\sum fi.Yi}{\sum fi} \dots.. (2), \quad \overline{\overline{X}} = \frac{\sum fj.\overline{X}j}{\sum fj} \dots.. (3), \text{ dan } \overline{\overline{Y}} = \frac{\sum fj.\overline{Y}j}{\sum fj} \dots\dots (4) \quad ,$$

Where :

$\overline{X}$ = mean of respondent's answer

$\overline{Y}$ = mean of standard deviation of respondents' answers

fi = number of respondents

$\overline{\overline{X}}$ = the mean of the respondent's mean

$\overline{\overline{Y}}$ = the mean of the mean standard deviation of the answer Respondents

fj = number of respondents' questions

The average result of the respondent's answer is then maped into 4 criteria in the form of four quadrant of Cartesius Diagram based on the mean value data and the mean standard deviation of answers of each responder group as follows :

1. Quadrant I : $\overline{X} \geqq \overline{\overline{X}}$ and $\overline{Y} \leq \overline{\overline{Y}}$: (very good)
2. Quadrant II : $\overline{X} \geqq \overline{\overline{X}}$ and $\overline{Y} > \overline{\overline{Y}}$: (good)
3. Quadrant III : $\overline{X} < \overline{\overline{X}}$ and $\overline{Y} \leq \overline{\overline{Y}}$: (bad)
4. Quadrant IV : $\overline{X} < \overline{\overline{X}}$ and $\overline{Y} > \overline{\overline{Y}}$: (very bad)

Each of the four quadrants in the Cartesian Diagram is a representation of the results of the study that need to be discussed further.

3. RESULT AND DISCUSSION

3.1 Respondent data

The study respondents consist of 25 contractor companies and 35 professional association companies. The contractor shall consist of small qualifications (sub-qualifications K1, K2, K3 and K4), intermediate qualifications (M1 and M2 sub-qualifications) and substantial qualifications (sub-qualifications B1 and B2) with the composition of the sub-qualification amounts as shown in Figure 1. Where the names of professional association data is shown in Figure 2.
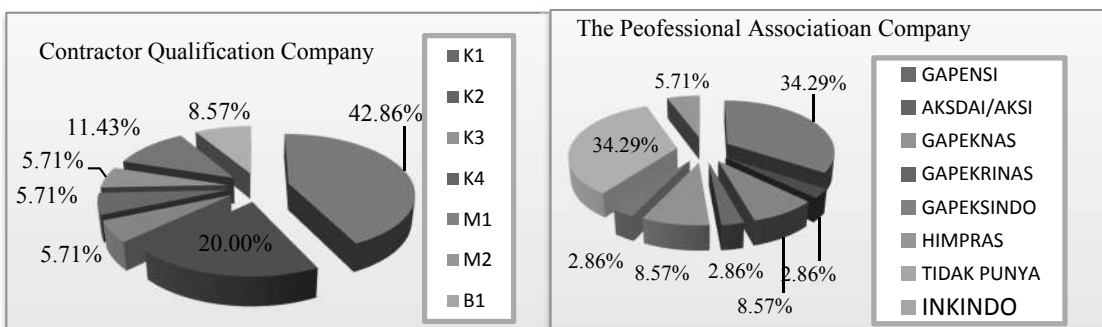
Figure 1 Contractor Company Qualification   Figure 2.Company of Professional Associations
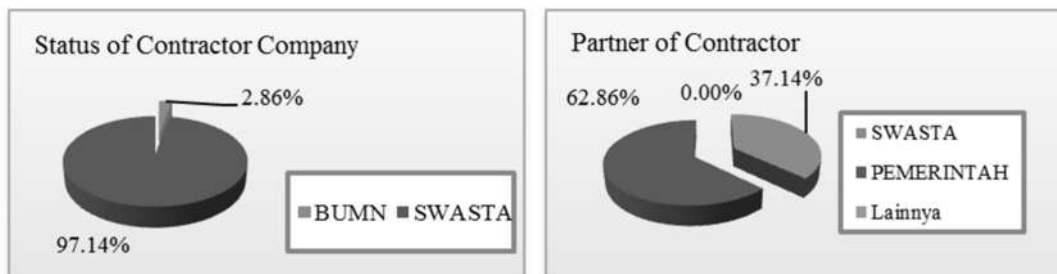
Figure 3. Status of Contractor Company   Figure 4. Partner of Contractor

Figure 3 shows company data consisting of BUMN contractor (2.86%) and private contractor (97.14%). Figure 4 shows the company's data on private projects and government projects.

3.2 Profile of respondents

Respondent profile data consist of: gender, age, last education and experience. Respondent profile data are shown in Figure 5 to Figure 8
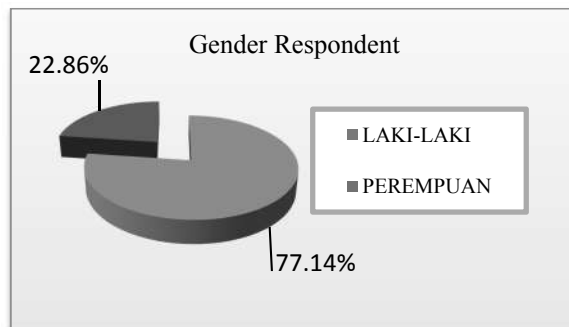
Figure 5 Gender Respondents
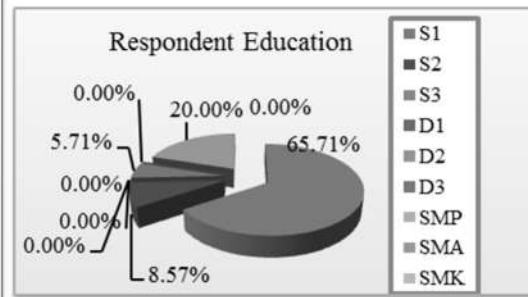
Figure 6. Respondent Education
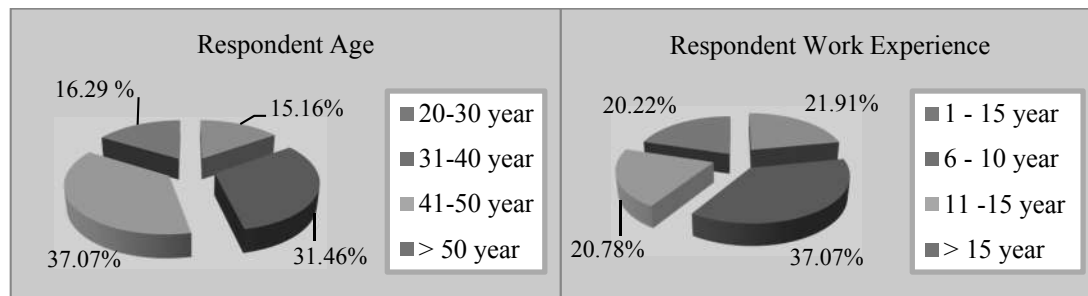
Figure 7. Respondents Age

Figure 8. Respondent Work Experience

3.3 Research Results

Table 2 shows the result of mean analysis and standard deviation analysis of each variable and its indicator from the respondent of the contractor company. Each mean and standard deviation of the indicator are then calculated average of mean = 3,475 and average of standard deviation mean = 0,958. Each quadrant has the following criteria:

1) Quadrant I: Mean ≥ 3,475, and Standard Deviation ≤ 0.958. Indicators that enter quadrant I have the category that the implementation of the certification expertise and skills of construction labors has been running well and must be maintained.

2) Quadrant II: Mean ≥ 3,475, and Standard Deviation > 0.958. Indicators that enter the first cadrant have the category that the implementation of the certification expertise and skills of construction labors has been running well enough, but still biased to be improved for better.

3) Quadrant III: Mean < 3,475, and Standard Deviation ≤ 0.958. Indicators that enter the third cadrant have the category that the implementation of the certification expertise and skills of construction labors less well, so it is necessary to get attention and improvement.

4) Quadrant IV: Mean < 3.475, and Standard Deviation> 0.958. Indicators entering IV cadrant have the category that the implementation of the certification expertise and skills of construction labors is not going well and should get serious attention to be better. Research result

Table 2. Average Mean and Standard Deviation

Code	Variable and Indicators	Result		N	QW
		Mean	SD		
A	**Organizing Performance**				
A1	Information on certification	3.686	0.900	60	1
A2	The socialization of certification	3.600	0.946	60	1
A3	Implementation of certification	3.686	0.796	60	1
A4	The cost of certification	3.743	0.950	60	1
A5	Fees for the cost of certification	3.743	0.886	60	1
A6	Compliance of certification fee rate	3.229	1.239	60	3
A7	Certification management requirements	3.486	0.887	60	1

Table 2. Average Mean and Standard Deviation

Code	Variable and Indicators	Result		N	QW
		Mean	SD		
A8	Certification procedures	3.286	0.860	60	4
A9	Certification implementation schedule	3.314	0.867	60	4
A10	Processing time at Association level	3.086	1.121	60	3
A11	Processing time at NCSBDN	3.029	1.150	60	3
A12	Validity period	3.571	0.948	60	4
A13	Requirements for government project tender	3.029	1.014	60	3
A14	Requirements for private project tenders	3.200	0.994	60	3
A15	Requirements for implementation of government projects	3.657	0.802	60	1
A16	Requirements for the implementation of private projects	3.343	1.027	60	3
B	**Benefits of certificates for labor**				
B1	Job guarantees according to expertise and skill	3.571	0.948	60	1
B2	Higher salary guarantees	3.629	1.031	60	2
B3	Guaranteed salary will rise	3.400	1.117	60	3
B4	Guarantee of increased expertise and skill	3.486	1.040	60	2
B5	Guaranteed career enhancement	3.829	0.857	60	1
C	**Benefits of certificates for the company**				
C1	Terms of establishment of new company	3.343	0.968	60	3
C2	Company registration requirements	3.629	0.942	60	1
C3	Rented for tender	3.143	1.004	60	3
C4	Be sold out to participate in the tender	2.629	1.190	60	3
C5	Purchased to other companies	2.543	1.094	60	3
D	**Performance of the Association of Organizational**				
D1	Has written guidelines	3.657	0.958	60	1
D2	Has a written SOP	4.086	0.853	60	1
D3	Working as per the guidelines	3.800	0.868	60	1
D4	Working according to SOP	3.857	0.810	60	1
D5	Has a cost of certification fee written	3.543	0.950	60	1
D6	The cost of certification is in accordance with the written rates	3.686	0.993	60	2
D7	Performance Service implementation	3.714	0.825	60	1
D8	Performance certification according to regulations	3.657	0.765	60	1
D9	Implementation of certification and renewal is done at any time	3.743	0.919	60	1
	Average	3.475	0.958		

Source: Primary Data Analysis Result

After that, then each indicator variable can be mapped into four quadrants namely: quadrant I up to the awareness IV as shown in Figure 9.and described as follows:
1) Quadrant Group I is an excellent research group and needs to be maintained
2) Quadrant Group II is a group of research results are good and need to be improved in order to become better,
3) Quadrant Group III is a group of unfavorable research results and needs to get attention to be improved in order to become better,
4) Quadrant Group IV is a group of unfavorable research results and desperately need to get to be improved in order to become better
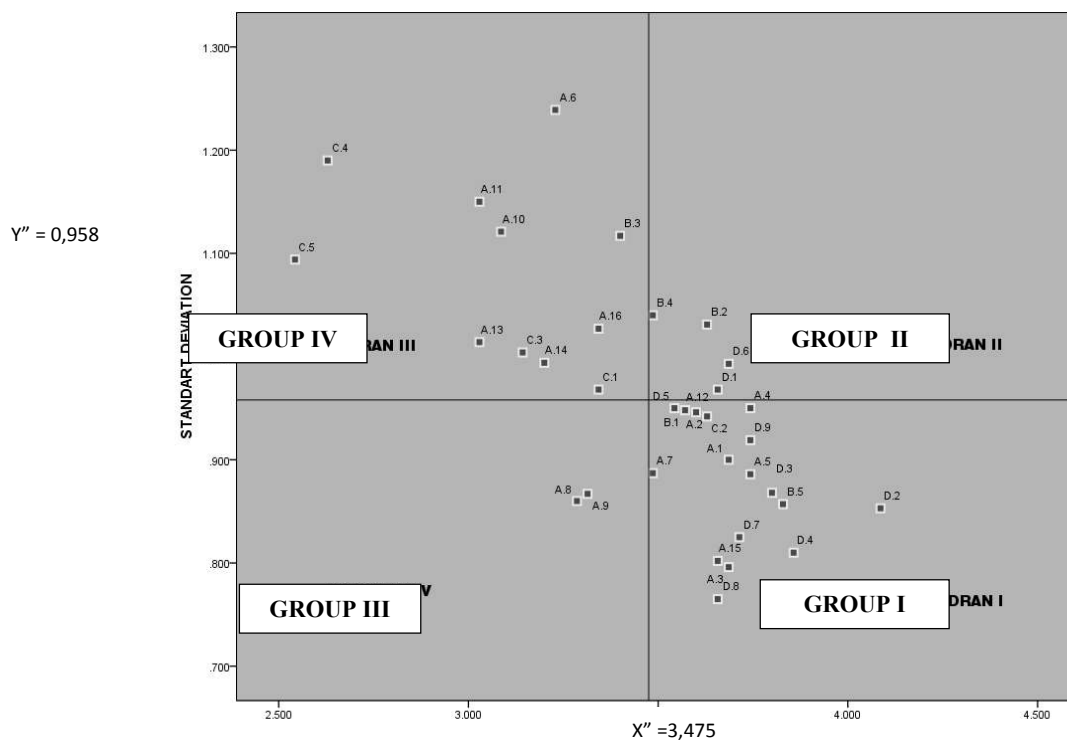
Figure 9. Mapping of Research Results

4. CONCLUSIONS AND SUGGESTIONS

4.1 Conclusions

Based on the analysis of data, results and research findings that have been discussed in the previous chapter, this study concludes the following matters:

1) The results of the implementation of the certification expertise and skills of construction labors conducted in Surabaya City generally has been running quite well especially in terms of: information, requirements and implementation of the implementation of the certification expertise and skills of construction labors. But there are still some things that are not working with: the requirements of management and certification is difficult enough especially for the certification of madya or major qualification skills and the timing of verification and validation process at professional association level and registration process at NCSDB level too long

2) The value added or benefits gained for construction laborers who have obtained the certification expertise and skills of construction labors in Surabaya City are; guaranteed to be easy enough to get a job and gain career levers according to expertise or skill, easy enough to earn higher salaries and gain expertise or skill, but not guaranteed regular salary increases

3) The added value or benefit of the certification expertise and skills of construction labors for the contractor company in Surabaya City is that the certification expertise and skills of construction labors has not been fully used for the requirements of: establishing a new company, participating in tenders and implementing government or private projects. Similarly, the certification expertise and skills of construction labors may be borrowed or traded between contractor companies for the following requirements: establishing a new company, participating in tenders and implementing government or private projects.

4) Professional associations of contractors already have written manual and standard operating procedures (SOP) in accordance with prevailing laws and regulations and have been conducting certification of the certification expertise and skills of construction labors in accordance with the guidelines or SOP owned and service satisfactory. The implementation of the certification expertise and skills of construction labors shall be conducted at any time at a non-compliance cost, very expensive and there is no uniform tariff of fees among certification providers (professional associations).

4.2 Suggestions

Based on the results of the conclusions outlined above, it is recommended that the following things:

1) To contractor company and construction professional company in Surabaya City, it is suggested to: utilize the certification expertise and skills of construction labors as a means to improve the quality of company's competence by involving all expertise and skills personnel to perform the certification expertise and skills of construction labors.

2) To the Surabaya City Government and the East Java provincial government it is advisable to intervene through NCSBD and the Regional Construction Service Provider so that the certification expertise and skills of construction labors can be carried out at a uniform cost, relatively cheaper, no illegal fees and with faster processing, especially for small and medium qualified contractors with limited funds

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BI-DIRECTIONAL FLYBACK DC-DC CONVERTER FOR THE DC HOUSE PROJECT

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ABSTRACT

The DC House project strongly relies on renewable energy sources to provide power to the house for various loads. However, when these sources are unable to provide power at a certain time, a back-up energy source from a battery must be readily available to fulfill the house's power needs. This thesis proposes a bi-directional flyback power converter to allow a single-stage power path to charge the battery from and to discharge the battery to the DC House 48 V system bus. The design, simulation, and hardware prototype of the proposed flyback bi-directional converter will be conducted to demonstrate its feasibility. Results from a 35W prototype demonstrate the operation of the proposed converter for both charging and discharging purposes.

Keywords: *Bidirectional Converter, Battery Charging, Flyback Converter*

1. INTRODUCTION

According to the Census Bureau, the world population has steadily increased from 2,557,628,654 people in 1950 to 7,095,217,980 in 2013 [1]. Because of increasing population in the world, energy demand in developing nations is expected to rise 65% by 2040 compared to 2010, reflecting growing prosperity and expanding economies [2]. In response to the population growth, a greater demand for electricity will be seen from all developed and rural countries [2]. Figure 1 reflects the projected energy demand from 2010 to 2040 for different continents and countries.
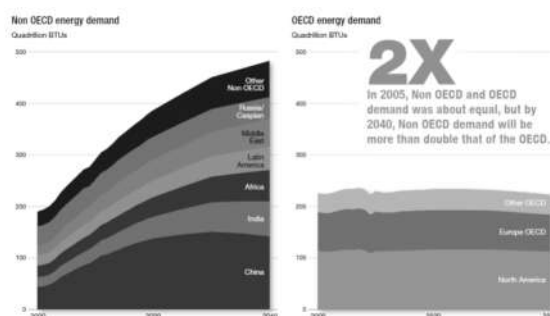
Figure 1. Projected Energy Demand for Different Continents and Countries by 2040 [2]

For the next 30 years, electricity generation represents the largest energy use across four different sectors: industrial, transportation, electricity generation, and residential/commercial. However even with advancements in science and technology, according to the International Energy Agency (IEA), around 1.3 billion people today still do not have access to electricity [2]. Therefore, in order to help combat the dependency on electricity, renewable energy has become a larger priority in order to help provide for those that do not have electricity especially in areas inaccessible by the utility grid. According to the US Energy Information Association, renewable energy accounts for 32 percent of the overall growth in electricity generation from 2011 to 2040 [3]. The ability to provide electricity power through both new methods and renewable energy creates an opportunity for new technology to meet the electricity demand such as the DC House Project.

The DC House project started in 2010 by California Polytechnic State University in hopes of creating an operating house whose electricity is provided from DC power. The purpose of the DC House project is to help those in third-world countries receive electricity in locations that are not accessible to grid generation. In our predominately AC system, small-scale renewable energy sources are generally putting out DC power and hence require intermediate energy conversion to AC in order to be accessible to the consumer [4]. However, converting from DC power to AC power may imply extra cost for equipment to implement such a system as well as potentially increase the amount of power loss that the system experiences and thus reducing the overall efficiency of the system. The DC House attempts to bypass such a power conversion in order to provide enough energy for typical household items without the reliance of AC power.

The initial study and modeling of individual DC powered home including the design for several possible DC power sources was reported in references [5] to [8], and [10]. The preliminary design of the multiple-input-single-output (MISO) DC-DC converter that ties all the outputs of the possible DC energy sources to a single output which provides the main DC bus voltage that feeds power to the DC house was presented in [9]. For the battery charging component of the DC House, a bidirectional DC-DC converter is needed to allow power flow to go from the DC Bus to the battery (charging) and from the battery back to the DC Bus (discharging).

A majority of DC-DC converters provide current in a unidirectional fashion by having a single path for current to flow from the input source to the load. For example, a non-isolated topology known as the Buck converter provides current from the input source to the output through the MOSFET switch, the inductor, and the free-wheeling diode during the time when the MOSFET switch is off. Because of the inability for the switch and the diode to carry current in the reverse direction from the load to the input voltage source, the Buck converter is a unidirectional DC-DC converter.

Bi-directional DC-DC converters fall into a generic circuit structure illustrated in Figure 2 which is characterized by current or voltage being fed from one side to the other [16]. Based upon the magnitude of the voltage and current as well as the placement of the energy storage items, the bi-directional DC-DC converter can either operate as a Buck converter by stepping down a higher voltage to a lower voltage or as a Boost converter by stepping up from a lower voltage to a higher voltage.
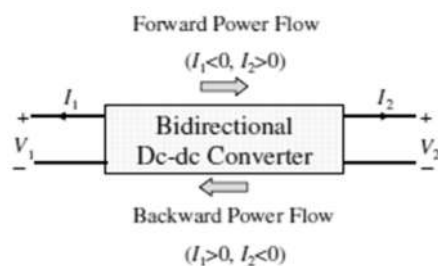
Figure 2. Generic Circuit describing Power Flow of a Bi-directional DC-DC Converter [16]

In order to allow bi-directional power flow between two energy storage items with a DC-DC converter, a secondary switch and a reverse diode on the main commutating switch is needed for a uni-directional converter. Bi-directional DC-DC converters have been used in applications for charging batteries, electrical vehicle motor drives, and interruptible power supplies. Such topologies that have been used include a non-isolated topology such as the buck-boost and isolated topologies such as the half-bridge, the full-bridge and the flyback. The non-isolated buck-boost is an advantageous topology because the converter does not require the transformer to be used as an energy transfer or energy storage component and for applications that do not require isolation between the input and output [17]. Despite the lack of a transformer, the buck-boost topology relies heavily on soft switching techniques such as zero voltage switching (ZVS) or zero current switching (ZCS) in order to compensate for high voltage spikes seen by switching MOSFETs and inductors [17]. The half-bridge and full-bridge topology are suitable for high power applications and high voltage applications but require large amounts of components and use of snubbers, making the design portion of the converter complex [18]. The flyback topology on the other hand uses the transformer as an energy storage device, but the topology yields low costs, good transient response, and low amount of components [19].

As long as the requirement of allowing two paths of current flow is satisfied, any topology, non-isolated or isolated, can be converted into a bi-directional topology. Because of the low amount of required components, the use of the transformer to compensate for low duty cycle, and the availability of controller chips for commercial purchase, the flyback topology will be chosen for the proposed bi-directional DC-DC converter. This paper presents the use of the flyback topology for the bi-directional DC-DC power converter. The bi-directional power converter is needed for the battery system used in the DC House project.

2. TOPOLOGY AND DESIGN REQUIREMENTS

Generally speaking, any uni-directional converter can be turned into a bi-directional converter by adding an additional secondary switch on the output diode and a reverse diode on the main commutating switch. Due to its lower cost, low component count, good transient response, and the ability to use the turns ratio to increase the duty cycle of the overall system, the flyback topology will be used for the proposed DC House bi-directional converter [20]. Two flybacks will be chosen to regulate the discharging and charging stages of the bi-directional converter. Figure 3 shows the power stage of the dual flyback with the reverse diodes placed across the switches to make the converter bi-directional. Two controller chips will be selected based upon the output voltage and power requirements defined in this chapter.
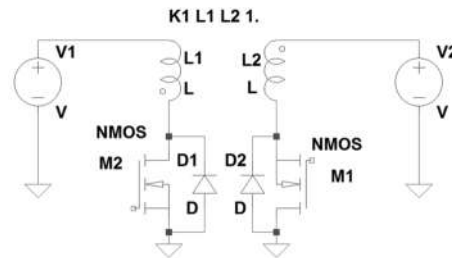
Figure 3. Dual Flyback Power Stage of Bi-directional Converter

Efficiency is an important aspect of the bi-directional converter because of the lifetime of the car battery as well as reducing the amount of switching losses from two separate flyback topologies. Therefore, the proposed design is expected to operate with greater than 80% efficiency at maximum load for both the charging and discharging stage. Although the integrity of the output voltage is not necessarily important since the battery will be charged using constant current, the output voltage ripple will be expected to be less than 5% of the 48V output for the discharging stage and the 12.5V output for the charging stage. Line and load regulations will be less than 5% for both the discharging and charging stage of the bi-directional DC-DC converter. Table 1 summarizes the design requirements for the proposed bi-directional converter.

Table 1. Specifications of the Bi-directional DC-DC Converter

	Charging Stage	Discharging Stage
Input Voltage	48V ± 5%	(11V-13V), 12V Nominal
Output Voltage	12.5V	48V
Maximum Output Current	2A	1A
Maximum Output Wattage	25W	48W
Line Regulation	5%	5%
Load Regulation	5%	5%
Output Voltage Ripple	5%	5%
Efficiency at Full Load	≥ 80%	≥ 80%

3. SIMULATION RESULTS

Because of the power constraint, the LT3748 controller chip is chosen because of its power rating as well as its ability to derive information from the output voltage based upon the primary-side flyback pulse waveform [21]. The controller features a boundary mode control method, where the output voltage can be derived from the transformer primary voltage when the secondary current is almost zero. Using this feature reduces the size of transformer, excludes subharmonic oscillations, and improves load regulation [21]. Figure 4 shows the complete 48V to 12V charging flyback with calculated resistors and capacitors for each pin of the controller chip.
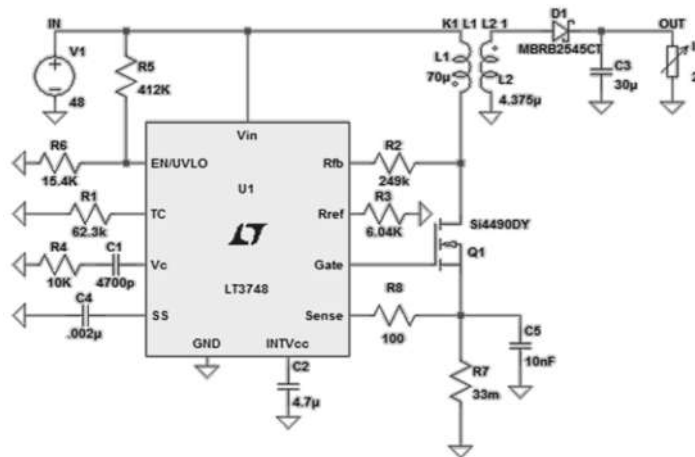
Figure 4. 48V to 12V Charging Flyback with LT3748 Controller Chip

Figure 4 details the output voltage ripple of the charging flyback with a full load of 2A. The average voltage is determined to be 12.6V, with a peak to peak ripple voltage of 0.4V or 3% of the output voltage. Figure 5 shows the voltage of the current sense pin of the LT3748 controller when the charging flyback is supplying power for full load. Boundary conduction mode can be seen as the voltage of the current sense pin drops to zero. Since the voltage of the current sense pin is below the threshold voltage of 100mV, the MOSFET is able to be turned on and off to achieve the output voltage.   The line regulation of the charging flyback is calculated to be approximately 0%, while line regulation is 0.83%. Figure 7 shows the charging efficiency of the system ranging from a minimum load current of 0.4A up to full load current of 2A in increments of 0.4A.
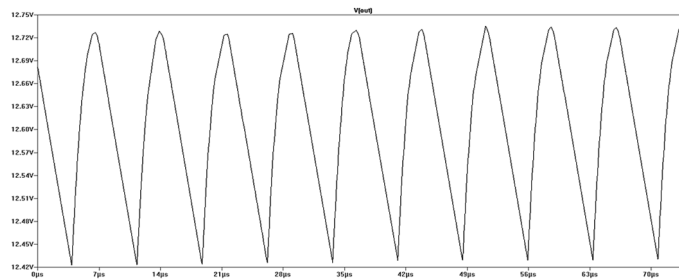
Figure 5. Simulated Output Voltage Peak-to-Peak Ripple at Full Load (2A) for Charging Flyback
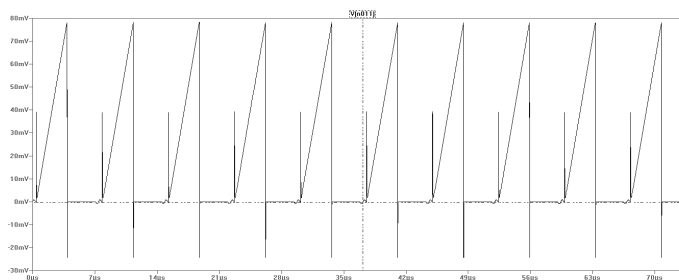
Figure 6. Simulated Voltage at Sense Pin at Full Load (2A) for Charging Flyback

Figure 8 shows the complete 12V to 48V discharging flyback with calculated resistors and capacitors for each pin of the controller chip. Figure 9 shows the output voltage ripple for the discharging flyback with a full load of 1A. The average voltage is observed to be 48.3V, with a peak to peak ripple voltage of 0.4V or 0.83% of the output voltage. Figure 10 shows the voltage of the current sense pin of the LT3748 controller when the discharging flyback is supplying power for full load. Figure 11 shows the efficiency of the discharging flyback from 0.2A to 1A load current in increments of 0.2A. The line and load regulations of the discharging flyback are 0% and 1% consecutively.
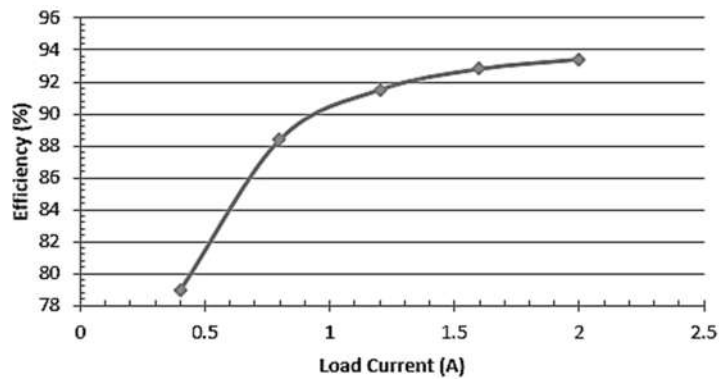
Figure 7. Efficiency of the Charging Flyback with Varying Load Current from 0.4A to 2A
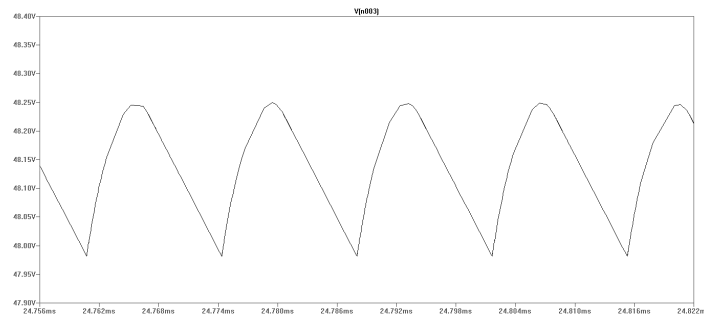
Figure 8. Simulated Output Voltage Peak-to-Peak Ripple for 1A Load for Discharging Flyback
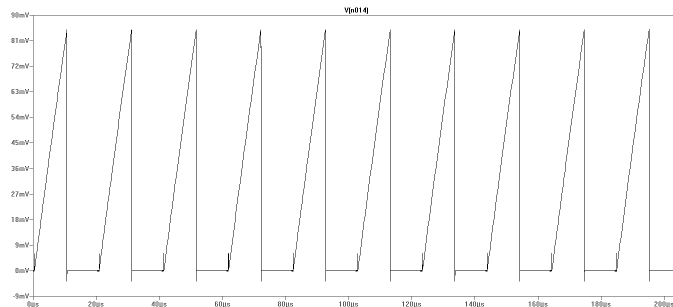
Figure 9. Simulated Voltage at Sense Pin at Full Load (1A) for Discharging Flyback
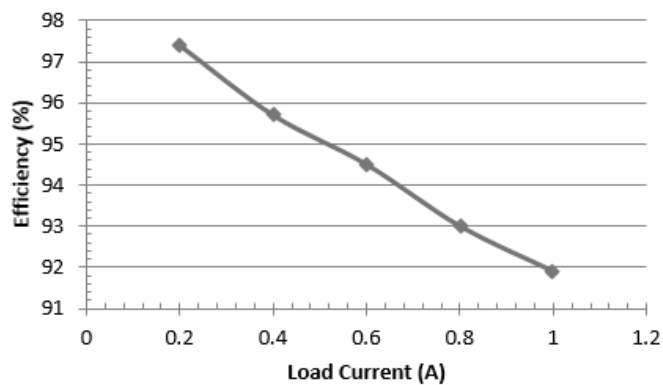
Figure 10. Efficiency of Discharging Flyback vs. Varying Load Current

Figure 11 shows the entire bi-directional DC-DC converter design with the complete LT1716 control scheme.
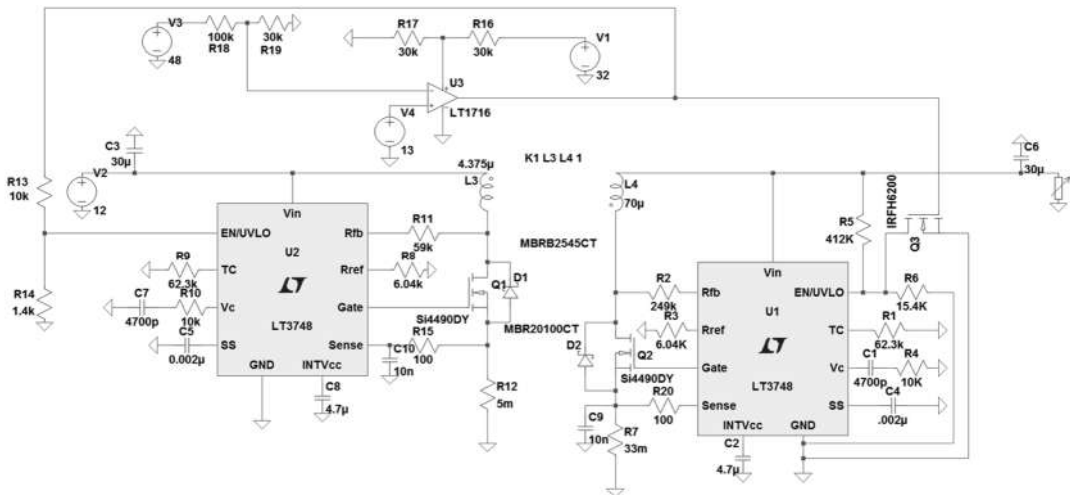
Figure 11. Full Bi-directional DC-DC Converter LT Spice Design

2. HARDWARE RESULTS

The bi-directional DC-DC converter was designed using a PCB layout program provided by Express PCB. Common-practice rules for design were followed, including minimum trace spacing and proper trace width dependent upon average current seen by each trace. The PCB layout was designed using 4 layers: top copper layer, power layer, ground layer, and bottom copper layer. Figure 12 shows the entire PCB design with the top layer traces and bottom layer traces. The hardware lab test setup is depicted in Figure 13.
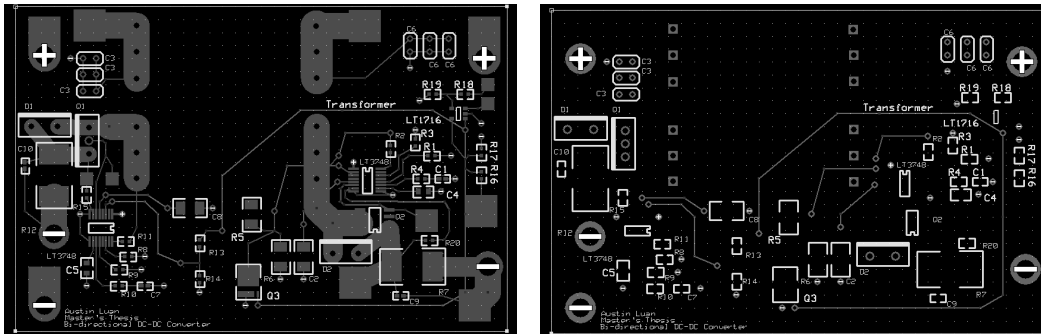
Figure 12. Top Layer with Silkscreen and Bottom Layer of PCB

The charging flyback must be able to supply a full load of 2A at a regulated voltage of 12.5V. Thus, the flyback will be tested in percent of load increments to monitor the efficiency of the flyback. Also, the output voltage ripple will be observed as well as the gate voltages of both flyback controllers to prove that while the charging flyback is commutating, the discharging flyback is disabled. Load regulation was measured to be 2.6% while the line regulation was 0.252%. The load and line regulations for the charging flyback meet the requirement of less than 5%. Figure 14 shows the efficiency of the charging flyback of the bi-directional DC-DC converter over percentage of load. Figure 15 shows the output voltage peak-to-peak ripple of the charging flyback at full load conditions calculated to be 16%.
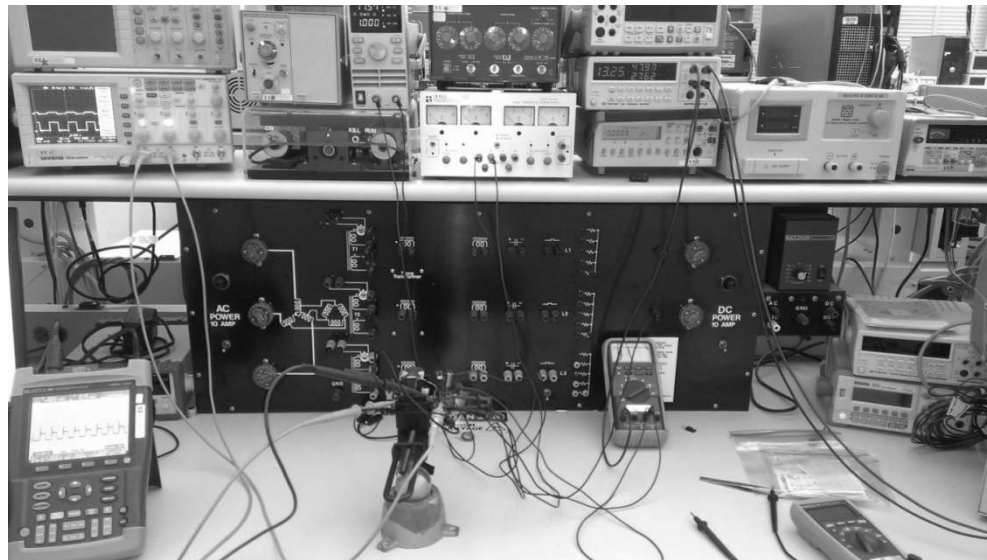
Figure 13. Test Set-up and Equipment Used for Testing Bi-directional DC-DC Converter
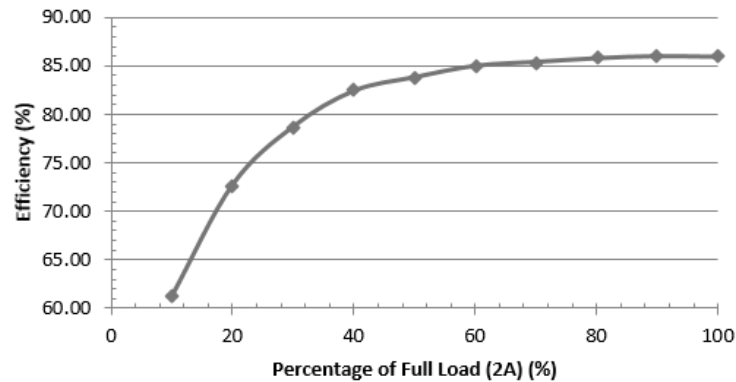
Figure 14. Efficiency vs. Percent Load for Charging Flyback
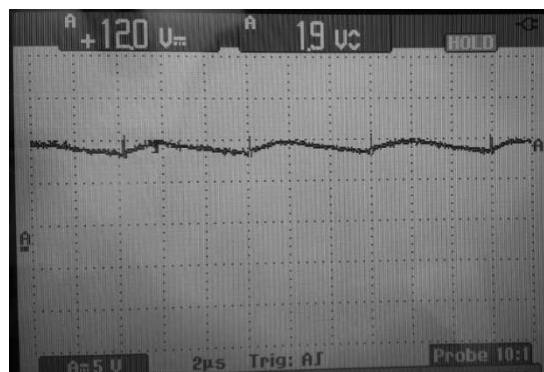
Figure 15. Output Voltage Peak-to-Peak Ripple of Charging Flyback at Full Load Conditions

For the discharging mode, the load regulation was calculated to be 2.87%, and the line regulation was calculated to be 1.84%. The efficiency plot is shown in Figure 16. Figure 17 shows the output voltage peak-to-peak ripple of the discharging flyback at full load conditions. With a measured peak-to-peak voltage of 4V, the output voltage ripple is calculated to be 8.2%. Compared to the simulation results, hardware results such as the efficiency, line regulation, load regulation, and output voltage of the discharging flyback meet the requirements. The peak-to-peak output voltage of the discharging flyback at full load conditions is higher than the required 5%.
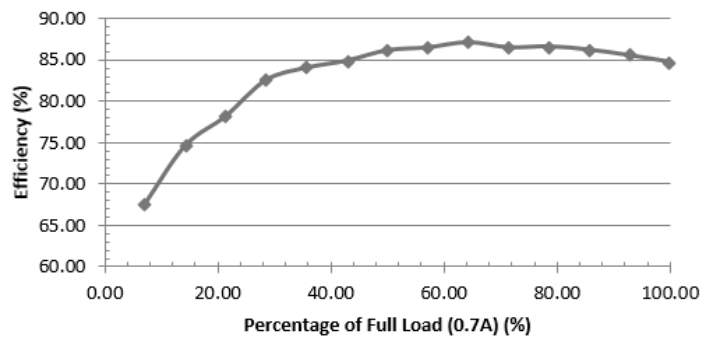
Figure 16. Efficiency vs. Percent Load for Discharging Flyback
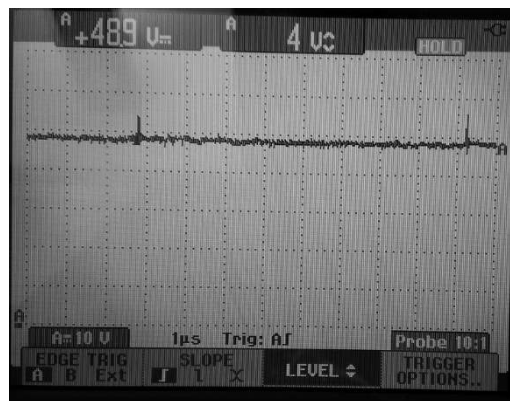
Figure 17. Output Voltage Peak-to-Peak Ripple of Discharging Flyback at Full Load Conditions

Table 2 shows a summary of the hardware results and simulation results compared to the design requirements.

Table 2. Design Requirements Summary after Simulation and Hardware Results

	Charging Flyback			Discharging Flyback		
	Design Requirement	Simulation Results	Hardware Results	Design Requirement	Simulation Results	Hardware Results
Input Voltage	48V	48V	48V	12V	12V	12V
Output Voltage	12.5V	12.6V	11.88V	48V	48.3V	48.8V
Full Load Current	2A	2A	2A	1A	1A	0.7A
Full Load Output Wattage	25W	26.6W	24W	48W	53W	34W
Line Regulation	5%	0%	0.25%	5%	0%	1.8%
Load Regulation	5%	0.7%	2.6%	5%	0.2%	2.9%
Output Voltage Ripple	5%	2.4%	16%	5%	0.3%	8.2%
Efficiency at Full Load	≥ 80%	95 %	86%	≥ 80%	92%	85%

4. CONCLUSION

The bidirectional converter did meet most of the target electrical constraints. During hardware implementation, the converter was able to provide a single path power flow for both the discharging and charging flyback using the LT1716 control scheme. For the charging flyback, the bidirectional converter was able to operate from an input voltage ranging from 11V to 13V at excellent line regulation. The charging flyback also produced an efficiency of 86% with a total output power of 24W at full load conditions of 2A. The charging flyback was also able to maintain load regulation from a minimum load of 0.2A up to a full load of 2A.

For the discharging flyback, the bi-directional converter was able to operate from an input voltage ranging from 46V to 50V at excellent line regulation. The discharging flyback also produced an efficiency of 85% with a total output power of 34W at full load conditions of 0.7A. The discharging flyback was also able to maintain load regulation from a minimum load of 0.05A up to 0.7A.

Although the concept of the bi-directional converter is feasible, further improvements can be done in the future such as a better control scheme, larger output power capability, and implementation of the converter with the DC House system. The current control scheme does allow the converter to switch between the discharging and charging flyback. However, the exchange between each flyback is centered on the set voltage of 11V. Thus, the charging and discharging flybacks can only operate between the battery voltages of 11V to 11.1V. An improved control scheme would allow the bi-directional converter to operate for a wider battery voltage range. Currently, the proposed bi-directional converter is able to supply 35W using the flyback topology. Using other topologies or improving on the flyback design of the converter can help achieve the ultimate goal of an output power of 150W. Protection schemes such as fuses or current limiting applications on the battery side are needed to preserve not only the battery but the 48V DC bus line that feeds into the DC House.

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A Single Board Buck and Boost Bidirectional DC-DC Converter for DC House Energy Management System

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ABSTRACT

This paper entails the design, construction, and testing of a single board buck and boost bidirectional DC-DC converter to reduce components and improve efficiency. The approach aims to replace the previously designed converter which made use of a separate buck converter and boost converter boards. The bidirectional converter will eventually reside in the Energy Management System (EMS) of the DC House system. This new converter also makes use of the temperature sensing capabilities of the state of charge sensor selected in the previous design to allow for a better understanding of the system's operation. Additionally, the sensor and all passive components were incorporated into a printed circuit board to create a more reproducible product. Analysis of the bidirectional DC-DC converter shows high efficiency especially at larger load currents. Testing of the system demonstrated its ability to successfully direct power between the 48V DC bus and load and the 12V battery.

Keywords: *Bidirectional Converter, Energy Management System, DC House Project*

1. INTRODUCTION

Electric power is essential to modern life. As the ability to store and transmit power improves, so do standards of living. One such improvement was the development of power electronics. Power electronics is an area of electrical engineering that focuses on efficiently controlling the flow of electric energy by using solid-state switches and other electronics. Power electronics is everywhere. Over 40% of the world's electric power generated utilizes power electronics systems. The emergence of switched-mode power supplies to replace large linear power supplies allowed advancement in a wide range of industries that now rely on power electronics. Some examples of these systems are: consumer electronics (smart phones, laptops), power supplies, renewable energy, data centers, transportation (electric vehicles, trains), and DC-DC converters. During the power conversion process, power electronics aims to achieve two goals. The first goal focuses on having a small power loss. This, in turn, leads to high energy efficiency which means lower cost. The second goal of power electronics is to decrease the size and weight of the system, also leading to a lower cost [1].

The design of power converters relies heavily on power electronics. The different types of power converters are rectifiers (AC-DC), inverters (DC-AC), AC-AC converters, and DC-DC converters. Rectifier and inverter circuits take one form of electric energy (AC or DC) and convert it to the other (DC or AC). AC-AC converters take AC power and convert it to a different level and/or frequency of AC power through circuit designs such as phase control and integral cycle control. DC-DC converters take DC power and convert it to different levels of DC power [1].

The use of DC power by many devices and household electronics makes DC-DC converters especially prolific. DC-DC converters come in two main types, isolated and non-isolated. Isolated DC-DC converters utilize transformers while non-isolated DC-DC converters do not. The non-isolated topologies include for examples the buck converter, the boost converter, and the buck-boost converter. The step-down buck converter is essential due to the need for high line voltages to be stepped down to lower voltage levels required by different devices. The step-up boost converter produces a higher voltage output from a lower voltage input [2]. This function is needed for transferring power back to a grid; for example, renewable energy sources like solar and hydro powered generators.

The desire to utilize clean sources of energy has led to expansion of renewable energy production. The distribution of power from a large central plant is disadvantageous due to losses during transmission. This drives the

need for smaller scale power sources such as rooftop photovoltaics [4]. Renewable energy sources are naturally not stable resources of constant energy. The use of a battery and battery management makes renewable energy sources more reliable and practical for widespread use [3]. The function of transferring power from a battery to a higher voltage bus or from a higher voltage bus to be stored in a battery requires the functionality of a step-down and a step-up regulator. The converter system between a DC bus and a battery must therefore allow for a bidirectional power flow.

The DC House Project is a humanitarian effort that aims to bring electricity to rural areas. Locations that are too remote to afford or have access to conventional AC power distribution are prime candidates to utilize renewable energy sources such as hydro, wind, and solar power. Designing a house to use DC power from DC renewable sources also bypasses AC to DC conversion and losses associated with conventional AC houses [3]. The operation of the DC House is based on DC renewable power generators connected to a DC bus by a Multiple Input Single Output (MISO) controller. The DC bus also connects to a battery system and to the DC House. Energy storage compensates for the inconsistent nature of renewable sources such and wind or solar. An energy management system (EMS) is required to control power flow and direction on the DC bus [5]. Figure 1 shows the basic block diagram of the whole DC House system.
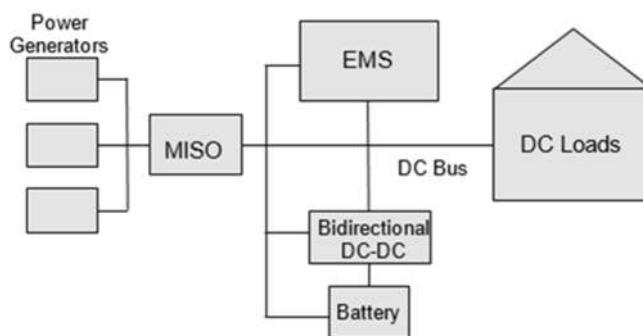
Figure 1. DC House Block Diagram Overview

The current Energy Management System (EMS) for the DC House (as reported in [5]) controls energy flow on the 48V bus between the MISO, 12V battery system, and devices inside the DC House. This EMS charges or discharges the battery depending on available power and demand from the load. The system also protects the battery by regulating its operation. The chip used for battery monitoring is the BQ78412 which is designed to work with single 12V Pb-Acid batteries. This state of charge (SoC) indicator is capable of monitoring battery voltage, current, and temperature and calculating runtime-to-empty [7]. The system uses an Arduino microcontroller, display, and relays that engage the converters between the battery and the DC bus [5].

Several design changes could improve the operation of the EMS. In the current implementation, the EMS does not include temperature monitoring of the battery. Sensing temperature would make a safer and more robust system. Additionally, the current design lacks a PCB layout. Implementing the entire EMS system in a PCB layout would reduce production costs and create a more easily reproducible product [5]. Lastly, the current EMS system utilizes two DC-DC converters; one Buck (step-down) converter used to step down the DC bus voltage to charge the battery, and one Boost (step-up) converter used to step up the battery voltage to supply power to the DC House. The use of two separate converters is costly, inefficient, and requires excess physical space. A design using a single, bidirectional converter would be an improvement in price, efficiency, and size.

The purpose of this project is to build and improve upon the existing Energy Management System (EMS) to create a more efficient and cost-effective solution. The new EMS system will still perform the same duties as that of the present system. It will control the flow of energy between the DC bus, batteries, and the DC house. The EMS will also still protect the batteries from overcharge and deep discharge. The improvements and additions that are going to be the main focus of this project are as follows:

- Replace two-converter Buck and Boost system with a single Bidirectional converter
- Add battery temperature and state of charge (SoC) sensing
- Create a PCB design to increase product reproducibility

These improvements should all improve the overall efficiency of the EMS systems as well as lead to a low-cost and easily reproducible product.

2. TOPOLOGY AND DESIGN REQUIREMENTS

The Energy Management System (EMS) is designed for the users of the DC House. For this purpose, the entire EMS system is required to be efficient, safe, and affordable. It must be reliable and be protected by a weather resistant enclosure. The first step to design the EMS system for the DC House was to determine the basic inputs and outputs of the system. The inputs are the 12V Battery bank and the 48V from the DC Bus and the MISO. The outputs of the EMS system are the 12V Battery bank and the 48V to the DC Bus and the house load. Figure 2 shows the basic block diagram with these inputs and outputs.
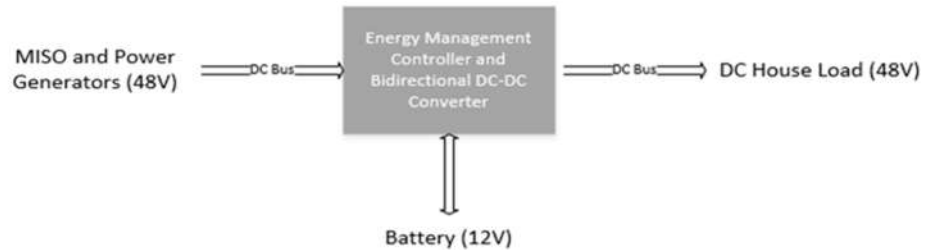
Figure 2. DC House EMS Block Diagram

The DC House Loads will demand a certain amount of power based on the present usage in the house. If the power generators can supply this level of power to the MISO and DC Bus, the EMS system will accept input power from the DC Bus and the Multiple Input Single Output (MISO) converter, and direct it to the DC House load. When the power generators cannot supply enough power, additional power from the battery bank will be input into the EMS system and converted to supply power to the DC House (batteries take on the role as inputs here). When the power generators supply excess power, the extra power will be supplied from the DC Bus to charge the batteries until fully charged (batteries change role to outputs here).

From these basic high-level design choices, more in-depth design choices can be derived. For starters, one of the primary goals of this project was to improve upon the conversion system between the 12V battery bank and the 48V DC bus. Previously, two separate DC converters were used (one step-up and one step-down). The design of this project implements a single, bidirectional DC-DC converter [8][9]. The use of a bidirectional converter will allow of a higher efficiency, lower cost, and a more technologically advanced system.

To determine the state of charge (SOC) of the battery, a SOC chip was needed to monitor battery voltage, current, and temperature levels. The SOC chip will allow for critical measurements to avoid overcharging or deeply discharging the batteries. This complex chip, along with other signals to monitor DC bus current and voltage, need to be controlled and monitored by a microcontroller. Furthermore, the bidirectional controller requires some input signals to switch between its step-up (Boost) from 12V to 48V and step-down (Buck) modes from 48V to 12V. These signals will also be controlled and output by the microcontroller. These design additions can be viewed in the more detailed block diagram of Figure 3.
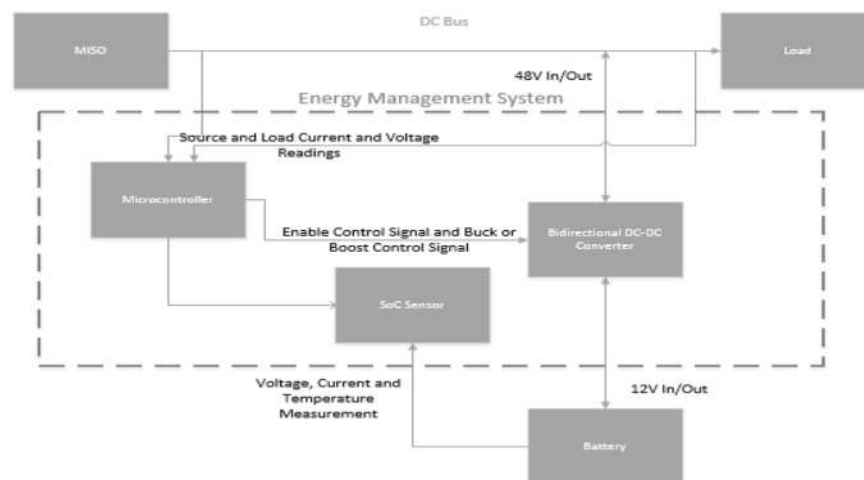
Figure 3. Detailed DC House EMS Block Diagram

3. DESIGN

This design of the DC House Energy Management System (EMS) builds on a previous implementation. To improve the system, the two separate DC-DC converters responsible for stepping voltage up or down between the battery and DC bus will be replaced with a single bi-directional converter. The system software will also be altered to utilize the temperature sensing capabilities of the state-of-charge (SOC) sensor. Additionally, the bi-directional converter and the SOC sensor will interface with a microcontroller that will output voltage levels and battery data to a LCD screen. Lastly, a PCB will be fabricated for the system to create a more replicable product.

For the bi-directional DC-DC converter, the LTC3871 controller chip was selected. Additionally, this chip is available on a demo board, the DC2348A-B, which meets the interface requirements and power capabilities of the DC House (48V/12V and high current capabilities). Figure 4 shows the outline of the demo board as well as connections to the board; Vhigh and GND connect to the 48V DC bus and Vlow and GND connect across the 12V battery. The controls BUCK/BOOST, RUN, and SETCUR are connected to and controlled by the digital output pins of the Arduino microcontroller (discussed later).

The converter will need to be run in constant-voltage (CV) boost mode to supply power to the 48V DC bus. In this mode, Vlow (12V) is the input and Vhigh (48V) is the output. Additionally, the BUCK turret is set to 0V and the SETCUR turret is set to GND (0V). To charge the 12V battery, the converter will need to be run in constant-current (CC) buck mode. Here, Vhigh (48V) is the input and Vlow (12V) is the output. Now the BUCK turret is set to 5V and the SETCUR turret is set to 1.3V by an external resistive divider powered by the microcontroller. The demo manual indicated that for CC buck mode, a 1.25V signal should be applied to the SETCUR turret to start the mode with a minimum current. Testing of the board showed that a 1.27V signal was the minimum needed to enable the board to run and charge the battery at around 2A. Thus, a safe voltage of 1.3V was selected to drive the SETCUR turret. Additionally, test results showed indicated that as the battery voltage drops, the battery draws more current from the converter to charge itself.

A resistor divider network was designed to supply the SETCUR input from the digital input/output (I/O) pins of the Arduino. These I/O pins are either 0V or 5V. Since resistor tolerances could result in a voltage slightly different than ideal values, and since CC buck mode will not run with a SETCUR voltage below 1.27V, the network was designed aiming for a 1.3V output. The following calculations show how the resistor values were determined using 1% resistor tolerances.
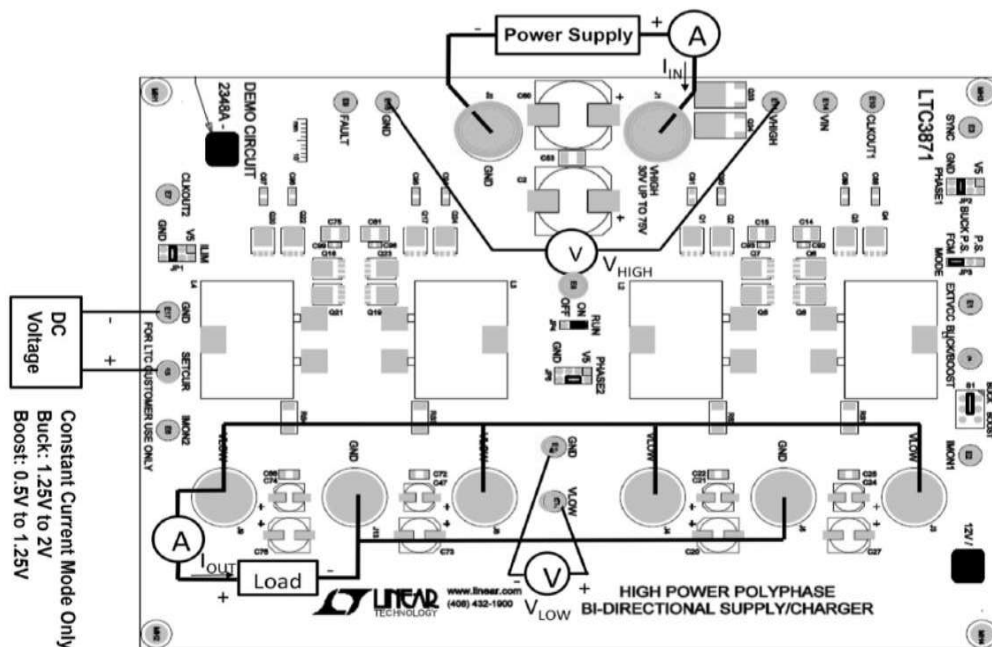
Figure 4. Bi-Directional DC-DC Converter Board and Connections

For the SOC sensor, the BQ78412 was chosen as it was the chip used in the previous EMS implementation. This sensor was selected as it was designed for lead acid battery banks, has a capacity of 327 Ahr, and can be controlled by a microcontroller over UART communication [5]. The circuit for the SOC chip was also preserved from the previous implementation of the system. While the state of charge can be approximated using battery voltage and discharge curve for the battery, a SOC chip will provide a more accurate measurement. The nodes TX and RX are connected to the microcontroller, VBAT+ and VBAT- are connected to the terminals of the 12V battery, and Vlow- is the low voltage (12V) bus. The grounded pins of the IC should be connected to the ground of the microcontroller.
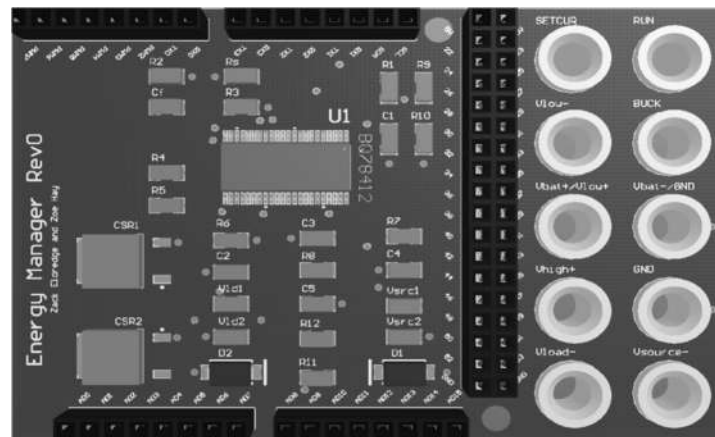
Figure 5. 3D PCB layout

For the microcontroller, the Arduino Mega2560 was selected. This microcontroller was also used in the previous EMS implementation thus allowing the reuse of a majority of the code that had already been written. The Mega2560 was chosen because it has enough input and output ports, sufficient current driving capabilities, and its widespread use and relatively low cost [5]. Additionally, an LCD screen was selected to interface to the Mega2560 through the SDA and SCL pins. This screen indicates the various voltage and SOC readings to the system user.

The SOC sensor system and a majority of the additional components required for the microcontroller to take voltage and current measurements were incorporated into a printed circuit board (PCB) layout. The PCB was designed using Altium Designer 17.0 software and was carefully mapped out to go on top of the Arduino with compatible header pins. Figure 5 shows a three-dimensional rendering of the manufactured and soldered PCB.

4. HARDWARE RESULTS

This version of the EMS for the DC House expands on the software written for the previous implementation [5]. The software is modified to support the changes to the system and to add off-states for the converter. The simple state diagram remains generally the same as the EMS still performs the same function of charging or discharging the battery based on measurements from the system. This state diagram can be seen in Figure 6.
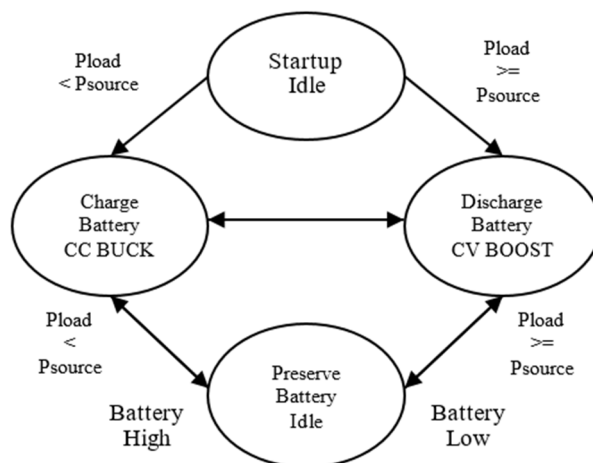
Figure 6. Simple State Diagram of Arduino Code

After the system design and PCB layout were completed, the components were selected and ordered. The parts are listed in the Bill of Materials included in Appendix A4. A large part of the construction of the system required populating the PCB. The Arduino specific header pins provide electrical and mechanical connections between the PCB and the microcontroller to allow the PCB to mount directly onto the microcontroller. Figure 7 shows a picture of the populated PCB mounted on the microcontroller.
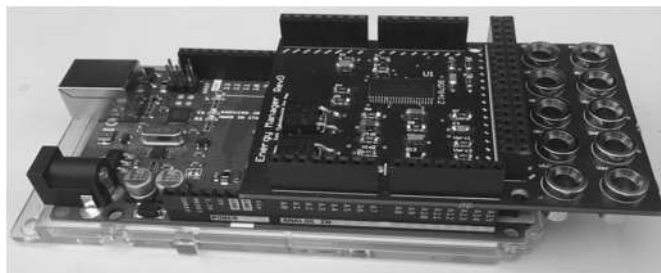
Figure 7. PCB and Arduino Microcontroller Setup

Connections to the bidirectional converter and the external button, switch, and display were made with leads and jumpers. A significant part of the design procedure was selecting appropriate connectors. Most of the power connections were made for banana-to-banana leads. The remaining connections, including the signal control connections, were made using banana-to-wire wrap. The LCD display is controlled and connected to the microcontroller via jumpers. An enclosure was selected and holes were drilled for the display, button, and external connectors. The system components were then mounted inside of the protective case. Figure 8 depicts the constructed enclosure.
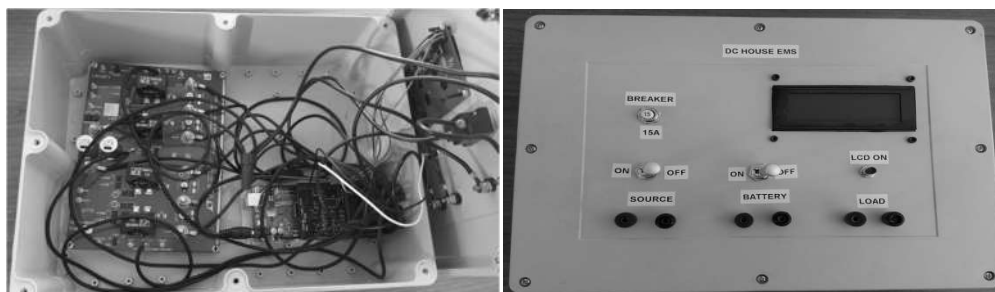
Figure 8. Fully constructed enclosure: inside (left) and outside (right)

The Bidirectional DC-DC converter was tested to determine its operating efficiency. Boost mode will be used when discharging the 12V battery to supply power to the 48V DC bus. This mode was tested with a 12V DC

power supply connected to the Vlow side of the converter and an electronic load set to a constant voltage of 48V connected to the Vhigh side. In boost mode, the converter is rated for a maximum output current of 15A [9]. However, when testing in the lab, the DC power supply was only able to supply up to 4.95A at 11.9V. The results are shown in Figure 9. This power supply limit corresponds to an output current of only 1.1A, a fraction of the 15A maximum (note that the output current here is on the Vhigh side). As shown by the results, efficiency improves as the output current approaches the full capability of the converter, reaching a maximum of 90% at 1.1A. The significantly higher capability of the converter indicates that a much greater efficiency could be reached when operating at a higher input/output currents exceeding those which could supplied during the lab test.
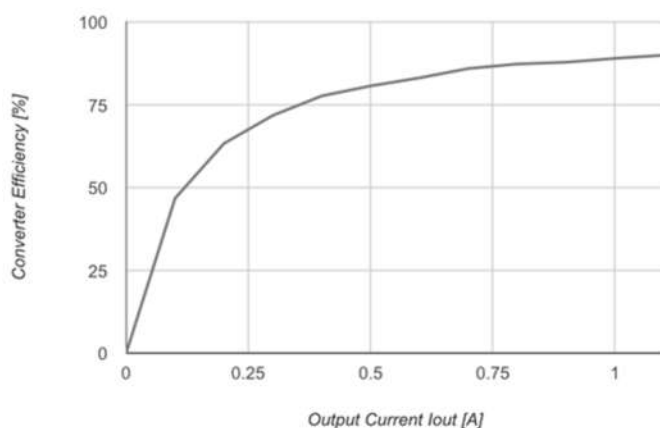
Figure 9. Efficiency of the Bidirectional DC-DC Converter Operating in Boost Mode

The converter will be operated in buck mode when power is drawn from the 48V DC bus to charge the 12V battery. This mode was tested with a DC power supply set at 48V connected to Vhigh and an electronic load set at a constant 12V connected to Vlow. In this mode, the output current can be controlled by changing the voltage applied to the SETCUR turret (note that the output current here is on the Vlow side). The valid range for the SETCUR voltage for buck mode operation is from 1.25 to 2V as indicated by the operation manual [9]. Again, due to power limitations in when testing in the lab, the full capabilities of the converter could not be tested. In buck mode, the converter is rated for a maximum output current of 60A. The results are shown in Figure 10. During testing, the DC power supply was only able to supply up to 1.1A input current at 48V. This corresponded to a maximum efficiency of 88.1%. Again, the converter efficiency improved as output current increased indicating greater efficiency could be observed by testing the converter at a higher power. It was observed that a SETCUR voltage of between 1.29V to 1.33V was the range where the converter operated at 88% efficiency. This corresponds with the design decision to select resistors to set the SETCUR voltage between 1.291V and 1.329V when accounting for worst case resistor values based on their tolerances.
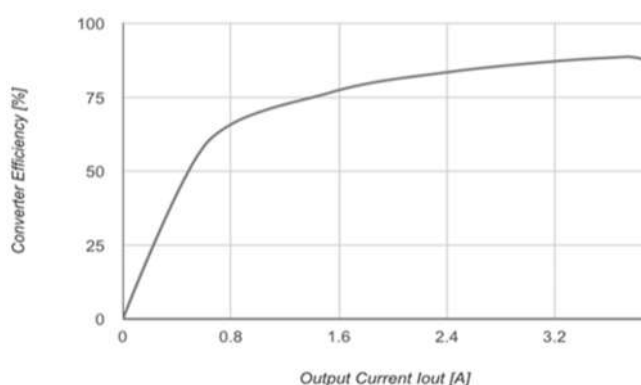
Figure 10. Efficiency of the Bidirectional DC-DC Converter Operating in Buck Mode

The system was tested using different setups depending on the mode of operation being simulated. Figure 11 shows the test setup for when the EMS directs power from the 12V battery to supply power to the 48V DC bus.

The power supply and electronic load were adjusted to emulate different conditions and control the mode of the converter.
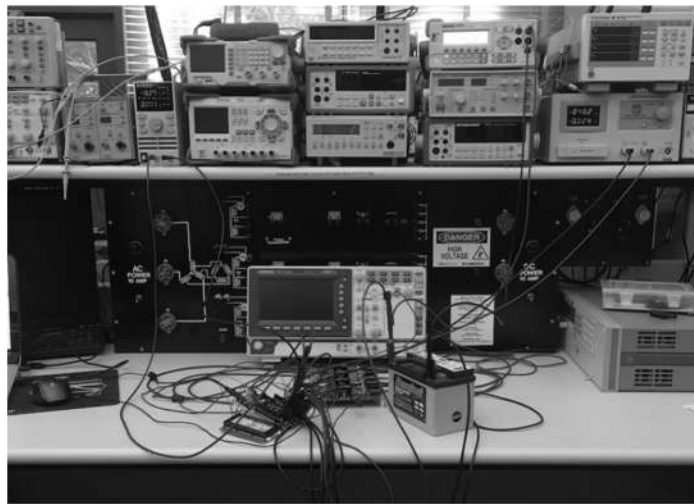
Figure 11. Efficiency of the Bidirectional DC-DC Converter Operating in Buck Mode

Table 1 shows a summary of the module's behavior corresponding to the logic implemented in the system's software. As in the Bidirectional DC-DC Converter Testing section, testing of the system was limited by the power capabilities of the available supplies. Other research for the DC House project (such as in [6]) indicated a maximum load current of 6.25A. As stated in the converter test section, the power capabilities of the DC power supply used to act as the 48V DC bus input to the converter allowed only a maximum output current to the load of 1.1A. More powerful test equipment would be required for testing at more realistic load conditions of at least several amps.

Table 1. System Conditions and Behavior

Power	Battery State of Charge	State of Bidirectional Converter	Mode
Pload > Psource	>=80%	Discharge Battery	Constant-Voltage BOOST
Pload <= Psource	>=80%	Don't Run	OFF
Pload < Psource	<=20%	Charge Battery	Constant-Current BUCK
Pload >= Psource	<=20%	Don't Run	OFF
Pload > Psource	20% - 80%	Discharge Battery	Constant-Voltage BOOST
Pload <= Psource	20% - 80%	Charge Battery	Constant-Current BUCK

5. CONCLUSION

Test results for the EMS exhibited the behavior desired for control of power flow in a DC House system. Using voltage and current sensing, the EMS charges, discharges, or remains idle depending on the power needs of the system and the SOC of the battery. The LCD outputs these measurements as well as battery voltage, temperature, and SOC readings taken from the SOC sensor. This design of the EMS for the DC House aimed to create a more developed version of a previous proof of concept. The fabrication of a PCB will allow the system to be more replicable and the larger LCD can display more system information. The bidirectional DC-DC converter accomplishes the function previously achieved by two separate converters and the newly revised code utilizes the temperature reading capabilities of the SOC sensor as well as including off states when the system should preserve the battery voltage for more efficient operation.

While this implementation of the EMS for the DC House made some improvements to the previously completed proof of concept, future works could produce a more robust system. When observing the system's measurements during testing, there was significant delay between a change in test conditions and the update of the display. This was due to the slow nature of the serial data communication. A chip with faster communication protocol would allow the system to be more responsive. Another aspect of the system that requires reconsideration is

the overvoltage protection method for the analog input pins of the Arduino Mega which are used to take voltage sense readings. This issue might be able to be addressed in code by determining how much voltage corresponds to the current being conducted by the Zener diodes. In the final design of the system, this function could not be reliably implemented and the Zener diodes were removed. Alternatively, a passive low pass filter could be used at the point where the Arduino pin is connected.

A future design of the EMS should consider a different method for taking current measurements. This implementation relies on an analog voltage reading taken by the Arduino from across a current sense resistor which is then processed in code to output a current measurement. Another error observed during testing was caused by the technique of biasing the source current sense analog input pin of the Arduino to 2.5V to bring the negative voltage across the current sense resistor into the positive voltage range. While the current measurements obtained from this design were acceptable for the basic functionality of the system, they were not as accurate as those taken directly with a multimeter during testing. Another method such as a dedicated IC or current transducer could provide more accurate readings.

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TECHNOLOGY MANAGEMENT OF SUNFLOWER SEED PROCESSING INDUSTRIAL AS A SUSTAINABLE HEALTH PRODUCT

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ABSTRACT

Today, herbal products are so phenomena in the society. Technology is so important in this industry. The benefits and the efficacy that contained in this product can be maintained if the technology can be managed properly. This research present how the technology management is applied in the herbal product industry. This research is descriptive qualitative with sunflower seed oil as object and Sunflower CV. as subject. From this research found that the owner mostly use natural process and enough science technology to produce the herbal product. The owner do the management very well so the product really naturalness and usefulness. By combining the technology of science, equipment and machines which is self created, the efficacy of sunflower seed are well preserved.

Keywords: *Technology, Technology Management, Sunflower seed oil.*

1. INTRODUCTION

Activities management are not only limited on company activity but also outside the company. Management activities are very abroad including in the field of technology. Today, it seems difficult to separate engineering and management activities (Nazaruddin, 2008). This is because the role of technology is so important for the company's life cycle, including the sunflower seed processing industry into health product. Wrong technology can reduce the efficacy of sunflower seed or may even be life-threaten to the sufferers. Therefore, technology management is needed.

Many people do not know the usefulness of the flower that has the latin name of Helianthus Annuus Linn and belong to the family of composite (Asteraceae). The function of Sunflower not only as an ornamental plant but also has many benefits. According to Cholid & Balittas (2009) sunflower can be utilized as foodstuff, biofuel, health and medicine, and other added value.

The benefit of health and medicine taken from the oil. This oil can be used as an anti aging skin care, either in supplements form or pure oil form that used for cooking. The sunflower seed has a balanced nutritional composition that is beneficial to body's health, such as vitamin A, Vitamin E and good fats (omega-6) so that this oil can be used internally and externally for the body (Fahrudin, 2015).

The concept of healthy lifestyle "back to nature" done by the community. This movement is also supported by WHO through their programs "Traditional Medicine Strategy". WHO also signed MOU, one of them is with India to promote traditional medicine. Sunflower seed oil can be an alternative. The efficacy of sunflower seed oil can perceived by the society if technology done properly. Therefore, technology management is required. Besides to improve business efficiency, the existence of technology management also impact on improving business competitiveness and innovation creation.

Sunflower CV. is one of the company that produce health product with sunflower seed oil as raw materials. This CV was established in 2003, based in Blitar. The product is sunflower seed oil which then formulated into various products. This research focuses on how the company implements management of technology in the process of producing sunflower seed oil.

2. METHODOLOGY

This research is a qualitative research so the test is done without using statistical tools to find meaning. The method is descriptive method. This method is used by searching the elements, characteristic, to illustrate why the phenomenon occurs. This method is also used to get in-depth data and contains the meaning of the actual data and exact data (Suryana, 2010). This method begins by collecting data, analyzing data and interpreting it.

The variables in this research are : sunflower seed oil, technology and technology management. Based on some understanding of variables, Setyawan (2008) concluded that the variable is an attribute or character or value of people, objects or activities that have certain variations set by the researchers to be studied and drawn conclusions.

This research uses qualitative approach. In this research did not use population an sample because this research departs from certain cases that exist in certain social situation in which case the research departs from the role of technology and application of technology management on the Sunflower CV. This is like what was said by spradley that cited by Sugiyono (2011) which uses the term of population as a "social situation" that consisting of three elements, namely: place, actors and activity that interact synergistically.

Data in this research consist of primary and secondary data. Primary data were collected through a basic theory search of technology management to support the processing of research. It starts from collecting all the relevant literature and studying the researches that have been done before. The output of this literature study is the collection of relevant references with problem formulation that is about the application of appropriate technology management to the sunflower seed processing industry as a sustainable health product. Secondary data were collected through direct observation and depth interviews with the owners on sunflower CV. Esterberg (2002) suggest that there are several types of interviews, including structured, semi-structured and unstructured. In this research use semi-structured and unstructured interviews so then interviewee can be more free to express their opinions and interviewer can get the information beyond the guide question but it is still in the research area.

The method of qualitative data analysis according to Miles and Huberman, as quoted Sutopo and Arief (2010) are three technique there are data reduction, data presentation and conclusion,.

3. RESULTS (Technology Management in Sunflower CV.)

3.1 Technology management definition

The word **Technology** comes from the Greek 'Technology'. Where *Techno* means art/craft and *Logia* means science, theory, study of something or branch of knowledge of a discipline. Technology can also mean entity that are useful to humans like machines, but can also include a wider range such system, organizational method and technique (Dj, 2009).

Technology refers to several things (Wanridz, 2015) :
a. Application of equipment and method for the production process
b. Method of applying knowledge or technical equipment
c. Machines and systems are considered as a set
d. A set of knowledge of a society or culture that is practical (applied)

Technology has some definition based on reasoning of the experts. Dosenit.com (2015) conclude the technology as follows:
a. Technology is a practical method used to create something useful and can be used repeatedly.
b. Technology is created by humans, many related to the practical activities that humans do daily.
c. Creation and development of a technology is for the purpose of human development where technology was deliberately created to help facilitate the job and human activities.
d. The basic of science that possessed by technology is scientific science which is a practical version.
e. Every technology can be created and also developed in accordance with the needs and also the capabilities of humans. The limits of a technology are just human thoughts. As long as humans can look for new ideas then technology development will never stop.

Still according Dosenit.com (2015), some examples of technology are:
- Information technology
- Mechanical and industrial technology
- Computer technology
- Other technologies

If connected with management, then technology management is a discipline that bridges the field of engineering and science with the field of management devoted to planning, development and implementation of

technology in order to achieve the strategic and operational goals of an organization. Thus described as follows (Khalil, 2005) :
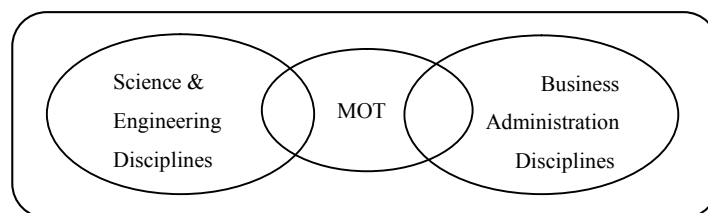
Figure 1. Technology Management

According Sinaga (2010) Management is the process of planning, setting, supervising, and controlling. Or often we hear about management abbreviation is POAC (Planning, Organizing, Actuating, Controlling). The purpose of applying technology management is to create and/or add value to the company through technology either self-created or obtained from the outside. Creation/enhancement of value can be done through the creation of business, the creation/improvement of products and services or the creation /improvement of processes (Nazaruddin, 2008).

So it can be concluded that doing technology management means managing a technology starting from planning, Organizing, Actuating and Controlling the technology to create and add value to the company in order to achieve the strategic and operational goals of an organization.

3.3 Processing of sunflower seed oil

Cholid & Balittas (2009) suggests seed peeled with peeling machine before pressed and then heated 180°-240° F then mechanically pressed using expeller. The next stage is placed in the process of extraction solvent to separate the rest of the oil by washing chemically. The oil that produced is exported as crude oil or refined for local consumption. The purification process includes degumming process by adding hot water and combined with a centrifuge. The oil is then washed and given fragrance by the heating/cooling process and the final filtration does not require hydrogenation. Then if described is as follows:
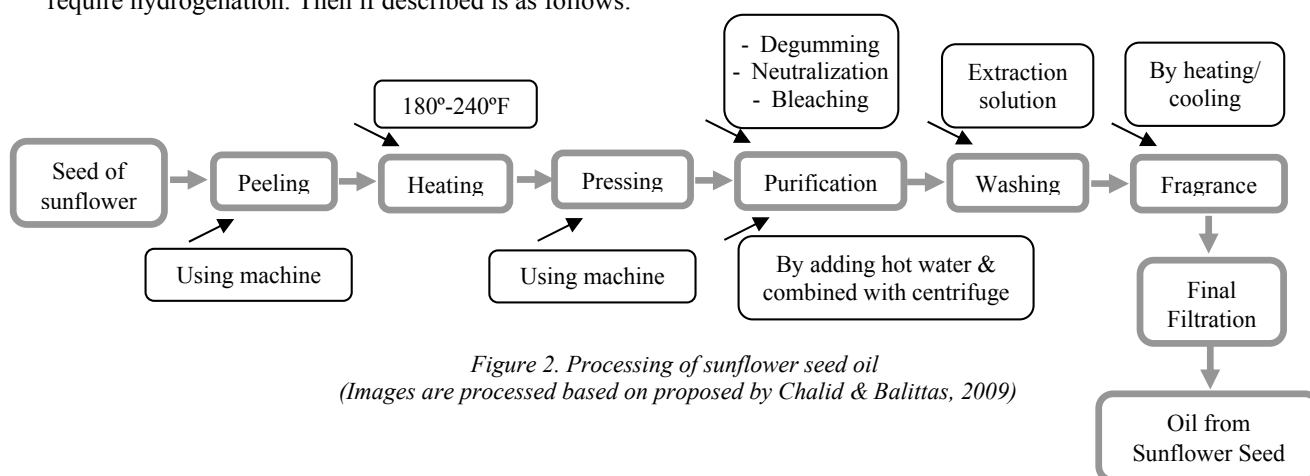
Figure 2. Processing of sunflower seed oil
(Images are processed based on proposed by Chalid & Balittas, 2009)

Almost same with Chalid & Balittas, Endah (2013) also described the processing of sunflower seed into oil and flour product through the process of drying, peeling, cleaning and sorting, smoothing and pressing the seed with screw press (cold pressing). The process of drying and sorting using the machine while other process without machine. Endah continued, for oil after produced from screw press machine must be purified first. The purification process includes degumming, neutralization and bleaching. Oil, flour, and other products are subsequently consumed for health improvement. If described is as follows:
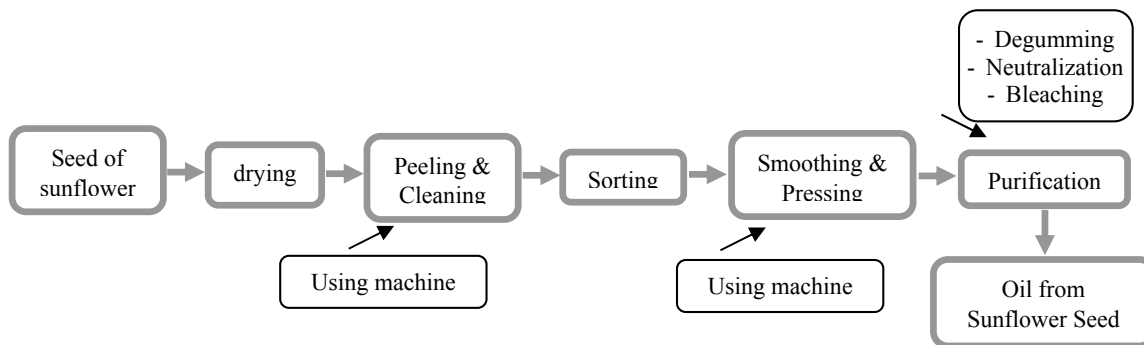
Figure 3. Processing of sunflower seed oil
(Images are processed based on proposed by Endah, 2013)

Some of the processes that need to be explained are as follows:
- **Purification**, through different several process in each company, but generally there are :
1. Degumming. The process of separating gum (sap), by dehydration gum then followed by the centrifugation process with add chemicals that can absorb water (Ilham, et al, 2013)
2. Neutralization. The process of separating free fat acid from oil or fats. It can using Caustic Soda, Natrium Carbonate, Solvent Extraction, Ethanol Amine and Ammonia (Ilham, et al, 2013).
3. Bleaching. The process to remove undesirable dyestuffs in oil. It can using absorbent or chemicals (Ilham, et al, 2013).
- **Extraction** is the process of separating a substance from its mixture by dividing a solute to taking the solute from one solvent to the other solvent. (Ilham, et al, 2013). He continued for extraction, oil solvents or fats commonly used are petroleum ether, gasoline carbon disulfide, carbon tetra chloride, benzene and n-hexane. Caesari and Martadilla (2010) explained about the manufacture of make cooking oil from sunflower seed using extraction from n-hexane solvent. Lukito A., et al, (2004) also conducted comparative experiment of extraction sunflower seed oil using n-hexane and ethanol.

3.4 Implementation technology management in the company

From some processing of making sunflower seed oil above shows that the process is susceptible to using chemicals. Although used in small quantities according standard but chemicals remain dangerous, moreover as a medicine, it will be consumed in the longterm and continuously. Besides, by the process of heating or cooling can damage the substances that are in sunflower seed. Gunawan (2009) said that "the best oil is processed without heating or cold press"

Just for example, caustic soda (NaOH) in neutralization process. Juanda (2011) suggest caustic soda if contact with the skin causes irritation and burns and if swallowed, caustic soda can be fatal. Another example is n-hexane as extraction solvent. Outbreaks of nerve disorders that hit shoe workers in Japan and Italy. Doctors determining the disease was caused by the workers breathing air containing high concentrations of n-hexane that came from glues and solvents the workers used in assembling the shoes (US Department of health and human services, 1999). In Material Safety Data Sheet (2008) identification that n-hexane is danger of serious damage to health by prolonged exposure through inhalation. Breathing vapors may cause drowsiness and dizziness. Causes eye and skin irritation. Possible risk of impaired fertility. Aspiration hazard if swallowed. Can enter lungs and cause damage, also dangerous for blood, central nervous system, liver, and respiratory system.

Sunflower CV innovates how to keep the product still original, natural, nutritious, so the body remains healthy. They combining the simple tools and machine (own creation) with his knowledge, created a natural health products and safe to consume continuously. The process is as shown in figure 4.
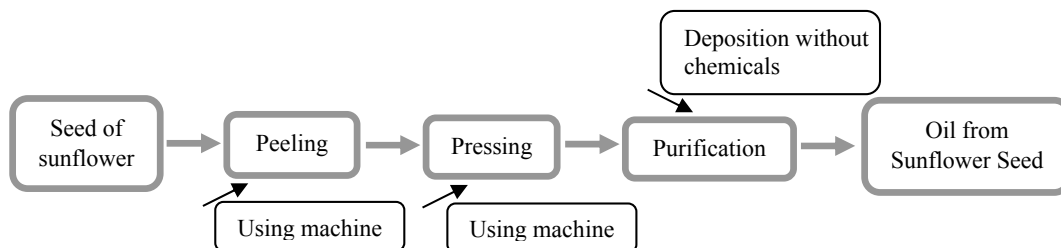
Figure 4. Processing of sunflower seed oil
(Images are processed based on interview result to the owner)

The picture shows that the owner does not use chemical process at all in the manufacture of sunflower seed oil, neither in the purification nor in the extraction process until it becomes oil. According to the owner, in addition to maintaining health welfare, the process of such as degumming is unnecessary. It is because after conducted a number of research by the owner, evidently, gum from sunflower seed, also efficacious. Therefore, the gum doesn't need to be removed.

Although it doesn't use a chemical process at all, pure sunflower seed oil can last up to 4 years (based on the results of the research owner). In his research, he also found, if sunflower seed oil splashed on dead rats then the oil is taken again, the bacteria becomes disappear and not in oil. This is indicates that the oil of sunflower seed can prevent the entry of bacteria.

In a day, sunflower CV produces about 500-700 bottles, marketed almost all regions of Indonesia and abroad (England, America). In the packaging, sunflower CV also innovate, initially, they using box now without box.

Past   *Now*
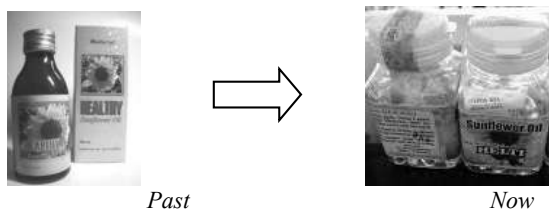
4. CONCLUSION

The owner of Sunflower CV has been doing technology management activities very well. There are apply technology as needed. The owner are wise enough and able to manage technology kindly. Because this is a herbal product industry. Where the product used both inside and outside the body. Inside by absorbed and outside by applied to the body. If wrong or over technology, the danger can be life-threatening.

Such cases of making oil from sunflower seed, although there is a technology to separate 2 or more mixtures using chemicals but in the process of medicine, chemicals are should not be used at all. Because, even though consumed in small quantities but if repeatedly, it will accumulate in the body.

So, in technology management, before decide what technology will be used, it need to be identified, if the output of production process is a product that will be consumed, then removed technology that using chemicals. The steps are as follows:
1. Product identification
   a. Product consumed by the body, or
   b. Product are not consumed by the body, or
   c. Services
2. Especially for product that consumed by the body (either absorbed or applied to the body), make sure, raw materials and production processes without chemicals at all.
3. Management process begins, for example starts from planning
   Planning of technology,
   - What technology will be used, equipment, machines, science, computer or another technology.
   - How technology is used in the production process.
   - Quality of technology safety.
   - Pay attention with limitation/weaknesses of technology that will be used.
4. Management process is done from the beginning of production until packaging and distribution

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THE APPLICATION OF COST-SIGNIFICANT MODEL ON THE ESTIMATED COST OF RESIDENTIAL PROJECT IN SURABAYA, GRESIK, AND SIDOARJO

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ABSTRACT

In the early stages of housing project planning, the project owner requires an initial cost estimate as an estimate in determining the value of the investment. For that we need to develop a cost estimation model that is more precise, easy to use, and can be justified. Cost Significant Model is one method of estimating the cost of projects that have been widely applied with fairly accurate results according to some previous research. This study aims to develop estimation model in the early stages of housing project planning in Surabaya, Gresik and Sidoarjo. The development method uses the principle of "Cost Significant Model" and multiple linear regression equation. The data were taken from 8 simple housing project packages using Bill of Quantity method from fiscal year 2012 until 2016 then compared with 1 work package to be implemented. The results concluded that the cost significant item of 85, 78% consists of work: roof and ceiling (X6), painting (X8), sanitation and channel (X11). Cost estimation model of housing development using cost significant model obtained equation $Y = 1,782,020.22 + 0.893 X6 + 4.479 X8 + 4.675 X11$

Keywords: *cost, estimate, significant, model, hosing.*

1. INTRODUCTION

The growth of the property market is expected to be followed by rising house prices, where the rise in prices is inseparable from rising prices of construction materials and inflation factors. For every residential project developer requires a precise and accurate estimate of price estimates, related to early marketing before the project is completed[1]. Therefore, inaccurate estimation of costs can lead to project efficiency being disrupted which in turn is the main cause of losses and less than optimal results, even the construction project cycle can be cut off [2]. One important process in the project is the cost estimation phase. Often, when the project is in its early stages, the information to estimate is not too detailed, so estimation results tend to be less accurate. Therefore, a cost estimation model is needed that can explain most projects based on as little information as possible. One method of estimation that can be used is the Cost Significant Model, which is an estimation model that uses the cost of work that significantly affects the total project cost [3],[4],[5]

The Cost Significant Model is a model of total cost forecasting of a construction project based on contractor bidding data that has been implemented, which focuses on the most significant job prices affecting the total project cost as the basis for forecasting which is translated into multiple regression 6]. To estimate the cost of the concept of the Cost Significant Model is to rely on well-documented findings, that 80% of the total project cost is contained in the most expensive 20% of work items. For projects that have similar characteristics, the cost-significant items are roughly the same [7].

This study uses data from similar projects that have been implemented previously. This study uses Cost Significant Model method to estimate the total cost of simple and healthy residential development projects in Surabaya and its surrounding areas. The data is collected by using sampling method that is sourced from several developers and contractors in Surabaya, Gresik and Sidoarjo from 2012 until 2016. The purpose of this research is to

get estimation of housing cost to be used by investor and developer in determine the initial of residential project cost estimate.

2. METHODOLOGY

2.1 Research design

The design of this study begins with the collection of bill of quantity project data then the data grouped on each more specific functions. To obtain a more accurate conceptual cost estimation model, this research will develop by Cost-Significant Model estimation method. As the basis of the Cost Significant Model in this study is to group the percentage of mean results on each independent variable to 80% percent of the total value of the highest project then ranked.

2.2 Data Collection

Sampling should produce accurate and precise samples. Inaccurate samples will give unexpected research conclusions or result in false conclusions [8]In this study, data collection is done by reference as follows:
1. Data collected in the form of bill of quantity residential project.
2. Component price of bill of quantities collected without value added tax

2.3 Identification of variables

Identification of variables of this study uses the cost of several jobs as independent variables consisting of: preparation work (X1), foundation work (X2), reinforced concrete work (X3), couple and stitching work (X4), floor work (X5), roof and ceiling work (X6), doors and windows work (X7), painting work (X8), locks and hangers work (X9), electricity work (X10), sanitation and drainage work Meanwhile, the dependent variable (Y) is the total cost of the project.

2.4 Analysis Method

For the implementation of data analysis techniques, initially the data are grouped, then After the results are grouped data analysis techniques in this study carried out with the following stages:

1. **Calculation of influence time value**
    The influence of time value can be calculated because of the reduced value of money due to the factor of inflation each year. The calculation uses Future Value (FV) with the following equation [9]

$$F = (P + i)^n$$

    Where:
    F : The Future value
    P : The Present value
    I : Inflation factor
    n : Year of projection

2. **Determine the cost-significant items**
    By looking at the description of research results, obtained the proportion of each cost component (independent variable) to the total cost (dependent variable). The proportions are sorted from the largest to the smallest. Significant items are identified as the largest items whose percentage is equal to or greater than 80% of the total cost. The independent variables identified as cost-significant items will then be analyzed using the SPSS program [7].

3. **Test requirements for analysis**
    Normality test aims to determine whether the data obtained is Normal distribution or not. The statistical method for testing normality in this study is Shapiro Wilk [sn2 (x) -Sn2 (x)], D = max ". [10]

4. **Multiple linear regression analysis test.**

    $Y = a_0 + a_1 X_1 + a_2 X_2 + a_3 X_3 + \ldots\ldots\ldots + a_n X_n$

    Where:
    Y = estimate for the dependent variable Y,
    a_0 = estimated parameter constant a_0,
    $a_1, a_2, a_3, ..., a_n$ = estimated parameter of regression coefficient $a_1, a_2, a_3, ..., a_n$,
    $X_1, X_2, X_3, ..., X_n$ = the value of the independent variable.

3. RESULTS
3.1 Research Data

Research data in the form of budget development cost of some residential projects obtained from various source developer and contractor in Surabaya, Sidoarjo and Gresik from 2012 until 2016 can be seen in Table 1. While data of inflation value from 2012 until 2017 in Surabaya city according to sources from the Indonesian Statistics (2017) [12], can be seen in Table 2

Tabel1 Residential Project in Surabaya City 2012-2016

No	Name of Residential	Location of City	Sample Housing	Year	Type	Building Area	Total Cost (Rp)
1	Golden City	Gresik	R_1	2012	40	40 m2	91.000.000,-
2	MentariBumi Sejahtera	Sidoarjo	R_2	2012	45	45 m2	101.500.000,-
3	Istana Mentari	Sidoarjo	R_3	2013	40	40 m2	105.000.000,-
4	Mutiara Land	Gresik	R_4	2014	40	40 m2	110,000,000.-
5	Taman Anggun Sejahtera 5	Surabaya	R_5	2014	36	36 m2	103,500,000.-
6	SipoaCitylink	Surabaya	R_6	2015	35	35 m2	102,000,000.-
7	Bukit SekarAnom	Gresik	R_7	2016	30	30 m2	95,000,000.-
8	The Sun Garden	Sidoarjo	R_8	2016	45	45 m2	145,000,000.-

Source: Secondary data (2017)

Table 2. Inflation Data of Surabaya City 2012-2016

No	Tahun	Inflasi
1	2012	1,26
2	2013	2,67
3	2014	2,23
4	2015	0,94
5	2016	2,64

Sumber: Indonesian Statistics, Surabaya City (BPS)[12]

Based on Table 1 above and on the basis of data supporting the cost plan of each type of work for each type of house, the sample research data can be recorded as in Table 3. In Table 3 Each independent variable and its value from 2012 to 2016 is grouped from X_1 Up to X_{11}. Similarly, the value of the dependent variable (Y) from 2012 to 2016 can be seen in Table 3

Table 3 Recapitulation of Research Data Sample

Var	Work Item	Budget Cost of Housing, Years				
		2012	2013	2014	2015	2016
		$R_1 + R_2$	R_3	$R_4 + R_5$	R_6	$R_7 + R_8$
X_1	Preparation	2,193,038	2,310,000	2,562,000	2,244,000	5,280,000
X_2	Foundation	7,992,405	4,620,000	8,753,500	4,488,000	10,560,000
X_3	reinforced concrete	19,688,608	11,760,000	19,855,500	11,424,000	26,880,000
X_4	couple and stitching	42,138,006	20,685,000	44,835,000	20,094,000	47,280,000
X_5	Floor	7,753,608	4,410,000	11,102,000	4,284,000	10,080,000
X_6	roof and ceiling	48,951,044	24,675,000	58,926,000	23,970,000	56,400,000
X_7	doors and windows	25,049,367	14,070,000	26,047,000	13,668,000	32,160,000
X_8	Painting	15,619,304	9,975,000	19,428,500	9,690,000	22,800,000
X_9	locks and hangers	492,215	1,575,000	427,000	1,530,000	3,600,000
X_{10}	Electricity	5,755,506	2,730,000	5,764,500	2,652,000	6,240,000
X_{11}	sanitation and drainage	16,862,025	8,190,000	15,799,000	7,956,000	18,720,000
	Total (Y)	192,500,000	105,000,000	213,500,000	102,000,000	240,000,000

Source: Secondary data (2017)

3.2 Calculation of influence time value

The calculation of the influence of time value of each variable can be calculated by calculating the index of each square meter price of each variable multiplied by the inflation value in 2013, 2014, 2015 and 2016 (see Table 2). Completely calculate the influence of time value on the unit price index of perimeter square work can be seen in Table 4

Table 4. Conversion of Price Index per m2 Against Inflation Rate

SAMPLE	$R_1 + R_2$	R_3	$R_4 + R_5$	R_6	$R_7 + R_8$
YEAR	2012	2013	2014	2015	2016
AREA (m2)	85	40	76	35	75
DEPENDENT VARIABLE					
Y	2,324,494.1	2,694,300.0	2,883,373.7	2,991,222.9	3,284,480.0
INDEPENDENT VARIABLES (X)					
X_1	26,481.6	59,274.6	34,600.5	65,806.9	72,258.6
X_2	96,510.6	118,549.2	118,218.3	131,613.8	144,517.1
X_3	237,745.7	301,761.6	268,153.8	335,017.0	367,861.8
X_4	508,828.8	530,777.1	605,508.5	589,270.9	647,042.6
X_5	93,627.1	113,160.6	149,935.4	125,631.4	137,948.2
X_6	591,098.3	633,160.5	795,811.1	702,937.4	771,852.8
X_7	302,478.5	361,036.2	351,771.6	400,823.9	440,120.3
X_8	188,607.7	255,958.5	262,387.0	284,166.2	312,025.6
X_9	5,943.6	40,414.5	5,766.7	44,868.3	49,267.2
X_{10}	69,499.4	70,051.8	77,851.1	77,771.8	85,396.5
X_{11}	203,613.9	210,155.4	213,369.7	233,315.4	256,189.4

Source: Recapitulation of Research Data Sample

The variable price of Y and variable X during 2012 to 2016 is calculated average and standard deviation. The proportion of the components of each variable Y, X_1 through X_{11} can be seen in Table 5.

Table 5. Proportion of Cost Components

No	Variable Description	Symbol	MEAN	SD	%
1	Total Cost	Y	2,835,574.1	2,681,281.5	100.00
2	Preparation	X_1	51,684.4	46,527.7	1.82
3	Foundation	X_2	121,881.8	114,366.3	4.30
4	reinforced concrete	X_3	302,108.0	289,471.1	10.65
5	couple and stitching	X_4	576,285.6	565,066.2	20.32
6	Floor	X_5	124,060.5	115,478.0	4.38
7	roof and ceiling	X_6	698,972.0	678,666.9	24.65
8	doors and windows	X_7	371,246.1	354,514.5	13.09
9	Painting	X_8	260,629.0	234,454.1	9.19
10	locks and hangers	X_9	29,252.1	27,530.2	1.03
11	Electricity	X_{10}	76,114.1	76,065.1	2.68
12	sanitation and drainage	X_{11}	223,328.8	225,067.1	7.88

Source: Statistical Analysis Results

3.3 Determine cost significant items

From Table 5 Description of Research Results of Proportion of Cost Components, can be determined cost-significant items as shown in Table 6.

Table 6. Cost Significant Item

No	Variable Description	Symbol	Mean (%)	Cumulative (%)
1	roof and ceiling	X_6	24.650	24.65
2	couple and stitching	X_4	20.320	44.97
3	doors and windows	X_7	13.090	58.06
4	reinforced concrete	X_3	10.650	68.71
5	Painting	X_8	9.190	77.90
6	sanitation and drainage	X_{11}	7.880	85.78

Source: Statistical Analysis Results

3.4 Normality Test

Since the number of samples is less than or equal to 50 then the data normality test using Shapirow Wilk method. Testing is conducted based on the guidance of comparison of probability value with significance value ($\alpha = 0,05$). The data requirement is called normal if probability or $p > 0,05$ or ($p > \alpha$). The summary of normality test results based on Shapirow Wilk value can be seen in Table 7.

Table.7. Normality test based on Shapiro Wilk value

No	Variable Description	Symbol	Probability (sig)	Taraf (sig)	Remarks
1	roof and ceiling	X_6	0,700	0,05	Normal
2	couple and stitching	X_4	0,312	0,05	Normal
3	doors and windows	X_7	0,125	0,05	Normal
4	reinforced concrete	X_3	0,634	0,05	Normal
5	Painting	X_8	0,154	0,05	Normal
6	sanitation and drainage	X_{11}	0,276	0,05	Normal
	Total Cost	Y	0,715	0,05	Normal

Source: Results of SPSS Analysis

3.5 Multiple linier regression analysis test

The results of multiple linear regression analysis can be seen in Table 8. From Table 8 coefficients, the significance value states that; roof and ceiling work (X6) = 0,000 <0.05, painting (X8) = 0,000 <0.05 and sanitation work and drainage (X11) = 0,000 <0.05, meaning those works have a significant effect on cost (Y) at 95% confidence level. B constant value = Rp 1,782,020.22 states that if roof and ceiling work (X6), painting work (X8) and sanitation and drainage work (X11) are ignored, the cost of house construction per m2 is Rp 1,782,020.22. Value B = Rp 1.782., 20.22 states that each additional house expansion cost per m2 will increase Rp 1,782,020.22.

Table 8. Constants and Regression Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1,782,020.22	6.953		-.176	.889
roof and ceiling(X_6)	0.893	.000	.219	105067.215	.000
Painting (X_8)	4.479	.000	.576	174345.697	.000
sanitation and drainage (X_{11})	4.675	.000	.281	104026.185	.000

Dependent Variable: Total Cost; Source : Results of SPSS Analysis

Based on the value of B constant and coefficient values (X_6), (X_8) and (X_{11}) in Table 8, a linear regression equation (model) can be made:

$$Y = 1,782,020.22 + 0.893 X_6 + 4.479 X_8 + 4.675 X_{11}$$

Where:
Y = The cost of building a simple and healthy house (Rp / m2).
X6 = roof and ceiling (Rp / m2).
X8 = painting (Rp / m2).
X11 = sanitation and drainage (Rp / m2).

4. CONCLUSION
4.1 Conclusions
1. Roof and ceiling work, painting and sanitation and drainage have a significant effect of 85.78% on the cost of building a simple and healthy house in Surabaya and surrounding areas, while the remaining 14.22% is influenced by other causes.
2. Model cost estimation of development with "Cost Significant Model" is:

$$Y = 1,782,020.22 + 0.893 X_6 + 4.479 X_8 + 4.675 X_{11}$$

4.2 Recommendations

In order to do further research with the object of research with the number of samples more, to improve the modeling results. In addition, future research should be conducted within a wider range of other areas to be more general.

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CONTROL SYSTEM AND MONITORING OF SOLAR CELL LIGHTING BASED ON ANDROID USING ARDUINO UNO

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ABSTRACT

Increased global energy demand resulted in an energy crisis. Solar Cell is one alternative to fossil energy because it can convert solar energy into electrical energy. In this study aims to use energy from solar cell battery as a replacement for PLN energy.

In this Final Project, an equipment control apparatus will be generated from the solar cell battery voltage through the wifi network, where application users do not necessarily have to go to the switch box to turn on the equipment, but only by pressing the button on the android to activate the equipment desired.

1. Introduction

The development of various electronic devices around us already have the ability of wireless computing and communications, for example; TV, VCD, air conditioner. To illuminate a number of rooms and home pages of course we need a lot of lights so by itself must have many different outlets (as control devices) that are located differently. Therefore for the convenience of user device that I will make this must be able to interact with user without complicated configuration. Standard Remote control uses Infra Red (IR), while new technology uses radio waves, one example is Wifi.

Technology has several advantages over IR. The main advantage of wifi over IR is that Wifi devices do not have to be in line of sight, so devices can interact with each other in spite of obstacles. For that, by utilizing existing technology on android-based phones, the authors here want to develop methods of controlling and monitoring Solar Cell Lights using Wifi found on Android-based smartphones on the application of technology that will be designed authors.

This application can be an alternative to control and monitoring of Solar Cell Lamps where the old controller is a switch connected with the cable and cannot monitor the state of the lights on or off, this will be replaced by utilizing Wifi on Android-based phones, so it can control and Monitor lights.

2. System Design
3.1 Control System

In this system, the user inputs from the existing lamp control app on the Android device. The input used is a standard input that is switch button. The data entered is serial data sent to Arduino via Wifi. Data sent from Android will be received by the wifi module in the microcontroller system. Where in this case the microcontroller is Arduino. The serial data is translated by microcontroller into parallel data. Parallel data generated by

Microcontroller forwarded relay through LED indicator that serves to ascertain whether there is wrong pairs or not. If up to this stage the process runs smoothly, then relay will forward the data used for

Turn on and off the lights. Led indicator functions as feedback. That is when the lamp is alive, led will also live. Vice versa. The led conditions on / off are used as inputs to the Arduino. Data obtained from the Arduino is sent back to the Android device.
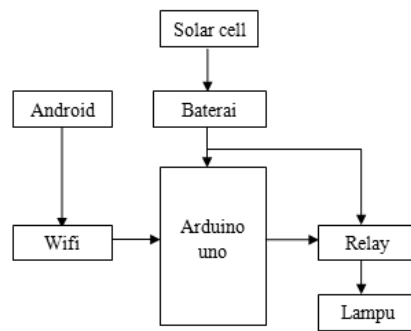
Fig 3.1 Block diagram control system

In the above block diagram, the solar cell is the input voltage to charge a battery used to power the arduino and DC lamps connected using the module relay.

Arduino as a data processor sent by android via Wifi module.

3.1.1   Arduino Program

This program functions as a recipient of data sent from an Android device. Here is the program list:

Fig 3.2 Arduino Program

Once the arduino program for the control has been uploaded, then assemble arduino, wifi module and relay module to be able to control the light via wifi and android as in figure 3.3.
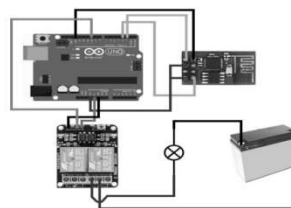
Fig 3.3 Control system circuit

3.2 Monitoring Design

Material Monitoring

• Voltage Sensor

The voltage sensor here as the incoming voltage detector at the lamp is then processed by the arduino microcontroller and displayed on the lcd.

• Current Sensor

The current sensor as a current detector that flows on the lamp into, is then processed by an arduino microcontroller and displayed on the lcd.

• Microcontroller

Microcontroller used is the type of arduino UNO which in charge of receiving data with all the advantages such as analog data receiver etc, which later data can be accessed via computer. But the arduino itself must first be programmed according to the need.

• LCD

As the output of data that has been processed in microcontroller can be displayed various ways, one of which is the use of LCD. This LCD is required for users who want to see the measured energy quantity does not have to always look at the monitor or computer, simply by looking at the LCD display.
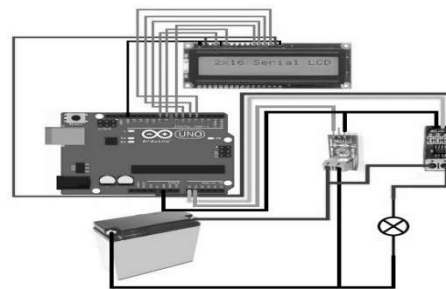
Fig 3.4 Monitoring circuit

3. *Testing*

To know whether the work or not the device that has been made either hardware or software must be done a test in the form of performance as well as with measurement of the device also to the response generated. A system is said to work well if the system works in accordance with the initial goal achieved when first done the design.

From this test will be obtained data that contains the advantages or disadvantages of the components or sensors and systems used. With this test it is expected that the weaknesses of the system can appear and be improved in order to obtain better results through corrections to the weaknesses encountered during the test.

4.1 Testing Mini Solar cell

Mini solar cell functions to convert solar heat into DC volt voltage, the maximum voltage generated by mini solar cell reaches 6 VDC only. However, the voltage can be increased by using step up-down boost buck converter.

Fig 4.1 Step up-down boost buck converter.

Thus we can increase / decrease the voltage according to our wishes.

Fig 4.2 Testing of solar cell voltage

Table 4.1 Testing of solar cell voltage

Time (Clock)	V out from Solar Cell (Volt)	V out from step up converter (Volt)
12:10	5.3	12.26
12:15	5.1	11.79
12:20	4.7	10.87
12:25	4.7	10.87
12:30	4.9	11.33
12:35	4.6	10.63
12:40	5.1	11.79
12:45	5.2	12.02
12:50	4.9	11.33
12:55	4.8	11.1
13:00	5.6	12.95

4.2 Current and Voltage Sensor Testing

This test aims to determine the function of equipment on electronic equipment and the functioning or not the equipment.

Fig 4.3 Testing voltage and current sensors with no load

Fig 4.4 Testing voltage and current sensors with load

4.3 Testing Controller Applications

This test aims to determine the function of control devices on / off on electronic equipment and the distance of control activation lamp using android phone.

Fig 4.5 Testing the controller app before the button is pressed
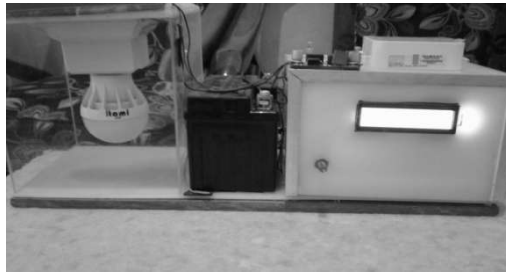
Fig 4.6 Light off

Fig 4.7 Testing controller app after button is pressed

Fig 4.8 Light on

The test results from designing prototype solar cell light control system using arduino based Android phone is as follows:

Table 4.2 Results of testing wifi controls

No	Range Distance	Time	Without Barrier	With Barrier
1	1 Meters	5 second	ON	ON
2	5 Meters	5 second	ON	ON
3	10 Meters	5 second	ON	ON
4	15 Meters	5 second	ON	ON
5	20 Meters	5 second	ON	ON
6	25 Meters	5 second	ON	ON
7	30 Meters	5 second	ON	ON
8	35 Meters	5 second	ON	ON
9	40 Meters	5 second	ON	ON
10	45 Meters	5 second	ON	ON
11	50 Meters	5 second	ON	OFF
12	55 Meters	5 second	ON	OFF
13	60 Meters	5 second	ON	OFF
14	65 Meters	-	OFF	OFF

4.4 Advantages and disadvantages

4. Conclusion

Based on explanations and experiments, we can illustrate the advantages and disadvantages of the lighting control system as follows.

1. Advantages
- Time and energy efficiency.
- Practical to use.
- Users can control this electronic device within a specified range, which is in the table.
- Users can control electronic devices more safely because they do not make direct contact with electrically powered devices.
- Safe for children and people who are afraid of being electrocuted.
- Can be controlled more than one device.

2. Weakness

The range of connections using Wifi is far enough for unobstructed space conditions. However, when crossing a wall or other barrier material, the connection distance will decrease. Or it could be called reduced range effectiveness.

Cost of devices that tend to be expensive compared to switches in general.

Based on the results of the analysis, the results of experiments and tests that have been done on this control system, obtained some conclusions as follows:

- In the manufacture of prototype devices control system and lighting monitoring using Arduino-based Android phone has a main design, namely the mechanical design of the Arduino, wifi module, voltage sensor, current sensor, lcd, relay module, and lighting devices.

- Wifi communications can only be done under limited distance conditions depending on the transmitter signal capture power of the wifi module and the android smartphone.

- This research has produced a simple and user-friendly interface to be easily operated by the user.

- Android has supported the complete features to build a communication system with a microcontroller.

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SELECTING PRIORITY ON INFORMATION TECHNOLOGY WORK PLANS USING AHP: A CASE STUDY IN CLINICAL LABORATORY POPULER

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ABSTRACT

Information technologies are playing vital and expanding roles in business. The increasing number of newcomers creates a competition where each companies have to survive in clinical laboratory industry. Aware with that competition, Clinical Laboratory Populer are trying to utilize information technology as their competitive strategy to improve interoperability with agencies, to integrate information systems between their departments, and also to improve their overall quality of service. An IT strategic plan have been developed, however, their work plans are limited by the company's budget and time.

Deciding the priority within the limits is important. The decision-making process is complex and both can generate positive results, or make a significant loss to the company. One method that has been used by companies to assist in this decision-making process is Analytic Hierarchy Process (AHP), a multi-criteria method of classification hierarchies, created in 1980's (Saaty, 1980). The objective of this study is to use AHP method in IT work plan priority selection process in Clinical Laboratory Populer.

As the result, by using AHP the weight of all alternatives can be measured. The priority of Process Area sorted from the highest to the lowest consecutively are SD (0,222), OT (0,179), CAM (0,130), OPF (0,126), SCON (0,112), SSD (0,088), RSKM & IRP (0,72). The overall inconsistency ratio is 0,08 (≤ 0,10). Therefore, it can be concluded that Process Area SD becomes the priority.

Keywords: AHP, decision-making process, priority selection.

1. INTRODUCTION

Information technologies are playing vital and expanding roles in business. Information technology can help all kinds of businesses improve the efficiency and effectiveness of their business processes, managerial decision making, and workgroup collaboration, which strengthens their competitive positions in rapidly changing marketplaces (O'Brien, 2011). Efforts in utilizing information technology at clinical laboratory facilities have shown good results such as improving the service processes and creating simplicity in communications with patient. Integrated laboratory equipments within a computer system could prevent duplication of test results, and also could speed up the laboratory services, which could optimize its overall usability.

The increasing number of newcomers creates a competition where each companies have to survive in clinical laboratory industry. Aware with that competition, Clinical Laboratory Populer are trying to utilize information technology as their competitive strategy to improve interoperability with agencies, to integrate information systems between their departments, and also to improve their overall quality of service. An IT strategic plan have been developed, however, their work plans are limited by the company's budget and time.

Therefore, deciding priority within the limits is important. The decision-making process is complex and both can generate positive results, or make a significant loss to the company. One method that has been used by companies to assist in this decision-making process is Analytic Hierarchy Process (AHP), a multi-criteria method of classification hierarchies, created in 1980's (Saaty, 1980). The objective of this study is to use AHP method in IT work plan priority selection process in Clinical Laboratory Populer.

2. RESEARCH FRAMEWORK

2.1. Process Area Mapping

IT work plans are mapped into the relevant CMMI-SVC Process Area (PA). They are distinguished based on categories and specific goals (SG) documented in CMMI-SVC. The results are shown in Table 1, showing the IT work plans and their relevant process areas, categories, and spesific goals. 8 Process Areas have been mapped from the IT work plans; Service System Development (SSD), Capability and Availability Management (CAM), Service Continuity (SCON), Organizational Training (OT), Risk Management (RSKM), Incident Resolution and Prevention (IRP), Service Delivery (SD), Organizational Process Focus (OPF).

Table 1. IT Work Plans Mapped Into CMMI-SVC Process Area

IT Work Plans	CMMI-SVC Process Area	Category	CMMI-SVC Specific Goals
Development of Clinical Laboratory Information System	Service System Development (SSD)	Service Establishment and Delivery	SG 1. Develop and Analyze Stakeholder Requirements SG 2. Develop Service Systems SG 3. Verify and Validate Service System
IT Infrastructure Improvement	Capability and Availability Management (CAM)	Project and Work Management	SG 1. Prepare for Capacity and Availability Management SG 2. Monitor and Analyze Capacity and Availability
Maintain usability of the previous information system until the development process is finished	Service Continuity (SCON)	Project and Work Management	SG 1. Identify Essential Service Dependencies SG 2. Prepare for Service Continuity SG 3. Verify and Validate the Service Continuity Plan
IT training programme for employee and IT staff	Organizational Training (OT)	Process Management	SG 1. Establish an Organizational Training Capability SG 2. Provide Training
Build Disaster Recovery Center to protect data and IT services	Risk Management (RSKM)	Project and Work Management	SG 1. Prepare for Risk Management SG 2. Identify and Analyze Risks SG 3. Mitigate Risks
Improvement for IT support services by helpdesk	Incident Resolution and Prevention (IRP)	Service Establishment and Delivery	SG 1. Prepare for Incident Resolution and Prevention SG 2. Identify, Control, and Address Individual Incidents SG 3. Analyze and Address Causes and Impacts of Selected Incidents
Promotion and education for patients through website	Service Delivery (SD)	Service Establishment and Delivery	SG 1. Establish Service Agreements SG 2. Prepare for Service Delivery SG 3. Deliver Services
Standardize IT	Organizational Process Focus	Process	SG 1. Determine Process

service	(OPF)	Management	Improvement Opportunities SG 2. Plan and Implement Process Actions SG 3. Deploy Organizational Process Assets and Incorporate Experiences

2.2. HIERARCHY STRUCTURE

There are 4 main criteria used to determine priority on the Process Areas, they are Impact on Business Objectives, Ease of Implementation, Human Resource Availability, and Budget Availability. These criteria are identified from interview with the managers and the director of Clinical Laboratory Populer. Figure 1 shows a hierarchy of the criteria, each are broken down into the 8 Process Areas.
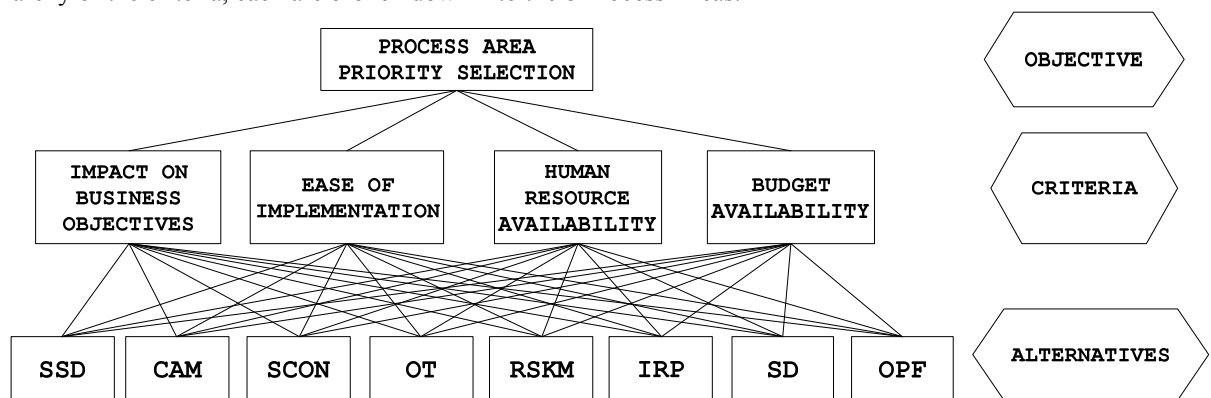
Figure 1. Hierarchy to determine priority Process Area

Definitions of each criteria are explained as follows:
1. Impact on Business Objectives: Priority of Process Area is determined based on its impact on the business objectives of the company. The greater positive impact that could be given by a Process Area, the greater the chance for the Process Area to be prioritized.
2. Ease of Implementation: Priority of Process Area is determined based on its ease of implementation. The less complex a Process Area means it is easier to implement and the priority is higher.
3. Human Resource Availability: The company considers about human resource availability in a chosen Process Area. Clinical Laboratory Populer is not an IT company, so utilization of human resource should be done efficiently. The company will try to fulfill roles needed within a Process Area.
4. Budget Availability: The company considers about budget availability, it means if a Process Area requires big budget during the implementation, then the company should be able to provide it. If the company could not afford the budget, then the priority of the Process Area becomes smaller.

2.3. DATA COLLECTION

There are 2 types of questionnaires used in process area priority selection, a pairwise comparison questionnaire used among criteria and a pairwise comparison questionnaire used among process area in each criteria. The comparative scale used in this step refers to the scale made by Saaty, the scores ranges between 1 to 9.

In the pairwise criteria comparison questionnaire, there are 6 comparative questions which compare all four criteria. Meanwhile in process area comparison questionnaire, there are 28 questions which compare the 8 process area.

2.4. RESPONDENT

There are 19 respondents which consist of: 5 branch managers, 1 finance manager, 1 processing manager, 1 marketing manager, 1 IT manager, 5 IT staffs, and 5 specialist pathology doctors. The respondents are asked to

fill the questionnaires, comparing the criteria and the process area in each criteria. The filling process are also guided so errors could be minimized.

2.5. PAIRWISE COMPARISON

The comparison data among criteria and process area obtained from questionnaire are summarized into a pairwise comparison matrix. The average score or combined score from questionnaire are arranged in a table following this condition:

The ratio value of element Ai compared to element Aj is stated as Aij which express the importance relationship between Ai and Aj. When the value of Aij is set, theoretically the value of Aji is 1/Aij, whereas if the value of i is equal to j then the absolute value is 1. Numerical values used in the comparison are obtained from the ratio scale, refer to the ratio scale table created by Saaty. Table 2, 3, 4, 5, and 6 show pairwise comparison matrices among criteria and alternatives.

Table 2. Pairwise Comparison Matrices Among Criteria

Criteria	Impact on Business Objectives	Ease of Implementation	Human Resource Availability	Budget Availability
Impact on Business Objectives	1	5,23	3,72	0,82
Ease of Implementation	0,19	1	3,02	0,35
Human Resource Availability	0,27	0,33	1	0,26
Budget Availability	1,22	2,87	3,80	1

Table 3. Pairwise Comparison Matrix Among Process Area for Criteria Impact on Business Objectives

Criteria	SSD	CAM	SCON	OT	RSKM	IRP	SD	OPF
SSD	1	0,79	1,94	0,81	0,85	4,86	0,67	0,38
CAM	1,26	1	2,20	0,94	1,23	5,22	0,85	0,51
SCON	0,51	0,45	1	0,41	0,56	3,94	0,39	0,30
OT	1,24	1,06	2,44	1	1,51	5,66	1,05	0,55
RSKM	1,17	0,81	1,79	0,66	1	3,77	0,83	0,33
IRP	0,20	0,19	0,25	0,18	0,26	1	0,17	0,18
SD	1,49	1,18	2,57	0,95	1,21	5,86	1	0,55
OPF	2,63	1,97	3,34	1,80	2,99	5,66	1,82	1

Table 4. Pairwise Comparison Matrix Among Process Area for Criteria Ease of Implementation

Criteria	SSD	CAM	SCON	OT	RSKM	IRP	SD	OPF
SSD	1	0,20	0,29	0,19	1,41	0,25	0,18	3,02
CAM	4,90	1	1,42	0,71	4,95	0,88	0,34	5,36
SCON	3,45	0,70	1	0,45	4,40	0,85	0,34	4,86
OT	5,31	1,40	2,20	1	5,56	2,54	0,85	5,86
RSKM	0,71	0,20	0,23	0,18	1	0,25	0,17	1,94
IRP	4,02	1,13	1,18	0,39	4,02	1	0,38	4,65
SD	5,51	2,95	2,91	1,18	5,97	2,61	1	6,41
OPF	0,33	0,19	0,20	0,17	0,51	0,21	0,16	1

Table 5. Pairwise Comparison Matrix Among Process Area for Criteria Human Resource Availability

Criteria	SSD	CAM	SCON	OT	RSKM	IRP	SD	OPF
SSD	1	0,40	0,43	0,33	2,22	0,47	0,28	2,87
CAM	2,48	1	1,29	0,72	4,73	1,33	0,65	5,76
SCON	2,32	0,77	1	0,73	3,69	1,09	0,37	4,05
OT	3,02	1,38	1,37	1	5,22	1,86	0,90	5,86
RSKM	0,45	0,21	0,27	0,19	1	0,27	0,18	2,24
IRP	2,12	0,75	0,92	0,54	3,75	1	0,45	3,98
SD	3,62	1,53	2,70	1,11	5,41	2,22	1	5,86
OPF	0,35	0,17	0,25	0,17	0,45	0,25	0,17	1

Table 6. Pairwise Comparison Matrix Among Process Area for Criteria Budget Availability

Criteria	SSD	CAM	SCON	OT	RSKM	IRP	SD	OPF
SSD	1	0,82	0,39	0,45	1,47	0,76	0,36	3,23
CAM	1,22	1	0,55	0,53	3,02	0,90	0,46	3,77
SCON	2,54	1,80	1	0,82	3,09	2,01	0,35	4,33
OT	2,24	1,87	1,22	1	3,51	2,79	0,65	5,86
RSKM	0,68	0,33	0,32	0,28	1	0,48	0,18	1,99
IRP	1,31	1,11	0,50	0,36	2,07	1	0,27	3,69
SD	2,76	2,18	2,82	1,53	5,58	3,64	1	6,29
OPF	0,31	0,26	0,23	0,17	0,50	0,27	0,16	1

3. THE RESULT AND ANALYSIS

Expert Choice 11 software is used to calculate the weight of all criteria and alternatives. The results are explained in the following:
a. Weight of all criteria
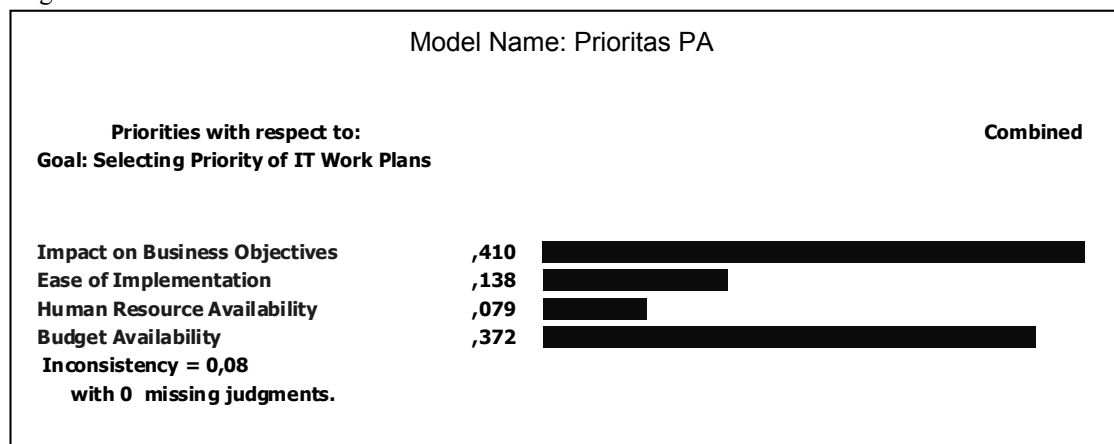
Figure 2. Weight comparison among criteria

The inconsistency ratio obtained from the weight calculation among criteria is 0,08 (≤ 0,10). This means the result is reliable. The criteria Impact on Business Objectives has the biggest value 0,410. This means the company management believe that the criteria is very affecting the priority selection. The second biggest value is Budget Availability (0,372), this means the company management also believe that the criteria can be affecting the priority selection, but not as big as the Impact on Business Objectives. The values of the other two criteria, Ease of Implementation and Human Resource Availability are 0,138 and 0,079. Both have smaller value than the previous two criteria, this means both of these criteria have less impact on determining the priority of process area.

b. Weight of alternatives for criteria Impact on Business Objectives
The inconsistency ratio obtained from the calculation is 0,00992 (≤ 0,10). This means the result is reliable. The biggest weight for the alternatives after processing the pairwise comparison matrix is OPF process area (0,253). This means the process area OPF is considered having the biggest impact on the present business objectives compared to the other process area. The second biggest weight is the process area SD by 0,150 and followed by OT by 0,149.

Both of these process area have quite similar impact on the present business objectives, although smaller than OPF. Figure 3 shows the weight calculation among alternatives for criteria Impact on Business Objectives.
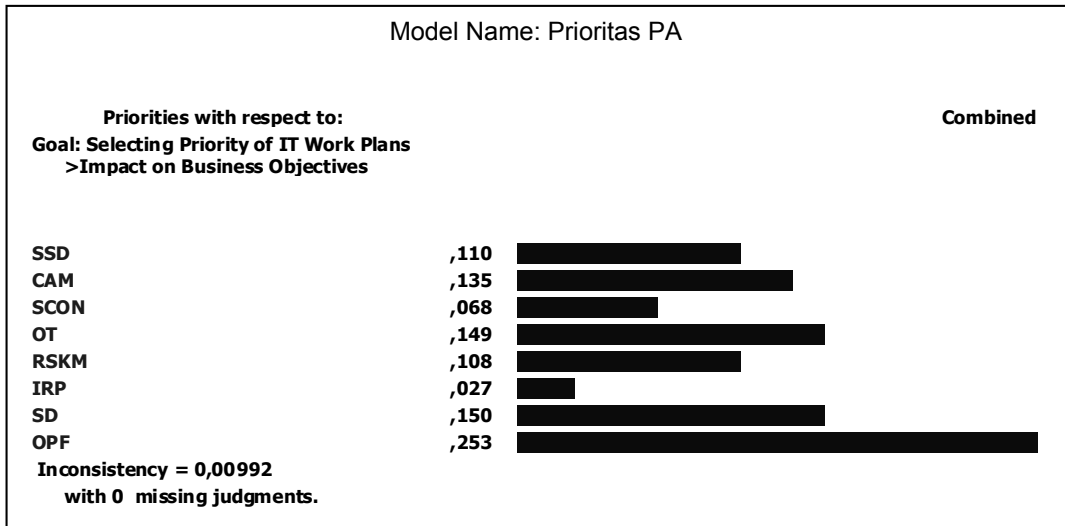
Figure 3. Weight calculation result among alternatives for criteria Impact on Business Objectives

c. Weight of alternatives for criteria Ease of Implementation
The inconsistency ratio obtained from the calculation is 0,03 ($\leq$ 0,10). This means the result is reliable. The biggest weight of the alternatives after processing the pairwise comparison matrix is SD Process Area (0,277). This means the process area is considered as the least complex and its implementation is the easiest than the other process area. The second biggest process area is OT with value 0,223 followed by CAM by 0,147. Figure 4 shows the weight calculation result among alternatives for criteria Ease of Implementation.

d. Weight of alternatives for criteria Human Resource Availability
Expert Choice's calculation shows the value of inconsistency ratio as 0,01 ($\leq$ 0,10), this means it is reliable. The calculation show that SD Process Area has the biggest weight with value 0,244. The company considers the human resource requirement in that process area is the most suitable process area to be fulfilled. Figure 5 shows the weight calculation result among alternatives for criteria Human Resource Availability.
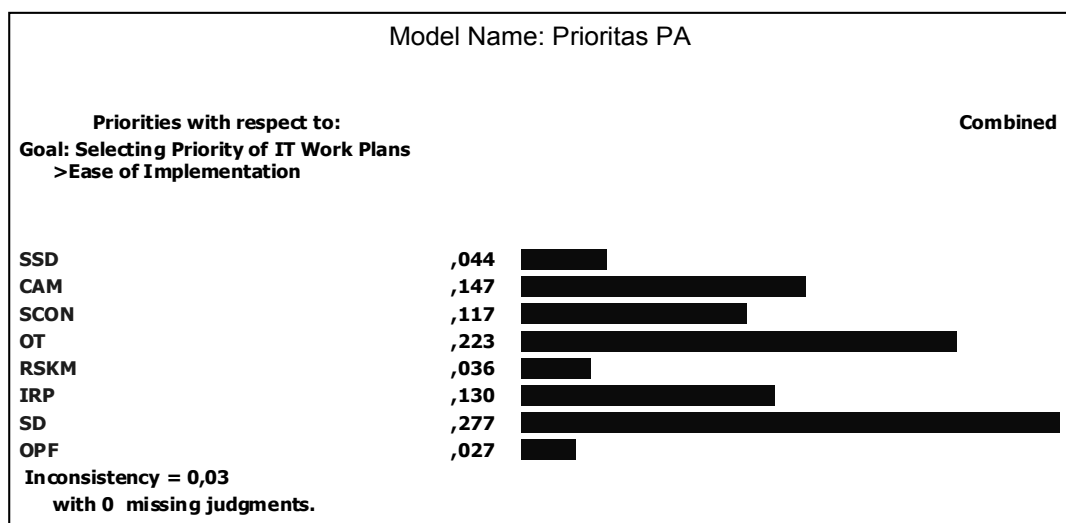
Figure 4. Weight calculation result among alternatives for criteria Ease of Implementation

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Model Name: Prioritas PA


        Priorities with respect to:                                    Combined
Goal: Selecting Priority of IT Work Plans
    >Human Resource Availability


SSD          ,068   ████████
CAM          ,164   ████████████████
SCON         ,130   █████████████
OT           ,202   ████████████████████
RSKM         ,040   ████
IRP          ,123   ████████████
SD           ,244   ████████████████████████
OPF          ,029   ███
 Inconsistency = 0,01
    with 0  missing judgments.
```
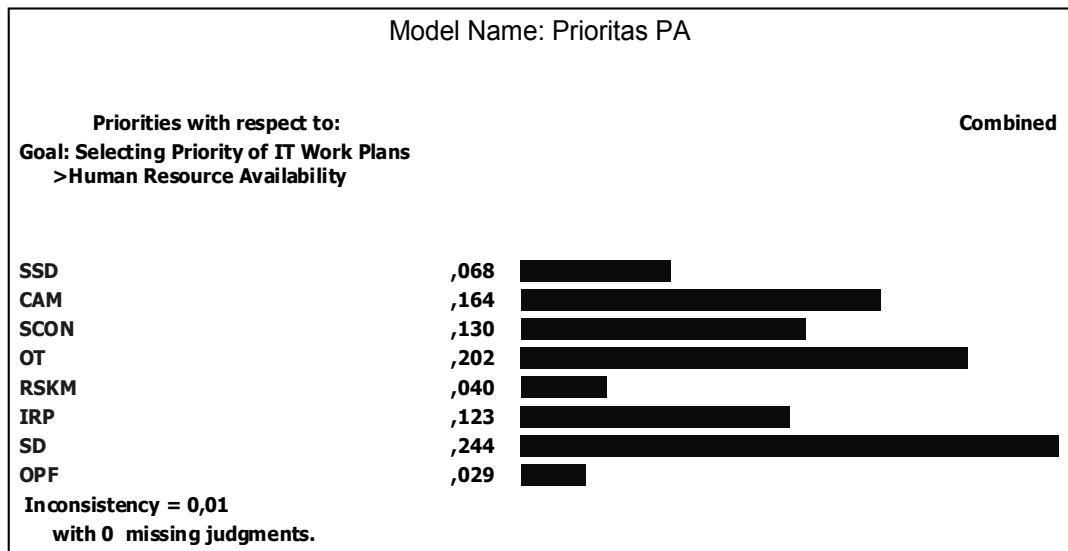
Figure 5. Weight calculation result among alternatives for criteria Human Resource Availability

e. Weight of alternatives for criteria Budget Availability

Expert Choice's calculation shows the value of inconsistency ratio as 0,01 (≤ 0,10), this means it is reliable. The calculation show that SD Process Area has the biggest weight with value 0,283. This means the company considers the budget required on that Process Area is the most able to be fulfilled. The second biggest weight is OT with value 0,193. Figure 6 shows the weight calculation result among alternatives for criteria Budget Availability.

```
Model Name: Prioritas PA


        Priorities with respect to:                                    Combined
Goal: Selecting Priority of IT Work Plans
    >Budget Availability


SSD          ,082   ████████
CAM          ,108   ██████████
SCON         ,159   ███████████████
OT           ,193   ██████████████████
RSKM         ,050   █████
IRP          ,094   █████████
SD           ,283   ████████████████████████████
OPF          ,031   ███
 Inconsistency = 0,01
    with 0  missing judgments.
```
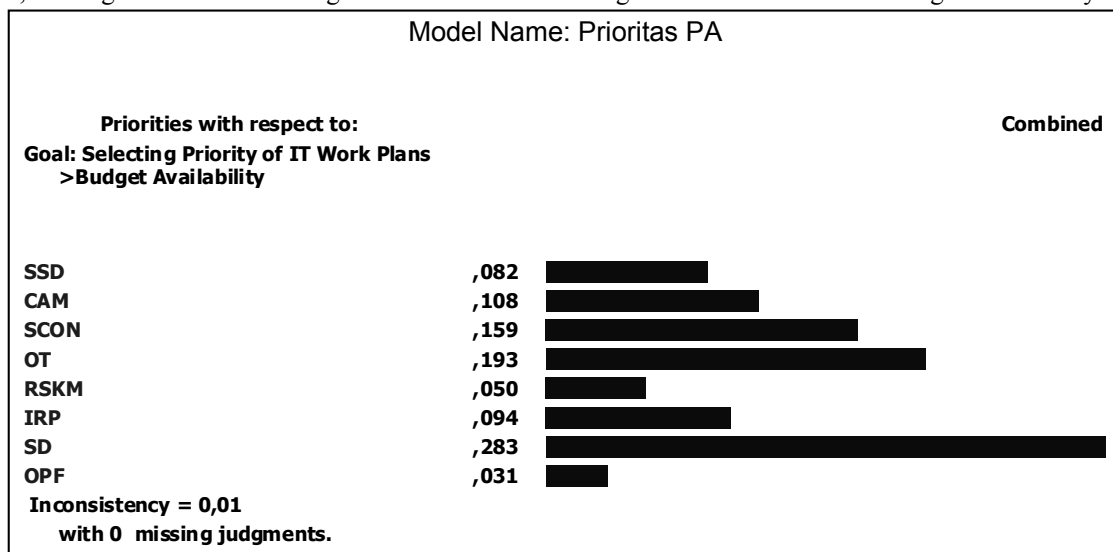
Figure 6. Weight calculation result among alternatives for criteria Budget Availability

f. Determining the priority of Process Area

Determining the priority of Process Area on each criteria has given different results. The highest priority on criteria Impact on Business is OPF, while on the other three criteria is SD. Expert Choice is used once again to measure the highest priority from all criteria by calculating the total weight among alternatives. The total weight are obtained from the sum of all multiplication among alternative weight in each criteria and related criteria weight. The total weight of alternatives will determine the priority of Process Area. Figure 7 and Table 7 show the total weight calculation result for all alternatives.

Figure 7. Total calculation result of the alternatives weight
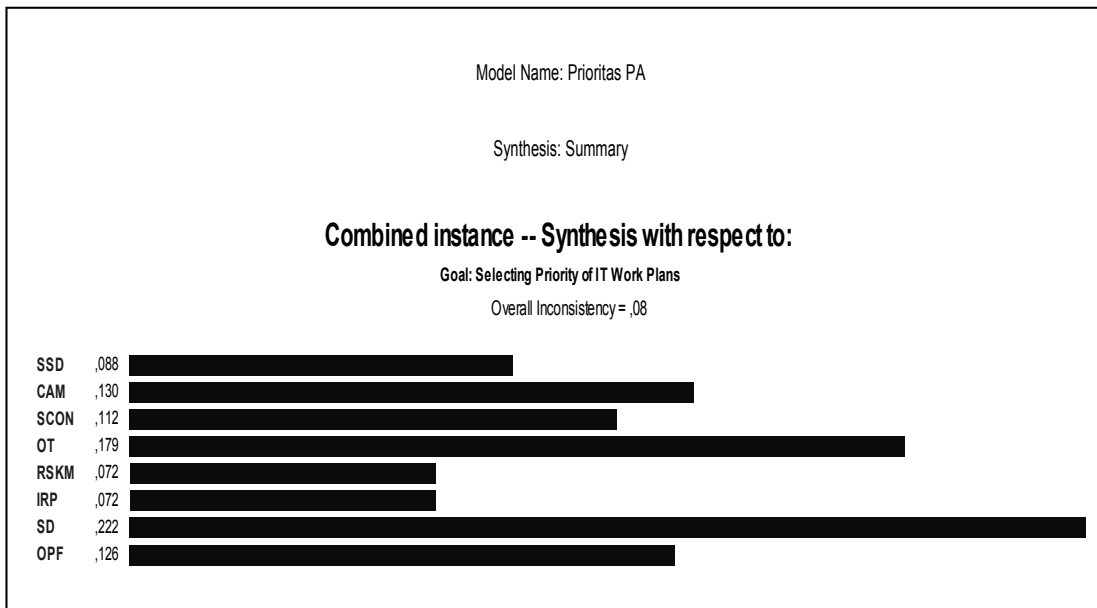
Table 7. Total weight calculation of Process Area alternatives

No	Criteria			Process Area								
	Criteria name	Weight	SSD	CAM	SCON	OT	RSKM	IRP	SD	OPF	Total
1	Impact on Business	0,410	0,110	0,135	0,068	0,149	0,108	0,027	0,150	0,253	1,000
2	Ease of Implementation	0,138	0,044	0,147	0,117	0,223	0,036	0,130	0,277	0,027	1,001
3	Human Resource Availability	0,079	0,068	0,164	0,130	0,202	0,040	0,123	0,244	0,029	1,000
4	Budget Availability	0,372	0,082	0,108	0,159	0,193	0,050	0,094	0,283	0,031	1,000
	Total Weight	0,999	0,087	0,129	0,113	0,180	0,071	0,074	0,225	0,121	

4. CONCLUSIONS

By using AHP, the weight of all alternatives can be measured. Process Area SD has the biggest weight among the other alternatives as shown in Table 7 and Figure 7. The priority of Process Area sorted from the highest to the lowest consecutively are SD (0,222), OT (0,179), CAM (0,130), OPF (0,126), SCON (0,112), SSD (0,088), RSKM & IRP (0,72). The overall inconsistency ratio is 0,08 (≤ 0,10). Therefore, it can be concluded that Process Area SD becomes the priority.

This study has shown that AHP can be used to help the company choose the priority on IT work plans. Process Area SD represents the IT work plan of promotion and education for patients through website. If that process area becomes the priority, then this means the company considers the work plan as the most important work plan. It has to be the first priority and has to be done first than any other work plans.

For further study, the AHP method could be implemented in a software so the company could choose the priority of work plans quicker and simpler. Also the AHP method could be combined with any other decision making methods so there will be a comparative results between them.

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Design Analysis of Solar Powered Systems
Full Flexible 10 WP Capacity

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Abstract

The need for electricity is good for the industry, offices, and public and individuals are greatly increased. However, the increase in demand for electricity is not accompanied by the additional power supply. Based on these problems, chosen solar energy as an alternative energy to generate electric power. A tool that is used here is the solar cell because it can directly convert solar radiation into electrical energy (photovoltaic process). So that solar energy can be used at night, then during the day, the electrical energy generated is stored before a battery which is controlled by the regulator. Regulator output is directly connected to the inverter from the DC to AC. The test results of solar modules (photovoltaic) indicated that the results of the average power output reached 7.6 Watt, and the currents were 0.4 A. This is because the photovoltaic follows the direction of movement of the sun and always located at the photovoltaic to remain facing the sun. Therefore, it will still be able to capture the radiant sun to the fullest

Keywords: Solar Cell; Design Analysis; Photovoltaic System; Electric Power.

1. Introduction

Energy is the ability to do the job. Energy is the power that can be used to perform various processes of activity including mechanical energy, heat, and others. Therefore, almost all disputes in this world, stems from the struggle for energy resources. There is some natural energy as a clean, non-polluting, secure and unlimited alternative energy known as renewable energy (Akhmad, 2011). New and renewable energy sources in the future will increasingly have a very important role in meeting energy needs. This is because the use of fossil fuels for conventional power plants over a long period of time will deplete petroleum, gas and coal resources whose reserves are increasingly depleted (Anggara etc, 2014). In Indonesia located in this tropical region. Actually has a considerable advantage of receiving sustained sunlight throughout the year. Unfortunately the energy seems to be left wasted for natural purposes only (Hasan, 2012). In addition solar energy can be utilized with the help of other equipment, that is by changing the radiation of the sun of another form. There are two kinds of ways to convert solar radiation into other energy, that is through solar cell and collector (Karmiathi, 2012). There is no doubt that solar energy is one of the most environmentally friendly and promising sources of energy in the future, since no pollution is generated during the energy conversion process, and also its energy source is widely available in nature (Rahayuningtyas, etc, 2014). Therefore, the application of Solar Power (PLTS) technology to utilize the available solar energy potentials in those locations is the right solution (Subandi, etc 2015). PLTS or better known as solar cells (Photovoltaic cells) will be more desirable because it can be used for various relevant purposes and in various places such as offices, factories, housing, and others. So it is deemed necessary to be studied further, in order to obtain a comprehensive technical study (Ubaidillah, etc 2012). In this study will analyze the design of solar power plant system design capacity of 10 WP on the laboratory scale. With the aim of research to calculate the characteristics of solar power plants by using Solar Cell 10 WP and calculate the maximum power generated by the solar power generated. So it can be analyzed the performance of the design of solar power generation system for 10 WP capacity.

2. Research Methods

The method used in circuit analysis design is done several stages, including:

(A). Determination of solar panels used, so that in its use there is no damage to the solar panel itself.

(B). Determination of the regulator component to be used, so that in the application there is no error of use that result in less good or can damage the solar panels and electrical equipment installed later.

(C). In terms of the use of components, also considered economic terms and conditions in the market, so that in the search component is not experiencing difficulties.

(D). In terms of aesthetics, design tools to be made in such a way that neat, attractive and safe in its use.

(E). Selecting components that pass the qualifications and according to system requirements, such as BCR and inverter (if there is AC load). The methodology used in the design of 10 WP solar power generation analysis can be described in the form of a systematic flowchart such as Figure 1.

3. Results and Discussion

The first step in this research is to study the literature and design of related systems regarding solar cell *power system as shown in Figure 2.*
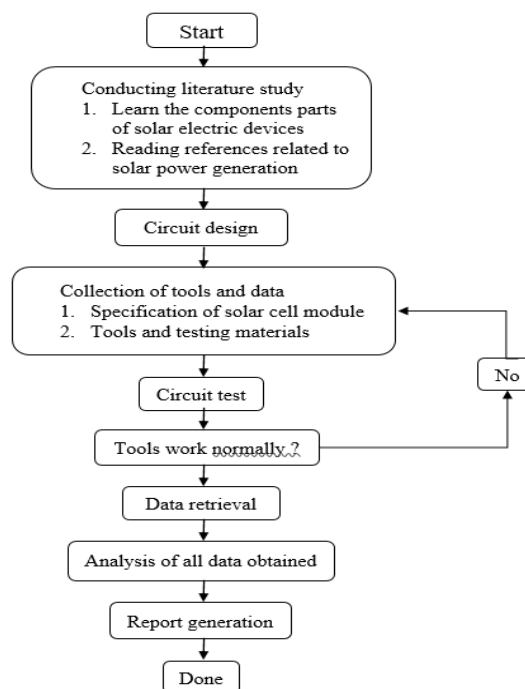

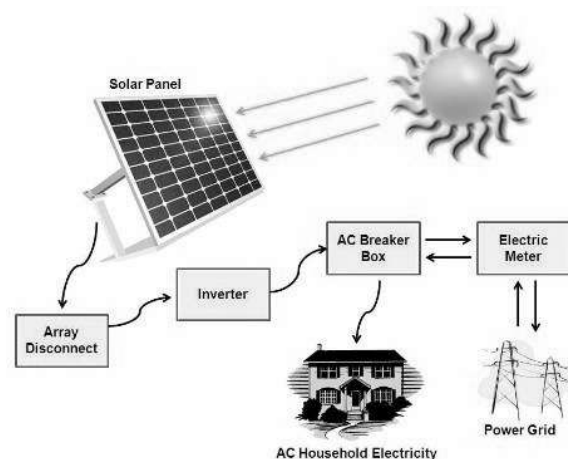*Figure 1. Diagram of the research flow*

Figure 2. Installation of 10 WP solar cell

Based on Figure 2, the PLTS block diagram is designed, the working principle of the Solar Power Generation (PLTS) created is as follows: the sun is shining, the radiation produced from the sunlight is then captured by the photovoltaic solar panel. This solar panel is a combination of several solar cells of very small size and thin both in series, parallel or mix (series and parallel), so it becomes a large solar panel and can produce large currents and voltages. The working principle of solar panels is that if sunlight is on solar panels, the electrons in the solar cell will move from N to P, so that at the output terminal of the solar panel will generate electrical energy. The amount of electrical energy generated by solar panels varies depending on the number of solar cells combined in the solar panel. The output of this solar panel is a large direct current (DC) electric current. The outlet voltage depends on the number of solar cells installed in the solar panel and the amount of sunlight that illuminates the solar panel (Bansai, 1990). The output from these solar panels can already be used directly to loads requiring a DC voltage source with a small current consumption. In order for the resulting electric energy to be used in conditions such as at night (the condition when solar panels are not exposed to sunlight), the output of this solar panel must be connected to a storage medium, in this case Is the battery. But this is not directly linked from the solar panel to the battery, but must be connected to the regulator circuit, where in the circuit there is a charging circuit Automatic charger (Automatic charger). The function of this regulator is to regulate the output voltage of the solar panel and adjust the incoming current to the battery automatically. In addition, the Regulator works to connect and disconnect the current from the Solar Panel to Battery automatically and also serves to disconnect the flow from the load battery when there is a short circuit or excessive load. The type of regulator designed here is a type of modification or a combination of series and parallel. Solar panels can actually be directly used without a regulator or battery set, but this is not done because it can overload the performance of the panel (due to excessive load) so there will be no fatal damage to the solar panel. In addition, this regulator also serves to secure from the overload of solar panels so that solar panels are not easily damaged (Widodo et al. 2010). The connection of the battery to the load is connected directly to the parallel load. If the battery is fully charged. To protect the batteries due to overload or short charge in the load, then before the batteries are connected directly must pass through the protection circuit. Where the function is clear enough, namely to protect or protect the battery due to excessive load (over load) or short circuit at the load. If it is desired that the output of electricity from this PLTS in the form of alternating current electricity (AC) then the PLTS can already discharge the direct current (DC) power must be connected to an electronic circuit / electronic module called Inverter DC-AC. Where Inverter DC-AC function to convert electric current direction (DC) become electric current back and forth (AC). Once the electric current is converted to alternating electric current, the output of this inverter which has the form of alternating current can be directly used to supply electrical equipment and electronics that require alternating current. The magnitude of the voltage and output power that can be connected to the load must be in accordance with the ability of the inverter used and the size of the storage system used (the amount of ampere hour (AH) or the amperage of the battery). In this research, we tested the effect of solar angle on the output of solar cell. It aims to find out how big the influence of the angle of the sun comes and also how big the influence of the angle can be ignored. The way of testing is done as Figure 3.
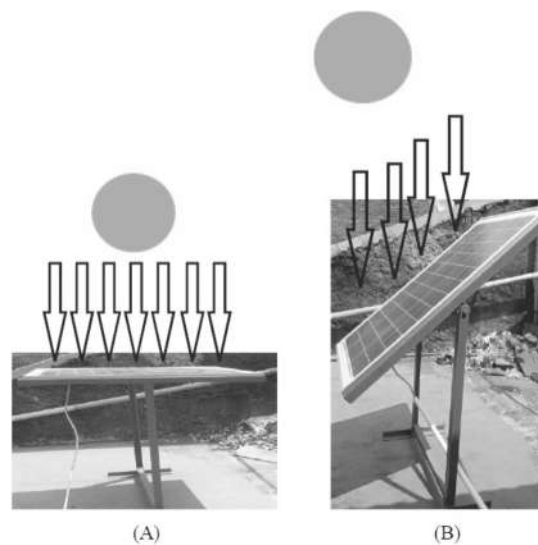
Figure 3 : Testing the influence of the direction of the sun angle to the output of the solar cell (A) the direction of ray perpendicular (B) the direction of the rays to form a certain angle.

The installation of a solar cell panel in a position perpendicular to the direction of sunlight as Fig. 3A is done to find out the maximum output, while to know the effect of sunlight direction on the output panel is done by changing the direction of solar cell panel every 10□ to reach Angle 45□ to the coming sun angle as Fig. 3B. From these steps can be known the influence of the direction of sunlight on the output of solar cell panels. Data collection of sun position / angle is required. It aims to know how big the shift angle of the sun at a certain time interval. This data retrieval is done from 9:00 to 16:00. Test results can be seen in Table 1. Using the data in Table 1 above can be made graph of the relationship between open circuit voltage with time, as in Figure 4.

Table 1. Results of stress, current and power testing for various angular positions of solar cells

NO	Hour	Straight Position			Angle Shape Position		
		Voltage (Voc)	Current (A)	Output Power (W)	Voltage (Voc)	Current (A)	Output Power (W)
1	8.00	4.08	0.2	3.306	4.14	0.28	4.706
2	9.00	4.18	0.21	3.568	4	0.514	8.306
3	10.00	3.86	0.362	5.65	3.76	0.61	9.162
4	11.00	3.9	0.416	6.522	3.64	0.61	8.826
5	12.00	3.8	0.394	5.988	3.66	0.61	8.874
6	13.00	3.6	0.416	5.936	3.66	0.61	8.874
7	14.00	3.8	0.194	2.948	3.86	0.574	8.896
8	15.00	4.14	0.17	2.856	4	0.41	6.626
9	16.00	4.04	0.166	2.712	2.16	0.27	4.566
Rata - rata		3.934	0.28	4.382	3.654	0.498	7.648
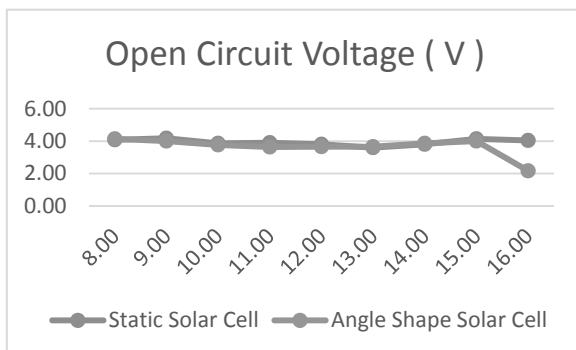
Figure 4. Graph of the relationship between the open circuit voltage to the time on the solar cell.

Based on Figure 4. explains that the average measurement value of open circuit voltage in the solar module angular position position of 3.654 V and obtained the average value of short circuit voltage when the solar module upright position (horizontal) of 3.934 V. Differences in open circuit voltage results (Voc) obtained because the solar module always positioned perpendicular to the sun so that the results obtained will be larger than the solar module with the position to form an angle. Furthermore, to know the comparison of short-circuit current to time can be seen in Figure 5.

Figure 5 illustrates that the current generated by the solar module that forms an angle greater than the current generated by the solar module in the horizontal position has a static property, this occurs because the irradiation captured by the solar module on the position of forming a larger angle so that The current captured in the position to form a larger angle because the greater the irradiation value the greater the irradiation value. From the measurement result data, it is obtained the measurement value of the average short circuit current in the solar module in the position of forming an angle of 0.498 A and obtained the average value of short circuit current when the solar module is perpendicular (horizontal) of 0.28 A. For Knowing further about the magnitude of the ratio of the output power to the time in the solar cell, can be seen in Figure 6.
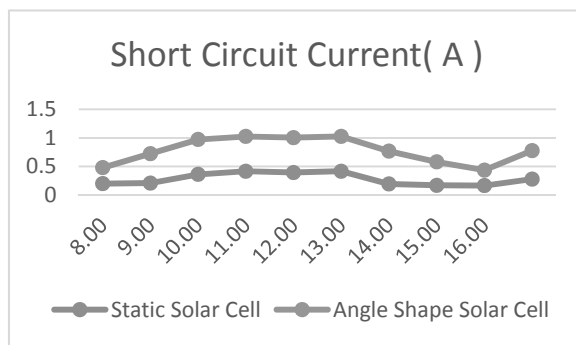
Figure 5. Graph of the comparison between short-circuit current to time on solar cell.
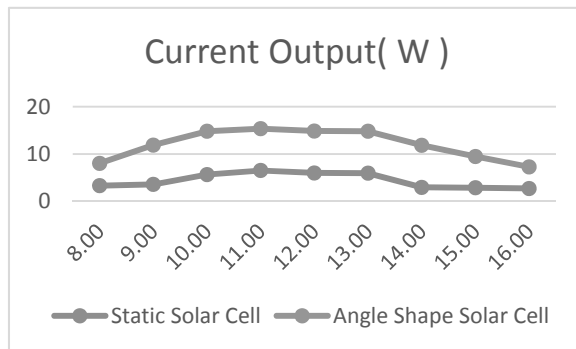
Figure 6. Graph of the comparison between the output power of time on the solar cell.

From the open circuit voltage (Voc) and the short circuit (Isc) obtained at the time of testing the resulting output power by multiplying the fill factor (FF) in the sury module so that the graph of the ratio of output power at the angle position with the solar module at position perpendicular. The average output power generated at the moment of the solar module positioning an angle of 7,648 W and obtained the average output power value when the solar module position is perpendicular (horizontal) of 4,382 W.

4. Conclusion

From the results of design analysis of solar power generation system with 10 WP solar panels can be obtained the following conclusion:

(A). Characteristic of the Design that is, the position of the angle of the solar module when following the direction of the movement of the sun produces an average open circuit voltage (Voc) of 3.654 V and the average current of short circuit (Ioc) 0.498 A and the horizontal position creates an average voltage Average The open circuit (Voc) is 3,934 V while the average current short-circuit (IOC) 0.28 A

(B) The position of the slope angle of the solar module when following the direction of the movement of the sun produces Output Power (Pout) of 7,648 W and the position perpendicular (horizontal) produces Output Power (Pout) 4.382 W.

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ROAD MAINTENANCE MANAGEMENT USING PAVEMENT CONDITION INDEX (PCI) SURVEY

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ABSTRACT

Road maintenance management is a very important issue in the highway management. Existing roads infrastructure on Jl. Prof. Dr. Sardjito and Jl. AM. Sangaji that has been passed by the volume of traffic requires maintenance to prevent severe condition as predicted in design life. Therefore, the objective of this study is to appraise a survey pavement condition method so that the road can be functional more optimal. This study was visually completed by using Pavement Condition Index (PCI) method. It was started by dividing the road into several units length in 30 m for each unit sample. Then, each of the sample unit was observed, evaluate, and analyze to identify the distress type and severity level in order to obtain PCI rating value of the pavement condition. The result of the study showed that the distress types in this research included the corrugation, longitudinal and transverse cracking, patching, polished aggregate, raveling, and potholes. The most distresses that usually occur are longitudinal and transverse cracking, patching and raveling with low severity. From the analysis of PCI method, the rating for both road conditions is excellent; therefore, the suggestion that can be given for those sample roads is preventive maintenance to extend a pavement's life. The road repair options are compared between PCI method by US Army and Asphalt Institute.

Keywords: *Road Maintenance Management, Pavement Condition Index, Road Condition, Pavement's Life, Distress Type*

1. INTRODUCTION

Road maintenance management is a very important issue in the management of the highway. Existing road infrastructure that has been passed by the volume of traffic vehicle would have decrease quality (structural and functional) as predicted in design life. Therefore, road maintenance program requires good planning and adequate funding that is continuous, so that the maintenance system can be properly selected and applied optimally. Data analysis and evaluation of pavement performance for a certain project objectives require accuracy measurements. Mechanism of collecting data is visually to detect and analyze the road condition to obtain representative data as an input to define a strategy and priority programs. The output of this road maintenance management program will be referred for treatment decision making of road condition.

Roads in Sleman and Yogyakarta will be the focus of this study, particularly Jl. Prof. Dr Sardjito (Mirota Kampus intersection to SMK 2 Yogyakarta intersection) and Jl. AM. Sangaji (SMK 2 Yogyakarta intersection to the Tugu Yogyakarta intersection), it can be seen in Figure 1 and Figure 2. The volume of traffic is fairly high at this location, especially at the intersection of Tugu as one of the tourist spots and a connecting road to Jl. Malioboro. Moreover at Jl. Prof. Dr Sardjito and Jl. AM. Sangaji is a connector road to the Gadjah Mada University and to various important locations in the city of Yogyakarta. Pavement condition surveys give an indication of the serviceability of the road pavements and also the physical condition of the assets. It is referred to as the collection of data to determine the ride quality and structural integrity of a road segment. They are based on observations by surveyors as well as measurements of pavement roughness, surface distress, skid resistance, deflection, among others. Condition ratings may be done manually or through automated means. The choice of whether automated or manual depends on an agency's priorities and its available resources. The condition rating for a particular section is chosen from a scale, which may range from 0 to 100, 0 to 5 or even 0 to 99. Damage appears slowly at first, and then gradually accelerates, accumulating to become visible as structural distress and tangible as ride quality reduced. If distress is observed and corrected in a timely manner, low cost strategies will restore the road to nearly its original

condition. However, if early treatment is neglected or postponed, the accumulated damage will require a more costly repair treatment. Recognizing that damage accumulation and acceleration is a key to understanding the need for early, low-level, low-cost preventive maintenance treatments.

1.1   Problem of Study

Main problems in this research are:
a.   What kind of distress that obtained on Jl. Prof. Dr Sardjito and Jl. AM. Sangaji?
b.   What are PCI values on Jl. Prof. Dr Sardjito and Jl. AM. Sangaji?
c.   How are the road conditions rating on Jl. Prof. Dr Sardjito and Jl. AM. Sangaji?
d.   What are the best maintenance strategies that can be determined?
e.   What are the repair options of each distress type that can be obtained?

1.2   Objectives

This research focused in the main objectives mentioned below:
a.   Investigate and evaluate the asphalt pavement defects by using pavement condition index (PCI),
b.   Estimate the maintenance options.

Figure 1. Survey location: Jl. Prof. Dr. Sardjito

Figure 2. Survey location: Jl. AM. Sangaji

1.3   Benefits

Besides the main objectives of the identified problem, there are also additional benefits from this project.
a.   Through this survey it can be analyzed how are the PCI value and the rating conditions of the roads on the research location,
b.   The proposing road maintenance strategies can be determined,
c.   The repair options of each distress type can be obtained,
d.   Further, based on the analysis, the measurements that can be taken to improve road performance can be acquired.

2. THEORITICAL BASE

2.1   Pavement Condition Index (PCI)

Pavement Condition Index (PCI) is a numerical rating of the pavement condition that ranges from 0 to 100 with 0 being the worst possible condition and 100 being the best possible condition (ASTM D6433 – 07, 1999). Pavement Condition Index is the most precise index in many pavement evaluation studies. PCI incorporates data from 19 different kinds of pavement distresses as well as their severity and quantity. Furthermore, it gives an insight to the causes of distresses and the relation between pavement deterioration and climatic and/or loading conditions. Therefore, it provides an index of the pavement's structural integrity, as well as surface operational condition. PCI index is extensively used in pavement condition surveys for airfield pavement, roads and parking lots and has gained popularity among the pavement experts (Zultuom, 2011). Federal Aviation Administration (F.A.A.), U.S. Air Force, American Public Works Association (APWA) and many other agencies worldwide accept this method for pavement condition assessment. More details on PCI method are available in ASTM D6433 – 07 (1999): Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys. PCI is the only pavement-rating index that has gained an ASTM standard designation.

In PCI calculation, pavement deterioration rate is a function of distress type, distress severity, and density of distress. For each type, each level and extent of damage according to some nomographs a deduct value is obtained. Deduct values indicate the degree of effect that each combination of distress type, severity level, and distress density has on pavement condition. Eventually, a proportion of the sum of these deduct values is subtracted from 100 and the PCI is determined. The value of PCI varies between 100 for a new pavement with no distress to 0 for a failed pavement. Hence, pavements with lower PCI should be given higher priority for maintenance. Pavement quality condition for different values of PCI is illustrated in Figure 3. In AHP modeling, the PCI criterion was divided to 7 sub-criteria. Using this evaluation index also enables decision makers to account for pavement life cycle costs, by

introducing the critical point. Critical PCI is the PCI after which the pavement begins to deteriorate rapidly. Therefore, it would be a wise and prudent decision to keep all the sections above this point. A sample of deterioration model and rate of changes in PCI during years was also published for the same case study (Moazami et al., 2011).
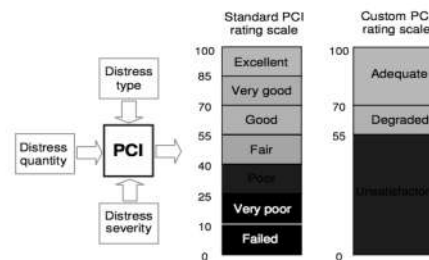
Figure 3. Numerical representation of PCI and pavement quality condition

The PCI is normally conducted annually in order to evaluate changes that occur in a road network system. It is a subjective method of evaluation based on inspection and observation. The PCI is also an informative tool that shows the current condition of the road network and its deterioration over time as illustrated in Figure 4. Some uses and benefits of PCI include, identifying the need for immediate maintenance and rehabilitation (M & R) (Galehouse et. Al. 2003) of roads; developing a road network preventive maintenance strategies and budgets; and for evaluating pavement materials and designs (see Figure 5).

Figure 4. Pavement condition vs age
(Source: Road Millage, August 7, 2012)
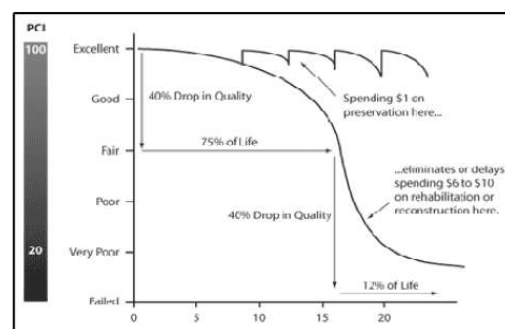
Figure 5. Benefits of M & R as a function of pavement condition (PCI)
(Source: Galehouse et. al. 2003)

2.2   Road Maintenance Strategies

The PCI procedure was developed by the Colorado Division of Aeronautics (2011) to provide a numerical indication of overall pavement condition. During a PCI survey, visible signs of deterioration within a selected sample unit are recorded and analyzed. Distress type, severity, and quantity are all identified and recorded. This information is then used to develop a composite index (PCI number) that represents the overall condition of the pavement in numerical terms, ranging from 0 (failed) to 100 (excellent). In general terms, pavements above a PCI of 65 that are not exhibiting significant load-related distress will benefit from preventive maintenance actions, such as crack sealing and surface treatments. Pavements with a PCI of 40 to 65 may require major rehabilitation, such as an overlay. Often, when the PCI is less than 40, reconstruction is the only viable alternative due to the substantial damage to the pavement structure. This concept, along with the PCI rating scale, is illustrated in Figure 6.

PCI	Repair Type
91 – 100	
81 – 90	Preventive Maintenance
71 – 80	
61 – 70	
51 – 60	Major Rehabilitation
41 – 50	
0 – 40	Reconstruction

Figure 6. PCI rating scale and recommended repair action
(Source: Colorado Division of Aeronautics, 2011)

The types of distress identified during the PCI inspection provide insight into the cause of pavement deterioration. PCI distress types are characterized as load-related, climate/durability-related, and other (distress types that cannot be attributed solely to load or climate/durability). Each of the distress types and their associated primary cause of distress are identified in Table 1. By knowing the causes of the pavement deterioration, more appropriate repair and rehabilitation alternatives can be identified. Table 2 provides additional information on the likely cause of each distress type and feasible maintenance strategies for addressing each distress type for AC pavements.

Table 1. Distress types and primary distress categories for AC pavements

Pavement Distress Category		
Load-Related	*Climate-Related*	*Other*
Fatigue (Alligator) Cracking	*Block Cracking*	*Bleeding*
	Joint Reflection Cracking	*Corrugation*
Rutting*	*Longitudinal and Transverse Cracking*	*Depression*
		Jet Blast
	Patching	*Oil Spillage*
	Raveling and Weathering	*Polished Aggregate*
		Shoving
		Slippage
		Swelling

Table 2. Causes of flexible pavement distresses and feasible maintenance strategies

Distress Type	Probable Cause of Distress	Feasible Maintenance Strategies
Alligator Cracking	Fatigue failure of the asphalt concrete surface under repeated traffic loading	If localized, partial- or full-depth asphalt patch. If extensive, major rehabilitation needed.
Bleeding	Excessive amounts of asphalt cement or tars in the mix and/or low air void content	Spread heated sand, roll, and sweep. Another option is to plane excess asphalt. Or, remove and replace.
Block Cracking	Shrinkage of the asphalt concrete and daily temperature cycling; it is not load associated	At low severity levels, crack seal and/or surface treatment. At higher severities, consider overlay.
Corrugation	Traffic action combined with an unstable pavement layer	If localized, mill. If extensive, remove and replace.
Depression	Settlement of the foundation soil or can be "built up" during construction	Patch.
Jet Blast	Bituminous binder has been burned or carbonized	Patch.
Joint Reflection	Movement of the concrete slab beneath the asphalt concrete surface because of thermal and moisture changes	At low and medium severities, crack seal. At higher severities, especially if extensive, consider overlay.
Longitudinal and Transverse Cracking	Cracks may be caused by 1) poorly constructed paving lane joint, 2) shrinkage of the AC surface due to low temperatures or hardening of the asphalt, or 3) reflective crack caused by cracks in an underlying PCC1 slab	At low and medium severity levels, crack seal. At higher severities, especially if extensive, consider overlay options.
Oil Spillage	Deterioration or softening of the pavement surface caused by the spilling of oil, fuel, or other solvents	Patch.
Patching	N/A	Replace patch if deteriorated.
Polished Aggregate	Repeated traffic applications	Aggregate seal coat is one option. Could also groove or mill. Overlay is another option.
Raveling and Weathering	Asphalt binder may have hardened significantly	Patch if isolated. If low-severity, consider surface treatment if extensive. At medium and high severity levels, consider major rehabilitation if extensive.
Rutting	Usually caused by consolidation or lateral movement of the materials due to traffic loads	Patch medium and high severity levels if localized. If extensive, consider major rehabilitation.
Shoving	Where PCC pavements adjoin flexible pavements, PCC "growth" may shove the asphalt pavement	Mill and patch as needed.
Slippage Cracking	Low strength surface mix or poor bond between the surface and next layer of pavement structure	Partial- or full-depth patch.
Swelling	Usually caused by frost action or by swelling soil	Patch if localized. Major rehabilitation if extensive.

2.3 Type of Repair Options

According to Shahin et al. (2005) the PCI method provides repair option according to the distress type and the severity level shown in Table 3. In addition to PCI method, there are so many road maintenance methods such as *Asphalt*

Institute method, AASHTO method, and *Austroad* method. Other method to be compared to PCI method in this research is *Asphalt Institute*–MS 16 with the type of repair options shown in Table 4.

Table 3. Type of repair options based on PCI method

No.	Distress Type	Type of Repair Options		
		Low (L)	Medium (M)	High (H)
1	Alligator cracking	Do nothing; overlay	Partial or full depth patch; overlay; reconstruction	Partial or full depth patch; overlay; reconstruction
2	Bleeding	Do nothing	Spreading sand or aggregate	Spreading sand or aggregate
3	Block cracking	crack > 1/8 in (3 mm);crack closure	Crack closure; surface recycling, heater scarify; overlay	Crack closure; surface recycling, heater scarify; overlay
4	Corrugation	Do nothing	Reconstruction	Reconstruction
5	Depression	Do nothing	Leveling; partial or full-depth patching;	Leveling; partial or full-depth patching;
6	Jet Blast			
7	Joint reflection cracking	Crack closure > 1/in (3 mm)	Crack closure; partial-depth patch	partial-depth patch, reconstruction, joint
8	Longitudinal and Transverse Cracking	Width of crack closure > 1/8 in (3 mm);	Crack closure	Crack closure; partial-depth patch
9	Oil Spillage			
10	Patching and utility cut patching	Do nothing	Do nothing, reoverlay	Do nothing, reoverlay
11	Polished aggregate	Do nothing; surface treatment; overlay; scrab and overlay	Do nothing; surface treatment; overlay; scrab and overlay	Do nothing; surface treatment; overlay; scrab and overlay
12	Raveling and Weathering	Do nothing; Closure surface; surface treatment..	Closure surface; surface treatment.; overlay	Surface treatment; overlay; recycling; reconstruction.
13	Rutting	Do nothing; scrab and overlay	Levelling or partial; or full depth patch; scrab and overlay	Levelling or partial; or full depth patch; scrab and overlay
14	Shoving	Do nothing; scrab	scrab; partial- or full -depth patch.	scrab; partial- or full -depth patch.
15	Slippage cracking	Do nothing; partial-depth patch.	Partial-depth patch.	Partial-depth patch.
16	Swelling	Do nothing	Do nothing; reconstruction	reconstruction
17	Potholes	Do nothing; partial or full-depth patch	partial or full-depth patch	full-depth patch

Source: Shahin et al., 2005

Table 4. Type of repair based on Asphalt Institute (MS-16) Method

No.	Distress Type	Repair Option		
		Low (L)	Medium (M)	High (H)
1	Alligator cracking	Slurry seal; surface treatment or skin patching.	Full-strength patch.	Full-strength patch.
2	Bleeding	Seal coat.	Spreading Hot sand; or spreading hot rock screening.	Spreading Hot sand; or spreading hot rock screening.
3	Block cracking	Surface seal.	Asphalt emulsion'slurry; surface treatment or slurry seal; overlay.	Asphalt emulsion'slurry; surface treatment or slurry seal; overlay.
4	Corrugation	Surface treatment	Levelling; milling; overlay	Full-depth patch.
5	Settlement or grade depressions	Surface treatment; micro-surfacing.	Skin patch or full-depth patch;	Skin patch or full-depth patch;
6	Edge cracking	Closure or filling the cracks with asphalt emulsion slurry or mix asphalt sand	Replacement of the shoulder material, installation of drainage	Replacement of the shoulder material, installation of drainage
7	Reflective cracks	Surface treatment (slurry seal or chip seal), seal cracks.	Cleaning and crack closure	Filling with asphalt emulsion slurry or HMA finely graded
8	Linear cracking	Closure or cracks repair	Closure or cracks repair	Closure or cracks repair
9	Utility cut and/or patch failure	Do nothing	Full depth patch	Full depth patch
10	Polished aggregate	Overlay HMA; sand seal or aggregate seal coat.	Overlay HMA; sand seal or aggregate seal coat.	Overlay HMA; sand seal or aggregate seal coat.
11	Potholes	Cleaning and holes closure with cold mix asphalt.	full-depth patch.	full-depth patch.
12	Rutting	Skin patching; micro-surfacing; or chip seal.	Full depth patch or overlay HMA.	Reconstruction
13	Shoving	Surface treatment	Levelling; scrabing; overlay.	Full-depth patch.
14	Slippage cracking	Replacement of the surface patches	Replacement of the surface patches	Replacement of the surface patches
15	Swell	Full-depth patch.	Full-depth patch.	Full-depth patch.
16	Weathering and raveling	Surface treatment (chip seal or slurry seal)	Surface treatment (chip seal or slurry seal)	Surface treatment (chip seal or slurry seal)

Source: Asphalt Institute MS-16, 2001

3. METHODOLOGY

Quantitative research approach is chosen instead over qualitative research. The used data is primary data, and after that the available data is being analyzed. The methodology flow chart for this research can be seen in Figure 7. The data analysis flowchart can be seen in Figure 7.

1. Proposing The Road Maintenance Strategy

The road maintenance strategy is proposed after the road condition rating is obtained. The road maintenance strategy is selected in accordance with Figure 6. Road maintenance priority is determined based on the lowest condition of the road and the highest AADT.

2. Determine The Road Repair Options

Maintenance is an essential practice in providing for the long-term performance and the esthetic appearance of an asphalt pavement. The purpose of pavement maintenance is to correct deficiencies caused by distresses and to protect the pavement from further damage. After road maintenance obtained, then repair options is determined based on the distress type and the severity level that occurs in accordance with Tables 2, 3, and 4.
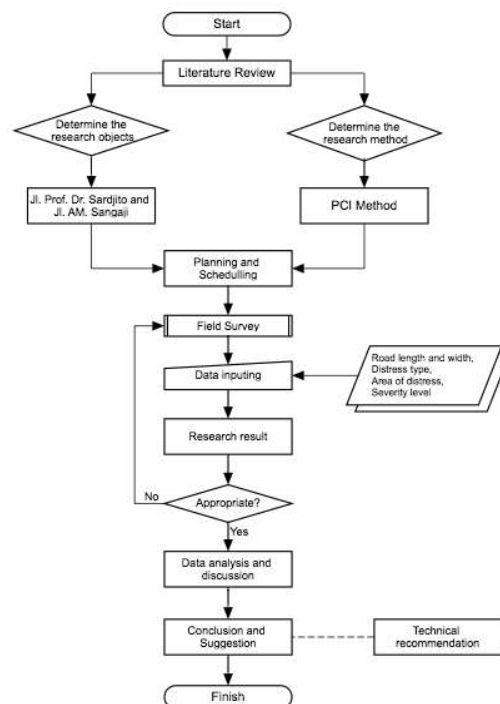
Figure 7. Research methodology flowchart

4. RESEARCH RESULT AND ANALYSIS

4.1 PCI Calculation Results

4.1 Jl. Prof. Dr. Sardjito

PCI calculation results for each sample unit on Jl. Prof. Dr. Sardjito are on Table 5.2, the number of distress types in each sample unit can be seen on Figure 8, while the PCI Rating for Jl. Prof. Dr Sardjito can be found on Figure 9.

Table 5. PCI calculation results of each sample unit on Jl. Prof. Dr. Sardjito

Sample Unit	PCI	Rating	Sample Unit	PCI	Rating	Sample Unit	PCI	Rating
Sample Unit 1	100	EXCELLENT	Sample Unit 12	100	EXCELLENT	Sample Unit 23	100	EXCELLENT
Sample Unit 2	100	EXCELLENT	Sample Unit 13	100	EXCELLENT	Sample Unit 24	100	EXCELLENT
Sample Unit 3	100	EXCELLENT	Sample Unit 14	100	EXCELLENT	Sample Unit 25	100	EXCELLENT
Sample Unit 4	100	EXCELLENT	Sample Unit 15	100	EXCELLENT	Sample Unit 26	91	EXCELLENT
Sample Unit 5	100	EXCELLENT	Sample Unit 16	100	EXCELLENT	Sample Unit 27	97	EXCELLENT
Sample Unit 6	100	EXCELLENT	Sample Unit 17	100	EXCELLENT	Sample Unit 28	100	EXCELLENT
Sample Unit 7	100	EXCELLENT	Sample Unit 18	100	EXCELLENT	Sample Unit 29	100	EXCELLENT
Sample Unit 8	100	EXCELLENT	Sample Unit 19	100	EXCELLENT	Sample Unit 30	100	EXCELLENT
Sample Unit 9	100	EXCELLENT	Sample Unit 20	75	VERY GOOD	Sample Unit 31	100	EXCELLENT
Sample Unit 10	95	EXCELLENT	Sample Unit 21	72	VERY GOOD			
Sample Unit 11	100	EXCELLENT	Sample Unit 22	81	VERY GOOD	**Average**	**97**	**EXCELLENT**
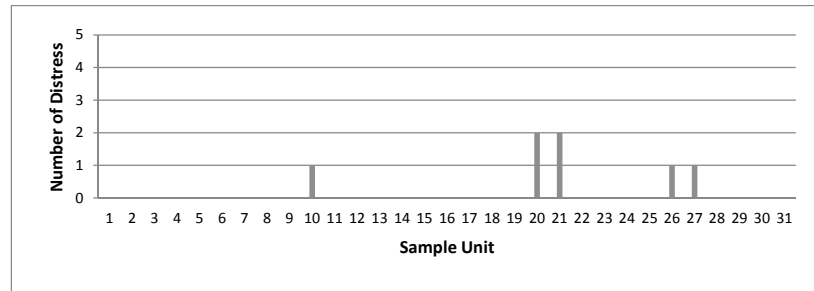
Figure 8. Number of Distress Types in each sample unit on Jl. Prof. Dr. Sardjito
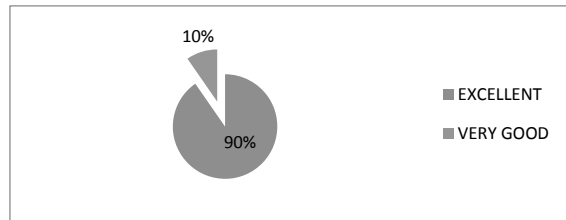
Figure 9. PCI Ratings on Jl. Prof. Dr. Sardjito

4.2 Jl. AM. Sangaji

PCI calculation results for each sample unit on Jl. AM. Sangaji are on Table 6, the number of distress types in each sample unit can be seen on Figure 10, while the PCI Rating for Jl. AM. Sangaji can be found on Figure 11.

Table 6. PCI calculation results of each sample unit on Jl. AM. Sangaji

Sample Unit	PCI	Rating	Sample Unit	PCI	Rating
Sample Unit 1	77	VERY GOOD	Sample Unit 10	80	VERY GOOD
Sample Unit 2	89	EXCELLENT	Sample Unit 11	90	EXCELLENT
Sample Unit 3	87	EXCELLENT	Sample Unit 12	78	VERY GOOD
Sample Unit 4	90	EXCELLENT	Sample Unit 13	90	EXCELLENT
Sample Unit 5	86	EXCELLENT	Sample Unit 14	54	FAIR
Sample Unit 6	84	VERY GOOD	Sample Unit 15	79	VERY GOOD
Sample Unit 7	87	EXCELLENT	Sample Unit 16	79	VERY GOOD
Sample Unit 8	87	EXCELLENT	Sample Unit 17	70	GOOD
Sample Unit 9	86	EXCELLENT	**Average**	**82**	**VERY GOOD**
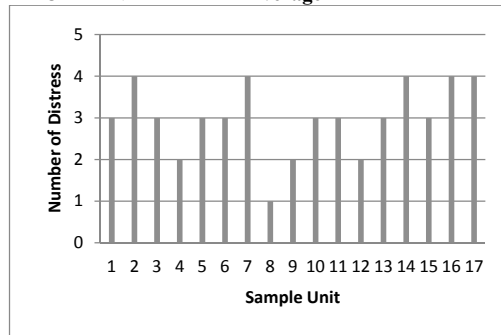
Figure 10. Number of Distress Types in each sample unit on Jl. Prof. Dr. Sardjito
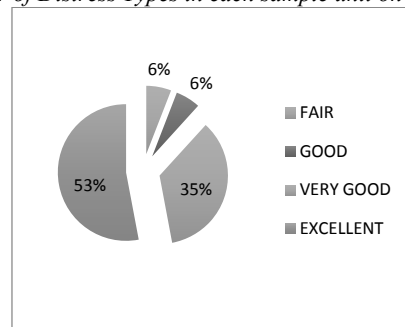
Figure 11. PCI Ratings on Jl. AM. Sangaji

4.3 Jl. Prof. Dr. Sardjito and Jl. AM. Sangaji

The road condition rating based on PCI calculation for both roads, Jl. Prof. Dr. Sardjito and Jl. AM. Sangaji can be seen on Figure 12, while the PCI distribution value for both roads can be found on Figure 13.
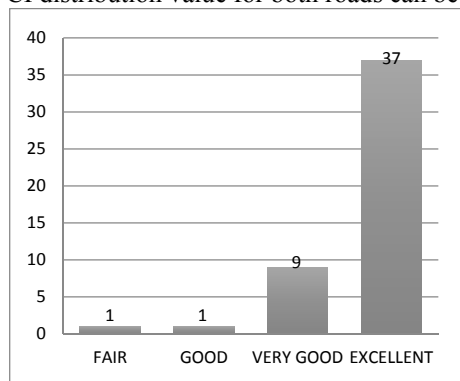
Figure 12. *Road condition rating based on PCI calculation on Jl. Prof. Dr. Sardjito and Jl. AM. Sangaji*
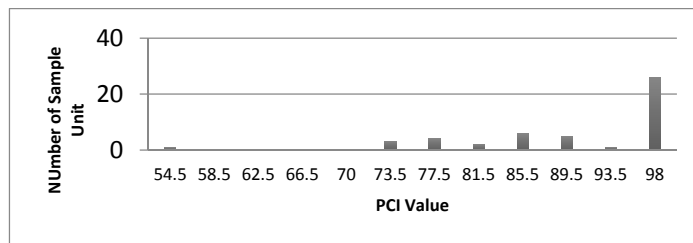
Figure 13. PCI distribution value on Jl. Prof. Dr. Sardjito and Jl. AM. Sangaji

4.2 Road Maintenance Strategies

After determine the road maintenance priority, which presented on Table 7, road maintenance strategies based on the PCI method is selected based on Figure 6. Pavement with PCI values above 65, generally do not show significant distress level (due to load) and can be treated with preventive maintenance such as the closure of cracks and surface maintenance. Pavement with 40-65 PCI values needs rehabilitation, such as overlay. If PCI value is less than 40, then the most viable alternative maintenance to be applied is the reconstruction because the damage that occurs is structural damage. Road maintenance strategy based on the value of the PCI is showed in Table 8.

Table 7. *Road maintenance priority based on PCI method*

No.	Link	PCI	Rating
1	Jl. AM. Sangaji	82	VERY GOOD
2	Jl. Prof. Dr. Sardjito	97	EXCELLENT

Table 8. *Road maintenance strategies based on PCI method*

No.	Link	PCI	Rating	Maintenance Strategy
1	Jl. AM. Sangaji	82	VERY GOOD	Preventive Maintenance
2	Jl. Prof. Dr. Sardjito	97	EXCELLENT	Preventive Maintenance

The importance of choosing the right maintenance strategy will have an impact on the resources to be spent, such as costs, labour, tools, and time. The precision maintenance strategy needs to be taken with a rational basis. PCI illustrates the maintenance strategy selection related to PCI value and time as shown in Figure 14.
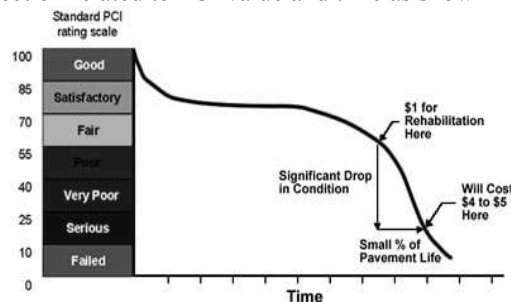
Figure 14. PCI rating vs dan Time
(Colorado State University, 2013)

Pavement in fair condition needs to be rehabilitated immediately in order not to worsen the condition. Figure 14 illustrates that if it is assumed that pavement design life is 10 years of service, so the required time for pavement of the fair condition becomes failed only takes 1.5 years. Therefore if the road PCI value is 65, it must be rehabilitated, such as thin overlay or patching. If the pavement becomes failed due to late rehabilitation, it takes 4 to 5 times the cost of rehabilitation.

4.3 Road Repair Options

As the road priority maintenance has been completed obtained, the road repair options have to be determined, so the fieldwork can be done immediately. Repairs must be done immediately to prevent the worsen damage, so that the repair options chosen is still appropriate to the type of distress, the severity level, and the quantity of the damage. This is because the damage is affected by time, load, and weather; so the longer it is not repaired, the worse the type, the severity level, and the quantity of damage. Road repair options based on the method of PCI and Asphalt Institute MS-16 can be seen in Table 9 and Table 10. PCI method by The Unified Facilities Criteria (2004) does not consist the distress type as follows: railroad crossing, potholes, bumps and sags, edge cracking, and lane/shoulder drop off. The repair option of pothole in Table 9 is determined by Shahin et al. (2005).

Table 9. Road repair options based on PCI method and Asphalt Institute Method on Jl. Prof. Dr. Sardjito

	Low	Repair Options	
	Number of Sample Unit	**PCI**	**Asphalt Institute**
Patching (10)	10, 20, 21, 22, 27	Do nothing	Do nothing
Raveling/ Weathering (12)	20, 21, 22	Do nothing; Closure surface; surface treatment	Surface treatment (chip seal or slurry seal)
Pothole (17)	26	Do nothing; partial atau full-depth patch	Cleaning and holes closure with cold mix asphalt.

Distress Type	Severity Level and Repair Options

Distress Type	**Severity Level and Repair Options**			**Severity Level and Repair Options**		
	Low	**Repair Options**		**Medium**	**Repair Options**	
	Number of Sample Unit	**PCI**	**Asphalt Institute**	**Number of Sample Unit**	**PCI**	**Asphalt Institute**
Corrugation (4)	7	Do nothing	Surface treatment	-		
Long. And Trans. Cracking (8)	1, 2, 3, 5, 6, 7, 9, 10, 14, 16, 17	Width of crack closure > 1/8 in (3 mm)	Closure or cracks repair	10	Crack closure	Closure or cracks repair
Patching (10)	1, 2, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15	Do nothing	*Do nothing*	1, 2, 6, 7, 8, 11, 14, 16, 17	Do nothing, reoverlay	Full depth patch
Polished Aggregate (11)	2, 3, 11, 13, 14, 15, 16, 17	Do nothing; surface treatment; overlay; scrab and overlay	Overlay HMA; sand seal or aggregate seal coat.			
Raveling/ Weathering (12)	2, 4, 5, 6, 12, 13, 14, 15, 16, 17	Do nothing; Closure surface; surface treatment	Surface treatment (chip seal or slurry seal)	3, 4, 7, 10, 11, 12, 13, 14, 16	Closure surface; surface treatment; overlay	Surface treatment (chip seal or slurry seal)
Rutting (13)	1	Do nothing; scrab dan overlay	Skin patching; micro-surfacing; or chip seal.			

Table 10. Road repair options based on PCI method and Asphalt Institute Method on Jl. AM. Sangaji

Distress Type	Severity Level and Repair Options		
	High	**Repair Options**	
	Number of Sample Unit	**PCI**	**Asphalt Institute**
Long. And Trans. Cracking (8)	9	Crack closure; partial-depth patch	Closure or cracks repair
Patching (10)	10, 12, 17	Do nothing, reoverlay	Full depth patch
Raveling/ Weathering (12)	13, 15	Surface treatment; overlay; recycling; reconstruction	Surface treatment (chip seal or slurry seal)

5. CONCLUSION

From all the discussions from the previous chapter, this section would figure out the conclusion of this research. After conducted an analysis and discussion of the results using the PCI method, the conclusions can be explained as follows.

a. The PCI value of Jl. Prof. Dr. Sardjito is 97, while on Jl. AM. Sangaji is 82.

b. The road condition rating of Jl. Prof. Dr. Sardjito is "Execllent", while on Jl. AM. Sangaji is "Very Good".

c. The road maintenance of Jl. AM. Sangaji is higher priority than Jl. Prof. Dr. Sardjito. Both of Jl. Prof. Dr. Sardjito, and Jl. AM. Sangaji only needs preventive maintenance.

d. Both of Jl. Prof. Dr. Sardjito, and Jl. AM. Sangaji only needs preventive maintenance. Effective maintenance can extend a pavement's life. Crack sealing and surface treatments can reduce in aging of asphalt pavement. The provision of necessary equipment for maintenance work in order to raise the level of efficiency of maintenance.

e. PCI method by The Unified Facilities Criteria (2004) should consist the distress type and also the repair options, as follows: railroad crossing, potholes, bumps and sags, edge cracking, and lane/shoulder drop off.

f. Axle-load of vehicles must be controlled for preserving the pavement condition.

g. For Public Works Service of Yogyakarta and Sleman, periodic inspection is necessary to provide current and useful evaluation data. It is recommended that ratings be updated every year. The survey should be conducted in a more thorough and conducted by surveyors who have knowledge and high sense of engineering in assessing the distress. Each surveyor should be trained under the supervision of engineers who have experience in advance to ensure the reliability of data to be obtained.

h. It is necessary to study the application of the preventive maintenance management then compared with corrective maintenance or reactive maintenance, which commonly implemented in Indonesia.

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Vibration Data Classification with Fast Fourier Transform and Neural Network

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ABSTRACT

Implementation of vibration data classification method with Neural Network (NN) for electrical compressor mechanical looseness condition was proposed in this paper. With used NN was successfully trained for vibration data classification for three conditions that detected: normally condition, mechanical looseness conditions: screws buffer induction motor compressor were looseness and baseplate was weakness). The input matrix of vibration data from detection with two vibration detector were processed with Fast Fourier Transform (FFT). Vibration data from first vibration detector (LVDT1) 98% was successfully classification and for vibration data from second vibration detector (LVDT2) 99% was successfully classification.

Keyword: Vibration, FFT, NN, Classification

Introduction

Vibration is a representation of the mechanical oscillations at the point of equilibrium. In general, vibration is not desirable because it can weaken and cause unwanted noise such as noise. Excessive vibration in the engine is the beginning of some symptoms of damage to the engine such as Mechanical looseness that is a symptom of damage to the machine that may cause damage to others, such as unbalance and misalignment on the machine, so it will affect the efficiency of the engine work.

The main cause of the mechanical vibration is mechanical looseness, unbalance, misaligment, damage to gear (gearing), the imprecision of coupling (coupling inaccuring), damage to the drive belt, alternating style, style rotor/stator that is not straight, which is not the direction the rotor shafts, rotor shaft damage, and so on. High frequency vibration spectrum contains information on errors that can be followed well in advance of actually affecting the ability of machines to run the job, while the low frequency indicates when damage has occurred (Dimarogonas, 1992).

Linear Variable Differential Transformer (LVDT) used to vibration detector for detection of induction motor mechanical looseness shimptom with fast fourier transform (FFT) method (richa et.el, 2008).

Fast Fourier Transform (FFT)

Fast Fourier Transform (FFT) is an efficient method to compute the Discrete Fourier Transform (DFT). Let $x_0,.....,x_{N-1}$ be the timeseries. The DFT is defined by the formula :

$$X[k] = \sum_{n=0}^{N-1} x(n) \, W_N^{kn} \qquad k = 0,1, ..., N-1 \quad ....(1)$$

For this study, the frequency axis is devided into bins that correspond to frequency zones of interest. The magnitudes of the FFT coeffisients in the bins are used as features.

Process calculations directly in the process of computerization can cause quite a while because there are N2 DFT complex multiplication number. In this case to speed up the process of calculation method was used Fast Fourier Transform (FFT). The basis of calculation of Fast Fourier transform calculation process is to remove the existing twin within DFT. One method of komputansi Fast Fourier transform; there is komputansi Butterfly FFT using radix-specific 2.syarat komputansi using the radix-2 FFT Butterfly is that the amount of data must meet the 2n number of fruit. In the method of radix-2 FFT Butterfly there is (N / 2 log2 N) complex multiplication.

Neural Network (NN)

Artificial Neural Network is a representation of man-made to simulate the learning process that occurs in the human brain. The term artificial aids diimplimentasikan use of computer equipment primarily to complete the calculation and storage of information provided during the learning process. Like the human brain, the neural network consists of several interconnected neurons. Information received through the network of neurons will be transformed into the output neuron to another, this relationship is known as the weights. The information is stored on a specific value on the weights. Input is processed by a propagation function that will add up the value of all the weight updating. The sum is then compared with a threshold value (threshold), usually through the activation function of each neuron. If the input passes the threshold value of the neuron and the neuron is activated it will send the output via the output weight of all these neurons are connected, and so on.

Multi Layer Perceptron Networks

Multi Layer Perceptron Networks or Multi Layer Perceptron (MLP) is a Neural Network which is the development of a single layer perceptron. Artificial neural networks with a single layer has its limitations in pattern recognition. Drawback is overcome by adding one or more hidden layers between input and output layers. Multi layer perceptron network architecture as shown in Figure 1 consists of input layer (input layer) is coupled with a bias, hidden layer (hidden layer) plus a bias, and output layer (output layer). Vij is a Xi weights from input units to hidden layer units ZJ, and Wjk is the weight of Z_J hidden layer unit to unit output Yk.
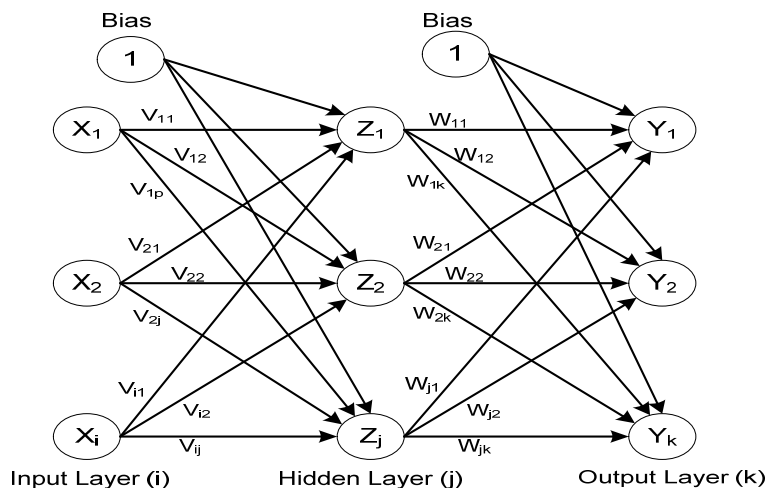
Figure 1. Architecture of multi layer perceptron neural network.

Using the delta learning algorithm called error backpropagation training algoritm. Input argument in the forward direction is fed while the process of learning in addition to utilizing the forward direction of propagation as well take advantage of back propagation direction, when the results do not correspond with the target then the weights updated during the process of learning cycles to obtain the value errror minimum expected or output equal to the target (Muis, 2006).

Training phase is a step to train a NN in a way to change the weight (connection between layers that form the NN through each unit). Problem solving is referred to as the testing process will be conducted after the training process has been completed. Use of more than one hidden layer will require a long training time so that it starts to use a single hidden layer first.

Backpropagation training algorithm includes three stages. The first stage is the advanced stage. Input pattern is calculated forward from input layer to output layer using the specified activation function. The second stage is the stage of retreat.The difference between the net output with the desired target is the error that occurred. These errors are propagated backwards, starting from the line that relates directly to the units in the output layer.

Methodology

Vibration Data processing with FFT

In the FFT calculation, first performed FFT data sorting step is adjusted by the number of data samples used. Data sorted by reflection of the number of binary data sequence is concerned.

By using data that have been sequenced, FFT calculation process followed by 2N-1 komputansi point DFT, then the data is real and the imaginary numbers are obtained computed so that it becomes a value that represents the amplitude of the frequency in question. In the figure 2 (a) is a major program utuk flowchart describing the process of data collection, data processing and vibration using FFT methods teraknir process is showing the vibration spectrum. Whereas in Figure 2 (b) is a sub program for processing vibration data using FFT methods.
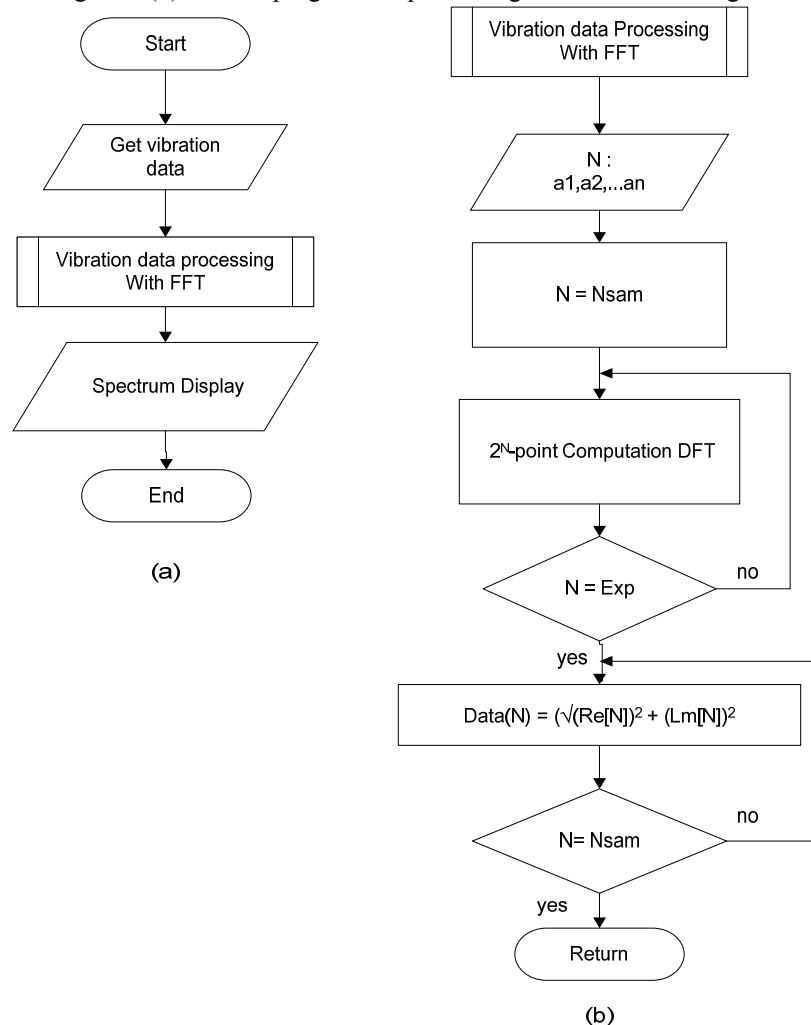
Figure 2. Flowchart of system, (a) main program, (b) sub program of FFT.

Vibration Data Classification with NN

Neural Network (NN) used in this study is many layered perceptron or Multi Layer Perceptron with Backpropagation training of an supervised learning algorithm. As inputs of neural network is the RMS value of the vibration data that have processed with FFT method and they are normalized. The design of Multi Layer Perceptron (MLP) using 3 layers, namely input layer, hidden layer and output layer as shown in figure 3.
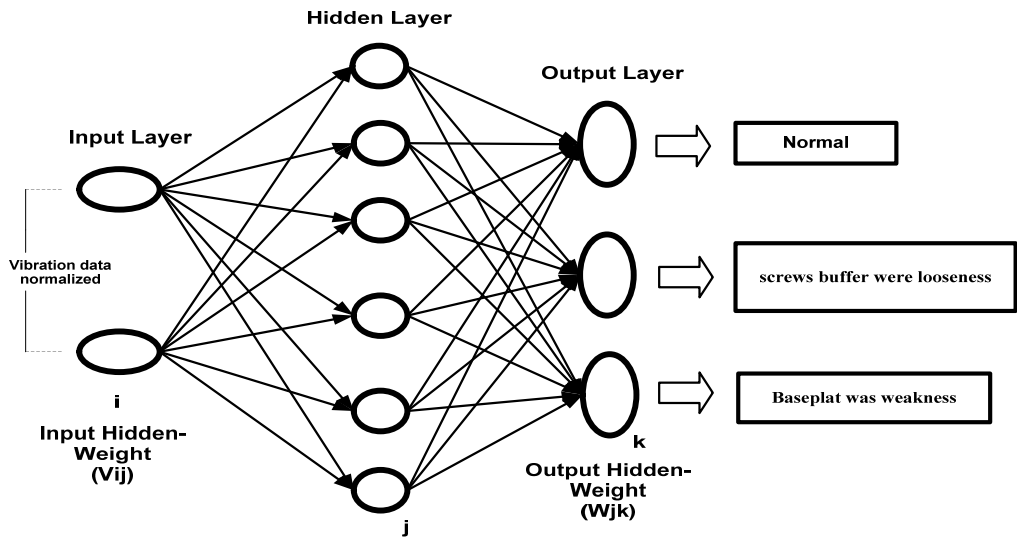
Figure 3. NN-Backpropagation schematic of vibration data classification.

Vibration Data Normalized

Before vibration data used as input in the NN, then the first data on the average vibration into the RMS value normalization is then performed using the equation:

$$Xn = \left(\frac{X}{1.5 \times X \max} \right) \times 0.8 + 0.1 \quad \text{..(2)}$$

where, X is actual data, Xmax is nilai maximum value of the data and Xn is the normalized data. The maximum value is obtained from vibration data set. The maximum value is multipled by the factor 1.5 so that if vibration data is more than what is considered till now, same neural network can be useful for classification purpose.

At the time of learning in the NN, the highest value of the input variables affect the lower input variable value, the better the data processed by averaging the data input variable vibration before it becomes the input for NN. These data were then normalized within the limits of 0.1 and 0.9 to minimize the effect on the input variables. Limits 0.1 and 0.9 in the select as a replacement for 0 and 1 because 0 and 1 cannot be realized by the activation function (Sigmoid Function). Table 1 is the target/output for each condition is detected.

Table 1. Target/output of tree condition was detected

No.	Condition	O1	O2	O3
1.	Normal	1	0	0
2.	Screws buffer were looseness	0	1	0
3.	Baseplate was weakness	0	0	1

Trainning Process

The parameters used in the ANN:

a. Learning Rate (β)

Learning will accelerate the rate of error reduction, especially in the early stages of learning process JST. Although the constant learning of the ANN can accelerate the learning process, but there are certain conditions which can not achieve the desired minimum error, because the ANN depends on the actual minimum error. When used in a small learning constant of the ANN can achieve the desired minimum error, but the learning process takes a long time (kanata, 2001).

b. Momentum (α)

The larger (β) then the greater the error reduction, but often the error could not reach the global minimum error, so it is used to overcome the learning rate is small, but it requires a large number of iterations. To overcome this momentum can be used to help the process of error reduction on a faster network (Kanata, 2001).

c. Maximum Epoch

The number of iterations affects the length of the learning process, because one requires m iterations of the process, then for n epoch needed nxm process and a process corresponding to the specified intervals. The number of iterations also affects the error, due to an error that tends to get smaller required number of iterations increases.

d. Number of Layer

Layer number used in this studyis 3 layers. The number of cells of each layer are used for training is the result of the FFT vibration data. 4 samples for the learning process vibration data from two vibration sensors (LVDT) for the three conditions was measured as follows: Under normal conditions, the condition of loose bolts and bearings have weak structura lcondition:

- Input Layer   = 2 (derived from the results of the FFT of the sensor LVDT1 and the proceeds of the FFT of the

Sensor LVDT2).

-Hidden Layer = 10, 12, 14, 16, 18, 20, 22, 24, 25, 26, 28 and 30.

- Output Layer = 3 (normal condition, the condition of the bolts loose and weak structural condition of bearings.

e. Minimum Error

The smaller the error (ideal error = 0) then the network output (vibration data for condition is detected) is almost equal or equal to the target (vibration data for condition is detected). Error related to the number of epoch, the epoch in which the greater the error tends to get smaller.

Table 2 is the parameter that used for trainning process backpropagation-NN for vibration data classification.

Table 2. The parameter of NN-Backpropagation trainning.

No.	Parameter	Value
1.	Epoch Maximum	$1e^6$
2.	Mean Square Error (MSE) Minimum	$1e^{-4}$
3.	Learning rate	0,5
4.	Momentum	0,1
5.	Trainning Function	*Feedforward (newff)*
6.	Activation Function	*logsig, logsig,* TRAINGDM

Result and Discussion

Vibration Data Processing

Vibration data is retrieved and then displayed in the form of the spectrum which aims to give an overview spectrum of the original data in the time domain. By using the original vibration data later in the process with the FFT method so that it can be seen more information in the form of the data at low frequencies and high frequencies. On the application of FFT to give a picture of time-frequency vibration signal on the output data in the form of decimated, where the shape is dependent on the detail level based on the data in a state machine of a machine. The first test performed on the three conditions for data sampled as many as 1024 as shown in Figure 4.

Vibration data is retrieved and then displayed in the form of the spectrum which aims to give an overview of the original data in the time domain. By using the original vibration data later in the process with the FFT method so that it can be seen more information in the form of data at low frequencies and high frequencies.

Do some testing times based on some data based on input data, results of some experiments on the spectrum contains the information, to the high frequency is selected as input for the FFT. Then the high frequency vibration spectrum contains information on the errors that can be followed well before they affect the actual capability of the machine to run the job, while the low frequency indicates damages when it has occurred.
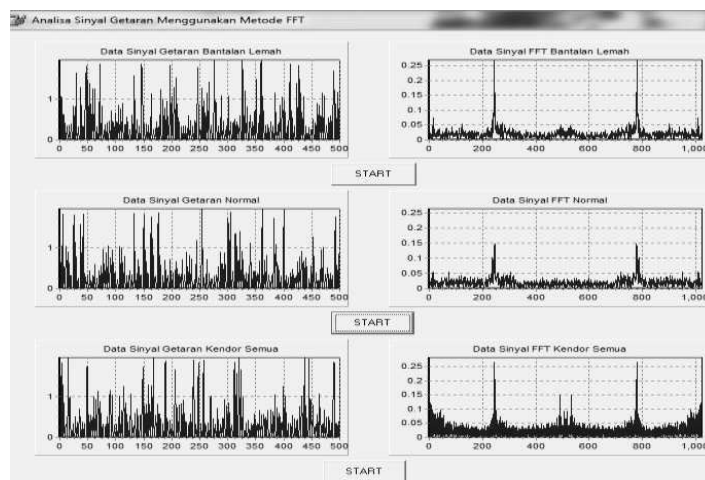
Figure 4. Testing system for the three conditions.

From the results of vibration data processing using the FFT method, the data obtained that there are differences in the spectrum for each condition, the weak bearing conditions, normal conditions Screws buffer were looseness

conditions. For vibration data processing results of the testing diberasal the first can be described in which there are significant differences for weak bearing conditions, normal and Screws buffer were looseness all.

When the normal condition of the vibration signal is more stable than the weak bearing conditions, it occurs because of an increase in the spectral range of data between the data into the data to the 200 and 800, it is because when the pads in a weakened condition, the vibration signal to detect vibrations greater than the vibration signal normal circumstances. conditioned as are normal when it detects vibrations smaller than the bearing vibration signal is weak as all the bearings in tight circumstances. Likewise when all the slack conditions in the state of vibration signals show a large vibration than the vibration signal in a state of weakness and normal bearing seen from the spectrum in the range of data enhancement 200.500, and 800. Of the three trials that have been made of data obtained as shown in Table 4.1 for a gain range of vibration data is based on the vibrational spectrum of the x-axis to the frequency of its amplitude increases.

Table 4.1 Increament in Range Data

Condition	Experiment	Increament in Range Data (0-1024)		
		250	500	780
weak bearing	1	0.25	0.05	0.25
Normal		0.15	0.025	0.15
Screws buffer were looseness		0.25	0.10	0.25
Baseplate was weakness	2	0.15	0.10	0.15
Normal		0.10	0.015	0.10
Screws buffer were looseness		0.25	0.13	0.25
Baseplate was weakness	3	0.15	0.10	0.15
Normal		0.10	0.015	0.10
Screws buffer were looseness		0.25	0.14	0.25

Vibration Data Classification With NN

Neural Network (NN) that uses the Backpropagation learning method works in the M-File Matlab7 off-line (simulation). Network architecture using the function "newff" on Matlab7 used for learning. To speed up the process of learning the methods applied learning rate = 0.5 and momentum = 0.1. In the process of learning, the network is doing the learning to achieve the Mean Square Error (MSE) is desired which is 10e-4 with the maximum epoch 10e6. From the results of the learning process that has been done by the NN can be seen that to achieve the desired MSE at the 1889 epoch can be achieved, it is as shown in Figure 4.
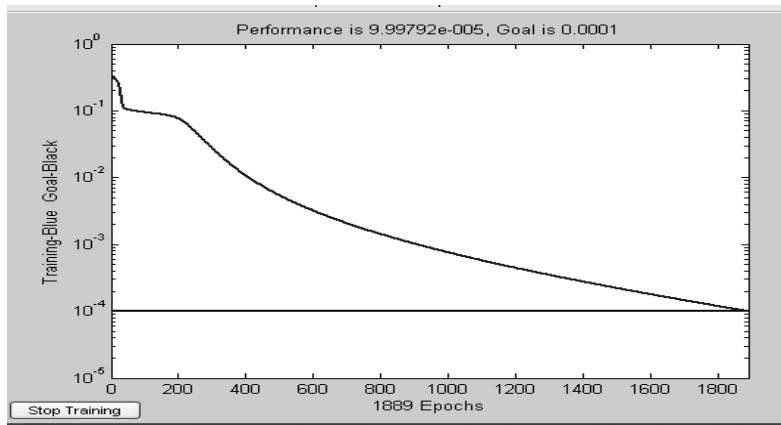
Gambar 4. Grafik hubungan error dan epoch untuk jumlah
hidden layer 30 neuron.

Figure 5, 6 and 7 are the results of NN, Backpropagation learning for classification of the vibration data LVDT1 and LVDT2. Where in the learning process applied to the function of hidden layer neurons between 10 and 30 to get the right number of hidden layer for classification of vibration data.
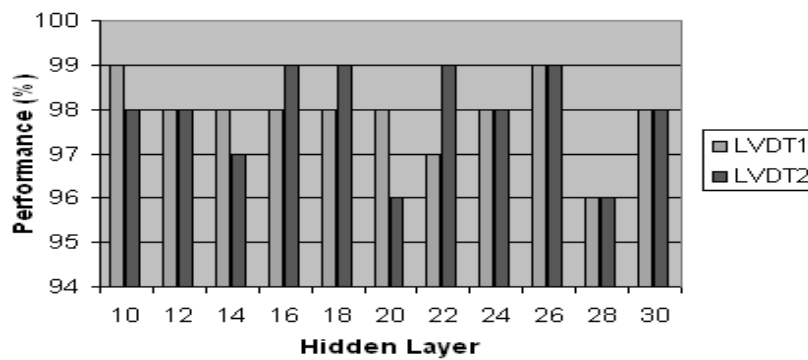
Figure 5. Vibration data classification results for Normal conditions
of LVDT1 and LVDT2.
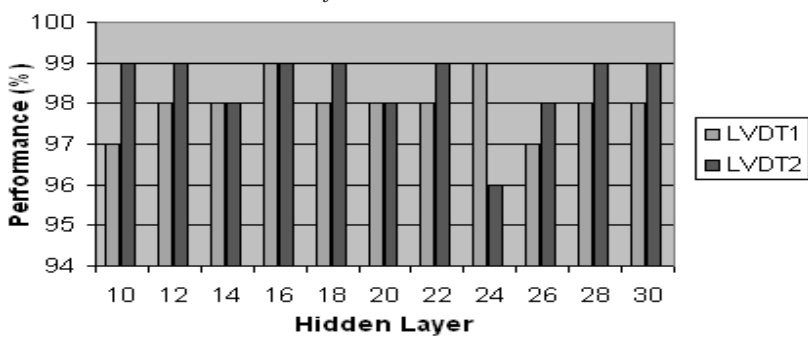
Figure 6. Vibration data classification results for conditions
Bolts loose from LVDT1 and LVDT2.
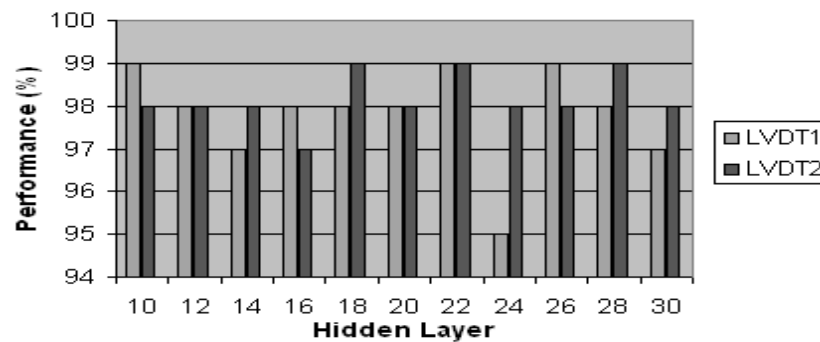
Figure 7. Vibration data classification results for the condition of bearings
Structural weak from LVDT1 and LVDT2.

From the results of NN, Backpropagation learning is used for data classification in detecting mechanical looseness vibration is based on the graph shown in Figure 5, 6 and 7 that for the vibration data from sensors LVDT1 successfully classified 98%, while for vibration data from sensors successfully LVDT2 99 % classified on the application of a total of 18 hidden layer neurons.

Conclusion

By applying FFT and NN-Bacpropagation method used for the classification of vibration data from sensors LVDT1 successfully classified 98%, while for vibration data from sensors LVDT2 successfully classified 99% for the three conditions are normal and the condition of mechanical loosesness bolts loose and weak structural bearing conditions

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DC MOTOR CONTROLLER DESIGN
FOR TRACKING ANTENNA SYSTEM
BASED ON CVBS ANALOG SIGNAL PROCESSING

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ABSTRACT

DC motor is often used in tracking antenna system. Generally rotation of the motor is controlled manually by using the remote control. To be able to rotate automatically, then the tracking antenna system requires compatibility between input parameters with decision making process. Thus, the ability of auto tracking on tracking antenna system can be achieved. In this research, DC motor controller is designed as an effort to build the tracking antenna system which has auto tracking capability. In the design, the input parameters are obtained from analog CVBS signal processing. Results from the processing yield 2 parameters, among other are Composite rising transition and Vertical rising transition. Characteristics of both parameters are used as a reference in the decision making process. The trial results show that the DC motor controller has been designed to produce minimum tracking time of 1.6 second and maximum 115.2 second.

Keywords : *Tracking Antenna System, CVBS, Auto Tracking, Analog Television, DC Motor*

1. INTRODUCTION

In analog TV receivers, the automatic tracking function of the antenna tracking system allows the antenna to rotate automatically in an effort to achieve optimal video clarity. Tracking antenna systems on analog television is generally based on user control. In this case, the tracking process done by using the remote control manually. By using the automatic tracking function, the tracking process becomes easier for the user.

The automatic tracking function of the antenna tracking system can be built if there are 2 points. The first point is the existence of input parameters used as a reference. The second is the decision making process that matches the input parameters. In terms of input parameters, one of the potential parameters used is AGC *(Automatic Gain Control)* as performed on satellite receiver technology [1]. In this case the antenna rotates based on AGC signal processing. But on analog TV, this method is less effective because generally the AGC out facility is not present physically on the TV panel. Another way is using analog signal processing of CVBS *(Composite Video Baseband Signal)* which is generally available on AV-Out connection [2]. While the compatibility between input parameters and decision making process can be achieved if the input parameter characteristics are adjusted to the type of actuator used. The most commonly used actuator component is a DC motor. Not only in analog television, DC motors are also commonly used in satellite TV receivers as in previous research [3], [4].

The current study is a continuation of previous research, where CVBS signal processing performed in an attempt to obtain the input parameters for the tracking antenna system [2]. If in previous research used servo motor as actuator to rotate antenna, hence in this research used motor DC. Therefore, the design and implementation of DC motor controller in this research is equipped with decision-making algorithm that is arranged to be able to adjust to analog CVBS signal processing result.. The parameters tested are, *minimum azimuth rotation*, *optimum drive timing* and tracking time.

2.   METHODOLOGY

In this research, the design of DC motor control system including implementation, trials and analysis. The design of the DC motor control system is as shown in Figure 1. CVBS analog signal on AV-Out TV will be inputted to DC motor control block input. Then the output block DC motor controller will produce a decision related to DC motor rotation. In the DC block of the motor controller, there are 2 important parts including the analog signal processing block CVBS and decision making algorithm.
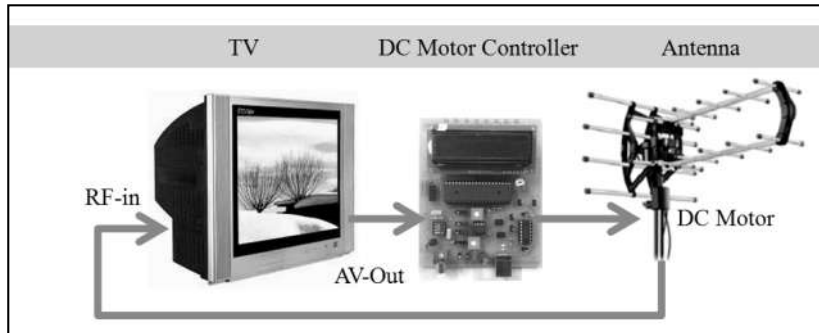
Figure 1. System Design.

2.1   CVBS Analog Signal Processing

Signal CVBS *(Composite Video Baseband Signal)* or so-called *Composite Video* is analog video interface that contains a combination of *luminance signal* (black and white image), *chrominance* signal (color), *burst signal* and *synchronization* are channeled on a single wire [5]. Tracking antenna system on analog television requires reference parameter. In a previous study [2], in order to obtain input parameters, the method used to perform analog CVBS signal processing on AV-Out. In detail, the *sync pulse* on the CVBS signal is calculated every second. To calculate the *sync pulse,* the thing to do is to calculate the number of *transitions rising* between the *sync level* and the *blanking level* on the CVBS signal. This calculation result is called *rising transition*. Figure 2 shows the visual definition of the *rising transition* parameter.

At the PAL B/G standard, the number of lines is 15625 per second or 625 per frame.The number of frames is 25 per second and each frame has 2 fields (odd and even) so the number of fields is 50 per second. The number of *rising transitions* on the overall *sync pulse* is 640 per frame. If every second there are 25 frames, then the *rising transition* number is 16000 per second. This nominal is calculated from standard PAL B/G system *synchronization pulse*. In detail as shown in Figure 3. If the video clarity level is optimal, the value of the *rising transition* parameter will be closer to 16000. Conversely, if the video clarity level gets worse, it will further away from the value of 16000.
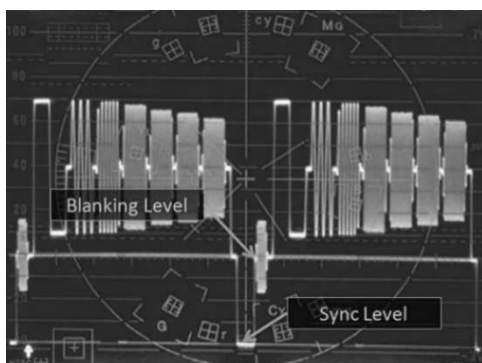
Figure 2. Rising Transition [6].
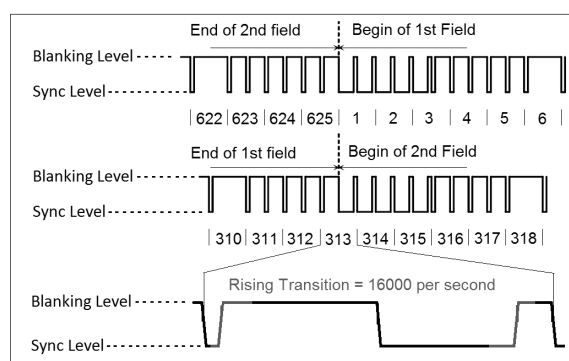
Figure 3.
PAL B/G Pulse Synchronization Standard [7].

2.1.1 Sync Separator Block

In this research, to get the *rising transition* parameter, the thing to do is to separate the *synchronization pulse* from CVBS signal by using *sync separator* block. This block can separate the *composite synchronization* and *vertical synchronization pulses* from the CVBS signal. This block has been designed to have 2 outputs namely CSO *(Composite Sync Output)* and VSO *(Vertical Sync Output)*. CSO output serves to produce the *composite synchronization pulse*. While VSO serves to produce the *vertical synchronization pulse*. Then, both CSO and VSO

outputs will be calculated the amount of *rising transition* using 2 timer counter on the microcontroller. The microcontroller used is type AT-Mega 32 A. Counter timer counting results will produce 2 variable values used as parameters. In this study, these parameters were initialized as *composite rising transition* (C_{RT}) and *vertical rising transition* (V_{RT}). In this case, both parameters are variables that have no units. Figure 4 shows a complete DC motor controller block diagram in which there is a *sync separator* block. While figure 5 shows the realization of *sync separator* block
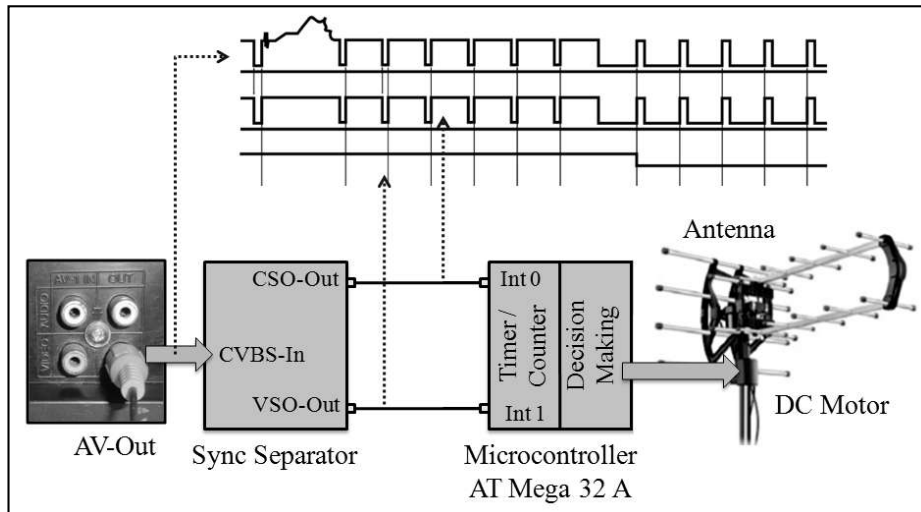
Figure 4. Block Diagram of DC Motor Controller.
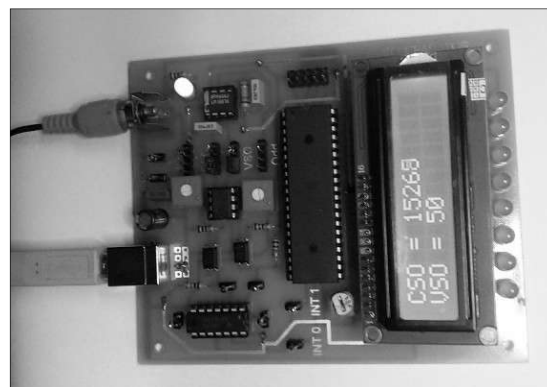
Figure 5. Realization of Sync Separator Block.

2.1.2 Composite Rising Transition (C_{RT}) and Vertical Rising Transition (V_{RT}) Characteristic

Composite rising transition (C_{RT}) and *vertical rising transition (C_{RT})* are the parameters used in the decision making process. Therefore, an analysis of the characteristics of both parameters needs to be done. Characteristics are obtained from trials at several levels of video clarity. Trials were conducted by observing C_{RT} and V_{RT} parameters at several levels of video clarity. In this study, the video clarity level is classified into 5 scales : Good Clarity, Fairly Clarity, Bad Clarity, Worst Clarity and Noisy. Table 1 shows the video clarity level based on the user's visual perception approach. While the characteristics of C_{RT} and V_{RT} parameters are shown in Table 2.

Table 1. Clarity Level of Video and Visual Perception by User
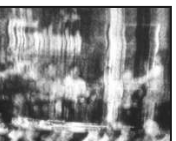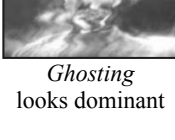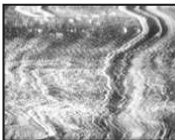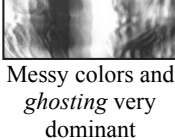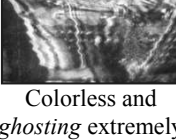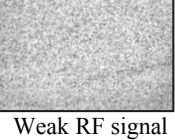
Good Clarity	Fairly Clarity	Bad Clarity	Worst Clarity	Noisy
Perfect colors & without *ghosting*	Fairly colors & minimum *ghosting*	*Ghosting* looks dominant	Messy colors and *ghosting* extremely dominant	Extremely blurring and colorless
Perfect colors & minimum *ghosting*	Fairly colors & fairly *ghosting*	Messy colors and *ghosting* very dominant	Colorless and *ghosting* extremely dominant	Formless / Weak RF signal

Table 2. Composite Rising Transition and Vertical Rising Transition Characteristic

Clarity Level of Video	Composite Rising Transition (C_{RT})		Vertical Rising Transition (V_{RT})	
	Minimum Value	Maximum Value	Minimum Value	Maximum Value
Good Clarity	15171	15687	42	50
Fairly Clarity	13600	15221	42	50
Bad Clarity	8794	12203	42	50
Worst Clarity	2607	6982	0	0
Noisy	0	1182	0	0

In ideal conditions where RF signals are not disturbed by *noise* and *ghosting,* the value of the *composite rising transition* (C_{RT}) parameter is the same as the *rising transition* parameter of 16000. While the value of the *vertical rising transition* (V_{RT}) parameter is the same as the number of fields in the CVBS standard PAL B/G which amounts to 50 fields per second. Thus, if the video clarity is optimal, then the value of the *composite rising transition* (C_{RT}) parameter will be closer to 16000 and the *vertical rising transition* (V_{RT}) parameter value will be closer to 50. Conversely, if the video clarity becomes worse, it will further away from the value 16000, and the value of *vertical rising transition* parameters (V_{RT}) will further away from the value 50.

Good Clarity is the video clarity level desired by the user. While Fairly Clarity is the desired video clarity level if Good Clarity is not possible to obtain. To obtain the clarity level, the DC motor must be able to rotate automatically until the minimum value of C_{RT} parameters obtained reaches ≥13600 and the minimum value of V_{RT} parameters obtained reaches ≥ 42. For that, the value of 13000 on C_{RT} and 42 parameters on the V_{RT} parameter will be entered on the decision making algorithm.

2.2. *The Decision Making Algorithm*

The decision making algorithm put simply sets the timing drive on DC motor rotation. DC motor used in tracking antenna systems does not require speed control. In this case, the PWM control is not required but the *timing drive.* The *timing drive* is used to determine the motor rotation duration which can automatically determine the angle direction of the antenna. The longer the timing drive, the larger the *azimuth rotation.* The shortest duration *timing drive* which include with the *rising transition* parameter change is the ideal *timing drive.*

Therefore, the *optimum drive timing* is the variable sought. In this study, *optimum drive timing* is initialized as a DT_{OPT} parameter. More simply, the decision making algorithm is structured as shown in Figure 6.
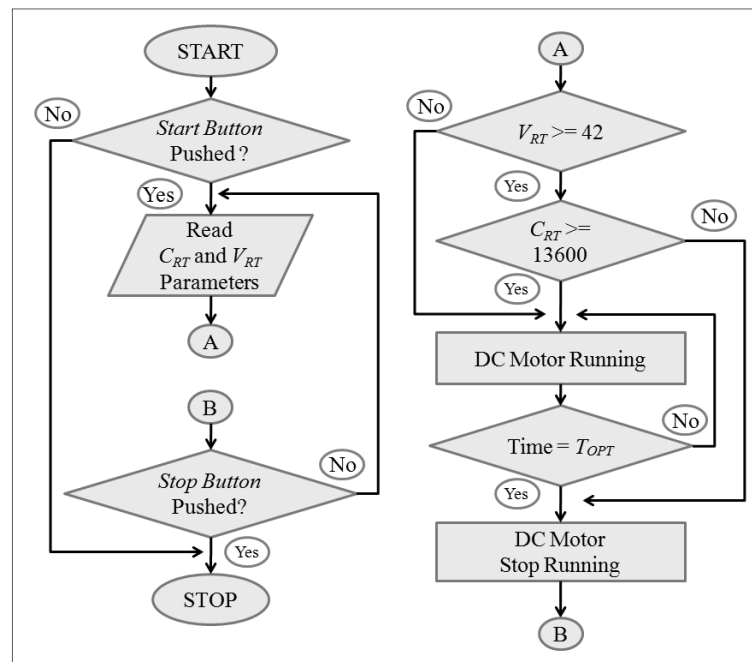
Figure 6. Decision Making Algorithm.

Generally on the tracking antenna system, DC motor rotation is controlled by 2 buttons, namely spin left button and spin right button. But in this study, DC motor rotation is controlled by start button and stop button. When the user presses the *start button,* the DC motor control system will run automatically looking for the directions where the optimal video clarity level can be obtained.

As seen in Figure 6, the details of the decision making algorithm are as follows :

- ➢ When the start button is pressed, the system will read C_{RT} and V_{RT} parameters.
- ➢ Furthermore, if $V_{RT} \geq 42$, then it describes that video clarity level on TV screen is on 3 possible scales that is, *Good Clarity, Fairly Clarity and Bad Clarity.* To ensure the video clarity level in more detail, the system only checks C_{RT} parameters.
  - If $C_{RT} < 13600$, then it describes that the video clarity level is at *Bad Clarity* scale. In this condition, the DC motor will rotate until the time setting reaches the DT_{OPT} variable. Then, the DC motor stops spinning and the system re-checks the C_{RT} and V_{RT} parameters.
  - If $C_{RT} \geq 13600$, then it describes that the video clarity level on a *Fairly Clarity* or *Good Clarity* scale. In this condition the DC motor does not need to rotate to find the ideal direction of the antenna.
- ➢ If $V_{RT} = 0$, then it describes that the video clarity level on the TV screen is in 2 possibilities of *Worst Clarity* and *Noisy.* The DC motor will rotate to find the ideal direction of the antenna.
- ➢ Stop button is pressed to turn off the auto tracking function on DC motor controller.

3. RESULTS

In this study, trials were performed on several points including *minimum azimuth rotation, optimum drive timing* and tracking time. The trials of *minimum azimuth rotation* and *optimum drive* are important because the trial results will be used in DC motor controller design process. While trials on tracking time is important because the trial results will describe the overall DC motor controller performance.

3.1. *Minimum Azimuth Rotation*

Minimum azimuth rotation (AR_{min}) is the minimum angle formed by rotating the antenna direction from the starting point to the next point, accompanied by the change in the video clarity level on the TV screen. The trial performed to find the minimum rotation angle of the antenna. Trial perfomed by observing C_{RT} parameters on different *azimuth rotation.* In this trial, *azimuth rotation* is limited from 0º to 45º. Figure 7 shows the trial results.
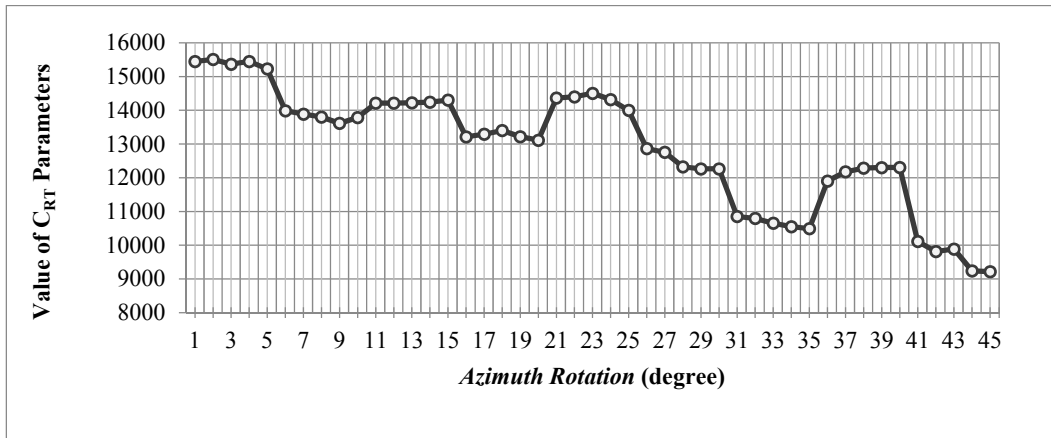
Figure 7. Trial Result of Minimum Azimuth Rotation.

From the test result in Figure 7, it can be concluded into several points, among others are as follows :

> When the *azimuth rotation* reaches 0° to 5°, there is no significant change in C_{RT} parameters. Significant changes occur when the *azimuth rotation* reaches 6°. This occurs also when the *azimuth rotation* reaches 6° to 10°, there is no significant change in C_{RT} parameters. Significant changes occur when the *azimuth rotation* reaches 11°.
> From the trial result, it can be concluded that the *minimum azimuth rotation* is 5°. This can mean a change in the video clarity level on the TV screen occures if the direction of the antenna changes every 5°.

3.2. *Optimum Drive Timing*

Optimum drive timing (T_{opt}) is the time required for a DC motor to rotate to a minimum of *azimuth rotation.* The trial performed by observing the resulting *azimuth rotation* in several different *timing drive* settings. The shortest *timing drive* in the trial is 0.1 second, while the longest is 2 second. The trial results will be used as constants on the DT_{OPT} parameter. Figure 8 shows the results of the trial to determine the *optimum drive timing.*
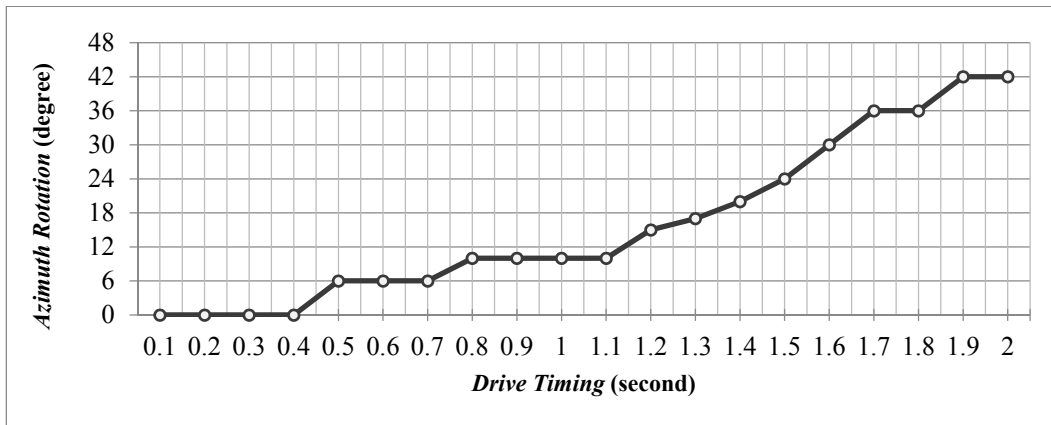
Figure 8. Trial Result of Optimum Drive timing (T_{OPT}).

From the test result in Figure 8, it can be concluded into several points, among others are as follows :

> The DC motor can only rotate when the *timing drive* is ≥ 0.5 second.
> The graph in Figure 8 shows that the DC motor used, has a less linear characteristic.
> When the *timing drive* is arranged 0.5 to 0.7 second, the *azimuth rotation* obtained is 6°. While at 0.8 to 1.1 seconds, the *azimuth rotation* obtained is 10°.
> If the *minimum azimuth rotation* on the previous test result is 5°, then the *drive timing* at 0.5 to 0.7 second is the closest to the *minimum azimuth rotation.*

> ➢ *Optimum drive timing* can be determined by taking the average value between 0.5 to 0.7 second ie 0.6 second.

3.3. *Tracking Time Analysis*

The analysis done to estimate the time required by the system in tracking antenna. If the *minimum azimuth rotation* (AR_{MIN}) is 5° (trial result in chapter 3.1), the *optimum drive timing* (DT_{OPT}) is 0.6 second (trial result in sub chapter 3.2), the *maximum azimuth rotation* (AR_{MAX}) is 360° and if the computational time (C_{TIME}) is 1 second, then the tracking time (T_{TIME}) applies the rules as in Equation 1. The results of the analysis if visualized into the graph, then as shown in Figure 9. From the trial results, it can be concluded that the minimum tracking time (shortest) is 1.6 second and maximum tracking time (longest) is 115.2 second.

$$T_{TIME} = \sum_{n=0}^{360/5} (DT_{OPT} + C_{TIME}) \, x \, n \tag{1}$$
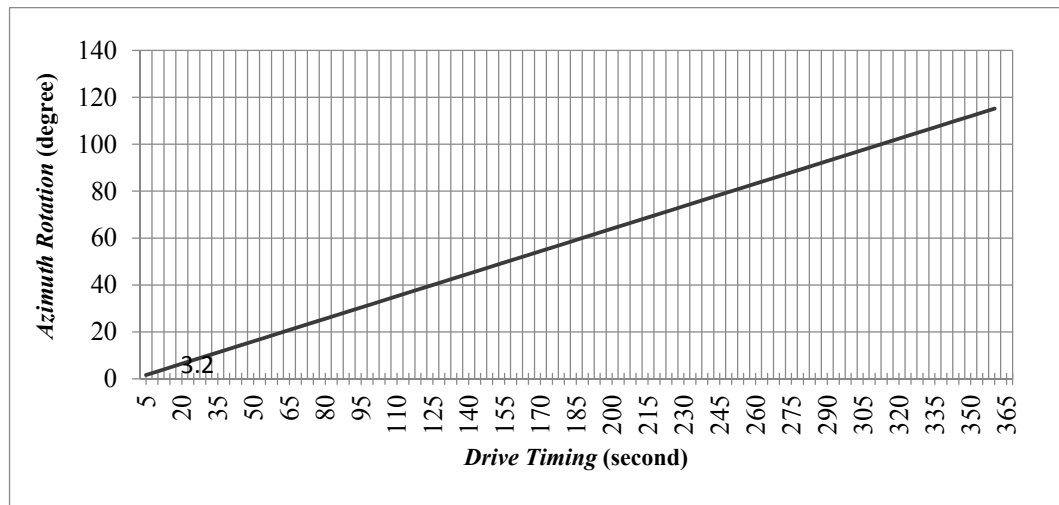
Figure 9. Tracking Time Analysis Result.

4. CONCLUSION & FUTURE WORK

This research is a design and implementation of DC motor controller for tracking antenna system on analog television. Design and implementation includes analog CVBS signal processing and decision making algorithms. Technically, this design produces a minimum tracking time of 1.6° and a maximum tracking time of 115.2° at a minimum of 5° *azimuth rotation* and an *optimum drive timing* of 0.6 second.

Tracking time in this study is still too long, it is necessary to make improvements to tracking time becomes shorter. *Rising transition* is a parameter that obtained after passing the calculation process during1 second or 25 frames, need to be tested where the *rising transition* parameters obtained from the calculation process during 1 frame. In this research has not discussed the method of mixing DC signal with RF signal from antenna to TV. If further research is related to the addition of sensors to the antenna design, then a multiplexer is required that allows a single core coaxial cable to accommodate RF signals, DC supply, and many sensor datas.

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CLASSIFICATION OF SCOUT SKILL USING NAÏVE BAYES CLASSIFIER ALGORITHM

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ABSTRACT

Developing the skill and ability of Scout member often meet some problem, that is the difficulty caused by the error in determining of which skill is owned by the Scout member. The way to solve the problem is to decide the class or classification of the Scout Ability class owned by the Scout member. This research is going to build a system to classify the Scout skill class using Naïve Bayes algorithm to help the Scout master decide the Scout skill class owned by the Scout member. So that, the Scout master could develop the Scout skill suitable with the skill class owned by the Scout member optimally. Criteria used in this research are the scores of General Knowledge, Scouts Knowledge, Sign Languages (Code, Morse, Semaphore), Rope and Knotting, Pioneering, and Handicraft. The type of all of the criteria used are numerical. The result of the classification is the participant involved in Intelligence class, Physical class, or Creativity class. The result of this research is a program which has ability to decide the Scout skill class. The Scout Skill Classification using Naïve Bayes Algorithm program has been tested and the accuracy reached 100%.

Keyword : *Scout, Scout skill, Classification, Naïve Bayes Classifier*

1. INTRODUCTION

There are some skills which are trained in Scout Organization. Those skills can be applied in the social life. In other way, those skills are tested in Scout Competition. Developing the skill and ability of Scout Members often meet the difficulty. It is caused by the error in determining of which skill is owned by the Scout member. Computer program can solve the problem with a classification program using Naïve Bayes classifier algorithm. Bayes is a simple probabilistic based prediction technique with strong independencies(Naïve). The formulation of problem is how to build a system to classify the Scout skill using a Naïve Bayes classifier algorithm. Data needed in this research will be taken from 5 (five) junior high school. They are State Junior High School 1 Tumpang, State Junior High School 2 Tumpang, State Junior High School 1 Pakis, State Junior High School 1 Poncokusumo and Junior High School Diponegoro Tumpang. Each data consist of scores of General Knowledge, Scouts Knowledge, Sign Languages (Code, Morse, Semaphore), Rope and Knotting, Pioneering, and Handicraft. The result of the classification is the participant involved in Intelligence class, Physical class, or Creativity class. Purposes of this research is to facilitate the Scout master to decide which skill is owned by the Scout member. So that the Scout member can developing effectively suitable with their skill.

2. METHODOLOGY

2.1 System Analysis

This step is aims to explain the problem of the system, analyzing the system requirement and elements needed in process of classifying the Scout skills.

2.1.1 Problem Analysis

Scouting activity has now became a part of Indonesian government program to improve the quality of education in Indonesia. One of the ways to measure the ability of Scout member is to organize the competition. The participants of the competition are the Scout member from the educational institutions. Competition organized covers the skill classes that can be classified to intelligence class, physical class, and creativity class. By using the data mining system, specially Naïve Bayes Classifier, then a program for classification was developed to classify the classes of Scout skill.

2.1.2 Data Analysis

Data used in this research are 2015-2016 data of Scout member in 5(five) Junior High School in Tumpang District and around it. Each data consist of scores of General Knowledge, Scouts Knowledge, Sign Languages (Code, Morse, Semaphore), Rope and Knotting, Pioneering, and Handicraft. There are 712 data available which are consist of 447 data for training and 265 data for testing.

2.2 System Design

Designed system consist of two main parts. They are master data process and Naïve Bayes algorithm calculation process.

2.2.1 Master Data Process

Master data process containing data which is going to be used as training data and testing data. In master data process there are function to input data, data editing, and delete the data. The input data needed by the system are participant data for training and participant data for testing.

2.2.2 Naïve Bayes Algorithm Calculation Process

Development of Naïve Bayes model has several steps to do. Those steps explained in following figure.
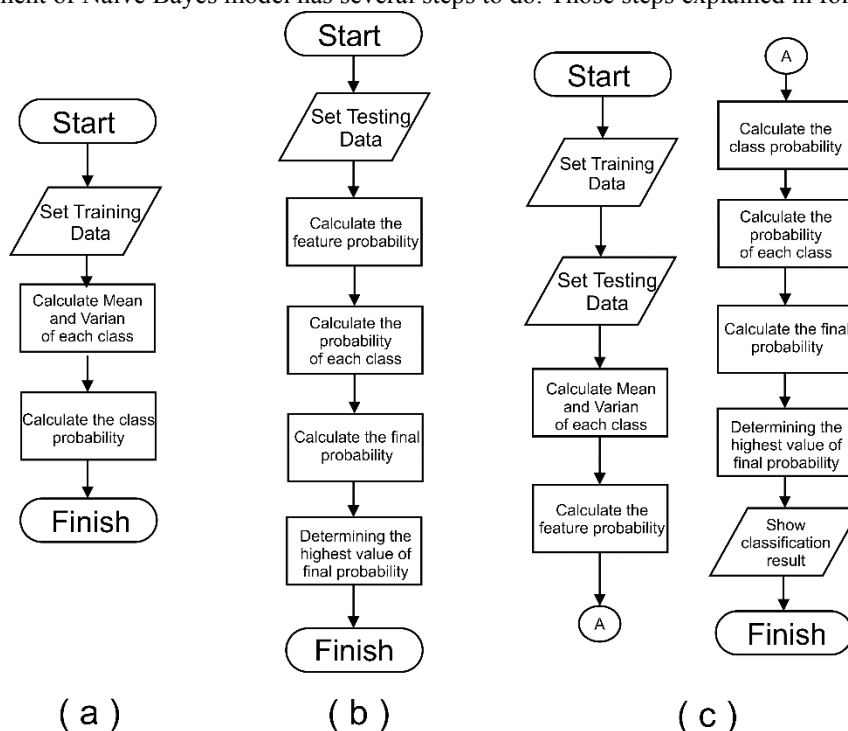
Figure 1. (a) Flowchart of Training Process, (b) Flowchart of Testing Process, (c) Flowchart of Implementation Process

All features are numeric, so that calculation of features probability doesn't exist in training process. But, features probability will be calculated in testing process by involving the value of mean and variance from the training process. The whole process from training process and testing process are involved in implementation process. After highest value of final probability is determined, the system will show the result of classification using Naïve Bayes Classifier algorithm.

2.2.2.1 Calculation Example for Scout Skill Classification using Naïve Bayes Classifier

To do a calculation process of Naïve Bayes Classifier, data for training and testing are needed by the algorithm. These are several data which is going to be used as a training data.

Table 1. Example of Data for Training

NO	NAME	SCHOOL	PU	PK	SMS	SI	PIO	HK	CLASS
1	BAGAS IMAM ABDILLAH	JHS 1 TUMPANG	80	84	86	96	98	78	PHYSICAL
2	RAKA IQBAL RAMADHAN	JHS 1 TUMPANG	88	86	88	76	74	98	CREATIVITY
3	BEBBYTO AYUMI R.E.	JHS 1 TUMPANG	100	100	100	70	60	72	INTELLIGENCE
4	RYAN HIDAYAT	JHS 2 TUMPANG	94	90	90	82	76	78	INTELLIGENCE
5	KHOIRUL DWI ANAM	JHS 1 PAKIS	80	78	74	88	90	80	PHYSYCAL
6	EKO SETIAWAN	JHS DIPONEGORO TUMPANG	76	78	78	88	82	76	PHYSICAL
7	RISKA FANIDHATUS	JHS 1 PONCOKUSUMO	70	78	64	94	88	78	PHYSICAL
8	EKA NUR WAHYUDI	JHS DIPONEGORO TUMPANG	94	84	88	80	70	78	INTELLIGENCE
9	FEBBY ANTI S.	JHS 1 PAKIS	80	78	72	84	76	94	CREATIVITY
10	ROSALIA PUTRI ERLANDA	JHS 1 PAKIS	82	84	76	72	68	90	CREATIVITY

From the example of data for training, average and variance are calculated. Average from each feature calculated based on which class they are involved. For instance, there are 3 data involved in intelligence class. That is mean only the scores of those 3 data calculated to find the average of each features for intelligence class. Averages of the data for training can be seen below.

Table 2. Average Value of Data for Training

CRITERIA	INTELLIGENCE	PHYSYCAL	CREATIVITY
PU	96.00	76.50	83.33
PK	91.33	79.50	82.67
SMS	92.67	75.50	78.67
SI	77.33	91.50	77.33
PIO	68.67	89.50	72.67
HK	76.00	78.00	94.00

Next step is to determine the variance and final variance value of the data for training. They need the average value from data for training. To calculate the variance value, it is decreasing the scores of every single criteria with the average value of the same criteria, and then square it. Do it for the data in the same class. And the count the total summary. After that, divide the total summary with the numbers of the data in the same class decreased by one. And then, the final variance value can be calculated by rooting the variance value. For instance, this is the calculation of variance for General Knowledge(PU) criteria in intelligence class :

$$s^2\,PU\mid INTELLIGENCE = \frac{(100-96)^2 + (94-96)^2 + (94-96)^2}{3-1}$$

$$s^2\,PU\mid INTELLIGENCE = \frac{24}{2} = 12$$

$$s\,PU\mid INTELLIGENCE = \sqrt{12} = 3.46 \tag{1}$$

Variance and final variance value can be seen in the table below.

Table 3. Variance Value of Example Data for Training

CRITERIA	INTELLIGENCE	PHYSYCAL	CREATIVITY
PU	12.00	22.33	17.33
PK	65.33	9.00	17.33
SMS	41.33	83.67	69.33
SI	41.33	17.00	37.33
PIO	65.33	43.67	17.33
HK	12.00	2.67	16.00

Table 4. Final Variance Value of Example Data for Training

CRITERIA	INTELLIGENCE	PHYSYCAL	CREATIVITY
PU	3.46	4.73	4.16
PK	8.08	3.00	4.16
SMS	6.43	9.15	8.33
SI	6.43	4.12	6.11
PIO	8.08	6.61	4.16
HK	3.46	1.63	4.00

After average values, variance values, and final variance values have been found, the next step is to calculate the feature probability for numerical features. To do it, a data for testing is needed. This is the data for testing.

Table 5. Example Data for Testing

NAME	SCHOOL	PU	PK	SMS	SI	PIO	HK	CLASS
KHARISMA PRAMISWARA	JHS 1 TUMPANG	86	88	86	80	72	74	

Naïve Bayes algorithm does the calculation the data one by one to classify it based on it's each class through several steps inside it. So, 1(one) data for testing is enough to test the calculation of Naïve Bayes Classifier algorithm. The whole criteria are numerical. This is the formula to calculate the probability of numerical features :

$$P(X_i = x_i \mid Y = y_i) = \frac{1}{\sqrt{2\pi}\,\sigma ij} \exp^{-\frac{(xi - \mu ij)^2}{2\sigma ij^2}} \qquad (2)$$

Where :

$P(X_i = x_i \mid Y = y_j)$ = Conditional probability of numerical features in each class.

μ_{ij} = Average of sample $\overline{X}_i$ (x) from all data for training belongs to y_j class.

σ_{ij} = Final variance value of sample (s) from data for training.

σ^2_{ij} = Variance value of sample (s^2) from data for training.

These are the values of numerical features probability of participant named Kharisma Pramiswara.

Table 6. Numerical Features Probability Value of Participant Kharisma Pramiswara

CLASS	CRITERIA					
	PU	PK	SMS	SI	PIO	HK
INTELLIGENCE	0.0018	0.0453	0.0363	0.057	0.0453	0.0975
PHYSICAL	0.0112	0.0024	0.0226	0.0019	0.0018	0.0122
CREATIVITY	0.0781	0.0422	0.0325	0.0594	0.0946	0.0000

After numerical features probability found, the next step is to calculate the value of class probability. It is calculated by dividing the numbers of each class of the data for training by the total numbers of data for training. For instances, there are 3(three) data in intelligence class, and the total numbers of data is 10(ten). Then the class probability value for intelligence class are 0.3(point three). These are the values of class probabilities.

Table 7. Class Probabilities Value of Data for Training

CLASS	INTELLIGENCE	PHYSICAL	CREATIVITY
SUMMARY	3	4	3
P	0.3	0.4	0.3

Next step, is to calculate the probability of each class values. This calculation needs the value of numerical features probability of Kharisma Pramiswara. The calculation is doing by multiplying all numerical features probability values in the same class. These are the calculation formula for values of probability od each class.

P (Kelas)   = P(PU | Kelas) × P(PK | Kelas) × P(SMS | Kelas) × P(SI | Kelas × P(PIO | Kelas)

       × P(HK | Kelas)   (3)

This is the calculation of intelligence class probability :

P (INTELLIGENCE)   = 0.0018 × 0.0453 × 0.0363 × 0.057 × 0.0453 × 0.0975
               = 0.0000000007394

This is the calculation of physical class probability :
P (PHYSICAL)   = 0.0111 × 0.0024 × 0.0226 × 0.0019 × 0.0018 × 0.0122
               = 0.00000000000002649

This is the calculation of creativity class probability :
P (CREATIVITY)   = 0.0781 × 0.0422 × 0.0325 × 0.0594 × 0.0946 × 3.718e-07
               = 0.0000000000002237

After each class probability found, next step is to calculate the final probability of the data for testing. The calculation needs the value of each class probability and the class probability. Just simply multiply the value of each class probability with the class probability in the same class. Here are the calculation.

Calculation of final probability for intelligence class :
    P (INTELIGENSI)   = 0.0000000007394 × 0.3
               = 0.0000000002218

Calculation of final probability for physical class :
    P (FISIK)   = 0.00000000000002649 × 0.4
               = 0.00000000000001059

Calculation of final probability for creativity class :
    P (KREATIFITAS)   = 0.0000000000002237 × 0.3
               = 0.00000000000006712

The last step of Naïve Bayes Algorithm classification is to compare the value of each final probabilities found. The highest value of final probability means the data is involved in that class. Highest value of final probability from data for testing is the value of intelligence class. This means that participant named Kharisma Pramiswara is involved in intelligence class.

2.3 Data Flow Diagram (DFD)

Data flow diagram is a developed methods of structured data system. DFD describe whole activities inside system clearly.
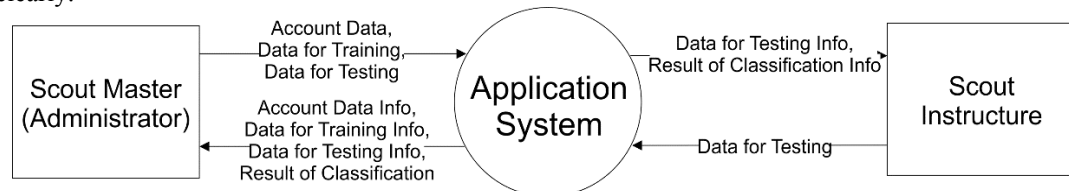
Figure 2. Data Flow Diagram

Based on figure 2, Scout Master is an administrator (Super user) of system, and the Scout Instructure as the user of system. Scout Master has full access of system. It can manage the data for training and data for testing, it also can access the classification process and get the result of classification. But the Scout Instructure as user, it only has access to manage data for testing and see the result of classification.

2.4 Entity Relation Diagram (ERD)

ERD is a main data modelling which help to organize data in a project into entities and determine the relationship between entity. ERD also a model to explain relation between data in a database based on objects which has relation between entity. In this case, ERD design explained the relationship between attribute which used in Naïve Bayes algorithm calculation.
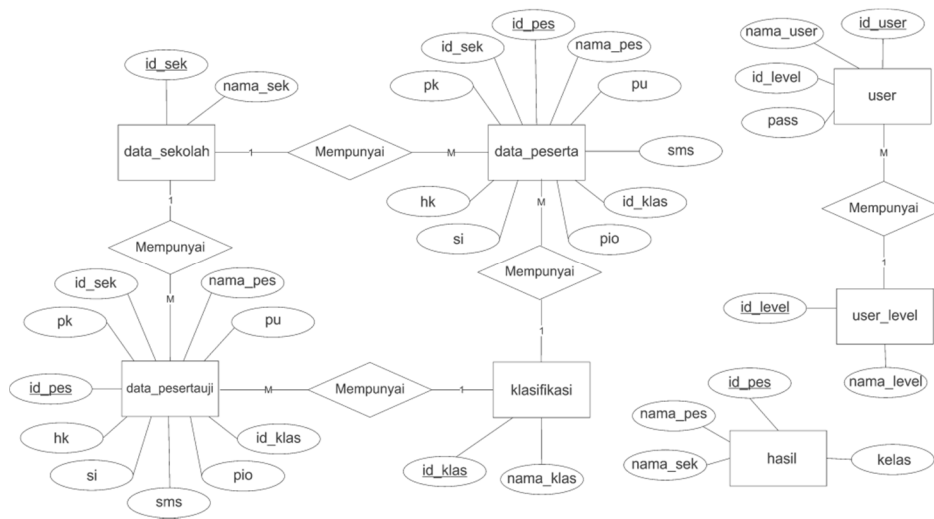
Figure 3. Entity Relation Diagram of System

3. RESULTS

This research resulted a program which has ability to classify the Scout skill owned by the Scout member. The program is Java Programming language based. Interface of the program is shown in figure 4.

Figure 4. Master Data Interface of the Program

In the Master Data process, administrator can manage the data used by system. By click on the name of data, administrator can edit the details of the data.

Figure 5. Classification Result in Naïve Bayes Calculation Process

To perform calculation, firstly the user has to set the data for training. The user simply type the number of the data used for training, and then click the "Set Data" button. And then, click "Set Data" button to set the data used for testing. User doesn't need to set the number of data for testing. Because it is automatically test whole data available in the database. After that, just click the "Next" button and follow the steps. In the last tabbed pane, user will be able to see the result of the classification. There, user may choose if they want to save the result or not. Any unsaved classification result can't be seen in the report page.

3.1 System Testing

Testing phase is performed to find the accuracy value of the calculation by system using Naïve Bayes Algorithm. Since the calculation of male and female participant are separated, the testing of the system also performed twice for each calculation.

Table 8. Testing Result Analysis

Testing	Gender	Numbers of Data for Training	Numbers of Data for Testing	Same Result with Real Class	Different Result with Real Class	Accuracy Value(%)	Error Value(%)
First	Male	150	125	125	0	100	0
	Female	150	140	140	0	100	0
Second	Male	207	125	125	0	100	0
	Female	240	140	140	0	100	0
Average						100	0

Can be seen in the table 8, with a part of data for training used, the accuracy of system calculation reach 100% for both gender. So as the testing using whole data for training available, the result shown that none of testing data classified differently with the real class or original class. This means, the accuracy of the programs reached 100%. The average of Accuracy reached 100% and Error value is 0%.

3.1.1 Analysis of The Effect of Data for Training Class toward Classification Result

From system testing, has been known that system accuracy reached 100%. Next, will be performed analysis toward testing with involving the data which classified inappropriately into the data for training. There are 60 inappropriate data for each gender. The class of the data have been changed into wrong classification. Here are the result.

Table 9. Analysis of The Effect of Data for Training Class toward Classification Result

Gender	Numbers of Data for Training	Numbers of Data for Testing	Same Result	Different Result	Accuracy Value (%)	Error Value (%)
Male	207	125	113	12	90.4	9.6
Female	240	140	134	6	95.7	4.3

As shown in Table 9, there are several different result calculated by the system. For male testing, there are 12 different result. The accuracy value decreased into 90.4%, and the error value increased to 9.6%. While female testing result in 6 different classification. Accuracy value is decreased into 95.7%, and error value increased to 4.3%. This is showing that the deciding of the class of data for training has effect toward the final result of classification using Naïve Bayes Algorithm.

4. CONCLUSION

Naïve Bayes Classifier algorithm has high level of accuracy in classifying the Scout skill. It reached 100% accuracy value while using all data available for training. They are 207 data for male, and 240 data for female.

Based on test results that have been done using accurate data for training, as well involving inappropriate data for training, can be known that variation of the class of data for training can affect the result of classification using Naïve Bayes Classifier Algorithm.

Determining the class when insert a new data for training can affect the variation of class probability in the calculation, so it affect the final result of classification using Naïve Bayes Classifier algorithm.

Since the data for training still picked randomly by system, it is suggested to develop the program with ability to choose the data for training. For the next development, the application developed based on web browser for a larger access by user.

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FUZZY LOGIC BASED FAULT CLASIFICATION OF INDUCTION MOTOR BEARING USED IN HOME WATER PUMP SYSTEM

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ABSTRACT

The water pump is a device for moving the water from a lower pressure to a higher pressure or a lower place to a higher place. The use of the water pump is still a lot of obstacles such as it does not remove the water, short circuit in the winding, and bearing failure. This paper discusses the development of fault bearing classification of induction motor (IM) used in home water pump system using fuzzy logic model. It is difficult to classify fault bearing of IM using a mathematical model. Thus, a fuzzy logic classification is employed in this matter. This classification is divided into four conditions such as all bearing normal (N), front bearing fault (F), rear bearing fault (R), and both bearing fault (B). Whereas, the classification process consists of three stages such as taking fault data, features extraction, and fuzzy logic fault classification. The data of bearing fault is obtained from the current of the water pump IM taken using soundcard oscilloscope software. For further process these data are changed from time domain into frequency domain using Fast Fourier Transform (FFT) to aquire more fault signs during features extraction. In this stage, 4 features fault bearing data are extracted. In last stage, fuzzy logic model is used to select and clasify fault bearing of IM. The robustness of proposes fuzzy logic model is examined and results of clasification for four bearing fault condition are shown.

Keywords: *Home Water Pump System, Bearing Fault, Fuzzy Logic, Fast Fourier Transform.*

1. INTRODUCTION

Water pump is used to easily work human, especially move water from a lower pressure to a higher pressure or a lower place to a higher place. The use of water pump in home appliance is still a lot of obstacles such as it does not remove the water, short circuit in the winding, and bearing failure. The bearing is one part of the induction motor (IM) components. It has the important function to reduce the friction occur in shaft of IM, so that the rotor of IM can be rotated. The bearings must be built from strong material to allow the shaft and other engine elements to work properly. Several tests of bearing condition have been conducted and developed to detect the bearing fault of induction motor [1-4]. However, it requires a complex mathematical model and expensive fault detection devices [2,4,5].

In this paper, fault classification of induction motor bearing is developed using fuzzy logic model. Purpose of this classification is to know bearing fault types and early detection of bearing failure on home water pump system. The fault types consist of four conditions such as all bearing normal (N), front bearing fault (F), rear bearing fault (R), and both bearings fault (B). While, the classification process consists of three stages such as taking bearing fault data, features extraction, and fuzzy logic fault classification. First stage, the data of bearing fault is obtained from current of the water pump IM taken using soundcard oscilloscope software v.1.41 through audio line input of personal computer [6]. In second stage, these data obtained from first stage are converted from time domain into frequency domain using Fast Fourier Transform (FFT) to aquire more fault signs during features extraction stage and than 4 features fault bearing data are extracted. In last stage, fuzzy logic model is used to select and clasify fault bearing of IM. The effectiveness of proposes fuzzy logic model is clarified by simulation using MATLAB. The results of clasification for four bearing fault condition are shown and concluded.

2. RESEARCH METHODOLOGY

The research methodology used to classify bearing failure of induction motor is shown in Figure 1. The bearing fault data used in this paper is obtained from the current of induction motor employed in home water pump system. The fault types consist of four conditions such as all bearing normal (N), front bearing fault (F), rear bearing fault (R), and both bearings fault (B).
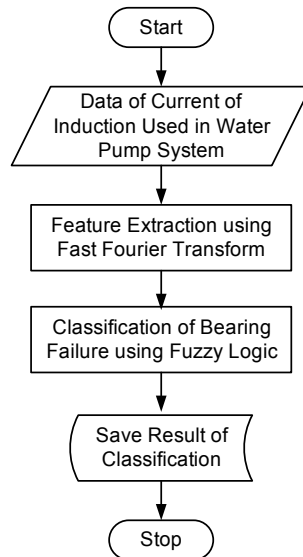
Figure 1. Methodology to classify the bearing fault of induction motor

In the feature extraction stage, bearing fault signal is converted from time domain to frequency domain using Fast Fourier Transform (FFT) to obtain more fault signals during features extraction and 4 features fault bearing data are extracted. Next stage, fuzzy logic model is used to select and clasify fault bearing of induction motor reffer to 4 bearing fault types.

2.1 Bearing of Induction Motor (IM)

Mechanical components of home water pump system are induction motor (IM), impeller, and foot valve. In the IM, the important mechanical component is bearing. Bearing is required to reduce friction at the shaft. Bearing fault can be caused over load, over heat, and corrosion [2,4]. Figure 2 show a bearing failure caused by corrosion.

Figure 2. A Bearing fault caused by corrotion

2.2 Fast Faurier Transform (FFT)

Frequency domain analysis used Fast Fourier Transform (FFT) method to convert from time domain into frequency domain. Frequency domain is used to show the frequency componets of a signal. Meanwhile, a time domain signal can be shown its time componets [1-3,6]. Formula of FFT for a signal *f(t)* can be expressed in Equation (1).

$$f(t) = \sum_{n=1}^{\infty} C_n \cos(n\omega t + \theta_n)$$

(1)

where c_n, $n\omega t$ and θ_n are magnitude of the n[th] component, frequency of the n[th] component, and phase angle of the n[th] component, respectively.

2.3 Fuzzy Logic Classification

Fuzzy logic is a system control method for problem solving which is suitable to be implemented into a system, from small systems to large and complex systems. This method can be employed to hardware, software, or a combination of both. In conventional logic, it states that everything is binary, meaning it has only two states, "yes or no", "1 or 0", and others. Therefore, the systems based on this logic have only a membership value of 0 or 1. Different on fuzzy logic control method, fuzzy logic control allows membership values to be between 0 and 1. This means that a situation may have two "Yes and No", "True and False" values, at the same time, but the value depends on the weight of the membership. Fuzzy logic control can be used in many fields [7-9] particularly classification and pattern matching of signals.

Block diagram of fuzzy logic control can be seen in Figure 3. Fuzzy logic control is built by fuzzification, inference mechanism, rule base, and defuzzification. Inference mechanism very depends on rule base of fuzzy logic. Fuzzy rule base are yielded through the knowledge of the process system [7-9]. In this paper, input signal of fuzzy logic control is current of induction motor and output signal of fuzzy logic control is bearing condition faults of induction motor used in home water pump system such as normal, front fault, rear fault, and both faults.
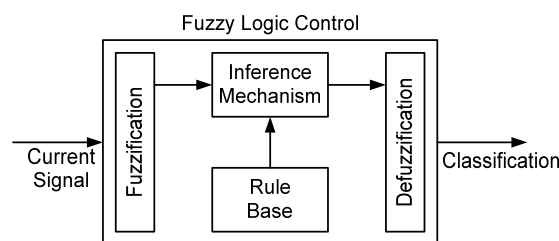
Figure 4. Block diagram of fuzzy logic control

2.4 Taking Data of Induction Motor Current

Taking data of induction motor current is shown in Figure 4. Taking data of induction motor (IM) current is conducted by connecting output current transformer (CT) to audio input of personal computer through probe oscilloscope circuit. Current of IM entered through line in audio of personal computer is read and stored using soundcard oscilloscope software version 1.41.
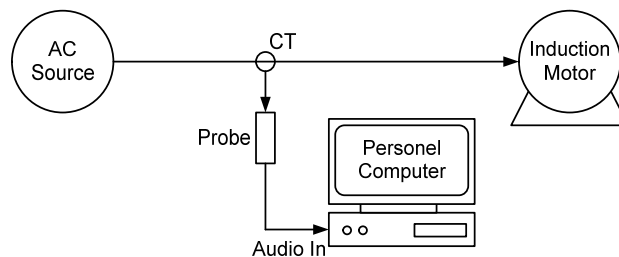
Figure 4. *Taking current data of IM.*

3. RESULT AND ANALISIS

Experimental setup of induction motor (IM) bearing fault classification used in home water pump system using fuzzy logic control is shown Figure 5. Furthermore, results of experiment setup are used to validate the fuzzy logic control model of IM bearing fault classification using SIMULINK-MATLAB. Parameters of IM are nominal voltage of 220 volts, frequency of 50 Hz, nominal power of 125 watts, total heat of 33 meters, suction head of 9 meters, and maximum capacity of 42 liter per minutes.
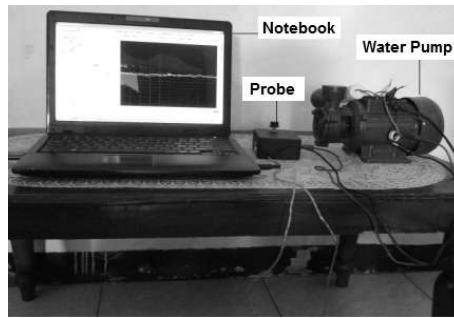
Figure 5. *Experiment setup of IM bearing fault classification*

3.1 Data of Induction Motor (IM) Current

Data of induction motor current is taken using soundcard oscilloscope software version 1.4 for bearing normal (N), front bearing fault (F), rear bearing fault (R), and both bearings fault (B). Figure 6, Figure 7, Figure 8 and Figure 9 show the current waveforms of IM for four bearing fault conditions.
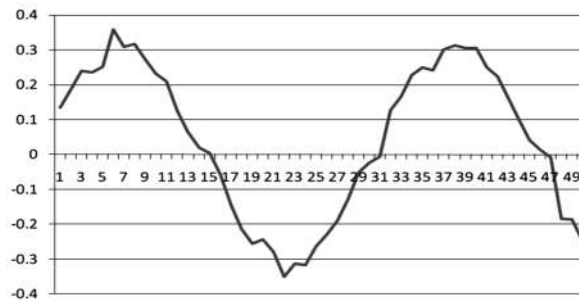
Figure 6. *Current waveform of IM for normal condition*
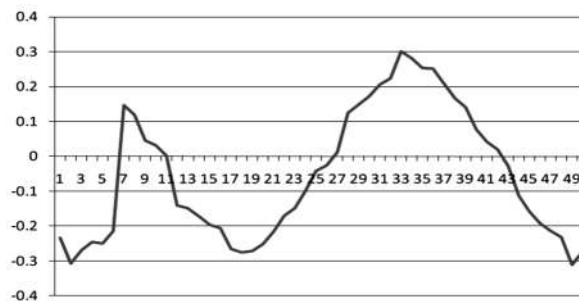
Figure 7. *Current waveform of IM for front bearing fault condition*
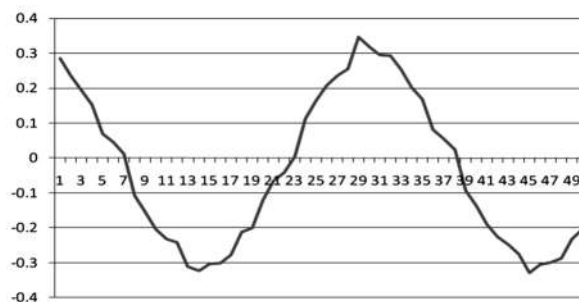
Figure 8. *Current waveform of IM for rear bearing fault condition*
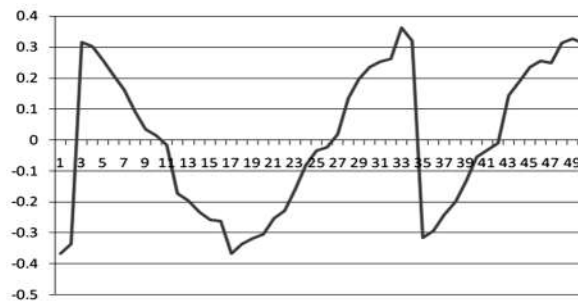
Figure 9. *Current waveform of IM for both bearing fault condition*

3.2 Features Extraction.

Features extraction of IM current waveform for 4 bearing fault conditions are done using Fast Fourier Transform (FFT). Feature extractions are based on Equation (1) and produce the magnitude of the n^{th} component FFT (C_n). Table 1 show the magnitude of the n^{th} component FFT (C_n) for each bearing fault condition.

Table 1. *Magnitude of the n^{th} component FFT (C_n)*

n^{th} component of FFT	Bearing condition			
	Normal (N)	Front fault (F)	Rear fault (R)	Both fault (B)
1	2.9528	0.1879	0.8783	1.8315
2	1.0375	1.9709	1.8326	1.34
3	0.2116	0.9284	0.7423	0.5156
4	0.2178	0.6013	0.633	0.197
5	0.0803	0.6013	0.3421	0.3817
6	0.024	0.3162	0.3545	0.2811
7	0.1609	0.3704	0.3241	0.0764
8	0.0564	0.254	0.308	0.1939
9	0.0564	0.254	0.308	0.1939
10	0.1609	0.3704	0.3241	0.0764

3.3 Classification of Bearing Fault using Fuzzy Logic Control

Fuzzy logic control (FLC) method used in bearing fault classification of IM is FIS SUGENO type. Design of FLC model for bearing fault classification has ten inputs and an output. Ten inputs represent $1^{st} - 10^{th}$ components of FFT ($C_1 - C_{10}$) from feature extraction process of induction motor current for each fault conditions. Whereas, an output of FLC is fault conditions of induction motor bearing. FLC model of bearing fault classification can be seen in Figure 10.
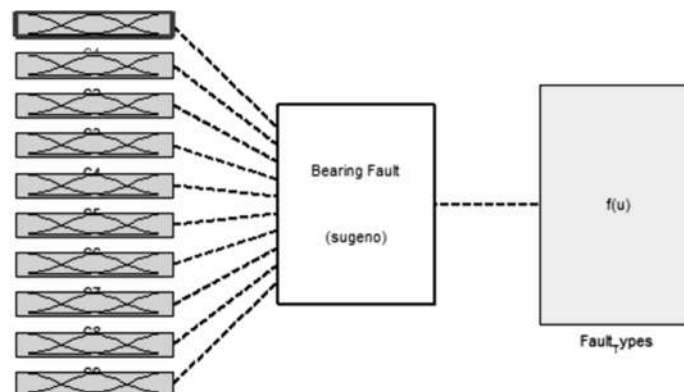
Figure 10. *FLC model for fault classification of induction motor bearing*

Each input of FLC model has 4 membership functions (MF). This membership functions describe 4 bearing fault conditions such as normal (N), front fault (F), rear fault (R), and both faults (B). Parameters of each membership functions base on the n^{th} component of FFT in feature extraction process. Figure 11 show 4 membership functions for first input (C_1).
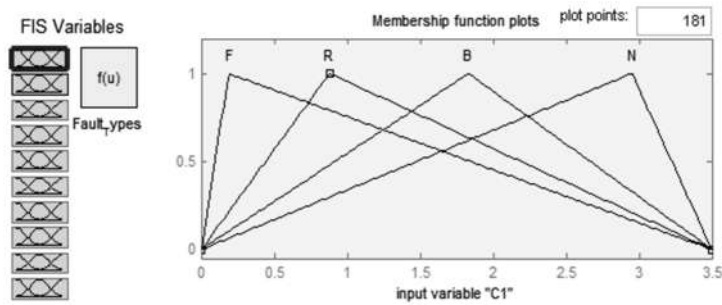
Figure 11. *Membership functions for first input (C_1)*

An output of FLC model also has 4 membership functions. Figure 12 express membership function for an output of FLC model. Whereas, the value of membership functions for a FLC output is shown in Table 2.
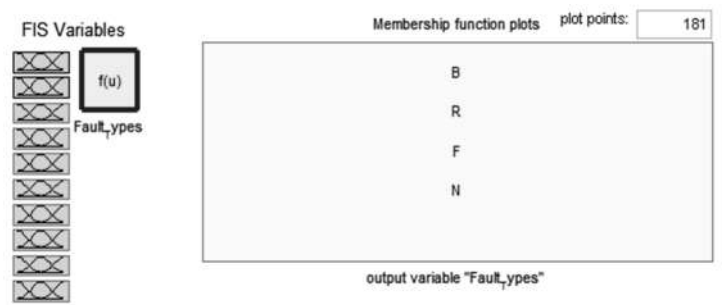
Figure 12. *Membership functions for an output of FLC*

Table 2. Value of membership functions for an output of FLC

Bearing Conditions	Values
Normal (N)	0
Front fault (F)	0.333
Rear fault (R)	0.666
Both fault (B)	1

The proposed FLC model is validated to indicate its performances. Its performances base on error value between design of FLC output and examination value of FLC output. Examination of FLC model is conducted using SIMULINK-MATLAB. Examination of FLC model using SIMULINK-MATLAB can be seen in Figure 13.
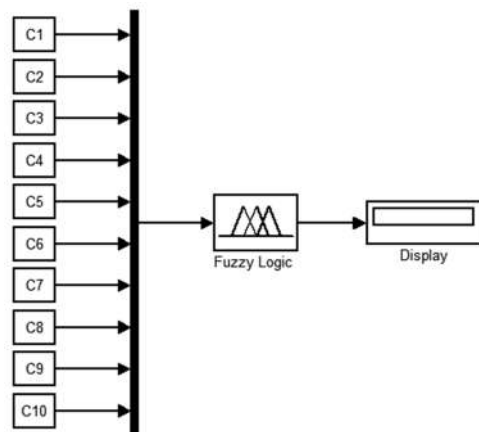
Figure 13. Examination of FLC model using SIMULINK-MATLAB

Examination results of proposed FLC model for each bearing fault condition are shown in Table 3. Examination results of proposed FLC model are compared with value of FLC output according to Table 2.

Examination results show that FLC model for IM bearing fault classification is successfully done, because error values of FLC model are less than 5%.

Table 3. *Result assessments of proposed FLC model*

Bearing Conditions	Values	Assessment
Normal (N)	0	0.047
Front fault (F)	0.333	0.349
Rear fault (R)	0.666	0.641
Both fault (B)	1	0.975

4. CONCLUSION

Fuzzy logic control (FLC) applied in fault classification of induction motor (IM) bearing has been presented and discussed. Fuzzy logic control (FLC) method is used to select and classify fault bearing of IM used in water pump system. The classification of bearing faults consist of four conditions such as normal (N), front bearing fault (F), rear bearing fault (R), and both bearings fault (B). The classification process is divided in three stages such as taking data of IM currents, features extractions, and fault classification using FLC model. The proposed FLC model is clarified to indicate its performances based on error values between design of FLC output and examination value of FLC output. Examination results show that FLC model is successfully conducted to classify the induction motor bearing fault which error values are less than 5%.

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MELANOMA CLASSIFICATION USING AUTOMATIC REGION GROWING FOR IMAGE SEGMENTATION

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ABSTRACT

Melanoma or skin cancer is one of the most common cancer in the world and can be fatal if not diagnosed early. Many methods have been developed to perform the segmentation process of melanoma classification, including region growing. However region growing method has disadvantages, such as there is a threshold parameter that must be set and the seed parameter that must be manually determined by the user. In this research, we proposed a system for melanoma classification that use automatic region growing to perform image segmentation. The analysis of interclass variance of the overall intensity of melanoma image is implemented to obtain the seed point and threshold parameter values that can provide optimal segmentation results for each image automatically. Then several features are extracted from the melanoma object and classification is performed to classify benign and malignant melanoma. The average accuracy, sensitivity, and specificity of the automatic region growing method on 12 test images were 97.6%, 94.8%, and 98.7%, respectively. Based on the experimental results, the automatic region growing method gives better segmentation results than the region growing method because the threshold value used is adaptive in accordance with the grayscale information of the input image and because the proposed method is able to provide several seed points automatically. The classification result of 30 images of benign melanoma and 30 images of malignant melanoma give 83.3%, 80.0%, and 86.7% average value of accuracy, sensitivity, and specificity, respectively.

Keywords: *Automatic Region Growing, Classification, Image Segmentation, Melanoma, Statistical Analysis*

1. INTRODUCTION

Melanoma or skin cancer is a type of cancer that starting from the human skin and can spread to other organs of the body. Melanoma is one of the most common cancer in the world and can be fatal if not diagnosed early. Doctor diagnose whether the melanoma is benign or malignant after performing a biopsy examination. If the diagnosed melanoma is still in the early stages (benign), surgery will usually successfully cure this skin cancer. However, if melanoma is not immediately operated until it reaches a severe stage (malignant), treatments are performed only to slow the spread and reduce the symptoms that occur.

There are several researches conducted to facilitate medical personnel in the melanoma classification using computer assistance. According to [1], general researches on melanoma classification consists of four processes, which are image preprocessing, segmentation, feature extraction, and classification. Many methods have been developed to perform the segmentation process of melanoma classification. Those methods can be classified based on their automatic level (automatic and semi-automatic), the number of parameters used, and the required preprocessing method [2]. Segmentation methods that have been used for melanoma segmentation are including

Fuzzy C-means, center split, multiresolution, split and merge, median cut, adaptive thresholding, gradient vector flow, set level, expectation-maximization (EM) level set, and fuzzy-based split-and-merge. According to some comparisons, median cut, adaptive thresholding, and fuzzy-based split-and-merge methods provide good results in robustness to noise [3] [4].

Region growing is a semi-automated segmentation method that performs segmentation processes starting from one starting point (seed) on a user-selected object region that will then grow and combine the surrounding pixels within a given threshold range onto object class. In the field of medical image processing, this method is commonly used to classify melanoma and blood cell detection because both types of images generally have objects that are clumped and have a color range that does not vary much between pixels. However the semi-automatic region growing method has disadvantages, such as there is a threshold parameter that must be set and the seed parameter that must be manually determined by the user. In fact, due to the type of image that is diverse, to get optimal segmentation results, the value of threshold parameter will be different on each type of image.

In this research, we proposed a system for melanoma classification that use automatic region growing to perform image segmentation. To improve robustness, preprocessing using Gaussian filtering is carried out. Furthermore, the analysis of statistical values, which is interclass variance, of the overall intensity of melanoma image is implemented to obtain the seed point and threshold parameter values that can provide optimal segmentation results using region growing for each image automatically. Classification result of the system whether the melanoma in the analyzed image is benign or malignant can be used as a tool for medical personnel in determining the treatment that would be given to the patient.

2. METHODOLOGY

The methodology of the system is consisted of four main stages, which are preprocessing, segmentation, feature extraction, and classification as shown in Figure 1. The segmentation of melanoma is performed using automatic region growing which consist four process, which are calculation of interclass variance, determination of seed's intensity, automatic selection of seed points and threshold value, and region growing.
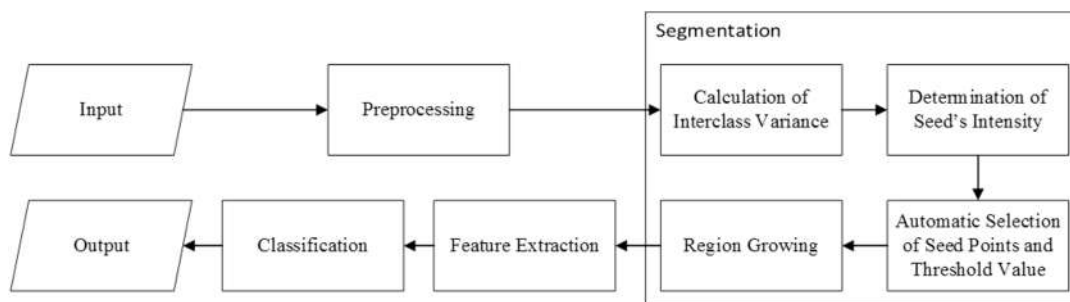
Figure 1. Flowchart of the Proposed System

2.1 Preprocessing

Preprocessing is done to remove unneeded artifacts in the process of detecting melanoma, such as skin hair or air bubbles, thereby increasing the system's robustness to noise. In the preprocessing stage, the color image (RGB) is converted to grayscale. Then Gaussian filtering is performed so that the image becomes smooth and the artifacts such as hair or air bubbles become blur and invisible.

Gaussian filtering use Fourier transform to convert the image from the spatial domain to the frequency domain and then multiply the frequency domain image with the Gaussian low-pass filter for smoothing or blurring. Afterwards, inverse Fourier transform is performed to return the filtered image back to the spatial domain. Figure 2(a) shows an example of the image in the spatial domain and Fig. 2(b) shows the result of the Fourier transformation of Figure 2(a). In the frequency domain as shown in Figure 2(b), the low frequency is collected in the middle of the image, while the high frequency is on the edge of the image.

(a)   (b)
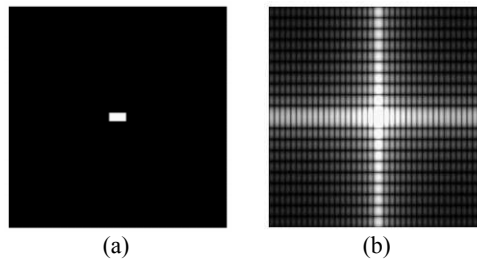
Figure 2. Image in (a) Spacial Domain and (b) Frequency Domain [5]

Low-pass filter removes high frequency on the image by creating a filter that have one as value for the center of the filter but have zero as value for the edge of the filter. The shape of the Gaussian low-pass filter corresponds to the Gaussian function as shown in Figure 3. If the filter is multiplied by the frequency domain image, only the middle part (low frequency) of the frequency domain image is left. When the filtered image is inversed to spatial domain, it will gives smoothing blurring effect, as shown in Figure 4.

(a)   (b)
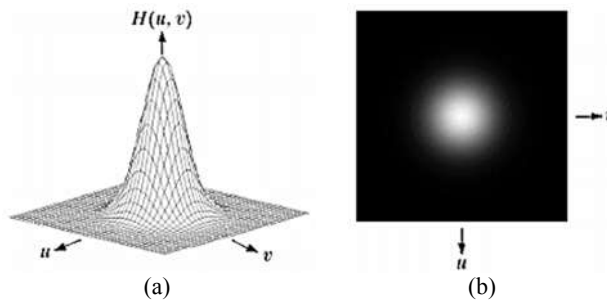
Figure 3. (a) Plot and (b) Image of Gaussian low-pass filter [5]
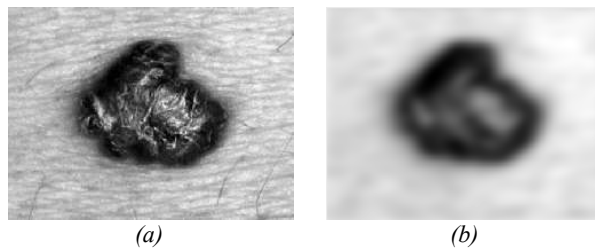
(a)   (b)
Figure 4. Melanoma Image (a) Before and (b) After Preprocessing

2.2 Segmentation

Segmentation method proposed in this research is automatic region growing using interclass variance analysis. Interclass variance analysis is used to determine the seed point and threshold value automatically. First, intensity histogram from the image from preprocessing result *I* is created. The histogram has 256 graylevel intensities.

Afterwards, using each graylevel *t* as a threshold in turn, the interclass variance is calculated between the class on the left and right of the threshold. Interclass variance $\sigma_\omega^2(t)$ is defined as the sum of object class's variance and background class's variance using Equation 1 [6]. Weight ω_i is the cumulative probability that graylevels in class *i* are appear in the image and σ_i^2 is the variance of class *i* where *i*=1 for background and *i*=2 for object.

$$\sigma_\omega^2(t) = \omega_1(t)\sigma_1^2(t) + \omega_2(t)\sigma_2^2(t) \tag{1}$$

To determine the graylevel intensity of the region growing's seeds, first the graylevel with the smallest interclass variance *g* is obtained, as written in Equation 2. Then the lowest graylevel found in the image *h* is also obtained, as written in Equation 3. The graylevel intensity of the seed *s* is the mean value between the graylevel with smallest interclass variance and the lowest graylevel found in the image, as written in Equation 4. The lowest graylevel found in the image is used because the melanoma object in the image tends to be darker than the background.

$$g = \arg \min_{0 \leq t \leq 256} \sigma_\omega^2(t) \qquad (2)$$

$$h = \min_{t \in I} t \qquad (3)$$

$$s = \frac{1}{2}(g + h) \qquad (4)$$

The seed points for the region growing is the pixels in the image that have a graylevel intensities around the value of *s*. The threshold value for the region growing is the difference between the graylevel intensity of seed *s* with the graylevel with smallest interclass variance *g*. After the seed points and threshold value are obtained, a growing region is performed at each seed points.

Using the seed points as the initialization of the object region, the region growing method adds neighboring pixels of the object region that meets certain criteria into the object region. The criterion is that the pixel must have an intensity whose value is less than or equal to the intensity of the seed *s* that added or subtracted by the threshold value. The size of the object region continues to widen until no more neighboring pixels meet the criteria. Pixels that are not included in the object region are grouped in the background region. Pixels in the object region will have white color while the pixels in the background region will have black color. Because the proposed automatic region growing method may use more than one seed points, the final result of the segmentation process is the union of the results of region growing of each seed points. Figure 5 shows the example of segmentation process on the melanoma image using automatic region growing. In Figure 5(a), the seed points are marked as red dots.

(a)   (b)
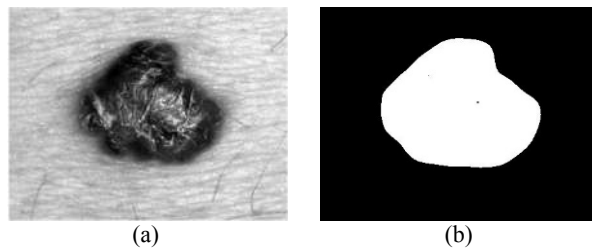
Figure 5. (a) Result of Automatic Seed Selection and (b) Result of Segmentation Process

2.3 Feature Extraction

The difference between benign and malignant melanoma can be seen from its size, shape, and color. Benign melanoma has a relatively narrow size, regular shape, and its color tends to be light. Malignant melanoma has a large size and irregular shape because spread of the cancer cells, as well as its color that tends to be dark. Based on that information, the extraction of features that represent the size, shape, and color criteria of the melanoma is performed on the image from segmentation process.

For the size criteria, area ratio of melanoma objects is taken. Because the size of each melanoma image varies, the area ratio of the extent of the melanoma object is the area of the melanoma object divided by the size of the image. The larger the value of area ratio, the larger the size of melanoma. For shape criteria, circumference ratio of the melanoma object is taken. The circumference ratio of the melanoma object is the circumference of the melanoma object divided by the area of the melanoma object. The larger the value of circumference ratio, the more irregular the shape of the melanoma because the regularly shaped objects tend to have a smaller circumference than the irregularly shaped objects.

For color criteria, average of RGB (red, green, blue) color values of the melanoma object (not from the entire image) is taken. To get color feature of the melanoma object, the output image of segmentation process and the input image are used. On the output image of segmentation process, the position of each pixels that have white color (object) is taken. Then the color value information at each position is obtained from the input image and the mean for each red, green, and blue channel is calculated. In total there are five features that are extracted to classify melanoma.

2.4 Classification

Using features obtained from the previous process, classification using the Support Vector Machine (SVM) method is performed to classify the data into two class: benign and malignant. SVM seeks to find the best separator function (hyperplane) to separate vectors from two classes. The best hyperplane is the hyperplane that gives the

highest margin value, where margin is the distance between the hyperplane with the vector closest to the hyperplane (support vector). Finding the best hyperplane is equivalent to maximizing margins or spacing between two sets of objects from different classes.

3. EXPERIMENTAL RESULTS

The data used in this research are obtained from the https://isic-archive.com/ repository which is divided into 2 types of classes, namely benign and malignant melanoma, where each class consists of 30 pieces of image as shown in Figure 6 and Figure 7. In addition, from the data, 6 images from each class are selected to be used in the evaluation of segmentation method hence its segmentation's ground truth are created as shown in Figure 8 and Figure 9.
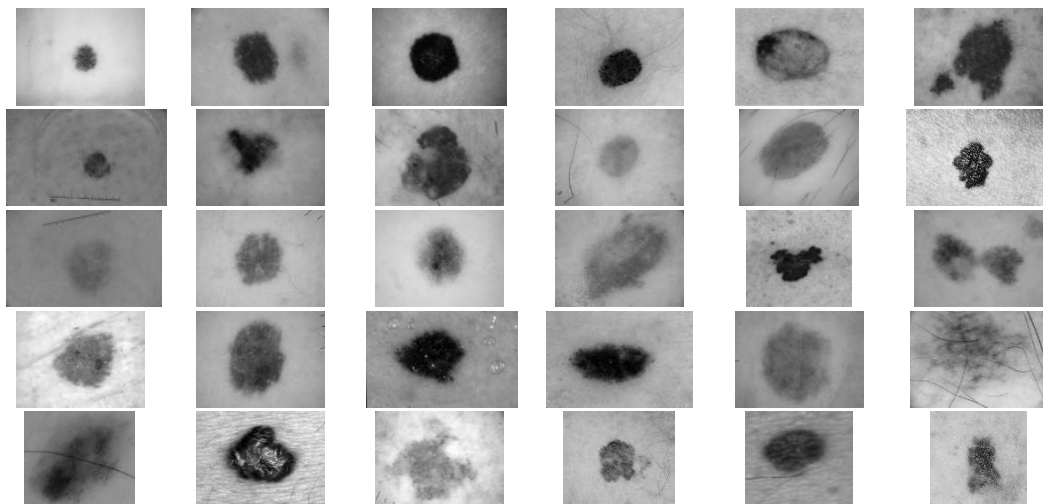
Figure 6. Data of Benign Melanoma
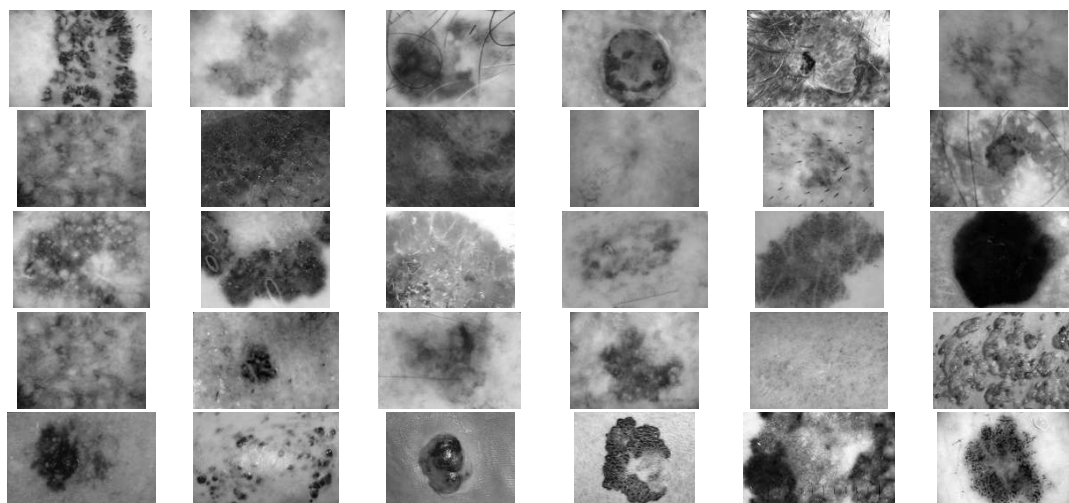
Figure 7. Data of Malignant Melanoma

| (1) | (2) | (3) | (4) | (5) | (6) |
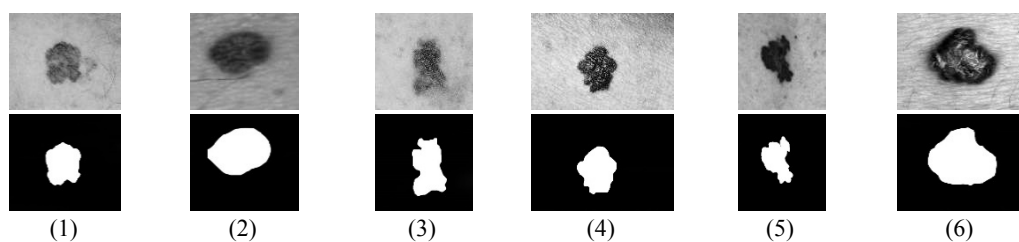
Figure 8. Segmentation's Ground Truth of Benign Melanoma

(7)   (8)   (9)   (10)   (11)   (12)
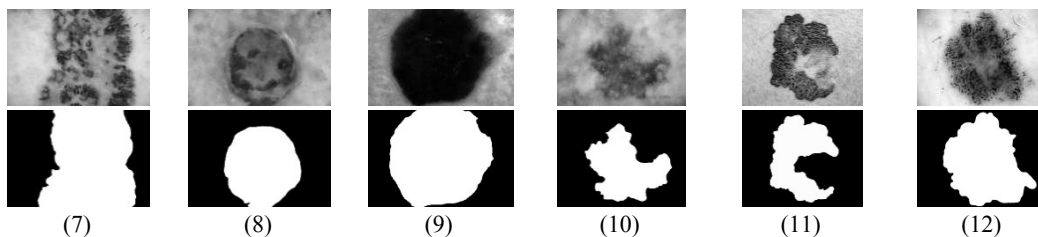
Figure 9. Segmentation's Ground Truth of Malignant Melanoma

Two experiments were conducted, which are experiment to measure the performance of segmentation methods and experiment to measure the performance of the melanoma classification system. Both in experiment on segmentation methods or classification process, the performance is measured using accuracy, sensitivity, and specificity values that are calculated based on confusion matrix. The confusion matrix is shown in Figure 11, where TP=True Positive, FN=False Negative, FP=False Positive, and TN=True Negative.

		System Output	
		1	**0**
Ground Truth	**1**	TP	FN
	0	FP	TN

Figure 10. Confusion Matrix

Accuracy is the number of data classified correctly. Sensitivity or true positive rate is the number of data in class 1 are classified in class 1. Sensitivity or a true negative rate is the number of data in class 0 are classified in class 0. The formula for calculating accuracy, sensitivity, and specificity is consecutively written in Equation 5-7. In the experiment on segmentation method, class 1 is the object area and class 0 is the background area. In the experiment on classification process, class 1 is the malignant melanoma and class 0 is the benign melanoma.

$$Accuracy = \frac{TP+TN}{TP+FN+FP+TN} \tag{5}$$

$$Sensitivity = \frac{TP}{TP+FN} \tag{6}$$

$$Specificity = \frac{TN}{FP+TN} \tag{7}$$

3.1 Experiment on Segmentation Method

Experiment were conducted on 12 images in Figure 8 an Figure 9 to compare the performance of the proposed automatic region growing method with the (original) region growing method. For the region growing method, the seeds used in the first seed value are obtained using the automatic region growing method and the threshold value used is 0.18, which is obtained from the average threshold value in the automatic region growing method on 12 image. Figure 11 shows the segmentation results of the automatic region growing. Figure 12 shows the segmentation results of the region growing method. Performance comparison between automatic region growing and region growing method is shown in Table 1. From Table 1 it appears that the automatic region growing method gives more accurate segmentation results than the (original) region growing method.

(1)   (2)   (3)   (4)   (5)   (6)

Figure 11. Segmentation Results Using Automatic Region Growing
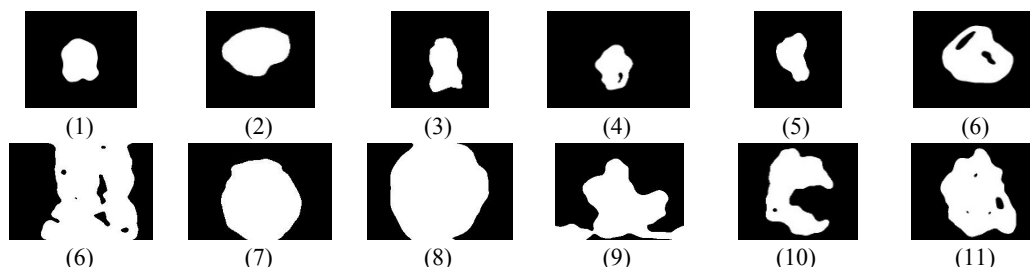
Figure 12. Segmentation Results Using Region Growing (Original)

Table 1. Experiment Result on Segmentation Method

No	Automatic Region Growing			Region Growing		
	Accuracy (%)	Sensitivity (%)	Specificity (%)	Accuracy (%)	Sensitivity (%)	Specificity (%)
1	**99.0**	96.8	**99.3**	98.6	**99.7**	98.5
2	**97.8**	92.9	**99.1**	96.2	**96.6**	96.2
3	98.3	91.3	**99.5**	98.3	**92.3**	99.4
4	**99.2**	**91.5**	99.9	98.8	86.9	**100.0**
5	97.8	100.0	97.5	97.8	100.0	97.5
6	**97.4**	**99.6**	96.7	96.6	90.8	**98.3**
7	**98.5**	**98.2**	98.9	95.5	92.5	**99.4**
8	**97.0**	95.8	**97.6**	96.5	**97.1**	96.2
9	97.1	96.0	**98.5**	97.2	**96.2**	98.4
10	**95.9**	90.7	**98.2**	88.9	**96.0**	85.9
11	**98.7**	**99.0**	98.6	98.6	97.7	**99.0**
12	**94.0**	**86.1**	100.0	91.1	79.2	100.0
Average	**97.6**	**94.8**	**98.7**	96.2	93.8	97.4

3.2 Experiment on Classification Process

For classification process, the experiment was conducted using *k*-fold cross validation method with *k*=10. The *k*-fold cross validation method is used to validate the accuracy of a system. In the *k*-fold cross validation method, the input data will be divided into *k* folds in which each fold has the same amount of data and has an even distribution of classes. Then the accuracy of the system is calculated using one fold as testing data and the rest folds as training data. Fold is chosen as testing data alternately until all folds has become testing data. Accuracy of the system is calculated from the average accuracy of each fold of testing data. Table 2 shows the performance of the classification system using 10-fold cross validation. The accuracy score is only about 80% because there are some malignant melanoma images that look similar with benign melanoma.

Table 2. Experiment Result on Classification Process

Fold	Accuracy(%)	Sensitivity (%)	Specificity (%)
1	66.7	66.7	66.7
2	100.0	100.0	100.0
3	83.3	66.7	100.0
4	83.3	66.7	100.0
5	83.3	100.0	66.7
6	83.3	100.0	66.7
7	83.3	66.7	100.0
8	66.7	33.3	100.0
9	83.3	100.0	66.7
10	100.0	100.0	100.0
Average	**83.3**	**80.0**	**86.7**

4. CONCLUSION

Proposed system for melanoma classification that use automatic region growing to perform image segmentation can provide threshold value and seed points for region growing automatically. The system is consisted of four main stages, which are preprocessing, segmentation, feature extraction, and classification. Preprocessing is used to remove unnecessary artifacts thereby increasing robustness to noise. Segmentation process using the proposed automatic region growing is performed. The extracted features are the area ratio, the circumference ratio, and the color of the melanoma object. Classification of benign or malignant melanoma was performed using Support Vector Machine (SVM).

The average accuracy, sensitivity, and specificity of the automatic region growing method on 12 test images were 97.6%, 94.8%, and 98.7%, respectively. Based on the experimental results, the automatic region growing method gives better segmentation results than the region growing method because the threshold value used is adaptive in accordance with the grayscale information of the input image and because the proposed method is able to provide several seed points automatically. The classification result of 30 images of benign melanoma and 30 images of malignant melanoma using 10-fold cross validation method give 83.3%, 80.0%, and 86.7% average value of accuracy, sensitivity, and specificity, respectively. This is because there are some images of malignant melanoma that look similar with benign melanoma.

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ANALYSIS AND DESIGN SIDOARJO ON HANDS (SOH) SYSTEM
FOR SUPPORTING SIDOARJO POTENTIAL PROMOTION

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ABSTRACT

SoH is mobile application android based which has importance in a discipline oriented to help people get information about local potential of Sidoarjo. The analysis and design SoH presented here carry out objective to support promotion of potential of Sidoarjo.
Specific analysis and design tools will be essential to assure the development of SoH itself. This paper addresses the results of analysis and design SoH. The result includes 5 steps : digitized map of Sidoarjo, design of system architecture, flowchart for describing SoH system flow, design of SoH database using entity relationship diagram (ERD), data flow diagram (DFD) for describing relation between system flow and SoH database, and design of SoH user interface
We evaluate the result of analysis and design of SoH. The final result is used as blueprint to develop an effective SoH system. In this paper, the final result has satisfied user requirements. The result will be used as preliminary study on the future research.
Keywords : analysis and design system, Sidoarjo on Hands, potential promotion

Introduction

Sidoarjo is one of district in Jawa Timur province. Its coverage area is 714,243 km^2 (Bagian Telekomunikasi dan Informatika Kabupaten Sidoarjo, 2015). Sidoarjo provides many kind of local potential which can attract tourists for visiting Sidoarjo. The local potentials are including potential of industry, agriculture, fishery, crafts, tourism and culinary.

The local government has implemented various way to promote potentials of Sidoarjo using conventional media promotion such as newspaper, billboard, and local television. But it seems the promotion method is less optimum. The official website is owned by local government and tourism department has less known even by local population itself. Besides that, the information which is shown inside less complete and uninformative.

With the increase of mobile application technology, it was possible to implement this technology for promoting potentials of Sidoarjo. We can take advantages of Sidoarjo on Hands (SoH) mobile application as a promotion medium. Thus the need arose to study the analysis and design SoH that could help in introducing potentials of Sidoarjo. Next, we can get all information about local potentials of Sidoarjo easily. So, people who wants to know deeply about Sidoarjo can retrieve the information using SoH.

Research Methodology

The following are the procedures for finishing the analysis and design phase of SoH :

1. Analyze and map all of potentials of Sidoarjo. This first phase aimed to classify each potential into its main category.
2. Collect primary data of local potentials at each districts in Sidoarjo.
3. Collect and validate secondary data from related departments of local government at each district in Sidoarjo.
4. Combine analysis between primary and secondary data.
5. Digitize map of Sidoarjo areas.
6. Set marking point at the Sidoarjo digital maps.
7. Create design of SoH system architecture
8. Describe of SoH system flow using flowchart.
9. Design of SoH database using entity relationship diagram (ERD)
10. Design of SoH of user interface.
11. Evaluate the result of analysis and design phases above.

Discussion

The first phase is analyze and map all of potentials of Sidoarjo. At the first time, we had six main categories for local potentials of Sidoarjo. They are potential of industry, agriculture, fishery, crafts, tourism and culinary. We used this pattern when collected primary and secondary data of local potentials at each districts in Sidoarjo. Then we took the combination of those data for analysis. We found that some categories need to be decomposed into some sub categories. They are :

1. Main category of industry potential has three sub categories which are home appliances, exhaust, and iron tools.
2. Main category of craft potential has six categories which are bag and suitcase, embroidery, batik, convection, hat, and slippers.
3. Main category of tourism potential has two sub categories which are natural tourism and artificial tourism.
4. Main category of culinary potential has seven sub categories which are crackers, tofu, tempe, salted egg, petis, nugget, and sausage.

The fourth phase is digitize map of Sidoarjo areas. We implemented GoogleMaps API library. Then, we marked the Sidoarjo map using pointer to specific area according to the result of second phase. As general, the architecture of SoH system as shown in the figure 1 below :
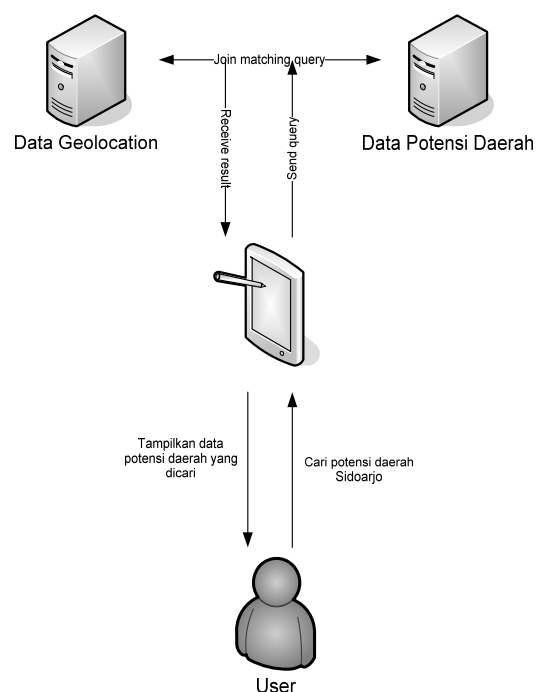
Figure 1. The architecture of SoH system

Figure 1 showed that user of SoH will retrieve the information about potentials of Sidoarjo easily. User only need to entry data about any kind of potential that he wanted. System will use the input data as predefined data searching inside server. System implemented join matching query as searching method. This searching method is combine between text data searching at Sidoarjo potential server and maps data searching at geo spatial server. The searching result will be shown at client side of SoH application itself.

As stated previously, in order to derive an effective SoH system, we provide an optimum database design of SoH. Following is entity relationship diagram of SoH :
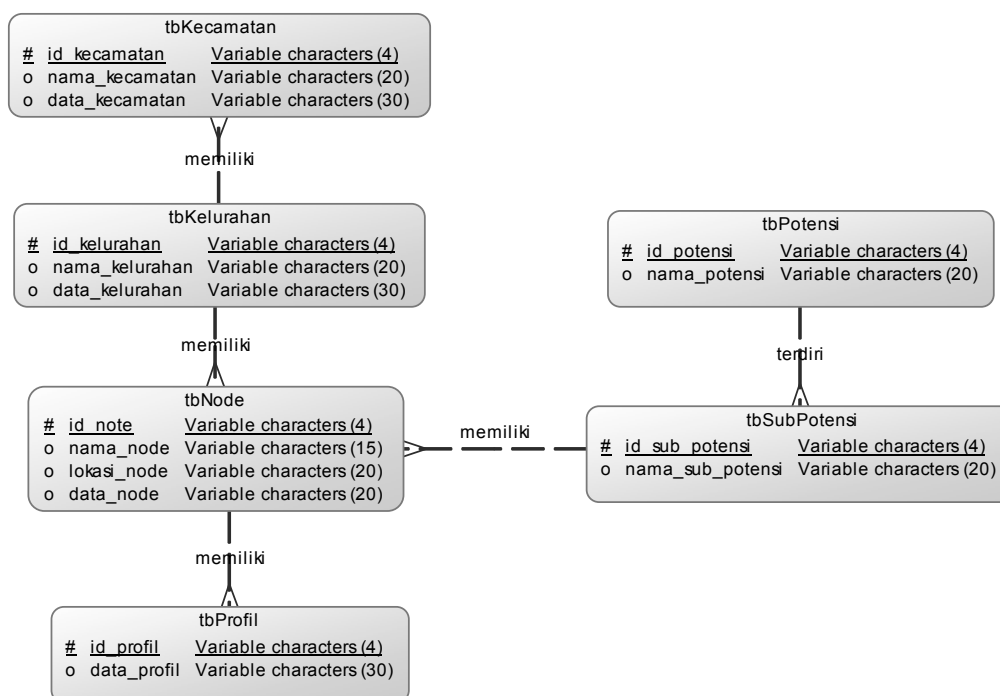
Figure 2. Design of SoH entity relationship diagra

Each table has own function as shown as below :

1. Table of Kecamatan was used to save data of 18 districts in Sidoarjo. They are Balongbendo, Buduran, Candi, Gedangan, Jabon, Krembung, Krian, Porong, Prambon, Sedati, Sidoarjo, Sukodono, Taman, Tanggulangin, Tarik, Tulangan, Waru dan Wonoayu (Bagian Telekomunikasi dan Informatika Kabupaten Sidoarjo, 2015).
2. Table of Kelurahan has function to keep data of village in each districts of Sidoarjo. Sidoarjo has amount of 322 villages.
3. Table of Potensi was used to save data of main category of potentials of Sidoarjo. We have six main category of potentials data which are potential of industry, agriculture, fishery, crafts, tourism and culinary.
4. Table of SubPotensi was used to save subcategory data of each main category.
5. Table of Node was used to save all of location points which contain specific potential.
6. Table of Profil was used to save supporting data for each location which has own potential.

Following are design of SoH user interface which are including startup form and main forms of SoH :
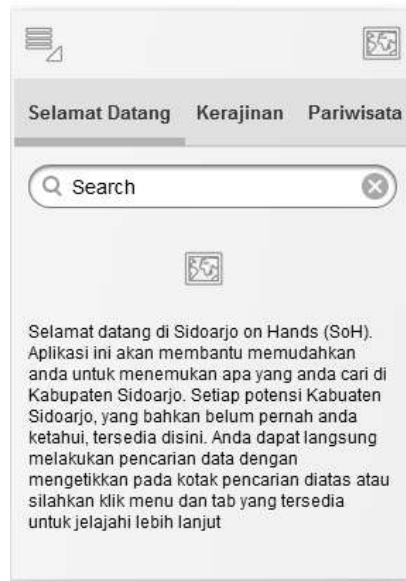
Figure 3. Welcome screen

While SoH was running, startup form of SoH was shown by figure 3. This form provided a brief description of SoH and simple guidance for operating SoH. User can use the searching box for finding general information which is provided by SoH.
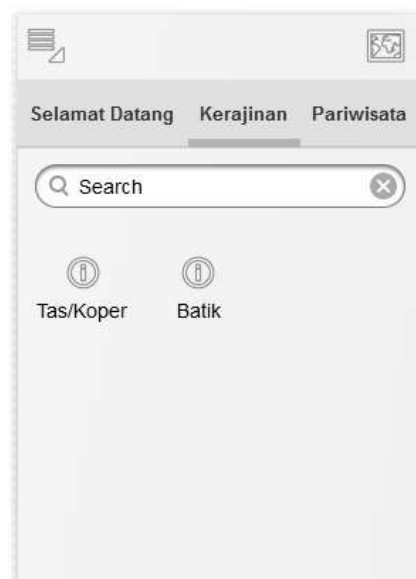
Figure 4. Design form for each main category

Figure 4 showed design of main form of SoH. Each SoH main category will be displayed using tab dialog. Each tab dialog contains sub category of each main category. The sub category will be displayed using mini icon. If user chooses one of mini icon, then user will pursue to the next form as shown in figure 5. User can use searching box in this form for finding the information in accordance with the chosen main category.
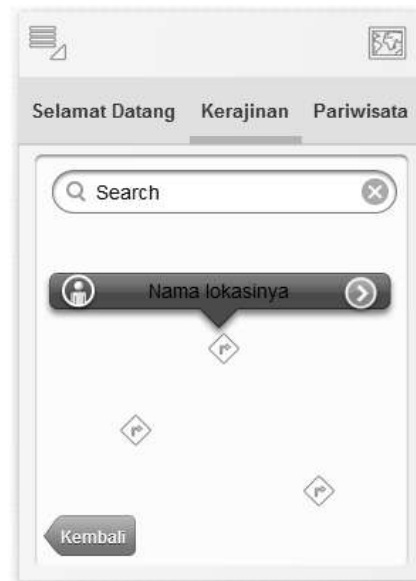
Figure 5. Design form for each sub category

Figure 5 showed form within Sidoarjo map inside. The digitize map had completed with points. The points which is shown on the map in accordance with sub category had been chosen by user from the previous form. Each point displayed the name of each potential in Sidoarjo. If user chose one of these points, then SoH will display the profile of its potential on the next form. See figure 6.

Figure 6. Design form of potential profile

The result of analysis and design phases above will be evaluated. Below are the result of evaluation phase :
1. There are two searching box with different purpose. Searching box in the welcome screen was used to find general information inside SoH. And the other one, which is in the main form, can be used to find information which is suitable with user chosen category.
2. System will search local potential data using join matching query as searching method. This searching method is combine between text data searching at Sidoarjo potential server and maps data searching at geo spatial server.
3. System will implement Apriori TID algorithm on the future research. It is aimed to optimize result of SoH searching (Astuti, 2016)
4. SoH doesn't provide login form. System will create user log activity by Universal Unique Identifier (UUID). System will use this identifier as the searching key on the next research.

Conclusion

This research discuss analysis and design of SoH system using Structured Analysis and Design (SAD) approach. It presents design of SoH system in flowchart, entitiy relationship diagram, and data flow diagram. On the next discussion, SoH will implement Apriori TID algorithm for searching engine inside. Also, SoH will use UUID as key of data searching. The output of this research will be used as a blueprint for developing an effective SoH. Based on this research, we conclude the final result has satisfied user requirements.

Acknowledgement

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POWER FACTOR CORRECTION OF THREE PHASE AC-DC CONVERTER VIA CURRENT CONTROLLER AND PWM TECHNIQUE

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ABSTRACT

Use of three phase AC-DC converters for DC loads can cause high harmonics on the AC side, reducing power factor. To improve the power factor can not be done by adding a passive filter on the input side of the conveter. This paper proposes the improvement of power factor through the regulation of current on the AC side and the PWM technique. The current control method uses PI and the exact PWM technique is SVPWM. The System behavior and power factor observations are studied through simulations.

Keywords: *AC-DC Converter, SVPWM, Current Controller*

1. INTRODUCTION

The AC/DC power converters are extensively used in various applications like household electric appliances, power conversion, dc motor drives, adjustable-speed ac drives, HVDC transmission and UPS. The main problem faced by using switchs on an AC-DC converter is to generate high harmonics on the AC side, reducing power factor in low or medium power applications. Normally the input voltage to an AC-to-DC converter is sinusoidal but the input current is non-sinusoidal i.e. harmonic currents are present in the ac sides. Harmonics have a negative effect on the power factor as well. The addition of harmonic currents to the fundamental component increases the total rms current hence harmonics will affect the power factor of the circuit. Unity power factor, lower harmonic current or low input current THD and fixed DC output voltage with minimum ripple are the important parameters in rectifier.

The switch used in this research already uses the transistor family and has left diode and thiristor [1-2]. The use of switch components is IGBT, because IGBT has a higher switching speed / working frequency than other transistors. That's why IGBT is often used in drivers (motor drives) that require large currents and operate in high voltage, because it has better efficiency than other transistor types [3-4]. In figure 1. A three phase phase rectifier with an igbt switch component has been shown. To flatten the ripple on the DC side added capacitor components.

Several ways have been done by researchers for power factor improvements such as by adding passive filters on the input side [5-12]. But the addition of this passive filter does not solve the problem of power factor decline. The method used in this paper by SVPWM technique is a pulse width modulation technique on the IGBT switch component and adjusts the current amplitude on the AC side.
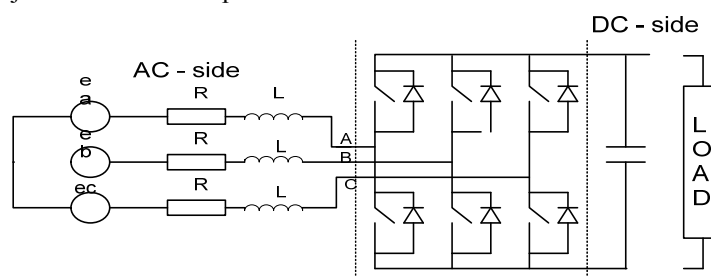
Fig. 1   System of Three-Phase AC-DC converter

2. DESCRIPTION OF SYSTEM

System of the three phase AC-DC converter is shown in Fig. 1. The System is consist of the AC voltage is a balanced three phase supply, IGBT is ideal switch and lossless. Where e_a , e_b and e_c are the phase voltage of three phase balanced voltage source , R and L are mean resistance and inductance respectively, C is smoothing capacitor across the DC bus, R_L is DC side Load.

The following equation describe the dynamic behaviour of the AC-DC converter using space vector :[13]

$$v(t) = e(t) - Ri(t) - L \, di(t)/dt \qquad (1)$$
$$v(t) = \tfrac{1}{2} s(t)v_o(t) \qquad (2)$$
$$i_o(t) = (3/4) \, Re\{s(t)i^*(t)\} \qquad (3)$$
$$i_c(t) = C \, dv_o/dt = i_o(t) - i_L(t) \qquad (4)$$

Where
$v(t) =$ rectifier input voltages
$i(t) =$ rectifier input currents
$i^+(t) =$ complex conjugate of $i(t)$
$e(t) =$ the input line voltages
$i_o(t) =$ rectifier output current
$i_c(t) =$ capacitor current
$i_L(t) =$ load current
$s(t) =$ switching function
$v_o(t) =$ output voltage

3. METHODE OF THE SYSTEMS

3.1 SPACE VECTOR PWM (SVPWM)

SVPWM is to form or encode analog signals into on-off signals for switching using space vector. A Three Phase AC-DC converter has eight active states comprising six active states and two zero states. If depicted in the space vector field, the space vector voltage of the six active states divides the space vector into the same six sectors while the space vector voltage of the zero state lies at the center of the reference plane.

Figure 2 shows the voltage space vector for the AC-DC converter. Vector Vs1, Vs2 .... Vs8 is a vector stationer, meaning it does not rotate by time so its magnitude is determined by dc voltage and its argument is unchanged. Using the PWM modulation technique, it is possible to generate dc voltage with reference voltage vector Vs through vector state synthesis
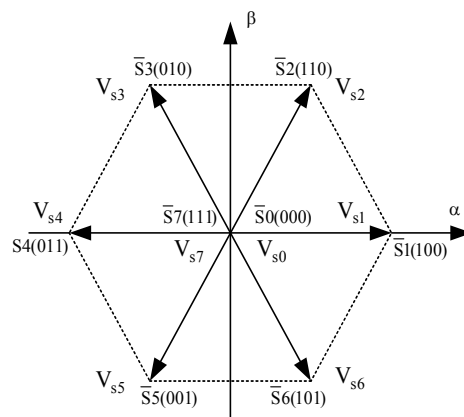
Fig. 2. Space Vector PWM

The six sectors are

$$0^0 \quad < \text{sektor I} \; < \; 60^0 \qquad\qquad 180^0 < \text{sektor IV} \; < \; 240^0$$

$$60^0 \quad < \text{sektor II} < 120^0 \qquad\qquad 240^0 < \text{sektor V} \; < \; 300^0$$

$$120^0 \quad < \text{sektor III} < 180^0 \qquad\qquad 300^0 < \text{sektor VI} < 360^0$$

.

When state 1 and state 2 voltages are generated alternately and at high speeds with respective durations are T1 and T2 in a given time interval, the space vector voltage generated by state1 and state 2 forms the resultant space vector voltage Vs as:

$$V_s = V_\alpha + V_\beta \tag{5}$$
$$V_\alpha = T_1 \; V_{s1} \quad \text{and} \quad V_\beta = T_2 \; V_{s2} \tag{6}$$

Generally the space vector voltage Vs is formed by the vector of adjacent states in the sector where the desired vector voltage space is located. Thus the space vector voltage Vs in sector 2 is formed by vector state 2 and state 3 and so on in other sectors.

The process of calculating the time duration of the active states and the zero state is performed, when both components of the reference voltage vector and sector position are known. Time state zero T0, active state time T1 and T2 can be calculated by considering triangle on sector 1
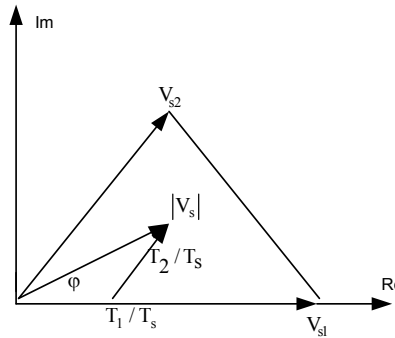
Fig. 3. Determine the switching time of each Sektor I

T 1 dan T 2, can be obtained by considering the following relationship.:

$$\frac{T_1/T_s}{\sin(\pi/3 - \varphi)} = \frac{T_2/T_s}{\sin \varphi} = \frac{|V_s|}{\sin 2\pi/3} \tag{7}$$

$$\frac{T_1/T_s}{\sin(\pi/3 - \varphi)} = \frac{|V_s|}{\sin 2\pi/3} \quad, \quad \text{then} \quad \frac{T_1}{T_s|V_s|} = \frac{\sqrt{3}}{2}\sin(\pi/3 - \varphi_n) = \frac{\sqrt{3}}{2}\cos(\varphi_n + \pi/6) \tag{8}$$

$$\frac{T_2/T_s}{\sin \varphi} = \frac{|V_s|}{\sin 2\pi/3} \quad, \text{then} \quad \frac{T_2}{T_s|V_s|} = \frac{\sqrt{3}}{2}\sin \varphi_n \tag{9}$$

Determine T0 = Ts - Tm - Tm + 1 used for OFF time for AC-DC converter. So in each sampling period there are two active states m and m + 1. T1, T2 and T0 times, it can be determined which combination of switches should be activated according to state and the length of time the active states and zero state.
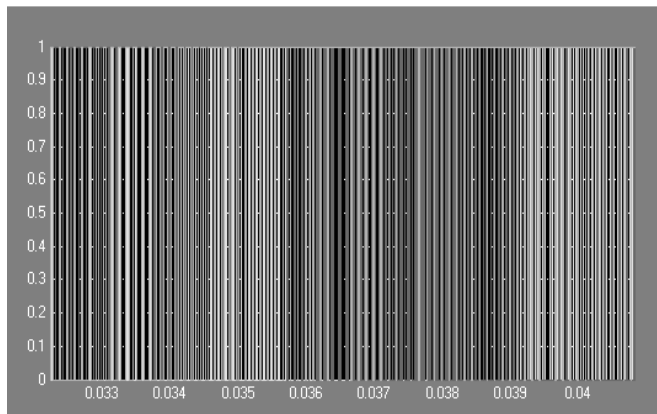
Fig 4. Combinationi T0, T1 and T2

2.2 Current Controller

The control current to get variation of the DC voltage based on SVPWM for three phase of Converter and uses switching variable in d–q frame (s_d , s_q) as input instead of voltage (v_d , v_q) or current (i_d , i_q) that are often used. The system also used a PI controller to control the amplitude of the line current based on the error of the DC voltage. Therefore, a regulated variation of line current amplitude will obtained a low Total harmonic distortion of the line current, a DC voltage variation stable, unity power factor, low ripple. The PI Current Control Proposed was showed in Fig 5.
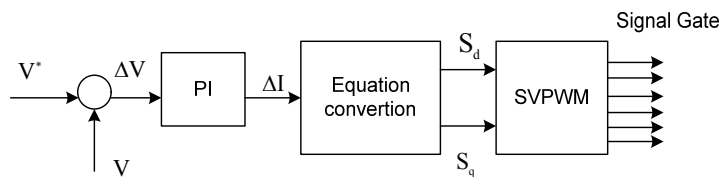
Fig. 5. Block Diagram of the current controller

Convertion Equation

$$s_d = \frac{2}{v_o}\left\{E_m - \frac{L}{T_s}\Delta I_m\right\} \tag{10}$$

$$s_q = \frac{2}{v_o}[-\omega L I_m] \tag{11}$$

4. RESULTS

The simulation has been done using MATLAB/SIMULINK software which it is easy to implement. Various Parameters Used for Simulation Study: AC input voltage = 220V with Supply frequency = 50Hz, Load resistance = 60Ω, DC reference voltage = 600V, Switching Frequency = 9KHz. Figure 6 shows the transient response of the DC link voltage for a switching frequency of 9KHz . The Line current shows on the AC side is stable at 0.04 sec with THD 2.457 on Fig. 7.
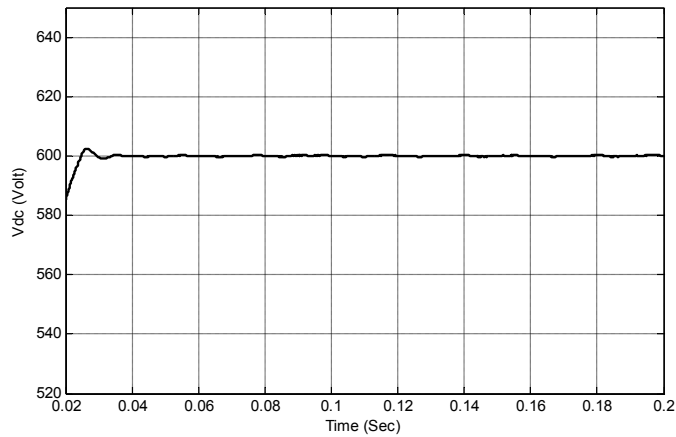
Fig. 6. Simulation result for DC-link voltage dynamics
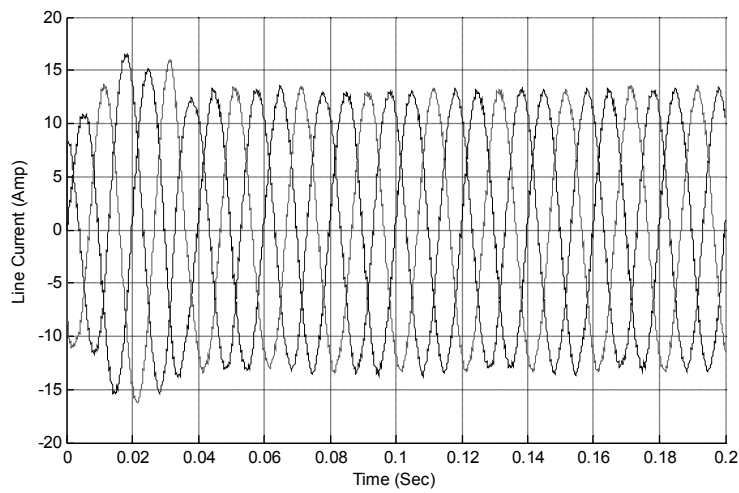
Fig. 7. Simulation result for line current

Fig. 8 shows the voltage and current on line side. We can see the current of sinusoidal wave is the same phase with the voltage. The power factor calculation is achieved using with difference switching frequency. Fig 9. Shows power factor at switching frequency 9 KHz   and Fig. 9 shows Power Factor (PF) at switching frequency 5 KHz
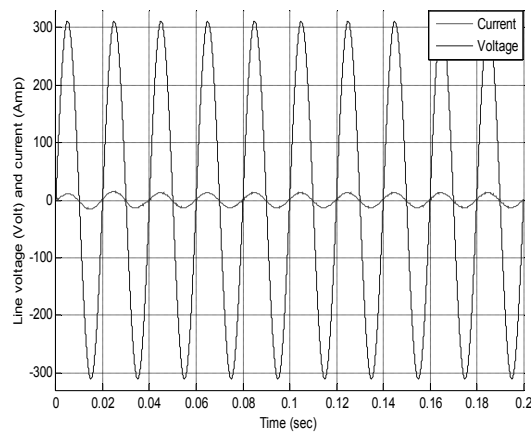
Fig. 8. Simulation result for line current and line voltage

183
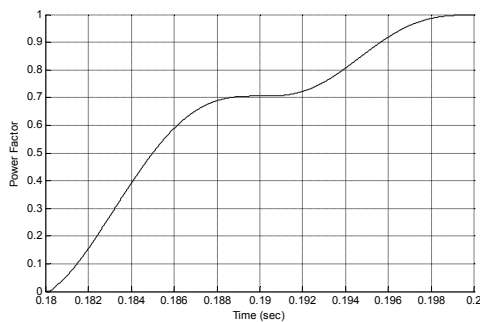
Fig.9 Power Factor (PF) with switching	Power Factor (PF) with switching
frequency 9 KHz	frequency 5 KHz

5. CONCLUSIONS

The System behavior and power factor observations are studied through simulations using matlab/simulink. From the simulation, power factor obtained for frequency switching 9 khz is 0.998, Total Harmonic Distortion 2.457 and for frequency switching 5 khz is 0.9968, Total Harmonic Distortion 4.136. Thus, using SVPWM method and PI current controller on three phase ac-dc converter are obtained unity power factor and minimum Total Harmonic Distortion, stable DC voltage

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FORECASTING GOLD PRICES USING SINGLE EXPONENTIAL SMOOTHING METHOD (SES) AND DOUBLE EXPONENTIAL SMOOTHING METHOD (DES)

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ABSTRACT

The Condition of gold prices that experienced an unstable increase and decrease, causing people who invest with gold suffered losses. To solve these problem, forecasting gold prices is required. Forecasting is an activity of predicting the future using the condition or data in the past. There are so many method that have been used, but in this study using Single Exponential Smoothing and Double Exponential Smoothing Method. Based on the test from forecasting gold prices data 2013-2015 from Antam, the results of the value of Mean Square Error obtained using single exponential smoothing method is 162,5101 at α = 0,5 and at α = 0,9 is 143,9416. While when using double exponential smoothing method at α = 0,5 is 174,67 and at α= 0,9 is 266,33. The lowest error value -62,84 at α =0,1 is obtained by using single exponential smoothing method. So, the single exponential smoothing method is better to forecast gold prices problem.

Keyword : *Forecasting, Gold, Gold Prices, Single Exponential Smoothing, Double Exponential Smoothing.*

1. INTRODUCTION

Gold is one of the most valuable precious metals to gain optimum benefits. For people who invest in gold, expect to get the lowest price at the time of purchase and high selling price. Due the increase and decrease in gold prices are unstable, sometimes causing people who make investments have a loses. To solve these problems, required a system to predict the price of gold. In this journal, forecasting gold prices using the Single Exponential Smoothing method and Double Exponential Smoothing method. The Single Exponential Exponential Method is the development of a simple moving average method. While the Double Exponential Smoothing method is a method used to solve the difference between actual data and forecasting values if there is a trend in plot data. Forecasting Gold prices using gold price data 2013-2015 from Antam in Dollar unit.

2. METODOLOGY

2.1 System Analysis
This step is aims to explain the problem of the system, analyzing the system requeriment and elements method in process of forescasting gold prices.

2.1.1 Problem Analysis
For people who invest in gold, expect to get the lowest price at the time of purchase and high selling price. Due the increase and decrease in gold prices are unstable, sometimes causing people who make investments have a loses.

2.1.2 Data Analysis
Data used in this study are gold price data 2013-2015 from Antam in Dollar unit.

2.2 System Design
Design system consist of two main parts. They are master data process and Single Exponential Smoothing and Double Exponential Smoothing method calculation process.

2.2.1 Master Data Process
  Master data process containing data whitch is going to be used as training data and testing data. In master data process there are function to input data, update data, and delete the data. The input data needed by the system are participant data for training and participant data for testing.

2.2.2 Single Exponential Smoothing and Double Exponential Smoothing Calculation
  Development of Single Exponential Smoothing and Double Exponential Smoothing method has several steps to do. Those steps explained in follwing figure.
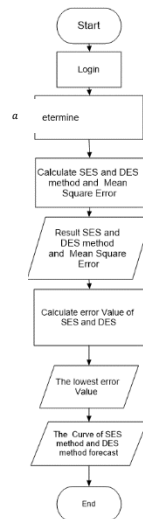
Figure 1 Flowchart of implementation process

  Based on figure 1, Input data for the first process, then determine the value of α. The next step is calculate forecasting value using Single Exponential Smoothing and Double Exponential Smoothing method. Error value is calculated using Mean Square Error (MSE) method and then determine the lowest error value. After the calculation have been done, the results of forecasting among the forecasting value of gold prices, the results of MSE calculations, the lowest error value and curves will shown.

2.2.2.1 Calculation Example Forecasting Gold Prices
  To do a calculation process of Single Exponential Smoothing and Double Exponential Smoothing method. These are several data which is going to be used for training.

Table 1 Sample data of Gold Prices and The Result of forecasting gold price using SES and DES for training data

Date	X_t	SES	e_t (SES)	e_t^2 (SES)		S'_t	S''_t	a_t	b_t	F_{t+m}	e_t (DES)	e_t^2 (DES)
01/01/13	1660	1660.00	0.00	0.00		1660.00	1660.00	1660.00	0.000	1660.00	0.00	0.00
02/01/13	1662	1660.00	2.00	4.00		1661.00	1660.50	1661.50	0.500	1660.00	2.00	4.00
03/01/13	1665	1661.80	3.20	10.24		1663.00	1661.75	1664.25	1.250	1662.00	3.00	9.00
04/01/13	1667	1664.68	2.32	5.38		1665.00	1663.38	1666.63	1.625	1665.50	1.50	2.25
05/01/13	1669	1666.77	2.23	4.98		1667.00	1665.19	1668.81	1.813	1668.25	0.75	0.56

  The calculation example for 2013-2014 is shown below.
1) Calculation example using single exponential smoothing using α = 0,9:
X_t = 1660 (01-01-2013) / First data
S_t = 1660

$$S_{t+1} \qquad = \alpha X_t + (1 - \alpha) S_t$$
$$= 0{,}9 \ (\ 1660 \ ) + (\ 1 - 0{,}9 \ ) \ 1660$$
$$= 1494 + (0{,}1) \ 1660$$
$$= 1494 + 166$$

$$= 1660 \ (02\text{-}01\text{-}2013) \ / \text{ Second data}$$

$S_t = 1660$

$$
\begin{aligned}
S_{t+1} \quad &= \alpha \, X_t + (\, 1 - \alpha \,) S_t \\
&= 0{,}9 \ (\, 1662 \,) + (\, 1 - 0{,}9 \,) \ 1660 \\
&= 1495{,}8 + (0{,}1) \ 1660 \\
&= 1495{,}8 + 166 \\
&= 1661{,}8 \quad (03\text{-}01\text{-}2013) \ / \text{ Third data}
\end{aligned}
$$

2) Calculation example using double exponential smoothing using $\alpha = 0{,}5$:

a. Determine value of *Eksponensial Smoothing* (S'_t)

$$
\begin{aligned}
X_t \quad &= 1660 \qquad (01\text{-}01\text{-}2013) \\
X_t \quad &= 1662 \qquad (02\text{-}01\text{-}2013) \\
S'_{t-1} \quad &= 1660 \\
S'_t \quad &= \alpha X_t + (1 - \alpha) S'_{t-1} \\
&= 0{,}5(1662) + (1\text{-}0{,}5) \ 1660 \\
&= 831 + (0{,}5) \ 1660 \\
&= 831 + 830 \\
&= 1661 \qquad (02\text{-}01\text{-}2013)
\end{aligned}
$$

b. Determine value of *Double Eksponential Smoothing* (S''_t)

$$
\begin{aligned}
S'_t \quad &= 1661 \\
S''_{t-1} \quad &= 1660 \\
S''_t \quad &= \alpha S'_t + (1 - \alpha) S''_{t-1} \\
&= 0{,}5 \ (1661) + (1\text{-}0{,}5) \ 1660 \\
&= 830{,}5 + (0{,}5) \ 1660 \\
&= 830{,}5 + 830 \\
&= 1660{,}5 \qquad (02\text{-}01\text{-}2013)
\end{aligned}
$$

c. Determine value of *constanta* (α_t)

$$
\begin{aligned}
S'_t \quad &= 1661 \\
S''_t \quad &= 1660{,}5 \\
\alpha_t \quad &= 2 . \, S'_t - S''_t \\
&= 2 \ (1661) - 1660{,}5 \\
&= 3322 - 1660{,}5 \\
&= 1661{,}5 \qquad (02\text{-}01\text{-}2013)
\end{aligned}
$$

d. Determine value of *slope* (b_t)

$$
\begin{aligned}
S'_t \quad &= 1661 \\
S''_t \quad &= 1660{,}5 \\
b_t \quad &= \frac{\alpha}{1-\alpha} (S'_t - S''_t) \\
&= \frac{0{,}5}{1-0{,}5} (1661 - 1660{,}5) \\
&= 0{,}5 \qquad (02\text{-}01\text{-}2013)
\end{aligned}
$$

e. Determine value of *forecast*

$$
\begin{aligned}
\alpha_t \quad &= 1661{,}5 \\
b_t \quad &= 0{,}5 \\
m \quad &= 1 \\
F_{t+m} \quad &= \alpha_t + b_t \, m \\
&= 1661{,}5 + 0{,}5 \ (1) \\
&= 1662 \qquad (03\text{-}01\text{-}2013)
\end{aligned}
$$

For the calculation forecasting 02-01-2013 using the gold price of 2013-2014 for Double Exponential Smoothing method use the last formula of forecasting $F_{t+m} = \alpha_t + b_t \, m$. Calculation for 01-01-2013 is shown below:

$$
\begin{aligned}
\alpha_t \quad &= 1660 \qquad (\text{ Result } \alpha_t \text{ from } 1\text{-}01\text{-}2013) \\
b_t \quad &= 0 \qquad (\text{ Result } b_t \text{ from } 1\text{-}01\text{-}2013)
\end{aligned}
$$

$$m \qquad = 1$$
$$F_{t+m} \qquad = \alpha_t + b_t\,m$$
$$= 1660 + (0)\,(1)$$
$$= 1660\ (\text{ Result 02-01-2013})$$

2.2.2.2 Calculation Example For Error Value Process

1) *MSE* of *Single Eksponential Smoothing* α=0,9

$$\text{MSE} = \frac{\sum_{t=1}^{t=n} = e_t{}^2}{n}$$

$$\text{MSE} = \frac{135006{,}92}{730}$$

$$= \mathbf{184{,}94}$$

2) *MSE* of *Double Eksponential Smoothing* α=0,9

$$\text{MSE} = \frac{226208{,}90}{730}$$

$$= \mathbf{309{,}88}$$

3) *MSE* of *Single Eksponential Smoothing* α=0,5

MSE = **239,28**

4) *MSE* of *Double Eksponential Smoothing* α=0,5

MSE = **218,04**

Table 2 The Value of Mean Square Error

α	MSE	
	SES	**DES**
0,5	*239,28*	**218,04**
0,9	**184,94**	*309,88*

Based on the table 2 the training result that obtained from the lowest error value of MSE is using Single Expinential Smoothing method at $\alpha = 0,9$ and using Double Expinential Smoothing method at $\alpha = 0,5$. So, the value of a is going to be used for testing is 0,5 and 0,9 .

Table 3 The lowest error value

α	The lowest error value	
	SES	**DES**
0,1	**-103,40**	*-91,81*
0,9	*-83,95*	**-123,65**

Based on the table 3 the training result that obtained from the lowest error value is using Single Expinential Smoothing method at $\alpha = 0,1$ and using Double Expinential Smoothing method at $\alpha = 0,9$. So, the value of a is going to be used for testing is 0,1 and 0,9 .

2.3 Data Flow Diagram

Data flow diagram is developed methods of structured data system. DFD describe whole activities inside system clearly.
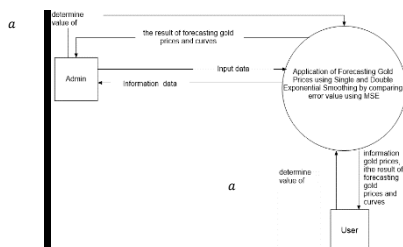
Figure 2 DFD Level 0

Based on figure 2, Admin has full access of system. It can manage the data for forecasting, it also can access the forecasting process and get the result of forecasting. But user only has access the forecasting process and get the result of forecasting.

3. RESULT

The program is Java Programming language based, interface of the program is shown in the figure 3 and figure 4.
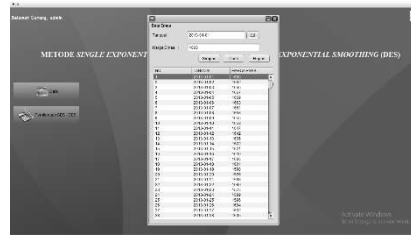
Figure 3 Master data interface of the program
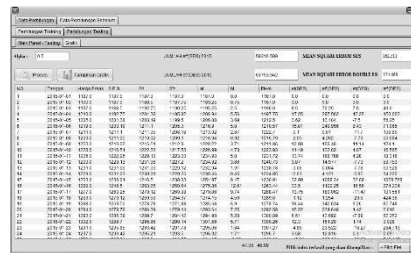
Figure 4 Implementasi Interface

In the Master data process, admin can input data, edit data and delete data.

Figure 4 show the result of forecasting process after input data. The value of α, forecasting value using Single Exponential Smoothing and Double Exponential Smoothing method, the value of MSE, the lowest error value, and curves is shown.

3.1 System Testing

The experiment have been done 2 times using α = 0,9 and α = 0,5 and got the following result:

Table 4 Sample data of Gold Prices and Testing Result using SES and DES Method at α = 0,9

Date	X_t	SES	e_t (SES)	e_t^2 (SES)	S'_t	S''_t	a_t	b_t	F_{t+m}	e_t (DES)	e_t^2 (DES)
01/01/15	1187	1187.00	0.00	0.00	1187.00	1187.00	1187.00	0.000	1187.00	0.00	0.00
02/01/15	1190	1187.00	3.00	9.00	1189.70	1189.43	1189.97	2.430	1187.00	3.00	9.00
03/01/15	1197	1189.70	7.30	53.29	1196.27	1195.59	1196.95	6.156	1192.40	4.60	21.16
04/01/15	1210	1196.27	13.73	188.51	1208.63	1207.32	1209.93	11.737	1203.11	6.89	47.47
05/01/15	1205	1208.63	-3.63	13.16	1205.36	1205.56	1205.17	-1.764	1221.67	-16.67	277.82

Table 5 Sample data of Gold Prices Testing Result using SES and DES Method at α = 0,5

Date	X_t	SES	e_t (SES)	e_t^2 (SES)	S'_t	S''_t	a_t	b_t	F_{t+m}	e_t (DES)	e_t^2 (DES)
01/01/15	1187	1187.00	0.00	0.00	1187.00	1187.00	1187.00	0.000	1187.00	0.00	0.00
02/01/15	1190	1187.00	3.00	9.00	1188.50	1187.75	1189.25	0.750	1187.00	3.00	9.00
03/01/15	1197	1188.50	8.50	72.25	1192.75	1190.25	1195.25	2.500	1190.00	7.00	49.00
04/01/15	1210	1192.75	17.25	297.56	1201.38	1195.81	1206.94	5.563	1197.75	12.25	150.06
05/01/15	1205	1201.38	3.63	13.14	1203.19	1199.50	1206.88	3.688	1212.50	-7.50	56.25

Table 6 The Value of Mean Square Error

A	MSE	
	SES	**DES**
0,5	*162.5101*	*174.67*
0,9	*143.9416*	*266.33*

Based on the table 6 the results of the Single Exponential Smoothing method is considered better to apply than the Double Exponential Smoothing method because when using the Single Exponential Smoothing method the value of MSE at α = 0,5 ie 162, 5101 and at α = 0 , 9 that is 143,9416, whereas in Double Exponential Smoothing method the value of MSE at α = 0,5 that is 174,67 and at α = 0,9 that is 266,33.

Table 7 The lowest error value

A	The lowest error value		Date
	SES	**DES**	
0,1	-62,84	-49,932	7-11-2015 and 6-2-2015
0,9	-44,03	-37,09	27-12-2015 and 31-8-2015

Based on the table 7 the lowest error value is -62,84 using Single Expinential Smoothing method at α = 0,1.

4   CONCLUTION

This study applied single exponential smoothing method and double exponential method to the forecasting gold prices using Java and database MySQL. Based on the calculation value forecasting error using MSE is known the best value of α is α =0,9 and α =0,5. The value of MSE using Single expotential smoothing method at α =0,5 that is 162,5101 and at α =0,9 that is 143,9416. While when using double exponential smoothing method, the value of MSE at α =0,5 that is 174,67 and at α =0,9 that is 266,33. The lowest error value is -62,84 using Single Expinential Smoothing method at α = 0,1. Single exponential smoothing method and double exponential smoothing method is not good for forecasting gold prices because these method obtained big value of MSE.

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NOISE MINING USING MODIFIED SHARED NEAREST NEIGHBORS ALGORITHM

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ABSTRACT

Removing objects that are noise is an important goal of data cleaning as noise hinders most types of data analysis. Most existing data cleaning methods focus on removing noise that is the result of low-level data errors that result from an imperfect data collection process, but data objects that are irrelevant or only weakly relevant can also significantly hinder data analysis. One of the way to enhance the data analysis as much as possible, is finding and removing the right noise data. Consequently, if the attributes for the noise can be found, a new and better way to remove the noise in a large data set can be applicated.

1. INTRODUCTION

Noise as described in Oxford Dictionary is "Random Fluctuations that obscure or do not contain meaningful data or other information". The term has often been used as a synonym for corrupt data. For most existing data cleaning methods, the focus is on the detection and removal of noise (low-level data errors) that is the result of an imperfect data collection process. However, its meaning has expanded to include any data that cannot be understood and interpreted correctly by machines, such as unstructured text. Any data that has been received, stored, or changed in such a manner that it cannot be read or used by the program that originally created it can be described as noisy.

The need to address this type of noise is clear as it is detrimental to almost any kind of data analysis. However, ordinary data object that are irrelevant or only weakly relevant to a particular data analysis can also significantly hinder the data analysis, and thus these objects should also be considered as noise, at least in the context of a specific analysis. For instance, in document data sets that consist of news stories, there are many stories that are only weakly related to the other news stories. If the goal is to use clustering to find the strong topics in a set of documents, then the analysis will suffer unless irrelevant and weakly relevant documents can be eliminated. Consequently, there is a need for data cleaning techniques that remove both types of noise.

In some cases, the amount of noise in a data set is relatively small. For example, it has been claimed that field error rates for business are typically around 5% or less if an organization specifically takes measures to avoid data errors [24]. However, in other cases, the amount of noise can be large. For example, a significant number of false-positive protein interactions are present in current experimental data for protein complexes. Gavin *et al*. [9] estimates that more than 30% of the protein interactions they detect may be spurious, as inferred from duplicate analyses of 13 purified protein complexes. Although this is an example of a data set that has a large amount of noise due to data collection errors, the amount of noise due to irrelevant data objects can also be large. Examples include the document sets mentioned earlier [7] and Web data [25], [26]. Therefore, data cleaning techniques for the enhancement of data analysis also need to be able to discard a potentially large fraction of the data.

Noisy data can give a lot of problems, but the main problems with noisy data are:
1. Noisy data unnecessarily increases the amount of storage space required and can also adversely affect the results of any data mining analysis. Statistical analysis can use information gleaned from historical data to weed out noisy data and facilitate data mining.
2. Noisy data can be caused by hardware failures, programming errors and gibberish input from speech or optical character recognition programs.
3. Spelling errors, industry abbreviations and slang can also delay in machine reading.

Schema-related data quality problems occur because of the lack of appropriate model-specific or application specific integrity constraints. For examples, due to data model limitations of poor schema design, or because only a few integrity constraints were defined to limit the overheard for integrity control. Instance-specific or application specific problems relate to errors and inconsistencies that cannot be prevented at the schema level. Table 1 and Table 2 shows the single source problem at schema level and single source problems at instance level.

Table 1. Examples for Single-Source Problems at Schema Level

Scope/Problems		Noise	Reasons/Remarks
Attribute	Illegal Values	Bdate = 01.09.78	Values outside the domain range
Record	Violated Attribute Dependencies	Age=22, bdate=01.09.78	Age = current year-birth year should hold
Record Type	Uniqueness Violation	Emp1=(name="Rifki F", ID="123456") Emp2=(name="Hartatik S", ID="123456"	Uniqueness for ID violated
Source	Referential Integrity Violation	Emp=(name="Rifki F", ID_Dept=127)	Referenced Departement (127) not defined

Table 2. Examples for Single-Source Problems at Instance Level

Scope/Problems		Noise	Reasons/Remarks
Atribute	Missing Values	Phone=9999-9999	Unavailable values during data entry(dummy values or null)
	Misspelling	City="Sursbaya"	Usually typos, phonetic errors
	Cryptic values, Abbrevations	Experiences="B" Occupation="DB Prog"	
	Embedded Values	Name="Rifki F 01.09.78 Surabaya"	Multiple values entered in one attribute
	Misfielded Values	City="Surabaya"	
Record	Violated Attribute Dependencies	City="Surabaya", zip=101200	City and zip code should correspond
Record Type	Word Transpositions	Name1="Rifki F", name2="Hartatik S"	Usually in free form field
	Duplicated	Emp1=(name="Rifki F") Emp2=(name="Rifki F")	Same employee represented twice due to some data entry errors

When multiple sources are integrated, the problems present in single source are aggregated. Each source may contain dirty and inconsistent data and the data in the sources may be represented differently, overlap or contradict. This is because the sources are typically developed, deployed and maintained independently to serve specific needs. This results in a large degree of heterogeneity with data management systems, data models, schema designs and the actual data. Tabel 3 shows the multisource problems.

Table 3. Examples of Multisource Problems at Schema & Instance Level
Data Source 1

CID	Name	Street	City	Sex
11	Rifki Fahrial	Jemursari VI/26	Surabaya	1
24	Hartatik Sri	Kutisari Selatan 2/14	Surabaya	0

Data Source 2

CNO	LastName	FirstName	Gender	Address	Phone/Fax
24	Rahayu	Rejeki	F	Rungkut Sier 16 Surabaya	333-222-6542
493	Fahrial	Rifki	M	Jemursari VI/26 Surabaya	444-555-6666

Integrated Target with Cleaned Data

No	LName	FName	Gender	Street	City	Phone	CID	CNO
1	Fahrial	Rifki	M	Jemursari VI/26	Surabaya	444-555-666	11	493
2	Sri	Hartatik	F	Kutisari Selatan 2/14	Surabaya		24	
3	Rahayu	Rejeki	F	Rungkut Sier 16	Surabaya	333-222-6542		24

Data cleaning routines is to clean the data by filling in missing values, smoothing noisy data, identifying or removing outliers, and resolving inconsistencies. Dirty data can cause confusion for the mining procedure, resulting in unreliable and poor output. There is necessity for useful preprocessing step to be used some data-cleaning routines, specially the missing values. The missing values are to be corrected by following measures

    a)   Ignore the missing values

    b)   Fill in the missing values manually

    c)   Use a global constant to fill in the missing values

    d)   Use the attribute mean to fill in the missing values

    e)   Use the most probable value to fill in the missing values.

The missing values can be ignored if the class label is missing. This method is not very effective, unless the missing values contains several attributes with missing values. It is especially poor when the percentage of missing values per attribute varies considerably.

The second approach is time consuming and may not be feasible to the large data set with many missing values. To shorten the time of the process, the missing value in the data sets are filled by using a global constant in the missing value and replace all missing attribute values by the same constant. The other way is to fill the missing values with the attribute mean. The last approach, which is using the most probable value to fill in the missing value may be determined with regression, inference-based tools using a Bayesian formalism, or decision tree induction.

For example, using the other attributes in the soil data set, we may construct a decision tree to predict the missing values for income. This is a popular strategy. In comparison to the other methods, it uses the most information from the present data to predict missing values. This procedure is bias the data. The filled-in value may not be correct. It is important to have a good design of databases or data entry procedures which would minimize the number of missing values or errors.

On the other hand, noisy data or data that contains errors can be corrected with Binning, Regression or Clustering. Binning methods have the tendency to smooth a sorted data by consulting its "neighborhood", that is, the data around it. The sorted data are distributed into a number of "buckets" or bins. Because binning methods consult the neighborhood of values, they perform local smoothing. In smoothing by bin means each value in a bin is replace by the mean value of the bin.

Smoothing by bin medians can be employed, in which each bin value is replaced by the bin median. In smoothing by bin boundaries, the minimum and maximum values in a given bin are identified as the bin boundaries. Each bin value is then replaced by the closest boundary value. In general, the larger the width, the greater the effect of the smoothing. Alternatively, bins may be equal-width, where the interval range of values in each bin is constant. Binning is also used as a discretization technique.

The Regression methods smoothed the data by fitting the data to a function. Linear regression involves finding the "best" line to fit two attributes (or variables), so that one attribute can be used to predict the other. Multiple linear regression is an extension of linear regression where more than two attributes are involved and the data are fit to a multidimensional surface.

The last methods is by using clustering methods. Outliers or noise may be detected by clustering where similar values are organized into groups or clusters. Intuitively, values that fail outside of the set of clusters may be considered outliers or noise. This method can be used not only to find class for each of the data in the data sets, but

also able to clean the noise in its process. But the process of finding the noise among one big data set, is a long and time-consuming process.

In this paper, we propose a way to use the clustering methods to find the noise and examining it, thus finding the attributes for the noise. Then by using the noise attribute, we can do several things such as avoiding filling in the missing values with the noise values, or cleaning the data set with the right attribute for the noise.

2. METHODOLOGY

There are several clustering methods that can be used to find the noise. This paper use the Shared Nearest Neighbors (SNN). SNN is a density based clustering algorithm which is capable of finding clusters of arbitrary shapes, sizes and densities and we need not mention the number of clusters as parameter. This algorithm makes use of a similarity measure which is obtained from the number of neighbors two points share. This can be computed from the k-nearest neighbors of each point. In order to identify the k-nearest neighbors, we need a distance function like Euclidean distance.

2.1 SNN Algorithm

This algorithm requires the following input:
a. K: number of nearest neighbors to be identified for each point.
b. Eps: Density threshold-minimum number of points shared by two points in order to be considered close to each other.
c. MinPts: minimum density a point should have to be considered a core point.

Algorithm includes the following steps:
1) Create the distance matrix using a given distance function and identify for each point, the k nearest neighbors.
2) For each two points, calculate the similarity, which is given by the number of shared neighbors.
3) Establish the SNN density of each point. The SNN density is given by the number of nearest neighbors that share Eps or more neighbors.
4) Identify the core points of the data set. Each point that has a SNN density greater or equal to MinPts is considered a core point.
5) Build clusters from core points. Two core points are allocated to the same cluster if the share Eps or more neighbors with each other.
6) Handle noise points. Points not classified as core points and that are not within Eps of a core point are considered noise.
7) Assign the remaining point to cluster. All non-core and non-noise points are assigned to the nearest cluster.

The inmportant step in the SNN algorithm is identification of k-nearest neighbors. In order to identify the nearest neighbors, we make use of a distance function. Various distance functions that could be applicable to numerical data are:
1) Euclidean Distance:
   It is the straight-line distance between two points. It computes the root of squares difference between coordinates of pair of objects.

$$Dist_{xy} = \sqrt{\sum_{i=1}^{n}(X_i - Y_i)^2} \qquad (1)$$

2) Manhattan Distance:
   Manhattan Distance computes the absolute differences between coordinates of pair of objects.

$$Dist_{xy} = \sum_{i=1}^{n}((|X_i - Y_i|)) \qquad (2)$$

3) Minkowski Distance:
   Minkowski Distance can be defined as the generalized metric distance. It is formulated as

$$Dist_{xy} = \sum_{i=1}^{n}((|X_i - Y_i|)^p)^{\frac{1}{p}} \qquad (3)$$

   When p=2, it becomes Euclidean Distance.

The algorithm has been implemented by using the above measures in order to obtain the efficient distance measure. It is found that using Manhattan as distance measures, the algorithm doesn't perform well. Using Euclidean it has produced the effective results. Since Minkowski also behaves like Euclidean, it also has produced the same results. Therefore, we have implemented the algorithm by using Euclidean distance in this paper.

In the first step, we create a distance matrix and identify the k-nearest neighbors of each point. Then for each two points, we calculate similarity i.e. number of nearest neighbors two points share. Then SNN density is computed. The points whose SNN density is greater than MinPts are considered as core points. All core points that share Eps or more neighbors are allocated to the same cluster and continue to be core points. Then we start clustering remaining points with the help of core points.

2.2 Modified SNN Algorithm

For the noise mining, we need data considered as the noise in the data set. In this paper, we propose a modified SNN algorithm by using only 1 to 4 steps in the original SNN algorithm. After we form and compute the SNN density, we can find the noise data by using the MinPts. For each points that have SNN density greater than MinPts are considered core points. While the points not classified as core points and that are not within Eps of a core point are considered noise.

This noise data than can be used as the core points for our noise mining or to avoid confusion now called the noise core points. We modified the next step whereas the original is build cluster from core points, we use the noise core points as the core points for the clusters. Two noise core points are allocated to the same cluster if they share Eps or more neighbors with each other. This modified SNN algorithm gives us a fast solution to perform analysis for the noise data.

The modified Algorithm includes the following steps:
1) Create the distance matrix using a given distance function and identify for each point, the k nearest neighbors.
2) For each two points, calculate the similarity, which is given by the number of shared neighbors.
3) Establish the SNN density of each point. The SNN density is given by the number of nearest neighbors that share Eps or more neighbors.
4) Identify the noise core points of the data set. Each point that has a SNN density lower to MinPts is considered a noise core point.
5) Build noise clusters from noise core points. Two noise core points are allocated to the same cluster if the share Eps or more neighbors with each other.

For each noise cluster can gives us a new point of view to see the bigger pictures. It can reveal a new perspective. Thus, opening the way of noise mining.

3. CONCLUSION

The modified SNN algorithm can gives a new way to perform noise mining. By using the result of noise mining, we can find the noise attributes to help us cleaning the data. Another way of using noise mining is to help providing the values of the missing values. In this case, is the value that should not be given to the missing values. Still need a further research to find the full ability of the noise mining.

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APPLYING USABILITY TESTING ANALYSIS OF INDONESIAN ONLINE TRAVEL AGENT WEBSITE FOR FLIGHT TICKET SALES

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ABSTRACT

Online Travel Agents (OTA) now is become compete with traditional travel agents to become travel agents a convenient and practical for users. Online Travel Agents (OTA) provides the convenience, practicality, and relatively more affordable price for customers. Online Travel Agents (OTA) also provide facilities for supplying the airlines and other accommodation needs access to regulate pricing, availability and promotions in real-time to users. Thus, the Online Travel Agent needs to develop so that in accordance with the requirements requested by the user. The development can be done with Usability Testing, this research will discuss with detail how good Usability Testing for online travel agent web and how to evaluate the result. The final result of this research is the comparison of web research usability testing and web recommendation.

Keywords: *Usability , Human Computer Interaction, Usability Testing, Online Travel Agent*

1. INTRODUCTION

A. Background Analysis

Online travel agent become increase day by day. This statement is provide by a lot of start up bussines in online travel agent field. The things that really important for online travel agent bussines is a usability. The usability can be reach by using a usability testing. Usability testing is a method that we use for measure the criteria of usability. The selected criteria for this research are Learnability, Satisfaction, and Error. This usability testing object reasearch of this paper are Traveloka.com, Tiket.com, and Indonesiaflight.id. at the end of this research the final result are recommendation online travel agent website which is designed using usability test analysis also comparison within 3 object research websites and recommendation website.

B. Problem Identification

Traveloka.com , tiket.com, and IndonesiaFlight.id are some of Indonesian online travel agent. All of the company privide a ticketing sales for airplane and train also hotel room booking in a one easy way. As a big company on tourism world these company need a usability test for their websites. Why they are need, because usability is one of the important things that's needed by online travel agent company. The result of this usability testing can improve the company from every side of bussines such as sales, marketing, and business strategy.

Based on the problem in the above paragraph, the problem statement for this paper research are :

1. How to do usability testing for online travel agent websites?
2. How to design recommendation website using usability analysis?
3. How is the result of usability testing for recommendation website?

C. Research Methodology
 1. Literature study
 2. Determine the usability criteria
 3. Usability testing selected object research
 4. Design recommendation website
 5. Usability testing for recommendation website
 6. Analyst the usability result
 7. Writing the report

D. Research Goals
 1. Identify Usability and problems in online ticket booking web.
 2. Create a prototype design of web reservations online ticket reservations with regard to Usability factors.
 3. Evaluate the results of prototype design of web design recommendations

E. Scope

 1. Online airline ticket booking website which will be analyzed for ease of use is Traveloka, Tiket.com, Indonesia Flight.
 2. Support software used is Google Chrome, Morae Recorder and operating system used is Windows 8.
 3. Improvements made is to improve the appearance of online ticket booking website seen from the criteria of Learnability, Satisfaction, and Error.
 4. This research is done until prototype testing stage of online airline ticket booking website.
 5. Usability Testing based on Traveloka web display on February 5, 2017, Tiket.com on March 5, 2017, and Indonesia Flight on April 5, 2017.
 6. Target Users of Usability Testing maximum of 5 people with the provisions of male or female aged 17-40 years who is the first user of online ticket sales application.

2. LITERATURE STUDY

A. Human Computer Intrreaction

   Definition Human Computer Interaction is a discipline that emphasizes computer systems can interact with humans and consider aspects of design, evaluation, and implementation based on phenomena around the human environment itself.

   There are several aspects that must be considered that must be considered in order to produce a strong bridge to connect human with computer The purpose of Human Computer Interaction namely:

 1. Usable
 2. Safe
 3. Safety
 4. Utility
 5. Usability
 6. Effectiveness
 7. Efficiency

B. User Experience

   The main purpose of the User Experience is to find the exact needs that the user desires. Then another purpose of the User Experience to beautify and beautify a display of products or programs that are processed. User Experience is the attitude, behavior, and emotion of the user when using a product, system, or service.

C. Usability

Usability is the level that can measure a quality of a system, a web page, or an existing product. Usability generally has the main components that become the reference for measurement that is easy to learn, easy to use, and encourage users to use the program.

Usability Components:

1. .Learnability
2. Effieciency
3. Memorability
4. Errors
5. Satisfaction

In doing usability testing, there are some things that need to be understood first by (Nielsen, 2015) of which are:

1. Make the task as realistic as possible
2. Make tasks easy to implement and
3. Avoid providing illustrations of the steps that will be done

2. RESULT

Data processing in this research is divided into three parts, which is evaluate usability testing for website object research, design the recommendation website, and evaluation the result of usability testing for recommendation website. Testing begins by finding and selecting participants. After that test Usability by providing a terminology questionnaire that contains questions about the interface. then proceed by testing the task scenario and ending with Interview. After all it is done it will go into the evaluation phase that is with Measure the test results based on the usability criteria used in this study, Namely learnability, errors, and satisfaction. After all of the evaluation done the next step is designing the recommendation website. The website development is using HTML and CSS. The comparison of usability testing result will be described in paragraph below.

a. Efficiency

Efficiency is represented by the time difference and path chosen by the participant, the following is the data:

Table 1 Comparing Average Time Testing

Site	Average Time				
	Ticket searching	Fill The Passanger Detail and Information	Booking / complete booking / review	Choose the Payment Methods	Total Time
1	00.00.31	00.01.42	00.00.42	00.00.29	00.06.08
2	00.00.31	00.02.31	00.00.30	00.00.34	00.07.11
3	00.01.34	00.01.09	00.00.37	00.00.16	00.04.04
4	**00.00.21**	**00.00.47**	**00.00.09**	**00.00.09**	**00.01.56**

For the path is :

1. Traveloka

Table 2 Usability Testing Path Traveloka

2. Tiket.com

Table 3 Usability Testing Path Tiket.com

3. Indonesia Flight

Table 4 Usability Testing Path Indonesia Flight

4. Recommendation Website

Table 5 Usability Testing Path Recommendation Web

B. Learnability

Learnability is a criteria that measures the ease of a site to be learned and used, especially for first-time users viewing and browsing the site. To illustrate learnability of traveloka website, ticket.com, indonesia flight, and recommendation website can be seen in table below, this table is obtained from the test results of respondents in this research.

Participant	Task Scenario								Participants	Task Scenario						
	1	2	3	4	5	6	7			1	2	3	4	5	6	7
1						■			1						■	
2									2							
3		■	■						3			■				
4									4							
5	■								5							

Participants	Task Scenario								Participants	Task Scenario						
	1	2	3	4	5	6	7			1	2	3	4	5	6	7
1									1							
2									2							
3		■							3							
4					■				4							
5									5							

C. Satisfaction

Satisfaction in this study is represented from the results of the Likerts questionnaire which is given to all participants after the usability testing process. The results of the questionnaire are listed below.

No	Question	Stongly Disagree	Disagree	Un-decided	Agree	Strongly Agree	Score
1	How easy it is to search with recommended websites	-	-	-	3	7	94%
2	Are you satisfied to search with recommended websites	-	-	-	3	7	94%

D. Error

This criteria are assesses the site through the number of mistakes made by the participants when doing usability testing with the scenario task.

Scenario	Participant					Scenario	Participants				
	1	2	3	4	5		1	2	3	4	5
1					■	1	■				
2			■			2					
3			■			3			■		
4			■			4					
5						5					
6	■					6				■	
7		■				7					

3. CONCLUSION

Based on the results of the description starting from the design process to the implementation process and testing conducted, the following conclusions are obtained

A. Conclusion

1. Evaluation on the website recommendation prototype shows 52.9% faster results than Ticket.com website, and 75% faster than all Online Travel Agent website that became the object of research on the segment of flight destinations selection.
2. Evaluation on the recommended website prototype shows 10% faster results from Indonesia Flight website and 47% of all other Online Travel Agent websites in the filling segment of departure date.
3. Evaluation on the recommended website prototype shows 25% faster results from Traveloka and 60.5% of all Online Travel Agent websites that become objects in the use of ticket search buttons.
4. Evaluation on the website recommendations prototype shows 45% faster results from Ticket.com website and 61.2% faster than all websites used as research objects in total segment ticket search time.

B. Suggestion

1) Traveloka.com, Tiket.com, and Indonesiaflight.id may consider the results of the initial site testing evaluation and prototype recommendation website.
2) Usability testing should be done periodically for a certain period of time, for example every 12 - 18 months.
3) Consider other aspects, such as marketing, sales, promotion.
4) Using web design software to get maximum results.
5) Pay attention to content changes, not just views.

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POWER QUALITY PERFORMANCE OF MULTI PHOTOVOLTAIC CONNECTED TO GRID UNDER VARIABLE SOLAR TEMPERATURE AND IRRADIANCE LEVEL

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ABSTRACT

Photovotaic (PV) other than capable to result power, it also generates harmonics due to the presence of an inverter as a medium to convert DC to AC voltage so can reduce power quality. PV generator also has intermitten characteristic and generate power depend on environment condition e.g. temperature and irradiance level. The paper presents performance improvement of power quality due to the influence of multi PV integration to low voltage distribution line of 380 kV (phase-phase) 50 Hz on point common coupling (PCC) bus under variable solar temperature and irradiance level. The model consists of three PV generator groups with 100 kW active power. In addition to connecting on a three phase grid, PV generator is also connected to three groups of three phase loads with 20 kW active power each. The power quality parameters studied are voltage and current unbalance as well as voltage and current harmonics in eight scenarios PV generator connected on three phase grid. The single tuned filter is used to improve power quality using two conditions before and after filter installed. Multi PV models with three phase generators connected three phase grid, without and with single tuned filters at all irradiance and temperature levels results phase maximum voltage (phase A, B, and C) in relatively stable of 308 and 310 Volt respectively, and generating unbalanced voltage of 0%. The maximum phase current value, for system without single tuned filter at all irradiance and temperature levels are different as 12.5, 9.8, and 10 A, respectively, resulting in unbalanced current of 16.0991%. Under the same condition, single tuned filters are capable to balance maximum phase currents (phase A, B, and C) of 10.45 A respectively, so able to reduce unbalanced current to 0%. The implementation of single tuned filter can reduce unbalanced current values according limit ANSI/IEEE 241-1990. At a constant temperature and irradiance levels are increasing, voltage and current average harmonics (total harmonics distortion) are also increasing. The use of single tuned filter is the most effective in suppressing 5[th] harmonics so can reduce average value of voltage and current harmonics significantly within IEEE 519-1992.

Keywords: *Power Quality, Total Harmonic Distortion, Multi PV Generator, Temperature, Irradiance*

1. INTRODUCTION

Microgrid with distributed generations (DGs) sources in which electricity is supplied to local loads and may operate separately from conventional grid. DGs have many benefits such as being able to reduce transmission costs, lower investment costs, reduce distribution line losses and improve grid reliability. DGs using renewable energy to generate power are classified as disperse energy sources. Solar or PV generator are one of the most potential DGs technologies because they only require sunlight to generate electricity, where their resources are available in abundance, free, and relatively clean [1]. In order to support 35 thousand MW electricity program, starting in early 2016 Indonesia government will build a number of PV generator in the urban areas on the top of urban buildings called name roof top PV, as one solution to develop small scale electric power. The consideration is more on economic aspect because development of conventional PV generator requires relatively wide land, whereas price of land in urban areas is very expensive. The roof top PV will be deployed on several roofs of government buildings and airports in eastern Indonesia. It also will be integrated into Indonesia Electric Company (PLN) distribution network, so that if there is an excess of power, the PV power can be supplied and purchased by PLN [2].

The weakness of PV generator is in addition to supply power to grid, it also generates harmonics due to the presence of an inverter as a medium to convert DC voltage to AC so can reduce power quality in system. PV generator also has intermitten characteristic and generate power depend on environment condition e.g. temperature and irradiance level. Research of power quality problem on grid connected to PV system using LCL filter has been done by Kon Keng Weng et. al. The simulation results indicate that a number of electrical power quality problems such as over voltage, less voltage, power fluctuations, inrush currents, low power factor, and current harmonics will appear on microgrid. The disadvantage is that research is conducted only on conditions of certain solar irradiance and

temperature (1000 W/m^2 and 25^{0}C) as environmental input parameters for PV systems [1]. Minas Patsalides, et.al has made investigation an effect of solar irradiance on grid connected PV generator to power quality e.g. voltage harmonics, current harmonics, active power, reactive power, and power factor. The study considers on two different scenarios of average and low irradiance. The weakness of study is not to consider temperature effect as variable environment input of PV generator [3]. Renu, et. al. has conducted a research of grid conneted to single phase PV generator inverter using a current proportional resonant, proportional resonant integral, and genetic algorithm controller using active filter to reduce current harmonic on inverter output. The shortcoming of research is only performed on a single phase system as well as fixed solar irradiance and temperature [4].

Massoud Farhoodnea, et. al. has examined analysis of dynamic power quality due to high penetration effect of grid connected to PV array on distribution system under different solar irradiance condition. The analysis was performed on a 16 bus system model and the result showed that high level penetration of grid connected PV would cause a number of power quality problems e.g. voltage swell, voltage flicker, power factor losses and current harmonics. The weakness of research is the analysis only held on voltage harmonics and does not consider enviromental temperature condition [5]. The research on power quality characteristics in a number of three phase PV inverters at roof top PV including harmonics distortion, voltage fluctuations, and reactive power and power factors have been performed by K.P. Kontogianis, et. al [6]. Almas Hossain Mollah, et.al. has investigates three phase grid connected to PV generator using MPPT with Perturb and Observe method and a voltage source inverter controller, as well as its effect on current harmonics injected into grid and grid voltage harmonics . The drawback of research are only carried out on single level of irradiance and temperature (1000 W/m^2 and 25^{0}C) and does not consider harmonic improvement limitation (current and voltage) according to IEEE 519-1992 [7]. Amirullah, et. al. has examined the effect of PV power integration on power quality on three phase point common coupling (PCC) bus under different solar irradiance conditions using a double tuned filter. The results showed that at a fixed solar irradiance level, the more number of PV generator connected to three phase grid, average THD of voltage and current increased. While at the level of solar irradiance increased, average THD grid voltage and current also increased. Double tuned passive filters can reduce THD value of average voltage and current. The disadvantage is the research analysis is carried out at a fixed temperature level of 40^{0}C, whereas the fact shows that ambient temperature is the main input variable for a PV generator other than solar irradiance whose value is always changing with time [8].

The objective of this paper is to improve the performance of power quality due to the influence of multi PV integration to low voltage distribution line of 380 kV (phase-phase) 50 Hz under variable solar temperature and irradiance level. The model consist of three PV generator groups with 100 kW active power each were used in this study. In addition to connecting on a three phase grid, the PV generator is also connected to three groups of three phase loads each having 20 kW active power. The power quality parameterr studied are the value of three phase voltage and current unbalance as well as voltage and current harmonics in eight scenarios PV generator connected on three phase grid. The band pass filter model (single tuned) is used to improve power quality using two conditions before and after filter installed. The simulation parameter results in PCC bus are further validated against to limit ANSI/IEEE 241-1990 (voltage and current unbalance) and IEEE 519-1992 (THD voltage and current), as the basis for determining power quality level. Simulation and research analysis use Matlab/Simulink environment. The rest of this paper is organized as follow. Section 2 shows research methodology which proposed model of single PV generator connected three phase grid, model of three PV generator connected three phase grid, simulation parameters, equivalent circuit and mathematical of PV model, harmonics and voltage/current unbalance, and single tuned filter model. Section 3 describes influence of variable solar irradiance and temperature level of three model PV generator to voltage and current unbalance as well as voltage and current THD without and with single tuned filter. In this section, example cases studied are presented and the results are verified with those of Matlab/Simulink. Finally, the paper in concluded in Section 4.

2. METHODOLOGY
2.1. Research Method

A system model of 100 kW single PV generator connected to a three phase grid is shown in Figure 1. The PV generator produces output voltage and becomes as input for DC/DC boost converter. The MPPT with Pertub and Observe algorithm further helps single phase PV generator result maximum power. The DC output voltage from PV generator is relatively low and then the voltage is increased by DC/DC boost converter to produce output voltage by adjusting duty cycle using switching equipment. The DC voltage is then converted by a three phase of DC/AC inverter to an AC voltage to three phase grid, using a six pulse width modulation (PWM) voltage source inverter controller based on proportional integral. Figure 2 shows proposed model of three groups of PV generator to 380

Volt (phase-phase) 50 Hz three phase low voltage on point common coupling (PCC) bus and 100 MVA 20 kV three phase grid through 100 kVA 20 kV/380 V three phase transformer.

The paper presents performance of power quality improvement on three phase grid of PCC bus due to influence of PV generator integration to 380 kV (phase-phase) 50 Hz low voltage distribution system at different temperature and irradiance conditions. The study used multi (three) models of PV generator each with an active power of 100 kW. The power quality parameters studied are voltage and current unbalance, as well as voltage and current harmonics in eight PV generator scenarios connected to three phase distribution on PCC bus at variable temperature and irradiance levels. The first scenario is before a single tuned filter installed at the irradiance level: (i) 400 W/m^2, (ii) 600 W/m^2, (iii) 800 W/m^2, and (iv) 1000 W/m^2. The second scenario is after installing a single tuned filter at the irradiance level: (i) 400 W/m^2, (ii) 600 W/m^2, (iii) 800 W/m^2, and (iv) 1000 W/m^2. The degree of temperature of each condition is 20^0 C, 25^0 C, 30^0 C, 35^0 C, and 40^{0}C. So the total scenario number are eight different irradiance levels (without and using a single tuned filter) where each of them are five temperature levels.

The simulation of circuit model is performed to determine voltage and current curve of three phase distribution line on PCC bus. To improve power quality performance, a model single passive band pass filter (single tuned) that serves suppress single 5th harmonics. A three phase circuit breaker (CB) is used to connect and disconnect a single tuned filter between PV generator with a three phase system. The next step is to determine voltage and current unbalance as well as voltage and current harmonics or total harmonics distortion (THD) of three phase grid on PCC bus in each scenario. The last step is to compare voltage and current unbalance as well as voltage and current THD of low distribution line on PCC bus referring to ANSI/IEEE 241-1990 and IEEE 519-1992 as the basis for determining power quality in eight irradiance and temperature level scenarios. Simulation and analysis of research results using Matlab/Simulink.
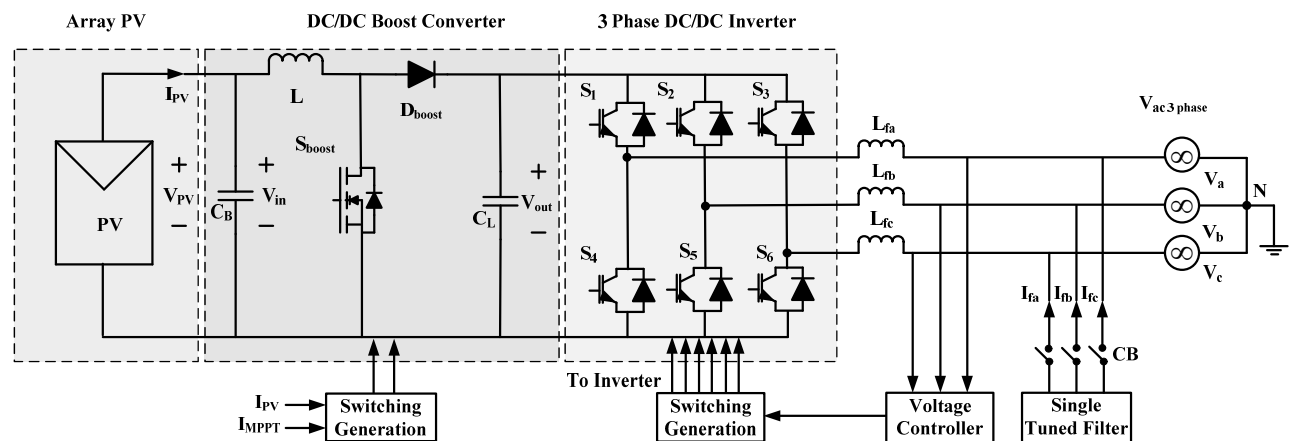
Figure 1. Model of single PV generator connected three phase grid
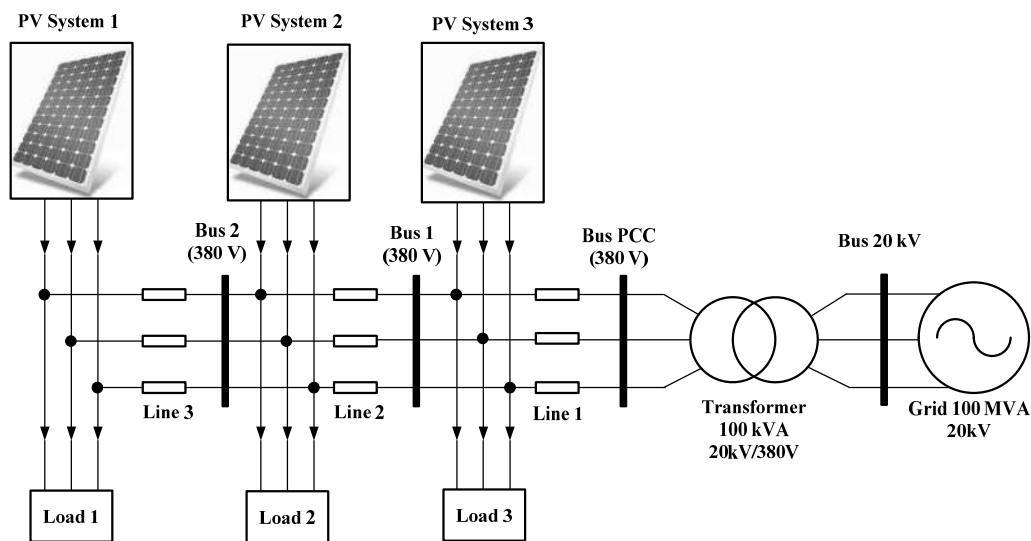
Figure 2. Proposed model of three PV generator connected to three phase grid

2.1. Simulation Parameters

Table 1 shows the devices, parameters, and simulation values of proposed model.

Table 1. Simulation Parameters

Devices	Parameters	Values
PV Generator 1, 2, and 3	Active Power Temperature Irradiance	100 kW $20^0, 25^0, 30^0, 35^0,$ and 40^0 C 400, 600, 800, and 1000 W/m^2
Three Phase Grid	Short Circuit MVA Voltage (phase-phase) Frequency	100 MVA 380 volt 50 Hz
Power Transformer	Power Frequency Voltage	100 kVA 50 Hz 380 Volt/20 kV
Load 1, 2, and 3	Actve Power Frequency Voltage	20 kW 380 Volt 50 Hz
Low Voltage Line 1,2, and 3	Resistance Inductance Capacitance	R = 0,1273 Ohm/km L = 93,37 mH/km C = 1,274 µF/km
Length of Low Voltage Line 1,2, and 3	Line 1 Line 2 Line 3	1 km 1 km 1 km
DC Link Capasitor	Capacitance	2000 µF
PWM Generator on Each PV Generator	Frequency Sampling time	4 kHz 5×10^{-6} detik
Single Tuned Filter	Reactive Power Voltage (phase-phase) Frequency System Frequency Tuning Quality Factor (Q)	50 MVAR 380 V 50 Hz f = 5 x 50 Hz 16

2.2. Photovoltaic Model

Figure 3 shows the equivalent circuit of a solar panel. A solar panel is composed of several PV cells that have series, parallel, or series-parallel external connections [9].
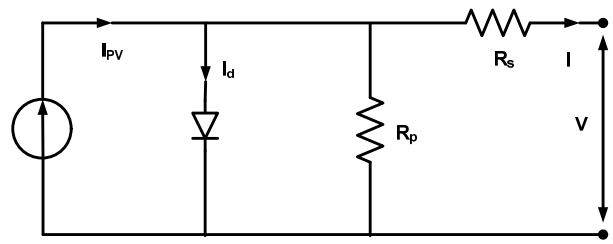
Figure 3. Equivalent circuit of solar panel

The V-I characteristic of a solar panel is showed in (1) [10] :

$$I = I_{PV} - I_o\left[\exp\left(\frac{V + R_S I}{aV_t}\right) - 1\right] - \frac{V + R_S I}{R_P} \tag{1}$$

where I_{PV} is the photovoltaic current, I_o is saturated reverse current, 'a' is the ideal diode constant, $V_t = N_S KTq^{-1}$ is the thermal voltage, N_S is the number of series cells, q is the electron charge, K is the Boltzmann constant, T is the temperature of p–n junction, R_S and R_P are series and parallel equivalent resistance of the solar panels. I_{PV} has a linear relation with light intensity and also varies with temperature variations. I_o is dependent on temperature variations. The values of I_{pv} and I_o are calculated as following (2) and (3):

$$I_{PV} = (I_{PV,n} + K_1\Delta T)\frac{G}{G_n} I \tag{2}$$

$$I_o = \frac{I_{SC,n} + K_I\Delta T}{\exp(V_{OC,n} + K_V\Delta T)/aV_t - 1} \tag{3}$$

In which $I_{PV,n}$, $I_{SC,n}$ and $V_{OC,n}$ are photovoltaic current, short circuit current and open circuit voltage in standard conditions ($T_n = 25$ C and $G_n = 1000$ Wm^{-2}) respectively. K_I is the coefficient of short circuit current to temperature, $\Delta T = T - T_n$ is the temperature deviation from standard temperature, G is the light intensity and K_V is the ratio coefficient of open circuit voltage to temperature. Open circuit voltage, short circuit current and voltage-current corresponding to the maximum power are three important points of I-V characteristic of solar panel. These points are changed by variations of atmospheric conditions. By using (4) and (5) which are derived from PV model equations, short circuit current and open circuit voltage can be calculated in different atmospheric conditions.

$$I_{SC} = (I_{SC} + K_1\Delta T)\frac{G}{G_n} \tag{4}$$

$$V_{OC} = V_{OC} + K_V\Delta T \tag{5}$$

2.3. Harmonics and Voltage/Current Unbalance

Power quality means quality of voltage and current. Power quality is determined based on the voltage and current value or the tolerance limit of equipment used. In general, current and voltage wave form of pure sinusoidal waves. One problem that occurs is non sinusoida or distorted current and voltage waves generated by harmonics in the power system [11]. Harmonic is distorted periodic steady state wave caused by the interaction between the shape of a sine wave at the fundamental frequency system with another wave component which is an integer multiples frequency of fundamental frequency. The most common harmonic index, which relates to the voltage waveform, is THD, which is defined as the root mean square (rms) of the harmonics expressed as a percentage of the fundamental component as showed in (12). For most applications, it is sufficient to consider the harmonic range from the 2nd to 25th, but most standards specify up to the 50th. Second harmonic index is current THD means the ratio of rms harmonic current value to rms fundamental current which expressed in (7) [11].

$$THD_V = \frac{\sqrt{\sum_{n=2}^{N} V_n^2}}{V_1} \times 100\ \% \tag{6}$$

$$THD_I = \frac{\sqrt{\sum_{n=2}^{N} I_n^2}}{I_1} \times 100\ \% \tag{7}$$

where V_n and I_n (the rms voltage and current at harmonic n), V_1 and I_1 (the fundamental rms voltage and current), N (the maximum harmonic order to be considered). The allowable maximum THD value for each country is different depending on the standard used. THD standards most often used in electric power system is IEEE 519-1992 standard. There are two criteria used in the analysis of harmonic distortion that voltage distortion limit and current distortion limit [13].

There are several standards that can be used to determine level of voltage unbalance in three phase systems, e.g. IEC, NEMA, and IEEE. In this study, value of unbalance voltage use Equation 8 is based ANSI/IEEE 241-1990 Standard [14] as follows:

$$V(\%) = \frac{\left| V_{a\,var age} - V_{a,b,c\,\min or\,\max} \right|}{V_{a\,var age}} \times 100\% \qquad (8)$$

By using Equation 8, value of unbalance voltage expressed in percent (%) and is defined as follows; $V_{avarage}$ is the average value of maximum voltage on phase a, b, c, (volt), $V_{a,b,c\,\min}$ is minimum voltage on phase a, b, c, (volt), $V_{a,b,c\,\max}$ is maximum voltage on phase a, b, c (volt). By using the same equation, then percentage of unbalance current can be calculated by replacing voltage magnitude into current magnitude.

2.4. Single Tuned Filter

The shunt passive filters always considered as good solution to solve harmonics current problems. Shunt passive filters can be classified into three basic catagories as follows (a) Band pass filters (of single or double tuned), (b) High pass filters (of first, second, third-order or C-type), and (c) Composite filters as shown in Figure 4. A single tuned filter consisting of inductor L_f, capacitor C_f and small damping resistor R_f are connected in parallel with non-linear loads to provide low-impedance paths for specific harmonic frequencies, thus resulting in absorbing the dominant harmonic currents flowing out of the load. Furthermore it also compensates reactive power at system operating frequency [15]. Single tuned passive filters are used to suppress single harmonics e.g. 5th, 7th, 9th, 11th, or 13th harmonics. Whereas double tuned passive filter is used to eliminate double harmonics such as the 5th and 57th harmonics or the 11th and 13th harmonics. In this paper a single tuned active filter model is used to reduce the 5th harmonics.

(a) Circuit   (b) Impedance characteristic
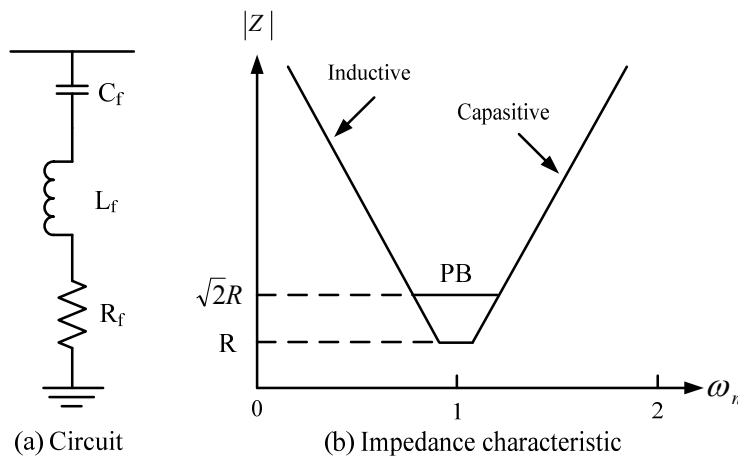
Figure 4. Single tuned filter circuit and impedance characteristic curve

Figure 4 shows a single tuned filter which is a series RLC circuit tuned to a single harmonics frequency provides a low harmonic impedance charuracteristic generally. As shown in Figure 4, the filter pass band (PB) is defined as being bounded by the frequencies at which the filter reactance is equal to its resistance; i.e., the impedance angle is 45° and the magnitude is $\sqrt{2}R$. Relationship between the quality factor and pass band can be expressed as follows [16]:

$$Q = \omega_n / PB \qquad (9)$$

Where Q is defined as the ratio of the inductance (or capacitance) to resistance at the resonant frequency and ω_n is the tuned angular frequency (rad/s).

The impedance versus frequency of this filter is shown [15]:

$$Z_f(S) = \frac{1 + R_f C_f S + L_f C_f S^2}{C_f S} \qquad (10)$$

Where S = j2πf

Generally the filter capacitor is sized for known reactive power compensation Q_c required to improve power factor, C_f can be expressed as:

$$C_f = \frac{1}{2\pi f_1 U^2}\left(1 - \frac{1}{n^2}\right) \tag{11}$$

Where U is the supply voltage, n is the harmonic order and f_1 is a fundamental frequency.

At the harmonic frequency $f_n = n\, f_1$ the filter reactor provides a series resonance.

$$L_f\, 2\pi f_n = \frac{1}{C_f\, 2\pi f_n} \tag{12}$$

The inductive value of filter can be obtained from equation 6 as:

$$L_f = \frac{1}{(2\pi f_n)^2 C_f} \tag{13}$$

The value of the low-impedance R_f for each single tuned filter is affected by the quality factor of filter Q.

$$R_f = 2\pi f_1\, n\, \frac{L_f}{Q} \tag{14}$$

The quality factor Q determines the sharpness of tuning. Usually, a value of Q ranges between 20 and 100. High Q-value filter give the best reduction in harmonic distortion. The interaction of the filter with the source reactance L_s, creates a parallel resonance condition addition to the series resonance frequency of the filter.

$$f_p = \frac{1}{2\pi(\sqrt{(L_f + L_s)C_f}} \tag{15}$$

3. RESULTS

Analysis of the results starts from determination of maximum and minimum grid voltages in each phase, to compute unbalanced voltage using Equation 8, as well as voltage THD of three phase grid on PCC bus without and with single tuned filter each. By using the same procedure and equation, then we get unbalance current and current THD of three phase grid. Table 2 shows unbalanced voltage and average voltage harmonics (THD$_V$) in three PV generator integration model to a three phase grid and four levels of irradiance with five different temperature levels. Table 3 shows the unbalanced current and average harmonic current (THD$_I$) on the PCC bus under the same condition.

Table 2. Voltage Unbalance and Voltage Avarage Harmonics

No.	Irradiance Level (W/m²)	Temperature (⁰C)	Maximum Voltage (V)			Unbalance Voltage (%)	THDᵥ			Avarage THDᵥ (%)
			A	B	C		A	B	C	
					Without Single Tuned Passive Filter					
1.	400	20	308	308	308	0	2.66	2.51	2.59	2.59
		25	308	308	308	0	2.62	2.56	2.56	2.58
		30	308	308	308	0	2.69	2.60	2.63	2.64
		35	310	310	310	0	2.67	2.53	2.59	2.60
		40	310	310	310	0	2.68	2.58	2.62	2.62
2.	600	20	308	308	308	0	3.59	3.60	3.63	3.61
		25	308	308	308	0	3.70	3.64	3.61	3.65
		30	308	308	308	0	3.61	3.55	3.49	3.55
		35	310	310	310	0	3.66	3.56	3.55	3.59
		40	310	310	310	0	3.66	3.60	3.54	3.60
3	800	20	310	310	310	0	4.16	4.19	4.06	4.14
		25	310	310	310	0	4.21	4.21	4.12	4.18
		30	310	310	310	0	4.12	4.14	3.99	4.11
		35	310	310	310	0	4.16	4.14	4.06	4.12
		40	310	310	310	0	4.11	4.14	4.03	4.10
4.	1000	20	310	310	310	0	4.12	4.08	4.01	4.07
		25	310	310	310	0	4.15	4.07	3.98	4.06
		30	310	310	310	0	4.04	3.99	3.93	3.98
		35	310	310	310	0	4.03	3.94	3.90	3.96
		40	310	310	310	0	4.03	3.90	3.90	3.94
					With Single Tuned Passive Filter					
1.	400	20	308	308	308	0	0.22	0.23	0.22	0.22
		25	308	308	308	0	0.22	0.23	0.23	0.23
		30	308	308	308	0	0.23	0.23	0.22	0.23
		35	310	310	310	0	0.23	0.23	0.23	0.23

		40	310	310	310	0	0.23	0.23	0.23	0.23
2.	600	20	308	308	308	0	0.33	0.33	0.34	0.33
		25	308	308	308	0	0.34	0.34	0.34	0.34
		30	308	308	308	0	0.34	0.34	0.34	0.34
		35	310	310	310	0	0.34	0.33	0.34	0.34
		40	310	310	310	0	0.35	0.34	0.35	0.35
3	800	20	308	308	308	0	0.42	0.43	0.43	0.43
		25	308	308	308	0	0.43	0.43	0.43	0.43
		30	308	308	308	0	0.43	0.41	0.43	0.42
		35	310	310	310	0	0.42	0.42	0.42	0.42
		40	310	310	310	0	0.43	0.42	0.43	0.43
4.	1000	20	310	310	310	0	0.43	0.43	0.43	0.43
		25	310	310	310	0	0.41	0.42	0.43	0.42
		30	310	310	310	0	0.42	0.42	0.42	0.42
		35	310	310	310	0	0.41	0.42	0.42	0.42
		40	310	310	310	0	0.41	0.42	0.42	0.42

Table 3. Unbalance Current and Current Avarage Harmonics

No.	Irradiance Level (W/m²)	Temperature (°C)	Maximum Current (A)			Unbalance Current (%)	THD$_I$			Avarage THD$_I$ (%)
			A	B	C		A	B	C	
			Without Single Tuned Passive Filter							
1.	400	20	12.5	9.5	10	17.1875	2.01	1.27	1.69	1.657
		25	12.4	9.8	10	15.5278	2.02	1.26	1.68	1.654
		30	12.5	9.8	10	16.0991	2.01	1.27	1.68	1.653
		35	12.5	9.8	10	16.0991	2.02	1.27	1.70	1.663
		40	12.5	9.8	10	16.0991	2.02	1.27	1.70	1.663
2.	600	20	12.5	9.8	10	16.0991	2.28	1.47	1.93	1.893
		25	12.5	9.8	10	16.0991	2.23	1.47	1.83	1.843
		30	12.5	9.8	10	16.0991	2.01	1.27	1.68	1.653
		35	12.5	9.8	10	16.0991	2.02	1.27	1.70	1.663
		40	12.5	9.8	10	16.0991	2.02	1.27	1.70	1.663
3	800	20	12.5	9.8	10	16.0991	2.29	1.57	1.95	1.937
		25	12.5	9.8	10	16.0991	2.30	1.56	1.95	1.936
		30	12.5	9.8	10	16.0991	2.29	1.55	1.95	1.930
		35	12.5	9.8	10	16.0991	2.29	1.55	1.95	1.930
		40	12.5	9.8	10	16.0991	2.29	1.55	1.93	1.923
4.	1000	20	12.5	9.8	10	16.0991	2.36	1.63	1.88	1.957
		25	12.5	9.8	10	16.0991	2.35	1.64	1.87	1.953
		30	12.5	9.8	10	16.0991	2.34	1.63	1.87	1.947
		35	12.5	9.8	10	16.0991	2,32	1.62	1.86	1.933
		40	12.5	9.8	10	16.0991	2.32	1.61	1.83	1.920
			With Single Tuned Passive Filter							
1.	400	20	10.45	10.45	10.45	0	0.09	0.09	0.09	0.09
		25	10.45	10.45	10.45	0	0.09	0.09	0.09	0.09
		30	10.45	10.45	10.45	0	0.09	0.09	0.09	0.09
		35	10.45	10.45	10.45	0	0.09	0.09	0.09	0.09
		40	10.45	10.45	10.45	0	0.09	0.09	0.09	0.09
2.	600	20	10.45	10.45	10.45	0	0.13	0.13	0.13	0.13
		25	10.45	10.45	10.45	0	0.13	0.13	0.13	0.13
		30	10.45	10.45	10.45	0	0.13	0.13	0.13	0.13
		35	10.45	10.45	10.45	0	0.13	0.13	0.13	0.13
		40	10.45	10.45	10.45	0	0.13	0.13	0.13	0.13
3	800	20	10.45	10.45	10.45	0	0.17	0.17	0.17	0.17
		25	10.45	10.45	10.45	0	0.17	0.17	0.16	0.17
		30	10.45	10.45	10.45	0	0.17	0.17	0.17	0.17
		35	10.45	10.45	10.45	0	0.17	0.17	0.16	0.17
		40	10.45	10.45	10.45	0	0.17	0.16	0.16	0.16
4.	1000	20	10.45	10.45	10.45	0	0.17	0.17	0.17	0.17

	25	10.45	10.45	10.45	0	0.17	0.17	0.17	0.17
	30	10.45	10.45	10.45	0	0.16	0.16	0.16	0.16
	35	10.45	10.45	10.45	0	0.16	0.16	0.16	0.16
	40	10.45	10.45	10.45	0	0.16	0.16	0.16	0.16

Figure 5 shows a grid voltage curve of PV generator model connected three phase grid on two levels of solar irradiance (600 W/m^2 and 1000 W/m^2) in PCC bus without and with single tuned filter.

(a) Without single tuned filter (irradiance 600 W/m^2)   *(b) With single tuned filter (irradiance 600 W/m^2)*

(c) Without single tuned filter (irradiance 1000 W/m^2)   *(d) With single tuned filter (irradiance 1000 W/m^2)*
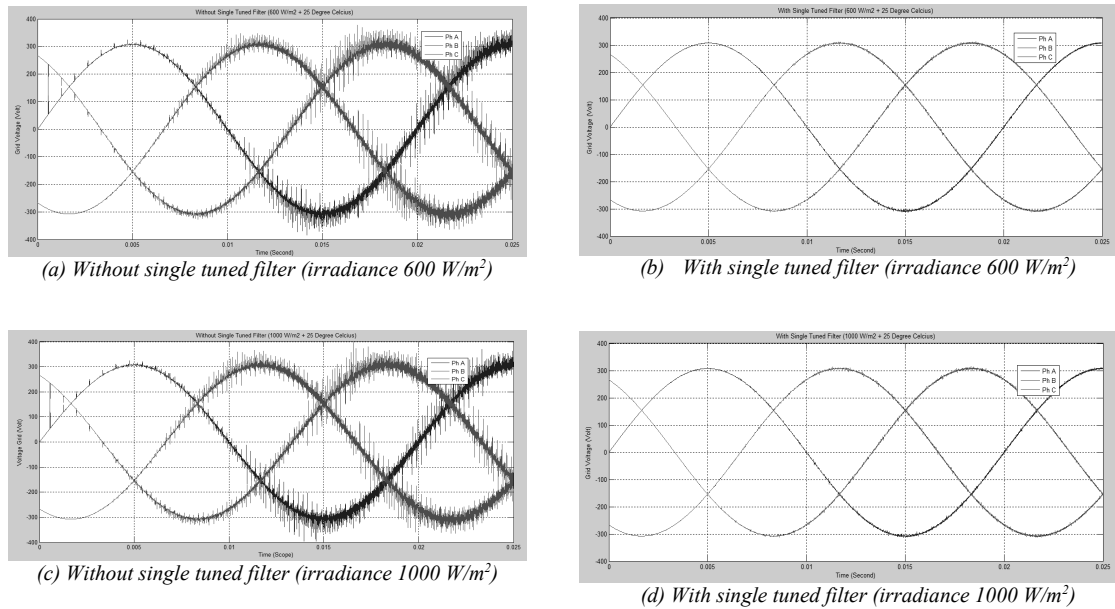
Figure 5. Grid Voltage Curve at Two Levels of Solar Irradiance with Temperature of 25^0 C

Figure 6 shows harmonics spectra of grid voltage of PV generator model connected three phase grid on two levels of solar irradiance (600 W/m^2 and 1000 W/m^2) in PCC bus without and with single tuned filter.

(a)   Without single tuned filter (irradiance 600 W/m^2)   *(b)   Without single tuned filter (irradiance 600 W/m^2)*

(c)   Without single tuned filter (irradiance 1000 W/m^2)   *(d)   With single tuned filter (irradiance 1000 W/m^2)*
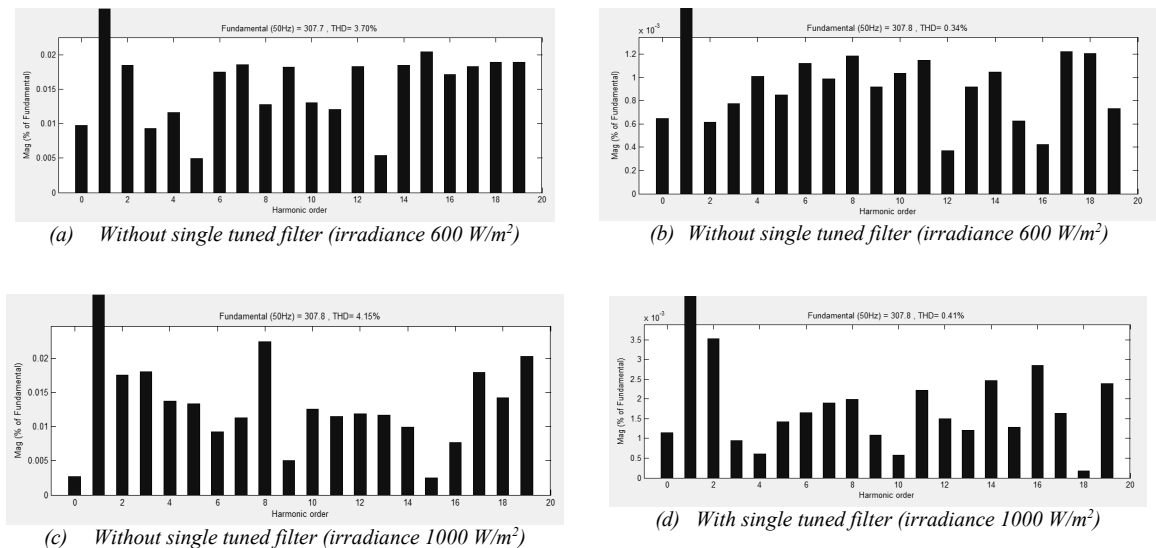
Figure 6. Grid Voltage Harmonics Spectra on Phase A at Two Levels of Solar Irradiance with Temperature of 25^0 C

Figure 7 shows the graph of voltage and current average harmonics values in three PV generator model connected three phase grids on PCC bus at four levels of irradiance (temperature 25^0 C), without and with single tuned passive filter.
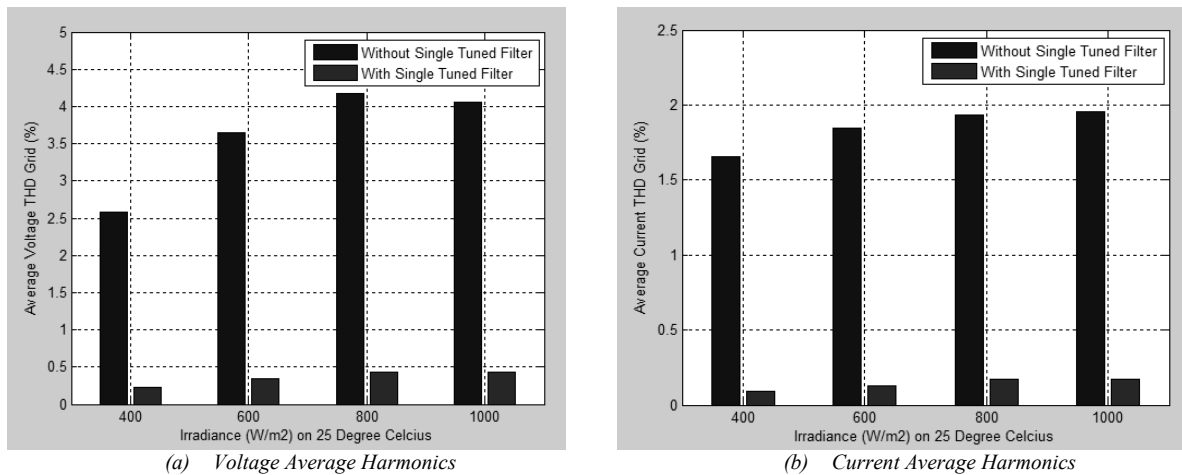
(a) Voltage Average Harmonics   *(b) Current Average Harmonics*
Figure 7. Average Harmonic of Voltage and Current at Four Irradiance Levels (Temperature 25^0C)

Table 2 shows that maximum voltage values (phase A, B, and C), systems without single tuned filter at all irradiance levels (400 W/m^2 to 1000 W/m^2) and temperatures (20 ^{0}C to 40^{0}C) are still stable at 308 and 310 Volt, resulting in an unbalanced voltage as 0%. The maximum phase voltage value of system using single tuned filter at all irradiance levels and temperatures (20^{0}C, 250C, and 300C) is equal to 308 volt and at temperatures (350C and 400C) the value increases to 310 Volt respectively, resulting in same unbalance voltage of 0%. Under conditions without using single tuned filter, the irradiance level is fixed and the temperature increases (20^{0}C to 40^{0}C), voltage average harmonics (THD$_V$) is relatively same. Otherwise in the conditions without filter and temperature remain, but in irradiance level increases, then voltage average harmonics increases. The lowest harmonic value is generated at irradiance level of 400 W/m^2 and temperature of 25^{0}C is 2.58%, while the highest harmonic occurs at the irradiance level of 800 W/m^2 and temperature of 25^{0}C is 4.18%. Under the same conditions using single tuned filter, fixed irradiance level, and temperature increases (20^{0}C to 40^{0}C), voltage average harmonic is relatively same. In unfiltered condition and fixed temperature, but irradiance level is increasing, then voltage average harmonic is also increasing. The difference is single tuned filter can suppress the 5th harmonics so as to lower voltage average harmonics significantly compared to system without using filters to average below 0.5%. In the system using single tuned filter, the lowest voltage average harmonics is generated at 400 W/m^2 irradiance level and temperature of 20^{0}C as 0.22%, while the highest voltage average harmonics happens at irradiance level of 800 W/m^2 and temperature of 25^{0}C is 0.43%.

Table 2 shows that maximum current values in phase A, B, and C, for systems without using single tuned filters at all irradiance levels (400 W/m^2 to 1000 W/m^2) and temperature (20^{0}C to 40^{0}C) are 12.5, 9.8 and 10 A respectively, so unbalanced current is achieve 16.0991%. In the same condition the single tuned filter is able to balance maximum phase currents of 10.45 A each, resulting in an unbalanced current equal to 0%. Under conditions without using single tuned filter, fixed irradiance level, and temperature increases (20^{0}C to 40^{0}C), current average harmonics (THD$_I$) is relatively same. While at conditions without filter and temperature remain, but irradiance level is increasing, current average harmonics increases. The lowest current average harmonics is generated at 400 W/m^2 irradiance level and temperature of 25^{0}C is 1.654%, while the highest current average harmonics occurs at irradiance level of 1000 W/m^2 and temperature of 20^{0}C is 1.957%. Under conditions using single tuned filter, fixed irradiance level, and increasing temperature (20^{0}C to 40^{0}C), current average harmonics value is relatively same. Under unfiltered conditions and fixed temperature, but irradiance level is increasing, current average harmonics is also increasing. The use of single tuned filter can eleminate 5th harmonics so can reduce current average harmonics compared to without using filter to average below 0.2%. The lowest current average harmonic is generated at irradiance level of 400 W/m^2 and the temperature (200C to 40%) is 0.09%, while the highest current average harmonics at irradiance level of 800 W/m^2 and temperature of 25 ^{0}C as 0.17%.

Figure 7.a. shows that at increasing irradiance level (400 W/m^2 to 1000 W/m^2) and fixed temperature (25^0 C), voltage average harmonics is also increasing. The application of single tuned filter capable to suppress 5th harmonics so can reduce significantly reduce voltage average harmonics. Figure 7a also shows that at increasing irradiance level (400 W/m^2 to 1000 W/m^2) and fixed temperature (25^0 C), the current average harmonics is also increasing.

Single tuned active filter is also effective enough to eliminate 5th harmonics so as to slightly reduce current average harmonics.

4. CONCLUSION

Multi PV models with three phase generators connected three phase grid, without and with single tuned filters at all irradiance and temperature levels results phase maximum voltage (phase A, B, and C) in relatively stable of 308 and 310 Volt respectively, and generating unbalanced voltage of 0%. The maximum phase current value, for system without single tuned filter at all irradiance and temperature levels are different as 12.5, 9.8, and 10 A, respectively, resulting in unbalanced current of 16.0991%. Under the same condition, single tuned filters are capable to balance maximum phase currents (phase A, B, and C) of 10.45 A respectively, so able to reduce unbalanced current to 0%. The implementation of single tuned filter can reduce unbalanced current values according limit ANSI/IEEE 241-1990. At a constant temperature and irradiance levels are increasing, average harmonics of voltage and current is also increasing. The use of single tuned filter is the most effective in suppressing 5th harmonics so can reduce average value of voltage and current harmonics significantly within IEEE 519-1992.

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ANIMATION CONTROL FOR DIGITAL STORYTELLING USING HAND MOTION CAPTURE BASED FINITE STATE MACHINE

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ABSTRACT

The animated characters that tell the story of the people can be one of the medium of learning for children. animation was designed and presented to the media learning has grown in recent times, Way of presenting different instructional animation content can lead to interest children to learn, one with a hand motion capture as an animated presentation. Digital Storytelling is the practice of combining images with a narrated soundtrack including voice, music and videos. Storytelling becomes a form of learning through an efficient game in which the user can see and understand that learning is delivered. In the concept of storytelling players do not directly play the game but is told advance the story.

Limitations of tools that should be played by one user can be maximized to two people with each using one hand to navigate the character, the testing process synchronization error recognition rate obtained by 90%, then increasing the capability of the hardware and software needed so that errors can be minimized by destination improve comfort in navigation when playing.

Keywords: *character, hand motion capture, Digital Storytelling, animation.*

1. INTRODUCTION

Hand motion capture developed seriously by many developers, take advantage of free software is always an alternative to design a medium learning for the preservation of culture in Indonesia.

Manik Angkeran folklore presented in an interactive form is divided into three parts, the first is the opening section featuring the story introduction, both are part of the game or interaction which in turn display Manik Angkeran have to deal with the dragon, the third is the concluding part of the show message- moral message in the legend of folklore are served.

In this research method based Finite State Machines (FSM) is a control system design methodology that describes the behavior or the working principle of the system by using the following three things: State (State of), Events (events) and action (action). At one moment in a significant period of time, the system will be in one of the active state. The system can switch or transition to another state if getting input or specific events, either from external devices or components within the system itself (eg timer interrupt).
.

2. METHODOLOGY

Problem formulation in this research is how to control two characters at once in the story and create a digital storytelling folktale with interesting and interactive that once of the user can interact directly.The purpose of this research are to movement control of the dynamic between the two characters animated with motion-based hand gesture leapmotion devices so that digital storytelling presented becomes more interesting and interactive.

The most important thing in storytelling is a process. In the process of telling this interaction between storyteller with the audience. Through storytelling process can be established communication between storyteller and

audience. Because this activity is very important for children, then these activities must be packed in such a way that interesting.

Figure 1 is a leather puppeteer activity, this activity usually tell the story - the story of the traditional Javanese royal era, and it takes skill to be able to play props such as *wayang kulit* and should understand the story being played.

Figure 1. puppeteer of Wayang Kulit (historia.id)

According Pudentia, the legend is a story that is trusted by some of the locals really happened, but it is not considered holy or sacred which also distinguishes myth. In KBBI 2005, the legend is the folklore of ancient times that has to do with historical events. According Emeis, the legend is an ancient story that is half based on history and the other half is based on wishful thinking. According to William R. Bascom (1954), the legend is a story that has characteristics similar to the myth, which is considered really happened, but it is not considered sacred and things that are based on the history that contains something magical or events that signify magic.

Devices that use is leapmotion, this device detects the movement of the arm and fingers using a depth sensor, replace the function of the keyboard and mouse and allows users to explore the computer only with finger movements. How it works is by creating a leap motion 4 cubic feet of interactive space that is capable of detecting the finger, hand and arm movements. Leapmotion technology is similar to the Kinect, but more accurate motion leap this because different methods are used Kinect work with leap motion (Hadi, 2013).

Leapmotion detect the depth of the finger and arm motion, with a finger or hand axis translating approaching as vector changes in the skeleton hands and fingers.

In Figure 2 This is the position, direction and speed of hand and fingers and 3D vectors that will be used in this device, this device refers to a right-handed Cartesian coordinate system, with the origin at the center of the X and Z axes lie in the plane horizontal and vertical Y axis.

Figure 2. The coordinate system on leapmotion
(jperedadnr.blogspot.com)
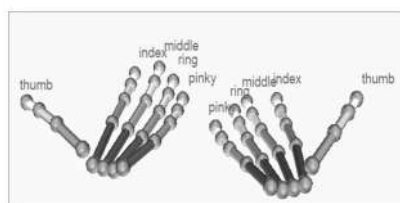
Figure 3. name of joint finger on leapmotion
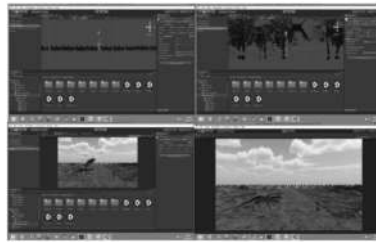
Figure 4. The making of the fight scene using unity.

Figure 3 is the name of each finger joint on leapmotion, where each finger thumb umtuk identified by the thumb, the index for the index, midle of the middle finger, ring and pinky to pinkie.

The method used is qualitative method to perform 50 tests on game systems resulting from the process of programming and design rules in a game that is based on the method of Finite State Machine (FSM), by using a single story line, the flow of the game added a reward in the form of schemes scene to trigger the curiosity of players.

In Figure 4 is for making scenes of interaction between two character using unity software For Unity acceptable programming languages are Java Script, CS Script (C #) & BOO Script.
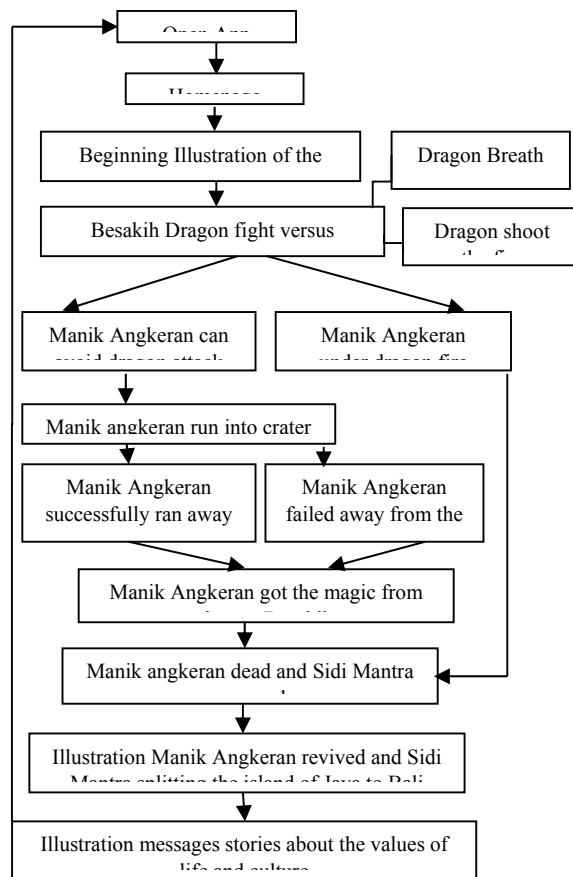
Figure 5. Finite State Machine Digital Storytelling
Folklore Origin of the Bali Strait.

Rules of the game finite state machine (FSM) using motion capture folklore origin bali strait is appropriate in Figure 5 which explained that the initial stage to the final stage in the making of this digital storytelling, which included a fight scene between Manik Angkeran and Dragon besukih, and also interactions made by dragon besukih and Manik Angkeran, including dragon can breathe and put out the fire, as well as Manik Angkeran to avoid attacks dragons and dragon attack and die.

Modeling phase is divided into three processes, namely modeling Manik Angkeran, dragon besukih, and 3D environments, texturing, rigging, and skinning as well as pay attention to the size, pipeline and lighting (Cohen, 2010). Figure 6 shows the illustration of an avatar character modeling Manik Angkeran that have texture and rigging.
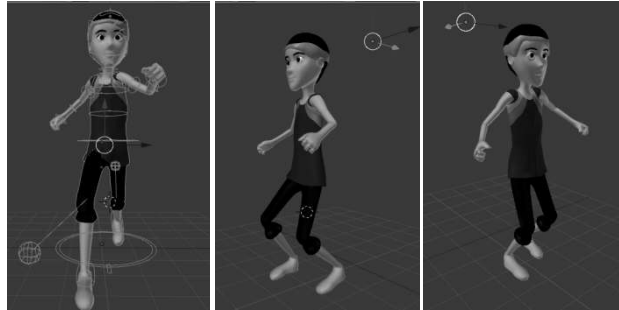
Figure 6. 3D character modeling Manik Angkeran

Figure 7. Phase dragon besukih character modeling

Figure 7 shows the modeling process besukih dragon, continues the process of rigging, or the manufacture of bone to model the dragon avatar besukih. After the rigging process, is the process of skinning, namely bone connecting with the model. After that, the model will be animated as needed in the game. 3D environmental modeling refers to a story that is in the crater of the mountain, where there are areas of forests and meadows around the mountain as shown in Figure 8.
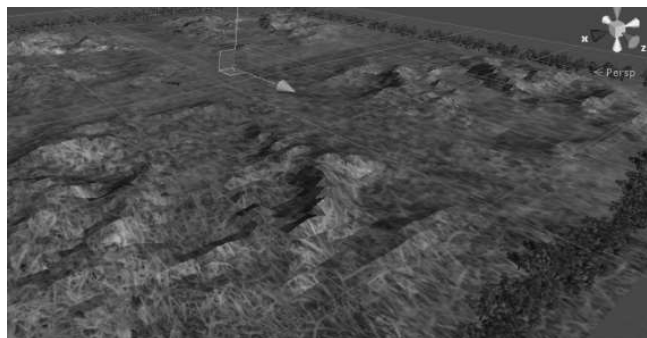
Figure 8. 3D environment used in the game
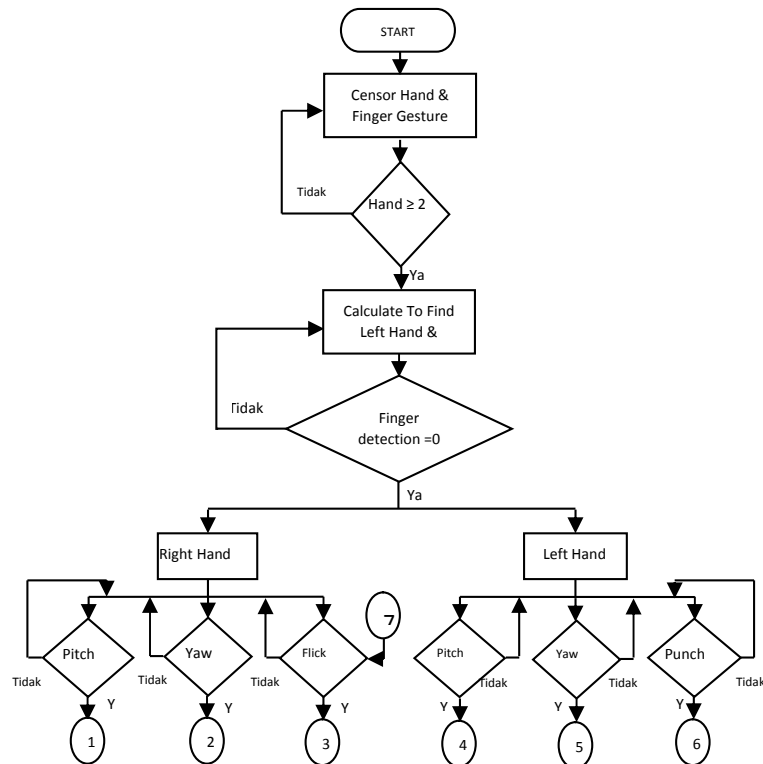
Figure 9. State fight scene

And in Figure 9 is a picture of the flowchart in making the fight scene between the dragon besukih with Manik Angkeran, wherein when the fight scene appears, then the hand and finger gesture sensors will detect hands and fingers, if not detected two hands then do it again the introduction by sensors for the detection of two hands until detected two hands on the sensor.

If there are two hands on the sensor, the sensor will do more recognition for finger detection, if not detected finger or "finger = 0" will return to the detection of finger hinga met. And if detected fingers on two hands where the sensor will recognize where the right hand and left hand.

3. RESULTS

Table 1. Function Hand Movement

Hand Movement	Fungsi dalam digital storytelling	
	Left Hand	Right Hand
Sweap	For move the *scene*.	For move the *scene*.
Pitch	To Move Up or Fly besukih dragon	To Jump Up manik angkeran.
Yaw	To Move forward and backward besukih dragon	To Move forward and backward Manik angkeran
Flick	To shoot the fire	____
Punch	____	To hit the dragon

Functions described in Table 1. are five movements with the left hand and arm, where there are differences in command of each movement in the right hand and left hand as described in the table. In digital storytelling origin folklore bali strait, there are five types of hand movements, pitch, yaw, flick, punch and sweap.

Pitch is a movement upward, yaw is moving to the right or to the left, flick is the movement of the tip of the finger right up to the left hand, the punch is the movement of the finger left up to the right hand, and the last is that the movement of the hand sweap "sweep "to the left and to the right.

Control of character animation in digital storytelling folklore, using five hand movements in Figure 10. There are two prominent character-driven animation with two hands, in this case is the animated character Dragon besukih controlled using the left hand and Manik Angkeran controlled with the right hand.

Control function for the left hand is the first one is the pitch to fly movements, yaw to go forward or backward movement, flick to issue a fire. And control functions for the right hand is to jump pitch, yaw to go forward or backward movement, punch to hit. While sweap is a movement to move the scene, done with one hand, and to the left hand or right hand.

| pitch | Yaw right and left | flick |
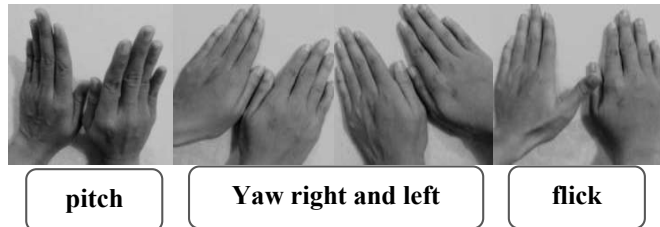
Figure 10. Control of hand movement

Table 2. Experiment results Sweap Movement

Number test	Trials	≤ 30 cm		≥ 30 cm	
		detect	Not detect	detect	Not detect
1	50 x	45	5	43	7
2	50 x	44	6	38	12
3	50 x	47	3	31	19
4	50 x	48	2	35	15
5	50 x	47	3	36	14

Based on Table 2. it can be seen that the controller can recognize leapmotion sweap movement is not entirely on account of distance of ≤ 30 cm and ≥ 30 cm between hands with leapmotion controller. So from the above experiment sweap movement gained an average value based on the percentage of the maximum value in each hand movement distance which is derived, are described in Table 3.

Table 3. Average Score Results Experiment Sweap

Hand movement	≤ 30	≥ 30
Sweap	96 %	86%

For testing and analysis of digital storytelling. Researchers also use the media questionnaires to determine the child's interest and aspects contained in the application, such as the ease of movement of the right hand or left hand.In the questionnaire, there are three parts group of questions, ie questions about the basic knowledge of folklore origin Bali strait, the question of the overall presentation of the manufacture of digital storytelling and technical questions in terms of hand gestures by the user.

Filling the questionnaire conducted by 15 elementary school children, the percentage obtained more who do not know about the story of the origin of the Strait of Bali with 73.33%, which is like the story of the origin of the Bali strait there 100% with a composition of 40% and 60% liked very likes.Data showed that the overall presentation of digital storytelling, from the look, the animation and the sound is very liked by the children with the acquisition of 86.33% with 53.33% composition 33.33% like and really liked. Digital storytelling application participant easier to use than the right hand with left hand, by composition 80.00% 46.63% 33.33% simple and very easy. Then suitability hand movement is in conformity with the character animation is seen from the percentage of 73.33% with 53.33% composition 20.00% fit and very appropriate.

4.CONCLUSION

Conclusion from this study is the concept of cultural content can be integrated with the use of technology, one of them by adapting the game model and supported the use of equipment that provides a new experience in interacting with the computer.

Control using leapmotion are based hand gesture recognition as well as a Finite State Machine can to control two characters at once by using a two-hand movement. And from the questionnaire analysis conducted found that for the story and presentation of the material in digital form storytelling was appropriate and able to attract children to learn and know the story of the origin of the story of the people especially the Strait of Bali, but in technical terms need adapted again for children to interact.

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SINGLE EXPONENTIAL SMOOTHING METHOD IN FORECASTING NUMBER OF RAINY DAYS PER YEAR BY DISTRICT OF OBSERVATION STATIONS LAMONGAN

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ABSTRACT

In Lamongan regency, East Java, especially in the rainy season, the observation station recorded every year the average rainy day is still around 130 rainy days. This is very important for some sectors, especially agriculture, fisheries, industry and other business sectors in the region. As many methods of forecasting are used in predicting a situation. Then the need for a data forecasting system to determine the number of rainy days per year according to Lamongan district observation station using Single Exponensial Smoothing method in order to assist the rain observation station in predicting the results of his observations every year.

From the results of this study it can be concluded that the result of forecasting with the smallest error value obtained at observer station Prijetan when forecasting using α value of 0.7 and forecasting results with the largest error value obtained at observer station Mantup when done prediction using α value of 0.1. From a total of 25 observer stations, the best forecasting results were obtained when using α values of 0.9 for 9 stations, namely Sukodadi, Bluluk, Baru / Girik, Pucuk, Babat, Brondong, Bluri, Pangkatrejo and Karanggeneng, as the 9 observer stations have day data The rain is steep.

Keywords : Forecasting, Single Exponential Smoothing, Rainy Days.

INTRODUCTION

1.1 Background

In Lamongan regency, East Java, especially in the rainy season, the observation station recorded every year the average rainy day is still around 130 rainy days. This is very important for some sectors, especially agriculture, fisheries, industry and other business sectors in the region.

In the era of advanced technology that has been developed then used a method called forecasting with the purpose and function as management to decide an action to move into the future by taking samples of samples and the results of past or previous events with various techniques, will But there are still factors that may affect the forecasting result. This needs to be reviewed by experts in order to develop and improve methods of forecasting with techniques that have results that are close to what is being foreseen and can be used to predict what is necessary for common and common interests.

As many methods of forecasting are used in predicting a situation. Then the need for a data forecasting system to determine the number of rainy days per year according to Lamongan district observation station using Single Exponensial Smoothing method in order to assist the rain observation station in predicting the results of his observations every year.

1.2 Gals

The purpose of this study is as follows:

Provide results and solution problems to facilitate the observer station to know the steps and how to predict the number of rainy days each year.

Provide benefits and convenience for common interests so as to provide information forecasting the number of rainy days from observation stations each year from data observations results of previous years observation year.

METHODOLOGY

2.1 Literature

Application of Exponential Smoothing Method for Forecasting Use of Telephone Time at PT. TELKOMSEL DIVRE 3 SURABAYA (Alda Raharja, Wiwik Anggraeni and Retno Aulia Vinarti, 2005). Forecasting System of MITSUBISHI Car Unit Supply at PT. SARDANA INDAH BERLIAN MOTOR using Exponential Smoothing Method (Afni Sahara, 2013).

SYSTEM DESIGN

3.1 Exponential Smoothing Methodss

Metode Exponential Smoothing (Makridakis,1999) merupakan prosedur perbaikan terus-menerus pada peramalan terhadap objek pengamatan terbaru. Metode peramalan ini menitik-beratkan pada penurunan prioritas secara eksponensial pada objek pengamatan yang lebih tua. Dalam pemulusan eksponensial atau exponential smoothing terdapat satu atau lebih parameter pemulusan yang ditentukan secara eksplisit, dan hasil ini menentukan bobot yang dikenakan pada nilai observasi.

3.3 Moving Average

Used for query or seasonal data requests that are not yet known to the request component system at the same level. The level level in t period is the average demand during the last n period.

$(\sum_{i=1}^{n} x_i)/n$

$F_t = (x_t + x_{t-1} + \ldots + x_{(t-n+1)}) / n$

3.4 Single Exponential Smoothing

Also known as simple exponential smoothing used in short-term forecasting, usually only 1 month ahead. The model assumes that the data fluctuates around a fixed mean value, with no consistent trend or growth pattern. (Makridakis, 1999). The formula for Simple exponential smoothing is as follows:

$F_{t+1} = \alpha * X_t + (1-\alpha) * F_t$

Whereas :

F_t = Forecasteing for periode t

X_t = actual time series

F_{t+1} = Forecasting for periode t+1

α = levelin constant between 0-1

3.5 Data Analysis

The following will be given example calculations starting from the calculation of the average number of rain days, to the calculation of forecasting and forecasting error rate. Given examples of data on the number of rainy days from January 2011 to May 2011 are shown in the following table.

Table 1 Rainy Days

No	Observation Station	District	Month				
			1	2	3	4	5
1	Lamongan	Lamongan	19	14	18	10	11
2	Takeran	Tikung	16	12	19	11	10
3	Mantup	Mantup	0	10	13	5	1
4	Kembangbahu	Kembangbahu	14	13	16	11	11
5	Sukodadi	Sukodadi	16	12	15	10	10
6	Gondang	Sugio	17	15	19	14	10
7	Kedungpring	Kedungpring	15	15	21	12	13
8	Gandang	Ngimbang	10	11	14	8	7
9	Prijetan	Kedungpring	11	17	16	10	9
10	Kayen	Ngimbang	11	12	15	11	9

For that obtained value of the prediction of the number of rainy days for Lamongan observation station in January 2011 are as follows:

$$Forcasting\ Lamongan\ (January\ 2011) = \frac{\sum_{i=1}^{n} x_i}{n} = \frac{(19 + 14 + 18 + 10 + 16)}{5} = 64,2$$

While for the month of February 2011, calculated by using the value of α of 0.4. The result of January 2011 forecast for Lamongan observation station is as follows:

$$Forecasting\ Lamongan(February\ 2011) = (0,4)\big(Aktual_{Januari\ 20\ 11}\big) + (1 - 0,4)\big(Ramalan_{Januari\ 20\ 11}\big)$$

$$= (0,4)(19) + (0,6)(64,2) = 46,12$$

Overall, forecasting values and actual data for ten observation stations can be seen in the following table.

Table 2 Forecasting Data

No	Observation Station	District	Rainy Days			
			Forecasting	Jan	Forecasting	Feb
1	Lamongan	Lamongan	64,2	19	46,12	14
2	Takeran	Tikung	13,6	16	14,56	12
3	Mantup	Mantup	5,8	0	3,48	10
4	Kembangbahu	Kembangbahu	13	14	13,4	13
5	Sukodadi	Sukodadi	12,6	16	13,96	12
6	Gondang	Sugio	15	17	15,8	15
7	Kedungpring	Kedungpring	15,2	15	15,12	15
8	Gandang	Ngimbang	10	10	10	11
9	Prijetan	Kedungpring	12,6	11	11,96	17
10	Kayen	Ngimbang	11,6	11	11,36	12

From the forecasting results are then calculated error value using RMSE value. Calculation of RMSE value is done using the formula:

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(\widehat{Y_i} - Y_i)^2}{n}}$$

Dimana :

$\widehat{Y_i}$ = Forecasting-*i*

Y_i = Actual Data-*i*

n = Total Data

3.5 Flowchart
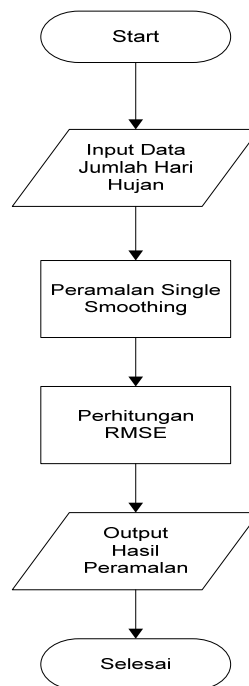
Figure 1 System Flowchart

Figure 1 describes the flow of the system to be designed. Starting from input data of the number of rainy days. Furthermore, the calculation of Single Smoothing. After that calculated the forecast error rate using RMSE.

3.6 Use Case Diagram
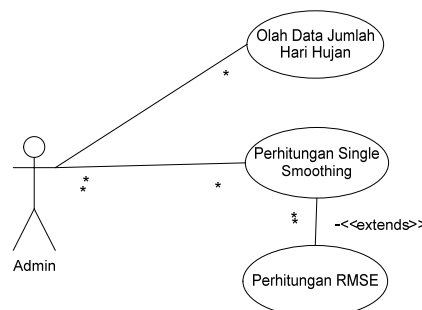
Figure 2 Use case diagram

Figure 2 describes the actors involved in the system. Actors can login to process the data of the number of rain days (insert, update, delete, search) and forecasting calculations.

5. RESULT AND ANALYSIS

5.1 Test Result

The experiment was conducted using 2011-2013 data as training data, while data of 2014 as test data. The experimental results show that there are 9 observation stations that have the best forecasting result at α constant value of 0.9 ie observer station: Sukodadi, Bluluk, Baru / Girik, Pucuk, Babat, Brondong, Bluri, Pangkatrejo and Karanggeneng.

5.2 Test Analysis

The best RMSE value is the smallest RMSE value. From 9 α constants and 25 observation stations, the highest value of α gives the best forecasting result is 0.9. From a total of 25 observer stations obtained the results:

Figure 3 Rainy Day Forecasting Differential

6. Conclution and Suggestion

6.1 Conclution

From the work of this final report can be drawn some conclusions, among others are forecasting result gives RMSE result between 0,0156756656 until 7,2645156022

6.2 Suggestion

Applications and experimental results can be improved in subsequent studies with suggestions as follows Research can be done by using more rainy day data so that can be obtained better forecasting.

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Boost Converter Design DC – DC
Through Inverter Process and Voltage Multiplier

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ABSTRACT

In this increasingly modern life electronic equipment is growing and widely used in many sectors. Both in industry, offices, households and transportation. For all applications of electronics equipment required a voltage-generating power tool (dc), Dc-dc converter is a dc voltage regulator device which is regulated output voltage according to need. This research will make a dc voltage converter through Inverter process and Voltage Multiplier. With 5 volts dc input will be converted to 220 ac which then will be converted into dc voltage and multiplied voltage value.

Keywords : Boost Converter DC – DC, Inverter, Voltage Multiplier

1. INTRODUCTION

The DC-DC converter is a device that direct-voltage power supply (dc) generated through the input dc voltage conversion of a lower or higher output dc voltage. In its development the application of dc-dc converter has enabled an electronic device to work with a small energy source, Where the output voltage can be changed as needed. Until now various configurations of dc-dc converter has been developed.

Direct or dc voltages are widely used in industry, Not just as a dc motor power source, But also many for other applications. Usually this dc voltage is obtained from the ac voltage rectified with semiconductor components such as diodes, thyristors, mosfets etc..

In the boost converter circuit there is an inductor component, The function of the inductor is to store electrical energy, This electrical energy will be channeled to the load. The voltage at the load is the result of the input voltage plus the energy stored on the inductor, So the output voltage boost converter becomes larger than the input voltage.

The boost converter output voltage is always greater than the input voltage for steady state operation, Boost converter consists of inductor, power MOSFET, diode, filter capacitor and load resistor. MOSFET Switching on and off at switching frequency vs = 1 / T with working ratio D = ton / T where Ton is the time interval when MOSFET on. Boost converter can operate in either mode continuous or discontinuous mode, Dependent signal from the inductor current. Boost converter DCM mode can not operate on RL = □ because the filter capacitor has no gap for discharge

The purpose of this research is to design and create a series of dc-dc boost converter that utilizes inverter system and voltage multiplier, The issued voltage will be multiplied to be greater than the input voltage.

Design of DC-DC Boost Converter System with Inverter System and Voltage Multiplier

I. **System Description**

Block diagram below is a system as a whole ranging from sumper input voltage to output voltage

Explanation of the block diagram as follows :

- The input used is a DC voltage of 5 volts

- Then converted to 220 volt AC voltage using iverter system

- The output from the inverter system was converted back into DC with the Voltage Multiplier system

- The output generated by the Voltage Multiplier system becomes multiplied

II. Design Inverter

To increase the voltage multiply it requires a voltage multiplier system where the system requires input of 220 volt ac voltage To get 220 volt input ac needed inverter.

The inverter used is a series of joule thief which was originally known as a vampire torch or a series of power thieves, Actually it is a way that wants to be able to provide the maximum output power of its input source as small as possible.

The required components for this inverter are quite simple and easy to obtain, among them is :
- TmTip40 npn Transistor. Can we also use other npn transistor like tip31 or tip3055, etc ..
- E ferrite mini transformer Former hp charger, we can get from the series of former hp charger that is not used or damaged
- Resistor of 470 Ohm can also use 100 Ohm
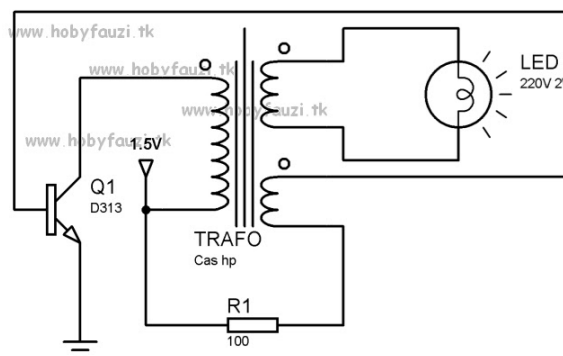
Fig. 2. Inverter Circuit (source : www.hobyfauzy tk)

I.   **Design Voltage Multiplier**

Voltage Multiplier System is a voltage multiplier with diodes serves to multiply an input voltage into a larger DC output voltage. By using a series of voltage multiplier (voltage multiplier) on the transformer relatively small scale can be obtained output voltage output of two, three, four or more times the input voltage. Voltage compression circuits can be made with basic components of diodes and capacitors, with half-wave and full-wave configuration. This circuit is widely used in high voltage generators but with a small current.

When the secondary voltage of the transformer has a positive polarity (half positive cycle), Then diode D1 conducts and diode D2 does not deliver. Ideally, the conducting diode is considered to be a short circuit. Therefore C1 filled the voltage through D1 until it reaches Vm.

At half the next cycle is negative cycle, Then diode D1 does not deliver and diode D2 conducts. Therefore the capacitor C2 is charged from the transformer's secondary voltage Vm and from C1 of Vm, So a total of 2 Vm. The voltage multiplier circuit image can be seen below:
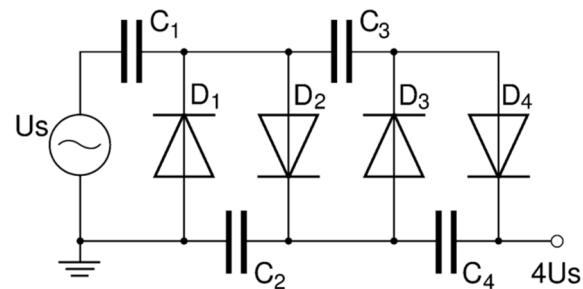
1. Conclusions

1. DC Boost Converter system with voltage multiplier system requires inverter to convert DC input to AC
2. The joule thief circuit used is a series of inverters that want to be able to provide the maximum output power from the input source as small as possible
3. The voltage multiplier system can raise the voltage up to 2 times or more

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INTELLIGENT EDUCATION MONITORING SYSTEM USING ARTIFICIAL NEURAL NETWORK BASED ON DATA MINING APPROACHES

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ABSTRACT

Database system has been used in most universities and schools to implement the school information system or also known as academic information system. This database system supports automation of education operationals including capacity planning, courses monitoring, and periodic evaluations. Current school information system can provide operational or transactional report and statistical report. Statistical report is an important information for decision maker to evaluate the current education process and prepare the required strategies to improve its quality. Educational data mining (EDM) is an emerging branch of data mining researches which concerned with developing methods to understand education characteristics, covering students, teacher, study environment, learning substances, and other supporting data. Many researches have been discussed the educational data mining methods for analysing student enrollment, predicting student performance, and predicting student failure. Those methods mine information mainly from school information database system. This research focuses on designing a framework for incorporating business intelligent and data mining on current school information system to improve its functionality as an intelligent education monitoring system. Main entities in education process are observed to determine the required structure to be stored in the database. As a prototype of an implementation of this proposed framework, a prediction of learning output using artificial neural network is observed and tested with the proposed database structure.

Keywords: *educational data mining, business intelligent, decision support system, artificial neural network*

1. INTRODUCTION

Improving educational quality is one of government's task. One of parameter that can be used to evaluate national education quality is school failure. Problem of school failure has become an interesting thing to investigate. Many researchers spawn great deals about the various factors which influence the low performance of school. Those can be from the student aspect, teacher aspect, and school aspect. As a method of information aquisition, survey can be used to collect data with a very flexible data structure and flexible sampling population. This method is commonly used to capture information which are not stored in current transactional database system, for example collecting public opinion about learning facility in public school. An accurate data analysis requires data which are presenting actual learning process. One of an important source data for this purpose is the school information system. In most school information system, data can be drilled down into an individual data such as details of each student biodata, details of teacher biodata, details of school facilities, details of learning substance, details of learning process (lecturer teaching class, student takes courses, lecturer supervises students, etc). This detailed information in school information system is more suitable for statistical analysis compare to snapshot data from survey which probably limited to aggregate date.

Education process is a continuous process which last several years for every student. During this process, learning process data are captured regularly. At the beginning of semester, each university student takes a list of courses. At the end of semester, an evaluation mark is given for every course. On the next semester, these processes are repeated with different details. To store this activity, a database system must support temporal data handling. Current school information system provides many type of education transactional reports and statistics. The main

concern by existing information system is storing data, processing data, and producing output data. An improvement is promising by incorporating intelligent system into the database system. With intelligent system, the education system will be modeled and together with data mining approach, an intelligent education monitoring system is proposed.

This paper propose a model for organizing educational data, introducing a framework for incorporating data mining in education statistics as described in the next section. We apply our proposed model to the case of predicting school failure by adding teacher and school variable which affect failure or success. We use Artificial Neural Network as the proper method for predicting, because we believe that method has ability to obtain output based on the result of data training, although we do not have the real data training as the input. System has artificial for determining output value from the inputs which are not included in the input matrix by using prediction based on the weight of each neuron. From the result of prediction, we expect that some actions can be taken for preventing school failure as the effort to increase those school's educational quality.

2. METHODOLOGY

A school can be classified as a good school, if it fulfills several criterias, which are: (1) student aspect: quality of graduates have to be admitted by other institutions, (2) teacher aspect: teacher plans adequate subjects to learn, adequate number of teachers, (3) organization activity: schools have national holiday and religious celebration programs, (4) parents accept their children's report of study well. Parents have choices of schools for sending their children to the school [2]. While according to Ministry of National Education, a school can be categorized as a good school, if it fulfills the following eight criterias: (1) high quality enrolled students. Students will be evaluated based on their academic achievements, psychology test, and physical test, (2) fulfillment of facilities for teaching and learning process, (3) ideal atmosphere for learning activities, (4) High rating of teacher professionalism, (5) improvement of curriculum for fulfilling the students who have high motivation in studying, (6) Long-run student's learning hours, (7) better quality in learning process, (8) have benefit for the environment around that school [1].

2.1 Educational Data Organization

This section discusses a conceptual design of educational data, based on the education process. There are three main characteristics of educational data which are considered as the most important form of educational model, which are:

a. Relational

Education process or learning process has four main entities which are: student, lecturer, school, and learning substance. A relationship between lecturer and learning substance produces a lecturer's competence. This is an example of a correlation or relationship between two entities. Many relationships can be build by selecting two entities, three entities, or all four entities. The Venn diagram on the upper left side of Figure 1 shows this relational characteristic.

b. Longitudinal

Education process is a long term process. In a formal education, the process is recorded from the playgroup or kindergarten class, followed by six-years learning process in an elementary school, followed by three-year learning process in a junior high-school, then another three-year learning process in a high school, and followed by learning process in a university. Recording educational data should consider this process, as shown on the bottom right side of Figure 1.

c. Individual

The term individual is used here as an opposite of aggregate data. In aggregate data, a total number is given to an attribute, usually based on a survey, for example the total number of teachers in a school, or total number of students for the first year class in a school. This aggregate data limits the possibility of the data analysis. Instead of storing aggregate data, the detail of each individual should be recorded in the database.

The following Figure 1 shows the three main characteristics the educational data, which is proposed as a new approach in defining database
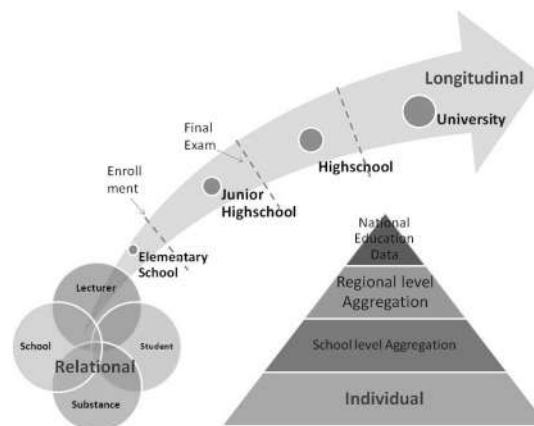
Figure 1. Longitudinal-Relational-Individual

2.2 Intelligent Education Monitoring System

To automate and organize operational system in an educational environment, a school information system has been established in the form of database system. This system supports most of the data processing which are required for producing various reports. A good school database system, can be extended as a bottom-up decision support system by integrating business intelligence into the system. The integration of business intelligence transform a transactional database system into a data warehouse system which supports more sophisticated analysis.

With the integration of business intelligent in a school information system, education process in a certain environment can be better modeled and understood. To perform a standard periodic statistics of education, a Generic Statistical Business Process Model (GSBPM) has been established by the United Nations Economic Comission for Europe (UNECE). Steven Vale [4] determines 9 phases of statistics routine within a GSBPM. For education model, this nine-phases GSBPM can be used as a framework for producing periodic or routine statistics. The following Figure 2 shows this nine-phases of routine statistics in education system.

Figure 2. Nine Phases of Routine Statistic in Education System

As shown by above Figure 2, the routine statistics produce reports for recommendation, data quality audit for data assurance, and findings. To follow-up this findings, a next step named Intelligent Education Monitoring System is required. The specification of Intelligent Monitoring System in an education environment is considered as follows:

a. Data structure of the education information system is used. It consider the data form of education model: individual, relational, and longitudinal.

b. Data mining approach for data preprocessing, processing, and reporting

c. Business process integration is adopted using the nine-phases of GSBPM.

The proposed conceptual model of this Intelligent Education Monitoring System from a periodic statistics is shown by the following Figure 3.
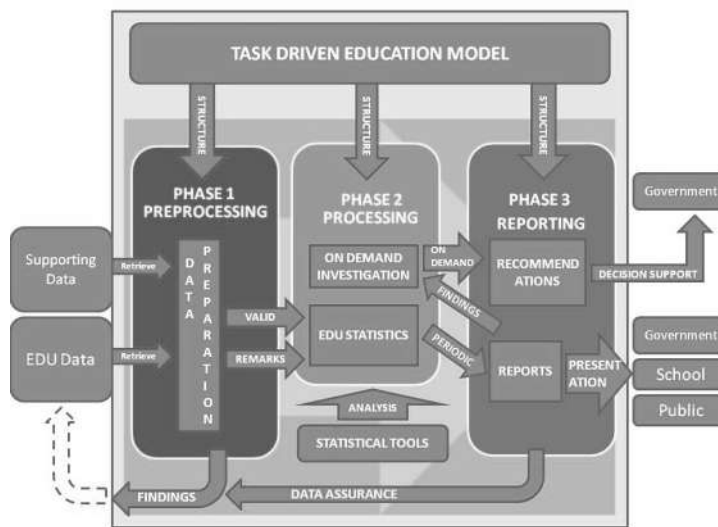
Figure 3. Conceptual Design of Intelligent Eduxation Monitoring System

In this conceptual model, education statistics is produced from education primary report or periodic report. Additional supporting data will be used depend on the requirement of analysis as defined by the education model. Each analysis task is driven by the education model which provides the system with the list of required data structure and input data specification (scope of data). Data processing is divided into three phases similar with those in data mining, namely preprocessing, processing, and reporting.

3. RESULTS

This section discusses an example of an implementation of proposed conceptual design. Primary data for this implementation will be from EDU data. The Intteligent Education Monitoring System is defined as "predicting a school learning output using artificial neural network". This investigation is initiated from a finding from current periodic statistic which analyses student failure based on students atributes only. To better understand the environment influence in a learning process, a set of variables from students entity, teacher entity, and school entity will be observed. This model setup the input requirement, which are the list of attributes from EDU Data.

3.1 Phase 1: Pre Processing

In pre processing phase, data is extracted from primary data. The next step is data cleaning, where each record is examined to remove possible duplication, missing data, and redundant data.

3.1.1 Data Selection

In this data selection process, we identify all of the variables to be used in this research. As shown in Table 1, there are four columns: Parameter, Variable, Individual, and Longitudinal. Parameter is something to be measured that belongs to student, teacher, or school variables. Some parameters can be obtained from relationship between variables. Individual data is non aggregate data. In statistics, aggregate data describes data combined from several measurements. Longitudinal is data collection sample from a larger population with a certain time period.

Table 1. Parameter Selection.

Parameter	Relational Variable	Individual Data	Longitudinal Data
Name	Student	Yes	No
Class	Student – School	Yes	Yes
Sex	Student	Yes	No
Academic Score	Student – School	No	Yes
Address	Student	Yes	Yes
Living Distance	Student – School	Yes	Yes
Living Status	Student	Yes	Yes
Mother's Education	Student	Yes	Yes

Mother's Job	Student	Yes	Yes
Father's Education	Student	Yes	Yes
Father's Job	Student	Yes	Yes
Family Size	Student	Yes	Yes
Family Relationship	Student	Yes	Yes
Reason Choosing School	Student – School	Yes	No
Study Time	Student	No	Yes
Extra-curricular	Student – School	No	Yes
School Support	Student – School	No	No
Family Support	Student	Yes	Yes
Internet Home	Student	Yes	Yes
Internet School	Student – School	Yes	Yes
Hand phone	Student	Yes	Yes
Higher Education	Student	Yes	Yes
Romantic	Student	Yes	Yes
Free Time	Student	No	Yes
Go Out	Student	No	Yes
Health	Student	Yes	Yes
Absences	Student	No	Yes
Accreditation	School	Yes	Yes
School Experience	School	No	Yes
Certification Status	Teacher	Yes	Yes
Teacher's Experience	Teacher	No	Yes
Teacher's Age	Teacher	Yes	Yes
School Support	Student – School	No	No
Family Support	Student	Yes	Yes
Internet Home	Student	Yes	Yes
Internet School	Student – School	Yes	Yes
Hand phone	Student	Yes	Yes
Higher Education	Student	Yes	Yes

3.1.2 Data Cleaning

This process is used for removing duplicate data, checking inconsistent data, handling missing value data and smoothing noisy data.

3.1.3 Data Ranking

In this phase, data can be transformed or remodeled based on the requirement of educational data model. In this experiment, we rank the distance of student's home address from school into three categories as shown in Table 2. This step ensures each record contains uniform data which suitable for classification scale.

Table 2. Rank of the distance between student's home and school

Rank	Distance (kilometer)
1	> 20
2	11 – 20
3	0 – 10

3.1.4 Normalization

Before we implement input data and target data into ANN, we must first normalize the data. Normalization is one of some techniques in transformation data, which converts the original data into its data range between 0 and 1 corresponding to the activation function to be used. Its function is for recognizing the data that will become weight input.

$$Normalization = (A - A_{min})/(A_{max} - A_{min}) \tag{1}$$

where A is an Attribute Input Value, A_{min} is a Weight Minimum Value, A_{max} is a Weight Maximum Value.

3.2 Phase 2: Processing

In this processing phase we use ANN as the method to evaluate multivariate relationship between variables which affect school failure or success. The total number of data that we collected is 107. We use 55 data for training process, and the rest 52 data for testing process. The first step is a training process using part of existing dataset. Then, testing process with our data sample is executed. We train and test our dataset using a toolbox from MATLAB software.

Table 3. Data testing based on Student Factor using ANN

No	Student	Target	Output	Deviation
1	0.85	0.688	0.6946	0.0066
2	0.46	0.38	0.3731	0.0069
3	0.23	0.2	0.1998	0.0002
4	0.08	0.06	0.0766	0.0166
5	0.54	0.428	0.4303	0.0023
6	0.31	0.24	0.2365	0.0035
7	0.08	0.06	0.0766	0.0166
8	0.85	0.68	0.6738	0.0062
9	0.15	0.132	0.1073	0.0247
10	0.31	0.252	0.2614	0.0094
11	0.38	0.3	0.2941	0.0059
12	0.62	0.492	0.495	0.003
13	0.85	0.668	0.6298	0.0382
14	0.46	0.372	0.3661	0.0059
15	0.69	0.56	0.5635	0.0035
16	0.77	0.628	0.6249	0.0031
17	0.46	0.368	0.3686	0.0006
18	0.77	0.628	0.6249	0.0031
19	1.00	0.8	0.7509	0.0491
20	0.77	0.632	0.6307	0.0013
21	0.62	0.5	0.4983	0.0017
22	0.38	0.3	0.2941	0.0059
23	0.46	0.36	0.3535	0.0065
24	0.54	0.42	0.4147	0.0053
25	0.31	0.24	0.2365	0.0035
26	0.46	0.368	0.3686	0.0006
27	0.00	0	0.0685	0.0685
28	0.46	0.36	0.3535	0.0065
29	0.46	0.36	0.3535	0.0065
30	0.54	0.42	0.4113	0.0087
31	0.31	0.248	0.2498	0.0018
Average Deviation				0.009121154

Table 4. Data testing based on student, teacher and school factors using ANN

No	Student	Teacher + School	Target	Output	Deviation
1	0.85	0.5	0.71	0.724	0.014
2	0.46	0.5	0.476	0.477	0.001
3	0.23	0.75	0.438	0.434	0.004
4	0.08	0.5	0.248	0.247	0.001
5	0.54	0.75	0.624	0.625	0.001
6	0.31	0.625	0.436	0.435	0.001
7	0.08	0.5	0.248	0.258	0.01
8	0.85	0.625	0.76	0.746	0.014
9	0.15	0.875	0.44	0.435	0.005

10	0.31	0.75	0.486	0.484	0.002
11	0.38	0.75	0.528	0.529	0.001
12	0.62	0.75	0.672	0.673	0.001
13	0.85	0.5	0.71	0.724	0.014
14	0.46	0.75	0.576	0.577	0.001
15	0.69	0.625	0.664	0.661	0.003
16	0.77	1	0.862	0.851	0.011
17	0.46	0.75	0.576	0.577	0.001
18	0.77	0.75	0.762	0.745	0.017
19	1.00	0.625	0.85	0.851	0.001
20	0.77	0.625	0.712	0.716	0.004
21	0.62	0.75	0.672	0.673	0.001
22	0.38	0.75	0.528	0.529	0.001
23	0.46	0.5	0.476	0.477	0.001
24	0.54	0.625	0.574	0.573	0.001
25	0.31	0.25	0.286	0.292	0.006
26	0.46	0.625	0.526	0.526	0
27	0.00	0.5	0.2	0.21	0.01
28	0.46	0.875	0.626	0.623	0.003
29	0.46	0.75	0.576	0.577	0.001
30	0.54	1	0.724	0.721	0.003
31	0.31	0.875	0.536	0.535	0.001
Average Deviation				0.004211538	

3.3 Phase 3: Reporting

Processing and analysis of datasets results in last phase, both routine and on-demand, will then be delivered to several stakeholders such as governments, schools, management, and public. From the processing phase, the result of measurement based on student variable only is presented using a simple table as shown in Table 3. While the result of measurement based on student, teacher and school variables is presented in Table 4. In this paper, we only serve first 31 rows data testing for efficiency.

Several steps to obtain value in student, teacher+ school columns:
a. Count the number of weights from each feature (per data) $\rightarrow$ A.
b. Determine minimum and maximum weights of all data $\rightarrow$ A_{min} and A_{max}
c. Normalize each data using Normalization formula as explained in Normalization step.

Output column in those two tables are obtained from testing process using ANN in MATLAB toolbox. The target in those two tables, are obtained from processing student and teacher + school variables. We make priority for each variable : Student variable = 60% and Teacher + School variable = 40%.

Deviation column in each table shows the difference between target and output. The average deviation in measurement based on student, teacher and school factors is 0.004211538. While the measurement based on student factor only, the average deviation 0.009121154. From those two kinds of experiment can be concluded that student, teacher and school variables have significant effect on school success or failure.

4. CONCLUSION

This research introduces a concept of organizing educational data which supports transactional database system and intelligent educational data mining using data mining approach. In the database structure concept, this research emphasizes the importance of the characteristics of educational data namely individual, relational, and longitudinal. In the intelligent data analytical process, this paper proposes a conceptual design which determines the flow of information. In this proposed design, the analysis is driven by educational model, and the processing phase is divided using three phases which are commonly used in data mining approach.

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EFFECT OF MIXTURE COMPOSITION OF BAGASSE CANE, COCONUT SHELL CHARCOAL, AND TAPIOCA ADHESIVE TO BIOEPELET QUALITY

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ABSTRACT

Biopelet is one of renewable alternative energy sourced from biomass. Raw materials in this study, making biopelet, derived from bagasse and coconut shell charcoal. Biopelets vary in size, ie between 6-12 mm in diameter and between 10-25 mm in length. The method used is the addition of coconut shell charcoal powder percentage from 0%, 25%, 50%, 75% and 100% with the addition of tapioca adhesive as much as 10% and 20% from the weight of the material. Testing of this biopelet includes density, moisture content, ash content, airborne content and bound carbon content. Parameters used as reference of the quality in accordance with the Indonesian National Standard. From the research result, it is known that the best composition of biopelet made from mixed bagasse and coconut shell charcoal is found in biopelet with the composition of 25% bagasse + 75% coconut shell charcoal. In this composition yield 5.39% moisture content, ash content 6.63%, airborne content 36.66%, bonded carbon content 51.32% and the optimum density of 0.5903 gr / cm3.

Keywords : Biopelet, Bagasse, Coconut Shell Charcoal, Tapioca

1. INTRODUCTION

Today the use of fossil fuels is still a mainstay in the economy in Indonesia. Fuel consumption continues to rise, not in proportion to the decline in production from 2010 to 2013. This is inversely related to the growing domestic demand (import) every year. The imbalance between the rate of energy availability and demand causes the energy security in Indonesia to be low.

The provision of alternative energy energy is one of them is utilizing biomass contained in this nature. According to Yokoyama and Matsumura [1] biomass is an energy reserve derived from biological natural resources. These resources include thousands of plant species, land and oceans, various agricultural sources, forestry, industrial waste residues, waste and animal waste. Biomass is then processed into alternative energy sources in the form of biogas, bio-oil, biopelet, charcoal briquettes, and others.

Sugarcane is a plant that is used as the main raw material in the sugar industry. In the sugar industry, many produce bagasse as a solid waste derived from sugar cane milling process. During this time the bagasse is widely used as feed for livestock, boiler fuel for the sugar factory itself, as raw materials for paper and pulp industries, fertilizer manufacture and also liquid fuels such as bioethanol. This research was conducted to determine the potential of bagasse as solid fuel in the form of biopelet.

Coconut plants are widespread in the tropics such as Indonesia. Coconut plants have many benefits. In addition to the meat as a producer of oil, coconut shell is widely used as charcoal. The purpose of this research is to

find out the most optimum composition of the bagasse mixture and coconut shell charcoal into biopelet, so it can be used as an alternative fuel energy in the future.

2. METHODOLOGY

Biomass is a material that can be obtained from plants either directly or indirectly. Specifically, biomass refers to wood, straw, rice husk, kitchen waste, pulp mud, animal waste, and waste. The component of biomass is the photosynthetic product of CO_2 with H_2O consisting of carbon, oxygen and hydrogen formed in complex macroscopic polymers. These components include cellulose, hemicellulose, lignin which in some plants the composition is different. [2]

Sugarcane is a species of grass growing only in tropical climates. Sugarcane has stems that grow upright to reach 3-5 meters. Structured hard, green, yellow, purple, dark red, or a combination. Sugarcane leaves are incomplete leaves consisting only of midrib and leaf blade. Flowers on sugar cane-shaped compound flowers that are about 70-90 cm long. Each flower has three petals, one crown, three stamens and two pistil. Sugar cane has a fiber root that can reach a meter. When the sugarcane is young there are 2 kinds of roots, namely root cuttings and single roots. [3]

Side products from sugar factories are sugar cane, filter crust (sugar liquid residue) and molasses. Of every 1 ton of sugarcane will approximately produce 105 kg of sugar, 500 kg of water, 280 kg bagasse, 30 kg of filter crust and 55 kg molases. [4].

Table 1. Content of Bagasse

Water Content	92,15 %
Ash Content	2,69 %
Bound Carbon Content	0.50 %
Crude Protein	1,15 %
Crude Fiber	26,33 %
Rough Fat	0,62 %
Cellulose	35,45 %
Lignin	7,45 %

Source: Laboratory of science and technology of feed, IPB (2016)

The coconut shell is a hard layer with a thickness of 3-5 mm. A good quality coconut shell that is an old and dry coconut shell is shown with a dark brownish color. The coconut shell belongs to a hardwood group with a moisture content of about 6% to 9% (calculated based on dry weight) which is similar in structure to wood, which is composed of lignin, cellulose and hemicellulose. Coconut shells are usually used as the main ingredient in the manufacture of charcoal and activated charcoal. This is because the coconut shell is a material that can produce a calorific value of about 6,500-7,600 kcal / kg. In addition to having a fairly high calorific value, coconut shell is also quite good for active charcoal raw materials.[5].

Table 2. Coconut Shell Content

Cellulose	26,60 %
Lignin	29,40 %
Pentosan	27 %
Ash Content	0,60 %
Extractive Solvent	4,20 %
Nitrogen	0,11 %
Water	8.00 %

Source: Suhardiyono (1995) melalui Ndraha (2010)

Tapioca is a starch made from cassava raw material. Tapioca is widely used for food industry, pharmaceutical, textile, adhesive industry and others. According to Saleh [6], starch is composed of two kinds of carbohydrates in different compositions of amylose and amylopectin. Amylose causes hard properties, while amylopectin gives stickiness. Tapioca starch is often used as an adhesive because it is easily found in the market and the price is cheap.

According to Grover and Mishra [7] through Syamsiro [8]. In general, briquetting technology can be divided into three. that is :

- High pressure formation
- Heat pressure forming medium
- Low pressure briquetting with a binder (adhesive).

Windarwati [9] revealed that biopelet is a solid type of biomass-based solid fuel that has a smaller size than briquettes. The process used in making biopelets is forging with temperature and pressure to form a uniform product with high production capacity. This biopelet technology has been around for a long time abroad. Making the first biopelet in Sweden in the 80s. While this new biopelet technology developed in Indonesia.

Dissolution or pelletization is a process to suppress biomass raw materials into biopelet form. The raw materials used are biomass that has been reduced in size and biomass that has been nested. Wood pellets are pellets made from wood waste, such as sawdust and wood dust destruction. The diameter of the wood pellet is 6-12 mm and the length is 10-25 mm. While wood briquettes larger size of 50-80 mm diameter and length 300 mm.

Table 3. Standard Wood Pellets in Indonesia

Parameter	Satuan	Persyaratan
Water Content	%	maks. 12
Ash Content	%	maks. 1,5
Carbon Content	%	min. 14
Density	g/cm^3	min. 0,8
Volatile Substances	%	maks. 80
Heating Value	kal/g	min. 4000
Diameter	mm	4-10
Length	mm	5xD

Source : BSNI (2014)

3. RESULT

This research was conducted in Chemical Laboratory of Faculty of Engineering, Bhayangkara University of Jakarta Raya and conducted in July until November 2016. Tools used include blender, scissors, 40 mesh filter tool, digital scales, electric oven, beaker glass, pellet mold ± 15mm diameter, sliding range.

Fixed variables research

- The powder of bagasse passes 40 mesh sieve
- Common charcoal and charcoal activated coconut charcoal pass 40 mesh sieve
- Temperature of 200oC biopelet densification Research control variables
- Comparison of bagasse composition with coconut shell charcoal that is: 100%: 0%; 75%: 25%; 50%: 50%; 25%: 75%; And 0%: 100%
- Comparison of tapioca adhesives used 10% and 20%.

Research procedure

a. Drying of raw materials.
   The bagasse was washed first and then dried in the sun.
b. Decrease the size and filtration of the bagasse powder.
   Sizing of bagasse was done in 2 stages. The first stage by cutting it into a smaller size. The second stage is destroyed with a blender. Once ground the bagasse is powdered, then filtered with a 40 mesh filter.
c. Analysis of physical and chemical properties of powdered bagasse.
   The analysis of sugarcane bagasse powder is intended to be able to compare the nature of chemical physics or to know the improvement of the properties before and after becoming biopelet. Analysis of physical and chemical properties include moisture content, fat content, ash content, coarse fiber content, crude protein content, cellulose levels and lignin levels.
d. Coconut shell charcoal size reduction.
   Coconut shell charcoal obtained from the market subsequently crushed by using mortar. If the charcoal is not yet fully into fine powder, the charcoal is destroyed again using a blender.
e. Biopelet making.
   Biopelet is made by mixing the powder of bagasse and coconut shell charcoal. Comparison of bagasse and charcoal used is 100%: 0%; 75%: 25%; 50%: 50%; 25%: 75%; And 0%: 100%. Each mixture was added with 10% tapioca starch and 20% of the total weight of the material.
f. Biopelet printing.
   Biopelet printing is done by printing it on a preheated mold in an oven with a temperature of 200oC. The size of the mold used is with a diameter of 15 mm and length of 20 mm.
g. Testing the physical properties of biopelet chemistry Testing is done by measuring the size of biopelet (length and diameter), density test, moisture content, ash content, airborne content, and bound carbon content.

3.1 Biopelet Density Test

Density is the ratio of mass to volume in the biopelet. According to Saputro et al (2012), density will affect the amount of heat value in biopelet and the quality of biopelet. The relationship between the density and the calorific value shows the energy content per volume, where the energy content will increase as the density of the biopelet increases

Table 4. Density Test Results on Adhesives 10%

Composition	Mass (gr)	Diameter (cm)	Height (cm)	Volume (cm^3)	Density (gr/cm^3)
(100 : 0)	0.7024	1.4913	1.3458	2.3495	0.2990
(75 : 25)	0.8664	1.5038	1.1460	2.0344	0.4259
(50 : 50)	0.9932	1.4873	1.2283	2.1329	0.4656
(25 : 75)	1.0472	1.4828	1.2610	2.1765	0.4811

(0 : 100)	1.8134	1.4760	1.5400	2.6337	0.6885

Table 5. Density Test Results on Adhesives 20%

Composition	Mass (gr)	Diameter (cm)	Height (cm)	Volume (cm³)	Density (gr/cm³)
(100 : 0)	0.8341	1.4758	1.3888	2.3745	0.3513
(75 : 25)	0.9115	1.4800	1.4745	2.5353	0.3595
(50 : 50)	1.1029	1.4828	1.2028	2.0760	0.5313
(25 : 75)	1.4706	1.4833	1.4425	2.4914	0.5903
(0 : 100)	1.6338	1.4740	1.5045	2.5660	0.6367

Based on the result of biopellet density research, it is obtained from 0.30 - 0.69 gr / cm3. The density resulting from the highest mixture of bagasse and coconut shell charcoal is shown in the raw material composition of 25%: 75%, ie 0.4811 gr / cm3 in 10% tapioca adhesive and 0.5903 gr / cm3 in tapioca adhesive 20% . While the amount of density generated from the second experiment, that is by using a mixture of bagasse and coconut shell activated charcoal on the composition of 25%: 75% with 20% adhesive that is equal to 0.6156 gr / cm3.

The density generated in this study, both the 1st and 2nd experiments, still does not meet the standards of SNI, the countries of Austria, Germany or Sweden. However, when compared to the standards of the South Korean country, the density of the research results has exceeded the established standard of ≥ 0.2 gr / cm3. From this it can be concluded also that if the biopelet produced by the study is commercially produced, South Korea is one of the possible market potentials.

Table 6. Comparison of density quality standards in biopelets in some countries

Country	Density (gr/cm³)
SNI (Indonesia)	>0.8
Austria Standard (ONORM M 7135)[a]	>1.12
Germany Standard (DIN 51731)[a]	1.0 - 1.4
Swedia Standard (SS 18 71 20)[b]	>0.64
South Korea [c]	≥0.2
Result of experiment 1	0,5903
Result of experiment 2 (active charcoal)	0,6156

Source : a)WIP-RE (2009)   b) Hahn (2004) c) Depdagri (2014)

3.2 Water Content Test

Water content in the manufacture of biopelets has a great influence in terms of quality. The higher the moisture content, the quality of biopelet will decrease. The effect is related to the calorific value of biopelet produced. The higher the water content, the biopelet will be more difficult to ignite. Charcoal has a high hygrochemical or very easy to absorb water. Therefore, the determination of water content aims to determine the hygroscopic properties of biopelets.

From the results of the previous density test, it is known that the highest biopelet density value is between the mixture composition of 25%: 75% in the 20% adhesive that is 0,5903 gr / cm3 and the density of biopelet using a mixture of bagasse and coconut shell activated charcoal on the composition of 25% : 75% with 20% adhesive ie equal to 0.6156 gr / cm3. From the results then, biopelet tested its water content.

Based on the result of test of experimental water content of experimental biopelet 1, the mixture composition 25%: 75% and 20% adhesive yield 5.39% moisture content. While in the second experiment that is biopelet using mixed bagasse and coconut shell activated charcoal on the same composition obtained water content of 6.25%.

The value of water content resulting from this research, both experimental 1 and 2nd experiment, have met the standards of SNI and other countries. This happens because the value of biopelet water content of the research results is lower than the standard of SNI and the German state that determines the water content contained in the biopelet is a maximum of 12%. Meanwhile, Austria and Sweden state the water content contained in the biopelet is a maximum of 10%. The comparison of water content of the research results with water content standards in several countries is presented in Table 7.

Table 7. Comparison of quality standards of water content in biopelets in some countries

Country	Water Content (%)
SNI (Indonesia)	<12
Austria Standards (ONORM M 7135)[a]	<10
Germany Standards (DIN 51731)[a]	≤12
Swedia Standards (SS 18 71 20)[b]	<10
South Korea[c]	≤15
Result of experiment 1	5,39
Result of experiment 2 (active charcoal)	6,25

Source : a)WIP-RE (2009)   b) Hahn (2004)   c) Depdagri (2014)

3.3 Ash Content Test

Ash is a non-combustible mineral and left behind after the combustion process or the accompanying reactions are completed. Ash can leave the crust or dirt on the furnace surface, corrosion and can decrease the quality of biopelet burning. This is because the ash contained in the biomass has a low melting point. [10]

According to a study conducted by Triono [11], which treated the composition between a mixture of sawdust sawdust and coconut shell charcoal to ash values, it was concluded that the addition of coconut shell charcoal to the material composition tended to increase the ash content. The increase in ash content is caused because the silica content of coconut shell is higher than silica from sawdust sawdust. One of the elements in the ash content is silicates that have a poor effect on the resulting heating value. The lower the ash content, the better the quality of the biopathet produced.

Based on test result of ash content of biopelet, ash content obtained from experiment to-1 is 15,69%. While the ash content resulting from the 2nd experiment using active charcoal was obtained by 20.13%. The value of ash content resulting from this research is still higher than the ash content standard of SNI and several other countries so that it can not meet the quality standard. This is because the dominant composition of the biopelet used is the composition of charcoal or activated charcoal that is equal to 25% bagasse and 75% charcoal and activated charcoal. A comparison table of ash grade quality standards is presented in Table 4.5.

Tabel 8. Comparison of quality standards of ash content in biopelets in some countries

Negara	Kadar Abu (%)
SNI (Indonesia)	≤1.5
Austria Standards (ONORM M 7135)[a]	<0.05
Germany Standards (DIN 51731)[a]	≤1.5

Swedia Standards (SS 18 71 20)[b]	<0.7
South Korea[c]	≤6.0
Result of experiment 1	15,69
Result of experiment 2 (active charcoal)	20,13

Source : a)WIP-RE (2009)   b) Hans (2004)   c) Depdagri (2014)

3.4 Content of Fly Substance Test

Levels of flying substances or volatile matter are substances that can evaporate as a result of the decomposition of compounds that are still present in charcoal other than water. The level of the fly substance will affect the speed at which the combustion, combustion time and the smoke generated in combustion. High levels of fly substances in the biopelet will cause more smoke when the biopathet is turned on, so the efficiency of fuel combustion will decrease further.

Based on the result of the test of the content of fly substance in experiment to-1 obtained equal to 36,66%. While the content of fly substance from the 2nd experiment using a mixture of bagasse and activated charcoal was obtained by 38.43%. Based on this matter, it can be concluded that the value of fly substance produced from this research is still lower than the content of fly content determined by SNI that is max 80%, so that the result has fulfilled the standard of airborne content.
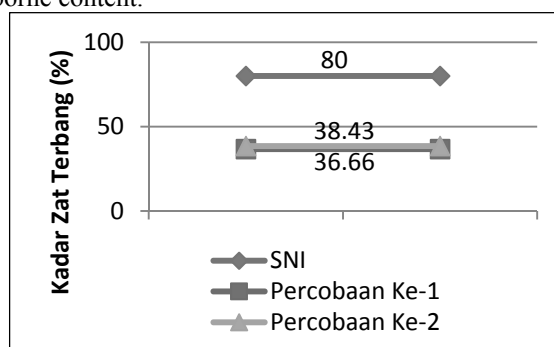
Figure 1. Comparison of Quality Standard of Flying Content Result of Research with SNI Standard

3.5 Test of Bound Carbon Content

According to Saragih [12], it is revealed that the bound carbon content is a carbon fraction bound in charcoal in addition to the fraction of water, ash and fly substances. The carbon content bound in the biopelet is affected by the value of ash content and the content of the fly substance. If the level of ash and the substance fly is low then the bonded carbon content will be of high value. The value of the bonded carbon content will affect the calorific value of the biopelet thus determining the quality of the fuel. The heating value in biopathet will be high if the carbon content value is tied to high biopelet.

Based on the results of testing the bonded carbon content obtained from the experiment to-1 that is equal to 42.26%. While the carbon concentration resulted from the 2nd experiment using active charcoal was obtained for 36.19%. Based on these results, it can be concluded that the value of the bonded carbon content resulting from this study, either the first experiment or the 2nd experiment, is higher than the standard bound carbon level determined from the SNI that is at least 14%, so that the result has met the standard The quality of carbon bound.
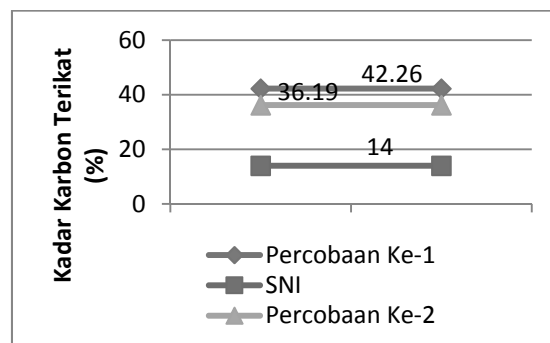
Figure 2. Comparison of Carbon Level Quality Standard Tied Research Result with SNI Standard

3.6 Heating Value Test

This heat value test is based on the composition of a mixture of bagasse with coconut shell activated charcoal which is determined to test the composition of 25%: 75% in 20% adhesive. Based on the test result, the 2nd experimental biopelet calorific value obtained is 4,090 cal / gram. In Graph 4.3 it can be concluded that, the heating value of biopelet research results is higher than the calorific value determined by SNI that is at least 4,000 cal / gram, so that the calorific value of this research has met the standard of calorific value for biopelet.
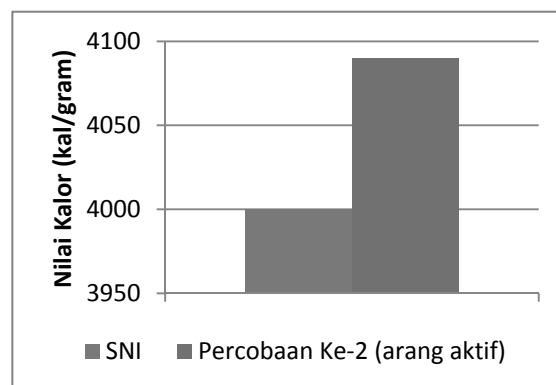
Figure 3. Diagram Comparison of Quality Standards Calorific Value of Research Results with SNI Standards

1. CONCLUSIONS AND SUGGESTIONS

4.1 Conclusions

1. The most optimum composition of biopelet production from mixture of bagasse, coconut shell charcoal and tapioca adhesive is the composition of bagasse: coconut shell charcoal (25%: 75%) with 20% adhesive.
2. Biodelet density value of mixed bagasse, coconut shell charcoal and tapioca adhesive is 0,5903 gr / cm3. The resulting water content is 5.39%. Ash content of 15.69%. Flying substance produced is 36.66% and the resulting carbon content is 42.26%.
3. While the large density value of biopelet from a mixture of bagasse, coconut shell activated charcoal and tapioca adhesive is obtained for 0.6156 gr / cm3. The resulting water content is 6.25%. Ash content of 20.13%. Level of flying substance produced is 38.43%. The resulting bonded carbon content is 36.19% and for the resulting calorific value is 4,090 cal / gram.
4. Biopelet from a mixture of bagasse with coconut shell charcoal can be used as solid fuel alternative in the future.

4.2 Suggestions

The need for further development in the manufacture of biopelet printing machines (in large scale) to facilitate the manufacture of solid fuels such as biopelets, so that biopelet production from biomass can meet the export market.

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APPLICATION OF K-MEANS METHOD IN MONITORING SYSTEM OF BASED ON ANDROID STUDENTS (CASE STUDY: SMK YPM 4 TAMAN)

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ABSTRACT

In some schools, the actual point of such systems already exist or are already implemented in the school since a few years ago, where each student will have the initial point of, Say 250 points at the beginning of the school year. Throughout the school year, this point will be reduced, if Siwa concerned violated the school rules. Point reduction amount for each violation will be different from one another, terganting of pelanggaranya level. For a minor offense, it will usually be given a reduction point between 5-20 points, depending on the case. As for the major violations, will be given a point reduction by 50 points and even up given warning letters to students who commit violations. In implementing this algorithm testing data used are from SMK YPM 4 TAMAN, in the application of this method of K-means.

Keywords: *Monitoring system, Smk YPM 4 Taman, Kmeans*

1. INTRODUCTION

In some schools, the actual point system already exists or has been applied to schools since a few years ago, where each student will have the initial point of, say 250 points at the beginning of the school year. Throughout the school year, this point will decrease, if the student concerned violates the school rules. The number of point deductions for each violation will be different from one another, severed from the level of the offender.

For minor offenses, it will usually be given a point deduction of between 5-20 points, depending on the case. While for large violations, will be given a reduction point by 50 points and even be given a warning letter against students who commit violations. In the next few years, when the world of education we have a lot of computer use, the recording process will be done with the help of spreadsheet software, such as Microsoft excel, so that at the end of the school year, teachers or student sections will be able to recruit violations of the students. But with the help of the program, there are many encountered weaknesses such as:

1. Data Integrity, by storing into one file, there is the possibility of this file accidentally deleted, or can also corrupt, so that data can not be accessed again.
2. Securities, for the issue of securities also become one of its own concerns. Although the file can still be protected with a password, but there is always a chance to be broken, so that data can be accessed by unauthenticated people.
3. Single User, by storing data violations of students into a single file, meaning that the file can only be accessed by one person only, so be bebean separate bangi the person in charge, where for any changes to the data, we must contact the person.

Starting from these weaknesses, I want to design a system that can overcome the weaknesses that exist in the previous system. So the data should be centered on a server that is essentially a central database, has a pretty good security system and most importantly, accessible to all school communities, especially teachers, so they can monitor the developmental process of their students.

Based on the description above to support the application of K-means For Development of monitoring of violations of students based on android, k-means algorithm is a simple iterative grouping algorithm that divides the given dataset into a number of clusters k determined by the user. The algorithm is simple to implement and run, relatively fast, easy to adapt, and commonly used in practice.

2. METHODOLOGY

2.2 Monitoring System

Monitoring is a routine process of data collection and measurement of progress on program objectives. Monitoring changes, which focus on process and output Monitoring involves calculating what we do.

2.1.1 The purpose of Monitoring

In general, Monitoring aims to get feedback for the needs of the ongoing learning process program, by knowing this need the implementation of the program will immediately prepare the needs in the learning. Needs can be cost, time, personnel, and tools. The implementation of the program will know how much it will cost, how long it will take for the activity.

2.2　Smk Ypm 4 Taman

SMK YPM 4 Taman Sidoarjo was established in 1993 which is the development of SMK YPM 1 Sepanjang. Vocational School located at Jalan Raya Bringinbendo No.1 Taman was established after SMK YPM 1 Sepanjang has a class that exceeds the limit of provisions of the Directorate of Vocational School of the Ministry of Education and Culture at that time. In it's development, from the academic year of 1996/1997 to the school year 2007/2008 SMP YPM 4 Taman Sidoarjo, which has won several times the Automotive Skill Competition SMK Negeri / Private se East Java and Bali has 24 study groups with the number of students as many as 1186 people.

Public interest to choose SMK YPM 4 Taman Sidoarjo keep increasing, so that starting year 1998/1999 new student acceptance done through selection process. This is done considering that every year the number of applicants exceeds the available class capacity. In the preparation of this school site it certainly involves many parties, for which we would like to thank to:

1. Leadership and Staff of SMK YPM 4 TAMAN

2. Head of Technical Automotive Engineering Program SMK YPM 4 Park

3. Head of Technical Video Audio Program SMK YPM 4 TAMAN

4. Mr / Mrs Teacher SMK YPM 4 TAMAN

5. All parties involved directly or indirectly

2.3 Definition of K-Means Method

K-means is one of clustering algorithm. The purpose of this algorithm is to divide the data into several groups. This algorithm receives input in the form of data without class label. This is in contrast to the supervised learning that receives inputs in the form of vectors ($\neg x \neg 1$, y1), ($\neg x \neg 2$, y2), ..., ($\neg x \neg i$, yi), where xi is data from a training data and Yi is the class label for xi. In this learning algorithm, the computer classifies its own data into its input without first knowing the target class [1]. This learning is included in unsupervised learning. The received input is the data or object and k of the desired cluster. This algorithm will group the data or objects into the k group of the group. In each cluster there is a centroid that represents the cluster.

K-means found by some people namely Lloyd (1957, 1982), Forgey (1965), Friedman and Rubin (1967), and McQueen (1967) [1]. The idea of clustering was first discovered by Lloyd in 1957, but it was only published in 1982. In 1965, Forgey also published the same technique so sometimes known as Lloyd-Forgy in several sources.

3. RESULTS

In some schools, the actual point system already exists or has been applied to the school since a few years ago, where each student will have an initial point of, say 250 points early in the school year. Throughout the school year, this point will decrease, if the student concerned violates the school rules. The number of point deductions for each violation will be different from one another, severed from the level of the offender.

For minor offenses, it will usually be given a point deduction of between 5-20 points, depending on the case. While for big offense, will be given a point deduction of 50 points and even to be given a warning letter against students who commit violations.

If we violate the school rules, we will be dealing with BP teachers (Guidance and Counseling) who will record the reason we committed the offense and will certainly provide coaching in accompanying advice.

3.1 Data Requirement

The data requirement in this application is student violation data consisting of audio video class and light vehicle technique, each class consists of approximately 41 students.

3.2 Interface Need

The analysis is based on inputs and outputs that have been generated beforehand so as to produce 4 (four) needs of the interface in general namely:

1. Interface for the main menu
2. An interface for violation data
3. An interface for k-means method calculation
4. Interview for results or conclusion

3.3 Calculation of K-Means

The first step to solve the problem on the violation of the student will be calculated by k-means method by making 10 random data that will determine the cluster point and arrange as the table below.The second step of calculating the center distance of the cluster   And then continue for data to 2, 3, ... n Then we get the following results:To measure the distance between the data with the center cluster used Euclidian

Distance, then we get the distance matrix as follows:

Euclidian distance :

$$d = \mid x - y \mid = \sqrt{\sum_{i=1}^{n}(x_i - y_i)^2}$$

x = cluster center
y = data

3.4 Design System

After doing a system analysis consisting of making flowchart, data flow diagrams, entity relationship diagrams, making database design, layout display program that has been described above, then the system design will be done. This program is created using Php programming language using sqlite database. Creating a system design or system design that will be made in accordance with the needs of analysis.
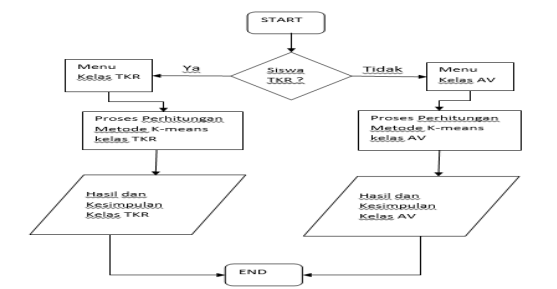
Figure 1. Flowchart of Design System

3.5 Interface Implementation

The process of interface system implementation is divided into several processes and forms that are the overall system view. The process of viewing the monitoring system from the menu to the final conclusion. This class menu form there are 2 choices of Audio video class and light vehicle engineering, which appears as shown in Figure 2.

Figure 2. Interface Application

3.6 Iteration Process

From result of random data one and random data two then yield 0 iteration following result :

Figure 3. Iteration Process

4. CONCLUSION

From the interaction image 0 got the result:
1. The first student gets the result to 1 that is 0, the result to 2 is 7.5, the 3rd result is 0.8333333, the result to 4 is 0, the result to 5 is 0, the result to 6 is 5, the result to 7 is 0.
2. The second student gets the result to 1 that is 10, the result to 2 is 0, the result to 3 is 0, the result to 4 is 0, the result to 5 is 15, the result to 6 is 0, the result to 7 is 0.
3. Student to 3 get the result to 1 is 0, the result to 2 is 0, the result to 3 is 2.5, the result to 4 is 0, the result to 5 is 0, the result to 6 is 15, the result to 7 is 50.

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FORECASTING SYSTEM OF LIBRARY BOOKS USING SINGLE SMOOTHING EXPONENTIAL (CASE STUDY BHAYANGKARA SURABAYA UNIVERSITY LIBRARY)

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ABSTRACT

This research proposes a solution to ease UBHARA library to add their books collection by forecasting the books amount using single smoothing exponential method with MSE error formula and RMSE error. The data which is forecasted starts from year 2012 until 2016 collected from each field, economics, law, politics and social, and engineering. The data will be processed through pre-processing to prepare the forecasted data. In the calculation example, this programme used data start from 2012 until 2015, alpha value = 0,1 and calculated from the 1st month until the 3rd month, and the 4th month data would be forecasted. The result shows the highest data of book loan comes from the Economics field because in each data of book loan the economics data are more dominant. The value of MSE error and RMSE error are shown in those calculations for year 2015. The error value determines whether the forecast results are better or not. The error value for data forecasting newer than 2015 will be shown.

Keywords: *Library, single smoothing exponential, alpha, pre-processing, MSE error, RMSE error.*

1. INTRODUCTION

Library is a place that has role as a medium of learning through reading books that are provided in accordance with the field title of the book. The task of the library is to develop a collection of books, to manage, and to care library materials, to provide services as well as to carry out library administration. One example is like grouping books on every shelf that must be appropriate and neat, so it can facilitate visitors to search for a book. If the library is well managed, it can be used as a place to read as well as to learn comfortably for library visitors.

Library is a place where students seek knowledge by reading books so that students can obtain additional knowledge other than the knowledge obtained from lecturers, by reading books in the library they can also encourage other students to visit the library and to borrow books in the library. But the process of book loan in the library of Bhayangkara Surabaya University is still using manual way so librarians face difficulties in determining the number of books to be added and determining the title or field that they will add in the library.

Therefore, in this research entitled "Forecasting system of library books using single smoothing exponential (Case Study Bhayangkara Surabaya University Library)". This research will be pre-processing each book loan which later will be used as a feature to get the field of books to be added. This research proposes a system for forecasting the field of books in the library.

The purpose of this research is to design a system to predict the data field of the book, thus facilitating the librarian in adding a list of reference books in the library of Bhayangkara Surabaya University based on book loan data.

2. METHODOLOGY

In this system there will be a pre-processing first for the amount of book loan data so that a total amount of each month are obtained in each field. It is hoped that this research can produce a system to predict the addition of

data field of books based on book lending data to make it easier for librarians to ease additionof collection of books field in the library.

The data of book loan is obtained from UBHARA library manual notes in the form of excel format which used as a guide in this research and processed for forecasting system. Book loan data that the author received must be processed first to fit the application made. This last result is later used as a feature in the grouping process. The following will be given a sample process for processing up to the forecasting process. Given examples of book loan data from 3 months of year 2012 in January, February, and March. Next for the 4th month will be forecasting data addition of books that will be added by looking at the highest field of forecasting results.

2.3 System Design

Context diagram that aims to facilitate the modeling and functions in the development of the system and provide an overview of the system built. Context diagram / level 0 chart can be seen in Figure 1.
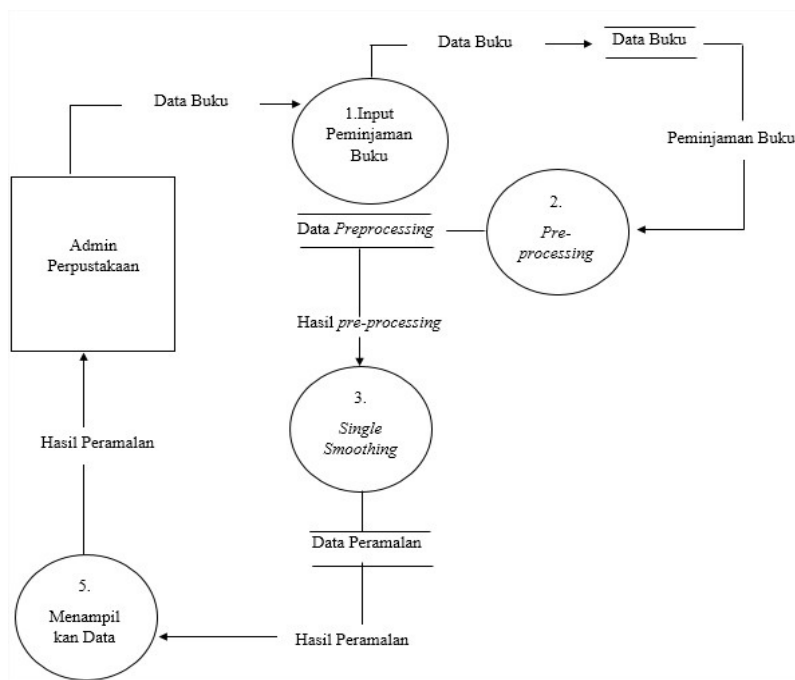
Figure 1. System Design

2.2 Single Exponential Smoothing

The first order exponential smoothing method is actually the development of a simple moving average method. This method is widely influenced in forecasting because it is simple, efficient in calculation and forecast changes, easily adapted to data changes, and the accuracy of this method is quite high. But this method is not good enough applied if the data is not stationary, since the equation used in single exponential method has no trend effect smoothing procedure which causes non stationary data to remain non stationary, but this method is the basis for the other method of smoothing exponential.

The following is the equation used in Single Exponential Smoothing calculations :

$$F_{(t+1)} = \alpha D_t + (1 - \alpha)F_{(t-1)} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

Where :

$"F"_{"t-1"}$	= The old smoothing value or the average value until t-1 period
$"F"_{"t+1"}$	= The forecasted value for the next period
α	= Smoothing Parameter
D_t	= Actual demand or sales for t-1 period

2.5 Mean Square Error

The Mean Squared Error (MSE) is another method for evaluating forecasting methods. Each error or residue is squared. Then summed and added with the number of observations. This approach sets a large forecasting error

because the errors are squared. The method produces moderate errors that are likely to be better for small errors, but sometimes make a big difference. The goal of statistical optimization is often to choose a model for minimum MSE, but this measurement has two weaknesses. First, this measurement shows the matching of a model to historical data. Matching by using a high-order polynomy or an appropriate Fourier transform. A model that fits well into the same data series is equivalent to including the random element as part of the raise process. This is just as bad as failing to recognize non-random patterns, in the data.

MSE (Mean Squared Error) is the average of the square difference between the predicted and observed value (the actual value). Here is the MSE formula.

$$\text{MSE} = \frac{1}{n}\sum_{i=1}^{n}(Y_1 - Y_t^{\wedge})^2$$

Y_1 = original data value

$Y_1^{\wedge}$ = forecast data value

3. RESULTS

Forecasting book loan data that will be conducted in this research is in accordance with the amount of data on each field of borrowing or faculty. The experiment was conducted 4 times, they were for the data in year 2012, 2013, 2014, and 2015 with an alpha value of 0.1. For experiments displayed in this abstract is only in year 2015.

Each trial will be conducted for 3 months in a year. Before doing the data forecasting, the data will be processed into data selection of the month and year to determine which will be used as forecasting data and the process is called pre-processing. After that, the data is ready to be used in book loan data forecasting. From the data, the field can be divided into 4 fields or faculty in each book data, they are: Economics, Law, Politics and Social, Engineering.

3.1 Test Result for Year 2015

Test is done by giving the alpha number of 0.1, the process is done as much as 1 times. In 2015 the error-MSE and error-RMSE will be displayed. And here are the experimental results:

The results of forecasting data in the next 1 month 2015 economic field, law, politics and social, engineering are as follows.

Figure 1. Forecast Economic Data for year 2015

The calculation result of the smoothing value for the 4th month by using α = 0.1 economic field is as follows :

Economic 1st Month :

F_{t+1} = **155**

Economic 2nd Month :

F_{t+1} = $\alpha\,D_t + (1 - \alpha)(F_t\text{-}1)$

= 0,1 (155) + (1 − 0,1) (155-1)

= 0,1 (155) + (0,9) 154

= 15,5 + 138,6

= **154,1**

Economic 3rd Month :

$$F_{t+1} = \alpha D_t + (1 - \alpha)(F_t\text{-}1)$$
$$= 0,1 (279) + (1 - 0,1)(154,1\text{-}1)$$
$$= 0,1 (279) + (0,9) 153,1$$
$$= 27,9 + 137,79$$
$$= \mathbf{165,69}$$

Economic 4th Month :

$$F_{t+1} = \alpha D_t + (1 - \alpha)(F_t\text{-}1)$$
$$= 0,1 (424) + (1 - 0,1)(165,69\text{-}1)$$
$$= 0,1 (424) + (0,9) 164,69$$
$$= 42,4 + 148,221$$
$$= \mathbf{190,621}$$
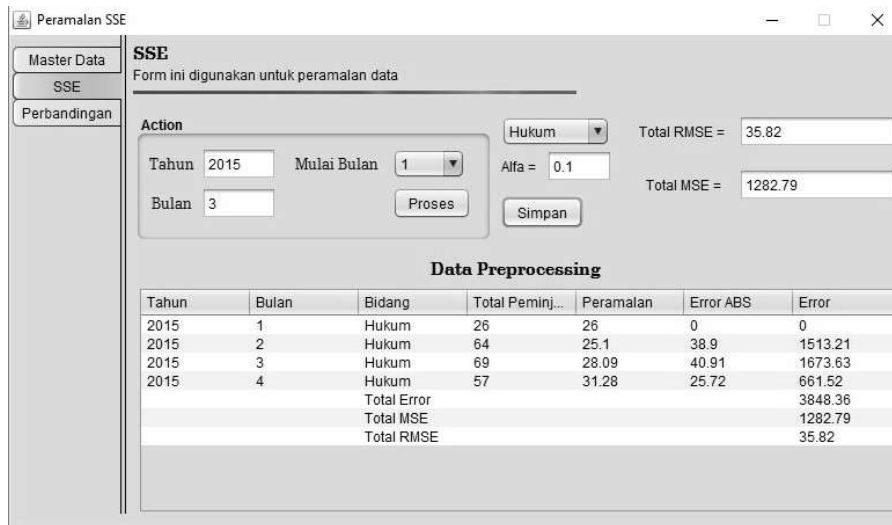
Figure 2. Forecast of Law Field for year 2015

The calculation result of the smoothing value for the 4th month by using α = 0.1 law field is as follows :

Law 1st Month :

$$F_{t+1} = \mathbf{26}$$

Law 2nd Month :

$$F_{t+1} = \alpha D_t + (1 - \alpha)(F_t\text{-}1)$$
$$= 0,1 (26) + (1 - 0,1)(26\text{-}1)$$
$$= 0,1 (26) + (0,9) 25$$
$$= 2,6 + 22,5$$
$$= \mathbf{25,1}$$

Law 3rd Month :

$$F_{t+1} = \alpha D_t + (1 - \alpha)(F_t\text{-}1)$$
$$= 0,1 (64) + (1 - 0,1)(25,1\text{-}1)$$
$$= 0,1 (64) + (0,9) 24,1$$
$$= 6,4 + 21,69$$
$$= \mathbf{28,09}$$

Law 4th Month :

$$F_{t+1} = \alpha D_t + (1 - \alpha)(F_t\text{-}1)$$
$$= 0,1 (69) + (1 - 0,1)(28,09\text{-}1)$$
$$= 0,1 (69) + (0,9) 27,09$$
$$= 6,9 + 24,381$$
$$= \mathbf{31,281}$$
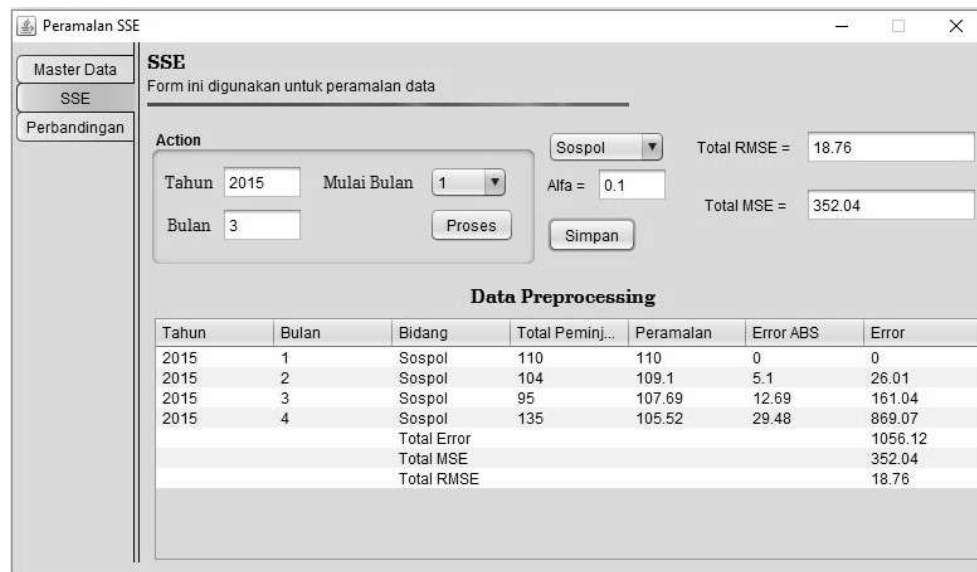
Figure 3. Forecast of Politics and Social Field for year 2015

The calculation result of the smoothing value for the 4th month by using α = 0.1 economic field is as follows :

Politics and Social 1st Month :
F_{t+1} = **110**

Politics and Social 2nd Month :
F_{t+1} = $\alpha D_t + (1 - \alpha)(F_t\text{-}1)$
           = 0,1 (110) + (1 − 0,1) (110-1)
           = 0,1 (110) + (0,9) 109
           = 11 + 98,1

           = 1**09,1**

Politics and Social 3rd Month :
F_{t+1} = $\alpha D_t + (1 - \alpha)(F_t\text{-}1)$
           = 0,1 (104) + (1 − 0,1) (109,1-1)
           = 0,1 (104) + (0,9) 108,1
           = 10,4 + 97,29
           = **107,69**

Politics and Social 4th Month :
F_{t+1} = $\alpha D_t + (1 - \alpha)(F_t\text{-}1)$
           = 0,1 (95) + (1 − 0,1) (107,69-1)
           = 0,1 (95) + (0,9) 106,69
           = 9,5 + 96,021
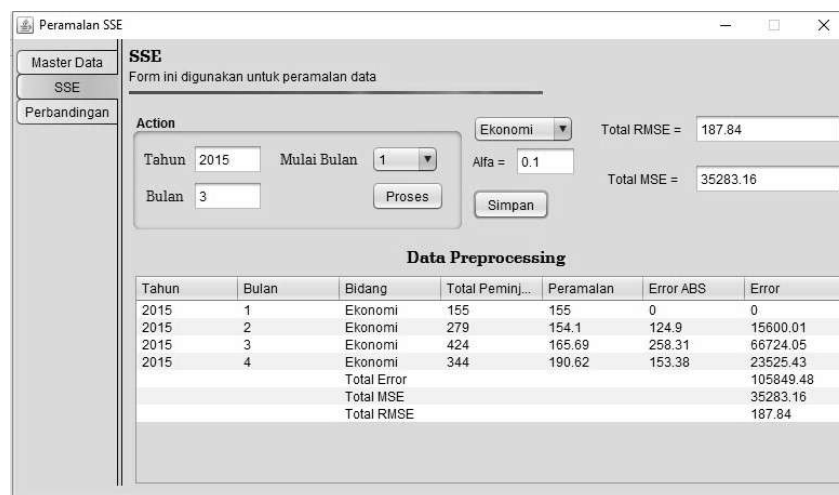
           = **105,521**
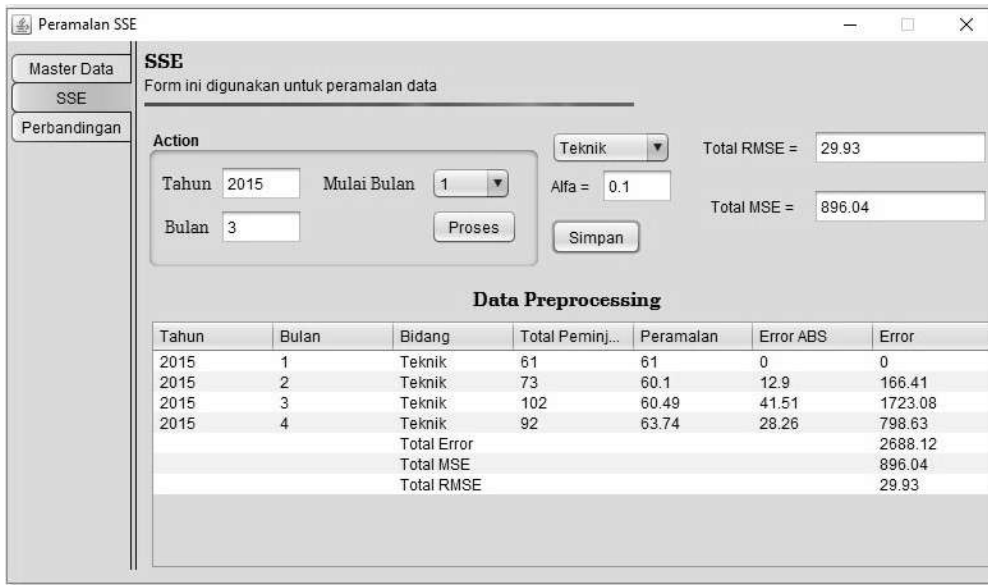
Figure 4. Forecast of Engineering Field for year 2015

The calculation result of the smoothing value for the 4th month by using α = 0.1 economic field is as follows :

Engineering 1st Month :
$$F_{t+1} = 61$$

Engineering 2nd Month :
$$F_{t+1} = \alpha D_t + (1 - \alpha)(F_t\text{-}1)$$
$$= 0,1 (61) + (1 - 0,1) (61\text{-}1)$$
$$= 0,1 (61) + (0,9) 60$$
$$= 6,1 + 54$$
$$= \mathbf{60,1}$$

Engineering 3rd Month :
$$F_{t+1} = \alpha D_t + (1 - \alpha)(F_t\text{-}1)$$
$$= 0,1 (73) + (1 - 0,1) (60,1\text{-}1)$$
$$= 0,1 (73) + (0,9) 59,1$$
$$= 7,3 + 53,19$$
$$= \mathbf{60,49}$$

Engineering 4th Month :
$$F_{t+1} = \alpha D_t + (1 - \alpha)(F_t\text{-}1)$$
$$= 0,1 (102) + (1 - 0,1) (60,49\text{-}1)$$
$$= 0,1 (102) + (0,9) 59,49$$
$$= 10,2 + 53,541$$
$$= \mathbf{63,741}$$

4. CONCLUSION

			Data Perbandingan			
Tahun	Bulan	Alfa	Bidang	Peramalan	MSE	RMSE
2015	4	0.1	Ekonomi	190.62	35283.2	187.84
2015	4	0.1	Hukum	31.28	1282.79	35.82
2015	4	0.1	Sospol	105.52	352.04	18.76
2015	4	0.1	Teknik	63.74	896.04	29.93
2015	4	0.1	Ekonomi	190.62	35283.2	187.84
2015	4	0.1	Hukum	31.28	1282.79	35.82
2015	4	0.1	Sospol	105.52	352.04	18.76
2015	4	0.1	Teknik	63.74	896.04	29.93
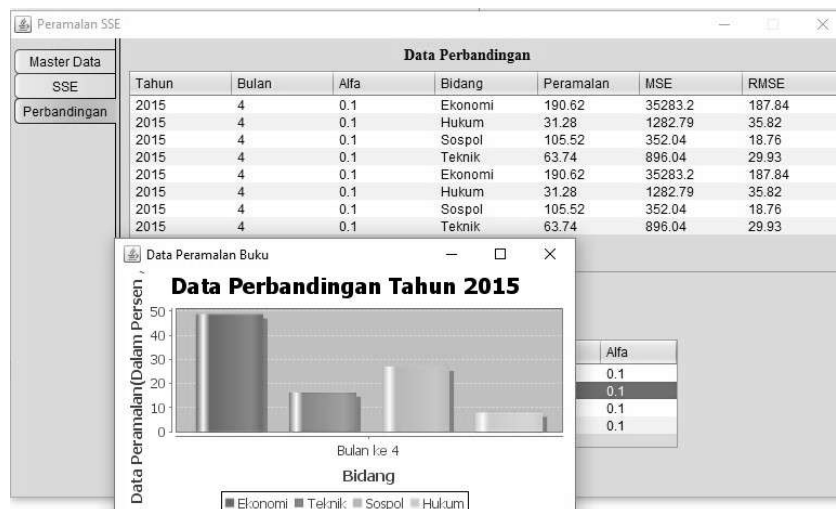
Figure 5. Comparison & Graph for 2015

Figure 5 shows the results of data forecasting in form of data tables and comparison charts. The largest amount is the economic field data. The data has been converted into percentages.

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ANALYSIS OF SERVICE QUALITY INFLUENCE ON E-COMMERCE CUSTOMER SATISFACTION (CASE STUDY TRAVELOKA)

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ABSTRACT

Business information technology in the field of so-called e-commerce, one of the e-commerce with a form of Online Travel Agents (OTA) is Traveloka. Industry Online Travel Agents (OTA) has stiff competition, which makes industrial Online Travel Agent must provide more value to consumers to increase the level of satisfaction, one of them using the service quality. The independent variable of this research is reliability (X1), assurance (X2), responsiveness (X3), empathy (X4), and tangible (X5), which adopted from the theory of service quality, while the dependent variable in this study is Traveloka customer satisfaction (Y1). Object of this research is a service on Online Travel Agents (OTA) Traveloka. Methods of data collection is done by distributing questionnaires to the 300 respondents. The data in this study obtained from questionnaires distributed online, for then analyzed using SPSS. Based on results, regression formula Y = 0,199 X1 + 0.135 X2 + 0.184 X3 + 0.045 X5+ 0,388 X5. Variable tangible become the most influential variable with a regression coefficient 0.388. Online Travel Agent Traveloka expected to maintain the service quality to increase customer satisfaction levels.

Keyword: E-commerce, Traveloka, Service Quality, Customer Satisfaction, Multiple Regression.

1. INTRODUCTION

Information technology has progressed very rapidly, it is because information technology is always explored continuously to always fulfill its function that is to solve problems, improve effectiveness and efficiency, also improve productivity. Continued exploration causes information, communication, and internet technology to spread in life including in business and commerce [1]. Information technology in business is commonly called e-commerce, which is growing with the help of the internet in our lives [2]. E-commerce also makes consumers easy to get the goods or services needed.

Total revenue from travelers in Indonesia reached USD 10.5 billion [3]. It became one of the causes of the emergence of many startup technology in the field of Online Travel Agent (OTA), such as Traveloka, Tiket.com, nusatrip.com, and pegipegi.com. The emergence of many startup of these technologies, giving rise to fierce and competitive competition. It forces online service providers to be customer-oriented, where customers have their own expectations. Customer expectations can be seen from the level of satisfaction, if the high level of customer satisfaction means that services provided Traveloka has been in line with expectations. Conversely, if the low customer satisfaction level means that the services provided by Traveloka are not in line with expectations. Satisfaction is also influenced by a value. Therefore Traveloka mandatory to provide more value to its customers, one of them by providing good quality service [4]. Service quality is a measure of how well a service is delivered according to customer expectations, divided into 5 dimensions reliability, assurance, responsiveness, empathy, and tangible [5]. Based on the background of the above problems, the researchers hope to see how far the influence of reliability, assurance, responsiveness, empathy, and tangible to customer satisfaction Traveloka.

2. METHODOLOGY

This research method is associative research method with causal relation. Associative research with causal relationships

is a study that explains the effect of independent variables on the dependent variable [6]. The independent variable or variable that influence on this research is 5 dimension of service quality that is reliability, assurance, responsiveness, empathy, and tangible. While the dependent variable or variable that is influenced in this research is customer satisfaction of Travel Travel Agent Traveloka service. Here is the model of this research:
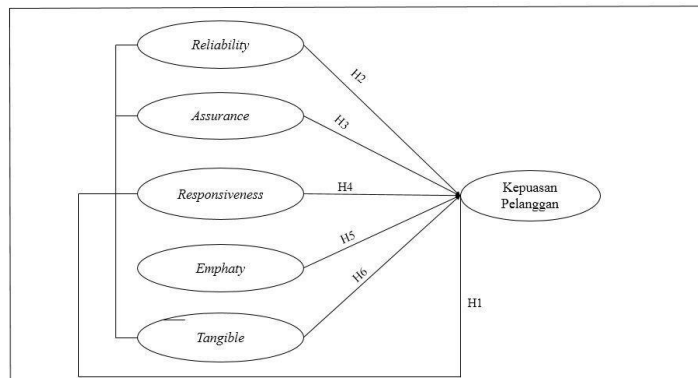
Gambar 1.1 Model Penelitian

2.1 Hipotesis Penelitian

- H1 : All dimensions of service quality are expected to have a positive and significant impact on customer satisfaction of e-commerce Traveloka
- H2 : The dimension of reliability is expected to have a positive and significant impact on customer satisfaction of e-commerce Traveloka
- H3 : The dimension of assurance is expected to have positive and significant impact on customer satisfaction of Traveloka e-commerce
- H4 The dimension of responsiveness allegedly have a positive and significant impact on customer satisfaction e-commerce Traveloka
- H5 : The dimension of emphaty is expected to have positive and significant impact on customer satisfaction of Traveloka e-commerce
- H6 : The dimension of tangible is expected to have a positive and significant impact on customer satisfaction of e-commerce Traveloka

3. RESULTS

In this research conducted several stages of testing, this test is done to ensure all data used in this study can be justified and feasible to be taken into consideration of the company in making future decisions.

Researchers conducted the distribution of questionnaires for the process of data collection. All the data collected obtained from the respondents amounted to 366 people. From the total data obtained from the online distribution of online, it was found that 41 respondents never used Travel Agents Travel Agreement website or online, then the valid data source to use only amounted to 325 people.

The test is done by conducting outlier test, the outlier test is done by Zscore method after the outlier test, it is found that 16 data sources of Zscore value pass the limit value that is less than -3, then the 16 data sources are considered outlier and not feasible in this research .

All data sources that have been valid for use in this study amounted to 309 people, the source data will be processed and tested in accordance with the process of multiple linear regression procedures in order to obtain good analysis results.

After testing all the indicators in this study were valid and reliable. In the classic assumption test, regression models have normally distributed, no multicollinearity, no heteroscedasticity except variable emphaty (X4), no autocorrelation and linear.

Tabel 1. 1 Multiple Regresion Testing

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	,815	,537		1,519	,130
RAT	,197	,047	,199	4,199	,000
AST	,135	,053	,135	2,569	,011
RET	,172	,048	,184	3,555	,000
EMT	,037	,040	,045	,916	,360
TAT	,406	,052	,388	7,830	,000

a. Dependent Variable: SAT

From the test that has been done, shows that all independent variables have a positive direction in the influence of the dependent variable in this study.

Variable tangible become the most influential variable with a regression coefficient 0.388, then the variable reliability with a regression coefficient 0.199, variable responsiveness with a regression coefficient 0.184, variable assurance with a regression coefficient 0.184, and a variable empathy has the most low impact with a regression coefficient of 0.045

Tabel 1. 2 Rsquare Table

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,795[a]	,631	,625	1,076

a. Predictors: (Constant), TAT, RAT, EMT, RET, AST

After testing the coefficient of determination (R^2 Testing), it is known that the adjusted R square value of 0.625. Thus means 62.5% customer satisfaction Online Travel Agent Traveloka influenced by five dimensions of service quality that is reliability, assurance, responsiveness, empathy, and tangible. While the rest 37.5% customer satisfaction Online Travel Agent Traveloka influenced by other variables that are not examined in this study.

4. CONCLUSION

Based on the results of multiple linear regression analysis that has been done in this study, obtained the regression equation as follows:

Y = 0,199 X1 + 0,135 X2 + 0,184 X3 + 0,045 X4 + 0,388 X5

The regression equation proves that the coefficient of the regression equation is positive. With it can be deduced as follows:

1. The analysis results found that the value of fcount of 103.842 which means greater than the value of FTable of 2.4 with a significance value of 0.000. This proves that the overall dimensions of service quality that is reliability, assurance, responsiveness, empathy, and tangible simultaneously have a positive and significant influence on customer satisfaction of Travel Travel Travel Online Travel. Hence, Hypothesis 1 is accepted.
2. The results of the analysis found that the coefficient of variable reliability regression value 0.199 which means having a positive direction in the influence of customer satisfaction, with the more reliable and more accurate quality of Travel Travel Agent Traveloka service then the level of customer satisfaction will increase as well, and get the value of tcount 4,199 with a significance value of 0.000. This proves that the variable reliability has a significant influence on customer satisfaction. Hence, Hypothesis 2 is accepted.
3. The results of the analysis found that the regression coefficient of assurance variables worth 0.135 which means having a positive direction in the influence of customer satisfaction, with the better guarantee given Travel Travel Agent Traveloka services then the level of customer satisfaction will increase as well, and get a tcount of 2.569 with Significance value of 0.011. This proves that assurance variable has a significant influence on customer satisfaction. Hence, Hypothesis 3 is accepted.
4. The results of the analysis found that the regression coefficient of responsiveness variable is 0.184 which means having a positive direction in the effect on customer satisfaction, with the faster and more responsive the quality of Travel Travel Agent Traveloka service then the level of customer satisfaction will increase as well, and get the value of tcount 3,555 with a significance value of 0.000. This proves that the variable responsiveness has a significant influence on customer satisfaction. Hence, Hypothesis 4 is accepted.
5. The analysis results found that the regression coefficient of variables emphaty worth 0.045 which means having a positive direction in the influence of customer satisfaction and get the value of t count of 0.916 with a significance value of 0.360. This proves that emphaty variables do not have a significant effect on customer satisfaction. So with this Hypothesis 5 is rejected. Nevertheless the equation coefficient regression variables empathy shows positive results, meaning emphaty variable has a positive effect on customer satisfaction. The better the attention given Travel Travel Agent Traveloka services the higher the level of customer satisfaction, otherwise the worse the attention given Travel Travel Agent Traveloka services the lower the level of customer satisfaction.
6. The results of the analysis found that the tangible variable regression coefficient is 0.388 which means having a positive direction in the effect on customer satisfaction, with the better the view of the website and Travel Travel Agent Traveloka application the higher the level of customer satisfaction, and get the value of tcount 7,830 with a significance value of 0.000. This proves that tangible variables have a significant influence on customer satisfaction. Hence, Hypothesis 6 is accepted.
7. The results of the analysis found that tangible variables tangible variable becomes the most influential variable with regression coefficient of 0.388, and tcount of 7,830.

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INTERLINKING CONVERTER IN
HYBRID AC/DC MICROGRID

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ABSTRACT

Nowadays, renewable energy sources (RES) demand has grown. Meanwhile, more RES will be connected to utility grid. Depend on the power source that generate by RES, microgrid can be divided into three types system, DC microgrid, AC microgrid and unified between them, that is hybrid ac/dc microgrid. Hybrid AC/DC microgrid is microgrid that separates based on the power generated and its load, it's mean ac power generated will be located with ac load, and dc power generated will be located with dc load. And between them it can be connected with interlinking converter. This converter has two mode operation, rectifier mode and inferter mode, the benefit of this configuration is it will reduce the use of converter on the system, as we know that converter is non linier equipment so it coused harmonic in the system. This paper proposed interlinking converter that connecting AC and DC microgrid, this converter based on bidirectional converter. The simulation verify the proposed system, that the interlinking converter can maintain the voltage and power transferred.

Keywords: hybrid AC/DC microgrid; renewable power generation; interlinking converter; bidirectional converter

1. INTRODUCTION

Based on the available energy sources from a region, microgrids can be constructed consisting of several energy sources. For example, a solar-powered solar cell power source, or a solar cell with a micro-hydro, or a solar cell with a fuel cell, and other combinations so that it can be said that a microgrid system is built as a hybrid microgrid.

The plants connected to the hybrid microgrid system produce different types of power. Like solar cell power, the fuel cell produces unidirectional power or dc, while the wind turbin, microhydro can generate alternating or ac power. Based on the power generated by each plant makes a microgrid system becomes complicated, because in the system there are various loads as well, so that in the application requires a variable power converter. The power converter is a non-linear power electronics device, so that with many power converter devices it will increase the distortion in current and voltage waves or so-called harmonics.

AC-DC Hybrid Mikrogrid regulates the power generated by the plants connected to the system, for the dc-generating regions to be localized to dc load, whereas the ac power-generating area will be localized to the ac power load. The advantage of this system is the reduction in the number of converters installed in the system. In addition to meeting their own needs these two microgrids are connected with ac / dc bidirectional converter.
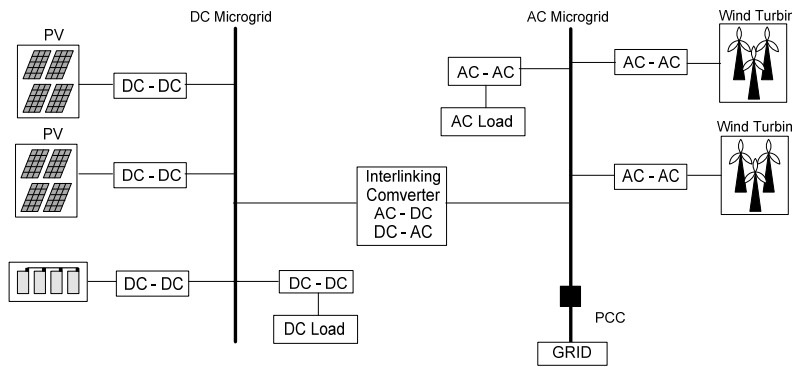
Fugure 1 Hybrid AC/DC Microgrid

The main task of this converter is to drain power from ac microgrid to dc microgrid or vice versa from dc microgrid to ac microgrid. Technically this converter is tasked as a rectifier and an inverter according to microgrid conditions. To perform that function then the control of IGBT component ignition on the converter must function properly. Sinusoidal Pulse Width Modulation (SPWM) is one of the most widely used IGBT ignition techniques. Ideally the control of this SPWM produces a pure sinusoidal wave. However, in reality the resulting waveform is distorted by waves having a multiple frequency of its fundamental frequency so that the resulting waveform is not pure sinusoidal.

The high content of harmonics in microgrid systems can cause various problems in the system. One effort to eliminate harmonics on the Bidirectional converter can be installed LCL filter. The advantages of LCL filters compared to other passive filters are L filters and LC filters are These filters will remove the ripples on the current and voltage waves so that the harmonic / Total Harmonic Distortion (THD) of the resulting waveform is smaller. LCL filter is a passive filter whose application is cheaper and easier than the active filter.

2. METHODOLOGY

2.1 Bidirectional Converter as Interlinking Converter

Mode Rectifier
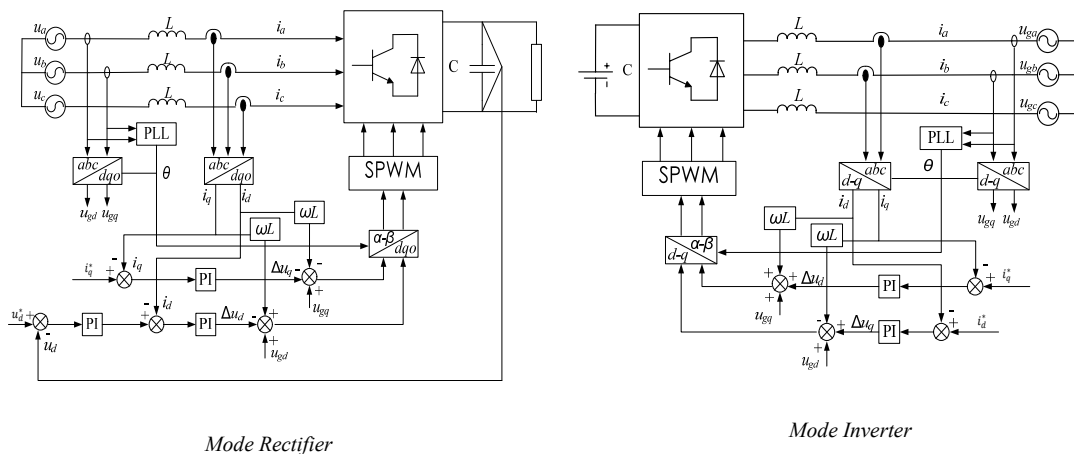
Mode Inverter

Figure 2 Control of Interlinking Converter

In Figure 2, a diagram of the controller for the rectifier mode is using the d-q coordinates. Control using closed loop with input of current and voltage from ac side and voltage from dc side. Before the voltage on the ac side is converted to d-q coordinates, the voltage becomes input on the phase lock loop (PLL). The output of the PLL is the phase angle and used to change the coordinates of the abc into the dq coordinates of the voltage transformation box and the final transformation box of the voltage and current that will be input to the SPWM generator, which in

this transformation box will change the current and voltage from the dq coordinates to abc coordinates. In inverter mode, iq is set to zero and id is current from ac source.

2.2 Total Harmonic Distortion (THD).

Harmonics in electric power systems are defined as a periodic distortion of a sine wave voltage, current, or power with a distorted waveform representing the sum of the fundamental and harmonic waves (h1, h2, ... etc) at the frequency of their multiples.

The more harmonic waves are included in the fundamental wave, the wave will approach a non sinusoidal square wave.

The percentage of total harmonic component with its fundamental component is called Total Harmonic Distortion (THD).

$$THD_V = \frac{\sqrt{\sum_{h=1}^{\infty} V_h^2}}{V_1} \tag{1}$$

$$THD_I = \frac{\sqrt{\sum_{h=1}^{\infty} I_h^2}}{I_1} \tag{2}$$

Where:

V_1 = Basic voltage ; V_h = Voltage of harmonics ; I_1 = Ground flow ; I_h = Harmonic current

h = Order of harmonics

An increase in the percentage of THD will increase the risk of damage to the equipment due to both the current and voltage. Referring to the IEEE International standard 519-1992, THD percentages should not exceed 5%.

3. RESULTS

Simulation was performed using Simulink/Matlab. The system was built with two sources, dc and ac. Dc sources represent dc microgrid so did the ac source that represents ac microgrid. The system parameter in the simulation can be seen in Table 1.

Tabel 1

System Parameter

	DC Microgrid	AC Microgrid
Nominal Voltage	48 V	380 V
Load	$R_1 = 1000\Omega$ $R_2 = 10000\Omega$	$R_1 = 2500\Omega$ $R2 = 2000\Omega$
Frequency		50 Hz
LC Filter	$L_1 = 10e^{-3}$ H; $C = 10e^{-6}$ F; $R_c = 2\Omega$	

In dc system, voltage were setting on 48V and the first load 1 kΩ plus 10 kΩ in parallel when 0,65 mili second. In AC system voltage were setting on 380V and the first load 2,5 kΩ plus 2 kΩ in parallel when 0,65 mili second until 1,35 mili second.

The simulation begins with the rectifier mode on interlinking converter control and it is change into inverter mode in 3,35 mili second. This situation makes fluctuation in dc microgrid, the response in dc microgrid can be seen in Figure 3
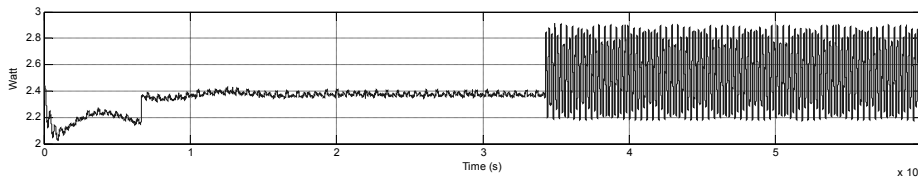
(a) Dc Microgrid Power
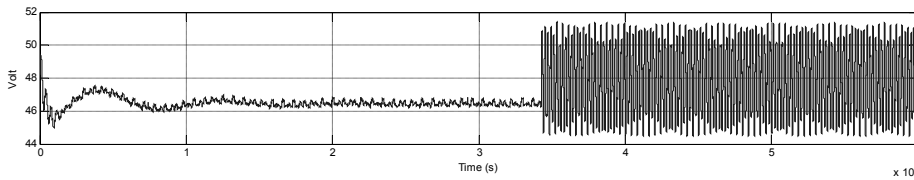
(b) DC Microgrid Voltage
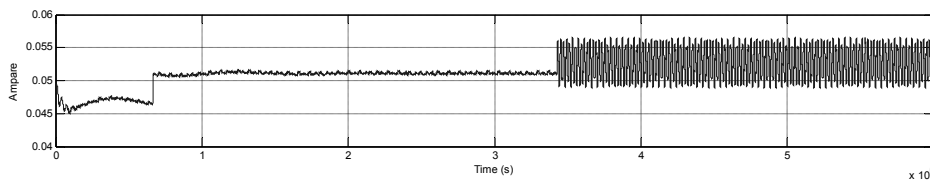
(c) DC Microgrid Current

Figure 3. DC Microgrid Responces

All ac microgrid responses are describe in Figure 4. The voltage and current in ac microgrid are maintained stable during the simulation, event when thare is a change in the interlinking converter control, but there are fluctuations in active and reactive power. The THD of voltage and current are under 5 %.
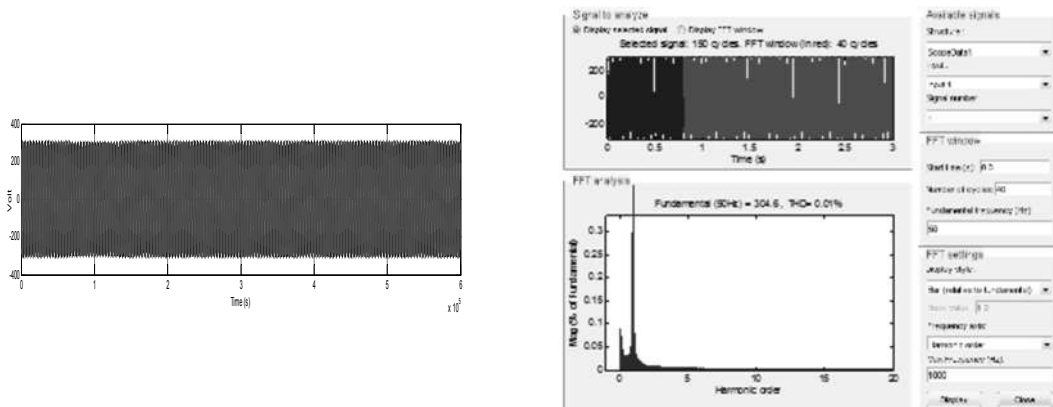
(a) AC Microgrid Voltage and THD
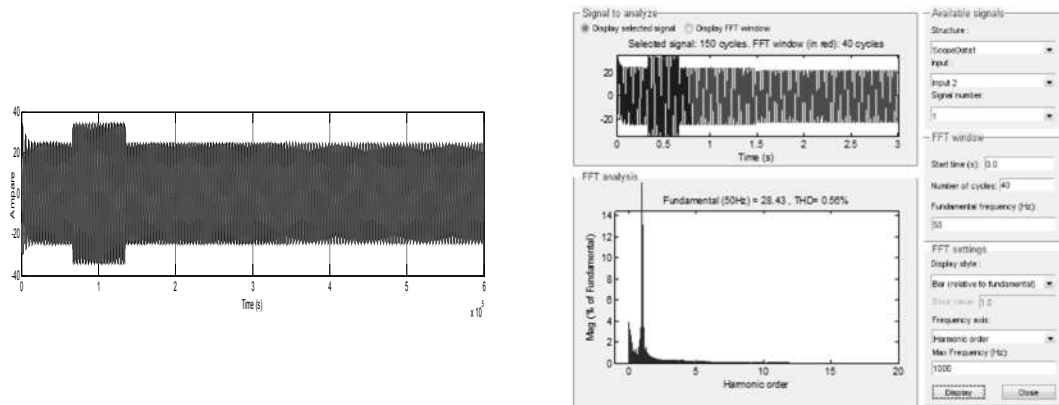
(b)   AC Microgrid Current and THD

Active Power
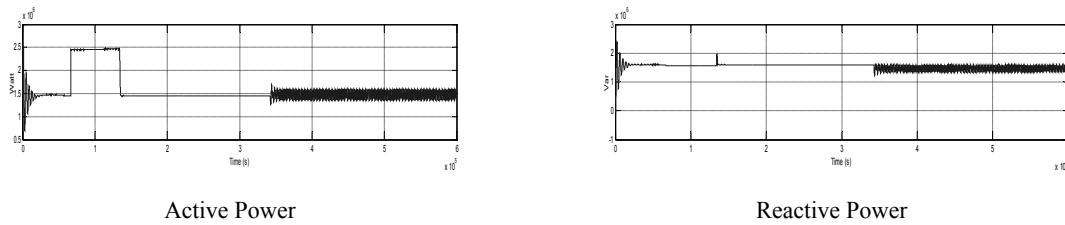
Reactive Power

(c)   AC Microgrid Actif and Reactif Power

Figure 4. AC Microgrid Responses

The voltage and current in interlinking converter are stable, even there is an impulse in the voltage when the converter control is change. The active and reactive power is seems to change the direction when thare is a change in the control.
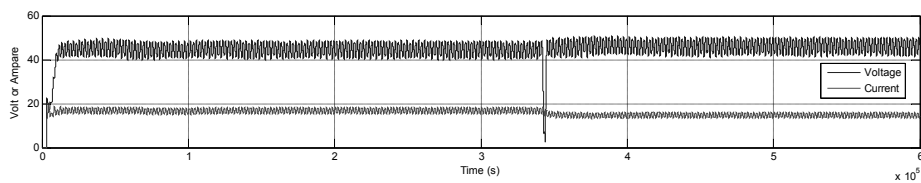
(a)   Interlinking Converter Voltage and Current
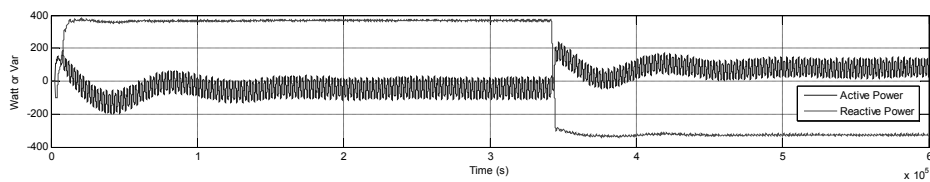
(b)   Interlinking Converter Actif and Reactif Power

Figure 5. Interlinking Converter Responses
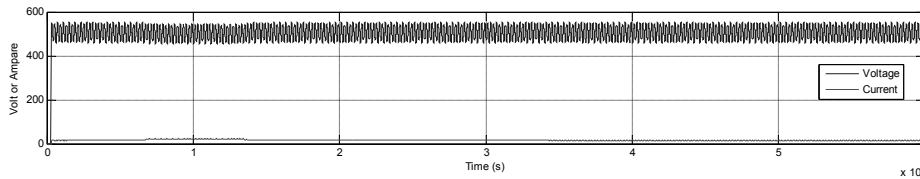
(a)   AC Load Voltage and Current
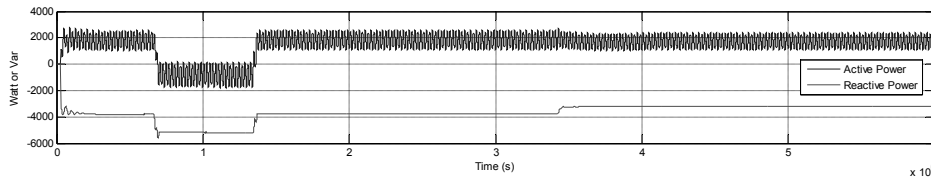
(b)   AC Load Actif and Reactif Power
Figure 6 AC Load Responses

The voltage and current of load in ac microgrid is maintain stable, it ac be seen in Figure 6

4. CONCLUSION

A new hybrid microgrid is proposed and briefly studied. The connection between ac and dc microgrid using interlinking converter is running well. Stable ac and dc bus voltage and current can guaranteed when the operating condition or load capacities change and event when the interlinking converter control change , beside that fuction the interlinking converter ensuring the security of energy supply.

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IMPLEMENTATION OF BARCODE AND QR-CODE SCANNER ON ANDROID APPS RETAIL SHOP APPLICATION BASED ON CLOUD COMPUTING BY USING LAPLACIAN SHARPENING METHOD

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ABSTRACT

Retail business had been very fast growing all over the place, this is proven by the large number of retail stores in many different places. To support this business required the application of the post (Point Of Sale) that is able to help calculate the billing transactions. Currently, android is an OS that is very popular. Android users are increasingly growing. This is offset by the large number of application developers who are in the playstore also increasingly numerous. In this research-based P.O.S application development android and cloud computing can be applied. The barcode image have to be read by the barcode scanner by android Phone within the application. Before we read the barcode images, it must be sharpened by using laplacian sharpening methods.Then do a comparison between the barcode image before sharpened and after. On Final Result , On Barcode image that has been sharpened is can be read faster than before, which is can be proven by compared with the average value 3.05 s of response. On Qr-Code image after it has been sharpened, the average respone value is 0.398 s more faster than before, In addition the development of cloud computing-based android application successfully developed in this research

Keywords: *: Laplacian, Barcode and QrCode, Android App.*

1. INTRODUCTION

Application of barcode scanner android retail stores in an application-based cloud computing is expected to support mobility applications POS (Point Of Sale). So there are no many tools that are required to run cash register retail store. In the 2000s emerged the latest technology called smartphones. A Smartphone is a smart phone that almost resembles a computer. This technology very popular community, because it serves many interesting features. The development of any technology leads to the development of applications and the infrastructure of the smartphone[1].

Cloud computing is a combination between a computer and the internet. In this digital era of all-round cloud computing is the latest technology that continues to evolve. Almost the whole of the development of information technology is now a cloud-based computing. Not just computers, cloud computing is also developing in the device smarthphone.

Based on explanation above, to support the implementation of the barcode scanner in the retail application by using android. Zxing library technology is the one of many libraries which is usually required by android apps for scanning Barcode or QrCode image based open source application.on my research POS (Point Of Sale) application that runs on the server and json web service for data communication between server and client. The final result for our research are expected to be able to support the creative economy program that initiated by the current Government[1].

Based on the above background, we can made any summary :
1. How to cultivate an image of the barcode input is broken and then fix it.
2. how the manufacture of API (Application Programming Interface) yasng running on the server to be read in the android client.
3. How to build mobile applications with cloud computing-based motto BYOD (Bring Your Own Device), anytimeas and anyplace

2. METHODOLOGY

2.1 Barcode

The barcode can be defined as a set of code-lines and spaces, each of which the thickness of each line and spasinya differ according to the contents of the code. Early use of barcodes was to automate the inspection system in the supermarket. Beginning of each barcode is usually "1-1-1" or if it was read from the left of the black line consists of 1 unit, followed by whitespace 1 unit, followed again by a black line 1 unit[4].

Example :

Figure 1. Barcode Example

Step by step to read barcode image :
1. Starting with the initial standard i.e. 1-1-1 (bar-space-bar).
2. Zero is 3-2-1-1 (space-bar-space-bar).
3. The four figures are 1-1-3-2 (space-bar-space-bar).
4. Trey is a 1-4-1-1 (bar-space-space-bar).
5. Three zeros is the next 3-2-1-1 (space-bar-space-bar).
6. In the middle is usually the standard 1-1-1-1-1 (space-bar-space-space-bar).
7. The number one is a 2-2-2-1 (bar-space-space-bar).
8. Number eight is 1-2-1-3 (bar-space-space-bar).
9. The number one is a 2-2-2-1 (bar-space-space-bar).
10. The number seven is a 1-3-1-2 (bar-space-space-bar).
11. Zero is a 3-2-1-1 (bar-space-space-bar).
12. Number six is a 1-1-1-4 (bar-space-space-bar).
13. The stop Character is typically 1-1-1 (bar-space-bar).

2.2 QR Code

QrCode code is a matrix barcode or two-dimensional developed by Denso Wave, a division of Denso Corporation is a company of Japan and published in 1994 by the major functionality i.e. can easily be read by a scanner QR stands for quick response or a response quickly, which corresponds to the purpose is to convey information quickly and get a fast response. Unlike the barcodes, which only store information horizontally, the QR code capable of storing information horizontally and vertically, therefore automatically QR code can hold more information than barcode.
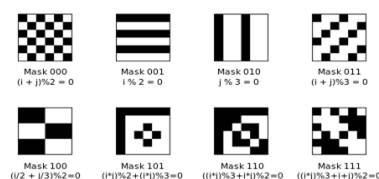
Figure 2. Patern of QrCode

2.3 Image Sharpening By Using Laplacian Method

The requirement in process of sharpening using the laplacian, it has to follow the rules:

➢ Filter Coefficients can be positive, negative or zero.
➢ Amount of all coefficients are 0 or 1

The Laplacian Formula :

$$\nabla^2_{f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \ (1)$$

$$\frac{\partial f}{\partial y} = f(x+1, y) - f(x, y)\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2)$$

$$\frac{\partial^2 f}{\partial x^2} = f(x+1, y) - 2f(x, y) + f(x-1, y)\dots\dots\dots\dots\dots\dots\dots\dots (3)$$

$$\frac{\partial^2 f}{\partial y^2} = f(x, y+1) - 2f(x, y) + f(x, y-1)\dots\dots\dots\dots\dots\dots\dots\dots (4)$$

$$\nabla^2_f = [f(x+1, y) + f(x-1, y) + f(x, y+1) + f(x, y-1)] - 4f(x, f) \ \dots(5)$$

2.4 Cloud Computing

Cloud computing is a general concept that includes SaaS, Web 2.0, and the latest technology trends of other widely known, with a common theme in the form of dependence towards the Internet to provide the computing needs of users. For example, Google Apps provides common business applications online that are accessed through a web browser with software and data stored on the server. Cloud computing is the latest technology trends, and examples of forms of Cloud Computing Technology development this is the iCloud.

- *Infrastructure as a Service* **(IaaS).**
  Infrastructure as a Service is a cloud services provides IT infrastructure in the form of CPU, RAM, storage, bandwidth and other configurations. The components used to build the virtual computer. Virtual computers can install the operating system and applications as needed. IaaS service benefits it is not necessary to purchase a physical computer and thus more cost-saving.
- *Platform as a Service (PaaS)*
  Platform as a Service is a service that provides a computing platform. Usually, there is already an operating system, database, application server and web framework in order to run applications that have been created. Companies that provide services that are responsible for the maintenance of the computing platform.
- *Software as a Service (SaaS)*
  Software as a Service is a cloud computing service where we can directly use the applications that have been provided. The service provider manages the infrastructure and platform that is running the application. Example application services email i.e. gmail, yahoo and outlook while the examples of social media applications are twitter, facebook and google +.

2.5 Android Operating System

Android is an operating system with open source, and Google released the code under the Apache license. Code with an open source license and permissions in Android allows the software to be freely modified and distributed by device makers, wireless operators, and application developers. In addition, Android has a large number of developer community applications (apps) that extend the functionality of a device, generally written in the Java programming language customization version. In October 2013, there are more than one million applications available for Android, and around 50 billion apps have been downloaded from Google Play, the main application store Android. A survey in April-May 2013 found that Android is the most popular platform for developers, used by 71% of application developers move. At the Google i/o Google reported there are 2014, more than a billion monthly active users of Android, increased from 583 million in June 2013.

3. RESULT
3.1 System Design and Analysis

P.O.S. application system created server based client. Where the application server is useful for providing information to client-based android. The server application is capable of providing the information data, including image processing master barcode for later done sharpening the image. Client applications were later do a barcode image data retrieval from a server that is already in the tajamkan image, henceforth conducted the identification and retrieval of data that already exist in the server.

Figure 3.1 System Design

3.1.1 Capturing image

The first to do is to take the value of the pixels in an image. In this case we will take one image size 3264 x 2448 pixels[2], Figure 3.1.

Figure 3.2 Capturing Image

Table 3.1 Image matrix table

	1	2	3	4	5	6	7	8	9	10	11	12	13	.	.	.	2448
1	7359265	8937786	8279602	8278835	8475962	8541502	7226673	7096116	7294009	4794389	5386781	5517338	6634534				
2	7161632	8345908	8016431	8212788	8607550	8673858	6305571	676715	6109735	5057561	5189402	5188373	6437155				
3	8609081	8214323	7358247	834437	9397066	7555379	8213568	6175014	5649184	5649698	4530702	6109221	6700329				
4	9003587	8214071	8937283	8673857	8344123	7423539	7424054	7424824	7030837	5649184	4991253	4069638	6436644				
5	8016440	9398093	6765861	6896677	6436128	7357746	6042401	7556410	7622460	6701871	6043428	5911583	8278848				
6	8673858	8410688	6831656	5712405	5186063	6699302	6502437	5976608	6108964	6964273	7359029	7818810	6830888				
7	9133643	8804678	8212541	6040859	6764582	6501410	6896681	6568230	6108192	6897708	7489586	8870469	7817011				
8	7290926	7685684	7619891	9001031	7685171	7488046	7751475	7554609	6699300	7423023	7620402	7883315	7092516				
9	6435104	5974553	7289899	8868929	9197894	9197894	8080183	6895907	5909012	8540732	9264455	8013618	7092259				
10	6894626	7223591	8407865	9131588	9855311	8803136	9066306	8342583	7289895	9066306	8606010	9263427	9854794				
11	7289384	8671037	8934209	8605244	8539451	7289384	8737084	8868670	8539705	8079154	8868669	9065278	9262657				
12	8144177	9460037	8868670	9000002	8605244	8276279	9065795	9131588	8473658	7223845	9066049	8538935	8275762				
13	8538935	8670521	8605498	9197381	9000515	8737345	8868931	9000517	9000004	8736832	8736830	9592393	9658186				
.																	
.																	
.																	
3264																	

3.1.2 Determine Mask Laplacian Values

$$\nabla^2_{f=\frac{\partial^2 f}{\partial x^2}+\frac{\partial^2 f}{\partial y^2}} \quad\text{...} 3.1$$

$$\frac{\partial f}{\partial y} = f(x+1,y) - f(x,y) \quad\text{...} 3.2$$

$$\frac{\partial^2 f}{\partial x^2} = f(x+1,y) - 2f(x,y) + f(x-1,y) \quad\text{..................................} 3.3$$

$$\frac{\partial^2 f}{\partial y^2} = f(x,y+1) - 2f(x,y) + f(x,y-1) \quad\text{............................} 3.4$$

$$\nabla^2_f = [f(x+1,y) + f(x-1,y) + f(x,y+1) + f(x,y-1)] - 4f(x,f) \quad\text{................} 3.5$$

In this research we use mask laplacian Values :

$$\begin{array}{ccc} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{array}$$

3.1.3 Create Image Convulsive with mask laplacian.

Create the image convulsive pixel values with the mask of the laplacian The formula for between laplacian mask with the image below:

$$f(x,y) = [(x1*y1) + (x2*y2) + (x3*y3) + (x4*y4) + (x5*y5) + (x6*y6) + (x7*y7) + (x8*y8) \quad\text{...................} 3.6$$

And the result of calculation is shown on table 3.2

Table 3.2 Result of Image Convulsive mask Laplacian

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	2448
1	-13337642	-11766369	-7885356	-8146988	-8475961	-9789515	-6963503	-13187067	-11175796	-1439205	-6045995	-4859664	-14583643	0	0	0	0
2	-4332274	-1053460	130821	-7113899	329474	-3685430	-431470	22979576	-5761471	1512980	-594191	2499624	-7225384	0	0	0	0
3	-10056782	-329985	-3430514	30304210	-12246775	3486515	-5394254	-2735765	2368548	-1712161	3816766	-3947842	-7818296	0	0	0	0
4	-11174756	2697002	-4737096	-9682908	-1445902	987146	-591884	-1512981	-1777696	1776923	327940	7170149	-6697761	0	0	0	0
5	-4990222	-6185312	5000265	1543	2040097	-2829614	4671043	-3159347	-3091758	-528139	790024	2564392	-13936277	0	0	0	0
6	-9134661	65533	1774871	2105635	4868165	-1249552	-394756	2829609	2235677	-789520	-1120019	-2303271	-3408883	0	0	0	0
7	-11765110	-1776156	-3553080	5527123	-1644825	1842971	-263172	263170	1841434	394242	789264	-4473154	-8474171	0	0	0	0
8	-5909273	-1052688	1709591	-5789274	1710869	1183766	-986381	-2303524	197636	66050	1578771	63745	-5577479	0	0	0	0
9	-5580311	4736066	1711642	-855304	-1184271	-3222317	590850	2302759	5789786	-2500132	-4277058	1448984	-3408108	0	0	0	0
10	-6630425	1053717	-1052173	-789003	-3749175	196351	-2302238	-1249554	2698026	-3749433	2038817	-1514008	-13800833	0	0	0	0
11	-5447696	-1776927	-1184020	1184274	197379	5198414	-658181	-723720	-1447443	1381909	-658185	-327424	-9854794	0	0	0	0
12	-7288352	-3485743	525066	-723469	395271	592652	-1249298	-1117712	510	5460313	-2895917	1843742	-5643270	0	0	0	0
13	-17341042	-8077614	-7685420	-10183509	-9462090	-8803655	-8672067	-9001545	-9789009	-9986649	-7552046	-11435621	-20764589	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3264	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

3.1.4 Reduce original pixel's value results image

After getting the result calculation values, the next step is to reduce the original pixel values with the results of Convulsive, then make a new image pixel. and the last step is to rebuild the image that has been generated , the values image pixel is shown on table 3.3.

Table 3.3 Result of Reducing original pixel's value

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	2448
1	7359265	8937786	8279602	8278835	8475962	8541502	7226673	7096116	7294009	4794389	5386781	5517338	6634534	0	0	0	0
2	7161632	8345908	7885610	8212788	8278076	8673858	6305571	-22302861	6109735	3544581	5189402	2688749	6437155	0	0	0	0
3	8609081	8214323	7358247	-29469773	9397066	4068864	8213568	6175014	3280636	5649698	713936	6109221	6700329	0	0	0	0
4	9003587	5517069	8937283	8673857	8344123	6436393	7424054	7424824	7030837	3872261	4663313	-3100511	6436644	0	0	0	0
5	8016440	9398093	1765596	6895134	4396031	7357746	1371358	7556410	7622460	6701871	5253404	3347191	8278848	0	0	0	0
6	8673858	8345155	5056785	3606770	317898	6699302	6502437	3146999	3873287	6964273	7359029	7818810	6830888	0	0	0	0
7	9133643	8804678	8212541	513736	6764582	4658439	6896681	6305060	4266758	6503466	6700322	8870469	7817011	0	0	0	0
8	7290926	7685684	5910300	9001031	5974302	6304280	7751475	7554609	6501664	7356973	6041631	7819570	7092516	0	0	0	0
9	6435104	1238487	5578257	8868929	9197894	9197894	7489333	4593148	119226	8540732	9264455	6564634	7092259	0	0	0	0
10	6894626	6169874	8407865	9131588	9855311	8606785	9066306	8342583	4591869	9066306	6567193	9263427	9854794	0	0	0	0
11	7289384	8671037	8934209	7420970	8342072	2090970	8737084	8868670	8539705	6697245	8868669	9065278	9262657	0	0	0	0
12	8144177	9460037	8343604	9000002	8209973	7683627	9065795	9131588	8473148	1763532	9066049	6695193	8275762	0	0	0	0
13	8538935	8670521	8605498	9197381	9000515	8737345	8868931	9000517	9000004	8736832	8736830	9592393	9658186	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3264	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

3.1.5 Final Result

Before Sharpening   After Sharpening

Figure 3.2 The Final Result Barcode Image sharpening using Laplacian Method

4. CONCLUSION

From the experiment there are 3 criterias for testing materials, namely, bar code, point of view, capture and shooting distance.

For the determination of the value of the specified average formula as follows:

1. Reduce the time image before ditajamkan with the image already was sharpened.
2. The amount of time divided the number of test data.

The results of these tests,

1. Barcode image sharpening Results faster to read than before sharpened with an average rating of 3.05 s.
2. Barcode image sharpening Results made from plastic are faster to read than before sharpened with the average value of 1.32 s.
3. The results of the paper-based barcode image sharpening faster read than before sharpened with the average value of 4.79 s.
4. Barcode image sharpening Results with straight corners retrieval faster read than before Sharpened with the average value of 0.84 s
5. Barcode image sharpening Results with taking the top corner faster read than before sharpened with the average value of 1.92 s.
6. Barcode image sharpening Results with taking the left corner faster read than before sharpened with the average rating 4.67 s.

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CLASSIFICATON OF COMPUTER NETWORK ATTACTS BY USING IDS SNORT BASED ON THE FUZZY C MEAN METHOD

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ABSTRACT

In the digital era, the development of technology makes people as familiar with digital information technology. However, technological developments also led to many attacks on computer networks. This study aims to facilitate network administrators in analyzing attacks on computer networks. The method used for this research is Fuzzy C-Means. This grouping aims to know what variables are often the target. This system works based on log data on IDS Snort. It is used this Fuzzy C-Means method because it is capable of clustering (with quadratic convergence level) and does not require complicated mathematical operations.

In research the number of clusters sought as much as 3 and with the smallest error value 0.001. Resulting cluster 1 data with 204% precision calculation and 4% recall, while in cluster 2 precision calculation is 2500% and recall 8%, and cluster 3 precision calculation is 1250% and recall 92%. For the level of accuracy reached 68%

Keywords : Grouping, Intrusion Detection System (IDS), Snort, C-Means

INTRODUCTION

1.1 Background

Increasingly the development of information technology in modern times, many things that can help simplify human work, especially in the field of information technology. Human dependence on technology, the more gaps that can be used by a handful of people to use negative things. Security on a computer network becomes a very important issue and will continue to grow in the future. And the increasing number of attacks from outside on the computer network that we have then it is necessary to take precautions / detection. Intrusion Detection System (IDS) is a software or hardware application that can detect suspicious activity in a system or network. IDS can inspect inbound and outbound traffic in a system or network, perform analysis and look for evidence of intrusion experiments (intrusions). Spoofing, DdoS, Sniffer, DNS Posioning, Script Kiddies, SQL Injection are examples of attacks that can damage / disrupt network performance that we have.

On that basis we need a system that can detect these attacks before the attack goes deeper into our system. IDS can also be combined with clustering algorithms in order to facilitate the mapping of existing attacks. And no less important is we can see the pattern of new attacks and can be detected by the IDS system. Snort is one of the Network-based IDS (software) software applications. Snort uses a system of rules to perform the detection and logging of various types of attacks on computer networks.

By creating various rules (rules) to detect and perform logging against these attacks. Snort can be operated in three modes, namely Sniffer mode, Packet logger mode, and Intrusion Detection mode. With the existence of Snake IDS system on the computer network system, then the expected security is more secure computer networks.

1.2 Problem Formulation

Based on the above background it can be formulated the main issues to be selected as the topic of this research are:

A. How to deal with computer network problems.

B. How to generate database logs from Snort, which serve as attack data.

C. How to classify attack data using Fuzzy C-Means Algorithm method, thus becoming cluster with category of malicious attack, medium attack and harmless attack.

1.3 Scope Of Problem

For more focused research discussions and focused on achievable goals. So this research will discuss things as follows:

A. The utility used for IDS implementation is Snort.

B. Attack data used only from snort logs database with data selection that is only needed as attack data ie data protocol, d_port, freq and tcp_flags.

C. This system only analyzes and classifies attack data from the snort log database.

For more focused research discussions and focused on achievable goals. So this research will discuss things as follows:

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B. Attack data used only from snort logs database with data selection that is only needed as attack data ie data protocol, d_port, freq and tcp_flags.

C. This system only analyzes and classifies attack data from the snort log database.

D. Testing Snort on the network you are trying to infiltrate.

1.4 Objectives

The purpose of this research is to make soft-programming that can classify log data from IDS Snort.

1.5 Research Methodology

In writing this thesis is to build a keyword-based attack detection application with clustering techniques required following steps:

A. Analysis and Data Collection Method
   a. Library Studies on the Fuzzy C-Means method and IDS Snort through reference books, scientific journals, and papers.
   b. Collecting the data needed to create the application, obtained from the database log snort.
   c. Literature Study, in conducting research the author will make the literature study materials of the kind as a reference to know the shortcomings and advantages of the system that has been made before.

B. System Design
   Designing Fuzzy C-Means algorithm model and designing application model used to display the application that has been made.

C. Application Design
   Conducting soft programing that includes the process of getting attack data from the snort database log selection results that will then be grouped with the Fuzzy C-Means method.

D. Conduct trials and analysis.
   Testing and analysis is intended to determine the extent to which the system created in this final project can work in accordance with the expected system process with the data - data that has been collected or obtained and do some methods of attack on the PC / Server that has been installed and configuration snort.

E. Reporting
   Create documentation of all the above process stages in the form of a report containing the basic theory and the results of this final task.

THE SUPPORTING THEORY

3.1 IDS

Intrusion Detection System or IDS is software, hardware, or combination of both used to detect intruder activity. Snort is an open source IDS that is publicly available. IDS may have different capabilities, depending on how complex and sophisticated components are. IDS appliances are a combination of hardware and software available in many companies. As mentioned earlier, an IDS may use signatures, anomaly-based techniques or both. IDS works on the network layer of the OSI model and the passive network sensor that is specifically positioned on the choke point of the network of methods of the OSI layer which can be seen in the table below. This is to analyze the packet to find the pattern of a network traffic. All existing patterns will be recorded and stored as log files. Basically IDS is almost identical with antivirus software in recognizing patterns of malicious code.

3.2 SNORT

Snort is a software to detect intruders and is able to analyze packets that traverse the network in real time traffic and logging into the database as well as being able to detect various attacks coming from outside the network. Snort is available free on the internet, www.snort.org. Snort bias is used on Linux, BSD, Solaris, Windows operating system platforms.

Snort can be operated in three modes:

A. Package.
B. Package logger.
C. NIDS.

3.3 Cluster Analysis

Cluster Analysis is a theory about a series of observations on subsets. Clustering is a common technique for the analysis of statistical data used in various fields, including machine learning, data mining, pattern recognition, image analysis, and bioinformatics. This method also not only classifies objects but also features of the object. In this paper will be presented on the basic theory of this method and how the appropriate algorithm in doing this grouping and what kind of structure of the formation that occurred from the data analysis. In addition, in this paper there are also illustrations or examples of problems to be solved using this cluster analysis method. The problems of the illustrations will be solved using the formulas presented on the basic theory and carried out by approach through hierarchical methods by means of merging and splitting. That way we can find out how the implementation of formulas and algorithms in this method so that obtained basic understanding enough to explore cluster analysis further.

In general, cluster analysis has two methods, namely:

A. Method hierarchy.
   This method is used to find the grouping structure of objects. Thus, the grouping results are presented in a hierarchical or tiered manner. This hierarchy method consists of two ways, namely:
   a. Agglomerative (merging).
   b. Division.

B. Non-hierarchical methods.
   This method is used when the desired number of groups is known and is usually used to group large amounts of data.
   Characteristics of clustering is divided into 4, as follows:
   a. Partitioning clustering
      Partition clustering is also called exclusive clustering, where each data must belong to a particular cluster. Characteristics of this type also allows for any data that includes a particular cluster at a stage of the process, in the next stage move to another cluster.
      Example: K-Means, residual analysis.
   b. Hierarchical clustering
      In hierarchical clustering, each data must belong to a particular cluster, must belong to a particular cluster at a process stage, unable to move to another cluster in the next stage.
      Examples: Single Linkage, Centroid Linkage, Complete Linkage, Average Linkage.
   c. Overlapping clustering
      In overlapping clustering, any data allows including to multiple clusters. The data has a membership value on some clusters.
      Example: Fuzzy C-Means, Gaussian Mixture.
   d. Hybrid
      Hybrid characteristics are characteristic clustering that combines characteristics of partitioning, overlapping, and hierarchical.

3.4 Fuzzy Clustering

Fuzzy Clustering is one technique for determining the optimal cluster in a vector space based on the normal form of euclidian for the distance between vectors. Fuzzy Clustering is especially useful for fuzzy modeling especially in identifying fuzzy rules. Clustering method is a grouping of data along with its parameters in groups - groups according to the tendency of the nature of each data (similarity of nature). There are several data clustering algorithms, one of which is Fuzzy C-Means. Fuzzy C-Means is a clustering technique in which the existence of each data point in a cluster is determined by the degree of membership. This technique was first introduced by Jim Bezdek in 1981.

The concept of Fuzzy C-Means was first to determine the center of the cluster, which would mark the average location for each cluster. In the initial conditions, the center of the cluster is still not accurate. Each data point has a membership degree for each cluster. By repairing the cluster center and the degree of membership of each data point repeatedly, it will be seen that the center of the cluster will move towards the right location. This loop is based on the minimization of objective function that describes the distance from the data points assigned to the center of the cluster which is weighted by the degree of membership of that data point. The output of Fuzzy C-Means is a cluster

of central clusters and some degree of membership for each data point. This information can be used to build a fuzzy inference system.

3.5 Fuzzy C-Means

Clustering with Fuzzy C-Means (FCM) method is based on fuzzy logic theory. In fuzzy theory, membership of a data is not given a firm value with a value of 1 (being a member) and 0 (not a member), but with a membership degree value whose value range is 0 to 1. The membership value of a data in a set becomes 0 when Not at all a member, and become 1 when becoming a full member in a set. Generally the value of membership between 0 and 1. The higher the membership value the higher the degree of membership, and the smaller the lower the degree of membership. Here's an image showing the grouping results shown on the graph.
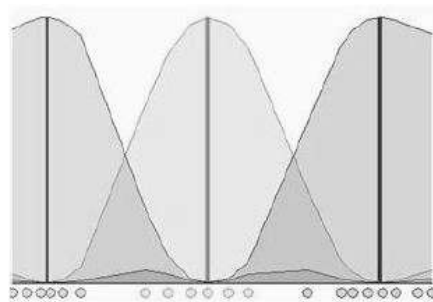

Figure 3.3 Fuzzy C-Means Clustering

    A. Determining the number of clusters
    B. Allocate data according to the number of clusters specified
    C. Calculate the centroid value of each cluster
    D. Calculates the membership value function of each data to each cluster back to Step 3. if the membership function value change is still above the specified threshold value, or if the change in the centroid value is still above the specified threshold value, or if the change in the value Objective function is still above the specified threshold value.

3.5.1 Fuzzy C-Means algorithm

Fuzzy C-Means algorithm is as follows:

A. Input data to be in cluster X, a nx m size matrix

(N = number of sample data, m = attribute of each data). Xij = data samples kei (

I = 1,2, ..., n), the attribute of j (j = 1,2, ..., m).

B. Specify:
    a. Number of clusters = c;
    b. Rank = w;
    c. Maximum iteration = MaxIter;
    d. The smallest expected error =;
    e. Initial objective function = P0 = 0;
    f. Initial iteration = t = 1;

C. Generate random values μ_ik, i = 1,2, ..., n; K = 1,2, ..., c; As elements of the initial partition matrix u. Mik is the degree of membership that refers to how likely a data can be a member into a cluster. The position and value of the matrix are constructed randomly. Where the value of membership lies in the interval 0 to 1. In the initial position of the partition matrix U is still not accurate as well as its cluster center. So the tendency of data to enter a cluster is also not accurate.
Calculate the number of each column (attribute)

$$Q_j = \sum_{k=1}^{c} \mu_{ik}$$

Qj is the sum of degree of perkolom membership membership = 1

With j = 1,2, ... m

Count:

$$\mu_{ik} \frac{\mu_{ik}}{Q_j}$$

D. Calculate the center of the k-cluster: V_kj, with k = 1,2, ... c; And j = 1,2, ... m.

$$V_{kj} = \frac{\sum_{i-1}^{n}((\mu_{ik})^w * X_{ij})}{\sum_{i=1}^{n}(\mu_{ik})^w}$$

E. Calculate the objective function in the t, P_t iteration, Objective functionality is used as a recurrence requirement to get the right cluster center. So that obtained the tendency of data to enter the cluster where in the final step.

$$P_t = \sum_{i-1}^{n}\sum_{k=1}^{c}\left(\left[\sum_{i=1}^{m}(X_{ij} - V_{kj})^2\right](\mu_{ik})^w\right)$$

F. Calculate the partition matrix change:

$$\mu_{ik} = \frac{\left[\sum_{i=1}^{m}(X_{ij} - V_{kj})^2\right]^{\frac{-1}{w-1}}}{\sum_{k=1}^{c}\left[\sum_{i=1}^{m}(X_{ij} - V_{kj})^2\right]^{\frac{-1}{w-1}}}$$

with: i=1,2,…n;and k=1,2,..c.

G. Check stop condition:

   a. If : $(|P_t - P_{t-1}| < \zeta)$ or (t > max Iter) then stop;
   b. If not: t=t+1, repeat step 4.

ANALYSIS AND SYSTEM DESIGN

4.1 Data Analysis

In general, this research is conducted in order to create a soft programming that can process the log of the snort application to be analyzed. This is because many of the network administrators only read and analyze snort logs manually.

This study was conducted, aimed at network administrators in analyzing the spay attack on the computer. In this research the method used is Fuzzy C-Means. And in building applications for this research there are several stages:

   a. Analyzing snort logs
   b. Inserting the snort log into the database for processing.
   c. Processing the log using Fuzzy C-Means method.

4.2 System Design

This chapter explains what preparations and initials are needed in the study. In this chapter also includes sub-chapters of input design, output design, and process design.

Below is an example of a global diagram diagram of the research start from the first step is log snort which is then processed into a new database in order to be processed by Fuzzy C-Means method.
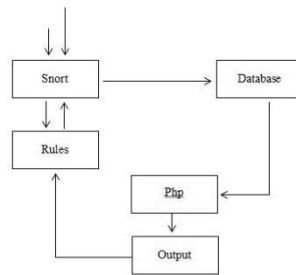
Figure 4.1 Block grouping process diagram Attacks on computer networks with Fuzzy C-Means

In the results that will be displayed by web-based applications (php) will display the results of a grouping that has been processed previously. This system runs by reading logs that have been imported into the database for analysis. The admin or authorized user will analyze what are the weak points on a network in order to prevent similar attacks.

4.3 Fuzzy C-Means Calculations

In this sub-chapter contains an explanation of the calculation example with the Fuzzy C-Means method.

1. Inialization,
$$U = [U_{ij}] \ matrix, U^0$$

2. The next step is to determine the number of clusters, ranks (W), the smallest error value, and maximum iteration.
$$C^{(k)} = [C_j] \ with \ U^{(k)}$$

3. Generate the matrix U^{ik} where i = the number of data k = number of clusters
$$C_j = \frac{\sum_{i-l}^{N} U_{ij}^m \cdot X_i}{\sum_{i-l}^{N} U_{ij}^m}$$

4. Compute the cluster center
5. a. Calculate the objective function
   b. Miqua X1
   c. Miqua X2
   d. Miukuadrat X3
   e. Center cluster
6. Update $U^{(k)}, U^{(k+l)}$
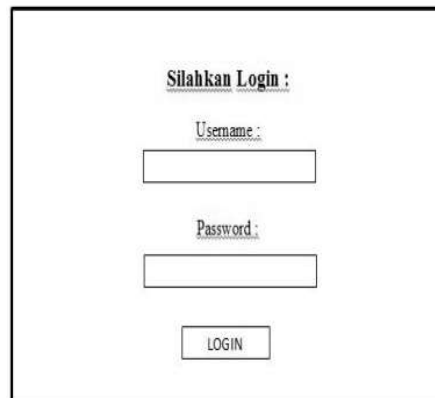
$$U_{ij} = \frac{1}{\sum_{k-l}^{C} \left(\frac{||X_i - C_j||}{||X_i - C_k||} \right)^{\frac{2}{m-1}}}$$

7. If, $if \ ||U^{(k+l)} \cdot U^k || < \in$
   So stop, until the difference in objective function is no greater than the expected difference of objective function. If not then repeat process number 3.

4.4 Interface Design of the Program
4.4.1 The design of the login menu

Figure 4.10 Login

4.5 Local snort network design design
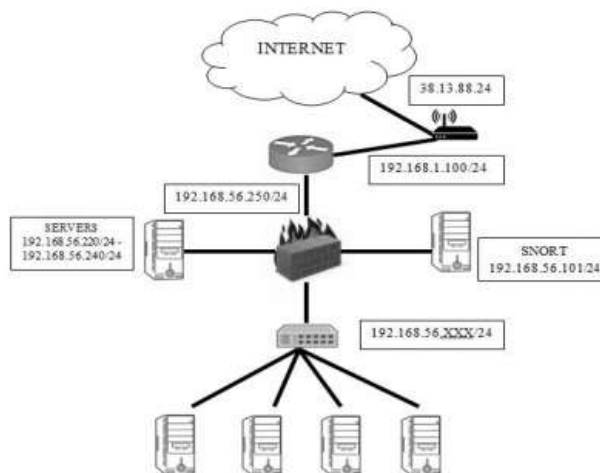
Figure 4.15 Local network design

4.6 Configure Snort, Acid Base, MySQL, and Apache2

Before installing and configing Snort, Acid Base, MySQL, and Apache2, the first thing to do is to install all the updates on Ubuntu. For the update process is System> Administration> Update Manager. Then enter the password and select (tick) all plihan. Then select install updates.

Packages that will be updated as follows:

• Acidbase with all affected packages
• Snort-MySQL with all affected packages

6.1 Test results

The test conducted is to clustering the data log snort that has been imported into the database. The data used is attack data from log snort. From the data used to group the network attack with Fuzzy C-Means method.

6.1. 1 Test 1 with 25 IP Address

At the time of the process of FCM data attack on 25 data IP Address with parameters protocol, port, flag, and frequency, with the number of cluster = 3, rank (w) = 2, maximum iteration = 100, and the smallest error = 0.001. The FCM process stops at the 74th iteration with the result of clustering 3 clusters

6.2 Comparison Results Fuzzy C-Means With Log Data Attack Analysis

The determination for the grouping of computer attacks is determined manually. And the results done with the analysis of log data attacks processed by Fuzzy C-Means method and will give its own results. The figure below describes the comparison manually with the Fuzzy C-Means method.

Based on the grouping of log data attack analyzes and Fuzzy C-Means is divided into 3 clusters ie cluster 1 is a group of attacks with the category of harmless, cluster 2 is a group of attacks with the category of being, cluster 3 is a group of attacks with dangerous categories.

Based on the results of the tests conducted, it can be concluded that the accuracy level of log data analysis with the calculation of Fuzzy C-Means here reaches 68%.

REFERENCES

[1] Gellysa Urba, Helmi Fauzi Siregar 2015, Pemodelan UML E-Marketing Minyak Goreng, Universitas Sumatra Utara

[2] Setiady, Hendy. 2009. Sistem Informasi Pemesanan Dan Penjualan Berbasis Web Pada Dewi Florist. STMIK GI MDP. Palembang

[3] Widodo, Agus, Purhadi , Perbandingan Metode Fuzzy C-Means Clustering dan Fuzzy C-Shell Clustering, ITS Surabaya

[4] Sanmorino, Ahmad 2012, Clustering Batik Images using Fuzzy C-Means Algorithm Based on Log-Average Luminance, Universitas Indonesia

[5] Faisal Mirza, Muhammad 2009, Metode Clustering Dengan Algoritma Fuzzy C-Means Untuk Rekomendasi Pemilihan Bidang Keahlian Pada Program Studi Teknik Informatika, Universitas Dian Nuswantoro

[6] Hanifa Setianingrum, A 2014, Model Pemetaan Evaluasi Penilaian Kualifikasi Lulusan Berbasis Metode Fuzzy C-Means Clustering, Univesitas Islam Negeri Syarif Hidayatullah Jakarta

[7] Yudihartanti, Yulia, Hidayatullah, Sudiyanur 2014, Pemilihan Minat Topik Tugas Akhir Menggunakan Metode Fuzzy C-Means, STMIK Banjarbaru

[8] Permatasari, Yunita 2012, Klasifikasi Risiko Bahaya Kehamilan Dengan Metode Fuzzy C-Means, UNS Surakarta

[9] Nugraheni, Yohana 2011, Data ining Dengan Metode Fuzzy Untuk Customer Relationship Management (CRM) Pada Perusahaan Retail, Universitas Udayana Denpasar.

KEYNOTE SPEAKER OF ICTA

Name : Taufik

Phone :(805) 756-2318

E-mail :taufik@calpoly.edu

EDUCATION

1. Doctor of Engineering, Electrical Engineering, Cleveland State University, May 1999
   Emphasis :Power Electronics, Power Systems, and Controls
   Dissertation :Parallel AC-AC Converters with Master/Slave Control
2. Master of Science, Electrical Engineering and Computer Science, University of Illinois at Chicago, May 1995
   Thesis: Theory of Rectangular Waveguide Filled with Bianisotropic Material
3. Bachelor of Science, Electrical Engineering & minor in Computer Science, Northern Arizona University, May 1993 Graduated with Honors (Cum Laude, Tau Beta Phi, Phi Kappa Phi)
4. Final Project: Piezoelectric Amplifier for Telescope Viewing Stabilization PROFESSIONAL AFFILIATIONS
   Senior Member, Institute of Electrical and Electronics Engineers (IEEE)
   Member, American Society of Engineering Education (ASEE)

ACADEMIC EXPERIENCE

06/09 – present 09/11 – present 08/04 – 06/09 08/99 – 07/04 09/97 – 05/99 08/96 – 08/97 01/96 – 08/96 01/94 – 12/95

Professor of Electrical Engineering, Cal Poly State University, California, USA Director of Electric Power Institute, Cal Poly State University, California, USA Associate Professor of Electrical Engineering, Cal Poly State University, California, USA Assistant Professor of Electrical Engineering, Cal Poly State University, California, USA Research Assistant to Power Electronics Lab, Cleveland State University, Ohio, USA Teaching Assistant to Control Systems Lab, Cleveland State University, Ohio, USA Research Assistant to Microelectronics Laboratory, University of Illinois Chicago, Illinois, USA Graduate Assistant to English Department, University of Illinois Chicago, Illinois, USA

INDUSTRY EXPERIENCE

- Summer Faculty Fellow, Substation Engineering Group, San Diego Gas & Electric, California, 06/16 – 09/16
- Engineering Consultant, Sempra Energy, California, 07/14 – 06/15
- Engineering Consultant, Partoe Inc., Berkeley, California, 07/09 – 07/14
- Summer Faculty Fellow, Innovation and Technology, San Diego Gas & Electric, California, 06/12 – 09/12; 06/13 – 09/13
- Engineering Consultant, Enerpro Inc., Goleta, California, 06/09 – 06/10
- Engineering Consultant, Diodes Inc., Westlake Village, California, 09/07 – 09/08
- Summer Faculty Fellow, Transmission Engineering Group, San Diego Gas & Electric, California, 06/08 – 09/08
- Summer Faculty Fellow, APD Semiconductor, Redwood City, California, 07/06 – 09/06
- Summer Faculty Fellow, Power Quality Group, San Diego Gas & Electric, San Diego, California, 06/05 – 09/05
- Engineering Consultant, Rantec Power Systems, Inc., Los Osos, California, 06/02 – 06/04
- Summer Faculty Fellow, Transmission Planning Group, San Diego Gas & Electric, San Diego, California, 07/01 – 09/01
- Engineering Intern, Power Electronics Group, Capstone Turbine Corporation, Tarzana, California, 05/97 – 08/97
- Engineering Technician, Power Electronics Group, Picker International, Cleveland, Ohio, 09/98 – 06/99

- Hardware Engineer, Fast Ethernet Module Group, Rockwell Automation - Allen Bradley, Cleveland, Ohio, 01/97 – 09/98

AWARDS & RECOGNITIONS

STATE AND NATIONAL:

- 2013 Power Engineering Society Chapter Outstanding Engineer Award, IEEE Central Coast Section
- 2012 Outstanding Teaching Award, American Society of Engineering Education – Pacific Southwest Region
- Indonesian Diaspora Award on Education, Los Angeles, July 2012
- Appeared on the cover of EEWeb PULSE magazine, Sept 2011, http://www.eeweb.com/pulse/issue-10-2011
- 1st Place at the 2004 California State University Wide Research Competition under the category "Undergraduate Engineering"
- 3rd Place at the 2008 National Junior Space Elevator Competition sponsored by NASA

UNIVERSITY:

- 2005 – 2006 Outstanding Faculty Advisor Award, Recipient Academic Advising Council, Cal Poly, SLO

COLLEGE OF ENGINEERING:

- 2014 Outstanding Professor, College of Engineering, Cal Poly State University, SLO.
- 2014 Faculty/Staff Appreciation Award, "For Going Above and Beyond in Inspiring and Assisting MEP Students", Multicultural Engineering Program, Cal Poly, SLO.
- 2013 Faculty/Staff Appreciation Award, "For Going Above and Beyond in Inspiring and Assisting MEP Students", Multicultural Engineering Program, Cal Poly, SLO.
- 2005 Professor of The Year, Society of Hispanic Professional Engineers , Cal Poly, SLO
- 2005 Lockheed Martin "Most Supportive Professor", Society of Women in Engineering, Cal Poly, SLO

ELECTRICAL ENGINEERING DEPARTMENT (PARTIAL LIST):

- AY 13–14, 15-16 Recipient of Hood Endowed Professor, EE Department, Cal Poly, SLO
- 2014 – 2015 The Most Influential Professor, IEEE Student Branch and EE Department, Cal Poly, SLO
- 2011 – 2012 High Pass Filter Faculty Award, IEEE Student Branch and EE Department, Cal Poly, SLO
- 2010 – 2011 Fourier Faculty, IEEE Student Branch and EE Department, Cal Poly, SLO
- 2009 – 2010 Favorite Professor, IEEE Student Branch and EE Department, Cal Poly, SLO
- 2008 – 2009 Favorite Professor, IEEE Student Branch and EE Department, Cal Poly, SLO
- 2007 – 2008 Professor With Best Class Projects, IEEE Student Branch and EE Department, Cal Poly, SLO
- 2006 – 2007 Best Overall Professor, IEEE Student Branch and EE Department, Cal Poly, SLO
- 2005 – 2006 Most Outstanding Lecturer, Electrical Engineering Department, Cal Poly, SLO
- 2006 – 2007 Electrical Engineering – Lockheed Martin Excellence in Teaching Award, Cal Poly, SLO
- 2004 – 2005 Best EE Lab Instructor, Electrical Engineering Department, Cal Poly State University, SLO
- 2003 – 2004 Instructor From Whom Students Learn The Most, Electrical Engineering Department, Cal Poly, SLO
- 2001 – 2002 Best EE Lecturer, Electrical Engineering Department, Cal Poly, SLO

ORGANIZATIONAL EXPERIENCE

- Chair, IEEE Central Coast Section, 01/04 – 12/05 (approximately 1,000 members)
- President, Indonesian Student Association, Northern Arizona University, 08/91 – 05/93
- President, Ikatan Silaturahmi Muslim Indonesia Cleveland, 08/97 – 05/99

COURSES AND LABORATORY TAUGHT

- Cleveland State University: EEC 441   Control Systems Laboratory
- Cal Poly State University:
- EE 563   Graduate Seminar
- EE 527   Advanced Topics in Power Electronics
- EE 444   Power Systems Lab
- EE 433   Introduction to Magnetic Design
- EE 433 Lab Introduction to Magnetic Design Lab
- EE 411   Power Electronics II
- EE 411 Lab Power Electronics II Lab
- EE 410   Power Electronics I
- EE 410 Lab Power Electronics I Lab
- EE 407   Power Systems Analysis II
- EE 406   Power Systems Analysis I
- EE 353   Signal Transmission Laboratory
- EE 342   Automatic Control Systems Laboratory
- EE 302   Linear Control Systems
- EE 295   Energy Conversion Laboratory
- EE 255   Energy Conversion Electromagnetics
- EE 248   Electronic Devices Laboratory
- EE 242   Electric Circuit Analysis III Lab
- EE 241   Electric Circuit Analysis II Lab
- EE 212   Electric Circuit Analysis III
- EE 151   Introduction to Electrical Engineering
- EE 111   Introduction to Electrical Engineering Lab

SENIOR PROJECTS AND MASTER'S THESES

- Supervised a total of 158 senior design projects
- Supervised 58 master's theses

RESEARCH AND SCHOLARLY ACTIVITIES

1) PATENTS

- Taufik and Owen Jong, "Multiple Input Single Output DC-DC Converter with Equal Load Sharing on the Multiple Inputs", submitted for a US Patent.
- Garinto, Taufik, K. Ohn, and I. Waters, "System Method and Apparatus for a Multi-Phase DC-to-DC Converter", US Patent No. 7,782,032.

2) CURRENT PROJECT/RESEARCH

- The DC House Project with 14 International Partners (http://www.calpoly.edu/~taufik/dchouse/)

3) INVITED TUTORIALS, LECTURES AND PRESENTATIONS INTERNATIONAL:

- Visiting Professor, Electrical Engineering Department, Universitas Padjadjaran, Jatinangor, August 2016.
- Guest Speaker, "Cal Poly at a Glance", Universitas Pendidikan Indonesia, Bandung, August 2016.
- Guest Speaker, "The DC House Project as an Alternate Solution to Rural Electrification", Universitas Pertamina, Jakarta, August 2016.

- Keynote Speaker, "Intelligent Systems in DC House for Residential Electricity", International Seminar on Application for Technology of Information and Communication Science and Technology, Semarang, August 2016.
- Invited Lecture, "Seminar on How to Write a Successful Paper", Universitas Muhammadiyah Yogyakarta, August 2016.
- Keynote Speaker, "Residential Electricity the DC House Way: Progresses, Challenges, and Opportunities", the 6th International Annual Engineering Seminar, Yogyakarta, August 2016.
- Keynote Speaker, "Intelligent Systems in DC House for Residential Electricity", International Seminar on Intelligent Technology and Its Applications, Lombok, July 2016.
- Guest Speaker, "Rural Electrification: The DC House Solution", Universitas Mataram Lombok, July 2016.
- Keynote Speaker, "The DC House Project as an Alternate Solution to Rural Electrification", International Conference on Applied Electrical, Electronics, and Informatics Engineering, Pontianak, July 2016.
- "Pengelolaan dan Pengembangan Laboratorium Sebagai Pusat Riset Terapan Yang Berkelanjutan", Guest Speaker, Politeknik Negeri Semarang, Indonesia, July 2015
- "The DC House Project: An Alternate Solution to Rural Electrification", Guest Speaker, Universitas Dian Nuswantoro, Indonesia, July 2015.
- "The DC House Project: An Alternate Solution to Rural Electrification", Guest Speaker, Institut Teknologi Surabaya, Indonesia, July 2015.
- "A Discussion of Potential Collaboration Between Cal Poly and PENS", Guest Speaker, Politeknik Negeri Surabaya, Indonesia, July 2015.
- "The DC House Project: An Alternate Solution to Rural Electrification", Guest Speaker, Universitas Bhayangkara, Indonesia, July 2015.
- "The DC House Project: An Alternate Solution to Rural Electrification", Guest Speaker, Universitas Islam 45, Indonesia, June 2015.
- "The DC House Project: An Alternate Solution to Rural Electrification", Guest Speaker, Universitas Negeri Jember, Indonesia, June 2015.
- "Toward an ABET Accredited Electrical Engineering Curriculum", Guest Speaker, Universitas Padjadjaran, Bandung, Indonesia, April 2015.
- "Cal Poly at a Glance" and "The DC House Project: An Alternate Solution to Rural Electrification", Guest Lecturer, Universitas Sultan Ageng Tirtayasa, Indonesia, April 2015.
- A Discussion on Engineering Curriculum, Universitas Prof. Dr. Moestopo (Beragama), Jakarta, Indonesia, April 2015.
- "Cal Poly at a Glance" and "The DC House Project: An Alternate Solution to Rural Electrification", Guest Speaker, Universitas Borneo Tarakan, Indonesia, April 2015.
- "DC Electricity: Technology of the Past and the Future", Guest Speaker, Universitas Muhammadiyah Sidoarjo, Indonesia, April 2015.
- "DC Electricity: Technology of the Past and the Future", Guest Speaker, Universitas Muhammadiyah Malang, Indonesia, April 2015.
- "DC Electricity: Technology of the Past and the Future", Guest Speaker, Politeknik Negeri Malang, Indonesia, April 2015.
- "Writing for Publication in International Journals", Guest Speaker, Electrical Engineering Department, Universitas Brawijaya Malang, Indonesia, April 2015.
- "The DC House Project: An Alternate Solution to Rural Electrification", Guest Speaker, Politeknik Negeri Ujung Pandang, Indonesia, April 2015.
- "DC Electricity: Technology of the Past and the Future", Guest Speaker, Technological Institute of the Philippines, April 2015.
- "Design of Practical Buck Converter", Guest Lecturer, Technological Institute of the Philippines, April 2015.

- The DC House Project: An Alternate Solution to Rural Electrification", Guest Speaker, Technological Institute of the Philippines, April 2015.
- "The DC House Project: An Alternate Solution to Rural Electrification", Guest Speaker, Universitas Muhammadiyah Tangerang, Indonesia, April 2015.
- "Cal Poly at a Glance" and "The DC House Project: An Alternate Solution to Rural Electrification", Guest Speaker, Universitas Jendral Soedirman, Indonesia, April 2015.
- "Powering Future Microprocessor", Guest Speaker, ST3 Telkom, Purwekerto, Indonesia, April 2015.
- "DC Electricity: Technology of the Past and the Future", Guest Lecturer, Telkom University, Bandung, Indonesia, April 2015.
- "DC Electricity: Technology of the Past and the Future", Guest Lecturer, Universitas Padjadjaran, Bandung, Indonesia, April 2015.
- "Rural electrification: The "DC House" solution", Panelist, Powering up Perspectives on Indonesia's energy future, Indonesian Summit, The Economist, Jakarta, Indonesia, Feb 2014.
- "Recent Status and Challenges of the DC House Project for Rural Electrification", Guest Lecturer, Universitas Negeri Jakarta, Indonesia, 2013.
- "Getting Scholarships for Graduate Studies in the U.S.", Guest Lecturer, Universitas Bakrie, Indonesia, May 2013.
- "Recent Status and Challenges of the DC House Project for Rural Electrification", Guest Lecturer, Surya University, Indonesia, May 2013.
- "Recent Status and Challenges of the DC House Project for Rural Electrification", Guest Lecturer, Universitas Muhammadiyah Malang, Indonesia, May 2013.
- "Smart House for a Smarter Grid : An Electrical Engineering Perspective", Guest Lecturer, Politeknik Negeri Malang, Indonesia, May 2013.
- "Recent Status and Challenges of the DC House Project for Rural Electrification", Invited Speaker, Padjadjaran International Physics Symposium, Indonesia, May 2013.
- "DC House Project for Sustainable Rural Electrification", Panelist at the EBTKE Conference and Exhibition, Jakarta Convention Center, Indonesia, July 2012.
- "DC House Untuk Akses Listrik di Pedalaman dan Beasiswa Kuliah Di Amerika Serikat", Guest Lecturer, Universitas Trunojoyo Madura, Indonesia, July 2012.
- "DC House Untuk Akses Listrik di Pedalaman dan Pengalaman Studi di Amerika Serikat", Guest Lecturer, Universitas Brawijaya Malang, Indonesia, July 2012.
- "DC House Untuk Akses Listrik di Pedalaman", Panggung Inovasi, Ikatan Ilmuwan Indonesia Internasional, Aula RRI, Indonesia, July 2012.
- "The DC House Project: Providing Access to Electricity for the Unfortunates", Guest Lecturer, Universitas Negeri Jakarta, March 2012.
- "The DC House Project: Providing Access to Electricity for the Unfortunates", International Conference on Sustainable Innovation, Yogyakarta, March 2012.
- Keynote Speaker at the Conference on Information Technology and Electrical Engineering (CITEE 2011), "Solar Energy: Potential and Product Development for Remote Areas", Yogyakarta, July 2011.
- "Kesempatan Beasiswa Studi Lanjut di Amerika Serikat dan Sekilas Tentang Cal Poly", Balai Pendidikan dan Latihan, Department Perdagangan Republik Indonesia, Bandung, Indonesia, July 2010.
- "Kegiatan Riset di Cal Poly", Physics Department, University of Padjadjaran, Bandung, Indonesia, July 2010.
- "Sekilas Tentang Cal Poly dan Potensi Kerjasama Akademis Dengan Universitas Padjadjaran", Physics Department, University of Padjadjaran, Bandung, Indonesia, July 2010.
- "Sekilas Tentang Cal Poly dan Potensi Kerjasama Akademis Dengan IEU", Indonesian European University, Surabaya, Indonesia, July 2010.
- "Sekilas Tentang Cal Poly dan Potensi Kerjasama Akademis Dengan Politeknik Sakti", Polytechnic Sakti, Surabaya, Indonesia, July 2010.

- Guest Speaker for the Master & Doctoral Consortium at the 2nd Indonesia International Conference on Innovation, Entrepreneurship, and Small Business, Universitas Multimedia Nusantara, Indonesia, July 2010.
- "Solar Energy: Potential and Product Development for Remote Areas", The 2nd Indonesia International Conference on Innovation, Entrepreneurship, and Small Business, Universitas Multimedia Nusantara, Indonesia, July 2010.
- "Solar Energy: Potential and Product Development for Remote Areas", Politeknik Negeri Malang, June 2010.
- "Academic Exchange Program: Where To Go From Here?" Politeknik Negeri Malang, June 2010.
- "Soft-Switching in DC-DC Converters", Universitas Muhammadiyah Malang, June 2010.
- "Solar Energy: Potential and Product Development for Remote Areas", Universitas Muhammadiyah Malang, June 2010.
- "Solar Energy: Potential and Product Development for Remote Areas", Universitas Negeri Jakarta, June 2010.
- "Beasiswa Studi Lanjut di Amerika Serikat", Institut Sains & Teknologi Al-Kamal, June 2010.
- "A Short Course in DC-DC Converters", Technological Institute of the Philippines, Quezon City, December 2009.
- "Practical Design of Buck Converter", A Tutorial Session at the 2008 IEEE Power Engineering Conference, Johor Bahru, Malaysia, December 2008.
- One-Day Workshop on "Practical DC-DC Converter Design", IEEE Power Electronics Chapter of Malaysia Section, July 2007.
- Two-Day Workshop on "DC-DC Converter Design and Simulation Using MathCAD and OrCAD Pspice", Politeknik Negeri Malang, Indonesia, June 2007.
- Two-Day Workshop on "DC-DC Converter Design and Simulation Using MathCAD and OrCAD Pspice", Universitas Muhammadiyah Malang, Indonesia, June 2007.
- "Powering Future Microprocessors", Wesleyan University, Cabanatuan City, Philippines, Aug 2007.
- "Powering Future Microprocessors", Technological Institute of the Philippines, Quezon City, Aug 2007.
- "Powering Future Microprocessors", Technological Institute of the Philippines, Manilla, Aug 2007.
- "Power Program at Cal Poly State University", Universiti Teknologi Malaysia, Skudai – Malaysia, July 2007.
- "Powering Future Microprocessors", Universiti Teknologi Malaysia, Skudai – Malaysia, July 2007.
- "Learning Theory – Training For Trainers", PT. Delta Metro, Jakarta, Indonesia, July 2007.
- "Adjustable Speed Drives: Impacts on Power Quality", Universitas Diponegoro, Semarang, Indonesia, July 2007.
- "Electrical Engineering Curriculum at Cal Poly", Universitas Brawijaya Malang, Indonesia, June 2007.
- "Powering Future Microprocessors", Politeknik Negeri Malang, Indonesia, June 2007.
- "Powering Future Microprocessors", Universitas Muhammadiyah Malang, Indonesia, June 2007.
- "Higher Education System in U.S.A.", Universitas Muhammadiyah Malang, Indonesia, June 2007.
- "Recent Status of Wind Energy in the U.S.", Universitas Muhammadiyah Malang, Indonesia, June 2007.
- "Higher Education System in U.S.A.", Sekolah Tinggi Manajemen Informatika dan Komputer (STMIK), Bandung, Indonesia, June 2007.
- "Efficiency Improvement for Low Voltage DC-DC Converter Using Synchronous Rectification", NUEST Cabanatuan, Philippines, August 2004.
- "Role of Power Electronics in Power Transmission and Distribution", Universitas Trisakti, July 2004.
- "Switching Mode DC-DC Converters: Circuits and Design Considerations", Universitas Muhammadiyah Malang, July 2004.
- "Getting Scholarships in the US", Universitas Muhammadiyah Malang, July 2004.
- "Efficiency Improvement for Low Voltage DC-DC Converter Using Synchronous Rectification", Universitas Kristen Indonesia, June 2004.
- "Soft-switching Method in Power Converters", University of Muhammadiyah, Malang, Indonesia, July 2000
- "Resonant Power Converters: An Overview ", IEEE International Conference on Power Electronics and Electric Machines, Indonesia, July 2000.

NATIONAL & STATE:

- "Education: Perpetual Impact; A Self Reflection and Personal Stories", Keynote Speaker, Cerdas Foundation Fundraising Dinner, Seattle, Washington, USA, April 2014.
- Panelist, panel session on Smart Grid Integration, 2012 North America Renewable Energy World and Exposition
- "Power Program at Cal Poly, San Luis Obispo", Helix Electric, San Diego, July 2008.
- A Short Course on "DC-DC Converter Topologies and Design", Advanced Analogic Technologies Inc., Sunnyvale, May 2007
- "Power Program at Cal Poly, San Luis Obispo", Chevron Energy Solutions, San Francisco, August 2006.
- "Power Program at Cal Poly, San Luis Obispo", ChevronTexaco, Richmond, August 2006.
- "Power Program at Cal Poly", Linear Technology, Milpitas, August 2006.
- "Adjustable Speed Drives: Impact on Harmonics", Arup Inc., Los Angeles, June 2006.
- "Improving Efficiency of DC-DC Converters Using Soft-Switching", Qualcomm, San Diego, February 2006.
- "A Crash Course in Switching Regulators", Cal Poly State University, San Luis Obispo, California, May 2006.
- "Power Electronics: Basic Circuits and Applications", San Diego Gas and Electric, San Diego, California, August 2005.
- "Power Electronics: Basic Circuits and Applications", San Diego Gas and Electric, San Diego, California, July 2005.
- "Providing Power For Digital Society: A Summary and Recommendations", San Diego, August 2005.
- "Cal Poly's Power Program: An Overview", General Atomics, San Diego, July 2005.
- "Technical Training on Power Electronics for Engineers", April – June 2004, Los Osos.
- "Resonant Converter Design Improves Efficiency of Switching Power Supply", University of Wisconsin Platteville, April 2003.
- "Cal Poly Power Electronics Emphasis: An Overview", IEEE Power Electronics Society – LA Chapter Meeting, November 2002.

LOCAL:

- EIT Review Session on Electrical Engineering, PEITRCC (www.peitrcc.com), San Luis Obispo, March 2007.
- "A Simple DC Motor Experiment", Saint Joseph High School, Santa Maria, February 2007.
- "Electrical Power", Arroyo Grande High School, February 2006.
- "Delivering Electrical Power", San Luis Obispo High School, February 2006.
- "Electrical Power", Saint Joseph High School, Santa Maria, January 2006.
- EIT Review Session on Electrical Engineering, PEITRCC (www.peitrcc.com), San Luis Obispo, March 2005.
- "Renewable Energy Sources", Saint Joseph High School, Santa Maria, February 2005.
- "Zero Current Switching Resonant Switch Converters", IEEE Central Coast Section, Goleta, October 2004.

UNIVERSITY:

- "Recent Status and Results of the Multiphase Project: Paving a Path to Power Future Microprocessors", Graduate Seminar, Cal Poly, San Luis Obispo, October 2007.
- "A Conversation with Distinguished Advisors", Workshop Panelist, the Center for Teaching and Learning, Cal Poly, Jan 2007.
- "Powering Future Microprocessors", Graduate Seminar, Cal Poly, San Luis Obispo, November 2006
- EIT Review Session on Electrical Engineering, Chi Epsilon, April 2004
- EIT Review Session on Electrical Engineering, Chi Epsilon, October, 2003
- "Technical Training on Power Electronics for Technicians", April – June 2003, Los Osos.
- EIT Review Session on Electrical Engineering, Chi Epsilon, April 2003
- EIT Review Session on Electrical Engineering, Chi Epsilon, October 2002

- "Improving DC-DC Converter Efficiency Using Synchronous Rectification", Graduate Seminar, Cal Poly, Nov 2002.
- "PG&E Workshop on Power System and Power Electronics", Electric Power Institute, Sep 2002 "Synchronous Rectification", Graduate Seminar, Cal Poly, San Luis Obispo, CA, Mar 2002.
- "Paralleled Series Loaded Resonant Converter", Graduate Seminar, Cal Poly, San Luis Obispo, March 2000.

4) GRANTS (PARTIAL LIST)

- 2015 – 2016 Assigned Time for Exceptional Levels of Service to Students
  4-WTU Released Time for Spring 2017
- 2015 – 2016 Development of an Energy Storage System for the Microgrid Laboratory R-IDC College of Engineering, Cal Poly, Total Amount: $4,950
  PI: Taufik, Dale Dolan
- 2014 – 2015 High Density Inverter for the Little Box Google Challenge
  Power Integrations, Inc. and Enerpro, Inc., Maxim, and Cal Poly, Total Amount: $38,000
  PI: Taufik, Students: Alfredo Moreno, Vattsalya Karanam, Evan Manrique
- 2012 - 2014 Arc Fault Circuit Interrupter Development for Residential DC Electricity California Energy Commission, Amount: $150,000
  PI: Andrew Kean, Co-PI: Taufik, Student: Cassidy Aarstad, George Bushnell, Adam Sahr
- 2013 - 2014 Condition Based Maintenance for Power Transformer San Diego Gas and Electric, Amount: $7,500
  PI: Taufik, Student: Michael Babalola
- 2013 - 2014 Portable Nanohydro Generator
  Chevron, Amount: $5,000
  PI: Taufik, Student: James Biggs, Andrew Aw
- 2013 - 2014 Propulsion High Voltage Power Supply
  NASA Jet Propulsion Lab, Amount: $5,000
  PI: Taufik, Student: Nicholas Weiser
- 2012 - 2013 Smart Grid Technology Projects
  San Diego Gas and Electric, Amount: $10,000
  PI: Taufik, Students: Abesh Mubaraki, Timothy Haskell, Ben Johnson, Anthony Ma
- 2012 - 2013 Solar Concentrator Design and Development
  Cal Poly CPConnect, Amount: $3,000
  Advisor: Taufik, Students: F. Reiling, Scott Leonard
- 2011 - 2012 Regenerative Braking for Electric Bicycle
  Cal Poly CPConnect, Amount: $3,000
  Advisor: Taufik, Students: F. Reiling, Scott Leonard 2011 - 2014 Algae Biofuel
  Boeing and Cal Poly, Amount: $25,000/year
  Dean Arakaki, Elena Keeling, Taufik, and others.
- 2010 - 2011 Ground Fault Interrupter Circuit
  Chevron, Amount: $100,000
  PI: Dale Dolan, Taufik, Ali Shaban, Ahmad Nafisi.
- 2009 - 2013 Development of Power Electronics Lab
  Enerpro Inc., Amount: $40,000
  PI: Taufik
- 2009 - 2011 Bidirectional DC-DC Converter for Battery Charger Amperex, Amount: $10,000
  PI: Taufik, Student: Randyco Prasetyo
- 2009 - 2010 Development of Sustainable Energy Lab
  Sempra Energy, Amount: $66,400
  Taufik, Ali Shaban, Ahmad Nafisi

- 2009 - 2010 Design and Development of High-Performance High-Density DC-DC Converters C3RP Cal Poly Partnership, Amount: $33,000
  PI: Taufik, Student: Randyco Prasetyo
- 2008 - 2009 Power Quality And Performance Study of a Fuel Cell Based Power Electronics System Malaysian Ministry of Science, Technology and Innovation, Amount: $50,000
  PI: Makbul Anwari, Co-PI: Taufik, M.I. Hamid
- 2004 - 2005 Investigation of Efficiency Improvement in High-Density Light-Weight DC-DC Converter C3RP Cal Poly Partnership, Amount: $33,000
  PI: Taufik, Student: Sarah Ahrendes
- 2003 - 2004 Technical Training on Power Electronics for Engineers Rantec Power Systems, Total Amount: $8,000
  PI: Taufik
- 2001 - 2002 Building Photovoltaic Facility
  C3RP Cal Poly Partnership, Amount: $30,000
  PI: Taufik, Students: Kevin Quetano, Karl Buckman
- 2001 - 2002 Optimization of Water and Energy Resources Associated with Irrigation Water Delivery and Management Cal Poly ITRC and California Energy Commission, Amount: $75,000
  PI: Ali Shaban, Co-PI: Ahmad Nafisi, Taufik
- 1999 - 2000 Development of New Power Electronic Lab Experiments
  Cal Poly College of Engineering, Amount: $5,000
  PI: Taufik

SERVICES

NATIONAL/INTERNATIONAL

- Associate Editor, Jurnal Material dan Energi (2011 - present)
- Associate Editor, International Journal of Science and Technology, http://www.jost-journal.com, (Feb 2010 - present)
- International Advisory Committee, the International Conference on Advanced Science, Engineering and Information Technology
- International Advisory Committee, International Conference on Pattern Analysis and Intelligent Robotics
- International Advisory Committee, International Conference on Power Engineering and Renewable Energy
- Technical Reviewer, Jurnal Rekayasa Elektrika, Universitas Syiah Kuala, Aceh, Indonesia (Sep 2009 – present)
- Technical Reviewer, 2009 IEEE Technical Conference, Singapore 2009
- Technical Reviewer, IEEE Transactions on Industry Applications Society, (2000 – 2002)
- Technical Reviewer, Annual IEEE Transactions on Industry Applications Society Conference, (2000)
- Technical Reviewer, California Energy Commission, Energy Innovations Small Grant Program, (2000 – 2004)
- Technical Reviewer, American Power Electronic Conference (APEC) 2012
- Technical Reviewer, International Conference on Power Electronics - ECCE Asia (2011)
- Technical Reviewer, International Conference on Business, Engineering and Industrial Applications (2011)
- Technical Reviewer, International Conference on Electronic Devices, Systems & Applications (2011)
- Technical Reviewer, The International Conference on Information Technology - New Generations (2011)
- Technical Reviewer, IEEE Applied Power Electronics Colloquium (2011)
- Technical Reviewer, International Conference on Advanced Science, Engineering and Information Technology (2011)
- Technical Reviewer, Applied Power Electronics Colloquium (2011)

- Technical Reviewer, International Power and Energy Conference (2010)
- Technical Reviewer, Annual IEEE Transactions on Industry Applications Society Conference, (2000)
- Member, IEEE Industry Applications Society, Industrial Automation Control Subcommittee, (2000 – 2002)
- Member of Steering Committee, North American Power Symposium, Steering Committee, (1999, 2001)

UNIVERSITY LEVEL

- Faculty Advisor, Philippine Cultural Exchange Program, Cal Poly State University (2002 – 2014)
- Faculty Member, Electric Power Institute, Cal Poly State University, San Luis Obispo (1999 – present)
- Faculty Member, 2005 Cal Poly Solar Decathlon Team, (2003 – 2004)
- College Representative and Member, International Education and Program Council, (2004 – present)
- College Representative and Member, University Scholarship Committee, (2006 – 2008)
- Member, University Academic Senate Fairness Board Committee, (2001 – 2004)
- Member, University Academic Senate Instructional Advisory Committee on Computing, (2001 – 2002)
- Member, University Campus Dining Advisory Committee, (2001 – 2004)

COLLEGE LEVEL

- Member, CENG International Exchange Program (2002 – present)
- Member, CENG Curriculum Committee, (2006 – 2009)
- Member, CENG ABET Assessment Committee, (2006 – 2009)
- Member, CENG Scholarship Committee (2002 – 2005)
- Member, CENG Computer Advisory Committee (2000 – 2001)

DEPARTMENT LEVEL

- Chair, Tenured and Probationary Faculty Committee (2012 – 2014)
- Coordinator for the Accreditation (ABET) for the Electrical Engineering Department (2006 – 2008)
- Chair (2006 – 2009) and Member (2002 – 2006) of the Curriculum Committee
- Chair, EE Student Awards Committee, (2002 – 2006)
- Power Technical Area Committee
- Chair (2000 – 2001; 2002 – 2003)
- Member (1999 – 2000, 2001 – present)
- Faculty Advisor, Power Engineering Society Club, (2000 – 2009)
- Member, EE Laboratory Committee, (1999 – 2004)
- Member, EE Microwave and Photonics TAC, (2000 – 2001)
- Member, EE Lab Manual Improvement Committee, (1999 – 2001)
- Member, EE Network Administration Committee, (1999 – 2001)
- EE Webmaster and Web-designer (2000 – 2001)

PUBLICATIONS

1) BOOKS

- Editors: Taufik, T., Prabasari, I., Rineksane, I.A., Yaya, R., Widowati, R., Putra Rosyidi, S.A., Riyadi, S., Harsanto, P., "ICOSI2014: Proceedings of the 2nd International Conference on Sustainable Innovation", Springer, April 2016, ISBN: 978-981-287-660-7.
- Taufik, "Beasiswa Kuliah di Amerika", (Indonesian), 1st edition, PT. Citra Aditya Bakti, Bandung, 2007, ISBN: 979-414-958-6.

2) COURSE READERS

- Taufik, EE 212 Lecture Notes, Cal Poly State University
- Taufik, EE 255 Lecture Notes, Cal Poly State University
- Taufik, EE 302 Lecture Notes, Cal Poly State University
- Taufik, EE 406 Lecture Notes, Cal Poly State University
- Taufik, EE 407 Lecture Notes, Cal Poly State University
- Taufik, EE 410 Lecture Notes, Cal Poly State University
- Taufik, EE 411 Lecture Notes, Cal Poly State University
- Taufik, EE 433 Lecture Notes, Cal Poly State University
- Taufik, EE 527 Lecture Notes, Cal Poly State University

3) PEER REVIEWED JOURNALS

- M. F. E. Purnomo, S. H. Pramono, M. A. Pamungkas, and Taufik, "Study of the Effect of Air-Gap to Array Microstrip Antenna for Mobile Satellite Communications", Asian Research Publication Network Journal of Engineering and Applied Sciences, Vol. 10, No: 20, November 2015.
- B. Afarulrazi, M.U. Wahyu, T. Taufik, S. Aizam, Jumadril, "Design Study of Zero Voltage Switching for DC/DC Boost Converter", Applied Mechanics and Materials, Vol. 785, pp. 136-140, April 2015.
- M. F. E. Purnomo, Taufik, "Study of the Effect of Air-Gap to Array Microstrip Antenna for Mobile Satellite Communications", Asian Research Publication Network Journal of Engineering and Applied Sciences, 2015.
- M. Taufik, Taufik, J. Brinsfield, G. Bergdoll, "Effect of Resonant Capacitance and Inductance on Peak Capacitor Voltage and Inductor Current in SLR Converter", International Review on Modeling and Simulations (IREMOS), 2015.
- Muqorobin, P. Irasari, Taufik, "Comparison of Unmodulated Current Control Characteristics of Permanent Magnet Synchronous Motor", Journal of Mechatronics, Electrical Power, and Vehicular Technology, Volume 5, No. 2, 2014.
- R. I. Putri, S. Wibowo, M. Rifa'i, Taufik, "Fuzzy Incremental Conductance for Maximum Power Point Tracking in Photovoltaic System", International Journal of Engineering ,Science and Innovative Technology, Volume 3, Issue 6,November 2014.
- Y. Husodo, S. M. Ayob, M. Anwari, Taufik, "Simulation of Modified Simple Boost Control for Z-Source Inverter", International Journal of Automation and Power Engineering, Vol. 2, Issue 4, May 2013.
- W.M.Utomo, Z.A. Haron, A. A. Bakar, M. Z. Ahmad and Taufik, "Voltage Tracking of a DC-DC Buck-Boost Converter Using Neural Network Control", International Journal of Computer Technology and Electronics Engineering, Volume 1, Issue 3, 2011.
- S. Samosir, Taufik and A. H. M. Yatim, "Simulation and Implementation of Interleaved Boost DC-DC Converter for Fuel Cell Application", International Journal of Power Electronics and Drive Systems, Dec 2011.

- M. Anwari, M. I. Hamid, A. Hiendro and Taufik, "Power Quality Analysis of Adjustable Speed Drive with Multi-Pulse Rectifier", Journal of the Japan Society for Applied Electromagnetics and Mechanics.
- Taufik, A. Polleri, and M. Taufik, "Modeling of Paralleled Series-Loaded-Resonant Converter with Phase-Shifting Control", International Journal of Modeling, Simulation, and Scientific Computing, Vol. 2, June 2011.
- Y. Husodo, M. Anwari, S. M. Ayob, Taufik, "Analysis and Simulation of a New Three Phase LLCC Resonant Inverter for Fuel Cell Applications", International Review on Modeling and Simulations, Vol. 4 N. 1, February 2011.
- D. Romero, A. S. Prabuwono, Taufik, and A. Hasniaty, "A Review of Sensing Techniques for Real-time Traffic Surveilance", Journal of Applied Science, Vol. 11, No. 1, pp. 192-198, 2011.
- Xiao-Hua Yu, Weiming Li, and Taufik, "Design and Implementation of a Neural Network Controller for Real-time Adaptive Voltage Regulation", Journal of Neurocomputing, Science Direct, Elsevier, ISSN: 0925-2312, Volume 73, Issues 1-3, December 2009, Pages 531-535.
- M. I. Hamid, M. Anwari, and Taufik, "Comparison of Current Control Methods on Carrier Based VSI-PWM Inverter Drives from Line Power Quality Aspect", TELKOMNIKA Journal, ISSN: 1693-6930, Vol. 6, No. 2, August 2008.
- Charles M. Burt, Xianshu Piao, Franklin Gaudi, Bryan Busch, and Taufik, "Electric Motor Efficiency Under Variable Frequencies and Loads", ASCE Journal of Irrigation and Drainage Engineering, April 2008.
- V. Rodov, A. Ankoudinov, Taufik, "Super Barrier Rectifier – A New Generation of Power Diode", IEEE Transactions on Industry Applications, January 2008.

4) REPORTS

- 2008 EE ABET Accreditation Self Study Report developed the first draft, and co-authored the final version.
- Taufik, "Distributed Temperature Sensing for Underground Cables", submitted to SDGE, July 2008.
- Burt, X. Piao, F. Gaudi, B. Busch, and Taufik, "Electric Motor Efficiency under Variable Frequencies and Loads", Irrigation Training and Research Center, Cal Poly State University, San Luis Obispo, October 2006
- Taufik and Bisrat Yohannes, "Diode Voltage Spike Measurements in Flyback Circuit using PN, SBR and Schottky Diodes", submitted to APD Semiconductor, August 2006
- Taufik, "Calculation of Diode Losses", submitted to APD Semiconductor, August 2006.
- Taufik, "Junction Capacitance: Contribution to Diode Loss and Inrush Currents", submitted to APD Semiconductor, Aug 2006
- Taufik, "Impact of Diode's Reverse Recovery Time and Junction Capacitance to Rectifier's Voltage Spike in Flyback Circuit", submitted to APD Semiconductor, July 2006.
- Taufik, "Providing Power For Digital Society: A Summary and Recommendations", submitted to SDGE, August 2005.
- Taufik, "Improving Efficiency of High-Density DC-DC Converters", submitted to ONR/C3RP, June 2005.
- Taufik, "Building Photovoltaic Facility", submitted to ONR/C3RP, June 2003.
- Taufik, et.al., "Study on SDGE Transmission Circuit Breaker Replacement Criteria", submitted to SDGE, September 2001.

5) MAGAZINE ARTICLE

- "Featured Engineer – Interview with Dr. Taufik", EEWeb Electrical Engineering Online Community, 2011.
- Taufik, J. Chiem, and Y. Ang, "Replacing Schottky Diodes with Super Barrier Rectifier Diodes", Bodo's Power Systems – Electronics in Motion and Conversion, February 2009.
- Taufik, "Snubber Circuit Implementation in Electronic Switch ", Elektro National Indonesian Electronics Engineering Society Magazine, v., November 2000.
- Taufik, "On the Impact of Power Electronics Technology Advancement to Power Transmission", Teknologi Indonesian Magazine, October 2000.

- Taufik, "Resonant Switching Mode DC-DC Converters", Elektro National Indonesian Electronics Engineering Society Magazine, v.29, January 2000.
- Taufik, "Switching Mode DC-DC Converters", Elektro National Indonesian Electronics Engineering Society Magazine, v.25, April 1999.
- Taufik, "Various Methods For DC Supply", Elektro National Indonesian Electronics Engineering Society Magazine, v.24, January 1999.
- Taufik, "Internet Services Using Power Transmission Lines", Swasembada Indonesian Business Magazine, November 1998.
- Taufik, "FACTS as The Future Technology in Electrical Power Transmission", Elektro National Indonesian Electronics Engineering Society Magazine, v.15, November 1998.
- Taufik, "Micro Turbine Generators for Business Applications", Swasembada Indonesian Business Magazine, December 1997.

6) PEER REVIEWED CONFERENCE PAPERS (149 TOTAL)

- K. Htoo, Taufik, and G. Larson, "Multiple-Input Bridge Converter for Connecting Multiple Renewable Energy Sources to a DC System", Proc. of 2016 Future Technologies Conference, December 2016, to appear.
- Magdefrau, Taufik, M. Poshtan, and M. Muscarella, "Analysis and Review of DC Microgrid Implementations", Proc. of International Seminar on Application for Technology of Information and Communication Science and Technology, August 2016.
- Taufik, D. Sawitri, and M. Muscarella, "'Power Quality Analysis of Variable Frequency Drives Connected to a Reactively Compensated Mixed Load System'", Proc. of International Seminar on Technology of Information and Communication Science and Technology , August 2016.
- Taufik, and M. Muscarella, "'Development of DC House Prototypes as Demonstration Sites for an Alternate Solution to Rural Electrification'", Proc. of the 6th International Annual Engineering Seminar, July 2016.
- M. Muscarella, J. Mitchell, and Taufik, "Design Considerations of Diode Source Protection in Multiple Buck Converter", Proc. of International Conference on Applied Electrical, Electronics, and Informatics Engineering, July 2016.
- Aarstad, Taufik, A. Kean, and M. Muscarella, "Development of Arc Fault Interrupter Laboratory Testing for Low Voltage DC Electricity", Proc. of International Seminar on Intelligent Technology and Its Applications, July 2016.
- R. I. Putri, A. Priyadi, M.H. Purnomo, M. Pujiantara, and Taufik, "Optimum Control Strategy of Grid Connected PMSG Wind Turbine Based on Energy Storage System", Proc. of International Seminar on Intelligent Technology and Its Applications, July 2016.
- Taufik, F. Milan, and M. Taufik, "WIP: International Partnership on the DC House Project for Rural Electrification", ASEE PSW Conference, April 2016.
- Milan, M. Yumul, and Taufik, "Design for the Adaptation of Prepayment Energy Metering System for Multi-Tenant Office Building and Rented Accommodations", International Conference on Engineering and Information Technology, Cebu, Philippines, January 2016.
- Taufik, F. Milan, and M. Yumul, "An Isolated Bidirectional Converter for Battery Charging/Discharging System", International Conference on Engineering and Information Technology, Cebu, Philippines, January 2016.
- M. Taufik, and Taufik, "Unpad's DC House Prototype to Showcase an Alternative Solution to Rural Electrification", 1st International Conference on Rural Development and Community Empowerment, Bandung, November 2015.
- M. Taufik, Taufik, A. A. Bakar and W. M. Utomo, "Multiphase Charge Pump for High Output Voltage", IASTED International Conference on Advances in Power and Energy Systems, Marina Del Ray, October 2015.

- Sawitri and Taufik, "Fault Detection Using SVM Based Motor Current Signature Analysis for 3-Phase Induction Motors", IASTED International Conference on Advances in Power and Energy Systems, Marina Del Ray, October 2015.
- A. Bakar, W. M. Utomo, Taufik, S. A. Zulkifli and Jumadril Jn, "DC/DC Boost Converter with PI Controller using Real-Time Interface", The International Conference on Electrical and Electronic Engineering, Malaysia, August 2015.
- M. F. E. Purnomo, Taufik, "Study of the Effect of Air-Gap to Array Microstrip Antenna for Mobile Satellite Communications", The International Conference on Electrical and Electronic Engineering, Malaysia, August 2015.
- S. Westdal, K. Mendoza, Taufik, A. Parastiwi, "Calculating Frequency and Max Duty Cycle for the TI UCC38C4X Family PWM Controllers", 2015 National Seminar on Information Technology and Its Applications, June 2015.
- Dolan, V. Prodanov, Taufik, "Energy and Economic Losses due to Soiling on Utility Scale PV Systems to Guide Timing of Cost Effective Cleaning", 42th IEEE Photovoltaic Specialist Conference, New Orleans, June 2015.
- S. Westdal, K. Mendoza, Taufik, A. Parastiwi, "Calculating Frequency and Max Duty Cycle for the TI UCC38C4X Family PWM Controllers", National Seminar on Information Technology and Its Application, Indonesia, June 2015.
- Taufik, D. Dolan, "Work-In-Progress: Enhancing Students' Learning in Advanced Power Electronic Course Using a USB Solar Charger Project", ASEE PSW Conference, April 2015.
- Bakar, M. Wahyu, Taufik, S. Aizam, Jumadrill, "Design Study of Zero Voltage Switching for DC/DC Boost Converter", Ninth International Power Engineering and Optimization Conference, March 2015.
- Afarulrazi, M. Wahyu, Taufik, S. Aizam, M. Yonis, "Design of Analog to Digital Converter for DC to DC Boost Converter with Constant Output Voltage", Third International Conference on Computer Engineering and Mathematical Sciences, Dec 2014.
- Taufik, "The DC House Project: An Alternate Solution for Rural Electrification", IEEE Global Humanitarian Technology Conference, October 2014.
- Parastiwi, Taufik, "Microhydro for Rural Electrification as a Learn-By-Doing and Multidisciplinary Project: Lessons Learned", ASEE PSW Conference, April 2014.
- Parastiwi, Taufik, "Experience from Faculty Exchange Program: Student Success Lesson from Cal Poly State University", ASEE PSW Conference, April 2014.
- Taufik, "Rural Electrification: The DC House Solution", The Economist, Power Up: Perspectives on Indonesia's Energy Future, January 2014.
- D. Dolan, M. Ducasse, Taufik, "Variability in Detailed Energy Useage on Repeated Trips in the Chevrolet Volt", EVS27 27th International Electric Vehicle Symposium, Barcelona, Spain, November 2013.
- D. Dolan, J. Dunning, Taufik, "Analysis of Detailed Electric Vehicle Data in Electrical Engineering Education", EVS27 27th International Electric Vehicle Symposium, Barcelona, Spain, November 2013.
- D. Dolan, Taufik, "Characterizing Energy Usage of Chevrolet Volt Versus Speed", Proc. of SusTech, 2013.
- Taufik, K. Liang, and M. Taufik, "Design and Simulation of DC Light Bulb for DC House", Proc. of 2013 PIPS, May 2013.
- Taufik, D. Dolan, "WIP: Enhancing Students' Learning in Introductory Power Electronic Course Using an LED Driver Project", Proc. of 2013 ASEE-PSW Conference, April 2013, to appear.
- M. Taufik, A. Soriano, E. Loza, Taufik, and Soeprapto, "Steady-State Analysis of Step-Down Charge Pump", Proc. of 2012 MICEEI, December 2012.
- M. Taufik, C. Arntzen, G. Chavoor, Taufik, and S. Sidopekso, "Analysis of Flyback Current-Fed Push-Pull DC-DC Converter", Proc. of 2012 MICEEI, December 2012.
- M. Taufik, D. Gonzalez, R. Baake, and Taufik, "Steady-State Analysis of Step-Down Charge Pump", Proc. of 2012 MICEEI, December 2012.

- Taufik, Soeprapto, S. Sidopekso, M. Taufik, "A Comparison of Multiple Boost Configurations for Small Renewable Energy Battery Storage Systems", Proc. of 2012 International Conference on Sustainable Energy Engineering and Applications, November 2012.
- Soeprapto, Taufik, S. Sidopekso, M. Taufik, "The DC House Project for Sustainable Rural Electrification", Proc. of 2012 International Conference on Sustainable Energy Engineering and Applications, November 2012.
- M. Taufik, Taufik, J. Thornton, "Piezoelectric Wind Energy Harvesting for Small Scale Systems", Proc. of 2012 International Conference on Sustainable Energy Engineering and Applications, November 2012.
- Amin , S. Sidopekso, and Taufik, "Studi Rancang Bangun Portable Nano-Hydro Sebagai Alternatif Sumber Pembangkit Energi Listrik", (In Indonesian) Seminar Nasional Teknik Mesin, Jakarta, October 2012.
- M. Taufik, Taufik, T. Wong, "Multiple-Input Single-Output Converter for Renewable Energy Sources", IEEE Symposium on Industrial Electronics & Applications, September 2012.
- Taufik, M. Taufik, "The DC House Project: Promoting the Use of Renewable Energy for Rural Electrification", The International Conference on Power Engineering and Renewable Energy, July 2012.
- Taufik, J. Thornton, M. Taufik, "Small-Scale Wind Energy Harvesting Using Piezoelectric Converter", The International Conference on Power Engineering and Renewable Energy, July 2012.
- D. Dolan, V. Le, Taufik, "Geographic Variation in Environmental Benefits Achieved by Plug in Electric Vehicles and Electric Vehicles", Electric Vehicle Symposium, May 2012.
- D. Dolan, Taufik, "Use of Online Review to Increase Student Performance on Online and In-Class Evaluations in Power Electronics", 2012 ASEE PSW Conference, April 2012.
- D. Dolan, P. Lehn, Taufik, "Harmonics and Dynamic Response of a Virtual Air Gap Variable Reactor", Conference on Information Technology and Electrical Engineering, April 2012.
- Taufik, T. Wong, O. Jong, and Dale Dolan, "Design and Simulation of Multiple-Input Single-Output DC-DC Converter", Conference on Information Technology and Electrical Engineering, April 2012.
- Taufik, J. Thornton, and D. Dolan, "Piezoelectric Converter for Wind Energy Harvesting", Conference on Information Technology and Electrical Engineering, April 2012.
- Taufik, "The DC House Project: Promoting Sustainable Innovations in Renewable Energy Technology", International Conference on Sustainable Innovation, March 2012.
- S. Prabuwono, A. R. A. Besari, R. Zamri, M. D. M. Palil, and Taufik, "Surface Defects Classification Using Artificial Neural Networks in Vision Based Polishing Robot", Lecture Notes in Artificial Intelligence, the 2011 International Conference on Intelligent Robotics and Applications.
- Samosir, A. H. M. Yatim, K. Kamal, and Taufik, "Simulation and Implementation of Interleaved Boost DC-DC Converter for Fuel Cell Application", IEEE TENCON 2011, Nov. 2011.
- Taufik, J. Thornton, and M. Anwari, "Design and Simulation of Multiple Input DC-DC Converter for Piezoelectric Wind Harvesting", 2011 Jordan International Energy Conference, Sep. 2011.
- J. Wong, N. Idris, M. Anwari and Taufik, "A Parallel Energy-Sharing Control for a Fuel Cell-Battery-Ultracapacitor Hybrid Vehicles", IEEE Energy Conversion Congress and Exposition, Sep. 2011.
- D. Dolan, J. Durago, and Taufik, "Development of a Photovoltaic Panel Emulator Using Labview", Proc. of 37th IEEE Photovoltaic Specialist Conference, Seattle, Washington, Sept. 2011.
- Taufik, S. McClusky, J. Paolucci and D. Dolan, "A New Undergraduate Laboratory Course in Magnetic Design", Proc. of 2011 North American Power Symposium, Boston, August 2011.
- D. Dolan, Taufik, "Development of Wind Tunnel for Laboratory Wind Turbine Testing", Proc. of 2011 North American Power Symposium, Boston, August 2011.
- Taufik, and D. Dolan, "Web-Based Magnetic Design", Proc. of 118th ASEE Annual Conference and Exposition, Vancouver, Canada, June 2011.
- Taufik, and D. Dolan, "An Active Power Factor Correction Laboratory Experiment for Power Electronics Course", Proc. of 118th ASEE Annual Conference and Exposition, Vancouver, Canada, June 2011.

- D. Dolan, V. Prodonov, and Taufik, "Student Perception of Lecture Video Use as a Means to Increase Time for in Class Problem Solving Applications", Proc. of 118th ASEE Annual Conference and Exposition, Vancouver, Canada, June 2011.
- Taufik, B. Luc, and W. Utomo, "Analysis of Multiphase Zero-Voltage-Switching Buck Converter for Powering Microprocessor", Proc. of International Symposium on Humanities, Science and Engineering Research, June 2011.
- Taufik, J. Adamson, and A. Prabuwono, "Pulse Density Modulated Soft-Switching Single-Phase Cycloconverter", Proc. of IEEE Applied Power Electronics Colloquium, April 2011.
- Taufik, M. McCarty, M. Anwari and A. Prabuwono, "Optimization of Operating Parameters in a Unipolar PWM Inverter", Proc. of IEEE Applied Power Electronics Colloquium, April 2011.
- Taufik, D. Forbes, D. Dolan and R. Putri, "Digital Control of Parallel-Connected DC-DC Converters", Proc. of the 8th International Conference on Information Technology, April 2011.
- W. Utomo, A. Bakar, M. Ahmad, Taufik and R. Heriansyah, "Online Learning Neural Network Control of a DC-DC Buck Boost Converter", Proc. of the 8th International Conference on Information Technology, April 2011.
- Taufik, J. Arakaki, D. Dolan, M. Anwari, and M. Hamid, "Comparative Study of 4-Switch Buck-Boost Controller and Regular Buck-Boost", Proc. of the International Conference on Advanced Science, Engineering and Information Technology, Jan 2011.
- Taufik, R. Prasetyo, D. Janigian, A. Prabuwono, "A Bidirectional Flyback Topology for an Off-Line Battery Charger/Discharger", Proc. of the International Conference on Advanced Science, Engineering and Information Technology, January 2011.
- Taufik, Q. Le, A. Hilario, and R. Putri, "Comparative Analysis of Two-Switch and Four-Switch Buck-Boost Controllers", Proc. of the 5th Electrical Power, Electronics, Communication, Control and Informatics Seminar, December 2010.
- R. Putri and Taufik, "Pembangkit Pulsa Tegangan Tinggi Untuk Pasteurisasi PEF Dengan Pengaturan Waktu Dan Tegangan", Proc. of the 5th Electrical Power, Electronics, Communication, Control and Informatics Seminar, December 2010.
- Taufik, R. Prasetyo, D. Dolan, D. Garinto "A New Multiphase Multi-Interleaving Buck Converter With Bypass LC", Proc. of the 36th Annual Conference of the IEEE Industrial Electronics Society, Phoenix, November 2010.
- M. R. Sahid, A. H. M. Yatim, Taufik, "A New AC-DC Converter Using Bridgeless SEPIC", Proc. of the 36th Annual Conference of the IEEE Industrial Electronics Society, Phoenix, November 2010.
- N. Bahari, Z. Salam and Taufik, "Application of Differential Evolution to Determine the HEPWM Angles of a Three Phase Voltage Source Inverter", Proc. of the 36th Annual Conference of the IEEE Industrial Electronics Society, Phoenix, Nov 2010.
- D. Siddiqi, A. S. Prabuwono, Hasniaty A., Z. Tahir, Taufik, "Optimization Techniques of Hybrid Renewable Energy System: A Review", Proc. of 2nd Makassar International Conference on Electrical Engineering & Informatics.
- Akbar, A. S. Prabuwono, Hasniaty A., Z. Tahir, Taufik, "Product Quality Inspection Based on Machine Vision System", Proc. of 2nd Makassar International Conference on Electrical Engineering & Informatics.
- Y. Husodo, M. Anwari, S. M. Ayob, Taufik, "Analysis and Simulations of Z-Source Inverter Control Methods", Proc. of 9th International Conference on Power and Energy, Singapore, October 2010.
- M. McCarty, Taufik, D. Dolan, "Determining the Optimum Operating Parameters of A Unipolar PWM Inverter Using Experimental Approach", Proc. of 2010 North American Power Symposium, September 2010.
- Dolan, J. Durago, J. Crowfoot, Taufik, "Simulation of A Photovoltaic Emulator", Proc. of 2010 North American Power Symposium, September 2010.
- Taufik, R. Prasetyo, D. Dolan and D. Garinto, "A New Multiphase Interleaving Buck Converter With Bypass Cell Capacitor and Inductor", Proc. of the 53rd IEEE Int'l Midwest Symposium on Circuits & Systems, August 2010.

- M. I. M. Rashid, M. Anwari, and Taufik, "Harmonic Analysis of Grid-Connected Photovoltaic System with Adjustable Speed Drives", Proc. of International Conference on Control, Automation and Systems, Korea, August 2010.
- Taufik, "Lessons Learned: Encouraging Product Competitiveness through In-class Projects", Proc. of 2nd Indonesia International Conference on Innovation, Entrepreneurship, and Small Business, July 2010.
- M. McCarty and Taufik, "Determining the Optimum Operating Parameters of a Unipolar PWM Inverter", Proc. of 2010 Conference on Information Technology and Electrical Engineering, July 2010.
- Luc and Taufik, "Analysis and Simulation of Two-Phase Zero-Voltage-Switching Resonant Buck Converter", Proc. of 2010 Conference on Information Technology and Electrical Engineering, July 2010.
- M. Anwari, M. Hamid, A. Hiendro, and Taufik, "Power Quality Analysis of Adjustable Speed Drive with Multi-Pulse Rectifier", Proc. of The Asia-Pacific Symposium on Applied Electromagnetics and Mechanics, July 2010.
- Taufik, J. Ruckdaschel, D. Dolan and M. Anwari, "Modeling and Analysis of a Static VAR Compensated Mixed Load System", Proc. of IASTED International Conference on Modeling and Simulation, July 2010.
- Taufik, R. Prasetyo, D. Dolan and D. Garinto, "A Cell-Based Multiphase Interleaving Buck Converter with Bypass Capacitors", Proc. of International Conference on Computer, Electrical, and Systems Science, and Engineering, July 2010.
- Taufik, T. Gunawan, D. Dolan and M. Anwari, "Design and Analysis of Two-Phase Boost DC-DC Converter", Proc. of International Conference on Computer, Electrical, and Systems Science, and Engineering, July 2010.
- Taufik, R. Prasetyo, A. Hernadi and D. Garinto, "Multiphase Interleaving Buck Converter With Input-Output Bypass Capacitor", Proc. of 7th International Conference on Information Technology, April 2010.
- M. Anwari, B. Y. Husodo, Taufik, "Performance Study of a Fuel Cell Based Power Electronic System", Proc. of The 4th South East Asian Technical University Consortium (SEATUC) Symposium, Tokyo, February 2010.
- Taufik, M. McCarty, S. Watkins, and M. Anwari, "Performance Study of Series-Loaded Resonant Converter Using Super Barrier Rectifiers", Proc. of the IEEE TENCON 2009, Singapore, November 2009.
- M. Anwari, M. Rashid, M. Hamid, and Taufik, "Experimental Harmonic Analysis of a Network of Adjustable Speed Drives", Proc. of the IEEE TENCON, November 2009
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RESEARCH INTERESTS

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- Microcontroller Systems

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22. Indonesia Towards Conservative Islam, (Editorial) The Pioneer, 24th October, 2002
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24. Conservative Islamisation of Indonesia and Its Strategic Impact on India" paper in May 2000, "Indonesian In the New Millenium" Organized by Embassy of Indonesia,
25. Understanding Indonesian Islam" Vol. XXX, No 15:: Jan-Feb 2003, JNU News
26. Gave a seminar on "India-Indonesia Relations" on 6th March 2003, organized by SPANDAN (Society for the Promotion of the Activities of National Development and Nation Building), New Delhi
27. Gave lectures on Indonesian Music and art in more than 100 higher secondary schools in Delhi 2000-2003.

Peer Reviewed Journals:

1. Indonesian Cultural System and the Undercurrents: Heritage of Nusantara; Vol 5 No 2, December 2016. International Journal of Religious Literature and Heritage ISSN 2303-243X E-ISSN: 2442-9031
2. India-Indonesia Collaboration and Prospects, ISSN 2322-0686 (POLITICO, India-ASEAN Relations: Challenges & Opportunities for 21st Century. 2014
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TV Panel Discussion

1. Public Forum: India-Indonesia Ties (14/12/2016) - YouTube (Published on Dec 15, 2016
   Public Forum : India-Indonesia Ties पिब्लक फोरम : भारत-इंडोनेशिया संबंध
   https://www.youtube.com/watch?v=0tPsCaUFYMM

Guest Lectures Abroad:

1. Invited by University of Muhammadiah Malang, as a speaker on " Innovation and the Down streaming for the Development and Competitiveness of Indonesia 16-17 October 2016. (http://malangvoice.com/seminar-nasional-gelar-produk-senaspro-2016-wadahi-peneliti-unjuk-karya/)
2. Raise with East-Vistas of Indian Cooperation with Southeast Asian Commerce, Culture, Capacity and Connectivity. Organized by USTM, Meghalaya, and Green School Bali_26-27 February, 2016
3. Invited by University of Halu Oleo, Kendari, Sulawesi, Indonesia as a KeyNote Speaker at Celebes International Conference on Diversity at Wallacea Line (CICDWL)May 8-10,2015
4. Speaker " Whistle Blower" the movie show at University of Bina Nusantara, May 28, 2014 (http://ir.binus.ac.id/2014/06/10/ir-binus-movie-review-at-america/)
5. Invited by International Conference for Aceh and Indian Ocean Studies, ICAIOS, 17-18 November 2014
6. Invited by Jogjakarta State University to speak on " Exploring Potential Collaboration among Indian and Indonesian Higher Institutions, Yogyakarta, 9-12 October 2014
7. Invited by Bhayangkara University (UBHARA) Surabaya, Indonesia, May 31, 2014 to give a lecture on "Opportunity to Study Abroad", May 31, 2014.
8. Invited by Haluoleo University, Kendari, Indonesia, Prospects of Higher Education in India for Indonesian Students: May 25, 2014.
9. Invited by University of Lampung, Sumatra, Indonesia. (UBL) May 21st, 2014, Foreign Language in Nation Building: A Case Study of India, 2nd International Conference on Education and Language 2014
10. Invited by World Culture Forum, Bali by the Ministry of Education & Culture, Government of Indonesia, 24- 27 November 2013.
11. Invited by State Institute of Islamic Studies (STAIN) Salatiga, Java, Indonesia to give a series of lectures on Research Methodology and Education System of India 16-22 June 2013
12. Invited by IAIN, Institute of Islamic Studies, Bengkulu, Sumatra, Indonesia to give lecture on Prospect of Education in India. India-Indonesia Bilateral Ties: Prospects and Challenges. 22-26 June 2013

Paper Presented:

1. Foreign Language in Nation Building, YSU, State University of Yogyakarta, Indonesia, May 17, 2017
2. Democratization in Asia: An Experience in India: National University of Indonesia (UNAS) Universitas Nasional, Jl. Sawo Manila, #61, Pejaten, Ps. Minggu, May , 13, 2017
3. Woman Empowerment India and Indonesia: A Half Day International Seminar jointly organized by International Collaboration Cell and The Centre for Chinese and Southeast Asian Studies, SLL&CS, JNU, 23 Jan 2017
4. Soft Power and Act East: India and Southeast Asia, at an International Conference on Raise with East-Vistas of Indian Cooperation with Southeast Asian Commerce, Culture, Capacity and Connectivity. Organized by USTM, Meghalaya, and Green School BaliFeb 27-28, 2016
5. Indonesian Religious Culture and the Undercurrent, International Conference on Religious Literature and Heritage, organized by Center for Research and Development of Religious Literature and Heritage, Division of Research and Development, Ministry of Religious Affairs, Jakarta, Indonesia, September 16, 2015
6. Disaster Management of India and Indonesia: A Comparative Study of Post Disaster Recovery at International Conference for Aceh and Indian Ocean Studies, ICAIOS, 17-18 November 2014
7. Prospect of Higher Education & Research in India at State University of Yogyakarta, Indonesia 9-12 October 2014.
8. Opportunity to Study Abroad, Bhayangkara University (UBHARA) Surabaya, Indonesia, May 31, 2014 (http://ico.ubhara.ac.id/en/k/24/seminar-opportunities-to-study-abroad)
9. Foreign Language in Nation Building: A Case Study of India, 2nd International Conference on Education and Language 2014, University of Lampung, Sumatra, Indonesia. (UBL) May 21st, 2014, (artikel.ubl.ac.id/index.php/icel/article/download/246/249)
10. Prospects of Higher Education in India for Indonesian Students: Haluoleo University, Kendari, Indonesia, May 25, 2014.

11. "Sustainability ofCulture Based Tourism: A Case Study of Bali" at a national conference on "21-22 Feb 2014 organized by IBM , C.S.J.M. University, Kanpur.
12. "Oral Tradition of Ramayana and Mahabharata in Indonesia" at the 11-12 Jan 2014, at the Dept of Maithili, Darbhanga, Lalit Narayan Mithila University organized by Central Institute of Indian Languages (CIIL)
13. "Indonesian Ramaleela in the form of Puppetry" at International Conference on "India-Indonesia Bilateral Ties" Nov- 18-20, 2013, JNU.
14. Indonesian Shaivism: Looking for Undercurrents of the Mainland at International Congress of Vedanta, July 11-14, 2-13, Centre for Indic Studies, University of Massachusetts, Dartmouth, MA USA.
15. Indonesian Ramleela Projection through Puppetry at First International Ramleela Conference (July 12-14,2013) held at the University of the West Indies,St. Augustine,Trinidad & Tobago.
16. India's Prospect of Leadership in Southeast Asia at Society for Social Empowerment, Jawahar Youva Kendra, New Delhi Feb 2013.
17. Empowerment of Youth in Nation Building: A Case Study of Indonesia Dec 2012
18. India: Indonesia Bilateral Relationship: Pivotal Points: Symposium Empower of Youth in Nation Building December 2012, JNU, New Delhi

Chairing Seminar/Symposium

1. External Discussant at IDSA Fellow Seminar on "From Conflict Containment to Transformation: Negotiating Security in the Patani and Mindanao Peace Process", June 9, 2017, by Dr Janjira Sombatpoonsiri, Visiting Fellow at IDSA
2. Chaired a half day Conference on "Woman Empowerment: India and Indonesia: Jan 24, 2017
3. Chaired a Session in a two-day International Conference "Look East_Look Indonesia, Sep 3-4 2015
4. Chaired a Session in International Conference "International Seminar on RESISTANCE AND TOLERANCE Emerging Responses to Chinese belligerence in the South China Sea, Aug 7, 2015
5. Chaired a Session in "International Conference "India-Indonesia Bilateral Ties, Nov 18-20 2013
6. Chaired a session in a three-day Symposium on "Empowerment of Students in Nation Building: December 2012

Organizing Conference/Symposium/Lecture/Workshop

1. Organized a half day International Seminar on "Woman Empowerment" 23 Jan 2017.
2. Organized a half day public lecture of Ambassador Arif Hawas Oegroseno on "Maritime Axis: To Build A Maritime Partnership Initiative in The Asia Pacific Region" jointly with Indonesian Embassy on 7th October 2015 at Convention Centre, JNU
3. Organized a half day public lecture of.Prof Syafiq Hasyim "Nahdlatul Ulama and its Social and Political Dynamics on 24 Nov, 2015 PM at Convention Centre.
4. Organized a workshop on "Interaction: ASEAN Delegates & JNU Students" Center Of Chinese And Southeast Asian Studies, Jawaharlal Nehru University with collaboration with Confederation of Indian Industries (CII) 2nd November , 2015Auditorium 2, Convention Centre, JNU, New Delhi
5. Organized a workshop on on "ASEAN and India" jointly with CII (Confederation of Indian Industries) on 10th September 2015 at Convention Centre, JNU
6. Organized a two-day International Conference "Look East: Look Indonesia, September 3-4 2015 in collaboration with Embassy of Republic of Indonesia, JNU and Indian Council for Social Science Research. at Convention Centre, JNU
7. Organized a One Day International Seminar on "Resistance And Tolerance Emerging Responses to Chinese belligerence in the South China Sea, 7th August 2015 jointly with Philippine Embassy, Convention Centre, JNU
8. Organized a Lecture Demonstration on Indonesian Ramayana Shadow Puppet by Sujiwo Tejo jointly with JNU and Indonesian Embassy on 26th November 2014 at the SSS Auditorium, JNU
9. Organized a three-day International Conference "India-Indonesia Bilateral Ties, Nov 18-20 2013in collaboration with Embassy of Republic of Indonesia, JNU and (ICSSR) Indian Council for Social Science Research, New Delhi

10. Organized a three-day International Conference on "Empowerment of Students in Nation Building: 19-21 December 2012, in collaboration with Indonesian Student Association (PPI) and JNU

Lecture/Lecture Demonstration

1. Organized a lecture on "Islam: A Religion of Love and Mercy" by Dr Haidar Bagir was organized on Feb 23, 2015 in collaboration with Embassy of Republic of Indonesia, JNU
2. Organized a Lecture Demonstration of Indonesian Puppet by Indonesian Puppeteer Mr Sujiwo Tejo, November 26, 2014

Administrative Roles:

1. Member of Review Committee of Necessity of Membership of Association of Commonwealth University Association (ACU), London, 28 March 2017
2. Was Coordinator of the 10th Orientation Programme being conducted by UGC Human Resource Development Centre (HRDC)-JNU from 13th February to 10th March, 2017.
3. Continuing as Warden of Sanitation, Maha-Mandavi Hostel
4. Warden of Mahi-Mandavi Hostel since 2013 till present, was Senior Warden from Jan 2015 to Jan 2016
5. Office Bearer of Gender Sensitization Committee Against Sexual Harassment (GSCASH) since June 2016 (Warden Representative)
6. Member of Core Committee of JNU Open Day since May 2016
7. Member of Environment Task Force since June 2016
8. Member of E-Governance Committee since May 2016
9. Member of Cultural Committee Under Dean of Students Welfare (DSW) since Aug 2016

Project Undertaken:

1. Carrying research and translation of Indonesian-Indian Folklore under UPE II since 2015

Education

1. PhD(2003)
2. Islamisation of Indonesian Polity: A study of Perspectives and Problems (Center for Southeast Asian and Southwest Pacific Studies (CSCSEASWPS), School of International Studies (SIS), JNU)
   (Published as Pan-Islam and Indonesia: Lambert Academic Publishing GmbH& Co. Kg, Germany)
   (https://www.lap-publishing.com/catalog/details/store/gb/book/978-3-8473-7089-5/pan-islam-and-indonesia)
3. MPhil   (1999)
4. Islamic Parties in Indonesia, since 1965 to 1998 (Center for Southeast Asian Studies, SIS, JNU)
5. MA (1996)
6. Persian, School of Language, Culture & Literature, JNU, New Delhi
7. Indonesian Performing Arts (1995)
8. (One year degree course in Indonesian Traditional Performing Arts through the Darmasiswa Program with special emphasis on Traditional Sundanese Music Katawitan from the Akademi Seni Tari Indonesia, Bandung, Indonesia in July 1995
9. Recipient of National Level Awards and Token of Appreciation from Indonesian Minister of Commerce in 1999 by Professor Hartarto, for disseminating Indonesian language and culture in India.