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**1<sup>st</sup> International Conference  
on Computer Science and Engineering**



**Converging Technologies  
for Smart Environments**

**Palembang, South Sumatera  
Indonesia  
October 1-2, 2014**

PROCEEDING

1st International Conference on Computer Science and Engineering

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## PREFACE



First of all, I would like to say “ Welcome to Palembang, Indonesia” to all participants. It is an honor fo us to be entrusted to organize **The first international conference on computer science and engineering 2014 (ICON CSE 2014)**. The aims of this conference is to promote exchange ideas and research result related to computer science and engineering.

In partnership between Faculty of Computer Science, Sriwijaya University, Kirklareli University and Institute of Advanced Engineering and Science (IAES), we are delighted to be hosting the first international conference on computer science and engineering 2014 from September 30- October 2 and welcome all the Scientists, engineers and students from various countries in world. This is a great privilege and we are honored to host the conference this year.

The first international conference on computer science and engineering 2014 is more than just a conference but a good educational platform, to generate a good research and publication among young and talented students, scientists and engineers who will be the future scientists, engineers and technology innovators. For this year the paperswere 28 papers and 60 posters.

I would like to take this opportunitytothank all of the authors, who have shown interest to contribute to this conference, and also to thank all of keynote speakers :Assoc. Prof. Dr. Jafri Din, from UniversitiTeknologi Malaysia(UTM) and Augie Widyotriatmo, Ph.D, from InstitutTeknologi Bandung (ITB)as well as from the stakeholder PT TELKOM, Ir. HenriyantoToha for the short talk session. Without your contribution and participation this conference will not happen.

Last but not least, I would like to thank our faculty and university and also sponsor for the support of this conference. My deepest gratitude goes to all members of organizing committee have worked extremely hard to prepare this special conference

I hope that all participats enjoy the conference and have a memorable time visiting our city, Palembang.

Palembang, 1 October 2014

A handwritten signature in blue ink, appearing to read 'Siti Nurmaini'.

Assoc.Prof.Dr. Ir. Siti Nurmaini, MT  
Conference Chair ICONCSE 2014  
<http://iconcse.unsri.ac.id>

## FOREWORD



**RECTOR OF UNIVERSITAS SRIWIJAYA**

I would like to appreciate and recognize the 1<sup>st</sup> International Conference on Computer Science and Engineering (ICON-CSE 2014) that has been carried out to provide a forum for all speakers and researchers to share their valuable works. I believe and feel confident that this conference will stimulate a discussion and share experiences about various topics related to Computer Science & Engineering to support industrial development and research collaboration.

In this opportunity I would like to express my deepest gratitude to all keynote speakers for your valuable contribution to ensure high quality of this conference. This great work is part of collaborations among Universitas Sriwijaya, Institute Advanced Engineering and Science (IAES) - Indonesian Section and Kırklareli University Turkey.

The collaboration is reflective of the increased globalization that now characterizes higher education; growing ties between the ASEAN Countries, and the importance of international collaboration to advance higher education as a fundamental engine of national development and social change in our countries.

At the end, I would like to express sincere gratitude to the Organizing Committee members and the staffs of Universitas Sriwijaya for their effort, hospitality and support. I hope this conference will give a significant contribution to the development of electrical engineering and computer science to our society in Indonesia and humankind world wide

Sincerely Regard,

**Prof. Dr. Hj. Badia Perizade M.B.A.**  
**NIP. 195307071979032001**

## FOREWORD



**Committee from IAES Indonesia Section**

Bismillahirrohmannirrahim,  
Assalamualaykumwarohmatullahiwabarakatuh and Good Day,  
Ladies and Gentlemen,

We would like to welcome our colleagues around the world to the First International Conference on Computer Science and Engineering (ICON-CSE) 2014 in Palembang – Historical City on September 30- October 2, 2014.

ICON-CSE 2014 is proudly to be presented and supported by Institute Advanced Engineering and Science (IAES) collaborationon with Faculty of Computer Science – Sriwijaya University and Kirklareli University.

ICON-CSE 2014 is a grand event in the field of Automatic Control and System Engineering, Artificial Intelligence, Machine Learning, Robotics and Autonomous Systems, Internet Research, Data Communication and Computer Network, Image Processing, Vision and Graphics, Biomedical and Bioinformatics Engineering, Programmable Devices, Circuits and Systems, Computer Based Learning, Software Engineering, Information System , Digital Signal Processing, Energy and Power System and other related fields. On this occasion, I would like to congratulate all participants for their scientific involvement and willingness to share their findings in this conference, so it is expected that the conference can be beneficial to all participants.

I would like to express my sincere gratitude to all partners in reviewing the articles, publications and sponsorships for their valuable supports.

I would also like to extend my thanks to all the organizing committee and all staffs of Faculty of Computer Science – Sriwijaya University and Kirklareli University for their works to make ICON-CSE 2014 as today.

We wish you a happy conference and success in Palembang.

Thank you.

**Mochammad Facta, Ph.D**  
**IAES Indonesia Section**

## FOREWORD



**Committee From Kırklareli University Turkey**

It is our great pleasure to collaborate and to welcome all participants of the 1<sup>st</sup>International Conference on Computer Science and Engineering (ICON-CSE) 2014 in Palembang. I am happy to see this great work as part of collaborations among Universitas Sriwijaya, Institute Advanced Engineering and Science (IAES) - Indonesian Section and Kırklareli University Turkey. On this occasion, I would like to congratulate all participants for their scientific involvement and willingness to share their findings in this conference.

I believe that this conference can play an important role to encourage and embrace cooperative, collaborative and interdisciplinary research among the engineers and scientists. I do expect that this kind of similar event will be held in the future as part of activities in education research and social responsibilities of universities, research institutions, and industries internationally.

My heartfelt gratitude is dedicated to Organizing Committee members for their generous effort and contribution toward the success of ICON-CSE 2014.

Thank you

**Assoc. Prof. Dr. Tahir Cetin AKINCI**  
Kırklareli University  
Faculty of Engineering  
Department of Electrical & Electronics Engineering  
Kayali (Kofcaz) Campuss 39100  
KIRKLARELI - TURKEY

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## SHORT TALK



### **Indonesia Digital Society : Enhancing the role of Business & Government towards Sustainable City Development**

Ir. Henriyanto Toha

*General Manager WITEL Sumsel  
Jl. Jendral sudirman, Palembang , Indonesia*

#### **Abstract :**

The progress and development of the Technology, Information and Communications Technology (ICT) has pushed every layer of the communities to be able to use ICT maximal. Society life style also changed with the development of ICT. It also wants to encourage governments and businesses make use of ICT in developing and advancing regional / city. Telkom Indonesia has a program of Digital Society (Indiso) which helps enhancing the role of business and government towards sustainable City Development. Various applications are very useful summarized in Indiso Program. Some of local government are already implementing Indiso Jakarta, Bandung and Banyuwangi

## KEYNOTE SPEAKER #1



### **Challenges of Next Generation Broadband Multimedia Satellite Communication & Its Propagation Impairment Mitigation Techniques :**

#### **The wave propagation Perspective**

Assoc. Prof. Dr. Jafri Din

*Communication Engineering Department  
Faculty of Electrical Engineering, Universiti Teknologi Malaysia, 81310  
UTM Johor Bahru, Johor.*

#### **Abstract :**

Modern satellite communication systems are moving towards high operational frequencies band such as Ka-band (20/30 GHz) and Q/V band (40/50 GHz) to provide wider bandwidths and higher data rate on broadband and multimedia services in response to increasing demand and congestion of lower band frequencies. However, in these frequencies band, microwave signal propagating through the atmosphere is mainly impaired by rain, cloud, water vapor and turbulence. In fact, classical approach of a fixed system margin is not feasible and uneconomical to satisfy the required availability and Quality of Service (QoS) promised. Therefore, the adoption of appropriate techniques, known as propagation impairment mitigation techniques (PIMT) are necessary. The aim of this talk is to give an overview survey on the recent developments of propagation community on next generation broadband satellite communication systems operating at Ka-band and above, focus from the perspective of wave propagation. We will discuss in brief atmospheric impairments, mainly on the impact of precipitation as well as their mitigation techniques. Finally, preliminary developments of Ka-band propagation experiment campaign in Tropical region supported by European Space Agency are presented.

#### **Keynote Speaker Biography #1**

Jafri Din received his BSc. in Electrical Engineering from Tri-State University, U.S.A in 1988, and PhD in Electrical Engineering from University of Technology Malaysia in 1997. He is currently an associate professor and the Deputy Dean (Development) at Faculty of Electrical Engineering at Universiti Teknologi Malaysia. Since 1990, his research activities have been relative to electromagnetic (EM) wave propagation through the atmosphere radio and optical frequencies: physical and statistical modelling for EM. propagation applications; analysis and dimensioning of wireless terrestrial, satellite communication systems and High Altitude Platforms (HAPs) operating in the 10-100 GHz range; design and simulation of systems implementing Propagation Impairment Mitigation Techniques; assessment of the impact of the atmosphere on Earth-space systems; assessment of the impact of raindrop size distribution on Ka-band SatCom system in heavy rain region. He is currently involved in propagation experimental campaign in tropical region, collaboration with Joanneum Research, Austria and Politecnico di Milano, Italy supported by the European Space Agency (ESA).

## KEYNOTE SPEAKER #2



### Human-machine Interaction Technology for Smart Devices in The Smart Environment

Augie Widyotriatmo, Ph.D

*Instrumentation & Control Research Group  
Faculty of Industrial Technology  
Institut Teknologi Bandung (ITB)  
Bandung, Indonesia*

#### Abstract:

Smart environment is a concept where sensors, actuators, displays, computational elements are embedded in the everyday objects of our lives and connected through a network. Smart devices such as mobile phones, wearable computing devices, robots, and other embedded devices have become and will be more ubiquitous in the next future. The human-machine interaction technology contributes to the success of the implementation of the smart devices in the environment. The technology promotes the ideas of how devices can comply with human being, increases the safety factor in the manufacturing environment, assists people in doing their jobs, facilitates unables, and many more. In this talk, the technology of human-machine interaction that has been implemented as well as that currently developed, and that will evolve in the future will be presented. Technologies include brain computer interface, robotics, haptics, drones, that are found in many applications such as medical, military, industry, mobile devices, disaster mitigation systems, forest-fire monitoring.

#### Keynote Speaker Biography #2

Augie Widyotriatmo received bachelor degree in Engineering Physics Program and master degree in Instrumentation and Control Program at Bandung Institute of Technology (ITB) Indonesia, and Ph.D. degree in School of Mechanical Engineering at Pusan National University, South Korea. Currently, he is a faculty member at ITB, for the program of Engineering Physics and leads the Instrumentation and Metrology Laboratory.

His research interest include robotics, autonomous systems, human-machine interaction, energy optimization and automation, medical instrumentation, and metrology. He is the vice chair of IEEE Indonesia Control Systems and Robotics and Automation Joint Chapter Societies from 2013 until now.

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# Numerical Solution of Internet Pricing Scheme Based on Perfect Substitute Utility Function

Indrawati<sup>1</sup>, Irmeilyana, Fitri Maya Puspita, Eka Susanti, Evi Yuliza and Oky Sanjaya

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**Abstract**— In this paper we will analyze the internet pricing schemes based on Perfect Substitute utility function for homogeneous and heterogeneous consumers. The pricing schemes is useful to help internet service providers (ISP) in maximizing profits and provide better service quality for the users. The models on every type of consumer is applied to the data traffic in Palembang server in order to obtain the maximum profit to obtain optimal. The models are in the form of nonlinear optimization models and can be solved numerically using LINGO 11.0 to get the optimal solution. The results show that the case when we apply flat fee, usage-based and two part tariff scheme for homogenous we reach the same profit and heterogeneous on willingness to pay we got higher profit if we apply usage based and two part tariff schemes. Meanwhile, for the case when we apply usage based and two part tariff schemes for heterogeneous on demand, we reach better solution than other scheme.

**Keywords**— Utility functions, perfect substitute, pricing schemes, consumer homogeneous, heterogeneous consumers.

## I. INTRODUCTION

Internet has an important role in the economy and education around the world. The Internet is a multimedia library, because it has a lot of information that is complete [5]. Complete information and quickly make consumers interested in becoming a consumer internet services. Consumers who make a lot of Internet Service Providers (ISPs) compete to provide services of the highest quality (Quality of Service) and the optimal prices for consumers. In addition to maintaining the quality of service and optimal prices for consumers, Internet Service Provider (ISP) should also consider profits.

There are some assumptions for utility function to be applied in the model but the researchers usually use the bandwidth function with fixed loss and delay and follow the rules that marginal utility as bandwidth function diminishing with increasing bandwidth [1-14]. The other reason dealing with the choices of utility function is that the utility function should be differentiable and easily to be analyzed the homogeneity and heterogeneity that impacts the choice of pricing structure for the companies. Kelly [15] also contends that the utility function also can be assumed to be increasing function, strictly concave and continuously differentiable.

The studies on pricing schemes based on utility function analytically originate from [16-22]. This paper essentially seeks to provide optimal solutions numerically for three internet pricing schemes which are flat fee, usage-based, and two-part tariff for homogeneous and heterogeneous consumers based on perfect substitute using LINGO 11.0 [23]. The results

can help ISPs to choose a better pricing schemes to improve their profit.

## II. RESEARCH METHOD

In this paper, the internet pricing schemes will be completed by the program LINGO 11.0 to obtain the optimal solution. The solution obtained will help determine the optimal price on the flat fee, usage-based, and two-part tariff pricing schemes.

## III. MODEL FORMULATION

The general form of utility function based perfect substitute  $U(X, Y) = ax + by$   
For the case of homogeneous consumers  
Consumer Optimization Problems

$$\text{Max}_{x,Y,Z} aX + bY - P_X X - P_Y Y - PZ \tag{1}$$

with constraints

$$X \leq \bar{X}Z \tag{2}$$

$$Y \leq \bar{Y}Z \tag{3}$$

$$aX + bY - P_X X - P_Y Y - PZ \geq 0 \tag{4}$$

$$Z = 0 \text{ or } 1 \tag{5}$$

For the case of heterogeneous upper class and lower class consumers, suppose that there are m consumers upper class ( $i=1$ ) and n lower class consumers ( $i=2$ ). It is assumed that each of these heterogeneous consumers have a limit on the same  $\bar{X}$  and  $\bar{Y}$  with each one is the level of consumption during peak hours and during off-peak hours,  $a_1 > a_2$  dan  $b_1 > b_2$ .

For consumer optimization problems:

$$\text{max}_{X_i, Y_i, Z_i} aX + bY - P_x X_i - P_y Y_i - PZ_i \tag{6}$$

with constraints :

$$X_i \leq \bar{X}_i Z_i \tag{7}$$

$$Y_i \leq \bar{Y}_i Z_i \tag{8}$$

$$aX + bY - P_x X_i - P_y Y_i - PZ_i \geq 0 \tag{9}$$

$$Z_i = 0 \text{ or } 1 \tag{10}$$

As for the case of heterogeneous consumers of a high level of usage and low usage level classes, suppose that we assume the two types of consumers, high consumer consumption level

( $i = 1$ ) with a maximum consumption rate of  $\bar{X}_1$  dan  $\bar{Y}_1$  and low consumer usage rate ( $i = 2$ ) with a maximum consumption rate of  $\bar{X}_2$  dan  $\bar{Y}_2$ . There are  $m$  consumers of type 1 and  $n$  consumers type 2 with  $a_1 = a_2 = a$  dan  $b_1 = b_2 = b$ .

IV. OPTIMAL SOLUTION

Table I-III below show the parameter value used in the model. The values originally from local server internet traffic.

TABLE I  
PARAMETER VALUES FOR HOMOGENOUS CASE

Case	a	b	X	Y	Px	Py	P	Z
1	4	3	2656.2	5748.8	0	0	27871.3	1
2	4	3	2656.2	5748.8	2.2	3.8	0	1
3	4	3	2656.2	5748.8	2.5	3.6	2.9	1

TABLE II  
PARAMETER VALUES FOR HETEROGENEOUS CASE FOR HIGH AND LOW CLASS CONSUMERS

Case	X <sub>1</sub>	X <sub>2</sub>	Y <sub>1</sub>	Y <sub>2</sub>	Z <sub>1</sub>	Z <sub>2</sub>	P <sub>x</sub>	P <sub>y</sub>	P
4	2656.2	2314.4	5748.8	2406.8	1	1	0	0	19814.1
5	2656.2	2314.4	5748.8	2406.8	1	1	0.1	4.8	0
6	2656.2	2314.4	5748.8	2406.8	1	1	4.8	0.1	0.1

TABLE III  
PARAMETER VALUES FOR HETEROGENEOUS CASE FOR HIGH AND LOW CLASS CONSUMER CONSUMPTION

Case	X <sub>1</sub>	X <sub>2</sub>	Y <sub>1</sub>	Y <sub>2</sub>	Z <sub>1</sub>	Z <sub>2</sub>	P <sub>x</sub>	P <sub>y</sub>	P
7	2656.1	2314.4	5748.8	2406.8	1	1	0	0	15611.6
8	2656.1	2314.4	5748.8	2406.8	1	1	3.7	0.1	0
9	2656.1	2314.4	5748.8	2406.8	1	1	0.1	3.7	0.1

Then, we substitute the parameter values in Table I-III above to each model, then we have as follows.

**Case 1:** For flat fee Pricing schemes we set  $P_x = 0, P_y = 0$  and  $P > 0$ , meaning that the prices used by the service provider has no effect on the time of use.

**Case 2:** For Usage-based pricing scheme we set  $P_x > 0, P_y > 0$  and  $P = 0$ , meaning that service providers deliver differentiated prices, the price of consumption during peak hours and when the price of consumption at off-peak hours.

**Case 3:** For the pricing scheme with a two-part tariff scheme, we set  $P_x > 0, P_y > 0$  and  $P = 0$  which means that service providers deliver differentiated price, i.e the price of consumption during peak hours and the price of consumption at off-peak hours.

**Case 4:** For the pricing scheme by setting a flat fee scheme, we set  $P_x = 0, P_y = 0$  and  $P > 0$ , meaning that the prices used by the service provider has no effect on the time of use, then consumers will choose the maximum consumption rate of  $X_1 = \bar{X}, X_2 = \bar{X}, Y_1 = \bar{Y},$  dan  $Y_2 = \bar{Y}$ .

**Case 5:** For Usage-based pricing scheme by setting  $P_x > 0, P_y > 0$  and  $P = 0$ , with a maximum consumption rate  $X_1 = \bar{X}, X_2 = \bar{X}, Y_1 = \bar{Y},$  dan  $Y_2 = \bar{Y}$ . Then consumers will choose the maximum consumption rate  $X_1 = \bar{X}, X_2 = \bar{X}, Y_1 = \bar{Y},$  dan  $Y_2 = \bar{Y}$ .

**Case 6:** For the pricing scheme with a two-part tariff scheme, we set  $P_x > 0, P_y > 0$  and  $P = 0$ , with a maximum consumption rate  $X_1 = \bar{X}, X_2 = \bar{X}, Y_1 = \bar{Y},$  dan  $Y_2 = \bar{Y}$ . then consumers will choose the maximum consumption rate  $X_1 = \bar{X}, X_2 = \bar{X}, Y_1 = \bar{Y},$  dan  $Y_2 = \bar{Y}$ .

**Case 7:** For the flat fee pricing schemes then we set  $P_x = 0, P_y = 0$  and  $P > 0$ , by choosing the level of consumption  $X_1 = \bar{X}_1, Y_1 = \bar{Y}_1$  atau  $X_2 = \bar{X}_2, Y_2 = \bar{Y}_2$ .

**Case 8:** For Usage-based pricing scheme by setting  $P_x > 0, P_y > 0$  and  $P = 0$  we choose the level of consumption  $X_1 = \bar{X}_1, Y_1 = \bar{Y}_1$  atau  $X_2 = \bar{X}_2, Y_2 = \bar{Y}_2$ .

**Case 9:** For the pricing scheme with a two-part tariff scheme, we set  $P_x > 0, P_y > 0$  and  $P = 0$ , by choosing the level of consumption  $X_1 = \bar{X}_1, Y_1 = \bar{Y}_1$  atau  $X_2 = \bar{X}_2, Y_2 = \bar{Y}_2$ .

Table IV below explains the data usage at peak and off-peak hours.

TABLE IV  
DATA USAGE AT PEAK AND OFF-PEAK HOURS

	Mail (byte)	Mail (kbps)
$\bar{X} - \bar{X}_1$	2719914.01	2656.17
$\bar{X}_2$	2369946.51	2314.40
$\bar{Y} - \bar{Y}_1$	5886849.92	5748.88
$\bar{Y}_2$	2464637,66	2406.87

where

1.  $\bar{X}$  or  $\bar{X}_1$  is the maximum possible level of consumption during peak hours both in units of kilo bytes per second.
2.  $\bar{X}_2$  is the maximum possible level of consumption during off-peak hours in units of kilo bytes per second.
3.  $\bar{Y}$  or  $\bar{Y}_1$  is the maximum possible level of consumption both during peak hours in units of kilo bytes per second.
4.  $\bar{Y}_2$  is the maximum possible level of consumption during peak hours in units of kilo bytes per second.

Table V below describes the optimal solution of using the perfect substitute utility function with the aid of LINGO 11.

TABLE V  
OPTIMAL SOLUTION FOR ALL CASES

Objective	Case		
	1	2	3
Profit	27871.3	27871.3	27871.3
Objective	Case		
	4	5	6
Profit	99070.7	107105	107105
Objective	Case		
	7	8	9
Profit	78058	84370.5	84370.5

We can see from Table V that in homogenous case, we obtain the same maximum profit for all case of flat fee, usage based and two part tariff schemes. In other case, when we deal with heterogeneous high end and low end user consumers, the maximum profit is achieved when we apply the usage based and two part tariff. The last case when dealing with high and low demand users, again, the usage based and two part tariff yield the maximum profit.

If we compare the result in [16, 24], we have slightly difference. If using the modified Cobb-Douglass utility function, the maximum profit achieved when we apply the flat fee and two part tariff schemes for homogenous case. For heterogeneous case, maximum profit occurs when we apply the flat fee and two part tariff schemes. In our utility function, the

three schemes yield the same profit in homogeneous case, while in heterogeneous case we obtain higher profit if we apply usage based and two part tariff schemes in heterogeneous case.

In using the perfect substitute utility function, the provider has more choices in applying pricing schemes that attract the customer to join the schemes.

## V. CONCLUSIONS

Based on the application of the model on each data traffic, the use of perfect substitute utility functions for homogeneous and based on the flat fee, usage-based and two-part tariff pricing scheme obtained the same optimal solution, while the problem of heterogeneous consumer's consumption levels pricing schemes based on usage-based and two-part tariff obtained more optimal than the flat fee pricing schemes.

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# Generalized Model and Optimal Solution of Internet Pricing Scheme in Single Link under Multiservice Networks

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**Abstract**—In this paper, we will analyze the internet pricing scheme under multi service network by generalizing the model into 9 services. The scheme is determined from the base price, quality premium and number of links to aid the internet service provider to maximize the profit and to serve better service to the customers. The objective function is generated by setting up the base price and quality premium as a constant or variable. We use nonlinear optimization model and solve it by using LINGO 11.0 to obtain the optimal solution. The results show that for each case by generalizing the model, the ISP obtains better solution by fixing the base price and fixing and varying the quality premium. ISP has a choice to adopt the model when ISP fixes the base price and also fix or vary the quality premium with maximum profit adopted by ISP is when fixing the base price and varying the premium quality.

**Keywords**— multi service network, internet pricing scheme, generalized model, service quality, base price, quality premium.

## I. INTRODUCTION

The service quality of the network is determined by the user satisfaction utilizing the network. The ISPs have a task to serve better and different service quality (QoS) to all users in achieving the best information quality and obtain the profit from available resources. The knowledge to develop the new pricing plan which fulfills the consumer and provider requirements is available, but few involving QoS network [1], [2] dan [3].

Sain and Herpers [4] had investigated the pricing scheme for internet by considering the price, total network capacity and level of QoS for each offered service The model then solve as an optimization model and solved by using optimization tool to obtain the maximum profit for ISP. The extended investigation proposed by [5] is by generating the improved internet pricing model based on [3, 4, 6] by adding the new parameter, the decision variables, the constraints, and by considering the base price and quality premium to yield better maximum revenue than previous model.

The research on the improved model of single link internet pricing scheme under multi service network and multi class QoS networks are due to [1-5, 7-15] under the original model proposed by [5] and [9] by fixing and varying both base price and quality premium and setting out the QoS level to obtain better maximum revenue for ISP from previous model discussed. That model applies 3 services for multi service network and 2 users and classes in single link multiclass QoS

network. In reality, in enhancing the quality, ISP provides many services and many classes to the consumers.

This paper basically attempt to show the generalized optimal solution of the internet pricing scheme model with numerous services based on model presented [3, 5] for the case when the base price and quality premium are constants, the case where the base price is constant whereas the quality premium as a variable, the case when the base price and quality premium are as variable and the case where the base price is as variable and quality premium is as a constant. The obtained solution can assist ISP to choose the best pricing scheme.

## II. RESEARCH METHOD

In this paper, the internet pricing scheme model is solved by using LINGO 11.0 to obtain the optimal solution. We apply set-endset and data-enddata to have structured coding to enable us to apply the optimization model with many numbers of users. We fix 9 services to be served in the plan. The solutions will help us to clarify the current issue on internet pricing, network share, network capacity and level of QoS and also the number of services offered is compatible with the real situation in the internet network.

## III. MODELS

We adopt models from [5] by considering for cases when the best price ( $\alpha$ ) and quality premium ( $\beta$ ) as constant,  $\alpha$  constant and  $\beta$  as variable,  $\alpha$  and  $\beta$  as variables and  $\alpha$  as variable and  $\beta$  as a constant. The QoS level for each case is modified into three conditions

$$I_i = I_{i-1} \text{ or } I_i > I_{i-1} \text{ or } I_i < I_{i-1}. \quad (1)$$

For the case when  $\beta$  is variable then the ISP will be able to promote the certain service, so

$$\beta_i = \beta_{i-1} \text{ or } \beta_i > \beta_{i-1} \text{ or } \beta_i < \beta_{i-1}. \quad (2)$$

For the case when  $\alpha$  then ISP is able to conduct market competition, so

$$\alpha_i = \alpha_{i-1} \text{ or } \alpha_i > \alpha_{i-1} \text{ or } \alpha_i < \alpha_{i-1} \quad (3)$$

## IV. RESULT AND ANALYSIS

We use the same model proposed by [5] with the parameter value of  $\alpha = 0.5$  and  $\beta=0.01$ . Table I below presents the other parameter values in the model.

TABEL I  
PARAMETER VALUES IN MULTI SERVICE NETWORK

i	Parameter								
	C	d <sub>i</sub>	p <sub>i</sub>	m <sub>i</sub>	n <sub>i</sub>	l <sub>i</sub>	b <sub>i</sub>	c <sub>i</sub>	g <sub>i</sub>
1	102400	97.5	3	0.01	20	0.01	0.5	0	1
2	102400	13312.3	45	0.01	20	0.01	0.5	0	1
3	102400	367,9	15	0.01	20	0.01	0.5	0	1
4	102400	825,8	35	0.01	20	0.01	0.5	0	1
5	102400	593,5	32	0.01	20	0.01	0.5	0	1
6	102400	489,3	25	0.01	20	0.01	0.5	0	1
7	102400	98,9	5	0.01	20	0.01	0.5	0	1
8	102400	1407,2	38	0.01	20	0.01	0.5	0	1
9	102400	393,5	20	0.01	20	0.01	0.5	0	1

**Case 1:**  $\alpha$  and  $\beta$  as constants.

$$Max R = \sum_{i=1}^9 (\alpha + \beta \cdot I_i) \cdot p_i \cdot x_i = (0,5 + 0,01I_1) \cdot 3x_1 + (0,5 + 0,01I_2) \cdot 45 (0,5 + 0,01I_3) \cdot 15x_3 + \dots + (0,5 + 0,01I_9) \cdot 20x_9 \quad (4)$$

Subject to

$$95,7 I_1 x_1 \leq 102.400a_1$$

$$13.312,3x_2 \leq 102.400a_2$$

$$367,9I_3x_3 \leq 102.400a_3$$

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·  
·

$$393,5I_{10}x_{10} \leq 102.400a_{10} \quad (5)$$

$$97,5I_1 * x_1 + 13312,3I_2 * x_2 + 367,9I_3 * x_3 + \dots + 393,5I_9 * x_9 \leq 102.400 \quad (6)$$

$$a_1 + a_2 + a_3 + \dots + a_9 = 1 \quad (7)$$

$$0 \leq a_i \leq 1 \quad (8)$$

$$0,01 \leq I_i \leq 1 \quad (9)$$

$$0 \leq x_i \leq 20 ; \forall i = 1,2, \dots, 9 \quad (10)$$

$$\{x_1, x_2, x_3, x_4, x_5, \dots, x_9\} \text{ integer} \quad (11)$$

By modifying the QoS level and index quality we add the following constraints.

If  $I_i = I_{i-1}$  then  

$$I_i - I_{i-1} = 0 \quad (12)$$

If  $I_i > I_{i-1}$  then  

$$I_i - I_{i-1} > 0 \quad (13)$$

If  $I_i < I_{i-1}$  then

$$I_i - I_{i-1} < 0 \quad (14)$$

**Case 2:** for  $\alpha$  as constant and  $\beta$  as variable

$$Max R = \sum_{i=1}^9 (\alpha + \beta_i \cdot I_i) \cdot p_i \cdot x_i = (0,5 + \beta_1 I_1) \cdot 3x_1 + (0,5 + \beta_2 I_2) \cdot 45x_2 + (0,5 + \beta_3 I_3) \cdot 15x_3 + \dots + (0,5 + \beta_5 I_9) \cdot 20x_9 \quad (15)$$

subject to (4)-(14) and additional constraints

$$\beta_i \cdot I_i \geq \beta_{i-1} \cdot I_{i-1} ; \forall i = 2,3, \dots, 9 \quad (16)$$

$$0,01 \leq \beta_i \leq 0,5 ; \forall i = 1,2, \dots, 9 \quad (17)$$

With modifying the quality premium ( $\beta$ ) as a variable then we add these constraints.

If  $\beta$  as  $\beta_i = \beta_{i-1}$ , then  

$$\beta_i - \beta_{i-1} = 0 \quad (18)$$

If  $\beta$  as  $\beta_i > \beta_{i-1}$ , then  

$$\beta_i - \beta_{i-1} > 0 \quad (19)$$

If  $\beta$  as  $\beta_i < \beta_{i-1}$ , then  

$$\beta_i - \beta_{i-1} < 0 \quad (20)$$

**Case 3:**  $\alpha$  and  $\beta$  as variable

$$Max R = \sum_{i=1}^9 (\alpha_i + \beta_i \cdot I_i) \cdot p_i \cdot x_i = (\alpha_1 + \beta_1 I_1) \cdot 3x_1 + (\alpha_2 + \beta_2 I_2) \cdot 45x_2 + (\alpha_3 + \beta_3 I_3) \cdot 15x_3 + \dots + (\alpha_9 + \beta_5 I_9) \cdot 20x_9 \quad (21)$$

subject to (4)-(14) and (16)-(20) and additional constraints

$$\alpha_i + \beta_i \cdot I_i \geq \alpha_{i-1} + \beta_{i-1} \cdot I_{i-1} ; \forall i = 1,2, \dots, 9 \quad (22)$$

$$0 \leq \alpha_i \leq 1 ; \forall i = 1,2,3, \dots, 9 \quad (23)$$

And

If  $\alpha$  as  $\alpha_i = \alpha_{i-1}$ , then  

$$\alpha_i - \alpha_{i-1} = 0 \quad (24)$$

If  $\alpha$  as  $\alpha_i > \alpha_{i-1}$ , then  

$$\alpha_i - \alpha_{i-1} > 0 \quad (25)$$

If  $\alpha$  as  $\alpha_i < \alpha_{i-1}$ , then  

$$\alpha_i - \alpha_{i-1} < 0 \quad (26)$$

**Case 4:**  $\alpha$  as variable and  $\beta$  as constant

$$Max R = \sum_{i=1}^9 (\alpha_i + \beta \cdot I_i) \cdot p_i \cdot x_i = (\alpha_1 + 0,01I_1) \cdot 3x_1 + (\alpha_2 + 0,01I_2) \cdot 45x_2 + (\alpha_3 + 0,01I_3) \cdot 15x_3 + \dots + (\alpha_9 + \beta_5 I_9) \cdot 20x_9 \quad (27)$$

subject to (4)-(14) and (23)-(26) and additional constraints

$$\alpha_i + I_i \geq \alpha_{i-1} + I_{i-1} ; \forall i = 2,3, \dots, 9 \quad (28)$$

We will solve the model by using LINGO 11.0 then

- 1) Case 1:  $\alpha$  and  $\beta$  as constant by modifying the QoS level so we divide Case 1 into three sub cases.
- 2) Case 2:  $\alpha$  as constant and  $\beta$  as a variable by modifying the quality premium and QoS level so we divide Case 2 into 9 sub cases.
- 3) Case 3:  $\alpha$  and  $\beta$  as variables by modifying the base price, quality premium and QoS level so we divide Case 3 into 27 sub cases.
- 4) Case 4:  $\alpha$  as variable and  $\beta$  as constant so we divide Case 4 into 9 cases.

We have total of 48 sub cases. According to the results of LINGO 11.0 we have one solution of sub case from each case as follows.

- 1) In Case 1:  $\alpha$  and  $\beta$  as constant for  $I_i=I_{i-1}$
- 2) In case 2 :  $\alpha$  as constant and  $\beta$  as  $\beta_i = \beta_{i-1}$  for  $I_i=I_{i-1}$
- 3) In case 3:  $\alpha$  as  $\alpha_i = \alpha_{i-1}$  and  $\beta$  as  $\beta_i = \beta_{i-1}$  for  $I_i=I_{i-1}$
- 4) In case 4:  $\alpha$  as  $\alpha_i = \alpha_{i-1}$  and  $\beta$  as constant for  $I_i=I_{i-1}$

Table II to Tabel V below present the optimal solution of our four cases. Tabel II shows that in Case 1:  $\alpha$  and  $\beta$  as constant for  $I_i=I_{i-1}$ , we obtain the optimal solution 192.7. The value of quality premium is 0.5 for each service with the number of users is 20, which means that the service provider offer all services to the users. Total capacity used is 103,399.99 kbps or 99.99% of total capacity available. The highest profit is obtained in Service 2 of 452.6 with capacity used of 77,523.4 kbps atau 75.7% of total capacity used.

Table III explains that in Case 2:  $\alpha$  as constant dan  $\beta$  as  $\beta_i=\beta_{i-1}$  for  $I_i=I_{i-1}$ , we obtain the optimal solution of 2814.76. The quality premium is 0.5 for each service with QoS level is 0.291 or 29.1%. The users utilize the service is 20 users, which means that the service provider offer all services to the users. Total capacity used is 103,399.99 kbps or 99.99% of total capacity available. The highest profit obtained from service 2 is 581.03 with the capacity used of 77,523.4 kbps or 75.7% of total capacity used and this value is the highest capacity usage from every service.

TABLE II  
CASE 1 SOLUTION WITH  $\alpha$  AND  $\beta$  AS CONSTANTS FOR  $I_i=I_{i-1}$

Service (i)	QoS level (I <sub>i</sub> )	# of User (x <sub>i</sub> )	Capacity Used (I <sub>i</sub> d <sub>i</sub> x <sub>i</sub> )	Profit (( $\alpha+\beta$ ·I <sub>i</sub> )·p <sub>r</sub> ·x <sub>i</sub> )
1	0.291	20	557.3	30.17
2	0.291	20	77523.4	452.6
3	0.291	20	2142.4	150.9
4	0.291	20	4809	352.04

5	0.291	20	3456.2	321.86
6	0.291	20	2849.2	251.46
7	0.291	20	575.9	50.29
8	0.291	20	8194.8	382.2
9	0.291	20	2291.5	201.16
Total Capacity			102399.99	-
Total Profit				2192.7

TABLE III  
CASE 2 SOLUTION WITH  $\beta$  AS  $\beta_i = \beta_{i-1}$  FOR  $I_i=I_{i-1}$

Service (i)	QoS level (I <sub>i</sub> )	# of User (x <sub>i</sub> )	Capacity Used (I <sub>i</sub> d <sub>i</sub> x <sub>i</sub> )	Profit (( $\alpha+\beta$ ·I <sub>i</sub> )·p <sub>r</sub> ·x <sub>i</sub> )
1	0.291	20	557.3	38.74
2	0.291	20	77523.4	581.03
3	0.291	20	2142.4	193.68
4	0.291	20	4809	451.9
5	0.291	20	3456.2	413.18
6	0.291	20	2849.2	322.79
7	0.291	20	575.9	64.56
8	0.291	20	8194.8	490.65
9	0.291	20	2291.5	258.23
Total Capacity			102399.99	-
Total Profit				2814.76

Table IV shows that in Case 3:  $\alpha$  as  $\alpha_i = \alpha_{i-1}$  and  $\beta$  as  $\beta_i=\beta_{i-1}$  for  $I_i=I_{i-1}$  we obtain the optimal solution of 4994.76. The base price and quality premium are 1 and 0.5 for each service with the QoS level of 0.291 for each service or 29.1%. The number of users apply the service is 20 users, which means that the service provider offer all services to the user. The total capacity used is 103,399.99 kbps or 99.99% of total capacity used. The highest profit of 1031.03 is in service 2 with total capacity used is 77,523.4 kbps or 75.7% of total capacity used. This capacity is the highest capacity used from other services.

TABLE IV  
CASE 3 SOLUTION WITH  $\alpha$  AS  $\alpha_i = \alpha_{i-1}$  AND  $\beta$  AS  $\beta_i = \beta_{i-1}$  FOR  $I_i=I_{i-1}$

Service (i)	QoS level (I <sub>i</sub> )	# of User (x <sub>i</sub> )	Capacity Used (I <sub>i</sub> d <sub>i</sub> x <sub>i</sub> )	Profit (( $\alpha+\beta$ ·I <sub>i</sub> )·p <sub>r</sub> ·x <sub>i</sub> )
1	0.291	20	557.3	68.74
2	0.291	20	77523.4	1031.03
3	0.291	20	2142.4	343.68
4	0.291	20	4809	801.91
5	0.291	20	3456.2	733.18
6	0.291	20	2849.2	572.79
7	0.291	20	575.9	114.56
8	0.291	20	8194.8	870.65
9	0.291	20	2291.5	458.23
Total Capacity			102399.99	-
Total Profit				4994.76

TABLE V  
CASE 4 SOLUTION WITH  $\alpha$  AS  $\alpha_i = \alpha_{i-1}$  AND  $\beta$  AS A CONSTANT FOR  $I_i=I_{i-1}$

Service (i)	QoS level (I <sub>i</sub> )	# of User (x <sub>i</sub> )	Capacity Used (I <sub>i</sub> d <sub>i</sub> x <sub>i</sub> )	Profit (( $\alpha+\beta$ ·I <sub>i</sub> )·p <sub>r</sub> ·x <sub>i</sub> )
1	0.291	20	557.3	60.17
2	0.291	20	77523.4	902.62
3	0.291	20	2142.4	300.87
4	0.291	20	4809	702.04

5	0.291	20	3456.2	641.86
6	0.291	20	2849.2	501.46
7	0.291	20	575.9	100.29
8	0.291	20	8194.8	762.21
9	0.291	20	2291.5	401.16
Total Capacity		102399,99	-	
Total Profit		4372.7		

Table V depicts that in Case 4:  $\alpha$  as  $\alpha_i = \alpha_{i-1}$  and  $\beta$  as a constant for  $I_i=I_{i-1}$ , we obtain the optimal solution of 4372.7. The base price value is 1 for each service and QoS level for each service is 29.1%. The number of users apply the service is 20 user, which means that the provider offers all services. Total capacity used is 103,399.99 kbps or 99.99% of total capacity available. The highest profit obtained is 902.62 in service 2. Total capacity used for service 2 is 77,523.4 kbps or 75.7% of total capacity used.

TABEL VI  
RECAPITULATION OF FOUR CASE SOLUTIONS

	Case			
	1	2	3	4
Total capacity used	102,399.99	102,399.99	102,399.99	102,399.99
Percentage of total capacity used	99.99%	99.99%	99.99%	99.99%
Profit per service	452.6	581.03	1031.03	902.62
Total Profit	2192.7	2814.76	4994.76	4372.7

The summary of the results is presented in Table VI menunjukkan that the maximum total profit is obtained in case 3:  $\alpha$  as  $\alpha_i=\alpha_{i-1}$  and  $\beta$  as  $\beta_i=\beta_{i-1}$  for  $I_i=I_{i-1}$  which is 4994.76. So, ISP adopts the internet pricing scheme by setting up the base price and quality premium as a variable with the condition of the base price, quality premium and the QoS level to be the same value for each service. The solution will enable ISPs to compete in the market and promote the certain service to the users. The number of service offered and the number of users apply the service will yield higher total profit for ISPs.

## V. CONCLUSION

The generalized model of internet pricing scheme based on the base price, quality premium to be fixed or varied and modified quality index, quality premium and QoS level enable ISP to achieve the maximum profit according the ISP's goals. The solutions show that the connection among index quality, capacity needed and number of users applied the service is important in determining the total capacity used. In all cases, the highest profit and capacity used is in service 2 due to highest service sensitivity price from the services offered. All cases show that the total capacity used is 99.99% of total capacity available with the QoS level of 29.1%. However, the maximum total profit is in case 3 by fixing the base price and varying the quality premium. Toward these generalized models, ISPs can obtain better and higher maximum profit with service offered is close to real internet traffic.

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# Analysis of Security Service Oriented Architecture (SOA) With Access Control Models Dynamic Level

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**Abstract**— Now we are moving towards the "Internet of Things" (IOT) in millions of devices will be interconnected with each other, giving and taking information provided within a network that can work together. Because of computing and information processing itself IOT core supporters, So in this paper introduces "Service-Oriented Computing" (SOA) as one of the models that can be used. Where's it at each device can offer functionality as a standard service [4]. In SOA, we can make the resources available to each other in the IOT together. However, a major challenge in these service-oriented environment is the design of effective access control schemes. In SOA, the service will be invoked by a large number, and at the same time authentication and authorization need to cross several security domains are always used. In this paper, we present the analysis of data safety suatu *Workflow-Based Access Control Model associated oriented* (WABAC) to troubleshoot problems that occur within a system integration. The analysis showed that the point system function model based integration system that is lower than the legacy model of SOA-based systems, by designing several services using WOA approach. In addition, we have observed that the integrated model can guarantee the quality of service, security and reliability main, by applying SOA approach when needed. Finally, experimental results have proved that the service can be run side by side seamlessly without performance degradation and additional complexity.

**Keywords**— Service Oriented Architecture (SOA), Integration, Operational Data, Web Services, Security, Access control Models Dynamic Level

## I. INTRODUCTION

In this paper, Describing a security that takes into account the needs of access control in a distributed environment such as service-oriented architecture-based services are handled. In a software development, as a whole, is a complex process that occurs in a safety, and the constantly changing requirements in the development stage. Configuration management software happens to be the most important part because it requires modifying large enough in doing software design and code. Here are a few examples of the architecture of access control models based services are analyzed with Workflow models - oriented Attributed Based Access Control (WABAC). Software development process provides a solution to a changing

environment. WABAC models using an incremental approach to developing high-quality software within time, cost and other related constraints through several iterations.

In the process of this WABAC models raises some important factors in software project management, for example, scope, cost, time and quality. Software engineering explore constructive and dynamic way to manage the entire project life cycle.

According to analysis carried out with regard to WABAC models have a dynamic and flexible structure which is higher than the other models, so it can be concluded that this model is more appropriate for a dynamic environment such as service-oriented architecture environment and integrated systems on a system that occurred a considerable transaction.

## II. SERVICE ORIENTED ARCHITECTURE (SOA)

Service Oriented Architecture (SOA) is a collection of services that communicate with each other to fulfill a particular business process. This paradigm passes data between service consumer and service provider either simply or complicatedly. SOA is a popular strategy to provide an integrated, flexible, and cost efficient (Web) Service-based enterprise. It promises interoperability, reusability, loose coupling, and protocol independency of services as core principles of SOA. Normally, this standard-based approach uses Web Services as building block to support particular business tasks. Web Services are published with Web Services Description Language (WSDL) interface and they use Simple Object Access Protocol (SOAP) as a communication protocol. Figure 1 shows the operation that each component can perform.

## III. WEB SERVICES

According to, Web Services are loosely coupled computing services that can reduce the complexity of building business applications, save costs, and enable new business models. Web Services are application components that using open protocols to communicate and they are self-contained and self describing. Web Service can be discovered using UDDI and used by other applications. Extensible Markup Language (XML) is the basic for Web Services. Web Services can be able to publish the functions and data to the rest of the world. A Web Service is a software interface that describes a collection of operations that can be accessed over the network through standardized XML messaging. It uses protocols based on the XML language to describe an operation to execute or data to exchange with another Web Service.

IV. SOA AND WEB SERVICES

Although much has been written about SOA and Web services, there still is some confusion between these two terms among software developers. SOA is an architectural style, whereas Web services is a technology that can be used to implement SOAs. The Web services technology consists of several published standards, the most important ones being SOAP and WSDL. Other technologies may also be considered technologies for implementing SOA, such as CORBA. Although no current technologies entirely fulfill the vision and goals of SOA as defined by most authors, they are still referred to as SOA technologies. The relationship between SOA and SOA technologies is represented in Figure 1. Much of the technical information in this report is related to the Web services technology, because it is commonly used in today's SOA implementations.

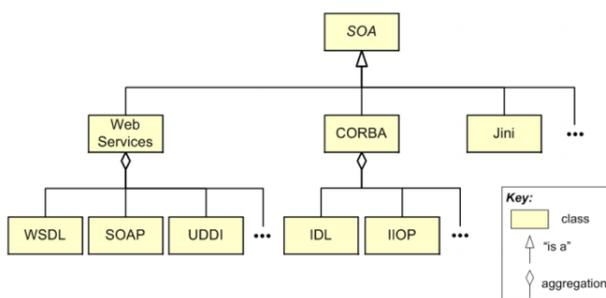


Fig. 1 SOA and SOA Technologies

V. WSARCH (WEB SERVICES ARCHITECTURE)

The WSARCH (Web Services Architecture) [7] is an architecture which allows accessing Web services using a combination of functional and non-functional aspects of Quality of Service (QoS). These QoS aspects aim at evaluating the performance of Web services in order to achieve QoS in a service-oriented architecture. These QoS attributes were mapped to the components participating in a service-oriented architecture that incorporates quality of service. The architecture provides the monitoring of service providers and the data obtained are used to locate the most appropriated service. A prototype for the WSARCH allows performance evaluation studies being conducted considering different components of the architecture, algorithms, protocols and standards.

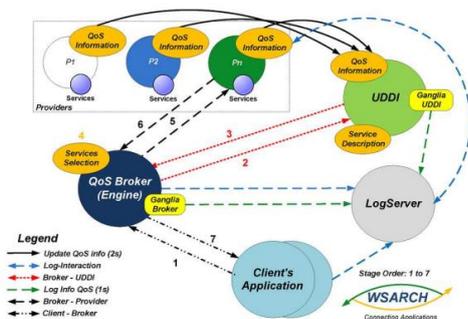


Fig. 2 WSARCH

By now, we want include security attributes in this architecture involving all the components (UDDI, Broker, clients and

providers). The WSARCH and its components are presented in Figure 2.

V. ACCESS CONTROL MODELS

So far various models have been proposed to solve access control problem that each one has its own advantages and disadvantages. In this section, some examples of such models are dealt with.

A. Identity-Based Access Control

Under this Model, permissions to access a resource is directly associated with a subject's identifier (e.g., a user name). Access to the resource is only granted when such an association exists. An example of IBAC is the use of Access Control Lists (ACL), commonly found in operation systems and network security services [7]. The concept of an ACL is very simple: each resource on a system to which access should be controlled, referred to as an object, has its own associated list of mappings between the set of entities requesting access to the resource and the set of actions that each entity can take on the resource.

B. Role-Based Access Control

The RBAC model restricts access to a resource based on the business function or the role the subject is playing. The permissions to access a resource are then assigned to the appropriate role(s) rather than being directly assigned to subject identifiers [8]. When a user changes jobs, another user is allowed to take on that role. No ACL changes are needed. Of course, sometimes only a few of the user's rights change. In that case, a new role needs to be introduced. Often the rights associated with a role depend on which user is acting in that role. In that case, too, a new role needs to be introduced[9]. The RBAC reference model is defined in terms of four model components: Core RBAC, Hierarchical RBAC, Static Separation of Duty Relations, and Dynamic Separation of Duty Relations [10]. Although RBAC may take slightly different forms, a common representation as defined in [11] that is depicted in Fig. 3.

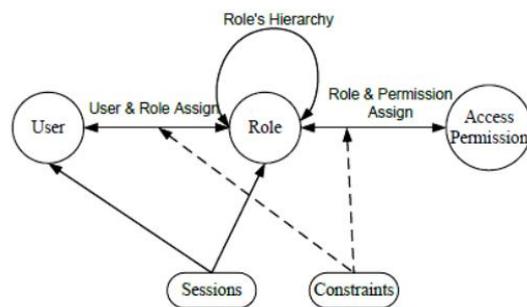


Fig. 3 Role-based access control model

C. Attribute-Based Access Control

Policy Based Access Control (PBAC), which is called Attribute-Based Access Control (ABAC) in the US Defense Department jargon, extends RBAC to a more general set of properties [1]. Unlike IBAC and RBAC, the ABAC model [9] can define permissions based on just about any security relevant characteristics, known as attributes. For access control purposes, we are concerned with three types of attributes:

1. Subject Attributes (S). Associated with a subject that defines the identity and characteristics of that subject.
2. Resource Attributes (R). Associated with a resource, such as a web service, system function and or data.
3. Environment Attributes (E). Describes the operational, technical, or situational environment or context in which the information access occurs.

ABAC clearly provides an advantage over traditional RBAC when extended into SOA environments, which can be extremely dynamic in nature. ABAC policy rules can be custom-defined with respect to semantic context and are significantly more flexible than RBAC for fine-grained alterations or adjustments to a subject's access profile. ABAC also is integrated seamlessly with XACML, which relies on policy-defined attributes to make access control decisions. One additional benefit behind web service implementations of ABAC lies in the nature of the loose definition of subjects. Because ABAC provides the flexibility to associate policy rules with any actor, it can be extended to web service software agents as well [10].

One additional advantage of ABAC web service implementations is related to the nature of the loose definition of the subjects. Because ABAC provides the flexibility to associate policy rules with any actor, it can be extended to web service software agents as well. Figure 4 illustrates how an ABAC attribute authority (AA) can be integrated into a SAML framework. In this diagram, the AA generates attribute assertions containing all attributes necessary for an ABAC policy-based access control decision written in XACML. The PDP uses the attribute assertions, the authentication assertion, and the XACML policy to generate an authorization decision assertion [2].

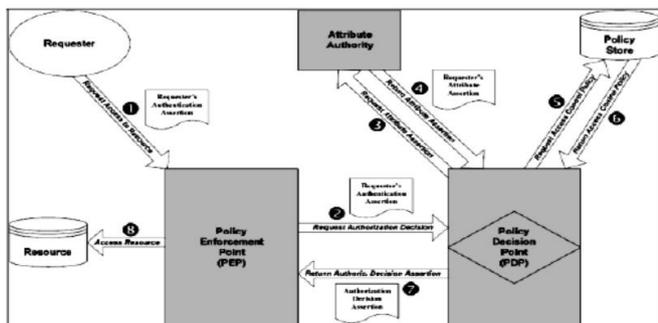


Fig. 4 Use of SAML and XACML in implementing ABAC

#### D. Risk Adaptive Access Control

Risk Adaptive Access Control (RAdAC) [13] is another variation access control method. Unlike IBAC, RBAC and ABAC, however, RAdAC makes access control decisions on the basis of a relative risk profile of the subject and not necessarily strictly on the basis of a predefined policy rule. Fig.3 illustrates the logical process governing RAdAC, which uses a combination of a measured level of risk the subject poses and an assessment of operational need as the primary attributes by which the subject's access rights are determined.

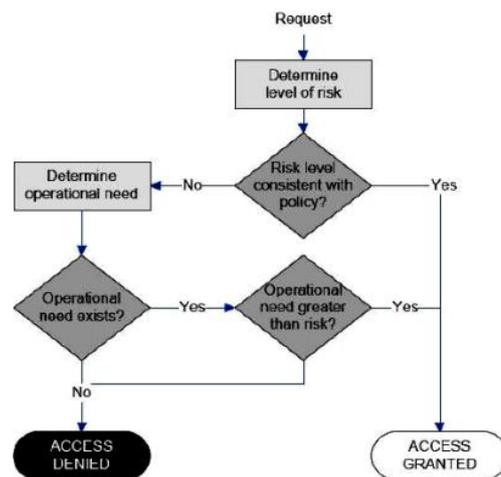


Fig. 5 RAdAC Decision Tree

#### E. WABAC Access Control Framework

The model of WABAC can realize fine-grained access control of cross-domain system; also it can manage subject's permissions dynamically. This model is suitable for access control of SOA, especially workflow based distributed computing system [6]. Fig.3 depicts the access control view of WABAC. The following will discuss the implementation of WABAC model and present an access control framework.

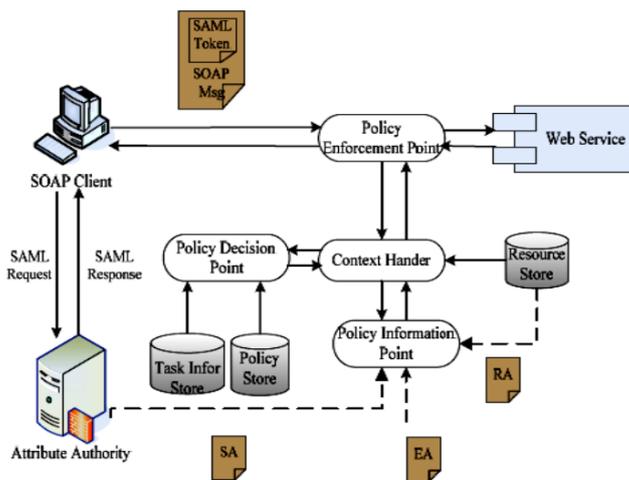


Fig. 6 WABAC Access Control Framework

With Web services implemented and the inclusion of their security policies, experiments and data collection were performed for this analysis. Thus, the performance of a Web service without security with other Web services using the WS-Security to add encryption and digital signatures in SOAP messages exchanged in communication have been compared. Furthermore, the results obtained with the WS-Security were compared with results obtained in an experiment where the Web service using the SSL security standard. As could be seen, despite having a relatively lower response time, SSL does not guarantee end-to-end security. Due to the inherent characteristics of the protocols that make up a service-oriented architecture, security becomes a key item. Thus, studies and performance evaluation of the inclusion of security in this environment are important, since such inclusion causes a

considerable reduction in the performance of a service-oriented architecture. The study presented in this paper demonstrates that in addition to encryption factor, the number of concurrent clients requesting a particular service confirms the performance degradation.

## VI. CONCLUSION

In this paper, Describing a security that takes into account the needs of access control in a distributed environment such as service-oriented architecture-based services are handled. In a software development, as a whole, is a complex process that occurs in a safety, and the constantly changing requirements in the development stage. Configuration management software happens to be the most important part because it requires modifying large enough in doing software design and code. Here are a few examples of the architecture of access control models based services are analyzed with Workflow models-oriented Attributed Based Access Control (WABAC). Software development process provides a solution to a changing environment. WABAC models using an incremental approach to developing high-quality software within time, cost and other related constraints through several iterations. In the process of this WABAC models raises some important factors in software project management, for example, scope, cost, time and quality. Software engineering explore constructive and dynamic way to manage the entire project life cycle.

According to analysis carried out with regard to WABAC models have a dynamic and flexible structure which is higher than the other models, so it can be concluded that this model is more appropriate for a dynamic environment such as service-oriented architecture environment and integrated systems on a system that occurred a considerable transaction.

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# An Improved Model of Internet Pricing Scheme Of Multi Link Multi Service Network With Various Value of Base Price, Quality Premium and QoS Level

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**Abstract**— Internet Service Providers (ISPs) nowadays deal with high demand to promote good quality information. However, the knowledge to develop new pricing scheme that serve both customers and supplier is known, but only a few pricing plans involve QoS networks. This study will seek new proposed pricing plans offered under multi link multi service networks. The multi link multi service networks scheme is solved as an optimization model by comparing our four cases set up to achieve ISPs goals in obtaining profit. The decisions whether to set up base price to be fixed to recover the cost or to be varied to compete in the market are considered. Also, the options of quality premium to be fixed to enable user to choose classes according to their preferences and budget or to be varied to enable ISP to promote certain service are set up. Finally, we compare the previous research with our model to obtain better result in maximizing the ISPs profit.

**Keywords**— multi link multi service network, internet pricing, base price, quality premium, QoS level

## I. INTRODUCTION

Previous works on pricing scheme of QoS networks is due to [1-3]. They described the pricing scheme based auction to allocate QoS and maximize ISP’s revenue. The auction pricing scheme is actually scalability, efficiency and fairness in sharing resources (see in [4-10] ).

Recent studies have also been conducted to address problem of multiple service network, other kind of pricing scheme in network. Sain and Herpers [11] discussed problem of pricing in multiple service networks. They solve the internet pricing by transforming the model into optimization model and solved using Cplex software. Also, [12, 13] discussed the new approach and new improved model of [11, 14] and got better results in getting profit maximization of ISP.

Although QoS mechanisms are available in some researches, there are few practical QoS network. Even recently a work in this QoS network proposed by [14-17], it only applies simple network involving one single route from source to destination.

So, the contribution is created by improving the mathematical formulation of [1, 13, 14, 18] into new formulation by taking into consideration the utility function, base price as fixed price or variable, quality premium as fixed prices and variable, index performance, capacity in more than one link and also bandwidth required. The problem of internet charging scheme is considered as Mixed Integer Nonlinear Programming (MINLP) to obtain optimal solution by using LINGO 13.0 [19] software. In this part, the comparison of two

models is conducted in which whether decision variable is to be fixed of user admission to the class or not. This study focuses to vary the quality premium parameters and see what decision can be made by ISP by choosing this parameter.

Our contribution will be a new modified on solving internet charging scheme of multi link multi service networks Again, we formulate the problem as MINLP that can be solved by nonlinear programming method to obtain exact solution.

## II. PAST LITERATURE REVIEW

Table I and Table II below present the several past research focusing on internet pricing and current research on wired internet pricing under multiple QoS network.

TABLE I  
SEVERAL PAST RESEARCH ON INTERNET PRICING

Pricing Strategy	How it Works
Responsive Pricing [20]	Three stages proposed consist of not using feedback and user adaptation, using the closed-loop feedback and one variation of closed loop form.
Pricing plan [21]	It Combines the flat rate and usage based pricing. Proposed pricing scheme offers the user a choice of flat rate basic service, which provides access to internet at higher QoS, and ISPs can reduce their peak load.
Pricing strategy [14]	Based on economic criteria. They Design proper pricing schemes with quality index yields simple but dynamic formulas’. Possible changes in service pricing and revenue changes can be made
Optimal pricing strategy [22]	The schemes are Flat fee, Pure usage based, Two part tariff. Supplier obtains better profit if chooses one pricing scheme and how much it can charge. Two part of analysis homogenous and heterogeneous.
Paris Metro Pricing [23, 24]	Different service class will have a different price. The scheme makes use of user partition into classes and move to other class it found same service from other class with lower unit price.

TABLE II

CURRENT RESEARCH CONDUCTED ON WIRED INTERNET NETWORKS

Method	How It works
New Approach on solving optimization of internet pricing scheme in multiservice networks proposed by Puspita et al [12]	By comparing with previous work done by Sain and Herpers [11], we obtain better result done by LINGO 13.0. Work in multi service network with availability of QoS level.
Improved Model of internet pricing scheme in single bottleneck multi service network proposed by Puspita et al.[6] and in multiple bottleneck links proposed by Puspita et al. [18]	By improving and modifying the method proposed by Sain and Herpers [11] and Byun and Chatterjee [14], the new improved methods are proven to result in better profit for ISP. The improved model proposed works in single and multiple bottleneck links in multiservice network which has QoS level for each service.
Improved Model of internet pricing scheme in single bottleneck and multi bottleneck links in multiple QoS networks proposed by Puspita et al. [4], Puspita et al. [5-9]	By Improving and modifying the method proposed by Yang [1], Yang et al. [2, 3, 25] and Byun and Chatterjee [14], the new improved models that are solved by LINGO 13.0 can perform better results that maximize the ISP profit. The models work on both single and multiple bottleneck links in multi QoS networks.

$$0 \leq a_{il} \leq 1, i = 1, \dots, S; l = 1, \dots, L \quad (5)$$

$$m_i \leq I_i \leq 1, i = 1, \dots, S \quad (6)$$

$$0 \leq x_{il} \leq n_i, i = 1, \dots, S; l = 1, \dots, L \quad (7)$$

With  $m_i$  and  $n_i$  are prescribed positive integer numbers.

$$\{x_{il}\} \text{ integer} \quad (8)$$

Formulation when we assign  $\alpha$  fixed and  $\beta$  vary is as follows.

$$\max \sum_{l=1}^L \sum_{i=1}^S (\alpha + \beta_i I_i) p_{il} x_{il} \quad (9)$$

subject to (2)-(8) with additional constraints as follows.

$$\beta_i I_i \geq \beta_{i-1} I_{i-1}, i > 1, i = 1, \dots, S \quad (10)$$

$$k \leq \beta_i \leq q, [k, q] \in [0,1] \quad (11)$$

Formulation we have when  $\alpha$  and  $\beta$  vary

$$\max \sum_{l=1}^L \sum_{i=1}^S (\alpha_i + \beta_i I_i) p_{il} x_{il} \quad (12)$$

III. MODEL FORMULATION

We have parameters as follows (adopted in [18]).

- $\alpha_j$  : base price for class  $j$ , can be fixed or variables
- $\beta_j$  : quality premium of class  $j$  that has  $I_j$  service performance
- $C_l$  : total capacity available in link  $l$
- $p_{il}$  : price a user willing to pay for full QoS level service of  $i$  in link  $l$

The decision variables are as follows.

- $x_{il}$  : number of users of service  $i$  in link  $l$
- $a_{il}$  : reserved share of total capacity available for service  $i$  in link  $l$
- $I_i$  : quality index of class  $i$

Formulation when we assign  $\alpha$  and  $\beta$  fixed is as follows.

$$\max \sum_{l=1}^L \sum_{i=1}^S (\alpha + \beta I_i) p_{il} x_{il} \quad (1)$$

Such that

$$I_i d_{il} x_{il} \leq a_{il} C_l, i = 1, \dots, S, l=1, \dots, L \quad (2)$$

$$\sum_{l=1}^L \sum_{i=1}^S I_i d_{il} x_{il} \leq C_l, i = 1, \dots, S; l = 1, \dots, L \quad (3)$$

$$\sum_{l=1}^L a_{il} = 1, i = 1, \dots, S \quad (4)$$

Subject to Constraint (2)-(8) and (10) with additional constraints

$$\alpha_i + \beta_i I_i \geq \alpha_{i-1} + \beta_{i-1} I_{i-1}, i > 1, i = 1, \dots, S \quad (13)$$

$$y \leq \alpha_i \leq z, [y, z] \in [0,1] \quad (14)$$

Formulation when we have  $\alpha$  vary and  $\beta$  fixed

$$\max \sum_{l=1}^L \sum_{i=1}^S (\alpha_i + \beta I_i) p_{il} x_{il} \quad (15)$$

Subject to constraint (2)-(8) and (13)-(14).

Since ISP wants to get revenue maximization by setting up the prices chargeable for a base price and quality premium and QoS level to recover cost and to enable the users to choose services based on their preferences like stated in (1). Constraint (2) shows that the required capacity of service does not exceed the network capacity reserved. Constraint (3) explains that required capacity cannot be greater than the network capacity  $C$  in link  $l$ . Constraint (4) guarantee that network capacity has different location for each service that lies between 0 and 1 (5). Constraint (6) explains that QoS level for each service is between the prescribed range set up by ISP. Constraint (7) shows that users applying the service are nonnegative and cannot be greater than the highest possible users determined by service provider. Constraint (8) states that the number of users should be positive integers. Objective function (9) explains that ISP wants to get revenue maximization by setting up the prices chargeable for a base price and quality premium and QoS level to recover cost and to enable the users to choose services based on their preferences. Constraint (10) explains that quality premium has different level for each service which is at least the

same level or lower level. Constraint (11) states that value of quality premium lies between two prescribed values. ISP wants to get revenue maximization by setting up the prices chargeable for a base price and quality premium and QoS level to recover cost and to enable the users to choose services based on their preferences like stated in (12). Constraint (13) explains that the summation of base cost and quality premium has different level for each service which is at least the same level or lower level. Constraint (14) shows that the base price should lie between prescribed base price set up by ISP. ISP wants to get revenue maximization by setting up the prices chargeable for a base price and quality premium and QoS level to recover cost and to enable the users to choose services based on their preferences as stated in objective function (15).

IV. OPTIMAL SOLUTION

Will solve the model by using LINGO 13.0 then

1. Case 1:  $\alpha$  and  $\beta$  as constant by modifying the QoS level so we divide Case 1 into three sub cases.
2. Case 2:  $\alpha$  as constant and  $\beta$  as a variable by modifying the quality premium and QoS level so we divide Case 2 into 9 sub cases.
3. Case 3:  $\alpha$  as variable and  $\beta$  as constant so we divide Case 4 into 9 cases
4. Case 4:  $\alpha$  and  $\beta$  as variables by modifying the base price, quality premium and QoS level so we divide Case 3 into 27 sub cases.

We have total of 48 sub cases. According to the results of LINGO 13.0 we have two solutions of sub case from each case as follows. We also compare out results with the result previously discussed by [18].

Table III to Tabel VI below present the optimal solution of our four cases. Tabel III shows that in Case 1:  $\alpha$  and  $\beta$  as constant, we obtain the highest optimal solution of 750.445. Total highest capacity used is 7965 kbps or 79.65% of total capacity available. The highest profit is obtained in our model with  $I_i < I_{i-1}$  and model proposed by [18] with capacity used of 7950 kbps or 79.50%.

TABLE III  
CASE 1 SOLUTION WITH  $\alpha$  AND  $\beta$  AS CONSTANTS

Link 1						
<i>i</i>	Model [18]		$I_i=I_{i-1}$		$I_i<I_{i-1}$	
	<i>C</i> Used	Profit	<i>C</i> Used	Profit	<i>C</i> Used	Profit
1	600	15.3	210	15.105	600	15.3
2	3375	227.025	2625	226.575	3375	227.025
3	0	75	1155	75.525	0	75
Link 2						
1	600	30.6	600	30.6	600	30.6
2	3375	282.52	3375	282.52	3375	282.52
3	0	120	0	120	0	120
$\Sigma$	7950	750.445	7965	750.325	7950	750.445

TABLE IV  
CASE 2 SOLUTION WITH  $\alpha$  AS CONSTANT AND  $\beta_i = \beta_{i-1}$

Link 1						
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<i>i</i>	Model [18]		$I_i=I_{i-1}$		$I_i<I_{i-1}$	
	<i>C</i> Used	Profit	<i>C</i> Used	Profit	<i>C</i> Used	Profit
1	210	23.4	210	23.4	600	39
2	2625	351	2625	351	3375	387
3	1155	117	1155	117	0	75
Link 2						
1	210	46.8	210	46.8	210	46.8
2	2625	436.8	2625	436.8	2625	436.8
3	1155	187.2	1155	187.2	1155	187.2
$\Sigma$	7980	1162.2	7980	1162.2	7965	1171.8

Table IV depicts the solution of case 2. We obtain the highest optimal solution of 1171.8 with the highest capacity used is 7965 kbps or 79.65% of total capacity available. The highest profit is obtained in our model with  $I_i < I_{i-1}$  and model proposed by [18]. In Table V, The highest profit is 1197.445 which is obtained in our model with  $I_i < I_{i-1}$  and capacity used of 7950 kbps or 79.50%. Table VI shows that the highest profit of 1627.6 is obtained in our model with  $I_i < I_{i-1}$  with capacity used of 7950 kbps or 79.50%.

TABLE V  
CASE 3 SOLUTION WITH  $\alpha$  AS  $\alpha_i = \alpha_{i-1}$  AND  $\beta$  AS A CONSTANT

Link 1						
<i>i</i>	Model [18]		$I_i=I_{i-1}$		$I_i<I_{i-1}$	
	<i>C</i> Used	Profit	<i>C</i> Used	Profit	<i>C</i> Used	Profit
1	210	24.105	210	24.105	600	24.3
2	2625	361.575	2625	361.575	3375	362.025
3	1155	120.525	1155	120.525	0	120
Link 2						
1	210	48.21	210	48.21	600	48.6
2	2625	449.96	2625	449.96	3375	450.52
3	1155	192.84	1155	192.84	0	192
$\Sigma$	7980	1197.215	7980	1197.215	7950	1197.445

TABLE VI  
CASE 4 SOLUTION WITH  $\alpha$  AS  $\alpha_i = \alpha_{i-1}$  AND  $\beta$  AS  $\beta_i = \beta_{i-1}$

Link 1						
<i>i</i>	Model [18]		$I_i=I_{i-1}$		$I_i<I_{i-1}$	
	<i>C</i> Used	Profit	<i>C</i> Used	Profit	<i>C</i> Used	Profit
1	210	32.4	210	32.4	600	48
2	2625	486	2625	486	3375	522
3	1155	162	1155	162	0	120
Link 2						
1	210	64.8	210	64.8	600	96
2	2625	604.8	2625	604.8	3375	649.6
3	1155	259.2	1155	259.2	0	192
$\Sigma$	7980	1609.2	7980	1609.2	7950	1627.6

In all cases, the requirement for QoS level for service *i* should be less than service *i-1* scheme yield the highest optimal solution. From all 4 cases, the highest optimal solution will be case 4 when we set up base price and quality premium as variables. It means ISP is able to compete the market and

promote certain services if ISP varies the base price and quality premium and set up the QoS level of  $I_i < I_{i-1}$ .

## V. CONCLUSIONS

We have shown that by considering new parameters, more decision variables and constraints, we obtain better profit maximization. The cases shown above basically are ISP strategy to vary its preference to achieve their goals. ISP is able to adopt the cases to suit their goals. The highest maximum profit that can be obtained by ISP is by setting up the base price and quality premium to be varied and also setting up  $I_i < I_{i-1}$ .

However, like stated in [11, 14] since it is more theoretical point of view and assumptions, we limit our result only static result in data changes, and cost preference is just based on our discrete data.

Further research should address more generalization of the model to also consider numerous services offered or generalization of more services

## ACKNOWLEDGMENT

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# Automated Vehicle Monitoring System

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**Abstract**— An automated vehicle monitoring system is proposed in this paper. The surveillance system is based on image processing techniques such as background subtraction, colour balancing, chain code based shape detection, and blob. The proposed system will detect any human’s head as appeared at the side mirrors. The detected head will be tracked and recorded for further action.

**Keywords**— Sveillance, Suspicious Activities, Video Image, Vehicle, Short Message

## I. INTRODUCTION

Safety is one of the essential aspects of human lives. Safety assurance that someone has could affects his/her quality of life. Safety assurance also deal with things that belong to us. This paper will particularly focus on monitoring parked vehicle based on image processing mechanism.

Numerous methods have been proposed for an anti-theft system for a vehicle. Song *et al.* [1] proposed a system based on sensor network, where car sensor form a network which will monitor unauthorized vehicle movements. However, this system may not work well in a sparse parking area in a sense that sensors cannot generate a good enough network for protection purposes. An anti-theft system based on 24 GHz frequency intrusion sensor was proposed by Hori *et al* [3] to sense object movement. However, this system is still does not has any practical use yet.

A system that detect an unlocked door and enabled the owner to monitor the vehicle position through GPS once the engine is started was developed [4]. While in [5], a combination of face detection and finger print recognition were used to complement the car intrusion avoidance system. The system will stored the owner’s face image which will act as a reference image to compare with the face image of the driver. In addition, fingerprint of the driver will be scanned although the paper did not mentioned clearly on how these being implemented. The drawback of this system is that the system will fail to recognize suspicious activity such as breaking windows.

Approach introduced in this paper took different mechanism where motion detection algorithm is used. Through the motion detection algorithm several parameters will be extracted which will be used to determine the status of the current frame whether it contains suspicious activity. Movements near the vehicle will be monitored and recorded, where an intrusion is considered when activity such as breaking the glass windows of the vehicle is taken place. The system will notify the owner once suspicious activity is detected.

The rest of this paper is organized as follows. Section 2 describes the approach of the system, while the detailed implementation will be presented in section 3. Section 4 concludes this paper and suggest the future research directions.

## II. REAL-TIME SURVEILLANCE SYSTEM

The proposed system consist of two main modules: (1) image processing module and (2) database module. Moving human will be detected through motion detection technique in the first module. A notification will be sent to the owner through short message service when a suspicious activity is detected. A centralized database will stored the current frame and status of the vehicle. However, this paper focuses only on the image processing module as shown in the following figure.

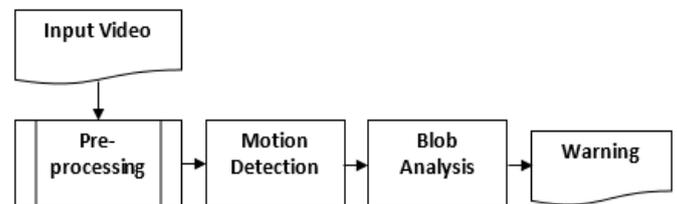


Fig. 1 Image processing module

### A. Image Processing Module

Stream of real-time video captured using two webcam monitoring right and left side window is feed into the system. The video is capture in resolution of 480x640 with fifteen frames per second rate in RGB color space. For simulation purposes, the processed video is a recorded video. Each frame will go through the first stage in the system which is a pre-processing stage

The input video will be processed on frame by frame basis. At first each frame will be converted to grayscale image for efficiency purposes [7]. Region of interest (ROI) will be defined in this stage, where it will define the processing area. In this case, our processing area is the respective vehicle’s window area. The boundary of ROI also could be used to determine the distance of an object from the vehicle.

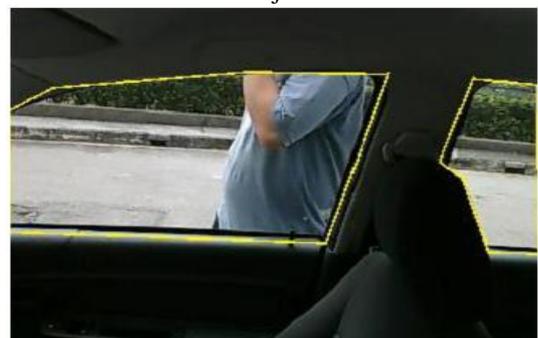


Fig. 2 Sample ROI

### B. Motion Detection

Produced output from pre-processing stage is further processed in motion detection stage in order to locate a moving object in the scene. Background subtraction method is used for

motion detection purposes [8]. Color balancing mechanism is required before background subtraction technique. Color balancing process is necessary to reduce or minimize the effect of different level of light intensity on the image [15]. Color balancing is important in motion detection stage as area with different light intensities can be detected as moving object on the scene. Color balancing technique used in this paper is based on gray world algorithm which stated that average of three color channels is neutral gray [13].

Residual image produced by background subtraction could give an indication whether there is moving object candidate in the scene. Any residual which located outside region of interest will be ignored. A pre-defined threshold value will be used to sufficiently remove noise from the residual image and at the same time preserve any meaningful information. This filtered residual image will go through a blob processing stage.

### C. Morphological Operations and Filtering

Operation such as morphological operation, blob filtering and monitoring will be carried out in blob analysis stage. At the first step, the residual image will be dilated and eroded respectively [9]. Erosion operation is done to remove any unwanted noise in the residual image. While dilation operation is aiming to fill the holes inside blobs, result in more solid blobs. After the system performed morphological operations, blobs that formed will go through filtering process.

Information such as blob position and width-length ratio is utilized in blob filtering process. Filtering through ratio is used with assumption that human object will possess bigger height value compare to the width. Blob position is determined using the location of its centroid. The system will removed a blob that does not intersect with lower boundary of ROI. This step was based on assumption that object that does not intersect with lower boundary is located on "safe distance" from the vehicle. The system will monitor the position of the centroid to classify whether an object is moving or stay still object.

System will run head-shoulder similarity check when there is a blob that keeps static for certain period of time. Similarity check is based on predefined head-shoulder shape which described using chain code [10, 11]. These two chain code series is compared using Chain Code Histogram and Chain Code Distance Vector.

## III. EXPERIMENTAL RESULT

At the beginning of the process, the system will received stream of video input which will be converted into grayscale color space. ROI will be defined to specify the extracted area and determine the position of an object relative to the vehicle. It will allow the system to be more efficient and robust. Color balancing is applied before background subtraction mechanism which compensate the variation of intensity in the current and reference frame. Binary residual image will be produced from this motion detection stage. Sample result of residual image is shown in Fig. 3.

Beside noises reduction, the effect of different threshold value also can be seen in the main blob or silhouette of the person. In residual image with higher threshold value, more holes are observed on the blob. Less holes or more compact blob is seen on residual image with smaller threshold value. This shows that threshold value needs to be determined by compensating between noise and compactness of the blobs. In this work, threshold value of 30 is used. This value was based

on several tests and consideration to sufficiently remove noises and preserve meaningful information.

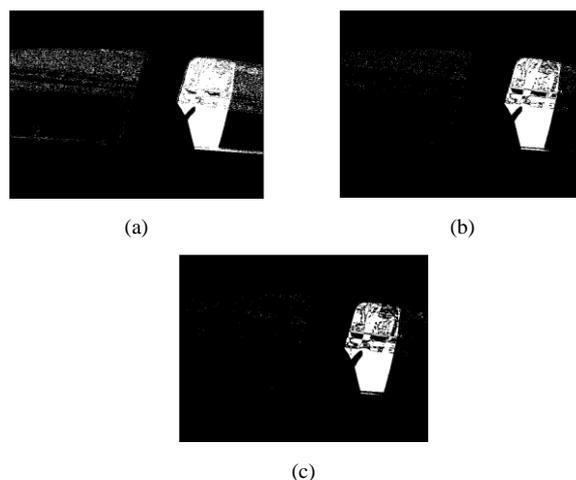


Fig. 3 Residual image with various threshold value: (a)  $t = 10$ , (b)  $t = 30$ , (c)  $t = 50$

The residual image then went through morphological and filtering process. Morphological operation used here is dilation followed by erosion. Filtering process is using several criteria such as ratio between height and width of the blob, blob size and blob position compared to upper and lower boundary of ROI. Sample result of morphological operation is showed in Fig. 4, while there are still some holes and crack, but the blob can be considered sufficient to represent the moving object on the scene.

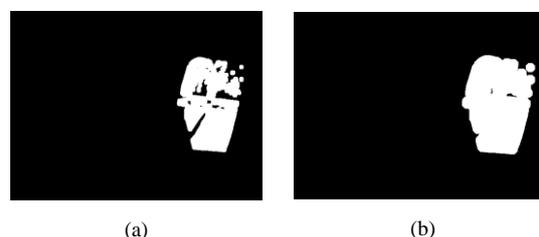


Fig. 4 Eroded image with: (a) disk size of 12, (b) disk size of 6

A scene where there is a person walking beside the monitored a vehicle is illustrated in sequence of frames as shown in Fig. 5. In this outdoor environment, color balancing becomes important feature since the difference of light intensity across the scene is likely to happen and affect the motion detection algorithm. The person walk and stop in front of the vehicle's window for a moment. At the time an object stand still for a pre-defined moment in front of the window, the system will perform a head-shoulder check and record the current scene. The recorded scene is displayed in centralized website monitoring system.

In Fig. 6, sequence of frames is shown to illustrate the moving object detection where there is two meaningless moving objects and one suspicious activity. In this video, there is a motorcycle that pass by and a car that moving out form its car park (at the upper-right position). These kind of movement not happened near the vehicle, so the system will ignore these movement as they are less possible to do any harm to the monitored vehicle. The other movement recorded is movement

of a person that walk beside the car and look inside the car. This action can be categorized as suspicious activity that possibly do any harm to the vehicle.

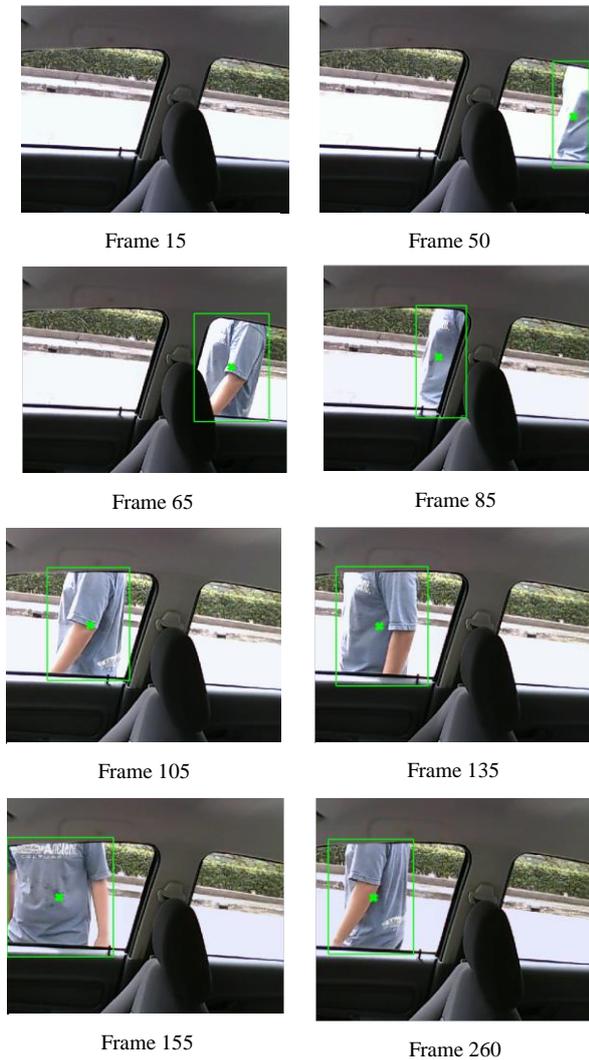


Fig. 5 Moving human object passes by the vehicle

The motion detection is based on monitoring the position of blob's centroid. Centroid is used since it marks the central point of the blob, therefore slight changes in blob shape or position will not cause many changes in centroid position. The centroid is recorded and compared frame by frame. When centroid of a blob remains relatively at the same place, system will start to mark it as a possible suspicious activity around the vehicle.

Centroid monitoring may enable the system to keep track the object around the vehicle, but it is not enough to conclude that certain object can be categorized as suspicious activity. Therefore the system employs head and shoulder detection which is done using chain code. Chain code will provide the series of code to the system which describe the boundary line of a blob. The problem may arise when boundary shape is has similar shape as reference shape or it has chain code series that has similar code with reference code. Therefore, predefined similarity value is set to 40% similarity index. This value is set to still able to capture the blob that actually has head – shoulder on it, but has not similar chain series.

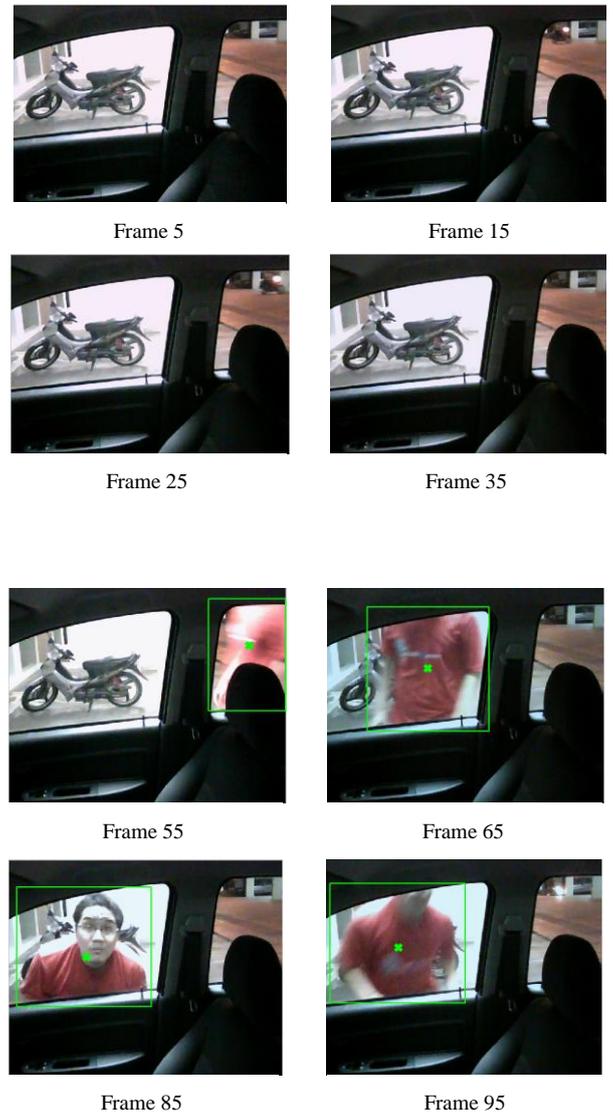


Fig. 6 Moving human object passes by, along with other moving vehicle and motorcycle

When series of chain code satisfy the similarity level, the system will categorize the blob of having head and shoulder on it. Any detected head will be stored as a database for further action.

#### IV. CONCLUSIONS

Image processing algorithms have been implemented to build a real-time vehicle surveillance system. The surveillance system was based on background subtraction and chain code to detect head shoulder shape. Motion detection with background subtraction produced sufficient result although it is sensitive to lights and shadow. Shape comparison result is quite satisfying and enough to be used in shape detection.

Some recommendations for future works can be used to improve the system in the future development. In motion detection stage, the system can be improved to be more robust especially in facing change of lights and shadow. Improvement also could be done in blob analysis stage by employing other filtering criteria. Detection scheme may employ face detection or combine with face recognition. Warning system through SMS also can be integrated into the system. Thus, any detected head will be captured and sent to the vehicle's owner.

The surveillance system also may use GPS to enhance the surveillance system. Other possible improvement is integration between vehicle surveillance systems. This integration will create such a surveillance network among the vehicle which may provide information when the respective vehicle cannot provide.

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# Target Localization with Fuzzy-Swarm Behavior

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**Abstract**—In this paper describes target localization using deliberates fuzzy and swarm behavior. Localization is the process of determining the positions of robots or targets in whole swarms environment. To localize the target in real environment, experiment is conducted utilize three identical robots with different color. Every robot has three infrared sensors, two gas sensors, 1 compass sensor and one X-Bee. A camera in the roof of robot arena is utilized to determine the position of each robot with color detection methods. Swarm robots are connected to a computer which serves as an information center. Fuzzy and swarm behavior are keeping the swarm robots position and direction with a certain distance to the target position. From the experimental results the proposed algorithm is able to control swarm robots, produce smooth trajectory without collision and have the ability to localize the target in unknown environment.

**Keywords**— *swarm robot, IT2FLC, motion control*

## I. INTRODUCTION

Swarm robotic system first introduced in [1]. This is a novel approach for coordination of large numbers of robots. It is inspired from the observation of social insects such as ants, termites, wasps and bees, which stand as fascinating examples of how a large number of simple individuals can interact to create collectively intelligent systems [2-4]. The concept of swarm behavior is based on local sensing of neighborhood. They emerges in the system even if no group leadership, hierarchical control and global information are present [5-7].

Single operation of intelligent robot commonly used expensive autonomous mobile robots [8]. On the other hand, swarm robots consists of a large number of homogenous autonomous relatively incapable or inefficient robots [9]. The swarm shares information about the environment and individual members interact with each other, therefore a distinction between the sensing and the communication network is made. The main advantages of swarm robotics are robustness, flexibility and scalability of the system [10].

This system can be applied in areas, where the use of a single robot is insufficient. The specific applications can be search and rescue operations, dangerous environment exploration or surveillance. For instance, during a search and rescue operation the robotic swarm is deployed in the target environment.

## II. SWARM ROBOTS LOCALIZATION

Swarm robotics system need a coordination of large numbers of relatively simple robots. Basically, these systems try to employ a large number of simpler agents to perform different types of tasks to reach the target. In this situation, swarm robot localization should be conducted to support efficient goal directed performance. It can facilitate navigation

between points of interest without having to introduce additional nodes.

Localization is the process of determining the positions of robots or targets in models of the environment and aids in the navigation of both individual robots and whole swarms [11]. However, a difficulty associated with conducting localization processes with swarm robots systems is that these systems usually are highly decentralized which makes it hard to synthesis and access global maps, which in turn decreases its flexibility. Unless some centralized mechanisms also are integrated into the system [12].

Some localization technique using vision based self-localization technique that can be used by individual robots in swarm robots systems is described in [13], include the particle swarm optimization (PSO) based techniques that are presented in [14], and neural network [15]. However, this approach does not ensure efficient goal directed behaviour. Centralized mechanism must be use to syntesise and accest global map to support goal directed navigation. To overcome that drawback, in this paper fuzzy behavior navigation strategies deliberates with swarm behavior. It's facilitate the centralized mechanisms that are necessary for conducting flexible localization tasks to ensure that swarm robotic system is robust towards failure of any one individual.

The proposed algorithm deliberates the fuzzy control from low-level navigation tasks such as formation keeping, obstacle avoidance and reaching the target. At the same time the swarm behavior is covering a large area of the searched environment, thus leading to a faster localization of possible target. The controller works as an adaptive intelligent mechanism and improves the maneuvering performance of the swarm robots.

Fuzzy systems are known the popular linguistic rules based knowledge acquisition machine, it is highly desirable to represent the human thinking to utilize the domain knowledge to create autonomous strategies for controlling the mobile robot plan. By using fuzzy logic, each sensor provides some input about the world around the robot; that input being incorporated into a membership functions (MFs). From this MFs, appropriate rules about output actions taken in response to input are generated. These rules allow the robot, to interact with its surroundings in a way that hopefully achieves some goal.

Lately, many of type-1 fuzzy logic control controller (T1FLC) which consists of linguistic control rules is a technique to design motion coordination controller based on human expert knowledge and experience [16-18]. However, only few of existing results have been presented to solve the problem of this behavior in multi-agent systems based on interval type-2 fuzzy logic controller (IT2FLC) [19-21]. This paper aims to investigate the swarm robot localization problem

base on IT2FLC, where the problem of collision avoidance and target seeking are considered.

### III. EXPERIMENTAL SET-UP

#### A. Swarm Robot Design

Swarm robots have the ability to move in the real environment. In this experiment the swarm robots with circular shape have diameter is 15 cm and height is 17 cm. The robot uses three wheels which two behind wheels of robot functions as a controller which one wheel that can move freely. Both robot's wheel is connected with dc motor as well as connected with a motor driver that can be controlled using PWM. Swarm robot experimental situation shown in Fig. 1.

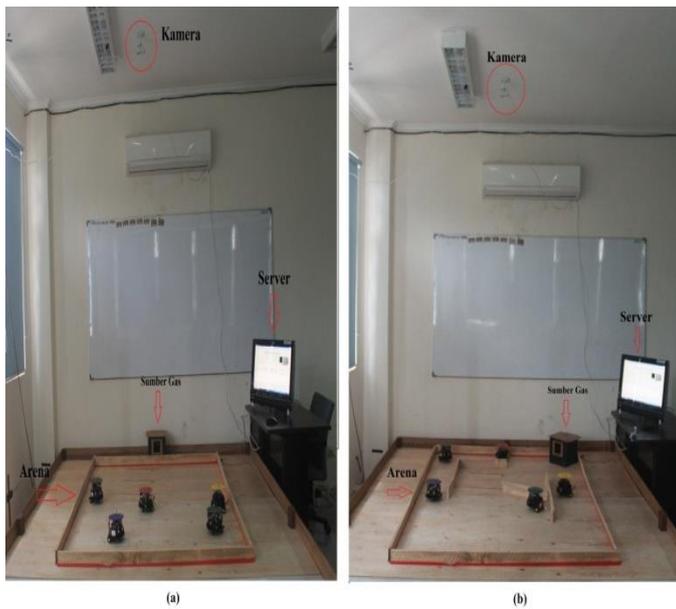


Fig. 1 Swarm robots experiment

Camera is used for tracking and detecting swarm robot position or their orientation. Its resolution is largely determined by the resolution of the camera and the optical system. The camera has a resolution of 480 by 360 pixels. The x and y coordinate to the vision system is designed for calculating the real resolution. In the experiment, the camera is mounted on a bracket fixed on the ceiling. Due to the limitation of ceiling's height, the viewable area on the test bed is of 2 m by 3 m. To identify the robot's position and orientation, a color pad is attached on the top of a robot. The center of each circle can be calculated through the image processing hardware and software. Coordinates of the centers of the the color circles is used to calculate the position of the robot's center and its orientation as well.

The hardware for multi-robot as shown in Figure 2. Communication system between swarm robots using X-Bee, they also connected to the central computer for collecting the experimental data. For controlling all the existing systems on the real robot platform, microcontroller ATmega16 is used as embedded controller.

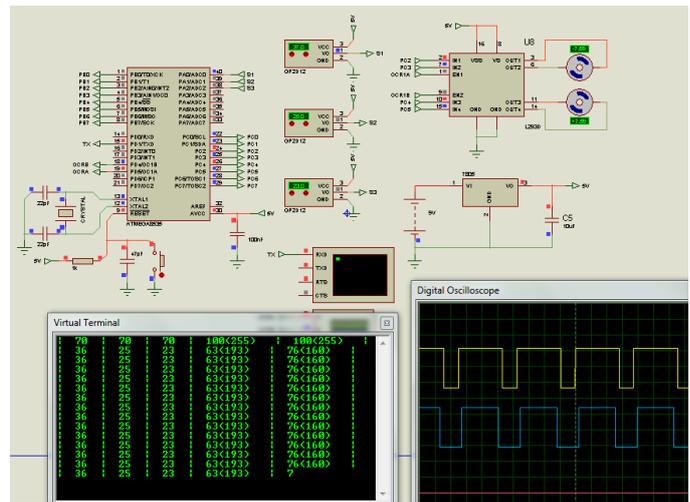
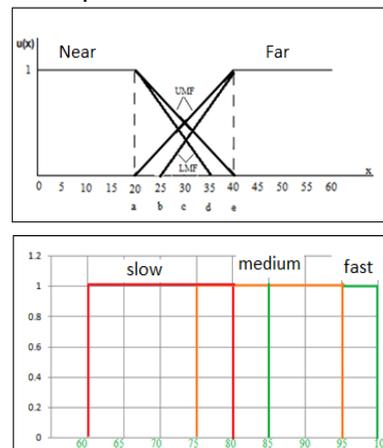


Fig. 2 Swarm robot design

#### B. Fuzzy behavior Design

Fuzzy system employ a mode of approximate reasoning that makes them a suitable tool to implement a robust robot behavior tolerating noisy and unreliable sensor information [16]. The fuzzy rules describe the relation between the external and internal states of the robot and the set of possible actions. To date all the fuzzy logic system (FLS) implementation in robot control are based on the traditional type-1 fuzzy logic system (T1FLS). The most common way is to construct the FLS by eliciting the fuzzy rules and the membership functions based on expert knowledge or through the observation of the actions of a human operator controlling the mobile robot.

Unlike type-1 fuzzy sets (T1FSs) where the membership grade is a crisp number in [0,1], type-2 fuzzy sets (T2FSs) are characterized by fuzzy MFs. However, in general, T2FLS produce computationally overhead [22]. To simplify the computation of T2FLS then become the Interval Type-2 Fuzzy Logic System (IT2FLS) which can easily to determine [23]. In this work the implementation of IT2FLS design, each antecedents have two membership functions (MFs), that is far and near. Both are trapezoid formed of MFs, as depicted on Fig 3 (a). The number and form of each MFs of antecedents cannot be changed, but the parameter for each set can be modified.



(a) distance sensor as input (b) motor speed as output

Fig. 3 Membership functions

The data parameters of input MFs and output MFs as shown in Figs 3(a) and (b). The MFs and rule base parameters

are the basic criteria of mobile robot performance. The MFs is made from sensor detection relation to motor output of swarm robots. The fuzzy rule bases are determined by the number of the fuzzy MFs. The rule bases are used to control the motor speed as shown in table 1.

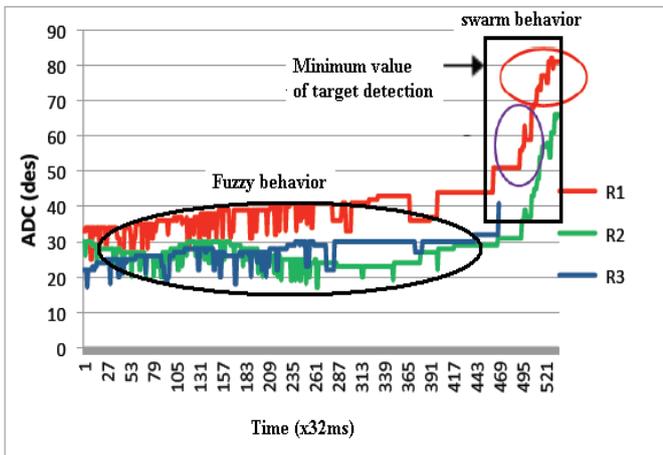
TABLE 1  
RULE'S TABLE

Rule	Sensor			Speed Reference	
	Left (S1)	Front (S2)	Right (S3)	Motor 1	Motor 2
1	Near	Near	Near	slow* condition	fast*condition
2	Near	Near	Far	Fast	Slow
3	Near	Far	Near	Slow	Slow
4	Near	Far	Far	Medium	Slow
5	Far	Near	Near	Slow	Fast
6	Far	Near	Far	Fast	Slow
7	Far	Far	Near	Slow	Medium
8	Far	Far	Far	Fast	Fast

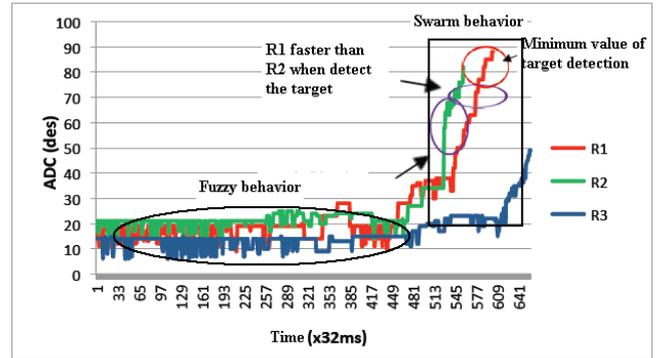
Before defuzzification stage, the IT2FL sets resulted from the previous step has to be reduced first called "type-reduction". Type-reduction (TR) represents a mapping of a IT2FSs into a ITFSs. The type-reduced set is always an interval set and is determined by its left end points  $y_l(x)$  and right end points  $y_r(x)$ . In this works, the type reduction is center of sets (CoS), where reduced set value is comprises of  $y_l$  and  $y_r$ , which is the approach of inferencing result midpoint. Karnik-mendel iterative algorithm is utilized to determine  $y_l$  and  $y_r$  [22]. Finally, the output of defuzzification step of IT2FLS is obtained by averaging the values of  $y_l$  and  $y_r$  obtained from type reduction step.

IV. EXPERIMENTAL RESULTS

The experiments are conducted in our robotic laboratory with environmental space about 1.5 x 2.1 m. In this experiment, three identical robots with different color move together towards a predetermined to find target position. The target position is gas source from artificial source in the environment.



(a) Target localization in experiment 1



(b) Target localization in experiment 2  
Fig. 4 Target Localization use deliberates fuzzy swarm behavior

In Figs. 4 (a) and (b) respectively, shows experimental results of swarm robots motion in two environment with obstacle and without obstacle. In such environment the swarm robots are keeping the position and direction with a certain distance to the target position. In this work deliberate centralize control with swarm behavior and fuzzy behavior, it means the swarm behavior active if one robot detects a target, then the control system will send a signal in the form of color and positions of robot. When the target source not in range swarm robots move with fuzzy behavior. From the result, the target localization using fuzzy-swarm behavior algorithms generate a satisfactory performance, the swarm robots move in the group without collision, keeping safe distance each other and the pathways taken to convergen at the target locations.

V. CONCLUSION

This paper presents swarm robots design with deliberates fuzzy and swarm behavior for target localization. The experimental results show that the proposed algorithm produce smooth trajectory, it capable keep the robots movement in the group without collision and have the ability to localize the target in simple algorithm. In the future works, we want to combine this technique with particle swarm optimization and will apply this platform with several sensors gas as target. The swarm robots will be implement in unknown environment with some source target and complex obstacle.

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# Sensor Fusion and Fuzzy Logic for Stabilization System of Gimbal Camera on Hexacopter

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**Abstract**— Hexacopter has the ability to fly in the air can be used as an air monitoring system. To get the video or images that have good quality then it is used gimbal camera as a movement stabilizer and vibration damping. Stabilization System consists of two axes, x axis (roll) and y axis (pitch) and has a 2-axis camera gimbal controller which is have microcontroller ATMEGA 328 that serves to regulate the stability of the gimbal camera. The Input of this system is derived from accelerometer and gyroscope sensors that are within the sensor module MPU 6050, to determine the tilt position of hexacopter. The output of this sensor will be filtered first using complementary filters that serve to reduce noise of both sensors and complement advantages and disadvantages of each sensor. The output of this system is the movement of two brushless motors, brushless roll and pitch, that are controlled with Sugeno fuzzy logic method because it has a simple calculation so the response is faster and more suitable for real-time applications. From the case study with the data of the roll at by 35 ° and pitch at by 17 ° resulting PWM duty cycle value by -69.47% roll and pitch resulting PWM duty cycle value by -25.5 %, where (-) represents the direction of movement.

**Keywords**— Hexacopter, Gimbal Camera, Accelerometer, Gyroscope, Complementary Filter, Fuzzy Logic

## I. INTRODUCTION

Hexacopter an unmanned multicopter has 6 propellers as actuator. The advantages of the hexacopter are able to fly in all directions and heavy lift so that can be used to air monitoring system and aerial photography. When hexacopter airs, the position of the camera will be oriented and hindered by the movement and vibration of hexacopter itself so that the resulting video or image to crash.. To maintain the stability needed a tool and a method as a stabilizer. The stabilizer is a gimbal camera that has a control system based on the axis of motion, namely roll, pitch and yaw. Each axis movement governed by brushless motors. Gimbal camera input derived from the two sensors, accelerometer sensor and gyroscope sensors. To get the good angle and there is a lot of noise, input from both sensors will be filtered to complementary advantages and disadvantages of each. Filter method used is complementary filters. This filter combines the data from the two sensors to form an angle value. In this study will be tested using Sugeno fuzzy logic system is developed to control the gimbal camera stabilizer. This system is focused to maintain a stabilizer position when the camera follows the movement of the hexacopter. In addition, use of this method to obtain performance automatic control gimbal camera stabilization better because controlled with Sugeno fuzzy logic method because it has a simple calculation so the response is faster and more suitable for real-time applications.

## II. BASIC THEORY

### A. Hexacopter

Hexacopter is one type of multicopter that has 6 propellers or motor which located vertically from a hexagon and same distance from the the center of gravity [1]. There are 2 configuration synchronization brushless motors are commonly used in the hexacopter, the configuration of the frame plus (+) and frame plus (x) which can be seen in Figure 1.

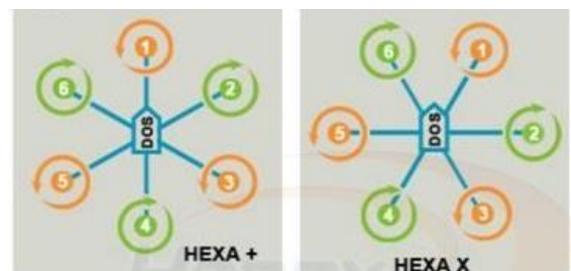


Fig.1 Configuration Frame Hexacopter

Hexacopter has advantages and disadvantages, while the advantages are when the one of motors broke in the air, the vehicle can still be saved indirectly pierced the ground and heavy lift offered hexacopter greater in comparison quadcopter or tricopter. While the disadvantages are when hexacopter has bigger size so when maneuvering feels more bit responsive because the motors is larger.

### B. Accelerometer Sensor And Gyroscope Sensor

Accelerometers are sensitive to both linear acceleration and the local gravitational field. The working principle of this sensor is based on the laws of physics that when a conductor is moved through a magnetic field will give rise to an induction voltage on the conductor. Accelerometer placed on the surface of the Earth can detect the acceleration of 1g (the size of Earth's gravity) at the point of the vertical, the acceleration due to horizontal movement of the accelerometer to measuring acceleration directly when moving horizontally. Accelerometer sensor output in the form of an analog voltage that represents the data in units of gravitational acceleration (g) is directly proportional to the slope[2].

Gyroscope has an output that is sensitive to the angular velocity of the x-axis direction which will be the angle phi (roll), on the y-axis will be the angle theta (pitch), and the z-axis will be the psi angle (yaw). Now gyroscope applied together with the accelerometer. When the accelerometer

measurements combined with measurements gyroscope, developers can create applications that can sense motion on six-axis, ie the top and bottom, left and right, forward and backward, as well as rotational roll, pitch and yaw. The following describes the orientation of the gyroscope roll, pitch and yaw axis [2].

### C. Control Board

Brushless gimbal control board which utilizes a 6-axis gyro/accel with Motion Processing Unit to stabilize your camera gimbal while in flight. It offers highly precise and smooth brushless gimbal stabilization. Microcontroller this board is ATmega328. Onboard FT232RL for debug and On board logic level converter

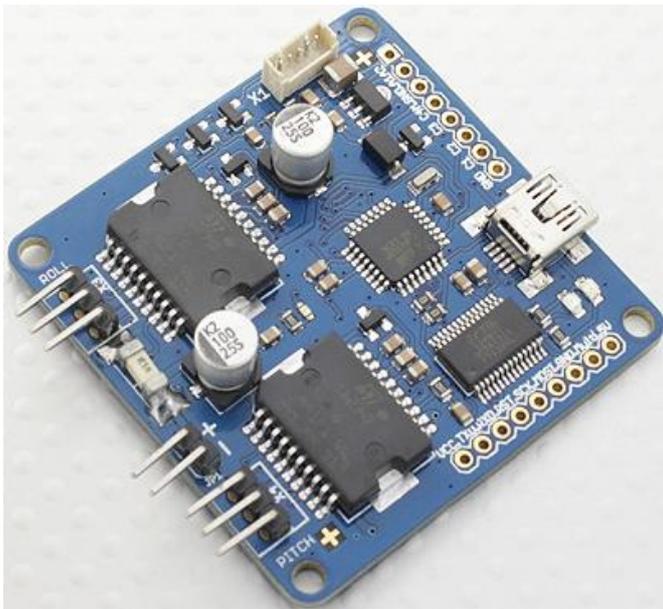


Fig. 2 Control board Gimbal Camera 2-Axis

### D. Gimbal Camera and Brushless Gimbal Direct Drive

Gimbal Camera system that serves as a stabilizer and as a vibration damper for produced by the movement of multicopter. Gimbal is a device used cinematography to keep the camera so that the camera can take pictures with either at a particular point of view [4]. Gimbal has enhancements to rotate which allows the rotation of an object mounted on a single axis gimbal to remain independent of the rotation support. In implementation, the brushless motor is placed on roll axis and pitch axis. Depending on the application, a number of key performance characteristics are of primary importance when selecting a positioning system:

1. Accuracy is defined as the difference between the actual position in space and the position as determined by an independent measurement device.
2. Repeatability is the range of positions attained when the system is repeatedly commanded to one location under identical conditions.

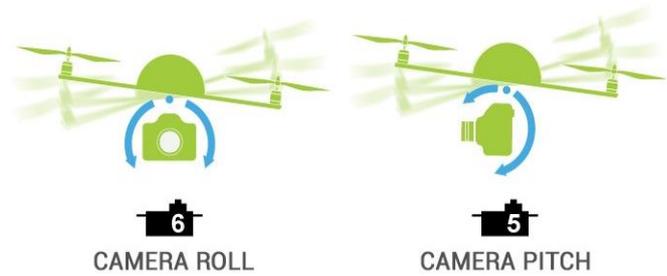


Fig.3 Example for Gimbal Stabilitation

Gimbal camera has a type. One type of gimbal camera is brushless gimbal direct drive. brushless gimbal direct drive is Direct drive mechanism to take the power that comes directly from the motor without reduction (such as the gearbox). So direct drive can achieve higher accuracy than using the gear. Brushless direct drive gimbal has three main components, the IMU controller, brushless motor and mechanical framework. Brushless dreadlocks require a very precise balancing of the center of gravity. This allows the motor to rotate the camera with ease and responsiveness.

### E. Complementary Filter

Complementary filter algorithm is used to combine the readings from the sensor Accelerometer and Gyroscope sensor. The merger was intended to obtain results more accurate angle measurement. Accelerometer sensor can give an accurate value of the tilt angle when the system is at rest (static), but the accuracy is reduced when the system is in motion (dynamic) because the sensor accelerometer not able to follow the rapid movement because it has a slow response and also has a noise in the measurement. Meanwhile, Gyroscope sensor can provide value tilt angle in motion (dynamic) but become inaccurate in a state of long-term due to the effect of bias (drift) generated by the gyroscope. Below is a schematic of Complementary Filter algorithm. In general, the equation applicable to the algorithm Complementary Filter is:

$$\text{Angle} = (a) * (\text{Angle} + \text{Gyroscope's value} * dt) + (1-a) * (\text{Angle Calculation of the Accelerometer's Value}) \quad (1)$$

When :

1. a = Filter coefficients
2. dt = sampling time, adjusted for the time value of sensor sampling
3. Angle = angle complementary filter output
4. Gyroscope's value = a gyroscope sensor output angular velocity
5. Calculation Angle of the Accelerometer's Value = output accelerometer sensor which has a angle

Value of a can used of 0.98 in the above equation is constant value for the High-Pass Filter contained in Gyroscope sensor, while the value of 0.02 (1-a) is the constant value of the Low-Pass Filter contained in accelerometer sensor.

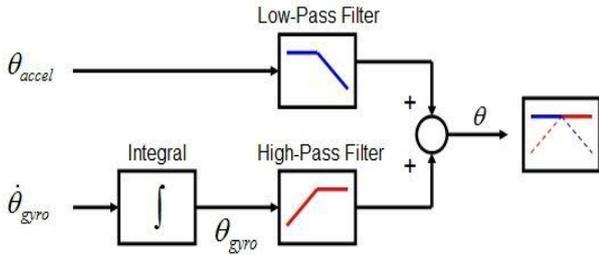


Fig. 4. Complementary schemes Filter algorithm [5]

F. Fuzzy Logic Method

Fuzzy logic is a logic that has a blur value between right and wrong. A fuzzy rule-based system consists of three main components: Fuzzification, Inference and defuzzification as shown in Figure 5. Shows block diagram system of the fuzzy rule-based.

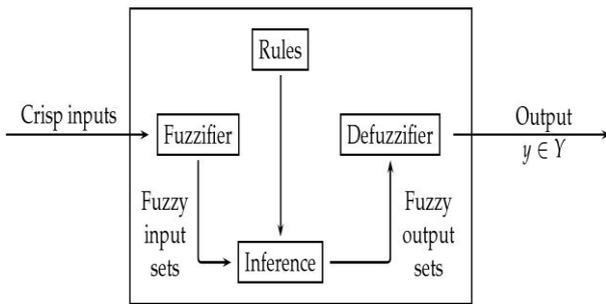


Fig.5 Block Diagram System Of The Fuzzy Rule-Based[7].

Fuzzy logic has several methods of which Takagi-Sugeno method, Mamdani method and fuzzy logic, and etc. Takagi Sugeno method proposed by Takagi and Sugeno [2] is described by fuzzy IF-THEN rules which represents local input-output relations of a nonlinear system. The main feature of a Takagi-Sugeno fuzzy model is to express the local dynamics of each fuzzy implication (rule) by a linear system model. Sugeno models using singleton membership functions. Singleton is a fuzzy set with a membership function which has a degree of membership of 1 in a single crisp value and 0 at all other crisp values [7].

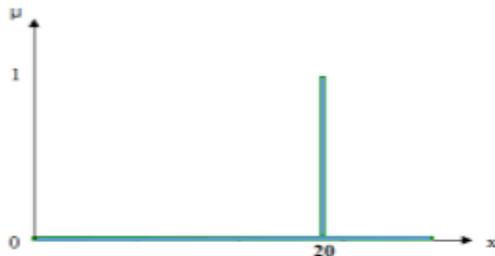


Fig. 6 Membership Function Singleton

Fuzzy model with the sugeno method of having rules in the form:

$$\text{IF } (x_1 \text{ is } A_1) \text{ AND } \dots \text{ AND } (x_n \text{ is } A_n) \text{ THEN } y = f(x_1, \dots, x_n) \quad (2)$$

where f can be any function of the input variables whose values are in the interval of the output variable. In the Sugeno method, defuzzification is done by calculating Weighted Average (WA) which takes the average value using a weighted membership degrees. So  $y^*$  is defined as follows [7]:

$$y^* = \frac{\sum \mu(y)y}{\sum \mu(y)} \quad (3)$$

where y is the crisp values and  $\mu(y)$  is the degree of membership of crisp values of y.

III. DESIGN AND IMPLEMENTATION SYSTEM

A. General Design of Stabilization System 2-Axis Gimbal Camera

The system is designed for 2-axis gimbal camera stabilization can be seen in Figure 7.

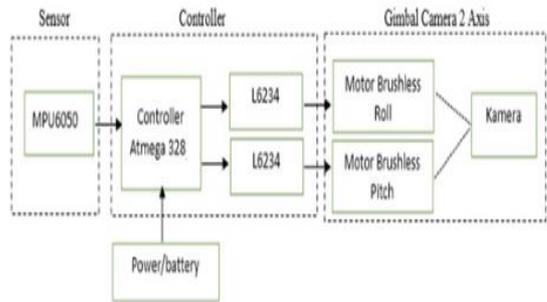


Fig. 7 Block Diagram System

From Figure 7 is an illustration of the design of the 2-axis gimbal camera stabilization system as a whole based on the block diagram. Needs of the system in this study is a hexacopter that already has a good configuration as the plant to be controlled. The system input is derived from accelerometer sensor and gyroscope sensors are integrated in the module datu MPU6050 hexacopter a tilt angle which will in advance filters using complementary filters. The input will be processed in the module control board 2-axis gimbal that is integrated with the controller ATmega 328. Method used to control the camera gimbal stabilizer using fuzzy logic as an automatic controller. The system used is a method of fuzzy Sugeno. The output of the microcontroller in the form of the movement of two brushless motors roll and pitch that functions as a stabilizer gimbal camera.

B. Hardware Design

Hardware used in this study consists of MPU 6050 module, 2-Axis Gimbal Control Board and motor brushless 2-axis gimbal camera gimbal. This section, the design of a prototype 2-axis gimbal camera stabilization system can be seen in Figure 9. Where there is a 2-axis gimbal control board that has been integrated. MPU6050 module that serves as an input accelerometer sensor and gyroscope sensor connected to the control board via the I2C lines. I2C lines is one type of communication between electronic components with a

microcontroller. This communication requires 2 cables which SDA cable and SCL cable. SCL cable is used to give the corresponding clock. SDA cable is used to obtain the data from the electronic components. Two 2-axis gimbal brushless DC motor driver connected to L6234PD integrated on the control board. And the battery used as a power supply of the system 2 axis camera gimbal stabilization is battery 3 cell Li-Po 1000 mAh capacity and 11.1 V. Programming on 2-axis gimbal control board using the Arduino programming the microcontroller ATMEGA 328. Where the latter has been found firmware from the vendor that is open source. Hardware design 2-axis gimbal camera stabilization can be seen in the figure below:

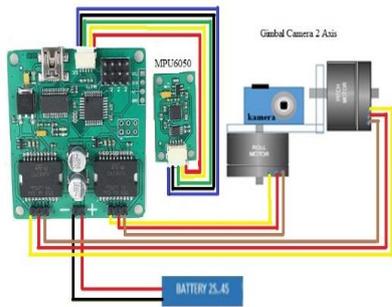


Fig. 8 Design Hardware Stabilization System

C. Software Design

The software design in this study consisted of two, that is complementary filters and Sugeno Fuzzy logic. In this final design software used to create the program that is microcontroller using the C programming language. Design Software (software) is done by creating a flow diagram (flowchart) first. After that, the program is made by following the flow diagram (flowchart) as shown in Figure 9.

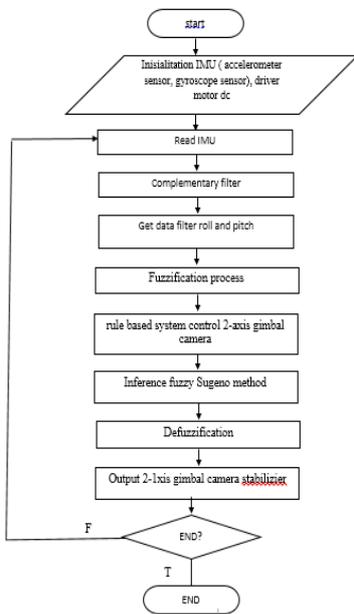


Fig. 9 Flowchart of Software

1) Complementary Filter

Basically complementary filter is the sum of the angles between the accelerometer readings are passed LPF (Low Pass filter) and the angle of the gyroscope readings after passed HPF (High Pass Filter). Here is a flowchart from complementary filters on the IMU sensor as shown in Figure 10.

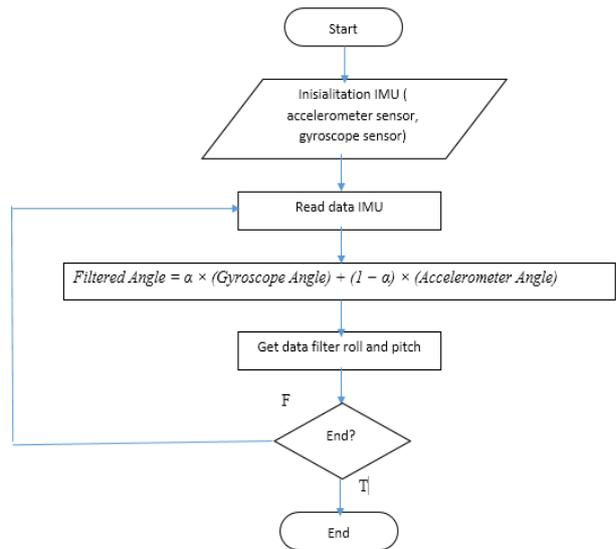


Fig. 10. Flowchart of Complementary Filter

2) Fuzzy Logic

Fuzzification

Design of Fuzzy Controller intended that the controller output as wished in order to obtain the expected output. Determination of fuzzy control diagram using the reference gimbal desired way of working, which can stabilize the position of the camera. Fuzzification process in roll variable has three linguistic variable that are Miring Kiri, Stabil, and Miring Kanan. Based on specified linguistic variables, then the membership function of the roll variable can be seen in the figure 11 below

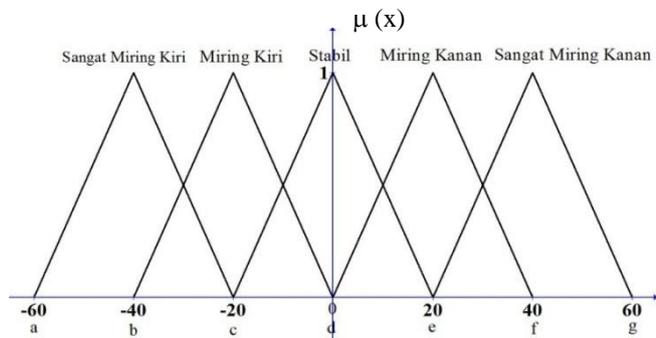


Fig.11 Membership functions Roll Variables

Fuzzification process in pitch variable has three linguistic variable that are Angguk Bawah, Stabil, and Angguk Atas. Based on specified linguistic variables, then the membership function of the roll variable can be seen in the figure 12 below

$\mu(x)$

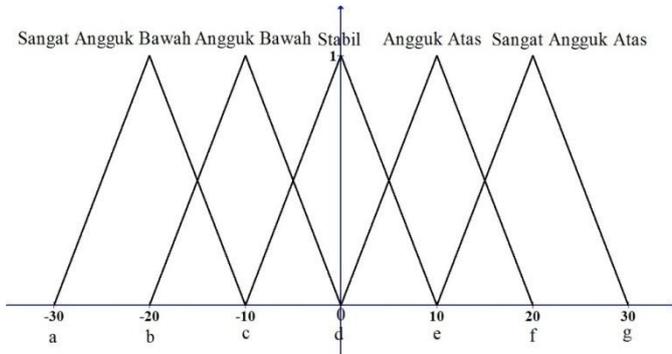


Fig. 12 Membership functions Roll Variables

*Fuzzy Inference*

Inference process used is a clipping method, that is Max-Min function of the linguistic values of the fuzzy rule base and generate output with singleton function. In figure 13 and 14 shows the linguistic variables to the output of a brushless roll and brushless pitch.

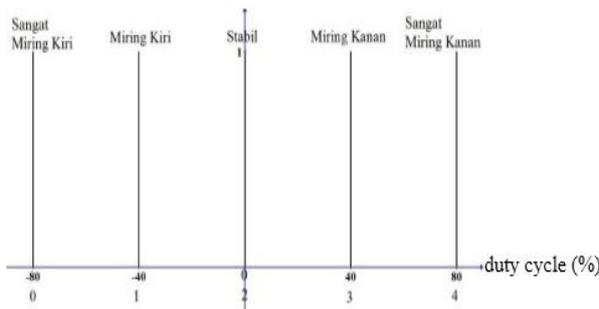


Fig. 13 Membership Functions Value Variables PWM (Roll)

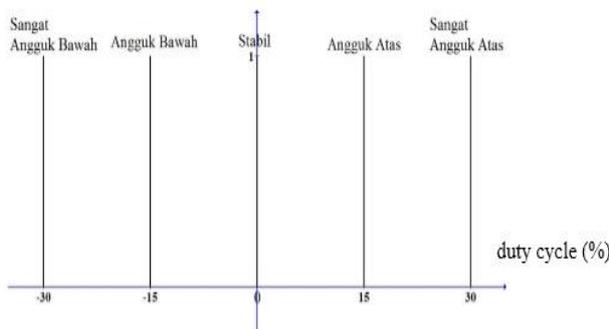


Fig. 14 Membership Functions Value Variables PWM (Pitch)

*Defuzzification*

In defuzzification using the Weighted Average method as suitable for Sugeno method which has one dimension. This method takes the average value using a weighted membership degree. The formula of the Weighted Average used can be seen in equation 3.

IV. TEST RESULTS AND ANALYSIS

A. Design Results

The result of the design of a mechanical system of 2-axis gimbal camera on hexacopter that a proper connection at each of its components. Overall, stabilization 2-axis gimbal camera system on hexacopter seen in Figure 15.



Fig.15 Stabilisation System Gimbal Camera on Hexacopter

B. Sensor Test Results

Output accelerometer sensor and gyroscope sensor in the design of this system will produce output of angle on the x-axis (roll) and the y-axis (pitch). In graph below will be seen the comparison angle on each axis before and after filtration by using complementary filters. This is graph x-axis results

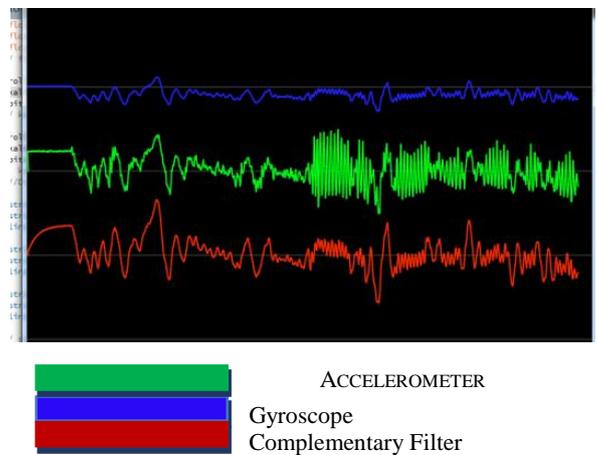


Fig. 16 Output Sensor x-axis

This is graph y-axis results :

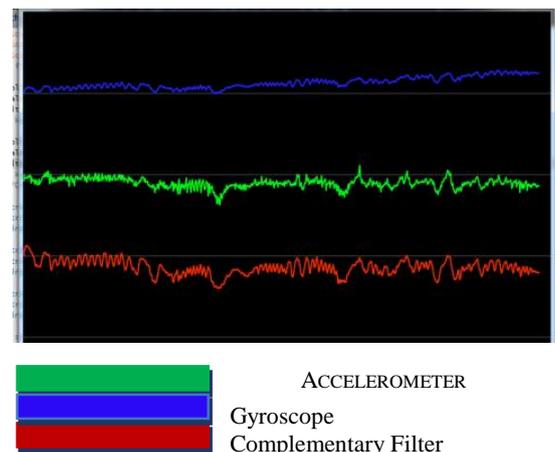


Fig. 17. Output Sensor y-axis

V. ANALYSIS AND SIMULATION RESULT

Testing in this paper using MATLAB Fuzzy Inference System Editor (FIS Editor) with Takagi Sugeno method. Fuzzy Toolbox is used to facilitate the use of fuzzy logic in MATLAB that can be seen in Figure 18.

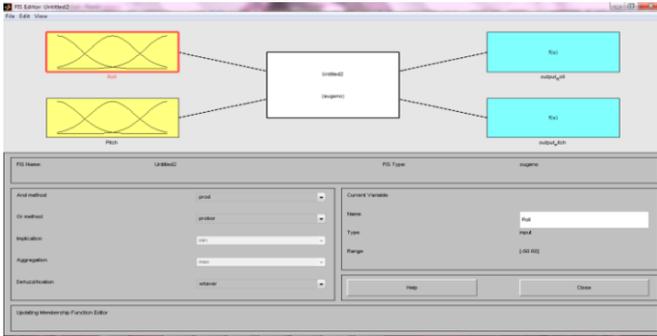


Fig. 18 . Fuzzy Inference System Editor (FIS Editor)

The first validation process is performed while fuzzification process where we determine that the input angle x-axis (roll) and the input angle y-axis (pitch) and the output of a brushless gimbal duty cycle consisting of roll and pitch output. The range of values for the input linguistic angle of the x-axis (roll) is (-60°) -60°. While the angle of the y-axis (pitch) is (-30°) - 30°. The range of values of the linguistic output brushless roll is (-80%) - 80%. As for the output brushless pitch is (-40%) - (40%).

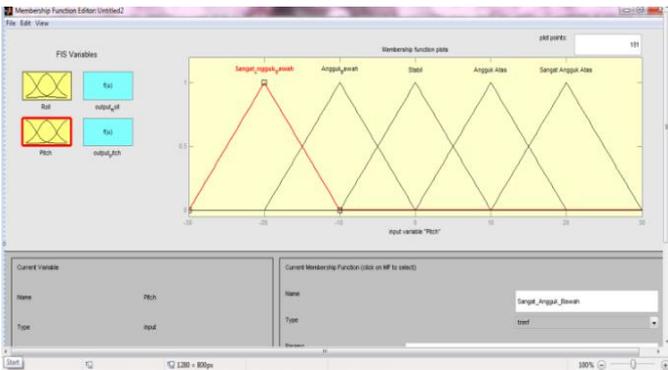


Fig. 19 Degree of Membership Functions Input x-axis (roll)

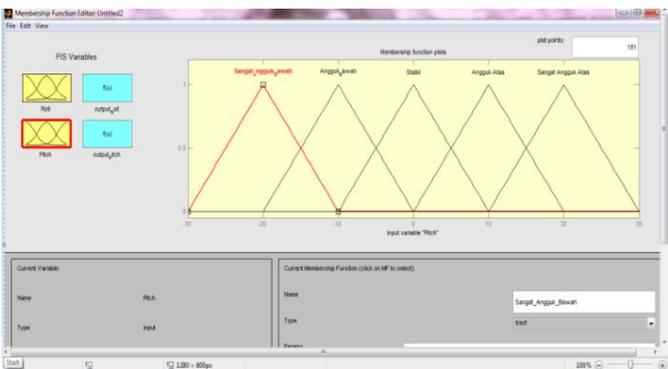


Fig. 20 Degree of Membership Functions Input oy-axis(pitch)

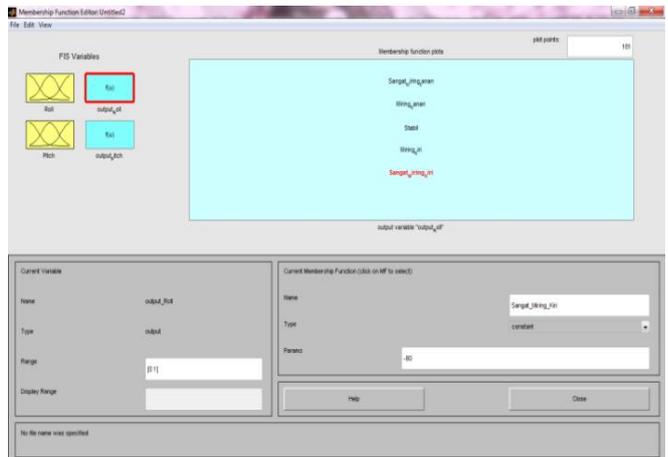


Fig. 21 Degree of Membership Function Duty Cycle Output (Roll)

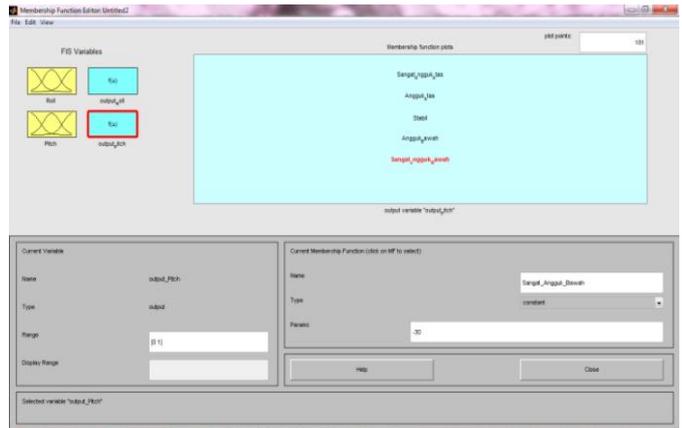


Fig. 22 Degree of Membership Function Duty Cycle Output (Pitch)

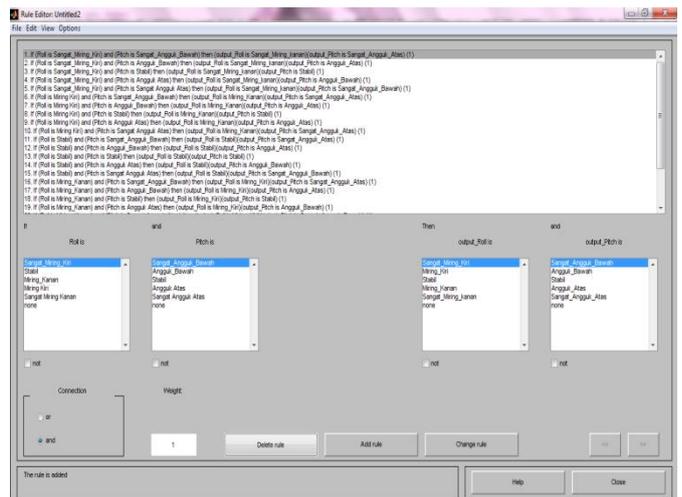


Fig. 23 Rule Base\_1

The second process validation on Fuzzy Inference System Editor determine the rule base. In this system there are 25 rule base, each of which has a corresponding input and output. To see the rule base of the fuzzy inference system editor can be seen in Figure below :

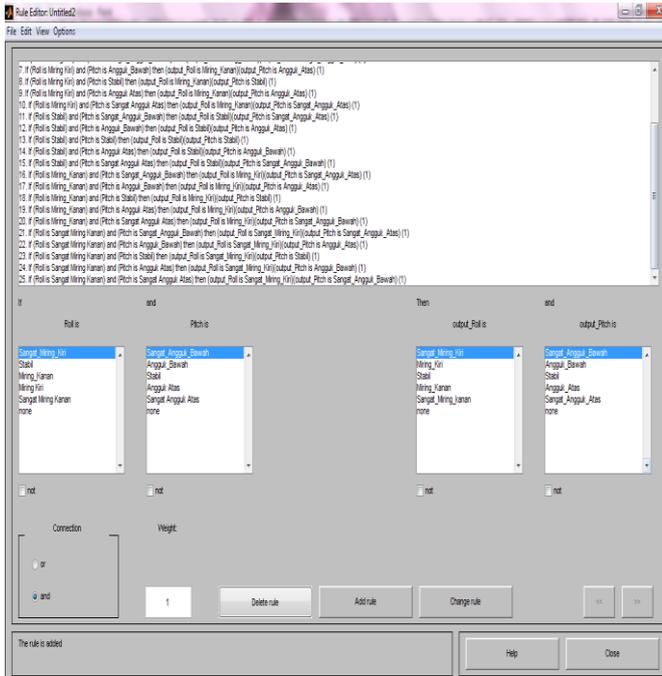


Fig. 24 Rule Base\_2

A simple case studies of the value of the two inputs on the roll and pitch is 35° and 17°. What is the value of output duty cycle is generated?

In the rule viewer FIS Editor, the value of both inputs 35° and 17°. will be entered into the *Fuzzy Inference System Editor (FIS Editor)* to see the results of fuzzy simulation. The output can be seen in figure 24 which shows the results of roll -70% and the results of pitch -25.5%.

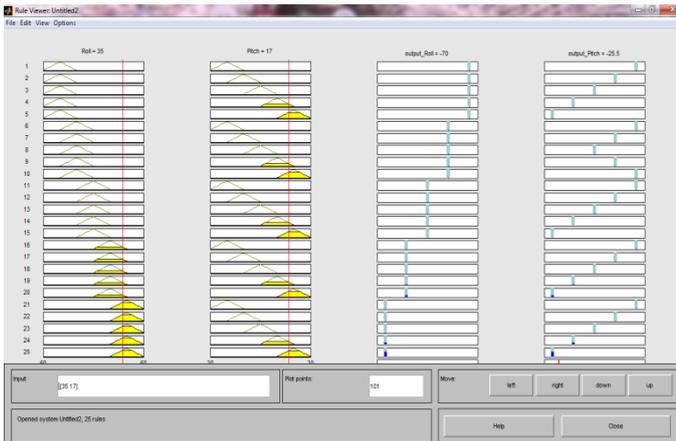


Fig. 25 Results of MATLAB FIS Editor

To test this MATLAB simulation results, we can use a manual calculation using the formula.

a. Output Roll

$$y * = \frac{[(0.25) * (-40)] + [(0.7) * (-80)]}{(0.25) + (0.7)}$$

$$\frac{(-10) + (-56)}{0.95}$$

$$\frac{(-66)}{0.95}$$

$$y * = -69,47 \%$$

b. Output Pitch

$$y * = \frac{[(0.3) * (-15)] + [(0.7) * (-30)]}{(0.3) + (0.7)}$$

$$\frac{(-4.5) + (-21)}{1}$$

$$\frac{(-25.5)}{1}$$

$$y * = -25,5 \%$$

VI. CONCLUSIONS

After testing and analysis on the implementation of the stabilisation gimbal camera system, it can be concluded:

1. The results showed that the sensor output data has noise that greatly affect the stability of the 2-axis gimbal camera, so the author uses a complementary filter to reduce the noise of the sensor output in order to get more accurate data and menggabungkan cover the advantages and disadvantages of each sensor.
2. Studies case to output brushless 2-axis gimbal camera using fuzzy logic method manually later in validation while using MATLAB (Fuzzy Inference system Editor) showed similar results with 2 inputs and 2 outputs. Where the duty cycle output for brushless roll (x-axis) is -69.47% is rounded to -70% on MATLAB and the output duty cycle for brushless pitch (y-axis) is -25.5%.

ACKNOWLEDGMENT

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# Noise Reduction Technique for Heart Rate Monitoring Devices

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**Abstract**— Electrocardiogram (ECG) signal has been widely used to detect the heart rate of the human, and it is useful in cardiac pathology. ECG detects several heart diseases of the patients. Wearable technology comes to be conducted as work as the monitoring devices to get the ECG signal directly from the patients. However, the movement of the patients will cause noises which interfere the result of the ECG. To overcome this problem, the digital filter is proposed to be designed and used in getting an accurate ECG signal. The filtering ECG results give likely in analysing the heart disease. The structures and the coefficients of the digital filters are designed using Filter Design & Analysis (FDA) tool in MATLAB. The analysis of magnitude response is done in two type of the digital filter - the infinite impulse response (IIR) and finite impulse response (FIR). This paper evaluates that the FIR digital filter is more stable and better to be used in removing noise from ECG signals.

**Keywords**— Electrocardiogram; noise reduction technique; digital filter; Finite Impulse Response (FIR); Infinite Impulse Response (IIR)

## I. INTRODUCTION

There are more than six billion people alive today, and the number is expected to reach nine billion in another 30 to 40 years. This projected growth in population because of testament to medical and agricultural successes; it brings in declining birth rate and rate on aging population getting increase. As a result, it is expected that more elderly people than the young children for the first time in human history. The services and the quantities on hospital cannot stand for this booming population. The wearable technology provides the solution to sustain for people and get rid in solving these problems.

Wearable technology may provide an integral part of the solution for providing health care to a growing world population that will be strained by a ballooning aging population. By providing a means to conduct telemedicine – the monitoring, recording, and the transmission of physiological signal from outside of the hospital – wearable technology solutions could ease the burden on health-care personal and use hospital space for emergent or responsive care [1].

The electrocardiogram will be focused in measuring by using the wearable technology. The ECG is a tool that used to record the electrical and muscular functions of the heart in exquisite detail. It is also a non-invasive test that records the electrical activity of heart over time and it is very useful in the investigation of heart disease, for example a cardiac arrhythmia. The electrodes which placed on the body's surface

can be used to measure the signal generated by rhythmic contractions of the heart. The function of the pumping blood of heart performs through the circulatory in human body. But the every movement will lead the electrode give a noisy ECG. Filtering is important and required to be the step on getting a clean ECG signal. To achieve the requirement on cancellation the noise from the ECG signal, designing the filter is indeed.

In the figure 1 below is a clean and normal ECG signal. The ECG signal waveforms consists of six continuous electromagnetic peaks which namely as P wave, QRS wave, T wave and U wave. First, the P wave gives the activation of the right and left atria. Depolarization of the right and left ventricles is reflected by the QRS complex. The T wave shows ventricular activation. The main function of the electrocardiogram is used to measure the rate and the rhythm of the heartbeat, as well as provide indirectly become an evidence of blood flow to heart muscle [2].

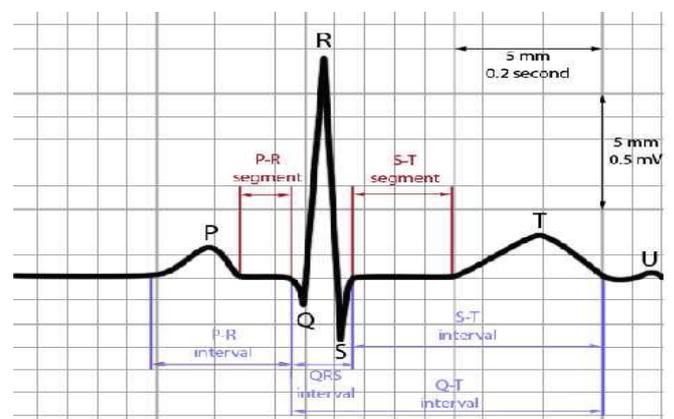


Fig.1 1v Normal ECG signal [2]

### A. Various kinds of artifacts

The ECG signal will get to be corrupted due to different types of artifacts and interferences such as powerline interference, electrode contact noise, muscle contraction, baseline drift, instrumentation noise which is generated electronic and mechanical devices, electrosurgical noise as described as below [2-5]:

**Baseline wander:** The patients' movement and their respiration can cause the low frequency wander. The wander T peak which is higher than R peak will cause detected as R peak. The variation on amplitude is 15% of the peak to peak of the ECG amplitude.

**Electrode contact noise:** The loss contact between the electrode and the skin generated that disconnects the measurement system from the subject. The result of movement and vibration would be the case on loosing the electrode is brought in or out of the contact of the skin in permanent or can be intermittent. The duration is in 1 sec only and the amplitude is maximum recorder output with the frequency 60Hz.

**Powerline interference:** Powerline interference contains 50/60Hz pickup and harmonics that can be modelled as sinusoids and combination of sinusoids. Its amplitude can rise up to 50% of peak to peak of the ECG amplitude.

**Muscle contractions (EMG):** This type of noise brings artifactualmilivolt-level potentials but it usually insignificant. The standard deviation is about 10% of the peak to peak ECG amplitude and the frequency content –dc to 10 KHz.

**Motion artifact:** Motion artifact happens in a transient baseline changes in the electrode-skin impedance with electrode motion. The ECG amplifier sees different source impedance which forms a voltage divider with the amplifier input impedance therefore the amplifier input voltage depends upon the source impedance which changes as the electrode position changes as the impedance changes. The duration is between 100 to 500ms and the amplitude is 500% percent of peak-to-peak of the ECG amplitude.

For correct extraction of the features of ECG signal, these significant noise signals that corrupt ECG signal have to be cancelled. Digital filter makes the noise reduction to produce the ECG signal measurement more accurate [2-5].

## II. LITERATURE REVIEW

Different techniques and method on noise reduction have been proposed and supported by many researchers. Sonuet al presented the moving median filter with the help of artificial neural network system and successfully denoised ECG signal [6]. Poornachandra suggested a wavelet-based denoising technique for the recovery of signal contaminated by white additive Gaussian noise and investigates the noise free reconstruction property of universal threshold [7]. There are several samples and efficient signs and errors nonlinearity-based adaptive filters, which are computationally superior having multiplier free weight update loops are used for cancellation of noise in electrocardiographic (ECG) signals by Muhammad [8]. Rahman et al proposed some samples and efficient sign based normalized adaptive filters, which are computationally superior having multiplier free weight update loops are used for cancelation of noise in electrocardiographic (ECG) signals [9]. Monisha et al used two types of filtering, the first type is bandpass filtering of ECG, the filter taken from Pan Tompkins' algorithm of QRS detection and the second type is Savitzky-Golay filtering of ECG in requirement noise reduction for accurate representation [10]. Sanyal et al used a time frequency transformation technique which is based on smooth wavelet tight frame with vanishing moments to eliminate baseline wander from ECG signal [11].LMS, NLMS,RLS and BPNN algorithm are utilized for the comparison noise cancellation and the analysis of ECG signal presented in paper [12].

Different digital filter is designed to achieve this cancellation of significant noise in ECG. Mbachu et al designed and implemented FIR filter with hamming window for reducing 50Hz powerline noise in ECG signal. Thus, the comparison on the effectiveness between the filter designed with hamming window and adaptive filter is carried out [13].Smita et al proposed two types of filter, band-pass filter and notch filter, in removal of noise like baseline wander and powerline interference from signal [14].

## III. METHODOLOGY

In this paper, the data is collected from the PhysioNet [15]. It provides several types of physiologic signals such as ECG signal, thus the analysis is done by using the data from MIT-BIHdatabase provided by PhysioNet.The collected ECGs are from MIT-BIH Arrhythmia Database which is a set of over 4000 long term Holter recordings that were obtained by the Beth Israel Hospital Arrhythmia Laboratory between 1975 and 1979. Twenty-three recordings were chosen at random from a set of 4000 24-hour ambulatory ECG recordings collected from a mixed population of inpatients (about 60%) and outpatients (about 40%) at Boston's Beth Israel Hospital; the remaining 25 recordings were selected from the same set to include less common but clinically significant arrhythmias that would not be well-represented in a small random sample. The data is sampled with sampling frequency of 360 Hz per second per channel with 11-bit resolution over a 10 mV range. This directory contains the entire MIT-BIH Arrhythmia Database. About half (25 of 48 complete records, and reference annotation files for all 48 records). The database contains 23 records (numbered from 100 to 124 inclusive with some numbers missing) chosen at random from this set, and 25 records (numbered from 200 to 234 inclusive, with some numbers missing) selected from the same set to include a variety of rare but clinically important phenomena that would not be well represented by a small random sample of Holter recordings. Figure 2 shows an example of the ECG signal of the patient who hasarrhythmia disease [15].

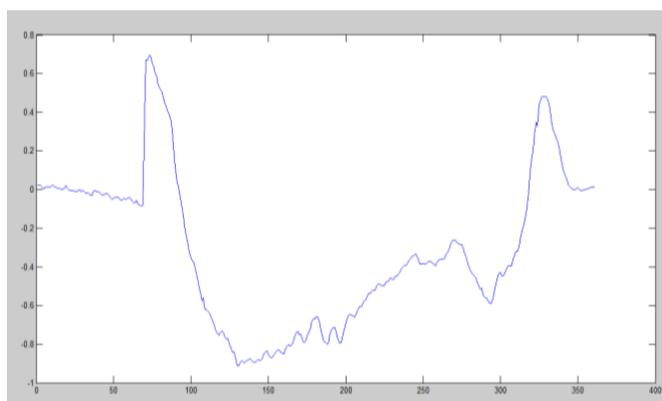


Fig. 2 The Arrhythmia disease ECG [15]

MATLAB is used to evaluate both digital filters performance on FIR and IIR, instead of their capability to eliminate the noise from ECG. Parameters in FDA tool are set up with sampling frequency 360 Hz and minimum order.

The effectiveness of the performance of the FIR digital filter is determined by the number of order used. High order will give stable response of filter for the system.

#### IV. DIGITAL FILTER FOR NOISE REMOVAL

##### A. Infinite Impulse Response (IIR)

By having an impulse response, IIR filters are outstanding by which does not become exactly zero past a certain point, but continuous indefinitely. This is in contrast to a finite impulse response (FIR) in which the impulse response  $h(t)$  does become exactly zero at times  $t > T$  for some finite  $T$ , thus being of finite duration. In practice, the impulse response even of IIR systems usually approaches zero and can be neglected past a certain point [16].

The IIR system function in the  $z$ -plane is [16]:

$$H(z) = \frac{\sum_{k=0}^M b_k z^{-k}}{\sum_{k=1}^N a_k z^{-k}} \quad (1)$$

where  $a_k$  and  $b_k$  are the filter coefficients,  $M$  the number of zeros and  $N$  the number of poles. The function shows that the output of IIR depends on the input before it as AND output samples.

The problems which IIR brings are they do not have a linear-phase characteristics, so they should not be used when the applications where linearity is a big issue. The poles and zeros must stay in the unit circle to eliminate from the poor designed of the IIR [16].

##### B. Finite Impulse filter (FIR)

It has the impulse response which is finite duration, since it settles to zero in finite time. FIR is in contrast to infinite impulse response (IIR) filters, which may have internal feedback and may continue to respond indefinitely (usually decaying). The impulse response of an  $N$ th-order discrete-time FIR filter lasts exactly  $N + 1$  samples (from first nonzero element through last nonzero element) before it then settles to zero [16].

#### V. RESULT AND DISCUSSION

To evaluate the performance of the filter means to select the coefficients such that the system has specific characteristics. The required characteristics are stated in filter specifications. Most of the time filter specifications refer to the frequency response of the filter. There are different methods to find the coefficients from frequency specifications:

##### A. Window Design Method:

The main idea behind the Window Design Method is to consider an ideal IIR filter and then apply a window function to it. This is - in time domain- a multiplication of the infinite impulse by the window function. These results in the frequency response of the IIR being convolved with the frequency response of the window function – thus the imperfections of the FIR filter (compared to the ideal IIR filter) can be understood in terms of the frequency response of the window function [17].

##### B. Frequency Sampling Method:

This type of design method is using a filter with a frequency response exactly equal to the desired response at a particular set of frequencies [17]. In this paper, the frequency sampling is set to be 360 Hz.

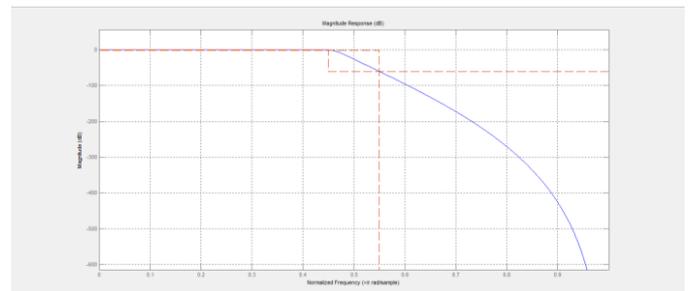


Fig. 3 IIR magnitude response with minimum order

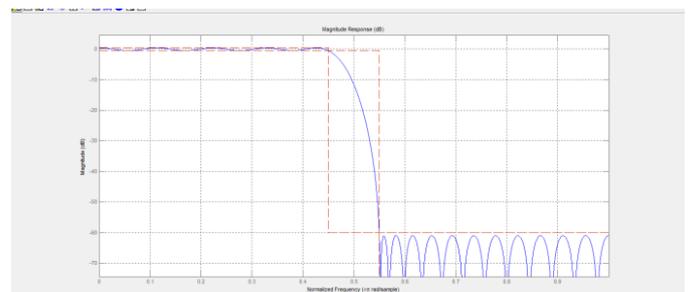


Fig. 4 FIR magnitude response with minimum order

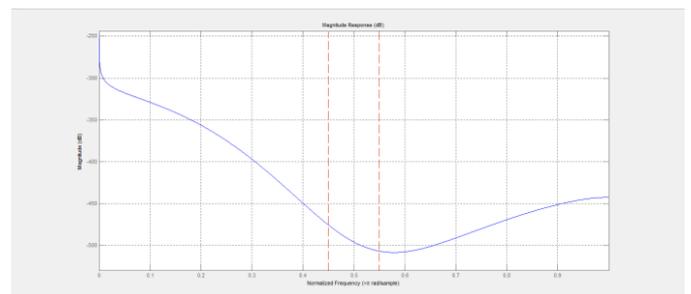


Fig. 5 IIR magnitude response with maximum 50 order

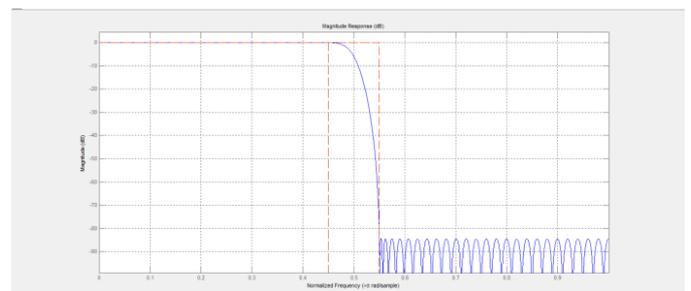


Fig. 6 FIR magnitude response with 100 order

As shown in Fig3, Fig 4, Fig 5 and Fig 6, each of the graphs have their own result for IIR and FIR filter in term of magnitude response. Fig 3 and Fig 4 shows that the minimum order for the IIR and FIR filter. From the graph, this shows that the range of the FIR filter is wider than IIR. For the Fig 5, the maximum order for the IIR is shown and it cannot stand for the filter order which is more than 50. But at the same time, the FIR can support more than 50 orders which is until 100 which is twice of the IIR's order as shown in Fig 6.

Based on the analysis above, FIR filters can be easier to design in order to fulfill a particular frequency response requirement. Furthermore, FIR filters can be easily made to be linear phase a property that is not easily met using IIR filters and then only as an approximation. Another issue regarding

digital IIR filters is the potential for limit cycle behaviour when ideal, due to the feedback system in conjunction with quantization [18].

Comparison on FIR over the filter IIR. The FIR filters have the following advantages over the IIR [3, 19].

- a. FIR always stable and its feedback is not involved
- b. FIR has the exact linear phase while IIR can be only be used in the applications where the linear characteristics are not concerned.
- c. It brings effectiveness realizable in hardware.
- d. The response of the FIR is finite.

## VI. CONCLUSION

From the graph above, it shows that the finite impulse response (FIR) filter gives the magnitude response which has a better limited number of terms than the infinite impulse response (IIR). FIR will be chosen and used to be designed on the noise reduction issues in the wearable technology monitoring devices. The investigation will be done further on the designing on FIR digital filter and be implemented with the wearable technology.

## ACKNOWLEDGMENT

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# Implementation of Quadcopter for Capturing Panoramic Image at Sedayu Bantul

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**Abstract**—The aims of this study to deploy an aerial photography system has the ability to capture panoramic image of specific area. The planned research activities completed within 2 years, with the first year's target is Quadcopter design and manufacture that is equipped with a camera for image acquisition process. Target for the second year is shooting and processing panoramic images thus obtained are accurate. The steps to implement this study are divided into two parts: 1) the design and manufacture of quadcopter and 2) implementation of image capture and processing. The expected results of the study is the automated system that have capability of imaging an area and perform image stitching on the imaging results so obtained image represents an area with a particular area with an adequate level of resolution. Thus this system can be referred for the next advance that is more complex for example: prediction system of agricultural crops with aerial photography, residential density estimation system with aerial photos, and hazard mitigation systems by using aerial photographs. The preliminary result of this research is panoramic images capturing with quadcopter. Quadcopter could flight as high as 6 meters for 3 minutes. Improvement is expected to reach flight capability of quadcopter as high as 100 m within 10 minutes flight time minimum.

**Keywords**— aerial image, panoramic image, otomatic system, image stitching, quadcopter

## I. INTRODUCTION

Aerial photography (aerial photography) is a process of taking a photo or image of an area that is made from a certain height. In general, this process is done with a camera that does not use a buffer which rests on the ground. Camera for aerial photography generally installed on an aerospace vehicle or carried by a person while they are in the aerospace vehicle. The process image is taken with manual control or remote control or automatic control. Rides are often used in aerial photography include aircraft, helicopters, unmanned multicopter rides, balloon, rocket, kite or parachute.

Quadcopter (Quadrotor) is a vehicle multicopter (propellers plural) that has four propellers, located at the four corners of the vehicle. The propeller quadcopter is fixed pitch, which does not change the angle to the axis of rotation during operation. Examples quadcopter as shown in Figure 1 below. Quadcopter aerospace vehicle is one that is currently very popular studied and used in various applications, eg for the purposes of SAR (search and rescue) as well as the purpose of sensing / imaging.

Image stitching or photo stitching is the process of combining multiple images which have overlapping part to produce a panoramic image and high-resolution images. This process is usually done using computer software, the most common approach used is similar to overlap and similar light levels to be able to obtain a smooth result.

## II. OBJECTIVE

The main benefit of this research is expected to contribute to the development of science and technology fields of electrical engineering and in particular for the development of sensing systems based quadcopter aerial photographs which serve to produce a panoramic image of the rice fields in the area of Sedayu Bantul.

## III. LITERATURE REVIEW

Changes in the angle of nod (pitch) is affected by changes in rotor speed difference in numbers 1 and 3, as shown in Figure 1, which will result in the movement forward or backward on the quadcopter. If we do the same thing on the rotor numbers 2 and 4 it will produce tumble angle changes, which in turn causes lateral movement (sideways).

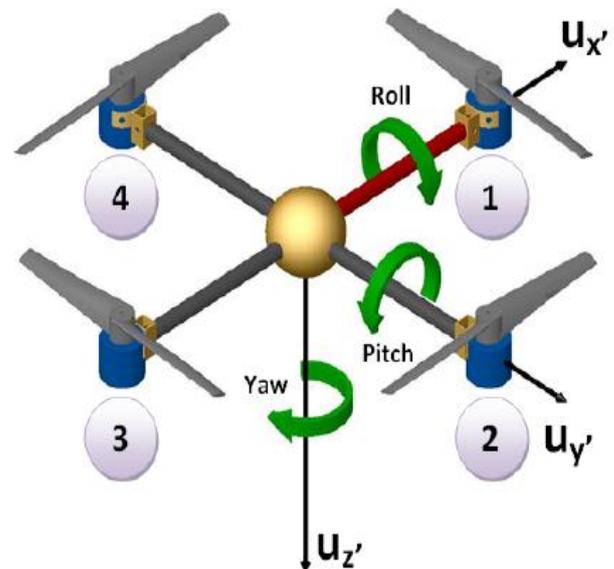


Fig. 1 Angles of quadcoptere

As depicted at figure 2, shake can be obtained by altering the aerodynamic torque balance (set to occur on the thrust cumulative offset between pairs rotor rotating in opposite directions, so that by making changes to the third corner (nod, roll and shake), we can arrange for quadcopter maneuvered in all directions [1].

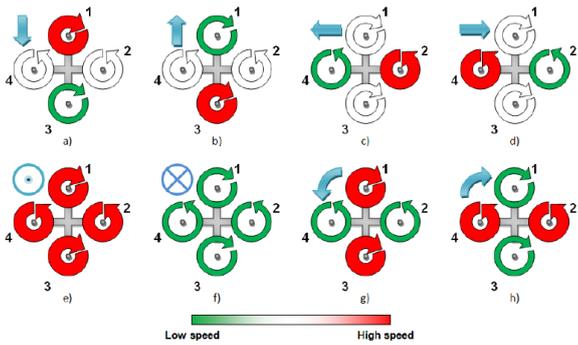


Fig. 2 Manauver of *quadcoptere*

Image stitching process can be divided into three main components, namely component recording (registration) imagery, calibration components and component mixing (blending) [2].

IV. RESEARCH METHODOLOGY

The materials used in this study are: Module digital camera, component mechanical, electronic sensors and Wifi module. Meanwhile the other instruments used to carry out this research are: Computer with specification Intel Core-i3, 2,7GHz, 2GB DDRAM. This computer is used for image stitching process with Visual Studio 2012.

A. System Design

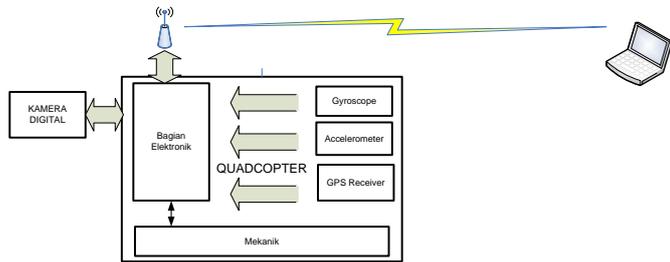


Fig. 3 Aerial System based on *quadcoptere*

Fig 3 shows that diagram block could be defined as follow : Digital camera module is deployed for capturing images from the air and produce a digital image format. Quadcopter is a vehicle carrying a camera and a webcam to the location in a certain height. Data transmission system, is implemented use Wifi Module as media transmission digital image from quadcopter to main processor also data transmission controlling and navigation from main processor to quadcopter. Main processor is arranged by hardware and software.

B. Quadcopter

In this study the quadcopter type is AR.DRONE 2.0, with specification as follow : **Main Processor:** 1GHz 32 bit ARM Cortex A8 processor dengan 800MHz video DSP TMS320DMC64x, Linux 2.6.32, 1Gbit DDR2 RAM at 200MHz, Port USB 2.0 , Wi-Fi b,g,n. **Sensor :** Gyroskop 3 axis with a precision of 2000 ° / sec, 3-axis accelerometer with a precision of + -50mg, 3-axis magnetometer with a 6 ° accuracy, thoroughness +/- Pressure Sensor with 10 Pa, Ultrasonic Sensors for measuring height / distance to the soil surface 60 fps QVGA camera mounted vertically for speed measurement. **Capturing Camera :** HD Camera. 720p 30fps,

wide-angle lens: 92 ° diagonal.. **Motor :** 4 inrunner brushless motors 14.5W 28,500 rpm, Micro ball bearing, AVR microcontroller for each motor controller board.

A.

C. Quadcopter Software Controller

Software that allows the operating system windows things required to make the adjustment and control AR.Drone2.0. Software is widely used feature in AR.Drone SDK 2.1. Facilities that have been successfully developed in this software are: The ability to make a connection with the AR.Drone, make delivery arrangements AR.Drone, exercise control, receive and display navdata, display live streaming video from the AR.Drone, perform a snapshot (image capture), and the simple ability to autopilot settings.

D. Image Processing Software

To be able to compose a picture / image of the panorama, the basic idea is to define the same points in the two images are there and continued projecting one image over another image, so that these points can be met. To be able to determine the location of these points, which is hereinafter referred to as interest points, used corner detection method known as Harris Corners Detector.

To be able to compose a picture / image of the panorama, the basic idea is to uncertain Once detected, the operation needs to be done to make the correlation between those points that exist in the two images to be merged. This operation is done by analyzing a window / area number of pixels that are around the point which has been found in the first image and correlate to the window / area number of pixels that are around the point which has been found in the second image.

The points which has the two-way maximum correlation will be taken as a pair between two existing image. After pairing between the same points on the second image can be found then this is a kind of image transformations that can be used to project an image on top of another image with a given to the points the same on both the image, it is commonly called homografi. This research used RANSAC, random sample consensus.

V. RESULT

The example of image capturing by quadcopter is shown in figure 4.

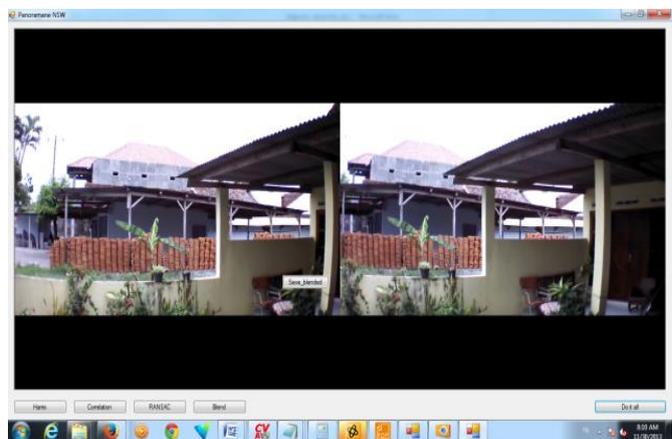


Fig. 4 Capturing image before stitching operation

As shown in figure 4, capturing image are in partial form. In the next process, both of the image will be stitched by Harris Corner Detector operation as depicted in figure 5.



Fig. 5 Quadcopter image after Harris Corner Detector operation

## VI. CONCLUSIONS

Aerial photography system with image stitching based quadcopter could work well to make the process of aerial photographs. The preliminary result of this research is panoramic images capturing by quadcopter. Quadcopter flight as high as 6 meters for 3 minutes. Improvement is expected to the future so it could fly at 100 m in 10 minutes minimum flight time.

## ACKNOWLEDGMENT

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# First Person View on Flying Robot For Real Time Monitoring

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**Abstract**— Radio control nowadays not only control the car but can control the copter. First Person View is a way to change the viewpoint of the controller looks like in the copter. By using radio telemetry communication that sends video data from the camera on the copter and will be shown on a display on ground station. Radio telemetry communication will use wideband modulation techniques to transmit video at high speed until the video is shown to be a real time video. The transmitter has been designed which is able to transmit video data up to 1 kilometers. Good quality video data can be sent about 500 meters below. measurement of Peak Signal to Noise Ratio (PSNR) that distance and wall are greatly affect the quality of the video. Deficiencies in the delivery of video communication can be minimized by increasing the gain and transmission power of the radio frequency telemetry and matching between the video telemetry radio and radio control copter.

**Keywords**— Hexacopter, Remote Control, Telemetry, Receiver, Transmitter, FPV, PSNR

## I. INTRODUCTION

Hexacopter controllers often only done at close distances, due to the limitations of the controller to see hexacopter. To overcome it, then do the monitoring on the area around the copter can make controlling hexacopter at longer distances. Monitoring is monitoring carried out to collect data and make measurements progress toward an object. One way to do air monitoring at the hexacopter using First person view (FPV). FPV makes the controller has a point of view seems to be inside the hexacopter. To do perancangan it takes some additional data communication with the device at high speed. Some of these devices such as mini-cameras, video sender and display.

## II. MATERIALS AND METHOD

### A. Hexacopter

Among world Aeromodeling may already be familiar with the term Multicopter or Multicopter. Multicopter is the spacecraft flown by the rotor, which amounted to more than one, is divided into several types that are widely used for beginners which include twincopter (2 rotor), tricopter (3 rotor), quadcopter (4 rotors) and for the more advance for Arial Video or photography where benefits have a bigger lift making it capable of raising professional camera/video i.e., hexacopter (6 rotors) and octocopter (8 rotors) [1]. Hexacopter using three pairs of propeller CCW CW with into 6 propeller. Where each pair of opposite motor rotates in the opposite direction. This allows the copter to turn (yaw) right or left by speeding up and slowing down one pair and another pair of rotors. Horizontal

movement is done by accelerating the rotor (increasing thrust) on one side and decrease it. [1]

There are 2 Configuration synchronization motor brushless commonly used at the hexacopter, namely configuration frame plus (+) and the frame X (x).

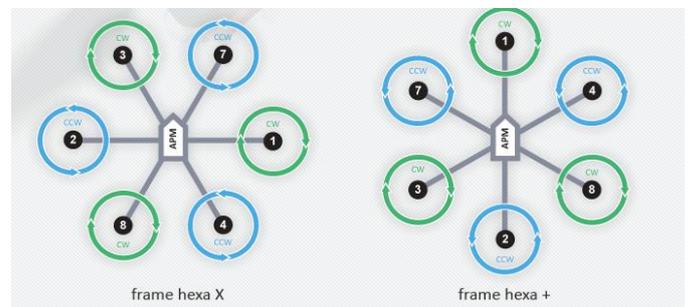


Fig. 1 Frame Hexacopter

### B. Monitoring system

The monitoring system is a process of collecting data about themselves and perform analysis of these data with the aim to maximize all of its resources. Where is the data that has been collected real-time data, whether the data is obtained from the hard real-time systems and systems soft real-time. Processes that occur in the monitoring system generally has a 3 processes, namely data collection, data analysis, and show result data. Source of data to be retrieved may include information about the hardware, experiments on the system, or other sources to be obtained about the system itself. The process of data analysis is the selection of the data that has been obtained or can also be a manipulation of the data thus obtained the expected information. And featuring result data to be information from the previous process which is useful for taking decisions on the running system and can be a curve, images, tables or animation.

### C. First Person View

First Person View or FPV is a system that change the way pilots (vehicle control) becomes as if it were on the bicycle itself. Vehicle radio control (RC) which is controlled from the pilot viewpoint originated from an onboard camera and transmitted via wireless to a display, using either the LCD monitor or goggles porteble. FPV involves installing a small video camera and video transmitter analog RC plane and flew via live video, usually displayed on a video glasses (goggles) or a portable LCD screen. As a result, FPV aircraft can be flown well beyond visual range which is limited only by the reach of the eye while flying vehicle. [3]

### D. Peak Signal to Noise Ratio (PSNR)

Video quality measurement method is the calculation of widespread Peak signal to noise ratio (PSNR) image after image. PSNR is a derivative of the signal to noise ratio (SNR) that compares the error signal energy with energy. PSNR is the basis of the quality metrics used in the framework to test the results of video quality. PSNR comparing the maximum possible signal energy to the energy error, which has been shown to result in a higher correlation with subjective quality perception with conventional SNR.

$$PSNR(n)_{db} = 20 \log_{10} \left( \frac{V_{peak}}{\sqrt{\frac{1}{N_{col} N_{row}} \sum_{i=0}^{N_{col}} \sum_{j=0}^{N_{row}} [Y_S(n, i, j) - Y_D(n, i, j)]^2}} \right) \quad (1)$$

E. Transmitter

Data transmission from the camera to the display using medium frequency radio with a high frequency is 5.8 GHz. transmitter has some electronic circuit to modulate the input signal into an analog signal to be transmitted as a VCO (Voltage Controlled Oscillator), PLL (Phase-Locked Loop), amplifiers, and digital control circuits.

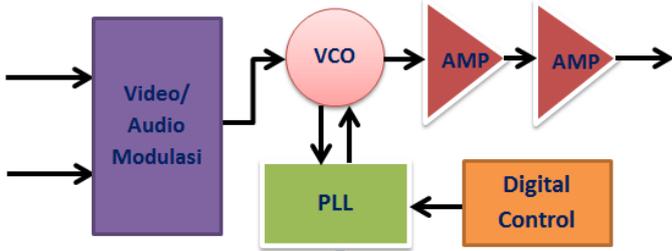


Fig. 2 Block Diagram of The Transmitter

F. Receiver

Receiver is also a combination of some of the same series as the transmitter, such as a VCO (Voltage Controlled Oscillator), PLL (Phase-Locked Loop), amplifiers, and digital control circuits. But the difference between the transmitter and receiver are on the receiver there is also a series of LNA (low noise amplifier) as the received signal amplifier, then there is a low pass filter (LTF) and SAW filters for filtering the received signal from the noise, and mixer circuits to separate between data signal and the carrier signal.

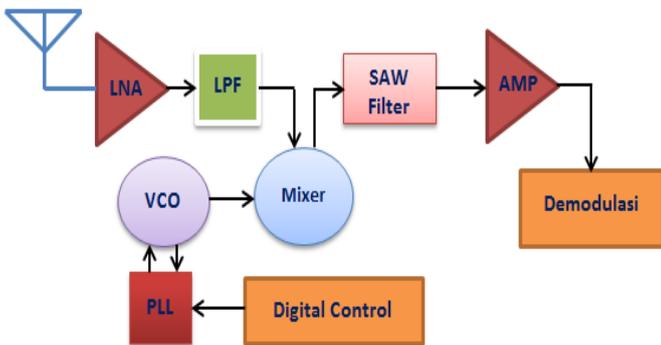


Fig. 3 Block Diagram Of The Receiver

III. DESIGN AND IMPLEMENTATION SYSTEM

FPV system starts from a video capture performed by the camera and the camera will send the data to the telemetry. In the video data telemetry will be superimposed on the carrier signal is sent over the air to the receiver. Receiver will separate the information signal and the carrier signal. Then the signal information will be sent via Audio Video output to the display. Display will featuring video data so the area around the copter can be monitored.

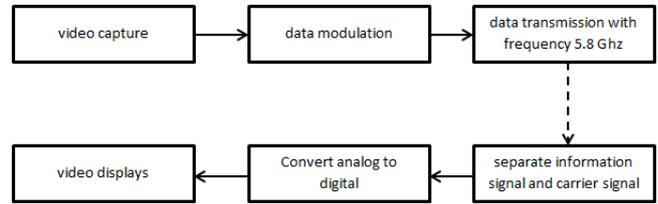


Fig. 4 Communication Block

A. Hardware design

Mini camera will be mounted on the gimbal frame hexacopter used as video data retrieval module. TX TS832 is a telemetry transmitter used to send the data have been taken from the mini camera. Data received from the camera will TX TS832 modulated and converted into an analog signal that is modulated. Analog signal that has been modulated spread in the air and then propagate that can be received by the RX RC805. RX RC805 is a telemetry receiver which will demodulate analog signals into analog data captured. Analog data which is output from the RX RC805 actually can be displayed on the display but in this study the data must be processed and analyzed, the data will dimasuk to analog converter. In the analog data converter is converted into digital data and entered into the display or PC to be processed and displayed.

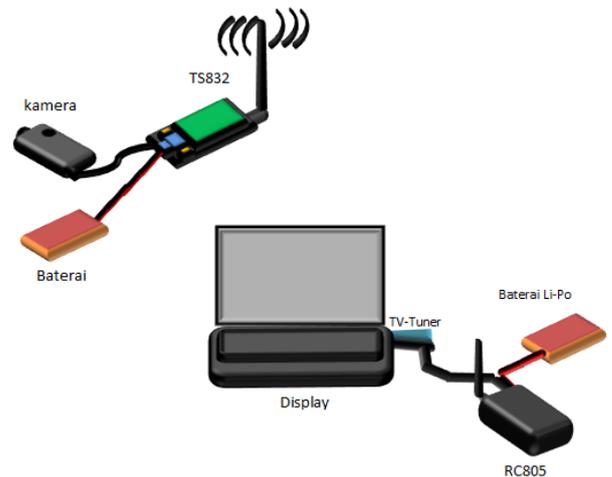


Fig. 5 Hardware Design

IV. TEST RESULTS AND ANALYSIS

Tests carried out to analyze the farthest distance to monitor use hexacopter. Testing is done from a distance of 1 meter to 1 kilometer where the distance is the distance between transmitter and receiver. The result will be a comparison between the data before it is sent and the data is sent after, to get the value of PSNR.

FPV system has been designed and can work well. Each component of the system can work well and the communication of data from the system is running as expected.

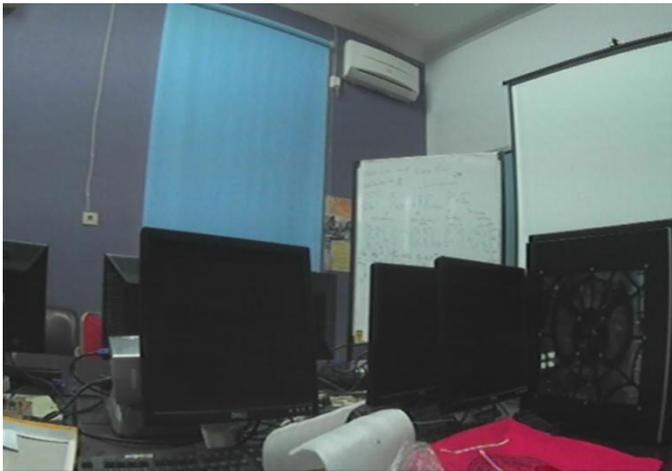


Fig. 6 Views On Display At Performance Testing System

In the first experimental results while the second condition has been met, but in close proximity. Maximum distance that can be on a video monitoring only 500 meters in the absence of obstacles between the transmitter and receiver. At a distance of more than 500 meters with the video quality will decrease PSNR below 30 db, thus proving that the distance affects the delivery of video data as well as lower transmission power so affects the video quality obtained.



Fig. 7 Results Video on Distance 500 Meter

## V. CONCLUSIONS

FPV systems can work well, but the initial design of the device only uses the standard video transmission cannot be performed with optimal distance. This can be achieved by adding a power gain of the antenna used transmitter and receiver. With the addition of making quality video with low noise ratio at a distance of over 500 meters. but at a distance of 500 meters with good video quality monitoring is sufficient to perform the air video. Time delay that occurs is in the category can be tolerated because of the time delay is less than 1 second.

## ACKNOWLEDGMENT

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# Design of Context Dependent Blending (CDB) in Behaviour Based Robot Using Particle Swarm Fuzzy Controller (PSFC)

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**Abstract**—Behaviour-based control architecture has successfully demonstrated their competence in mobile robot development. One key issue in behaviour-based design is the action selection problems. In behaviour-based system, a composite behaviour is implemented as a system using Context Dependent Blending (CDB) that activates the underlying individual behaviours according to the current robot's context in a certain degree. However, the compromises of conflicting behaviours decision might be sub-optimal or even worse than any of the individual commands. It is caused by using the un-optimized fuzzy context rules. Therefore, most of the works in the field generate a certain interest for the study of fuzzy systems with added learning capabilities for best fuzzy context rules. This paper presents the development of CDB with Flexible Fuzzy Context Rules (FFCR) using Particle Swarm Optimization (PSO) called as Particle Swarm Fuzzy Controller (PSFC). Several experiments with MagellanPro mobile robot have been performed to analyse the performance of the algorithm. A set of Fuzzy Context Rules, called as Single Fuzzy Context Rules (SFCR) are used as comparison. The promising results have proved that the proposed control architecture for mobile robot has better capability to accomplish special task in office-like environment.

**Keywords**— Behaviour Based Robot, Context Dependent Blending, Particle Swarm Optimization, Fuzzy Logic

## I. INTRODUCTION

Designing a mobile robot is a challenging task. Generally, the mobile robot should face complex environment, perceive imprecise sensor and act with imperfect actuator in fast response. Behaviour-based control architecture is an alternative approach suitable to address these problems. The architecture is able to act with fast real-time response, provides for higher-level deliberation and has demonstrated its reliable performance in standard robotic activities.

However, a kind of soft computing is needed to perform a key issue in behaviour-based systems named as Action Selection Problem [1] or Behaviour Coordination Problem. The problem arises here because it is necessary to decide which behaviour(s) should control the mobile robot at any given time to select the action that most satisfied the system goal. Several researchers have proposed various schemes to solve the problem.

Fuzzy logic system offers useful mechanism to address the behaviour coordination problem. The most general form of fuzzy behaviour coordination that realized using fuzzy logic is obtained by using both fuzzy context rules to represent the arbitration policy and fuzzy combination to perform command fusion [2]. This form of combination is initially suggested by Ruspini [3], then fully spelled by [4] and called as Context Dependent Blending (CDB). In CDB, preferences are

represented by fuzzy set of controls, generated by fuzzy controllers. The contexts are represented by formulas in fuzzy logic, which serve as the antecedent in the fuzzy arbitration rules. Fusion and choice are respectively performed by a fuzzy combination operator and by defuzzification.

However, the compromises of conflicting behaviours decision might be sub-optimal or even worse than any of the individual commands. It is caused by using the un-optimized fuzzy context rules. Therefore, most of the works in the field generate a certain interest for the study of fuzzy systems with added learning capabilities for best fuzzy context rules.

This paper presents a new behaviour coordination algorithm that coordinates predefined individual behaviours. The method will identify the preference context for each of them and then execute the optimized rules using Particle Swarm Fuzzy Controller (PSFC), a fuzzy system that its parameters are tuned automatically using Particle Swarm Optimization (PSO). The overview of behaviours interaction in fuzzy context rules is initially explained. Then, the block diagram of the proposed behaviour coordination algorithm is described and designed in the next sections. Several experiments will be run to determine the fuzzy context rules, to test the performance of the proposed algorithm and to be compared with other techniques.

## II. DESIGN METHODOLOGY

### A. Behaviour Based Robot

The analysis of behaviour is an important part. The main goal of the mobile robot must be investigated in detail. It is a top-down approach that involves decomposing the main objective into smaller ones; in such way that main objective is achieved as a result from the execution of simpler behaviours and from their interaction.

Based on the robot's target behaviour, the proposed approach decomposed the task of robot into four behaviours, namely: goal seeking behaviour (*goal*), left wall following behaviour (*lwall*), right wall following behaviour (*rwall*), and obstacle avoiding behaviour (*obs*). Goal seeking behaviour steers and moves the robot to the right direction and reach the goal effectively. The mobile robot movement towards the goal is according to the distance and angle between the current position of the mobile robot and the goal position. Furthermore, wall following behaviours navigate the robot to follow wall in order to help goal completion. Based on some distances measured between the mobile robot and the walls, the

mobile robot would maintain some fixed distance between both robot and the wall even at edges. Moreover, obstacle avoiding behaviour is responsible to control the robot from colliding with objects in the environment. Actually, the obstacle avoiding is a complex behaviour. The mobile robot has to detect first whether there is any obstacles or not. Then, the direction should be determined to avoid the obstacles. Some distances between the mobile robot and obstacles should be measured to complete the task of this behaviour. Each of behaviour generated two control actions that are linear velocity,  $v$ , and angular velocity,  $\omega$ , as outputs. Two types of sensors, odometer and sonar, are used to determine the current situation of the mobile robot. The mathematical model of the mobile robot and fuzzy system parameters applied here are based on our previous work [5].

Once the individual behaviours have been singled out, their interactions can, and must, be completely defined. According to Colombetti *et al.* [6], there are types of interactions among behaviours that should be taken into account. Those interactions are: independent sum, combination, suppression, and sequence. Ability to determine the appropriate behaviours interaction will result in a mobile robot that can perform tasks optimally, according to the shortest path and the fastest time.

The outputs of each behaviour in CDB are fused according to fuzzy meta rules or fuzzy context rules. The fusion process defines how outputs from different behaviours are mixed together in a fuzzy way to give a coherent output. The fuzzy context rules determine which behaviours are fired, and to what degree. Different types of behaviours interaction as described above can be expressed using fuzzy context rules based on different fuzzy operators. Mostly, fuzzy context rules designed by user as a planner for a certain environment are obtained by learning process or applying the available one. However, all fuzzy context rules are implemented in CDB as single rules.

A flexible fuzzy context rule (FFCR) is proposed in this work to obtain the best arbitration strategies corresponding to behaviours interaction required in any situation. Inspired by Saffiotti [6] that a mobile robot can perform a task in complex environment using a modular logical format of fuzzy context rules, a schema that has several different formats of fuzzy context rules is proposed in this work. These formats are used for the control rules and the arbitration rules according to behaviours interaction required in particular situation. The number of modules for fuzzy context rules corresponds to the number of behaviours coordination occurring in the mobile robot.

The FFCR block interprets each environment situation as an agent expressing preferences. These degrees of preferences are calculated by a fuzzy systems based on some parameters from sensors accordingly. Afterward, the behaviour coordination selection block will determine which behaviours are active in a particularly time from the degrees of preferences values. Then, based on fuzzy context rules corresponding to active behaviours, the degrees of preferences are combined into a collective preference as Behaviour Weight,  $BW$ , respectively. These behaviour weights determine which behaviour is fired and to what degree. Lastly, a final action as output of CDB will be generated by a defuzzifying process based on the collective preference values obtained and the control action from

behaviours, respectively. Fig. 1 provides a block diagram of CDB with FFCR.

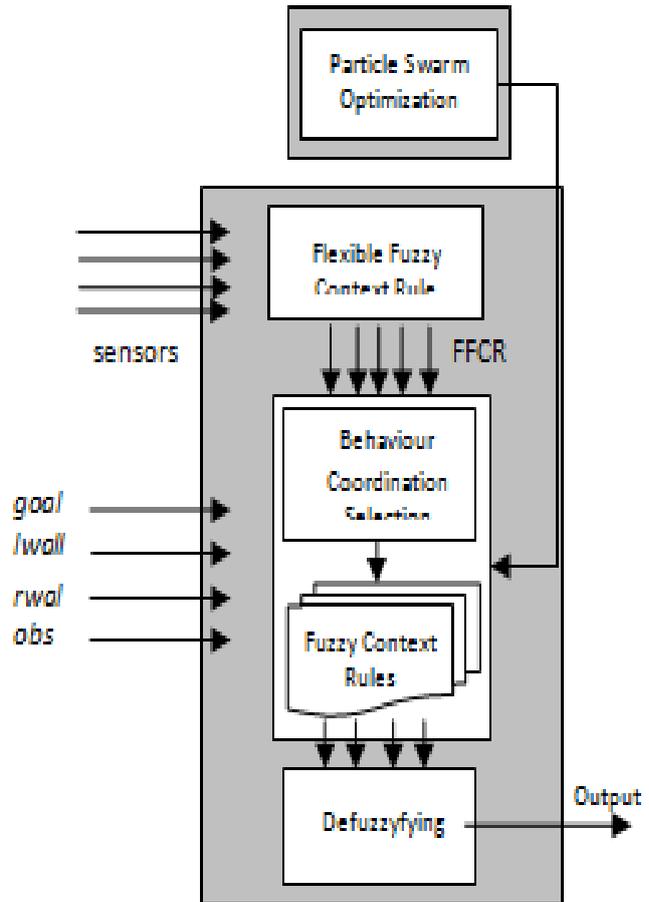


Fig. 1 Block Diagram of CDB with Flexible Fuzzy Context Rules

There are a number of fuzzy context rules in FFCR block according to the number of basic behaviours combination. In order to find the appropriate fuzzy context rules, the Particle Swarm Fuzzy Controller (PSFC), a fuzzy system that its parameters are tuned automatically using Particle Swarm Optimization (PSO), is used. Some PSO processes are run according to basic behaviours combination required and certain fitness function, respectively.

### B. Flexible Fuzzy Context Rules (FFCR)

In FFCR several parameters must be calculated in the fuzzy system. These parameters are the minimum distance of the front zone sensors,  $d_{front}$ , the minimum distance of the left zone sensors,  $d_{left}$ , the minimum distance of the right zone sensors,  $d_{right}$ , the minimum distance of the target,  $d_{goal}$ , and the angle of the target,  $\delta_{goal}$ .

The set of fuzzy Membership Functions and linguistic terms for those parameters are shown in Fig. 2. The values of  $a$ ,  $b$ , and  $c$  that are used in this work for the minimum distances are listed in Table 1. For the target angle, the value of  $c$  is chosen as  $\pi/16$ .

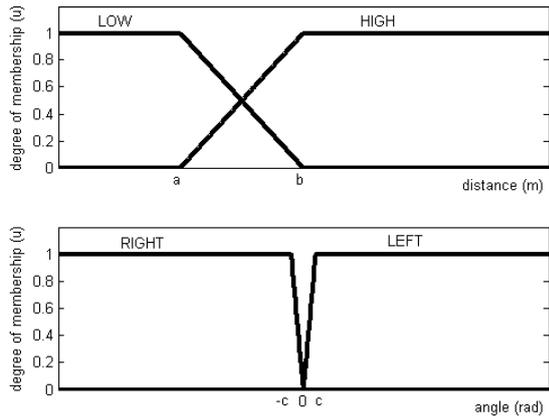


Fig. 2 Membership functions of minimum distances and target angle

TABLE I  
MEMBERSHIP FUNCTION VALUES OF MINIMUM DISTANCES

	a	b
$d_{front}$	0.8	1.2
$d_{left}$	0.4	0.8
$d_{right}$	0.4	0.8
$d_{goal}$	0.8	1.2

Each degree of membership value of those parameters determines the degree of preference. This value corresponds to the behaviours that active at a particularly time. These values are provided to FFCR block. Since there are four behaviours in this work and goal seeking behaviour, *goal*, is considered as a variable, the rests are concatenated as

$$obs. lwall. rwall \tag{1}$$

where the value of *obs*, *lwall*, and *rwall* are corresponding to the degree of preferences of them, respectively. The value for the degree of preferences is from zero to one, [0 , 1]. The possible combinations based are depicted in Fig. 3. For example, the *bbc<sub>2</sub>* means there are combination between left wall following behaviour, *lwall*, and goal seeking behaviour, *goal*.

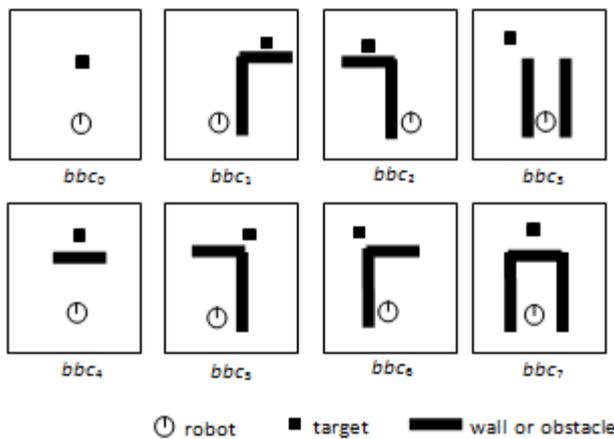


Fig. 3 Basic behaviours combinations

The fuzzy context rules are designed as fuzzy set rules with conjunctions and negations structures. This form is chosen because it needs only one linguistic term of each fuzzy membership function and reduces the number of the rules required. The fuzzy context rules have the following form:

$$RB_i \equiv IF X_{i1} \in A_{i1} \wedge \dots \wedge X_{in} \in A_{in} THEN Y_{i1} = B_{i1} \wedge \dots \wedge Y_{im} = B_{im} \tag{2}$$

where  $X_{i1} \dots X_{in}$  are the  $n$  input variables,  $Y_{i1} \dots Y_{im}$  are the  $m$  output variables, and  $A_{i1} \dots A_{in}$ ,  $B_{i1} \dots B_{im}$  are degree of memberships from trapezoidal fuzzy sets. The input variables,  $n = 5$ , are arranged as,  $d_{front}$ ,  $d_{left}$ ,  $d_{right}$ ,  $d_{goal}$  and  $\lambda_{goal}$ . On the other hand, the output variables,  $m = 4$ , are arranged as *obs*, *lwall*, *rwall* and *goal*. Equation (2) is consequent with the initial fuzzy context rules [2]-[4] that have a basic form as:

$$IF \text{ context } THEN \text{ behavior} \tag{3}$$

A PSFC is applied in this part. A modified PSO is used to search the optimized fuzzy context rules for every basic behaviours combination effectively.

Because of a PSO deal with coded parameters, the new schema of encoded strings is proposed to form a complete particle of possible fuzzy context rules. A complete particle of possible rules is concatenated as

$$\begin{matrix} \text{Particle} & |r_{11}|, \dots |r_{1n}| & \dots & |r_{41}|, \dots |r_{4n}| \\ \text{Parameter} & | \text{context}_1 | & \dots & | \text{context}_4 | \end{matrix} \tag{4}$$

where  $r_{kn}$  is the  $k$ -th of fuzzy context rules code for  $n$ -th context. The value of  $r_{kn}$  is corresponding to behaviours interaction required at a particular state and encoded into integer codes that are based on fuzzy interaction. For fuzzy interaction, ‘-1’, ‘0’, and ‘1’ means fuzzy with negations, no fuzzy interaction, and fuzzy with conjunctions, respectively. For the example, since particle,  $r = [00000 \ 00000 \ 00000 \ -1-1-1-00]$ , *obs*, *lwall*, and *rwall* have zero *BW* and thus there are no obstacles and walls around the mobile robot. In this case the fuzzy goal seeking behaviour, (*goal*), has a high *BW*.

However, in order to reduce the size of particle used in PSO process, the result of behaviour coordination selection is also applied to select the consequent context. Therefore, PSO searches for different size of particles depending on the basic behaviour coordination. For example, PSO searches 10 sizes in a particle for *bbc<sub>1</sub>* but PSO needs 20 sizes in a particle for *bbc<sub>7</sub>*.

The PSO process for fuzzy context rules also starts with randomly generated initial populations. Afterward, all populations of particles are evaluated and associated based on fitness function to determine the *pbest* and *gbest*. The fitness function has to measure how good each basic behaviours combination is, which actually affect the performance of the mobile robot.

Based on several initial investigations, the general fitness function for fuzzy context rules can be obtained as

$$f_{er} = \sum_{i=0}^I (c_1 \cdot Time + c_2 \cdot Way + c_3 \cdot Coll + c_4 \cdot DeltaWallsq) \quad (5)$$

where  $I$  is the number of iterations corresponding to the number of target positions,  $Time$  is the percentage of the number simulation steps performed from the total time provided,  $Way$  is the percentage of the distance left from the start position to the target position in the current stage,  $Coll$  is the number of the mobile robot collisions with obstacles or walls, and  $DeltaWallsq$  is the sum of square of difference between the left distance and the right distance. The fitness function thus defined tries to take into account the different aspects relevant to a good robot performance: rewarding low execution times ( $Time$ ) and the degree of completion of the task ( $Way$ ), punishing collisions with the obstacles or walls ( $Coll$ ), and maintaining the mobile robot movement in centre of the corridor ( $DeltaWallsq$ ).

The determination of the fitness function in Equation (5) above depends on the basic behaviours combination mission and is stated as the value of  $c_i$ . For example in the case of corridor situation,  $bbc_3$ , aligning to the centre line can be obtained by minimizing the difference between the left distance and the right distance and gives a high value for  $c_4$ . In another side, in conflict between obstacle and target situation case,  $bbc_4$ , the value of  $c_3$  is set high but the value of  $c_4$  is set zero.

Finally, as shown in Figure 1, four behaviour weights are generated as outputs of FFCR block. The number of behaviour weight is consequent to the number of behaviours applied in this mobile robot system.

### C. Defuzzyfying

Once the behaviour weight of each of behaviour has been singled out, their fusion must be completely defined. Saffiotti [11] gave a centre of gravitation defuzzyfying formula for fusion the command preferences, as follows

$$Y = \frac{\sum_i (BW_i * Y_i)}{\sum_i BW_i} \quad (6)$$

where  $Y$  is the final control action,  $i$  represents the active behaviour activated by rules,  $BW_i$  is the behaviour weight preferences and  $Y_i$  is the behaviour command output.

## III. RESULTS AND DISCUSSIONS

Several experiments have been performed to demonstrate the performance of the designed algorithm. A MagellanPro mobile robot is used for verification and performance analysis of the proposed algorithm. The MagellanPro is a circular mobile robot from iRobot, Real World Interface (RWI), the acknowledged industry leader in the exciting field of cutting-edge mobile robotic [8]-[9]. Fig. 4 shows the physical structure of MagellanPro mobile robot.



Fig. 4 The MagellanPro mobile robot

An office-room scenario that has 10 by 10 meters spaces was also used for testing the mobile robot movement in basic behaviours combination and in complex environment. Several simulation fields as shown in Fig. 5 were designed to test the performance of the mobile robot in basic behaviours combination. Generally, each field contains obstacles, a start and a target position. Several conflict scenarios between obstacles, walls and target point, corridor-like environment and dead end condition were included in the fields to test the ability of the proposed algorithm. The fitness values are used to analyse the performance of this proposed algorithm. A single fuzzy context rules (SFCR) applied by Hagrais *et al.* [7] is used as a comparison. The fitness values of each simulation field are listed in Table II.

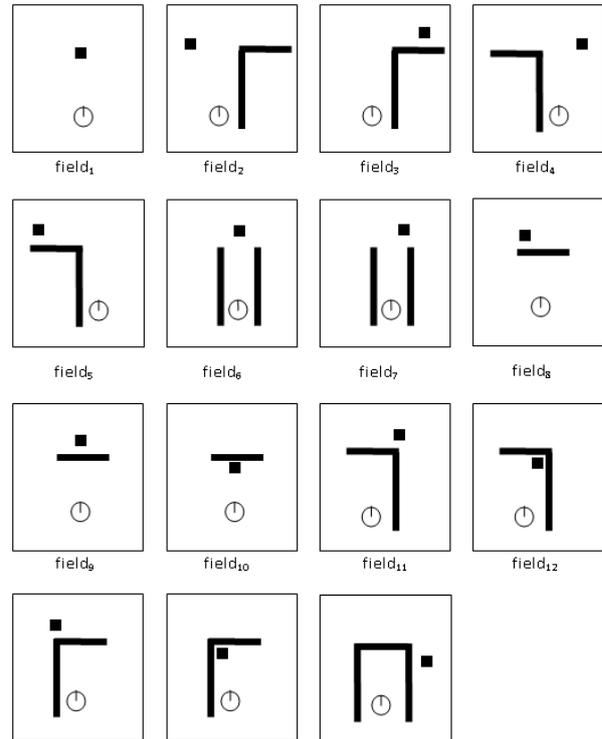


Fig. 5 A set of simulation fields

The minimum fitness value was also used to analyse the performance of each field. Generally, according to Table 3, the fitness value of FFCR is better than the fitness value of SFCR. However, for some fields, such as field<sub>1</sub>, field<sub>5</sub>, field<sub>8</sub>, field<sub>9</sub>, and field<sub>13</sub> have the same fitness value.

To analyse the performance of both algorithms, the behaviour activation was used here beside the mobile robot movement. Behaviour activation displays the value of degree of preferences each of behaviour after coordination process, respectively. The higher the value of behaviour activation means higher the individual behaviour is considering in behaviour coordination.

As an example, in field<sub>2</sub> there was a conflict between goal seeking behaviour, *goal*, and right wall following behaviours, *lwall* in field<sub>2</sub>. The mobile robot should follow the right wall and approach the target but in shortest path and time. The fitness values in this field show that the FFCR is better than SFCR. Fig. 6 illustrated the mobile robot movement and the behaviour activation in field<sub>2</sub>. In the beginning, the mobile robot has detected the target and the wall in the environment. However, in FFCR, the target is not assumed as a conflict with the wall. Therefore, the goal seeking behaviour, *goal*, inhibits the right wall following behaviour, *rwall*. It was shown in Fig. 6(a) that the degree of activation of the goal seeking behaviour is always 1 while the degree of activation of the right following behaviour is always 0. Consequently, the mobile robot moved to the target directly. Nevertheless, the mobile robot should follow the wall in advance and then go to the target in SFCR. It was demonstrated in Fig. 6(b) that the degree of activation of the goal seeking is zero in the first path while the degree of activation of the right wall following is one. After finishing in following the wall, the degrees of activations were changed. The degree of activation of the goal seeking behaviour was going to one while the degree of activation of the left wall following was going to zero. Fig. 7 shows the photograph of MagellanPro robot movement.

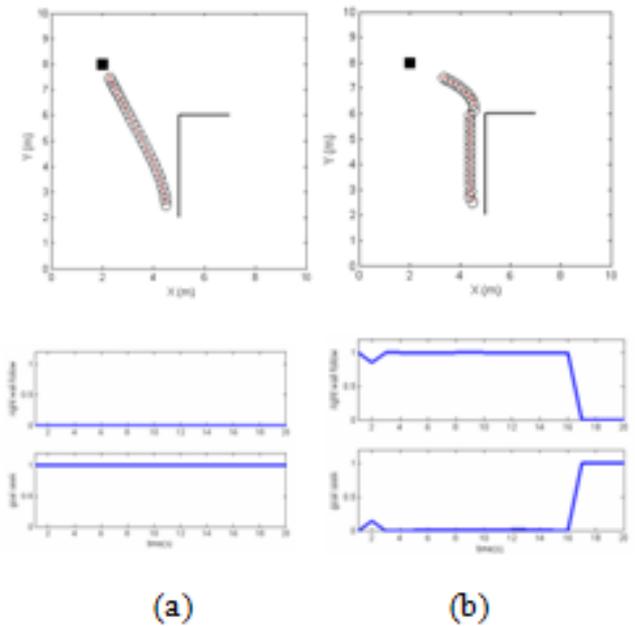


Fig. 6 Mobile robot movements and behaviour activations for simulation field<sub>2</sub>: (a) FFCR and (b) SFCR

TABLE II  
FITNESS VALUE COMPARISON BETWEEN FFCR AND SFCR

Field	FFCR	SFCR
Field <sub>1</sub>	1.2304	1.2304
Field <sub>2</sub>	1.7630	3.1377
Field <sub>3</sub>	1.7461	2.1140
Field <sub>4</sub>	1.6900	2.1821
Field <sub>5</sub>	4.0754	4.0754
Field <sub>6</sub>	5.9507	7.6691
Field <sub>7</sub>	6.4720	8.6753
Field <sub>8</sub>	1.8302	1.8302
Field <sub>9</sub>	4.5515	4.5515
Field <sub>10</sub>	0.8715	6.1038
Field <sub>11</sub>	8.5668	8.5251
Field <sub>12</sub>	3.4522	7.3865
Field <sub>13</sub>	6.2967	6.2967
Field <sub>14</sub>	5.9814	11.9814
Field <sub>15</sub>	69.1019	979.4689



Fig. 7 Photographs of Mobile Robot Movements in field<sub>2</sub>

Another experiment was performed to investigate the movement of the mobile robot in field<sub>6</sub>. The robot started from (2.5, 1.25,  $\pi/2$ ), moved in 1.5 m wide corridor and went to the target at (3, 4.75, 0) located after the end of the corridor and in front of a line obstacle. The MagellanPro mobile robot movement was depicted in Fig. 8.

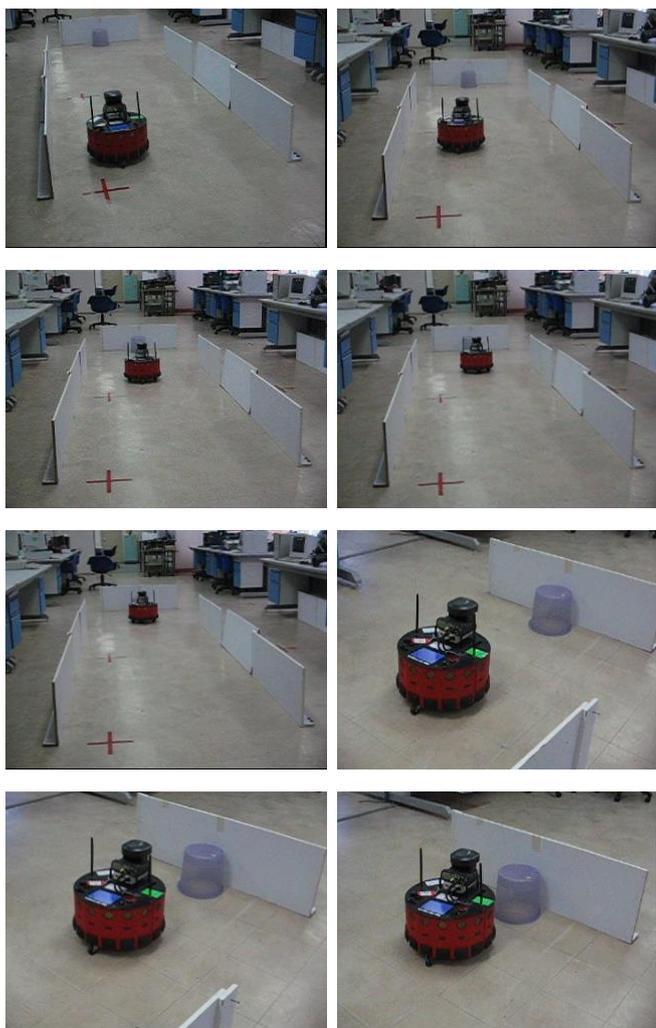


Fig. 8 Photographs of the mobile robot movement in field<sub>6</sub>

Actually, the mobile robot has detected the target and two walls as a corridor in the environment. The mobile robot has awareness about the target location, but it should handle the faced environment. Based on the FFCR process, the CDB generate set of behaviour preferences in certain degrees as shown in behaviour activation. It is noted that the robot movement can be divided into some stages: (i) the robot starts to move in following the left wall, (ii) the robot moves in to the centre of the corridor, (iii) the robot travels in the centre of corridor, (iv) the robot goes out from the corridor, and (v) the robot reaches the target without colliding with the obstacle.

It can be noted that, generally, the mobile robot was able to accomplish the task effectively although running in unplanned environment with incomplete and imprecision sensors, and imperfect actuators.

## V. CONCLUSION

The paper highlighted the development of behaviour coordination algorithm with flexible fuzzy context rules. In FFCR, the fuzzy context rule is decomposed in several basic behaviours combination rules. A PSFC process has been applied to obtain the optimized fuzzy context rules for each of basic behaviours combination. Several experiments have been performed to investigate the performance of the algorithm. It

is noted that the mobile robot is able to deal with conflicts of behaviours problems and generates the good behaviours interaction, that are more smooth response between behaviours, moves in the centre-line in tight corridor, more robust path in avoiding obstacle and reaching the target, and goes out from the trap and escapes from the dead end situation.

## ACKNOWLEDGMENT

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# ELCONAS Electronic Control Using Android System With Bluetooth Communication And Sms Gateway Based Microcontroller

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**Abstract**— ELCONAS (Electronic Control with Android System) is a tool designed to control electronic devices. This control Android via Bluetooth communication and SMS Gateway that can be controlled by the user. Control using Bluetooth, applied for a certain distance which is connected to android, Bluetooth with limited distance range of services and the use of the remote system is used SMS Gateway is connected via a short message that is sent to the microcontroller through a module that has been installed on the microcontroller, using ArduinoMega 2560. ELCONAS designed to minimize the occurrence of short circuits and even prevent fires because the user can handle it via the application without having to interact directly with electronic devices that are at home or office.

**Keywords**—ELCONAS, Android, Bluetooth, SMS Gateway, Microcontroller

## I. INTRODUCTION

Technological developments make electronic circuits applications to replace the role of man as the thoroughness and accuracy in work. Need a good installation by a qualified electrical appliance supported in accordance with established standards of course, very necessary so that electricity can be used safely and comfortably, so they can avoid things that are not desirable, such as short circuit that could cause fire.

Data based on the Fire Department and Disaster Management (Damkardan PB) Jakarta, in the period January to August 2013 has been 509 fire incidents occurred in the capital Jakarta, and the main cause of the fire is still dominated by short circuit (State Intelligence Agency, September 27 2013). Fire prevention can actually be done by increasing citizen awareness of the dangers of fire. Residents must be able to anticipate potential threats early fires in their respective communities.

With regard to the issue of researchers intend to create an instrument to control electronic devices through Bluetooth communication via Android and SMS gateway that can be controlled by the user.

The purpose of this electronic control device he designed to help humans work in controlling electronic devices using Bluetooth communication on the use of near and distance using SMS gateway for longer distances as well as the design of which is controlled by a microcontroller-based smartphone with the Android OS.

The system design is made with implementing the analog input function based on microcontroller ATmega 2560 Arduiniomega 2560 gets input from the Bluetooth Module with Baseboard for a limited distance and SMS Gateway system uses Quad-band GPRS / GSM Shield For Arduino Mega for the remote already integrated internally on ATmega 2560. Using Arduino programming language Software hex format that will be downloaded to the Arduino board or other board microcontroller systems and using the Android Development Tools (ADT) plugin for Eclipse create a new application on Android. The output of the microcontroller is connected to the Relay Module with Opto Isolated Inputs are already connected to the electronic device can be enabled / disabled by Opto-Isolated digital input is indicated by the on / off switch on the appliance electronics. Overall the system is connected to a smartphone with Android OS already installed application ELCONAS.

Hope the author is that ELCONAS tool is expected to minimize the occurrence of short circuits and even prevent fires because users can overcome through the application without the need to interact directly with electronic devices that are at home or office.

## II. METHOD

The method applied in the event of a framework that encapsulates and describes in outline the sequence carried by Figure 1. The first begins the process of preparation tools and materials. The main equipment needed include laptop / computer, software / application Proteus Professional 7:10 to make the simulation program, the Arduino software compiler to compile the program, Downloader software and the Android Development Tools (ADT) plugin for Eclipse create a new application on Android. While the main ingredient that is based ATmega Microcontroller Arduiniomega 2560 2560 Bluetooth Module with Baseboard, Quad-band GPRS / GSM Shield For Arduino and Relay Module with Opto Isolated Inputs. As well, do initialization in electronic devices at home ELCONAS miniature.

Furthermore, the design stage is the stage of doing the design tool, making simulation program, perform the Arduino programming and programming on Android. Then do the stages of implementation by creating a simulation program using Proteus 7:10 Professional application, simulation is the

real design of the tool so that we can know the error to minimize errors in tools that will be made.

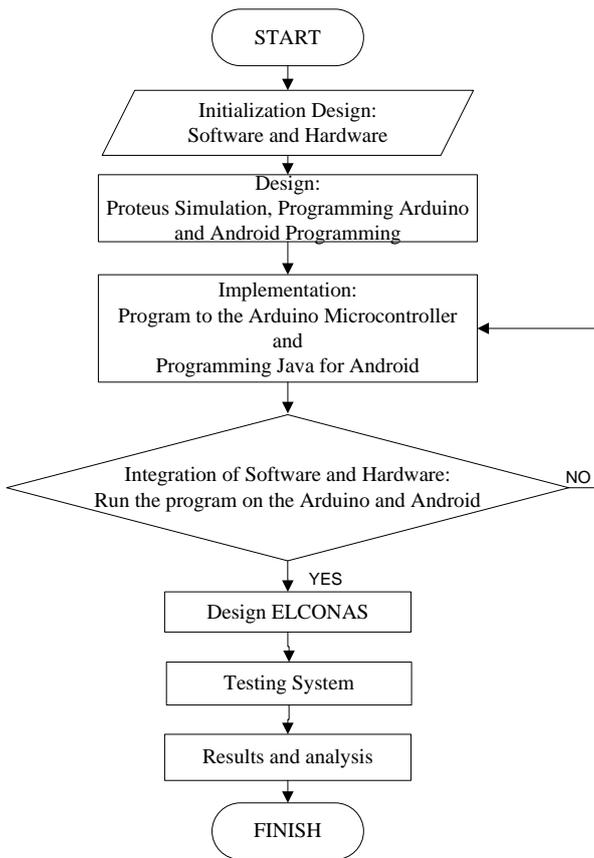


Fig.1 Framework ELCONAS

When the simulation is running as expected then the next step of simulation in the form of a prototype. Components - components such as the Arduino microcontroller, relays, transistors, resistors, LED and electronics assembled as props appropriate simulations we created earlier in the program Proteus Professional 7:10. And then performed on the components of the program are to be connected using cable connectors and rainbows. Then download the Arduino software program compiler results that have been made to the Microcontroller ATmega2560. How to download the program into Microcontroller ATmega2560 use to the downloader.

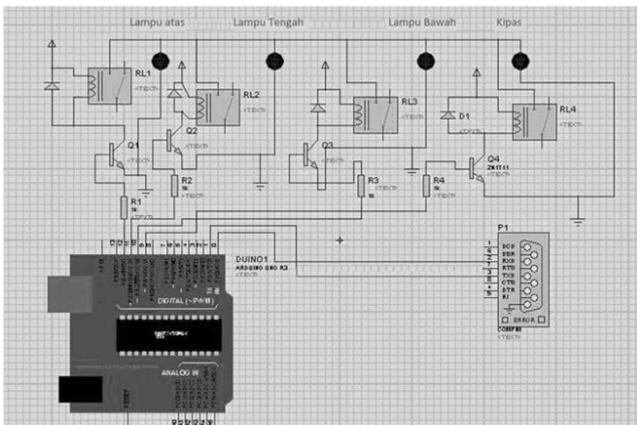


Fig.2 The Circuit Simulation in Proteus 7 Professional Program

In making the pairing condition VSPE between software prototype software simulator can communicate with programs created using Arduino IDE controller ADT as an interface tool. Then be checked against the prototype software controlling life and death so that the LED display relay can live and die as expected then the simulation has been running well.

The next stage is integration of hardware and software perform a stage makes these components into a single unit. A program on the microcontroller, an application in android, which is integrated with the hardware on the microcontroller, Bluetooth, SMS gateway implementation, and testing of the responsibility to relay / switch automatically to the tests performed on electronic devices.

Furthermore, do the designing miniature house ELCONAS therein contained electronic equipment such as lights and fans so that tools neatly arranged.

Once the house is finished miniature optimization testing and feasibility testing of electronic devices on a miniature house ELCONAS by applying some android component that has been designed with a microcontroller that is android and test the connection using SMS gateway ELCONAS tool to control the tool with long distances and using Bluetooth for control tool with limited distance. And test electronic equipment contained in a miniature house that will ELCONAS control via android.

The final stage is the identification of a problem or problems that occur when ELCONAS not working properly. Later analysis of the results of performance testing tools ELCONAS whether the tool has given results consistent with established specifications.

All these stages of processing tools ELCONAS done at the Laboratory Automation Industry Fasilkom Sriwijaya University.

### III. RESULT AND DISCUSSION

ELCONAS is a controller electronic devices at a relatively far using Android with based Microcontroller Arduino mega 2560 R3 effectively minimize the possibility of fire events caused short circuiting.

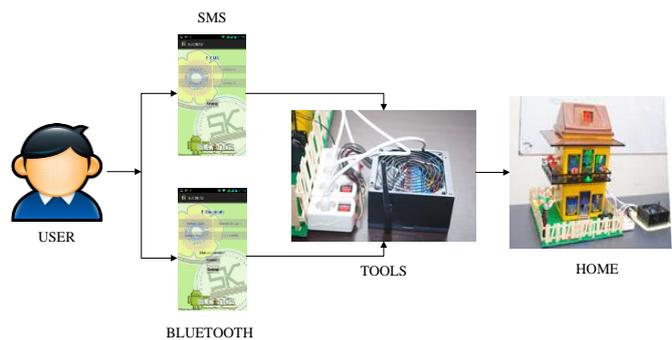


Fig.3 The Working System ELCONAS

ELCONAS working system that the user can control electronic equipment via the Android through Bluetooth communication and the SMS Gateway. In the android interface, as shown in Figure 3.1 is explained that the main view of the ECLONAS, there is a choice of control using Bluetooth or SMS.

When selecting commands via SMS are display devices that will be in control, previously to facilitate users to control electronic devices is done setting the name of the device in accordance with the layout of the main house ELCONAS, and

also setting the destination number, and a brief message that will be delivered to the tool ELCONAS and the reply given in the form of an on / off on electronics and indicators given instructions on / off on the application form when electronics flaming red color.



Fig. 4 Android Interface

Likewise, when using a Bluetooth control for implementation at close range. By doing paired Bluetooth advance of Android with the tools ELCONAS. Then, the next display as well as SMS, but the Bluetooth is not required setting the destination number.

Bluetooth and SMS Gateway is connected via a short message that is sent to the microcontroller through a module that has been installed on microcontroller ArduinoMega 2560 is connected to the relay. Relay is connected directly to the appliance electronic using an electrical terminals.



Fig. 5 Implementation of The Tool is Connected to The Electrical Terminals



Fig.6 Miniature Of ELCONAS House's

The advantages of ELCONAS how to use it easily just by pressing a button on the Android app without having to interact directly with electronic devices at home. Then be helped, effectively minimize losses due to an electrical short or fire. ELCONAS can be tailored to the wishes of users (user customizable) based on the number of use of electronic equipment in the home.

After PKM ELCONAS is expected to be implemented in the community, especially in controlling the electronic devices at home, the office, or the industry in general. In order ELCONAS through increased security on electronic devices and reduce the occurrence of fire.

#### IV. CONCLUSION AND SUGGESTION

##### A. Conclusion

- 1) ELCONAS is control electronic devices using Android System with Bluetooth communication and SMS Gateway. Using the main components of the microcontroller ArduinoMega 2560 R3, Bluetooth Module, GPRS / GSM Shield, and Relay is applied directly to a miniature house ELCONAS.
- 2) ELCONAS been shown to work effectively with turn on / off electronic devices.
- 3) Easy to use by pressing a button on the application Android without having to interact directly with electronic devices at home.
- 4) ELCONAS effectively minimize losses due to short circuit or fire occurs.

##### B. Suggestion

- 1) ELCONAS is a prototipe that can be used by the user, but hope can be implemented directly in the home, office or industrial.
- 2) ELCONAS should be given a password for user convenience.

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# Data Optimization on Multi Robot Sensing System with RAM based Neural Network Method

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**Abstract**— Monitoring the environment activities is an attractive thing for development. That is because the human life would affect the surrounding environment. There's a lot of research of environment has been done, one of those is the changes of air quality in urban areas. To measure the level of air quality, the data and information from field measurements and laboratory analysis result was needed. This paper review the research result that focus on sensor data processing in multi robot using RAM based neural network. There are 11 pattern input data were processed by temperature data optimization from 25°C until 35°C, humidity data from 20% until 60% and gas data from 350ppm until 450ppm. The obtained result is from 8 bits and 9 bits become 6 bits in certain level with optimization percentage is 25% and 33,3%. This result effect to the computationan load, it's become more simple, the execution time and data communication becomes faster.

**Keywords**— Air Quality, Multi Robot, RAM based neural network dan data optimization.

## I. INTRODUCTION

Monitoring the environment activities is an attractive thing for development. That is because the human life would affect the surrounding environment. There's a lot of research of environment has been done, one of those is the changes of air quality in urban areas [2][3]. To measure the level of air quality, the data and information from field measurements and laboratory analysis result was needed One of the control and monitoring system is currently being developed is the Intelligent Wireless Mobile Sensor Network (IWMSN).

IWMSN system consist of switching nodes which are individual that able to interact with its environment by sensing, controlling, and communication on the physical parameters. In applications IWMSN system can be made using a combination of static sensor and robotic networks that spread as a base station and mobile station [4][10].

The principle of sensor data processing in application can also be combined with ram-based neural network method. The mechanism is input data amount  $2^n$  will be in group into small group, each data group will processed on certain level and produce the desired output data. For obtained data sensor optimization, ram optimization technique that only process the data on most significant bit (MSB) is one of method approach that best to solve the problem above. Meanwhile the algorithm would help in solving the data processing problem in each data group in certain level [13] [18][20].

For the detection of source simultaneously, using a group of robot (swarm robot) has been developed lately, using a

technology derived from a flock of bird's behavior, fish swarm, a colony of ants or a swarm of bees [9].

## II. SYSTEM OVERVIEW

### A. RAM Node

Basic architecture of artificial RAM based neural network is single general neural (SGN) or RAM node. SGN was the most primary component, which is comparable to a node of a conventional neural network. A single SGN consists of input vector, memory register, data input register and data output register. Input vector was divide into several parts, each part was connect to the address input of the RAM 1-bit units. SGN hereinafter called RAM node [19][24]. Figure 1 is a RAM node.

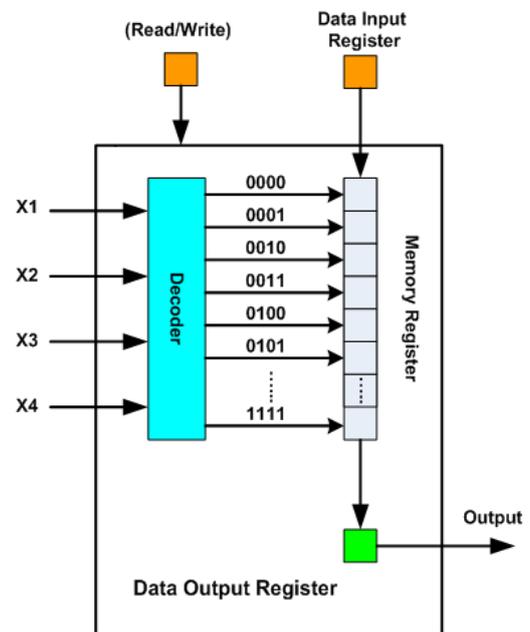


Fig 1. RAM node

### B. RAM Discriminator

A RAM-discriminator consists of a set of  $X$  bit word RAMs with  $n$  inputs and a summing device ( $\Sigma$ ). Any such RAM-discriminator can receive a binary pattern of  $X.n$  bits as input. The RAM input lines were connecting to the input pattern by a "biunivocal pseudo-random mapping". In order to train the discriminator one has to set all RAM memory locations to 0 logic and choose a training set formed by binary of  $X.n$  bits patterns. For each training pattern, a 1 is stored in the memory location of each RAM addressed by this input pattern. Once the

training of patterns is completed, RAM memory contents will be set to a certain number of 0's and 1's. Figure 2 is a RAM discriminator [18].

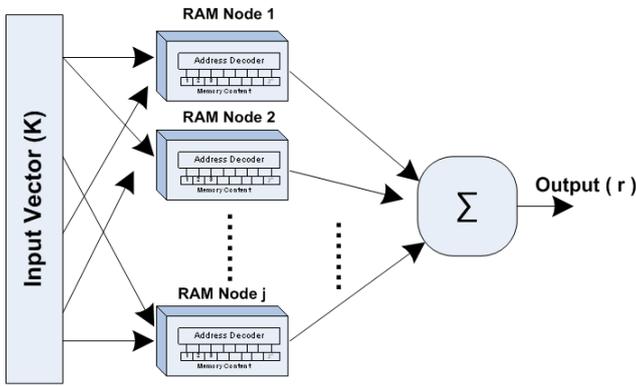


Fig 2. RAM discriminator

C. Multi Robot

Multi robot has a simple physical structure but powerful, each robot has a common behavior so able to cooperate, communicate, and coordinate [19]. There are some intelligence algorithm of swarm commonly used in optimization problem, one of that is particle swarm algorithm. Particle swarm optimization (PSO) Algorithm was first introduced by Dr. Eberhart and Dr. Kennedy in 1995 at neural network conference in Perth, Australia. PSO Algorithm is a stochastic-based optimization technique inspired by social behavior of a flock of birds and fish swarm [11].

Compared to the single robot approaches, multi robot-solution potentially provide the superiority in term of resistance to failure, accelerating the completion of a task because it work in paralel way or increase in accuracy due to the exchange of sensory information [22].

D. Temperature and Humidity Quality

: The temperature show the degre of heat object, the higher temperature of an object, the more heat that object. Microscopically, temperature shows the energy of an object. Each atom in each object is moving, whether it in displacement or movement in vibration place. The higher atoms energy that making up the object, the higher the temperature of that object [23].

According to Block and Richardson (2001), relative humidity of a mixtuer of water-air defined as a partial pressure of water vapor ( $e$ ) in the mixture to saturated vapor pressure ( $e_s$ ) at that temperature. Humidity relative using the unit percent and calculated this following way

$$RH = \frac{P(H_2O)}{P^*(H_2O)} \times 100\% \dots(1)$$

where:

RH is a relative mixture humidity

$P(H_2O)$  is partial pressure of water vapor and

$P^*(H_2O)$  is mixture to the saturated vapor pressure

E. Environmental Quality

In its development, the various research about environment localization using autonomous robot have been carried out to obtain the variety of alternative solutions, such as localization signal sources including the voice [16], light [3], the leaks in pressurized systems [7], the danger of aerosols from spilled nuclead/ chemical [17][8]. The fire's source in forest fires [20], Sea hydrothermal [21], hazardous chemical discharge in water body [6], and the spills of an oil [1]. But the research about simultaneously localization for various target has still rarely did [2].

III. HARDWARE IMPLEMENTATION

A. Single Robot

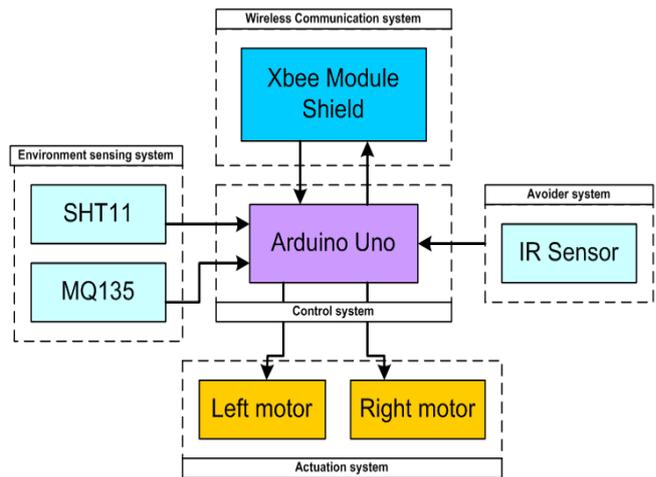


Fig 3. Single robot architecture

Figure 3 is a single robotic achitecture The purpose of designing single robot is to find out the characteristic, data retrieval and data processing individually. The environmental data such as temperature, relative humidity, and air quality.

B. Multi Robot

The purpose of designing the swarm robot is to find out the characteristic, data acquisition and data processing collectively. That environmental data such as temperature, relative humidity, and air quality have been first optimized using RAM-based neural network method. Figure 4 is a multi robot scheme.

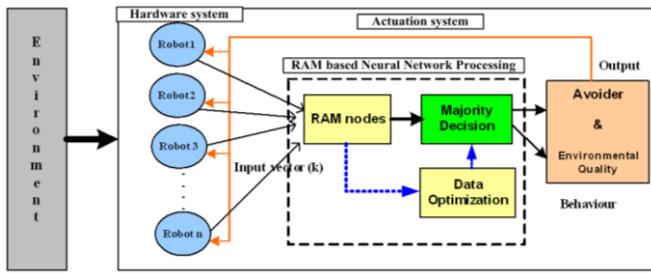


Fig 4. Multi robot scheme

### C. RAM Node Data Optimization

The used strategy in this sensor data optimization is in its node RAM. Each RAM node will store 6 bits of input data that is 6 bits of MSB data. The processed data is temperature sensor data, humidity and gas sources with total 18 bits data. This is intended to make the input pattern becomes more optimal because there are only 3 pattern that is invisible, so the computational process become more simple. Design of RAM node can be seen in Figure 5.

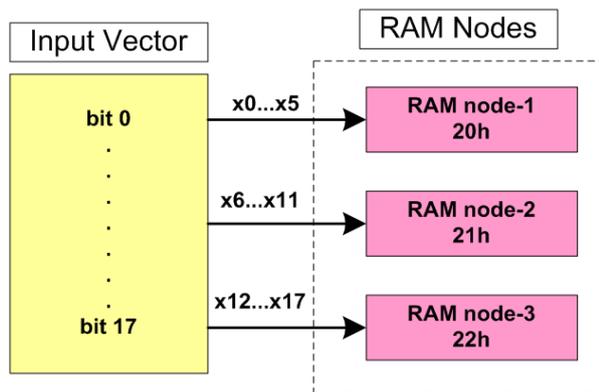


Fig 5. RAM node

In the design of RA node devide into 3 group of input data pattern, that is RAM node-1 for the temperature data, RAM node-2 for the humidity days, and RAM node-3 for the gas data. Sequentially, its data is 011001 until 011101, 001100 until 100110 and 01011001 until 1110011. All of the input data pattern has been optimized.

### D. Discriminator Data Optimization

RAM discrimanator has 2 RAM nodes, each node has 6 bits word ( $X=6$ ), with a total input vector 8 bits ( $n=8$ ) so each RAM discriminator can receive 48 binary input patterns. In the design, there are 2 RAM discriminator. Discriminator\_A is a temperature data and humidity, while Discriminator\_B is the gas source data. The output of each discriminator will determine the winner of class winner. For the design block of RAM discriminator can be seen in Figure 6.

### E. Training Process at Neural Network

Temperature sensor data, humidity and gas respectively stored at address 20h, 21h and 22h. This addresses is RAM

node address for each nerve. Temperature sensor reading range devided into two reading parameter group, that is **Medium** and **Warm**, with the data 011001 until 011101 and 011100 until 011101. While for humidity **Normal** and **Medium** with the data 001100 until 100011 and 100110 until 100111. For gas parameter is **Good** and **Bad**, with the data 1011001 until 1110011 and 1000000. The values of parameter above is a threshold value for the neural network. If the sensor value doesn't match the threshold, so the activation function indicates the input is 0 (0000b).

The class of neural that grouped in RAM discriminator, consist of 2 class. That is discriminator\_A and discriminator\_B, with consecutive addresses 30h and 32h. RAM discriminator receive the maximum data 10000b and minimal data 00100b. RAM discriminator\_A and discriminator\_B can determine the final result (output) directly (class winner).

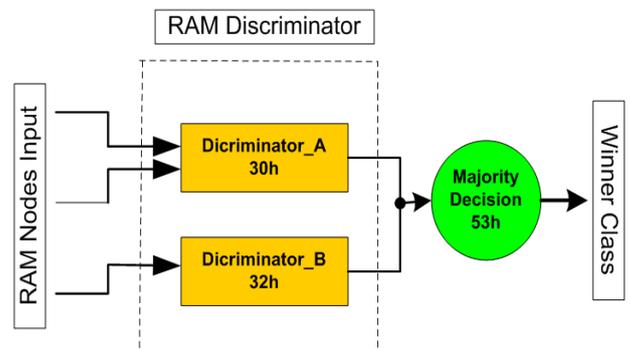


Fig.6 RAM discriminator

## IV. EXPERIMENTAL EVALUATION

### A. Input Pattern Data

Input data is the actual data being used as a reference data in data process to the neural network. Pattern input consist of 3 data group which is each temperature, humidity, and gas. Temperature data pattern is the data taken from temperature 25°C until 35°C, while the humidity data is 20% until 60%. For the gas data from 350pp, until 450ppm. Table I represents the data input pattern.

### B. RAM Node Data Optimization

The result of RAM node can be seen in Table II, which is sensor data before and after optimization. The data that processed in RAM node only the data that has been optimization, that is 4 bits MSB data. There are 5 RAM nodes representing 5 of input patterns. The percentage of memory allocation optimization is 50% for each RAM node.

RAM node-1 data and RAM node-2 data were optimized in percentage is 25% and RAM node-3 data percentage is 33,3%.

### C. Discriminator Data Optimization

Discriminator data grouped in discrimintaor\_A thas has the maximal data 100110 and minimal data 001100. This data is the result from RAM node-1 and RAM node\_2 process. Discriminator\_B has the maximal data 111001 and minimal

data 101100. This data is the result from RAM node\_3. For the detail can be seen in Table III.

TABLE I  
INPUT PATTERN DATA

Input (Reference data)					
Temperature		Humidity (nonlinier)		Gas	
°C	result	RH %	result	(ppm)	result
5	0100 0110	5	0000 1101	50	00 0011 0011
10	0100 1110	10	0001 1010	100	00 0110 0110
15	0101 0101	15	0010 0110	150	00 1001 1001
20	0101 1101	20	0011 0011	200	00 1100 1101
25	0110 0101	25	0100 0000	250	01 0000 0000
30	0110 1101	30	0100 1101	300	01 0011 0011
35	0111 0100	35	0101 1001	350	01 0110 0110
40	0111 1100	40	0110 0110	400	01 1001 1001
45	1000 0100	45	0111 0011	450	01 1100 1100
50	1000 1011	50	1000 0000	500	10 0000 0000
55	1001 0011	55	1000 1100	550	10 0011 0011
60	1001 1011	60	1001 1001	600	10 0110 0110
65	1010 0011	65	1010 0110	650	10 1001 1001
70	1010 1011	70	1011 0011	700	10 1100 1100
75	1011 0010	75	1011 1111	750	10 1111 1111
80	1011 1010	80	1100 1100	800	11 0011 0010
85	1100 0010	85	1101 1001	850	11 0110 0110
90	1100 1010	90	1110 0110	900	11 1001 1001
95	1101 0001	95	1111 0010	950	11 1100 1100
100	1101 1001	100	1111 1111	1000	11 1111 1111
105	1110 0001				
110	1110 1001				
115	1111 0000				
120	1111 1000				
125	1111 1111				

TABLE II  
DATA OPTIMIZATION

Data Optimization				
RAM Node	Data 8 bits		Data 6 bits	
	Max	Min	Max	Min
RAM Node-1	0111 0011	0110 0010	0111 00	0110 00
RAM Node-2	1001 1001	0011 0011	1001 10	0011 00
RAM Node-3	1110 0110	1011 0011	1110 01	1011 00

TABLE III  
DISCRIMINATOR DATA

Discriminator Data Optimization		
Discriminator	Data 6 bits	
	Max	Min
Discriminator_A	1001 10	0011 00
Discriminator_B	1110 01	1011 00

#### D.. Output Pattern Data

Table IV is output pattern table. The greatest pattern value is the best pattern value, which is produces output pattern system (winner class). In table above, output pattern produced was parameter environmental quality 9temperature, humidity, and gas). Each input pattern has 2 different input pattern This is cause by each pola has common data but the position from each neural is different.

TABLE IV  
OUTPUT PATTERN

Input Pattern	Output Pattern		Explanation
0110 01	0101 1001	Medium	Temperature
0110 11	0101 10 11		
0111 00	0101 1100	Warm	
0111 01	0101 1101		
0011 00	1000 1100	normal	Humidity
1000 11	1010 0011		
1001 10	1010 0110	Medium	
1001 11	1010 0111		
1011 001	1110 1100	Good	Gas
1110 011	1111 0011		
1000 000	1100 0000	Bad	

#### V. CONCLUSION

The obtained result from the research are as follows, the taken sample data is the temperature data from temperature 25°C until 35°C, humidity data from 20% until 60% and gas data from 350ppm until 450ppm. The optimized data is done on 8 bits and 9 bits become 6 bits data in certain level, with optimization percentage 25% and 33%. This result is affect to the computation load to be more simple, the execution time and data communication become faster.

Out of 11 input pattern will be selected the best input pattern to determine the output pattern (winner class) which is its quality environmental quality parameters (temperature, humidity, and gas).

## ACKNOWLEDGMENT

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# Identification of Ambiguous Sentence Pattern in Indonesian Using Shift-Reduce Parsing

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**Abstract**— In a sentence writing, mistakes often happened unconsciously by the writers that caused a sentence has double meaning. This research developed a software that can identify the pattern of ambiguous sentences in Bahasa using Shift Reduce Parsing. Input for this software is a single sentence in Bahasa. This research involved three preprocessing namely case folding, tokenizing, and Part of Speech (POS) Tagging. Then the result of preprocessing used in identifying ambiguous sentence. In the process of identifying ambiguous sentences, Shift Reduce Parsing used to the parsing's result of a sentence. As the result, this software that can differentiate whether if it is an ambiguous sentence or not. Accuracy of identifying the pattern of ambiguous sentence in Bahasa using Shift Reduce Parsing reaches 83%.

**Keywords**— Ambiguous Sentence, Shift Reduce Parsing, Natural Language Processing.

## I. INTRODUCTION

Sentences that have more than one possible meaning of a sentence is called ambiguous sentence. Ambiguous sentences can hamper communication because the receiver (listener or reader) can interpret different meanings with the meaning intended by the speaker or writer[1]. This can happen either because the structures or patterns due to the use of his or her sentence. Humans can distinguish clearly the error occurred but not with the computer, the computer can not identify a particular sentence patterns.

One method that can be used in a sentence is to recognize patterns shift reduce parsing methods. There are two processes that occur in this method, namely: shift and reduce operations. Shift operation is the addition operation of said input sentence on top of the stack elements (piles) which is referred to as the top. While surgery is the surgical removal reduce top element on the stack and replace it with a new element in the form of a grammar rule corresponding elements are replaced such information. This method is often used in terms of grammatical categorization. This method will split the input sentence into words in the form of a stack. After that, some of these words can be recognized identity so that he will be processed in a particular grammar[2].

## II. AMBIGUOUS SENTENCE

Sentences that have more than one possible meaning of a sentence is called ambiguous sentence. Ambiguous sentences can hamper communication because the receiver (listener or reader) can interpret different meanings with the meaning intended by the speaker or writer [3]. Examples of ambiguous sentences can be seen in Table II-2.

TABLE I.

EXAMPLES OF AMBIGUOUS SENTENCE

No.	Sentence
1.	Tahun ini gaji karyawan baru dinaikkan.
2.	Tahun ini gaji karyawan-baru dinaikkan.
3.	Gaji karyawan tahun ini baru dinaikkan.

The word 'baru' in the sentence (1) in Table II-2 can lead to more than one interpretation (ambiguous). If the word 'baru' employee explained, the sentence can use hyphens and turned into sentences (2). If the word 'baru' to explain the increased (previous salary never increased), the sentence was commuted to a sentence (3).

## III. METHODOLOGY

The software accepts input in the form of a single sentence in Indonesian which will then be checked using the sentence pattern Shift-Reduce Parsing. The resulting output is the truth value obtained from the shift and reduce. If at the end of the process reduce accepted and have more than one parsing process, then input the correct sentence for an ambiguous sentence patterns. Software architecture to be built can be seen in Figure 1.

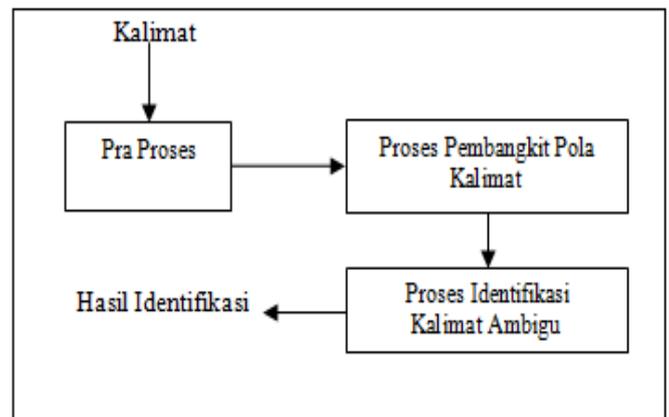


Fig.1. Software Architecture

### A. Preprocessing

Preprocessing is beginning the process of managing data before data processing is done [4]. The purpose of this stage is to remove the characters other than letters and break the sentence into a collection of words. Stages including preprocessing is performed on case folding and tokenizing. Case folding is changing all the letters in the document to lowercase. Only the letter 'a' to 'z' are acceptable [5]. Considered a delimiter character other than letters.

### B. Sentence Pattern Recognition

This process is a stage that serves to determine the identity of the words of each word in the input sentence. Steps being taken in this process are Part of Speech (POS) Tagging and generalization. POS tagging is a process that is done to determine the type of a word in the text. Type the word in question is a grammatical category, ie verbs, nouns, adjectives, adverbs, and so on. POS tagger is an important tool in many natural language processing applications such as word sense disambiguation, decomposers (parser), question answering, and machine. Input of a POS Tagger is a sentence and output in the form of tags for each word contained in the input sentence.

Hidden Markov Model is a statistical model where the system being modeled is assumed to be a Markov process with unobservable conditions. Hidden Markov models have a hidden condition (hidden states), the value of output (observation), the transition probability, possibility of emissions, and an initial condition.

Tag represents the hidden states represent the state and observation. Transition probabilities depend on the state of his tag partner. Emission probabilities depend on the applicable tag.

POS Tagger based on hidden Markov models has a running time better than the other such as the probabilistic method developed by Wicaksono dan Purwarianti[6].

### C. Identification Sentence

This process is a stage that serves to determine the pattern of the sentence is ambiguous or not of an input sentence. The method used to determine the pattern of the sentence is ambiguous or not the Shift-Reduce Parsing.

The process of parsing using Shift-Reduce Parsing can be seen in the parsing tree as follows:

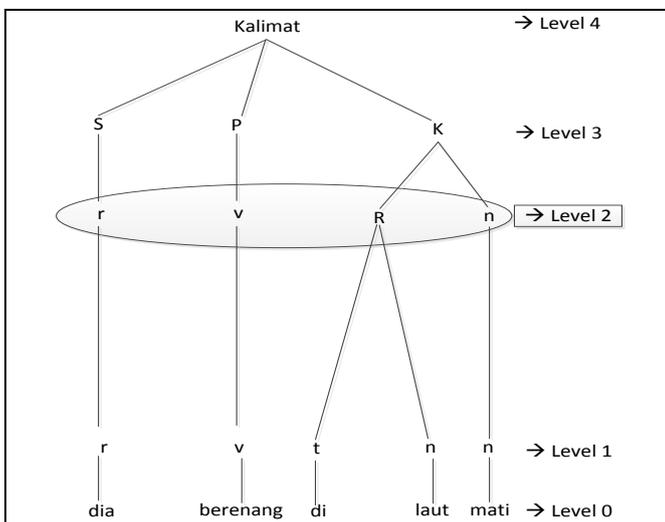


Fig. 2 Type-1 Parsing Sentence

Figure 2. shown the parsing process type-1 using Shift Reduce in sentence “Dia berenang di Laut Mati”.

In the description of the type-1 (Figure 2), the meaning of the sentence is that he swam in the ocean, where the sea is the name of the dead sea. While the results to the description of the type-2 (Figure 3), the ambiguous sentence can be interpreted as follows: he was swimming in the sea, and then he died. From the above, it can be concluded that the sentence that has more than one meaning called ambiguous sentence.

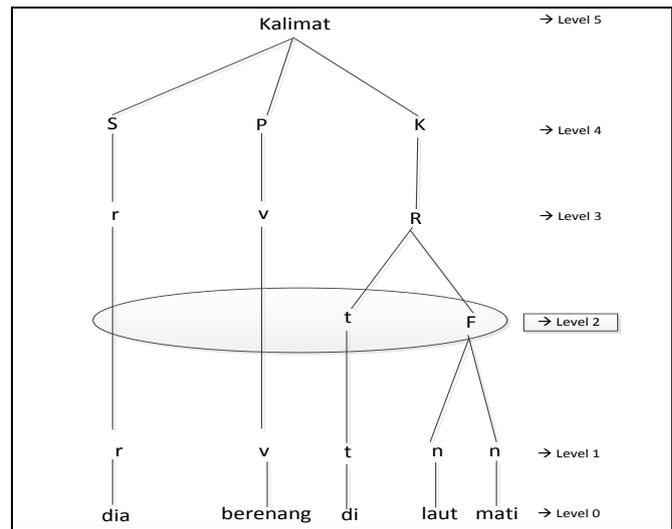


Fig. 3 Type-2 Parsing Sentence

The process of determining ambiguous sentences can be seen through the tree parsing, where there is more than one type of tree parsing of one sentence. Parsing process changes can be seen in the level 2 tree parsing in Figure 2 and Figure 3. At level 2 type-1 to the parsing, resulting in the sentence pattern is  $r + v + R + n$ , while the 2nd type of parsing the resulting pattern is  $r + v + t + F$ .

## IV. SHIFT REDUCE PARSING

Shift Reduce Parsing (SR Parsing) is a parsing technique which belongs to the category of bottom-up parsing. SR parsing used as tokens and form a production line to build the parse tree (parse tree). SR Parsing using stack in order to maintain the order of each token. SR Parsing is done after case folding process, tokenizing, and Part of Speech (POS) Tagging, is used to determine the sentence pattern of a sentence. In general, the Shift-Reduce Parsing algorithm has the following action:

- 1 Shift, add one element (token obtained from the input) on the stack. Shift action is only the displacement (shifting) the first item (the top of the pile of words, in this case the per-item(form a single word) of the RHS (Right Handle Stack) to the LHS (Left Handle Stack)
- 2 Reduce, remove top element on the LHS and replace it by adding one element corresponding nonterminal.

If the LHS is empty, then the only action that can do. If RHS Shift empty, Reduce the only action performed. If the RHS and LHS is not empty, then there is a possibility of that happening is both action, and processors must provide the conditions for action taken. If the action taken is reduce, then determined a non-terminal (in this rule) what should be added to the top of the LHS LHS replace the item itself. If the action is performed Shift, it will form a new terminal as the leaf nodes of the parse tree and will form a new sub tree. In software design, the input sentence in the form of sentences in Indonesian then the syntax rules of syntax used is Indonesian.

## V. IMPLEMENTATION AND RESULT ANALYSIS

The system implemented ambiguous sentence pattern identification is done by inserting a sentence in main Form. The

number of sentences which tested 30 samples of sentences, where each sentence to be tested is a single sentence, in the form of ambiguous sentences and the sentence is not ambiguous.

Testing is done by comparing the amount of data input sentence successfully tested and the overall amount of data input sentences tested. The accuracy of the software has reached 83.33%. Based on the results of testing of 30 samples of sentences, obtained 5 sentences cannot be checked with the appropriate sentence patterns. Errors caused by several things, such as:

1. Tagging error occurred when the defined word class process.
2. The input sentence does not belong to a single sentence patterns are usually the subject is in the beginning of the sentence.

## VI. CONCLUSION

The conclusion that can be obtained from this research are: Shift Reduce Parsing can be used to identify patterns of sentences in Indonesian and can be applied to the case of Ambiguous Sentence. The accuracy of identification of ambiguous sentence pattern in Indonesian using Shift Reduce Parsing method on software built by 83.3 %, and results of pattern recognition ambiguous sentence is determined by the defined word class, word class only of each word in a phrase that is used to process the Shift Reduce Parsing. Therefore, the software can not recognize an ambiguous sentence in appropriate if there is an error in the definition of the word class process.

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# Hand Contour Recognition In Language Signs Codes Using Shape Based Hand Gestures Methods

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**Abstract**— The deaf and speech impaired are losing of hearing ability followed by disability of developing talking skill in everyday communication. Disability of making normal communication makes the deaf and speech impaired being difficult to be accepted by major normal community. Communication used is gesture language, by using hand gesture communication. The weakness of this communication is that misunderstanding and limitation, it's due to hand gesture is only understood by minor group. To make effective communication in real time, it's needed two ways communication that can change the code of hand gesture pattern to the texts and sounds that can be understood by other people. In this research, it's focused on hand gesture recognition using shaped based hand algorithm where this method classifies image based on hand contour using hausdorff and Euclidian distance to determine the similarity between two hands based on the shortest range. The result of this research is recognizing 26 letters gesture, the accuracy of this Gesture is 85%, from different human hands, taken from different session with different lighting condition and different range of camera from image. It also can recognize 70% different hand contour. The different of this research from other researches is the more the objects are, the less the classification of hands size is. Using this method, hands size can be minimized.

**Keywords**— Hand contour, Gestures, Shape-based hand gesture methods, Hausdorff distance, Euclidean distance.

## I. INTRODUCTION

To communicate with deaf people, it is mostly used sign language or often called Indonesian Gestures Language Systems, i.e. the sign language that uses hand and finger movements. Along with advances in technology, it has developed some methods of learning (self-learning) for speech impaired and deaf people who want to learn to speak.

One of them is a method developed in English by the ABC organization, whereas in Indonesian this method has not been developed. Therefore, the researchers design a learning system for the speech impaired and deaf patients through a software with expectations the patients can perform the learning through computer media [1]. Indonesian with the hand gestures pattern was developed [2] by using an artificial network, with only 69% accuracy rate values. For the encoding, it must use a PC (Personal Computer) in order to overcome the problem on resolution, besides that gestures recognition was limited only 15 words, as well as pattern recognition (hand gesture recognition) used is still static, whereas for hand gesture recognition, it is needed dynamic hand gesture recognition due to the shift patterns of the hand gesture (movement sequences).

Several studies have been developed previously, as done by Rakhman et al. (2010) using the method of tracking haar

classifier and classifying image data set to train with K Nearest neighbors algorithms, the system is only able to recognize 19 letters of 26 gestures, the letters that are not be able to be recognized are; M, N, S, T, A and Z. This is due to the level of similarity between the letters signs is high and it is also due to the limitation of using only the same hand image. The purposes are to design a system of sign languages encoded by hand movements in real time for speech impaired and deaf people, by using the technique of hand gesture recognition.

The systems will be useful for speech impaired and deaf people as their two-ways communication. This study was developed using method 1: Feature consists of a hand contour data. Classifier based on the modified Hausdorff distance. Method 2: Feature consists of independent components of the hand silhouette. Classifier is the Euclidean distance. By using this method, the advantage of it, if compared with other studies, is that the more the number of objects (hand contours) are used, the less hand size classification is. Thus, using this method, although there are a lot of subjects to be used, the size of the hands can be minimized.

## II HAND SEGMENTATION

Image segmentation is the process of grouping the image into several regions based on certain criteria. In this study the hand segmentation aims to extract the hand region from the background. Segmentation divides two objects, which consist of the hand and the background, but in reality, the accuracy of the segmentation will be reduced because of the presence of rings, cuffs overlap, or rope/chain watches or folds around the boundary due to the slow or strong pressure. Moreover, the depiction of the hand contour must be accurate. It is caused of the difference between the hands of different individuals. Erdem Yoruk and friends had compared two different segmentation methods, namely clustering segmentation method, which is followed by morphological operations, and segmentation based on watershed transformation. Normalization hand image involves registration of a hand image (registering), i.e. the global rotation and translation, as well as the re-orientation of the fingers along the direction of each individual standard, without any distortion of the shapes [4]. In fact, this is the most critical operation for biometry applications based on hand shapes when global features are used. There are also schemes that use only local features for example contour separates the fingers. The need for re-orientation is shown in the figure below [5][6][7].

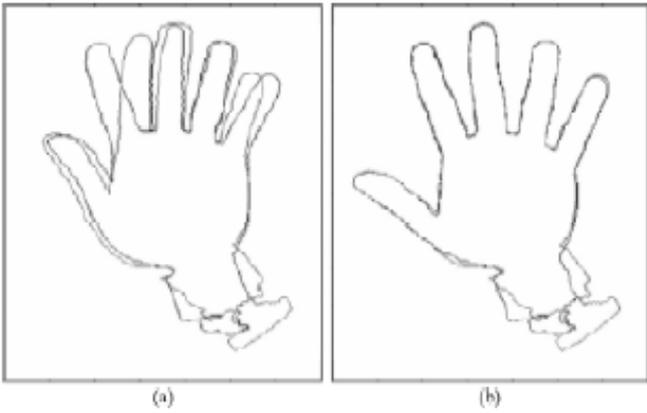


Fig 1 Superposition contour of same individuals hands  
 (a) Registration of global hand  
 (b) The alignment of fingers after fingers registration

#### A. Localizing Extremity Hand

The figure shows the same hand image, taken at 2 different sessions. The left image is the hand contour after global registration (but no registration finger), while the right image is the result after the registration of a finger. The registration process consists of two stages:

1. Translation of the center of the hand (centroid) such that it coincides with the center/center image.
2. Rotation toward the direction of the larger eigenvector, i.e. the eigenvector corresponds to the magnitude of the eigenvalue of the inertia matrix. Inertia matrix is a simple  $2 \times 2$  matrix of second order central moments of the binary hand center pixel spacing of the center (centroid).

Detecting and localizing extremity hand, the fingertips and valleys between the fingers, is the first step to the hand normalization. Due to the two extremities characterized by high curvature, we first experimented with curve gram contour, i.e. the curvature of the contour plots at various scales along the length path parameter. Nine maxima in curve gram, which is consistent at all scales, is the part that will be searched after hand extremity done. However, this technique is sensitive to contour irregularities, such as the alias and convoluted cavity (kinks), especially around the wrist area that is difficult to translate.

A more powerful alternative technique is given by the plot of the radial distance to the reference point in the area around the wrist. This reference point is taken as the first point of intersection of the major axis (eigen vector of the larger inertia matrix) with the wrist line. Sequence resulting from the minimum and maximum radial distance will correspond to the extreme point is searched. Extreme outcome is really stable because the definition of 5 maxima (fingers) and the minimal 4 are not affected by contour irregularities. The function of the radial distance and typical hand with the extremity contour marked on it are given in the figure below [8][9][10].

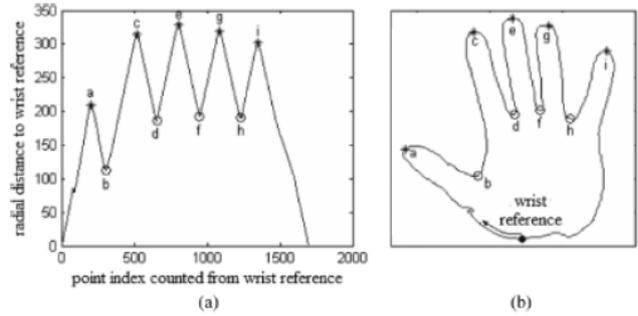


Fig 2 (a) Function of radial distance for fingers extraction and (b) Hand contour with marked extremity

#### B. Feature Extraction and Recognition

There are several options for selecting the features used in order to distinguish between hand-in biometric applications. Erdem Yoruk, Ender Konukoğlu, Bülent Sankur, 2006 introduced two schemes relative hand recognition that are very different in nature. The first method is based on a measure of distance between the contour that represents the hand, and therefore a shape-based. The second scheme considers the introduction of the whole scene image that contains of normalization hand and background, also apply the subspace method. Thus, the second method can be considered as a method of appearance-based, although the scene is composed of binary hand silhouette normalization. However, this approach can be applied to gray-level image of the hand, which will include hand texture and pattern of palm prints.

In order to compare the different hand geometry, Hausdorff distance is an effective method. According to M.P.Dubuisson, this metric has been used in the binary image and comparison forms and computer vision for a long time. The advantage of Hausdorff distance, when compared with the binary correlation, is the fact that this distance measures the proximity, not the exact superposition, making it more tolerant of disturbance at the location points [8][9][10].

$$\text{If } F = \{f_1, f_2, \dots, f_{N_f}\} \text{ and} \\ G = \{g_1, g_2, \dots, g_{N_g}\},$$

whereas  $\{f_i\}$  and  $\{g_j\}$  shows the two hands contour pixels for  $i = 1, \dots, N_f$  and  $j = 1, \dots, N_g$

Hausdorff distance will be determined as:

$$H(F, G) = \max(h(F, G), h(G, F)),$$

whereas

$$h(F, G) = \max_{f \in F} \min_{g \in G} \|f - g\| \quad (1)$$

In this equation,  $\|f - g\|$  is a rule for two sets elements and of course for contour pixels  $(f, g)$  that runs for index set  $i = 1, \dots, N_f$  and  $j = 1, \dots, N_g$

Template matching is a technique in digital image processing that has function to match each part of an image with the template image (reference). Template matching is a process where a pixel in the image has been made into a grouping of objects and relationships between different objects has been specified, this is the last step in the system recognition of an image object. Adjustments will do a comparison of each object image with a model that has been stored, thus it will be determined the most appropriate similarity between them.

Template matching, a basic pattern recognition, has been used both in the context of the introduction of posture and movement (gesture recognition). In the context of the image, template matching is done by comparison of pixel-by-pixel image of the prototype and the candidate. The similarity of the candidate with the prototype is comparable to the total score on the selected similarity measure. For hand posture recognition, detected hand image forms image candidate that is directly compared with the prototype of hand posture image. The best matching prototype (if any) is considered as a posture matching. Obviously, because of the comparison image uses a pixel-by-pixel, the template matching is not invariant to be scaled and rotated.

Template matching is one of the first methods used to detect hands on images. To overcome the variability due to scale and rotation, some authors have proposed a method of normalization scale and rotation, while others complete the set of prototype with the image of multiple angles. In H.Birk study, hand images for rotation normalized based on the detection of hands and the main axis, then, is scaled based on the dimensions of the hand in the image. Therefore, in this method, it is limited to the hands that move on a planar surface that is front to parallel of the camera. To overcome the computational cost when compared to some of the same prototype angles, the angles are described by the orientation parameter [H.Fillbrandt]. Searching of matching prototype will be accelerated, by searching only the relevant posture with respect to the prototype that was detected in the previous frame. A template that consists of the direction of the edge is used in [W.Freeman and Roth]. Edge image detection performed on isolated hand and edge orientation is calculated. Histogram of orientation is used as a feature vector. Evaluation of this approach shows that the end of the orientation histogram is not very discriminatory, because some of semantically different motion histograms show the same movement [8][9][10].

IV. IMPLEMENTATION

In the study, the software was designed to encode hand sign language. Sign language code of recognition system (hand gesture recognition) used an input from a camera. In this study the object used was a hand (palm and fingers), which is used as the encoding to deliver sign language. Hand sampling conducted in SLBB Palembang, with 10 deaf and speech impaired people.

System testing was conducted to determine the level of accuracy in identifying each image and the hand gesture letters. Tests carried out on 10 images with contours of different hands in the same distance. Table I shows that by using this system, it is able to recognize hand images with different contours by 70%. From the 10 samples of the hand contours used, 3 hands cannot be recognized, while the rest can be recognized.

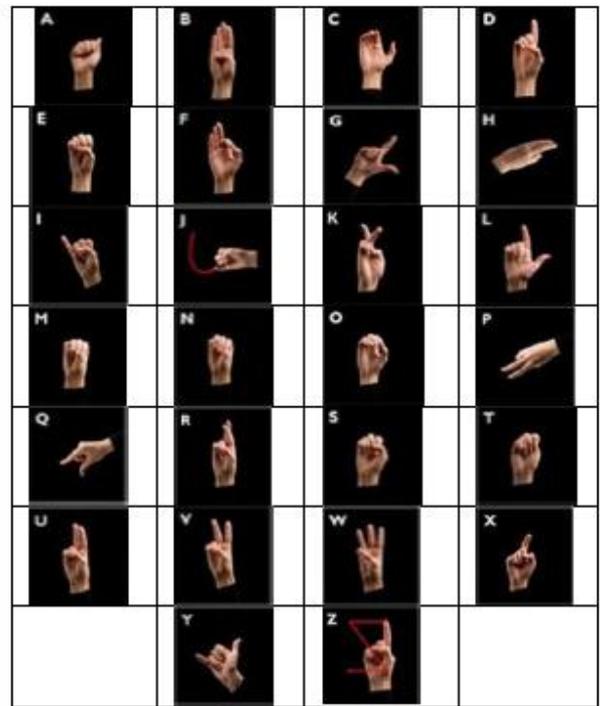


Fig 3 Sample Sign Language Code

TABLE 1  
SIGN LANGUAGE CODE RECOGNITION WITH 10 DIFFERENT HAND CONTOUR

Kontur Tangan	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	5	5	5	5	2	5	5	5	5	1	5	5	1	0	5	5	5	5	1	2	5	5	5	5	5	2
2	4	5	4	5	3	5	5	5	5	1	5	5	0	0	5	5	4	5	0	0	5	5	5	5	5	3
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	4	4	5	5	3	5	5	4	5	0	5	5	1	1	4	5	4	5	1	1	5	5	4	5	5	2
5	4	5	5	5	2	5	5	5	5	1	5	5	2	2	5	5	5	5	2	1	5	5	5	5	5	3
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	5	5	5	5	3	5	5	5	5	1	5	5	2	1	5	5	5	5	1	1	5	5	5	5	4	4
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	5	5	5	5	3	5	5	5	5	2	5	5	2	1	5	5	5	5	2	1	5	5	5	5	5	2
10	4	4	5	5	1	5	5	5	5	0	5	5	2	1	5	5	5	5	2	0	4	5	5	5	5	3

The introduction of code in each sign language can be recognized even if there is not recognized correctly, with a success rate of sign language recognition system correctly is 85%. Where the sign language code J, M, N, S, T and Z are in the small level recognition, this is because the code is rolled down form that makes it be difficult to perform the separation fingers in determining their owned boundaries. The tests of detecting the distance of the hand is done by using a distance of 10 cm to 70cm.

TABLE II  
THE TESTS OF DETECTING THE DISTANCE OF THE HAND

Kontur Tangan	JARAK (cm)						
	10	20	30	40	50	60	70
1	x	v	v	v	v	x	x
2	x	v	v	v	v	x	x
3	x	v	v	v	v	x	x
4	x	v	v	v	x	x	x
5	x	v	v	v	x	x	x
6	x	x	v	x	v	x	x
7	x	v	v	v	v	x	x
8	x	x	v	x	v	x	x
9	x	v	v	v	v	x	x
10	x	v	v	v	v	x	x

Various distance measurements will affect the accuracy of recognition, the minimum distance of the objects that cannot be able to be recognized is at 20 cm, while the maximum distance is at 60 cm, it is due to the reduction and enlargement of the region of interest (ROI) that form imperfect image.

## V. CONCLUSION

- a. The results of the tests performed system can recognize 26 letters gestures language, the accuracy of hand gesture recognition code language of the different contour hands is 70%.
- b. The introduction of code in each sign language can be recognized even if it is still not recognized correctly, the correctly sign language recognition system success rate is 85%. The sign language code J, M, N, S, T and Z are in the small level recognition, it is because of the code is rolled down form that makes it be difficult to perform the separation fingers in determining their owned boundaries.
- c. Various distance measurements will affect the accuracy of recognition, the minimum distance of the objects that cannot be able to be recognized is at 20 cm, while the maximum distance is at 60 cm, it is due to the reduction and enlargement of the region of interest (ROI) that form imperfect image.

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# Hand Gesture Recognition as Password to Open The Door With Camera and Convexity Defect Method

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**Abstract**—Computer Vision is one of reasearch that gets a lot of attention with many applications. One of the application is the hand gesture recognition system. By using EmguCV, will be obtained camera images from webcam camera. The Pictures will be disegmented by using skin detection method for decrease noises in order to obtain the information needed. The final project of this system is to implement the convexity defect method for extracting images and recognize patterns of hand gesture that represent the characters A, B, C, D, and E. The parameters used in pattern recognition of hand gesture is the number and length of the line connecting the hull and defects derived from the pattern of hand gesture.

**Keywords**—EmguCV, image processing, skin detection, convexity defect, hand gesture recognition.

## I. INTRODUCTION

Security is a condition where humans or animals feel avoid the danger that threatens or disturbing, furthermore, will pose a feeling of calm and comfortable. Security can be obtained in several ways, one of them is by applying technology. Application of technology security now have a very advanced ranging from conventional method to high-tech. In terms of security, it requires a key method for validation. Keys will later be referred to a password.

A password is codes to open or access a system. In practice there is a lot of passwords used, one who uses a figure letters, fingerprints, face, some even used the retina of the eye as password. In this study will be made a system that uses motion of hands as the password.

Motion of hands commonly used in daily life to communicate, as in greeting someone or as an auxiliary apparatus to communicate with a person who experienced deficient in verbal language [1]. Often occurring in communicating motion of hands can help clarify remarks someone, besides motion of hands can also presented a letter [2, 3].

Motion of hands are understandable by human who have studied it. To convict hand movement, it was required good eyesight, at that time the hand gestures be stored in memory and adapted to data stored in the brain then it will process results as an action. With this thought many researchers used camera as a substitute for the human eye, while the brain using microprocessor.

The use of camera as sensors usually relating to the field of computer vision such as used in the application of robotics, and control [4, 5, 6]. The application of computer vision said

succeed if the system using a right methods of image processing. Many techniques used in image processing, one of them is convexity defection. Convexity defection is a technique in which the image digitally can recognize an object [7,8,9].

## II. METHODS

### A. Obtain A Digital Image

At this stage, we will get RGB image realtime from the camera. The program will be built by using C# with Visual Studio 2013 compiler and supported by libraries emguCV. The Image Realtime captured by default which the resolution size is 640 x 480 pixels. In general, the camera has a resolution size is 640 x 480 pixels. However, there are some high end camera capable of capturing a larger resolution. in this system will be used a camera that has a resolution size is 640 x 480 pixels. As shown Figure 1. For cameras and computers that are used can be seen in figure 2 and figure 3.



Fig.1 Example of Digital Image



Fig. 2 The Camera

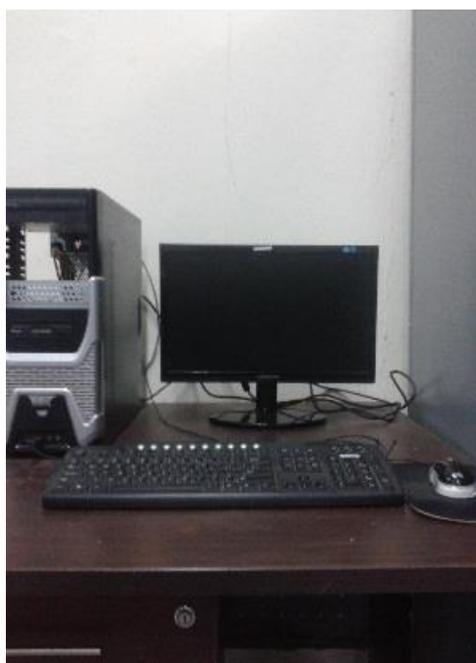


Fig. 3 The Computer

### B. Image Segmentation

At this stage, the digital image obtained from the previous stage and after that it will be filtered in order to filter the pixels that have the information needed [10,11]. There are two processes that will be used in this stage, namely skin detection and thresholding. The first is the skin detection process where the process will be sought the pixels that have a color corresponding to the color of the skin where skin color ranges had been specify before by us . To be able to detect the skin color with good pixel, The RGB pixels are converted into HSV [11,12,13]. By using the following equation, it will be obtained HSV values of each pixels.

$$V = \max ( R/255, G/255, B/255 )$$

$$S = \begin{cases} 0, & V = 0 \\ \frac{(V - \min(rgb))}{V} & V <> 0 \end{cases}$$

$$H = \begin{cases} 0, & S = 0 \\ 60 \frac{(g-b)}{SV}, & V = r \\ 60 \left[ 2 + \frac{(b-r)}{SV} \right], & V = g \\ 60 \left[ 4 + \frac{(r-g)}{SV} \right], & V = b \end{cases}$$

(1)

RGB value of each pixel is converted into HSV values where if the HSV values of each pixel are located in the range of pixel values is given then skin color detected. Next, come to the thresholding process where skin color pixels has been detected change into white and the other will be changed to black or just called a binary image.



Fig. 4 Binary Image

### C. Convexity Defect

At this stage, the binary image obtained in the previous process where the value of characters will be extracted by using the convexity defect. From the study of literature is read [14,15,16,17] this method can be used to extract the value of an image. This method has several stages for the solutions:

1. Obtain the largest contour of the binary image.
2. Save the pixel position from contour that formed and determine the pixel contour at the left most.
3. Sorting of the pixels and searching of hull defect.
4. Determine the distance of each hull length and defect.

#### 1) Determine the distance of each hull length and defect

At this stage, contour will be made by image that had been detected by skin color . Contour will be used for searching the position of the outermost from skin color pixels that are detected. Making contour of image that has been segmented

into the skin detection will be described in pseudocode as shown in Figure 5.

```

                                inda
x integer
For (i = 0; i < citra.width-1; i++)
For (j = 0; j < citra.height-1; j++)
    If (citra[i, j] != skincolor & citra[i+1, j+1] == skincolor)
then
        drawcontour[i+1, j+1]
        contour[x] = citra[i+1, j+1]
        x++
    End If
    Else If (citra[i, j] == skincolor & citra[i+1, j+1] !=
skincolor) then
        drawcontour[i, j]
        contour[x] = citra[i, j]
        x++
    End If
End For
End For
    
```

Fig. 5 Countour's Pseudocode

By using the algorithm as shown in figure 5 it will get skin contour detection from image as shown in Figure 6.



Fig. 6 Contour from skin detection had been detected

2) *Save the pixel position from contour that formed and determine the pixel contour at the left most*

At this stage, the position of the pixel on the contour will be stored into an array. The pixel will be compared and searched pixels that have the leftmost position, or in other words, pixels that have x values which is the smallest one. After obtained the leftmost pixel, the pixel index was changed to the first index. To more clearly be described with a flowchart as shown in Figure 7.

```

temp integer
indexMostleft integer
pixelMostleft point
pixelMostleft = contourX[0]
For (i = 0; i < jumlahcontourpixel - 1; i++)
    If (contourX[i] < contourX[i+1]) then
        indexMostleft = i
    End if
End for

temp = contour[indexMostleft]
contour[indexMostleft] = contour[0]
contour[0] = temp
    
```

Fig. 7 Pseudocode find the leftmost pixel

By using the algorithm, as shown Figure 7 are obtained leftmost pixel of contour skin detection as shown in Figure 8.



Fig. 8 Leftmost pixel of contour

3) *Sorting of the pixels and searching of hull defect*

After the leftmost pixel acquired at a later stage, on this stage each pixel will be sorted the index opponent based on clockwise direction (CCW). After we get the leftmost pixel, we only search of performed by 180 degrees starting from the bottom (0 degrees) and then to top (180 degrees). After the pixel sequentially based on clockwise direction and search hull and defect. The following equations are used in finding pointX that rotates 180 degrees counter-clockwise. However for PointY value will increase by 1 for angles which less than 90 degrees and will be reduced 1 to angle for more than 90 degrees.

For example, the image will be shown in figure 8 it will be visualized line from 0 to 180 degrees.

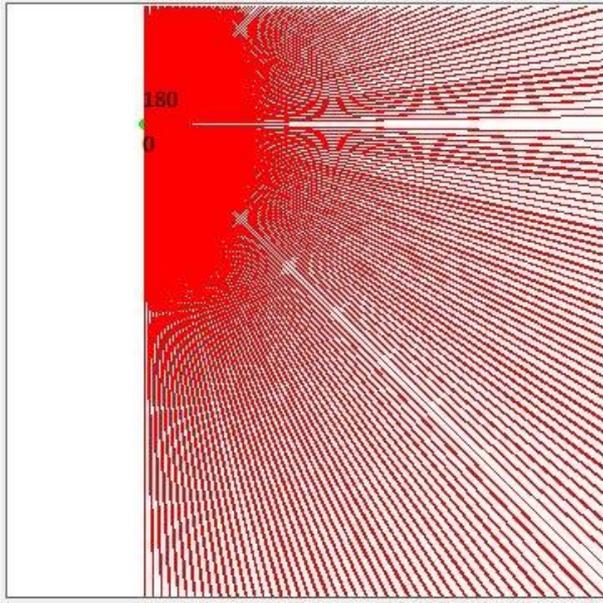


Fig. 8 The lines from 0 to 180 degrees

#### 4) Determine the distance of each hull length and defect

By using library EmguCV, we get the hull and defects from the skin color contour that has been detected. Figure 9 is an example of hull and defects acquired.

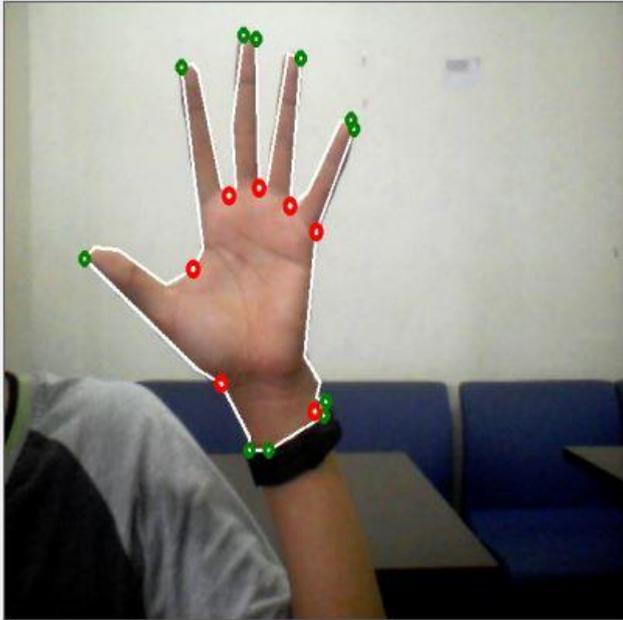


Fig.9 Hull and Defects

Next stage is to find the distance between the hull and the defect where the distance is what will represent the value of image pattern. The pattern that has pairs of hull and defect less than 10 then it will be added pair with distance value is 0. By using the Pythagorean formula, we will get distance hull and defects as shown in the following equation.

$$\begin{aligned} \text{Length} &= \text{end\_defectpointX} - \text{start\_defectpointX} \\ \text{Height} &= \text{end\_defectpointY} - \text{start\_defectpointY} \\ \text{Slant} &= \sqrt{(\text{Length}^2) + (\text{Height}^2)} \end{aligned} \quad (2)$$

By using the equations obtained distance of each hull and defects on each pattern as shown in Table I.

TABLE I  
THE DISTANCE LENGTH OF HULL AND DEFECTS

LENGTH OF LINE	DATA SAMPLE				
	A	B	C	D	E
INDEX 0	42.8	269.0	115.3	99.86	212.2
INDEX 1	174.8	237.5	278.4	161.8	202.2
INDEX 2	213.4	169.7	241.9	218	286.4
INDEX 3	134.4	148.9	219.8	255	246.4
INDEX 4	95.2	57.06	187.5	263.6	138.4
INDEX 5	72.1	40.9	1.53	15.06	119.3
INDEX 6	46.8	111.1	0	0	1.77
INDEX 7	40.7	80.02	0	0	0
INDEX 8	38.5	0	0	0	0
INDEX 9	5.13	0	0	0	0

#### D. Decision Making

At this stage, the distances obtained for each hull and defects on each pattern will be calculated of similarity by using equation dimensional Euclidean distance 1 dimension as shown in the following equation

$$\sqrt{(x - y)^2} = |x - y|. \quad (3)$$

#### E. Controls

On this stage, the pattern detected will verified by a pattern that has been stored in the database. If the pattern is correct then the computer will give orders to the microcontroller to unlock the keywords that have been installed. The shipping is sequent by serial with Bluetooth wireless media where the serial connection has a pretty good speed, and easy to apply on a microcontroller.

The microcontroller use the Atmel ATmega 16 which has a feature that supports serial USART serial connection [18, 19, 20].

### III. RESULT AND DISCUSSION

In order to obtain training data for each pattern, so that the experiments performed 200 times to get initial data for each pattern as shown in Table II.

The data that will be compared with the realtime data obtained. Every each index value of the data to be searched by using the smallest Euclidean distance equation. Realtime data is shown in Table III.

In the test, the value of each index pattern similarity can be seen in Table IV.

Patterns that have the most value similarity is pattern detected. The red column is the index that has the smallest similarity value. As shown in Table IV for each - one for each

pattern similarity number is A = 6, B = 3, C = 0, D = 0, and E = 1. From these data it can be seen that the detected pattern is a pattern A.

TABLE II  
DATA FROM EACH PATTERN

LENGTH OF LINE	DATA LATH (y)				
	A	B	C	D	E
INDEX 0	55.375	150.83	144.6	23.805	107.465
INDEX 1	38.015	118.10	101.48	24.23	67.535
INDEX 2	23.845	60.79	76.455	58.53	42.53
INDEX 3	27.965	81.62	118.18	55.245	125.87
INDEX 4	31.56	41.865	124.70	59.79	123.15
INDEX 5	28.675	18.585	0	46.985	86.925
INDEX 6	28.075	38.4	0	62.045	79.895
INDEX 7	31.37	48.085	0	48.35	0
INDEX 8	29.95	0	0	29.835	0
INDEX 9	23.4	0	0	6.695	0

TABLE III  
REALTIME DATA

LENGTH OF LINE	DATA REALTIME( x )
INDEX 0	154
INDEX 1	33
INDEX 2	63
INDEX 3	16
INDEX 4	14
INDEX 5	135
INDEX 6	36
INDEX 7	31
INDEX 8	41
INDEX 9	54

TABLE IV  
SIMILARITY VALUE IN WHOLE INDEX

LENGTH OF LINE	$\sqrt{(x - y)^2} =  x - y $				
	A	B	C	D	E
INDEX 0	98.6	3.1	9.4	130.1	46.5
INDEX 1	5	85.1	68.4	8.7	34.5
INDEX 2	39.1	2.2	13.4	4.47	20.4
INDEX 3	11.9	65.6	102.1	39.2	109.8
INDEX 4	17.5	27.8	110.7	45.7	109.1
INDEX 5	106.3	116.4	135	88	48
INDEX 6	7.9	2.4	36	26	43.8
INDEX 7	0.3	17	31	17.3	31
INDEX 8	11	41	41	11.1	41
INDEX 9	30.6	54	54	47.3	54

IV. CONCLUSION

According to the results and discussion, the system can detect the human hand gesture which are alphabet of A,B,C,D,and E. The system then sends the data code to the door lock

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# Signature Similarity Search Using Cluster Image Retrieval

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**Abstract**— Significant image search in the database of signatures on previous research is still 65%, because the data stored that result capture camera [13, 14, ]. In this paper, we do the retrieval pattern signatures automatically, the algorithm that is used to find data points based on contributions. Similarity search algorithms will optimize the intra cluster and cluster signatures in 3 classes i.e., Gx, Gy, gt. image capture-based content, which can calculate the similarity between the shape and texture of the images and do a grouping of pictures with minimum Euclidean distance consideration. CBIR is a set of techniques for taking pictures of semantically relevant than just image database based on recommended sources of images automatically. Performance evaluation method is now done with precision and recall for a different database. Response time to find most of the signatures from 3 grade database, giving the effect of a 78% accuracy rate higher.

**Keywords**— signature digital, k-mean clustering; calculate similarity; CBIR image; gradient magnitude Prewitt

## I. INTRODUCTION

Results of the capture image with a digital camera and saves the data into the database signature, the decline of the quality of the data. So in search of less accurate in finding the Indigo difference of the two pieces of the same image. Search in the database signature significantly on previous research is still 65% [14]. This research, we do two stages of uptake patterns automatically and the Signature Algorithm used to cluster the search based on the contribution of the data point. Content-based image retrieval of k-mean clustering algorithm. Similarity search algorithms will optimize the intra-cluster and cluster of signatures in 3 classes i.e., Gx, Gy, gt. search system, content-based image retrieval, which is able to calculate the similarity between the shape and texture of the image.

Significant image search in the database of signatures on previous research is still 65%, because the data stored that result capture camera. In this paper, we do the retrieval signature patterns automatically and cluster Algorithm used to search based on contribution data points. Content-based image retrieval of k-mean clustering algorithm. Similarity search algorithms will optimize the intra-cluster and cluster of signatures in 3 classes i.e., Gx, Gy, Gt. Search system, content-based image retrieval, which is able to calculate the similarity between the shape and texture of the image. The K Means Clustering Algorithm is then used to cluster the group of images based on feature vector of images by considering the minimum Euclidean distance. CBIR is a set of techniques for taking pictures of semantically relevant than just image database based on the features of the source image automatically.

One of the main tasks for the system of CBIR is counting in common, compare, extracting the signature feature of each image based on pixel values and defines rules for comparing images. This feature becomes the representation of images to measure the similarity with the other images in the database. The performance evaluation of the present method is done by Precision and Recall for different databases. Compute the difference compared with the image features components for other image descriptors.

## II. LITERATURE REVIEW

### A Signature Files

Faloutsos & Christodoulakis (1987), A signature file is a file that stores a signature record for each Image in the database. Each signature has a fixed size of b bits representing terms. A simple encoding scheme goes as follows. Each bit of a document signature is initialized to 0. A bit is set to 1 if the term it represents appears in the document[1,11]. A signature s1 matches another signature s2 if each bit that is set in signature s2 is also set in s1. Since there are usually more terms than available bits, there may be multiple terms mapped into the same bit. Such multiple-to-one mappings make the search expensive since a image that matches the signature of a query does not necessarily contain the set of keywords of the query. Improvements can be made by first performed frequency analysis, stemmed, and by filtering stop words, and then use a hashing technique and superimposed coding technique to encode the list of terms into bit representation [15]. Nevertheless, the problem of multiple-to-one mappings still exists, which is the major disadvantage of this approach.

### B Digital Signature

In this paper, paper-based authentication implementation document presented. The integrity of the message text and the author of the document can be verified by using a digital signature and QR codes. The proposed Methodology can be automated or semi-automated. It's a semi-automatic when OCR is inaccurate and requires the user to visually compare text messages on paper and obtained from the QR code; however, this method provides convenience for users dealing with large amounts of data [1, 10].

### C Content Based Image Retrieval (CBIR)

The images are very rich in the content such as in colour, texture, and shape information which are presented in them. Retrieving images based on colour similarity is achieved by computing a colour histogram for each image that identifies the

proportion of pixels within an image holding specific values (that humans express as colors) [4,13].

Colour searches will usually involve in comparing the colour of histograms, though this is not the only technique in practice. Texture measures look for visual patterns in images and how they are spatially defined. The identification of specific textures in an image is achieved primarily by modelling texture as a two-dimensional grey level variation [4,14]. The relative level brightness of pairs of pixels are computed such in the degree of contrast, regularity, coarseness and directionality that may be estimated. The shape does not refer to the shape of an image, but to the shape of the particular region that is being sought out.

We will make shapes often be determined firstly by applying segmentation with method Prewitt gradient magnitude edge detection to an image. In our cases, the accurate shape detection with method Prewitt gradient magnitude edge detection will require human intervention because methods like segmentation are very difficult to automate complete. Here are some discussions about shape extractions using gradient magnitude edge detection masks, like in Prewitt gradient operators.

### 1) Shape Feature

Shape is the most important and most powerful feature used for image classification, indexing and retrievals. Shape information extracted using histogram for edge detection. The edge information in the image is obtained by using the Prewitt edge detection [13,14].

In shape, we will segmentation of two Prewitt gradient magnitude edge detection are two images which at each point contain the horizontal and vertical derivative approximation techniques. Shapes representations can be generally divided into two categories, they are Boundary based and Region-based, see Fig. 1.

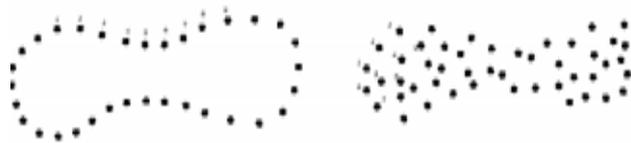


Fig. 1 Region based Images

### 2) Prewitt Edge Detection Technique

The Prewitt operator performs spatial gradient magnitude measurement in an image. The applying convolution  $K$  to pixel group  $p$  can be represented as [13,14]:

$$N(x, y) = \sum_{k=-1}^1 \sum_{j=-1}^1 K(j, k) p(x-j, y-k) \quad (1)$$

The Prewitt Edge Detector uses two convolution kernels, one is to detect changes in vertical contrast ( $h_x$ ) and the other is to detect horizontal contrast ( $h_y$ ). Fig. 2. shows the Prewitt Edge Detector uses two convolution kernels, one is to detect changes in vertical contrast ( $h_x$ ) and the other is to detect horizontal contrast ( $h_y$ ).

$$h_x = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix} \quad h_y = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$$

Fig. 2. Detect vertical contrast ( $h_x$ ) and Detect horizontal contrast ( $h_y$ )

Pandapotan Siagian (2013), these kernels are designed to respond maximal to the edges, running vertically and horizontally, relative to the pixel grid, one kernel for each of the two perpendicular orientations. The kernels can be applied separately to the input image, to produce separate measurements of the gradient component in each orientation (call these  $G_x$  and  $G_y$ ) [13,14].

We are can combine altogether to find the magnitude of the gradient at each point and the orientation of that gradient [14]. Typically, the steps used to find the similarity of gradient magnitude at each point in an input it fingerprints and signatures can be seen as follow:

- The image is fingerprint and signatures in format png with image size are 400 x 400 results.
- A data fingerprint and signatures on the shapes often be determined firstly by applying segmentation with method prewitt gradient magnitude edge detection. This method uses two convolution kernels, one is to detect changes in vertical contrast ( $h_x$ ) and the other is to detect horizontal contrast ( $h_y$ ). is stored in the directory
- Prewitt edge detector uses a pair of  $3 \times 3$  convolution masks, one is to estimate the gradient in the x-direction (columns) and the other is to estimate the gradient in the y-direction (rows).
- A convolution mask is usually much smaller than the actual image. As the result, the mask is slid over the image, manipulating a square of pixels at a time.
- If we define  $A$  as the source image, and  $G_x$  and  $G_y$  are two images which at each point contain the horizontal and vertical derivative approximations, then the masks will be marked as follows :

$$\begin{array}{ccc} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{array} \quad \begin{array}{ccc} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{array}$$

$G_x$   $G_y$

The magnitude of the gradient is then calculated using the formula:

$$|G| = \sqrt{G_x^2 + G_y^2} \quad (2)$$

Approximate magnitude can be calculated using:

$$|G| = |G_x| + |G_y| \quad (3)$$

The angle of the orientation of the edge (relative to the pixel grid) which is giving rise to the spatial gradient is given by:  $\theta = \arctan(G_y / G_x)$ , when,

$$G_x = \delta f / \delta x, G_y = \delta f / \delta y \quad (4)$$

### C Performance Evaluation of CBIR Systems

R. Xu and D. Wunsch (2005), Content-based image retrieval system is first evaluated in terms of retrieval effectiveness. In order to evaluate effectiveness of retrieval systems, two well known metrics, precision and recall are used :

Precision = (the number of retrieved images that are relevant) / (The number of retrieved images)

Recall = (the number of retrieved images that are relevant)/ (The total number of relevant images).

For a query q, the data set of images in the database that are relevant to the query q is denoted as R(q), and the retrieval result of the query q is denoted as Q(q). The precision of the retrieval is defined as the fraction of the retrieved images that are indeed relevant for the query using :

$$pre = \frac{IQ(g)IR(q)I}{IR(q)I} \tag{5}$$

The recall is the fraction of relevant images that is returned by the query using :

$$Re-Call = \frac{IQ(g)IR(q)I}{IR(q)I} \tag{6}$$

Usually, a tradeoff must be made between these two measures since improving one will sacrifice the other. In typical retrieval systems, recall tends to increase as the number of retrieved items increases; while at the same time the precision is likely to decrease. In addition, selecting a relevant data set R(q) is much less stable due to various interpretations of the images. Further, when the number of relevant images is greater than the number of the retrieved images, recall is meaningless. As a result, precision and recall are only rough descriptions of the performance of the retrieval system.

### D Contribution Based Clustering

J. Mac Queen (1967) and L. Kaufman (1990), Partitional clustering aims at partitioning a group of data points into disjoint clusters optimizing a specific criterion [5,7,8]. When the number of data points is large, a brute force. enumeration of all possible combinations would be computationally expensive. Instead, heuristic methods are applied to find the optimal partitioning. The most popular criterion function used for partitional clustering is the sum of squared error function given by

$$E = \sum_{j=1}^k \sum_{x \in C_j} (x - m_j)^2 \tag{7}$$

where k is the number of clusters, C<sub>j</sub> is the j<sup>th</sup> cluster, x is a data point and m<sub>j</sub> is the centroid of the j<sup>th</sup> cluster.

A cluster is a collection of data points that are similar to one another within the same cluster and dissimilar to data points in other clusters [2,3,6]. Clustering is a method of unsupervised classification, where data points are grouped into clusters based on their similarity. The goal of a clustering algorithm is to maximize the intra-cluster similarity and minimize the inter-cluster similarity. Clustering algorithms can be broadly

classified into five types: 1. Partitional clustering, 2. Hierarchical clustering, 3. Density-based clustering, 4. Grid-based clustering and 5. Model-based clustering [5].

Partitional and hierarchical clustering are the most widely used forms of clustering. In partition clustering, the set of n data points are partitioned into k non-empty clusters, where k ≤ n . In the case of hierarchical clustering, the data points are organized into a hierarchical structure, resulting in a binary tree or dendrogram [16].

### K-means Clustering Algorithm

Mac Queen (1967), K-means is one of the simplest unsupervised learning algorithms that solve the well known clustering problem [6]. The procedure follows a simple and easy way to classify a given data set through a certain number of clusters (assume k clusters) fixed a priori. The main idea is to define k centroids, one for each cluster. These centroids should be placed in a cunning way because of different location causes different result. So, the better choice is to place them as much as possible far away from each other. The next step is to take each point belonging to a given data set and associate it to the nearest centroid. When no point is pending, the first step is completed and an early grouping is done. At this point we need to re-calculate k new centroids as binary centers of the clusters resulting from the previous step. After we have these k new centroids, a new binding has to be done between the same data set points and the nearest new centred. A loop has been generated. As a result of this loop we may notice that the k centroids change their location step by step until no more changes are done. In other words centroids do not move any more. Finally, this algorithm aims at minimizing an objective function, in this case a squared error function. The objective function

$$J = \sum_{j=1}^k \sum_{i=1}^x \|x_i^{(j)} - C_j\|^2, \tag{8}$$

where  $\|x_i^{(j)} - C_j\|^2$ , is a chosen distance measure between a data point  $x_i^{(j)}$  and the cluster centre  $C_j$ , is an indicator of the distance of the data points from their respective cluster centred. The algorithm is composed of the following steps :1) Place K points into the space represented by the objects that are being clustered. These points represent initial group centroids, 2) Assign each object to the group that has the closest centred, 3) When all objects have been assigned, recalculate the positions of the K centroids, and 4) Repeat Steps 2 and 3 until the centroids no longer move[9].

It results in separation of the objects into groups from which the metric to be minimized can be calculated. Although it can be proved that the procedure will always terminate, the k-means algorithm does not necessarily find the most optimal configuration, corresponding to the global objective function minimum. The algorithm is also significantly sensitive to the initial randomly selected cluster center. The k-means algorithm can be run multiple times to reduce this effect. K-means is a simple algorithm that has been adapted to many problem domains and a good candidate for extension to work with fuzzy feature vectors [17].

### III IMPLEMENTATION

In our system, the digital Signature is obtained by the process of encode, decode web-based and use a paint pen. Any personal Data will be stored in three classes, namely class Gx, Gy, gt. application system perform a two-stage process i.e., the process of learning and classification. The input process of learning is the learning process with the input images stored in a database with three classes of data, results of pre-process by the method of gradient prewitt which aims to increase (i) feature extraction accuracy of the k-means algorithm (ii) an increase in the uptake of better accuracy, distance and similarity retrieval quick. This system is a web-based application. The system will calculate and display similarity 3 pictures at once, see in Fig. 3.

**A. Learning Process**

Learning process is the input of a collection of learning software image that has been known as the class label. Process code, decode signature is shown in Fig. 4 and the learning process system from administrator is shown in Fig. 5 and Fig. 6.

Learning Process input learned there step the process of digital data (fingerprint, signature), consist of:

- a) The digital signature is obtained by the process of encode, decode web-based and use a paint pen.
- b) Digitalize data in a data store in Portable Network Graphic (PNG) format with image size is 400 x 400 results.
- c) Prewitt gradient magnitude uses two convolution kernels, one is to detect changes in vertical contrast (hx) and the other is to detect horizontal contrast (hy). The data is stored in the directory, the signatures and image results prewitt gradient magnitude.
- d) Save the signatures data with a file name according to the name you have.

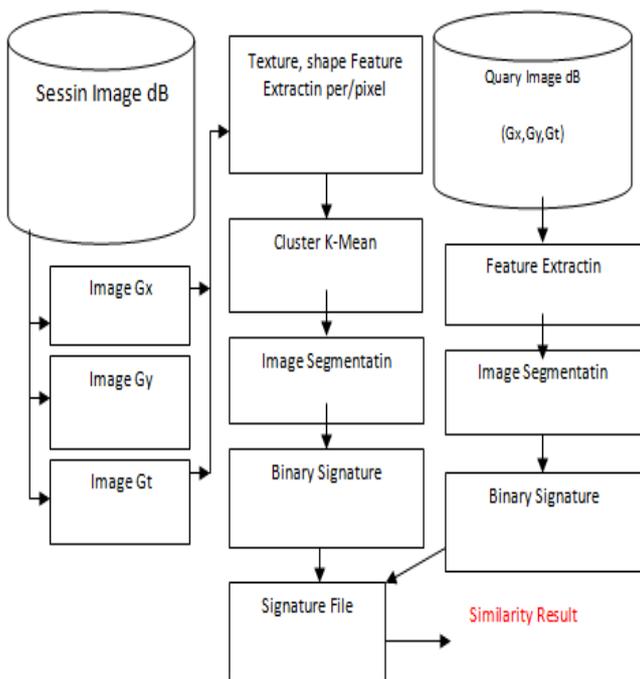


Fig. 3 System Overview

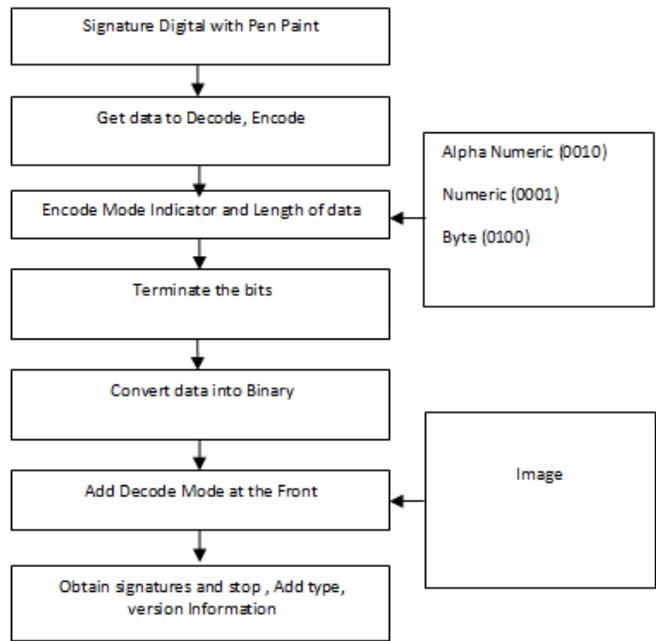


Fig. 4 Signature Decode Process

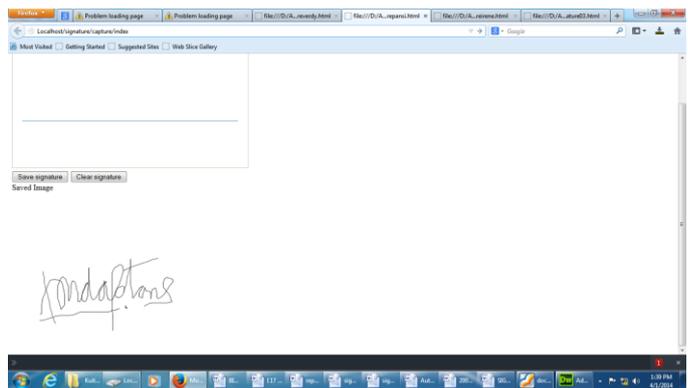


Fig. 5 Input Data Signature Digital

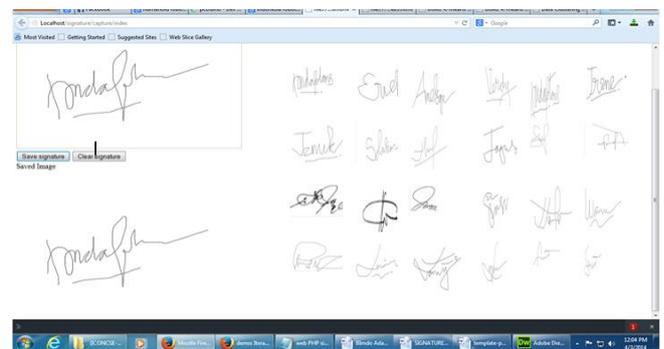


Fig. 6 Data Signature

**B Classification**

The algorithm consists of the following steps: (1) where K points in space represented by any class i.e. Gx, Gy, Gt specific value points represent initial group centroids per class, and (2)

defines each object to the group that has the closest centroid, (3) when all is set, recalculate the position of the K centroids, (4) determine the distance of each object to the centroid. and (5) repeat step 2 and 3 until the centroids no longer move. Because the same data is displayed for ID and a signature that has the same pattern. The pattern shown is the minimum, maximum and average the digital signature of each individual.

IV. RESULTS AND DISCUSSION

For the proposed method, experiments for testing in an environment Windows XP and PHP web Platform. Experiments conducted by various databases for different sizes. Signature image uploads from sub-directories, Gx, Gy, gt. consisting of 3 classes.

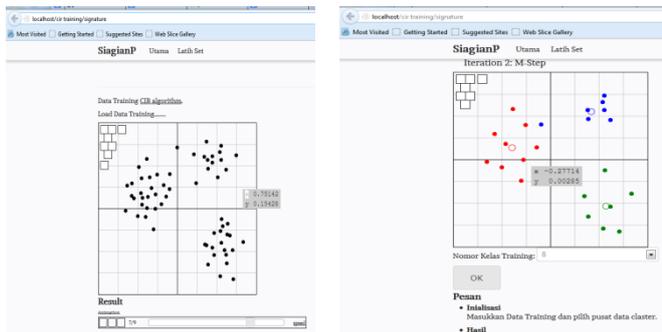


Fig. 6 Training of k-mean Cluster

A Clusters Of Min-Max

The grouping feature of extrasi for 3 classes of data i.e. Gx, Gy, gt. Grouping is done for the separation of objects into groups that can calculate the metrics to be minimized. Though it can be proved that the procedure will always end, k-means algorithm does not always find the most optimal configuration functions, the purpose of the global minimum. This algorithm also significantly sensitive to initial cluster Center is chosen randomly. The test results contained in Table I.

TABLE I  
CLUSTERING OF MIN-MAX

Class Image	K-Means cluster Signature	
	Min	Max
Gx	12.5%	Gx
Gy	13%	Gy
Gt	16%	Gt

B Precision And Recall

The success rate of the classification system for the same data in testing data in the database can be evaluated by using performance measures, re-call and precision. To measure the ability of a system to capture all relevant models, while the precision of measuring the ability of the system to take only the relevant model.

Below are the results of precision and recall for different databases. The K-means algorithm can be run multiple times to reduce this effect. K-means is a simple algorithm that has been adapted to many domain problem and a good candidate for the extension to work with vector gradient feature.

$$pre = \frac{\text{Numberofre levantCIRs signature}}{\text{Tota ln umberofCIR signature}}$$

$$Re-call = \frac{\text{Numberofre levantCIRs signature}}{\text{Tota ln umberofCIR signature int heDatabase}}$$

- a. Database of 50 and number of Clusters varying from 2 to 24 :

TABLE II  
PRECISION AND RECALL FOR DATABASE OF 2 TO 24

N0. Of Cluster	Precision	Re-call
2	100	100
4	87.89	92.44
8	83.76	75.29
10	80.28	70.78
12	78.67	74.39
14	71.38	71.25
16	73.78	73.69
18	74.21	74.10
20	75.67	75.60
22	74.66	74.69
24	70.12	69.20

- b. Database is varied from 30 to 100 and number of Clusters equal to 7:

TABLE III  
PRECISION AND RECALL FOR DATABASE OF 30 TO 100

N0. Of Cluster	Precision	Re-call
30	74.73	100
40	73.73	72.89
60	73.17	74.67
70	72.54	72.45
80	71.67	71.39
80	71.38	71.25
100	73.78	73.69

- c. Database of 200 and number of Clusters varied from 4 to 10

TABLE IV  
PRECISION AND RECALL FOR DATABASE OF 4 TO 10

N0. Of Cluster	Precision	Re-call	N0. Of Cluster
4	74.73	100	4
5	73.73	72.89	5
6	73.17	74.67	6
7	74.54	74.45	7
8	74.67	75.39	8
9	76.38	75.25	9
10	63.71	63.69	10

V. CONCLUSIONS

In this paper, we have the algorithm how K is combined with a combination of K means algorithm with Prewitt Filter. integrated clustering algorithm for image classification is tested with a different image that image signatures with a different gradient.

We found that then performs well compared to before. The algorithm is robust and highly effective in producing the

desired classification in particular in the field of pattern recognition as a fascinating area as shown by the results of the experiment.

Different neural network algorithm in the future can be used to classify images of signatures on gradient prewitt.

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# Rock Genre Classification using K-Nearest Neighbor

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**Abstract**— Music genre classification is a part of Music Information Retrieval. This research was a genre music detection based on signal from an audio. Divided into two processes namely extraction of features and classification. Signal would be transformed using Fast Fourier Transform to get frequency domain signal which will be processed to extract Short Time Energy, Spectral Centroid, Spectral Roll-Off, Spectral Flux, and Energy Entropy feature. Besides those features, Zero Crossing Rate would be counted from time-domain signal. In classifying phase, research using k nearest neighbor with accuracy reaching 54,44%.

**Keywords**— Music Information Retrieval, Digital Signal Processing, Fast Fourier Transform, Feature Extraction, K-Nearest Neighbor

## I. INTRODUCTION

The development has been increasingly diverse music in which various kinds of music has sprung up, especially in rock music. Previously, only a few types of rock music are there, but now has many new emerging types of rock. Increasing the number of types of rock music certainly adds to the difficulty in determining the type of rock music. One step that can be done to overcome the problems in determining the type of rock music is to create a system that is able to classify the rock itself. There have been many studies conducted in the determination of the type of music and the famous one is MUGRAT (Music Genre Recognition by Analysis of Texture) the results of the study Karin Kosina (2002)<sup>1</sup>. Where MUGRAT able to classify three types of music that is classical, metal, and dance with an accuracy of classification, is the extraction and classification.

The problem of this research is how to appropriately classify the type of music, especially rock music where rock music itself is divided into several sub-genres. However, to classify a genre of music, it takes a form of input data extraction features of a musical frequencies, classification using the K-Nearest Neighbor algorithm (KNN).

The purpose of this research is as follows measuring the accuracy of the classification of the type of software usage musik rock with algoritmaK-Nearest Neighbor (KNN).

The benefit of this research is to be able to classify three types of rock music is punk rock, psychedelic rock and hard rock so it can reduce frequent debate and helping ordinary people (who are not so familiar with rock music) to be aware of the three types of rock music.

Limitation problem of this study are as follows training and audio data input wav format with 8000 Hz sample rate and only have one channel (mono), Rock type specified only 3 kinds of music that is, punk rock, psychedelic rock and hard rock. Training and input audio data is basically songs that represent

the three types of rock music mentioned above. If there is someone who uses the data enter the 3 types of music outside of rock that has been determined, then the music input to be classified among the three rock music. For the training data selected band is legendary in every type of music. Sex Pistols punk rock as training data, the Jimi Hendrix Experience as training data psychedelic rock, and Black Sabbath as training data hard rock. The value of k-parameters used in the K-Nearest Neighbor classification is 5. The data used in this study is secondary data downloaded from the Internet in the form of an audio file mp3 format. Data collection techniques used in this research is to download an mp3 format songs from several internet sites which are then converted to wav format audio files with a sample rate of 8000 Hz with a single channel (mono). There are 12 songs that became the training data, where each of the types of rock music composed 4 songs. As for the input data, collected 30 songs for every type of rock music, thus totaling 90 songs.

## II. K-NEAREST NEIGHBOR (KNN)

K-Nearest Neighbor (KNN) algorithm is the most commonly used in the classification, although also can be used for estimation and forecasting. KNN has several advantages, namely robustness against training data has much noise and effective when the training data is large. KNN is an example of an instance-based learning which means the training data is stored, so that the classification for unclassified new data will be compared with the training data by taking the data of the most common training (Larose, 2005)<sup>2</sup>.

To determine the similarity, the euclidean distance function is needed to test the size of which can be used as an interpretation of proximity between two objects. Euclidean distance is represented as follows:

$$d_{euclidean}(x, y) = \sqrt{\sum_{i=1}^N (x_i - y_i)^2} \tag{1}$$

Where deulidean (x, y) is the scalar distance of two vectors x and y. In the training phase, the algorithm is just doing storage feature vectors (Larose, 2005). Object in question is the object of training data and input data.

So once known each euclidean distance between the input data with training data, will be selected as the training data parameter k has the smallest euclidean distance. Conclusion

Most of the data are going to be the choice for the new classification of the input data.

Training data and the input data are selected based on the observation through an internet search engine with keywords "greatest punk rock band", "greatest psychedelic rock band", and "greatest hard rock band". The results of these observations indicate bands such as Black Sabbath, Sex Pistols, Jimmi Hendrix Experience, Pink Floyd, Jimi Hendrix Experience, and the Ramones. So for the training data represented by the Sex Pistols (punk rock), Black Sabbath (hard rock), and the Jimi Hendrix Experience (psychedelic rock)<sup>7</sup>.

### III. ANALYSIS AND DESIGN

#### A. Analysis of Feature Extraction

Audio files pass through the first stage of feature extraction. In the feature extraction stage, the audio file will pass through four stages: frame blocking the signal, the signal windowing, signal transformation, and counting feature. Data from the audio file a number that describes the amplitude.

##### 1) Frame Blocking Signal Analysis

In the frame stage blocking signal, the input audio file will be divided into signal comprising several frames. The size of a frame consisting of several samples depending on how many seconds the audio file will be divided and how much sampling frequency. In this study the frame size of 50 milliseconds without overlapping. The purpose of this frame is that the blocking signal is invariant, which means no change. The outcome of this process is a signal that has been split into multiple frames.

##### 2) Windowing Signal Analysis

Once the signal is divided into many frames, then the signal will go to the windowing stage. The purpose of windowing is to eliminate the effects of discontinuities caused by blocking frame. There are several kinds of windowing methods, the Blackman Window, Window Rectangle, and Hamming Window. In this research, windowing used is Hamming Window,

$$w(i) = 0,54 - 0,46 \left( 1 - \cos \left( 2\pi \frac{i}{n} \right) \right) \quad (2)$$

untuk  $i=0 \dots n-1$

Hamming window is a windowing which include having a small side lobe and main lobe of the greatest so it will be more smooth windowing results in eliminating the effects of discontinuities. The results of this stage is the signal on the frames that have been windowing..

##### 3) Signal Transformation Analysis

At this stage it will change the original signal into a time berdomain berdomain frequency. In this research, to change the signal domain used Fast Fourier Transform (FFT). The purpose of a domain modifying the signal that the features of an input music can be calculated, where the features are the frequency characteristics of the music. All the signals that have been in

the framing and windowing were going to put into the equation 3.

$$X[k] = \sum_{n=0}^{N/2-1} x[2n]W_{N/2}^{nk} + W_N^k \sum_{n=0}^{N/2-1} x[2n+1]W_{N/2}^{nk} \quad (3)$$

Having obtained the results of the real and imaginary of the signal then the next step is to enter into the equation to obtain the signal magnitude 4.

$$M_t[k] = \sqrt{\text{Re}(X[k])^2 + \text{Im}(X[k])^2} \quad (4)$$

#### 4) Calculation Analysis Features

Signal has a frequency berdomain then be computed its features. In this experiment the features that will be calculated is the Zero Crossing Rate (ZCR), Short Time Energy (STE), Spectral Centroid (SC), Spectral Roll-off (SR), Spectral Flux (SF), and the Energy Entropy (EE). But for ZCR, not used with frequency domain signal, but the signal is the original signal berdomain time.

$$ZCR = \sum_{n=1}^{N-1} |(x[n]) - (x[n-1])| \quad (5)$$

$$STE = \frac{1}{N} \sum_{n=0}^{N-1} M_t[n]^2 \quad (6)$$

$$SC = \frac{\sum_{n=0}^{N-1} M_t[n] \cdot n + 1}{\sum_{n=0}^{N-1} M_t[n]} \quad (7)$$

$$SR = 0.85 \sum_{n=0}^{N-1} M_t[n] \quad (8)$$

$$SF = \sum_{n=0}^{N-1} (N_t[n] - N_t[n-1])^2 \quad (9)$$

$$EE = - \sum_{n=0}^{N-1} p(x[n]) \log_{10} p(x[n]) \quad (10)$$

#### B. Classification Analysis of Rock Music Type

The last phase will be the classification of types of music. The classification of music using the K-Nearest Neighbor algorithm (KNN). The features that have been previously obtained will be compared with the training data that is already available. By calculating the euclidean distance of each feature to the training data, which will be selected which has the smallest distance to the training data. From the results of euclidean distance calculation, we will get some kind of music as a candidate k-parameters. Music input will be classified into the type of music that most of the candidates.

IV. IMPLEMENTATION AND TESTING

Rock Music classification software with Algorithm Using K-Nearest Neighbor (KNN) includes hardware, software and programming languages. The hardware used in this implementation phase is a computer with the following specifications AMD FX-4100 Quad Core 3.6 GHz, 4GB RAM, 500GB Hard Disk. The software used in the implementation of this software are Operating system Microsoft Windows 7 Ultimate, Compilers NetBeans IDE 7.2. The programming language used in the implementation of this software is Java language.

Testing of this software using black box testing method based on alignment of the conduction of software design and software implementation results. Based on the results of testing that has been done on the suitability of software design and software implementation, it can be concluded that the interface unit and built to run well.

TABLE I  
EXAMPLE TRACK 1 WITH THE NUMBER 8 FRAMES

No Frame	ZCR	STE	SC	SR	SF	EE
Frame[1]	1	32,677.24	4.4	434.21	0.0829	0.89
Frame[2]	1	30,112.23	8.7	400.98	0.0781	0.77
Frame[3]	4	35,888.7	5.1	349.87	0.0784	0.78
Frame[4]	2	39,200.64	3.3	210.21	0.0956	0.44
Frame[5]	2	40,404.66	9.4	366.63	0.0741	0.65
Frame[6]	1	29,123.41	9.1	481.46	0.0646	0.61
Frame[7]	0	56,410.87	6.8	215.52	0.0832	0.84
Frame[8]	3	49,339.21	5.0	587.29	0.0474	0.71

In order to extract the value of each individual frame into one, then

$fiturZCR = std(ZCR) = 1.31$   
 $fiturSTE = std(STE) / mean(STE) = 9,547.48 / 39,144.62 = 0.24$   
 $fiturSC = std(SC) = 2.35$   
 $fiturSR = std(SR) = 127.39$   
 $fiturSF = std(SF) / mean(SF) = 0.014 / 0.075 = 0.19$   
 $fiturEE = std(EE) = 0.14$

TABLE II  
TRAINING DATA

Song	ZCR	STE	SC	SR	SF	EE	Y= Classification
1	2.42	0.5	2.34	120.88	0.18	0.13	Punk rock
2	3.05	0.44	2.77	135.44	0.17	0.16	Punk rock
3	1.54	0.57	1.98	140.55	0.17	0.14	Hard rock
4	1.76	0.21	3.47	123.32	0.2	0.15	Hard rock
5	2.25	0.36	2.14	150.6	0.21	0.11	Psychedelic rock
6	2.83	0.42	1.88	124.71	0.16	0.19	Psychedelic rock

The formula to calculate the distance euclide

$$Dk = \sqrt{\sum_{k=1}^N (a_k - b_k)^2} \tag{11}$$

then calculate the distance euclide one by one song, so obtained (Table III)

Obtained Punk rock category 2 pieces, 1 piece Hard rock, Psychedelic 1piece. Because most falls result in punk rock, the song expressed type 1 punk rock.

To test the classification results in the form input types of rock music 30 punk rock music, 30 music psychedelic rock, and 30 hard rock music.

TABLE III  
CALCULATE THE DISTANCE

Song	D= Euclid distance	Y= classification	Including KNN category?
1	6,608	Punk rock	Yes
2	8,249	Punk rock	Yes
3	16,169	Hard rock	No
4	1,613	Hard rock	Yes
5	23,23	Psychedelic rock	No
6	3,122	Psychedelic rock	Yes

Total records were examined as many as 90 data, the sample songs that fit with the music as much as 49 types of data, sample songs that are not in accordance with the type of music as much as 41 data.

The accuracy of the classification of the type of rock music success using the K-Nearest Neighbor algorithm with the k-value of the parameter 5 = 54,44 %.

V. CONCLUSIONS AND RECOMMENDATIONS

Conclusions obtained in this research are :

1. Input audio data can be classified into a type of music rock music because of the similarity of the features of input data with training data. Type of music most of the similarity of the training data that will be input data type of music.
2. Determination of the amount of free K-parameters and the selection of training data influences the classification success percentage.
3. Based on test data as the K-90 data with the parameter 5, the results obtained success rate of 54.44% accuracy for the classification of rock music. 49 Where the data according to the type of music, and 41 the data does not match the type of music.
4. Not that too much accuracy or success due to the lack of specific criteria of features for a particular type of music, so the classification is only based similarity features the largest and closest of the input data to the training data. While the training data does not necessarily include the right to represent a type of rock music.

Advice the further development of this research include the following:

1. The number of types of music reproduction,
2. extraction features to be reproduced;
3. Reproduced audio file formats, not just \* wav but can also \* Mp3, \* .cda, and other audio files;
4. Detection of music can be performed live (real time).

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# Simplification Complex Sentences in Indonesia Language using Rule-Based Reasoning

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**Abstract**-Complex sentence consist of two or more single sentence and one or more conjunctions. Complex sentences have many meaning, so that is quite difficult to be simplified because the results of simplification complex sentence does not match the original sentence. To solve this problem, this research using Rule-Based Reasoning method and Surface Expression Rules. Because Rule-Based Reasoning method can be adapted to the rules of surface expression that can look for patterns of complex sentences, so thus simplifying precise and accurate results. The results of researchis the Rule-Based Reasoning methods used in accordance with the accuracy of 93.8% and an assessment of questionnaires obtained values 76-100.

**Keyword**-complex sentences, simplification, rule-based reasoning, surface expression, pattern complex sentences.

## I. INTRODUCTION

Complex sentence consist two or more single sentence. Every complex sentences has different conjunctions and some are not wearing but use a comma. Complex sentences can be determined by looking at the use of conjunctions or punctuation used. People often difficult to understand what you want delivered in complex sentences. Using conjunctive or sign can make a complex sentence into a different meaning and content of information.

The problem is when simplification the sentence which divides complex sentences into a single sentence in which a single sentence that has been simplified to alter the meaning and content of information. Simplifying text (text simplification) is one of the fields of natural language processing (NLP) which rewrite a sentence to reduce syntactic complexity (syntactic complexity) and lexical complexity (lexical complexity) without changing or eliminating the meaning of the sentence and fill in the information sentence[1]. In particular, the simplification of the sentence has been developed in various countries. Development is done by a variety of methods and rules. However, in Indonesia the development of sentence simplification is not much, especially simplification complex sentences

## II. RELATED WORK

Some research on text simplification done. In this study, will try simplifying the text in Indonesian to simplify complex sentences. Previous research [2] studied the question and answer system development for Non-factiod question for Indonesian. Non-factoid question is a question-answer questions that generally require a fairly lengthy explanation as a definition of a term method for doing something or the cause of an incident. This indicates that non-factoid question is more complex, because it requires the classification of questions to

get the expected answer. Wear pattern classification question classification based on pattern Surface Expression. Types of questions can be included to predict the type of response generated.

Future studies related on the simplification of text in French[3] entitled Acquisition of Syntactic Simplification Rules for French. His research describes the simplification of syntax (syntactic simplification) is a data-driven approach that implements two methods. The first method is manual corpus analysis that aims to identify the word you would be simplified, then the second method is a semi-automatic that automatically identifies the simplified function informs sentence simplification rules. The results of his research to overcome obstacles no longer need the data as parallel resources and increase flexibility. In particular, syntactic simplification can explore domains on user-generated content as pre-editing for statistical machine translation.

Research simplification of text above, this study will examine the simplification of complex sentences in Indonesian using Rule-Based Reasoning method based on rules and their surface expression tagger post on the introduction of a class of words in a sentence. In a complex sentence simplification is expected to facilitate the delivery of simplifying complex sentences and the meaning of the sentence.

## III. PERFORMANCE

Natural Language Processing is the area of research and application that explores how computers can be used to understand and manipulate the natural language text or speech to do something useful [4].

### A Preprocessing

Preprocessing is process of managing the data before the processing data [5]. Preprocessing consist of case folding and tokenizing. Case folding is process of changing all the letters in a document / sentence to lowercase. Only the letters 'a' through 'z' received [6] while the characters other than letters received are considered delimiter. Examples delimiter can be seen in Table I.

TABLE I  
DAFTAR DELIMITER

Daftar Delimiter									
0	5	[	%	`	.	?		)	≥
1	6	]	^	~	,	:	!	-	∞
2	7	{	&	\\	/	;	@	_	π
3	8	}	*	£	<	'	#	+	±
4	9	\	(	€	>	,	\$	=	Φ

Tokenizing is process of identification the smallest units (tokens) of a sentence structure (Triawati, 2009). Breaking sentences into single words performed by scanning a sentence using white space separators such as spaces, tabs, and newline. Schematic of the process of folding and tokenizing case can be seen in Table II.

TABLE II  
PREPROCESSING SENTENCES SCHEME

Preprocessing Sentences	
Sentences :	Ibu Pergi Ke Pasar
Case folding :	ibu pergi ke pasar
Tokenizing :	"ibu" "pergi" "ke" "pasar"

**B Part of Speech**

Part of Speech (POS) tagging is a process that is done to determine the type of a word in the text. A simple form of this process is the identification of words as adjectives, adverbial, interjection, conjunction, noun, numeral, prepositions, pronouns, verbs, etc. [5]. The process of determining the type of words in a sentence can be seen in Figure 1.

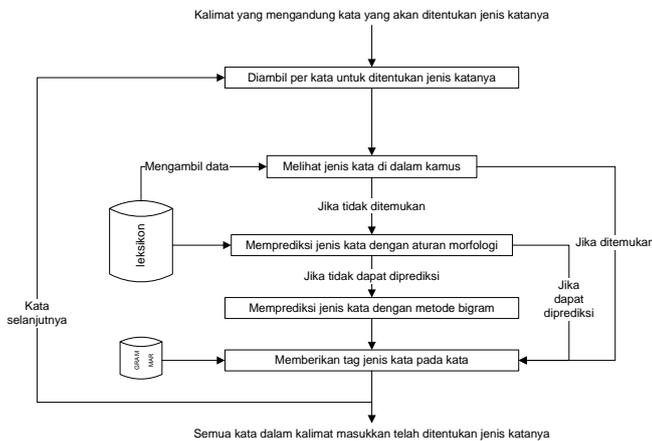


Fig. 1 Process of Identification Type of Word[5]

**C Rule-Based Reasoning**

Rule-Based Reasoning is a decision support system which also has a knowledge base. In this method, the settlement of the problem based on an artificial intelligence approach using problem-solving techniques based on the rules contained in the knowledge base [7].

[2] uses the rules of the component surface expression answer finder. Surface expression is the surface expression of the sentence or the pattern used in the sentence. regulation of surface expression in the study can be found in appendix

**D Complex Sentences**

Complex sentence is a merger of two or more single sentences using conjunctions. Examples of complex sentence simplification can be seen in Figure 2.

1. Tini berbelanja sayuran.
2. Tini memasak sayuran
3. Tini berbelanja sayuran dan memasaknya

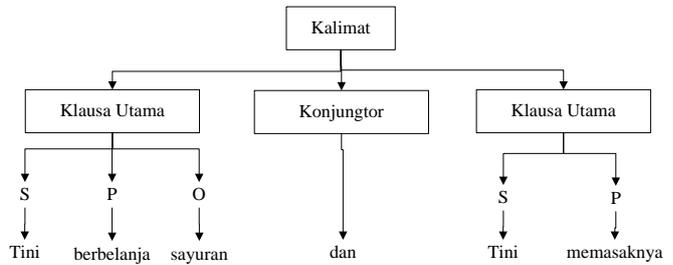


Fig. 2 Chart of Complex Sentences (3)

**IV. EXPERIMENTAL**

Simplification complex sentence is not as easy as one might imagine, some people find it difficult to simplification complex sentences, especially during the learning process in schools. Therefore, need a applications to help the learning process and make it more attractive. In this research, simplification complex sentence process starts from preprocessing which case folding and tokenizing. The results of the research complex sentence preprocessing can be seen in Figure 3.

**Preprocessing Kalimat Majemuk**

**Contoh Kalimat :**  
"Tini Berbelanja Sayuran dan Ibu Memasaknya"

**Hasil Proses Case Folding:**  
"tini berbelanja sayuran dan ibu memasaknya"

**Hasil Proses Tokenizing:**

Kata	tini	berbelanja	sayuran	dan	ibu	Memasaknya
Indeks	1	2	3	4	5	6

Fig. 3 Preprocessing of Simplification Complex Sentences

After we get a results in the form of preprocessing tokens (word class), tokenizing on this journal wear NLP\_ITB package where the package is Indonesian word dictionary. Token can make easy to process of simplification of complex sentences. Further, simplification complex sentences of the process that is using the Rule-Based Reasoning with rules Surface Expression. Process simplification of complex sentences can be seen in Figure 4 and Figure 5.

This research used 60 samples were taken from the complex sentence <http://bse.kemdikbud.go.id/>. Based on the experiment results of the software by entering the 60 samples of complex sentences, obtained 4 sample of complex sentences that can not be simplified accurately. Experiment result on this research using 60 sample of complex sentences can be seen on appendix B. This is due to several factors that the sentences can not simplified accurately, there are:

1. The token tagging errors occurred in the compound sentence "his face is thin and pale". The error occurs on the token marking words that should generate "n, v, c, n, v", but in POSTagging generated token is "v, n, c, v, n". The error occurs from the package NLP\_ITB.

2. Sentence Compound "It's fun playing ball so spaced out" can not be reduced to a single sentence and a two conjunctions appropriately. The fault lies in the pattern of compound sentence has no subject. So that can not be simplified complex sentences correctly.
3. Compound sentence "the birthday party would not be more festive if you come to attend". The error occurs on the token marking the word "if" is a word that should be connecting, but the token POSTagging recognizable words with a noun. The error occurs from the package NLP\_ITB.
4. Sentence compound "People panic because there was an earthquake" in POSTagging identified by the token of the word "n, n, c, v, v", but should have obtained a token word is "n, v, c, v, n". The error occurs from the package NLP\_ITB.

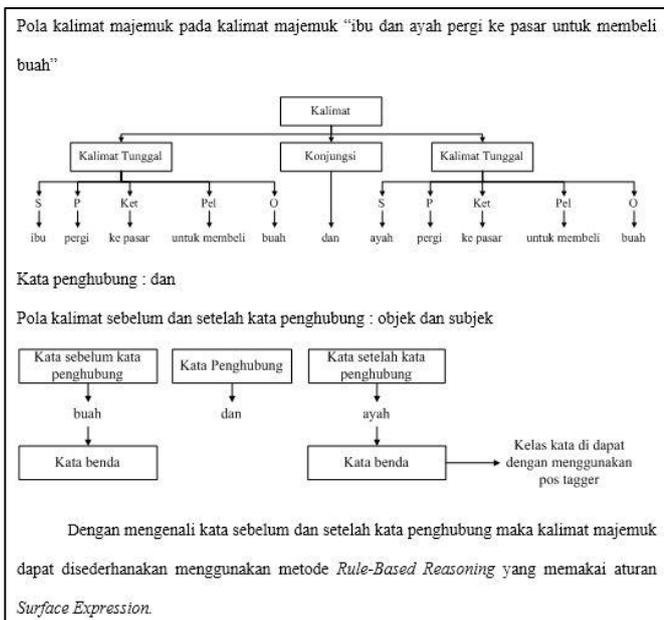


Fig. 4 Surface Expression Rules in Simplification Complex Sentences

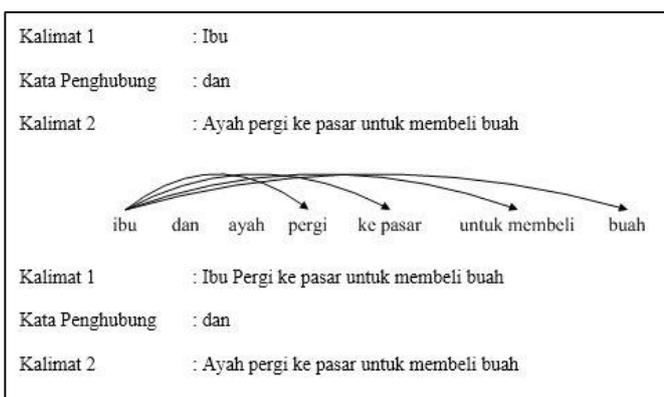


Fig. 5 Simplification Complex Sentences using Rule-Based Reasoning

Based on the experimental results of 60 samples of complex sentences obtained 4 sample of complex sentences that can not be simplified appropriately. Therefore, the percentage of success of software obtained for 93.3% of the software is built. Word tokens not generated as expected. However, the word is sometimes different tokens if put in a different sentence. Therefore, there are some words that can

not be replaced tokens he said. For example the word "if" is not a word said base so that the resulting token is different.

## V. CONCLUSION

The conclusion that can be take from this study are

1. Methods of Rule-Based Reasoning can be used to simplification sentence and can be applied to the case of complex sentences which basically has a single and a two-sentence conjunctions.
2. Rules Surface Expression can be used to describe the word before and after the conjunctive. So that the compound sentence can be simplified by appropriate because it does not change the meaning and information after simplifying complex sentences.
3. Sentence of 60 samples were available, the percentage of complex sentences simplification results in Indonesian using Rule-Based Reasoning on software as much as 93.3% of the 60 samples in which the existing manjemuk sentences, compound sentences there are four samples that can not be simplified appropriate. This
4. is because an error occurred while defining the token word and sample sentences compound does not have a compound sentence patterns that have been defined.
5. Results simplification of complex sentences are split into two single sentences and the conjunctive word is determined by the class defined. Just a word class of each word in a sentence compound sentence is used to simplify the process of using Rule-Based Reasoning. Therefore, the software can simplify complex sentences are not appropriate when an error in the definition of the word class by NLP\_ITB package.

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## Surface Expression Rules in Simplification Complex Sentences

	Conjunction	Before Conjunction Word	After Conjunction Word	Information
1.	Dan	Objek (noun)	Predikat (verb)	Conjunction on middle of complex sentences
2.	Dan	Subjek (noun)	Subjek (noun)	Conjunction on middle of complex sentences
3.	Dan	Objek (noun)	Objek (noun)	Conjunction on middle of complex sentences
4.	Dan	Predikat (verb)	Predikat (verb)	Conjunction on middle of complex sentences
5.	Tetapi	Predikat (kata kerja)	Predikat (verb)	Conjunction on middle of complex sentences
6.	Tetapi	Objek (noun)	Pelengkap (noun)	Conjunction on middle of complex sentences
7.	Tetapi	Keterangan (noun)	Predikat (verb)	Conjunction on middle of complex sentences
8.	Tetapi	Objek (noun)	Predikat (verb)	Conjunction on middle of complex sentences
9.	Tetapi	Predikat (verb)	Subjek (noun)	Conjunction on middle of complex sentences
10.	Tetapi	Keterangan (noun)	Keterangan (noun)	Conjunction on middle of complex sentences
11.	Jika	-	Subjek (noun)	Kata penghubung di awal kalimat
12.	Melainkan	Predikat (kata kerja)	Predikat (verb)	Conjunction on middle of complex sentences
13.	Melainkan	Keterangan (noun)	Predikat (verb)	Conjunction on middle of complex sentences
14.	Melainkan	Objek (noun)	Objek (noun)	Conjunction on middle of complex sentences
15.	Bahkan	Predikat (verb)	Predikat (verb)	Conjunction on middle of complex sentences
16.	Atau	Predikat (verb)	Predikat (verb)	Conjunction on middle of complex sentences
17.	Atau	Keterangan (noun)	Predikat (verb)	Conjunction on middle of complex sentences
18.	Atau	Objek (noun)	Objek (noun)	Conjunction on middle of complex sentences
19.	Biarpun	-	Subjek (noun)	Kata penghubung di awal kalimat
20.	Jangankan	-	Predikat (verb)	Kata penghubung di awal kalimat
21.	Sedangkan	Objek (noun)	Subjek (noun)	Conjunction on middle of complex sentences
22.	Sedangkan	Predikat (verb)	Subjek (noun)	Conjunction on middle of complex sentences
23.	Karena	Predikat (verb)	Predikat (verb)	Conjunction on middle of complex sentences
24.	Karena	Predikat (verb)	Subjek (noun)	Conjunction on middle of complex sentences
25.	Karena	Keterangan (noun)	Predikat (verb)	Conjunction on middle of complex sentences
26.	Karena	-	Predikat (verb)	Conjunction in Front of Sentences
27.	Daripada	-	Subjek (noun)	Conjunction in Front of Sentences
28.	Maka	Predikat (verb)	Subjek (noun)	Conjunction on middle of complex sentences
29.	Sehingga	Predikat (verb)	Subjek (noun)	Conjunction on middle of complex sentences
30.	Sehingga	Predikat (verb)	Predikat (verb)	Conjunction on middle of complex sentences
31.	Sehingga	Keterangan (noun)	Predikat (verb)	Conjunction on middle of complex sentences
32.	Sehingga	Objek (noun)	Predikat (verb)	Conjunction on middle of complex sentences
33.	Saat	-	Subjek (noun)	Conjunction in Front of Sentences
34.	Kemudian	Keterangan (noun)	Predikat (verb)	Conjunction on middle of complex sentences
35.	Kemudian	Objek (noun)	Predikat (verb)	Conjunction on middle of complex sentences
36.	Meskipun	-	Subjek (noun)	Conjunction in Front of Sentences
37.	Meskipun	-	Predikat (verb)	Conjunction in Front of Sentences
38.	Lalu	Objek (noun)	Predikat (verb)	Conjunction on middle of complex sentences
39.	Ketika	-	Subjek (noun)	Conjunction in Front of Sentences
40.	Walaupun	-	Subjek (noun)	Conjunction in Front of Sentences
41.	Walaupun	-	Objek (noun)	Conjunction in Front of Sentences
42.	Agar	Objek (noun)	Predikat (verb)	Conjunction in Front of Sentences

# Watershed Segmentation for Face Detection Using Artificial Neural Network

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**Abstract**— In a face image containing objects sometimes face has a color similar to the background color or objects that are nearby. This causes the system to detect any objects in the face in an image. This study wants to try to overcome these problems. The approach used in this study is a dynamic image segmentation. The segmentation will produce region-region are then used as input for the neural network. From the experiments conducted, the method used is good enough to detect faces. The results showed that the approach used in this study can detect all of the data that had trained, while for the data that has not been trained detection rate reached 70%.

**Keyword:** face detection, artificial neural network, dynamic segmentation

## I. INTRODUCTION

The face has a biological structure that is not simple. In addition to dynamic, face shape expression influenced by many things such as, age, and hair. Nevertheless, research shows that some elements of the face has a geometric characteristics that can be measured [1].

Face detection is the first step in the processing of facial images with a computer. Mechanisms are in the area looking for a computer that is considered as the face image. If found, then this area will be taken and then performed the identification process. In this case several methods have been developed, among others, Fuzzy Classifier [2], Viola Jones [3] and neural network [4].

Although some of these methods have been able to make the detection of the face, but still needs to be improved. The complexity of the face detection process is exceptionally high. In addition to dealing with the problem of the size of the face in the image is dynamic, increasing the complexity of the face detection when confronted with an image that contains other objects that might have a similar color intensity to the face.

In the face detection process through which one phase is segmentation. Mechanisms involved in this phase is a separate object with other objects. With this condition of each object can be retrieved, so it can be processed. One method that is often used is the watershed transformation. This method is one that is good enough to get a result object segmentation.

Artificial neural network is a processing model that mimicked the work principal nervous system of the human brain. This method uses the calculation of non-linear elements called neurons interconnected, so it can support the learning process. This condition allows the system has knowledge, so it can be used to solve problems related to pattern recognition, optimization, forecasting, and so forth. Dynamic weight adjustment process has enabled the neural network can be applied to solving problems that are also dynamic.

## II. METHODOLOGY

To solve the problems of face detection using artificial neural networks, the steps are as follows:

### A. Histogram

A histogram is a graph showing the distribution of the intensity of an image [5]. The histogram of a digital image in the form of a function  $h(r_k) = n_k$ , where  $r_k$  is the  $k$ -th color value and  $n_k$  is the number of pixels in the image that have that value. In the gray-level, gray-level  $r_k$  is the  $k$ -th level.  $k = 0, 1, 2, \dots, L-1$ .  $L$  is the maximum limit. Normalization of the histogram is to divide each value  $n_k$  with a total pixel of the image,  $p(r_k) = n_k / n$ . The total number of values ( $p(r_k)$ ) of the normalized histogram is 1 Manipulation of the histogram can be used effectively for image enhancement (improving the quality of the picture). It is also useful for other image processing applications such as segmentation, compression, and others. Histograms are also easy to be calculated in software [5].

### B. Dilatation

Dilatation is done to increase the size of the object segment by adding layers around the object. By way of background change all point to the neighboring boundary points into a point object, or simply set the neighbors of each point is a point object into a point object. With  $A$  and  $B$  lie in  $Z^2$ , dilation of  $A$  by  $B$  is characterized by  $A \oplus B$

$$A \oplus B = \{x \mid (B)_x \cap A \neq \emptyset\} \quad (1)$$

This equation is obtained from the reflection of point  $B$  on the original and then shifted by  $x$ . Dilation of  $A$  by  $B$  is a collection of all the change  $x$  so that  $B$  and  $A$  overlap at least one element that is not 0 (zero).

### C. Erosion

Erosion operation is the inverse of the dilation operation. In this operation, the object size is reduced to erode around the object. By setting all points around the point of the background becomes foreground point. With  $A$  and  $B$  located at  $Z^2$ , erosion  $A$  by  $B$  is :

$$A \ominus B = \{x \mid (B)_x \subseteq A\} \quad (2)$$

### D. Morphological Gradient

Gradient is one of the morphological approach to segmentation. The concept of morphological gradient is describing an image in 3-dimensional form by assuming gray level is considered as the height and the direction that the

higher the color white. So it is more suitable to say that the level of gray as the depth. The principle of morphological gradient is looking for a line Watershed (watershed) is the line along which the dots is the highest point of the depiction of an image into a 3-dimensional form [7]

Gradient is a morphological process that produces output in the form of images obtained from the reduction of the original image dilation results with the results of erosion of the original image, so it can be defined:

$$g = (A \oplus B) - (A \ominus B) \quad (3)$$

#### E. Minima Removal

Minima removal process is a process of flattening the basis of the minimum so that the minimum area has a uniform value. This process is performed before the image in segmentation, because the images produced by the preprocessing that does not use a threshold has a minimum value that is not flat.

#### F. Watershed Segmentation

The concept of morphological Watershed is describing an image in 3-dimensional form by assuming gray level is considered as the height and the direction that the higher the color white. So it is more suitable to say that the gray level is a level of depth. The principle of morphological watershed is looking lines (watershed) is the line along which the dots is the highest point of the depiction of an image into a 3-dimensional shape [6]. Determination of the area and checked the line of pixels with values ranging from a minimum to a maximum. If the pixel is a local minimum or do not have a slice with a collection of pixels that are connected to the previous value, then the pixel is forming a new area. If the slices with a collection of pixels that are connected to the previous value of only one component or area of the pixel belongs to the component or area. If more than one then it becomes dam or watershed lines.

#### G. Artificial Neural Network

Artificial neural network is an information processing system that has certain similarities with his biological neural networks. As a model, artificial neural networks are not as complex as the nervous system of the human brain. The use of backpropagation network consists of two stages, namely the stage of learning or training, which at this stage in the backpropagation given amount of training data and the target. Testing phase or the use, testing and use of back propagation is done after completion of learning.

Training with backpropagation method consists of three steps, namely data is entered into the network input (feed-forward), the calculation and back propagation of the error in question, as well as updating the weights.

Backpropagation algorithm consists of the action forward and backward process action. In the process forward action, the first time is to make random weights as initial weights. The next step is to get the output value (y) using random weights that have been obtained. If the output value has not been obtained in accordance with the target, then the program will perform the action backward. The process is carried out is the process of training or training process. In this process, the program will seek proper weight to the value of output produced in accordance with the targets set. Furthermore, the program will look for the value of z and y as was done in stages

the action forward. If the value of y is obtained not in accordance with the intended target, then the next process is to calculate the weighting factor of the output variable and variable weighting factor hidden layer. Furthermore, the weights in the update. Weight update process is done by summing the weights of the old with variable weighting factors have been obtained. The training process is done continuously until convergence. Having obtained the optimum weights, the program is ready to be tested.

In this study activation function used is sigmoid function. The formula sigmoid function is:

$$f(x) = \frac{1}{1+e^{-x}} \quad (4)$$

### III. RESULT AND DISSCUSION

The study was conducted using 8 training data obtained from the data set. Data the train will be tested with the use of artificial neural networks backpropagation. Also used are also 10 primary data obtained was examined by using the weights obtained from the training.

The image that has been segmented region-region is obtained that will be used for the detection process by artificial neural networks. Detection process consists of the process of learning and testing processes. In the learning process, the input values obtained from the results of segmentation. The image has been segmented divided into blocks consisting of 10x10 blocks. Of each block will be taken of how the region that is inside the block. So in the end gained 100 block containing the region-region segmentation results. 100 block will then be input neurons in the backpropagation algorithm After the learning process and obtained the optimum weights, so the image is ready to be tested. The test results of the original image is shown in Figure 1 and the watershed segmentation shown in Figure 2, the results image shown in Figure 3.

Neural network test results affect face recognition caused by factors not value segmentation obtained in accordance with the target value is determined as the face. Failures that occur in the program due to the results of testing an artificial neural network is > 0:05.



Fig.1 Original Image



Fig. 2 The Watershed Segmentation



Fig. 3 The Result Image

Test results of 8 pattern face to generate training data accuracy rate of 100% while the non-face pattern using training data accuracy rate reaches 70%.

#### IV. CONCLUSION

Conclusions obtained in this study are as follows:

- a. Watershed segmentation method is able to produce a feature extraction which will be input in the neural network learning faces.
- b. Segmentation is affected by the value of the histogram at brightness level of the image so that the error propagation is also different targets.

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# Evaluation of Protection Against Collapse from Buckling of Stiffened Column Based on ASME BPVC Sec. VIII Div.2 Using Finite Element Simulation

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**Abstract**— A protection against collapse from buckling of a stiffened column was evaluated based on ASME Boiler and Pressure Vessel Code Section VIII Division 2 using the finite element simulation. The column without the stiffener ring was also evaluated as a comparison. A finite element code ANSYS ver. 14.5 was used to perform the buckling analysis of the columns. The linear (eigenvalue) buckling analysis was performed to obtain a critical load factor then the value was compared with the minimum design factor required based on the ASME Code. The columns was modeled using a shell element and the geometric nonlinearities was not considered. The external pressure, the self-weight force and the temperature load were considered as the loading in the analysis. Among all applied loads, the external pressure was the most significant load contributing for the buckling of this column. The buckling strength of the column was greatly improved by the utilization of the stiffener ring, and the design stiffened column satisfied the requirement for protection against collapse from buckling.

**Keywords**— Buckling; Stiffened Column; ASME Sec.VIII Div.2; Finite Element Simulation; ANSYS

## I. INTRODUCTION

A vertical pressure vessel or known as column or tower is a common equipment designed for a mass or heat transfer in petrochemical, refinery, oil and gas and food industry. The column is generally constructed by a thin-walled cylindrical shell, heads and skirt. Due to the long and high diameter to thickness ratio, the common failure modes of the shell is buckling under external pressure and/or axial compressive load.

If a long and thin-walled circular cylinder is not ring-stiffened, its buckling resistance under uniform external pressure is very poor, and this vessel may fail by non-symmetric bifurcation buckling or shell instability [1]. To improve the buckling strength of such vessels, the stiffener ring is applied in their flanges. However, if the ring stiffeners are not strong enough, the general instability failure may occur, i.e. the ring-shell combination collapse due to the applied uniform external pressure [2].

The buckling stability of the circular cylindrical shells under the external load has been widely investigated. Lemak and Studnicka [3] have investigated the influence of the distance and stiffness of ring stiffeners on the buckling behaviour of a cylindrical steel shell under a wind loading. Ross et.al, [4] has

investigated the plastic general instability of ring-stiffened conical shells under external pressure. Prabu et.al, [5] applied the imperfections model for analysing the buckling of thin cylindrical shell subjected to uniform external pressure using the non-linear finite element model.

The American Society of Mechanical Engineers (ASME) have developed the Boiler and Pressure Vessel Code (BPVC) to ensure the safety on the design of the vessels for their operations, including for protection against the collapse from the buckling [6]. The design of the vessels according to this code is based on the rule and the analysis requirements. For the design by the analysis requirements to protect the vessels against the collapse from the buckling, the finite element simulation is performed to get the design factor of the vessel under the specified loads.

In the present study, the buckling of stiffened column was evaluated based on the requirement of ASME BPVC Sec. VIII Div. 2 using the finite element simulation. The column without the stiffener ring was also analysed as a comparison. A finite element code ANSYS ver. 14.5 was used to simulate the buckling of the columns. The buckling load factor obtained from the linear (eigenvalue) buckling analysis was compared to the minimum design factor required by the ASME BPVC Sec. VIII Div. 2.

## II. PROTECTION AGAINST COLLAPSE FROM BUCKLING BASED ON ASME SECTION VIII - DIVISION 2

To avoid buckling of components with a compressive stress field under applied design loads based on ASME BPVC Sec. VIII Div.2, a design factor for protection against collapse from buckling shall be satisfied [6]. The design factor to be considered in a structural stability assessment is based on the type of buckling analysis performed. When the buckling loads are determined using a numerical solution, the following design factors,  $\Phi_B$ , shall be the minimum values for use with the shell components.

- Type 1 – If a bifurcation buckling analysis is performed using an elastic stress analysis without geometric nonlinearities in the solution to determine the pre-stress in the component, a minimum design factor of  $\Phi_B = (2/\beta_{cr})$  shall be used.
- Type 2 – If a bifurcation buckling analysis is performed using an elastic-plastic stress analysis with the effects of non-linear geometry in the solution to determine the pre-

stress in the component, a minimum design factor of  $\Phi_B = (1.667/\beta_{cr})$  shall be used.

- Type 3 – If a collapse analysis is performed using an elastic-plastic stress analysis method, and imperfections are explicitly considered in the analysis model geometry, the design factor is accounted for in the factored load combinations in Table 5.5 of ASME Sec. VIII - Div. 2.

The capacity reduction factors,  $\beta_{cr}$ , to be is based on the shape of the structure and the applied load.

- For unstiffened or ring stiffened cylinders and cones under axial compression

$$\beta_{cr} = 0.207 \quad \text{for } Do/t \geq 1247$$

$$\beta_{cr} = \frac{338}{338 + \frac{Do}{t}} \quad \text{for } Do/t < 1247$$

- For unstiffened and ring stiffened cylinders and cones under external pressure

$$\beta_{cr} = 0.80$$

- For spherical shells and spherical, torispherical, elliptical heads under external pressure

$$\beta_{cr} = 0.124$$

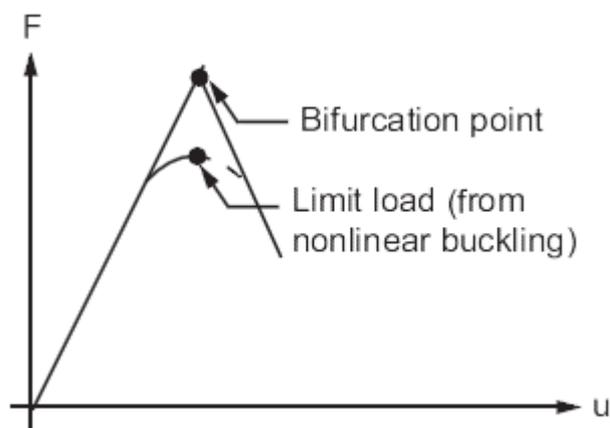
### III. BUCKLING ANALYSIS OF COLUMNS

#### A. Buckling Analysis Technique in ANSYS

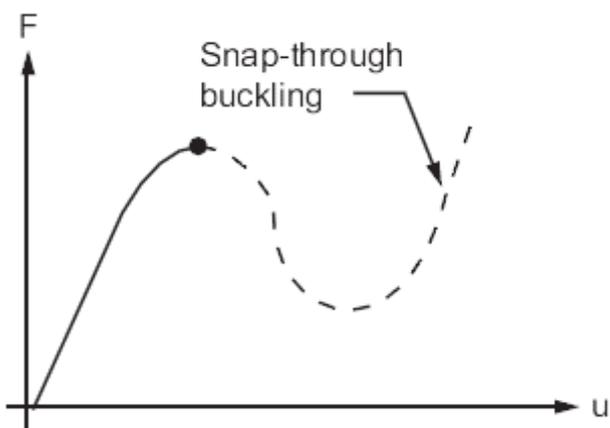
The buckling analysis in the present study was performed using the finite element commercial code ANSYS ver. 14.5. There are two techniques in the ANSYS for predicting the buckling load and buckling mode shape of a structure, that is eigenvalue (or linear) buckling analysis, and nonlinear buckling analysis [7].

- *Eigenvalue Buckling Analysis:* Eigenvalue buckling analysis predicts the theoretical buckling strength (the bifurcation point, as shown in Fig. 1 (a)) of an ideal linear elastic structure. This analysis used the linearised model of the elastic structure to predict the bifurcation point. However, imperfections and nonlinearities prevent most structures from achieving their theoretical elastic buckling strength.
- *Nonlinear Buckling Analysis:* Nonlinear buckling analysis is a more accurate approach to predict the buckling strength of the structure. This technique employs a nonlinear static analysis with gradually increasing loads to determine the load level at which the structure becomes unstable, as shown in Fig. 1 (b). This analysis gives more accurate results since the capability of analysing the actual structures with their imperfections. The post-buckled performance of the structure from this analysis also can be evaluated using deflection-controlled loading.

Although a bifurcation point obtained from the linear buckling analysis over-predicts the buckling limit load obtained from the nonlinear buckling analysis, Type 1 and Type 2 of the buckling analysis based on ASME Sec. VIII Div. 2 were used this linear method. Prior performing the linear buckling analysis in ANSYS, the static analysis have to be performed first to obtain the pre-stress effects, since the buckling analysis requires the stress stiffness matrix to be calculated [7]. An expansion pass analysis is then performed to review the buckled mode shape.



(a) Linear buckling curve



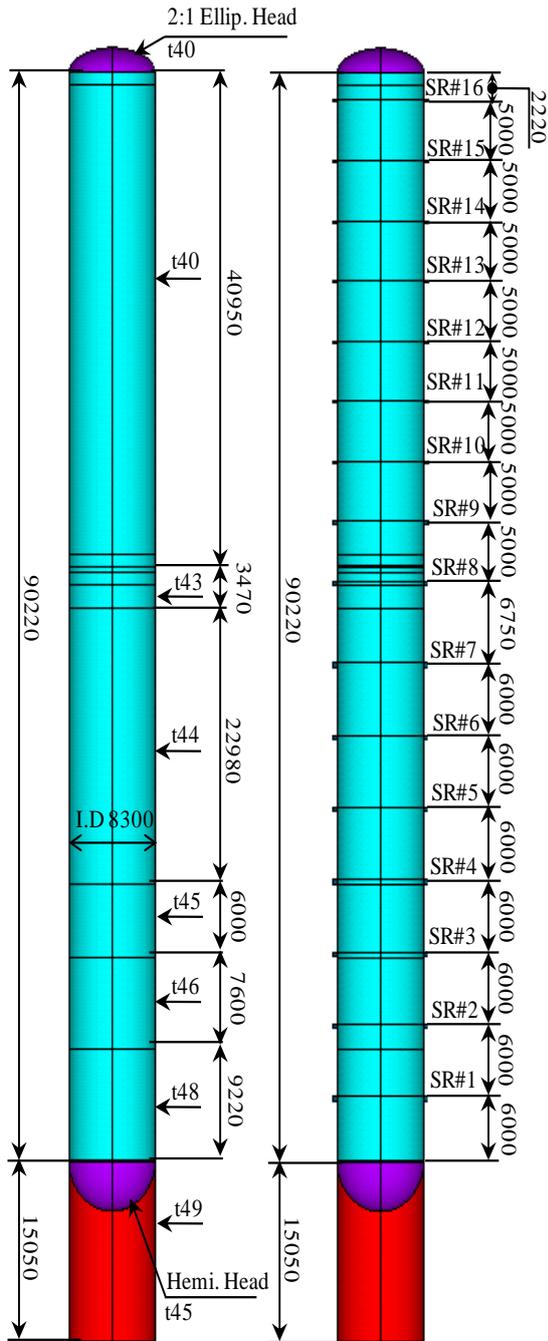
(b) Nonlinear buckling curve

Fig.1 Buckling curves: (a) linear and (b) nonlinear [7].

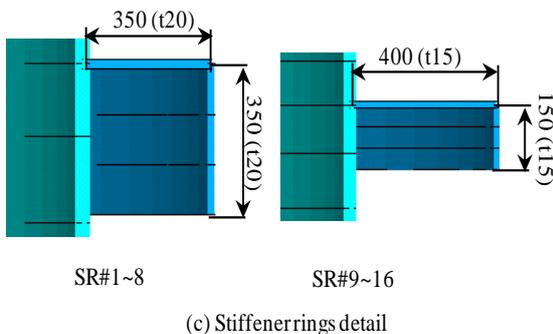
#### B. Model of Columns and Condition of Buckling Analysis

The buckling of columns with and without stiffener ring were analysed in this study. The geometry and dimension for the unstiffened and stiffened columns are shown in Fig. 2. The dimension of the unstiffened column was similar with that the stiffened column to evaluate the effect of the stiffener ring on the buckling strength of the column.

The condition used for the buckling analysis of the columns is shown in Table 1. The external pressure of 0.101 MPa was applied to the shell of the columns. The temperature was applied as a type of a body force obtained from the thermal analysis result. The acceleration of gravity was applied for considering the force from the weight of the columns. The cylindrical coordinate system was used for applying boundary conditions to the bottom of the skirt, where the displacement in the vertical and azimuthal direction were fixed, whereas in the radial direction was free. The geometric non-linearities of the columns was not considered in the static analysis solution.



(a) Unstiffened column (b) Stiffened column



(c) Stiffener rings detail

Fig. 2 Geometry and dimension for (a)unstiffened column, (b) stiffened column and (c) stiffener ring (unit in millimetre).

TABLE I  
CONDITIONS USED FOR BUCKLING ANALYSIS OF COLUMNS

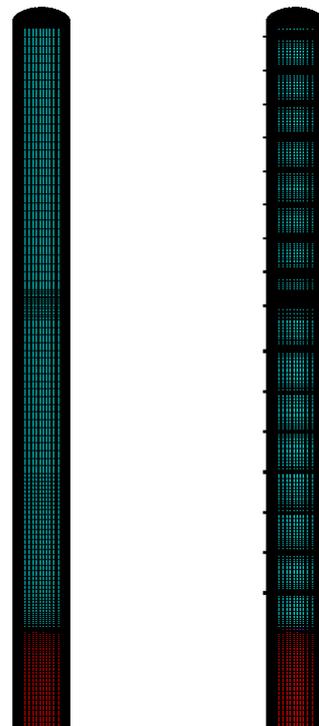
Design pressure	0.101 MPa
Design temperature	300 °C
Ambient temperature	20 °C
Corrosion allowance	3.2 mm
Operating weight (stiffened)	2,632,800 kg
Stiffener ring weight	48,802 kg

The carbon steel SA516-70N was used for the material of the columns. The material properties for SA516-70N is shown in Table 2. The density and the poisson's ratio for the steel used in the analysis was 7,800 kg/m<sup>3</sup> and 0.3, respectively.

TABLE II  
MATERIAL PROPERTIES FOR SA516-70N

Temp	Elastic Modulus (MPa)	YieldStress (MPa)	Thermal expansion (mm/mm/°C)	Thermal conductivity (W/mm.°C)
20	202,350	262	11.5E-6	60.4E-3
100	198,000	239	12.1E-6	58.0E-3
200	192,000	225	12.7E-6	53.6E-3
300	185,000	204	13.3E-6	49.2E-3

The finite element model of the columns was constructed using a shell element. A four-node structural element with six degrees of freedom at each node SHELL181 was used for structural analysis, whereas SHELL57 that has four-nodes and single degree of freedom (temperature) was used for thermal analysis. The finite element model of the unstiffened and stiffened columns are shown in Fig. 3.



(a) Unstiffened column (b) Stiffened column

Fig. 3 Finite element model of (a)unstiffened and (b) stiffened columns

IV. RESULTS OF BUCKLING ANALYSIS OF COLUMNS

The linear (eigenvalue) buckling analysis was performed to predicts the buckling load factorof the columns then compared with the minimum design factor required by ASME BPVC Sec. VII Div. 2. Since the geometry non-linearities of the columns was not consider in the analysis solution, thus the minimum required design factor for thesecolumns based on the ASME Code is Type 1,  $\Phi_B = (2/\beta_{cr})$ .

Since the columns was subjected with the external pressure, thus the capacity reduction factors,  $\beta_{cr}$ , for this analysis is 0.80. Thus the design factor to be satisfied for the buckling analysis of these columns is:

$$\Phi_B = \frac{2}{\beta_{cr}} = \frac{2}{0.8} = 2.5 \tag{1}$$

In this linear buckling analysis, the subspace method was used as the eigenvalue extraction method, since the used of the Black Lancos method for solving larger model requires a significant amount of computer memory and requires longer time for solving the model than the subspace. The first three eigenvalue was requested to obtained the lowest load buckling factor of the columns.

A. Buckling Analysis of Unstiffened Column

The plot of the first mode shape for the buckling analysis of the unstiffened column is shown in Fig. 4. The first and the lowest buckling mode for the column has a load factor of 0.6812. Since the load factor is lower than the minimum design factor of 2.5, thus the unstiffened column doesn't meet the requirements for the protection against collapse from buckling.

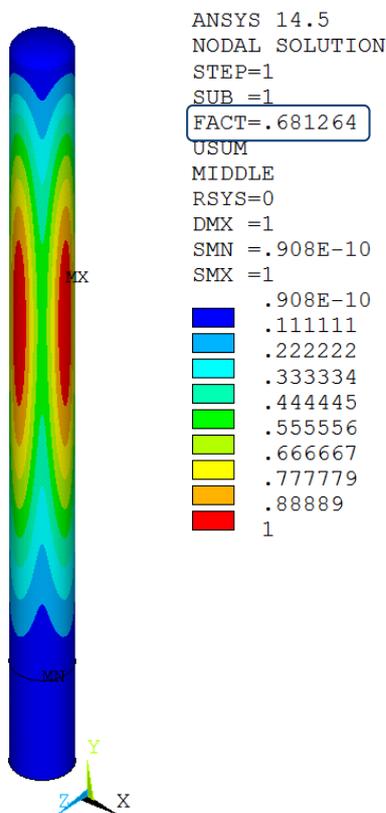


Fig. 4 Plot of first mode shape for buckling analysis of unstiffened column.

B. Buckling Analysis of Stiffened Column

The plot of the first mode shape for the buckling analysis of stiffened column is shown in Fig. 5. The first and the lowest buckling mode for the column has a load factor of 6.281 and is greater than the minimum design factor of 2.5. Thus the design of the stiffened column satisfies the requirements for the protection against collapse from buckling. It was found that the used of the stiffener ring significantly increase the buckling strength of the column.

The result obtained by the linear buckling analysis was the buckling load factor that scale the loads applied in the static structural analysis. Since the loads applied in these columns were consisted of a variable load (pressure) and constant loads (weight load and temperature load), thus the load factor was scaling both the constant and variable loads. To obtain the more accurate result of the buckling load factor, the variable load (pressure) should be multiplied by a certain factor until the buckling load factor of the structure becomes nearly to 1.0.

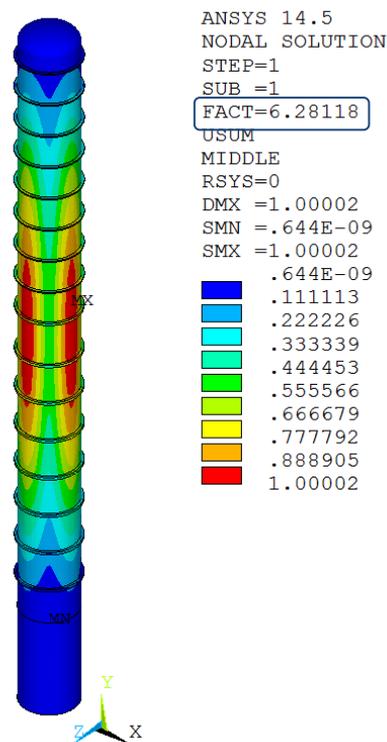
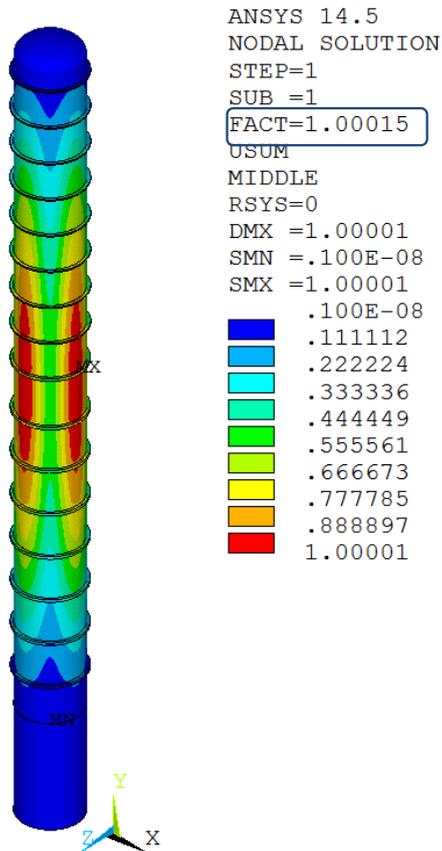


Fig. 5 Plot of first mode shape for buckling analysis of stiffened column

For the stiffened column, the load factor from the linear buckling analysis becomes nearly to 1.0 when the pressure load was multiplied by 6.273. The plot of the first mode shape for the buckling analysis of stiffened column with the pressure load of 0.6335 MPa is shown in Fig. 6.

From the prior analysis where the load factor multiplied all the applied loads, the critical buckling load factor is 6.281. When the weight and temperature load is multiplied by one, the critical buckling load is occurred when the pressure load multiplied by 6.273. The pressure load multiplier value almost have similar value with that the the load factor for all applied loads. It was found that the pressure load was the most significant load for contributing the buckling in this column.



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Fig. 6 Plot of first mode shape for buckling analysis of stiffened column with pressure load of 0.6335 MPa.

### V. CONCLUSIONS

A protection against collapse from buckling of a stiffened column was evaluated based on ASME Boiler and Pressure Vessel Code Section VIII Division 2 using the finite element code of ANSYS ver. 14.5. The column without the stiffener ring was also evaluated as a comparison. The linear (eigenvalue) buckling analysis was performed to obtain the critical load factor then the value was compared with the minimum design factor required based on the ASME Code. Among the external pressure, self-weight and temperature loads applied on this column, the external pressure was the most significant load contributing for the buckling of this column. It was found that the utilization of the stiffener ring significantly increase the buckling strength of the column and the design of the stiffened column satisfied the requirements for the protection against collapse from buckling based on the ASME code.

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# Searching Optimal Route for Public Transportation Of Palembang City Using A\* Algorithm

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**Abstract**— Palembang is the capital city South Sumatra Province as well as big city. For a big city, transportation is a critical issue for society as well as its tourist. This study develops an optimal route search system using A \* algorithm. A \* algorithm using nearest distance estimates to achieve goals and have a heuristic value that is used as a basis for consideration. The resulting software is capable of finding the optimal transportation solution in the Palembang area so that people can get information easily and the accuracy of the application by 91.8%.

**Keywords**— Algorithm A\*, Transportation route search, Windows Phone.

## I. INTRODUCTION

Palembang is the capital city of South Sumatra Province. Palembang is one of the big city in Indonesia. For a big city, transportation is important for society as well as its tourist. Because of the wide area of Palembang and many roads cause difficulty to find the most optimal route in terms of distance and cost.

Conventional city maps often do not provide the fullest. This is due not everyone can read a map properly, making it difficult to determine the most optimal route. Currently, many digital maps are easy to use but the information provided is not equipped public transport information. For tourists, public transport information is very important to be help them to the location of destination cheaply and quickly without having to use a taxi.

The purpose of this research is to build an application that can facilitate the tourists to find public transportation that they need to get to the destination. To produce the optimal solution from the cost and distance it takes a search algorithm is A \* [1].

## II. LITERATURE REVIEW

### A. Algorithm Search

Search algorithm is an algorithm that considers how to choose the optimal solution in the search [1,2]. At each search algorithm there is a difference in terms of development nodes to reach the goal state. There are four criteria for measurements search algorithm[2]:

1. Completeness: can algorithms certainly find a solution?
2. Time Complexity: how long algorithm takes time to find a solution?
3. Space Complexity: how much memory it takes to do a search?
4. Optimality: can the algorithm find the best solution?

Even the best search algorithm is not necessarily appropriate for all types of cases or problems, should be selected search algorithms appropriate to the needs of cases handled.

There are two search techniques based on the way developing the node that is uninformed Search or Blind Search and Informed Search or Heuristic Search [3,4,5]. Uninformed is searching for a solution algorithm without information that can direct the search to reach the goal state from the current state, the algorithm only can identify a goal state[1,2,5].

Informed Search is a strategy to make the process of a state space search problem selectively, which guide the search process of finding the best solution[1,2,3]. Informed Search often also called Heuristic Search as to reach the goal state uses rules to select the branches are most likely to resolve the problem that is received or often called heuristic function[4,6,7].

### B. Algorithm A\*

A \* algorithm generates an optimal path from the initial state and then through the graph towards the destination. The algorithm is classified as path finding algorithm which uses a technique Informed Search. In addition to calculating the path cost of the current state to the goal state with heuristic function, A \* algorithm is also considering the cost of the path that has been taken so far from the initial state to the current state [1]. So when a road has been taken and there is another way that has a lower cost but provide the same position seen from the goal state, the lower the new road that will be chosen. This algorithm calculates the heuristic value based on equation 1[1,4,2].

$$f(x) = g(x) + h(x) \tag{1}$$

Description :

- f(x): evaluation function,
- g(x): costs that was issued from the initial state to node x so far,
- h(x): estimated cost from the node x to reach the goal.

Principles of A \* algorithm is to find the shortest path from an initial state to the destination node by finding the node that has the value f (x) lowest. At each step of the process A \* search, select the node that has the highest priority. This is done by applying the evaluation function f (x) which is adequate at each node. The lower value of f (x), the higher priority. If one node is a goal then stop. If not, do the selection of the node again.

C. Geographic Coordinates

On the map there is a conventional longitudinal stripes (vertical) and transverse (horizontal) which will help to determine the position of a place on earth. The intersection between the lines of longitude and latitude named maps coordinates. Longitude-latitude coordinate system consists of two components that determine, namely:

1. The lines from top to bottom (vertical) which connecting north to the south pole of the earth, also known as latitude.
2. Horizontal line parallel to the equator, also called longitude

To calculate the distance between two coordinates using the formula Haversine as in equation 2[8].

$$d = R \times c \tag{2}$$

Description:

d: the distance between two points selected according R unit  
 R: determination the radius of the earth is 6,371 (km)[8].

To get value of c must use the equation 3

$$c = 2 \times \text{atan2}(\sqrt{a}, \sqrt{1-a}) \tag{3}$$

where A is obtained from equation 4, 5 and 6

$$a = \sin^2\left(\frac{\Delta Lat}{2}\right) + \cos\left(\frac{\pi \times Lat1}{180}\right) \times \cos\left(\frac{\pi \times Lat2}{180}\right) \times \sin^2\left(\frac{\Delta Lon}{2}\right) \tag{4}$$

Where ΔLat get from:

$$\Delta Lat = \pi \times (Lat2 - Lat1)/180 \tag{5}$$

Description:

Lat2 : Latitude of the destination point,  
 Lat1 : Latitude of the initial point,

$$\Delta Lon = \pi \times (Lon2 - Lon1)/180 \tag{6}$$

Description:

Lon1 : Longitude of the destination point  
 Lon2 : Longitude of the initial point

III. ALGORITHMS AND IMPLEMENTATION

A. A\* An Artificial Inelegant Algorithm for finding Directions

The main problem of this research is how to find the most optimal solution from the starting point to the destination point entered by users in the region of Palembang. The resulting solution is the result of the consideration of aspects of distance and cost to implement aspects of the A \* algorithm, but it is more focused on the aspects of distance.

One example of a search problem using public transport is the routing from the Start point to the PS point as shown in the figure below:

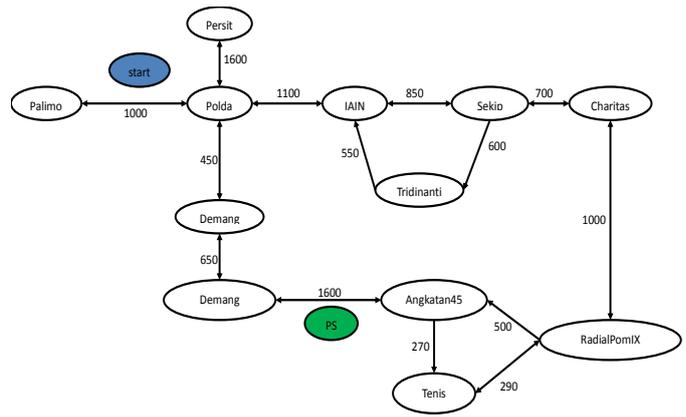


Fig. 1 Example of Map Search

To determine value of h of the problems in Fig. 1 can be seen in Table I which is the length of the straight line obtained from the calculation of the equation 1 calculation by using latitude and longitude coordinates at each node.

TABLE III  
 STRAIGHT LINE LENGTH OF EACH INTERSECTION TOWARD DESTINATION (PS)

No	Node	Distance to Goal (h(x))(m)
1	Start	1887
2	PS	0
3	Polda	1739
4	Palimo	2665
5	DemangAryodila	1470
6	Persit	2.594
7	IAIN	1210
8	Tridinanti	686.7
9	DemangAngkatan45	1237
10	Sekip Pangkal	1067
11	Charitas	1309
12	Angkatan45Tennis	282.4
13	TenisPomIX	416.7
14	RadialPomIX RivaiAngkatan45	658

Figure 1 is an example of a settlement made by A \* start from Polda to the PS node. Starting with the opening Demang aryodila branch and consider the best nodes. Node that has the smallest value of f will open all of its successors and will look for a branch that has the smallest value of F to find the destination node. A \* algorithm can optimize the search, because the A \* algorithm to consider the two costs, that is the cost estimates to the destination and the cost incurred.

After obtaining the last intersection, then do BackTrack to check Parent node, to find the Parent equal initial Intersection. To calculate the required fees must be checked by means of a series of sequentially tracing the intersection of the solution and count how many times a change of public transport. At issue this time is not a change of public transport, so fare is Rp. 3.000. While the optimum of this problem is: Start → Polda → DemangAryodila → DemangAngkat45 → PS.

a) Initial state



- b) After expanding Polda
- c) After expanding Demang Aryodila
- d) After expanding IAIN
- e) After expanding Sekip Pangkal

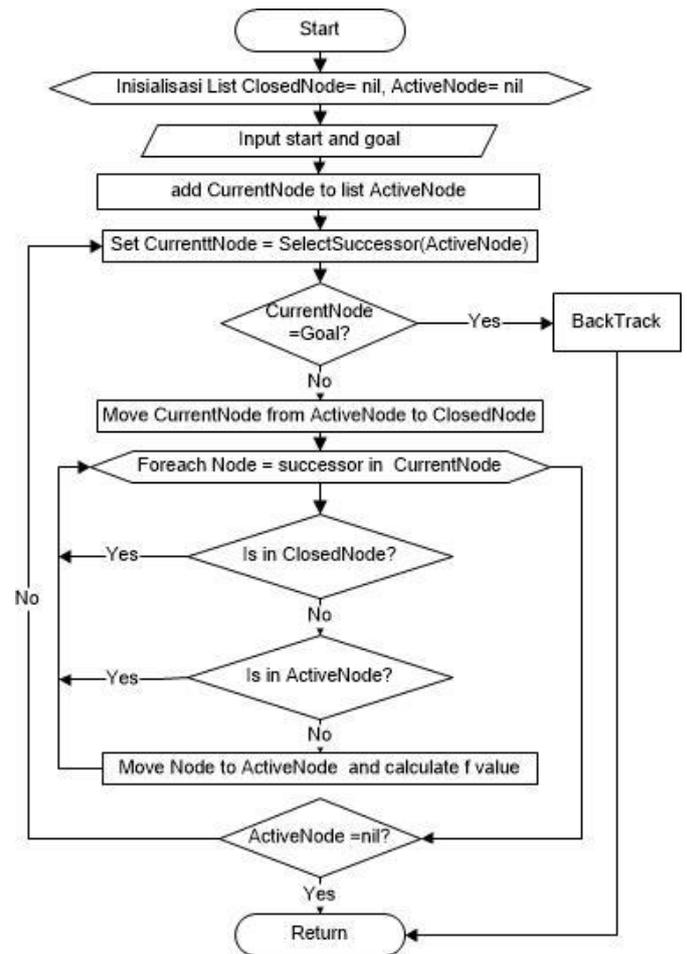


Fig. 2 Flowchart of algorithm A\*

Fig. 2 Steps for resolve the problem Fig 1

**B. Implementation**

Palembang city Public transportation consists of bus medium, small bus, and generally urban transportation. For the public transportation routes used in this application was obtained from the Department of Transportation of Palembang City in South Sumatra. In this study, every intersection is traversed by public transport will be set as a node. For the cost incurred from the initial state to a node x is the actual distance and transportation rates. For the estimate the cost of a node x is the distance to the destination obtained from equation 2. For the map used is a digital map of the Bing map. All the coordinates of the intersection will be stored in the database.

Figure 3 flowchart above describes how search software for public transportation routes. Search results very dependent on the A \* algorithm, in which the algorithm works from the starting point to the destination point by finding the intersection with the estimated weight of the lowest intersection (denoted by the notation g) summed with the lowest estimate of the intersection of weight to achieve the goal (denoted by the notation h). The route has a junction with value of f (x) is the smallest and can be reached by public transport in the Parent nodes will be developed first.

If the destination node has been found, the program will perform backtrack to the Parent of each node to get a series of intersections that form the most optimum.

**IV. ANALYSIS AND RESULT**

Here's the interface of the application if we have input the origin and destination, it will show the route of solutions that have been generated by the A \* algorithm. For the management of the map just send a command to Bing maps so that the solution generated by the A \* algorithm can be color.

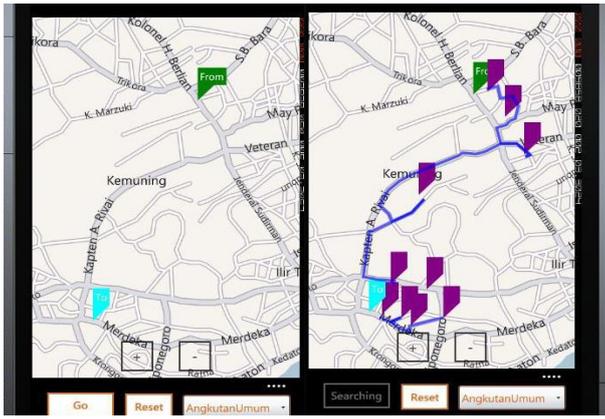


Fig. 4 Example of route interface

Besides route, users also get of public transportation information what should they drive and they will also need to know the cost of that spend to achieve the destination.

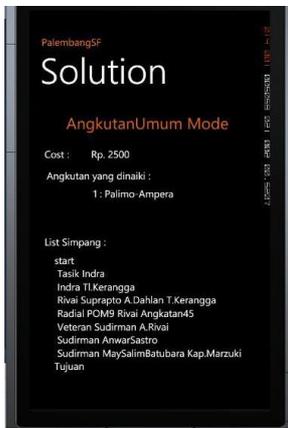


Fig. 5 Example of solution interface

From Origin coordinates, find the intersection at the start the closest to the intersection point and that intersection is Polda. Figure 6 is the interface of the application testing program is a modified application of the actual application. The solution shown is three solutions that has the smallest f value of all the possibilities, and we can see that the application is able to choose the solution which has the smallest f value.

Solution 1 is the best solution that is has the smallest F value, so the actual application that is shown only solution 1. the optimum solution that is a solution which has the smallest f value. After seeing the solution obtained is the optimum solution, it can be concluded that the analysis and the design is correct, so that the result in the implementation of the optimum solution.

For the testing, samples taken from all of public transportation route random. But for a sample can have more than one of public transportation so that sample taken is less than the number of public transportation. In the application of digital maps used are Bing Maps, therefore testing is done by comparing the distance generated by the application and the results obtained Bing Maps. Error is obtained from the equation:

$$Error = \frac{|Distance\ from\ Bing\ Maps - Distance\ from\ Aplikasi|}{Distance\ from\ Bing\ Maps} \times 100\% \quad (7)$$



Fig.6 Example if shown many solutions and include with value of f

The average value of the percentage error is 8.2%, the percentage of accuracy: 100% - 8.2% = 91.8%. Then from the results of Table IV-6 test, the accuracy of the identification of this application reaches 91.8%. This is caused by:

- 1 Applications take the distance between the intersection with a straight line and count them by using equation 2 is not using the actual distance. It is caused by the existing map Palembang on Bing Maps many have the difference.
- 2 Results calculated by Bing Maps already rounded, so that the data obtained had changed.
- 3 There is a public transportation routes that does not exist on Bing Maps, while the application is not in route Bing Maps coordinates taken from Google Maps so as to give effect to the accuracy of the application.

TABLE II  
RESULTS OF TESTING SAMPLES

No	Coordinat		Distance		Error
	Start	Goal	BingMap	Applic ation	
1	-2.999477, 104.768149	-3.019877, 104.749095	3300	3101	6%
2	-3.00804, 104.75990	-2.99073, 104.78522	3500	3370	3.7%
3	-2.995706, 104.76471	-2.991506, 104.74866	2400	2327	3%
4	-2.971020, 104.749266	-2.9816379, 104.7598	2300	2211	4%
5	-2.969252, 104.729776	-2.952537, 104.755611	3600	3512	2.4%
6	-2.9636810, 104.74187	-2.938823, 104.720592 4	3800	4249	11.8 %
7	-2.987338, 104.739561	-2.991881, 104.726428 9	2200	2080	5.4%
8	-2.978509, 104.74531	-2.967366, 104.73149	4100	2426	40.8 %
9	-2.953111, 104.767228	-2.933654, 104.76731	2200	2489	4%
10	-2.9308253, 104.768344	-2.918653, 104.78199	2300	2128	7.4%
11	-2.9822552, 104.762164	-2.979769, 104.77675	1800	1957	8.7%
12	-2.977283, 104.752723	-2.964169, 104.767658	2800	2682	4.2%
13	-2.976683, 104.75117	-2.975140, 104.77117	2100	1990	5.2%

## V. CONCLUSIONS

The conclusions of this research are:

1. PalembangSF application is a search application using the A\* algorithm has been successfully searching the optimal solutions of public transportation route based on distance and cost solutions with high accuracy percentage that is 91.8%.
2. This application can provide a list of what transportation should be used along with the location down comes the closest to the destination.

Suggestions for further development of this research include the following:

1. The data used by PalembangSF for of public transportation travel mode is the data Palembang City Department of Transportation in 2002, so that many transport routes that do not correspond to the current route.
2. Use a digital map of Palembang more complete, so the search is not only based on the coordinates but also by address.
3. The data used is the latest data, the solutions produced in accordance with current conditions. Data should be stored in a centralized data storage server so that the data processing easier.

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# The Simulation and Design of High Subsonic Wing Aircraft

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**Abstract**— This paper intends to present the application of Computational Fluid Dynamic (CFD) on the simulation and design of high subsonic wing of transport aircraft. The computation was performed using RAMPANT, an unstructured, multigrid flow solver. A 2-D and 3-D model of the wing was created using CATIA (2D and 3D modeling). A corresponding grid was created using preBFC and TGrid. The paper describes the technique of creating the grid and using the CFD on the wing design process. It then discusses the benefits and penalties of using the above tools. Description is then given in using the aerodynamic analysis result to optimize the wing. It concludes with a discussion of the results and recommendations for future work.

**Keywords**— computational fluid dynamic (CFD), wing design, aircraft design, aerodynamic configuration

## I. INTRODUCTION

Many aircraft operate at transonic speed, where part of the flowfield is subsonic and part is supersonic. At these speeds shock waves form on the wings, which cause an increase in drag and variable changes in lift. Multiple shock waves can develop and interact in ways that are difficult to predict, but that have large influences on lift and drag.

With detailed knowledge of the flowfield and shock wave locations, designers can shape the wing to delay the transonic drag rise and increase the lift to drag ratio. These result in higher transonic cruising speeds and reduced fuel consumption.

This flowfield knowledge can be obtained by predicting the chordwise pressure and spanwise distributions and modifying them by geometry changes. The flow around the wing can thus be controlled.

## II. COMPUTATIONAL AERODYNAMICS

Computational fluid dynamics is the analysis of systems involving fluid flow, heat transfer and associated phenomena such as chemical reactions by means of computer-based simulation [1]. The use of CFD to simulate and predict internal and external flows has risen dramatically in the past decade. Computational methods have revolutionized the aircraft design process. Prior to the mid sixties aircraft were designed and built largely without the benefit of computational tools. Design information was mostly provided by the results of analytic theory combined with a fair amount of experimentation. Analytic theories continue to provide invaluable insight into the trends present in the variation of the relevant parameters in a design. However, for detailed design work, these theories often lack the necessary accuracy, especially in the presence of non-linearities (e.g. transonic flow). With the advent of the digital computer and the fast development of the field of numerical analysis [2, 3 & 4], a variety of complex calculation

methods have become available to the designer. Advancements in computational methods have pervaded aerodynamics.

Computational methods first began to have a significant impact on aerodynamics analysis and design in the period of 1965-75. This decade saw the introduction of panel methods which could solve the linear flow models for arbitrarily complex geometry in both subsonic and supersonic flow. It also saw the appearance of the first satisfactory methods for treating the nonlinear equations of transonic flow, and the development of the hodograph method for the design of shock free supercritical airfoils.

Panel methods are based on the distribution of surface singularities on a given configuration of interest, and have gained wide-spread acceptance throughout the aerospace industry. They have achieved their popularity largely due to the fact that the problems can be easily setup and solutions can be obtained rather quickly on today's desktop computers. The calculation of potential flows around bodies was first realized with the advent of the surface panel methodology originally developed at the Douglas company. During the years, additional capability was added to these surface panel methods. These additions included the use of higher order, more accurate formulations, the introduction of lifting capability, the solution of unsteady flows, and the coupling with various boundary layer formulations.

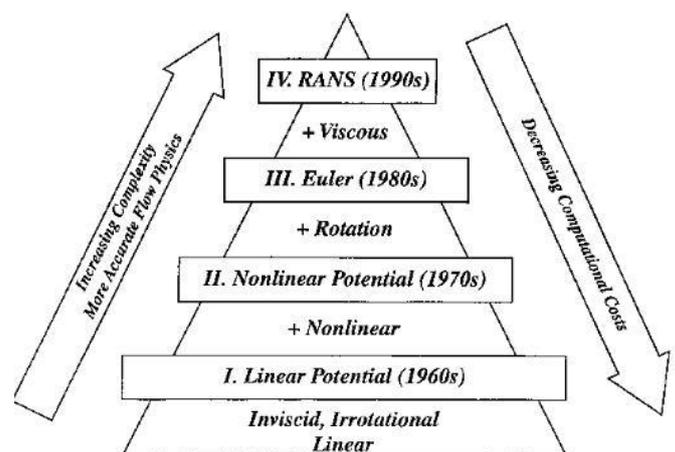


Fig. 1 Hierarchy of aerodynamic models with corresponding complexity and computational cost.

Panel methods lie at the bottom of the complexity pyramid for the solution of aerodynamic problems. They represent a versatile and useful method to obtain a good approximation to a flow field in a very short time. Panel methods, however, cannot offer accurate solutions for a variety of high-speed non-

linear flows of interest to the designer. For these kinds of flows, a more sophisticated model of the flow equations is required.

Figure 1 indicates a hierarchy of models at different levels of simplification which have proved useful in practice. Efficient flight is generally achieved by the use of smooth and streamlined shapes which avoid flow separation and minimize viscous effects, with the consequence that useful predictions can be made using inviscid models. Inviscid calculations with boundary layer corrections can provide quite accurate predictions of lift and drag when the flow remains attached, but iteration between the inviscid outer solution and the inner boundary layer solution becomes increasingly difficult with the onset of separation.

Procedures for solving the full viscous equations are likely to be needed for the simulation of arbitrary complex separated flows, which may occur at high angles of attack or with bluff bodies. In order to treat flows at high Reynolds numbers, one is generally forced to estimate turbulent effects by Reynolds averaging of the fluctuating components. This requires the introduction of a turbulence model. As the available computing power increases one may also aspire to large eddy simulation (LES) in which the larger scale eddies are directly calculated, while the influence of turbulence at scales smaller than the mesh interval is represented by a subgrid scale model.

The codes that are now on the market may be extremely powerful, but their operation still requires a high level of skill and understanding from the operator to obtain meaningful results in complex situations.

#### A. Role of Computational Methods

The role of computational methods in the aircraft design process is to provide detailed information to facilitate the decisions in the design process at the lowest possible cost and with adequate turnaround (turnaround is the required processing time from the point a piece of information is requested until it is finally available to the designer in a form that allows it to be used). In summary, computational methods ought to :

- Allow the simulation of the behavior complex systems beyond the reach of analytic theory.
- Substantial reduction of lead times and cost of new designs, hence increase competitiveness.
- Practically unlimited level of detail of results.
- Ability to study systems where controlled experiments are difficult or impossible to perform (e.g. very large systems).
- Ability to study systems under hazardous conditions at and beyond their normal performance limits (e.g. safety studies and accident scenarios).
- Enhance the understanding of engineering systems by expanding the ability to predict their behavior.
- Provide the ability to perform multidisciplinary design optimization.

Computational methods are nothing but tools in the aircraft designer's toolbox that allow him/her to complete a job. In fact, the aircraft designer is often more interested in the interactions between the disciplines that the methods apply to (aerodynamics, structures, control, propulsion, mission profile) than in the individual methods themselves. This view of the design process is often called multidisciplinary design (one could also term it *multidisciplinary computational design*). Moreover, a designer often wants to find a combination of

design choices for all the involved disciplines that produces an overall better airplane. If the computational prediction methods for all disciplines are available to the designer, optimization procedures can be coupled to produce *multidisciplinary design optimization* (MDO) tools.

The current status of computational methods is such that the use of a certain set of tools has become routine practice at all major aerospace corporations (this includes simple aerodynamic models). However, a vast amount of work remains to be done in order to make more refined non-linear techniques reach the same routine use status. Moreover, MDO work has been performed using some of the simpler models, but only a few attempts have been made to couple high-fidelity non-linear disciplines to produce optimum designs.

#### B. Potential Problems Arising from the Misguided Use of Computational Techniques

Although computational methods are a wonderful resource to facilitate the process of aircraft design, their misuse can have catastrophic consequences. The following considerations must be always in the aircraft designer mind when him/her decide to accept as valid the results of a computational procedure :

- *A solution is only as good as the model that is being solved:* if the aircraft designer try to solve a problem with high non-linear content using a computational method designed for linear problems, the results will make no sense.
- *The accuracy of a numerical solution depends heavily on the sophistication of the discretization procedure employed and the size of the mesh used.* Lower order methods with underresolved meshes provide solutions where the margin of error is quite large.
- *The range of validity of the results of a given calculation depends on the model that is at the heart of the procedure:* if the aircraft designer are using an inviscid solution procedure to approximate the behavior of attached flow, but the actual flow is separated, the results will make no sense.
- *Information overload.* Computational procedures flood the designer with a wealth of information that sometimes is complete nonsense! When analyzing the results provided by a computational method do not concentrate on how beautiful the color pictures are, be sure to apply the knowledge of basic principles, and make sure that the computational results follow the expected trends.

#### C. Computational Cost

The variable cost of an experiment, in terms of facility hire and/or man-hour costs, is proportional to the number of data points and the number of configurations tested. In contrast CFD codes can produce extremely large volumes of results at virtually no added expense and it is very cheap to perform parametric studies, for instance to optimise aircraft performance.

Computational costs vary drastically with the choice of mathematical model. Panel methods can be effectively used to solve the linear potential flow equation with personal computers (with an Intel 486 microprocessor, for example). Studies of the dependency of the result on mesh refinement have demonstrated that inviscid transonic potential flow or Euler solutions for an airfoil can be accurately calculated on a mesh with 160 cells around the section, and 32 cells normal to

the section. Using multigrid techniques 10 to 25 cycles are enough to obtain a converged result.

Consequently airfoil calculations can be performed in seconds on a Cray YMP, and can also be performed on 486-class personal computers. Correspondingly accurate three-dimensional inviscid calculations can be performed for a wing on a mesh, say with  $192 \times 32 \times 48 = 294,912$  cells, in about 20 minutes on a high-end workstation (SGI R10000), in less than 3 minutes using eight processors, or in 1 or 2 hours on older workstations such as a Hewlett Packard 735 or an IBM 560 model.

Viscous simulations at high Reynolds numbers require vastly greater resources. Careful studies have shown that between 20 and 32 cells in the normal direction to the wall are required for accurate resolution of the boundary layer. In order to maintain reasonable aspect ratio in all the cells in the mesh (for reasons of numerical accuracy and convergence) on the order of 512 cells are necessary in the direction wrapping around the wing, and at least 64 cells are required in the spanwise direction. This leads to over 2 million cells for a minimally resolved viscous wing calculation. Reynolds Averaged Navier-Stokes calculations of this kind can be computed in about 1 hour on a Cray C-90 computer or over 10 hours in a typical high-end workstation.

These computations not only require powerful processors; they also need computers with large memory sizes (1-2 Gb for this kind of calculations). The computer simulations save US\$ 150,000 during the development of the new commuter jet by reducing the need for some wind tunnel testing and flight tests [5].

#### D. The Organizational Structure of Computation

CFD codes are structured around the numerical algorithms that can tackle fluid flow problems. In order to provide easy access to their solving power all commercial CFD packages include sophisticated user interfaces to input problem parameters and to examine the results. Hence all codes contain three main elements : (i) a pre-processor, (ii) a solver and (iii) a post-processor. The aerodynamic computation uses in this work consists of :

- **CATIA**, pre-processor for 2D and 3D geometry modeling. For 3D complex geometry modeling, CATIA has better capability than preBFC.
- **preBFC**, pre-processor for 2D and 3D simple geometry modeling, unstructured 2D-mesh generator, and unstructured surface mesh generator.
- **TGrid**, pre-processor for 3D-volume mesh : 2D (triangular) and 3D (tetrahedral) mesh generator.
- **RAMPANT**, the solver and post-processor.

Figure 2 shows aerodynamic calculations program structure uses in this work.

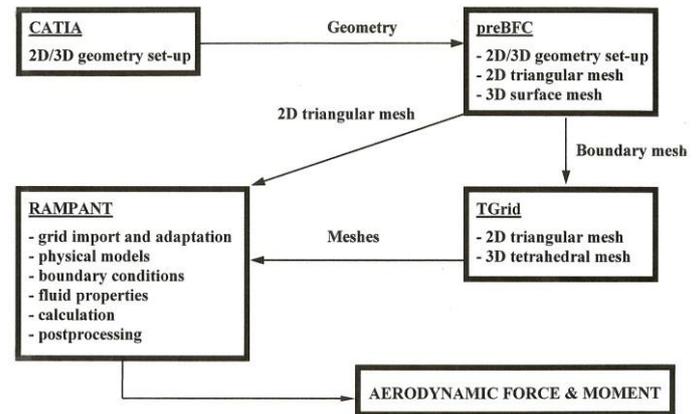


Fig. 2 Aerodynamic calculations program structure

### III. AERODYNAMIC WING DESIGN

The main objective of this section was to analyse whether the wing used in this work fulfils the design objectives or not. The high subsonic flow over the wing of a typical regional aircraft (W-ATRA) was calculated [6 - 10].

#### A. Aerodynamic Design Objectives

The main objectives of the wing design, which incorporates laminar technology are :

- a. To obtain a pattern of approximately straight isobar sweep at an angle at least equal to the wing sweepback angle, with the upper surface generally being critical for drag divergence. If this aim is achieved, the flow will be approximately two-dimensional and the drag-divergence will occur at the same Mach number every where along the span.
- b. To obtain the greatest possible amount of laminar flow on the wing this will significantly improve wing efficiency (L/D) in cruise flight. The maximum reduction in drag for the wing must be obtained for the cruise  $C_L$  corresponding to the design case for the proposed aircraft. To achieve the laminar flow objectives for the design, it was required that the laminar airfoil pressure distributions (suitably interpolated over the span) should be realized by the 3D wing.
- c. To have a good performance in off-design operations.

#### B. Configuration Description

For this study, a wing of a typical regional aircraft (W-ATRA) was sized [6 - 10] as shown in Figure 3.

To simplify the problem and also to keep the grid size low as possible, the analysis was performed for a half wing-body configuration only. Two flap of baseline configuration were used in this analysis :

- a. Configuration I : flap undeployed
- b. Configuration II : flap deployed

The variation of VC (variable camber) flap deflection (dvcw) along the span is not optimized yet, but these analyses show the effect of VC-flap deflection on the section pressure distribution along the span.

The wing surface grid of configurations I and II used for this analysis were created. The grids are for  $M_\infty = 0.8$ , angle of attack = 0 degree, and Reynolds number of  $21.6 \times 10^6$ . The computational domain was a rectangular box that extends a 5 fuselage length in front, behind, above, and below the wing, and 3 fuselage lengths (6.8 wing semispan) to the side of the wing. The size of the mesh of the above two configurations were as follows :

- a. Configuration I= 35,019 Nodes, 344,787 Faces, 165,256 Cells
- b. Configuration II= 36,215 Nodes, 355,903 Faces, 170,522 Cells

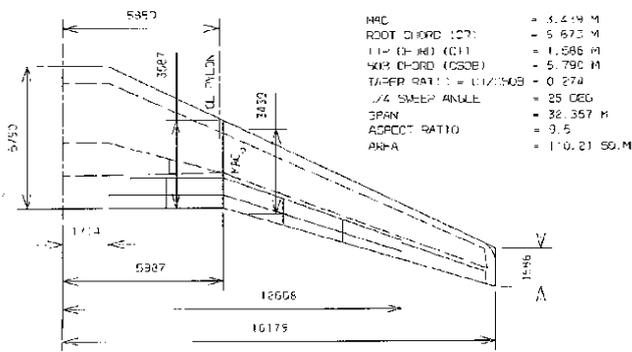


Fig. 3 Wing Configuration

C. Results

Figures 4 and 5 show pressure and Mach number contours on the surface of configuration I. Figures 6 and 7 show pressure and Mach number contours on the surface of configuration II [6 - 10].

From Figures 4 and 6, for both configurations, the average wing upper surface isobar sweep angle (taken at 50% chord) is approximately 21.8 degrees, instead of 25 degrees (wing quarter chord sweep angle). Thus, the isobar sweep efficiency is  $= 21.8/25 = 0.872$ . The inboard wing upper surface isobars are characterized by more sweeps forward at the front and less sweepback at the rear, and the shock strength is quite weak.

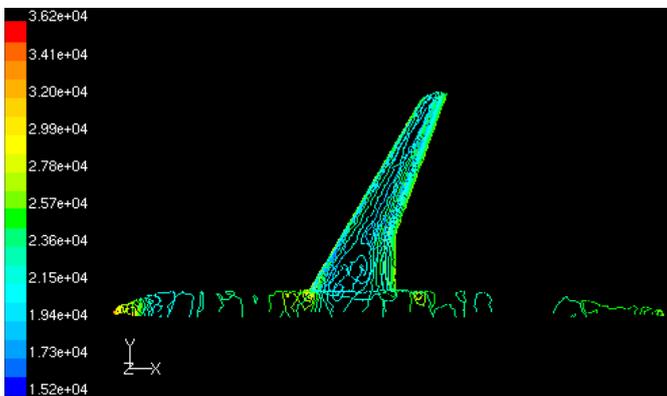


Fig. 4 Configuration I : contours of static pressure

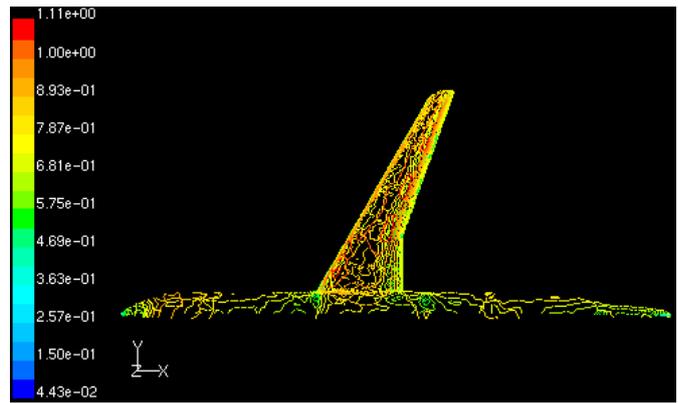


Fig. 5 Configuration I : contours of Mach number

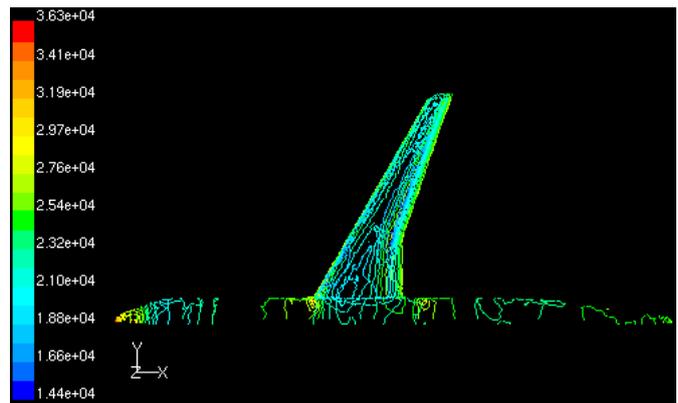


Fig. 6 Configuration II : contours of static pressure

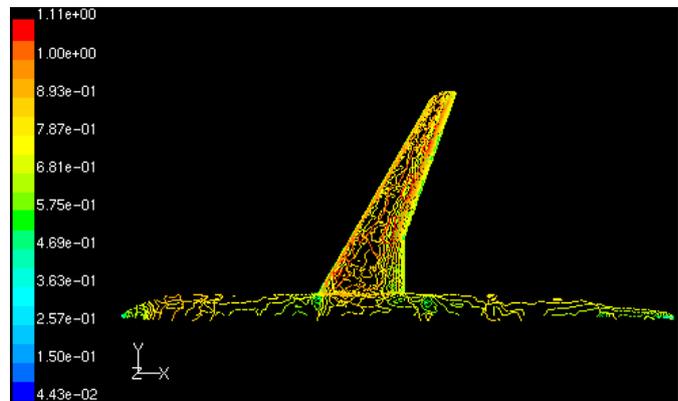


Fig. 7 Configuration II : contours of Mach number

IV. DISCUSSION

The W-ATRA wing configuration results were produced from only the first iteration of a very complex wing design process. The above wing is not yet optimum both for undeflected and deflected VC flap. Due to the limitations of time and computer memory, the first author can not analyze the VC at several flight conditions (at design point as well as off-design) to show its biggest benefit. Regardless of its weakness, its performance appears quite reasonable, and almost met the aerodynamic design objectives.

To improve the wing aerodynamic performance, it is recommended that further optimization be made of the airfoil sections, twist and VC-flap deflection distributions along the wing span, together with laminar suction requirements.

## V. CONCLUSION

A methodology has been developed for the aerodynamic wing design using CFD, allowing for the use of combined laminar and variable camber flap/wing concepts for transonic transport aircraft.

To simulate the real flow, the grid should be fine enough, especially in the region of high curvature (e.g. leading edge), the grid adjacent to the wall and in the regions of high pressure gradients.

The CFD simulations can save the design costs during the development of the new transport aircraft project by reducing the need for some wind tunnel testing and flight tests.

The conclusion can finally be drawn, that Computational Fluid Dynamic (CFD) is technically and economically feasible as a powerful design tool to optimize the aerodynamic wing shape.

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# Molecular Docking on Azepine Derivatives as Potential Inhibitors for H1N1-A Computational Approach

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**Abstract**—Azepine are an important class of organic compounds. They are effective in a wide range of biological activity such as antifeedants, antidepressants, CNS stimulants, calcium channel blocker, antimicrobial and antifungal properties. In our continue efforts to search for a potent inhibitor for H1N1 virus using molecular docking. In this study, 15 azepine (ligands) derivatives were docked to the neuraminidase of A/Breving Mission/1/1918 H1N1 strain in complex with zanamivir (protein). The Cdocker energy was then calculated for these complexes (protein-ligand). Based on the calculation, the lowest Cdocker interaction energy was selected and potential inhibitors can be identified. Compounds MA4, MA7, MA8, MA10, MA11 and MA12 with promising Cdocker energy was expected to be very effective against the neuraminidase H1N1.

**Keywords**— molecular docking, azepine derivative, H1N1, computational

## I. INTRODUCTION

Azepine are well established in pharmacological and medicinal chemistry. However, limited number of studies had been carried out on the synthesis and structure activity relationship (SAR) for azepine, especially in terms of anti-viral activities. The anti-viral effects of benzodiazepines and benzothiazepines have mainly been focused on HIV and hepatitis viruses. Dibenzothiazepinethione derivatives to have anti-viral activities against Varicella-Zoster virus, hepatitis B and HIV-1 [1]. In another study, Delpa and co-workers showed 1,4- benzothiazepines and 1,4-benzodiazepines with a peptide side-chain to have inhibitory effect on hepatitis B, and D viruses by affecting the binding of the hepatitis virus to annexin V [2].

Our recent interest in azepines has been inspired by the anti-viral properties of this class of compounds. Thus, in this study we explored on neuraminidase inhibitory activity. To the best of our knowledge, there are a limited number of reports on the computational approach (i.e. docking) of azepine derivative as H1N1 inhibitors.

## II. METHODOLOGY

The docking of these 15 azepine compounds [3] (i.e. general molecular structure as presented in Figure 1) onto the neuraminidase of A/Breving Mission/1/1918 H1N1 strain in complex with zanamivir which downloaded from PDB data

bank ([www.pdb.org](http://www.pdb.org), PDB ID: 3B7E) was achieved using Discovery studio 2.5 software packages (Accelrys). The docking proses were beginning with the preparation of ligand and the protein. Hydrogen atoms were added to the protein and its backbone was minimized. All ligands were minimized before docking.

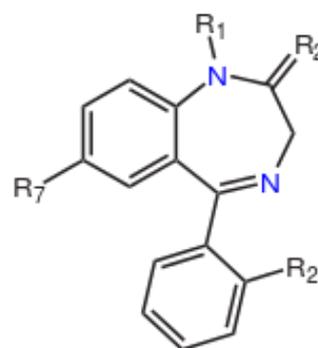


Fig. 1 Molecular structure of benzothiazepine

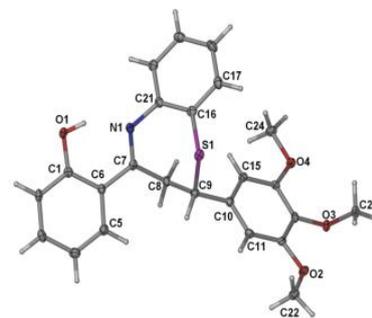


Fig. 2 Xray crystal structure

Docking was performed through the Cdocker protocol. In general, cdocker is a grid based molecular docking method that employs CHARMM forcefields. This protein was firstly held rigid the ligand were allowed to flex during the refinement. Two hundred ligand conformations were then generated from the initial ligand structure though high temperature molecular dynamic followed by random rotation, refinement with grid based (GRID 1) simulated annealing and a final grid based or

full force field minimization. Upon completion of the docking proses, conformations with the lowest cdocker energy were then chosen and compared with DANA (active agents against neuraminidase H1N1 with Cdocker energy equal to -46.11 kcal/mol).

### III. RESULT AND DISCUSSION

Docking studies were performed to evaluate the effects of agents against neuraminidase. The Cdocker energy reflects the interaction energy for the ligand-protein complex and the lower energy means the interaction is more stable. The results of Cdocker energy are presented in Table I.

TABLE I  
CDOCKER ENERGY OF AZEPINE

No	Compounds	Cdocker energy (kcal/mol)
1	MA1	29.26
2	MA2	27.82
3	MA3	32.81
4	MA4	40.52
5	MA5	28.85
6	MA6	28.75
7	MA7	32.86
8	MA8	35.34
9	MA9	25.63
10	MA10	34.31
11	MA11	36.23
12	MA12	39.08
13	MA13	23.50
14	MA14	29.75
15	MA15	23.26

The cdocker energy of MA4, MA7, MA8, MA10, MA11 and MA12 compounds were relatively close to the active agents (DANA). It indicated that those compounds can be used as new active compounds against neuraminidase H1N1, this observation might be due to the azepine as a ligand is binding well to the active site of the protein.

### IV. CONCLUSIONS

Azepines with promising Cdocker energy (compared to DANA with Cdocker interaction energy equal to -46.11 kcal/mol) were expected to be active against neuraminidase. Cdocker energy reflects a logical progression for early stage drug discovery that can be used to successfully identify drug candidates. Further studies are to do the biological test to validate the computational results.

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# Risk Management for Enterprise Resource Planning Post Implementation Using COBIT 5 for Risk

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**Abstract**— Risk management for ERP post-implementation is required to achieve ERP success. In this paper, risk management for ERP post-implementation is designed using COBIT 5 for Risk on APO12 processes. The design of a risk management framework begins with assessment of ERP post-implementation success adopting two approaches, namely the framework of ERP post-implementation success and Critical Success Factor of ERP post-implementation as an input to the risk identification adopted from COBIT 5 for Risk. The study was conducted at the company that has been entered the ERP post-implementation stage. The results of research on the case study company are ERP post-implementation success assessment by only 55.6% and there is a fairly high percentage of unsuccessful at 44.4% which indicates a risk that must be managed. Risks that need to be managed as many as 26 ERP post-implementation risks that are grouped into nine categories of risk. With the option of risk response is one risk are transferred, 21 are mitigated and four are accepted.

**Keywords**— risk management, ERP post-implementation, COBIT 5 for Risk, critical success factors, case study.

## I. INTRODUCTION

ERP is a system software which integrates all information flow in the company including finance, accounting, human resources, supply chain and customer information by using a single database that can be accessed by all divisions within the company [2].

Facts suggest that long-term survival and success of ERP depends on continuous operation, use, maintenance and improvement of the ERP post-implementation or exploitation stage of the system [11]. It shows that the ERP post-implementation stage is the stage that will determine the success of ERP in a company.

In the ERP post-implementation, failure can be determined by assessing the success of the ERP post-implementation [7] so that risks that occur in ERP post-implementation can be identified. Subsequently, the identified risks can be managed further by designing risk management for ERP post-implementation. This is relevant to Dey, Clegg, & Cheffi [1] that researchers can expand the practice of risk management in the post-implementation period to help ensure the sustainability of the enterprise information systems. One framework approach that can be used in risk management is COBIT 5 for Risk.

Research methodology that is used based on the development of the research methodology proposed by Ellis et al [8]. The first phase begins with the identification of problems and determination of research objectives. The next stage is to do a literature review on risk management for ERP post-implementation. Analysis and design stage is conducted to design risk management for ERP post-implementation. Implementation and evaluation stage is performed by implementing the design made before and evaluate it through implementation on a case study company. The last stage is to report the research results. The stages can be repeated according to the needs of research.

## II. RISK MANAGEMENT OF ERP POST-IMPLEMENTATION

Risk management of ERP post-implementation is part of the IT risk management. COBIT 5 for Risk defines IT risk as a business risk, in particular, the business risks associated with the use, ownership, operation, involvement, influence and adoption of IT within the company.

## III. DESIGN OF RISK MANAGEMENT FOR ERP POST-IMPLEMENTATION

In this section, the success factors of ERP post-implementation assessment is arranged which then used in the design of risk management for ERP post-implementation.

### A. Formulation of Success Component Assessment for ERP Post-Implementation

The intent of this analysis was to determine the factors that will be assessed for ERP post-implementation success by adopting the ERP post-implementation framework and Critical Success Factor (CSF) of ERP post-implementation. The results of the ERP post-implementation success assessment will be the basis for risk identification adopted from COBIT 5 for Risk framework as shown in Figure 1.

The ERP post-implementation success assessment is used to determine the success and failure factors of ERP post-implementation [7]. According to Dijk [3], the concept of identifying risk factors closely related to the concept of identifying success factors, since both aim to identify the obstacles on the way to ERP post-implementation success of system. This is reinforced by Gemi statement [4] that failure factors associated with risk.

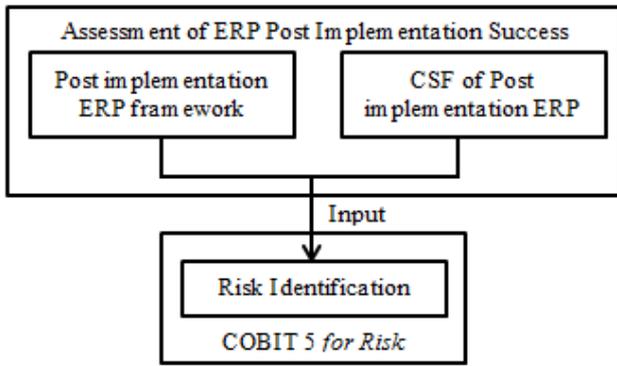


Fig.1 Linkages between ERP assessment of post-implementation success and COBIT 5 for Risk

Referring to Kiriwadeniya, et.al [7] and Nejb [10], it can be organized a success factors list of ERP post-implementation that were identified as shown in Table 1.

Based on table I, it is obtained ERP post-implementation success components include nine factors: (1) Customization of the ERP software, (2) the ERP post-implementation training, (3) care or support from managers in the use of ERP software, (4) the standards of the usage success of ERP application, (5) Change management to achieve the benefits of the ERP system, (6) maintenance level of the ERP system, (7) efforts to disseminate additional features following an ERP upgrade (8) prior to ERP implementation success rate, and (9) Support from the vendor.

TABLE I  
COMPONENT OF THE ERP POST-IMPLEMENTATION SUCCESS ASSESSMENT.

ERP Post Implementation Success Factors	Post-Implementation ERP framework [7]	CSF of Post-Implementation ERP [10]
Customization of ERP software	√	√
Training of post-implementation ERP	√	
Manager's support in the use of ERP software	√	√
Standards successful of ERP applications usage	√	
Change management to achieve the benefits of the ERP system	√	
Tingkat pemeliharaan sistem ERP	√	
Efforts to disseminate additional features after such ERP upgrade	√	
Success rate before ERP implementation	√	
Support vendors		√

For ERP success assessment scale measurement in this research will be made into four ratings shown in Table II.

TABLE II  
SCALE MEASUREMENT COMPONENT OF ERP POST-IMPLEMENTATION SUCCESS

Scale	Assessment	Description
1	Very Low	ERP failure
2	Low	ERP failure
3	High	ERP success
4	Very High	ERP success

B. Design of Risk Management for ERP Post Implementation

Guidelines of COBIT 5 enabling process explained that each company defines the process, and each management practices that is selected or adopted is adapted by considering the situation or circumstances in the enterprise [5]. The design of the risk management for ERP post-implementation based on COBIT 5 for Risk namely APO12 process. In the APO12 process there are six practices [6], namely:

- (1) Collect data (APO12.1), is the practice of identifying and collecting relevant data for the identification of risks that occur at this time and the history of IT-related risks.
- (2) Risk analysis (APO12.2), is the practice of developing information to support risk decisions by estimating the frequency and impacts associated with IT risk scenarios.
- (3) Maintain Risk profile (APO12.3), is the practice of maintaining an inventory of known risk and risk attributes and control activities at this time.
- (4) Articulation of risk (APO12.4), is the practice of providing information related to IT risk conditions and risk response options that can be utilized by all stakeholders.
- (5) Establish portfolio risk management measures (APO12.5), is the practice of managing risk response actions to reduce risk to an acceptable level as a portfolio.
- (6) Response to risk (APO12.6), is the practice of responding to risks in a timely manner with effective measures.

Based on APO12 process then the risk management for ERP post-implementation is designed referring APO12 practices and making some adjustments required by the case study company. The design of the risk management for ERP post-implementation is shown in Figure 2.

The explanation of the stages of the design as follows:

A. Risk Identification

In the early stages of risk identification is to perform data collection and assessment of data history document in accordance with the APO12.1 processes in COBIT 5 for Risk. The input of this phase is obtained from the results of the success assessment of ERP post-implementation by adopting two approaches, namely the framework of ERP post-implementation and CSF for ERP post-implementation. The results is unsuccessful factors for ERP post-implementation as the basis for identifying risks, which in turn studied with two approaches, top down and bottom up. The top down approach is an approach to identify risks based on the unreachability of business objectives while the bottom-up approach is an approach to identify risks through list of generic risks from COBIT 5 for Risk.

Details of the risks and risk categorization are determined by Risk Breakdown Structure (RBS) approaches. RBS is used primarily in an attempt to make the categorization of each risk to see risks in more detail [9].

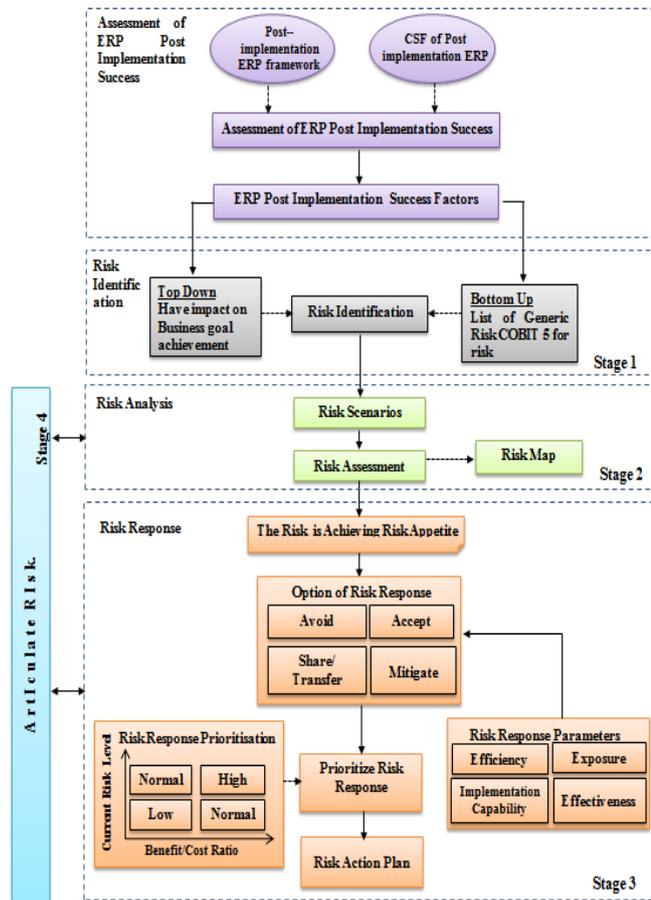


Fig.2 The design of risk management for ERP post implementation.

**B. Risk Analysis**

This stage corresponds to APO12.2 process in COBIT 5 for Risk. The risk analysis stage is performed by conducting a risk assessment of the risks identified by calculating the probability of the risk (likelihood) and how large the impact of risk for the company that could affect the company's strategic objectives and business goals, resulting in business process stalled. The result is a list of risk, which then became the basis for preparing risk maps.

**C. Risk Response**

In this stage, risk response is determined, in accordance with the APO12.6 process. Risk response tailored to the risk appetite set by the company. Risk appetite is a statement that shows a company's attitude towards risk management.

The choice of risk response action consists of four options, namely:

- (1) Avoid the risk, is an action to avoid doing activities that let the risk.

- (2) Reduce or mitigate risk, is an action to detect risks, then do activities to reduce the impact or frequency of occurrence of such risks.
- (3) Transfer the risk, is an action of dividing the whole or part of the risk to third parties.
- (4) Accept the risk, an action to accept the consequences if the risk actually occurs. Accept the risk having a meaning that risks are identified and then the management decided to accept the risk.

To determine the risk response that will be applied to follow up of risk, it needs measurement considering the risk response parameters, which include:

- (1) Efficiency, related to how far follow-up of risk in line with the business objectives of the organization.
- (2) Exposure, the impact and frequency of occurrence of the risk indicated by its position on the risk map.
- (3) Ability to implement, related to the company's ability to implement action risk selected.
- (4) The effectiveness, related to how far the response action options will reduce the impact and magnitude of risks.

Prioritizing selection of risk responses is necessary to align the risks of ERP post-implementation of the company's risk tolerance limits. Priorities include high, normal and low. The priority is used as a reference in the measurement to determine the risk actions of ERP post-implementation.

**D. Risk Articulation**

This stage is the articulation of risk in accordance with APO12.4. Articulation of risk is determined by doing analysis the stakeholders and the existing practices in APO12.4. Risk articulation process is giving information to the stakeholder using a RACI Matrix.

**IV. RESULTS**

The implementation is done at the headquarters of PT. Pusri. The selection of case studies by considering that PT. Pusri has entered the ERP post-implementation and use ERP for 14 years. So the longer the age of ERP utilization may pose risks. Questionnaire of ERP post-implementation success assessment, risk identification, risk assessment is distributed to 40 respondents of ERP users.

**A. Success Assessment of ERP Post-Implementation**

The success assessment of ERP post-implementation conducted by distributing questionnaires to obtain the results in Table III.

Table III shows the assessment analysis results of ERP post-implementation success factors. Success factors of ERP post-implementation with low-value consists of four factors: the customization of ERP applications in accordance with the company's business processes, ERP post-implementation training, efforts to disseminate additional features following an ERP upgrade and vendor engagement. These four factors indicate unsuccessful ERP post-implementation. 44.4% failure rate of ERP post-implementation is obtained from the calculation (4/9x100%). While the ERP post-implementation success factors are 5 factors so ERP post-implementation success rate is only 55.6% were obtained from the calculation (5/9x100%).

TABLE III  
SUCCESS ASSESSMENT RESULTS OF ERP POST-IMPLEMENTATION.

No	ERP Post Implementation Success Factors	Assessment	Description
1.	Customization of ERP software	2	Low
2.	Training of post-implementation ERP	2	Low
3.	Manager's support in the use of ERP software	3	High
4.	Standards successful of ERP applications usage	3	High
5.	Change management to achieve the benefits of the ERP system	3	High
6.	Tingkat pemeliharaan sistem ERP	3	High
7.	Efforts to disseminate additional features after such ERP upgrade	2	Low
8.	Success rate before ERP implementation	3	High
9.	Support vendors	2	Low

Furthermore, these results are validated by using triangulation techniques. Triangulation can be done using different techniques namely interviews, observation and documents [12]. The final result of data validation is four unsuccessful ERP post-implementation factors namely customizations in ERP applications in accordance with the company's business processes, ERP post-implementation training, efforts to disseminate additional features following an ERP upgrade and vendor engagement.

**B. Identification of Risk**

Risk identification is determined using two approaches, top down and bottom up. The results of risk identification are mutually supportive results from both approaches. It is found 28 details of risk that re-confirmed to ERP users through questionnaires. From the risk identification questionnaire found 26 risks grouped into nine risk categories of ERP post-implementation. A detailed list of risk categories shown in Figure 3.

**C. Risk Analysis**

Based on figure 3, the risk analysis carried out by conducting a risk assessment to the impact and frequency of risk occurrence. Assessment of the impact and frequency measures using a scale of 1 to 5 shown in table IV and V.

**D. Risk Response**

Choice of risk response actions first adapted to the company's risk appetite among  $\geq 4$  risk assessment  $\leq 15$  which is medium and high risk categories. Based on company policy, 4 low risks is accepted by the company with the risk of ID are: R9, R11, R15, R22. As for the 22 categories of risk namely moderate and high categories conducted risk response actions choices.

The results of the risk action choice of the 22 risk are 21 risks are mitigated and 1 risk is transferred. Table VI shows the recapitulation of risk response actions against 26 ERP post-implementation risks.

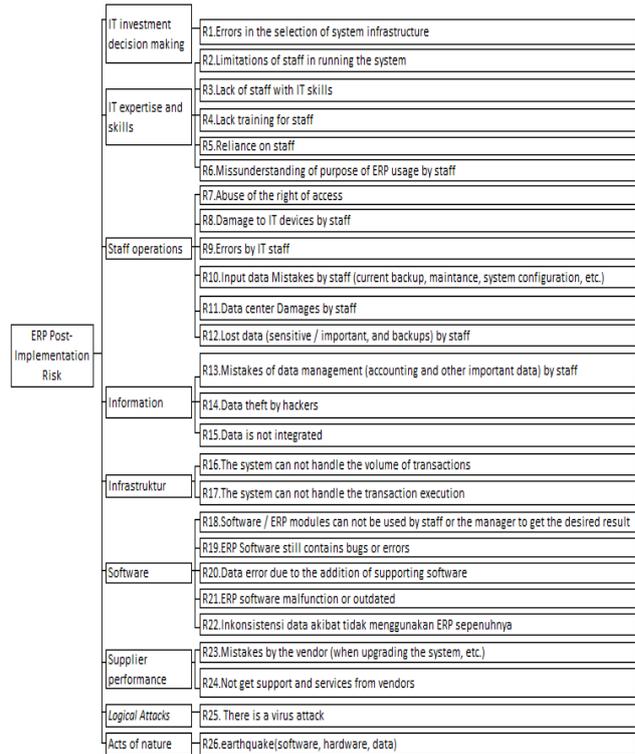


Fig.3 RBS Risk of ERP Post-Implementation

TABLE IV  
RISK IMPACT ASSESSMENT SCALE

Impact Value	Impact	Description
5	Very High	More than 50% of the company's strategic goals are not achieved, resulting in business process stalled
4	High	Between 30%-50% of the company's strategic objectives is assessed not achieved
3	moderate	Between 20%-30% of the company's strategic objectives is assessed not achieved
2	Low	10% of the company's strategic goals are not achieved, that need management attention so the risk is not spread
1	Very Low	Less than 10% of the company's strategic goals are not achieved, in the scale and small scope of risks

TABLE V  
RISK FREQUENCY ASSESSMENT SCALE

Frequency Value	Frequency	Description
5	Very High	Tends to occur in most circumstances (often happens)
4	High	There is likely to occur in most circumstances (may happen)
3	moderate	Tends to occur in some circumstances (sometimes happens)
2	Low	There may be in some circumstances (Rarely)
1	Very Low	There is likely to occur in very special circumstances (small possibility)

Referring to the above assessment, the results of the risk assessment is then mapped into a risk map. Risk maps are used to adapt the risk map of risk management at PT. Pusri. Mapping results shown in Figure 4.

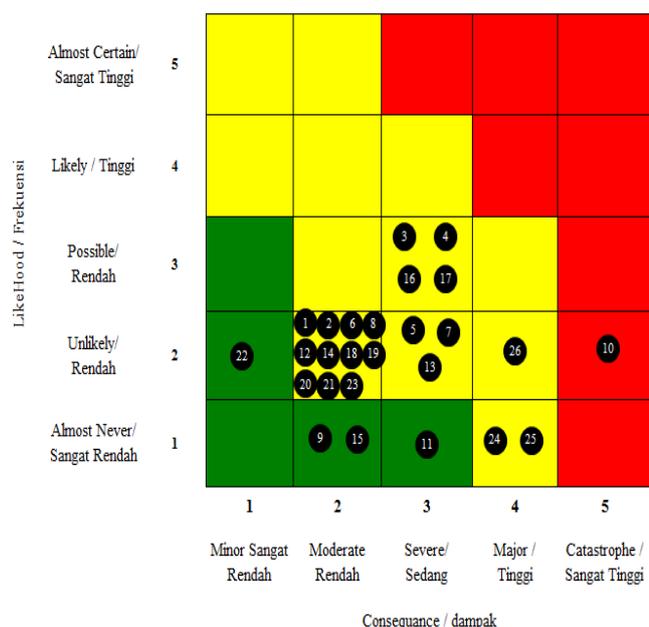


Fig. 4 Risk Map of Risk Assessment Result.

Referring to Table VI, by considering that risk mitigation and risk transfer are response actions that need a budget [7] it is necessary to determine the priority risks. Priority is determined by the results of the risk assessment. If the results of the risk assessment is high enough then the risk will be prioritized to mitigation action. Meanwhile, if the results of the risk assessment are the same then risk priorities are determined by the frequency value by considering the risk impact will be prioritized for risk mitigation action. Seen in Table VII, lists of the risk response is based on risk priorities

**E. Risk Articulation**

Articulation is important that is always needed in the stages of risk analysis and risk response. Articulation is done by involving all stakeholders associated with the ERP IFS system in PT. Pusri in order to manage the risk of ERP post-implementation. Codes and stakeholders involved as follows: (A) The Board of Commissioners, (B) Risk Monitoring Committee, (C) the Board of Directors, (D) Manrisk Manager, (E) Operations Division, (F) IT Manager, (G) Key IT Person, (H) Supervisor SisKom, (I) KomDat Supervisor. Shown in table VIII, the process of articulation and stakeholders.

TABLE VI  
Recapitulation of Risk Response Actions.

Risk	Respond Option		
	Mitigate	Share/Transfer	Accept
1. Errors in the selection of system infrastructure (R1)			
2. Limitations of staff in running the system (R2)			
3. Lack of staff with IT skills (R3)			
4. Lack training for staff (R4)			
5. Reliance on staff (R5)			
6. Missunderstanding of purpose of ERP usage by staff (R6)			
7. Abuse of the right of access (R7)			
8. Damage to IT devices by staff (R8)			
9. Input data Mistakes by staff (current backup, maintance, system configuration, etc.) (R10)			
10. Lost data (sensitive / important, and backups) by staff (R12)			
11. Mistakes of data management (accounting and other important data) by staff (R13)			
12. Data theft by hackers (R14)			
13. The system can not handle the volume of transactions (R16)			
14. The system can not handle the transaction execution (R17)			
15. Software / ERP modules can not be used by staff or the manager to get the desired result (R18)			
16. Inconsistency of data due to not using the ERP completely (there's a staff that does not use the ERP) ( R19)			
17. ERP Software still contains bugs or errors (R20)			
18. Data error due to the addition of supporting software (R21)			
19. Mistakes by the vendor (when upgrading the system, etc.) (R23)			
20. Not get support and services from vendors (R24)			
21. There is a virus attack. (R25)			
22. IT infrastructure (software, hardware, data) damaged or not functioning due to a disaster such as an earthquake (R26)			
23. Errors by IT staff (R9)			
24. Data center Damages by staff (R11)			
25. Data is not integrated (R15)			
26. ERP software malfunction or outdated (R22)			

TABLE VII  
RISK RESPONSE LIST BASED ON RISK PRIORITIES

Risk	Risk
------	------

	priority
1. Input data Mistakes by staff (current backup, maintance, system configuration, etc.) (R10)	1
2. IT infrastructure (software, hardware, data) damaged or not functioning due to a disaster such as an earthquake (R26)	2
3. Lack of staff with IT skills (R3)	3
4. Lack training for staff (R4)	4
5. The system can not handle the volume of transactions (R16)	5
6. The system can not handle the transaction execution (R17)	6
7. Reliance on staff (R5)	7
8. Abuse of the right of access (R7)	8
9. Mistakes of data management (accounting and other important data) by staff (R13)	9
10. Errors in the selection of system infrastructure (R1)	10
11. Limitations of staff in running the system (R2)	11
12. Misunderstanding of purpose of ERP usage by staff (R6)	12
13. Damage to IT devices by staff (R8)	13
14. Lost data (sensitive / important, and backups) by staff (R12)	14
15. Data theft by hackers (R14)	15
16. Software / ERP modules can not be used by staff or the manager to get the desired result (R18)	16
17. Inconsistency of data due to not using the ERP completely (there's a staff that does not use the ERP) ( R19)	17
18. ERP Software still contains bugs or errors (R20)	18
19. Data error due to the addition of supporting software (R21)	19
20. There is a virus attack. (R25)	20
21. Mistakes by the vendor (when upgrading the system, etc.) (R23)	21
22. Not get support and services from vendors (R24)	22

TABLE VIII  
ARTICULATION PROCESS AND STAKEHOLDERS

Articulation Process	Structure Functional (code)								
	A	B	C	D	E	F	G	H	I
Reported the results of a risk analysis related to the assessment of risk impact		C	C	R	I	A/	A/	C	C
Describe the risk scenarios to support decision making in response to the risk		C	C	R	I	A/	A/	C	C
Report the current risk profile	I	C	C	R	I	A/	A/	C	C
Review the the results of the risk assessment	I	R	A	R	C	C	R/		
Identify the increased use of ERP opportunities to respond the existing risk	I	C	A	C	C	A/	C		

## V. CONCLUSIONS

Research conducted is successfully implemented in the case study company. It is known that, the results of the ERP post-implementation success assessment only 55.6%, and there is a fairly high percentage of unsuccessful at 44.4% which indicates risks that must be managed. Risks need to be managed that successfully identified by 9 categories risks

include: IT investment decision-making, expertise and IT related skills, operations staff, information, infrastructure, software, supplier performance, logical attacks, and natural events. Those nine risk categories comprised 26 risk details that are one high risk, 21 medium risks and four low risks. While the results of the risk response options consisting of one risk transferred, 21 risk mitigated and four risk accepted. Further, risk mitigation actions adjusted using COBIT 5 for Risk. The results of the study have been validated by the case study company.

## ACKNOWLEDGMENT

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# Fuzzy Logic Implementation on Enemy Speed Control to Raise Player Engagement

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**Abstract**—Shoot em' up game is the sub-genre of action game. Action game is attractive because the game play usually use the interesting user interface and easily affect human emotion. With the aim to eliminate all the enemy, this kind of game will be boredom the player if the enemy behavior are monotonous. This game needs a controller to add dynamic system into the enemy such as the artificial intelligence. Therefore, this paper proposes Fuzzy Takagi Sugeno method that will take several input and give the response as the output. So, the game will manipulate the enemy behavior that make the game more challenging and interesting to be played.

**Keywords**—Component; Challenging Rate, Fuzzy Takagi Sugeno, Action Game, Artificial Intelligence (AI), and Aircraft Game

## I. INTRODUCTION

Good games are expected not only to give pleasure to the players, but the game should also have other positive values. One of the positive side is it can be the development of the human brain performance [1]. The game itself is a system where players are involved in the regulation and the prevailing culture in it, the player interacts with the system and the conflict in the form of artificially engineering.

One of the genre of game is an action game. One of the subgenre of action game is the shoot 'em up[2]. Shoot em 'up is a shooting game that can be done between players to players or players with the artificial intelligence enemy. The purpose of this game is pretty simple, where player shoot all the enemies while try to survive from enemy attacks.

This project will be represented the space craft motion speed while they are airing in the field and keep trying to kill the player. To make the game more interesting, the enemies in the game shoot em 'up is given artificial intelligence so that the game is more challenging to solve especially the response time of the enemy itself [3]. It can be guessed when they shoot, evade and so on so this likely the player become an auto machine by just memorizing the time of the enemy behavior. Shoot em' up game is a game that will be designed to target the enemy with the help of artificial intelligence to control the level of difficulty.

Existing shoot em' up game need to have a control that makes the differences among gameplay scenario. Because the constant speed of the enemy in this game makes player easy to guess enemy motion. So, speed controller by an artificial intelligence is necessary to make player difficult to guess enemy motion.

One example of the artificial intelligence that can modify the game is the fuzzy method. The actual research that already

uses the implementation of fuzzy method in a shoot em 'up is "the application of Intelligent Behavior in Object in Flash Tower Defense Game" (Penerapan Perilaku Cerdas Pada Obyek di Dalam Game Flash Tower Defense) by algorithms fuzzy Nuvem[4].

Beside Fuzzy Nuvem, fuzzy Takagi - Sugeno also can be used to control enemy speed patterns that were given artificial intelligence in the game shoot em 'up with objects such as space craft. Due to is the ability to tune certain variables easily by varying the linguistic rules or input variables, the algorithm is suitable for use the advantage of fuzzy logic[5]. Fuzzy Takagi Sugeno use several parameters as the input for the game and then there will be a collection of an output depends on the parameters. This more suited as a nonlinear control system[6].

## II. APPLIED TECHNIQUE

Fuzzy logic can make computer to reasoning about linguistic terms and rules like a human. To represent "wide" or "tight" of linguistic terms there will use the fuzzy set. The fuzzy set can be described as black, gray, and white. The fuzzy set enables values be assigned to set to a degree thing that called it fuzzification process. So, with fuzzified values, the computer can understand linguistic rules and make the output that consist of the fuzzy set to be defuzzified to give the crisp value[7].

Fuzzy set defined as a membership function. The function explains about the gradual transition from the region completely that on the outside within the set, so that enable a value to have partial membership in a set[7].

### A. Fuzzy Linguistic Variable (FLV)

FLV is the composition of one or more fuzzy sets to represent a concept or domain qualitatively. In this process, there will determine the values that made a linguistic value of the input sets and the output sets that will proceed. And after that, there will start to make a membership function for each linguistic value. The collection of the membership function that comprise the FLV will be called as fuzzy manifold or fuzzy surface[7].

### B. Fuzzification

Fuzzification is the process to change a crisp value in to the quantity fuzzy linguistic set or membership degree[8]. The interface of fuzzification will be explained by following steps [9]:

- i. Measure input variable value

- ii. Performs mapping scale that transfers range of input values into the variables in the corresponding universe of discourse
- iii. Performs fuzzification that converts a crisp function into a corresponding linguistic variable so it can be viewed as fuzzy sets

### C. Fuzzy Rules

Fuzzy rules advocated as key tool to express pieces of knowledge in “fuzzylogic”[10]. The antecedent describes a condition and the consequences the represents consequence if the condition is satisfied.

The difference with fuzzy rules from conventional rules where the consequent either fires or not, in fuzzy systems the consequent can fire to a matter of degree. The antecedent, can be found as a single fuzzy term or the set that is the result of a combination of several fuzzy terms.[7]

Each time a fuzzy system iterates through its rule set it combines the consequents that have fired and defuzzifies the result to give a crisp value.

### D. Fuzzy Evaluation and Fuzzy Aggregation

This is the process where will present the system with some values to see which rules fire and to what degree. Fuzzy inference follows these steps:

1. For each rule,
  - a. For each antecedent, calculate the degree of membership of the input data.
  - b. Calculate the rule’s inferred conclusion based upon the values determined in a.
2. Combine all the inferred conclusions into a single conclusion (a fuzzy set).
3. For crisp values, the conclusion from 2 must be defuzzified.

There are a few ways to handle multiple confidence. The two most used ways are bounded sum (sum and bound on one) and maximum value (equivalent to OR-ing all the confidences).

The next step is to combine the inferred results into a single fuzzy manifold. The outcome that will be obtained is the composite fuzzy set representing the inferred conclusion of all the rule base. The next step is going to process around and convert this output set into a single crisp value. This is can be acquired by a defuzzification process.

### E. Defuzzification

Defuzzification is the process turning inference results into crisp value[11]. For fuzzy Takagi Sugeno use Weighted Averagetechnique[12]. This method each output of the rule sets stored in the knowledge base of the system. The function of the weighted average defuzzification technique explained as (1):

$$x^* = \frac{\sum_{i=1}^n m^i w_i}{\sum_{i=1}^n m^i} \quad (1)$$

Where  $x^*$  is the defuzzified output,  $m^i$  is the each rule output membership, and  $w_i$  is the weight associated with each rule. This method is fast, easy and gives accurate result for the computerization process[13].

## III. GAME MECHANIC DYNAMIC AND AESTHETIC

Dynamic Mechanic and Aesthetics (MDA) is a formal approach to understand the game that is trying to bridge the gap between game design and development process, as well as technical game research.[14]

Mechanic describe the specific components of the game at the level of data representation and algorithms. Mechanics are a variety of actions, behaviors and mechanisms of control given to the player in the game context. Dynamics describe the run-time behavior of the mechanics who worked on player input and each output from time to time. Aesthetics describe the emotional response want raised against players when interacting with the gaming system.[14]

Mechanic made in this game when the player able to move in the direction forward, backward, left, and right, and can shoot some bullets. While the object of the enemy will continue to move forward. This game features two type enemy that shaped in the form of asteroids and plane shaped. Asteroid type only move forward when the plane shaped enemy will try to shoot player. The game will over when the condition fulfilled.

The dynamic that will be used later in a variety of battlefield conditions. Enemy will fight player's avatar object that continue to move forward while shooting it. Player's avatar which shoot by the enemy will be crushed and reduce remaining life new players then this object will respawn back. When there is no more life left, then the game over condition occurred. Whereas when enemy objects shoot, then enemy health point will decrease. When health point of enemies running off, then this object will immediately destroyed in battle. In addition, there are also cases when the object of the enemy left the battlefield then the object with some health remains still disabled regardless. Not only up to here, when enemy bullets and player bullet collide each other then that bullets will disappear from the game. Then the last condition when objects collide with objects enemy players, this will result in the destruction of enemy objects and the player object while reducing the player remaining lives.

The impact of the expansion of the implanted artificial intelligence game hopefully lead players seem to be handling the aircraft pilot, who must shoot down the enemy while try to survive. The purpose of aesthetics could be expanded to include the challenges that may limit the conquest game. Players are expected to respond in the coordinated movement patterns of expression may be far away even more difficult to catch. That will make the player must disclose the fear and hatred of the presence of their enemies.

## IV. APPLYING THE FUZZY TAKAGI SUGENO

In this project model, fuzzy logic used to compute the enemy movement speed. As described in Figure 1, this control system shown relative simple. This fuzzy method will activate when the game starts. First of all, the method is embedded into every object the enemy space craft that will receive several inputs.

Input in this case is the distance, enemy Health Point and the rest are enemy unit on field. Distance in this case is the form of the distance between the object space craft of the player space craft object. Then enemy health Point here refers to the rest of the health point which is owned by the enemy

before the plane dispose. Then the last factor is the number of enemy unit on the field when the game still played.

meters is considered as definitely close whereas a distance between 750 and 1000 meters is considered as definitely far.

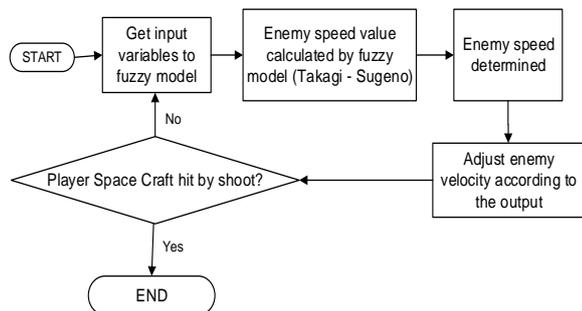


Fig.1 Fuzzy enemy speed control system

The output from this fuzzy process has one output variable. This value will determine the value of the speed of enemy space craft. After becoming crisp value, this value has become a value to determine the speed of the enemy. The enemy speed value which has three different linguistic values. For example, the three linguistic values are slow, medium, and fast.

The desired system behavior of the enemy speed can be defined through the rules and the FLV. The fuzzy sets variables and their ranges as illustrated in Figure 2.

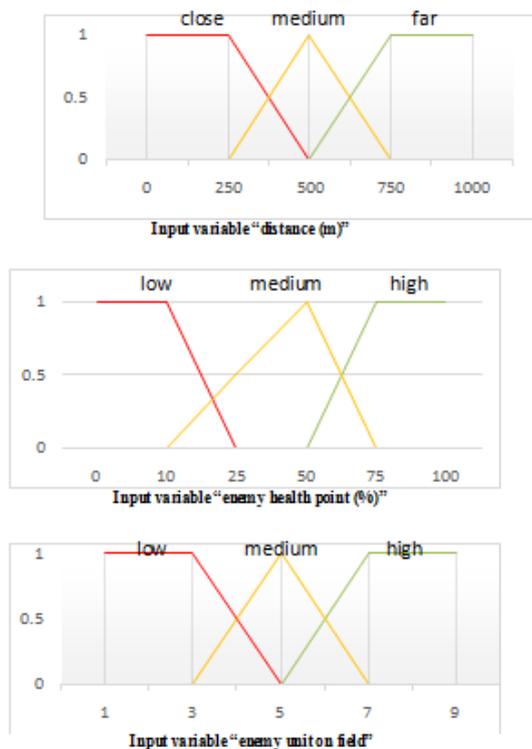


Fig. 2 Membership function and their input variables

**Distance:** The distance between the enemy and the player varies from 0 to 1000 meters. A distance between 0 and 250

**Enemy Health Point (HP):** The enemy health point bar are varies from 0% to 100%. Low amount of health point described between 0% and 25% is considered as definitely low and the health point between 75% and 100% is considered as definitely high.

**Enemy Unit on Field:** The enemy unit on field life are varies from 1 to 5. If the unit number on the field between 1 and 2 is considered as definitely low and the number of unit between 4 and 5 is considered as definitely high.

TABLE I  
LIST OF THE FUZZY IF-THEN RULES

R1:	IF distance is far and enemy HP is high and enemy unit is high THEN enemy speed is slow
R2:	IF distance is far and enemy HP is high and enemy unit is medium THEN enemy speed is medium
R3:	IF distance is far and enemy HP is high and enemy unit is low THEN enemy speed is medium
R4:	IF distance is high and enemy HP is medium and enemy unit is high THEN enemy speed is medium
R5:	IF distance is high and enemy HP is medium and enemy unit is medium THEN low enemy speed is slow
R6:	IF distance is high and enemy HP is medium and enemy unit is low THEN enemy speed is slow
R7:	IF distance is high and enemy HP is low and enemy unit is high THEN enemy speed is slow
R8:	IF distance is high and enemy HP is low and enemy unit is medium THEN enemy speed is slow
R9:	IF distance is high and enemy HP is low and enemy unit is low THEN enemy speed is medium
R10:	IF distance is medium and enemy HP is high and enemy unit is high THEN enemy speed is slow
R11:	IF distance is medium and enemy HP is high and enemy unit is medium THEN enemy speed is medium
R12:	IF distance is medium and enemy HP is high and enemy unit is low THEN enemy speed is fast
R13:	IF distance is medium and enemy HP is medium and enemy unit is high THEN enemy speed is slow
R14:	IF distance is medium and enemy HP is medium and enemy unit is medium THEN enemy speed is medium
R15:	IF distance is medium and enemy HP is medium and enemy unit is low THEN enemy speed is fast
R16:	IF distance is medium and enemy HP is low and enemy unit is high THEN enemy speed is slow
R17:	IF distance is medium and enemy HP is low and enemy unit is medium THEN enemy speed is medium
R18:	IF distance is medium and enemy HP is low and enemy unit is low THEN enemy speed is fast
R19:	IF distance is low and enemy HP is high and enemy unit is high THEN enemy speed is slow
R20:	IF distance is low and enemy HP is high and enemy unit is medium THEN enemy speed is medium
R21:	IF distance is low and enemy HP is high and enemy unit is low THEN enemy speed is medium
R22:	IF distance is low and enemy HP is medium and enemy unit is high THEN enemy speed is slow
R23:	IF distance is low and enemy HP is medium and enemy unit is medium THEN enemy speed is fast
R24:	IF distance is low and enemy HP is medium and enemy unit is low THEN enemy speed is fast
R25:	IF distance is low and enemy HP is low and enemy unit is high THEN enemy speed is medium
R26:	IF distance is low and enemy HP is low and enemy unit is medium THEN enemy speed is fast
R27:	IF distance is low and enemy HP is low and enemy unit is low THEN enemy speed is fast

*Enemy Speed*: only use three linguistic that distinguish the enemy speed: *fast*, *medium*, *slow*. In this paper each value is by increment of 3 (slow = 4, medium = 7, fast = 10).

Table I is the list of the sixteen rules that will be implemented into the model. Note that these rules have been set up without any particular expert knowledge.

When the enemy motion speed already computed using these input, the motion speed value of the enemy space craft will be adjusted accordingly. With that speed, the enemy will move closer to the player space craft while they shoot it. If the enemy fails to shoot the target space craft, the operator will modify the input and try again until they shoot the player or they pass the player space craft.

To apply the fuzzy to the game, the first step is to identify where the method to be placed. There are a variety of scripts that set the control of the game. One of them is a script to set the direction and speed of enemy movement. Through this script this method will be embedded.

The second step is to design the rule of this technique. The Fuzzy Takagi Sugeno method is executed in the game in progress. The input will be analyzed and taken each time the frame change. After the process of defuzzification, the speed of the enemy will be modified.

After that, the third step will talk about the game development. This game will use C# code that provided by Unity. Another code except the Fuzzy Takagi Sugeno is just about general script of game.

The lastly step is to integrate the method to the script. The logic that has been developed is imported to the game script so the game can compile the method when we play the game.

## V. FUZZY REASONING

In this paper, using the AND operation and the OR operation. The AND operation is the minimum value of the membership values. The OR operation is the maximum value of the membership values.[12]. As described before the defuzzification method is using weighted average method. For example, the input will be set as following:

*Distance*: 572 meters  
*Enemy HP*: 73 %  
*Enemy Unit*: 4

After all the input is entered, from the process of the evaluation as figure 3 and then defuzzification for all singleton value is calculated by the previous function, we will get 8.16 m/s.

## VI. EXPERIMENTAL RESULT

Testing techniques in this study is use questioner technique. The game created successfully and tested its gameplay to the player directly to 15 years old and above. The player will play the game with and without the use of Fuzzy Takagi Sugeno method embedded into the game. Once the players play, the player will be given gameplay questioner about the quality of game. With 20 players as the respondent.

There is a question that indirectly aimed to compare the level of satisfaction, the level of intelligence of the game, and the natural level of game between artificial intelligence game and the conventional game. From 20 players to be asked about conventional games distributed in 0% not satisfied, 5% less satisfied, 50% of normal respond, 40% quite satisfied, and 5%

satisfied. Difficulty level is described in more detail in Figure 3.



Fig. 3 Satisfaction level of Conventional Game

The level of satisfaction derived from player by the game that has been embedded by artificial intelligence distributed in 0% of not satisfied, 15% less satisfied, 15% of normal respond, 55% of quite satisfied, and 15% of satisfied. Difficulty level is described in more detail in Figure 4.



Fig. 4 Satisfaction level of Game with AI

The survey also obtained results with the majority of players have increased in satisfaction. From the survey the data obtained 45% of the vote increased satisfaction, 40% of votes were unchanged and 15% of the vote decreased satisfaction with the method have been embedded.

The dissatisfaction vote is the result of the planned game is too difficult to be solved make player happy to play a game without method. While the vote unchanged were according to vote the gameplay is too simple, does not recognize the changes that caused by the embedded AI, and less satisfied with some of the mechanics and dynamics that still lacking. Then the vote promoting increased satisfaction in the form because player have aesthetic challenge, competition and a sense of curiosity about the game, be aware of changes of the dynamics of the game by the method, the satisfaction of effects and gameplay interface, realizing that the game becomes more natural and realistic.

Results of the survey and the analysis then it can be concluded that the development of the game after embedded Takagi-Sugeno fuzzy method can increase satisfaction when compared with conventional game that more monotonous.

## VII. CONCLUSION

From the survey results and its analysis, there can be concluded that the game had been developed after implanted

Takagi-Sugeno fuzzy method is able to improve the satisfaction when compared with conventional game that tends to be more monotonous. Applied fuzzy Takagi-Sugeno method can be used to improve the dynamics of the game manipulate enemy movement speed in the game shoot em 'up.

From the results of the questionnaire that has been done can be concluded that the addition of artificial intelligence affect the level of players satisfaction with 45% more satisfied with the game that has been implanted artificial intelligence and 15% more satisfied with the vote for conventional game.

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# The Development Model for Customer Relationship Management (CRM) to Improve The Quality of Services in Academic Information Systems Faculty of Computer Science Sriwijaya University

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**Abstract—** The development and utilization of information technology will make the competition among universities, as a result the universities should maintain their quality of services to get their potential customers and key customers, in particularly to get related information, in order to being first choice in the society. Professional management will be able to provide outstanding quality services and highly competitive, especially in academic services. The development of academic information system to improve the services can be done by apply the Customer Relationship Management or (CRM). Implementation of CRM in academic information system can create an emotional bond that is able to build a two-way communication between users and academic system providers. With good and reliable communication can improve the quality of academic services to the customers, which in turn will be able to improve the customer loyalty and increase the customer satisfaction in the Faculty of Computer Science.

**Keywords —** CRM, Quality of Services in Academic, Faculty of Computer Science

## I. INTRODUCTION

University as one of the educational institution is an institution that provides public services, as like general firms. Competition among universities intensifies make them should maintain the quality of service for their stakeholders, especially in getting the related information, in order to remain the top choice in the society. Professional management will be able to provide outstanding service quality and highly competitive (Farr, 2003).

According to Berry and Parasuraman (1992), the quality of public services can be achieved through the implementation of an information system it capable to serving the academic needs of the users of the system transaction. Academic information system development in terms of improved service can be done either by applying the model of Customer Relationship Management or (CRM) (Binsardi & Ekwulugo, 2003). Fundamentally CRM built with emphasis on the principles of relationship marketing (Berry, 1983) and the client placement strategy as a processes center, activities and culture (Hamidin, 2010). This concept has been well known and widely implemented to improve services in the company. Nevertheless, CRM

concept here is not intended as a form of commercial in education, but rather the effort to improve service quality.

The development of academic system based on CRM in university has different with the implementation of CRM in the world of business. CRM systems are built should pay attention to cultural and academic characteristics of the institution (Raman, Wittmann, & Rauseo, 2006) and to know and understand the behavior and needs of key customers, such as students (Daradoumis et al., 2010). According Syaekhoni (2010), the implementation of CRM in the university can improve service to the customer, where the customer will get the information about the university more easily and also can create good cooperation relationship between the customer and can facilitate student trustee to monitor the activities of their children in campus and not have to bother anymore to come or call the university to determine the development of academic and financial processes of their children (Mabrur, 2011). Faculty of Computer Science (Fasilkom) is one of the faculty under the auspices of the University of Sriwijaya who have a vision of educational programs in Information Technology and Communication, relevant and have high competitiveness in the administration tridharma 2020. As a new faculty was established on February 22, 2006, the development of Fasilkom can be said to be progressing rapidly. The progress can be judged from the number of programs and in good academic cooperation and peer education institutions overseas as well as with government agencies. The development of Fasilkom can also be judged from interests of students who entered the Faculty.

One of the efforts of the Faculty of Computer Science in the improvement of public services is by providing enrollment services such as online registration of new students. Services can also be done on line for old students to process their KRS, KHS and transcripts through academic website. Based on the services outlined above, it appears that the service in Fasilkom was not implemented specifically method. This of course can cause customer dissatisfaction. Business processes are the features of academic websites have not been able to meet the information needs of users such as: Parents, prospective students, faculty and others. Quick solution is needed as a tool that able to bridge the needs of customers, both

prospective students, students, parents of students, faculty, academic and student section, and the top management. A tool that is able to present data quickly and provide ease of access for each user. Means are able to streamline the administrative issues related to academic services (Harrison Walker, 2010). To overcome this, it takes a special method such as Customer Relationship Management (CRM) it can help the management of Fasilkom in improving the academic quality of service. From the background above the researchers interested in developing CRM to the academic process at the Faculty of Computer Science with the title : The model of development for Customer Relationship Management (CRM) to improve the quality of services in Academic Information Systems faculty of Computer Science Sriwijaya.

## II. RESEARCH PURPOSE

The purpose of this research is as follows:

1. Analyzing academic processes which directly related to the services that contain in the Customer Relationship Management (CRM).
2. Produce an academic information system model by applying the approach to Customer Relationship Management (CRM) as an effort to improve service quality faculty.

## III. THE BENEFIT OF RESEARCH

The benefits of this research are as follows:

1. Assist the distributing process of information more effectively, efficiently and in accordance with the needs of stakeholders.
2. Increase direct interaction between the users of the system with the existing system of academic information.
3. Expand and improve the quality of academic services that have been implemented.
4. Improve customer satisfaction of the academic system services.

## IV. LITERATURE REVIEW

According to Whitten (2004), CRM is a software application that provides end-users with access to a business process from initial request through post-sales service and support sales. While Strauss (2001) stated that Customer Relationship Management is used to define the process of creating and maintaining a relationship with the customer-business customers or customers. CRM is a process to identify, attract, and retain customers and differentiate O'Brien (2002) argues Customer Relationship Management (CRM) is the use of information technology to create cross-functional enterprise systems that integrate and automate customer service processes in the areas of sales, marketing, and service of products / services related to the company.

Thus it can be stated that the CRM in academic services at higher education institutions is an integrated approach between people, process and technology to understand the

main customers (students and Guardians of students) at a university with a focus on key customers and the development of relationships between educational institutions and their customers. Basically, the purpose of a university is adopting CRM to improve durability and customer satisfaction. To be able to develop a good model of CRM needs to be done and preparation stages of CRM. Kalakota and Robinson (2001), states that there are 3 (three) main stages in the manufacture of CRM, namely:

1. The process for getting new customers (Acquire)
2. Processes to enhance customer value (Enhance)

CRM applications can be used by manufacturing and service companies. For the company consideration is choosing the right software and applications as required. The key success is to understand the whole fabric of CRM / cooperation going on in the organization / company, both internally and externally by utilizing IT-Based programs and software. This program and software should be able to gains both sides. For customers, this program and software should be easy to use, highly effective and efficient and can be used to keep track of things related to customer relationship. On the other hand, companies also benefit to improve the efficiency and productivity as well as to provide service and a consistent experience for customers through a variety of media that can be selected by users. Thus, it lead to creating a harmonious value chain in the long term.

## V. RESEARCH METHOD

### A. Sources Of Data

Source of data required in this study were obtained from the main customer of academic information system at the Faculty of Computer Science such as students, parents of students, academic information systems administrator, head of the academic, as well as future students.

### B. Data Collection

The techniques of data collection in this study were:

1. Interview
2. Observation
3. Library Studies

### C. Model Development Method CRM

In this study the model development method CRM used is Waterfall Model or Linear Sequential Model. This model is a systematic approach and sequence ranging from system level requirements and then headed to the stage of analysis, design, coding, testing/ verification, and maintenance.

1. Phase System/ Information Engineering and Modeling. This stage is search for the needs of the whole system to be applied to the stage in the form of software which is often called the Project Definition. The purpose of this phase is to find the needs of the whole system.
2. Phase Requirement Definition. This stage is focused on the needs of the software information domain from

devices, such as the required functionality, user interface, and so on.

3. Phase System and Software Design. This stage is used to change the above needs to be representation in the form of a "blueprint" software before the coding begins. The design should be able to implement the requirements mentioned in the previous stage.
4. Phase Implementation and Unit Testing. This stage is the implementation of the technical design it will produce a model of CRM.
5. Phase Integration and System Testing and Phase Operation and Maintenance. Basically this stage is the stage of the unification of these functions were a whole (system testing) and phase operate the program in its environment and perform maintenance, such adjustments or changes due to adaptation to the actual situation. This stage is also useful for the development of the system in the future such as when there is a change of the operating system, or other device. Due to this study is limited to the modeling of CRM, then this step will not be performed

## VI. RESULT

Based on the results of interviews with prospective customers and customer's CRM in the academic system Fasilkom can be defined several business processes is an urgent need of the users of the system through the existing problems. To clarify the results the interviews focused on the subject matter and the cause of the problem, the authors used cause and effect analysis matrix so it can be found that the real heart problem, while the search for appropriate solutions to improve their existing problems to improve business processes on a system that was developed to use the system improvement objectives matrix. Table I. is the identification of problems, causes and consequences of the problem, purpose of system development and system constraints are expected to be achieved in this study.

### A. Requirements Definition

Functional requirements are activity descriptions and service needs of the system must be met. While the non-functional requirements are different from the description of feature requirements, characteristics, and some solutions for improving the system (Whitten, 2004). Priority of user functional requirements of the system proposed is as follows:

1. The system must be able to manage the data that there is criticism and suggestions on customer service
2. The system receives input through the website critiques and suggestions
3. The system should be able to make a report for criticisms and suggestions to top management
4. The system must be able to manage personal attention
5. The system will inform the greeting for personalized birthday for students or lecturer

6. The system will inform the personal greeting to students or faculty who get good performance.
7. The system will inform the personal greeting to students who have graduation
8. The system able to inform
  - a. IP (GPA) on a particular semester and the details of the grade
  - b. IPs (temporary a Grade)
  - c. List of courses and the amount of credits (Semester Credit Units) are taken by students in a particular semester
  - d. The total number of credits that have taken up half run
  - e. Percentage of student attendance by students access, prospective students, or parents
9. The system able to inform
  - a. Course information to students who intended
  - b. Notice to parents of students who have not paid tuition fees
  - c. Academic announcements to students and faculty
10. Management system can perform academic announcements
11. Simulation test system provides services to prospective students.
12. The system can perform management reports to the Top Management of academic

### B. System and Software Design

To change the functional requirements described above to form "blueprint" software, the authors use data modeling approach. Data modeling is a formal way to describe the data used and created in a business system. This model can show the place, person or thing in which the data is retrieved and relationships between data.

In this research, data modeling is described using ERD (Entity Relationship Diagram) which consists of :

- a. Student entity: a table that defines the data associated with the student. This table contains all the personal data of students in the Faculty of Computer Science.
- b. Entities lecturer: a table that defines the data associated with the lecturer. All personal data held by the lecturer's table.
- c. Cama entities: a table that defines the data associated with the prospective student. All personal data is owned by the prospective student's table.
- d. Parent entity: a table that defines the data associated with the student's parent. All personal data is owned by the parents of students by this table.
- e. Entities subject: a table that contains all information related to the subject.
- f. Nilai\_mk entities: a table that defines the data associated with the value. This table has a field id\_nilai and value.
- g. Question entities: a table that defines the data relating to the questions and answers on simulation tests for prospective students

- h. Entities payment info: is a table that defines the data associated with payment information lectures.
- i. Entities criticism: a table that defines the data relating to criticism and suggestions. Both prospective students, students, or parents of students.

Visually, data modeling results are shown through the ERD in Figure 1. To make a model of the whole system of processes ranging from the input, process and output the author uses the modeling process. Modeling process is the formal way to describe how the business operates. Illustrate the activities undertaken and how data moves between those activities. In this study the modeling process for the new system will be described with DFD (Data Flow Diagram). Level 1 DFD shows all the processes that take place in the academic information system that will be proposed. In this DFD are 9 of processing and 4 pieces of entities.

1. The process 1.0 is a process to manage all the information about the customer service in the form of criticism and suggestions from students, prospective students, faculty, and parents of students
2. The Process 2.0 is in charge of managing the process of personal attention to students and faculty.
3. The process 3.0 is a process that served to show good attendance recapitulation students and faculty absenteeism This process involves pieces of entities such as students, faculty, parents and students of Academic and Student Affairs section
4. The process 4.0 is a process that displays KHS and transcripts for students and parents of students. This process requires the database to generate the output value.
5. The process 5.0 is a process to display all the information about the courses to students, prospective students, and parents of students
6. The process 6.0 is a process for information processing of tuition payments for Faculty of Computer Science. This process will result in a description whether the student has to pay tuition or not. Payment information will be provided to students and parents of students.
7. The process 7.0 is a process to cultivate academic announcements.
8. The process 8.0 is a process of simulation test, value to generate information that can support the decisions of prospective students in determining the ability to take the entrance exam for Fasilkom.
9. The process 9.0 is a process in charge of preparing reports required by the Dean Assistant I.
10. The process 10.0 is a process that performs data processing on the data of prospective students.
11. The process 11.0 is a process that performs data processing on the data of parents of students.
12. The process 12.0 is a process to show the value of KHS.

From DFD there is addition several processes that appear to support the implementation of CRM. These processes include processes for managing criticism and advice, to the

management of personal attention, managing payment information and management simulation tests. Criticism and suggestion process or customer service are a process where the customer (students, prospective students, faculty, and parents of students) can give critiques and suggestions to the Faculty of Computer Science which essentially will be reported to the PD I as a material consideration in the decision making efforts to improve the quality of faculty service.

Management of personal attention, a process to give special attention to the faculty and students in an effort to increase the loyalty of the faculty. Payment management is the process of delivering information relating to the payment of tuition / tuition to the students and parents of students. The process will be able to help the parents of students in implementing parental monitoring. Meanwhile, the simulation process is a process containing test on trials test on the ability of prospective students for entrance exams to fasilkom. Results of these simulated tests is a comparison of the simulation results with the passing grade fasilkom test. This will assist students in making decisions on their interests and abilities in the college entrance exams. In addition, this effort is also intended to get new customers for the fasilkom.

Amount of information received by each user of the system will improve the performance of the users of the system itself. More and varied information will also help the users of the system to make decisions so the resulting decision will be more fast and accurate.

## VII. CONCLUSION

Academic Information Systems (SIMAK) which has been implemented in the Faculty of Computer Science Sriwijaya University basically good enough and there are many features that can facilitate student academic data processing such as: KHS, KRS, transcripts, student registration. SIMAK existing on-line has not been touched prospective customers and increase customer loyalty academic itself. For it is necessary to build academic services with CRM approaches in an effort to improve service to users of the system.

This research resulted in a CRM model can improve the relationship between prospective customers (such as: students, parents, and the general public) and customer systems (such as student, faculty) with the Faculty of Computer Science as an institution of education services and can create an emotional bond were able to create a close and open relationship and create two-way communication between users and providers of the academic system. With good and reliable communication can improve the quality of academic services to customers, which in turn will be able to improve customer loyalty and increase customer satisfaction to the Faculty of Computer Science.

TABLE I  
PROBLEMS, OPPORTUNITIES, OBJECTIVES AND CONSTRAINTS MATRIX

Cause and Effect Analysis		System Improvement Objectives	
Problem or Opportunity	Cause and Effect	System goals	System limitation

<p>1. The absence of on-line process that can capture the interest of prospective students of Fasilkom</p>	<p>1. There is a new promotion process through direct visits to school, promotion in the mass media so that takes time, effort and considerable expense. 2. There is no mechanism to attract prospective students on line via the personality approach.</p>	<p>1. Provides a new simulation admissions test, which contains data about the admission procedure. 2. Provide data related to academic support services for prospective students to communicate with</p>	<p>1. Only prospective customers who already registered can use this facility.</p>
<p>2. The absence of critical management processes and suggestions from users of the system</p>	<p>1. There is no mechanism to accommodate criticisms and suggestions 2. There are no reports of services 3. Complaints and suggestions still delivered by conventional 4. Lack of fulfillment of the required customer information. 5. The absence of specific policies to support increased academic services</p>	<p>1. The system can display the report to customer service 2. Submission of comments and suggestions submitted via website 3. Submission of criticisms and suggestions can be submitted by SMS</p>	<p>1. Only customers who already registered can give criticism and advice. 2. The report can be accessed online 3. Criticism and suggestions accommodated by customer type 4. Criticisms and suggestions can be sent via SMS 5. SMS sending comments and suggestions should be made in accordance with the SMS format for inputting criticism and suggestions</p>
<p>3. The absence of the management personal attention for students and faculty</p>	<p>1. There is no harmonization between students and lecturers 2. The absence of processing of personal data of students and faculty 3. Students and faculty are less personal attention 4. Students and lecturers are rarely open academic website 5. The absence of specific policies to support the management of personal attention</p>	<p>1. The system can manage personal information. 2. Based on the results obtained information management will be given information about the student / faculty such as student / faculty's birthday, earn achievements, and graduate students. 3. Students and faculty get a special greeting through the website</p>	<p>1. Personal attention is given to students and faculty through the website 2. Just received a birthday greeting when student / faculty birthday 3. Congratulations on the anniversary, achievement, graduation or personally delivered to the customer when logging in on the website 4. Personal information sent through SMS.</p>
<p>4. Nonoptimal delivery of academic announcements</p>	<p>1. Submission of academic announcements are not up to date and continue 2. Submission of academic announcements still general 3. Students actively looking for information about academic 4. Students rarely open website to get academic announcements</p>	<p>1. Academic announcements delivered up to date and continue 2. Submission of certain academic announcements made directly to individuals associated with the announcement</p>	<p>1. Academic announcements submitted via website 2. Specific announcements are sent specifically to individuals associated with the announcement.</p>
<p>5. Prospective students / learners difficult to get academic information</p>	<p>1. Student / prospective student has no special access to communicate with faculty 2. The absence of mechanisms for communicating with prospective student-related information needs of the faculty academic 3. The absence of the data processing mechanism of prospective students</p>	<p>1. Provide special media for prospective students to interact with Fasilkom through website 2. Prospective students are given the right of access to academic information conformed to the requirements 3. Simulation test facility is provided for students' graduation exam (UN)</p>	<p>1. Prospective students will gain special access to Academic Information Systems 2. Only students who are already registered can interact with the Fasilkom website 3. Only prospective students already enrolled can use simulation test facility</p>
<p>6. The absence of parental monitoring features for parents of students associated with the development of his lecture</p>	<p>1. The absence of system privileges granted to the student's parent 2. There may be a misunderstanding between the parents and the faculty for incorrect information submitted by student 3. Parents difficult to get academic information from the faculty</p>	<p>1. Parents can get information related to the course (academic) 2. The system can provide academic information effectively and efficiently</p>	<p>1. The system gives access to the parents to get their children's academic information</p>

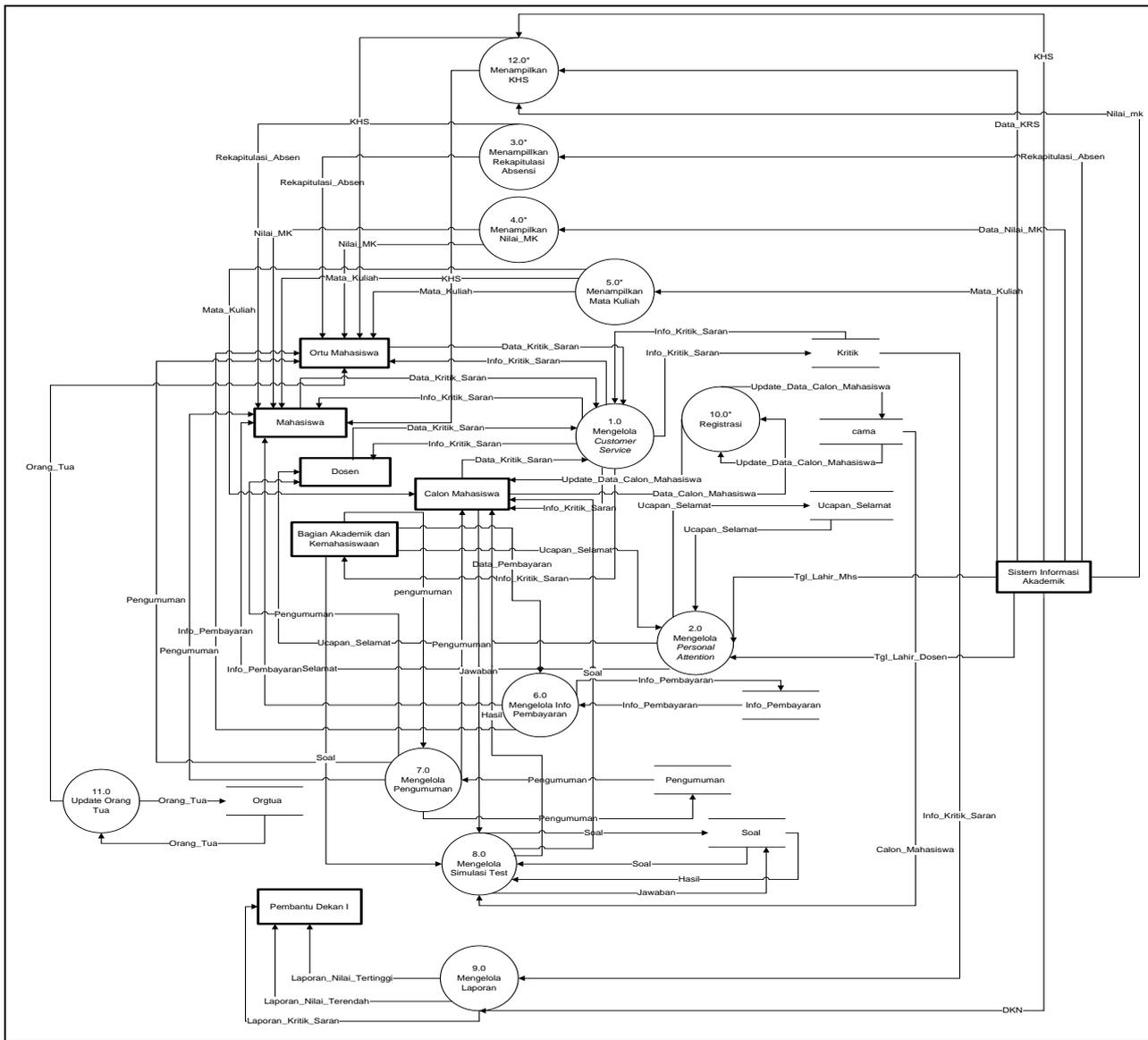


Fig.1 Developed System

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# Cost Estimation System for Construction Project (CES-CP)

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**Abstract**— Bill of Quantity is a form used by the contractor to submit a price to the owner in order to obtain a construction contract. It takes the ability and experience to make bill of quantity, not everyone can do it. The development of “Cost Estimation System for Construction Project (CES-CP)” aims to assist people to make Bill of Quantity. The development of this application use FAST (Framework for the Application of Systems Techniques) methodology. This application stored the knowledge that required to make Bill of Quantity. It can show which one of the Work Unit Price are recommended for use on Bill of Quantity and which ones are not. All Work Unit Data that used on Bill of Quantity of a project will be stored and can be displayed at any time as a reference. This application helps people to make Bill of Quantity and make the process of making Bill of Quantity becomes more efficient.

**Keywords**— Bill of Quantity, Construction Project, Cost Estimation

## I. INTRODUCTION

Construction is one of industry that has fierce competition in terms of price [1]. In attempting to obtain a construction contract, the contract must follow the tender or bid price to the owner. Tender is an activity that aims to select, acquire, establish and appoint the most appropriate company for doing a job package [2].

The proposed price at the time of tendering obtained from the cost estimation process. This cost estimates used to determine the amount of the construction costs needed to build a project and also the profit made by the construction company, in this case is the contractor.

In most tenders, deals for the lowest prices who will get the contract. The dilemma that faced by the contractor is in asking the price. If the proposed price is too high then the contract will be awarded to another contractor, but if the price is too low then it will hit the contractor’s profit.

Therefore we need an optimum price that contractors obtain construction contracts and also benefit from the contract. Estimates of construction cost of the project is presented in the form of Bill of Quantity (BoQ).

In a large construction project, work items which will be calculated and analyzed even more numerous and diverse. For each type of work should also be analyze done by one from the material requirements, the equipment used and the wages used to do the job. The results of the analysis determines the amount of unit price for each type of work.

One of the unit price of the construction work is by using a computer program. One of them is SIEB program (Cost Estimation Information System)[3]. This system provides convenience in preparing the data to calculate the unit price of

construction work by using software. Users just insert material prices, wages or equipment required on a job along with the volume and the system will calculate the total cost of the work[3]. But this system only handles the Employment Unit Price calculation, not up to the making of the Bill of Quantity.

The program was developed by Erich and Lusiana [4], which makes an application to assist the process of making the Bill of Quantity, where the filling of unit price, this application can be connected with SIEB, or manually inserted. Disadvantages of this application is lack of classification where the recommended of the unit price and which ones do not. And the absence of a history of the work that used on the project.

This paper describes an application that is used to store the Employment Unit Price, and show where the Employment Unit Price recommended and which ones are not. Then, the data unit of Employment that is used on the project, is stored and can be displayed at any time if required to be used as a reference to determine the Employment Unit Price will be recommended in the future. Web-based application was developed due to web-based applications more efficient because it can be accessed from anywhere and at anytime. This is important, considering that a construction company could have a construction project at various places. So, if a user wants to create a Bill of Quantity or accessing existing data, can be done anywhere and at any time, regardless of time and place. In addition, a web-based application also has several advantages, including a multi-platform (can be run on any operating system, requiring only a browser) and easier to install (no need to install software applications one by one to a computer, simply by hosting).

## II. METHODOLOGY

FAST (Framework for the Application of Systems Techniques) is used for system development, and the phase are: Scope Definition, Problem Analysis, Requirements Analysis, Logical Design, Decision Analysis, Physical Design, Construction, Installation and Delivery[5].

A. *Scope Definition*: In this phase, the collection of information that will be examined levels of feasibility and project scope is by using the PIECES framework (Performance, Information, Economics, Control, Efficiency, Service). This is done to find the core of the existing *problems*, the opportunity to improve organizational performance and the new requirements imposed by management or government (directives).

B. *Problem Analysis*: this phase will be examined issues that arise in existing systems. In this case the project charter resulting from the preliminary stages of investigation is the key. The results of this phase is to improve the performance of the system that will provide benefits in terms of the

company's business. Another result of this stage is a report that addresses the problems, causes, effects, and benefits solution.

- C. *Requirements Analysis*: In this phase will be sorting priority of the needs of existing businesses. The purpose of this phase is to identify the data, process and user interface of the desired new system.
- D. *Logical Design*: The purpose of this phase is to transform the business needs of the requirements analysis phase of the system model that will be built later. In other words, this phase will answer the questions surrounding the use of technology (data, processes, interfaces) that ensure usability, reliability, completeness, performance, and quality to be built in the system.
- E. *Decision Analysis*: In this phase of the selection will be considered a web-based application or desktop-based which will be selected and used in the implementation of the system as a solution to the problems and requirements that have been defined in the previous stages.
- F. *Physical Design*: The purpose of this phase is to transform business requirements represented as logical design into physical design will be used as a reference in making the system to be developed. If in the logical design will depend on a variety of technical solutions, the physical design represents a more specific technical solutions.
- G. *Construction*: After making the physical design, it will begin to construct a system that meets the business needs and design specifications. The database, application programs, and the interface will be built at this stage.
- H. *Installation and Delivery*: In This phase will be operated system that has been built. This stage will begin with deploy software to provide training to the users on the use of systems that have been built.

### III. SYSTEM ANALYSIS

#### A. Processes Modelling

The modeling process is a formal way to describe how the business operates. Illustrates the activities undertaken and how the data flows among those activities. In this final modeling process for the new system will be described with DFD (Data Flow Diagram). CES-CP process modeling can be seen in

Fig 1.

Estimators provide input to the system in the form of a username, password and level, tasks on the project, work measure unit, and resources needed task measure unit.

Managers provide input to the system in the form of a username, password, and level, measure unit, suppliers, resource price, taskmeasure unit, and resurces needed.

The first process is the "Manage Users". Process Manager is used to manage users who can access this application. The second process is the process of "Managing measureunit". This process is used to manage the measureunit that exist in this application. Measureunit data stored in the measure unit table.

The third process is "Managing Supplier". This process manage existing supplier data. Supplier Data will be stored into supplier table. The fourth process is the process of "Managing Resources". This process is carried out by the Manager to manage the data resources. The fifth process is the process of

"Managing the Task unit". The process to manage the Task Unit. Both Manager and Estimator can manage it, in accordance with the authority given.

The sixth process is the process of "Manage Budget Plan". this process performed by the Estimator. And the eight process is the process of "View History", to display the history of existing work on application to the Manager.

#### B. Data Modelling

Data modeling is a formal way to describe the data used and created in a business system. This model can show the place, person or object in which the data is taken and relationships among the data. In this paper, data modeling is described using ERD (Entity Relationship Diagram). CES-CP data modeling shown in

Fig 2.

There are 11 entities relate to each other and represent 11 tables that exist in the database. User entity, contains information about the users of this system. Project entity, contains information about the project. Task category entity, contains category of tasks. Task entity contains project tasks. Task Unit, contains information about the task unit. Detail entity, contains information about the volume and price of each resource used by taks in the project. Measure unit entity, contains the measure unit that will be used to indicate the measure un it used on the task and resources. Resources Entity, containing information about available resources. Supplier Entity, contains information about the supplier of resources available. Resource Category Entity, containing information on the category of existing resources. Price Entity contains price information on resource suppliers.



ID	Nama	Satuan	Volume Satuan	Harga Satuan (Rp)	Status
1	Pembersihan Area Pekerjaan	M2	1200,000	1,079.58	rekomendasi
2	Pasang Bowptank	M	10,000	11,516.75	rekomendasi
3	Galian Tanah	M3	1,000	20,737.50	rekomendasi
4	Unguan Pasir	M3	1,000	92,175.00	rekomendasi
5	Beton Tumbuk Ad 1:3:5	M3	1,000	497,544.00	rekomendasi
6	Beton Bertulang Ad 1:2:3	M3	1,000	2,634,300.01	rekomendasi
7	Pasangan Aantstamping	M3	1,000	140,812.50	rekomendasi

Fig 4. Previous Task Management

**Data Proyek**  
 Proyek Tempat Tinggal Palembang 10 Lili

**Rekapitulasi Sumber Daya**

ID	Kategori	Sumber Daya	Satuan	Harga (Rp)	Quantity	Supplier	Jumlah (Rp)
1	material	Kayu Kelas IV	M3	750,000.00	0.09	PT.XYZ	67,500.0
2		Paku Basa	Kg	8,000.00	0.06	PT.XYZ	480.0
2		upah					

Fig 7. Use of Resource Summary

B. Estimator Page

In this page (see Fig 5), project estimator assisted in managing project budget and viewing list of tasks from previous project.

Project budget plan development starts by clicking new project menu. On project budget plan worksheet page shown in Fig. 6, estimator able to manage categories, tasks, and resources. Estimator will be assisted in the preparation of the budget plan by the system with available existing task.

With the same page, estimator able to see the summary what resources has been used and its total amount. The summary can be shown in Fig. 7.

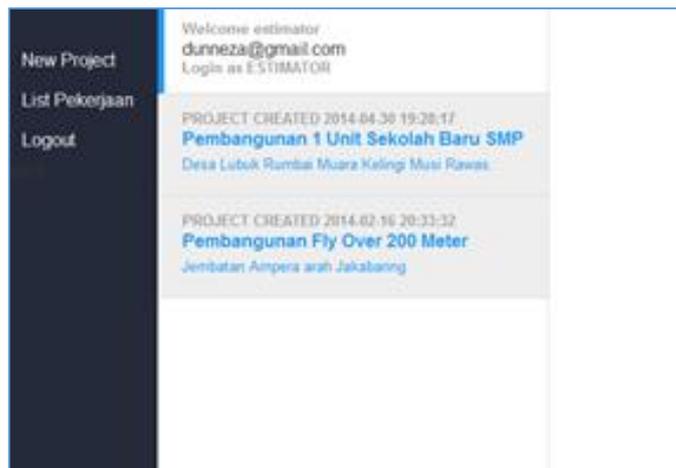


Fig 5. Estimator Page

**Data Proyek**  
 Pembangunan Fly Over 200 Meter Jembatan Ampera arah Jakabaring

**Rencana Anggaran Biaya dan Pekerjaan**

Kategori Pekerjaan	Nama Pekerjaan	Satuan	Volume Satuan	Harga Satuan (Rp)	Volume Pekerjaan	Biaya (Rp)	
Pembelian	1 Pembersihan Area Pekerjaan	M2	1,200,000	1,079.58	150,000	161,937.00	
	Sumber Daya		Harga Proyek (Rp)	Koefisien	Supplier	Jumlah (Rp)	
	1.1 Mandor	/hari	37,500,000	1,00	PT.TENAGA KERJA	37,500,000	
	1.2 Pekerja	/hari	26,000,000	48,00	PT.TENAGA KERJA	1,248,000,000	
1.3 Alat Bantu	set	5,000,000	2,00	PT.XYZ	10,000,000		
Pemasangan	2 Pemasangan Plank Nama Proyek	M	10,000	11,516.75	20,000	230,335.00	
	Sumber Daya		Harga Proyek (Rp)	Koefisien	Supplier	Jumlah (Rp)	
			100	750,000.00	0.06	PT.XYZ	47,500.00

Fig 6. Project Budget Plan Worksheet

V. CONCLUSIONS

CES-CP is a web-based system that is used to calculate the cost of a project by considering the history data of the budget plan have been made previously. CES-CP is eligible to be designed in order to improve efficiency in making BoQ. With CES-CP, less experience cost estimator can make BoQ accurately.

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**PROCEEDING**

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