

# Effect of Bamboo Leaves Extract Concentration (*Dendrocalamus sasper* L.) as Bioherbicide on Nutsedge (*Cyperus rotundus* L.)

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## ABSTRACT

*Cyperus rotundus* one cause of the decline in crop production due to the nature of parasitism in plants cultivation. *Cyperus rotundus* including important weeds in various types of plants that can cause reduced farming production. The use of chemical herbicides continuous and not wisely, today raises many problems, especially in environmental pollution and health. Alternatives that are used to control weeds in addition to using bioherbicide is with bamboo leaf ekstrak (*Dendrocalamus sasper*) containing phenolic compounds, coumarin and flavonoids. Based on the results of previous studies, the use of bioherbicide quite effective in controlling *Cyperus rotundus*. In this study will test the effectiveness of bamboo leaf extract (*Dendrocalamus sasper*) against *Cyperus rotundus*. The study used a completely randomized design (CRD) 7 treatments with 5 replicates. Research that has been carried out bamboo leaf extract (*Dendrocalamus sasper*) capable menghambat growth of sedges, it is evident from the parameters is done on research that has been carried out. Of the various parameters of observation, bamboo leaf extract treatment with a concentration of 90% real effect on all parameters and is the most effective treatment of all treatments.

Keywords: *Cyperus rotundus*, Bioherbicide, bamboo leaf extract.

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## 1. Introduction

Weed is a type of plant whose presence is undesirable on agricultural land because it can reduce productivity in cultivated plants, in addition to that weeds are also parasitic to plants in taking nutrients, water, space, CO<sub>2</sub>, and light (Lestari et al, 2012). Weeds on agricultural land cause competition in nutrients and water, so that the main crops cannot grow optimally and reduce agricultural production. The size (degree) of weed competition against the main crop will affect both the good and bad growth of staple crops and in turn will affect the high and low yields of staple crops (Harsono, 1993).

*Cyperus rotundus* is one of the weeds whose existence is detrimental to other plants, *C. rotundus* is included that is often found in various agricultural land. *C. rotundus* reduces production from various crops, such as corn 41%, onions 89%, okra 62%, carrots 50%, green beans 41%, cucumbers 48%, cabbage 35%, tomatoes 38%, rice 38% and cotton 34% (Kristanto, 2006).

Control that is often done by farmers using synthetic herbicides farmers do not pay attention to the impact of the use of synthetic herbicides continuously that can pollute the environment. An alternative that needs to be done is to look for control techniques to control weeds, from using chemicals to switching to environmentally friendly pesticides called bioherbicides. Bioherbicides are weed control that exploits the

potential of phenol compounds from plants that are able to inhibit growth or kill weeds that are able to provide phytotoxicity (poisoning) to weeds. .

One that can be used as an ingredient of making bioherbicides is bamboo leaf extract (*Dendrocalamus sasper*). Bamboo (*D. sasper*) is a type of plant that is often found in various regions and almost all regions of Indonesia have bamboo plants. According to the results of research Yanda et al (2013) bamboo leaves (*D. sasper*) contain phenolic compounds flavonoids, coumarin and phenolic. Bamboo plants are plants belonging to the genus *Dendrocalamus*, in the genus *Dendrocalamus* contain compounds of coumarin, flavonoids, anthraquinone, polysaccharides, phenolic and amino acids. According to the results of research Riskitavani and Purwani (2013) plants that contain phenolic compounds flavonoids, coumarin and phenolic can be indicated as bioherbicides or vegetable herbicides because compounds such as phenols, phenolic acids, coumarin, and flavonoids can provide phytotoxicity effects on weed puzzles (*C. Rotundas*).

## 2. Methods

This research was conducted from August 2016 to October 2016 at GreenHouse University of Jember

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### **2.1. Tools and materials.**

The tools used are stationery, paper labels, knives, scissors, measuring cup, seeding tub, blender, filter paper, 1000 ml Erlenmeyer, Buchner Funnel, Ruler, Analytical Scales, and Handsprayer. Materials that will be used in this study are Polybag (size 35 x 35), bamboo leaves (*Dendrocalamus asper*), Aquades, 70% Ethanol, and Teki Grass Bulbs.

### **2.2. Planting Media Preparation.**

The planting media used in this study were soil, sand, and compost with a participation of 1: 1: 1. The planting media to be used were divided into two parts, the first in the planting tub to plant puzzles and the second was soil for polybags.

### **2.3. Seeding.**

The soil is put into a tub of puzzles and tubers of puzzles that will be sown as many as 500 tubers of puzzles, then planted in a planting tub that has available soil and then watered every day during seeding glass. Seeding is done for 15 days, then transferred to a polybag in the form of a plot to be applied.

### **2.4. Making Bamboo Leaf Extract.**

Making the first bamboo leaf extract that must be done is taking bamboo leaves obtained from the Tenggara Bondowoso area. Bamboo leaves are taken at the shoots, middle and bottom of the tree. According to the leaves that have been taken then weighed as much as 3500 grams, then needed to use air and rinsed, then air-dried for 24 hours (reducing air content on bamboo leaves (H<sub>2</sub>O)). The dried leaves are then cut into small pieces using scissors, then bamboo leaves are weighed according to each of 150 grams, 300 grams, 450 grams, 600 grams, 750 grams, and 900 grams, then spent to use a blender. The results of the blender from each aid are then extracted using polar solvents, namely 70% ethanol as much as 1000 ml in 2000 ml Erlenmeyer until the powder is completely submerged. Soaking is done at room temperature for 24 hours. The results of the bamboo leaf extract were filtered with a Buchner funnel lined with filter paper. This bamboo leaf extract is used in space until when it is used for applications.

### **2.5. Removal.**

Puzzle grass, bulbs that have been sown for 15 days are then transferred to polybags. The transfer was carried out during the sick days and each polybag gave 10 plants of puzzles. After 2 days the turf is ready to be applied with a bamboo leaf extract solution.

### **2.6. Bamboo Leaf Extract Application.**

The application is carried out in the morning in accordance with the pesticide application technique, the application of bamboo leaf extract bioherbicides is done every 2 days until the 30th day after planting so that it takes 15 times the application on the turf. The application of bamboo leaf extract on puzzle grass is done using a hand sprayer of 3 spray parks so that each polybag gets 24 times the treatment of bamboo leaf extract.

### **2.7. Observation Parameters**

#### **a. Plant height**

The height observed in the turf began from day 2 after transfer from the nursery to polybags and was measured with a frequency of 2 days. Plant height measurements were measured from the base of the plant stem to the top of the puzzle leaves and measured using a ruler.

#### **b. Growth rate**

The growth rate parameter is carried out 3 times, namely within a period of 10 days in a 30-day research period. The growth rate is carried out to find out how many nutrients are absorbed by the *Cyperus rotundus* plant or it can be said that the dry weight of the puzzle grass plant. Phase parameters of the growth rate are carried out by removing plants in the study polybag as much as 2 plants/parameters, then cutting the roots of the puzzle grass plants. Parts of the puzzle grass that have been cut so that only the base of the plant leaves to the tops of the leaves, then dried using an oven with a temperature of 105o C (Sutaryo, 2009) for 24 hours and then weighed using analytical scales.

#### **c. Phytotoxicity**

This parameter is performed 2 HSA (days after application) which is the 3rd day with a frequency of 3 days and uses observation techniques with a true love score system, namely:

0 = no poisoning (with 0-5% poisoning, leaf shape and color are not normal).

1 = mild poisoning (with 6-10% poisoning rate, abnormal leaf shape, and color)

2 = moderate poisoning (with 11-20% poisoning rate, abnormal leaf shape, and color)

3 = severe poisoning (with 21-50% poisoning rate, abnormal leaf shape, and color)

4 = poisoning is very heavy (with a level of poisoning > 50%, the shape and color of the leaf is not normal, so the leaves dry and fall to death) (Rizkitavani and Purwani, 2013)

#### **d. Gross weight**

Puzzle grass that has been treated for 30 days with a frequency of 3 days treatment, after 30 days the puzzle grass (*Cyperus rotundus*) is removed from the poly bag and weighed wet using analytical scales.

#### **e. Root Length**

The puzzle grass that has been treated for 30 days with a frequency of 3 days treatment, after 30 days the puzzle grass (*Cyperus rotundus*) is removed from the polybag and measured the length of the root by using a ruler from the root base to the longest root.

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## **3. Result and Discussion**

Research on the Effect of Concentration of Bamboo Leaf Extract (*Dendrocalamus asper* L.) as Bioherbicides on Teki Grass (*Cyperus rotundus* L.) was conducted as an alternative in controlling weed puzzle grass. Variance Analysis Table (Table 1) of the observed variables of plant height, growth rate, wet weight, and root length.

**Table 1. Summary of F-Calculations Variable Analysis of Plant Height Variables**

Parameter	F-Hitung	F-Tabel 5%	F-Tabel 1%
Tinggi Tanaman (cm) (30hari)	8.94**		
Laju Pertumbuhan (g/10hari)	4.83**		
Berat Basah (gram)	3.96**	2.45	3.53
Panjang Akar (cm)	3.13*		

Note: \* = significantly different, \*\* = very real different, ns = not significantly different

The results of the analysis of variance (Table 1) show that the observed variables of plant height, growth rate, wet weight, and root length. The results of the analysis of variance on all observed variables above the time of emergence of shoots showed a real effect so that further tests were used using the Duncan 5% test.

**Table 2. Effect of bamboo leaf extract concentration on plant height variables.**

Perlakuan	HSA (Hari Setelah Aplikasi)
	30
A	45.35a
B	41.80ab
C	38.15bc
D	35.70cd
E	35.85cd
F	31.70d
G	34.30cd

Note: Numbers followed by different letters show significantly different results on the Duncan Test of 5%.

Based on Duncan's 5% test results (Table 2) it is known that the treatment of bamboo leaf extracts affects plant height. The last observation (day 30) of treatment A received the highest average of 45.35 cm, while the plants receiving treatment in treatment F gave the lowest average of 31.70 cm. Day 30 in Table 4.2 shows that treatment A was significantly different from treatment C, D, E, F and G and was not significantly different from treatment B. treatment F was significantly different from treatment A, B, and C.

These results are in accordance with Ariestiani's report (2000) that, herbicide treatment has been shown to show a very significant effect on weed height, which is to inhibit the process of growth in weeds so that growth occurs abnormally due to the presence of active compounds contained in the herbicide that is reversed in weeds. According to Khotib (2002) states that flavonoid compounds contained in bamboo leaves have a role in the process of growth inhibition, which acts as a strong inhibitor of IAA-oxidase. Astutik et. al. (2012) states that this inhibitory mechanism includes a series of complex processes through several metabolic activities which include growth regulation through disruption in growth regulators, nutrient uptake, photosynthesis, respiration, stomata opening, protein synthesis, carbon stockpiling, and pigment synthesis.

**Table 3. Effect of bamboo leaf extract concentration on the variable rate of growth of puzzles**

Laju Pertumbuhan Perlakuan	HSA (Hari Setelah Aplikasi)	
	10-20	20-30
A	0.12a	0.10a
B	0.10ab	0.06b
C	0.06c	0.04bc
D	0.07bc	0.07ab
E	0.06c	0.05bc
F	0.06c	0.03bc
G	0.05c	0.02c

Note: Numbers followed by different letters show significantly different results on the Duncan Test of 5%.

Duncan test results 5% last observation (30th day) treatment A is the highest average of 0.10 grams / 10 days, while treatment G gets the lowest value of 0.02 grams / 10 days. The average of the two treatments shows that weeds that get treated, absorb fewer nutrients.

The results of the research that have been carried out are getting significantly different results showing that the occurrence of photosynthesis that takes place in the turfgrass plants is disturbed or hampered due to the active substances contained in bamboo leaves (*Dendrocalamus sasper*) namely phenols, phenolic acids, coumarins, and flavonoids, in certain concentrations of phenol compounds used as bioherbicides can inhibit and reduce yields in major plant processes. These obstacles occur in the formation of nucleic acids, proteins, and ATP. The reduced amount of ATP can suppress almost all cell metabolic processes, so the synthesis of other substances needed by plants will also be reduced (Salisbury and Ross, 1995). Reducing the amount of ATP will thus create abnormal growth of the turf that affects the rate of growth of the turf.

**Table 4. Effect of bamboo leaf extract concentration on the wet weed grass variable**

Berat Basah (Gram)	Perlakuan						
	A	B	C	D	E	F	G
Hari ke-30**	4.33a	4.31a	4.17bc	4.18b	3.39d	3.58c	2.27e

Note: Numbers followed by different letters show significantly different results on the Duncan Test of 5%.

Duncan test results of 5% on the variable number of roots (Table 4) Treatment A gave the highest average of 4.33 grams, while plants that received treatment on treatment G gave the lowest average of 2.77 grams. Treatment A was significantly different from treatments C, D, E, F and G and was not significantly different from treatment B. Treatment C was significantly different from treatments A, B, E and G and was not significantly different from treatments D and F. Treatment G was significantly different with all treatments.

Bamboo leaf extract contains phenol compounds, causing abnormal growth in puzzles of weeds. Salisbury and Ross (1995) state that phenol acids can be toxic to plants so that they interfere with the growth of puzzle grass weeds. According to Devi et al (1997) states that phenol compounds inhibit plant growth through several ways, including inhibiting cell division and elongation, inhibiting the work of hormones, changing the working pattern of enzymes, inhibiting the process of respiration,

reducing the ability of photosynthesis, reducing the opening of stomata, inhibiting absorption water and nutrients and reduce membrane permeability. phenol is a chemical compound that is widely used as an insecticide, herbicide, and fungicide. These results are consistent with the opinion of Oudejans (1991) phenol is very high in toxicity, is non-selective and works effectively as an organic herbicide and is largely inhibited weed growth.

**Table 5. Effect of bamboo leaf extract concentration on the variable length of the puzzle grassroots**

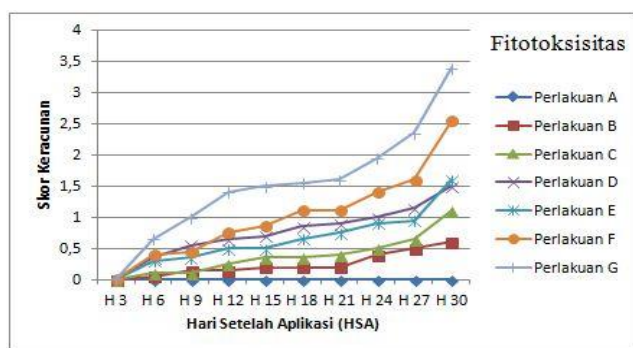
Panjang Akar (Cm)	Perlakuan						
	A	B	C	D	E	F	G
Hari ke-30*	20.45a	20.15ab	19.35bc	19.20bc	18.30c	18.00c	17.90

Note: Numbers followed by different letters show significantly different results on the Duncan Test of 5%.

Based on table 4.5 the data obtained from each treatment and in treatment A get the highest average compared to all treatments with a value of 20.45 cm, while in treatment G gets the lowest average of 17.90 cm.

The results of the treatment of bamboo leaf extracts applied to the puzzle grass get significantly different results because of the phenol compounds contained in the bamboo leaves. According to Devi et al (1997) states that phenol compounds inhibit plant growth, one of which is to reduce the ability of photosynthesis, the decreased process of photosynthesis in puzzle weeds will affect the growth of the puzzle weeds, including the roots of weeds. This is due to the inhibition of photosynthesis results which are translocated at the root (Haryanti, 2013) so that it affects the growth of roots in the weeds of puzzles.

Phytotoxicity (poisoning) is a parameter that is observed to determine the level of poisoning experienced by puzzle weeds and to see the effectiveness of bamboo leaf extracts used as plant-based herbicides by looking at the symptoms of poisoning arising from weed puzzles. Symptoms can be seen on the leaves of weed puzzles because the application stage is sprayed on the leaves that work systemically (entering through plant tissue).



Graph 1. Effect of bamboo leaf extract of various concentrations on phytotoxicity of puzzles

The administration of bamboo leaf extract (*Dendrocalamus sasper*) to the weed puzzle (*Cyperus rotundus*) affects the physical condition of the weed puzzle. Graph 3.1 shows the higher concentration of bamboo leaf extract shows the difference in the results of weed poisoning levels.

Bamboo leaf extract is effective in controlling weed puzzles, this can be seen in the graph above which shows that bamboo leaf extract is toxic in weed puzzles. Treatment F (concentration level 75%) and G (concentration level 90%) were the most effective treatments compared to other treatments, namely getting a high poisoning score compared to other treatments. Treatment G (concentration level 90%) is the best treatment that is able to give an average poisoning score of 3.4. Graph 3.1 shows that the 90% of treatment was the fastest phytotoxicity treatment.

Symptoms of poisoning that occur in puzzle grass plants that begin at the tip of the leaves of plants, yellow color and dries on the leaves of puzzles weeds are caused by the presence of active ingredients derived from bamboo leaf extracts that are sprayed on the leaves of puzzle weeds that enter through plant tissue. Bamboo leaf extract (*Dendrocalamus sasper*) containing flavonoids, coumarin, and phenolic can provide phytotoxicity to *Cyperus rotundus*. Bioherbicides derived from bamboo leaves are systemic, generally systemic bio-herbicides. According to Doflanmingo (2013) the disruption of physiological processes in *Cyperus rotundus* plants responds in several forms of symptoms, including the main symptoms (Main Symptoms) seen abnormal growth, can exceed normal size or smaller than normal size, then discoloration (symptoms phytotoxicity), both in the leaves, stems, roots, fruits, flowers, besides that there is also the death of tissue, plant parts become dry and are marked with the withering of the leaves of plants. Withered events are caused by the absorption of water that cannot keep up with the rate of evaporation of water from plants.

#### 4. Conclusion

Based on the research results obtained, bamboo leaf extract (*Dendrocalamus sasper* L) is effective in suppressing the growth of puzzle grass (*Cyperus rotundus* L) and the concentration of 90% bamboo leaf extract (*Dendrocalamus sasper* L) is the best in inhibiting the growth of weed puzzles (*Cyperus rotundus* L) and get the fastest level of phytotoxicity than other treatments.

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# Streaming Performance Analysis of Virtual Objects in Augmented Reality Cloud Based on X86 and ARM Processor Types

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## ABSTRACT

Augmented Reality is a technology that makes it possible to create 3D objects in the real world with the help of a camera on a gadget. In its development, Augmented Reality technology began to be developed and combined with cloud computing technology. With the existence of Cloud computing technology Augmented reality can work more efficiently because all 3D objects can be stored on the Cloud. With the development of this technology, the author feels the need to conduct an analysis to determine the right processor in making the Augmented Reality Cloud application, because there is no research that is used as a reference in developing hardware and software used for Augmented Reality Cloud. Result of this experiment can be concluded CISC architecture processors have faster time in detecting markers compared to RISC architecture processors, because CISC processor speeds are faster than RISC processors.

**Keywords:** Augmented reality, Cloud, CISC, Processor, RISC.

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## 1. Main text

Today the development of the computer world has made a lot of progress. The application of computers at this time almost becomes a necessity in every activity carried out by humans, almost in every activity we will not be separated from the computer. Image processing is one example of the development of the computational world which is now starting to be applied one of its applications, namely Augmented Reality technology. [1] Augmented Reality is an experience that brings out a form in the real world that is enhanced by computer-generated content that is intertwined with specific locations or activities, many uses of Augmented Reality ranging from being applied to education, health, and others. Along with the development of Augmented Reality technology and the many applications that utilize Augmented Reality technology, it shows great enthusiasm among users. From time to time the development of Augmented Reality has had many developments so that Augmented Reality began to be combined with many other technologies, one of which is Augmented Reality combined with Cloud technology.

With this Cloud technology makes it easy to store objects that will be displayed on Augmented Reality, making it easier for users to experience this Augmented Reality technology even with very small memory capacity gadgets. With the combination of Augmented Reality Cloud, it raises new problems, which are difficult for developers to develop applications based on X86 processors or ARM-based processors because

there is no reference for what processor is good to use in implementing Augmented Reality Cloud. In this paper I will discuss the processor whether it is optimal to be used for devices that use Augmented Reality Cloud technology

## 2. STATE OF THE ART

[1] Augmented reality is an experience in which a form emerges in the real world that is enhanced by computer generated content that is intertwined with specific locations or activities. [4] Augmented Reality is a technology that combines the virtual world with the real world so that it can bring an image of virtual objects to the real world with an Augmented Reality Environment. While the Augmented Reality Environment can be a computer, smartphone, or all computer-based equipment.

The framework for the Augmented Reality process can be described as follows.

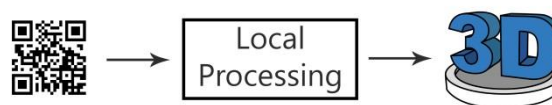


Figure 1. System Scheme

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In figure 1, the process of Augmented Reality is explained so that detection of markers is needed to be able to bring up Augmented Reality objects.

### 2.1. Cloud

Cloud computing is internet-based computing which means storing and accessing data, programs, and other computing devices via the internet.

Characteristics [5] cloud computing Users access data, applications, or other services with the help of a browser. The infrastructure provided by third parties is accessed using the internet. It doesn't have to require high level IT skills. Reliable services can be obtained by using several sites. Maintenance is easier because it doesn't need to be installed on each user's computer. Payments based on facilities used Performance can be monitored. Security can be as good or better than traditional systems.

Mobile Cloud is a cloud implementation that is implemented on mobile devices [6] mobile cloud also allows users to use all cloud resources on mobile devices.

### 2.2. Processor X86 and ARM

Broadly speaking, many processors on the market are types of X86 and ARM for X86-based processors using CISC (Complex Instruction Set Computing) instructions, while ARM-based processors use RISC (Reduce Instruction Set Computing) instructions. [7] CISC has characteristics. Has a very large and complex set of instructions.

- 1) Instructions generally take more than 1 clock cycle for execution.
- 2) The instructions have different sizes.
- 3) Complex addressing methods.
- 4) Works very well in simple compilers.

While RISC has the following characteristics:

- 1) Simple old instructions
- 2) The instruction is executed at 1 clock cycle
- 3) Format fixed instructions / fix
- 4) Experience instruction uses a fixed mechanism (load and store).
- 5) Need complexity before entering into the compiler.

### 2.3. Augmented Reality Cloud

Augmented Reality Cloud has the same process in the process of reading markers to bring up 3D objects but in Augmented Reality Cloud 3D objects are stored on the Cloud so that it can streamline memory on local devices. [2] The process of Augmented reality Cloud starts with capturing the marker using the camera on the device, then the data that has been processed on the local process is sent to the cloud. In the processed cloud data the local process is matched to the database, the corresponding results will be sent back to the device and bring up 3d objects. Below is a working chart for Augmented Reality Cloud.

## 3. SYSTEM SCHEME

The research design this time I tried to design an Augmented Reality Cloud application made from Unity software. This application was made into two versions, the version that runs on x86 and ARM processors. Once created, these two versions will be measured by how fast these two applications are in displaying 3d objects stored in the cloud. Following is the form of system design that will be made.

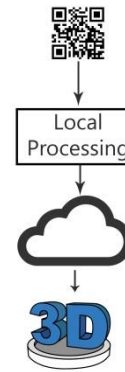


Figure 2. Augmented Reality Process.

In this study researchers used X86-based CPUs with Pentium III specifications with 700 MHz clock speed with 512 MB RAM then for ARM-based CPUs researchers used the Raspberry Pi with the same clock speed of 700 MHz and 512 RAM with Android Kitkat 4.4 operating system. In running Augmented Reality Cloud applications using Unity software. In measuring the 3d object streaming that will be displayed on both devices, measurements are made based on the time needed to bring up 1 whole object. This Augmented Reality object will consist of the first 3 types of objects that are static 3d objects, dynamic 3d objects or motion animations, and the last are multimedia objects.

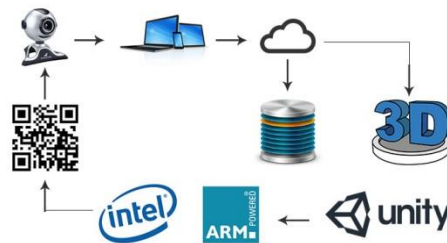


Figure 3. System Experiment Design

The following will be shown the assessment table for streaming object measurements.

Value	Time
Fast	< 5 second
Normal	= 5 second
Slow	> 5 second

In table below we will display experiment result that conduct with 2 computer architecture, one using x86 processor and second using arm processor. Experiment result displayed below. it can be concluded that

x86 processors have very fast detection speed when detecting markers compared to arm processors because there is a difference between the two architectures where x86 is a CISC architecture processor even though the CISC architecture program has properties requiring several cycles to run a program line but the CISC architecture has a very fast processing speed so that even though it is done in several cycles there is no significant delay. On ARM processors that have RISC architecture seen in the graph, it takes a long time to detect a marker because RISC architecture requires 1 cycle to run a program line, but the constraints of RISC architecture processors when the research took place have no processor that has a clock speed which quickly affects the results of the experiment.

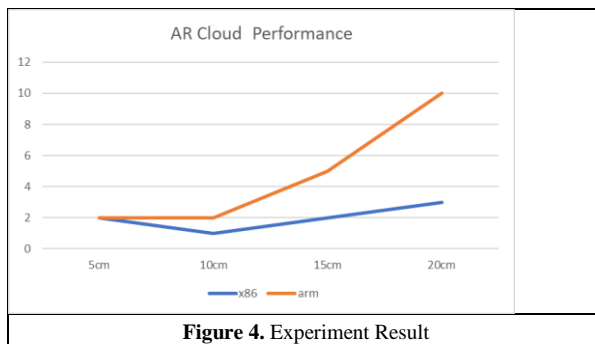


Figure 4. Experiment Result

But according to researchers if the RISC processor has a higher speed and the number of cores in the processor added does not rule out the possibility that RISC will be faster in detecting markers than CISC architecture processors.

#### 4. Conclusion

The conclusions in this study can be described as follows:

- CISC architecture processors have fast marker detection speeds compared to RISC architecture processors for AR Cloud technology.

- Judging from the characteristics of the RISC processor, it can be concluded that RISC processors can be faster in detecting markers on AR Cloud technology with the condition that the number of cores and clock speed is fast so that program line execution can be done quickly thereby reducing process delay.

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# An angle velocity of blade and lift force relationship of the single rotor system

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## ABSTRACT

Problems in utilizing Quadcopter, either as a hobby or as special needs are still many obstacles or weaknesses such as; plane easy to fall; plane easy hit; the battery is not durable; vulnerable to weather conditions and others. In this regard, Quadcopter's research and development has grown to include weaknesses of existing Quadcopter planes and to improve aircraft facilities and capabilities. In developing the knowledge and information about the Quadcopter aircraft, the data or parameters related to aircraft lift capability factors; fly long; flying high; type of motor used; the type of propeller used; including the sensors and control systems used. Thus, this study was to find the relationship between changes in the BLDC motor voltage source to the rotor angle velocity ( $\omega$ ); Change of rotor speed to wind velocity through rotor ( $v$ ); change of rotor speed to rotor lift ( $F_t$ ); change of wind speed to rotor lift; push the following rotor ( $C_t$ ). In this study, empirical testing was conducted in the laboratory to determine the relationship among others: changes in the BLDC motor voltage source to the rotor angle velocity ( $\omega$ ); Change of rotor speed to wind velocity through rotor ( $v$ ); change of rotor speed to rotor lift ( $F_t$ ); change of wind speed to rotor lift; push the following rotor ( $C_t$ ). Test and measurement results data show that; the relationship between lift power generated with rotational speed is not proportional Nonlinearity occurs when the rotor is released from the self and starts pulling the strain gauge when the rotation speed reaches around 65 rps. Once the rotation speed of the rotor is able to reach up to 1.5 Newton lift then the thrust rising trend increasing sharply to the increasing the speed of rotation of the rotor. A special rotor that has BLDC motor specifications such as; 1200 KV, 5 Volt and 30 Ampere; blade with a radius of  $r$  0.12 m; at a temperature of about 27 oC; in the condition there are no other wind currents then obtained thrust ( $C_t$ ) of 1.732.

**Keywords:** Rotation Speed, Quadcopter, Thrust Coefficient.

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## 1. Introduction

Today, Quadcopter aircraft has become a trend of the world's people, whether used as a special purpose or as a hobby. The special use of Quadcopter aircraft such as military interests, the interests of mapping surveys and other purposes such as natural disaster relief (Al Al, 2017). The use of Quadcopter as a hobby has spawned a community of Quadcopter maniac societies, almost covering any country in the world as a Quadcopter. Quadcopter existence will become more important to take a bigger role in various purposes including business. They will be an integral part of everyday human life activities, such as from small things to greater interests such as defense and security (Parhar 2016).

In the use of Quadcopter, both as a hobby or as a special need are still many obstacles or weaknesses such as; plane easy to fall; the plane is easy to hit; the battery is not durable; vulnerable to weather conditions and others. In relation to that, Quadcopter's research and development is becoming more and more developed to cover the weaknesses of the

existing Quadcopter aircraft as well as to improve aircraft facilities and capabilities (Magnussen, 2015). The Vertical Take off Landing (VTOL) Aircraft is a type of aircraft that can do take off and landing perpendicular to the earth so it can be done in a narrow place. The UAV of this type is suitable for the survey location function in a narrow area such as urban residential areas or many shrubs areas (Al Al, 2016).

Pounds 2006 has been researching about Pilot, quad-rotor robot chassis and avionics using custom-built motor and battery off-the-shelf, into a highly reliable experimental platform. This vehicle uses the plant dynamics are tuned with mounted on board attitude control to stabilize flight. SISO linear controller is designed to regulate the conduct flyer. The UAV has more dynamic stability than helicopters. Therefore, this aircraft does not require a special pilot to mengopersikannya. They are mostly used in different interests such as logistic purposes, agriculture, fire sensing, military exercises etc. Propeller and BLDC motors are integrated UAV rotor drive devices that generate a drive for takeoff. The process of rotor lift analysis is very complex and complicated. Analysis results this style is important, in choosing a motor for use on the UAV systems (Patel at. al 2017). Tao in 2016, examines the air traffic management system is

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unmanned. The purpose of this research is to: define the system; current system practices; how pilots use the system, and who has the authority; determine the physical architecture of what is needed in a system that handles a wide variety of aircraft. In developing the knowledge and information about the Quadcopter aircraft, the data or parameters related to the lifting ability factor of the aircraft; long flight; high fly; type of motor used; the type of propeller used; including the sensors and control systems used. Accordingly, this study proposes to find a relationship between changes in BLDC motor voltage source to rotor angle velocity ( $\omega$ ); changes in rotor angle velocity to wind speed through the rotor ( $v$ ); the change in the angular velocity of the rotor to the rotor lifts ( $F_t$ ); changes in wind speed to rotor lift; rotor thrust coefficient ( $C_t$ ).

## 2. Literature Review

The ability of aircraft to fly in the air is in principle based on; Newton's law; Archimedes; Pascal; Bernoulli, and the law of continuity. Newton's law describes the relationship between forces acting on an object and its motion. The law of Archimedes explains the upward pressure on an object when immersed in a liquid. Pascal's law states that the pressure given to the liquid is passed in all directions.

Bernoulli Law explains that the increase in fluid velocity causes a decrease in pressure on the flow. The Law of Continuity suggests the fact that the mass of the fluid moves will not change when the negative (Hydrodynamics 2006).

Newton's Law I states: every object will remain in perpendicular motion or remain in a static state if there is a resultant, force ( $F$ ) works on that object:

$$\sum f = 0, a = 0, V = 0 \quad (\text{constant})$$

Newton's law II, states that the force is equal to the difference in momentum (mass multiplied by the speed) of each time change.

$$F = m \cdot a$$

Newton's Law III states: that every action must have a reaction in the same direction and opposite direction ( $F_1 = F_1'$ ). The law of Archimedes says that: If an object is immersed in a liquid thing, it will be pressured upward as large as the weight of a liquid dampened by it.

$$FA = \rho \cdot g \cdot v$$

Where:

FA = Archimedes pressure ( $N/m^3$ )

$\rho$  = Mass Type of liquid ( $Kg/m^3$ )

g = Gravitation ( $N/Kg$ )

V = Volume of Dyed Objects ( $m^3$ )

Pascal's law states that "the pressure given by liquids in a confined space is passed in all directions equally." The difference in pressure due to differences in the increase in the liquid is formulated as follows:

$$\Delta P = \rho \cdot g \cdot (\Delta H)$$

Where :

$\Delta P$ : hydrostatic pressure (Pa)

P: fluid speed ( $kg/m^3$ )

G: sea level rise against earth gravitation ( $m/s^2$ )

$\Delta H$ : altitude difference of fluid (m)

According to Bernoulli, an increase in the fluid velocity will cause a decrease in pressure on the flow. This principle is actually a simplification of the Bernoulli Equation, which states that the amount of energy at a

point in a closed stream is equal to the amount of energy at another point on the same flow path. There are generally two forms of the Bernoulli equation; the first applies to incompressible flow, and the other is for compressible flow fluids.

Incompressible flow is a fluid flow characterized by an unchanged mass density (density) of the fluid along the stream. The form of the Bernoulli Equation for non-compressed streams is as follows:

$$p + \rho gh + \frac{1}{2} \rho v^2 = \text{constant} \quad (1)$$

where:

v = fluid speed

g = earth gravitation

h = altitude relative to a reference

p = fluid pressure

$\rho$  = fluid density

The above equation applies to non-compressed streams with the following assumptions: that the flow is steady state and there is no inviscid friction. In another form, the Bernoulli Equation can be written as follows:

$$p_1 + \rho g h_1 + \frac{1}{2} \rho v_1^2 = p_2 + \rho g h_2 + \frac{1}{2} \rho v_2^2 \quad (2)$$

The compressible flow fluid is a fluid flow characterized by changing the mass density of the fluid along the stream. The Bernoulli equation for compressed streams is as follows:

$$\frac{p}{\rho} + \phi + \omega = \text{constant} \quad (3)$$

where:

$\phi$  = gravitational potential energy per unit mass; if gravity is constant then  $\phi = gh$

$\omega$  = enthalpy of fluid per mass unit

$$\omega = \epsilon + \frac{p}{\rho} \quad (4)$$

where:  $\epsilon$  is the thermodynamic energy per unit mass, also referred to as the specific internal energy.

The moving fluid mass does not change as it flows. This fact leads us to an important quantitative relation called the continuity equation. To clarify the details of this centre pay attention to Figure 1

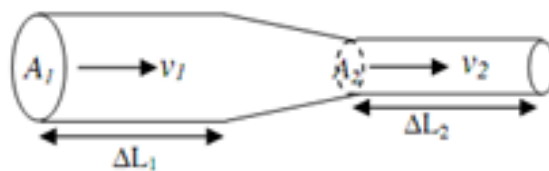


Figure 1. Mass Flow Rate

The volume of fluid flowing in the first part,  $V_1$ , which passes through the area of  $A_1$  at rate  $v_1$  over the time range  $\Delta t$  is  $A_1 v_1 \Delta t$ . By knowing the relationship of Volume and Mass type, the mass flow rate through the area  $A_1$  is

$$\frac{\Delta m}{\Delta t} = \frac{\rho_1 A_1 v_1 \Delta t}{\Delta t} = \rho_1 A_1 v_1$$

The same situation occurs in the second part. The mass flow rate passing through A2 for the time span  $\Delta t$  is:

$$\rho_2 A_2 v_2$$

The volume of fluid flowing over the time span  $\Delta t$  in the area A1 will have an amount equal to the volume flowing in A2. Therefore:

$$\rho_1 A_1 v_1 = \rho_2 A_2 v_2$$

or  $\rho \cdot A \cdot V$  is constant.

Guido et al. 2016, investigates UAV Uses for capturing reliable GPS technology as a benchmark. Video processing algorithm for vehicle track acquisition based on OpenCV libraries. Assessment of the accuracy of video processing algorithms of an instrumentation vehicle is equipped with high precision GPS. The video capture experiment was conducted in two case studies. The results of this experiment highlight the flexibility of UAV technology combined with video processing techniques in monitoring real-time traffic data. The Interests area is defined in which all points of the target vehicle trajectory collected through the GPS receiver are mapped.

Comparing this path monitored by the UAV with GPS traces used as a benchmark, the analysis shows that: Root Mean Square Equations Percentage in velocity evaluations equals 3.96% and 3.57%, for case studies 1 and 2 respectively. While on the other hand, more deeply analyzes various error ranges such as: camera position; angle of incident; the position of the object or the fetch frame. The results are used for the measurement and eligibility of the obvjek position (Babinec 2016). Research on lifts and drag force of a UAV by using Computational Fluid Dynamics (CFD) technique is proposed (by Karna S. Patel et al. 2014 ), because wind tunnel experiments are very difficult and additional cost more. This technique shows a close proximity to the real experiment. In the principle, when the aircraft is on the air, there are four main forces acting on the plane, the thrust T, drag D, lift and weight of the plane (weight W). The four aerodynamic forces in flight are discussed by George Cayley, 2008.

Meanwhile, the quadcopter movements such as back and forth; Left and right; up and down, influenced by variations in direction, speed and acceleration of four rotors. for a quadcopter that has fixed blade parameters that can change is the speed and acceleration of the propeller angle [kranik 2011]. The propeller serves to transfer power by converting rotational motion into thrust to propel a vehicle like an aeroplane, through a mass of air, by rotating two or more twin blades from the main axle. A propeller acts as a rotating wing and produces a force that applies Bernoulli principles and Newton's laws of motion, resulting in a difference in pressure between the front and back or top-down or left-right surfaces. The size of the blade used in quadcopter varies depending on the size of the quadcopter and the load to be lifted by the quadcopter. Therefore to take into account how much the lifting power and the speed of a quadcopter it is important to know a relation between size, rotational speed with the lift of a propeller. The relationship between lift power size and speed such as equation 6 and 7 [Brandt, 2011].

$$T = (C_t \cdot \pi \cdot \rho \cdot r^2 \cdot v^2) / 2 \quad (6)$$

On the line, Coefficient thrust (Ct) can be expressed as equation 7

$$C_t = 2 \cdot T / (\pi \cdot \rho \cdot r^2 \cdot v^2) \quad (7)$$

Where:  $C_t$  is thrust coefficient;  $T$  is rotor thrust;  $\pi$  is 3.14;  $\rho$  is density of air = 1.225;  $r$  is radius of blade;  $v$  is air speed.

### 3. Methodos

In this study, empirical testing was done in the laboratory to find out the relationship amongst other things: changes in BLDC motor voltage source to rotor angle velocity ( $\omega$ ); changes in rotor angle velocity to wind speed through the rotor ( $v$ ); the change in the angular velocity of the rotor to the rotor lifts (Ft); changes in wind speed to rotor lift; rotor thrust coefficient (Ct). To obtain the results of these measurements than required materials and equipment as follows:

- 1200 Kv BLDC Motor
- 30 Amper Electronic speed controller (ESC)
- Voltage sensor
- 500 K Ohm Potentiometer
- Arduino Uno Microcontroller
- Mekanik stand up
- LCD display
- Blade propeller with radius (r) is 0.12 meter
- Digital Anemometer
- Digital Tachometer
- Digital Strain Gauge

Implementation of this rotor parameter measurement is done in accordance with the block diagram as in Figure 2.

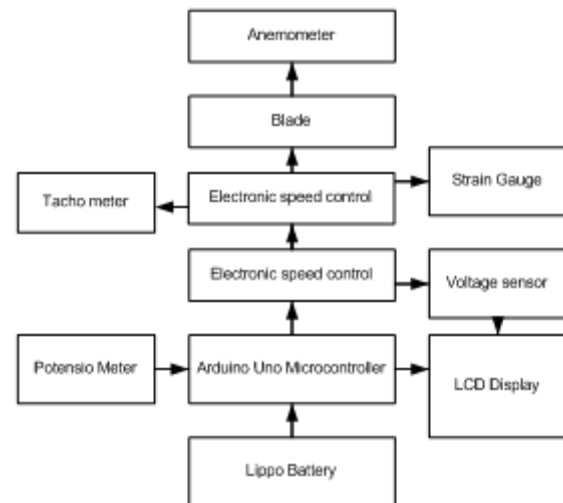


Figure 2. Block diagram of measurement system

The material and measurement equipment are shown as in Figure 3.



Figure 3. The material and measurement equipmen

#### 4. Result and Discussion

For the first time, rotor parameters were measured only by self-loading weighing 165 grams. Overall the results are shown in Table 1.

Table 1. Self Load

No.	Voltage source (Volt)	Rotor Speed (rpm)	Device condition	Airspeed km/h	Airspeed m/s
1	1	0	stag	0	0
2	1.5	0	stag	0	0
3	2	0	stag	0	0
4	2.26	964	stag	6.8	1.888889
5	2.5	2008	stag	13.7	3.805556
6	2.7	2633	stag	17.9	4.972222
7	2.85	2935	stag	19.3	5.361111
8	2.86	2972	cut in half	20.3	5.638889
9	2.96	3209	cut in half	21.4	5.944444
10	3	3339	cut in half	22.3	6.194444
11	3.1	3539	go up	23.5	6.527778
12	3.15	3627	go up	24.2	6.722222
13	3.25	3823	go up	25.1	6.972222
14	3.35	3957	go up	26	7.222222
15	3.5	4230	go up	28.3	7.861111
16	3.8	4643	go up	29.8	8.277778
17	4	4896	go up	32.3	8.972222
18	4.5	4967	go up	34.2	9.5
19	5	5285	go up	36.9	10.25

By observing Table 1 it can be seen that: providing a source ranging from 1 to 2 volts can not move propellers; by providing a source voltage between 2.26 to 2.85 volts the propeller has been able to spin but has not had the power to self-immersed; after being given between 2.86 to 3-volt rotor conditions are now floating or starting to lift. At the moment the source voltage is given as much as 3.1-volt and the rotor has been lifted and higher. The start of the rotor lift is marked by the rotor rotation speed of 3539 rpm. While the highest angular spin speed reaches 5285 rpm when given 5 volts source voltage.

Next, the rotor parameters were tested with self-loads added with a load of 50 grams, bringing the total load to 215 grams and its content shown as in Table 2.

Table 2. Measurement With 215-Gram Load

N0	Voltage Source	Speed (rpm)	Device Condition
1	1 Volt	0	stag
2	1,50 Volt	0	stag
3	2 Volt	0	stag
4	2,26 Volt	964	stag
5	2,50 Volt	2008	stag
6	2,70 Volt	2633	stag
7	2,85 Volt	2935	stag
8	2,86 Volt	2972	stag
9	2,96 Volt	3209	stag

0	0	0	stagnan
1	1 Volt	0	stagnan
2	1,50 Volt	0	stagnan
3	2 Volt	0	stagnan
4	2,26 Volt	964	stagnan
5	2,50 Volt	2008	stagnan
6	2,70 Volt	2633	stagnan
7	2,85 Volt	2935	stagnan
8	2,86 Volt	2972	stagnan
9	2,96 Volt	3209	stagnan
10	3 Volt	3339	stagnan
11	3,10 Volt	3539	stagnan
12	3,14 Volt	3612	stagnan
13	3,15 Volt	3562	cutinhalf
14	3,25 Volt	3733	go-up
15	3,35 Volt	3888	go-up
16	3,50 Volt	4034	go-up
17	3,80 Volt	4577	go-up
18	4 Volt	4708	go-up
19	4,50 Volt	4856	go-up
20	5 Volt	5185	go-up

With a load of 215 grams, it can be seen in table 2 that; between 1 to 3.14 volts source voltage, the rotor cannot be lifted. When given a 3.15-volt source voltage then the aircraft starts to float. Starting from the 3.25-volt source voltage and rushing up the rotor is already up and moving higher.

Furthermore, by providing a total weight of 315 grams, the result of the parameter measurement is shown as in Table 3. Table 3 shows that the rotor floats when the source voltage is given at 3.78 volts. Whereas, after the source voltage is given by 3.8 volts continues up to 5 volts, the rotor is raised and the higher.

Table 3. Measurement With 315-Gram Load

N0	Voltage source	Rotor Speed (rpm)	Device condition
1	1 Volt	0	stag
2	1,50 Volt	0	stag
3	2 Volt	0	stag
4	2,26 Volt	964	stag
5	2,50 Volt	2008	stag
6	2,70 Volt	2633	stag
7	2,85 Volt	2935	stag
8	2,86 Volt	2972	stag
9	2,96 Volt	3209	stag

10	3 Volt	3339	stag	18	3,77 Volt	4317	200
11	3,10 Volt	3539	stag	19	3,78 Volt	4355	200
12	3,14 Volt	3612	stag	20	3,80 Volt	4419	200
13	3,15 Volt	3562	stag	21	3,81 Volt	4578	floating
14	3,25 Volt	3716	stag	22	3,82 Volt	4492	Go-up
15	3,34Volt	3788	stag	23	4 Volt	4523	200
16	3,35 Volt	3823	stag	24	4,50 Volt	4611	200
17	3,50 Volt	3977	stag	25	5 Volt	4944	200
18	3,77 Volt	4317	stag				
19	<b>3,78 Volt</b>	<b>4355</b>	<b>floating</b>				
20	3,80 Volt	4419	go-up				
21	4 Volt	4581	go-up				
22	4,50 Volt	4622	go-up				
23	5 Volt	5079	go-up				

Hereinafter, the measurement of rotor parameters with a total load of 365 grams, the results are shown in Table 4. The data in Table 4 shows that the source voltage between 1 to 3.8 volts has not been able to hold the rotor along with the load. The rotor begins to float at a given source voltage of 3.81 volts with a rotor rotation speed of 4355 rpm. By providing a voltage source of 3.8 2volts to produce a rotor rotation speed of 4492-rpm rotor start moving upward, and so on the addition of source voltage up to 5 volts increase the speed of the rotor is marked with a peak rotation speed of 5079 rpm..

**Table 4. Measurement With 365-Gram Load**

N0	Voltage source	Rotor Speed (rpm)	Device condition
1	1 Volt	0	200
2	1,50 Volt	0	200
3	2 Volt	0	200
4	2,26 Volt	964	200
5	2,50 Volt	2008	200
6	2,70 Volt	2633	200
7	2,85 Volt	2935	200
8	2,86 Volt	2972	200
9	2,96 Volt	3209	200
10	3 Volt	3339	200
11	3,10 Volt	3539	200
12	3,14 Volt	3612	200
13	3,15 Volt	3562	200
14	3,25 Volt	3716	200
15	3,34Volt	3788	200
16	3,35 Volt	3823	200
17	3,50 Volt	3977	200

By examining the results of the test table 1 already with table 4, it is directly indicated that the increase in source voltage raises the increase to the speed of rotation of the rotor. The speed of rotation of the rotor makes the air velocity through it is proportional. The air velocity through the rotor is what will generate the rotor lift, according to the concept proposed by; Newton's law; Archimedes; Pascal; Bernoulli, and the law of continuity.

To know directly the relationship between; rotation speed of the rotor with a voltage source; speed of rotation of the rotor with wind speed and the rotation speed of the rotor to the resulting thrust, then continued simultaneous testing as a further explanation.

The rotor angular velocity and voltage source relationship test, the wind speed and the lift produced by the rotor are performed with stand up as Figure 4.



**Figure 4 Rotor Under Testing**

The preparations and test instruments in FIG. 1 comprises blades with a radius of 0.0645 m; BLDC Motor 1200Kv; Electronic speed controller (ESC); Arduino microcontroller UNO; Lithium 30 A 5 V Battery; LCD display as an indicator of the voltage source; Anemometer; Digital Tachometer and Digital strain gauge. While the test results between the rotor angular velocities to the voltage source obtained the results such as graphs in Figure 5.

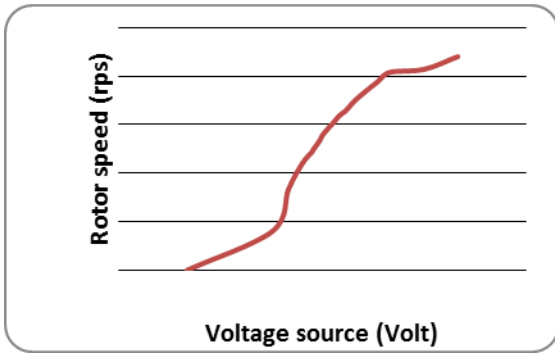


Figure 5. Rotor Speed vs Voltage Source

The graphic of Figure 5 shows that the increase in voltage source raises the rotor speed but this increase is not linear as long as the increase in voltage source. Between 2.8 volts up to 4 volts, the rotor speed has a linear almost increase. The results of the air velocity testing of the rotor speed are shown in the graph of figure 6. This graph illustrates that the increase in rotor speed produces air velocity proportional to the linear trend during the change.

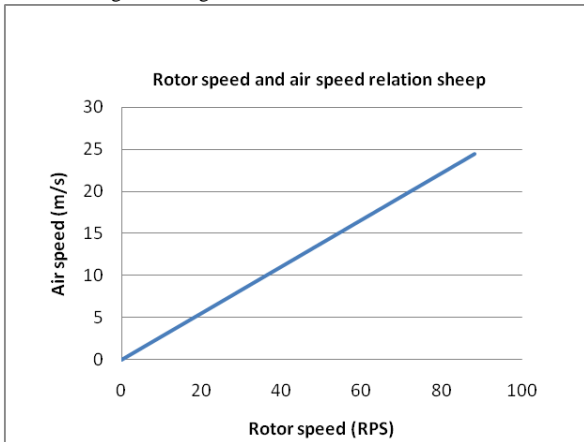


Figure 6. Rotor and Air Speed Relationship

Measurement of the rotor lift to the change in rotation speed of the rotor angle is done by measuring instrument of the digital strain gauge and digital tachometer. The result is shown in the graph in figure 7. Figure 4 states that the increase in rotor speed causes an increase in the rotor thrust. the relationship of both parameters increase is not linear at all. On the graph shows that between zero to 60 rps starts with a linear trend, between 65 up to 75 rps trend occurs bend and after that greater than 75 rps obtained linear trend back. In a non-linear condition between 65 and 75 rps, a change of thrust state is used only to elevate itself until it begins to draw the strain gauge as a measure of the rotor's lift power.

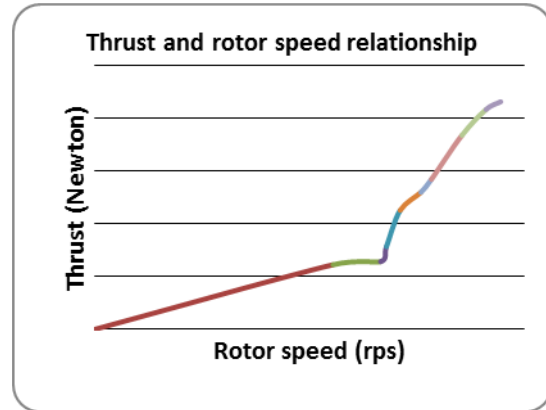


Figure 7. A Thrust and Rotor Speed Relationship

By using 1200 Kv / 5 Volt BLDC motor and blade which is has a radius  $r$  0.12 m, and then according to equation  $C_t = \frac{2T}{\pi \rho r^2 v^2}$  is obtained by the thrust coefficient ( $C_t$ ) according to the wind speed as shown in the Table 5. Where:  $C_t$  is thrust coefficient;  $T$  is rotor thrust;  $\pi$  is 3.14;  $\rho$  is the density of air = 1.225;  $r$  is the radius of the blade;  $v$  is airspeed.

After measuring more than 20 times, the average measurement value as shown in Table 3. Table 3 gives information that the conversion of wind speed generated by the rotor produces a comparable thrust.

Convertible results are influenced by many factors such as; the size and shape of the blade; earth gravitation; density of air; and constant changes. With blade conditions as described earlier and at an ambient temperature of 27o Celsius the coefficient of this rotor ( $C_t$ ) of 1.723 is obtained.

Table 5. Average of  $C_t$  From Thrust and Air Speed  $v$

Total thrust (Newto n)	Airspeed (m/s)	$\pi$	$\rho$	radius r (m)	Coefficient Thrust ( $C_t$ )
0	0	0	0	0	0
1.225	5.5	3.14	1.225	0.12	1.462219
1.225	5.9	3.14	1.225	0.12	1.270673
1.2838	6	3.14	1.225	0.12	1.287646
1.568	6.2	3.14	1.225	0.12	1.47287
2.254	6.5	3.14	1.225	0.12	1.926322
2.597	7	3.14	1.225	0.12	1.913717
2.842	7.5	3.14	1.225	0.12	1.82433
3.675	8	3.14	1.225	0.12	2.073381
4.165	8.5	3.14	1.225	0.12	2.081512
4.312	9	3.14	1.225	0.12	1.922186
				Total $C_t$	17.23486
				Average $C_t$	1.723486

## 5. Conclusion

After doing the measurement, testing and analysis of data then it can be concluded as follows. The increase in the rotation speed of the rotor is proportional to the increase of the source voltage applied to the motor bldc and the increase is not always linear as long as the voltage changes from 1 to 5 volts. The linear range occurs between 2.5 to 4 volts. The relationship between rotation speed and the resulting airspeed is proportional to the trend of linear.

The relationship between lift powers produced with rotational speed is not comparable. The nonlinearity occurs when the root is relieved of the weight of oneself and proceeds to start pulling the strain gauge when the rotation speed reaches around 65 rps. Once the rotation speed of the rotor is able to generate lift to reach 1.5 Newton then increase the endurance rotor has sharp increasingly.

Using a BLDC motor which is specifications as 1200 Kv, 5 Volt and 30 Ampere; blade with a radius of  $r = 0.12$  m; at a temperature of about  $27^\circ\text{C}$ ; in the condition is no other wind currents then obtained the thrust coefficient ( $C_t$ ) of 1.732.

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# Forecasting the Number of Admission of New Students of State Polytechnic Using Exponential Single Smoothing Methods

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## ABSTRACT

Forecasting is a prediction of uncertain events in the future. Forecasting the number of new students is one of the things that can be used for planning materials for the teaching and learning process, therefore it is necessary to predict the number of new students. This research was conducted at Malang State Polytechnic. The annual data analyzed was taken from 2011 to 2017. To predict the number of new students, the Single Exponential Smoothing method was used. This forecasting method focuses on decreasing the priority exponentially on the previous observation object. In exponential smoothing or exponential smoothing there are one or more smoothing parameters determined explicitly, and this result determines the weight imposed on the observation value. Based on the calculation results, the smallest error value is found at the value of  $\alpha = 0.9$  with MAD value 8.41, MAPE 7.21%, and RMSE 10.7.

**Keywords:** Forecasting, Students, Single Eksponential Smoothing

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## 1. Introduction

Forecasting is an activity that predicts or predicts what will happen in the future based on past data. Forecasting is an important thing in a company or organization in making a management decision. Whether or not the results of a study are largely determined by the accuracy of the predictions made.

Malang State Polytechnic is a vocational education in Malang City which has several departments with different levels of interest. One of the departments is Electrical Engineering, Mechanical Engineering, Information Technology, Civil Engineering, Chemical Engineering, Accounting, and Commerce Administration. The progress of a college is influenced by the size of the quality of graduation. Judging from the number of applicants for Malang State Polytechnic, they have large applicants from within or outside the region each year. This of course requires a prediction or forecasting system to predict the number of prospective new students with the aim of making decisions and prioritizing how many prospective students will be accepted.

To make a prediction system or forecasting the number of prospective new students required a good forecasting method and sufficiently precise calculations to predict the number of prospective students who register. In this study, the method to be taken is single exponential smoothing. This

method is done by repeating calculations continuously using the latest data.

## 2. Methodology

### 2.1. Forecasting

According to Heizer and Render (2009: 162), forecasting is art and science to predict future events. Forecasting is the most important part in making a decision in an organization or company. This is because forecasting can be the basis of short, medium, or long-term planning for the company. In addition, forecasting can also be used to find out when an event will occur, so that appropriate action can be taken. In making predictions strived for uncertainty can be minimized, by calculating prediction errors. Forecast errors can be measured by:

- Mean absolute deviation (MAD)

MAD is a value calculated by taking the number of absolute values of each forecasting error divided by the number of periods of data (n). The following equation 1 is the MAD calculation formula.

$$MAD = \frac{\sum |actual - forecasting|}{n} \quad (1)$$

- Mean absolute percent (MAPE)

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It is the average of the overall percentage of errors (differences) between actual data and forecasting data. Accuracy measures are matched with time series data, and are shown in percentages. The following equation 2 is the MAPE calculation formula.

$$MAPE = \frac{\sum(\text{absolute deviation}/\text{value}) * 100}{n} \quad (2)$$

- Mean squared error (MSE)

Each error or remainder is squared. Then added up and added to the number of observations. This approach regulates large forecasting errors because they are squared. The following equation 3 is the MSE calculation formula.

$$MSE = \frac{\sum(\text{forecast error})^2}{n} \quad (3)$$

- Root mean squared error (RMSE)

It is rooted in the value of the MSE that has been searched before. V The smaller the value generated the better the forecasting results will be done. The following equation 4 is the RMSE calculation formula.

$$RMSE = \sqrt{\frac{\sum(\text{forecast error})^2}{n}} \quad (4)$$

## 2.2. Single Exponential Smoothing

The Exponential Smoothing Forecasting Method is widely used to predict the demand for goods (demand) which is very fast. This method is not influenced by trend and season. The formula is as follows:

$$St+1 = \alpha Xt + (1 - \alpha) St \quad (5)$$

Where :

St + 1 : Prediction for period to t + 1

Xt : Real value of period to t

St : Forecast for period t

α : Weight which shows the smoothing constant

## 3. Result and Discussion

Many decisions can be made depending on the number of students including the ratio of the number of lecturers and students, the building for the teaching and learning process and other facilities on campus. Malang State Polytechnic is one of the campuses where the number of students increases every year. For this reason, a research system was created to help predict the number of students accepted each year. In collecting data, it is based on student data received in the last 7 years starting in the 2011 school year until the school year 2017. The data used are data from 9 D3 study programs and 8 D4 study programs. The following table 1 is the data used.

**Table 1. Student Data**

Level of Study	Study Program	2011	2012	2013	2014	2015	2016	2017
		11	12	13	14	15	16	17

D3	D-III T. Elektronika	96	92	99	10	12	13	12
		12	11	12	12	15	14	15
		3	9	2	6	4	7	4
	D-III T. Listrik	93	94	96	4	0	2	0
		14	14	13	18	16	18	18
	D-III T. Telekomunikasi	8	5	6	9	9	2	0
		19	21	22	25	25	22	23
	D-III T. M. Informatika	6	9	6	3	3	5	7
			12	12	13	18	17	16
	D-III T. Mesin	92	2	7	0	2	4	4
		10	12	13	16	16	15	15
	D-III T. Sipil	1	9	5	1	3	7	5
17		21	22	25	19	19	19	
D-III T. Kimia	0	7	1	4	7	5	3	
	16	19	20	22	20	21	20	
D-III Akuntansi	1	6	1	8	7	5	9	
	11	13	13	15	15	15	15	
D-III Administrasi Bisnis	80	33	63	50	52	49	50	
		10		10	10	13	13	
D3 Total	46	3	87	6	9	1	4	
				10	10	15	15	
D4	D-IV T. Elektronika	51	52	75	5	9	5	1
	D-IV Sistem Kelistrikan				10	13	13	13
D-IV Jaringan Telekomunikasi	59	81	78	5	7	1	6	
		12	16	20	29	25	25	
D-IV T. Informatika	98	7	4	2	4	6	5	
	D-IV T. Otomotif Elektronik	52	50	77	74	82	82	89
D-IV Manajemen Rekayasa Konstruksi	10	12	11	13	17	19	20	
	2	0	7	7	5	0	3	
D-IV Akuntansi Manajemen	11	12	17	21	27	25	24	
	7	6	0	9	4	0	7	
D-IV Manajemen Pemasaran		10	14	20	22	21	21	
	86	9	5	1	7	6	0	
D4 Total	61	76	91	11	14	14	14	
	1	8	3	97	07	11	25	
Grand Total	17	21	22	26	29	29	29	
	91	01	76	10	59	60	75	

In doing forecasting using the single exponential smoothing method, the amount of alpha (α) applied is 0.2, 0.5, and 0.9. In order to predict α which results in the smallest forecast error. The following is a calculation example for alpha constants (α = 0.2).

D-III T. Elektronika

Year 2011 : not yet determined

In 2012 : the number of prospective new students in 2011 was determined for 96 D3 Electronics study programs

Year 2013 :

$$F_{t+1} = a \cdot X_t + (1 - a) \cdot S_t$$

$$F_{t+1} = 0,2 \cdot 92 + (1 - 0,2) \cdot 96$$

$$F_{t+1} = 95.2 \approx 95$$

Year 2014:  
 $F_{t+1} = a \cdot X_t + (1 - a) \cdot S_t$   
 $F_{t+1} = 0,2 \cdot 99 + (1 - 0,2) \cdot 95$   
 $F_{t+1} = 96$

**Table 2. Forecasting alpha = 0.2, 0.5, and 0.9**

Study Program	Year	Actual Data	Forecast SES	Forecast SES	Forecast SES
			Alpha=0.2	Alpha=0.5	Alpha=0.9
D3 Elektronika	2011	96	N/A	N/A	N/A
	2012	92	96	96	96
	2013	99	95	94	92
	2014	105	96	97	98
	2015	127	98	101	104
	2016	132	103	114	125
	2017	128	109	123	131

Calculates errors / errors using MAD.

Year 2013:  

$$MAD = \frac{\sum |99 - 95|}{1}$$

$$= 4$$

Year 2014:  

$$MAD = \frac{\sum |105 - 96|}{1}$$

$$= 4$$

Calculates errors / errors using MAPE.

Year 2013:  

$$MAPE = \frac{\sum |4 - 92|}{1}$$

$$= 4.35\%$$

Year 2014:  

$$MAPE = \frac{\sum |4 - 95|}{1}$$

$$= 3.84\%$$

Calculates errors / errors using MSE.

Year 2013:  

$$MSE = \frac{(4.35)^2}{1}$$

$$= 16$$

Year 2014:  

$$MSE = \frac{(3.84)^2}{1}$$

$$= 14.4$$

$$RMSE = \sqrt{353.74}$$

$$RMSE = 18.8$$

**Table 3. Forecast alpha = 0.2 and forecast error**

Program studi	Tahun	Data Aktual	Alpha=0.2	MAD	MAPE	MSE
D3 Elektronika	2011	96	N/A	N/A	N/A	N/A
	2012	92	96	4	4,35%	16,0
	2013	99	95	4	3,84%	14,4
	2014	105	96	9	8,61%	81,7
	2015	127	98	29	23,02%	854,5
	2016	132	103	28	21,50%	805,7

2017	128	109	19	14,62%	350,0
<b>Total</b>			<b>15,53</b>	<b>12,66%</b>	<b>353,74</b>
<b>RMSE</b>					<b>18,8</b>

From table 3 above, conclusions can be drawn on  $\alpha = 0.2$  obtained by the value of MAD 15,53, MAPE 12,66%, and RMSE 18,8.

**Table 4. Forecast alpha = 0.5 and forecast error**

Program studi	Tahun	Data Aktual	Alpha=0.2	MAD	MAPE	MSE
D3 Elektronika	2011	96	N/A	N/A	N/A	N/A
	2012	92	96	4	4,35%	16,0
	2013	99	94	5	5,05%	25,0
	2014	105	97	9	8,10%	72,3
	2015	127	101	26	20,67%	689,1
	2016	132	114	18	13,73%	328,5
	2017	128	123	5	3,96%	25,6
<b>Total</b>				<b>11,16</b>	<b>9,31%</b>	<b>192,74</b>
<b>RMSE</b>						<b>13,9</b>

From table 4 above, conclusions can be drawn on  $\alpha = 0.5$  obtained by the value of MAD 11,16, MAPE 9,31%, and RMSE 13,9.

**Table 5. Forecast alpha = 0.9 and forecast error**

Program studi	Tahun	Data Aktual	Alpha=0.2	MAD	MAPE	MSE
D3 Elektronika	2011	96	N/A	N/A	N/A	N/A
	2012	92	96	4	4,35%	16,0
	2013	98	92	7	6,67%	43,6
	2014	105	98	7	6,34%	44,4
	2015	127	104	23	17,85%	513,7
	2016	132	125	7	5,51%	52,8
	2017	128	131	3	2,56%	10,7
<b>Total</b>				<b>8,41</b>	<b>7,21%</b>	<b>113,53</b>
<b>RMSE</b>						<b>10,7</b>

From table 5 above, it can be concluded that at  $\alpha = 0.9$ , the MAD value is



8.41, MAPE is 7.21%, and RMSE is 10.7. In general, the lower the value of MAD, MAPE, and RMSE means the better and more accurate. From tables 3, 4 and 5 above it can be seen that the smallest error value is found in the value of  $\alpha = 0.9$ .

## 4. Implementation

- Main menu form  
In the main menu form, the user will enter a username and password to be able to access the next form.

Figure-1. Main menu form

- Forecast menu form  
On this page users can do student forecasting in accordance with the study program and the desired forecast year.

No	Tahun	D-IV T. Elektronika	D-IV Sistem Kelistrikan	D-IV Jaringan Telekomunikasi Digital	D-IV T. Informatika	D-IV T. Otomotif Elektronik	D-IV Manajemen Rekayasa Konstruksi	D-IV Akuntansi Manajemen
1	2019	105	109	109	202	73	159	204

Figure-2. Forecast menu form

- Form error count  
On this page the user can calculate the error value.

No	Tahun	Data Aktual	Prediksi TM	Prediksi SES	Error TM	Error SES (0.2)
1	2013	99	88	95	11	4
2	2014	105	99	96	6	9
3	2015	127	107	98	21	29

Figure-3. Form error count

## 5. Conclusion

1. In determining the forecasting method the number of new students is best applied to the next period by doing a forecasting comparison for some alpha values ( $\alpha$ ) so that the smallest error value can be obtained at the value  $\alpha = 0.9$ .
2. Evaluation of forecasting results is done using the method of calculating forecasting errors MAD, MAPE and RMSE. These three methods are proven to be able to measure the performance of the model in forecasting.
3. This application can be used to forecast the number of new students at the same time for each new school year in accordance with the reports of new students' actual campus data so that they can save time in the forecasting process and the results are quite accurate.

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# The Application of HAAR Wavelet and Backpropagation for Diabetic Retinopathy Classification Based on Eye Retina Image

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## ABSTRACT

Diabetic Retinopathy is a disease that attacks eyes retina and can cause blindness. The severity of Diabetic Retinopathy consists of four; they are; normal, Diabetic Retinopathy Non-proliferative, Diabetic Retinopathy Proliferative, and Macular edema. In this research, author proposes a new strategy for Diabetic Retinopathy can be grouped by combining HAAR wavelet method and backpropagation. The number of data used were 612 images. The images size 2304x1536, 2240x1536 and 1440x960. The feature extraction of digital image used was HAAR wavelet at red image, green, and blue at level 1 and level 4 at subband LL and grouping with backpropagation with learning rate 0,1; 0,01 dan 0,001; the division percentage of training data and test data were 70:30, 80:20, 90:10 and 95:5, the value of MSE used was 10-6, epoch maximum 100.000 iteration. The results of this research is the highest test accuracy obtained is 56,25% with image size 2440x1448, HAAR level 4th and the percentage of comparative training data and test data 95:5, Learning rate 0,1;0,01 and 0,001. Thereby, HAAR wavelet algorithm cannot identify the feature of diabetic retinopathy and the decomposition process will eliminate much information from diabetic retinopathy.

**Keywords:** Backpropagation, Diabetic Retinopathy, Eye Retina Image, HAAR Wavelet, RGB

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## 1. Introduction

The position of Indonesia as a country with diabetes explained by Prof. Dr. Sidartawan Soegondo in 2005 that Indonesia is at number four as the country with many cases of diabetes. He conveyed that fact based on data of WHO (World Health Organization) about diabetes cases in 2000 which are India with number of cases 31,7 million, China with number of cases 20,8 million, United States of America with number of cases 17,7 million, and Indonesia with number of cases 9,4 million people. According to WHO, the number of diabetics in all over the world is 143 million. This number will increase doubled in 2030 and 77% will occur in developing country like Indonesia (Pangaribuan, 2016).

One of the consequences of diabetes mellitus disease complication is diabetic retinopathy which is the disease that attacks eye retina and can cause blindness (Sabrina and Buditjahjanto, 2017). Diabetics retinopathy starts from weak or the destruction of capillary obtained at eyes retina,

then blood leaks and then thickening occurs, bleeding, and large thickening. That causes vision becomes blur until finally blindness occurs (Gitasari, Hidayat and Aulia, 2015). The features of diabetic retinopathy are neovascluration, soft exudates, hard exudates, mikroneurisma and hemorrhages (Kauppi *et al.*, 2007).

Ophthalmologists conduct grouping towards those eye-to-eye retina features taken by using fundus camera (Sitompul, 2011). That way is less effective because it takes a long time in what makes an occurrence in conducting that observation. This causes the ophthalmologists to be slow and difficult to administer to patients (Putra and Suarjana, 2010). Therefore, this research, author of a new strategy for Diabetic Retinopathy can be grouped by combining HAAR wavelet method and backpropagation. To overcome that problem, image processing is necessary to conduct the grouping of diabetic retinopathy signs. The signs are done by conducting extraction features with wavelet HAAR for the energy difference from the image signs. Next, the energy obtained will be grouped by using the artificial neural network Backpropagation Neural Network (BPNN).

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The previous research about HAAR wavelet or backpropagation is identifying the signature by using HAAR wavelet method until 4th level and conducting grouping with backpropagation artificial neural network generating optimum results by using two hidden layer and each used 20 and 10 nodes that have accuracy in the amount of 95,56% and 100% (Kumalasanti, Ernawati and Dwiandiyanta, 2015). Another research about face identification by using HAAR wavelet and euclidean distance by using 5 basis of data that own accuracy for each is 63,33%, 82,67%, 92,67% 95,33% and 96% (Puri, 2010). Then comparative research HAAR wavelet and doubechies and classification of using backpropagation produces the highest accuracy of HAAR wavelet in the amount of 93,33% and doubechies wavelet 92,22% (Kumalasanti, Ernawati and Dwiandiyanta, 2016). Fingerprint identification research with wavelet transformation and classification by using backpropagation artificial neural network produces the best accuracy in the amount of 96,36% (Wijaya and Kanata, 2004). Java letter patterns identification research by using backpropagation artificial neural network produces accuracy in the amount of 99,563% (Nurmila, Sugiharto and Sarwoko, 2005). The research that compares between Backpropagation and learning vector quantization about diabetes mellitus classification produces higher accuracy level of backpropagation compared to learning vector quantization (Nurkhozin, Irawan and Mukhlash, 2011).

The previous research about diabetic retinopathy that had been conducted is Optic Segmentation towards diabetics of diabetic retinopathy by using GSF Snake (Ulinuha, Purnama and Hariadi, 2010). In that research, exudate detection was conducted, spotting blood at the eyes caused by diabetic retinopathy disease. Beside that, this research is specialized on disc optic or eye nerve center. Eye nerve center is the center point of eye retina and the position where all eye nerves meet.

## 2. Methodology

The stages or the steps in this research can be seen at Figure 1 as follows:

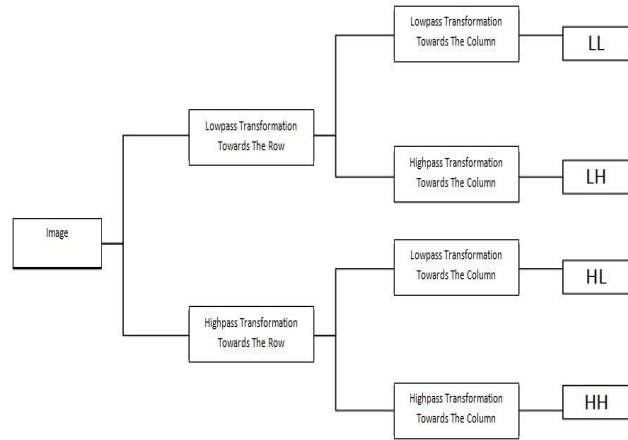
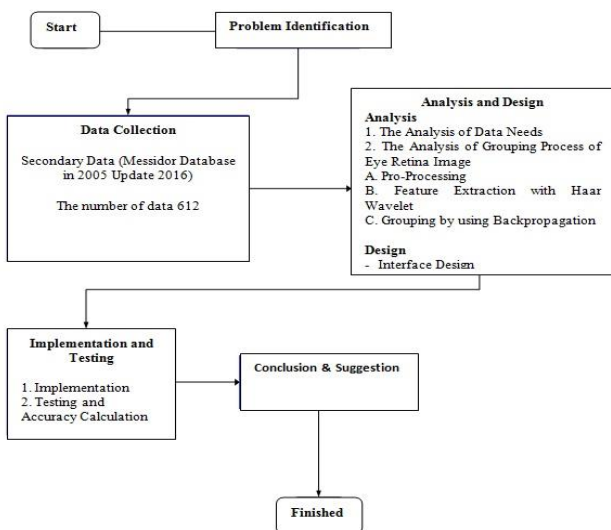


Figure 1 Research Method

### Pre-Processing

Pre-Processing conducted was eliminating background manually by using photoshop application.

### HAAR Wavelet

HAAR wavelet algorithm is as follows (Wijaya and Kanata, 2004):

Figure 2 HAAR Wavelet Algorithm

The stages of HAAR wavelet algorithm in accordance with Figure 2 are as follows:

1. An image that will be used either in the form of grayscale, colorful, or binary
2. Transformation process is conducted towards the image
3. The image result of the transformation is conducted filter lowpass or filter highpass process (Adi *et al.*, 2016) towards the row.

$$M = \begin{matrix} T_{11} & T_{21} & T_{n1} \\ T_{12} & T_{22} & T_{n2} \\ T_{1n} & T_{2n} & T_{nn} \end{matrix} M' = \begin{matrix} T_{11} & T_{12} & T_{1n} \\ T_{21} & T_{22} & T_{2n} \\ T_{n1} & T_{n2} & T_{nn} \end{matrix} \quad (1)$$

$$\text{Filter Highpass} = \begin{bmatrix} \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} & 0 & 0 \\ 0 & 0 & \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} \end{bmatrix} \quad (2)$$

$$\text{Filter lowpass} = \begin{bmatrix} \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & 0 & 0 \\ 0 & 0 & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{bmatrix} \quad (3)$$

4. The result of row filter lowpass is conducted transformation process back, then multiplied with column filter lowpass then it will get subband LL.
5. The result of row filter lowpass is conducted transformation process back, then multiplied with column filter highpass then it will get subband LH.
6. The result of row filter highpass is conducted transformation process back, then multiplied with column filter lowpass, then it will get subband HL.
7. The result of row filter highpass is conducted transformation process back, then multiplied with column filter highpass, then it will obtain subband HH.

8. After obtaining subband the result of HAAR wavelet, then next counting the value of energy with the equation as follows (Chang and Jay Kuo, 1993):

$$e = \frac{1}{MN} \sum_{i=1}^M \sum_{j=1}^N |x(i,j)| \quad (4)$$

e = energy value  
i = matrix row  
j = matrix column  
M = the number of rows  
N = the number of columns  
X(i,j) = the value of matrix pixel

factor. The equation used is as follows:

$$\delta_j = \delta_{inj} f'(z_{inj}) \quad (7)$$

Step 8 Output (Y1, Y2 ... Yk) conduct weight change from each hidden unit with the equation as follows:

$$W_{jk}(\text{new}) = W_{jk}(\text{old}) + \Delta W_{jk} \quad (8)$$

Likewise with hidden (Z1, Z2 ..... Zj) conducted weight change with the equation as follows:

$$V_{ij}(\text{new}) = V_{ij}(\text{old}) + \Delta V_{ij} \quad (9)$$

Step 9 Conducting examination of stop condition.

### 2.1. Backpropagation Neural Network

Backpropagation process is conducted for diabetic retinopathy grouping after the data pass normalization process. The following is backpropagation neural network algorithm (Siang, 2005):

Step 1 initialization. Conducting weight initialization and biased (conducted setting with random numbers take randomly. And conduct iteration maximal initialization, learning rate, and error tolerance.

Step 2 doing it during the condition to stop before it is fulfilled. For stop condition, it can be done with iteration maximum or with error tolerance given. If the condition has reached maximum iteration then the process stops or if the error tolerance condition has lacked or has been the same then the process stops.

Step 3 Input unit (X1, X2.... Xi) obtains input signal then conduct distribution to all existed hidden layers.

Step 4 Hidden (Z1, Z2, .... Zi) conduct input signal calculation and with the weight and its biased by using the formula as follows:

$$Z_{inj} = V0j + \sum_{i=1}^n x_i v_{ij} \quad (1)$$

Then by using activation function that has been determined, then will be obtained the output of the existed hidden, the equation used is:

$$y_k = f(z_{inj}) \quad (2)$$

Step 5 Output (Y1, Y2, .... Yi) that conducts calculation of hidden signal together with biased and its weight by using the equation as follows:

$$Z_{ink} = V0k + \sum_{j=1}^p Z_j W_{jk} \quad (3)$$

Then by using activation function that has been determined since the beginning, then obtained output signal.

$$y_k = f(y_{ink}) \quad (4)$$

Step 6 Next conducted error calculation between target and output issued by using Mean Absolute Percentage Error Method. If the requirement is still not fulfilled yet, then error correction calculation ( $\delta_k$ ) is conducted by using the equation as follows:

$$\delta_k = (t_k - y_k) f'(y_{ink}) \quad (5)$$

Step 7 Hidden (Z1, Z2 ..... Zj) conduct the weight calculation that has been sent by output unit. For the first condition then the equation used is:

$$\delta_{inj} = \sum_{k=1}^n \delta_k W_{jk} \quad (6)$$

Then multiplication is conducted towards the result of the equation above with derivative from activation function in order to get error

## 3. Result and Discussion

In this research, testing is conducted through the design as follows:

1. The testing conducted is by grouping eye retina image to be four groups, they are; Normal, Diabetic Retinopathy Non-Proliferative, Diabetic Retinopathy Proliferative and Macular Edema.
2. The feature extraction used is HAAR wavelet at level 1 and level 4.
3. The data extraction with the choice of the number of data 612 and the choice of image size 2304 x 1536, 2204 x 1488, 1440 x 960.
4. Training with learning rate choice 0.1, 0.01, and 0.001. Epoch maximum 100.000 iteration. Error target 10-6 and choose the training percentage that wanted to be conducted 70%, 80%, 90% and 95%.
5. Testing with the choice of percentage number 30%, 20%, 10% and 5%.
6. The testing of this research is by using white box and accuracy testing.

The result of testing by using HAAR wavelet level 1 and 4. Learning rate 0.1, 0.01, and 0.001. Image size 2304 x 1536, 2240 x 1488 and 1440 x 960. The comparative percentage of testing data and training data are 70:30, 80:20, 90:10 and 95:5 which can be seen at Table 1 and 2 as follows:

**Table 1 The Result of Feature Extraction Test HAAR Wavelet Level 4 and Backpropagation**

Image Size	Learning Rate	Data 30%	Data 20%	Data 10%	Data 5%
2304 x 1536	0,1	46.74%	51.61%	51.67%	40.63%
	0,01				
	0,001				
2240 x 1488	0,1	49.46%	50.81%	51.67%	<b>56.25%</b>
	0,01				
	0,001				
1440 x 960	0,1	49.46%	50.00%	51.67%	40.63%
	0,01				

0,001

The result of the higher testing with HAAR wavelet extraction level 4 and backpropagation reaches 56,25% at the division percentage of training data and testing data 95:5, learning rate 0.1,0.01 and 0.001. The image size 2240 x 1536.

**Table 2 The Result of Feature Extraction HAAR Wavelet Level 1 and Backpropagation**

Image Size	Learning Rate	Data 30%	Data 20%	Data 10%	Data 5%
2304 x 1536	0,1	46.20%	45.16%	53.33%	53.13%
	0,01				
	0,001				
2240 x 1488	0,1	46.20%	45.16%	<b>55.00%</b>	53.13%
	0,01				
	0,001				
1440 x 960	0,1	46.20%	45.16%	<b>55.00%</b>	53.13%
	0,01				
	0,001				

The result of the highest testing with extraction of HAAR wavelet level 1 and backpropagation reaches 55% at learning rate 0.1, 0.01 and 0.001. Data division 90:10. Image size 2240 x 1536 and 140 x 960.

#### 4. Conclusion

The level of testing accuracy with extraction of HAAR wavelet level 1, the highest reaches 55% at learning rate 0.1, 0.01 and 0.001. Data division 90:10. Image size 2240x1536 and 140 x 960. The level of testing accuracy with extraction of HAAR wavelet level 4, the highest reaches 56,25% at the percentage of data training division and testing data 95:5, learning rate 0.1, 0.01, and 0.001. The image size 2240 x 1536. The algorithm result of HAAR wavelet level 1 after conducted normalization generates the value with the closest difference between each classes, until it complicates the grouping process by using backpropagation neural network. Based on the research results obtained from the research, the results of the extraction algorithm that can't detect the features of diabetic retinopathy. HAAR wavelet algorithm cannot conduct retinopathy detection properly and correctly. This is because image decomposition process will eliminate many important features of that retinopathy. Future research is expected to add preprocessing such as only targeting to get the main characteristics of diabetic retinopathy.

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# Project Development Management of Rungkut Tower Apartments with Critical Path Method Approach and Pert

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## ABSTRACT

Project management is a science that is concerned with organizing and managing resources by techniques to the results determined the purpose of this study is to analyze the needs of the time and resources required, determine the critical path of the project, analyzing the timing of completion and cost of the project acceleration. This study uses a CPM (critical path method) and PERT. CPM is used to plan and supervision the project with the network system and time required to complete the project. Results of this research project scheduling with CPM can be completed earlier than conventional scheduling the number of labor costs Rp. 220.370.000. So that project can be completed faster with less cost that the scheduling PT. Tata Bumi Raya.

**Keywords:** CPM, PERT, Madura, Hotel, Information System.

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## 1. Introduction

Projects are activities that are take place within a limited time period by allocating certain resources and intended to produce a product or deliverable whose quality criteria have been clearly outlined [1]. PT. Tata Bumi Raya has several obstacles that cause disruption to the project. The obstacles in the implementation of this project according to the field coordinator PT. Tata Bumi Raya includes several things, for example delays in the supply of materials, some workers who do not comply with the project schedule, and planning schedules that are not appropriate, in this case the contractor, namely PT. Tata Bumi Raya does not use schedules or scheduling related to the existence of a critical path, so that activities overlap between one activity and another.

In a project the affirmation of the relationship between activities is needed for planning a project. In estimating time and costs, a project also needs to be optimized, this is usually done to optimize existing resources and minimize risks, but still obtain optimal results. The purpose of this study is to analyze the optimal time and resource needs to complete the project, find out the critical trajectories in the project that need to be considered smooth, analyze the project completion time and project acceleration costs before accelerating completion time.

## 2. literature review

### 2.1. Project

Projects in network analysis are a series of activities that aim to produce unique products and are only carried out within a certain period (temporary). Projects can be defined as a series of activities that only occur once [2].

### 2.2. Project Management

Project management is a science and an art relating to leading and coordinating human and material resources using modern processing techniques to achieve predetermined targets, namely the scope, quality, schedule, and costs, as well as the interests of the stakeholders [3].

### 2.3. CPM (Critical Path Method)

CPM is a network analysis which seeks to optimize the total project cost through reduction and acceleration of the total project completion time, Levin and Kirkpatrick (1972). With CPM the amount of time needed to complete various stages of a project is considered known with certainty, as well as the resources used with the time needed to complete the project. Network planning (network work) is a relationship of dependence between the parts of the work described in a network diagram.

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In previous research explain that in conducting critical path analysis, two two-pass processes are used, consisting of a forward pass and a backward pass. ES and EF are determined during the forward pass, LS and LF are determined during the backward pass[4]. ES (earliest start) is the time before an activity can be started, assuming all predecessors are finished. EF (earliest finish) is the time before an activity can be completed. LS (latest start) is the last time an activity can be started so that it does not delay the completion time of the entire project. LF (latest finish) is the last time an activity can be completed so as not to delay the completion time of the entire project.

Total Float is the difference between the time available to carry out activities and the time required to carry out these activities (D).

Free float for an activity is the time remaining when an activity is carried out at the earliest time, as well as the activities that follow it.

#### 2.4. PERT

PERT or Project Evaluation and Review Technique is a Management Science model for planning and controlling a project (Siswanto, 2007). Method PERT (Project Evaluation and Review Technique) is a method that aims to reduce the occurrence of delays, and production disruptions, as well as coordinate various parts of a work as a whole in order to accelerate the completion of the project.

### 3. Methods

CPM method to find out the path critical, then the calculation is done using the PERT method with Ms. software tools. Project to calculate the cost of time and resources needed.

### 4. Result and Discussion

This research was conducted in two stages, viz processing stage using CPM Method and PERT Method. At the estimated stages of the timeframe used to complete each of the project activities for the construction of Rungkut Tower Apartments. Estimated time period must be based on the duration of work activities and the relationship of each activity. The following is an estimated table of activity periods. Shown on table 1.

In the table above it is also explained the estimated timeframe used from each activity from the start of the activity to the end of the activity in the order of the activities guided by the preconditions of the previous activity. Cost budget analysis is a calculation of the total amount of costs required for workers' wages, as well as other costs related to project implementation. But at this time the calculation only calculates the cost of workers. The following are the results of the planned cost of workers whose time has been optimized based on the existing network diagram. Shown on table 2

**Table 1 Period of Activity**

No	Kegiatan	Durasi (jam)	Mulai	Selesai	Prasyarat
1	A0.G	192	Mon 26/01/15	Thu 26/02/15	
2	A0.LC.T	30	Fri 27/02/15	Wed 04/03/15	1
3	A0.LC.RP	18	Wed 04/03/15	Fri 06/03/15	2
4	A0.PC.T	60	Thu 12/03/15	Mon 23/03/15	2;8
5	A0.PC.RP	36	Mon 23/03/15	Fri 27/03/15	4
6	A0.BB.T	30	Tue 07/04/15	Fri 10/04/15	4;9
7	A0.BB.RP	18	Fri 10/04/15	Tue 14/04/15	6
8	A0.LC.B	24	Mon 09/03/15	Wed 11/03/15	3
9	A0.PC.B	48	Mon 30/03/15	Mon 06/04/15	5
10	A0.BB.B	24	Wed 15/04/15	Fri 17/04/15	7
11	A0.BB.BP	6	Mon 20/04/15	Mon 20/04/15	10
12	A1.K.T	10	Mon 20/04/15	Tue 21/04/15	6;10
13	A1.K.RP	4	Tue 21/04/15	Tue 21/04/15	12
14	A1.PL.T	10	Wed 22/04/15	Thu 23/04/15	12;18
15	A1.PL.RP	4	Fri 24/04/15	Fri 24/04/15	14
16	A1.BB.T	10	Mon 27/04/15	Tue 28/04/15	14;19
17	A1.BB.RP	4	Tue 28/04/15	Wed 29/04/15	16
18	A1.K.B	8	Tue 21/04/15	Wed 22/04/15	13
19	A1.PL.B	8	Fri 24/04/15	Mon 27/04/15	15
20	A1.BB.B	8	Wed 29/04/15	Thu 30/04/15	17
21	A1.K.BP	2	Wed 22/04/15	Wed 22/04/15	18
22	A1.PL.BP	2	Mon 27/04/15	Mon 27/04/15	19
23	A1.BB.BP	2	Thu 30/04/15	Thu 30/04/15	20
24	A2.K.T	10	Thu 30/04/15	Fri 01/05/15	16;20
25	A2.K.RP	4	Fri 01/05/15	Fri 01/05/15	24

**Table 2 Worker cost plan**

No	Kegiatan	jenis pekerja		Mulai	Selesai	jumlah pekerja	biaya (Rp)	total biaya
		mandor	kepala pekerja					
	gedung A	mandor				1	70000	70000
	gedung A	kepala pekerja				1	60000	60000
1	A0.G	operator		Mon 26/01/15	Thu 26/02/15	1	1440000	1440000
2	A0.LC.T	pekerja biasa		Fri 27/02/15	Wed 04/03/15	15	300000	4500000
3	A0.LC.RP	pekerja biasa		Wed 04/03/15	Fri 06/03/15	15	300000	4500000
4		waktu longgar						
5	A0.PC.RP	pekerja biasa		Mon 23/03/15	Fri 27/03/15	15	200000	3000000
6		waktu longgar						
7	A0.BB.RP	pekerja biasa		Fri 10/04/15	Tue 14/04/15	15	150000	2250000
8	A0.LC.B	pekerja biasa		Mon 09/03/15	Wed 11/03/15	10	150000	1500000
9	A0.PC.B	pekerja biasa		Mon 30/03/15	Mon 06/04/15	10	300000	3000000
10	A0.BB.B	pekerja biasa		Wed 15/04/15	Fri 17/04/15	10	150000	1500000
11	A0.BB.BP	pekerja biasa		Mon 20/04/15	Mon 20/04/15	15	50000	750000
12	A1.K.T	pekerja biasa		Mon 20/04/15	Tue 21/04/15	15	50000	750000
13	A1.K.RP	pekerja biasa		Tue 21/04/15	Tue 21/04/15	15	50000	750000
14		waktu longgar						
15		waktu longgar						
16		waktu longgar						
17	A1.BB.RP	pekerja biasa		Tue 28/04/15	Wed 29/04/15	15	50000	750000
18	A1.K.B	pekerja biasa		Tue 21/04/15	Wed 22/04/15	10	50000	500000
19		waktu longgar						
20	A1.BB.B	pekerja biasa		Wed 29/04/15	Thu 30/04/15	10	50000	500000
21	A1.K.BP	pekerja biasa		Wed 22/04/15	Wed 22/04/15	15	50000	750000
22	A1.PL.BP	pekerja biasa		Mon 27/04/15	Mon 27/04/15	15	50000	750000
23	A1.BB.BP	pekerja biasa		Thu 30/04/15	Thu 30/04/15	15	50000	750000
24		waktu longgar						
25	A2.K.RP	pekerja biasa		Fri 01/05/15	Fri 01/05/15	15	50000	750000

The table above is the cost of construction workers in the tower management building, but this does not include the optimization of loose time.

The following is a comparison of the research results schedule with the schedule from PT. Tata Bumi Raya:

In the table above we get the different calculation of labor costs, between scheduling using CPM in research and scheduling from PT. Tata Bumi Raya in the Rungkut tower apartment development project, the following details:

a. PT. Tata Bumi Raya

The total labor cost is Rp. 228,820,000

The project was completed on 16 October 2015

b. Research using CPM

Total labor costs using

CPM method of Rp. 147,070,000

The total cost of workers in the optimization of Rp. 73,300,000

The total labor cost is Rp. 147,070,000 + Rp. 73,300,000 = Rp 20,370,000

The project was completed on 16 October 2015

**Table 3. Ordinary Schedule Activity on PT Tata Bumi Raya**

No	Kegiatan	jenis pekerja		Mulai	Selesai	jumlah pekerja	biaya (Rp)	total biaya
		mandor	kepala pekerja					
	gedung A	mandor				1	70000	70000
	gedung A	kepala pekerja				1	60000	60000
1	A0.G	operator		Mon 26/01/15	Thu 26/02/15	1	1440000	1440000
2	A0.LC.T	pekerja biasa		Fri 27/02/15	Wed 04/03/15	15	300000	4500000
3	A0.LC.RP	pekerja biasa		Wed 04/03/15	Fri 06/03/15	15	300000	4500000
4	A0.PC.T	pekerja biasa		Thu 12/03/15	Mon 23/03/15	15	550000	8250000
5	A0.PC.RP	pekerja biasa		Mon 23/03/15	Fri 27/03/15	15	200000	3000000
6	A0.BB.T	pekerja biasa		Tue 07/04/15	Fri 10/04/15	15	150000	2250000
7	A0.BB.RP	pekerja biasa		Fri 10/04/15	Tue 14/04/15	15	150000	2250000
8	A0.LC.B	pekerja biasa		Mon 09/03/15	Wed 11/03/15	10	150000	1500000
9	A0.PC.B	pekerja biasa		Mon 30/03/15	Mon 06/04/15	10	300000	3000000
10	A0.BB.B	pekerja biasa		Wed 15/04/15	Fri 17/04/15	10	150000	1500000
11	A0.BB.BP	pekerja biasa		Mon 20/04/15	Mon 20/04/15	15	50000	750000
12	A1.K.T	pekerja biasa		Mon 20/04/15	Tue 21/04/15	15	50000	750000
13	A1.K.RP	pekerja biasa		Tue 21/04/15	Tue 21/04/15	15	50000	750000
14	A1.PL.T	pekerja biasa		Wed 22/04/15	Thu 23/04/15	15	50000	750000
15	A1.PL.RP	pekerja biasa		Fri 24/04/15	Fri 24/04/15	15	50000	750000

**Table 3. Schedule Activity on PT Tata Bumi Raya after implementing CPM**

No	Kegiatan	jenis pekerja		Mulai	Selesai	jumlah pekerja	biaya (Rp)	total biaya
		mandor	kepala pekerja					
	gedung A	mandor				1	70000	70000
	gedung A	kepala pekerja				1	60000	60000
1	A0.G	operator		Mon 26/01/15	Thu 26/02/15	1	1440000	1440000
2	A0.LC.T	pekerja biasa		Fri 27/02/15	Wed 04/03/15	15	300000	4500000
3	A0.LC.RP	pekerja biasa		Wed 04/03/15	Fri 06/03/15	15	300000	4500000
4		waktu longgar						
5	A0.PC.RP	pekerja biasa		Mon 23/03/15	Fri 27/03/15	15	200000	3000000
6		waktu longgar						
7	A0.BB.RP	pekerja biasa		Fri 10/04/15	Tue 14/04/15	15	150000	2250000
8	A0.LC.B	pekerja biasa		Mon 09/03/15	Wed 11/03/15	10	150000	1500000
9	A0.PC.B	pekerja biasa		Mon 30/03/15	Mon 06/04/15	10	300000	3000000
10	A0.BB.B	pekerja biasa		Wed 15/04/15	Fri 17/04/15	10	150000	1500000
11	A0.BB.BP	pekerja biasa		Mon 20/04/15	Mon 20/04/15	15	50000	750000
12	A1.K.T	pekerja biasa		Mon 20/04/15	Tue 21/04/15	15	50000	750000
13	A1.K.RP	pekerja biasa		Tue 21/04/15	Tue 21/04/15	15	50000	750000
14		waktu longgar						
15		waktu longgar						

#### 4. Conclusion

1. From the network diagram above of 203 activities overall in the tower rungkut apartment development project there are 100 activities that enter the critical path and 103 activities that do not enter the critical path.
2. Optimizing the time included in loose time by adding overtime hours for 4 working hours per day with a maximum of 6 workers per day. From the results of optimization of loose time using funds of Rp. 109,950,000
3. From the estimated project costs the results obtained are:
  - a. The total amount of labor costs in scheduling PT. Tata Bumi Raya in the amount of Rp. 228.82 million, the Project was completed on October 16, 2015
  - b. The total amount of labor costs by scheduling using CPM is Rp. 147,070,000 + Rp. 73,300,000 = Rp 220,370,000, the Project was completed on October 16, 2015.

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# Storage Layout on Spring Company using Shared Storage and Analysis Market Basket

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## ABSTRACT

Spring manufacturing company has finished goods warehouse, some storage area using manufacturing near-net-shape product. In observations made on finished goods warehouse for preparation and arrangement of product is less neat, especially on layout of a storage area in near-net-shape warehouse, resulting in slow arrangement of products, slow process of servicing the product, slow delivery of product, and a waste of space in finished goods warehouse. The aim of this study is to provide proposed improvements near-net-shape warehouse layout with a combination of two methods, namely shared storage and market basket analysis. Function of both make finished goods warehouse layout that takes into account consumer demand for products most in demand will be placed closest to warehouse door, and products that are often purchased together will be brought closer. Result of a combination of shared storage methods and market basket analysis can minimize mileage material handling, minimizing setup time, and service, so process becomes smooth delivery and avoid delays. Results from this study are shaped layout proposals are made based on calculation of shared storage methods and market basket analysis, so that layout products previously still unregulated to regulated, and service will be faster with placement of frequently purchased products and products that are frequently purchased simultaneously when placed at front. Products are placed in front of, among others. The most frequently purchased products BLS with 10.756 products and lowest purchased are K59 with 920 products.

**Keywords:** Design Layout, Market Basket Analysis, Shared Storage, Spring Manufacture, Warehouse

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## 1. Introduction

Facility layout and production planning, as two important phases during flexible production mode, have a significant effect on production efficiency and cost with the changing of consumer demand [1]. The layout of the warehouse is one support and an important part of one system production [2]. effective facility planning can significantly reduce the operational costs of companies [3]. In this research we observe an industrial companies that produce springs for vehicles, either in the form of leaf springs or coil spring produced by the cold or hot process, with a license from Mitsubishi Steel Manufacturing, Japan. Problems that exist in the warehouse of goods so among other things, the structuring system of goods which not neat where the same type of goods not in one storage area but rather in several storage areas, poor and regular shelf placement, less efficient storage space with service points so operators service takes a long time to take the goods that you want to send, the narrow distance of the rack to the operator line service and structuring so that the operator service and structuring is difficult in the process taking and structuring, and often late service due to a product the grouping is not good because of

the part the service must take a few items who want to be sent to a different place with a less effective distance.

Efforts to reduce requirements storage space on dedicated storage, several warehouse managers use a variety from dedicated storage where placement the final product is arranged more carefully, i.e. by using the Shared storage method which will create a warehouse layout to be efficient due to the advantages of the method this regulates product placement carefully and as much as possible use storage space, so it doesn't happen waste of space [4]. Market Basket Analysis is a function of the Rule Association Mining which is usually used for study consumer habits [5]. Advantages Market Basket Analysis method that is can know the frequency of items that are often purchased and items that are frequently purchased together, which later often goods purchased and frequently bought items simultaneously in one time purchase will be collected and brought near, so the process service can be smooth and minimize slow service

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## 2. Literature Review

Layout the factory is the procedure for organizing factory facilities to support smooth operation in the production process. These settings will take advantage of the area for placement machines or supporting production facilities others, fluency in material movement, good material storage temporary or permanent, work personnel and etc [4].

Economically. So that the main goal to be achieved from a factory layout namely

- Manufacturing process facility layout must be designed, so form including the arrangement of machines, flow planning, so the process manufacturing can be carried out with efficient way[6].
- Minimizing the transfer of goods. The layout must be designed such as that the transfer of goods lowered to a minimum, if possible component in the circumstances processed when moved.
- Maintain flexibility of arrangement and operation In a factory there are circumstances where capability changes are needed production, and this must be planned from the beginning.
- Maintaining the turnover of half the goods so tall Efficiency can be achieved if the ingredients walk through the operation process inside the shortest time possible.
- Reducing investment in layout equipment the right engine and right department can help decrease the amount of equipment that is needed.
- Save on the use of building space Every square meter of floor area inside a factory costs money. So every square meter must be used as well as possible.
- Increase labor inequality Good layout can be among others reduce the removal of material done manually, minimizing on foot.
- Provides convenience, safety, and comfort for workers inside carry out work.

Market basket analysis (MBA) is a technique in data mining that usually used to predict the customers purchasing [7]. Market Basket Analysis is a function from the usual Rule Mining Association used to learn habits consumers by looking for item set frequencies which are often bought and items that are purchased on a regular basis simultaneously [8]. Market Basket Analysis is mathematical techniques that are usually used marketing survey to look for relationships Individual or group product terms [9]. This analysis itself is a survey of the events that are it's very common inside supermarket, namely taking goods in a way simultaneously by customers when visiting supermarket [10]

Shared storage can be considered as fast moving goods system of a product, if each pallets are filled inside different warehouse areas from time to time [11]. Depends on the amount from the product in the warehouse on time delivery arrives, it will be possible that 5 pallets the filled will be in the storage space only 1 day. While 5 other pallets inside the same shipment will be in the warehouse for 20 days. From a perspective on position storage space in a warehouse, 5 pallets will very fast-moving; leftover palette seen as slower, maybe moderate transfer. Shared storage can take advantage of differences that can not be separated i.e length of time from an individual pallet to live in a warehouse.

The purpose of Market Basket Analysis for identify the product, or group products that tend to have a correlation. Market Basket Analysis is a tool powerful to be applied in the strategy cross-selling. The results of

this analysis can be used to organize spatial planning, organizing products that often sell together, and can also be used to increase promotion efficiency products..

## 3. Methods

Data collection conducting by direct observations and measurements dimensions and location of goods warehouse product demand during 3 months at PT. Indospring, Tbk with using a direct measure and guidance from the field supervisor. other than that data is also obtained from company documents such as production data and shipping data. After all the required data has been collected, then the next step by data processing by the method already determined. Things like lighting, noise, air changes, dust, dirt, must become attention of the planner. The right machine arrangement can also prevent accidents work.

## 4. Result

For using the Shared storage method as follows. Product used in this study i.e. there are 45 types of products, first step we determine the number of average product demand per month. Before calculating the garage demand per month, the number of products K 7H we ordered for 3 months first, after that it can be counted like equation 1 and the K 7H demand during observation can see on table 1.

$$\overline{DI} (K 7H) = \frac{1743}{3} = 581 \quad (1)$$

**Table 1. K 7H demands.**

Month	Demand
November 2018	535
December 2018	42
January 2019	1166
Total	1743
Average	581

Then we calculate the order frequency products can be seen from the number of each type products ordered every month. After known frequency of product type every month, then added up and divided by number month. Here are the calculations

$$\overline{FP} (K 7H) = \frac{21}{3} = 7 \quad (2)$$

Base on equation (2) we known the average frequency orders per month can be determined the number of products per order for each product by means of the number of requests per month divided by the average frequency see on equation 3.

$$\overline{DL} (K 7H) = \frac{1743}{7} = 249 \quad (3)$$

To find the average lead time with calculation as follows

$$\overline{LT} (K7H) = \frac{140}{21} = 7 \quad (4)$$

to determine space needs using the equation

$$KR = 7 \times 1100 = 7700 \text{ products.}$$

Determination of the size of the storage area, namely:

$$\begin{aligned} 1 \text{ storage area} &= \text{shelf length} \times \text{shelf width} \\ &= 117 \text{ cm} \times 94 \text{ cm} = 10,998 \text{ cm}^2 \end{aligned}$$

Because 1 storage area contains 6 shelf level and 4 storey, wide 1 storage area is  $10,998 \text{ cm}^2 \times 6 = 65,998 \text{ cm}^2$ . While for the storage area equation :

$$\begin{aligned} \overline{KAP} (K7H) &= \frac{(\text{lead time} \times \text{total product per day})}{\text{total product in a area}} \quad (5) \\ &= \frac{7 \times 1100}{4800} \\ &= 1,604 \sim 2 \text{ area} \end{aligned}$$

Determination of room allowance, i.e. to determine the area of the alley needed is based on the longest dimension diagonal on the forklift when carrying product

$$\begin{aligned} \text{Diagonal} &= \sqrt{(p)^2 + (l)^2} \quad (6) \\ &= \sqrt{(2,8)^2 + (1,3)^2} \\ &= \sqrt{(7,84) + (1,69)} \\ &= \sqrt{9,53} \\ &= 3,08 \sim 3 \text{ m} \end{aligned}$$

Layout storage area. Following is a layout created based on data product demand shown on picture.1

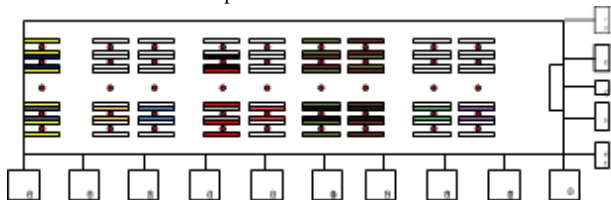


Figure 1. layout storage area based on demands

Calculate distance traveled storage (d) from the warehouse door. Calculation distance of storage location from the door warehouse i.e

$$\begin{aligned} d_{ij} (E) &= 5 + 14 \quad (7) \\ &= 19 \end{aligned}$$

Then we can find value of confidence (s) For using the basketball market method analysis. first we must find road delivery data used in the method Market Basket Analysis which is output from this method the product will be known what types are often purchased simultaneously. The number of product types in this travel document the same as the request data, which is 45 types product.

$$S_{K7H} = \frac{26}{328} = 6,81\% \quad (8)$$

Find for the following Confidence value (C).

$$C_{K7H} = \frac{0,52\%}{6,81\%} = 4,08\% \quad (9)$$

Determination of the minimum value support pay attention to the results of the support value. The hope, the product to be taken is not too little so that it can cause no visible improvement effect. However also not too much so it will only difficulty in the process of making layouts while the impact of the improvements provided small. Whereas in this study minimum support value of 1.5% is used.

Finding value of improvement ratio (I) by combination of products that qualify or are valuable above the minimum Confidence value then look for it the value of improvement ratio by using calculation as follows.

$$I_{K7H} = \frac{0,79\%}{6,81\% \times 3,66\%} = 3,15\% \quad (10)$$

Table 2 shown Support value, confidence and improvement ratio of all product in spring factory observed.

Table 2. Support value, confidence and improvement ratio of product In PT. Indospring

Product Set	C	Order	S	I	
K 7H	K 24H	21.43%	3	0.79%	3.15
KN 7	KN 25	16.67%	3	0.79%	1.30
KN 7	K 42H	21.43%	3	0.79%	1.67
KN7	DN	16.67%	2	0.52%	1.30
K 19H	KN 17	16.67%	2	0.52%	1.77
KN 19	KN 17	16.67%	2	0.52%	3.89
K 24	K 40	15.38%	1	0.52%	2.54
K 59	K 40	15.38%	9	0.26%	0.58
K 59	K 59H	17.65%	2	2.36%	1.32
K 59H	K 40	15.38%	9	0.52%	1.15
K 59H	K 59	17.65%	2	2.36%	1.32
D	DN	16.67%	2	0.52%	2.77
DH	KS	14.29%	3	0.79%	1.19
E	D	17.39%	4	1.05%	0.63
E	G	17.50%	7	1.83%	0.63
HN	KN17	16.67%	2	0.52%	0.49
HN	BLS	23.08%	3	0.79%	0.67
HN	D	17.39%	4	0.52%	0.49
HN	G	15.00%	6	1.05%	0.67
HN	S	18.18%	6	1.83%	0.51
IZ	K 40	15.38%	2	0.52%	0.44
IZ	K 129	20.00%	3	0.79%	0.53
IZ	BLS	16.97%	2	0.52%	0.41
IZ	KS	19.05%	4	1.05%	0.54
IZ	S	21.21%	7	1.83%	0.57
IZ	T	16.97%	28	7.33%	0.46
S	KS	19.05%	2	1.05%	2.20

After processing data by method shared storage and market basket analysis. The next step is making layout by combining the results of 2 methods. Here are the results of the layout of the combination method of shared storage and basket market analysis. From figure 2 we can see this layout model is easier to material handling and movement.

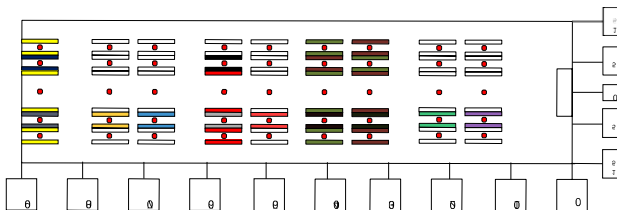


Figure 2. layout of combination shared storage and market basket analysis

## 5. Conclusion

Based on the results of the analysis and discussion in the previous chapter, a few are obtained conclusion as follows :

- Proposed effective layout can seen in figure 2. Layout made from processing the shared method storage and market basket analysis, where products that are often bought, and products that are often purchased simultaneously put on ahead and brought near.
- Products that have been arranged in a layout Figure 4.22 has been grouped with coding, and based on support values
- By using new layout there have increasing productivity for K 7H 3,1%

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# Use of Cartesius Method on Google Maps Api to Recommend Search for Batik Crafts and Andid-Based Crafts (Case Study of Bangkalan District)

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## ABSTRACT

ASmart City increasingly rife discussed in order to be a solution in solving problems arising from the dynamics of an increasingly advanced and modern city. The purpose of applying the concept of smart city to increase the sense of security and comfort for its citizens, making the city more effective and efficient. Madura is an island located north of Java island. The island is dubbed Salt island "Pulau Garam" is quite well known in the field of bull race and batik handicrafts, especially in Bangkalan regency. Bangkalan regency is a developing city to realize the concept of smart city. One way that can be done is to take advantage of the market needs of batik lovers by providing easy access to the location. Utilizing google maps location search technology with Cartesian method on smartphone electronic devices, consumers will be easier in terms of information search and location of batik craftsmen scattered throughout the district of Bangkalan.

**Keywords:** Smart City, Batik, Google Maps, Cartesian Method, Android Smartphone.

## Article History

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## 1. Introductions

Technological developments in making smart concepts are not only applied to various devices, but also to various systems, one of which is the concept of smart city.

This concept presents a smart city structure that can manage resources owned, both in the form of human resources and natural resources efficiently and effectively to achieve high livability, comfort, and sustainable development. With the application of this concept, the quality of human life that lives in one city will be better. There are many dimensions in the concept of smart city such as smart government, smart economy, smart environment, smart living, smart people, and smart mobility. In addition, almost all strategic sectors such as energy, industry, environment, tourism, governance, education, and knowledge and technology can play a role in building a smart city. [1]

Currently in Indonesia there are already 3 cities that can be called smart cities, namely Jakarta, Bandung and Surabaya. [1]

Madura is an island located in the north of the island of Java which is widely known as the island of salt land and the art of rapeseering. Madura is also known for its batik products which have superior artistic essence. Madura Batik is one of Indonesia's cultural heritages which has begun to attract many Indonesia due to the variety of written batik motifs that have their own uniqueness. Unique and free variety of styles while still

maintaining traditional ways of making use of environmentally friendly natural coloring materials that make Madura batik much in demand of batik lovers. For Madura batik is not only compared to a piece of cloth, but also used as a cultural icon that is often used as a lot of research objects. The motifs and colors contained in Madura batik cloth reflect the character of the community.

Bangkalan Regency itself has a place for processing and making batik which is famous among batik lovers, namely the Tanjung Bumi area. The potential of Tanjung Bumi batik was turned into a tourist attraction by the Bangkalan Regency government. Based on the statistical data of the Bangkalan Regency government in the book "Bangkalan in Numbers" issued by the Office of the Central Statistics Agency of Bangkalan Regency, since 2012 there have been 7.235 percent of domestic tourists and 15 percent of foreign tourists. Then in 2013 there were 13.469 percent of domestic tourists and 25 percent of foreign tourists, while in 2014 there were 11.562 percent of domestic tourists and 15 percent of foreign tourists. Based on the statistical data above there is an increase and decrease in the number of visitors who come to the tourist attractions of the earth's batik itself. [2]

In addition to Tanjung Bumi Madura batik tourism, there are also many batik tours in the form of batik handicrafts scattered in the Madura island region, especially in the Bangkalan Regency area. Of the many batik craft places in Bangkalan Regency, the writer tries to make a smart city in the field of smart living and smart mobility in order to advance and introduce

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various kinds of batik craft sites in Bangkalan Regency, so we need a system that displays the distribution map of batik crafts using technology Google Maps can help technology users find out the location of batik crafts in Bangkalan district. The use of Google Maps is now a good and very appropriate solution to make it easier for users to find the location of the desired location. Google maps itself is a free and online virtual globe map service provided by Google, but it can make it easier for developers to use applications that can be used to find a location. Google released an application called the Google Maps API which is a simple Application Programming Interface service in the form of a world map that is used to view an area, where the API itself is a program code interface or an application or web interface created to be able to access or run or utilize features that are provided by Google [3].

Technological developments are also accompanied by high mobility needs. One of the supporters of mobility in human daily life is the presence of smartphones and the internet. Digital marketing research institute Emaketer estimates that in 2018 the number of active smartphone users in Indonesia will be more than 100 million people, making Indonesia the 4th most active smartphone user country after China, India, and America [4]. Besides the use of the internet for the people of Indonesia is also in the stage of better improvement with the support of the government which says the government will build internet access to the villages [4]. With the smartphone and the internet, it can make it easier for people to search for various desired locations. Coupled with the Global Positioning System feature or GPS for short. GPS itself is used to provide location information services or position instructions to smartphone users [5].

In addition to making it easier for users to find batik handicraft locations, a system that can recommend the closest handicraft location is also needed, using the Cartesian method.

The Cartesian method is a mathematical equation that is used to find the distance between two points in a flat plane and can also be used in a geographical coordinate system to find the distance between two coordinates [6].

Based on the problem above, the solution that can be done is to create a smart city-based system that can provide recommendations for good batik craft locations for batik lovers who will visit Bangkalan Regency by utilizing the development of smartphone technology, so researchers will conduct research under the title "Using the Cartesian Method on the Google Maps API to recommend searching for Android-based Batik Crafts (Case Study: Bangkalan Regency)".

## 2. Methods

### 2.1. Batik

According to Dalijo & Mulyadi batik is a technique to decorate cloth with a process of closing and dipping into a dye which means that the closed part is not affected so that it will still have the color of the fabric [7].

### 2.2. Smart City

Smart City is a concept of developing smart city order that can manage resources efficiently and effectively to achieve the comfort and sustainable development of a city. A smart city is also one of the city development concepts that are currently still developing. The development of the concept of the smart city brings different definitions from various parties. Understanding the concept of a smart city is taken by looking and resuming the right characteristics for a smart city that tends to be common from several sources [8].

The concept of a smart city has attributes that can be referred to as dimensions and there are 6 dimensions of the concept of a smart city, as shown in Figure 1 below [8]:

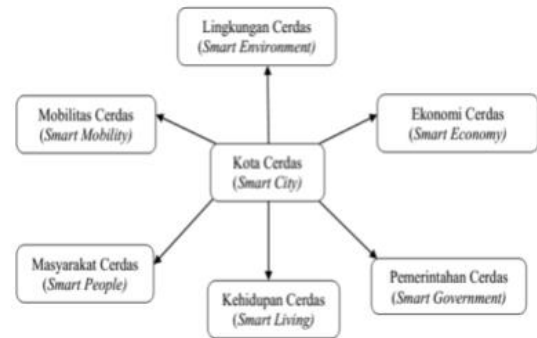


Figure 1. Six Dimensions of Smart Cities [8].

### 2.3. Google Maps API

Google Maps API which is a simple Application Programming Interface service in the form of a world map that is used to view an area, where the API itself is a program code interface or application or web interface that is made to be able to access or run or utilize features provided by Google [3].

### 2.4. Cartesius Method

The cartesian coordinate system of two-dimensional flat planes, the distance between two points can be searched through equation [6]:

$$D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \dots\dots\dots(1)$$

Where:

- D: Linear distance between 2 points
- xi: Position of the point i (1, 2, ..., n) on the x-axis
- yi: Position of points i (1, 2, ..., n) on the y-axis

because there is a comparability between different angles of latitude and longitude with different distances, it can be different positions in cartesian coordinates proportional to differences in position in latitude and longitude [6].

$$D \approx D_\theta$$

$$D_\theta = \sqrt{(\lambda_2 - \lambda_1)^2 + (\varphi_2 - \varphi_1)^2} \dots\dots\dots(2)$$

Where :

$D\theta$ : Angular distance between 2 points

$\lambda_i$ : Position of points  $i$  (1, 2, ..., n) at a latitude in degrees

$\phi_i$ : The position of the point  $i$  (1, 2, ..., n) on the longitude in degrees

The purpose of this formula is to find a search point, not to calculate the distance between them so that what is compared is the value of the angular distance between the specified coordinates and the coordinate points created in the database [6].

### 2.5. Android

Android is a java based system that runs on the Linux Kernel 2.6. Android was released by Google, under the Open Handset Alliance (OHA) in November 2007. Along with the launch, Google also created a Development Tool center and guide to become a developer on the system. Software Development Kit (SDK) and development community guide files can be obtained on the official Google Android website [9]

### 2.6. Web Service

Web Service is a software component that contains a modular, self-describing application that can be published, allocated, and implemented on the web. Web service is a technology to change the ability of the internet by adding web transactional capabilities, namely the ability of the web to communicate with each other with program-to-program (P2P) patterns. The focus of the web has been dominated by the program to user communication with business-to-consumer (B2C) interactions, while the transactional web will be dominated by program-to-program with business-to-business interactions [5].

### 2.7. System Analysis

The system is made using the concept of web service. where the admin is useful in managing data such as adding location data for new batik crafts, editing location data, deleting location data and seeing details of data entered into the server.

Then the server will send location data that has been entered by the admin to be accessed by the user using an Android smartphone that has been installed this batik location recommendation application. In addition, users also get a recommendation for the closest location from their position in the form of a list of 5 closest locations. Users can also see the entire mapping of batik craft locations in the Bangkalan district. In addition, users can also see details of the place of batik craft such as name, address, phone, and the advantages of these craft places. Users will also be directed to the google maps application if they want to find the closest route that will allow the user to get to the location of the craft.

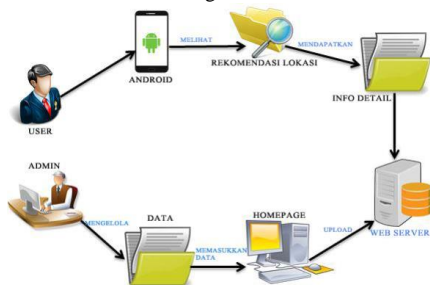


Figure 2. Application Design

Explanation of Figure 2 application design using the web service system above, that is, the admin manages the data and enters it into the database server. While the user sees the recommendation data and detailed info data from the database server that was previously entered by the admin.

### 2.8. Admin System Flowchart

The following below is an overview of the system admin flowchart.

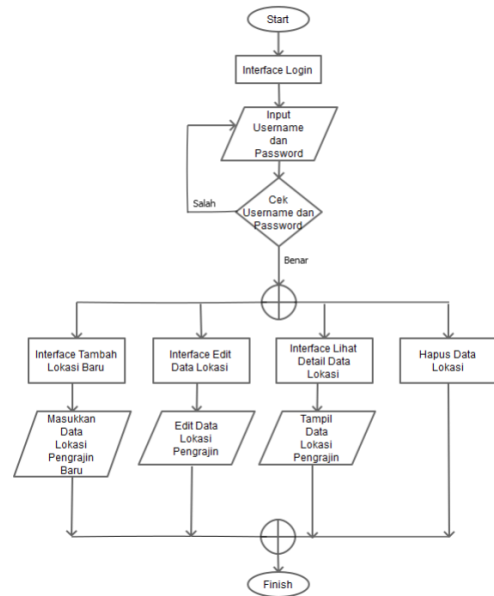


Figure 3. Admin system flowchart

In picture 3 above is the system admin work process. The following description from Figure 3.2:

1. Begin by entering your username and password to log in.
2. When you can log in there will be a check whether the username and password are correct.
3. If the username and password are correct, they will be directed to the admin dashboard page.
4. In the admin dashboard page, the admin can manage data such as adding new location data, editing location data, deleting location data, and viewing details of location data that has been entered into the server.
5. The process is complete.

### 2.9. User Flowchart

The picture below is a flowchart of the user's system. Where in the user system there are 2 main features namely Recommended Location Crafts and Handicraft Location Data

### 3. Result and Discussion

#### 3.1. Admin

##### Admin Dashboard Page

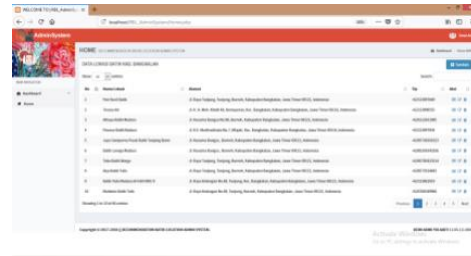


Figure 5. Admin Dashboard Page

Figure 5 is the admin dashboard page. This page contains data on the location of batik crafts in Bangkalan district. There are also several buttons that can be used to add new craft location data. Besides that in each table field, there are several action buttons that can be used to edit craft location data, view details of craft location data, and delete location data.

#### 3.2. Display Location Craft Data

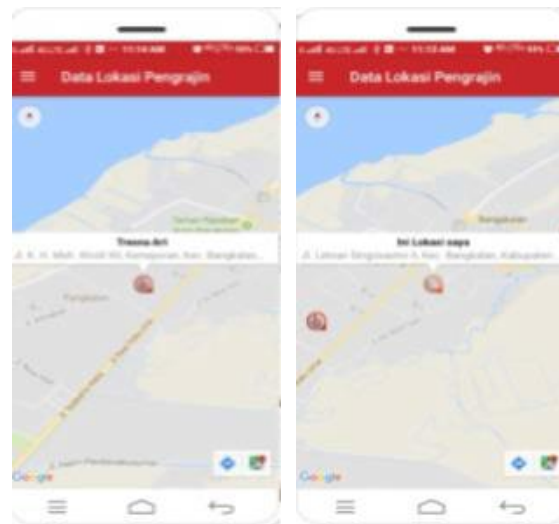


Figure 6. Display Location Craft Data

Figure 6 Display of Craft Location Data Figure 6 is a display of craft location data. In the form of a map of the distribution of all craft locations in Bangkalan district. In this feature the user will know his position is on the map, and also can see several craft locations scattered in the Bangkalan district.

#### 3.3. Analysis Of Results

Based on the results of the system analysis made using the Cartesian Method on the Google Maps API to recommend searching for android-based batik handicraft locations in the Bangkalan Regency case study,

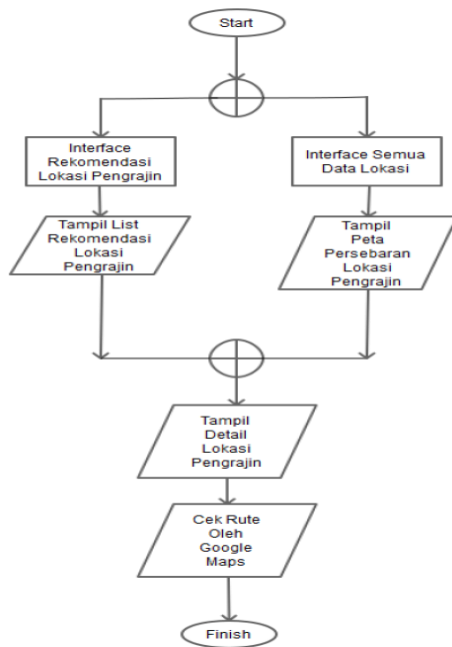


Figure 4. User system flowchart

In Figure 4 above is the work process of the user system. The following description from Figure 3.3:

1. The user will be directed directly to the craft location recommendation menu or craft location data.
2. If the user selects the craft location data, the system will display the position of the user and map the location of the existing batik craft.
3. After the craft location mapping appears, the user can see the details of the chosen batik craft location, then the user will also be directed to the google maps application when clicking on the route icon.
4. If the user chooses a craft location recommendation, the system will direct it to 5 list of the closest craft locations around the user.
5. In the location recommendation menu, this applies the Cartesian method to determine the distance.
6. After the craft location list appears, the user can see the details of the selected batik craft location, then the user will also be directed to the google maps application when clicking on the route icon.
7. The process is complete

there are differences in the distance results obtained from calculations using the Cartesian Method with the Google Maps application. The distance calculation using the Cartesian Method which calculates through the angular distance using the cosine law equation is closer than the distance calculation in the Google Maps application which calculates using the distance of the route. The above statement is supported by the picture below.

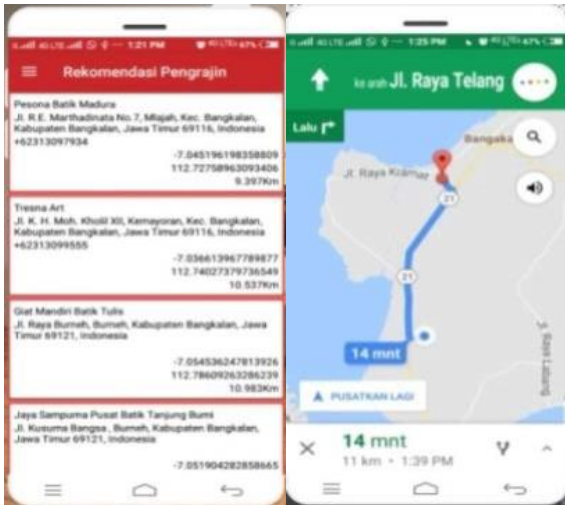


Figure 7. Distance Difference

Based on Figure 7 above the distance found in the location of Madura Batik Charms shows a distance of 9,397 Km from the user's position located on Jl. Raya Telang. While on the route application from google maps the distance listed is as far as 11 km. However, there is a drawback in this application because the resulting distance does not refer to the route to be passed because it only refers to the angular distance generated in the Cartesian method calculation.

#### 4. Conclusion

The following conclusions can be drawn from the research made under the title Use of the Cartesian Method on the Google Maps API to Recommend Searching for Android-Based Batik Crafts Case Studies in Bangkalan Regency is a Research This uses the Cartesian method as a reference calculation to determine the distance of the nearest batik craft location using the cosine law equation of spherical coordinates. Based on the analysis of the results there are differences in the results of the distance of the location of batik crafts after doing the calculations as evidenced by the application screenshot that is running. By using the

Cartesian method the distance can be less than the calculation of the distance of the route on Google Maps.

Suggestions that can be given from research for future system development are:

1. Many methods that can be used for comparison recommend the closest location point of the user.
2. The application is added by creating its own route, so it does not refer to the Google Maps application.
3. This application does not refer to the actual distance contained in the distance of the road to be traveled. That is because in the calculation of the distance used by using angular distance. So that some batik craft locations have visible distances close by using the Cartesian method, but when searching for locations using the actual distance away.

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