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Preface

Jurnal Ecotipe (Electronic, Control, Telecommunication, Information, and Power Engineering) published by the Electrical Engineering Department, Bangka Belitung University currently starting Volume 7 Number 2, October 2020 to Volume 12 Number 2, October 2025 has been accredited by the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia based on Decree No. 158/E/KPT/2021 with 3rd rank (SINTA 3).

Currently, Jurnal Ecotipe volume 9 issue 2, October 2022 has been published. In this edition of the journal, the journal articles are in full English. Starting from volume 9 issue 2 October 2022, for the next editions of the articles in Jurnal Ecotipe, articles will be published using English in their writing and presentation. The articles in this edition of the journal come from academics both from within and from outside the institution.

Our highest appreciation goes to the Reviewers, Editorial Board, Authors, and all parties involved in the preparation and publication of the Ecotipe Journal Volume 9 Issue 2 October 2022. Hopefully, this journal can provide benefits and add scientific insight into the field of Electrical Engineering in particular and engineering in general. Therefore, we still hope for suggestions and constructive criticism for improvements and improvements for the progress of this journal.

Editor-in-Chief

Indexed journal on:



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Design and Build Automatic Rice Winnowing and Weighing Equipment IoT (Internet of Things) Based

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ABSTRACT

Technological developments are growing rapidly without exception in the agricultural sector. Food needs are increasing every year in Indonesia, rice is a staple food for most Indonesian people before being distributed, it is necessary to process rice including cleaning and weighing so that it can reach the hands of buyers. This research was conducted using the R&D (Research and Development) method with a prototype development model. development procedures include the stages of needs analysis, system design, design, prototyping, testing, and validation. The design of this rice winnowing and weighing device uses the telegram application, Arduino ide which is connected to the internet as software and hardware NodeMCU ESP 8266, Arduino Uno as a controller, hx711 load cell sensor as a weighing sensor, power supply as a power supplier, relay module, LCD 16 x 20, buzzer, MG996 servo motor, and AC fan that can be controlled remotely using IoT (Internet of Things).

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1. INTRODUCTION

The development of telecommunications and information technology in Indonesia is growing rapidly, one of which is in the field of the Internet of Things (IoT). A scenario that is used on objects so that data and information can be sent using a network with no human intervention is used today in the world of 4.0. remotely called the Internet of Things (IoT) [1]. The Internet of Things (IoT) is something that certainly exists in every field without exception in agriculture. The growing population in the world, so that from year to year will certainly have an impact on increasing the need for food, is getting bigger which makes the agricultural system have to be better than before [5]. Increasing agricultural production currently has many obstacles, namely in agricultural production, modern technology agriculture, agricultural drones, animal monitoring, and modern greenhouses. The application of Internet of Things technology is a breakthrough that can make agricultural production more effective, and sustainable and accelerate the process of helping jobs farmers [3].

The increasing development of Internet of Things (IoT) technology today has made many changes to the agricultural system in this era [6]. The emergence of new technologies can be used by farmers to increase food production. Developed countries currently easier to adopt technology more than developing countries [7]. In developing countries such as Indonesia, farmers still use traditional and conventional methods compared to advanced technology, one of these things happens because farmers do not understand how to access the latest technology, inadequate knowledge, costs, and uncertainty about the effectiveness of the new technology [2].

To overcome this problem the Internet of Things (IoT) can be applied to help the performance of farmers in maximizing food production in Indonesia, one of which is a rice winnowing tool. The use of winnowing and rice weighing tools is still conventional, farmers in Indonesia still use winnowing tools in the form of winnowing tools made of bamboo so it takes a lot of time and energy [8]. The weighing equipment used by farmers is also an ordinary weighing tool so that after the winnowing process is complete, the farmer must manually weigh the rice again [4].

Over time, these tools can be modified so that their use is more effective. Winnowing and weighing rice tools are made to maximize the performance of farmers, with the concept of a tool that can clean and weigh rice simultaneously using one tool then the rice that has been cleaned and weighed will be directly recorded in a telegram application [9]. this can help with three jobs, namely cleaning, weighing, and recording the results of the rice. This will certainly be very effective and efficient in helping the performance of farmers in Indonesia[10].

2. RESEARCH METHOD

2.1. Device Design

In this study, a device design was made based on the needs that exist in the winnowing and automatic weighing device. The research framework is as follows.

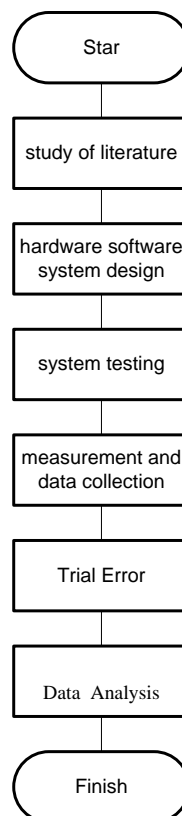


Figure 1. Research framework flowchart

Figure 1. Describes the Flowchart. The research framework starts with a literature study, hardware and software system design, system testing, trial and error, and when the tool has been completed it will be analyzed.

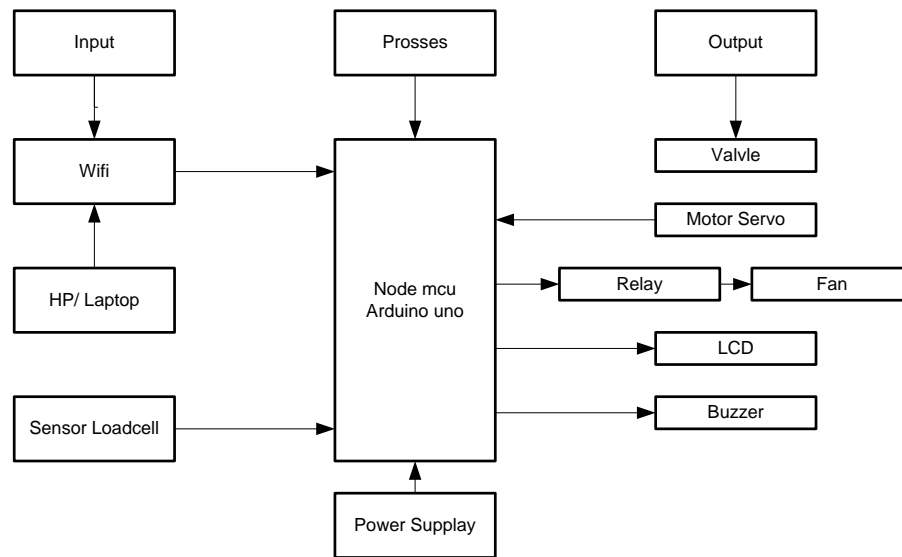


Figure 2. Block diagram of hardware

In figure 2. The process is carried out by the MCU and Arduino Uno nodes that communicate serially and function as a microcontroller, the power flow is obtained by the power supply. The output is obtained from the servo motor which functions to move the valve, the relay functions to control the flow of electricity, the LCD serves to display the results, and the buzzer functions as an alarm signal that the process has been completed. Furthermore, the input is in the form of wifi or hotspot and the loadcell sensor is used as a weight sensor.

2.2. How Automatic Winnowing and Weighing Tools Work

The workings of this automatic winnowing and weighing device are that when the rice enters the reservoir, it starts controlling the tool using a telegram to turn it on then press /star a notification will appear on how to use it starting from speed 1 for low speed, speed 2 for medium speed and speed 3 for high speed, then a notification in the form of the weight of rice that you want to process starting from 1kg to 5 kg if it is appropriate the valve will open, rice will be winnowed using a fan, dirt will fly to the side, while clean rice will fall into the loadcell sensor if the weight has reached then the valve will be automatically closed, the fan will turn off and an alarm will sound indicating the process has been completed, then a notification will appear on the tool's LCD and a telegram in the form of weighing completed.

3. RESULTS AND DISCUSSION

3.1. RESULTS

The design of automatic winnowing and weighing tools based on IoT (Internet of Things) is the design of tools that can be controlled using telegram. The appearance of the tool is as follows.

1. Display of Automatic Winnowing and Weighing Machine.



Figure 3. Automatic winnowing and weighing display

Figure 4 This is a display of the automatic winnowing and weighing machine, the machine has a height of 130 cm and a width of 60 cm with the function of cleaning and weighing rice simultaneously.



Figure 4. Display in automatic winnowing and weighing

In Figure 5. There is a series of automatic winnowing and weighing machines, the circuit consists of various components that are arranged to run the machine properly.

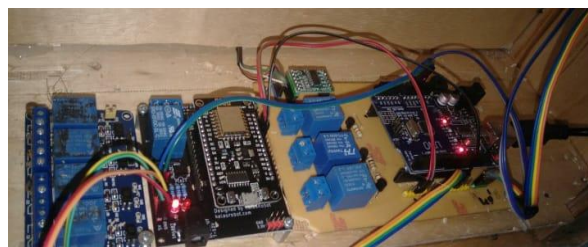


Figure 5. Display of automatic winnowing and weighing circuit

In Figure 8. There is a series of automatic winnowing and weighing machines, the circuit consists of various components that are arranged to run the machine properly.

2. Automatic winnowing and weighing device control application.

The application used to control this automatic winnowing and weighing device is a telegram application that will send notifications in the form of messages.

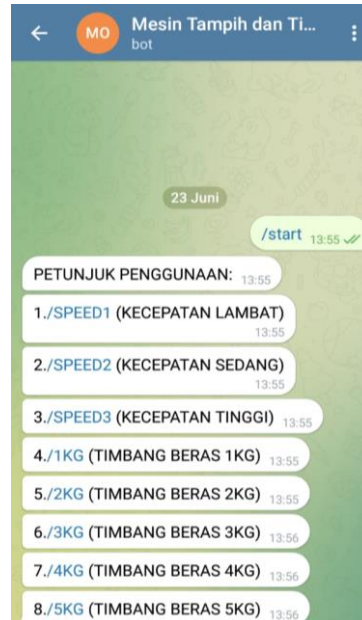


Figure 6. The initial appearance of telegram

In Figure 6. Contains the initial display of the Telegram application, if you want to start then type a star then automatically a message notification will be sent in the form of usage instructions.



Figure 7. Telegram display at work

In figure 7. Contains the display of the telegram application while working if you want to start then type the desired weight for example /1 kg and select a speed for example /speed 1 then a notification message will automatically be sent in the form of weighing 1 kg, slow speed and when finished a notification will come out weighing is complete.

3.2. Test

Table 1. Test Results

Heavy	Speed	Tool results	Digital scales	Before cleaning	After cleaning
 1 kg	 Speed 1	 1050 g	 1042 g		
 2 kg	 Speed 3	 2060g	 2055g		
 3 kg	 Speed 3	 3060g	 3062g		
 4kg	 Speed 2	 4060g	 4060g		
 5kg	 Speed 3	 5060g	 5057g		

In table 1. Trials using 3 speeds, namely speed 1 low speed, speed 2 medium speed, and speed 3 high speed. The weighing process is carried out for 5 weights, namely 1 kg, 2 kg, 3 kg, 4 kg, and 5 kg, this can be seen in the picture above.

3.3. Bibliography and Citation in Text

In the research, automatic rice winnowing and weighing tools were measured and tested using rice weighing 1 kg, 2 kg, 3 kg, 4 kg, and 5 kg. The rice winnowing process uses an AC fan where the dirt will fly to the side while the clean rice will fall under the loadcell sensor. As for sending data, the data sent is in the form of weight data that is obtained from the weight sensor or loadcell and can be seen on the LCD hardware and can also be controlled on the telegram application. During the measurements and tests carried out, it can be seen that the condition of the rice is dirty and the weight of the rice has not been weighed when it enters the top of the funnel. Measurement of weight is divided into 3 times, namely using speed or speed 1 means low speed, speed 2 means medium speed, and speed 3 means high speed.

Sensor measurements using speed 1 or low-speed results obtained on average have a tolerance of 50g while the results from digital scales get an average difference of 46.8g, meaning that the tolerance for a weight of 50g is about 5%, and the accuracy obtained is around 95%. Sensor measurements using speed 2 or medium speed results obtained on average have a tolerance of 60g while the results from digital scales get an average difference of 50.8g, meaning that the tolerance for a weight of 50-60g is about 5% accuracy, which is around 94%. Sensor measurements using speed 3 or high-speed results obtained on average have a tolerance of 60g while the results from digital scales get an average difference of 60g, meaning that the tolerance for a weight of 50-100g is about 5%, the accuracy obtained is around 94%.

At the time of measurement, it can be analyzed that the accuracy of the loadcell sensor is not good, this is due to the small diameter of the sensor so the rice that falls on the right side will weigh differently if it falls to the left side, therefore modifications are needed for the heavy sensor by making a buffer using plywood in the form of round to the top and bottom. The fan and valve controlled by the servo motor can be turned on as needed. In this study, the fan and valve will turn on and off automatically. The fan will be controlled at 3 speeds, low, medium, and high. While the valve controlled by the servo motor previously had problems because the servo motor could not pull the valve properly, which caused too much excess weight, therefore modification of the valve using acrylic was shaped in such a way that it could open and close automatically.

Data transmission is carried out serially from the Arduino Uno to the MCU node which can then be controlled using the Telegram application as desired. The results of the rice for speed 1, namely rice, can be said to be not very clean because the wind obtained is not strong, for speed 2 the rice is clean because the wind is moderate, and for speed 3 the rice is clean, but some grains of rice fly to the dirt catchment, this is because the wind is too strong. The results of the rice tray are quite good, the dirt in the form of powder goes to the left side, and several grains of rice fly and enter the dirt place, this happens because the mass is small and the fan at speed 3 is too tight.

4. CONCLUSION

Based on the results of the design, measurements, and system testing that have been carried out, it can be concluded that the sensor output data is created using the Arduino Ide application then the data will be sent to the MCU node to Telegram in the form of message notifications. Furthermore, the loadcell sensor measurement data that has been processed is displayed in the form of numbers and writing on the LCD of the automatic winnowing and weighing machine. From the test results, the sensitivity of the loadcell sensor can run well, but the accuracy is 95% this is because when the valve is closed, the remaining rice that falls first enters the scale reservoir. The use of the IoT application in the form of telegram can only be accessed locally and the speed of the device response varies depending on the connection speed used.

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Design for A Remote Smart Home Monitor Using the Internet of Things (IoT)

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ABSTRACT

Designing a Remote Smart Home Monitor Based on the Internet of Things (IoT) using the NodeMCU ESP32 microcontroller as a wifi network provider and also utilizing Firebase Technology as a data storage medium. This remote smart home monitor with the Internet of Things concept is safe because only people who have certain access can control home appliances such as turning on lights, fans, opening doors, filling water in the bath, preventing theft, in Remote Smart Home Monitors also uses CCTV cameras that utilize special applications, with the selection of these communication technologies efficiently and also saving power in controlling and monitoring from smart home remotely via smartphones. Test results control data can function properly when the switch control is activated then the lights, fans, doors will automatically turn on. Test results PIR sensor can detect movement or when the door is open and the buzzer will sound sending information on the android application. Test results, the ultrasonic sensor can work when the sensor reads the water distance >15 cm then the pump will work to fill the water and when the sensor distance reads the distance <2 cm then the pump will stop to fill the water.

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1. INTRODUCTION

Technological developments have become an important part of various needs in various fields, For example, the State Electricity Company (PLN) industry. All power tools are devices that require electrical energy to operate. The use of electrical energy today is not very effective, because many household electronic devices use electrical energy and its use is very excessive. Excessive use of electrical energy causes electricity scarcity. As for the need to turn on and off the switch, which is directly connected to electrical appliances. From time to time, there are some electrical devices that are known to be alive when not in use. This may be because the user neglected to turn off the electrical equipment[1]. If you have a large number of electrical appliances in your home, turning them off and on manually can be very ineffective and inconvenient. The use of electrical energy from these tools is also inefficient (waste of electrical energy)[2]. And also an electrical accident can occur due to direct contact with an electric switch. About 78% of the causes of fires are electricity, either due to household appliances, the use of non-standard electrical cables[3].

With the development of the Industrial Age 4.0 which allows remote control of all devices, the level of mobile phone usage in society has become very high. The built system is convenient for application because anyone can control the electrical equipment with a smartphone. In addition to

saving time, saving electrical energy, and easy to control electrical equipment, there is no direct connection to operate the equipment, thereby reducing the possibility of electrical accidents[4].

In Wahyuni Kurniasih's article (2020), using a Raspberry Pi microcontroller with a camera as a home monitoring system and various sensing sensors such as magnets, PIR Sensor, solenoid, etc. like auto lock. Home security. If the sensor detects something in the house, the owner will immediately receive a notification sent from the database to the smartphone application, and the owner record photos and videos installed in the house to record the house[5].

Technological developments are carried out to be more efficient and practical as well as to support human needs for saving electrical energy in our lives. One of them is the household sector, to help improve security and provide user comfort because some household appliances are controlled automatically. Internet of Things (IoT) can be described as everyday object communication where devices are shared automatically[6]. It allows you to form new connections over the internet between things and people, and between things themselves. This is the background of this research to design a remote smart home monitor that uses NodeMCU ESP32 as a command that operates on a real time database concept[7,8,9,10]. The establishment of a smart home monitoring system based on the Internet of Things concept is expected to be beneficial in terms of efficiency, power saving, and home security value.

2. RESEARCH METHOD

This device's design includes an overall schematic that serves as a framework for the stages of this study. The diagram's design is its most crucial component since it might reveal the steps that must be taken to complete this design. such that the overall shape of the research phases diagram will result in a functional system. Explaining the concept, designing the concept of a hardware block diagram (hardware), designing the concept of a software block diagram (software), and creating a flowchart to monitor the smart home are the stages of the study that will be done.

2.1. Equipment Design

This device's design includes an overall schematic that serves as a framework for the stages of this study. The diagram's shape is its most crucial component since it might reveal the steps that must be taken to complete this design. such that the overall shape of the research phases diagram will result in a functional system. Explaining the concept, designing the concept of a hardware block diagram (hardware), designing the concept of a software block diagram (software), and creating a flowchart to monitor the smart home are the stages of the study that will be done.

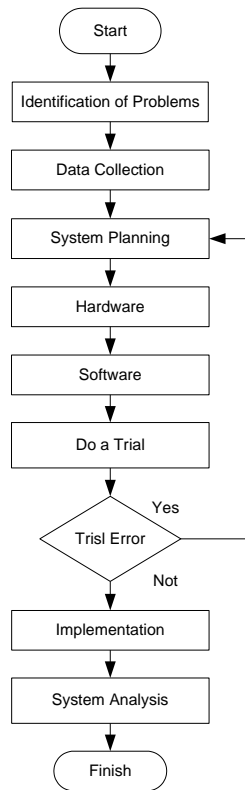


Figure 1. Concept explanation flowchart

In the flowchart Starting with problem identification, data collection, and system design, there is hardware and software. A system test is performed once all procedures have been completed. Implementation should proceed if successful. Execute analysis, come to conclusions, and finish.

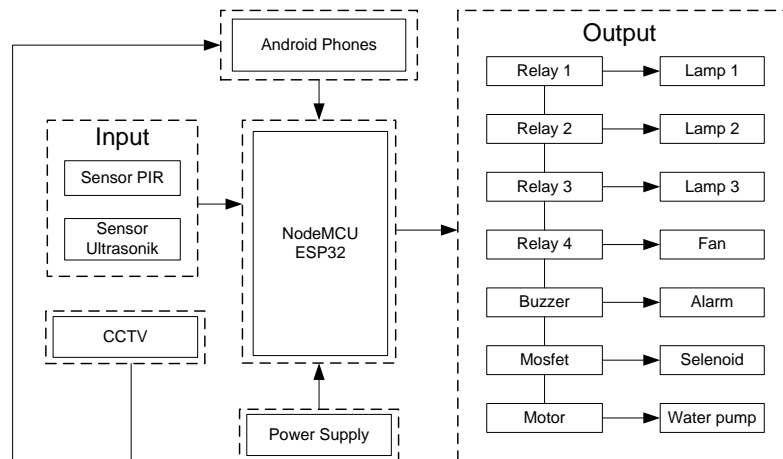


Figure 2. Hardware block diagram concept

The NodeMCU ESP32 microcontroller is used in the hardware block diagram for wifi and may also be utilized for serial communication. Power supply has the ability to rectify mains voltage and modify voltage to usage. The results of this remote smartphone's smart home technology (Android).

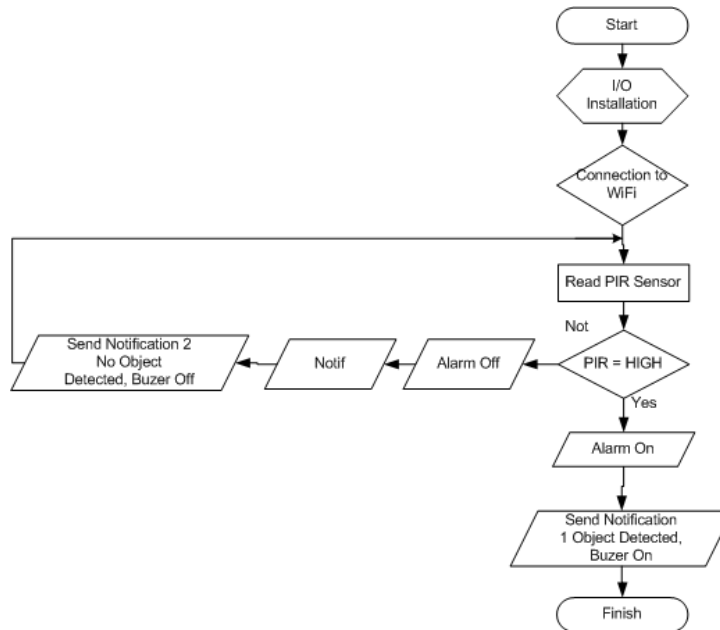


Figure 3. Includes the flow for reading PIR sensor data

The presence of a human may be determined using the flowchart interpretation of the PIR sensor data above. Making commands on the Arduino IDE while utilizing the NodeMCU as a microcontroller allows for the PIR sensor to be activated and allows for the transmission of commands. Following upload and I/O installation, the previously developed software is linked through wifi. The PIR Sensor will read the automatically generated data when all orders have been fulfilled.

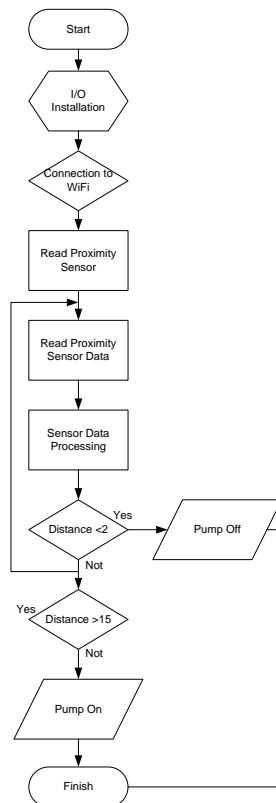


Figure 4. Data reading using distance sensor flowchart

When the water distance is less than 2 cm and greater than 15 cm for water filling, the flowchart of reading the distance sensor data above may be used to detect the water distance. Making commands on the Arduino IDE using the NodeMCU as a microcontroller in order to transmit commands in order to enable the proximity sensor. The previously created software is then uploaded, performing I/O installation, and linked over wifi. When the distance is less than 2 cm and greater than 15 cm, the proximity sensor will automatically fill the water once all orders have been carried out.

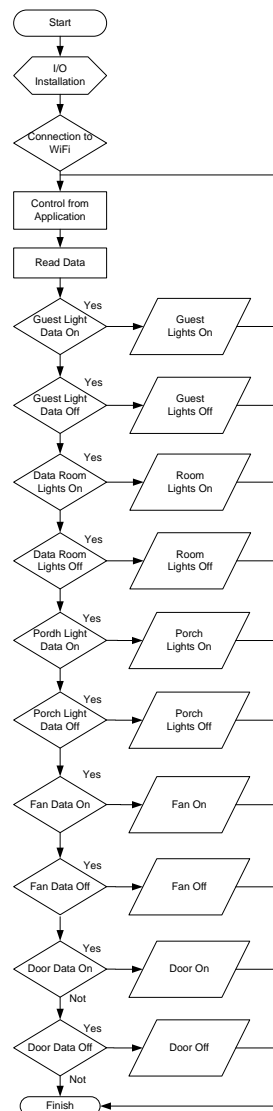


Figure 5. Read control data flowchart

In the flowchart reading the control data above, it is possible to control lights, fans, and doors in order to make use of the data, namely by creating commands on the Arduino IDE and utilizing the NodeMCU as a microcontroller to transmit orders. The previously created application will then react to the automated relay switch-on and perform the I/O installation before connecting via wifi. The control data output will also turn on automatically at this point. The data control output will automatically switch on after all commands have been performed.

2.2. The Operation of Remote Smart Home Monitors

The functional smart house remote smart home system uses a real-time Firebase based on the internet of things and works with NodeMCU, relay, lamp, MOSFET, selenoid, DC motor, buzzer, PIR sensor, and proximity sensor. Then, a laptop that is already linked to the internet is connected to all of

these gadgets. Then, control data, PIR sensor data, and proximity sensor data from the smart home will be shown on the remote monitor smart home.

3. RESULTS AND DISCUSSION

3.1. RESULTS

This remote smart home monitor was created using an Android IoT smart home application and a Ptorotype. The Internet of Things (IoT) application for smart homes uses real-time Firebase technology to remotely monitor control data, PIR sensor data, and proximity sensor data. The prototype's and the smart home application's look is as follows:

1. The Smart Home IoT

Serie of prototypes with the use of real-time Firebase technology based on the Internet of Things, this Smart Home IoT prototype is intended to provide a remote smart home monitoring system.



Figure 6. Shows the Smart Home IoT prototype home's display

This is the Smart Home IoT prototype home in Figure 6.



Figure 7. Shows the Smart Home IoT prototype home's display

Figure 7. The Smart Home IoT prototype house's visible portion is this.

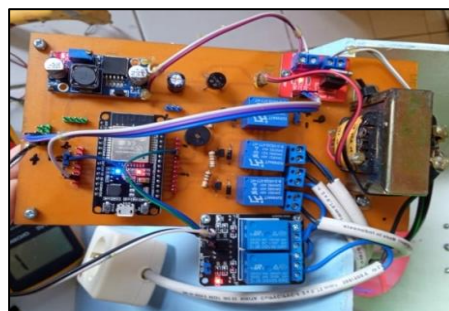


Figure 8. Shows many IoT prototypes for smart homes

Figure 8 shows a collection of Smart Home IoT prototype homes where a variety of parts have been assembled and connected in accordance with the blog's flow diagram.

2. The Smart Home IoT Monitor App

As a monitor that shows control data, PIR sensor data, and proximity sensor data, the Smart Home IoT monitor application may be accessed on Android devices.



Figure 9. Display on the splash screen

Before accessing the login page for the Smart Home IoT monitor application, this splash screen display serves as the application's primary screen.

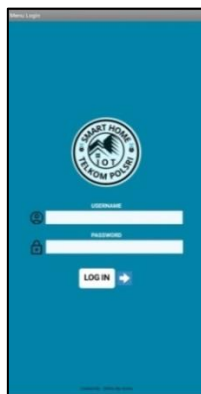


Figure 10. Display for Smart Home Log in

For accessing the main page of the Smart Home IoT application, this Smart Home Log in view is a display that includes a Username and Password.

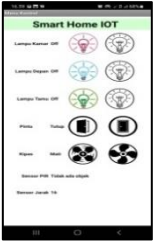

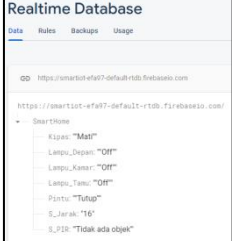


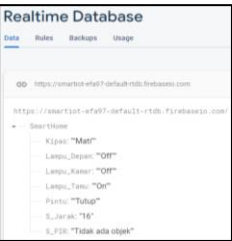




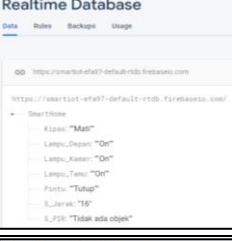
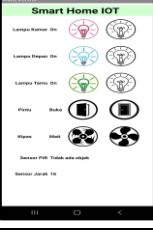

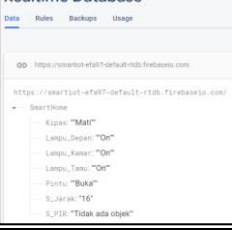






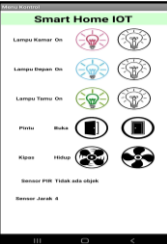


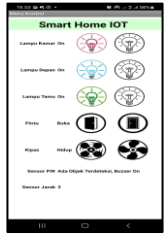




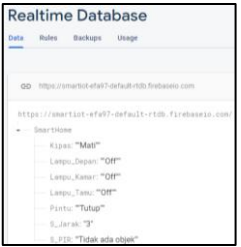
Figure 11. Display for Smart Home Control in

There are control buttons for things like doors, fans, and lighting on this Smart Home control display. The item will automatically turn on or off when the button is pressed.

3.2. Testing

Table 1. Shows the testing results for IoT applications and monitors for smart homes

No.	The commands that are activated	Application Display	Connection	Reading Real-Time Database
1.	Room Lights – Off Headlights – Off Guest Lights – Off Doors – Close Fan – Off PIR Sensor – No Proximity Sensor Object – 16			
2.	Room Lights – Off Headlights – Off Guest Lights – On Doors – Close Fan – Off PIR Sensor – No Proximity Sensor Object – 16			
3.	Room Lights – Off Headlights – On Guest Lights – On Doors – Close Fan – Off PIR Sensor – No Proximity Sensor Object – 16			
4.	Room Lights – On Headlights – On Guest Lights – On Doors – Close Fan – Off PIR Sensor – No Proximity Sensor Object – 16			
5.	Room Lights – On Headlights – On Guest Lights – On Doors – Open Fan – Off PIR Sensor – no Proximity Sensor Object – 16			
6.	Room Lights – On Headlights – On Guest Lights – On Doors – Close Fan – Off PIR Sensor – Object detected by Proximity Sensor – 16			

7.	Room Lights – On Headlights – On Guest Lights – On Doors – Close Fan – On PIR Sensor – No Proximity Sensor Object – 16			
8.	Room Lights – On Headlights – On Guest Lights – On Doors – Open Fan – On PIR Sensor – No Proximity Sensor Object – 4			
9.	Room Lights – On Headlights – On Guest Lights – On Doors – Open Fan – On PIR Sensor – Object detected by Proximity Sensor – 3			
10.	Room Lights – Off Headlights – Off Guest Lights – Off Doors – Close Fan – Off PIR Sensor – No Proximity Sensor Object – 3			

The status of the lights, fans, doors, PIR sensor data, and distance sensor data received on the smart home application are shown in Table 1 as the outcomes of the orders given. Where there are proximity sensors, on/off door fans, PIR sensor readings, and light monitor commands. The Smart Home application's status screen displays the outcomes of the supplied instruction.

3.3. Discussion

The target of this tool's design is to make it simpler for consumers to understand how to handle IoT data from Smart Homes as a system that can save energy and offer information through Android applications. The Arduino IDE is used as the command program that you wish to run by the Smart Home IoT Monitor tool's work system. The created software is then uploaded to the NodeMCU ESP32 as a microcontroller, after which it is connected via real-time technology to a firebase that is based on the Internet of Things. The results of the remote smart home monitor can then be seen on an Android device using an application. The Smart Home monitor's results will be shown together with control data, PIR sensor data, and proximity sensor data.

4. CONCLUSION

The Smart Home application can support with real-time technology monitoring of remote smart homes using only Android, according with results of building tools and apps for remote smart home monitoring. The improvements made throughout the development of this Smart Home application can making features more appealing and usable on a variety of platforms in additions to Android.

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Heartbeat and Body Temperature Monitoring System Based on Artificial Neural Networks

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ABSTRACT

Heartbeat and body temperature are vital sign parameters for paramedics in strengthening the diagnosis of a disease. Medical staff generally use an electrocardiogram and thermometer to check the heart rate and body temperature. These tools are still manual and require concentration to get accurate values. This examination system is less useful because it requires a long time to collect data, increasing the burden on medical personnel and rising operational costs. To improve health services optimally, the authors propose the manufacture of heart rate and body temperature monitoring devices for the elderly based on wireless using the Artificial Neural Network (ANN) method. The proposed method can assist medical personnel in diagnosing heart attacks with three conditions (normal, low risk, and high risk). This study aims to assist medical staff in monitoring patients' health conditions and diagnosing patients' heart disease in real-time. This system uses PPG HRM-2511E sensor to detect heart rate and a DS18B20 sensor to detect body temperature. The data detection process uses a raspberry pi, and the decision-making system uses the ANN method. The results of testing the success rate of detecting the heartbeat of 97.90%, and the body temperature of 99.51%. The heart rate and body temperature data processing using ANN went as expected.

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1. INTRODUCTION

Vital sign examination, especially heartbeat and body temperature, is critical for every human being to do [1] to strengthen the medical diagnosis [2, 3] and the subsequent treatment process [4]. The heart is one of the vital health organ parameters [5] in the human body, which functions to pump blood throughout the body. Based on data from the World Health Organization (WHO), it mentioned that the cause of death globally is caused by heart attacks. In 2014 in Southeast Asia, especially in Indonesia, the death rate reached 35% due to heart disease and 39% experienced by those under 44 years of age. One of the factors causing the high mortality rate in heart disease is the slow handling of examining the patient's disease condition [6].

Checking vital signs such as heartbeat and body temperature is a top priority that the health service centre must consider to make early prevention [7] and reduce mortality. Equipment used by medical personnel to carry out vital sign checks, such as electrocardiograms and thermometers, at hospitals. However, this equipment still has weaknesses related to time efficiency and manually [8]. This condition affects the level of health services such as the slow disease diagnosis process, the data processing not in real-time [9], high operational costs, and the workload of medical personnel increasing. To improve

health services optimally. The researchers designed medical devices that we're able to monitor and display diagnoses of elderly heart conditions in real-time [10].

Several researchers have proposed studies related to vital signs [11], such as monitoring heartbeat [12, 13], body temperature [14], blood pressure [15-17], and breathing [18]. Research results show that the proposed design works well, with an accuracy of 0.7% for heart rate [19] and a body temperature of 0.085% [20]. Proposed vital sign monitoring can be applied to car drivers [21] and prescribing [22] sent in real-time to each patient. However, the authors have not designed decision-making systems using artificial intelligence (AI) methods. Developing a decision-making system using AI methods will facilitate medical personnel in diagnosing patients' illnesses.

2. LITERATURE REVIEW

2.1. Vital Sign Monitoring

Vital signs are the most basic measurement of body functions to help determine a person's health status, especially in medically unstable patients. Vital sign monitoring is an examination related to vital signs to assess a person's physical health, which generally leads to the stage of recovery and helps diagnose the disease early. Vital sign monitoring is essential to monitor the condition of patients undergoing inpatient and outpatient treatment. Typical vital signs change with age, sex, weight, and exercise tolerance. Vital signs can use to monitor the patient's body temperature and heartbeat.

2.2. Body Temperature

Body temperature indicates the presence of metabolism in the human body. Heat production that occurs as part of metabolism and during exercise is balanced by heat loss mainly through evaporation of sweat. Factors that affect body temperatures include biological rhythms, hormones, exercise, stress, and medications. Body temperature can be measured using an analogue or digital thermometer. Average adult body temperature ranges from 36.5 - 37.2 °C. Checking body temperature is crucial to know a person's physical condition and is a routine part of almost all clinical assessments. This examination describes the severity of the disease, such as infection. In this study, the body temperature sensor used is the DS18B20 type.

2.3. Heartbeat

Heartbeat is the number of heartbeats per unit time or beats per minute (bpm). When the heart beats where the heart pumps blood through the aorta and peripheral blood vessels. This pumping causes the blood to press against the artery walls, creating pressure waves as the heartbeat that are felt peripherally as a heartbeat. Furthermore, this heartbeat can palpate to assess the heart rate, rhythm, and function. The normal heartbeat for adults is between 60 - 100 bpm. This study uses the PPG HRM-2511E type of heartbeat sensor.

3. RESEARCH METHOD

The stages of research begin with the development of research concepts based on the references. Furthermore, planning hardware and software systems. Figure 1 shows the process of the research stages. Data information includes the HRM-2511E pulse sensor as the heartbeat input and the DS18b20 sensor as the body temperature data input in real-time. Sensor data will process in the Raspberry Pi module. The next stage is to create a system design script using python programming on the Raspberry Pi IDE. Sensor input data that the server has processed and received will display on the smartphone.

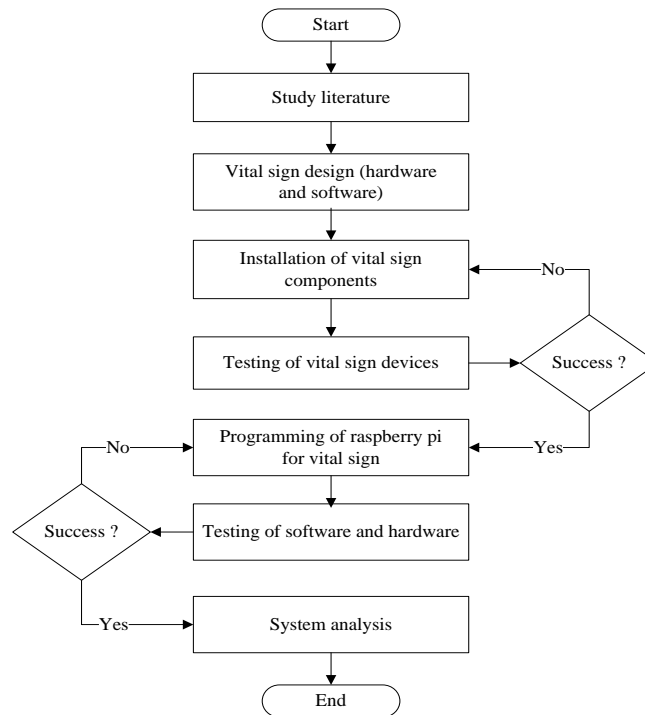


Figure 1. Stage of research

3.1. Block Diagram System

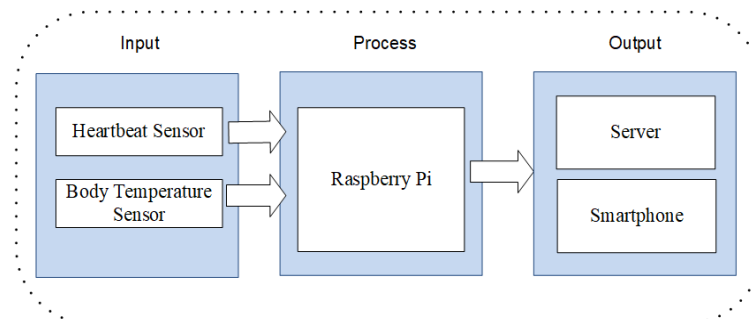


Figure 2. Block diagram system

Figure 2 shows the overall heart rate and body temperature monitoring system using ANN consisting of input, process and output units. On the input unit there is an HRM-2511E sensor which functions as a heart rate detection, and a DS18B20 sensor which works as a body temperature detection. The results of the sensor data input will process by the Raspberry Pi module, which functions as a data processor. The Raspberry Pi module is a liaison between the input and output unit. The data processing results from the Raspberry Pi will display on the server and smartphone.

3.2. Algorithm System

The system's initial state reads sensor data and sends data from the Raspberry Pi module to the server. Data sent and stored on the server will retrieve by software that has been made. The software processes the data and displays it on a smartphone. Any data changes that occur, the raspberry pi module will respond to these changes according to the designed algorithm. If there is no change, the automatic process will repeat itself back to the operation of reading and sending data that will carry out on the system.

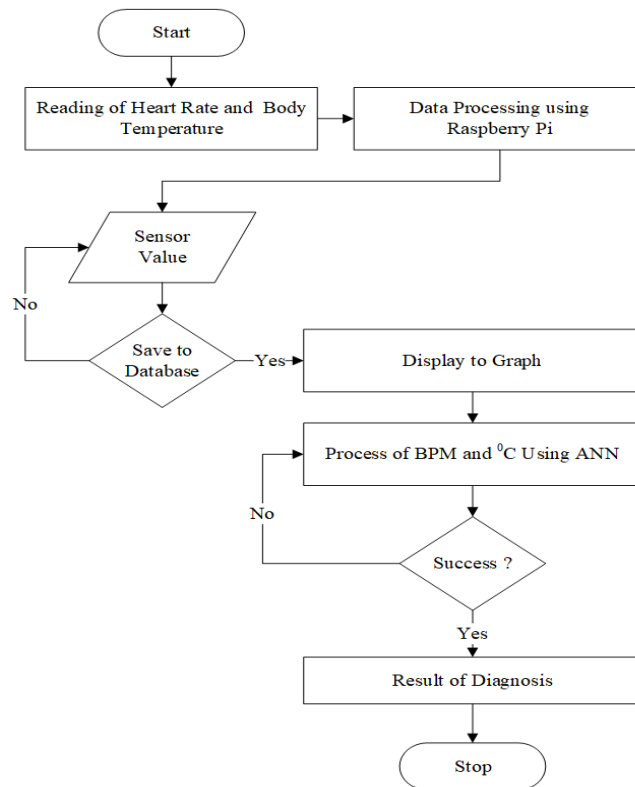


Figure 3. Flowchart of system algorithm

Figure 3 shows the working principle of this system is monitoring the heartbeat and body temperature in real-time.

4. RESULTS AND DISCUSSION

4.1. Testing of Heartbeat Sensor



Figure 4. Retrieval of heartbeat data

The process of testing the data is done by checking the pulse sensor response on each finger first so that the finger has better accuracy. The heart rate sensor used in this test is PPG HRM-2511E.

Table 1. Pulse sensor response on each finger

Number	Finger	Heartbeat (BPM)
1	Thumb	83
2	Index Finger	78
3	Midle Finger	80
4	Ring Finger	79
5	Little Finger	78

Table 1 shows that each finger's pulse sensor response did not differ significantly. The testing takes data from 10 objects with five sampling times. The purpose of receiving data 5 times is to produce the average value of the calculation generated by the sensor. The calculation results from the sensors are then compared with the results of calculations from digital devices for 10 seconds for each object. An estimate of the number of heartbeats using digital tools is done as a benchmark to determine the accuracy of the proposed sensor design. Table 2 obtained the most significant error value of 4.88% and the smallest error of 0%, where the average error of the pulse sensor testing of ten objects is 2.10%.

Table 2. Testing result of heartbeat data

Id Number	Heartbeat (BPM)		Error (%)
	HRM-2511E	Digital Heartbeat	
001	92	94	2.13
002	86	89	3.37
003	95	97	2.06
004	90	93	3.23
005	87	87	0
006	78	82	4.88
007	89	89	0
008	89	91	2.19
009	92	92	0
010	91	94	3.19
Average Error			2.10

4.2. Testing of Temperature Sensor



Figure 5. Retrieval of temperature data

Figure 5 shows the body temperature sensor used in this test is DS18B20. Testing by holding the sensor by hand for 2-3 minutes. Body temperature sensor testing is taken data from ten objects five times. Retrieval of data 5 times aims to produce the average value of the calculations generated by the sensor. The calculation results from the sensors are then compared with the digital thermometer calculations for 2-3 minutes for each object. Estimating body temperature using a digital thermometer is a benchmark to determine the accuracy of the proposed sensor design. The results of table 3 obtained

the most significant error value of 1.34% and the smallest error of 0%, where the average error of body temperature sensor testing of ten objects is 0.49%.

Table 3. Testing result of temperature data

Id Number	Temperature (°C)		Error (%)
	DS18B20	Thermometer	
001	36.48	36.60	0.33
002	36.80	36.80	0
003	36.90	36.60	0.82
004	36.80	36.50	0.82
005	36.90	36.40	1.34
006	36.60	36.60	0
007	36.80	36.40	1.09
008	36.90	36.80	0.27
009	36.80	36.70	0.27
010	36.40	36.40	0
Average Error			0.49

4.3. System Testing



Figure 6. Testing result of device

Figure 6 shows system testing done by sending ten sensor data to the server. System testing determines whether the system is designed to function as expected. The overall test results are carried out by sending data to the server. Table 4 shows the data from ten results sent to the server. System testing aims to determine the entire system, including the interface designed to display data from the sensor.

Table 4. Data testing

Time (AM)	Heartbeat (BPM) HRM-2511E	Temperature (°C) DS18B20	Status
10:07:25	92	36.48	Normal
10:07:28	86	36.80	Normal
10:07:33	95	36.90	Normal
10:07:35	90	36.80	Normal
10:07:40	87	36.90	Normal
10:07:45	78	36.60	Normal
10:07:48	89	36.80	Normal
10:07:50	89	36.90	Normal
10:07:55	92	36.80	Normal
10:07:58	91	36.40	Normal

4.4. Heartbeat and Body Temperature Monitoring Using Artificial Neural Network (ANN)

The heartbeat and body temperature monitoring design include the login menu facilities, data entry (id_number), name, age, gender, address, telephone number, data reports, data collection process, and data storage.

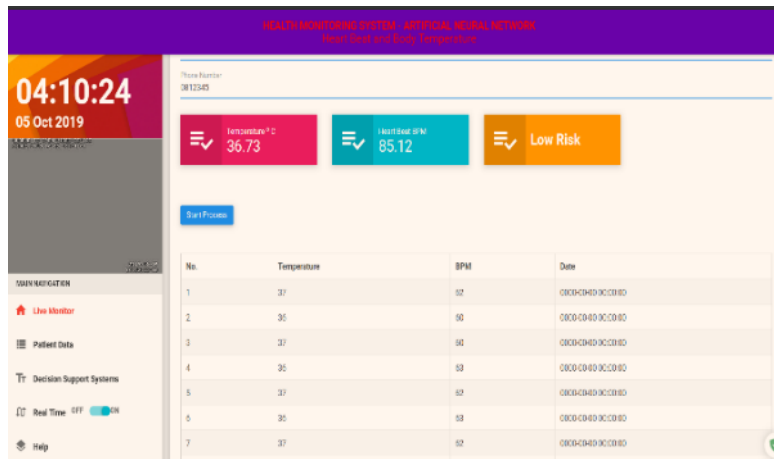


Figure 7. Monitoring system using ANN

Figures 7 show the method of processing heartbeat data and body temperature using the ANN method. Means of collecting data and inputting patient data. After entering patient data, insert the HRM-2511E sensor into the fingers. The DS18B20 sensor stuck to the palm. Next, enter the value of data duration into the time menu and choose the process menu. Patient data that has been processed will display on the monitor screen with BPM (heartbeat) and $^{\circ}\text{C}$ (body temperature) values. The heartbeat and body temperature obtained can save in the save menu. Display patient data can do by entering patient data based on id number. The results of the incoming sensor data will be processed using the ANN method with three conditions. The conditions displayed in the system include normal circumstances, a little risk, and a high risk of an occurring heart attack.

5. CONCLUSION

This research is designed to improve health services and assist medical personnel in monitoring heartbeat and body temperature. The system design can be used by medical staff in real-time using smartphone facilities. The test results show that the design of the proposed heart rate and body temperature monitoring system works with an accuracy rate of 2.10% heartbeat and 0.49% body temperature. The use of the ANN method in the application can run well by predetermined rules.

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Feasibility Study of Raw Material for Hybrid Power Plant in Coastal Cilacap Selatan

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ABSTRACT

Cilacap Regency is a coastal area south of the island of Java. The purpose of this study is to determine the potential of raw materials available in the South Cilacap Coastal area and to determine the potential power that can be generated for the PLTH system through the calculation of the raw material data that has been obtained. This research method begins with direct measurements of wind speed and light intensity. Both devices read data in real time and connect online. The data obtained is processed to determine the wind speed and the average intensity of sunlight. The results of these calculations are entered into the equations to calculate the potential power that can be generated. Based on the calculation, the average wind speed is 3-4 m/s and the light intensity is 54612 watt/m². The results of the calculation of the potential power that can be generated from the PLTB system in the coastal area of South Cilacap is equivalent to 508 watts/day. The potential power that can be generated from PLTS is 10.8 kW/day. The total potential power that can be generated from the PLTH system on the coast of South Cilacap is equivalent to 273.22 kWh/day.

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1. INTRODUCTION

Indonesia is a large and vast country that is bestowed with potential Natural Resources (SDA)[1] as well as Human Resources (HR) with diverse and diverse backgrounds. Potential natural resources can be utilized as much as possible to prosper and improve the economy of the Indonesian people. Abundant natural resources can be used as raw material [2,3] to convert energy into electrical energy in a power generation system [4,5]. SDA can be used as raw material with the greatest potential starting from geothermal; water; Sun; wind; wave; biomass; and others [6,7,8,9,10,11]. Abundant natural resources are used to the fullest to support government programs in meeting national energy needs in the new renewable mix.

Based on Law Number 30 of 2007 concerning Energy, it is stated that in order to regulate the supply and use of energy in a sustainable manner, the central government and local governments require the use of new and renewable energy in accordance with their respective authorities. Based on Government Regulation number 79 of 2014 concerning National Energy Policy, it is confirmed that the government is committed to increasing the ratio of new and renewable energy in the national energy mix by 23% by 2025 [12]. The use of new renewable energy that can be developed is hybrid technology. Hybrid technology is a technology that uses 2 (two) or more generating systems to convert energy into electrical

energy stored in power storage. The hybrid technology applied in this project consists of generating electricity from wind power and solar power.

A wind power plant is a generating system that utilizes energy from wind speed, which is converted into mechanical energy to drive propellers, which are connected to turbines and generators so that they can produce electrical energy. solar power plant, is a generating system that utilizes energy from the intensity of sunlight, which is then converted into chemical energy in the solar panel module, to produce electrical energy.

One of the provinces that has natural resource potential for wind and solar raw materials is Central Java, with its territory stretching from the south coast to the north coast. The southern coast of Central Java stretches from Cilacap Regency to the border with Kulonprogo, Yogyakarta Special Region. Cilacap Regency is one of the areas on the southern coast of Java which has an area of 2,124 km² with a population of 1,906,849 people in 2019. The purpose of this study was to determine the potential of raw materials available in the South Cilacap Coastal area and to determine the potential power that can be used. generated for the PLTH system through the calculation of the raw material data that has been obtained.

2. RESEARCH METHOD

Research on the feasibility study of the potential raw material for a new renewable energy-based hybrid system in Coastal Cilacap Selatan to support the government's program in meeting the new renewable energy mix target of 23% by 2025 was carried out around the Cilacap State Polytechnic campus. The research tools used are divided into 2 (two) types, namely the main tools and supporting tools. The main tools mostly function to assist the data collection process for this research. Support tools mostly function as data acquisition and data processing software. The research materials used are raw materials to support new renewable energy such as wind speed and sunlight intensity.

Sources of data obtained in this study are primary and secondary data sources. The primary data source is direct data collection, namely the measurement of wind speed and sunlight intensity for 24 hours in 6 consecutive months (July-December). Installation of wind speed monitoring equipment is placed on a 10 meter high pole. The situation around the tool is that there are several trees as high as 5-8 meters and there are buildings around it which have a height of 8 meters. The installation of a monitoring tool for the intensity of sunlight is placed in a field area near the Electrical Engineering Study Program building with conditions around the field without obstacles from falling sunlight onto the monitoring tool. Secondary data sources are obtained from the results of literature studies in the form of scientific articles and field observations.

The initial method of this research in data collection was carried out with research preparation consisting of checking tools and calibration of tools. The tools and equipment used in the research are Arduino; 16 x 2 LCD; I2C character LCD; anemometer; sim800 modem; RTC DS1307; 18650 battery; battery holder; battery chargers; plastic box; step-down DC; CB connector; jumper cables; usb cable; sensor data cable. The need for tools and materials after the design of the tool has a discussion of the needs caused by a lack or incompatibility of tools and materials in the design of environmentally friendly lawn mowers based on new and renewable energy. Discussion of tool requirements where the use of basic equipment such as combination pliers, (+) and (-) screwdrivers, wrenches, drills, electric welding, rivet pliers, hammers, markers, rulers, scissors, grinders taken from the tool room can be used in the design process mechanical parts, but the rotary drive holder requires a lathe which requires a good shape and level of precision in order to reduce friction and vibration levels when the knife is made, where the manufacture is carried out in an electrical workshop, Department of Electronics Engineering, State Polytechnic of Cilacap. The mechanical and electrical parts used are tinol, PCB, ferrite chlorite, connecting cable size 0.75, cable terminals, adhesive glue, insulation, fire insulation, tiret, cucumber and spiral then online purchase including rotation speed controller, jumper cable, sensor voltage, current sensor, INA219 sensor, DC motor optocoupler sensor, Solar cell, arduino and battery[13,14].

2.1. Measuring the power potential of wind energy

Measurements are made using an anemometer which is used to measure wind speed in real time. Wind speed is measured for a minimum of 3 months to determine the character of the wind speed in

certain trimesters during the year. The results of the wind speed obtained are entered in the following equation:

$$P = \frac{1}{2} \rho \pi C_p R^2 v^2 \quad (1)$$

Information in equation (1) where P is the power potential that can be generated (watts); ρ is the wind density (kg/m³); C_p is the maximum velocity coefficient with a value of 0.25 – 0.45; R is the turbine blade radius (meters); and v is the average wind speed (m/s).

2.2. Measuring the power potential of solar energy [15][16]

Measurements are made using a luxmeter which functions to measure the intensity of sunlight in real time. The results of the sunlight intensity obtained are entered in the following equation:

$$P = \frac{E}{I_{av} \eta_m} n \cdot p_m \quad (2)$$

Information in equation (2) where P is the power generated by the solar panel module (watts); E is energy (watt hour); I_{av} is the average luminous intensity (W/m²); η_m is the efficiency of the module (%); n is the number of modules; and P_m is the maximum power of a module (watts).

3. RESULTS AND DISCUSSION

3.1. Making Device for Data Retrieval

The process of making a data collection device consists of an anemometer that is associated with the process of collecting wind speed data. The data obtained can then be processed in real time and can be connected online with the website. The wind speed data collection process is carried out in a tower around the electrical engineering building with position coordinates at 7°43'06.5" South Latitude - 109°01'10.4" East Longitude at an altitude of 10 meters. The situation around the building is that there are trees that are approximately 5-7 meters high and there is also a 34-meter-high joint college building. Wind speed is stochastic, meaning that the data obtained cannot be conditioned because the wind is a natural trait that moves freely and randomly anywhere and anytime. The wind speed data processing approach is carried out using the Weidbull statistical method. Making the next device is taking data from the luxmeter which is related to the process of collecting data on the intensity of sunlight. The data obtained can then be processed in real time and can be connected online with the website. The process of collecting data on the intensity of sunlight is carried out in the area of the PNC electronics engineering building which has position coordinates at 7°43'06.5" South Latitude - 109°01'10.4" East Longitude. The value of the intensity of sunlight obtained varies depending on the weather in the data collection process, but the value of the intensity of sunlight at its peak at around 09.00 to 15.00 is the same value. The device that is made processes data every 10 minutes and the data is collected so that the average highest value is taken.

3.2. Analysis of Raw Material Data Collection Process for New Renewable Energy

The process of collecting wind speed data in the southern coastal area begins with making a wind speed measuring sensor connected to an anemometer as shown in Figure 1. Then the sensor is programmed to be able to send existing data in real time and the data can be transferred online via the android program. The data collected during the day is calculated with the average speed using the Weidbull method approach, so that the average wind speed is obtained for a full day. Based on the equation for calculating the power potential that can be generated from wind energy, the average wind speed in the southern coastal area is 3-4 m/s. This is evidenced by the data listed in the table in the data collection process. If it is known that the wind density value is 1.2 kg/m³. The blade radius used is 1 meter and the maximum speed coefficient value is 0.25. So based on the calculation, the potential value of wind energy generation in the coastal area of South Cilacap is 101,736 watts. In this project, it is planned that there will be 5 installed wind turbines, so that the total potential power that can be generated is 508 watts/day or equivalent to the energy produced of 12.2 kwh/day.

Table 1. Primary data of wind speed

Date	Time	Wind velocity (m/s)
August 1, 2020	22:31:00	2,83
August 2, 2020	02:13:00	4,9
August 3, 2020	10:23:00	5,65
August 4, 2020	12:27:00	5,09
August 5, 2020	05:43:00	8,86
August 6, 2020	09:55:00	4,52
August 7, 2020	11:56:00	3,77
August 8, 2020	15:32:00	5,28
August 9, 2020	23:11:00	5,28
August 10, 2020	03:09:00	4,71
August 11, 2020	06:06:00	13,19
August 12, 2020	09:03:00	3,77
August 13, 2020	16:02:00	4,52
August 14, 2020	19:11:00	6,35
August 15, 2020	20:12:00	3,96
August 16, 2020	21:15:00	3,77
August 17, 2020	22:18:00	3,77
August 18, 2020	17:19:00	4,15
August 19, 2020	18:21:00	3,39
August 20, 2020	04:24:00	9,52
August 21, 2020	07:26:00	3,58
August 22, 2020	06:27:00	5,28
August 23, 2020	08:29:00	5,65
August 24, 2020	02:37:00	4,9
August 25, 2020	01:38:00	4,15
August 26, 2020	00:33:00	5,47
August 27, 2020	17:30:00	6,41
August 28, 2020	12:39:00	8,29
August 29, 2020	22:45:00	4,15
August 30, 2020	20:48:00	5,77
August 31, 2020	18:49:00	6,25

Table 1. Shows primary wind speed data taken in the coastal area of South Cilacap using an anemometer that is connected to an android-based and real-time data collection device. Based on Table 1. The highest speed occurred on August 13, 2020 at 06.06 WIB at 13.19 m/s and the lowest speed occurred on August 1, 2020 at 22.31 WIB at 2.83 m/s. The wind speed data value reaches the highest point above the average because the device reads the wind speed data when the highest value is stored and processed by the anemometer wind speed measurement system that has been programmed. So that the value of the data obtained for 1 full month for the average value of wind speed has different variance values.



Figure 1. Primary wind speed data collection in the coastal area of Cilacap regency

Next, proceed with the process of taking data on the value of the intensity of sunlight by direct measurement using a luxmeter and a sensor measuring the intensity of sunlight. The solar light intensity sensor is integrated with the android program so that it can be monitored in real time and the data can be accessed online. The workings of measuring the intensity of sunlight with a sensor begins with creating a program with related equations. Then it is done by calibrating the sunlight intensity sensor with a luxmeter as shown in Figure 2.



Figure 2. Primary data collection of sunlight intensity in coastal areas, Cilacap regency

Measurement of the intensity of sunlight was carried out for 24 hours, with the highest value of sunlight intensity obtained at 54,612 watts/m². The value of the intensity of sunlight from the measurement results is always different every hour. If the manufacture of this prototype requires an area of 100 m² and the efficiency of the solar panel module used is around 20-30%, then the potential power that can be generated from a PLTS is 1.63 MW. If the dimension specifications of a solar panel module are 1482 x 992 x 35 mm and are able to produce a peak power of 200 Wp, then the effective area of a solar panel module is 1,470 m². Based on the needs assessment, it was found that the number of solar

panel modules used were 68 solar panel modules with a potential power that could be generated of 10.8 kW/day or equivalent to the energy produced of 261.12 kWh/day.

Table 2. Primary data intensity of sunlight

Time	Sunlight Intensity (watt/m ²)
00:00:00	1
01:00:00	1
02:00:00	1
03:00:00	1
04:00:00	1
05:00:00	1
06:00:00	1
07:00:00	22.089
08:00:00	22.109
09:00:00	33.850
10:00:00	54.612
11:00:00	54.612
12:00:00	54.612
13:00:00	54.612
14:00:00	54.612
15:00:00	33.850
16:00:00	15.400
17:00:00	12.462
18:00:00	1
19:00:00	1
20:00:00	1
21:00:00	1
22:00:00	1
23:00:00	1
24:00:00	1

Table 2. Shows primary data on the intensity of sunlight taken in the coastal area of South Cilacap using a luxmeter that is connected to an android-based and real-time data collection device. Based on Table 2. The value of the intensity of sunlight obtained from 10:00 to 14:00 WIB is 54,612 watts/m². The lowest value of sunlight intensity is at 17.00 WIB at 12,462 watt/m². The conditions for data collection were in a clear sky without clouds throughout the sunrise.

4. CONCLUSION

The conclusion in this study is that a suitable source of raw material to support new renewable energy systems in the Cilacap State Polytechnic area is wind energy reaching 10 kwh and solar energy 20 kwh. Raw material from the wind reaches an average speed of 3-4 m/s and the sun reaches 56,214 watts/m². The highest percentage of raw materials for new and renewable energy systems is solar energy reaching 67% and wind energy at 33%.

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Design of Controlling and Monitoring System for Room Temperature, Lighting, Power, and Energy Using Internet of Things

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ABSTRACT

One goal of a smart home is to save the use of energy. Savings can be made with a control system where the things related to electricity usage will be controlled automatically. This research designs a control system of several parameters in a replica of a room with a monitoring application. Those parameters include room temperature, lighting, voltage, current, power, and energy using the Internet of Things. The room temperature control system uses the DHT11 sensor, the light intensity controller uses the LDR HL01 sensor module, while measuring current, voltage, power, and electrical energy at the load uses the PZEM-004T sensor. The NodeMCU ESP8266 is used as a control center that receives, processes, and sends data to the Blynk application using WiFi. The core of the system is based on the detection of the room temperature threshold and the state of light intensity based on light or dark. From these two conditions, the control center will instruct the relay to turn on or turn off the fan and lighting according to the predefined conditions. If the load is on then the voltage, current, power, and energy data will be acquired and displayed on the Blynk application in real-time.

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1. INTRODUCTION

Almost every building, house, or office requires energy in their daily operation. This energy is usually used for various purposes, including lighting, regulating room temperature, or turning on various electronic devices and existing loads. Given its limited nature, energy needs to be saved in its use. One way to save energy is to implement an automated control system which is often called smart home [1] or home automation [2]. With this automation system, everything related to building or house electricity can be controlled and monitored. The technology that underlies all of this is the Internet of Things (IoT) [1][2]. IoT allows devices around us to be connected to the internet network so that they can be accessed remotely via mobile devices [3]. Furthermore, IoT also allows communication and data exchange between devices without human intervention so that automation can be done.

Considering that many human activities are carried out indoors, several studies on the automation of room temperature control have been carried out. The design of a temperature control system with Android was proposed by [3] with a temperature threshold of 29°C. It was found that the Arduino Uno control distance using WiFi was 150 meters with a data processing delay of 2-3 seconds. Using the

same Arduino Uno microcontroller, [4] developed smart insulation on an automatic room temperature controller using a fan processor with a temperature threshold of 28.5°C. On the other hand, [5] and [6] used a NodeMCU microcontroller with a temperature threshold of 30°C [5], while [6] used several temperature thresholds in the range of 25 to 31°C to set the fan's rpm (rotation per minute) speed. The speed of this fan will affect the use of electricity. The studies above show that the temperature threshold for turning on the fan is different in each study. However, they use the same sensor, namely the DHT11 sensor to measure room temperature.

In addition to room temperature, light intensity in the form of lighting is another parameter that is widely controlled in a home automation system. This is because these two parameters greatly affect the use of electrical power. Regarding room lighting, research carried out by [7] proposes an automation and remote control system for smart house lights based on NodeMCU ESP8266. Meanwhile, [8] designed IoT-based smart lighting for energy-efficient homes. On the other hand, [9] made an IoT-based room lighting decision support system using the MQTT and Tsukamoto Fuzzy protocols. Then [10] proposed optimization of artificial lighting systems, and [11] proposed lighting controller based on adaptive systems. All these studies lead to energy savings so that the electricity usage for lighting is not wasteful. For this reason, evaluation and optimization of lighting installations are necessary so that appropriate savings strategies can be implemented [12]. Furthermore, a monitoring system for electricity usage is needed. This can be conducted by measuring voltage (V), current (A), and power (VA) in real-time using IoT technology [13].

From the discussion above, it can be seen that only one parameter was studied in each study. Accordingly, this study aims to integrate the control of all parameters, namely temperature and light intensity along with monitoring the voltage, current, power and energy used by the load. The components used include a DHT11 sensor as an air temperature detector, an LDR sensor as a light intensity detector, a PZEM-004T sensor as a current, voltage, power, and load energy reader, and an ESP8266 NodeMCU as a data processor with Blynk as the basis for the IoT platform.

2. RESEARCH METHOD

This research was conducted using an experimental method which is divided into several stages starting from block diagram design, flowchart design, software design, hardware design, coding, implementation, testing and discussion.

2.1. Block Diagram Design

The design of the system block diagram is shown in Figure 1. This is the planning and design stage of the input, process, and output to be made. This block diagram makes it easier for us to read the flow of the system as a whole so that the components that act as inputs, controllers, and outputs will be known. From this block diagram, it can be described that the input section consists of 3 sensors, namely the DHT11 temperature sensor, the LDR module light intensity sensor, and the PZEM-004T current, voltage, power, and energy sensors. At the input, there is also a DC source. In the process section, there is a NodeMCU as a controller which will be the center for processing and sending data. This microcontroller already supports IoT functionality because it is equipped with an ESP8266 module that can be connected to the internet network. While at the output 2 relays will be connected to the load in the form of lights and fans. One more output is the Blynk application which will display the control interface and monitoring results remotely on iOS and Android devices.

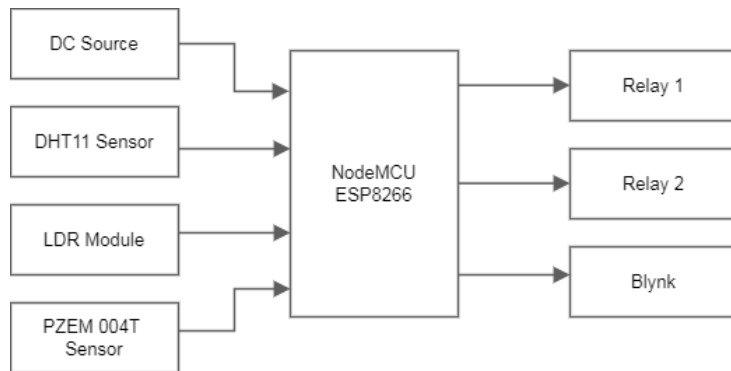


Figure 1. Block diagram of the system

2.2. Flowchart

The flow chart that describes the logic of the system can be seen in the flowchart Figure 2. The system work starts when the equipment is turned on and then immediately initializes the connection with WiFi. If connected then the system will configure the sensor. The three sensors will read the state of the room. When the room temperature has reached $> 32^{\circ}\text{C}$, the fan will turn on automatically, when the room is dark, the lights in the room will turn on automatically, and when the lights are on, the voltage, current, power, and electrical energy sensors will work. The control parameter data will then be sent to the Blynk application via WiFi in real-time. Thus monitoring can be done remotely from a distance.

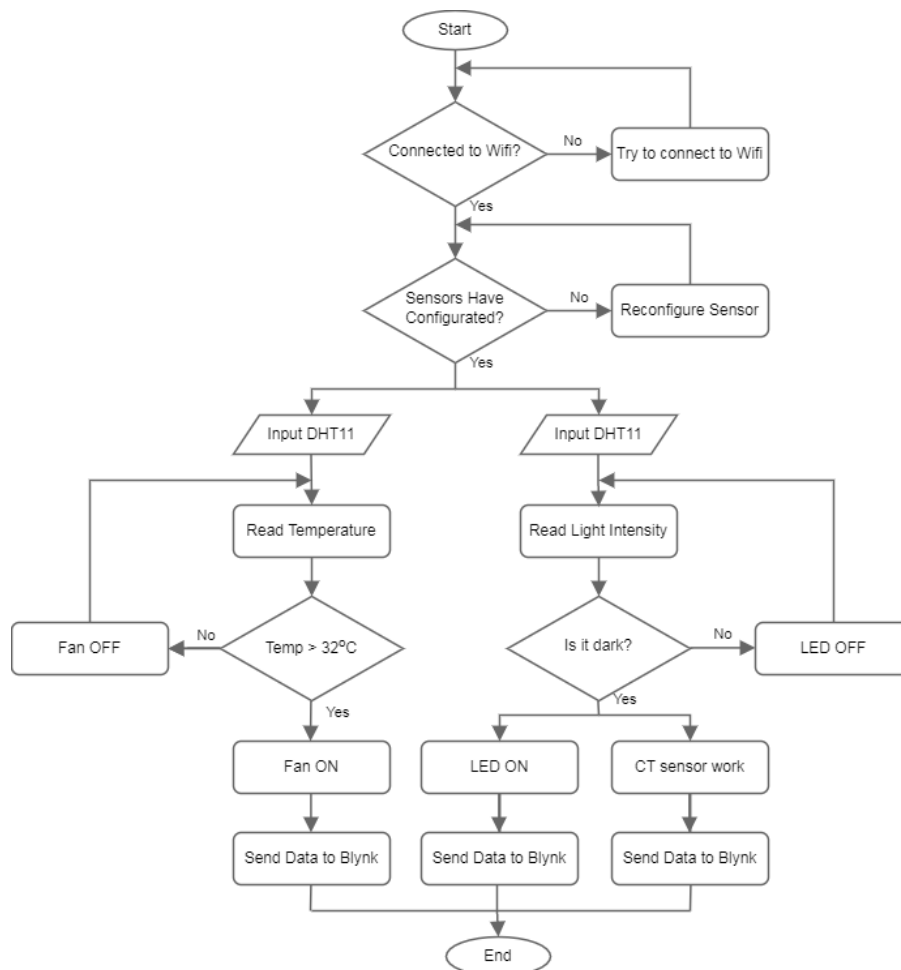


Figure 2. Flowchart of the system

2.3. Software Design

The software design is made so that the device can control the temperature, power, energy, and lighting of the room and then sends data to the Blynk application for monitoring. The software used is Arduino IDE. The program code which is made according to the flowchart design above is in the form of a sketch as shown in Figure 3. After the code is complete, it is uploaded to the NodeMCU board by compiling and uploading it.

```

MiniProject_SmartFan_And_MonitoringWithBlynk | Arduino 1.8.13
File Edit Sketch Tools Help

MiniProject_SmartFan_And_MonitoringWithBlynk
29 Serial.begin(9600);
30 pinMode(fan, OUTPUT);
31 Blynk.begin(auth, ssid, pass);
32 dht.begin();
33
34 void loop()
35 {
36   delay(2000);
37   float t = dht.readTemperature(); // suhu
38   float h = dht.readHumidity(); // kelembaban
39
40   if (isnan(t) || !isnan(h)) {
41     Serial.println("Periksa konfigurasi pin/kabelnya");
42     Serial.println("Sensor tidak terbaca");
43     return;
44   }
45   if (t>=32) {
46     digitalWrite(fan, HIGH); // eksekusi
47     led.on();
48   }
49   else {
50     digitalWrite(fan, LOW);
51     led.off();
52   }
53   Blynk.virtualWrite(V5, t);
54   Blynk.virtualWrite(V6, h);

```

Figure 3. Coding in Arduino IDE

The Blynk application is used as a medium to display data sent by NodeMCU ESP8266. Figure 4 shows the architecture of the Blynk application that can exchange data with the NodeMCU ESP8266 via the Blynk Cloud using the internet network. In this case, the Blynk server receives data on temperature, current, voltage, power, energy, and fan and light status to be displayed on the smartphone.

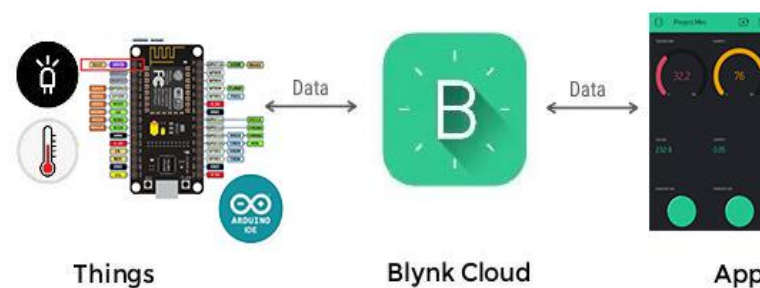


Figure 4. Blynk architecture: Things – Cloud - Apps

2.4. Wiring Diagram

The design of the hardware wiring of the tool made is shown in Figure 5. This wiring diagram contains the electrical circuit between components which will later be used as a reference for manufacturing the tool. The software used for this design is Fritzing.

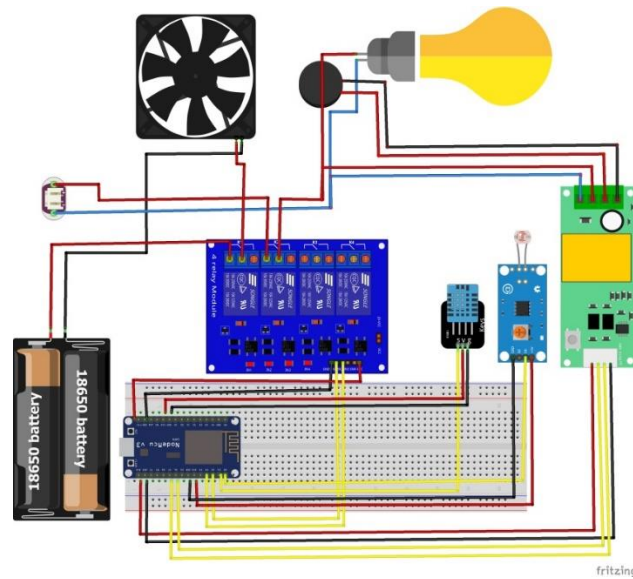


Figure 5. Wiring diagram of the system

From the wiring diagram above, it can be seen that the components used are NodeMCU, breadboard, 12V fan, DHT11 sensor, LDR module sensor, PZEM-004T sensor, relay, LED light, and DC power supply. The real components of the sensors are shown in Figure 6.

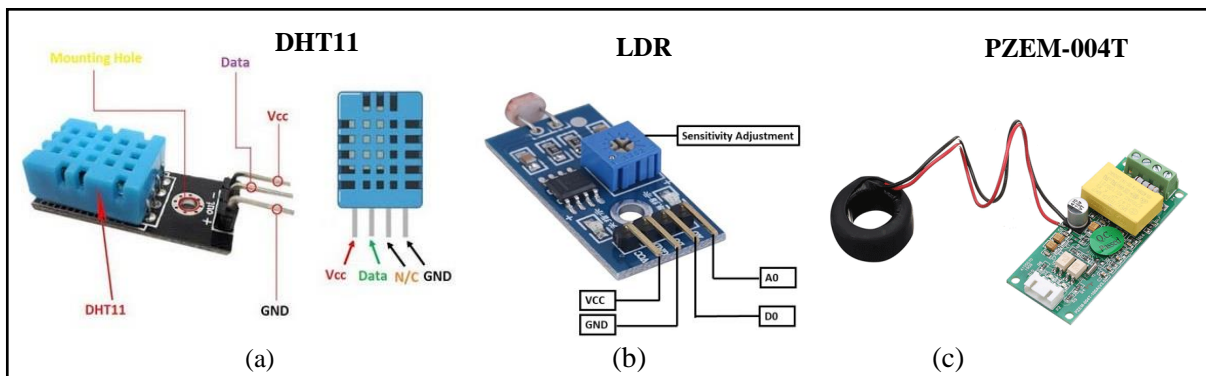


Figure 6. (a) DHT11, (b) LDR, and (c) PZEM-004T Sensors

The DHT11 sensor as shown in Figure 6 (a) is used to measure room temperature and humidity. Inside the DHT11 sensor there are 3 main components, namely the thermistor type NTC (Negative Temperature Coefficient) to measure temperature, humidity sensor with resistive characteristics to changes in water content in the air, and a chip that converts analog to digital and produces output in single-wire format, bi-directional or single bi-directional cable.

Meanwhile, Light Dependent Resistor (LDR), Figure 6 (b), is a type of resistor that is sensitive to light where the resistance value is influenced by the intensity of the light it receives. In this system the LDR sensor is used to sense the light intensity to turn on or turn off the room lights.

The PZEM-004T sensor, Figure 6 (c), is a sensor that functions to read directly the output value of the voltage, current, active power and energy used in the load. Serial communication is used by the PZEM-004T sensor to output.

3. RESULTS AND DISCUSSION

In accordance with the purpose of this study which is to create and test a room temperature and lighting control system automatically along with monitoring voltage, current, power, and energy, controlling and monitoring all these parameters was carried out on a replica room measuring 30 cm x

15 cm x 15 cm. Then the control and monitoring results are displayed in real-time on the Blynk application.

Tests are carried out directly on the prototype of the room that has been made. In this case, the DHT11 sensor was tested with a match to get a fast temperature change, while the LDR sensor was tested with a smartphone flash to get a dark to light change, and the PZEM-004T sensor was tested with a light load. For the load, 3 LED lamps were used with different types of watts which are 8, 15, and 18 watts. The results of these experiments can be seen in Tables 1, 2 and 3 below.

Table 1. Testing result of DHT11 sensor

Temperature condition	Fan
Initial temp 29°C	OFF
temp 32.5°C	ON
temp 29.1°C	OFF

Table 2. Testing result of LDR sensor

Room condition	LED
Dark	ON
Flashlight is ON	OFF
Flashlight is OFF	ON

Table 3. Testing result of PZEM-004T sensor

LED in 10 minutes ON	Voltage (V)	Current (A)	Power (W)	Energy (Kwh)
8 watt	223.2	0.05	7.6	0.03
15 watt	224.5	0.09	14	0.03
18 watt	223.2	0.10	15.7	0.03

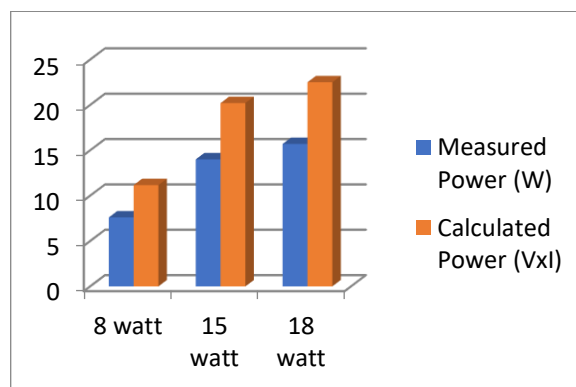


Figure 7. Comparison of measured power (W) with calculated power (VxI)

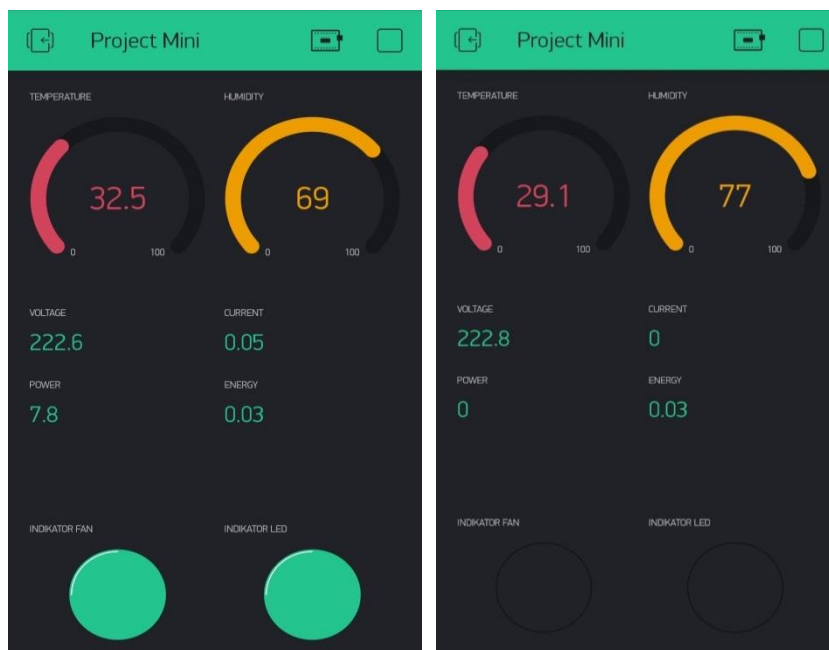
Table 1 shows the results of testing the DHT 11 temperature sensor where the fan works according to the set temperature threshold, which is 32°C. The fan will be OFF if the temperature is less than 32°C and ON if the temperature is higher. Likewise, the LDR sensor is already working to turn the lights on and off when they are light and dark, Table 2.

Meanwhile, Table 3 shows the measurement results of the PZEM-004T sensor for voltage (V), current (A), power (W) and energy (Kwh) for 8 watt, 15 watt and 18 watt lamp loads. The voltage when the lamp is ON is relatively the same, while the current increases according to the wattage of the lamp. There is a power difference between what is stated on the lamp, the measurement results, and the theoretical calculation ($V \times I$) as shown in the graph of Figure 7.



(a) (b)
Figure 8. (a) Condition when light is ON and (b) OFF

Figure 8 show the test display where the room is dark and the lights are on (a) and vice versa (b). All measured and controlled parameter data are then sent to Blynk, Figure 9. The state that Blynk displays is when it is dark and a temperature of 32.5°C where the lights and fan will turn on (the fan indicator and the light are green), Figure 9 (a).



(a) (b)
Figure 9. (a) Blynk display when light and fan turn on, (b) when light and fan turn off

Subsequent testing is carried out in the opposite situation, namely in a bright state where the LDR is given light from the cellphone flash light. The data on Blynk, Figure 9 (b), shows the indicator light is off and the LED in the room is also off. The temperature decreased to 29.1°C and the fan also went out. In this state, the measured voltage on the PZEM sensor is 235.5 V while the current flowing in the LED lamp load is 0.00 A.

All the experiments that have been carried out above show that the controlling and monitoring system created and applied to the replica room has been running well. In this case, the integrated parameters of temperature, lighting, voltage, current, power, and energy can be monitored from a single mobile-based application using a smartphone through an internet connection. Furthermore, not only those parameters, humidity, voltage, and current are also can be acquired and displayed as complements, Figure 9 (a) & (b). This system can provide insights into the energy usage of the building or homes on a daily basis. Knowing this real-time energy usage pattern, it is expected that a further energy savings scenario can be implemented.

4. CONCLUSION

This research has created and tested a control and monitoring system for room temperature, lighting, power, and energy as well as humidity, voltage, and current as complements based on the Internet of Things using the NodeMCU ESP8266 microcontroller and the Blynk application. The core of the system made is based on detecting the room temperature threshold with a DHT11 sensor and identifying light and dark conditions or light intensity with an LDR sensor. Then from these two conditions, the NodeMCU as a processor will instruct the relay to turn on or turn off the fan and lighting according to the conditions required. If the load is on, the PZEM-004 sensor will work to acquire voltage, current, power, and energy data. Furthermore, all parameters will be sent and displayed on the Blynk application in real-time. This prototype system has worked well and can be further developed to include more controllable parameters for complete home automation, such as visitor authentication and counter, security system, and audio-video.

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Design of Real-Time Face Recognition and Emotion Recognition on Humanoid Robot Using Deep Learning

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ABSTRACT

A robot is capable of mimicking human beings, including recognizing their faces and emotions. However, current studies of the humanoid robot have treated face recognition and emotion recognition as separate problems. Thus, this study proposed a combination of face and emotion recognition implemented in the real-time system. Face and emotion recognition systems were developed concurrently in this study using convolutional neural network architectures. The proposed architecture was compared to the well-known architecture, AlexNet, to determine which architecture would be better suited for implementation on a humanoid robot. Primary data from 30 respondents was used for face recognition. Meanwhile, emotional data were collected from the same respondents and combined with secondary data from a 2500-person dataset. Surprise, anger, neutral, smile, and sadness were among the emotions. The experiment was carried out in real-time on a humanoid robot using the two architectures. The accuracy of face and emotion recognition using the AlexNet model was 88 % and 56 %, respectively. Meanwhile, the proposed architecture achieved accuracy rates of 96 % for face recognition and 68 % for emotion recognition, respectively. Thus, the proposed method performs better in terms of recognizing faces and emotions, and it can be implemented on a humanoid robot.

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1. INTRODUCTION

The rapid advancement of technology has accelerated robotics research. A robot is an automatic device that can be interpreted as a piece of equipment that can be operated with or without human assistance. Many robots, such as humanoid robots, are currently in use to assist people in their daily lives. A humanoid robot is a human-shaped robot with a body, hands, and head, and a motion system that is designed automatically using various sensors and other supporting components. Humanoid robots have a variety of abilities, one of which is the ability to recognize people around them using their faces. This is accomplished by capturing facial images with a camera embedded as a robot's eye. Humanoid robots can use their ability to recognize faces to interact with humans. The face is a multidimensional visual stimulus that provides a variety of individual information as a person's identity, such as gender, age, race, mood, and emotions. The face has been widely used as a biometric in everyday life. Emotion is another type of information that can be obtained from the face. Emotions are feelings that can motivate

people to act or respond to a stimulus [1]. Emotions or facial expressions at the time and condition experienced by a human being can be used to assess a psychological condition. Because facial and emotional recognition systems utilize still images and video sequences on still images, they can be used as an accurate medium for recognition. The face can be identified by its eyes, mouth, nose, and other features, whereas emotions take many forms, such as smiles, anger, and happiness, which are not the same from one person to the next. Thus, the differences in these features can be extracted into features for facial recognition in order to recognize a person's identity.

Several studies have been conducted using various algorithms to recognize faces and facial expressions. In their research, S. Madanny, Samsuryadi and N. Yusliani discussed facial recognition using the hypersausage neural network method [2]. H. Zhi and S. Liu used the Principal Component Analysis (PCA) method to extract features of the gray-scale face, followed by the genetic algorithm to optimize the extracted features and support vector machine as the classifier [3]. Then, for face recognition, [4] compared two methods: multi-layer perceptron and radial basis function regardless the image quality and illumination. Zhang et al. developed a method for recognizing facial emotions using convolutional neural network and image edge computing [5]. AK. Bahreini, W. Van der Vegt, and W. Westera discussed the use of fuzzy systems for facial emotion recognition [6]. Adeyanju et al. evaluated the performance of various support vector machine kernels for face emotion recognition [7].

The methods mentioned above are quite good at facial recognition and facial expressions, but they have shortcomings such as low accuracy [2-7] and have not been implemented in real-time. In addition, face recognition and expression recognition were not combined into a single recognition system.

Based on the problems described above, this study aims to use a deep learning convolutional neural network (CNN) method to increase the accuracy during testing. CNN is one of the neural networks that has been used in image classification research. CNN is known to be superior to other deep learning in image classifications because of its high level of accuracy. In addition, the facial and emotion recognition system developed in this study is then implemented on a humanoid robot. As a result, the humanoid robot can recognize a person and his emotions in real-time.

The paper is structured as follows: Section 2 describes the methodology used in this study. Section 3 contains the findings and discussions. Finally, Section 4 concludes the paper.

2. RESEARCH METHOD

2.1. Hardware Design

In this study, several hardware accessories were used to support the implementation of humanoid robot, such as:

1. Webcam Camera
2. JX Servo 60KG
3. Arduino
4. Raspberry Pi
5. DOT Matrix

The positioning of the components used in this study was planned as shown in Figure 1 (A-D).

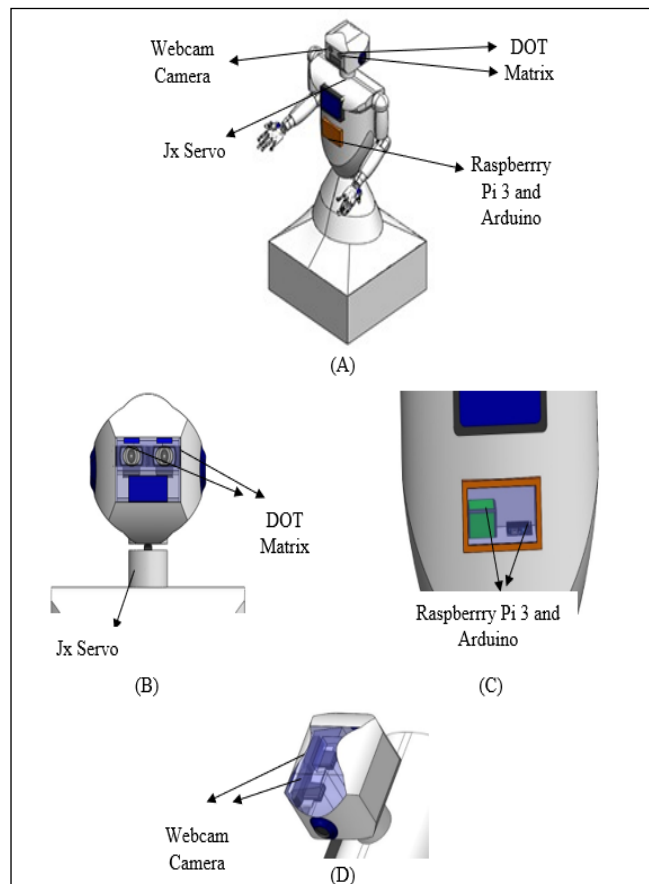


Figure 1. Component design on humanoid robot (A-D)

2.2. Data Collection

The face dataset for this study was obtained from 30 Universitas Sriwijaya students. Figure 2 depicts samples of face data. The data were obtained using a webcam with a resolution of 640×480 pixels. The collected data was then processed and extracted in order to perform face recognition and emotion recognition in the image.

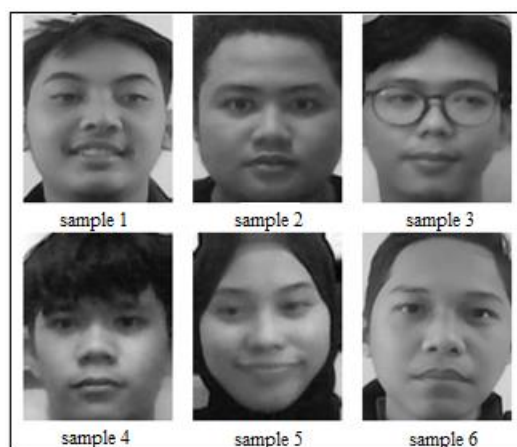


Figure 2. Samples of faces

Meanwhile, the same respondents provided the emotion data. The dataset from Kaggle [8] was used in this study to add variation. Figure 3 depicts a sample of emotions from Kaggle. In this study, the five facial emotions used were: smile, angry, surprise, neutral, and sad.



Figure 3. Samples of emotion (surprise, angry, neutral, sad, smile)

2.3. Face and Emotion Recognition Algorithm

Figure 4 depicts the design of the recognition system embedded in the robot to recognize a person's face.

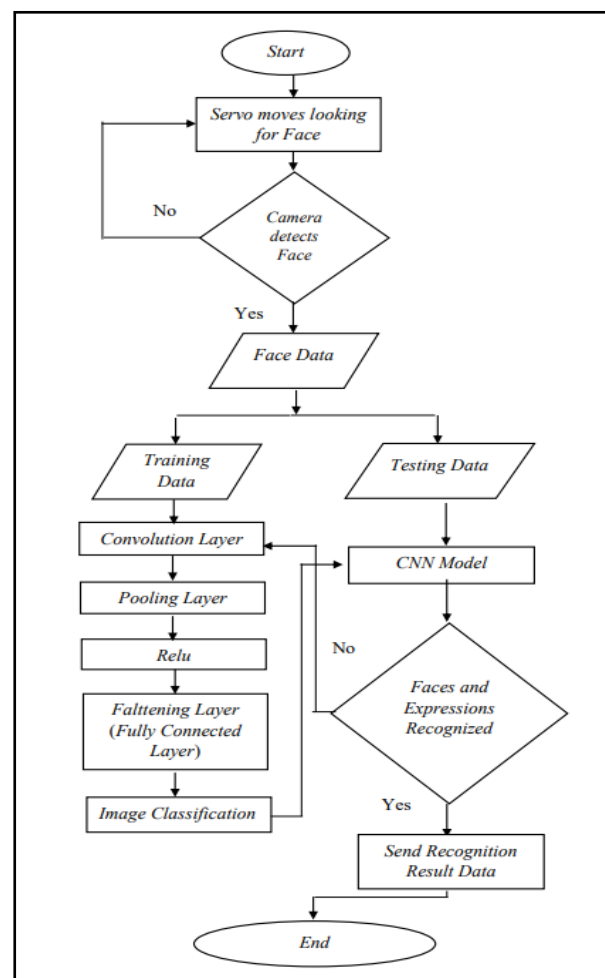


Figure 4. Flowchart of face recognition and emotion recognition

In this study, a convolutional neural network was used. A convolution neural network (CNN) is a variation of the multilayer perceptron that contains or modifies the neural network which is inspired by the visual perception of living creatures [9].

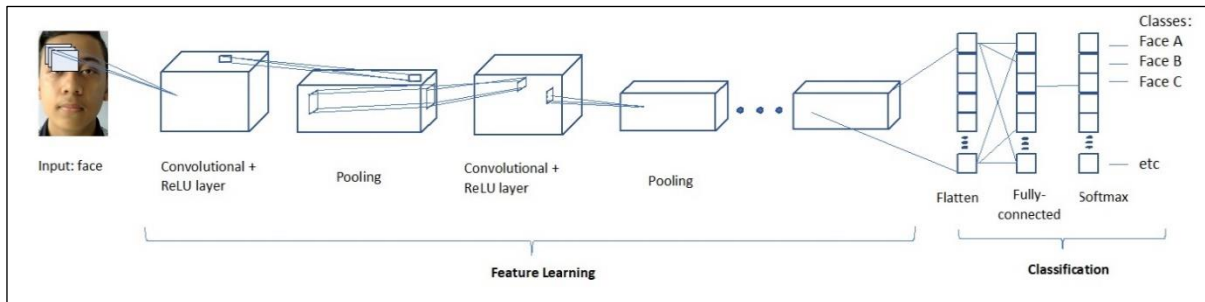


Figure 5. Convolutional neural network [10]

As shown in Figure 5, a layer in CNN has a 3-dimensional arrangement of neurons (width, height, depth). The width and height of the layer are measured, while the depth refers to the number of layers. In general, layers in CNN can be classified into 2 types:

1. The image feature extraction layer, which is at the top of the architecture. This layer is made up of several layers, each of which contains neurons connected to the previous layer's local region.
2. The classification layer is made up of several layers, each with its own set of neurons that are fully connected to the others.

AlexNet is one of several CNN architectures that can be used to carry out the training process. AlexNet contains eight layers, the first five of which are convolutional layers, some of which were followed by max-pooling layers, and the final three of which were fully connected layers [11]. It used the non-saturating ReLU activation function, which showed improved training performance over tanh and sigmoid [11]. Figure 6 depicts the AlexNet architecture.

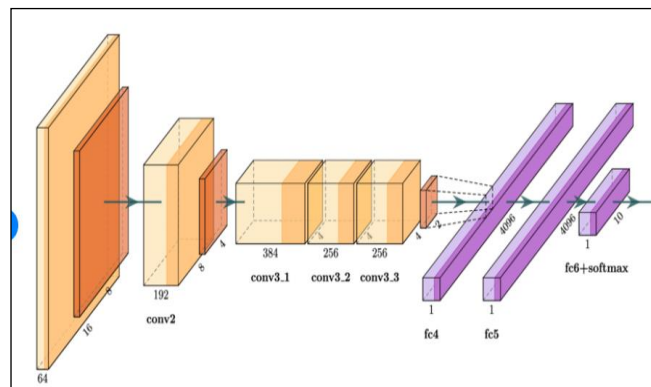


Figure 6. AlexNet architecture

2.4. System Evaluation

The performance of the facial recognition and expression recognition system that has been created is evaluated. It includes accuracy:

$$\text{accuracy} = \frac{TP+TN}{TP+FP+FN+TN} \quad (1)$$

Where TP is true positive, TN is true negative, FP is false positive, and FN is true negative. This formula is used to get the accuracy of face recognition or emotion recognition. A calculation of the accuracy value shows the level of effectiveness of a classification per class.

3. RESULTS AND DISCUSSION

This section discusses the results obtained for real-time face and emotion recognition on a humanoid robot. A new CNN architecture is proposed in this study. The proposed architecture has the same numbers of layers as the AlexNet but with some layer and parameter changes such as changing

the stride and size. Table I shows the parameters used in the proposed architecture. This proposed architecture was also compared to the AlexNet.

Table 1. Parameter of Proposed Architecture

Parameter	Value
Optimizer	Adam, SgD
Dropout After Pooling Layer	0.05, 0.1
Dropout Fully Connected Layer	0.25, 0.1
Dense Layer	64, 128
Learning Rate	0.0001
Batch size	16

3.1. Face Recognition

In this study, the proposed architecture was compared to AlexNet. The training loss of each class can be seen in Figure 7. As shown in the figure, the proposed architecture has lower training loss compared to the AlexNet. The training loss of the proposed architecture and the AlexNet were 0.05 and 0.13, respectively. These results showed that the proposed architecture may give better performance than the AlexNet for recognizing the face.

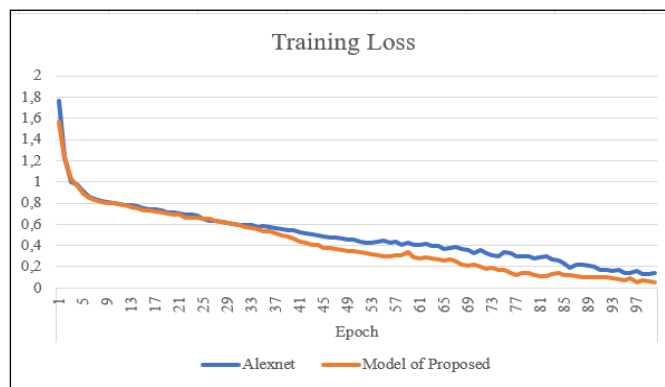


Figure 7. Training loss for face recognition

The accuracy obtained from the testing data is shown in Table 2. As shown in the table, the model based on the proposed architecture outperforms AlexNet. The proposed architecture recognized all of the testing data samples. Meanwhile, AlexNet recognized 26 of testing data. It encountered an error while recognizing samples 2, 8, 10, and 30. The accuracy of the AlexNet and the proposed architecture was 88% and 96%, respectively. These results demonstrated that the model of the proposed architecture was capable of accurately recognizing faces.

3.2. Emotion Recognition

Figure 8 depicts the results of training loss for emotion recognition. Based on the graph, AlexNet's and the proposed architecture's training losses were 0.44 and 0.33, respectively. The results once again showed that the proposed architecture outperformed the AlexNet. It could be due to the parameters in the proposed architecture.

Table 2. Face recognition results

Face Recognition					
No	Name	Accuracy		Recognition / Unrecognition	
		AlexNet	Model of proposed architecture	AlexNet	Model of proposed architecture
1	Sample 1	96 %	98 %	√	√
2	Sample 2	65 %	82 %	x	√
3	Sample 3	100 %	100 %	√	√
4	Sample 4	92 %	97 %	√	√
5	Sample 5	91 %	97 %	√	√
6	Sample 6	85 %	98 %	√	√
7	Sample 7	90 %	99 %	√	√
8	Sample 8	70 %	87 %	x	√
9	Sample 9	84 %	92 %	√	√
10	Sample 10	71 %	89 %	x	√
11	Sample 11	93 %	98 %	√	√
12	Sample 12	96 %	97 %	√	√
13	Sample 13	89 %	96 %	√	√
14	Sample 14	92 %	100 %	√	√
15	Sample 15	90 %	98 %	√	√
16	Sample 16	84 %	95 %	√	√
17	Sample 17	94 %	100 %	√	√
18	Sample 18	92 %	92 %	√	√
19	Sample 19	97 %	96 %	√	√
20	Sample 20	83 %	96 %	√	√
21	Sample 21	95 %	98 %	√	√
22	Sample 22	93 %	98 %	√	√
23	Sample 23	91 %	96 %	√	√
24	Sample 24	100 %	98 %	√	√
25	Sample 25	90 %	98 %	√	√
26	Sample 26	70 %	91 %	√	√
27	Sample 27	92 %	99 %	√	√
28	Sample 28	94 %	100 %	√	√
29	Sample 29	81 %	93 %	√	√
30	Sample 30	77 %	89 %	x	√

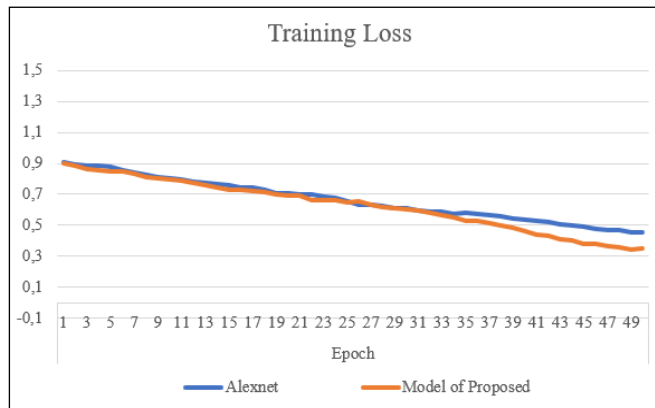


Figure 8. Training loss for emotion recognition

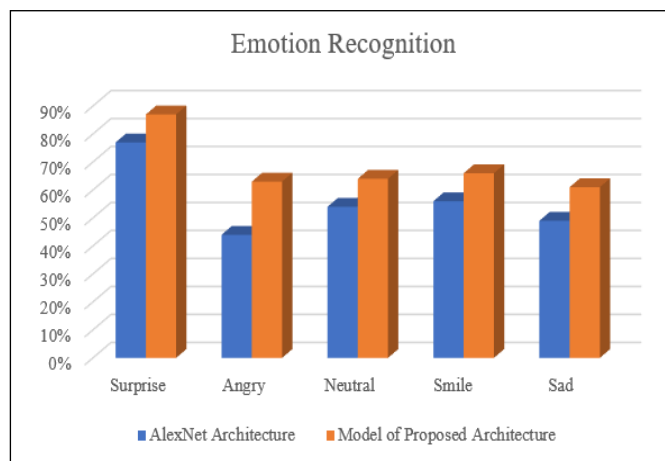


Figure 9. Results of emotion recognition

The accuracy of the proposed architecture and the AlexNet are shown in Figure 9. As shown in the figures, the proposed architecture is more accurate at recognizing emotions. For both models, the emotion of surprise provided the highest accuracy. This could be due to the difference in expression where the person opened his mouth. Sad expression yielded the lowest accuracy; for this expression, the AlexNet provided an accuracy of 56% whereas the proposed model’s accuracy was 68%.

3.3. Face Recognition and Emotion Recognition in Real-time on Humanoid Robot Using Webcam Module

The experiment was carried out in real-time with the help of a camera mounted on the head of a humanoid robot. The test was carried out by combining face recognition and emotion recognition together into one frame and then obtaining the results. This system can identify not one but two people. Figure 10 shows the result of face recognition, emotion recognition, and coordinate point recognition.



Figure 9. Face and emotion recognition in real-time

As shown in Figure 10, the accuracy of the proposed architecture was high enough to recognize both faces and emotions at the same time. The proposed recognition system has the advantage of being able to recognize two people at the same time. In addition, the proposed recognition system can determine the coordinate point, which is useful for determining the robot's position.

4. CONCLUSION

Based on the simulation and testing of face recognition and emotion recognition, it is possible to conclude that the proposed architecture model has better performance than the AlexNet. The AlexNet's accuracy in face recognition and emotion recognition was 88 % and 56 %, respectively. Meanwhile, the proposed architecture model has an accuracy of 68 % for emotion detection and 96 % for face recognition.

This study also showed that the proposed recognitions for humanoid robots can be implemented in real-time. However, the proposed system must be improved to send the coordinate position of the recognized object for future work so that the humanoid robot can work like a human.

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Monitoring and Protection System for Overvoltage, Undervoltage and Unbalance Voltage

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ABSTRACT

The biggest loss in the industry that caused the industry to experience financial losses that should have been the target of achieving 90% - 100% production was a decrease of up to 40%, due to the production machines not running due to excessive loads used resulting in overvoltage disturbances, voltage drops or unbalanced voltages. To overcome voltage disturbances, a monitoring tool and protection system are needed with a method that can cut off the load automatically when a disturbance occurs, namely by using a contactor as a load breaker from the source and then controlled. using a microcontroller that utilizes relays and voltage sensors. So that the results obtained in the manufacture of tools that refer to SPLN and NEMA then obtained overvoltage disturbances ranging from 399V - 413V, then a voltage drop occurs at 320V - 328V, while the voltage test is not balanced in the R phase which is different from the S phase and T phase, and the percentage of unbalance voltage is 3%, then the tool will cut off the load and it is hoped that from the results that have been carried out it can return the achievement target in the industry.

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1. INTRODUCTION

The electric power system has various types of components, including energy sources, energy generators, transmission systems, distribution systems and load centers. There are also various sources of electricity, namely water, steam, gas and other sources. This energy source is converted by the generating system into electrical energy which is transmitted through the distribution network. The distribution network as a divider of electrical energy to load according to consumer needs, this distribution network is directly related to consumers such as companies and housing, so that it determines the continuity of the flow of electric power to consumers. Therefore, the need for electrical power must be designed as well as possible, especially regarding its quality or reliability in distributing electrical energy so that it can guarantee high consumer satisfaction and consumers can see the value of voltage and current.

Securing electric power so that it remains in good condition, a system is needed that can prevent overvoltage, undervoltage, short circuit and voltage differences between the phases will cause a voltage imbalance in one of the phases. Therefore, a protective device will be designed that can cut off the network and can be monitored in case of problems such as overvoltage, undervoltage, unbalance voltage and short circuit.

To secure electrical loads that are sensitive to damage, protection is needed, especially in this case, voltage disturbances [2–5].

2. RESEARCH METHOD

In this stage, the hardware that will be used will be explained, to make it easier to design this final project, a flow chart is made which can be seen in Figure 1.

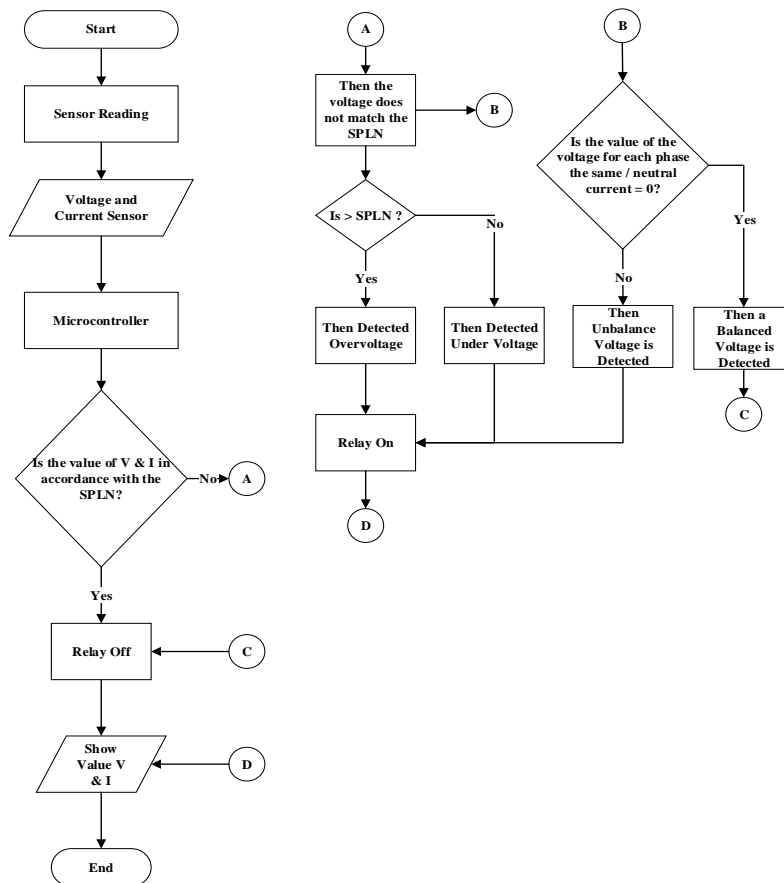


Figure 1. Tool work system

2.1. Microcontroller Design

STM32F407VGTx is a microcontroller based on a high-performance ARM Cortex-M4 32-bit RISC core with an operating frequency of up to 168 MHz. The core of the Cortex-M4 features a single-precision floating point unit (FPU) that can support all single-precision, process data instructions, and ARM data types. The STM32F407VGTx also includes high-speed embedded memories (flash memory up to 1 Mbyte for SRAM up to 192 Kbytes) for back-up of SRAM up to 4 Kbytes. The wide range of I/O and peripherals is connected by two APB buses, two AHB buses, and a 32-bit multi-AHB bus matrix. The following is an image of the STM32F407VGTx microcontroller pin shown in Figure 2.

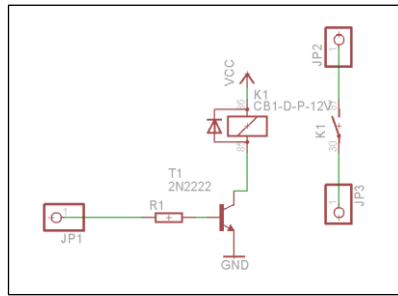


Figure 4. Relay driver circuit

From the picture above, the relay driver used is 5VDC and to drive it using a 2N222 transistor.

3. RESULTS AND DISCUSSION

In this section, the author explains the results of the study as well as provides a comprehensive discussion.

3.1. Overvoltage Test

In the overvoltage test using a variac by increasing the voltage greater than the normal voltage. Then on microcontroller the program is set to take action when there is an overvoltage for approximately 1 minute and the relay can work by disconnecting the load, so that the relay can be used as a protection system when the voltage experiences overvoltage. The following picture of the overvoltage test of the R, S, T phases can be seen in Table 1 and Figure 5.

Tabel 1. Overvoltage test result data

Number	Overvoltage Test			Contactor	Condition
	R (V)	S (V)	T (V)		
1	385	387	384	Normally Close	Normal
2	387	389	386		
3	390	389	389		
4	392	391	392		
5	395	397	394		
6	398	398	396		
7	400	399	400	Normally Open (Trip)	Overvoltage
8	402	403	402		
9	404	404	401		
10	408	408	408		
11	413	411	411		



Figure 5. Overvoltage test

In Table 1, if there is an overvoltage, the condition is declared overvoltage which can be observed every time there is a disturbance starting from 399V to 413V. In these conditions the relay will work to cut off the load.

3.2. Undervoltage Test

In the undervoltage test using a variac by lowering the voltage less than the normal voltage, when there is a voltage drop for approximately 1 minute and the relay can work by disconnecting the load, so that the relay can be used as a protection system when the voltage experiences undervoltage. The following picture of the undervoltage test of the R, S, T phases can be seen in Table 2 and Figure 6.

Tabel 2. Undervoltage test result data

Number	Undervoltage Test			Contactor	Condition
	R (V)	S (V)	T (V)		
1	382	381	380	Normally Close	Normal
2	371	364	363		
3	362	356	353		
4	360	353	350		
5	358	352	349		
6	338	331	330	Normally Open (Trip)	Undervoltage
7	339	333	332		
8	333	327	325		
9	332	323	324		
10	329	323	322		
11	329	322	320		



Figure 6. Undervoltage test

In Table 2, when it can be analyzed if there is an overvoltage, the condition is declared undervoltage which can be observed in the table in each phase there is an undervoltage disturbance ranging from 320V to 328V. In this condition the relay will work Normally Open so that the contactor can cut off the load.

3.3. Unbalance Voltage

In testing the unbalance voltage using a variac by testing various inputs and the relay works by disconnecting the load, so that the relay can be used as a protection system when the voltage experiences an unbalance voltage. The following picture of the unbalance voltage test of the R, S, T phases can be seen in the Table 3 and Figure 7.

Tabel 3. Unbalance voltage test result data

Number	Unbalance Voltage Test			Contactor	Condition
	R (V)	S (V)	T (V)		
1	374	374	371	Normally Close	Normal
2	374	373	372		
3	371	374	371		
4	369	369	366		
5	370	343	363	Normally Open (Trip)	Undervoltage
6	372	341	361		
7	370	355	367		
8	371	353	366		
9	370	354	365		
10	371	351	365		



Figure 7. Unbalance voltage test

In Table 3 it can be analyzed that there is an unbalanced voltage disturbance by adjusting the voltage in one phase that is different from the other so that it can be seen in Table 3, namely in phase S, disturbances occur starting from number 5 to number 10, and if the unbalance voltage is more than 3%, the voltage will trip. In this condition the relay will work Normally Open so that it can cut off the load.

4. CONCLUSION

After testing the tool, the author can conclude that the protective device that has been made obtained test results at undervoltage 320V - 328V, then the overvoltage test is 399V - 413V, while the unbalance voltage test is in the R phase which is different from the S phase and T phase, and the percentage of unbalanced voltage is 3%, so it has a tolerance of -10% and +5% of the nominal voltage which refers to the SPLN and NEMA standards.

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Auto-Tuning PI Controller Design Using Fuzzy Logic Controller for Web Tension Control in Roll Rewinder System

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ABSTRACT

Paper has a very important role, because it increases the productivity of pulp and paper companies in Indonesia. The company's development in 2018 increased by 2.1%, this was indicated by increasing consumer demand. Therefore, paper becomes a necessity in everyday life. The criteria for the paper to be produced are paper with a flat surface and cannot be wrinkled. However, errors in paper production that often occur are a lot of wrinkles and uneven paper surfaces. This happens because of a discrepancy in the dynamics of paper tension with the standards that have been set. The paper record is caused by the dynamics of the web tension in the Rewinder Roll system. In order for the web tension to remain stable, a controller is needed. The controller used is Auto-Tuning PI controller using Fuzzy Logic Controller (FLC). The controller can be said to be successful when it is able to perform automatic tuning of setpoint changes. The results showed that the system was able to achieve setpoint values, overcome overshoot and steady-state error (Ess) with response time values, namely $T_r=0.3151$ seconds, $T_s=0.3750$, $T_d=0.0721$, overshoot=0.0044%, and $Ess=0$ N.

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1. INTRODUCTION

In our life, paper has a very important role [1]. Even though the technology is now completely online, it does not reduce the need for paper use, it actually increases the productivity of pulp and paper companies in Indonesia [2]. This productivity is balanced with the great human needs and the rather rapid competition of the paper industry [3]. The development of pulp and paper companies in Indonesia in 2018 increased by 2.1%, this is indicated by increasing consumer demand [4]. Indonesia is ranked 9th for pulp and paper production in the world. Pulp output reached 4.55 million tons and paper production was 7.98 million tons [2]. In terms of exports, Indonesia can export 3.75 million tons of pulp worth US\$1.85 billion and 4.26 million tons of paper worth US\$3.76 billion. The European Union, the United States and China are the leading export providers for the pulp and paper industry.

With the increasing growth and development of the paper industry, the quality of the paper produced must also be improved, because in an industry quality is the main thing [5]. In addition, controlling the quality of the products produced must also be considered and anticipatory action is needed against errors that may arise during the production process [6]. In this case, the criteria for the

paper to be produced are paper with a flat surface quality and no wrinkles. However, based on several studies that have been carried out, errors in paper production that often occur are precisely the number of wrinkles and uneven paper surfaces [5,7]. This happens because of a discrepancy in the dynamics of the paper tension with the standards that have been set [8].

Sheet stress or web stress comes from the word web, which means the production material is pulled from the roll repeatedly, stress refers to the measured tensile strength stretched on the web [8]. The intended production material is paper, where before being rolled the paper has been dried which will later go through the printing process [9]. It can be concluded that web tension is a control of paper tension with the aim that the paper produced has a flat surface and the roll becomes solid. With this control will produce quality paper and errors / defects on the paper can be reduced [8].

In order for the quality of paper production to be stable, it is necessary to have a controller to maintain its stability. [10]. Several studies have been conducted, such as the use of adaptive force control to control the web force, a Neuro-Fuzzy approximator controller used to schedule gain in the web handling control system.

The controller performance with setpoint gain between 0.1 and 0.2 can reach steady state within 6 seconds [11]. In addition, research on web tension uses an optimal LQR controller that is able to respond to changes in set point optimally with an overshoot of 0.05% and a steady state error of 0.0025N [12]. Web voltage control is also discussed in other studies, especially the performance of a powerful PID controller, the focus of this research is to compare the performance of conventional PID controllers and conventional PID controllers. As a result, the Robust PID controller has a better system response than the conventional PID controller, with an overshoot value of 1.744%, and there is no oscillation [13].

In addition, research is also conducted on the comparison of the performance of the Self-Adaptive PI controller using Fuzzy Logic Controller (FLC) with the PI controller to control the servo motor on the ball tracking system, the performance of the Self-Adaptive PI controller using FLC with overshoot on the servo tilt 22%, servo pan 10.8 %, while the PI controller with servo pan 19.8% and servo tilt 22.7% [14]. Furthermore, research on speed control of electric bicycles using self-tuning Fuzzy-PI controller with load and without load. For load performance, settling time (T_s) is 4.9 seconds, overshoot is 0%, and the error is steady at 0. While for no-load performance, settling time (T_s) is 6.9 seconds, overshoot is 9.3%, and E_{ss} is 0 [15]. In this study, researchers will discuss FLC, which will then be combined into an auto-tuning PI controller using FLC. Fuzzy logic is an intelligent control system that imitates human thinking in decision making. The decision is based on an if-then (if-then) rule relationship [16]. A Fuzzy logic controller is equivalent to solving the problem of uncertainty in data by mapping the relationship between input and output. The controller has the ability to increase transient response, but is very sensitive to disturbance [17]. When combining the Auto-Tuning PI controller using Fuzzy Logic Controller, the controller has proportional-integral parameters in the form of K_p and K_i values which are set using Fuzzy logic. For Fuzzy logic, the input is an error and a delta error, and the output is a value of K_p and K_i [18].

2. RESEARCH METHOD

2.1. Rewinder Roll

The rewinding roll is part of the cutter (coating). The coater contains two rolls, a reverse roll and a loose roll. Rolling rewinding is a paper rewinding (pulling) machine, while roller rewinding acts as a rewinding machine. After the drying process, the dry paper is rolled into a large roll (Jumbo Roll), which is then removed to be cut into small rolls [10].

2.2. Mathematical Model of Rewinder Roll System

Before modeling the mathematical equations of the system, the first step that must be done is to make an analogy or assumption about the web tension [13]:

1. Elastic paper,
2. Strain / $\epsilon \ll 1$,
3. The transverse width of the paper is the same,
4. The acceleration of V_1 on the lead roll is constant,
5. No change in paper density.

$$\rho = \rho u + 1 \quad (1)$$

The paper dynamics modeling is:

$$\frac{d(\rho AL)}{dt} = \rho_1 A_1 V_1 - \rho AV \quad (2)$$

Information:

V = Speed

A = Surface area on a sheet of paper

ρ = Resivitation (paper density)

L = Paper length

The stress on the plant is used the following Law of Elasticity:

$$\sigma = E\varepsilon + C \frac{dE}{dt}, \sigma = \frac{T}{A} \quad (3)$$

then using the equation below can determine the strain and continue mass:

$$\varepsilon = \frac{L - Lu}{Lu}, \rho AL = \rho u Au Lu \quad (4)$$

Furthermore, using the simplification of equations 3 and 4 above, we get a way to find the characteristics of torque dynamics in the Rewinder Roll area, namely:

$$L \frac{dT}{dt} = EA(V - V_1) + CA \frac{d}{dt}(V - V_1) \quad (5)$$

Information:

L = Length between lead roll and Rewinder Roll

E = Young's Modulus of Elasticity on paper

A = Cross-sectional area of paper

V = Speed on Rewinder Roll

V1 = Speed on lead roll

C = Paper damping modulus

ε = Strain on web tension

σ = Tension on web tension

So from equation 2.5 obtained the Laplace equation, namely:

$$\frac{T}{(V - V_1)} = \frac{\frac{CA}{L}s + \frac{EA}{L}}{s + \frac{V_1}{L}} EA(V - V_1) + CA \frac{d}{dt}(V - V_1) \quad (6)$$

Equation 2.6 above is modeling the dynamics of the domain of the rewinder region. Components such as gearbox, rewinder roll, and motor are omitted parts which are expressed in Newton's law into the equation:

$$\sum \tau(t) = J\alpha(t) \quad (7)$$

Information:

τ = Turning Moment or Torque

J = Constant of Inertia

α = Rotation Acceleration

The rotary force or torque input (t) acting on a rotating mass having an inertia of mass J will cause a rotation with an angle of rotation (t), with angular velocity and acceleration (t) and (t). In each viscous

torsion friction (t), it causes the opposite torque rotational force due to the physical properties of the engine mass, with the equation:

$$tb(t) = B\omega(t) \tag{8}$$

Information:

τ_b = Twist Moment or Friction Torque

B = Coefficient of Friction

ω = Rotation Speed

From equations 7 and 8, the Laplace equation is obtained as follows:

$$\frac{\omega t}{\tau} = \frac{1}{(Js + B)} \tag{9}$$

Furthermore, equations 2.6 and 2.9 are linearized in the following tension web block diagram:

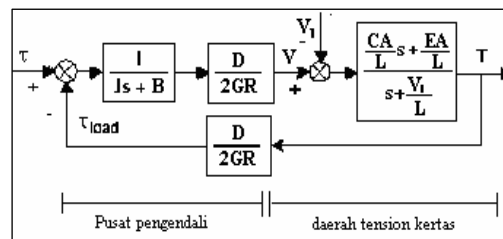


Figure 1. Rewinder roll circuit [13]

The second-order transfer function in the s-domain is obtained from the block diagram above starting from the motor torque to the tension of the sheet of paper, namely [13]:

$$\frac{T(s)}{\tau(s)} = \frac{\frac{DEA}{2GRJL} \left(\frac{C}{E} S + 1 \right)}{S^2 + \left(\frac{B}{J} + \frac{V_1}{L} + \frac{D^2 CA}{4GR^2 JL} \right) S + \left(\frac{BV_1}{JL} + \frac{D^2 EA}{4GR^2 JL} \right)} \tag{10}$$

2.3 Auto-Tuning PI Controller using Fuzzy Logic Controller

Auto-Tuning PI controller using Fuzzy Logic Controller (FLC) is a controller based on the traditional PI controller structure. The PI controller parameters are pre-set using traditional tuning methods such as the Ziegler Nichols method [19]. The FLC structure used by the PI-Fuzzy controller is the same as the FLC structure, which consists of a Fuzzy interface, knowledge base, reasoning and non-Fuzzy interface. Each component function is described in detail in the Fuzzy logic description. Figure 1 shows the block diagram of the proposed PI-Fuzzy controller.

Figure 2 shows the input and output variables for each controller. For the FLC, the input variables are error (e) and the rate of change of error (ec or de/dt), and the output variables are K_p and K_i . The controller design adopts Si and Wang [20]. It includes Fuzzy sets, linguistic values, Fuzzy rules, and equations for calculating new values of K_p and K_i in the PI controller.

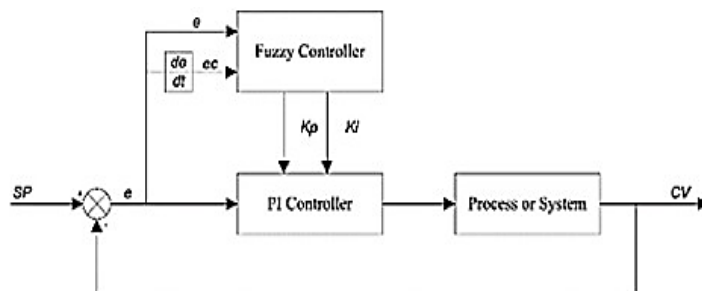


Figure 2. Auto-Tuning PI controller circuit using Fuzzy Logic Controller [19]

2.4 Proportional Integral (PI)

The Proportional Integral controller is a combined control system between the Proportional controller and the Integral controller [21]. Proportional Integral controllers are widely used in industrial processes because they optimally solve problems that arise [18].

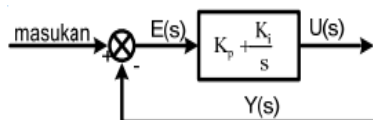


Figure 3. Integral Proportional control block diagram [22]

2.5 Close Loop System Testing

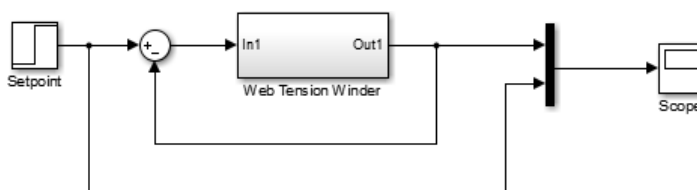


Figure 5. Close loop Simulink circuit

2.6 Tuning Kp and Ki Values

Table 1. Tuning Kp and Ki values

Heuristic Method Test		Transient Response		
Kp	Ki	Rise Time	Overshoot %	Steady-State Error
0.24147	1.6286	0.245s	0	0
0.4848	2.7606	0.121s	0.62	0.0001
0.32649	2.1696	0.172s	0.188	0
0.36864	2.2958	0.157s	0	0
0.30156	1.9063	0.1995s	0	0
0.2046	1.431	0.287s	0	0
0.18451	1.4064	0.291s	0.472	0
0.31567	2.0102	0.186s	0	0
0.27552	1.9198	0.201s	0.315	0
0.3644	2.3568	0.154s	0.387	0

Table 1. above is the determination of the values of Kp and Ki which was carried out using the heuristic method for ten times. From the table, the Kp value is 0.36864 and the Ki value is 2.2958 with system response results such as rise time (Tr) is 0 seconds, overshoot 0% and steady-state error (Ess) is 0. These values are chosen according to the output and transient response of the system which are better than other Kp and Ki values.

2.7 Auto-Tuning PI Controller Design Using Fuzzy Logic Controller

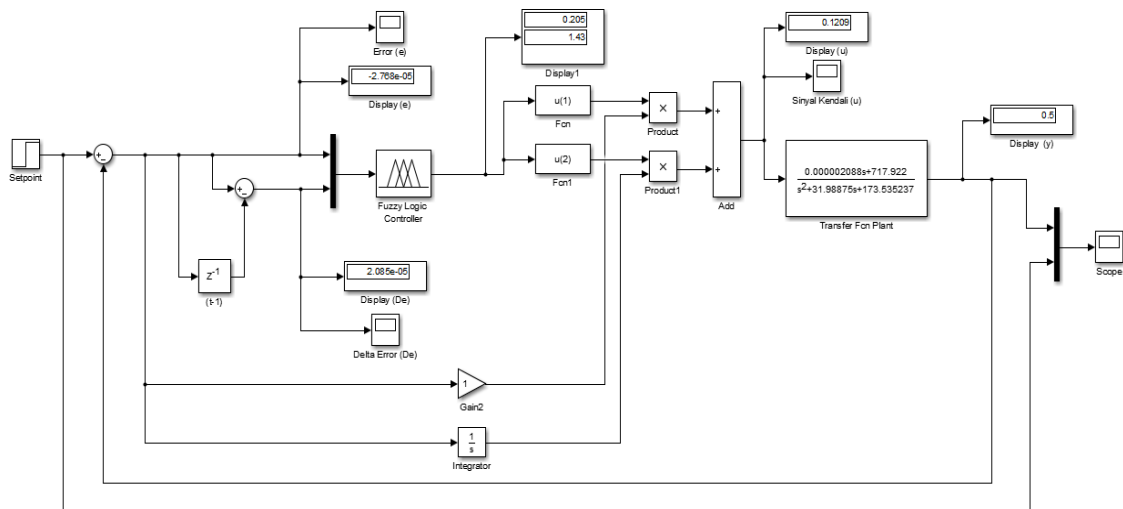


Figure 6. Auto-Tuning PI controller Simulink circuit using Fuzzy Logic Controller

In the picture above is the controller circuit that will be used. In FLC there are inputs and outputs in it, for the error and delta error values are input, while the values of K_p and K_i are Fuzzy outputs. Then, the linear interpolation method is used to find the value of the transient response after obtaining the K_p and K_i values that are relevant to the plant response.

3. RESULTS AND DISCUSSION

3.1 Analysis and Results of Web Tension Simulation on Close Loop Rewinder Roll System

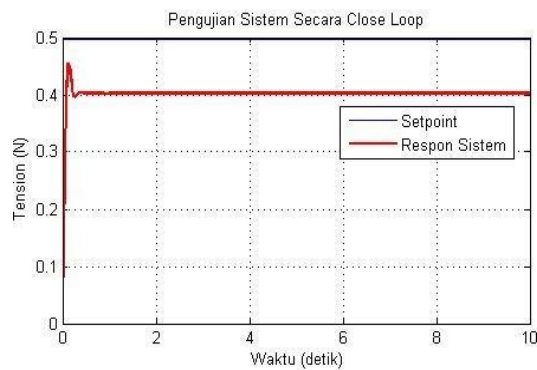


Figure 7. System response results in close loop

The results of the response of the web tension simulation in a close loop show that the set value is 0.5 N, but the system output shows that the value does not reach the set value, resulting in a steady-state error (E_{ss}) of -0.0455N.

Table 2. System response results in close loop

Response Analysis	Simulation Results
Rise Time (R_s)	-0.0127 detik
Settling Time (T_s)	0 detik
Delay Time (T_d)	0.052 detik
Maximum Overshoot	-0.091 %
Steady-State Error (E_{ss})	-0.0974 N

This research is divided into several stages, namely the validation of the mathematical model of the roll rewinder system to analyze the results of the system response. The design of the Auto-Tuning PI controller uses Fuzzy Logic Controller (FLC), which is applied to the roller system by deriving the mathematical model of the controller. Furthermore, the simulation results from the validation of the system's mathematical model and the design results using the Auto-Tuning PI-Fuzzy controller. The performance of the reel winding system was analyzed using a Auto-Tuning PI-Fuzzy controller. Then the last conclusion.

3.2 Results and Analysis of Web Tension Testing on Rewinder Roll System with Auto-Tuning PI Controller Using Fuzzy Logic Controller

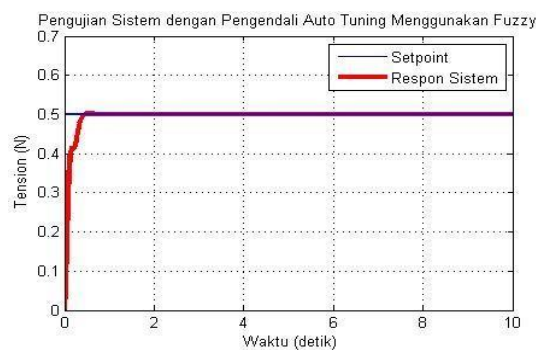


Figure 8. System response results with Auto-Tuning PI controller using FLC

Based on the picture above, it can be seen that the resulting system response has reached the specified set point with the simulation time used is 15 seconds.

Table 3. Results of system response with Auto-Tuning PI controller using Fuzzy Logic Controller

Response Analysis	Simulation Results
Rise Time (Tr)	0.3151 detik
Settling Time	0.3750 detik
Delay time	0.0721 detik
Maximum Overshoot	0.0044%
Steady-State Error (Ess)	0 N

4. CONCLUSION

This study discusses testing the web tension on the Rewinder Roll system using the Auto-Tuning PI controller using Fuzzy Logic Controller with the Fuzzy Mamdani method and the input values (error and delta error) in the form of Kp and Ki. After the test is carried out, the results show that the overshoot and the existing steady-state error (Ess) condition can be overcome. In addition, the performance of this controller can also be said to be good in overcoming the problems that exist in the Rewinder Roll system.

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Web-based Knowledge Sharing System in Faculty of Engineering Bangka Belitung University

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ABSTRACT

New lecturers must be quickly adapted to their work environment. Adaptation was difficult when colleagues did not provide space for discussion to the new lecturers. This condition occurred at the Faculty of Engineering Bangka Belitung University, with the planned to open a new study program, new lecturers had to be in a temporary homebase that was not their field. The expectation from the Dean was the existence of a knowledge sharing system that can be accessed anytime and anywhere by lecturers. But in reality, the knowledge sharing system still did not exist and knowledge sharing carried out manually by face-to-face meetings between lecturers and through Whatsapp groups. This research was conducted at the Faculty of Engineering, Bangka Belitung University. The knowledge sharing system methodology uses a combination of two methods, which are Socialization, Externalization, Combination, Internalization (SECI), and Knowledge Management Life Cycle. The result of this research was a development of web-based knowledge sharing system with an object-oriented approach which has been tested with black box testing and resulted as the system functions worked well.

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1. INTRODUCTION

Someone will be faced with something new at the beginning of entering work environment. This is what happened as well at the Bangka Belitung University (UBB). New lecturers must be able to quickly adapt to their work environment. Adaptation will be difficult when colleagues do not provide space for discussion and work experience to new lecturers. The conditions that occurred at the Faculty of Engineering Bangka Belitung University, with the plan to open a new study program, resulted in new lecturers have to be in a temporary homebase that was not their field. Exchanging information only uses Whatsapp (WA), therefore sometimes the information conveyed is only limited to the skin.

The expectation from the Dean of the Faculty of Engineering Bangka Belitung University regarding knowledge sharing is the existence of a knowledge sharing system (KSS) that can be accessed anytime and anywhere by lecturers. However, in reality, the knowledge sharing system still does not exist and knowledge sharing activities are carried out manually by means of face-to-face meetings between lecturers and through WA groups. In this case, there is a gap between expectations and reality which causes the problem of a lack of knowledge sharing activities between lecturers which causes the rotation and dissemination of knowledge to be less extensive so that the performance of lecturers also decreases.

To find out the root of the problem, a fishbone diagram used as a tool to determine the root causes of the problems seen. The most important thing about the knowledge management and knowledge sharing process in an organization is the existence of a way to connect the three critical elements, which are technology, processes and individuals or human resources that support learning in organizations and create a culture of knowledge sharing [1]. Figure 1 shows a fishbone diagram of the problems faced by Faculty of Engineering, UBB.

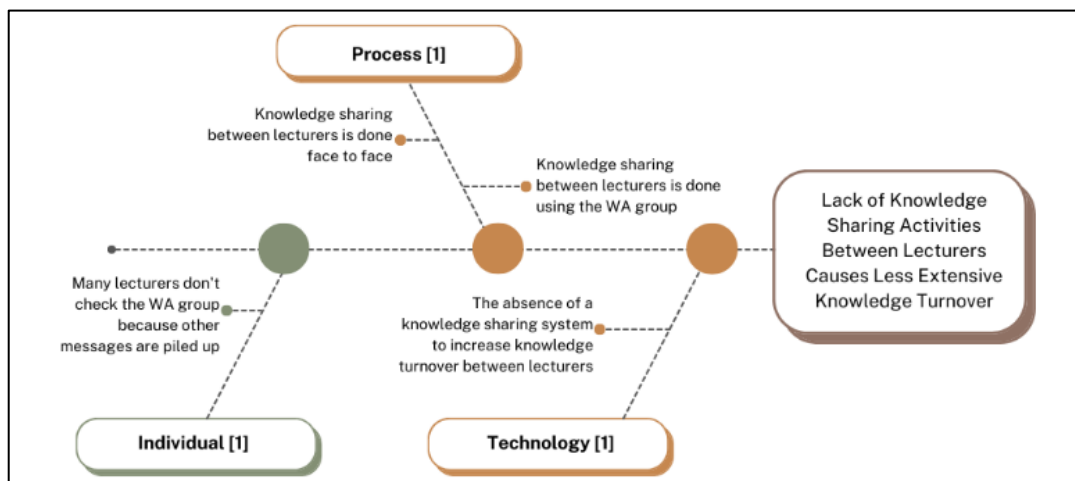


Figure 1. Fishbone diagram

From the results of the analysis using fishbone diagram, it was found that three domains were the focus of the problem, which are Technology, Process and Individual. Researchers decided to focus on the root of the problem in the technology domain, namely the absence of a knowledge sharing system to increase knowledge turnover between lecturers. According to [2], to support the implementation of knowledge sharing, a technology is needed that can ensure that knowledge sharing runs effectively and efficiently.

According to [3], sharing knowledge is a necessity for every organization, including universities. The importance of sharing knowledge in learning activities, making universities must always trying to improve the culture. Knowledge sharing is an activity of exchanging knowledge, experience and skills between individuals, teams, organizational units and organizations in an appropriate format. Enhancement of individual skills and knowledge sharing, each of which can assist individuals and groups in realizing their creative potential. Team knowledge sharing plays a role as the extent to which team members share ideas, information, and suggestions relevant to each other's tasks. The positive impact of team knowledge sharing on team creativity is consistent with the idea that knowledge communication between individuals within a team is a viable resource for teams to generate new ideas [4].

Purpose of this research is to develop a web-based knowledge sharing system to improve the performance of lecturers at the Faculty of Engineering, UBB. The research was carried out within 9 months starting from April 2022 to December 2022. The research location was carried out at the Faculty of Engineering, UBB. Then, the laboratory used is the Computer Laboratory of the Faculty of Engineering, UBB.

2. RESEARCH METHOD

To conduct this research, Knowledge Management System Life Method Cycle (KMSLC) by Awad and Ghaziri used to develop the knowledge sharing system. This method has eight stages as shown in Figure 2. However, in this research, only five stages which from evaluate existing infrastructure up to verify and validate the KM system conducted, refer to [5].

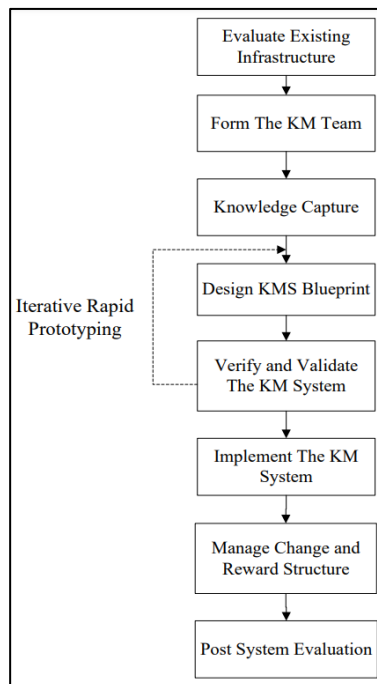


Figure 2. Knowledge Management System Life Method Cycle (KMSLC) by Awad and Ghaziri [5]

The five stages of KMSLC used in this research listed below.

1. Evaluate Existing Infrastructure
 This stage evaluates the infrastructure in terms of software and knowledge. In software evaluation, identification of applications that have been used in the knowledge sharing process is carried out. Then the knowledge evaluation will be carried out using the SECI method to determine the current state of knowledge sharing.
2. Form the KM Team
 This stage is carried out by forming a knowledge sharing team whose task is to support development of KSS at the Faculty of Engineering, UBB. Team formation is carried out through identification of users and stakeholders needed and then they are involved in the development of KSS.
3. Knowledge Capture
 The process of capturing knowledge is done by writing, recording and translating knowledge from senior lecturers and academic officials at the Faculty of Engineering, UBB.
4. Design KMS Blueprint
 Perform the process of converting the KSS design into web-based application.
5. Verify and Validate the KM System
 Conduct knowledge testing, which is user acceptance testing. User acceptance testing is used black box testing method to test the application function by looking at the output data generated.

3. RESULTS AND DISCUSSION

3.1. Evaluate Existing Infrastructure

Evaluate existing infrastructure, conducted by researchers using an analysis with SECI method. The SECI model developed by Ikujiro Nonaka and Hirotaka Takeuchi as shown in Figure 3 is a wheel of transformation of tacit and explicit knowledge, following four sub-processes, namely socialization, externalization, combination and internalization. This model is precise enough to allow an in-depth understanding of micro processing and can be easily interpreted from an Information Technology perspective.

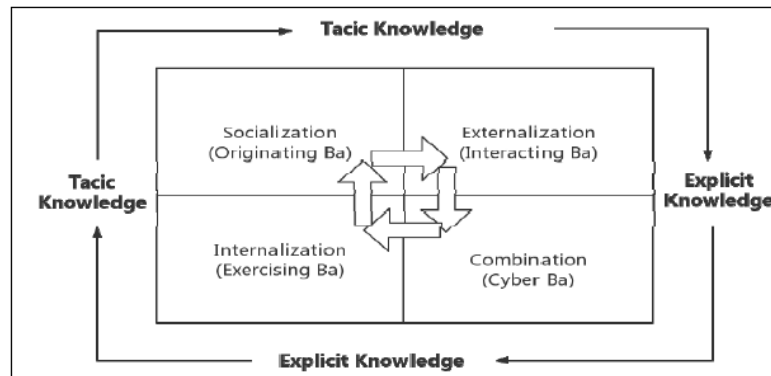


Figure 3. The SECI Model by Ikujiro Nonaka and Hirotaka Takeuch [6]

Each process has its own core. The essence of socialization is knowledge sharing. The essence of externalization is the codification of knowledge. The essence of the combination is the storage, systemization and processing of data, information and knowledge. Finally, the essence of internalization is to learn previously processed knowledge. Using these simple facts, the SECI model is quite appropriate for the practical classification of IT available for development or support of Knowledge Management Systems (KMS) [6].

Based on the results of the analysis of knowledge sharing that runs using the SECI method, several things were found, namely:

1. Socialization: knowledge sharing activities are carried out manually by means of face-to-face meetings between lecturers and through WA groups.
2. Externalization: The process of documenting knowledge is quite long because it requires a decision letter from the rectorate and this piles up because everything is done semi-manually.
3. Combination: The storage and dissemination of knowledge documents can only be accessed via WA and there are many possibilities for data to be lost or buried by other chats.
4. Internalization: Because there is no special container to store knowledge documents, many lecturers miss important documents and end up not knowing certain information or knowledge.

3.2. Form the KM Team

The next step of this method is to form the KM or Knowledge Sharing team. Because this research aims to develop a knowledge sharing system at the Faculty of Engineering, UBB, the knowledge sharing team formed must be around the academic community at the Faculty of Engineering, UBB. In designing this knowledge sharing team, referring to [7], the structure of the knowledge sharing team design is shown in Figure 4 below.

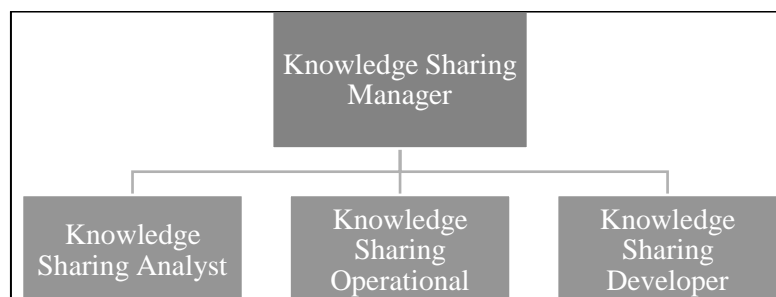


Figure 4. Knowledge Sharing Team

The roles of each position here are as follows:

1. Knowledge Sharing Manager is responsible for the sustainability of the system, making plans and strategies in the development of knowledge sharing. This position will be filled by the Dean of the Faculty of Engineering, UBB.

2. Knowledge Sharing Analyst will be responsible as admin where their job is as supervisor and approval in terms of deleting content activities carried out by knowledge sharing system users. This position will be filled by the staff of the Faculty of Engineering, UBB.
3. Knowledge Sharing Operational is responsible for adding, storing, and editing information or knowledge in the system. This position will be filled by all lecturers of the Faculty of Engineering, UBB. To enter the system, lecturers will be given their respective usernames and passwords.
4. Knowledge Sharing Developers are responsible for designing and building various facilities needed by system users, configuring servers and applications, and responding to all troubleshooting that occurs both in terms of hardware and software. This position will be filled by the academic community within the Faculty of Engineering, UBB who has more knowledge about IT.

3.3. Knowledge Capture

Knowledge Capture can occur through externalization and internalization, which through externalization process, tacit knowledge converted into explicit knowledge and vice versa [8]. Tacit knowledge, which is the knowledge of senior lecturers and academic officials, will form the background needed to build, develop and interpret explicit knowledge for junior lecturers to make it better accessible. This process done by writing, recording and translating knowledge into articles and videos. Where the videos and articles were stored in web-based knowledge sharing system that can be accessed anywhere and anytime.

3.4. Design KMS Blueprint

Referring to [9], according to its function, the knowledge sharing system can be divided into six modules, namely video module, article module, question answering module, credit module, audit module and recommendation module. However, according to the current needs of the Faculty of Engineering, UBB, the modules that will be included in this knowledge sharing system are three modules, namely video module, article module, and question answering module (QnA).

After determining the module, the design of the Knowledge Sharing System using UML diagrams can be described. First, researchers design Use Case Diagram which can be seen in Figure 5. Use Case Diagrams describe the expected functionality of a system. Use Case Diagrams also describe the interactions that occur in the system. The interaction is between the system inside and outside the system and users or actors with the system [10]. There are two actors in the designed knowledge sharing system, namely admin and KSS user. This admin is part of a predetermined knowledge sharing team, while the KSS users are all lecturers of the Faculty of Engineering, UBB.

The class diagram shown in Figure 6 is a description of the system structure that represents the relationship between classes or objects that contain attributes and methods [11]. The total class that must exist later in this knowledge sharing system is at least eight classes, each of which has a primary key (PK) so that the classes can be well connected to each other. These classes include a class that stores the usernames and passwords of users, then a class that stores the three modules in the knowledge sharing system, and finally information about user profiles.

Furthermore, the functional design implementation process is carried out using a Web-based application. The results of the system implementation for the video module which represents one of the three modules in this knowledge sharing system can be seen in Figure 7. There is a search feature to make it easier for users to search for specific information or knowledge without having to search one by one manually. Figure 8 shows the profile page of this knowledge sharing system. This page provides the option to edit user data if there is an error in the data.

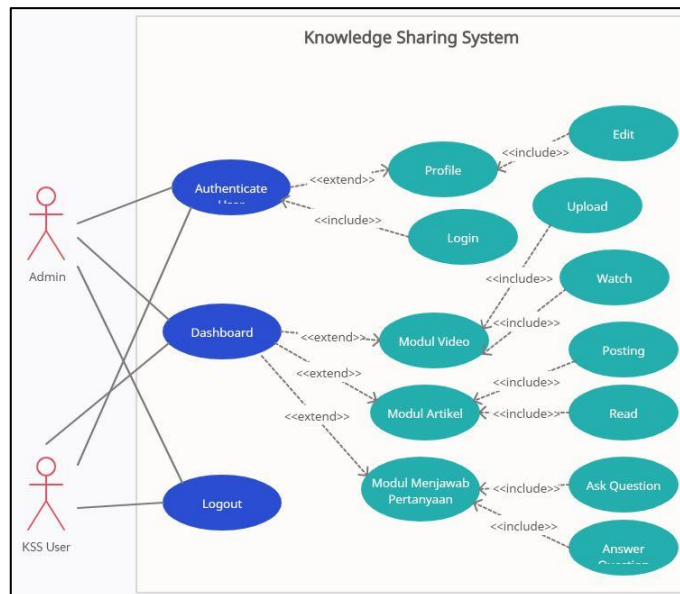


Figure 5. Use Case diagram

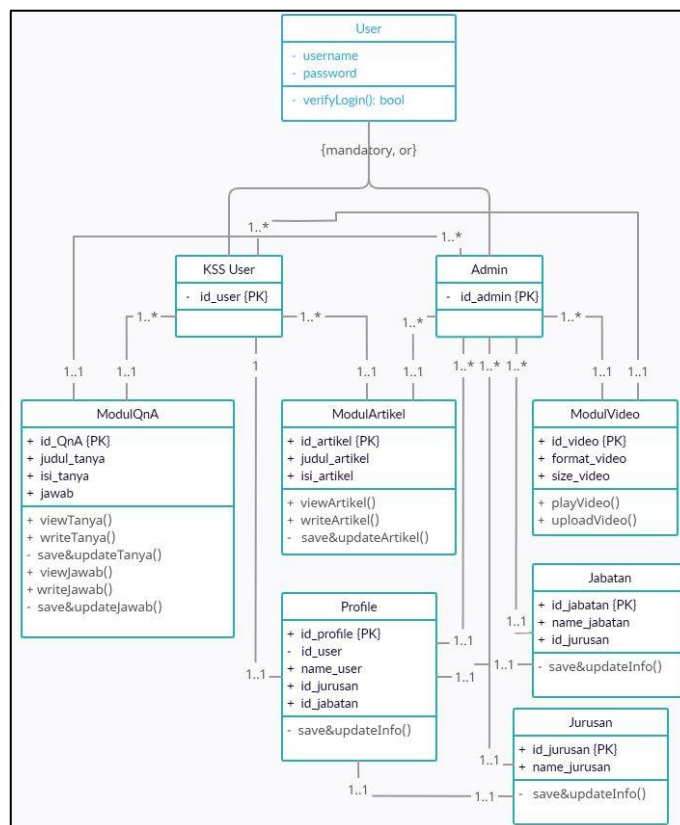


Figure 6. Class diagram

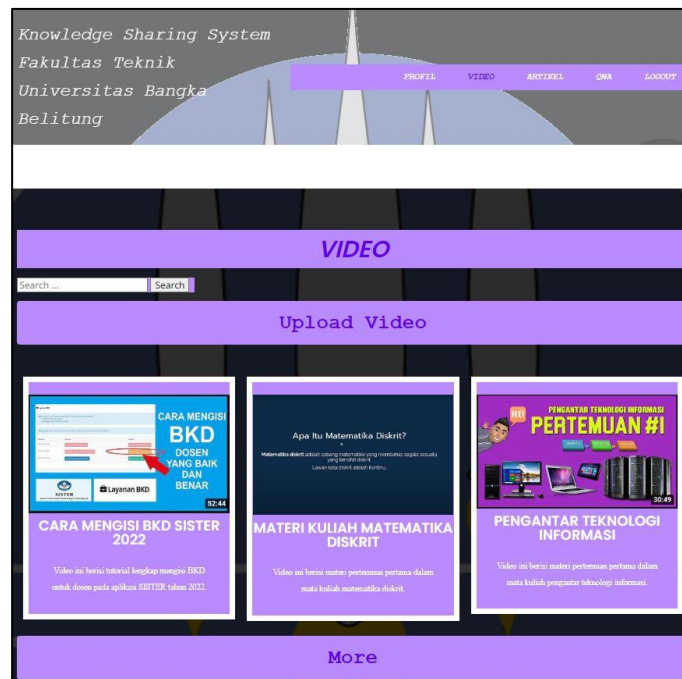


Figure 7. Video Module

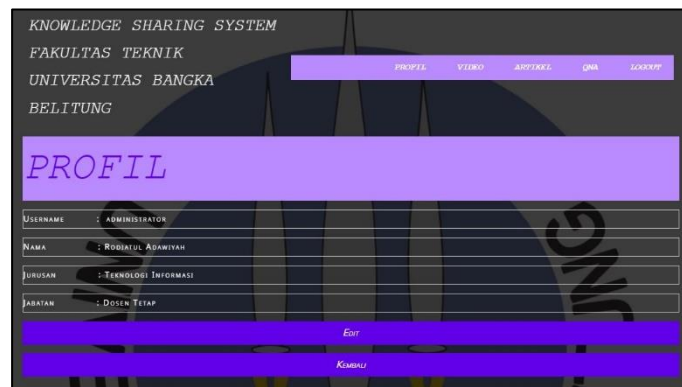


Figure 6. Profile Page

3.5. Verify and Validate the KM System

At this last stage, user acceptance testing is carried out using black box testing which can be seen in Table 1. Black box testing is to generate input values based on exercising the specification which means to have generated enough tests so that every component that makes up the implementation has been demonstrated to produce a valid result when executed [12]. Testing based on the main features in the knowledge sharing system which consists of several functions generated from the video module, articles module, question answering module and viewing and editing user profile pages. The results of black box testing show that the main features of this knowledge sharing system have been working well.

Table 1. Black Box testing

Description	Condition	Test	Result	Status
Login	On the login page	Input username and password	Successfully entered the dashboard page	Valid
Open Profile Page	On the profile page	Login and go to profile page	Successfully view profile page	Valid
Edit Profile	On the profile page	Press edit button, change profile and save	Successfully edit profile and the changes seen in profile page	Valid
Play Video	On the video module	Choose one video and click play button	Successfully play the video	Valid
Upload Video	On the video module	Click "Upload Video" button and upload a video	Successfully upload the video and the updates seen in video module	Valid
Read Article	On the article module	Click on of the article	Successfully view the correct article	Valid
Post Article	On the article module	Click "Post Article" button, write an article and save	Successfully add new article and the updates seen in article module	Valid
Ask Question	On the QnA module	Click "Ask Question" button, write a question and save	Successfully add new question and the updates seen in QnA module	Valid
Answer Question	On the QnA module	Click "Answer Question" button, write an answer and save	Successfully add new answer in a question and the updates seen in QnA module	Valid

4. CONCLUSION

The conclusion of this research is to develop a web-based knowledge sharing system to improve the performance of lecturers at the Faculty of Engineering, UBB. This research was carried out by following five of the eight stages in the Knowledge Management System Life Method Cycle (KMSLC) by Awad and Ghaziri, which are from Evaluate Existing Infrastructure to Verify and Validate the KM System. In the evaluation stage of the knowledge sharing process, the method of Socialization, Externalization, Combination, Internalization (SECI) by Ikujiro Nonaka and Hirotaka Takeuchi is used to see how are the current knowledge sharing activities at the Faculty of Engineering, UBB.

As a result, researchers can conclude that a Knowledge Sharing System is needed that can be a media for the Faculty of Engineering, UBB in sharing knowledge and information that can be accessed anywhere and anytime. The media was developed with an object-oriented approach and a web-based system. After being tested using black box testing, the result is that this system functions works well.

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Implementation of Data Mining Clustering Using the K-Medoids Method in Grouping Library Books Politeknik Negeri Balikpapan

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ABSTRACT

In order to procure the book according to the needs of users, Politeknik Negeri Balikpapan's Library needs information on the collection of books. To answer this problem, it is necessary to have a clustering system for existing books in the library by looking at the aspect of borrowing frequency. The Clustering system is made using the K-Medoids method with the selection of 3 Clusters, namely, very attractive, desirable and less desirable. From the results of data processing through the Rapid Miner Application with $K = 3$, the results obtained are cluster_0 (low) consisting of 97 book titles with the frequency of borrowing books in the rare category in other words less desirable to borrow, cluster_1 (high) consists of 2 book titles which are the most in-demand group of books namely Teknologi Bahan dan Teori dan Praktik Hotel Front Office. Cluster_2 (medium) consisting of 8 titles which are books with moderate borrowing frequency. The results of the performance obtained Davies Bouldin index value of 0.287. The results of grouping the data of these books can be used as input for library managers in procuring book collections based on the frequency of borrowing books.

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1. INTRODUCTION

The existence of the library cannot be separated from human culture. The high and low civilization of a nation can be seen from the condition of the library it has. In essence, the library is a cultural product in the form of an institution that collects, stores, organizes both printed and recorded works as a source of information and learning from generation to generation. In Indonesia there are five types of libraries and these five types of libraries are national libraries, public libraries, special libraries and university libraries.

The college library collections are held through a selection that refers to the needs of study programs that are organized and organized in such a way as to ensure the effectiveness and efficiency of services to the needs of the academic community. Even in every academic community, their needs cannot be equated because they have different needs in the literature. The literature used by students in each department is also different. With the organized grouping of each user in this case is a borrower from various majors, it can be seen what literature groups are most often borrowed by students.[1],[2],

Politeknik Negeri Balikpapan's Library aims to support information needs, the condition of library reading interest can be seen from the percentage of visitors, borrowers and borrowed books. Book borrowing data is used as a report. The library every year procures new book collections to be

reproduced so that they must know the types of priority book collections to be reproduced. So it is necessary to analyze the data processing of book lending transactions that explain the distribution of the intensity of book lending, the processing information helps to add to the collection.

To find out which books are the most popular, a cluster technique is used using the K-Medoids method. The K-Medoids algorithm is an iterative clustering algorithm that partitions the data set into a number of K Clusters that have been defined at the beginning. Calculations on K-Medoids do not refer to the average value (mean) of all data on each cluster, the goal is to reduce outliers or the sensitivity of the cluster that generated on the dataset [3], [4]. The K-Means and K-Medoids algorithms both work by minimizing the distance between data points that are labeled to be in one cluster and the specified data points. as the center of the cluster. The K-Medoids algorithm chooses a data point as the center of the cluster (medoids). done randomly at the data points of each cluster not based on the average value [4].

Data mining is a term used to describe the discovery of knowledge in databases. Data mining is a process that uses statistical techniques, mathematics, artificial intelligence, and machine learning to extract and identify useful information and assembled knowledge from various large databases [5].

Data mining is a series of processes to explore added value from a data set in the form of knowledge that has not been known manually [4]. Where the results of the excavation process will form patterns from the data set, which is often referred to as pattern recognition. Pattern recognition is part of data mining. Data mining is often also called Knowledge Discovery in Database (KDD), which is an activity that includes collecting, using historical data to find regularities, patterns or relationships in large data sets [6]. There have been many studies that have conducted clustering using the K-Medoid algorithm [7],[8],[9],[10]

Therefore, the authors in this study took the title "Implementation of Data Mining Clustering Using the K-Medoids Method in Clustering Politeknik Negeri Balikpapan's Library Books" to help classify loan book data of interest in supporting the Library Manager in procuring book collections.

2. RESEARCH METHOD

The following are the methods of carrying out the research:



Figure 1. Research Method

2.1. Planning Stage

The first step in this research is to do research planning. There are four activities in planning, namely determining research objectives, identifying problems, determining problem boundaries and studying literature.

In the data collection stage, it is carried out in two ways, namely:

1. Library study. In this activity, researchers search for and study books, ebooks and journals to support writing related to the topics raised. From the literature study, the theories and methods in solving research problems related to the topics raised are obtained.
2. Observations and interviews, From the results of interviews obtained interview data which will later be used for report writing and from observations obtained documentation data and library book borrowing data.

2.2 Preprocessing Stage

In the preprocessing stage, the activities carried out are retyping the data obtained into Microsoft Excel to record all book lending transactions. After the data is copied at this stage, data cleaning will also be carried out, namely deleting data that is not clearly written or data that cannot be read. This cleaning process is carried out in order to get the correct calculation results.

2.3. Data Processing Stage

Processing data with rapidminer software and also processing data based on problem identification in research. Using the K-Means method, and through the application of the k-means clustering algorithm, it is hoped that in processing this data, it is expected to get good results for grouping books based on the frequency of borrowing, learning outcomes and produce new knowledge. Processing data with Rapidminer software.

2.4. Analysis Stage

After all the data has been collected, then the analysis stage is carried out.

3. RESULTS AND DISCUSSION

3.1. Data Set

The dataset used is data on borrowing books at the Politeknik Negeri Balikpapan's Library from the period 2019-June 2022. The number of types of books recorded is 107 titles with a total borrowing frequency of 231, shown in Table 1 which contains records of book titles and the frequency of borrowing each year.

Table 1. Data set

Number	Book Title	2019	2020	2021	2022	Total
1	101 Amazing Public Relation Ideas				1	1
2	9 Days Umratan	1				1
3	Akuntansi Dasar 1 Dan 2				2	2
4	Akuntansi Manajerial Suatu Orientasi Praktis				2	2
5	Akuntansi Perbankan Syariah				2	2
6	Akuntansi Perbankan Syariah Teori Dan Praktik Kontemporer Berdasarkan PAPSII 2013 Edisi Kedua			2	1	3
7	Akuntansi Syariah				1	1
8	Akuntansi Perusahaan Manufaktur				2	2
9	Algoritma & Pemrograman Dengan C++ Edisi Kedua		1		1	2
10	All About Corporate Valuation				1	1
11	Anak Rantau		1			1
12	Analisa Laporan Keuangan Edisi Keempat		2		4	6
13	Analisis Kritis Atas Laporan Keuangan				7	7
14	Aneka Kue		1			1
15	Aplikasi Logika Fuzzy Edisi Kedua				1	1
16	Arduino Belajar Cepat Dan Pemrograman		1		2	3
17	Aroma Karsa		1			1
18	Auditing Buku 1 Edisi Keenam				5	5
19	Bahan Produk Bakery		1			1
20	Belajar Jaringan Komputer Berbasis Mikrotik OS	1				1
21	Budidaya Unggul Lele Phytan			1		1
22	Build Up Your English Reading Skill				1	1
23	Catatan Harian Anne Frank		1			1
24	Dahsyatnya Bisnis Hotel Di Indonesia				1	1
25	Dasar - Dasar Pengolahan Makanan	1				1
26	Dasar - Dasar Perbankan Edisi Revisi 2014				6	6
27	Drainase Perkotaan				3	3
28	Ekonomi Manajerial Dengan Pendekatan Matematis Edisi Revisi		1			1
29	Ekonomi Moneter				1	1
30	Emotional Intelligence	1	1			2
31	Ensiklopedia Mini - Hotel				2	2
32	Food And Beverage Service Operational				2	2
33	Front Office Management				5	5
34	Hidrologi				1	1

Number	Book Title	2019	2020	2021	2022	Total
35	Hidrologi Jilid 1				5	5
36	Hidrologi untuk Pengairan				1	1
37	Hotel Courtesy				1	1
38	Housekeeping Hotel				1	1
39	Housekeeping Hotel Edisi Kedua				2	2
40	Hujan		2			2
41	Investasi Dan Pasar Modal Indonesia				3	3
42	Jurus Sukses Beternak Lele Sangkuriang			1		1
43	Kamus Populer Istilah Komputer dan Informatika		2			2
44	Khasiat Buah Dan Sayur				1	1
45	Kitab Khasiat Buah Dan Sayur				1	1
46	Kitab Kue Super Yummy		1			1
47	Konfigurasi Wireless Routerboard Mikrotik	1				1
48	Lintang				1	1
49	Manajemen Divisi Kamar				2	2
50	Manajemen Keuangan (Finance Management)				2	2
51	Manajemen Keuangan Modern				2	2
52	Manajemen Keuangan Sebagai Dasar Pengambilan Keputusan Bisnis				2	2
53	Manajemen Keuangan Teori Konsep & Aplikasi Edisi Revisi				2	2
54	Manajemen Kinerja Edisi Kelima				1	1
55	Manajemen Pemasaran Bank				5	5
56	Manajemen Pemasaran Jilid 1 Edisi 12				4	4
57	Manajemen Penyelenggaraan Hotel				2	2
58	Manajemen Perkreditan				1	1
59	Manajemen Risiko				2	2
60	Mengelola Kualitas Layanan Perbankan (Cover Baru)				3	3
61	Metode Penelitian Kuantitatif				2	2
62	Metode Penelitian Pendidikan - Pendekatan Kuantitatif, Kualitatif Dan R&D				4	4
63	Metodologi Penelitian Bisnis & Ekonomi				6	6
64	Metodologi Penelitian Bisnis Untuk Akuntansi & Manajemen Edisi Pertama				4	4
65	Metodologi Penelitian Dan Statistika				3	3
66	Mikrotik Kung Fu Kitab 1		1			1
67	Mikrotik Untuk Pemula		1			1
68	Modul Pemrograman Web (HTML, PHP, & MySQL) Edisi Ketiga				1	1
69	Napoleon Hill's Keys To Success				1	1
70	Nikmatnya Bangun Pagi, Tahajud, Subuh dan Dhuha				1	1
71	Panduan Praktis Dasar Analisa Laporan Keuangan				4	4
72	Paradigma, Metodologi & Aplikasi Ekonomi Syari'ah				1	1
73	Pedoman Pengerjaan Beton				3	3
74	Penerapan Soft Computing Dengan Matlab Edisi Revisi				1	1
75	Pengantar Akuntansi Edisi IFRS				1	1
76	Pengantar Akuntansi Lengkap Dengan Kumpulan Soal Dan Solusinya				1	1
77	Pengantar Bisnis Respon Terhadap Dinamika Global Ed.2				1	1
78	Pengantar Falsafah Ekonomi Dan Keuangan Syariah				1	1
79	Pengantar Ilmu Bisnis				4	4
80	Pengantar Metodologi Penelitian				1	1

Number	Book Title	2019	2020	2021	2022	Total
81	Pengantar Statistika Sosial				3	3
82	Perempuan Kedua				1	1
83	Perencanaan dan Pemeliharaan Sistem Plambing				1	1
84	Perencanaan Struktur Baja Dengan Metode LRFD			1		1
85	Perilaku Konsumen Di Era Internet Implikasinya Pada Strategi Pemasaran				2	2
86	Praktikum Akuntansi Keuangan Manual Kasus Perusahaan Dagang Ed. Revisi				2	2
87	Rahasia Sukses Bisnis Dan Budi Daya Lele Unggul			1		1
88	Ranah 3 Warna		1			1
89	Rancang Bangun 3D dengan AutoCad 2012				1	1
90	Rangkaian Listrik		1			1
91	Santri Cangkir		2			2
92	Smart Traders Not Gamblers				3	3
93	Soal & Jawab Ekonomika Untuk Manajer		1			1
94	Statistik Deskriptif Untuk Ekonomi				2	2
95	Statistika Ekonomi & Bisnis				1	1
96	Sukses Beternak Lele Dumbo & Lele Lokal			1		1
97	Teknik Dan Prosedur Divisi Kamar Pada Bidang Hotel				3	3
98	Teknik Perhitungan Debit Rencana Bangunan Air				2	2
99	Teknologi Beton				14	14
100	Teknologi Perbankan				2	2
101	Teori Dan Praktik Hotel Front Office				13	13
102	The Greats On Leadership			1		1
103	The Maxwell Daily Reader	1		1		2
104	Ubur - Ubur Lembur				1	1
105	UMKM Aspek Hukum Dan Manajemen Pemasaran Produk				1	1
106	Who Am I				1	1
107	Who Moved My Cheese		2			2

3.2. Data Processing

At this stage, using RapidMiner tools with the K-Means method. The New Process view is to prepare a worksheet on RapidMiner. Import the data to be tested in .xls or .xlsx format. Next is the model for importing Microsoft Excel files. To enter data to be executed, you need to right click -> Insert Operator -> Data Access -> File -> Read Excel as shown in Figure 2



Figure 2. Import data

3.3. Modeling and Evaluation

At this stage, add the K-Medoids operator. via right click -> Insert Operator -> Modeling -> Segmentation -> K-Medoids.

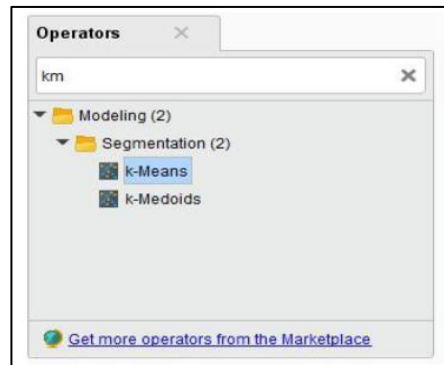


Figure 3. Addition of K-Medoids Operators

Next, work on the settings on the Parameters Clustering K-Medoids menu, setting the value of k, where k is the value that will be used to determine the number of clusters to be created. Here the number of clusters to be created is 3 clusters (low, medium, high) as shown in Figure 4.

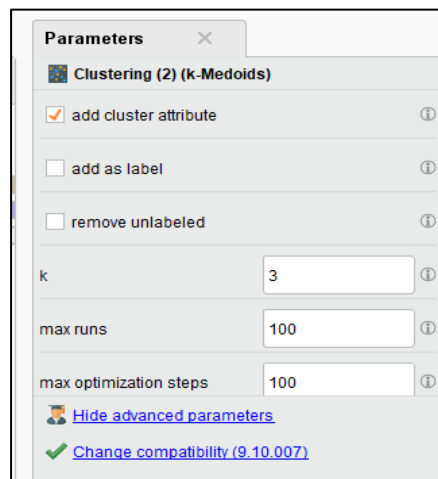


Figure 4. Number of clusters

The modeling form is as follows:

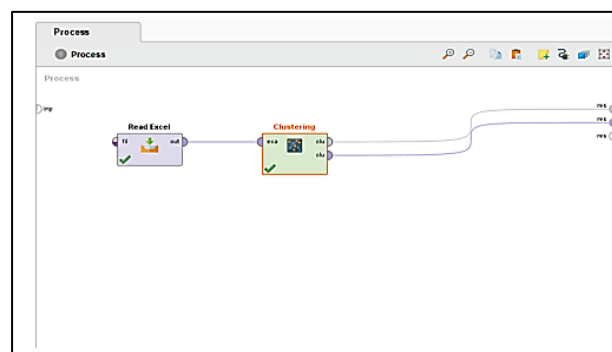


Figure 5. Clustering modeling with K-Medoids

In ExampleSet, you can see some of the cluster results contained in the Data View which is a display of the results of the data cluster that has been entered.

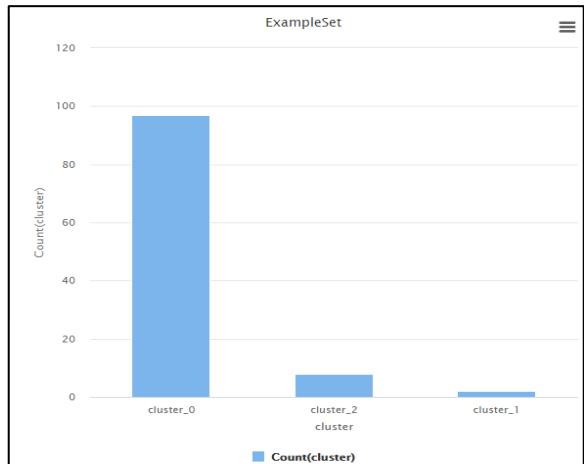


Figure 6. Data example set/cluster results in statistic

In Figure 6 the data results are broken down into 3 clusters, namely cluster 0, cluster 1, cluster 2 with each cluster pocketing the results of clustering data cluster_0 consisting of 97 book titles, cluster_1 consisting of 2 book titles, cluster_2 consisting of 8 book titles.

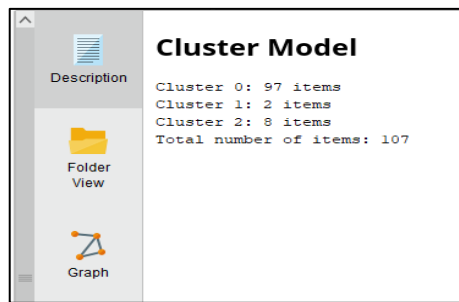


Figure 7. Cluster Model

The following are members of Cluster 0



Figure 8. Members of cluster 0

The following are members of Cluster 1



Figure 9. Members of cluster 1

The following are members of Cluster 2



Figure 10. Members of Cluster 2

From the results of clustering with $K = 3$, it can be seen that in Cluster 1 (high) is the most popular group of books consisting of 2 titles, namely Teknologi Beton, Teori dan Praktik Front Office Hotel in the period 2019 to June 2022 as much as 14 and 13 times the frequency of borrowing.

Cluster 2 (medium) consists of 8 titles, which are books with a moderate frequency of borrowing, in other words, they are categorized as desirable for borrowing. While Cluster 0 (low) consists of 97 titles with the frequency of borrowing books in the rare category, in other words, they are less desirable to borrow.

3.4. Performance

For clustering performance with $K=3$ using the Davies Bouldin Index (DBI) value. Evaluation using the Davies Bouldin Index has an evaluation scheme from an internal cluster, where the good or bad results of the cluster are seen from the quantity and proximity of the data from the cluster results. From the performance results, the Davies Bouldin index value is 0.287 as shown below.

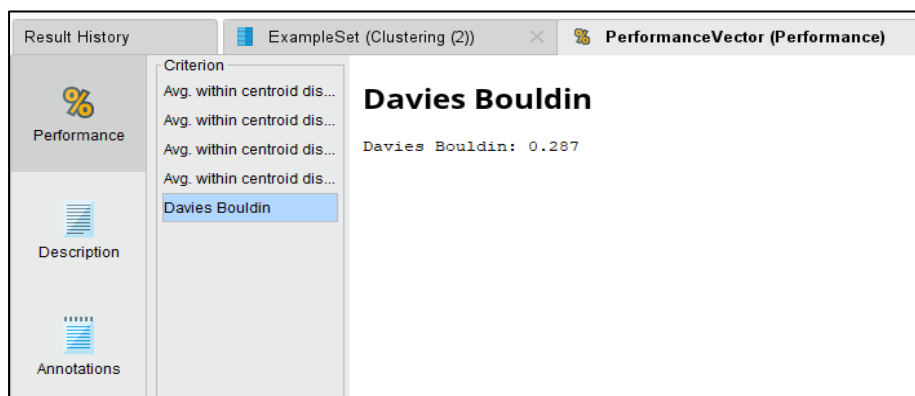


Figure 11. Davies Bouldin

4. CONCLUSION

From the results of data processing through the Rapid Miner Application with $K=3$, the results obtained are cluster_0 (low) consisting of 8 book titles with the frequency of borrowing books in the rare category in other words less desirable to borrow, cluster_1 (high) consists of 2 book titles which are books with moderate borrowing frequency, in other words, are categorized as desirable for borrowing, cluster_2 (high) consisting of 2 book titles, is the most popular group of books consisting of 2 titles, namely Teknologi Beton and Teori dan Praktik Hotel Front Office. The results of the performance obtained Davies Bouldin index value of 0.287

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Implementation of MFCC and SVM for Voice Command Recognition as Control on Mobile Robot

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ABSTRACT

The mobile robot is a system that can move according to function and task. An example is an industrial robot taking objects using a remote control system. Robots controlled using a manual remote system are generally carried out on mobile robots. Many researchers have developed manual control methods, such as image or sound-based robot control. In this study, the mobile robot was applied in an unobstructed room and controlled using voice commands. The methods used are Mel-Frequency Cepstral Coefficients (MFCC) and Support Vector Machine (SVM). MFCC is a characteristic identification of voice command patterns such as "forward", "backward", "left", "right", and "stop." SVM is used to recognize voice command patterns based on the value of the MFCC for each pattern. The experiment has been carried out 50 times with a success rate of 96%. Overall the robot can be controlled by voice commands with good movement.

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1. INTRODUCTION

A robot is a tool that can move to help humans work. Operators in certain tasks generally control worker robots. The robot's tasks include exploring the room, investigating, and patrolling. There are two types of worker robots, namely manipulators and mobile. The robot is a substitute for the role of humans who have physical limitations. Robots that are used to navigate the room are called mobile robots. Mobile robots are usually circular with several levels. Each level is used for various placements of electrical components, sensors, microcontrollers, and also power supplies. Robots, in general, already have a control system in the processor. The control system on the robot is autonomous [1], and there is also operator intervention [2]. The use of the control system aims to regulate the movement and navigation of the robot. On the other hand, applying a manual or semi-automatic control system adjusts the system's movement so that it can monitor the results and processes properly. The manual control of a robot can use a joystick, remote, or guide with an image or voice.

A mobile robot using remote control has been carried out by Hartono et al. [3]. The remote control is in the form of an Android smartphone. Movement data is in the form of a trajectory created in the mobile application and GPS coordinates so that the mobile robot moves to follow the specified trajectory. Devana et al. designed a surveillance robot with a manual control system based on a wireless joystick [4]. The robot is equipped with a mobile application-based camera so the operator can receive information about the robot. The development of manual control has entered the stage of using image processing methods and even voice commands. There are control systems on the robot that use images

such as hand gestures [5] and eye tracking [6]. On the other hand, the implementation of speech recognition also supports robot control [7]. Azargoshab et al. use voice command recognition to control the robot [8]. The commands given are "go", "stop", "left", "right", "forward", "backward", etc. The feature recognition technique they use is the Mel-Frequency Cepstral Coefficients (MFCC) method. Pattern recognition and speech characteristics are usually done using artificial intelligence or intelligent systems.

The application of intelligent systems is a compliment to controlling robots. The intelligent system is a method for creating a system that can make decisions based on the logic embedded in the microcontroller. Intelligent systems consist of methods such as Fuzzy Logic, Artificial Neural networks, Data Mining, Probabilistic, Reasoning, etc. On the other hand, there is a method similar to the Artificial Neural Network, namely the Support Vector Machine (SVM) method. SVM is supervised machine learning in data clustering as well as pattern recognition. Our previous research also implemented SVM for gas identification based on mobile robots [9, 10]. Therefore, this study developed a voice command-based mobile robot control method by applying the MFCC and SVM patterns. In several related experiments, SVM has similar accuracy to Artificial Neural networks and other clustering methods [11, 12] and is a good learning process for nonlinear data using kernel functions [13]. The motivation for developing this research is based on implementing a mobile application or computer-based patrol robot for investigation. The implementation of voice commands provides convenience in real-time teleoperation.

2. RESEARCH METHOD

The mobile robot is one type of robot that can move to help humans work. Mobile robots generally have wheels to move from one point to another. In this research, we develop a mobile robot connected to a computer. This mobile robot consists of a microcontroller module, an actuator, and Bluetooth communication media. Figure 1 shows the mobile robot used in this experiment. The mobile robot is a circle with a diameter of 40 cm with two levels. The first level is for the placement of the microcontroller and driver module, on the second level is for the placement of batteries and other electrical modules. This robot moves based on voice commands given by the operator.

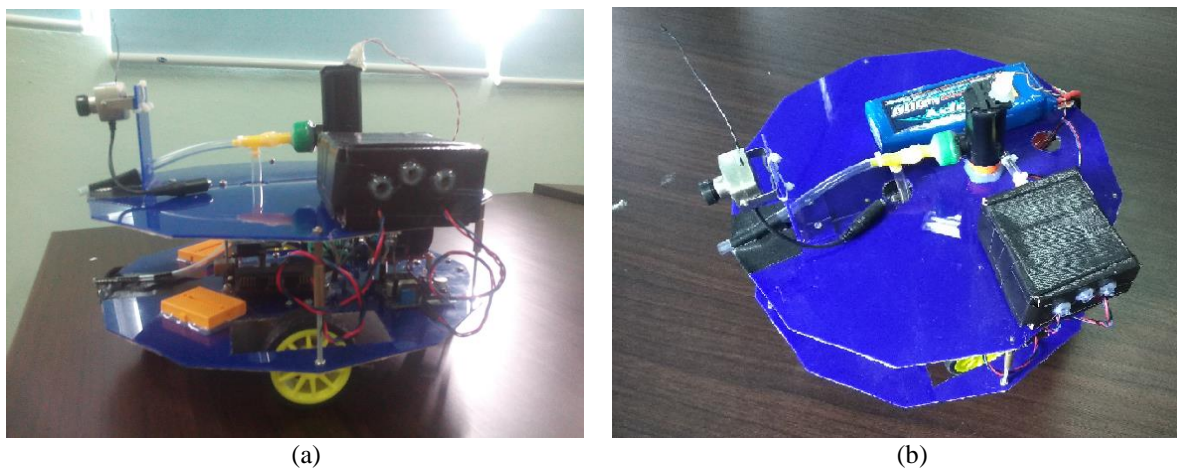


Figure 1. Mobile robot, (a) front view, and (b) top view

The operator gives voice commands through a microphone connected to a computer. The voice commands include "Forward", "Backward", "Left", "Right", and "Stop". The MFCC and SVM process the command on the computer. The results of the decision from the SVM are then transferred to the microcontroller via Bluetooth communication. The microcontroller processes the digital data and transmits the signal to the motor driver to drive the robot. A schematic illustration of the diagram system in the mobile robot is shown in Figure 2.

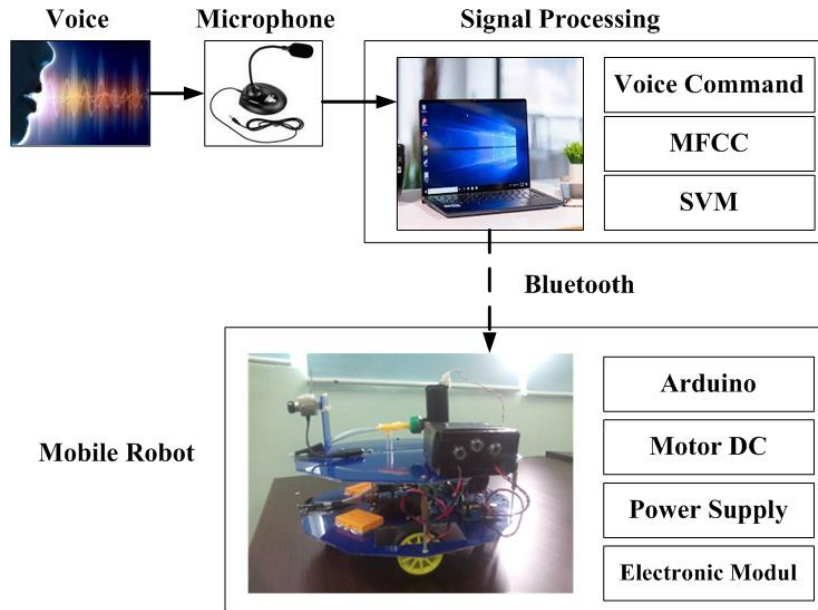


Figure 2. Diagram of a voice command-based mobile robot

The operator's voice is recorded on the computer for 2 seconds, and pre-processing is carried out to take the sound detection part. The detection of sound in the form of signal waves can be seen in Figure 3. The sound signal is processed digitally with a sampling frequency of $F_s = 11000$ Hz. The voice signal needs to be processed to find information in the form of features. The feature extraction method uses Mel-Frequency Cepstral Coefficients (MFCC) in this research.

The MFCC method is one of the methods used in recognizing voice command patterns or voice signals. The stages of the MFCC are as follows [14]:

Stage 1. Detect sound using a microphone. The voice signal is recorded (see Figure 3. a) and cropped for voice data only (see Figure 3. b).

Stage 2. Counting the number of frames from the sample signal with (1).

$$nFrame = \frac{Signal\ length}{Frame\ length} \quad (1)$$

The frame length used is 256.

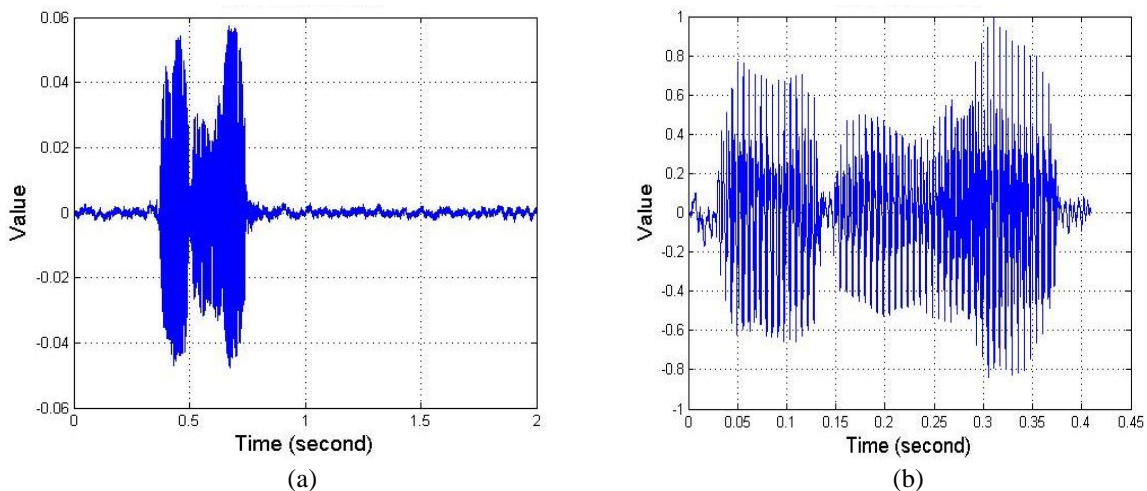


Figure 3. Signal of voice, (a) forward command, and (b) voice detection

Stage 3. Perform the Hamming Window process or a process called windowing. This process uses (2).

$$Y[n] = X(n) * W(n) \quad 0 \leq n \leq N-1$$

$$W(n) = 0.54 - 0.46 \cos\left(\frac{2\pi n}{N-1}\right) \quad (2)$$

Description for variable Y[n] as signal output, X(n) signal input, W(n) Hamming window process, and N number of samples per frame.

Stage 4. The Fast Fourier Transform (FFT) method processes the signal into a frequency response.

Stage 5. Calculating Mel frequency using (3). The Mel-frequency scale is a linear frequency below 1000 Hz and logarithmic above 1000 Hz.

$$F(Mel) = \left\lceil 2595 * \log_{10}\left(1 + \frac{f}{700}\right) \right\rceil \quad (3)$$

Stage 6. Converting log Mel spectrum into the time domain using Discrete Cosine Transform (DCT) as shown in (4). Determine the coefficient value of the MFCC from n = 1 to k.

$$\tilde{C}_n = \sum_{k=1}^K (\log \tilde{S}_k) \cos\left[n\left(k - \frac{1}{2}\right)\frac{\pi}{K}\right] \quad (4)$$

In this study, 20 coefficient values from the MFCC were used. These coefficient values become input for the pattern recognition process using the Support Vector Machine (SVM). SVM is implemented for voice command pattern recognition. SVM is a supervised machine learning technique that can cluster data linearly and non-linearly. SVM uses kernel functions to create a hyperplane to separate data by class. In general, SVM is used to separate two classes, so SVM has evolved to be able to separate multi-class cases. This study used the SVM one vs others technique to recognize voice commands such as “forward”, “backward”, “left”, “right”, and “stop”. Figure 4 shows a diagram of the SVM one vs others technique for recognizing patterns of voice commands.

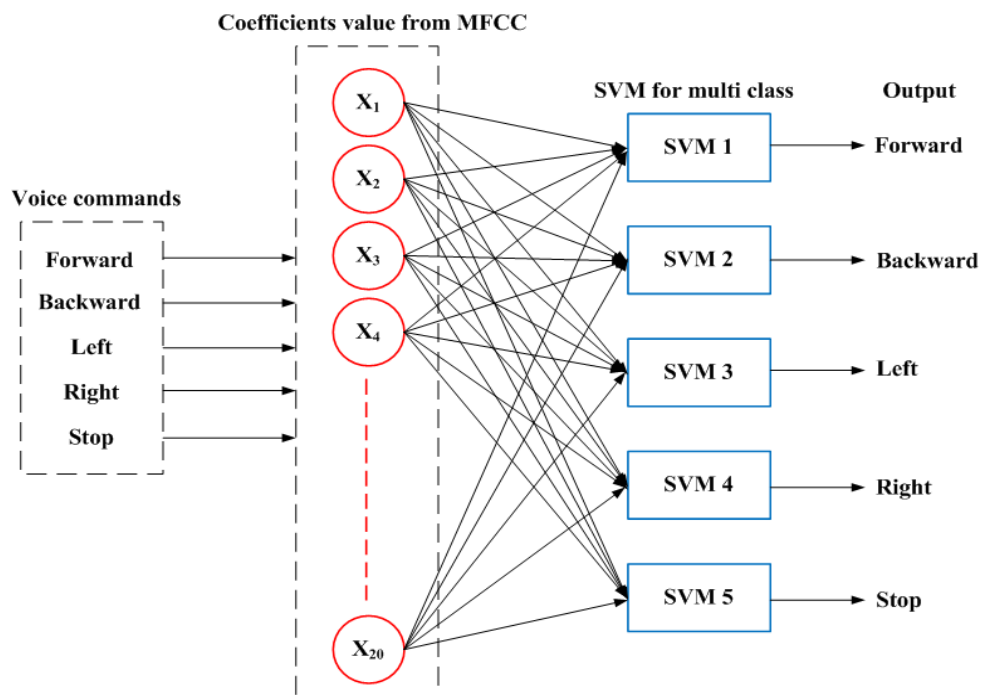


Figure 4. Diagram SVM one vs others

SVM training stage by following the sequential algorithm [9, 15] as follows:

1. Initialize the value $\alpha_i = 0$.
2. Calculating the D_{ij} matrix, see (5).

$$D_{ij} = y_i y_j \left(K \langle x_i, x_j \rangle + \lambda^2 \right) \quad (5)$$

for $i, j = 1$ to l . l is the number of data, and the parameter λ is a constant.

3. Each pattern to be clustered is calculated using (6), where the training data is from $i = 1$ to l .

$$E_i = \sum_{j=1}^l \alpha_j D_{ij}$$

$$\delta \alpha_i = \min \left\{ \max \left[\gamma (1 - E_i), -\alpha_i \right], C - \alpha_i \right\} \quad (6)$$

$$\alpha_i = \alpha_i + \delta \alpha_i$$

The parameter γ is the learning rate.

4. If the training process looks convergent, the process is stopped. Conversely, if it has not converged, repeat the process in (6). The indicator is convergent if the rate of change in value is low or close to zero.

This SVM algorithm produces an optimal Lagrange α value for clustered data, where the input data is converted to dimensional features using the Radial Basis Function kernel function as in (7). For is a kernel parameter with a value determined by the programmer, this study uses the kernel parameter 1000 [9, 13].

$$K(\bar{x}, \bar{y}) = \exp \left(-\gamma \|\bar{x} - \bar{y}\|^2 \right) \quad (7)$$

The testing stage follows the following rules:

1. Determine the number of classes in each SVM, namely clusters +1 and -1.
2. Solve the input data into feature space using the Radial Basis Function kernel.
3. Calculate the last decision-making function using (8).

$$f(x) = \text{sign} \left(\sum_{i \in SV} \alpha_i y_i K(x_i, x) + \alpha_i y_i \lambda^2 \right) \quad (8)$$

$$\text{sign}(k) = \begin{cases} -1 & ; k < 0 \\ 1 & ; k \geq 0 \end{cases}$$

The value of SV is the number of support vectors, and $\text{sign}(k)$ is used to determine the classification.

3. RESULTS AND DISCUSSION

The mobile robot experiment was carried out in the Robotics and Control Engineering Laboratory, Faculty of Engineering, UNSRI. First, an operator gives voice commands through the microphone installed on the computer. In the computer, MFCC and SVM programs are used to process voice signals into commands in controlling the robot's movement. The recognized voice commands are "forward", "backward", "left", "right", and "stop" commands. The MFCC program extracts the characteristics of the voice signal. The coefficient values of the MFCC are input into the SVM learning process. Figure 5 shows the pattern form of the MFCC for voice commands. Each voice command forms a unique pattern recognized by SVM learning. Each voice command takes as many as 10 sample data, so the total becomes 50. The SVM one vs others method (see Fig. 4) has five SVM blocks for each voice command cluster. SVM is a cluster for two classes, namely classes +1 and -1. Therefore each SVM block compares the clustered data against the other data.

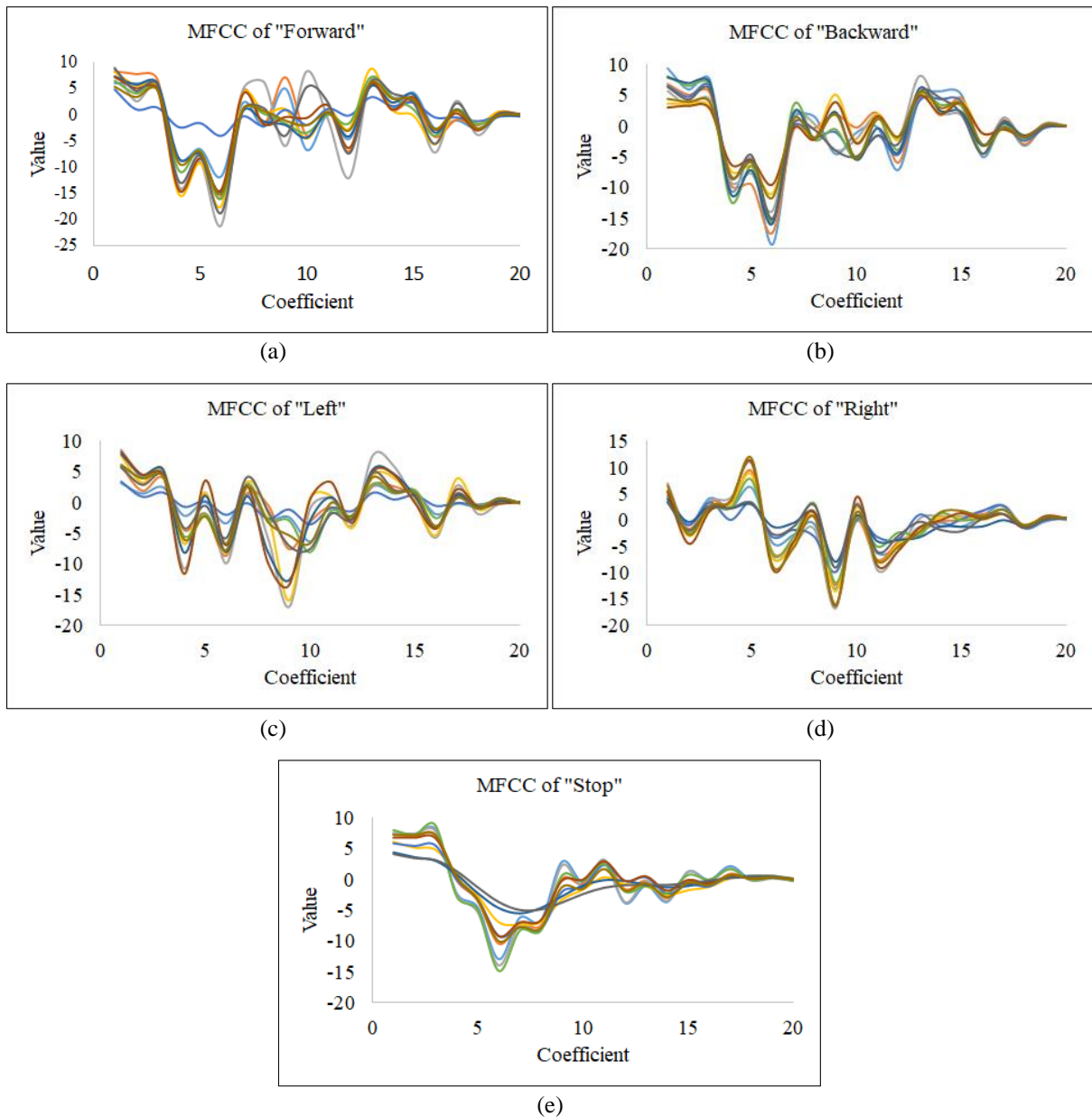


Figure 5. MFCC pattern of voice commands, (a) Forward, (b) Backward, (c) Left, (d) Right, and (e) Stop

Based on Figure 5, the MFCC pattern of this voice command has certain characteristics to the pattern of the voice command. SVM can classify the pattern of MFCC-based voice commands, and a good training process can be seen as shown in Figure 6. Training on SVM reaches convergence at the 100th epoch, and there is no change in the value of the support vector. The results of SVM learning are used to control the movement of the mobile robot based on voice commands. The mobile robot is placed in a free arena, and the robot is active according to orders given by the operator. Figure 7 illustrates an experiment on a mobile robot when it moves based on voice commands. Experiments on the movement of the robot for "forward", "backward", "left", "right", and "stop" carried out movements ten times each. The total number of experiments is 50 times.

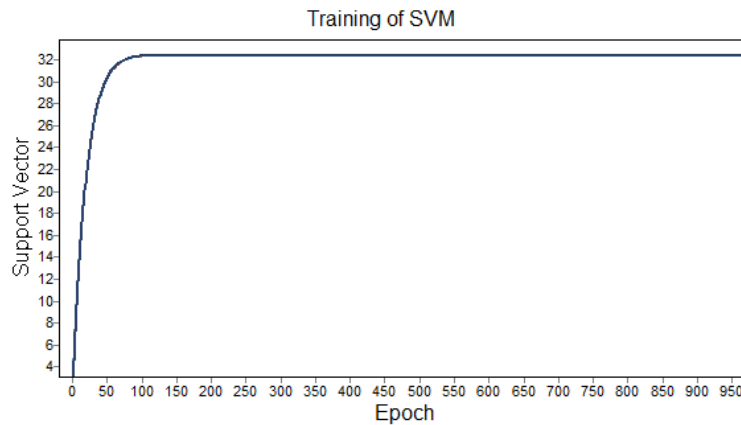


Figure 6. Training of SVM for voice command recognition

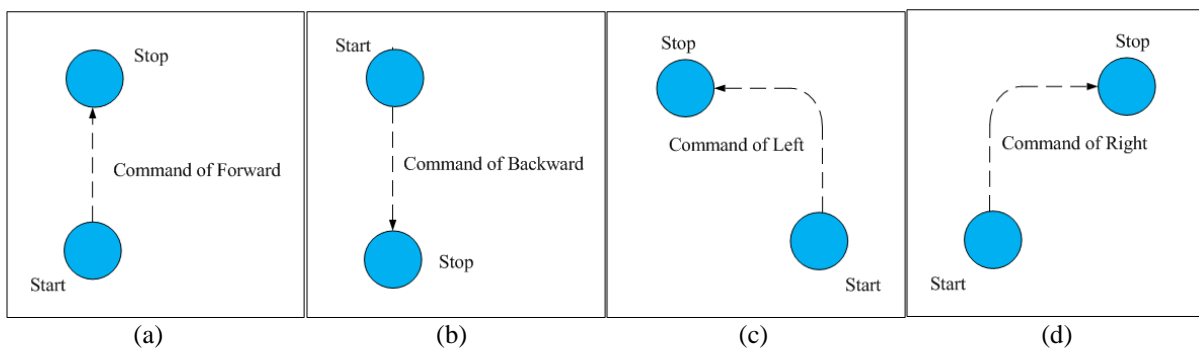


Figure 7. The illustration of the robot's movement when given a voice command, (a) forward, (b) backward, (c) left, and (d) right and stop

The results of the mobile robot experiment with voice commands are summarized in Table 1. For the forward and backward commands, each has failed once. The failure of the forward and backward movement is due to an almost similar pattern. In Figure 7. a, the robot is in the enabled position, and the operator gives a forward command. Within ± 3 seconds, the robot responds to the command to move forward continuously. The operator can give a stop command, and the robot responds to a stop. On the backward command, the robot returns to its original position (see Figure 7. b). On the left and right commands (see Figures 7. c and 7.d), the robot adjusts left or right navigation by deactivating one of the motors.

Table 1. The Experiment of recognizing voice commands to robot's responses

Command	Experiments	Success
Forward	10 times	9
Backward	10 times	9
Left	10 times	10
Right	10 times	10
Stop	10 times	10
Rate		96%

The results of this experiment show that the mobile robot can respond well to voice commands given by the operator. Applying the MFCC and SVM methods can give the robot system the ability to recognize voice command patterns. The experiments in Table 1 show that the robot can move according to voice commands with a success rate of 96%.

4. CONCLUSION

The mobile robot is a type of robot that can navigate to ease human tasks. This research has developed a mobile robot for voice command-based navigation. Voices from the operator are "forward", "backward", "left", "right" and "stop" commands. The pattern recognition method for voice commands uses MFCC, and 20 coefficients are created. The value of these coefficients becomes input data for the learning process using SVM. SVM can classify voice command patterns with one vs others technique. The experiments for each command are ten times, so a total of 50 experiments. There are two failures because there is a similar pattern for the forward and backward commands. The experimental results show that the system can recognize voice command patterns with success reaching 96%, and the robot can respond well to commands within a waiting time interval of ± 3 seconds.

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Implementation of Ad-Hoc Protocol On Tandem Multihop Wireless Network

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ABSTRACT

The utilization of Internet of Things (IoT) technology, especially in remote areas, is still relatively low, even though the technology is required to implement smart farming or smart villages, which aims to improve the quality of life of people in rural areas. The high investment cost for IoT networks that still use cellular networks or Wi-Fi is one of the causes of the slow implementation of this technology. Our previous research has developed an alternative network for IoT devices in remote areas with the concept of a Tandem Multihop Wireless Network focusing on developing simple message scheduling. This research focuses on implementing ad-hoc routing protocols in tandem with multi-hop wireless to analyze the advantages and disadvantages of the protocol. Each sensor periodically sends data to the monitoring server via IoT devices on each tower. The scenario was implemented using MININET-WIFI. Evaluations were carried out to determine delivery probability, latency average, and jitter. In general, the two Ad-Hoc protocols tested, namely OLSR and BATMAN, had the same performance when the data sent was 1 MB, but when the data size was increased to 2 MB, the OLSR routing protocol on several nodes had better performance than BATMAN.

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1. INTRODUCTION

The utilization of IoT-based technology is still constrained by the availability of telecommunication networks, where the technology requires WiFi and 4G networks to communicate and send sensor readings to the server so that they can be processed into useful information. On the other hand, the use of expensive WiFi and 4G networks and the uneven coverage of telecommunication networks keep IoT technology penetration in Indonesia relatively slow, especially for smart agriculture, smart farming, and small villages in rural areas. Where usually, the area is not yet available adequate telecommunications services. So like it or not, it is necessary to build a telecommunications network infrastructure, which requires investment costs that are not cheap.

In previous research [1,2], we have developed a global time slot assignment on a tandem multi-hop wireless network as a low-cost alternative network that IoT devices can use. The development uses a case study by utilizing pre-existing infrastructure, namely the High Voltage Air Line (SUTET) tower, as shown in Figure 1. Each tower is equipped with IoT devices that provide information about the current condition of the tower and transmission lines. IoT devices in each electric power transmission tower send data to the monitoring server through a gateway located in the power generation unit. Many SUTET

passes through remote areas, mountains, and through river routes, where most of the locations of these transmission lines do not have communication lines at all.

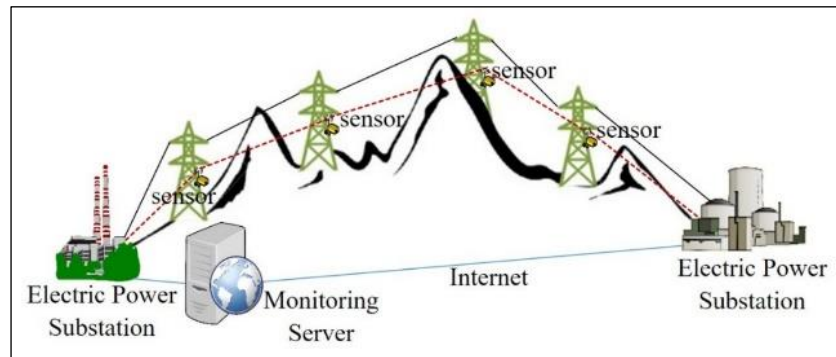


Figure 1. Scenarios of using the wireless sensor network as a monitoring system for very high voltage electricity transmission facilities

A Tandem multi-hop wireless network utilizes Ad hoc network technology which does not require an access point/router to connect multiple nodes. In an Ad-hoc network, each node not only acts as a host but also acts as a router. Nodes on an ad-hoc network can be classified as static or dynamic nodes. Therefore, several routing protocols in ad-hoc are made to work if the topology changes dynamically, where the protocol is divided into three classifications: proactive, reactive, and hybrid. [3,4]

Proactive routing protocols periodically update the routing table by sending information about the presence of each node on the network. O.L.S.R., D.S.D.V., and BATMAN are examples of proactive routing. BATMAN has been implemented by several researchers, one of them in research [15], by adapting and implementing the BATMAN protocol for lower-end devices with MCU and IEEE 802.15.4 transceivers. In addition, there is also reactive routing which does not update the routing table periodically after the existence of a node. When communication is in progress, the node makes a route from source to destination. In addition, there is a combination of the two types of protocols, namely Hybrid routing protocols (Z.R.P. and T.O.R.A.) [5].

Routing protocols play an important role in influencing the performance of ad-hoc wireless networks. This research analyzes the advantages and disadvantages of ad-hoc routing protocols implemented in a tandem multi-hop wireless network using a scenario, as shown in Figure 1. The evaluation scenario was implemented in the Mininet-WiFi emulator to evaluate the performance of popular routing protocols on ad-hoc networks, namely O.L.S.R. and B.A.T.M.A.N., in terms of delivery probability, latency average, and Jitter.

2. LITERATURE REVIEW

2.1. Tandem Multi-hop Wireless model

We developed this model in a previous study [1.2], a simple message transmission model using tandem multi-hop, as shown in Figure 2.2. Where n nodes ($j=1,2,\dots,n$) are connected in tandem, each node creates messages periodically at the beginning of time in 1 cycle. Messages created on each node can be transmitted from a node to neighboring nodes in a one-time slot. And sent using a store-wait-forward rule from the source node to gateway X or Y as the center of each tandem and will be forwarded from the gateway to the other node Server (S) over the internet. Each link has a loss rate value that describes the possibility of message transmission failing to be sent to the following link.

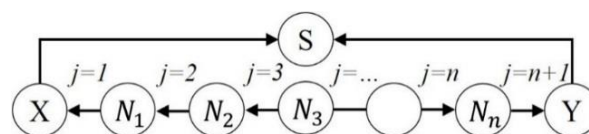


Figure 2. Tandem Multi-hop Wireless Network Scenario

2.2. Wireless Mesh Network

The wireless mesh network is one of the wireless telecommunications network technologies. The network consists of a series of interconnected nodes where each node has two or more communication lines. Nodes in the WMN topology can function as mesh hosts or mesh routers. The node, as a mesh router, serves to forward data transmission packets to other nodes that cannot communicate directly with the destination node. WMN can manage and configure its network (self-configure/self-organize). Therefore, WMN can establish and maintain its connectivity in case of problems in other nodes. The ability of WMN makes the nodes in the network have a high level of toughness and reliability because they are always connected even though there are damaged nodes [6, 7].

2.3. Adhoc Routing Protocol

The routing protocol is a rule used to determine the communication path when sending data from the sending node to the destination node. There are three types of routing protocols in ad hoc network technology: proactive, reactive, and hybrid. This study will compare the performance of two proactive routing protocols: OLSR (Optimized Link State Routing) and BATMAN (Better Approach to Mobile Ad-hoc Network). OLSR is a proactive routing algorithm that regularly communicates topology data between nodes in a network. Each network node selects a group of neighboring nodes to act as a Multipoint relay (MPR). OLSR operates separately from other protocols in the network. OLSR does not perform any calculations based on the connection layer behind it [8]. It was adopted for ad hoc network families such as MANET, VANET [9], and FANET [10].

The MPR is responsible for forwarding control traffic intended for dissemination throughout the network in the OLSR. MPR provides an effective and reliable mechanism for broadcasting control messages by reducing the number of transmissions required. Furthermore, the MPR has a special responsibility when announcing link status information on the network [11]. It is used in route computing to establish a route between two nodes in the network, starting from one source node and ending at another destination node in the network. Each node in the network controls topology control messages to maintain the databases required for packet routing. Different nodes broadcast TC messages regularly to create their MPR voter sets. OLSR is optimized regularly by sending TC messages reactively and reducing the maximum periodic time interval [12].

The BATMAN routing protocol (Better Approach to Mobile Adhoc Network) is a proactive routing protocol in which all decisions and information are distributed evenly to all nodes, so all nodes that are members of the BATMAN routing protocol know information on all nodes incorporated in the BATMAN routing protocol. one network routing protocol, BATMAN. If there is maintenance or disruption to the BATMAN routing protocol network, it will quickly update information regularly. The message used in the BATMAN routing protocol is referred to as OGM (Originator Message). OGM is used to determine the existence of neighboring nodes.

2.4. Mininet-WiFi

Mininet-WiFi is developed from the Mininet SDN network emulator by extending the functionality of Mininet with the addition of WiFi and a virtualized Access Point based on the standard Linux wireless driver and 80211_hwsim wireless simulation driver. Mininet-WiFi is developed based on the code base of Mininet by adding or modifying classes and scripts. So with the new functionality, it still supports all the SDN emulation capabilities of the Mininet network emulator.

The main components of developing Mininet-WiFi are illustrated in figure 3. In the kernel, the mac80211_hwsim module is responsible for creating virtual WiFi interfaces for stations and access points. In addition, MLME (Media Access Control Sublayer Management Entity) is realized on the station side, while in the user room, hostapd is responsible for this task on the AP side.

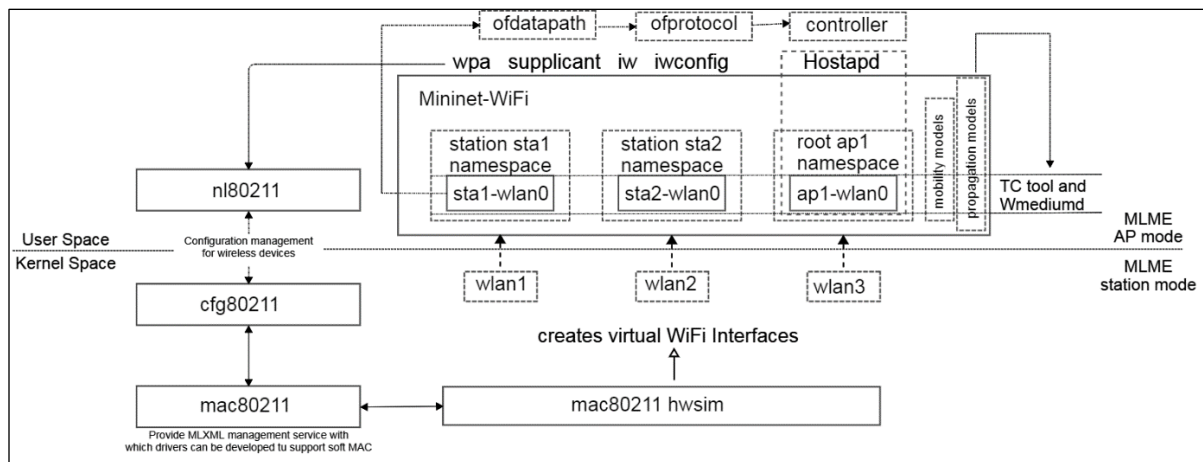


Figure 3. Mininet-WiFi architecture

3. RESEARCH METHODOLOGY

The research method used is a quantitative research method that emphasizes the aspect of measuring objectively the phenomenon. An artificial model of the real system was built to obtain measurement data. Emulation is used to select the appropriate model for the real system. In the emulation process, we use Mininet-WiFi. Table 1 shows the emulator parameters that we used in this study. As shown in Table 1, each node will generate 1 data per second, with the size of each data being 1 MB and 2 MB. The intermediate node then forwards the data to the gateway. So each node in this scenario, apart from creating data, is also tasked with forwarding data so that the gateway node can receive data.

Table 1. Evaluation parameter

Item	Parameter
Environment Size	2000x3000m
Node Number	18
Routing Protocol	OLSR dan BATMAN
Performa Metric	Delivery Probability, Average Latency, dan Jitter
Packet Data Size	1 MB dan 2 MB
Application Traffic	PING
Log Distance Path	2.8
Simulation Time	60 minutes
Number of transmitting Data	3600

3.1. Desain System of Simulation

The Tandem Multihop wireless network scenario used to evaluate the performance of the OLSR and BATMAN routing protocols consists of 18 nodes where one of the nodes acts as a gateway. Each node periodically, for 60 minutes, sends as much as 3600 data to the gateway node through several nodes as intermediate nodes. The intermediate node is in charge of forwarding sensor data. The node also creates and sends data to the gateway node. The network topology used can be seen in Figure 4. From a total of 18 nodes, one node will serve as a gateway. So 17 types of data are generated every second, namely data from Node 1 and Node 2 until Node 17.

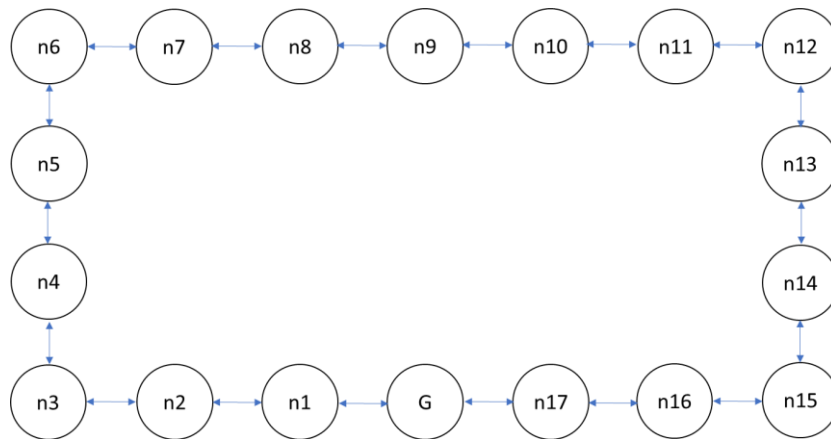


Figure 4. Topology of tandem multihop wireless network

There are 18 nodes with static positions. For routing protocol selection, declared in the creating links section, each node is defined as class Adhoc, mode='g', channel=5, ht_cap='HT40+', and proto="Adhoc". Each node is also defined with a different Mac Address. After the configuration script is executed, the Mininet-Wifi emulator will run, displaying a tandem multi-hop wireless network model, as shown in Figure 5. There are 18 nodes, where Node 18, with the label s18, acts as a gateway, and the other nodes labeled s1 to s7 are tasked with generating data and forwarding data to node s18.

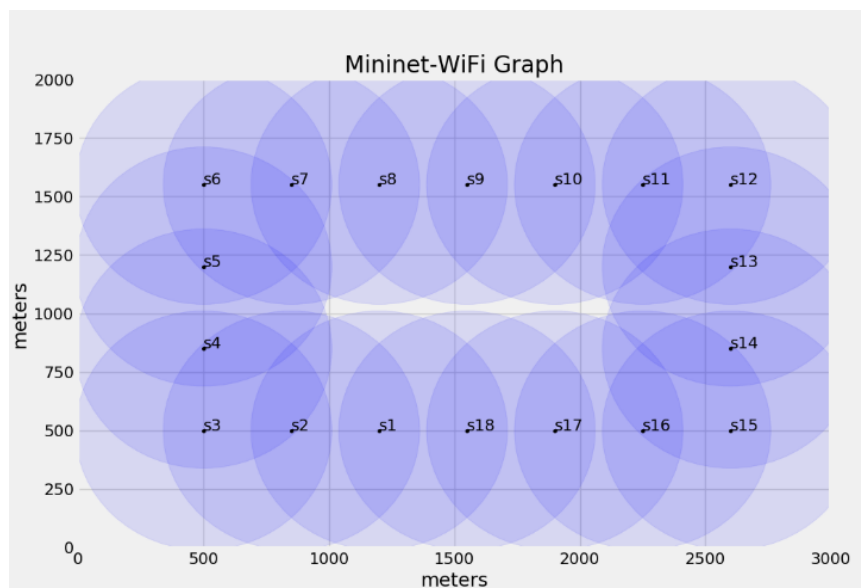


Figure 5. Mininet-WiFi graph topology of tandem multihop wireless network

3.2. Performance Evaluation

The performance of a tandem multihop wireless network and the advantages and disadvantages of the two protocols in a tandem multihop wireless network scenario evaluate using three metrics, namely Delivery probability, Latency average, and Jitter. Delivery probability measures the performance of the probability of the number of messages received at the gateway node. Delivery probability is the ratio of the total number of messages sent to the destination to the total number of messages created at the source, as shown in formula 1.

$$\text{delivery probability} = \frac{\text{Delivered Data}}{\text{Created Data}} \quad (1)$$

Latency or delay is defined as the average travel time of data sent from the source node to the destination node. A jitter determines the time delay in sending data from the source node to the destination node through the network. Jitter shows the many variations of delay in data transmission on the network. This is caused by network congestion and sometimes route changes.[14]

4. RESULTS AND DISCUSSION

4.1. Delivery Probability

Figure 6 shows the delivery probability of the data for each node. The higher the value of delivery probability, the better the performance of the routing protocol, where the percentage of packet loss on the way to the gateway node is getting less and less. With a data size of 1 MB, almost all data sent by each node can be received by the gateway node. This can be seen from the average delivery probability for each data above 0.98. Even in the BATMAN routing protocol, the delivery probability for data from each node is constant at a value of 1. This means that the network configuration and routing protocol can still anticipate the volume of data sent by each node. In this case, each node sends one data per second for 60 minutes.

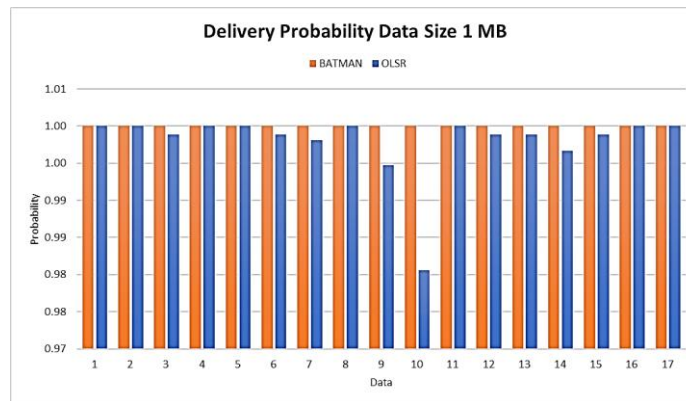


Figure 6. Delivery probability data from each node with a data size of 1 MB

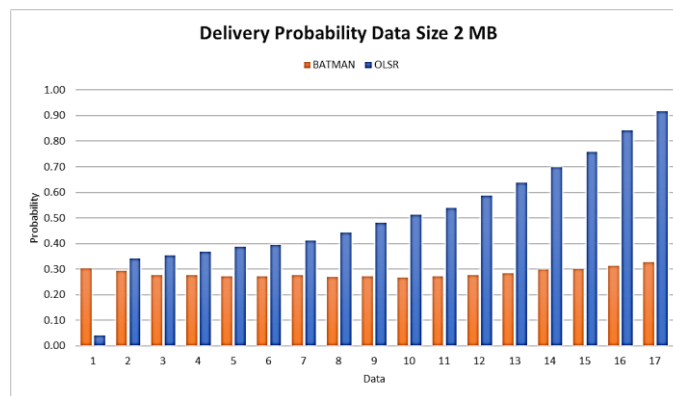


Figure 7. Delivery probability data from each node with a data size of 2 MB

Performance degradation is seen when the data sent's size is increased from 1 MB to 2 MB. The more data packets in the network, the higher the probability of data being dropped (dropped), the occurrence of data collisions (collision), and the accumulation of data queues (congestion) during the transmission process from the source node to the gateway node. Figure 7 shows that the performance of each routing protocol decreases with increasing data volume. In the BATMAN routing protocol, there is a significant decrease in delivery probability, from the delivery probability value of 1 when the data size of 1MB drops to an average of 0.3 for data on each node. In contrast to the OLSR routing protocol, the decrease in delivery probability is not evenly distributed at each node. Node 1 has the lowest delivery

probability and node 17, on the other hand, has the highest delivery probability even though the position of the two nodes is right next to the gateway node.

Differences in the workings of each routing protocol greatly affect the value of delivery probability. The route chosen by the OLSR routing protocol is centered on one node, node 1. So data accumulation occurs at node one, resulting in a very low delivery probability compared to node 17. On the other hand, the BATMAN routing protocol works by choosing a route fairly so that every node with the same route causes the delivery probability value to be almost the same at each node.

4.2. Average Latency

Figure 8 and 9 shows the average latency of data from each node. The lower the average latency value, the faster it takes for data to reach the gateway node. Here, it can be seen that the farther the node's position from the gateway node, the higher the average latency of the node. In general, BATMAN has a higher average latency than OLSR. Even in OLSR, some nodes have a lower average latency even though their position is further from the gateway node, namely at node 8 and node 10. But when the data size increases from 1 MB to 2MB, there is a significant change in the average latency value of OLSR. Route selection in OSLR causes an unbalanced data accumulation at node 1, causing several nodes adjacent to node 1 to have very high average latency. In contrast to BATMAN, the average latency value is almost evenly distributed according to the distance of the node position from the gateway node. The farther the node is from the gateway, the higher the average latency of the node.

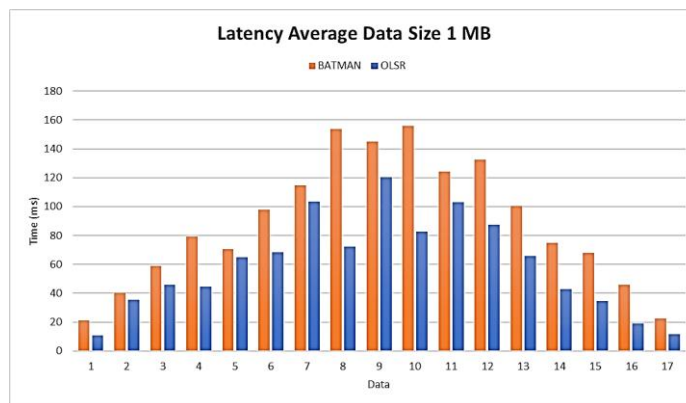


Figure 8. Latency average of each data node with a data size of 1 MB

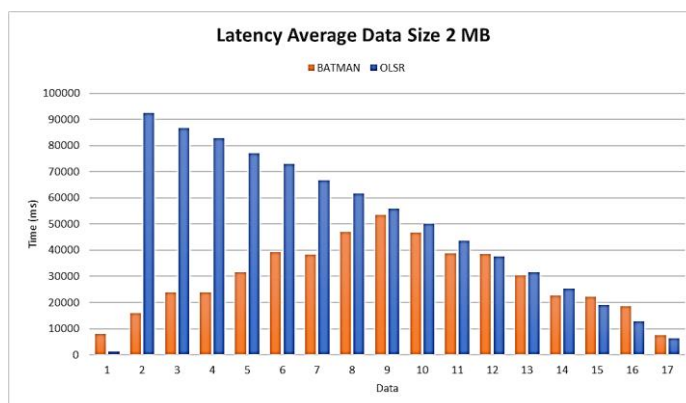


Figure 9. Latency average of each data node with a data size of 1 MB

4.2. Jitter

The jitter value of each routing protocol fluctuates based on the node's location. The lower the jitter value, the better the performance of a protocol. In BATMAN, the farther the node is from the gateway, the greater the jitter value generated. On the other hand, the OSLR routing protocol generally has the same jitter value pattern as BATMAN, but the jitter value in data 8 is smaller than in data 7 even though the location is further from data 7. Likewise, data from node 11 has a lower jitter value than data from

node 10 as shown in Figure 10 and Figure 11. Meanwhile, when the data size is increased from 1 MB to 2 MB, there is an increase in the jitter value for both routing protocols. The jitter value in BATMAN is consistent with the node's position with the gateway node. The farther the node from the gateway, the higher the jitter value. On the other hand, in OLSR, there is an anomaly in the jitter value, especially in data from node 2 to node 8. This is due to the selection of a different route from OLSR, which results in conjunction that occurs at that node.

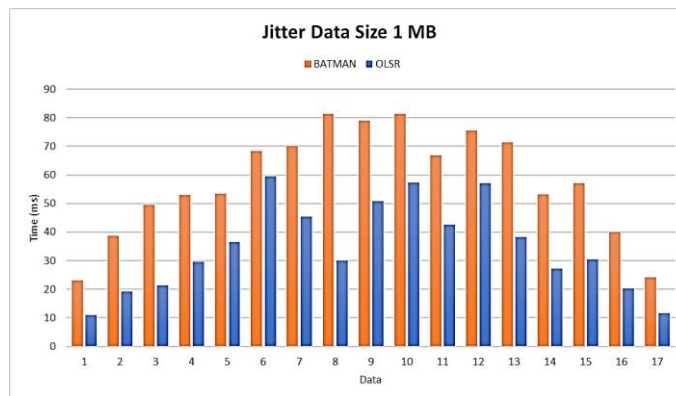


Figure 10. Jitter of each data node with a data size of 1 MB

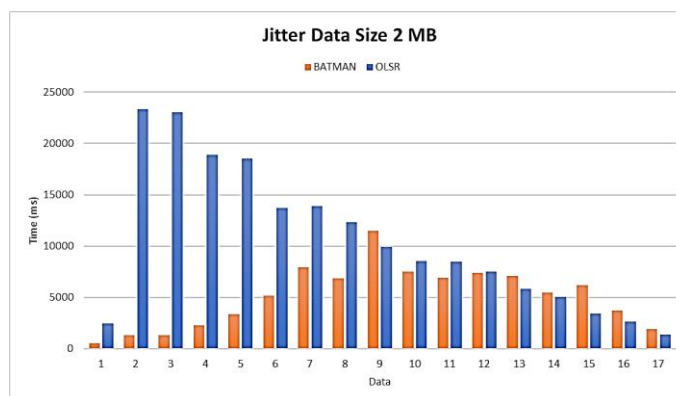


Figure 11. Jitter of each data node with a data size of 2 MB

5. CONCLUSION

In general, both protocols have the same performance when the size of the data sent is 1 MB, but when the data size is increased to 2 MB, OLSR routing on some nodes has better performance than BATMAN, but there is one node that has a very low delivery probability, and of course, it will affect the overall performance when it is implemented in actual conditions. On the other hand, BATMAN has a more consistent delivery probability value for each node, even though the value is still below the OLSR. Likewise, for average latency and jitter, when the data size is still 1 MB, all routing protocols provide good performance, but when the data size is increased to 2 MB, performance anomalies occur, especially in the OLSR routing protocol. Furthermore, the development of the following Tandem Multihop Wireless network is to compare the performance of several protocols, such as BABEL, AODV, and others, as well as the need to develop message scheduling that is integrated with the routing protocol.

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