Barong Is Bluetooth on Arduino Controlling Robotic Hand to Install Insulation Cover in Live Line

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Abstract: The cessation of electricity distribution can cause complaints from consumers. Maintenance of the electricity network is important to improve service to consumers. This research was motivated by the existence of problems in the installation of the insulator cover. This is a direct touch job, necessary to turn off the power because it can be dangerous for workers to touch the live line. The goal is to design a wireless-based robotic hand controller for the installation of the insulator cover so that workers have a safe distance and without touching live line during installation. This robot control system uses an application designed with the drag-drop block programming method on app inventor. This application is installed on smartphone, then connected to Bluetooth on the Esp32 which has been programmed with the H-Bride logic gate to control the direction of motor rotation. Controlling the motor direction on the robot's hand can be done with a voltage of 12 Volts. The output of this design can control the robot's hand to install the insulator cover with the remote work method using a stick on a live power pole. This is expected to help improve the reliability of the distribution of electrical energy supply.

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1 INTRODUCTION

1.1 System Security: Electrical Power Distribution Challenge

The more developed industrialization and modern buildings, the greater the level of dependence on electrical energy. The cessation of electricity distribution even for a moment can cause complaints from consumers. Therefore, maintenance of the electricity network is important, in order to improve service to consumers. This research was motivated by the existence of problems in the installation of the insulator cover to avoid external threats, especially the weather. In this era, technology is growing. Many human jobs that are done manually and require a lot of energy have been replaced by machines. The machine used can work automatically, or semi-automatically by simply pressing a button, so you don't need to exert a lot of energy. This of course aims to streamline human labor and time to complete work, especially public works which have limited time to complete. One of the jobs in question is the installation of an insulator cover on an electrical substation with a voltage of 20 kV. Electricity is a very important component of human activity (Richard, 2015). Global electricity consumption has continued to go up faster than energy consumption (Zhenya, 2016). In this globalization era, electrical energy has become a primary need in the world. Electricity consumption occupied by residential to reach its highest point in China. (Zhaoguang, 2014)

This installation is carried out to protect the wiring of substations or electricity poles from disturbances caused by external factors such as trees, animals or the weather. Especially in the part of the network construction that is still open, it needs to be protected to avoid external disturbances. This can be a concern because this open part may be passed by animals such

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as squirrels, resulting in a short circuit that causes the relay to work and forcibly turn off the electricity. This of course will cause the distribution of electrical energy to be hampered to consumers. So, the installation of this insulator cover is very important in maintaining the distribution of electrical energy. Installing this insulator cover is a direct touch job. This means that type of work is carried out in a non-voltage condition. However, if there is a blackout, it will certainly cause complaints from consumers because community activities that require electricity will be hampered. The world economy movement is strongly influenced by the availability of electrical energy. There will be several problems in human life without electrical energy. The electrical energy supply system consists of several parts, such as power plants, substations, transmission, distribution, and distribution substations. These parts should be reliable in handling problems in the electrical system. This reliable system is designed to guarantee continuously standard electrical energy availability. Security is very important in electrical energy distribution. The green electrical energy distribution system securely to the humans, environment, animals, and plants. There were many electrical blackouts caused by animal and tree disorders. This will disrupt the green electrical energy distribution because animals die after electrical discharge (Melo, 2014).

In this paper, some problems such as the insulator cover type YSL-70AP insulation resistance, breakdown voltage of the insulator cover type YSL-70AP, and the preferable of the insulator cover type YSL-70AP applied in the 20 kV system, were investigated. With the use of a wireless control system, the insulator cover can be installed without turning off the electricity and without touching the power cord directly (Jondra, 2019). With the use of a wireless control system, the insulator cover can be installed without turning off the electricity and without touching the power cord directly. Because, with a wireless control system, workers have a safe distance in the installation of the insulator cover and do not touch live power cables directly. This makes this tool an advantage in optimizing work time which can be done at any time without the need for a rotating blackout schedule. Problems in the field need to be observed for the purpose of obtaining a solution in solving an existing problem (Turan, 1986).

2 CONTROL SYSTEM FOR THE SOLUTION

This study uses 2 methodologies namely observation and experiment. To get the best solution, it is necessary to carry out various experiments on the object under investigation the first step taken is to review the research design and the components needed. To design a tool, it is necessary to study the literature so that the tool works in accordance with the expected goals (IEC, 2209).

2.1 Microcontroller

The function of the microcontroller is as the brain or controller of an electronic circuit for a specific purpose. ESP32 is a microcontroller introduced by the Espressif System which is the successor of the ESP8266 microcontroller (Sanjay, 2018).

One difference between the ESP32 and the ESP8266 is the processor. ESP32 is Dual-Core 32-bit obviously faster than ESP32 in performance. In addition, this module also has one feature that is not present in the ESP8266, namely Bluetooth which can receive data up to 25 meters away without a hitch.

2.2 Power Window Motor

The power window motor is a type of DC motor with a gearbox that usually functions as a driving force for the ups and downs of the windshield. This DC motor requires a voltage of 12 Volt DC (Salman, 2011).

We use this type of motorbike because it is easily available in the market and in terms of function, this motorbike has enough torque to see by moving the windshield. So that this motor is expected to be able to move the robot's hand insulator cover.

2.3 Motor Driver

The L298 Motor Driver is a module that is often used to control DC motors. By using the L298 Motor Driver we can easily control both the speed and direction of rotation of 2 motors at once. The L298 Motor Driver is designed using the L298 Dual H-Bridge IC. The Motor Driver contains H-Bride logic gates which are already very popular in the electronics world as controlling the speed and direction of motor rotation [5]. It should be noted that we use this motor driver because the Drive Current in this driver is able to supply up to 5A per channel, which is where the motor we use has been tested for load and the measurement results are less than 5A. So

this motor driver is able to control the DC motor we use (Peerzada, 2021).

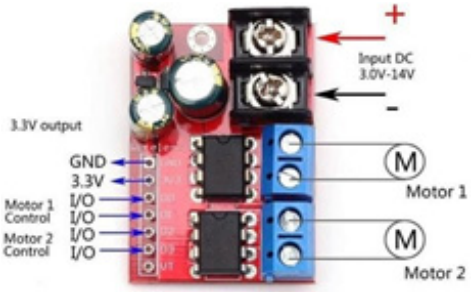

Figure 1: Motor driver L298.

2.4 How to Design of Barong System

The design of this system focuses on the wireless control system. The first thing that is needed here is hardware and software to support the wireless control system. One of the hardware needed is the Esp32 microcontroller. The Esp32 used has been planted with wifi and Bluetooth features. We use the Bluetooth feature to make it easier to use. The software needed is Arduino IDE. Arduino IDE is software used to program Esp32 microcontroller boards. Esp32 is the most important hardware part of this control system. As a controller, Esp32 plays a role in sending signals to the motor driver.

Table 1: Logics of H-Bridge.

I/O 1	I/O 2	Motor Condition
High	High	Off
Low	Low	Off
High	Low	Clockwise
Low	High	Unclockwise

The motor driver that we use is the L298 type, the DC voltage range is 3-14V as shown below. The above logic table is our basis for programming the control system on Esp32. The output pin of the Esp32 will provide a signal that will enter the IN pin of the motor driver. The rotation of the motor will depend on the signal given based on the above logic table.

The reason we use this motor driver is that we will design this system with a power window motor or a motor that is usually used as a windshield driver on a car in order to get enough torque to move the robot's hand. The voltage required to supply this motor is 12V DC. We also designed a power supply with 3 rechargeable batteries to allow charging the battery if the battery is running low. We have 3 series of 3,7V batteries in series controlled by the Battery Management System (BMS) in order to stabilize the

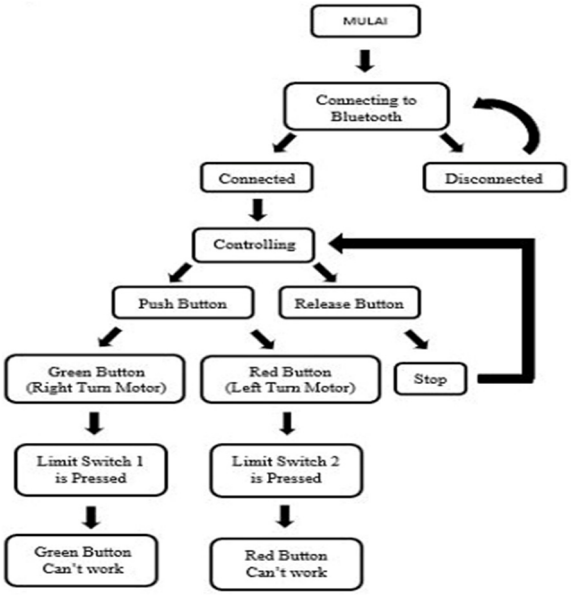

Figure 2: The design of Barong system.

output voltage and maintain battery health, especially by preventing overcharge and over-discharge.

2.5 Designing the Application for the Smartphone

The robot hand control is fully controlled by application users or workers in the field to adjust the installation conditions of the insulator cover. To summarize this wireless-based control, an application is designed as a medium for sending data to the controller. Kodular is the platform used in building this Android application. Kodular uses a drag drop block programming system in building an application (Knowles, 2013). The drag-drop block programming system is a programming system that uses function blocks as the logic for running an application. Even in designing this system, this system is based on visual programming, which means programming the design without writing. The following codular designs have been made:

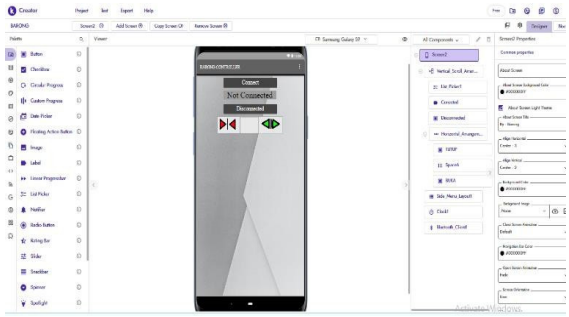

Figure 3: Design of visual programming for smartphone.

Control data or commands should be sent via Bluetooth on the Android device application to the controller. Therefore, Esp32 on the controller needs to authenticate the Bluetooth connection of nearby users to be able to connect to each other to send data to the controller. (Purnata, 2022). To realize this, Arduino IDE software is needed to program this control work system in an Esp32 microcontroller. This program will of course be integrated with the program block in the coded. Every data sent from the application will send a 1 byte number. Where this number will arrive at the Esp32 microcontroller, then executed according to the logic that has been made.

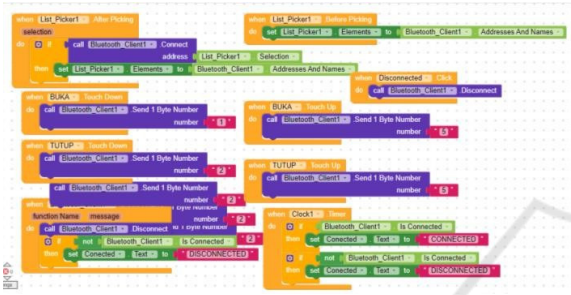

Figure 4: Application design of block programming to control robotic's hand by bluetooth.

First, it requires a library program or commonly called a library to summarize the program created. Defining the variables is also needed in engineering the work system later. In the void setup, categorize the output and input pins to be input data or output data. In void setup also initiates a Bluetooth connection, so that it is only enough to connect the android device with the controller once. In the void loop, logic is given to receive any data from coded. Receipt of data in the form of a byte number that has been adjusted to the coded program block. The delivery of each data is determined from the button control in the application. If the green button is pressed then byte number 1 will be sent. If the red button is pressed, then byte number 2 is sent. If both buttons are not pressed then byte number 5 will be sent.

The byte number data sent will be received by Esp32. If the byte number is 1 then the sublogic that is executed is void forward or the motor command will move forward. If the byte number is 2, then the sublogic that is executed is void backward or the motor command will move the other way around (backward). If the byte number is 5, then the motor will stop spinning. So these systems are integrated with each other, so that the designed control system can run as expected.

3 EXPERIMENT TESTED RESULT AND DISCUSSION

In this study, the experiments tested were divided into several test subsystems. Each of these subsystems has an indicator of the success of a designed tool. The first subsystem tests the success of the Bluetooth connection between the Android device and the device. Second, the success of controlling the motor on the robot's hand through the designed application. Third, the success of closing or installing the insulator cover in the field. The information obtained on this tool is in order to obtain its specifications, such as the maximum operating distance between the android device and the designed tool and battery resistance in carrying out work when installing the insulator cover.

3.1 Testing the Bluetooth Connection

We named each device three samples is "BARONG1", "BARONG2" and "BARONG3".

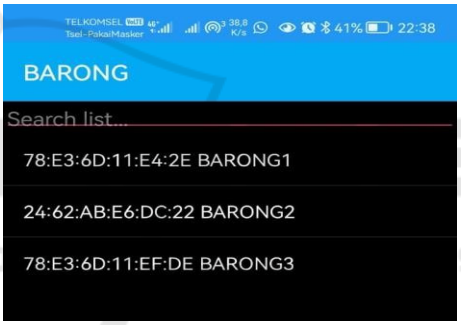

Figure 5: Bluetooth connectivity detection results.

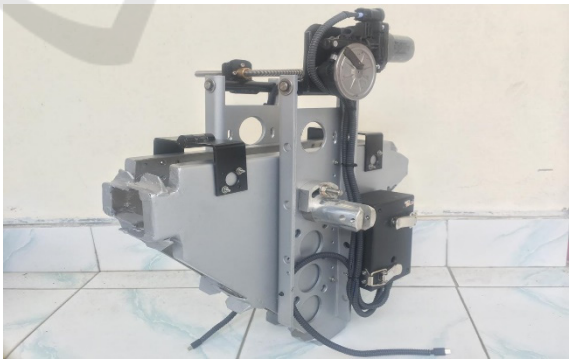

Figure 6: Barong ready to install insulator cover in the live line.

The test of the three tools that have been designed has been successfully detected by the application so that it can be connected to the Android device. The maximum operating distance measurement between

the designed tool and the Android device without obstruction is up to 24 Meters. Above 24 meters the Bluetooth connection becomes less stable which causes the connection to be disconnected suddenly.

Table 2: Bluetooth connectivity range measurement results.

No.	Distance (m)	Connectivity	Status
1	4	Connected	Stable
2	8	Connected	Stable
3	12	Connected	Stable
4	16	Connected	Stable
5	20	Connected	Stable
6	24	Connected	Stable
7	28	Connected	Unstable
8	32	Not Connected	

3.2 Testing the App Control Success and Battery Lifetime

Motor control uses an app with 2 button that can rotate the direction of rotation of the motor. The direction of rotation of this motor will determine the position of the robot's hand to close or open. Red button to close and green button to open. From the experimental results that have been tried, the control was successfully carried out to open and close the robot's hand. Battery life in the installation is quite good. When the battery is fully discharged, this tool can perform more than 10 times of installation. Charging the battery takes 2.5 hours.

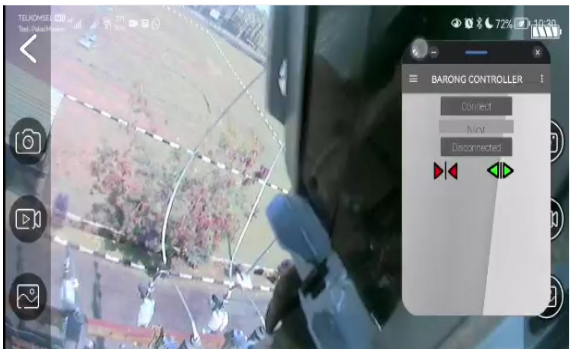

Figure 7: Performance of Barong with its bluetooth connectivity results.

There are three results and analyses of this research, i.e. digitalization process, laboratory web design process and upload digitalization result to the web process.

3.3 Final: Testing of Insulator Cover Installation in the Live Line

The insulator cover installation is tested to determine the reliability of its installation. The installation simulation was carried out several times to determine whether the insulator cover could be installed properly or not. Ensure that the insulator cover is securely attached and locks the clamps on the insulator cover.

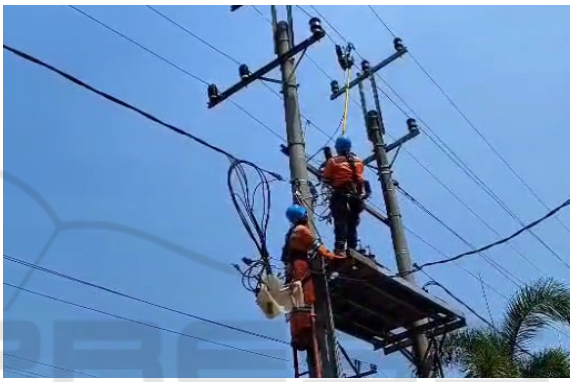

Figure 8: Barong install the Insulator Cover on Live Line in Udiklat PLN Semarang Center Java.

From the situation experiment, there are obstacles in limiting excessive control when pressing the button for too long when the condition of the robotic hand has opened or closed the maximum. This can cause the motor to overheat due to excessive performance and cause the tool or insulator cap to be damaged due to pressure on the construction. Based on the results of this description are many suggestions as described: PLN must utilize Insulator cover type: YSL-70 AP optimally because the results of this study indicate the performance is over than standardization. This insulator cover can protect again tree and animal disturbance. Tree disturbance is the problem of equipment outage. If it is deemed to increase the isolation resistance of this insulator cover it needs some modification, to improve the safety to install an insulator cover. The installation of the insulator cover by utilizing this Barong robotic hand will keep the line still live and workers safe from possibility of being exposed to high voltage electricity.

4 CONCLUSIONS – POTENTIAL AND PROSPECTS FOR THE INSTALLATION IN THE LIVE LINE SAFELY

The design system for the robotic hand control that installs the insulator cover has been realized and tested. From the experimental results obtained some information that needs to be considered.

First, this robotic hand can operate effectively with a range of up to 24 meters from the smartphone device used.

Second, the installation of the insulator cover is carried out perfectly without any locking clamps that have not been locked. So, the installation of this insulator cover can be said to be successful.

Third, the battery life is capable of installing up to more than 10 times of installation. So enough to support the work of the day. On the other hand, this tool needs to be improved, especially in limiting excessive control when pressing the button for too long when the robot's hand condition has opened or closed to the maximum.

As a suggestion, additional components such as a limit switch as a barrier to motor movement in order to prevent overheating of the motor due to excessive performance and prevent the tool or insulator cover from being damaged due to pressure on the construction.

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