Early Detection of Electric Short in Human Due to Lackage Current in Internet of Things (IoT) Based Electrical Instalation

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Abstract:
Touch voltage is one of the voltage differences that occur during the flow of ground fault current. At a small voltage value the resulting effect is not very significant but at a certain voltage value the effect is very dangerous and can even lead to human death. The Earth Leakage Circuit Breaker (ELCB) time trip is not affected by the resistance of the human body. With the application of the ELCB in an electrical installation system, it is hoped that the danger caused by the touch voltage can be minimized so that the system is safe for humans. To further refine the ELCB system, in this study, adding additional devices to the ELCB circuit; namely the ESP8266 microcontroller which is programmed using the Arduino application and connected via the Telegram Bot application on a cellphone, so that the installation user/owner can get notifications via the Telegram application on the cellphone. If the ELCB trips due to leakage current disturbances, this notification is expected to speed up handling in the field. From the test results it is found that the IOT-based ELCB functions properly with the response of sending notifications to telegrams according to the program time delay
Key Word:*ELCB, IoT, Node MCU ESP8266,Bot Telegram dan Arduino*.

I.   Introduction

Human safety is a very important factor to consider in the use of electrical energy. Lack of and minimal level of security in the electrical installation system can pose a risk of danger to the human body when in contact with active electrical parts can cause death (Syukriyadin, 2016: 111).

Earth Leakage Circuit Breaker (ELCB) as a protective device in the event of an electric current leak. The main purpose of installing the ELCB is to avoid hazards that can cause death to humans and other living things due to electric shock. The ELCB works to detect unbalanced electric currents, for example, when a voltage electrical installation, a person touches an electrical wire whose insulation is peeled off, then an electric current will flow through that person's body and will then activate the relay on the ELCB to cut off the electricity supply.

If at the time of the incident the owner of the installation was not at the location, he would not receive any information about the incident. Mobile can be used as a tool to inform or provide notifications in the form of a warning through the Telegram application if there are indications of living things being electrocuted, thus enabling the user/installer to be able to cope even though the user/owner is outside the incident location

In order to realize the above objectives, several problems arise as follows:
1. How to make a series of touch voltage protection system tools using an IOT-based ELCB
2. What components are needed for the design of the touch voltage protection system device
3. How can the circuit work so that it can provide notification to the user if someone is electrocuted

II.   Material And Methods

This study aims to design and create a prototype of an early detection system when an electric shock occurs in living things so that the ELCB works, then the installation owner gets information via the Telegram application on a mobile phone, so that it can be immediately addressed so that it does not have a fatal impact on humans or other living things even if the user/ the owner is out of the house.

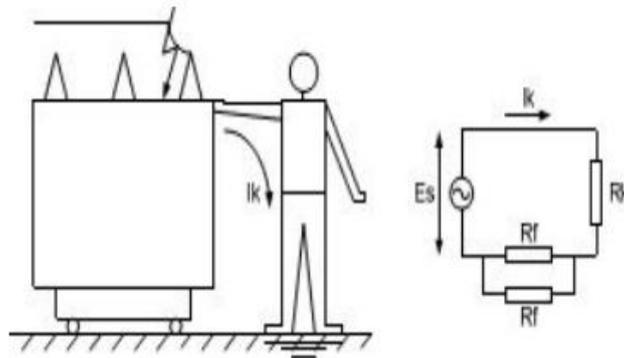Touch voltage according to a (Sudiartha, I. W., & Ta, I. K., 2017: 34).As Figure 1.

Figure 1. Touch voltage and its equivalent circuit.

and Muljono, et al (2019:78)From some of the opinions of the experts above, it can be concluded that touch voltage is the tension that exists between one object and another object that is touched one meter away, assuming that the object being touched is connected to the earth lattice below it.

According to (Ritongga, 2021: 15) states that the ELCB is a breaker device that is sensitive to leakage currents, which can break circuits including the neutral conductor automatically within a certain time. This tool can also be used as a safety device in the event of a leakage current on one of the conductors passing through the device.

Figure 2. ELCB on the voltage source

In line with the opinion above, Nugroho (2015) suggests that the ELCB is a breaker when there is positive current contact, negative current and grounding in electrical installations. And more importantly the ELCB can cut off the electric current when there is contact between electricity and the human body.

Meanwhile, according to Rustandi (2020: 34) states that the ELCB or MMCB basically functions as a circuit breaker just like the MCB. The working system is the same, namely as a relay connecting the voltage from the power source. But this ELCB has the advantage of working faster and more sensitive than the MCB to cut off the electric current from the source when an electric leak occurs.

ELCB Working Principle

According to Suryadi and Sofwan (2016: 143) the working principle of the ELCB is to detect the presence of leakage currents, where the current entering the system is compared to the current leaving the system, if there is a difference in a predetermined value then the ELCB will cut off the flow of electricity to the system.Meanwhile, according to Sudiartha&Ketut (2014: 33) the working principle of the ELCB is to detect leakage currents, the current entering the system is compared to the current leaving the system, if there is a difference in a predetermined value then the ELCB will cut off the flow of electricity to the system directly
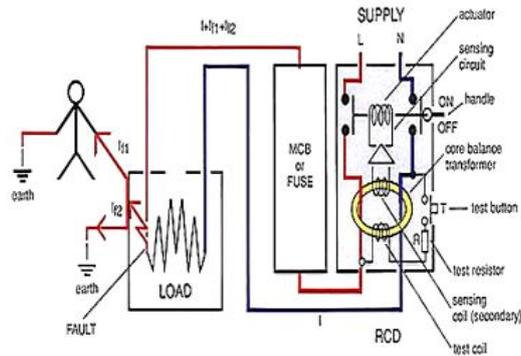
Figure 3. ELCB Working Principle

The ELCB will work on a differential system consisting of a current transformer (magneting core) with a core shaped like a bracelet, this core will be wrapped around a single-phase conductor, three-phase without neutral or three-phase connection with a neutral. When there is a phase to ground leakage current disturbance in the conductor, the current flowing will not be the same as the current flowing in the neutral conductor. When the current is unbalanced it can cause a magnetic flux in the toroid so that it will generate a voltage in the secondary winding of the toroid which can contact the relay mechanism then the main contact of the ELCB will disconnect with the system.
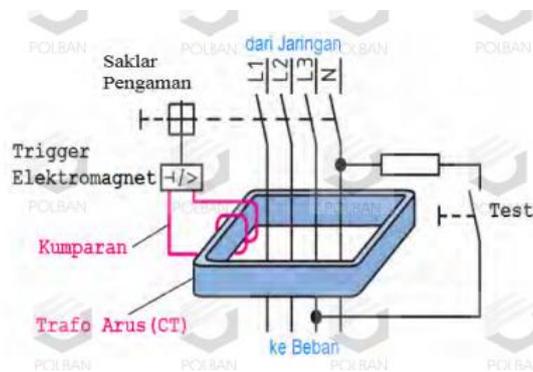

Figure 4. ELCB Working Principle

Meanwhile, according to (Efendi, 2018: 20) IoT is concept to connecting and make a communication between object in real concept, which every part of object are connect each other using the internet network as a link.From some of the opinions above, it can be concluded that the Internet of things is an idea or idea that aims to expand the benefits of internet connectivity as a medium or tool for communication.

Benefits of Internet of Things (IoT)
According to Sulaiman&Widarma (2017) the benefits of the Internet of Things are found in many activities, such as online transportation, e-commerce, online ticket ordering, live streaming, e-learning, remote temperature sensors, GPS tracking, and administrative archiving. education that uses the internet or network as a medium to do so.
Meanwhile, according to Budgetie& Indonesia (2017) the benefits of IoT are being able to monitor the environment, infrastructure management, equipment sensors, the health sector, and building and housing automation. The Internet of Things has the potential to change the world just like the Internet did, maybe even better (Ashton, 2009).

Node MCU ESP8266
According to Skad& Nanda (2020: 1220) NodeMCU is an open source IoT platform and development kit that uses foreign programming languages to assist in making prototypes of IoT products or you can use sketches with the Arduino IDE.

Figure 5. Node MCU ESP8266

Telegram as a new instant messaging application offers various advantages in its features compared to other instant messaging applications (Risanty&Sopiyan (2017).

The Telegram application was chosen because this application is free, lightweight and multiplatform. Telegram also has a bot API that is quite complete and growing, making it possible to create smart bots that can respond to messages from the public (Sastrawangsa, 2017).

Meanwhile, according to Mulyanto (2020: 53) Bots are third-party applications that can run on Telegram. Users can send messages, commands, and inline requests.

Research Flowchart

In making this tool, the design is carried out after knowing the background of this tool made. After that determine what tools and materials are needed to make a tool that can work automatically providing information to the owner/user if there is an electric shock caused by a leakage current in an electrical component.

Based on the steps of the research, including problems, literature studies, tool design, software design, data collection, analysis and testing, and conclusions. The shape of the flowchart can be seen in Figure 11.The first step is to look for problems, namely problems with electrical components that have been used for a long time and electric shocks in humans which was the beginning of this research.The second literature study aims to study some previous research related to electric power protection systems and ELCB monitoring using a microcontroller.The third step is tool design to determine the schematic of the tool to be made, then proceed with software design to determine software in the form of output monitoring, if errors still occur, the flow will return to the software design stage, if not, the research will continue at the next stage.The next stage is analysis and testing, aiming to solve the problem.

Then the conclusion which is the end result of the creation of the tool in this study.

Figure 6. Research Flowchart

Materials and Research Tools

The research materials used by researchers in designing a leakage current protection system design tool using an IoT-based earth leakage circuit breaker are: 1. Cable, 2. ELCB, 3. Switch, 4. Light bulb, 5. Arduino Application, 6. ESP8266 Microcontroller, 7. 9V Adapter, 8. Socket, 9. MCB, 10. Resistor.

The equipment used in this study are:

1. Solder which functions as a heater to melt tin.

2. The multitester functions as a measure of the output voltage and current in the circuit.

3. The drill functions as a tool to punch holes in the circuit board.

4. Tin acts as an adhesive on circuit components.

5. The circuit board serves as the body where the circuit components are attached.

6. Laptop as a reader and writing coding on Arduino.

7. The Arduino cable functions as a connection for the Arduino to the laptop for inputting the programming language.

In the design process, design steps are needed which are divided into several parts, namely: making the ELCB circuit, designing the regulator circuit for the ESP8266, programming the ESP8266 microcontroller with Arduino. This circuit serves to test the function of the ELCB whether it is functioning properly or not, here is the circuit:
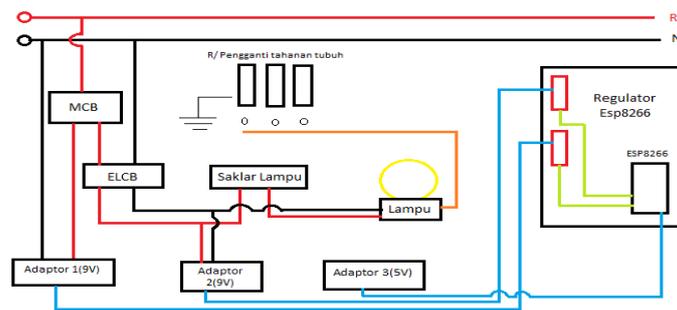
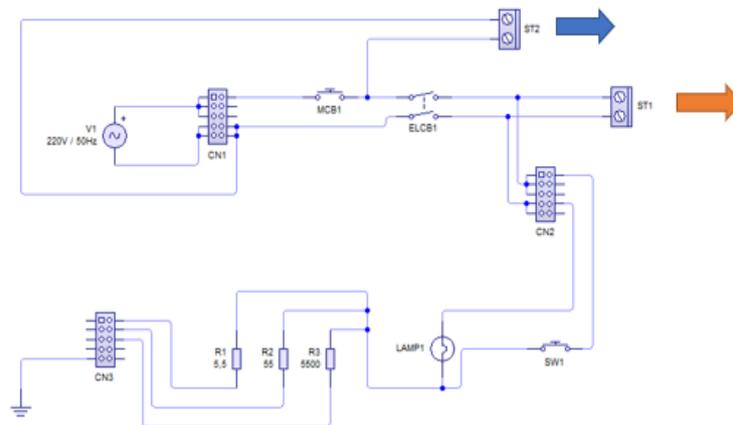**Figure 7.** ELCB Test Circuit Block Diagram
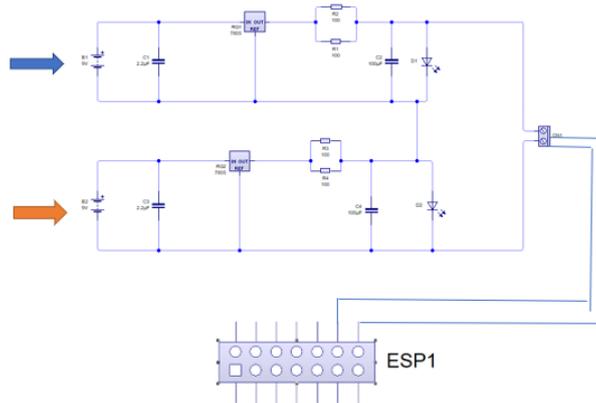

Figure 8 Overall Test Suite

Figure 9. Overall Testing Series

This circuit is made to convert 5V to 3.3V voltage which can be used by the ESP8266 microcontroller, the circuit is as follows:
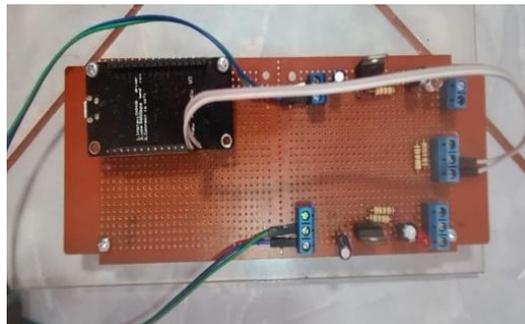

Figure 10. Circuit Component

III. Result
Testing the ELCB circuit is carried out with a light load then instead of human resistance the author uses 4 different resistors, namely: 300 Ohm, 1000 Ohm, 2000 Ohm and 3000 Ohm.

Table 1.Result

No.	Try	Resistor(ohm)	ELCB Result *Trip*(second)
1	First	300	1
2	Second	1000	1
3	Third	2000	1
4	Forth	3000	1

Figure 11. Circuit Test ELCB

From the test results it was found that the regulator circuit is functioning properly, namely reducing the voltage from 9V to 2.5V so that it can be used on the ESP8266 microcontroller.

After all the components are put together and assembled on the trial panel, it can be carried out as a whole, namely by conducting a trial in the presence of an electric shock. The display on the Telegram application also gives a message that someone has been electrocuted. This design uses an arduino-based protection system. The author conducted 4 experiments by changing the time delay on the ESP8266 microcontroller.
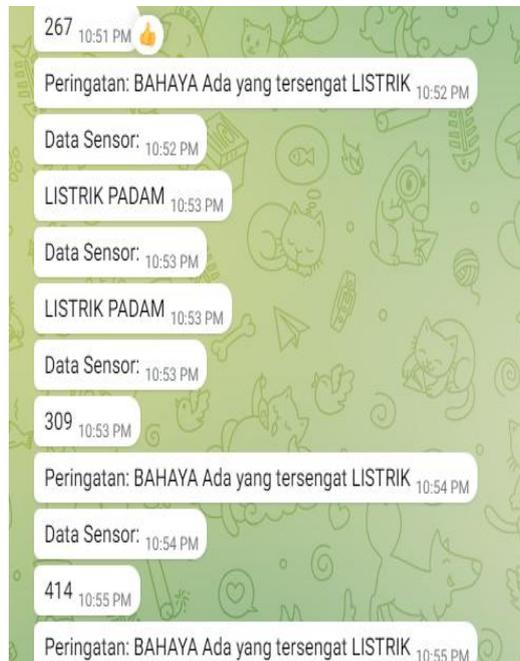
Figure 12. Test connection IoT

From the test results it is found that the IOT-based ELCB functions properly with the response of sending notifications to telegrams according to the program time delay.
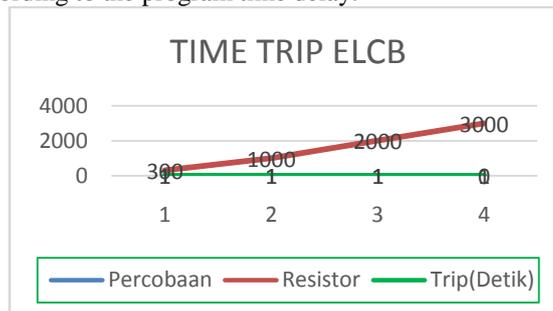

Figure 12. Time Trip ELCB

This was obtained by testing the ELCB circuit carried out with a light load then instead of the human body resistance using 4 different resistors, namely 300 Ohm, 1000 Ohm, 2000 Ohm and 3000 Ohm.

For the second test, namely testing the notification time delay to Telegram, the results are as follows:
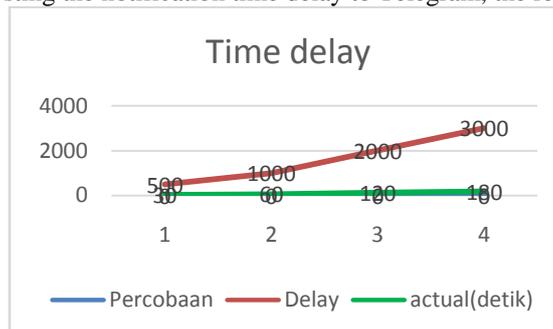

Figure 13. Time delay

IV. Conclusion

Arduino Microcontroller ESP8266 works as an additional control device on the combined ELCB circuit to provide notification to the user/owner when there is an electrical component that causes electric shock to living things. The ESP8266 microcontroller cannot work at a voltage of more than 5 volts, this will result in damage to the ESP8266 microcontroller. The results of testing the overall set of tools can be seen in the graph below:

ELCB time trip test

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