International Journal of Multidisciplinary Sciences and Arts

E-ISSN : 2962-1658
Volume 2, Number 1 , June, 2023
https://doi.org/10.47709/ijmdsa.v2i1.2301

LEAK CURRENT DETECTOR IN LOW VOLTAGE NETWORK (JTR) SYSTEM USING ZMPT101B SENSOR BASED ON THE INTERNET OF THINGS *(*IoT)

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Article History:
Submitted: 10-05-2023
Accepted: 18-05-2023
Published: 10-06-2023

Keywords:
Leakage current, Microcontroller. Blynk

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ABSTRACT

Phase-to-ground leakage in low-voltage network systems can cause transformer damage due to overload. Overloading on transformers is not caused by customer usage but rather by wasted electrical energy to the ground which causes losses. If there is a current leakage, the potential difference between neutral and ground is measured to produce a voltage value. Considering that there is little written about transformer damage caused by current leakage to ground in low voltage network systems, in this research a tool is made that can detect current leakage to ground in low voltage network systems using the ZMPT101B voltage sensor based on IoT.

This research is in the form of design and manufacture of a leakage current detector to ground. The method used is the Research and Development method (research and development), namely in the form of observation, literature study. The research stage starts from a literature study in the form of finding references related to research, designing tools, making tools and programs, and testing the tools that are made.

Based on the results of Based on the results of the research, this tool can detect leakage current to the ground from the lowest voltage of 24.3 Volts to the highest voltage of 184 Volts so that it can be displayed on the LCD and the blynk application and the system automatically sounds a buzzer as a warning of current leakage to ground. .

INTRODUCTION

The occurrence of problems in the distribution system of low voltage networks, especially the leakage of phase currents to the ground, is very difficult to detect by the safety devices installed on the Low Voltage Connection Panel / PHBTR. If a phase-to-ground leakage on the low voltage side occurs, the effect of this disturbance can cause damage to the transformer due to overload on the transformer, not solely due to excessive customer usage, but more on wasted electrical energy to the ground, which is called technical losses or losses. Physically, the transformer experiences excessive heat so that transformer oil can spill through the transformer bushings which leads to the burning of the distribution transformer due to a short circuit in the transformer coil due to excessive heat in the transformer oil. As evidence of the existence of one of the problems from transformer damage caused by current leakage to earth, it occurred at the ULP Baguala location, to be precise at the BGLLTR 104 2 substation.

The reason the author uses the ZMPT101B voltage sensor is because this sensor has been equipped with a summing-amplifier so that it can be used to increase the negative voltage so it is good for measuring voltage using a microcontroller and the ZMPT101B voltage sensor is an appropriate component when connected to a microcontroller because of its accurate signal function.

IoT solutions can be controlled by users via the dashboard of a computer, laptop or other mobile device. Users or employees who have been granted permission can manage and change actions and rules as needed. These changes will be sent back to the cloud and then the related sensors will be updated immediately. The most important factor in the running of the program lies in the internet network which is the link between systems and hardware.

The lack of writing regarding transformer damage caused by leakage of phase currents to ground in the low voltage network system, as well as the problems that occurred in the above case and the evidence of damage to one of the transformers at the Baguala Customer Service Unit (ULP), the authors are interested in making a design, namely "Leakage Detection Tool in Low Voltage Network Systems Using the ZMPT101B Sensor Based on the Internet of Things (IoT)".

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LITERATURE REVIEW

Transformer

According to Sentosa, et al. (2006), a transformer is an electrical device that changes alternating current voltage from one level to another through a magnetic coupling and is based on the principles of electromagnetic induction where the voltage ratio between the primary side and the secondary side is directly proportional to the ratio of the number of turns and inversely proportional to the current ratio.

Electric Leakage

According to Emedicine Health in (Hartono, 2017), explaining that an electric current leak is the occurrence of an electric current flow in an electrical network that is not proper. This condition is an abnormal condition that occurs in electrical installations and electronic devices. This abnormal condition can occur due to several factors, including: the occurrence of imperfect connections, the occurrence of insulation leaks, the occurrence of component damage or exfoliated cables. Electric current does not only flow through solid conducting materials or conductors, but can also occur through liquid mediums, such as water. As a result of leakage of electric current can cause electric shock to the human body.

ZMPT101B Voltage Sensor

The ZMPT101B sensor is an AC voltage sensor module that uses an isolation transformer with a voltage ratio of 1:1. The working principle of this sensor is to lower the input voltage using a step down transformer, then enter the op-amp and a stable output value will be obtained depending on the input value (Eko bayu, 2017).



Figure 1. ZMPT101B voltage sensor

NodeMCU ESP8266 microcontroller

NodeMCU is an open source IoT platform. It consists of hardware in the form of a System On a Chip ESP8266 type ESP-12E and the firmware used, using the Lua scripting programming language. The term NodeMCU actually refers to the firmware used rather than the development kit hardware (Saputro, 2018).



Figure 2. NodeMCU ESP8266 microcontroller

LCD 20X4

LCD is a tool that functions to display a size or number, so that it can be seen and known through the crystal screen display (Budiyanto, 2012).

The LCD has the function of displaying text or displaying menus and displaying a sensor result value in microcontroller applications. The matrix LCD module that will be used in this study has a configuration of 20 characters and 4 lines with each



Figure 3. Liquid Crystal Display (LCD) 20x4

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Arduino IDE (*Integrated Developtment Enviroenment*)

Arduino IDE software is software specifically used to program Arduino branded microcontrollers. (Kadir. 2012; 19-24). To be able to run the Arduino IDE software, you can double-click the Arduino logo in the C: Arduino\Arduino-1.8.1 folder. which was previously installed. A few moments later a display will appear as shown in the image below:



Figure 4. Display of the Arduino IDE Software Window

Blynk Cloud

Blynk is an open data platform and application programming interface (API) for IoT that enables users to collect, store, analyze, visualize and actuator. Blynk can work with various types of Arduino, ESP8266, NodeMCU, Particle Photon and Core, Raspberry, Pi, Electric Imp, Mobile and Web apps, Twitter, Twilio and others. (wagino dkk, 2018).



Figure 5. Blynk Display

Buzzer

Buzzer is an electronic component that functions to convert electrical energy into sound vibrations. The buzzer consists of a coil that is energized by current so that it becomes an electromagnet, and the coil will be pulled in or out, depending on the direction of the current and the polarity of the magnet. Each back and forth movement of the coil attached to the diaphragm will make the air vibrate to produce sound (Paul, A, 1989.).



Figure 6. Buzzer

METHOD

Tools and Materials (Hardware)

No	Nama Alat	Spesifikasi	Jumlah
1	Kabel Dupon	- M2M 20 Cm - M2M 10 Cm	2 Pcs 1 Pcs
2	Kabel Head	Kabel Input	30 cm
3	Box Electronic	15x10 cm	1 buah
4	Lem	- Korea - Castol - Kaca	1 Pcs 1 Pcs 1 Pcs
5	Terminal AC Power	-	1 Pcs

No	Nama Bahan	Spesifik	Jumlah
1	ESP	ESP8266	1 Pcs
2	Sensor tegangan	ZMPT101B	1 Pcs
3	LCD	LCD2004 (20x4)	1 Pcs
4	I2C LCD	LCM 1602 IIC	1 Pcs
5	Adaptor	9VDC	1 Pcs
6	Exp. Board ESP8266	NodeMCU v3	1 Pcs
7	Buzzer	OQC PASS	1 Pcs
8	LED	5mm	3 buah

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Software

The software used to detect current leakage in this low voltage network is:

1. Adruino Idea
   Used for programming connected to the NodeMCU ESP8266 Microcontroller
2. Blynk
   To display the leakage current measurement results

Circuit Block Diagram

The circuit block diagram for making a leakage current detector to ground can be shown in Figure 7.

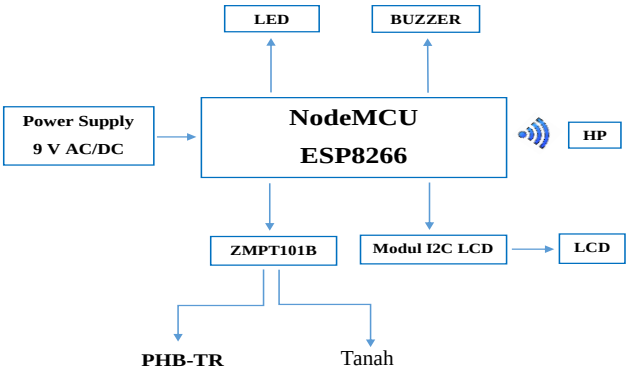


Figure 7. Block Diagram schema

Planning System Design

The design of a system for detecting leakage currents to ground can be shown in Figure 8.

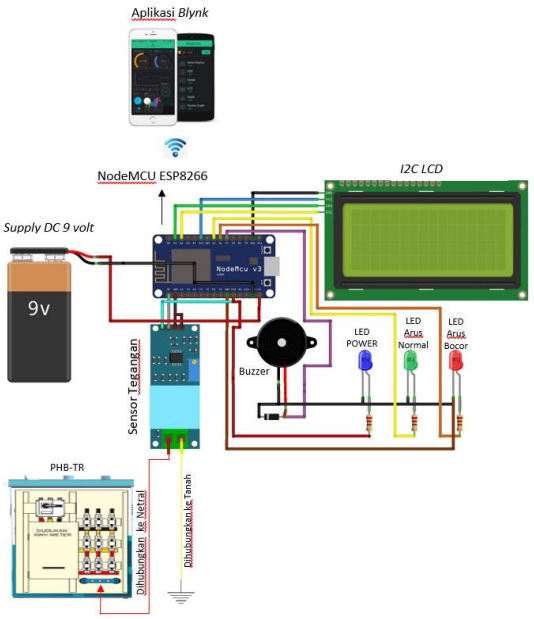


Figure 8. Planning System Design

The tool is supplied with an input voltage of 9 volts DC then lowered and stabilized on the ESP8266 board to get an

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operating voltage of 3.3 volts DC. The working principle of this tool is that the ZMPT101B voltage sensor has 2 input pins where Pin A is enabled to be connected to the PHB-TR neutral cable output and Pin B is enabled to be connected to earth. Connect to a voltage source then the tool will operate immediately and can be seen on the LCD monitor which is marked with the blue LED light On. Then connect internet connectivity from the smartphone to the ESP8266 so that later this tool can display the voltage value due to leakage current to ground to the LCD and also the blynk application. If the current is normal it will be marked with the green LED light ON, and if there is a leakage current it will be marked with the red LED light ON.

RESULTS AND DISCUSSION

System Testing

The overall test is testing the tool directly at the research location located at PT PLN (Persero) ULP Baguala. After all the equipment components are put together and assembled in the Electronic Box, the overall test of the tool can be carried out by applying the tool to the low voltage connection panel. The ZMPT101B voltage sensor has 2 input pins where Pin A is enabled to be connected to the neutral cable output of the low voltage network and Pin B is enabled to be connected to ground by plugging a copper rod into the ground. After Pin A and Pin B are installed, the device is given a voltage supply using a battery. 9VDC. The operating tool is marked with a blue indicator light that lights up together with the LCD display. Tests for measuring the neutral-ground voltage value at the BGLLTR 104 2 substation which has a current leakage to earth and at the BGLWY100 1 substation which has no current leakage to earth is shown in table 1.

Table 1. System Testing Results

Gardu	Waktu	Data Tegangan		
		Blynk	LCD	Tang Ampere
BGLLTR 104 2	17 : 52 : 40	106 V	106 V	131,7 V
	17 : 52 : 41	112 V	112 V	94,9 V
	17 : 52 : 42	24 V	24,3 V	55,3 V
	17 : 52 : 43	184 V	184 V	154,6 V
	17 : 52 : 44	141 V	141 V	155,1 V
	17 : 52 : 45	94 V	94,4 V	132,3 V
	17 : 52 : 46	158 V	158 V	176,5 V
	17 : 52 : 47	150 V	150 V	174,0 V
	17 : 52 : 48	104 V	104 V	96,6 V
	17 : 52 : 49	71 V	71,4 V	128,1 V
BGLWY 100 1	16 : 20 : 21	0 V	0 V	0 V
	16 : 20 : 22	0 V	0 V	0 V
	16 : 20 : 23	0 V	0 V	0 V
	16 : 20 : 24	0 V	0 V	0 V
	16 : 20 : 25	0 V	0 V	0 V
	16 : 20 : 26	0 V	0 V	0 V
	16 : 20 : 27	0 V	0 V	0 V
	16 : 20 : 28	0 V	0 V	0 V
	16 : 20 : 29	0 V	0 V	0 V
	16 : 20 : 30	0 V	0 V	0 V

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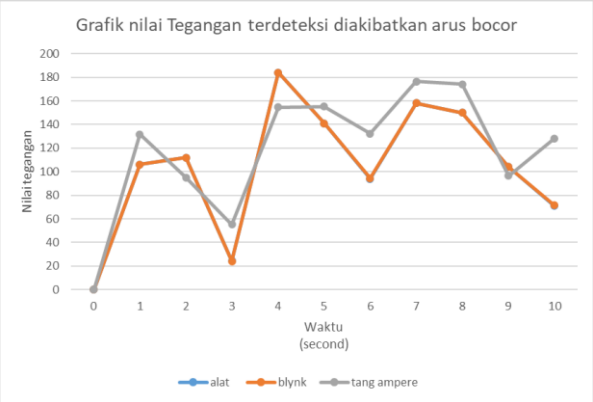


Figure 9. Voltage Value Graphic

The voltage value measured using digital amperage pliers measured the smallest value range, namely 55.3 volts to the highest measured value range of 176.5 volts, while measurements using tools made using the ZMPT101B voltage sensor measured the smallest value range, namely 24.3 volts up to the highest range measured 184 volts. The difference in measurement values between digital ammeter measuring instruments and devices made using the ZMPT101B voltage sensor is caused by the ZMPT101B voltage sensor being a sensor that outputs a signal in the form of an analog signal, so that when the measurement results are displayed, the ESP8266 converts the analog signal to a digital signal for display on the LCD. In this case it results in less accurate measured voltage values.

CONCLUSION

Leakage of phase current to ground can be known by measuring the potential difference between the neutral output of the low voltage network and the ground which will produce a voltage value. The detected voltage value due to a minimum detected leakage current is 24.3 Volts and the maximum value is 184 volts. The voltage fluctuates because the insulation leakage point on the conductor cable connected to the ground experiences Lost Contac.

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E-ISSN : 2962-1658
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https://doi.org/10.47709/ijmdsa.v2i1.2301

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