MODIFICATION OF TRANSFORMER TEMPERATURE MONITORING AND CONTROL SYSTEM DESIGN USING BLYNK-BASED APPLICATIONS

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ABSTRACT
Transformers that have a very important role in the continuity of electricity supply to the state electricity company (PLN), besides that when there is an increase in the capacity of the electric current voltage, the density between the connections of the cables and transformers will be stretched which can result in an increase in resistance and an increase in the temperature of the equipment. Because the results of this research are given as numerical data, the methodology used in this study is a quantitative methodology. This is in line with the idea that quantitative research is a method that heavily relies on statistics, from data collection through data interpretation to the presentation of the results. In this test technique, it is able to display the amount of temperature detected through LCD and smartphone. Data transmission is done online using the Wemos D1 Mini microcontroller. Changes in temperature that exceed the stage 1 limit will cause the fan to turn on and if it exceeds the stage 2 limit, both the fan and buzzer will turn on.

Keywords: *Transformer, DS18B20, Wemos D1 Mini*

1. INTRODUCTION

Electrical energy is one of the energy sources that are widely used by humans around the world. Electrical energy is used in various fields, such as industry, public places, education, and others. Equipment that uses electrical energy must have good quality, such as electrical energy voltage, decent and good frequency. To improve the quality of electricity consumption, electrical equipment is equipped with protection devices to protect equipment that is prone to damage. Generally, protection devices for electricity use include voltage protection, current protection, frequency protection, and short circuit protection. These protection tools have the function of a tool to prevent device damage caused by interference. Therefore, electrical protection is very important to protect electrical equipment or loads.

Transformers that have a very important role in the continuity of electricity supply to the state electricity company (PLN), of course, need special handling to maintain the continuity of the process, which is of course in accordance with the predetermined service level agreement. As is the case when the use of electricity in the community has increased, it can cause overcapacity of the transformer, which can increase the temperature of the equipment. (M. A. Muzar, 2018)

In addition, when there is an increase in the capacity of the electric current voltage, the density between the connections of the cables and transformers is tenuous, which can result in an increase in resistance and an increase in the temperature of the equipment. At this time, the officers at the substation, when they want to know the temperature conditions of the transformer equipment, must take measurements manually at several points, this is certainly less effective because it takes quite a long time and also considerable energy. (T. A. Sapuro and S. T. Agus Supardi 2018)

Along with the development of technology that is increasingly developing, many human activities should be made easier. Such as the emergence of Internet of Things technology, where this technology is able to make equipment that previously could not communicate or send data now accommodate it all. (J. H. Nord et al. 2019)

Transformer monitoring is currently still done manually, namely by looking directly at the field. To make it easier for technicians to monitor temperatures and avoid failures in the distribution of electricity, the authors are interested in designing a device that can control and monitor transformer temperatures automatically from a distance by utilizing Internet of Things technology.

Based on the background described above, the author takes the title of the final project with the title "MODIFICATION OF TRANSFORMER TEMPERATURE CONTROL AND MONITORING SYSTEMS USING IOT-BASED BLYNK APPLICATION".

2. METHOD

In its current condition, transformer maintenance is still done manually by field officers so that the condition of the transformer cannot be monitored in a short span of time. As a result, disturbances in the transformer cannot be recognized early. Therefore, this research is designed to build an online transformer temperature monitoring system that is also equipped with a remote control system using Internet of Things (IoT) technology.

Because the results of this research are given as numerical data, the methodology used in this study is a quantitative methodology. This is in line with the idea that quantitative research is a method that heavily relies on statistics, from data collection through data interpretation to the presentation of the results. (Arikuanto, 2010)

3.2.3 Component Tools

3.2.3.1 Hardware

This sub chapter will discuss testing techniques for the planning of hardware and software made by the author. This test is carried out to determine the performance of the system and to find out whether the system has been made according to plan or not. Testing is first carried out separately on each circuit unit, then proceed to testing the system that has been integrated as a whole.

1. Transformer

The transformer is used as a component that will be given a temperature sensor to find out how much temperature is detected.

2. Heater 12V

A 12V heater is used as a load to trigger overheating.

3. Diode

Diodes are used to conduct current in one direction and have infinite resistance in the reverse direction. The diode functions as a rectifier to convert the alternating voltage (AC) from the transformer into a direct voltage (DC) on the 12V heater.

4. Sensor DS18B20

The DS18B20 sensor is used to read the amount of temperature detected. The output of the DS18B20 is digital so to access it requires programming and no signal conditioner or ADC is required.

5. Wemos D1 Mini

The Wemos D1 is a microcontroller that is comparable to and compatible with the Arduino Uno, with the exception that it is based on the ESP8266-12 board module, which may also be used to link microcontroller devices to the internet through wifi.

6. Buzzer

The buzzer is used as an alarm when the temperature is above the stage 2 setting. The function of the buzzer itself is as a component that produces output in the form of beeps.

7. Fan DC 12V

Transformers require a cooling system to keep the device from overheating. Hot temperatures can cause permanent damage to the device. Here the Fan is used as a tool to help reduce the temperature when the temperature is above the stage 1 and 2 settings.

8. Relay

Relays employ electromagnetic principles to shift switch contacts so that they may supply greater voltage electricity with a modest electric current (low power). Relays are employed in this study to automatically switch on and off the fan.9. LCD

Liquid crystal display is referred to as LCD. One kind of electronic display module called an LCD is utilized in many different circuits and devices, including computers, cell phones, and calculators.10. Adapter

The adapter or power supply functions to provide a 12V DC voltage to the Wemos D1 Mini so that the tool can work properly.

3. RESULT AND DISCUSSION

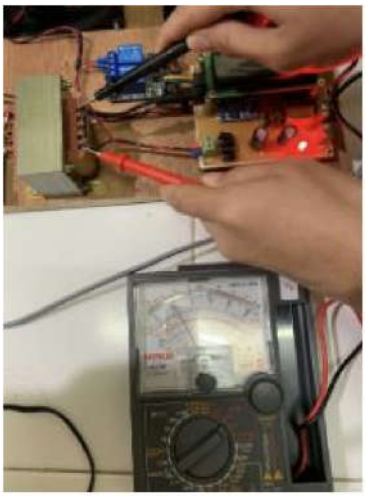
4.2.1 Hardware Testing Result

4.2.1.1 Transformer Testing

Testing on this transformer aims to determine that the transformer used is in good condition, therefore it is necessary to experiment with the voltage value generated from the transformer.

Testing Steps:

1. Prepare the transformer to be tested.
2. Connect the transformer to the power supply.
3. Connect the transformer with an avometer to measure the voltage.
4. Make sure the transformer can be used and record the test data results.



Gambar 1. Transformer Testing

From the test results that have been carried out, the transformer can work properly. This can be seen from measurements using an analog avometer. The measurement results show that the output voltage produced by the transformer is 12 Vac.

4.2.1.2 Wemos D1 Mini Testing

Testing the Wemos D1 Mini aims to find out that the Wemos D1 Mini used can work as expected, namely to control protection, temperature sensors and data viewers on the LCD. Wemos D1 Mini is also a Wifi connector.

Testing Steps:

1. Prepare the Wemos D1 Mini to be tested.
2. Connect the Wemos D1 Mini with a laptop using a USB cable.
3. Check using Arduino IDE software.

Testing on the Wemos D1 Mini is done by connecting several components such as temperature sensors, relays, fans, buzzers, and LCDs. From the results of the tests that have been carried out, the Wemos D1 Mini can function properly and work as expected. **Table 1.** Wemos D1 Mini Testing

No	Testing	Description
1.	Testing the Wemos D1 Mini with LCD	Can work properly
2.	Testing the Wemos D1 Mini with temperature sensor	Can work properly
3.	Testing Wemos D1 Mini with relay on the fan	Can work properly
4.	Testing the Wemos D1 Mini with buzzer	Can work properly

4.2.1.3 DS18B20 Sensor Testing

DS18B20 sensor testing aims to determine the amount of temperature produced.

Testing Steps:

1. Prepare the DS18B20 sensor.
2. Install the sensor on the transformer and connect the sensor with the Wemos D1 Mini.
3. Connect the transformer with the load to trigger the heat.
4. Connect the transformer and Wemos D1 Mini to the power supply.
5. View on LCD and smartphone to display the magnitude value of the detected temperature.

Table 2. DS18B20 Sensor Testing

DS18B20 Sensor	Description	Object	Time
26,31 ℃	Secure	Transformer 3A	0 minute
35,50 ℃	Alert	Transformer 3A	3,38 minute
40,06 ℃	Danger	Transformer 3A	4,20 minute

From the test results of the DS18B20 sensor, there is an increase in temperature which is influenced by the load and room temperature. There are 3 descriptions to indicate whether the temperature is in a safe, alert and dangerous condition. Changes in temperature will be displayed on the LCD screen and a notification will appear on the smartphone. The duration of time where the temperature rises in the transformer affects the length of time the transformer can receive a load.

Gambar 2. Display on blynk app

4.2.1.4 LCD Testing

LCD testing aims to determine whether the LCD can display temperature changes, information on internet connectivity, information on normal temperature conditions, alert and danger.

Testing Steps:

1. Prepare the LCD to be tested.
2. Connect the LCD with the Wemos D1 Mini.
3. Check whether the LCD can work properly or not.

In this LCD test, the LCD will first display the temperature change data when it is connected to the internet. The data displayed on the LCD is the same as the data on the Blynk application on the smartphone.

Gambar 3. Tampilan display LCD

4.2.1.5 Fan DC 12V Testing

Fan testing aims to find out whether the fan can turn on when the temperature is above stage 1 and stage 2. The fan will turn off when the temperature is below stage 1. Here the fan is used to help reduce the temperature in the transformer.

Testing Steps:

1. Prepare the fan to be tested.
2. Connect the relay on the fan with the Wemos D1 Mini.
3. Connect the transformer with the load to trigger the heat.
4. Connect the transformer and Wemos D1 Mini to the power supply.
5. View the LCD and Blynk app to know if the fan is on or off.

Table 3. Pengujian Fan DC 12V

Temperature	Descrption of *fan*	Stage
>35,50 ℃	1 fan on	Stage 1
>40,50 ℃	2 fan on	Stage 2
<35,50 ℃	2 fan off	-
<40,50 ℃	1 fan off	Stage 1

In the fan test that has been carried out, the fan can work properly. This can be seen from the temperature changes detected, namely one fan will turn on if the temperature is above stage 1 and two fans will turn on if the temperature is above stage 2. The measurement results show that the voltage generated by the fan is 12.14 Vdc.

4.2.1.6 Testing Buzzer

Buzzer testing aims to determine whether the buzzer can provide a warning when the transformer temperature is above stage 2. The buzzer will turn off when the temperature is below stage 2 on the transformer.

Testing Steps:

1. Connect the relay on the buzzer with the Wemos D1 Mini.
2. Connect the transformer with the load to trigger the heat.
3. Connect the transformer and Wemos D1 Mini to the power supply.
4. Look at the LCD and Blynk application to find out if the buzzer is on or off. **Table 4.** Buzzer Testing

Temperature	Description of buzzer
>40,50 ℃	On
<40,50 ℃	Off

In the buzzer test that has been carried out, the buzzer can work properly. This can be seen from the change in temperature when it is above stage 2 automatically the buzzer will sound to give a warning. 4.2.2 Disadvantages and Advantages of Tools

In the modification of the design of the transformer temperature control and monitoring system that has been designed by the author, there are disadvantages and advantages possessed in the tool.

Advantages:

1. Can monitor temperature using the Wemos D1 Mini microcontroller properly.
2. Can send notification of temperature changes and temperature information via smartphone and displayed on LCD.
3. Temperature change data can be stored on a smartphone.
4. Can control the fan manually or automatically through the application.
5. DS18B20 sensor can detect temperature quickly.

Disadvantages:

1. Depends on internet connection to monitor and control via smartphone.
2. Can only be used with one username and password.

3. This design has never been tested on a 1000 kVA transformer whether it can work properly or not.

4. CLOSING

A. Conclusion

Based on the results of the design and testing of the tool in the previous chapter, conclusions can be drawn, namely:

1. The control circuit on the device that has been designed can entirely work by using the Wemos D1 Mini microcontroller to control the temperature on the transformer.
2. The monitoring circuit on the device that has been designed can entirely work using the Wemos D1 Mini microcontroller to monitor the temperature of the transformer.
3. How the transformer temperature control system works using the Blynk application that can control the fan automatically and manually remotely. The relay breaker will automatically work if the temperature on the transformer is above 35.50 degrees Celsius.
4. How the monitoring system works the amount of transformer temperature detected will be displayed on the LCD and Blynk application.

B. Suggestion

The suggestions given to develop further research to be better, namely:

1. The design of this tool is still limited and requires good internet connectivity to work.
2. It is hoped that in the future there will be a module that is more practical and easy to apply to larger transformers.

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