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ATS AMF Monitoring System on DSE 4520 MKII Module Based on IOT (Internet Of Things)

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Abstract**—** *The increasing demand for electrical energy has resulted in several problems with the supply of electrical energy distributed to consumers, requiring a backup source of electrical energy in the form of a generator. The generator can be operated manually and automatically which can be controlled using a control system in the form of ATS (Automatic Transfer Switch) and AMF (Automatic Main Failure). The ATS (Automatic Transfer Switch) system is controlled using the DSE 4520 MKII module whose programming can use the DSE Configuration Suite software or manually. To simplify work and shorten time to be more efficient, an ATS AMF monitoring system tool was made on the IOT (Internet Of Things)-based DSE 4520 MKII module, this monitoring system will be used to monitor battery voltage and voltage, current, power, frequency on ATS AMF and on the generator, using the IoT wemos module to send data to the website, which will later be displayed on the IOT MIT App Inventor application that already exists on the smartphone. From the results of testing the monitoring system, the average reading voltage is no more than 224 volts, the frequency is 50 Hz, the battery voltage is 12.3 volts, the generator fuel is 11%. The highest data obtained in the test using a grinding wheel and compressor is a power of 795 watts, a voltage of 220 volts, a frequency of 50 Hz, a current of 3.9A..*

Keywords**—***Generator, ATS (Automatic Transfer Switch), AMF (Automatic Main Failure), DSE 4520 MKII, IOT (Internet Of Things).*

I. INTRODUCTION

Electrical energy is one of the basic human needs that is very important in modern times like now, a lot of modern equipment that uses electrical energy is good for use in industry, hospitals, offices, households, etc. [1]. This is the reason for the increasing demand for electrical energy in the world[2]. Due to the increasing demand for electrical energy, more and more problems will arise with the electricity supply distributed to consumers, so that consumers need a backup source of electrical energy, namely generators.

The generator can be applied in two ways, namely manually and automatically which can be controlled using a generator power switch control device and PLN power, namely ATS (Automatic Transfer Switch) AMF (Automatic Main Failure) using the DSE 4520 MKII Module.

Because of the increasingly dense activities and the many activities in daily life, it is not possible to directly monitor the ATS AMF system. With the IOT-based ATS AMF monitoring system that can be applied remotely, the work will be easier and can shorten the time.

II. LITERATUR REVIEW

A. Arduino Uno

Arduino Uno is a microcontroller board based on ATmega328[3]. It has 14 input pins from digital output where 6 input pins can be used as PWM outputs and 6 analog input pins, 16 MHz crystal oscillator, USB connection, power jack, ICSP header, and reset button. To support the microcontroller so that it can be used, it is enough just to connect the Arduino Uno Board to a computer using a USB cable or power with AC to a DC adapter or battery to run it.

Fig. 1. Arduino Uno.

B. PZEM 004T Sensor

PZEM-004T is an electronic module that functions to measure voltage, current, power, frequency, energy, and power factor[4]. With this complete function/feature, the PZEM-004T module is ideal for use as a project or experiment for measuring power tools on an electrical network such as a house or building.

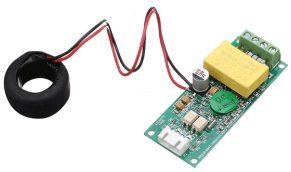

Fig. 2. PZEM 004T Sensor.

C. DC Voltage Sensor

The voltage sensor is used to read the voltage value of a circuit[5]. Arduino can read voltage values by using analog pins. If the voltage range is read between 0-5 V, you can directly use the analog pin, while if the voltage range is read > 5V, you must use an additional circuit, namely a voltage divider because the Arduino pin works at max 5 V.

The data received by Arduino is in the form of an ADC value, to convert it into a voltage value using the formula:

$$\text{Voltage} = \text{ADC}/1024 * 5\text{V} \quad (1)$$

- ADC : Read ADC value
- 1024 : Maximum ADC value (10 bits)
- 5V : Arduino ADC reference voltage (*default*)

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Fig. 3. DC Voltage Sensor.

D. Wemos D1 R1

The Internet of Things (IoT) is a concept that refers to the use of connected intelligent devices and systems to leverage data collected by sensors and actuators in machines and other physical objects[6]. IoT works by utilizing a programming argument with each argument command resulting in an interaction between machines that are connected automatically without human intervention and at any distance.

Fig. 4. Wemos D1 R1.

E. HX710B Air Pressure Sensor

Based on patented Avia Semiconductor technology, the HX710 is a 24-bit analog precision digital converter (ADC) with a built-in temperature sensor designed for weighing and industrial control applications to interact directly with bridge sensors.

Fig. 5. HX710B Air Pressure Sensor.

F. LM2596 Step Down Module

The LM2596 Step Down Module is a voltage-lowering module whose output can be adjusted via a multiturn potentiometer. The advantage of the LM2596 step down module is that the output voltage does not change (stable) even though the input voltage goes up and down.

Specification:

- Input Voltage : 3VDC - 40VDC
- Output Voltage : 1,25VDC - 35VDC

Fig. 6. HX710B Air Pressure Sensor

G. MIT App Invertor

MIT App Inventor is a platform to facilitate the process of creating simple applications without having to learn or use too many programming languages[7]. Can design android applications as desired by using a variety of layouts and components available. App Inventor allows users to program computers to create software applications for the Android operating system. App Inventor uses a graphical interface, similar to the user interface in Scratch and Star Log TNG, which allows users to drag and drop visual objects to create applications that can run on Android devices.

Fig. 7. MIT App Invertor

III. METHODOLOGY

A. Component Planning

To make it easier to design a tool and so that the tool can run properly, it is necessary to determine the specifications of the tool including the following:

1. Arduino Uno
2. PZEM-004T Sensor
3. Dc Voltage Sensor
4. Wemos D1 R1
5. HX710B Air Pressure Sensor
6. LM2596 Step Down Module
7. MIT APP Inventor
8. DSE 4520 MKII Module
9. Generator
10. Battery/Accu
11. Jumper Cuble
12. Acrylic
13. Iron

B. Work Chart

Work diagrams are made to make it easier to give an overview to readers who will study the system that has been created.

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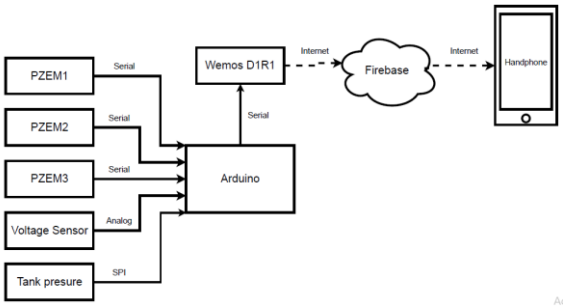

Fig. 8. Work Chart

The working diagram above is the working principle of the ATS AMF Monitoring System on the DSE 4520 MKII Module Based on IOT (Internet of Things). From the working diagram, it is explained that the main PLN electricity and backup power sources in the form of generators as backups from PLN electricity, sources from PLN mains and generators will enter the DSE 4520 MKII module which uses a 12 VDC source voltage. The PZEM-004T sensor will read power, voltage, frequency, and current from PLN sources, generators, and loads. While the DC voltage sensor will read the voltage from the battery source and the HX710B air pressure sensor will read the percentage of fuel used by the generator. The output of the five sensors will be processed by Arduino Uno to be sent to Wemos as an intermediary for sending data to the MIT App Inventor application.

C. *Wiring Diagram*

Wiring diagrams use electrical symbols like ladder diagrams, but they try to show the actual location of components. Wiring diagrams help identify cables and components such as those found on equipment.

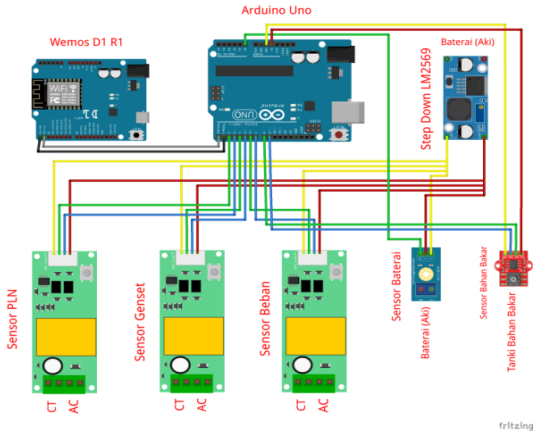

Fig. 9. Wiring Diagram

In accordance with the picture above, the 3 PZEM-004T sensors used will be connected to PLN voltage, generator voltage and load. The RX and TX pins on the PZEM-004T sensor will be connected to the digital pins on the Arduino, while the VCC and ground pins will be in series at the negative (-) and positive (+) outputs of the LM2596 step down module.

The DC voltage sensor is used to read the voltage on the battery (battery), the ground pin of the DC voltage sensor will be connected to the negative of the battery, and the VCC pin of the DC voltage sensor will be connected to the positive of the battery. As for the positive (+) and negative pins, the DC voltage sensor will be connected to the positive (+) and negative (-) outputs of the LM2596 step down module, and for the data pin (S) the DC voltage sensor is connected to the Arduino analog pin (A0).

The HX710B air pressure sensor is used to read the fuel in the generator tank. The sensor ground pin is connected to the Arduino ground pin, and the sensor VCC pin is connected to the Arduino 5V pin. As for the OUT pin and SCK pin, the sensor is connected to the Arduino digital pin.

The Arduino RX and TX pins are connected to the RX pins and the TX pins on the Wemos D1 R1 module, but in the installation they are installed in reverse (swapped).

D. *Display Applications on Android*

For the application display on Android, the first screen will display monitoring for PLN sources, the second screen will display monitoring for generator sources. Meanwhile, the third screen will display monitoring of the electrical load, and the fourth screen will display monitoring of the voltage on the battery (accu) and the percentage of fuel for the generator.

Fig. 10. Display App on Android

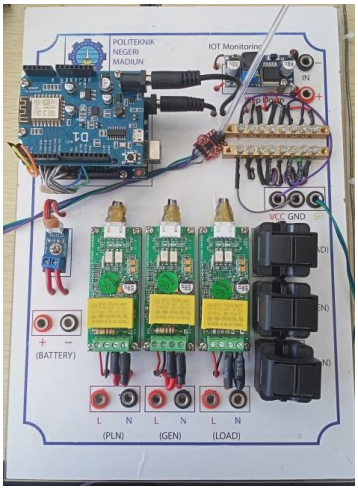

Fig. 11. ATS AMF Monitoring System

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This monitoring system uses 3 PZEM-004T sensors, 1 DC voltage sensor, and 1 HX710B air pressure sensor which will be connected to the Arduino Uno. Arduino uno will transfer sensor readings to wemos to transmit data on firebase. The components are assembled on A4-sized acrylic

IV. RESULT

At this stage of results and discussion, testing of the tools that have been planned and made previously will be carried out. In the test to be carried out using two types of voltage sources, namely the PLN voltage source and the generator voltage source.

A. *Working System*

Testing the work system is carried out using the input voltage from PLN and the generator, the first test is carried out by simulation using a source from the PLN voltage. Meanwhile, the second test was carried out with a voltage source from the generator.

TABLE 1. Working System Testing

No	Condition		Parameter			
	PLN	Genset	Voltage	Frequency	Current	Power
1.	ON	OFF	225 V	50Hz	0 A	0 W
2.	OFF	ON	224 V	50Hz	0A	0 W

Based on the tests that have been carried out and the data that has been obtained, the test is carried out with two conditions, namely first, when PLN is ON, the generator will be OFF because the main source uses PLN. Furthermore, the second condition is as if PLN goes out or OFF, when PLN goes out the generator will turn on or ON as a substitute for PLN or as a back up to the load.

B. *Working System*

In this test, a load of 1 grinder and 1 compressor will be used, with a PLN voltage source.

Fig. 12. Test Result on App if PLN ON

Based on the tests that have been carried out, the voltage used is the PLN voltage and uses a grinding load and a compressor. The resulting data has almost the same value, the test results on the DSE 4520 MKII module read 1kW of power. The indicator on the application display shows PLN ON and generator OFF. The battery (accu) and fuel are not readable because when using the PLN source, they do not use batteries and fuel.

TABLE 2. Result on DSE 4520 if PLN ON

Data	Parameter					Condition
	Power	Voltage	Frequency	Current	Percentage	On/Off
PLN	1 kW	219 V	50 Hz	3 A	-	On
Genset	0 kW	0 V	0 Hz	0 A	-	Off
Load	1 kW	219 V	50 Hz	3 A	-	-
Battery	-	-	-	-	-	-
Fuel	-	-	-	-	-	-

TABLE 3. Result on Measuring Instrument if PLN on

Data	Parameter			Condition
	Power	Voltage	Current	On/Off
PLN	619.77 W	219 V	2.83 A	On
Genset	0 W	0 V	0 A	Off
Load	619.77 W	219 V	2.83 A	-
Battery	-	-	-	-
Fuel	-	-	-	-

C. *Testing Using a Generator Voltage Source (Generator ON)*

In this test, will use a load of 1 grinder and 1 compressor, with a generator voltage source.

Fig. 13. Test Result on App

TABLE 4. Result on DSE 4520 if Generator ON

Data	Parameter					Condition
	Power	Voltage	Frequency	Current	Percentage	On/Off
PLN	0 kW	0 V	0 Hz	0 A	-	Off
Genset	0 kW	221 V	50 Hz	2 A	-	On
Load	0 kW	221 V	50 Hz	2 A	-	-
Battery	-	12.3 V	-	-	-	-
Fuel	-	-	-	-	-	-

TABLE 5. Result on Measuring Instrument if Generator on

Data	Parameter			Condition
	Power	Voltage	Current	On/Off
PLN	0 W	0 V	0 A	Off
Genset	628 W	222 V	2.83 A	On
Load	628 W	222 V	2.83 A	-
Battery	-	12.3 V	-	-
Fuel	-	-	-	-

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Based on the tests that have been carried out, the voltage source used is the generator voltage and uses a grinding load and a compressor. In the application display the test results show the PLN OFF indicator and the generator ON, for the battery voltage the resulting data shows a value of 12.3 V, while for fuel it shows a value of 11%. The test results on the DSE 4520 MKII module for fuel are not readable because the sensors used are different and the readings on the DSE 4520 MKII module use resistance parameters.

V. CONCLUSIONS

After going through several processes of planning, designing, and testing the system as well as data collection, it can be concluded as follows:

1. The design of the monitoring system tool has been successful, using the following components: Arduino UNO, Wemos D1 R1, DC voltage sensor, PZEM-004T sensor, HX710B air pressure sensor, and LM2596 Step Down Module. By using a PLN voltage source and a generator voltage source. The application used for the IoT system is MIT App Inventor.
2. The working principle of the monitoring system is monitoring the PLN source, generator source, electrical load, voltage on the battery (accu), and the percentage of generator fuel. With readings of power, voltage, frequency, current, and percentage parameters.
3. The program designed for the monitoring system uses two program data, namely the program for arduino uno and the program for wemos D1 R1 as sensor readings and as data transmission on IOT. The sensors used are already able to read the data well, the results of the monitoring system test results for the average reading voltage of no more than 224 volts, the read frequency is 50 Hz, the battery voltage is 12.3 volts, the generator fuel is 11%. The highest data obtained in the test using a grinding wheel and compressor is a power of 795 watts, a voltage of 220 volts, a frequency of 50 Hz, a current of 3.9 A.

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