An Optimization Of Reliability Electric Power System Based On Internet Of Things (IOT)

Solly Aryza[1*], Zulkarnain Lubis[2], Khairil Putra[3]
Faculty of Science and Technology,
Universitas Pembangunan Panca Budi
Medan, North Sumatera, Indonesia

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***Correspondence Address:**
sollyaryzalubis@gmail.com

Abstract: The growth in demand for reliable and safe electricity requires an increasingly sophisticated electricity distribution system. Internet of Things (IoT) technology has brought opportunities to improve the reliability of the electric power system through real-time monitoring and control. By using IoT-based devices, the electrical system can be analyzed in more depth to detect early disturbances, perform preventive maintenance, and improve operational efficiency. This study aims to optimize the simulation of the reliability of the IoT-based electric power system to ensure the stability of the electricity supply and minimize disturbances.

INTRODUCTION

The reliability of the electric power system plays an important role in maintaining the stability of the energy supply, especially amidst the increasing dependence of society on electricity. Disturbances in the distribution system can result in blackouts that are detrimental to various sectors, from households to industry. The application of IoT technology to the electrical system allows real-time network monitoring, providing important information about equipment conditions and detecting changes that have the potential to become disruptions.

IoT-based reliability simulation aims to model disruption scenarios on the electrical network, predict the risk of failure, and develop appropriate repair strategies. By optimizing this simulation, it is hoped that preventive measures can be taken more effectively to improve the reliability of the electrical network. This study focuses on optimizing the reliability monitoring system with IoT in the electric power distribution network.

The increasingly rapid development of technology is also directly proportional to the crime rate, including theft of valuables in the house. One way to anticipate theft instruments is with home security devices that can work automatically.

In addition to concerns about theft, home security from environmental instruments is also a problem in itself. For example, room temperature for stable room conditions, gas leaks that can cause fires, or excessive use of electricity to save electricity, such as lights that are turned on when not needed. The use of automatic security instruments has become an option today, although the costs required for home automation are still less affordable. This is the basis for the author to design a home security device at an affordable cost and not too complicated operation. In addition, the lights can also be turned on and off via a telegram bot. This research was conducted in order to help the surrounding community regarding protection control in the electrical system so that the Kelambir Lima community does not have anxiety in leaving their homes or places of residence.

Several countries in America and Europe have been very intensive in realizing this technology. In the USA, the implementation of smart grids is coordinated by the Department of Energy (DOE) together with EPRI (Electric Power Research Institute) with a project called "Intelligent optimization".

The focus of this research is to determine a new design in energy control with an IOT system, simulation and analysis equipment, smart technology, test infrastructure and demo plants, legal umbrellas and market frameworks. According to NIST, smart grids can be defined as a network of electric power systems that use two-way information technology, secure cyber communication technology and integrated computing intelligence across the spectrum of electric energy systems from generators to consumers. Meanwhile, according to the Department of Energy (DOE) USA, smart grids are power systems based on sensing technology, communication, digital control, information technology (IT) and other field equipment that function to coordinate processes in the electric network so that they are more effective and dynamic in their management.

The feasibility and reliability of electricity supply is one of the vital parameters in energy distribution, especially for cross-applications or operators. The information available in each area of generation, transmission and distribution is usually only for each local power grid and the system data is not yet based on real-time data. This is the challenge going forward so that the power grid can be of higher quality with a high level of reliability and safe from interference.

METHOD.

The method applied in this study is Research and Development (R&D). The main purpose of this method is to produce a certain product and test the level of effectiveness of the product (Sugiyono, 2011).

In the design of this solar power plant, there are main components such as solar panels, solar charge controllers, batteries, and loads. The use of supercapacitors in this design is carried out with variations of 5 times, using 1 to 4 supercapacitors with a capacity of 150,000 uf.

The goal is to examine the comparison and impact of each test carried out. It is known that the energy density of supercapacitors is 10-100 times greater than conventional capacitors, and has a high efficiency level of 95%. Supercapacitors also have a power density that is up to 50 times greater than batteries. Therefore, the decision to use supercapacitors in this design is based on these characteristics.

Figure 1. Research Scheme

The battery-supercapacitor control design is made to be the implementation of a hybrid electric power source. Each component, including the battery, supercapacitor, dc-dc converter, and battery-supercapacitor FLC control, is modeled in detail.

After the manufacturing and assembly process is complete, the next step is to test the tool and collect data to evaluate the impact of using Supercapacitors on Solar Power Plants. This study uses a research methodology that starts from a literature study with existing references and the components needed to create an IoT-based electrical power monitoring system. The microcontroller used is Arduino IDE with software for programming and Wemos D1 mini as a module that connects to the internet. The sensors used in the design of this system use current and voltage sensors as sensors to determine the current, voltage and power values from a 220 volt AC source and the use of a 5v relay module as a sensor to control current and voltage which are quite high. To secure the circuit if there is a deeper load in the design stage of the tool by programming using Arduino IDE software. The last stage is testing. Testing is carried out on each subsystem and analyzing the entire system. And can monitor and control so that the electrical power used is more efficient and optimal. The design of an IoT-based electrical power monitoring system at the Kelambir Lima sub-district office, in the design of this tool there are several specifications include hardware design, software design where both parts are integrated with each other. Hardware design is divided into several design stages.

Figure 2. Klambir Lima Officers

The design of the control and monitoring device is the process of explaining the internet-based electrical power monitoring system using two microcontrollers as components to process data. The microcontroller used is the Arduino UNO R3 as a monitoring of electrical energy usage in IoT (Internet of Things)-based boarding rooms. The sensors used will produce data that will later be used to read data that has been processed by the voltage sensor and current sensor. This data will be processed by the Arduino UNO R3 to display data that has been obtained from electrical equipment that is read by the voltage sensor and current sensor. So that it can find out the power that has been used. The Arduino UNO R3 also uses a 5V relay module. The relay functions as an electronic switch that is needed to control high current and voltage.

The 5V relay module can also connect and disconnect the electric current indirectly connecting and disconnecting the electric current simultaneously to secure the circuit if there is an overload from the electrical equipment used. The data is received by the Arduino UNO R3 which is obtained from the voltage sensor and current sensor. The value will be displayed via LCD 16X2 where the data has previously been processed by Arduino UNO R3.

After getting the value from the voltage sensor and ACS712 current sensor. data from this sensor will then be sent by Arduino UNO R3 to Wemos D1 mini via serial communication. Voltage sensor data Z and current sensor will be used as input which will later be processed by Wemos D1 mini.

The processed data in the form of current, voltage, and power values will later be carried out by the electrical power monitoring system and read by Arduino and sent via serial communication to Wemos D1 mini. In conducting this research, the type of research used is a qualitative method by collecting data. This type of research is considered very suitable for the research raised by the author so that the focus of the research is in accordance with the facts in the field. Qualitative method as a research procedure that produces descriptive data The location of this research was conducted in Kelambir Lima Village, Deli Serdang Regency with the instrument of the situation and its running mechanism. For the reliability of a tool, testing and discussion of the tool itself is needed. So that in the use of this tool, it can produce a circuit that can work well and can be operated well too. In this test, measurements were made of the parameters of the components contained in the system that has been designed.

RESEARCH METHODS

This research is a development or Research and Development, namely research with modeling as a function of creation and innovation in efforts to solve the energy crisis problem. This research was conducted at the Faculty of Engineering, Medan Area University with stages from the literature study process of data collection, data analysis, and conclusions.

In collecting data in a study, the method is important for the success of the research, therefore it is necessary to plan properly in choosing a method for data collection.

The equipment used in this research is as follows:

1. Electrical measuring instruments (multitester, ampere clamp, etc.)
2.Tool Kit

3. Screwdriver Set
4. Ring wrench
5.Lebtop
6.Calculator
7. Stationery

To design innovations in hybrid power generation technology with solar and wind power, precision in component selection is required. If the component selection is not right, there will be problems with the working system of the tool to be made. The accuracy and tolerance of the components greatly affect the accuracy of the tool's work.

Usually, the determination of the components to be used is the type of components that are easily available on the market. In addition to being easy to obtain, components also have economic value so that the manufacture of the tool does not require expensive costs. In addition to determining the right components, the layout of the components in the circuit also needs to be considered, so that later in the placement of the components according to the circuit and the components can work according to their functions.

This research takes data from the results of the design of hybrid power generation technology innovation with solar and wind power by measuring the current, voltage and rotation of solar panels and wind turbines from hybrid power generation technology innovation with solar and wind power.

In general, the system design can be seen in Figure 7. where the system is designed to consist of solar panels, windmills, charge controllers, batteries, inverters and loads.

RESULTS AND DISCUSSION

So that it produces a test that is in accordance with the design and can perform measurements on this tool. Testing on this tool includes several parts including:

3.1. Voltage Sensor Testing

Voltage sensor testing is done by measuring the changing voltage. This voltage sensor is a voltage sensor that uses a step down transformer as a medium to convert the actual voltage parameters to the voltage parameters that will be read by the Arduino which will then be processed further. Until getting a comparison of the right value to the measuring instrument that is more precise. The sensor used in this test is a sensor from the results of a multimeter.

In this test, several experiments were carried out which aimed to collect data that was directly connected to the PLN 220V AC voltage. Where the sensor used uses only 1 voltage sensor. After testing the voltage sensor, the test results data were obtained which are displayed in Table 1.

Table 1. Voltage measurement results Measurement Results (Volts)

No	Sensor iot	Multimeter manual	Nilai Error (%)
1	232	230	0.02
2	233	230	0.02
3	230	229	0.02
4	232	229	0.02
5	230	229	0.03

So the measurement results from the voltage sensor test with the calculation then obtained the average error value of 0.02%.

3.2. Current Sensor Testing.

This time the current sensor will be tested, but the voltage sensor is also used so that the power value can be calculated through the program created. Furthermore, the calculated values will be compared with the results of the current sensor reading. A program for reading current, voltage and power values will be uploaded to the wemos D1 mini to read the values generated by the current sensor.

Based on the measurement data above, calculations are carried out to determine the average error value on the current sensor. With Based on the measurement data above, calculations are carried out to determine the average error value on the current sensor. By using the formula equation 5, the average error value is obtained at 0.19%.

The results of the calculation will be sent by Wemos D1 Mini to thingspeak.com as data to be displayed on the internet page. The data is displayed in the form of a graph of the values that have been processed and sent. After that, the data is received by thingspeak.com, so that power monitoring in the boarding room can be accessed via the internet.

Table 2. Current measurement results

No	Load	Sensor	Multimeter	Error (%)
1	Lamp LED 3W	0.01	0.01	0,47%
2	Solder 35 W	0.10	0.92	0,08 %
3	Lamp 80 W	0,38	0,367	0,03 %
4	Iron 240W	1,55	1,308	0,42 %

From the data obtained from the tests carried out, the voltage, current, and power values produced have almost the same value. But the accuracy of the sensor used is the old sensor is still less accurate. However, from the calculations produced, the values obtained are not too far from direct measurements with a multimeter, so the test carried out can be said to be good.

CONCLUSION.

In this study, there are two sensors used, namely the ACS712 current sensor and the ZMPT101b voltage sensor. These sensors function as current and voltage detectors, then the read data will be sent to Wemos via serial communication. Furthermore, the data will be sent to the thingspeak.com server via the Wi-Fi network available on the Wemos D1 Mini, allowing online monitoring. The test results show that this tool has an average error value in the voltage sensor test of 0.02%, the results can be seen in Table 1. While the current sensor has an error value of 0.01%, the results can be seen in Table 2. In addition, the error value on power is 0.22%, the results can be seen in Table 3. Although there are small differences and errors, this tool is still considered good for use in this study because the measurement difference is small when compared to measurements using a multimeter.

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