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Design and Build a Data Collection System for a Solar Power Plant Based on Wireless Fidelity

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ABSTRACT

The solar cell module absorbs electrons from sunlight where the electrons are converted through a semiconductor intermediate in the solar cell module. In Kalimantan, in particular, it has the potential to install a Solar Power Plant because it is traversed by the equator. However, there are various disadvantages of the Solar Power Plant, namely the building is quite large, so it needs extra monitoring so that all the conditions of the Solar Power Plant can be known. One of the data communication methods in question is using the telemetry method or long distance communication. There are many ways for the telemetry method, one of which is to use a wireless system with a connection to a cloud storage database. In short, data in the field can be sent to users wherever they are. Data sent to previous users is sent through a cloud storage database where the data can be accessed by anyone. For data sent from the Solar Power Plant in the form of incoming and outgoing voltages as well as incoming and outgoing currents. Based on the research results, it is known that the design of the data transmission system for incoming and outgoing voltages as well as incoming and outgoing currents is made from a variety of component tools used are the solar cell module, Robotdyn Mega Wi-Fi, voltage sensor, current sensor, SCC, inverter, and battery. In the process of sending data using a Wi-Fi router, data originating from the sensor is sent to Robotdyn where inside Robotdyn there is a Wi-Fi module which will then be assisted to be forwarded via a Wi-Fi router whose internet network source uses GSM.

Keywords: solar cell, Robotdyn Mega Wi-Fi, GSM, PHP, HTML

INTRODUCTION

One of the largest and most widely used energies is fossil energy, where this energy is still a favorite for generating electrical energy. It is predicted that fossil energy reserves have reached their limit. It is known from data from the Ministry of Energy and Mineral Resources of the Republic of Indonesia that coal reserves will run out in 2036 with a reserve value of 7.3 – 8.3 billion tons. As for oil, it will run out in 2028 with a reserve value of 4.7 billion barrels and the value of gas reserves will run out in 2027. Meanwhile, the side effects of excessive use of fossil energy have an impact on the environment, such as the depletion of the ozone layer and other negative things. Therefore, it is necessary to develop environmentally friendly electrical energy to overcome this problem (Wiratmaja & Elisa, 2020).

There are many types of electrical energy that are environmentally friendly, such as water, wind, and sunlight whose conditions can be used to produce electrical energy (Saputra et al., 2019). Water requires a natural flow of water that is swift so that only certain areas can be installed. Likewise with wind energy which requires a plateau where the wind is very strong to turn a windmill. Unlike the case with sunlight. Sunlight can be felt by all regions, especially in Indonesia.

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Besides, the sunlight can be changed into electrical energy through solar cell modules. The solar cell module absorbs electrons from sunlight where the electrons are converted through a semiconductor medium in the solar cell module. In Kalimantan, in particular, there is a lot of potential to install PLTS (Solar Power Plant) where in addition to good light intensity, the equator is also traversed. However, there are various disadvantages of PLTS, namely the building is quite spacious so it needs extra monitoring so that all PLTS conditions can be known.

There needs to be reliable data communication related to the delivery of information conveyed in the PLTS field and in the control room. One of the data communication methods in question is using the telemetry method or long-distance communication (Pratama, 2017). There are many ways for the telemetry method, one of which is using a wireless system with a connection to a cloud storage database. In short, data in the field can be sent to users wherever they are provided they have a stable connection. The data sent to the previous user is sent through a cloud storage database where the data can be accessed by anyone (Shorina, 2018). For data sent from PLTS in the form of incoming and outgoing voltages and incoming and outgoing currents. The input voltage in question is the voltage from the solar cell module while the output voltage is the voltage used from the battery after going through the storage process from the solar cell module. This also applies to electric current (Taufik et al., 2019).

In previous research, a data communication process has been carried out using GSM (Global System for Mobile) (Saputra et al., 2019). However, there are some obstacles when using GSM and the most common problem is the frequent disconnection of the internet network connection due to unstable signal and power supply. In addition, the Arduino which is in charge of retrieving all the data cannot work together due to damage to the Arduino when the incoming and outgoing voltages or currents are connected simultaneously to one Arduino.

Therefore, in this study, updating the existing system by separating each for the incoming voltage and current as well as the output voltage and current so that it can work in parallel properly.

METHOD

Wireless Data Delivery System

The method of sending data over long distances or usually the so-calledas telemetry is a very effective method when the data needed is in a place that is difficult to reach by humans. This system has been widely used, especially in the field of power generation (Wicaksono, 2017). There are various kinds of power plants, such as hydroelectric power, wind power, and solar power or sunlight. For hydroelectric power plants, monitoring is usually carried out remotely because the area is usually in a forest or in a river that is far from residential areas. Wind power plants are usually difficult to reach because they are located in the highlands, so this long-distance data transmission system is needed. For solar power plants, data is transmitted wirelessly because the area is very large so an automated system is needed to retrieve the data (NURYASIN et al., 2020). The data that is usually taken is the voltage and current generated from a generator. Not infrequently there are also those who measure the speed of water and wind as well as the intensity of light at the input from each generator (Doni Anibta et al., 2019). Many wireless methods ranging from Bluetooth, GSM, and Wi-Fi (Wireless Fidelity) where all these methods certainly do not require a cable as a data transmission medium. One of the most widely used and most stable methods used is the Wi-Fi method where this method can be used as a local or long distance method. This media usually uses a router as a medium for spreading its wireless network. For more details, the following in Figure 1 is the router used at the time of the study. The router is used to send data obtained from the data acquisition tool to the cloud storage where the data will be displayed on the website.

Figure 1. Router as Data Delivery Media

Robotdyn Mega Wi-Fi

When creating a project related to Arduino, the easiest way is to use Arduino Uno. However, if you feel that the I/O (input-output) module is still lacking, then please use Arduino Mega (Wahyono et al., 2018). There are many choices regarding the type and function of the Arduino itself so you can freely choose. What about communication modules like Ethernet or Wi-Fi? Of course Arduino has a special module but this is outside the Arduino circuit itself or can be called an external module so it needs to be connected with several cables to get this function (Kurniawan et al., 2020).

Unlike Robotdyn, whose functions are all already in one module. Robotdyn itself was created to answer solutions to existing problems (Suryawinata et al., 2017). The Robotdyn used in this study is the I/O module the size of the Arduino Mega, which is about 54 I/O with a certain input and output division (Siregar et al., 2017). In addition, Robotdyn also includes a Wi-Fi module where if you want to use it simultaneously, there is a kind of switch that must be set so that you can exchange modules (Chamdareno & Azharuddin, 2017). The Wi-Fi module used is ESP8266 where this module also functions as IoT (internet of things) (Hanafie et al., 2020). For more details, the following in Figure 2 is Robotdyn Mega Wi-Fi.

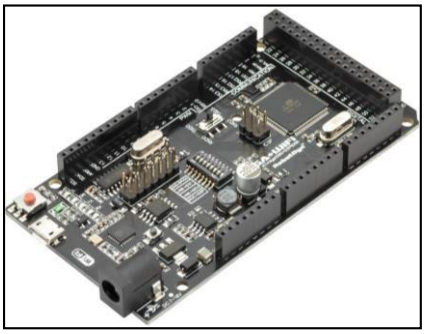

Figure 2. Robotdyn Mega Wi-Fi

Activity Plan

This research was started by conducting a literature study in which to find the right reference source for research on the Design of Data Retrieval Systems in Wi-Fi-based PV mini-grid. After

getting some references, the next step is to create and update the system so that data can be retrieved. If the system is successful, then the next step is to test the system and then analyze and conclude. The following in Figure 3 is a flow chart of the research conducted.

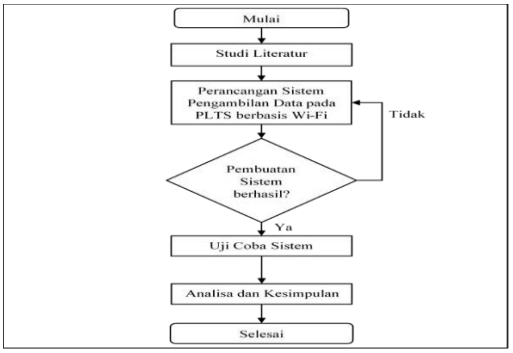

Figure 3. Research Flowchart

The data collection system in this PLTS uses two Robotdyn where each Robotdyn has its own task. Data from PLTS is given to a cloud storage database where the database will be displayed on the website as the output. For more details, see Figure 4 in the form of a system block diagram for how the water purification device works.

Wi-Fi Data Retrieval System Design

There are two Robotdyn used in this study with different functions, the first is used to retrieve incoming data from the solar cell module where the data taken is voltage and current and the second is used to retrieve data coming out of the battery or going to the load. where the data taken is the voltage and current. Variables that enter through the SCC (solar charge controller) where the SCC is the terminal where the voltage and current enter and exit from the solar cell module and their distribution to the load and storage to the battery. Among these processes, there are 4 sensors, each of which is two in number, namely a voltage sensor and a current sensor. After the data is taken from the sensor, it is then forwarded to Robotdyn where there is a Wi-Fi module via a Wi-Fi router. There are two installed batteries where each battery has a 12VDC specification with a capacity of 100Ah (Mainaki et al., 2020). The batteries are arranged in series and produce a voltage of 24VDC with a battery capacity of 100 Ah (Sugeng & Saputra, 2019).

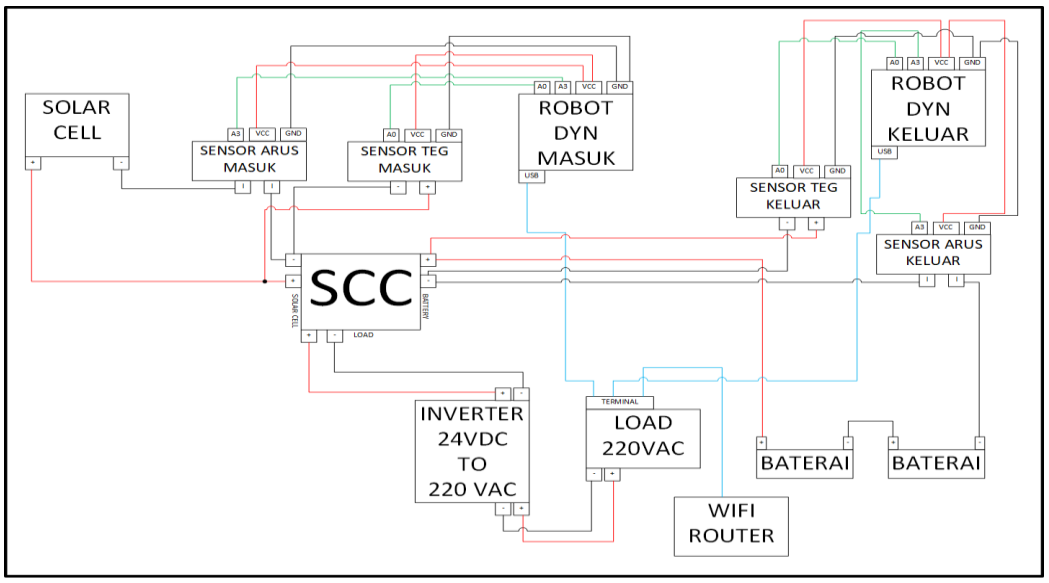

Figure 4. How the Water Purifier Works

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Research sites

The research was conducted at the Instrumentation Laboratory of the D3 Oil and Gas Engineering Instrumentation and Electronics Engineering Study Program, STT Migas Balikpapan campus.

RESULTS AND DISCUSSION

All components of the system are mounted on one thick wooden board neatly arranged with standard-compliant cables. The components consist of two Robotdyn, two voltage sensors, two current sensors, SCC, 24VDC to 220VAC inverter, Wi-Fi router, solar cell module with a total of 600 Wp and battery. The following in Figure 5 is a series of systems that have been successfully built with a battery system and Figure 6 is a continuation of a series of data transmission systems via Wi-Fi.
The data retrieval system uses a voltage sensor to measure voltage with a measurement range of 0-25 VDC and an ACS712-20A sensor to measure electric current whose maximum value is 20 A. Especially for the voltage sensor, before entering the sensor, a voltage divider circuit which consists of two resistors measuring 1k Ohm with a power of 10 W. This is done because the voltage is around 40 VDC where this value is a value that cannot be accepted by the voltage sensor because the maximum value for the voltage is 25 VDC. For more details can be seen in Figure 7 is a system module that has been designed on a wooden board and Figure 8 is a voltage divider circuit.

Figure 5 (left). Battery System Design

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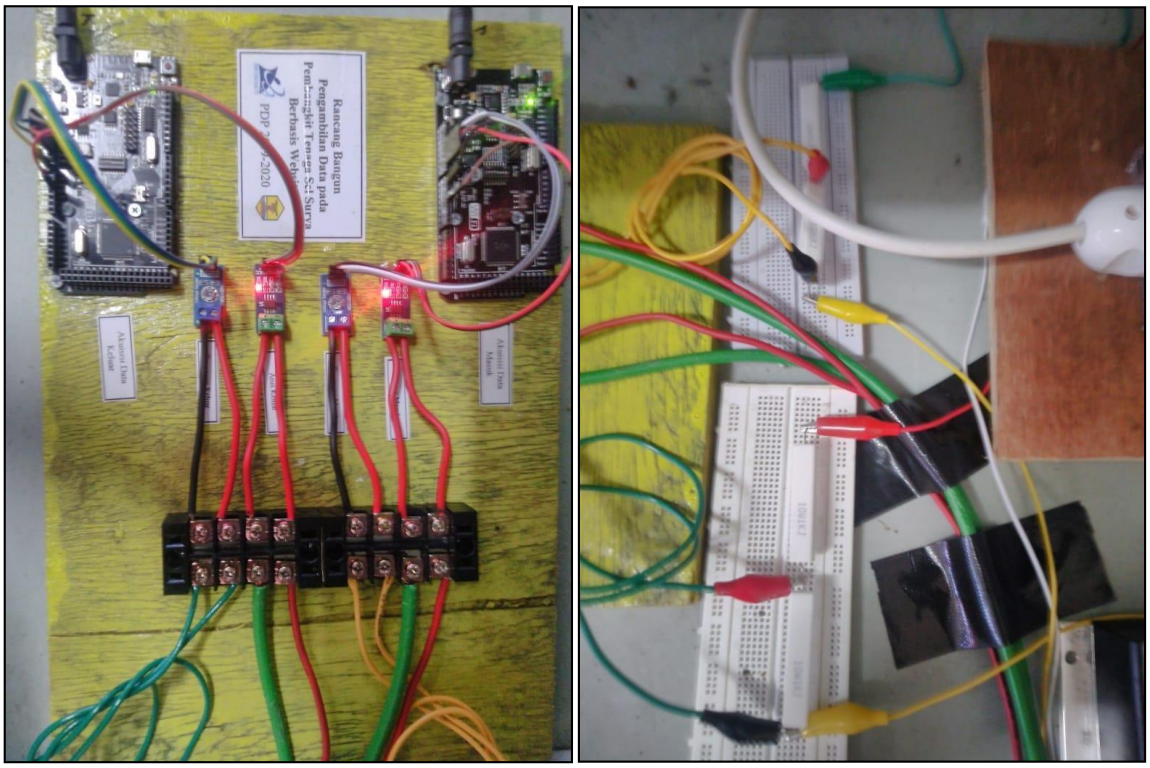

Figure 6 (right). Advanced Design of Data Delivery System via Wi-Fi

After the system is running, the next step is to forward the data into a cloud storage database which will later be displayed on the website. The use of this database uses MySQL with the help of the PHP language for data connection and the appearance of the website uses HTML (Hypertext Markup Language). For the website address, seehttp://plts.infomaterial.com. Here in Figure 9 is the display on the website for voltage data and Figure 10 is the display on the website for current data (Data was taken on Sunday, September 13, 2020).

Figure 7. Display of Inlet and Out Voltage

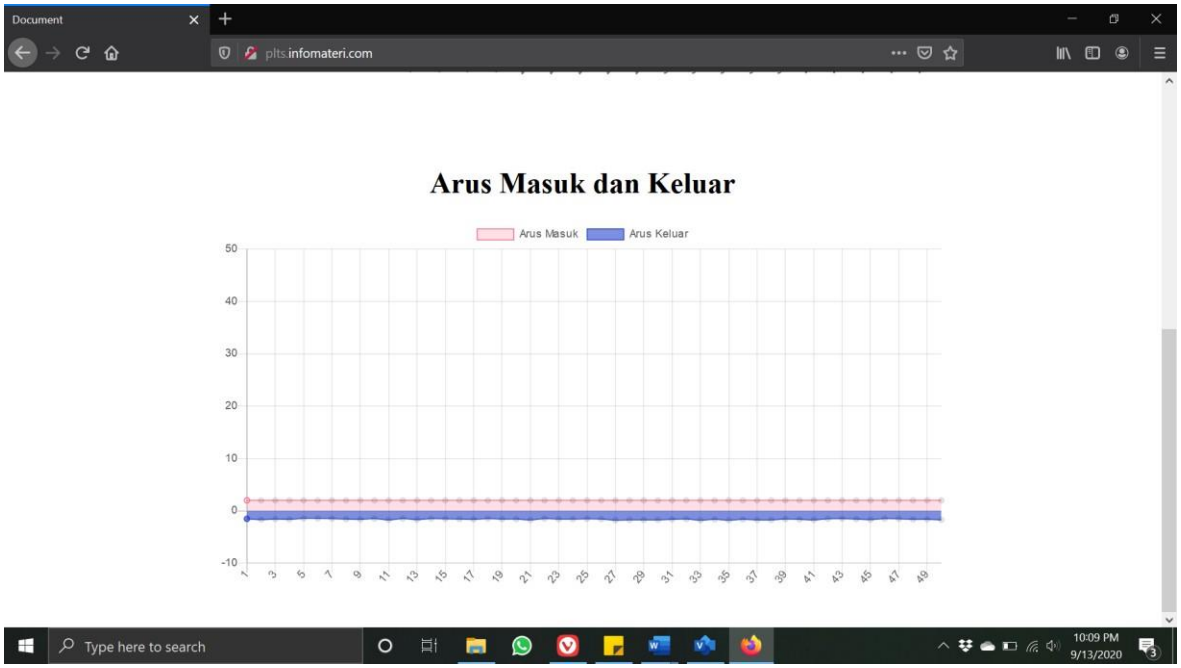

Figure 8. Inflow and Outflow Display

CONCLUSION

Based on the results of the study, it is known that the design of the data transmission system for incoming and outgoing voltages and incoming and outgoing currents is made from various component tools used, namely solar cell modules, Robotdyn Mega Wi-Fi, voltage sensors, current sensors, SCC (solar charge controller), inverters. , and battery. In the process of sending data using a Wi-Fi router, data coming from sensors is sent to Robotdyn where in Robotdyn there is a Wi-Fi module which will then be assisted to be forwarded through a Wi-Fi router whose internet network source uses GSM. The data sent to the cloud storage database is assisted by the PHP programming language and to display the website using the HTML programming language.

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