International Journal of Engineering and Science Applications
Vol 8 No.1 May 2021
ISSN 2406-9833

IJEScA

Solar Home System Performance Monitoring System for Agricultural Areas in Brebes

W Edifikar[1], A A Musyafiq[2]*and T Kamal[1]
[1]Computer Engineering Study Program, Nahdlatul Ulama University Yogyakarta
[2]Electrical Engineering Study Program Cilacap State Polytechnic
*corresponding authorl: afrizal.abdi.m@gmail.com

ABSTRACT

The area of paddy fields based on usage was 8,096.19 ha consisting of 3,540.40 ha used for paddy fields and 4,555.79 ha for non-rice fields. The area of paddy fields based on the type of irrigation in Brebes District was 1,872.00 ha of technical irrigation; 583,701 ha semi technical irrigation; 588.50 ha of simple irrigation; and 495.89 ha rainfed. The purpose of this research is to review the availability of solar energy sources to be used as power plants with SHS. Then with this research also known electricity generation for SHS. Remote monitoring system design for SHS can be implemented in Pasarbatang Brebes Village. The design in this study uses a sensor at the PV output to be connected to an Arduino microcontroller. The data recording from the sensor by the microcontroller is sent to the online storage media (cloud drive) via a wifi communication device. The results of the research can be accessed anywhere and anytime because the system was built using online storage media. This makes it easier to monitor the progress of the PV installed via the web or Android smartphone. Monitoring on android applications using NodeMCU ESP8266 to send and receive data. So that it can monitor the measurement results from the current and voltage sensors in real time

Keywords: Photovoltaic; Solar home syste;, Cloud drive)

1. INTRODUCTION

Brebes District is the capital of Brebes Regency, Brebes District administratively has 26 Hamlets / Dusun; 140 RW; and 716 RTs scattered and located in the southeast of Brebes Regency with the northern boundary being the Java Sea; south of Jatibarang District; west of Wanasari District; and east of Tegal City and Regency. Brebes District has an area of 80.96 km2 (4.87%) with an altitude of 3 masl. In climate terms, the average amount of rainfall is 195.33 mm / year. The total population of Brebes District was 160,340 people consisting of 80,333 men and 80,007 women in 2019. The area of paddy fields based on use is 8,096.19 ha consisting of 3,540.40 ha used as paddy fields and 4,555.79 ha non-rice fields. The area of paddy fields based on the type of irrigation in Brebes District was 1,872.00 ha of technical irrigation; 583,701 ha semi technical irrigation; 588.50 ha of simple irrigation; and 495.89 ha rainfed [1].

Water as a source of life energy is crucial things in human life. Water resources are managed by the Regional Government Enterprises under the PDAM. The number of PDAM customers increased compared to 2016 which was dominated by household categories as many as 298,969 customers in 2019. The number of irrigation infrastructure in Brebes District was 2 DAMs and 27 engine pumps. The area of non-rice fields based on the type of use consists of 1,720.42 ha of yards / buildings; 10.50 ha of dry land / garden; 2,485.03 ha of pond; 1.00 ha of swamps; and 338.84 ha of others. The harvested area for paddy rice is 2,620.1 ha and red onion 3,210 ha, while the production of mangoes is 25,803 ha and 3,440 bananas. The number of livestock population in Brebes District consists of 255 cows; buffalo 324 tails; 4,472 goats; 14,105 cows; native chickens 159,614; 1,476,650 broilers; and 83,496 ducks.

Pasarbatang Village administratively has 1 Hamlet / Hamlet; 14 RW; and 69 RTs that are scattered and located in the middle of Brebes District with the northern boundary are Pagejugan and Sigambir Villages; south of Brebes Village; west of Tengki Village; and to the east of Limbangan Kulon Village. Pasarbatang Village has an area of 5.18 km2 with an altitude of 3 masl. In climate terms, the average amount of rainfall is 195.33 mm / year. The total population of Pasarbatang Village was 19,059, consisting of 9,598 men and 9,461 women in 2019.

The area of paddy fields based on usage was 518.00 ha consisting of 297.62 ha used as paddy fields and 220.38 non-rice fields. The area of rice fields based on the type of irrigation in Pasarbatang Village is 225.62 ha of technical irrigation; 63.00 ha of semi-technical irrigation; 7.00 ha simple irrigation; and 2.00 ha rainfed. The area of non-rice fields based on the type of use consists of 184.38 ha of yards / buildings; and 36.00 ha of others. The number of irrigation infrastructure in Pasarbatang Village is 1 engine pump with a bent soil area of 23.40 ha for paddy fields. The number of livestock population in Pasarbatang Village consists of 327 goats / sheep; 1,357 chickens; and 1,011 ducks.

The purpose of this research is to review the availability of solar energy sources to be used as power plants with SHS in Pasarbatang, Brebes Village; Knowing the electricity generation from solar energy sources around the SHS; Designing a remote monitoring system for SHS which is implemented in Pasarbatang Village, Brebes. The urgency for this research to be carried out is the availability of environmentally friendly power plant technology that is easy and can be used directly by the community; Limited electricity network that is difficult to reach areas far from residential areas; Remote SHS performance monitoring.

2. METHODOLOGY

There are two forms of solar energy utilization, namely heat and electricity. Solar thermal energy can be used directly by concentrating and trapping the heat. For example, by concentrating the sun's heat on a fluid that produces steam to generate electricity. Another example is direct use as a solar stove, distillation, drying, and so on. Photovoltaic is a technology that functions to directly convert or convert solar radiation into electrical energy. These solar cells are usually packaged in a unit called a module. Solar cells function to convert light energy into electrical energy with a certain level of efficiency, depending on the type of silicon material used [2]. Solar panels are also very vulnerable to extreme temperature conditions and also clean panel surfaces. A single chip solar cell produces less than 3 watts at a voltage of about 0.5 V DC. The cells must be connected in series on a module in order to produce enough energy for applications requiring high power.

The work process of PV solar panels consists of sunlight which has many photons which will be absorbed by anti-reflection and channeled to the semiconductor; There will be a collision between photons and atoms in the semiconductor causing the release of electrons freely which creates an electric current; unidirectional electricity is then supplied to the connecting metal at the top and bottom of the solar cell [3]

Arduino is a single-board micro controller which is open source. Arduino launched from the

Wiring platform, designed to facilitate the use of electronics in various fields. The hardware has an Atmel AVR processor and the software has its own programming language. The board system used in this study was the Arduino Uno which was integrated with the ATMega328 microcontroller. This module is one type of microcontroller that is easy to use and affordable in terms of price. Arduino board as shown in the picture is given DC power input or directly connected to USB with a computer. The Arduino uno has 14 digital input / output pins and 6 analog input pins that can be programmed with IDE software.

PV voltage is measured by a voltage sensor module. This module can reduce the input voltage by up to 5 times the original voltage and is used to reduce the PV (V) output voltage between 0 and 22.7 V to another voltage (Vd) between 0 and 5 V so that it can be measured with Arduino, because of the analog input. Arduino is limited to 5 V.

The wifi module is a module that will be used to connect the system to be built with the internet / virtual / cloud world. The type of wifi module to be used is ESP8266. The wifi module functions as an additional device for a microcontroller such as the Arduino so that it can connect directly to wifi and make a TCP / IP connection. This module requires a power of about 3.3v by having three wifi modes, namely Station, Access Point and Both (Both). This module is also equipped with a processor, memory and GPIO where the number of pins depends on the type of ESP8266 we are using. So that this module can stand alone without using any microcontroller because it already has equipment like a microcontroller [4].

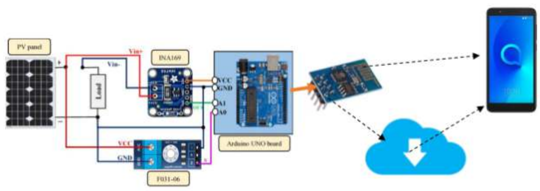

Figure 1. How the Solar Cell Transmitter System to Arduino and Monitoring System

The first device design to do is design a solar cell system that is used as an energy source by converting solar energy into electrical energy. The process of the stages of the solar cell system begins with the light energy that comes from sunlight falling on the earth which is absorbed by the solar cell. Light energy is then converted into chemical energy by solar cells which is then converted again into electrical energy [5]. The electrical energy generated is flowed through the cable and into the solar charge controller which functions as a control for the output voltage generated and distributed into the power storage. Power storage in the form of a battery is used to store the electrical energy generated. A lamp is used as a load for indicators and takes current and voltage measurements [6]. The next step is to make a device that controls the solar cell transmitter system to Arduino. The way this system works is to carry out the process of sending current and voltage to the solar cell which is then detected by the measured current and voltage sensor in the form of data into the Arduino Mega ADK microcontroller to process the data and display it on the LCD [7]. The flow diagram of how the solar cell transmitter system to Arduino works can be seen in Figure 1 (a).

The next step is to design a monitoring system with a monitoring system working process using two light sensors and Arduino ADK 2560 as a microcontroller to control the servo motor as an actuator [8]. This system uses two light sensors in the form of an LDR (Light

Dipendent Resisitor). Light sensor 1 is a sensor used to detect sunlight from the east, while light sensor 2 is a sensor used to detect sunlight from the west. If the sun's position is right above the sensor, sensors 1 and 2 will get the same level of light intensity and change the direction of the solar panels according to the direction of the sun's light. The way the monitoring system works is starting from the input in the form of an LDR sensor facing the east and west directions. Both LDR sensors are on and catch the sunlight coming from a certain direction [9]. The two sensors identify the difference in error in the ADC values captured based on the value of sunlight intensity. Determination of the ADC value is determined by getting the error value> = 61.5 then the servo motor moves east, if the ADC error value <= 61.5 then the servo motor moves west, then if the eastern ADC value LDR <100.50 & west LDR <100.50 then the servo motor moves in the upright position.

3. RESULT AND DISCUSSION

The next step is to conduct a voltage test, this test aims to determine the performance of the voltage sensor in detecting voltage in a closed and open circuit and to compare the measurement results on the system with a multimeter measuring instrument. Based on the results of these comparisons, the difference in voltage values read by a multimeter with a voltage sensor is analyzed. The test is carried out using open and closed circuits or with no load. The voltage sensor being tested is a sensor located on the battery. The battery used has a capacity of 9 Ah and has a normal voltage of about 14 V. This test V0 is a voltage condition in an open circuit or there is no load, and V1 is the voltage in a closed circuit or with a load. Load using a DC lamp 10 W. Δ V0 and Δ V1 is the difference from the voltage reading using the voltage sensor displayed on the LCD screen and a multimeter measuring instrument. The overall test results carried out for 10 hours, from 07.00-16.00 WIB in sunny weather can be seen in Table 1. which is the result of testing the voltage sensor on the battery.

Table 1. Light Sensor ADC Value on Sensor Testing

V_0 Multimeter (V)	V_1 Multimeter (V)	V_0 Sensor (V)	V_1 Sensor (V)	ΔV_0 (V)	ΔV_1 (V)
14,39	14,15	15,20	15,08	0,81	0,93
14,42	14,19	15,18	15,15	0,76	0,96
14,46	14,18	15,23	15,11	0,65	0,93
14,47	14,21	15,53	15,43	1,06	1,22
14,94	14,73	15,77	15,52	0,83	0,79
14,55	14,34	15,30	15,15	0,75	0,79
14,53	14,27	15,24	15,15	0,71	0,88
14,37	14,17	15,26	15,15	0,89	0,98
14,43	14.20	15,29	15,19	0,86	0,99

Test results, it can be seen that the voltage value at the beginning of data collection, namely at 10:00 - 14:00 using a multimeter, is 14.39 V to 14.47 V when no load, 14.15 V to 14.21 V with load. while the measurement with sensors is worth 15.20 V to 15.53 V without load, 15.08 V to 15.43 without load. data collection of voltage values at 15.00-14.00 WIB using a multimeter is worth 14.55 V to 14.41 V when without load, 14.34 V to 14.18 V with load. while the measurement with sensors worth 15.30 V to 15.37 V without load, 15.15 V to 15.24 without load. Maximum stress occurs when data collection is 14.00-15.00 WIB, namely 14.94 V without load and 14.73 V with load for measurements on a multimeter. While the sensor is 15.77 V without load and 15.52 with load. When the open circuit or no-load condition results in a difference in the average voltage value of 0.82 V, while in a closed circuit or using a load, the difference in the average voltage value is 0.95 V. The voltage value on the battery is generated from measurements with a multimeter and The sensor has a trend that the voltage value always increases by 0.24% to 0.35% according to time, meaning that the greater the value of the sunlight intensity received. the voltage value in the data collection process after the peak value, the trend of the battery voltage value tends to decrease by 0.11% to 0.15% by measuring using a multimeter, but measurements using the sensor value actually experience an increase in the voltage value of 0.15% to by 0.20%. this happens because of the intensity of sunlight that enters the two LDR sensors and is still read simultaneously by the system.

This next test aims to determine the performance of the ACS714 current sensor in reading DC currents. Current testing is carried out on the battery (power storage) and solar panels simultaneously with a multimeter and sensor. The sensor used is located on the load or battery. The test is carried out by comparing the current reading on the ACS714 current sensor with a multimeter measuring battery with a capacity of 9Ah and a voltage of 14V. In Table 3. ΔA is the difference from the current reading using a multimeter measuring instrument with the ACS714 sensor located on the battery battery. Based on Table 3. in testing the value of the current flowing in the power storage and solar cell shows the average difference in current of 0.33 A and 0.14 A. multimeter, the magnitude of the current value is directly proportional to the voltage value obtained at any given time and vice versa. this is in accordance with the existing theoretical basis that the current value is directly proportional to the voltage value and vice versa.

4. CONCLUSIONS

Solar cell moves to follow sunlight automatically based on 3 conditions, namely the solar cell facing east, perpendicular and west. When facing east, the average difference in ADC sensor values is 60.35, perpendicular to the average difference between ADC sensors is 0.3 and facing west, the average difference in ADC sensors is 85.35. Monitoring can be done through an android application that displays the results of the current and voltage values in 3 parts, namely the solar panel, battery and load in real time. the current value obtained is directly proportional to the voltage value on the measurement with a multimeter or sensor and vice versa. The relay control system in the application has an average delay time of 5.91 seconds.

ACKNOWLEDGEMENT

Thank you to the Department of Electronics Engineering, State Polytechnic of Cilacap for supporting the use of the Electronics Workshop Laboratory as a place to manufacture devices and thanks to the students of the Cilacap State Polytechnic Electrical Engineering Study Program who helped in this research. Thank you to the Institute for Research and Community Service (LPPM) Aswaja Center, Nahdlatul Ulama University Yogyakarta and the Directorate of Research and Community Service (DRPM) of the Ministry of Research, Technology and Higher Education who have funded this research.

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