Dual Axis Solar Tracker System Application Based on Arduino Atmega 2560 and Internet of Things (iot) for Submersible Pump Operation

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ABSTRACT- Most of the Solar Power Plants (PLTS) still use a static system which is considered less effective in absorbing solar energy. This is due to the earth's rotation which causes the sun to not always be in the same position. In order to optimize the absorption of solar energy so that the power produced is stable and maximum, a tracking system is applied to the solar panels. This tool works by using 4 LDR sensors and 2 DC Power Window motors as the driving force and the presence of Wi-Fi as a communication medium between the Arduino ATmega 2560 and the Android application so that the performance of the solar tracker can be monitored via a smartphone in real time. The purpose of this research is to optimize the efficiency of solar panels. The method used in this research is Research and Development (R&D). The test was carried out with the Dual Axis Solar Tracker system against a load in the form of a submersible pump. The test results show the average efficiency of the Dual Axis Solar Tracker system is 20.89% with an average power output of 84.81%.

Keywords: solar panels, solar tracker, research and development (R&D), submersible pump, dual axis solar tracker efficiency

I. INTRODUCTION

Indonesia is a country that has abundant energy resources, one of which is solar energy. However, the utilization of these energy sources is considered less than optimal because the use of PLTS is mostly still using a static system where this is considered less effective in the utilization of solar energy absorption. This is due to the earth's rotation which causes the sun to not always be in the same position. According to Wijaya et al (2010) scientific journals when viewed from the earth, the sun every day moves from east to west with a position of 0° at the equator rising to 23.5° N (lasts from March 21 to June 21). After that, the sun's position seemed to drop again to 0° on September 23, then continued to drop to 23.5° South Latitude on December 22. After

that it rose again to the 0° position on March 21, and so on until it formed a cycle. So when using a static system, solar panels are not optimal in absorbing sunlight and the power generated by solar panels is unstable. While the dynamic system in terms of absorption of sunlight can be maximized because the system can adjust to the direction of sunlight coming from all directions.

Therefore, one of the solutions and forms of innovation to optimize the absorption of solar energy so that the power generated is stable and maximum is by implementing a tracking system or tracking system on solar panels using Arduino Uno ATmega 2560 and as a result solar panels can produce relatively low power. -supply electric power from load usage plan.

II. METHODS

The research methods used include the Method*Research and Development (R&D)*, namely the method carried out by making a dual axis solar tracker test tool and developing a system with the addition of IoT (Internet of Things). Then, data collection in the form of a literature study was carried out to obtain primary data, namely data obtained directly from the field by being directly involved in activities and observing the processes that occurred during the operation of the test equipment. In addition, it also records the observations obtained. The actual data is then analyzed to evaluate and analyze the current case. The next method is the Literature Method, is a method of collecting data by studying the literature, in the form of lecture books or libraries or other media related to the literature review needed in the preparation of the final project report. And the last method, namely the Guidance Method, is to conduct consultation and guidance to the supervisor regarding the problems encountered during the work of this research.

In this research, the test was carried out at the Semarang State Polytechnic at the interval of 9.00-15.00 WIB. Data is taken every 10 minutes. Test results on test equipment*dual axis solar tracker* based on Arduino Atmega 2560 and Internet of Things (IoT). The data obtained are in the form of voltage

(V), current (I), air temperature (T), humidity (Rh), light intensity (Gu), and efficiency (η).

The data processing is calculated by the following formula:

a) Calculating the incoming power to the solar cell (Pin)

$$P_{in} = G_u \times A \quad (2.1)$$

Information :

P_{in} = Solar panel input power (Watt)
G_u = intensity of sunlight rated (W/m²)
A = Effective area of the module photovoltaic (m²)

b) Calculate the power that comes out of the solar cell (Pout)

$$P_{out} = V_{sel} \times I_{sel} \quad (2.2)$$

Information :

P_{out}= Solar cell output power (W)
V_{sel} = Solar cell voltage (V)
I_{sel} = Solar cell current (A)

c) Calculating efficiency on solar cell

$$\eta = \frac{Pout}{Pin} \times 100\% \quad (2.3)$$

Information :
η=Maximum output efficiency (%)
P_{out}= Solar panel output power (Watt)
P_{in}= Solar panel input power (Watt)

III. Results and Discussion

1. Calculation

a) Calculating the incoming power to the solar cell (Pin)

$$P_{in} = G_u \times A$$

$$P_{in} = 628{,}81\ W/m^2 \times 0{,}46\ m^2 \quad P_{in} = 289{,}2526\ Watt$$

b) Calculate the power that comes out of the solar cell (Pout)

$$P_{out} = V_{sel} \times I_{sel}$$

$$P_{out} = 14{,}76\ V \times 3{,}92\ A$$

$$P_{out} = 57{,}8592\ watt$$

2. Problem Analysis

The data analyzed in this study are the characteristics of the time with the intensity of sunlight, the time with the current generated by the solar cell, the time with the voltage produced by the solar cell, the time with the power that comes out of the solar cell, and the time with the efficiency of the solar cell.

a) Characteristics of Light Intensity Against Solar Cell Time

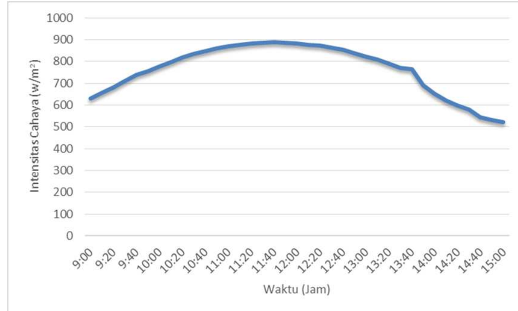

Figure 3. 1 Characteristics of Light Intensity Against Solar Cell Time

The test was carried out in sunny weather conditions and an average temperature of 33.97°C and an average air humidity value of 48.086%. The maximum light intensity value is 888.01 W/m² at 11:40 WIB, while the minimum light intensity value is 521.36 W/m² at 15:00 WIB. The average light intensity produced at the time of testing is 763,973 W/m2.

b. Current Characteristics AgainstSolar Cell Time

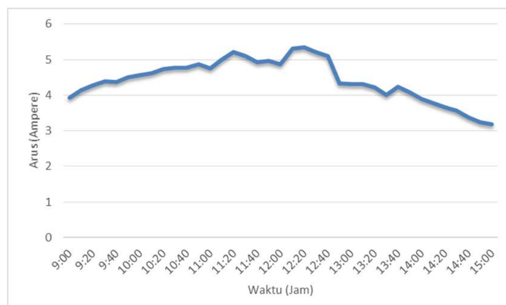

Figure 3.2 Current Characteristics Against Solar Cell Ti

In the graph it can be seen that the average value of the current generated on the dual axis solar tracker is 4.43 A. Then the minimum current value generated on the dual axis solar tracker is 3.18 A at 15:00 WIB, while the value of the maximum current is 5.34 A at 11:20 WIB.

b) Voltage Characteristics Against Solar Cell Time

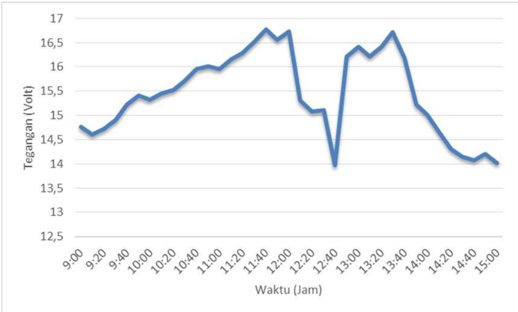

Figure 3.3 Characteristics Voltage Against Solar Cell Time

In the graph, the average voltage value generated on the dual axis solar tracker is 15.45 V. The minimum voltage value generated is 13.98 V at 12:40 WIB, while the maximum voltage value is 16.77 V at 12:40 WIB. 11:40 WIB.

Output Power Characteristics Against Solar Cell Time

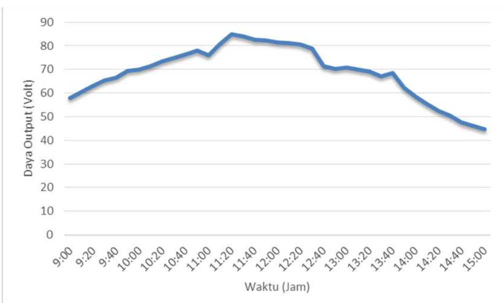

Figure 3.4 Characteristics of Output Power Against Solar Cell Time

In the graph, the average value of the output power generated on the dual axis solar tracker is 68.73 Watt. Based on the graph, it can be seen that the lowest output power of the solar cell with tracking system is 44.58 Watts at 15:00 WIB, while the maximum power generated at 12:20 WIB is
84.81 Watts.

c) Efficiency Characteristics Against Solar Cell Time

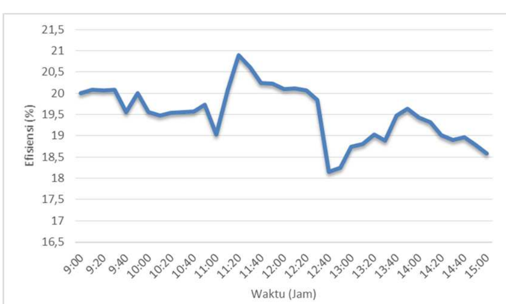

Figure 3.5 Characteristics Efficiency Against Solar Cell Time

When viewed from the graph above, it shows that the average efficiency value generated on the dual axis solar tracker is 19.52%. The lowest efficiency value for solar cells with tracking system is 18.15% at 12:40 WIB, while the maximum power generated at 12:20 WIB is 20.89%.

IV. Conclusion

In the research entitled "Dual Axis Solar Tracker System Application Based on Arduino ATmega 2560 and Internet Of Things (IoT) for Submersible Pump Operation" the conclusions are:

1. The Internet of Things (IoT)-based dual axis solar tracker with Arduino ATmega 2560 as the control center and LDR light sensor and DC Power Window motor as a driver can direct the solar panel by following the movement of the sun well.
2. Solar panels with the help of a DC Power Window motor can move solar panels in dual axes (vertical and horizontal axes).
3. The maximum power generated by the dual axis solar tracker is 84.81 Watt
4. The maximum efficiency value of solar panels with a dual axis tracker system is 20.89%.

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