1st Proceeding of International Conference on Science and Technology UISU (ICST)
"Contribution of Engineering Disciplines to Achieving Sustainable Development Goals Research Realizing the Vision of Golden Indonesia 2045"
ISSN: 3063-7929 (Online)
DOI: https://doi.org/10.30743/icst

A New Model Designer Of Solar Tracker Based On Wemos Based Real Time Clock Method

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Abstract - Nowadays, electricity is a source of energy that is really needed by humans, almost all aspects of human life require electricity, so electricity has become an indispensable part. One energy that can be used as an alternative is renewable energy such as the sun. Renewable energy has an unlimited supply and is a sustainable solution for the future. Indonesia, a country with a tropical climate, is located near the equator and has a special character caused by the high heat of the sun. PLTS is dependent on the sunlight it receives, so it affects the electrical energy produced. A sun tracking system is designed with a drive using a stepper motor for a single axis and sun tracking based on Real Time Clock (RTC) time which is not affected by cloudy weather. The sun tracker has been designed using the Wemos D1 Mini as a controller, a voltage sensor module to detect the voltage produced by the solar panels. 28BYJ-48 stepper motor with an operating voltage of 5V which has been adapted to the RTC module through the program. The sun tracking system can increase the performance of solar energy absorption compared to static solar systems with a value of 19.91% in a 12 hour test time.

Keywords: RTC, Stepper Motor, PLTS, Sensor Module.

1. INTRODUCTION

Solar Power Plants (PLTS) are one of the alternative power plants that are being developed in Indonesia because solar power plants have almost no negative impact on the environment compared to other fuel-based power plants. PLTS only utilizes radiation from sunlight which is converted into electrical energy. Indonesia is a country located on the equator with a lot of exposure to sunlight, so it has the potential to develop solar power plants

Solar power plants are dependent on the rays or sunlight they receive. The amount of sunlight received also influences the electrical energy produced. The number of solar panel collectors and the area of solar panel installation required to produce large amounts of electrical energy. In general, solar power plants are placed in a fixed or fixed position, so that the sunlight received is less than optimal. This is because when the sun rises, the position of the solar panels is not perpendicular to the sunlight. Solar panels need to be moved following the movement of the sun to get optimal sunlight. So we need a technology or system that can move the solar panels so that they are perpendicular to the position of the sun.

2. LITERATURE REVIEW

In carrying out this research, the author was more or less inspired and referred to previous research related to the background of the problem in this research. The following previous research related to this research includes:

Research conducted by Hassan Fathabadi, 2016 "High Accurate Sensorless Dual-Axis Solar Tracking System Controlled by Maximum Power Point Tracking Unit of Photovoltaic" [8]. Using the PV output to determine the optimum point of output power then using the altitude and azimuth deviation angles to direct the PV to find the optimum power. Provides results in increasing solar panel efficiency by 28.8-43.6%..

Research conducted by Yuwaldi Away, 2016 "Dual-axis sun tracker sensor based on tetrahedron geometry" [9]. Using 3 Light Dependent Resistor (LDR) light sensors arranged in a pyramid shape or known as tetrahedron geometry, this sensor is able to drive dual-axis solar panels. The results of this research are that it is able to detect light sources with a Field of View (FOV) of 289.40 with an error rate of 1.67%.

Research conducted by Nadia Al-Rousan, 2020 "Efficient single and dual axis solar tracking system controllers based on adaptive neural fuzzy inference system" [7]. Uses year, month and day input to determine the predicted location of the sun in the form of azimuth and altitude angles. Providing the final results of the research, namely the prediction rate in determining the direction of movement of solar panels of 83.01%. research that will be carried out with the title "Solar Panels with a Sunlight Direction Tracking System" using the Scanning for first initiation method, which uses a scanning method at the beginning of the movement to determine the maximum power produced by the solar panels. If the maximum power has been determined then the solar panels will go to the angle at which the maximum power is generated. And then the panel will move straight following the predetermined

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Hours Angle algorithm. However, if you are hampered by weather conditions and cannot find the desired angle, the solar panel will use the previous angle data that has been installed in the program.

3. METHOD

Solar tracking system with a drive that uses a stepper motor for a single axis and sun tracking based on Real Time Clock (RTC) time which is not affected by cloudy weather. The use of a single axis solar tracker is chosen taking into account the output produced by the solar panels and the costs required. Apart from that, Indonesia is located on the equator, which means that the movement of the sun is not very significant when compared to countries that are located outside the tropical circle. The output from the solar tracker is then compared with a static solar panel as a control variable to see the performance of the solar tracker.

a) Tool design design

Here solar panels are used with maximum power (Pmax) = 50 Wp, Maximum Voltage (Vmp) = 18 V, Maximum Current (Imp) = 1.11A, stepper motor 28BYJ-48 is used as a solar panel driver with input 5 VDC via ULN2003 motor driver for stepper motor controller unit. The microcontroller used as the main control unit in this device is the ESP12 Wemos D1 Mini, the RTC DS1307 is used as a timing unit which becomes a reference for the movement of the solar panels through a program that has been set in the microcontroller. Currently, many solar trackers have been made and developed using LDR sensors, but solar tracker systems that only use LDR sensors have shortcomings, when in cloudy weather solar trackers with LDR sensors cannot track or trace the sun properly because the sensors do not work optimally. with the light data it receives. So in this research a solar tracker was designed using the Real Time Clock method which was not affected by cloudy weather. The testing process was carried out by comparing the solar tracker system with a stationary solar panel system, called static solar. By using a solar panel with the same specifications, namely 20 WP, data collection was carried out on the same day with a testing time of 7 hours, namely from 09:00 WIB to 15:00 WIB with an interval of every 60 minutes. For the way

The work of the tool can be seen in the system flowchart below:

Figure 1. a System Flowchart

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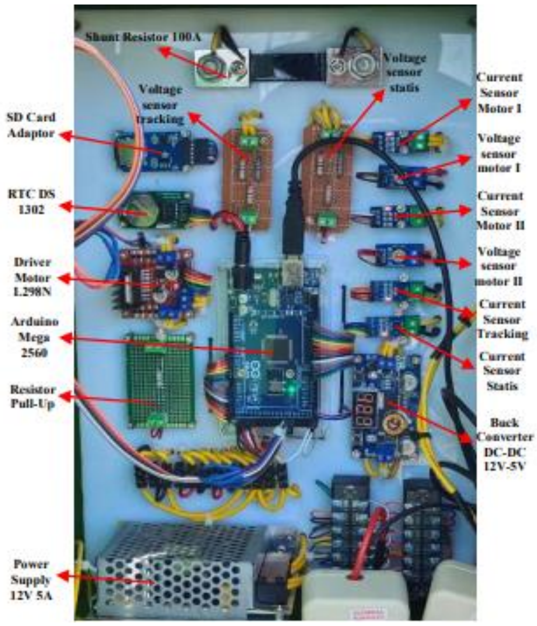

Figure 1.b System Flowchart

In the system flowchart of this tool there is a Real Time Clock (RTC) which will determine the movement time of the solar panels according to the program. In this tool the operating time is programmed from 09:00 WIB to 15:00 WIB. When the RTC shows a predetermined time, in this case every 60 minutes, it will move the solar panel to a predetermined angle. The Wemos microcontroller will send a signal to the motor driver to move the stepper motor clockwise (CW) which will cause the solar panel to move from east to west according to a predetermined angle. This process will loop until the tool operation time has finished, namely at 15:00 WIB. When the RTC shows the time 16:00 WIB, the Wemos Microcontroller will send a signal to the motor driver to move the stepper motor Counterclockwise (CCW) which causes the solar panel to move from west to east to reset the position of the solar panel at the starting point. The system will enter Sleep Mode until the RTC shows the operating time again.

However, this tool can also be controlled manually using a manual button which will move the stepper motor 15° CW in the time range from 09:00 WIB to 15:00 WIB. If the manual button is pressed outside of this time range, the stepper motor will move CCW to its original position.

Figure 2 Solar Tracker Design Results

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Figure 3. Solar Tracker Box Panel

In Figure 2 you can see the overall results of the design of the solar tracker using a light steel frame and 20 WP solar panels. Meanwhile, in Figure 3, the appearance of the panel box where all the system components are placed and the LCD as an indicator for monitoring the equipment is clearer.

4. RESULTS ANDDISCUSSION

To be able to determine the performance of the tool that has been designed, several tests and analyzes are carried out. The first data collection test is testing the stepper motor and RTC. The second test and data collection is to test the voltage, current and power output between the solar tracker and static solar.

A. Stepper Motor and RTC Testing

Stepper motor and RTC testing is carried out to find out how many steps or steps are taken by the stepper motor according to the time determined by the RTC, apart from that, you can also see the angle taken by the stepper motor as a reference for tracking in the system.

Table 1. Stepper Motor and RTC Testing

No	Testing Time (WIB)	Step	Angle Size	Direction
1	9:00	0	45°	East
2	10:00	2020	60°	East
3	11:00	3850	75°	East
4	12:00	5850	90°	Perpendicular Top
5	13:00	7690	105°	West
6	14:00	9600	120°	West
7	15:00	11450	135°	West

In Table 1 it can be seen that the movement of the stepper motor every hour is 15° with the initial position of the solar panel being 45°. At 09:00 the solar panel faces east and the device starts tracking the sun, at 12:00 the solar panel is straight up and at 15:00 the solar panel is facing west. The total steps or strides needed to cover the distance from the position at 09:00 to 15:00 is 11,450 steps.

B. Solar Tracker System Output Testing

In testing the outpus solar tracker system, data is taken every hour from 09:00 to 15:00. The form of data taken is voltage, current and power data which is measured using a multimeter and a voltage sensor installed on the tool. The following Table 2 is the test results of the solar tracker system taken on February 8 2024 in sunny, cloudy weather.

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Table 2. Solar Tracker System Output Test Results

No	Testing Time (WIB)	Great Voltage	Large Current	Big Power
1	9:00	14.6 V	0.92 A	13.4 W
2	10:00	15.0 V	0.94 A	14.1 W
3	11:00	15.2 V	0.96 A	14.6 W
4	12:00	15.8 V	0.97 A	15.3 W
5	13:00	15.5 V	0.97 A	15.0 W
6	14:00	15.4 V	0.97 A	14.9 W
7	15:00	15.4 V	0.96 A	14.7 W

In Table 2, the test results show an average voltage of 15.2 V, an average current of 0.95 A and an average power of 14.6 W.

C. Static Solar System Output Testing

Static solar system output testing is carried out by directing the solar panels 30° to the West. The following Table 3 is the test results of a static solar system taken on February 8 2024 in sunny, cloudy weather.

Table 3 Static Solar System Output Test Results

No	Testing Time (WIB)	Great Voltage	Large Current	Big Power
1	9:00	11.2 V	0.58 A	6.5 W
2	10:00	12.3 V	0.73 A	8.9 W
3	11:00	12.7 V	0.81 A	10.3 W
4	12:00	13.8 V	0.86 A	11.8 W
5	13:00	**14.7 V**	0.91 A	13.3 W
6	14:00	15.3 V	0.95 A	14.5 W
7	15:00	15.0 V	0.93 A	13.9 W

In Table 3, the test results show an average voltage of 13.2 V, an average current of 0.82 A and an average power of 11.3 W.

D. Performance Improvement

The increase in power is based on the results of measuring the voltage and current on the solar panels, then power calculations will be carried out as well as the percentage increase in electrical power produced by solar panels without a solar tracker (static) and solar panels using a solar tracker. Energy data is taken from the results of research that has been carried out later. The increase in efficiency will be calculated in the following way.

So the increase in energy performance resulting from the solar tracker system is 22.4%. Because it follows the direction of the sun's movement, the solar tracker system can absorb energy from morning to evening so that its performance can be maximized as written in the test table and graph above.

5. CONCLUSION

Based on the research and design of the equipment that has been carried out, it can be concluded that systems with solar trackers can be more efficient than systems with static solar by increasing solar energy absorption by 22.4% with a testing time of 7 hours. If the solar tracker system is used more, it will increase solar absorption performance even more

After conducting research on PV that uses a sunlight direction tracking system with the scanning for first initiation method and PV without a sunlight direction tracking system, the following conclusions were obtained.

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1) PV that uses a sunlight tracking system (Tracker) is more optimal compared to PV without a sunlight tracking system (Static). The average energy absorbed by the PV tracker is 577.47Wh with the 50 method and 529.80Wh with the 230 method, while for static PV it produces
2) The average energy is 398.65Wh with method 50 and 414.16Wh with method 230.
3) From the test results it was found that PV with a sunlight tracking system can increase the efficiency of solar panels by at least 20% on July 6 2021 and the highest on July 1 2021, namely 61%.
4) In the test results, the PV tracker is more optimal in the morning and evening. Where in the morning the difference in average panel power is 57.62Wh at 10 am and the difference in average panel power in the afternoon is 97.14Wh at 15.30 4) Motor energy consumption for driving solar panels with a sunlight tracking system is quite low namely 0.25Wh for motor I consumption and 0.91Wh for motor II, or around 0.1% and 0.3% of the total energy produced by solar panels with a sunlight tracking system.

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