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Minimum power of solar Panel Movement in Solar Tracker System Prototype

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Abstract. Population increase and economic growth lead to increased demand for world energy. With conventional energy supplies today means there is an increase in the use of fossil energy supplies and increased emissions from gases that can endanger the environment. Some renewable sources are available which can be used on a large scale to generate electricity in remote areas where electricity is available. Included in this type include sunlight, geothermal, wind, water, and so on. The amount of solar energy potential that can be absorbed depends on the area of the solar cell and the absorption capacity of sunlight. Absorption capacity can be optimized by making a control system for the solar cell's drive that will be flushed in the direction of the sun's motion so that the solar panel cells will absorb sunlight. Researchers focus on how the minimum motor power consumption, obtained from the results of the study occurred at 17:00 at an angle of 690 weight 8 kg voltage of 8.12 current 0.11.

1. Introduction

Population increase and economic growth lead to increased demand for world energy. With conventional energy supplies today means there is an increase in the use of fossil energy supplies and increased emissions from gases that can endanger the environment. If this happens continuously, our environment and future will be threatened [10].

Solar cells with technological advancements are becoming very common today. As we know, the solar cell is a device that converts sunlight directly into electricity and the advantage is that sunlight can be obtained every day freely [6]. The use of solar cells is very widespread in the world, for example the most common use in calculators and replacing the function of batteries. During the availability of light, the calculator can function forever. Most installed solar cells are still static. With this position the solar cell is not perpendicular to the sun's rays from sunrise to sunset [7]. This causes the reception of solar energy is not optimal. Therefore, it is necessary to make a system that can make the solar cell always follow the direction of the movement of the sun and at which angle has the optimum absorption of solar panels using a solar tracker [8].

By using a solar tracker is a solution to optimize the absorption of the solar panel to get a beam that is perpendicular. However, the solar tracker itself has problems with the power generated to drive the motor has a fairly large power to rotate the solar panel to always follow the movement of the sun. Therefore, in writing this thesis the author tries to provide new innovations by designing a prototype circuit for solar tracker, so that it is expected that the circuit that will be made can reduce the power load generated to drive the solar tracker motor and solar panels can produce maximum power. With
this the author takes the title "Minimum Power of Solar Panel Driving on the Solar Tracker System Prototype".

2. Research methodology
The study was conducted at the Sriwijaya Polytechnic Laboratory starting from September 2017 until July 2018. Research using a 50 wp Solar Mixeno Monocrystalline Module Module, Driving Motor, Solar Tracker. In this study researchers used a motor power drive of 0.25 Kw / year.

2.1. Research methods
The method used in this study is laboratory research to see the amount of power consumption each time to move the solar panel from 8:00 a.m. to 4:00 p.m. how much consumes power.

2.2. Research design of solar panel drives
The research carried out the design of a prototype circuit system for solar tracker, so that it was expected that it would be able to reduce the power load generated to drive the solar tracker motor and solar panels that would produce maximum power. The design of the equipment used is, Mixenoch Monocrystalline Solar Module 50wp, solar panel, drive motor, Charge Controller, Inverter, Accumulator, and Solar Tracker Shown in figure 1.

Figure 1. Solar power plant prototype.

2.2.1. Solar tracker
Solar Tracker is a device that directs payload towards the sun. The load can be solar panels, parabolic troughs, fresnel reflectors, mirrors or lenses. For flat panel photovoltaic systems, tracers are used to minimize the angle of incidence between incoming sunlight and photovoltaic panels [10]. This system increases the amount of energy generated from the amount that is still attached to the capacity of the power plant.

In the present technology Solar Tracker is divided into two systems, namely Single and Dual Axis. The main benefit of tracking systems is to collect solar energy for the longest day period, and with the most accurate alignment as the position shifts the sun to the season. In addition, the greater the level of concentration used, accurate tracking becomes more important, because the proportion of energy coming from direct radiation is higher, and the area where concentration energy is focused is smaller [5].

2.2.2. Solar panel driving motors
Stepper motors are electromechanical devices that work by converting electronic pulses into discrete mechanical movements [4]. The stepper motor moves based on the sequence of pulses given to the motor [3].
2.2.3. Driving motors (using a power window system)

Power Window is a system for electrically opening and closing windows. Power Window can work in principle as a power window to work manually and the power window works automatically. The driving motor in the power window that is used is a DC motor [1]. The driving motor rotates clockwise or vice versa which is converted into up and down motion [2].

In the use of prototypes, the Power Window system used is automatically to move the solar panels that are commanded by the solar tracking system. By using the time that has been set by the solar tracking system, the motor power window will move according to the angle of the sun that has been determined. The following power window specifications are used:

Table 1. Power window specification data used.

| Rate voltage | DC 12 volt |
|--------------|------------|
| Operating Voltage Range | DC 8 – 12 volt |
| Speed | 40 ± 5 rpm |
| Power Window Relay | 200 mA |
| Stall torque | 25 kg |

3. Results and discussion

This research was conducted to determine the power consumed by the motor to move the cell / solar panel. The results of the measurement of the power produced by the solar panel are shown in table 2.

Table 2. Measurement of solar panel power.

| Time (08.00) | Angle (Angel) | Voltage (V) | Current (A) |
|--------------|--------------|-------------|-------------|
| 08.00        | 55°          | 9.22        | 0.37        |
| 09.00        | 41°          | 12.82       | 0.50        |
| 10.00        | 27°          | 16.39       | 1.12        |
| 11.00        | 13°          | 18.79       | 1.32        |
| 12.00        | 0°           | 21.34       | 1.47        |
| 13.00        | 13°          | 19.95       | 1.62        |
| 14.00        | 27°          | 20.74       | 1.71        |
| 15.00        | 41°          | 13.79       | 1.43        |
| 16.00        | 55°          | 12.87       | 0.94        |
| 17.00        | 69°          | 11.54       | 0.53        |

After knowing the electrical power generated by the solar panel once every hour, this can measure the power calculation using a motor (power window) in moving the solar panels in a section of the cross section. Then the results of the calculation can be seen in table 3 dan 4.

Table 3. Loaded motor power calculation results data.

| Time (08.00) | Angle (Angel) | Cross Section | Output voltage | Current |
|--------------|--------------|---------------|----------------|---------|
| 08.00        | 55°          | 8kg           | 8.22           | 0.17    |
| 09.00        | 41°          | 8kg           | 8.82           | 0.43    |
| 10.00        | 27°          | 8kg           | 12.48          | 1.12    |
| 11.00        | 13°          | 8kg           | 13.79          | 1.24    |
| 12.00        | 0°           | 8kg           | 14.23          | 1.43    |
| 13.00        | 13°          | 8kg           | 12.95          | 1.31    |
In the table above, the results obtained by measuring the output voltage and current from the solar panel through a motor that drives solar panels with a load of 8kg has a maximum voltage and current occurs at 12.00 at 16.23 V and 1.29 A. So the power generated at at 12.00 at 20,937 W.

In the previous data the voltage and current of the motor has been obtained by using the load, so in the next measurement, doing the calculation with the motor without cross section load or solar panel can be shown in the following table.

| Time  | Angle | Cross section | Output voltage | Current |
|-------|-------|---------------|----------------|---------|
| 08.00 | 55    | 2kg           | 9.24           | 0.27    |
| 09.00 | 41    | 2kg           | 11.62          | 0.32    |
| 10.00 | 27    | 2kg           | 12.18          | 1.02    |
| 11.00 | 13    | 2kg           | 13.79          | 1.08    |
| 12.00 | 0     | 2kg           | 18.26          | 1.27    |
| 13.00 | 13    | 2kg           | 14.15          | 1.36    |
| 14.00 | 27    | 2kg           | 13.22          | 1.41    |
| 15.00 | 41    | 2kg           | 12.56          | 1.32    |
| 16.00 | 55    | 2kg           | 11.41          | 0.64    |
| 17.00 | 69    | 2kg           | 9.12           | 0.53    |

Then in the motor data drive without cross section load has different results in the previous data. And the data also has a maximum voltage and current at 12.00 at 18.26 V and 1.27 A. The power produced at 12.00 is 23.191 W. And can be seen in the following graph.

4. Conclusion

In a design must be considered several supporting components in conducting research. From the results of the study, it can be seen from the measurement of voltage or current that can affect the size of the voltage when driving the motor (power window), it can be seen that the minimum power consumption occurs at 17:00 at 690 8 kg weight 8.12 voltage 0.11 when the solar panel is cross sectioned.

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