Design and Optimization of Solar Panel Based on Sun Detector

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***Abstract*— Many factors cause people to be reluctant to apply solar panel technology as a source of renewable electrical energy, one of which is the efficiency level of solar panels which is still very low because the position of solar panels is generally facing in one direction. In this study, we designed a tool that can automatically drive the solar panel motor according to the comparison value obtained from the LDR sensor. There are four LDR sensors for comparison that are used as a reference tool to move towards the brightest light intensity. From this solar panel, the power will be stored in the battery which at the same time drives the motor so that the rays obtained are more optimal and faster for charging the battery. From the results of the research conducted, the energy efficiency in a day is 9 percent from normal conditions without using optimization. It is hoped that this tool can help the community to use alternative renewable energy sources that are more effective and efficient.**

***Keywords*— Detector, energy, optimization, panel, solar.**

I. INTRODUCTION

Sun is the primary source of Energy. The earth receives 16 x 1018 units of energy from the sun annually, which is 20,000 times the requirement of mankind on the Earth. Some of the Solar Energy causes evaporation of water, leading to rains and creation of rivers etc [1]. Some of it is utilized in photosynthesis which is essential for sustenance of life on earth. Man has tried from time immemorial to harness this infinite source of energy. But has been able to tap only a negligibly fraction of this energy till today. The broad categories of possible large-scale applications of solar power are the heating and cooling of residential and commercial buildings. The solar cell receives the solar energy [2]. The solar cells operate on the principle of photovoltaic effect, by using solar cells. Basically, the cells are placed in an open and fixed manner.

The increasing economy and the development of technology in Indonesia today, make the need for electrical energy supply continues to increase. System Planning Service PT. PLN (Persero) and the BPPT Energy Team project that electricity demand in Indonesia during the period 2003 - 2020 will increase by 6.5% every year. Based on these data and facts, the use of solar panels as a source of renewable alternative electrical energy is currently very limited [3].

Many factors cause people to be reluctant to apply solar panel technology as a source of renewable electrical energy, including the difficult process of installing solar panels, and the efficiency level of solar panels which is still very low because the position of the solar panels is generally facing in one direction and slightly tilted or tilted. in the direction of the roof. As is known, the efficiency level of solar panels currently only reaches the range of about 5-16% of the total solar energy that can be converted into electrical energy. Even to get a high level of efficiency (about 16%) requires high quality solar panels and expensive investment costs [4].

This causes people to be increasingly reluctant to apply renewable energy from solar panels as alternative energy. For this reason, the author has an idea to create a Solar Panel Optimization Design Tool Based on a Sun Detection System that is able to follow the movement of the sun's rays to produce more optimal energy to overcome the increasing electricity usage with easy installation, more efficiency and electricity generated from solar panels more optimally without using high-quality solar panels. It is hoped that this tool can help the community to use alternative renewable energy sources.

II. METHOD

A. Research Method

This is the method to conduct the research as shown in Fig. 1.

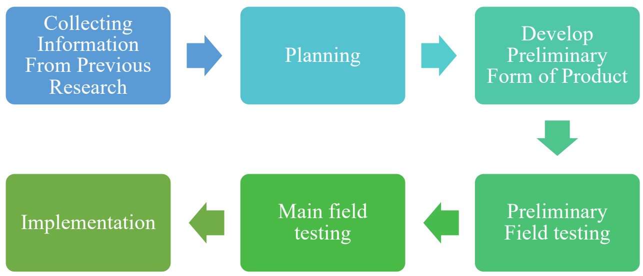

Figure 1. Research Method

- Research and information collecting, at this stage what is done is to seek information or study literature relating to the problem being studied, collect the needs of the tools to be made, from the needs of the equipment to the tools and materials to be used, and formulate a research framework.

- Planning, at this stage what is done is to plan and formulate skills and expertise related to problems, determine goals, and design the outputs to be produced.
- Develop Preliminary Form of Product, the author will make preparations for the manufacture of the tool including the main and supporting components and check the feasibility of the tool to be used.
- Preliminary Field testing, collecting data from the test results by observing the control system and then proceeding with analysing the test data. Tests carried out at this stage using white box testing and black box testing, namely testing to determine the level of product functionality generated from the commands written in the program and observing the empirical sea control behaviour [5].
- Main field testing, further testing after the tool is revised using Black box testing.
- Implementation, the product that has been made is implemented for the user.

B. Product Design

Fig. 2. is the product design that described in below

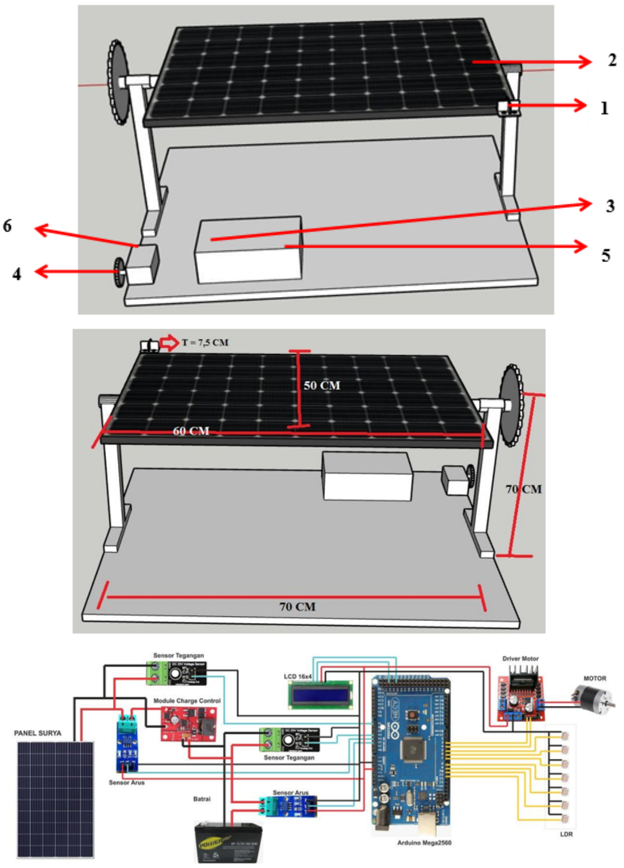

Figure 2. Design of Product

1. LDR sensor: This tool uses four LDR sensors to distinguish the light intensity from the value of the light produced by the sensor.
2. Solar panels: size 50x70 with Rated Nax Power (Pmax) 50 Watts and Open Circuit Voltage (VOC) 22.4 Volts. Used to absorb sunlight which will later be converted into electrical energy.
3. LCD: used to display the value of the voltage sensor, current sensor, LDR sensor.
4. DC Motor: this tool is a solar panel driver when the LDR sensor is exposed to sunlight.
5. Microcontroller: contains several components, especially the Arduino Mega which is used as a controller for every electronic component contained in the solar panel so that each sensor and output can run accordingly [6][7]. The sensor components in the box:
   - DC voltage sensor is used to calculate the value of the voltage that comes out of the panel and the value that goes into the battery [8]-[11].
   - Current sensor is used to calculate the current entering the battery and the current value coming out of the panel through the wire in the cable [12].
6. The 12 V battery is used to store power from the solar panels and continues to supply the motor to drive the solar panels [13]-[15].

III. RESULTS AND DISCUSSION

A. Result of Products

The following are the results of the hardware that has been made as a motor control system that is able to move the solar panel facing the optimal sunlight based on the value received from the LDR sensor. In this tool consists of several components that are connected to each other to determine the output based on the sensor of the tool. The results of the sensor readings are processed and combined into a microcontroller device as a reference.

Figure 3. Result of Product

In Fig. 3. there is a solar panel as the main role in the absorption of sunlight, and a microcontroller circuit for support a performance tool that the author made. From the microcontroller circuit, each component has its own function, the Arduino mega 2560 functions as a connection to all microcontroller components and has uses as an LDR sensor reader, Current Sensor, Voltage Sensor and setting the IBT Motor Driver to drive the Motor Power Window, adjusting the LCD display. set the time on the RTC (Real Time Clock).

Overall tool testing in the morning to evening starting at 08.30-16.30. The test is carried out every 30 minutes. Test following directions the sun starts to rise until it sets. Every time you do a test, the tool must be measured for temperature, light intensity, current, voltage, and the value of each LDR. Tests were carried out for 3 times to determine the accuracy of the related data.

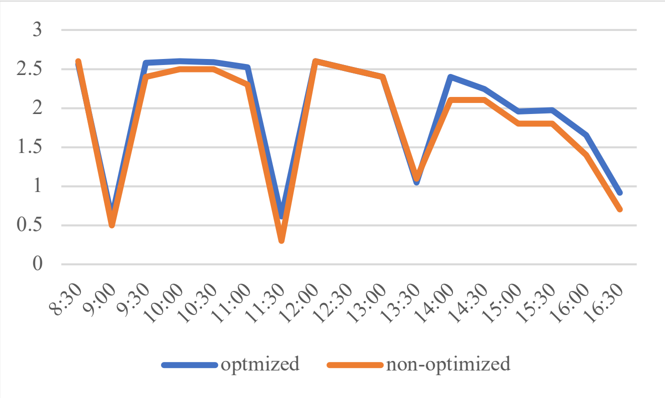

Figure 4: Comparison of current measurement between using optimized and non-optimized

As we can see in Fig. 4 that, the currents of optimize solar cell are better than non-optimized system. It is because the product moves the solar cell according the highest lux of the sun. As a result, it is produce more than 9 percent of current than non-optimized solar cell.

IV. CONCLUSION

Based on the experiment results and testing of the previous chapters, it can be concluded that with this solar panel optimization tool based on this sunlight detection system, it is easier for people to apply the use of solar panels as renewable alternative energy. Based on design and testing, this tool can work well. This is evidenced by the results of tool testing that has been carried out for 8 hours on fixed panels and moving panels. The result is different and more efficient moving panels because the voltage and current received is higher than fixed panels. The function of this LDR sensor is to capture sunlight and generate a value as a command so that the motor moves to the optimal point of sunlight. At 04.00 am the motor drives the solar panels automatically to the east. When it is 07.00-16.00, the solar panels will move to the west according to the predetermined working hours. After 16.00-04.00 the motor will stop moving the solar panels with a break command.

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