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Optimization of Solar Panel Module Positions

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ABSTRACT : The current condition of electrical energy needs each year continues to increase its use and depend on conventional energy that a time will be used up. Optimal utilization of alternative energy could increase the supply of electrical energy, especially Indonesia lot of wind and sun are not used optimally. Design of wind hybrid power generation and solar cells can increase the national electricity supply. In this study will be discussed potential power generation, solar cells as renewable power generation. Data collection was performed by changing the position of the solar panels from the east to the west movement of the sun with a change of 60, 30, 0 degrees eastward and 0, 30, 60 degrees west. As the load to determine the ability of the solar panels used 8 watt LED lamp load and 20 watts. Observations and data collection starts from 8:00 pm to 16:00 pm with data retrieval average solar intensity, voltage, current and power. At 8 watt LED lamp load obtained solar panel module position at an angle of 0 degrees with maximum power 12.64 watts, whereas for the 20 watt LED light load obtained solar panel module position at an angle of 0 degrees with maximum power 24.79 watts.

Keywords : Solar panel module, position the solar panel, maximum power.

1.0 INTRODUCTION

Climate Medan has a tropical climate, according to the Polonia station with minimum temperatures ranging from 23.0 to 24.1ºC and maximum temperatures range between 30.6–33.1ºC and according to Sampali Station minimum temperature ranges between 23.6–24.4ºC and maximum temperatures range between 30.2-32.5ºC [1]. According to NASA that the mapping of wind speed in Indonesia in general have almost the same characteristics ranging from 2.7 to 5.5 m/s, and the solar radiation an average of 46% by irradiation time 110 hours per year. The hybrid system is a potential beach with low demand [2]. Photovoltaic and batteries for hybrid wind-power generation, solar cells can charge batteries that can be stored in a long time [3]. A probability sunshine duration of 6 hours that can be used by approximately 75% PV and wind duration of 12 hours that can be used around 50% [4]. The combination of wind turbines and photovoltaic experiencing connection errors in the system, so it is necessary to overcome the synchronization tool [5]. Efficiency obtained is linear, followed by changes in temperature and decreases with the change of time [6]. Medan wind energy that can be converted into electrical energy by using the linear regression method, the amount of electrical energy produced 161.89 Watt/m^2 [7].

Solar power or solar cells are one of the promising sources in Indonesia. The energy released by sunshine is actually only received by the earth's surface by 69% of the total radiant energy of the sun. The amount of energy is equivalent to 10,000 times the energy consumption in the world today. In other words, by covering only 0.1 percent of the earth's surface by the solar cell device that has an efficiency of 10% has been able to cover the energy needs in the world today. On the bright middle of the day sun radiation is able to reach 1000 Watt/m². If a semiconductor device 1 m² has an efficiency of 10%, the solar cell module is capable of providing electrical power of 100 Watts. Currently the module efficiency of commercial solar cells ranged between 5-15%, depending on the constituent materials. Sunlight energy in Indonesia has very large potential for solar energy with an average daily insolation 4.5 to 4.8 kWh/m²/day. The potential of wind energy and solar energy is very good to be the alternative energy. Based on the solar radiation can be written as follows:

$$I_{tt} = I_{bt} + I_{dt} + I_{rt} \quad (1)$$

Where
I_{tt} = total radiation;
I_{bt} = radiation beam;
I_{dt} = diffuse radiation;
I_{rt} = radiation atmosphere

Power capacity of solar cell modules can be calculated by taking into account several factors, namely the energy needs required system, solar insolation, and the adjustment factor (adjustment factor). Adjustment factor in most solar installations is 1.1 (Mark Hankins, 1991 Small Solar Electric System for Africa page 68), so that the magnitude of the power capacity of solar modules are produced:

$$\frac{E_T}{insolasi\ sunlight} x adjusment\ factor \quad (2)$$

Batteries are the energy storage device in the form of electrochemical which are widely used to store energy for a variety of applications, and can be used up energy reserves. Equivalent circuit simplest battery shown in figure 1, in which consists of a voltage source in series with obstacles. From this figure, the voltage at the battery terminals (V_{bat}) is expressed by;

$$V_{bat} = V_0 - R_i i_b(t) \quad (3)$$

Where V_o is the internal voltage of the battery, and R_i is the internal resistance of the battery, and $I_b(t)$ is the current flowing from and to the battery. In this study, if the battery is used (discharge), the current i_b is positive (+), and if the

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battery is charged (charge), the current ib negative sign (-). The energy stored ($e_{bat}(t)$) is:

$$V_{bat}(t) = V_{bat\_init}(t) - \int V_{bat} i_b(t) dt \quad (4)$$

Where E_{bat_init} is the initial energy of the battery.

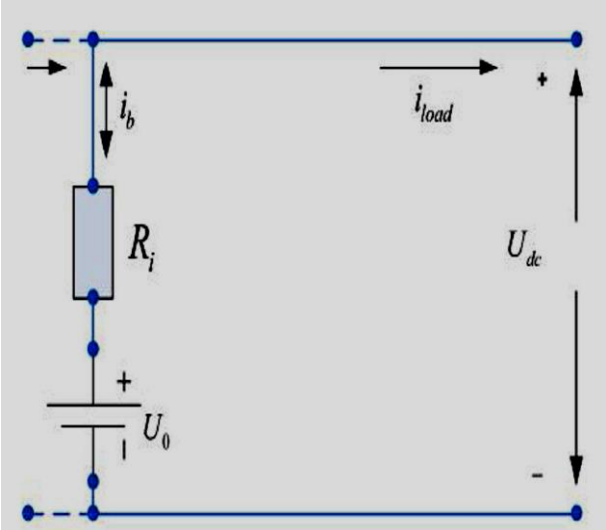

Fig 1. Equivalent circuit Lead-Acid Battery

2.0 RESEARCH METHOD

The experimental method used in this study tested a solar panel module with loading to determine the intensity of the sun, voltage, current and power. Data collection was performed on the solar panel module starts from 8:00 pm until 16:00 by changing the position of the solar panels, in this research, changes in the position of the solar panels toward the sunrise (east) at an angle of 600, 300, 00, and further changes from the direction of of sunset (west) at an angle of 00, 300, 600. To obtain parameter data observations, solar panel module loaded with 8 watt LED lights and LED lights 20 watts.

Loading on the solar panel with 8 watt LED lamp load produce optimal power an average of 12.63 watts solar panel module position 0 degrees towards the horizontal axis, and loading with 20 watt LED lamp produces optimum power at 24.79 watts in panel module position solar 0 degrees toward to the horizontal axis.

The results of measurements of solar panel modules do change positions starting from the east and west with a load of 8 watt bulbs and LED 20 watt load are shown in Table 1.

TABLE I
Results of measurement of the average solar panel module

LED Load 8 watt				
PV Position	**Average**			
EAST Direction	**Solar irradiance (Lux)**	**V load (Volt)**	**I load (A)**	**P load (Watt)**
60	59.077,8	17,90	0,65	11,64
30	65.400,0	17,89	0,66	11,81
0	55.055,7	18,57	**0,68**	**12,63**
WEST Direction	Solar irradiance (Lux)	V load (Volt)	I load (A)	P load (Watt)
0	55.055,7	18,57	**0,68**	**12,63**
30	54.222,2	18,26	0,64	11,69
60	58.011,1	18,39	0,65	11,95
LED Load 20 watt				
PV Position	**Average**			
EAST Direction	**Solar irradiance (Lux)**	**V load (Volt)**	**I load (A)**	**P load (Watt)**
60	46.911,1	16,15	1,30	21,00
30	51.544,4	18,58	1,30	24,15
0	58.133,3	18,64	**1,33**	**24,79**
WEST Direction	Solar irradiance (Lux)	V load (Volt)	I load (A)	P load (Watt)
0	58.133,3	18,64	**1,33**	**24,79**
30	42.666,7	18,26	1,31	23,92
60	57.944,4	18,17	1,30	23,62

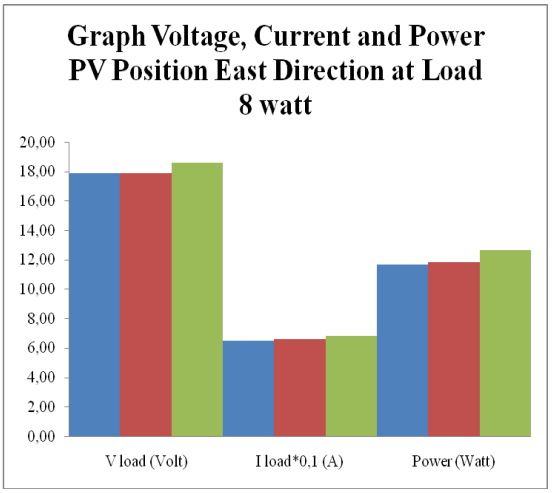

Fig. 2. The voltage, current and power on position towards the east

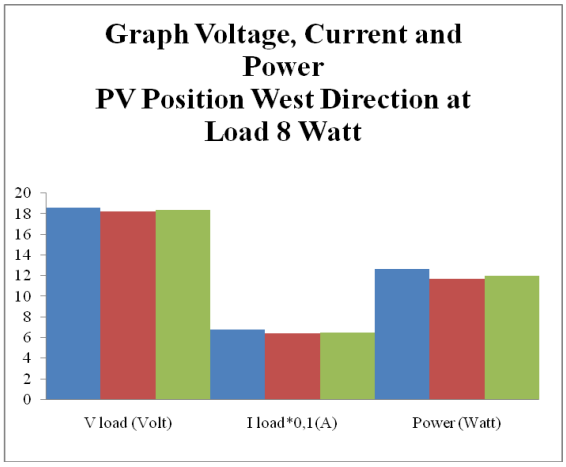

Fig. 3. The voltage, current and power on the position of West

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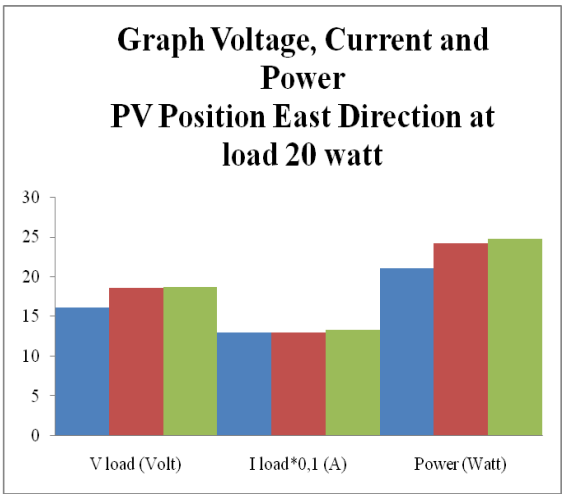

Fig. 4. The voltage, current and power on the position of the east

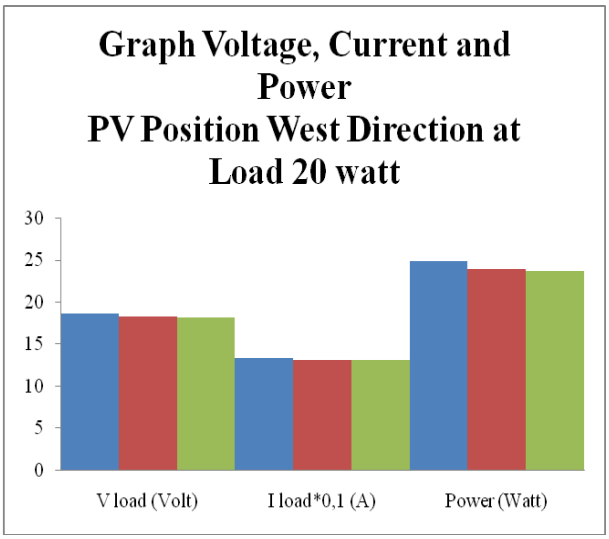

Fig. 5. The voltage, current and power on position towards the east

Based on the measurement data module, solar panel module with a capacity of 100 Wp (Watt peak) with 8 watt LED lamp load and 20 watts, it can be seen that the solar panels generate power modules minimum at a position angle of 60 degrees the east and produce maximum power at the position angle of 0 degrees horizontal axis. At 8 watt LED light load, the magnitude of the average intensity of the sun the east 59844.5 lux, while the average intensity of the sun the west 55 763 lux, the magnitude of the average stress the east 18.12 volts, while the average voltage of 18.41 volts the west , the magnitude of the average flow the east 0.66 amperes, while the average current of 0.66 amperes the west, the magnitude of the average power the east 12.02 watts, while the average power 12.09 watts the west. In the 20 watt LED light load, the magnitude of the average intensity of the sun the east 49 237 lux, whereas the average intensity of the sun the west 52 915 lux, the magnitude of the average stress the east 18.12 volts, while the average stress the west 18.41 volts, the magnitude average flow the east 1.31 amperes, while the average current of 1.31 amperes the west, the magnitude of the average power the east 23.24 watts, while the average power 24.11 watts the west.

3.0 CONCLUSION

The positioning modules solar panels on the most optimally capacity of 100 Wp solar panel module with 8 watt LED lamp load and 20 watts are in a position of 0 degrees on the horizontal axis.

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