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The Use of Solar Panels as an Alternative Energy the Performance of DC Water Pumps for Agriculture

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ABSTRACT

This study designs a system that is used to spray mushroom plants automatically with a timer module. The work of the tool starts when the solar panel produces electrical energy whose voltage and current are controlled by the controller during the battery charging process from 07-00 to 17.00. When the load is used for a certain period of time, the digital timer module will signal the relay to supply electric current to the water pump load and cut back the electric current to the water pump. The PLTS system is designed so that it can be used to help watering mushroom farmers regularly every day. Based on the testing of the tools that have been carried out, data obtained that charging the battery using solar panels takes about 5-7 hours. in sunny conditions. In sunny conditions the highest light intensity of 7450 lux can produce 4.01 watts of power, 13.25 V voltage, and 0.30 A current. The duration of watering time is 1 minute using a DC water pump and requires 1 liter of water and an input current of 1.72 A. This study designed a system used to spray fungal plants automatically with a timer module. The work of the tool begins when the solar panel produces electrical energy whose voltage and current are controlled by the controller during the battery charging process from 07-00 to 17.00 hours. When the load is used at a certain time span the digital timer module will give a signal to the relay to flow electric current to the water pump load and cut off the electric current back to the water pump. The solar power plant system is designed to be used to help localize mushroom growers regularly every day. Based on the testing of the tool that has been carried out, data were obtained that the charging of the battery using solar panels is about 5-7 hours. in sunny conditions. In bright conditions the highest light intensity of 7450 lux can produce 4.01 watts of power, a voltage of 13.25 V, and a current of 0.30 A. Watering time duration is 1 minute using a DC water pump and requires 1 liter of water and an input current of 1.72 A.

1. Introduction

The use of electrical energy that uses diesel fuel. It can have an impact on global warming at an alarming level, followed by a significant increase in electricity prices. This problem requires more attention from the government and the private sector to work together to find a solution [1][2]. DC power source that can be used as a means of storing electricity obtained from solar panels. Since the source of energy by solar panels relies heavily on sunlight, a large amount of electrical energy is generated and stored in batteries when the amount of solar radiation is high [3]. This stored electricity

can be used at night with low solar radiation. The battery component is called an accumulator, commonly used in solar applications is a maintenance-free lead-acid battery [4].

Mushroom cultivation is not new to Indonesian society in general. Our hot climate country with high humidity is an ideal condition for the growth of various types of fungi [5]. One of the processes of treatment of fungal plants is water spraying. To regulate the temperature and humidity can be done by spraying indoor water. The process of spraying the fungus in general should follow the path of the plant using a sprayer sling or hose. Of course, this can make mushroom farmers tired and take a long time. According to these problems, this study aims to develop the effectiveness of watering water on fungal plants [6][7].

This research will develop the use of solar panels as alternative energy in DC water pumps for automatic watering of mushroom cultivation with a timer module in the Pandan Saren area RT 02, RW 01, Hargobinangun, Pakem, Sleman. The development of this DC water motor uses 50W p solar cells as a source of electrical energy [8].

2. Method

2.1. System Design

The system used in the use of solar panels as an alternative energy for the performance of DC pumps for watering plants. Mushroom farming as an alternative energy supply of electrical energy to DC water pumps uses an automatic watering system with a digital timer and battery charging using solar panels. At the system design stage there is hardware design including the manufacture of an automatic watering system with a digital timer sourced from 50wp Solar Panel electrical energy using MPPT 5A Solar control panels can be seen in Fig. 1 [9][10].

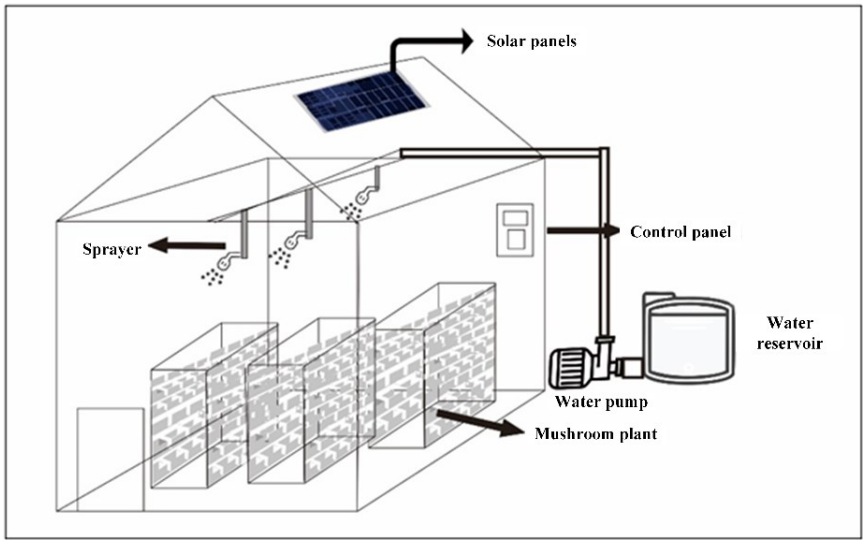

Fig. 1. Design tools

2.2. Hadware Planning

Hardware design of the DC water pump work system which serves as watering plants and processing data that is read from each measurement. The block diagram of the system designing tool can be seen in Fig. 2.

The explanation of the tool block diagram is that a system is created for spraying Mushroom plants automatically with a timer module. The way the tool works is that it starts when the solar panel emits electrical energy which will then be controlled voltage and current by the solar controller. In the safety section, the solar controller voltage and flowing current will cut off automatically according to the battery requirement voltage of 14.00. At the time of the watering process at 09.00 the digital timer module gives a signal to the relay to open the electric current to the water pump load and cut off the electric current back to the water pump for 1 minute.

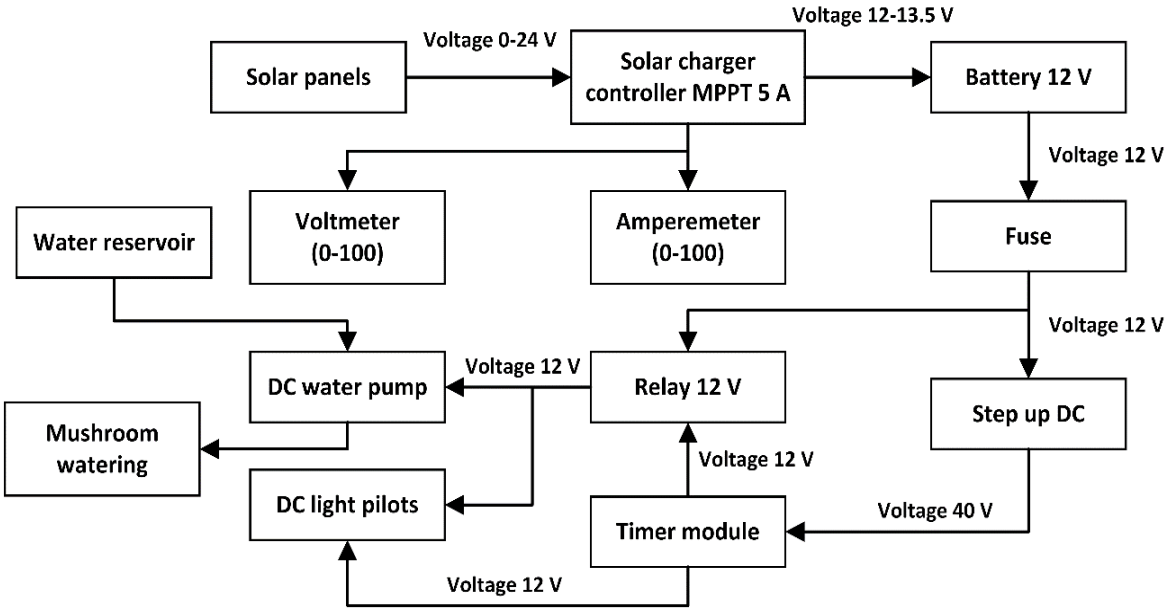

Fig. 2. Block diagram tool

The sun illuminates the solar panels, then the sunlight is converted into electrical energy. The solar charge controller limits the voltage and current flowing into the battery, then the battery will provide electrical energy to drive the high pressure pump which is controlled by a digital timer according to the time needed when watering the mushrooms. The PLTS system is designed so that it can be used to help watering mushroom farmers regularly every day and can be seen in Fig. 3 [11][12].

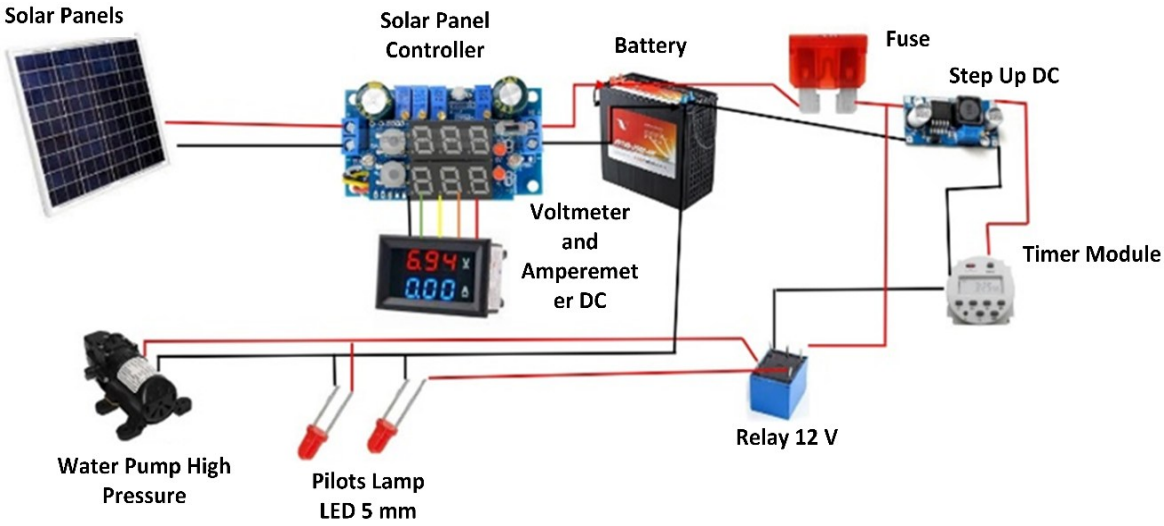

Fig. 3. Overall system set

2.3. System Flowchart

The flowchart shown in Fig. 4 is a work program for a water pump that is sourced from solar panel electrical energy. Starting from charging the battery with a time range of 07.00-17.00 using solar panels as a control. To set the on and off time of the water pump using a digital timer module according to a predetermined time.

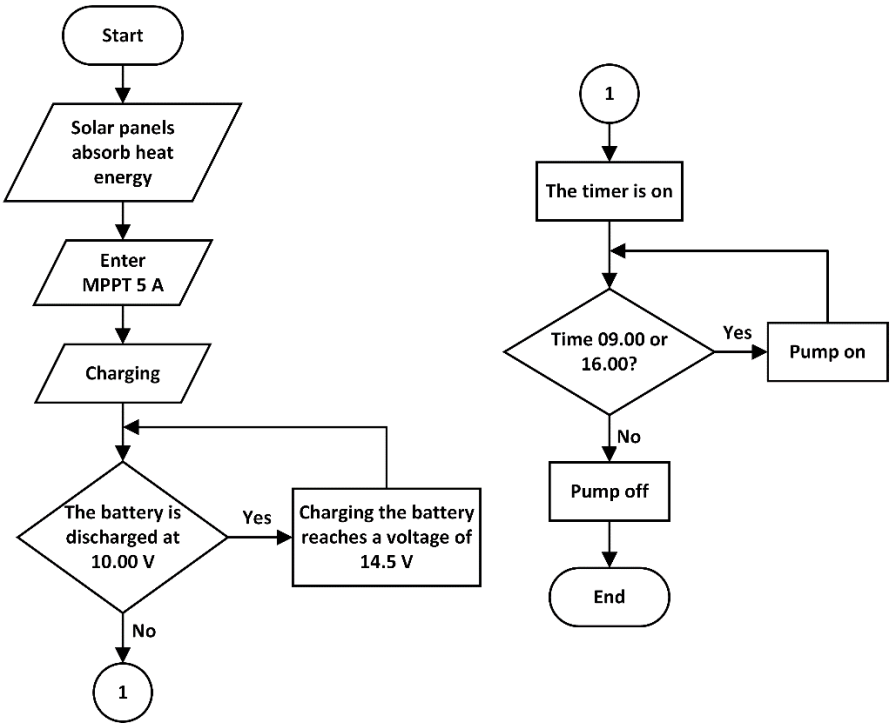

Fig. 4. Flowchart system

3. Results and Discussion

3.1. Tool Manufacturing Results

The result of making the tools used is assembling all the tools that have been assembled into one. There are solar cells as an energy source that converts solar energy into electrical energy. The energy generated by the solar panel is channeled to the control panel which consists of a solar control panel to limit the charging current of the battery by the solar panel, a 12 V battery used to store electric power, and a water pump control device using a digital timer. Monitoring voltage and current using a voltmeter and ammeter. The display of the results of making the tool can be seen in Fig. 5.

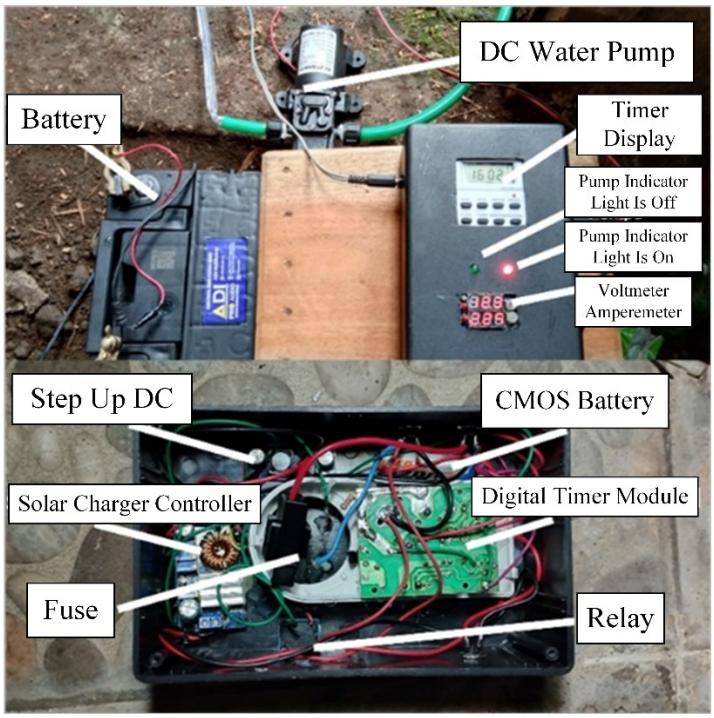

Fig. 5. Design tools

The working principle of the automatic sprinkler starts from the solar panel converting heat energy into electricity which will be stored in the battery. To limit the voltage when charging the battery using a solar control panel. We set the timer according to the desired time, namely at 09.00 and 16.00 the pump will turn on, within 1 minute then it will turn itself off.

3.2. Solar Panel Data Retrieval

Analysis of the possibility of generation is carried out by measuring the state of light insulation. the sun and the absorption ability of solar cells. Measurement data taken in the form of current and voltage data from charging the battery and pump when used for watering is done in the morning and evening at 07.00 - 17.00 WIB. The results of the data from measurements of voltage, current, and power were taken five days in different weather, namely hot, cloudy and rainy weather.

Table 1 shows the results of charging the battery by the solar panel on the first day. It is known that the highest charging was at 11.00 WIB with a current of 1.12A, a voltage of 12.95 V, and a light intensity of 68500 lux in hot weather conditions. For the smallest current of 0.7 A and a voltage of 13.20 V at 17.00 WIB. The average charging time from 07.00-17.00 WIT is 0.41 A with a voltage of 12.77 V.

Table 1. Measurement data of battery charge by solar panels on day 1

Day	Parameter	Time Variation											Average
		07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	
1	V	11.33	12.15	12.50	12.85	12.95	13.20	13.25	13.28	12.85	12.90	13.20	12.77
	A	0.23	0.27	0.32	0.48	1.12	0.54	0.30	0.20	0.13	0.18	0.7	0.41
	W	2.66	3.45	4.03	6.23	14.5	7.20	4.01	3.18	1,67	2.32	9.24	5.32
	Lx	32867	42600	54000	66700	68500	734000	754500	63400	54500	32400	15800	174478.82

Table 2 shows the results of charging the battery by solar panels on the second day. It is known that the highest charging was at 11.00 WIB with a current of 0.69 A, a voltage of 13.48 V, and a light intensity of 59000 lux in cloudy weather conditions. For the smallest current of 0.2 A and a voltage of 13.02 V at 17.00 WIB. The average charging from 07.00-17.00 WIT is 0.35 A with a voltage of 13.13 V.

Table 2. Measurement data of battery charging by solar panels on the 2nd day

Day	Parameter	Time Variation											Average
		07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	
2	V	12.20	12.95	13.22	13.25	13.48	13.52	13.21	13.31	13.32	13.00	13.02	13.13
	A	0.25	0.30	0.67	0.68	0.69	0.52	0.38	0.39	0.15	0.05	0.02	0.35
	W	3.13	3.85	8.92	9.01	9.39	7.09	5.04	5.23	2.06	0.65	2.60	5.18
	Lx	21200	32500	45200	57900	59000	67800	44500	43200	42300	33500	12900	208645.45

Table 3 shows the results of charging the battery by solar panels on the third day. It is known that the best charging is at 10.00 WIB with a current of 0.90 A, a voltage of 12.90 V, and a light intensity of 59000 lux in cloudy weather conditions. for the smallest current of 0.3 A and a voltage of 13.70 V at 17.00 WIB. The average charging time from 07.00-17.00 WIT is 0.37 A with a voltage of 12.18 V.

Table 3. Measurement data of battery charging by solar panels on the 3rd day

Day	Parameter	Time Variation											Average
		07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	
3	V	11.20	11.95	12.4	12.90	13.78	13.81	13.82	13.84	13.85	13.44	13.70	12.18
	A	0.13	0.40	0.70	0.90	0.29	0.27	0.26	0.25	0.24	0.20	0.3	0.37
	W	1.45	4.78	8.68	11.61	3.99	3.72	3.59	3.46	3.24	2.68	4.11	4.66
	Lx	32100	34500	41900	23100	34100	32767	28600	16700	22300	21000	11200	68188.36

Table 4 shows the results of charging the battery by solar panels on the fourth day. It is known that the highest charging was at 08.00 WIB with a current of 0.3 A, a voltage of 12.01 V, and a light intensity of 26000 lux in cloudy weather conditions. At 10.00 WIB in rainy weather the light intensity was 17600 lux, a current of 0.4 A and a voltage of 12.40 V were obtained.

Table 4. Measurement data of battery charging by solar panels on the 4th day

Day	Parameter	Time Variation											Average
		07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	
4	V	11.60	12.01	12.33	12.40	12.50	13.30	13.40	13.70	13.82	13.88	14.00	12.99
	A	0.15	0.38	0.24	0.4	0.29	0.24	0.23	0.22	0.21	0.2	0.1	0.24
	W	1.74	4.56	23.95	4.96	3.62	3.19	3.82	3.01	2.90	2.77	1.4	3.17
	Lx	2600	34500	24500	17600	27800	25400	14300	15600	11700	13600	10200	353354.91

Table 5 shows the results of charging the battery by solar panels on the fifth day. It is known that the highest charging was at 11.00 WIB with a current of 1.14 A, a voltage of 13.40 V, and a light intensity of 57800 lux on drizzly cloudy weather.

Table 5. Measurement data of battery charging by solar panels on the 5th day

Day	Parameter	Time Variation											Average
		07.00	08.00	09.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	
5	V	12.01	12.30	12.90	13.00	13.40	13.90	13.20	13.40	13.50	13.51	13.55	13.15
	A	0.90	0.47	0.91	0.94	1.14	0.67	0.70	0.30	0.20	0.4	0.5	0.55
	W	10.8	5.781	11.73	12.22	1527	9.313	9.24	4.02	2.7	5.40	6.77	8.477
	Lx	24500	23200	36700	38900	57800	34200	37900	21900	22400	19800	13030	229600.00

The graph shown in Fig. 6 is a graph of data collection for five days from different weather conditions, namely hot, cloudy and rainy. With a light intensity of 50000-80000 lux in hot conditions, overcast conditions 20000-30000 lux. Get the similarity value of the voltage value at 12.00 and the difference in values during testing on the graph. when conditions are hot, the battery charge reaches a maximum voltage of 14.00 V.

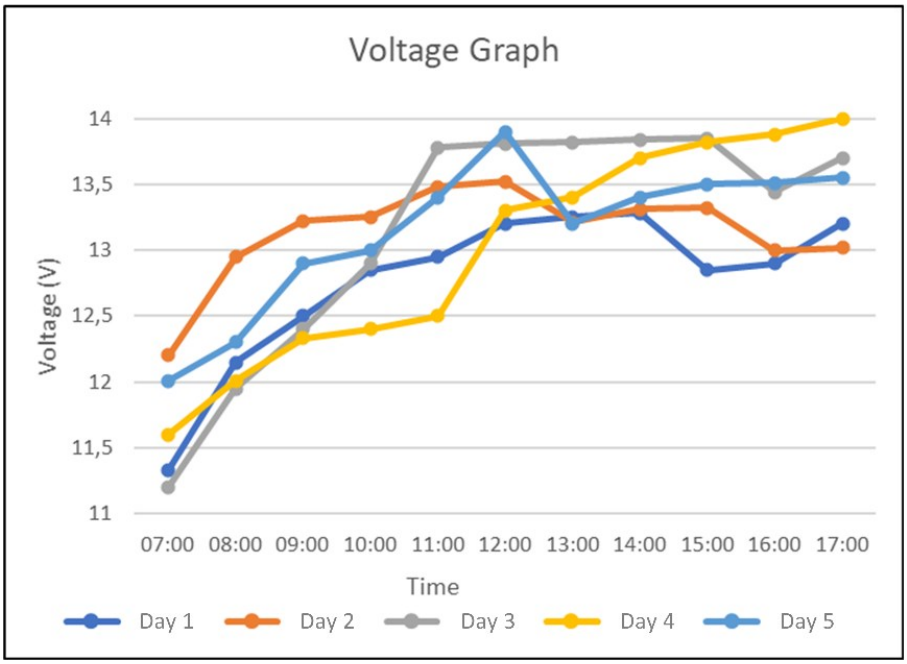

Fig. 6. Voltage graph

The graph shown in Fig. 7 is a graph of the flow of data collection for five days from different weather conditions, namely hot, cloudy and rainy. With a light intensity of 50000-80000 lux in hot conditions, overcast conditions 20000-30000 lux. The highest current value similarity was obtained on the first day at 11.00. The graphical form is clearly visible in the time range 13:00 to 16:00 when the current stops to control the charging of the storage at full capacity. Then it will rise again when the battery runs out.

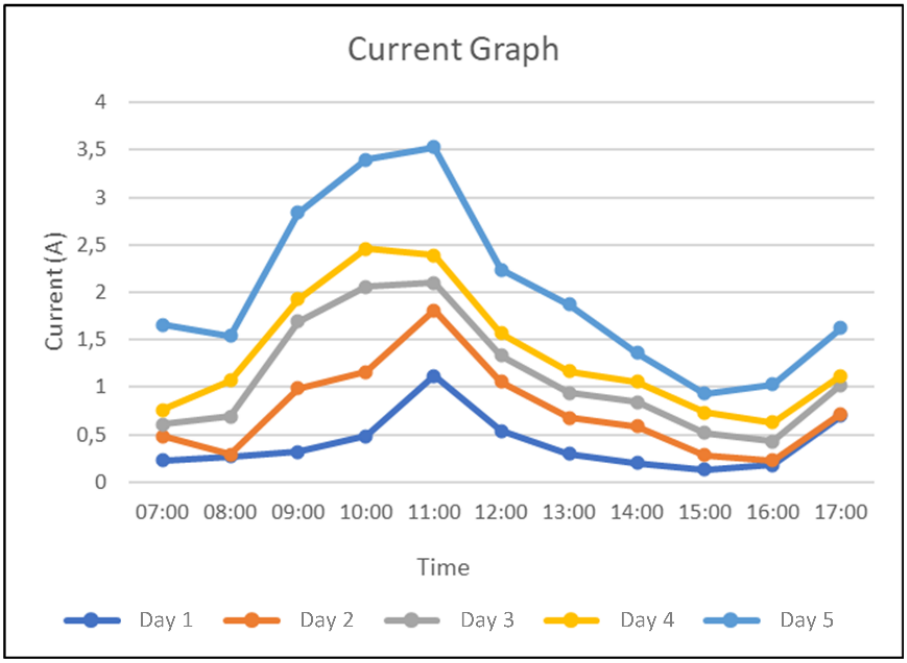

Fig. 7. Current graph

In the graph shown in Fig. 8 is a graph of power data obtained by solar cells. The form of the power graph produces the maximum power at 11:00 on the first day with a power of 15.27 W. For the smallest power on the third day with a power of 3.99 W.

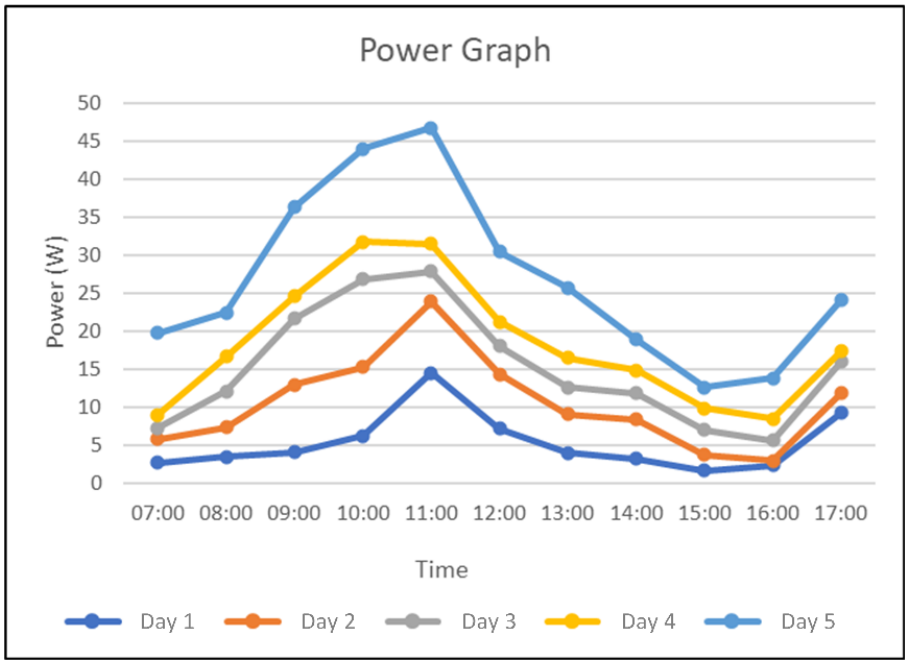

Fig. 8. Power graph

3.3. Water Pump Test Results

In Table 6 Testing the water pump when the water pump is running has an average voltage of 12.50 V and a current of 1.60 A. Meanwhile, when the pump is running without a load of water it has a current of 0.64 A and a voltage of 13.96 V. To calculate the number debit the water released with a volume of 2 liters in the holding tank with equation (1-3).

$$Volume = 2\ liters = 2000\ mililiters \quad (1)$$

$$Water\ filling\ time = 1\ minute = 60\ seconds \quad (2)$$

$$Discharger = \frac{2}{60} = 0.33\ liter = 33\ ml/second \quad (3)$$

Table 6. Pump test monitoring data at the time of watering

Day	Time	Voltage (Volt)	Current (Ampere)	Power (Watt)	Length of time	Water volume	Water discharge
1	09.00	12.10	1.60	19.36	1 minute	2 liters	33 ml/sec
	16.00	12.20	1.72	20.98	1 minute	2 liters	33 ml/sec
2	09.00	12.57	1.63	20.48	1 minute	2 liters	33 ml/sec
	16.00	12.68	1.70	2.155	1 minute	2 liters	33 ml/sec
3	Pump Off	12.90	0.00	0.00	-	0	0 ml/sec
4	No Water load	13.96	0.64	8.934	-	0	0 ml/sec

Based on the testing of the tools that have been carried out, data is obtained that when charging the battery using solar cells starting at 07.00, the average battery charge is full at 15.00-16.00. Battery charging takes about 5-7 hours in bright conditions. In the second day data table, it is written that within 1 hour, the current from the battery has increased by 0.4 A-1.14 A. Even at 17.00, the maximum voltage on the battery was recorded as 14.00 V. When testing the DC water pump, it was carried out at the same hour. different, that is, at 09:00 it has a voltage of 12.10 V and a current of 1.60 A. Meanwhile, at 16.00 it has a voltage of 12.20 V and a current of 1.72 A with a duration of 1 minute of running time of the pump in watering.

4. Conclusion

Based on the results of the research and discussion that has been done, the following conclusions can be drawn. Has succeeded in designing a system using solar panels as an alternative energy for DC water pump performance for agriculture. Researchers use a solar control panel MPPT 5A on a system using solar panels as an alternative energy for DC water pump performance. When the battery is full, reaching a certain voltage, the solar charging controller will cut off the current flowing in the battery. During the test, the average voltage value measured on five days was the highest, which produced a voltage of 14.00 V in sunny weather. The more the heat intensity of sunlight increases, the output current (power) of the solar panels stored in the battery increases.

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