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Power Supply System In Smart House Modeling With Solar Cells

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ABSTRACT

The development of science and technology is increasingly rapid, as are developments in the world of electronic technology. A lot of equipment that works with electronic systems. Solar cell technology is one of the technological developments. This solar cell technology is expected to reduce dependence on the provision of resources from the government. The solar cell system, which is equipped with an electronic system as a supporting device, such as detecting the position of sunlight and controlling battery charging, can increase the efficiency of the system's work. In this supply system using a Photovoltaic (PV) module. This solar cell will convert solar energy into electrical energy. This system is equipped with a battery charging system. This system is equipped with a light position detector. This light position detector will look for the origin of the light source, in this case the light source in question is sunlight. The solar cell will rotate according to the position of the light (in this case the light source is sunlight) with a light position detection device. This light position detector will rotate the solar cell from east to west and from north to south. The direction of rotation of this solar cell depends on the light source (the light source in this case is sunlight). As for this battery charging system, it will charge 12V batteries from solar cells. This light position detector will rotate the solar cell from east to west and from north to south. The direction of rotation of this solar cell depends on the light source (the light source in this case is sunlight). As for this battery charging system, it will charge 12V batteries from solar cells. This light position detector will rotate the solar cell from east to west and from north to south. The direction of rotation of this solar cell depends on the light source (the light source in this case is sunlight). As for this battery charging system, it will charge 12V batteries from solar cells.

Keywords:
solar cells, electrical energy, light, solar energy

INTRODUCTION

The available sunlight has many benefits, including for the drying process. Utilization of sunlight is increasingly being increased, one of which is as a supplier of resources[1]. The development of science and technology is increasingly rapid, as are developments in the world of electronic technology[2]. A lot of equipment that works with electronic systems. One example of technological developments in the field of electronics is the number of tools that initially worked manually and were replaced with automatic systems. With the development of this technology, it can reduce operating costs from simple equipment to sophisticated equipment[3].

Solar cell technology is one of the technological developments. This solar cell technology is expected to reduce dependence on the provision of resources from the government. The solar cell system which is equipped with an electronic system as a supporting device, such as detecting the position of sunlight and controlling the charging of the battery can increase the work efficiency of the system.[4].

In this solar cell system using Photovoltaic (PV) modules[5]. This solar cell will convert solar energy into electrical energy. This electrical energy can be used to meet the needs of providing energy sources[6]. This solar cell system is equipped with a battery charging voltage limiter. This battery charging voltage limiter makes the energy storage used safer and more durable[7]. This system is equipped with a light position detector. This light position detector will look for the origin of the light source, in this case the light source in question is sunlight[8].

METHOD

The power supply system that uses solar cells consists of several parts, namely: light source, light position detector, battery charging system, power storage and voltage regulator.
The function of each part is as follows:

a. Solar Cells. Serves to convert solar energy into direct current electricity.
b. Battery Charger. Serves as a controller in the process of charging the battery from the solar cell so that it does not exceed the limits of charging the battery.
c. Power Saver. Serves to store energy that has been converted by solar cells.
d. Voltage Regulator. Serves to lower the voltage from the battery.
e. Light position detector. Serves to detect the position of light, in this case the light source is sunlight.

The type of solar cell that will be used is amorphous silicon which has the characteristics of maximum output power (D(peak)) = 6.5 Wp. The maximum open circuit output voltage (Voc) = 20 V and the open circuit current (Ioc) = 0.5 A.

In the design of this battery charger using a Darlington pair as a passing transistor. When fully charged, the battery has a maximum voltage of 13.8 V. This voltage is used as the output voltage (vout). So the potential value that meets the minimum value is 1K□. The type of pass transistor Q3 is 2N3055. This transistor has□ dc = 50, while for transistors Q1 and Q2 are type 2N3904 which has □ dc = 100.

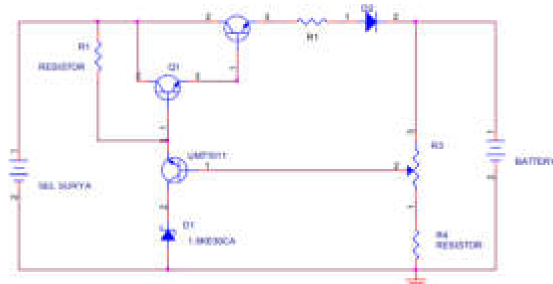

Figure 1 Battery Charger Circuit

The power storage design uses a 12 V lead battery. This dry battery has a maximum voltage of 13.8 V, so it is necessary to use a zener diode with an output voltage of 13.8 V, or by using two zener diodes with each voltage of 8 ,2 V and 5.6 V. Input from the positive (+) pole of this battery comes from the NO (No Connection) leg of the relay box.

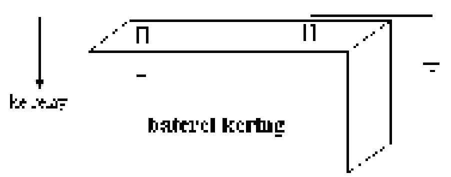
Figure 2 Storage Power Supply With Dry Battery

The voltage regulator circuit is shown in Figure 3 below.

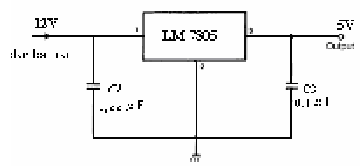

Figure 3 Voltage Regulator Circuit

IC regulator used is LM 7805. The output voltage of this regulator is +5 V. The value of the capacitor at the input pin 1 is 0.22 F and the capacitor at the output pin 2 is 0.1F. The values for these capacitors are usually listed on the datasheet.

This light detector consists of several parts, including: light sensor, differential amplifier, power amplifier, drive. The light position detection box diagram with four light sensors (LDR), namely: S1, S2, S3 and S4. The light sensor used is LDR. This LDR will convert light into electrical quantities. LDR has obstacles 1 m when it is dark and the resistance value will decrease when it is in a bright place.

The resistance value of this LDR will vary depending on changes in the intensity of the light hitting it. The change in the resistance value of the LDR is inversely proportional to whether or not the light hits it, the brighter the light hits it, the smaller the resistance of the LDR and vice versa. Changes in the value of this resistance will result in a change in the voltage across the LDR. Figure 4 shows a light sensor circuit that uses two light sensors / LDR. The value of V_Out will vary as the VLDR changes.

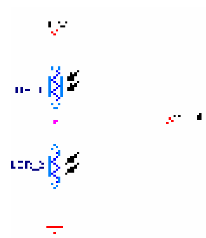

Figure 4 Circuit of Two LDR Sensors

The outputs of V_o1 and V_o2 have a difference, which will then be included in the comparison. This comparator will compare the two voltages between V_In and UTP or LTP. The comparison uses the LM 358 operational amplifier.

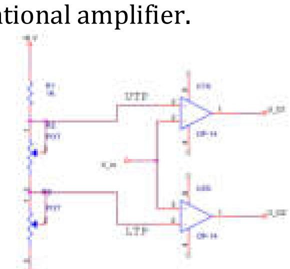

Figure 5. Comparison Circuit

The output of this comparator becomes the input to the motor rotation direction controller. This comparison circuit uses IC Op-Amp LF 358. If the voltage V_in is greater than UTP, then the Op-Amp that works is the lower Op-Amp. In this state V_o2 has a voltage while V_o1 has no voltage. If V_in is smaller than LTP then the top Op-Amp is working, then V_o1 will have a voltage value, while the voltage on V_o2 is zero.

The DC motor rotation direction controller used here is IC L293D. This IC is capable of driving a DC motor with an output current reaching a maximum level of 1.2 A. and only with a minimum input current of 0.1 mA for a high value input (high). All of these values are contained in the datasheet of each component. DC Motor Rotation Direction Control Circuit Using IC L293D.

The DC motor will rotate to the right if input 1 to the driver is 6.99 V and input 2 is 5.8 V. The DC motor will rotate to the left if input 1 is 5.88 V and input 2 is 6.99 V. The motor will silent if both inputs are rated at 6.99 V or 5.8 V. The same is true for the second DC motor.

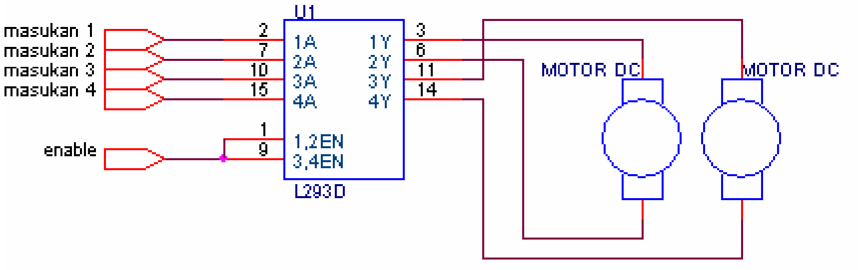

Figure 6. DC Motor Rotation Direction Control Circuit Using IC L293D

RESULTS AND DISCUSSION

Based on the data (max) obtained, the max voltage generated is +18 V and the current is 450 mA. This solar cell has a size of 25 cm x 25 cm, so the conversion efficiency is: = 34.105%. With an efficiency of 34.105%, it shows that solar energy which is converted into electrical energy is 34.105% of all solar energy captured by solar cells.

While the data contained in the solar cell voltage is +20 V, the current is 500 mA and the power is 6.5 Watt. From this comparison there is a difference, but this difference is not too big in value. When the solar cell is blocked, the voltage will drop as well as the current. The voltage generated when the solar cell is blocked is + 4.5V and the current is 120 mA.

Table 1. Data When Solar Cells Are Blocked

Test	Current (mA)	Voltage (V)
1	120	4.4
2	119	4.6
3	122	4.6

Observations on the battery charging section are changes in battery current and voltage during the battery charging process. Data from observations on the battery charging circuit can be seen in table 2.

Table 2 . Observational data on the battery charging system

No.	O'clock	Charging Current (mA)	Battery Voltage (V)	Time (minutes)
1.	09.00	450	0	0
2.	09.30	400	1	30
3.	10.00	355	2	60
4.	10.35	305	3	95
5	11.05	272	4	120
6	11.30	240	5	145
7	11.55	221	6	165
8	12.30	210	7	200
9	13.05	176	8	235
10	13.30	155	9	260
11	14.00	123	10	290
12	14.30	110	10.5	320
13	15.00	90	11	350
14	15.20	75	11.5	370
15	15.45	62	12	390
16	09.40	60	12	390
17	10.33	47	12.5	445
18	11.50	40	13	522
19	13.20	35	13.5	612

20	14.55	0	13.7	707

From table 2 it can be seen that the relationship between battery voltage and battery charging current is inversely proportional. When the battery voltage reaches the maximum value, the battery charging current is zero. Meanwhile, when the battery voltage is zero, the battery charging current reaches its maximum value. In this test, the battery used is a +12 Volt dry battery. This battery will reach its maximum state at a voltage of +13.8 Volts. From this test, the battery voltage when empty, the voltage is zero, and this voltage will increase until it reaches the maximum value. The increase in battery voltage from zero to +12 Volts is fast. But from +12 Volts to +13.7 Volts lasts a bit longer.

From Figure 7 it can be seen that when the battery is full, the charging current is zero and the time required to fully charge the battery with solar cells is 707 minutes. The graph showing the relationship between the time required for charging and the battery voltage at the time of charging is shown in the following graph:

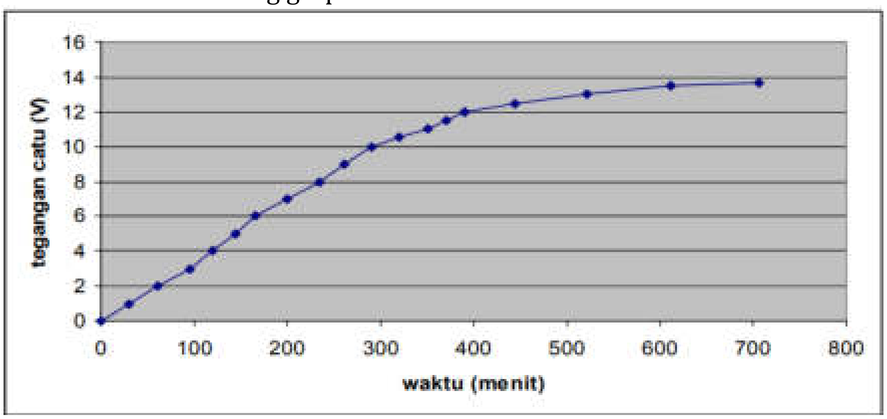

Figure 7. The Relationship Between Charging Time and Battery Voltage

Discussion

The complete range of light position detection using LDR is shown in Figure 10.

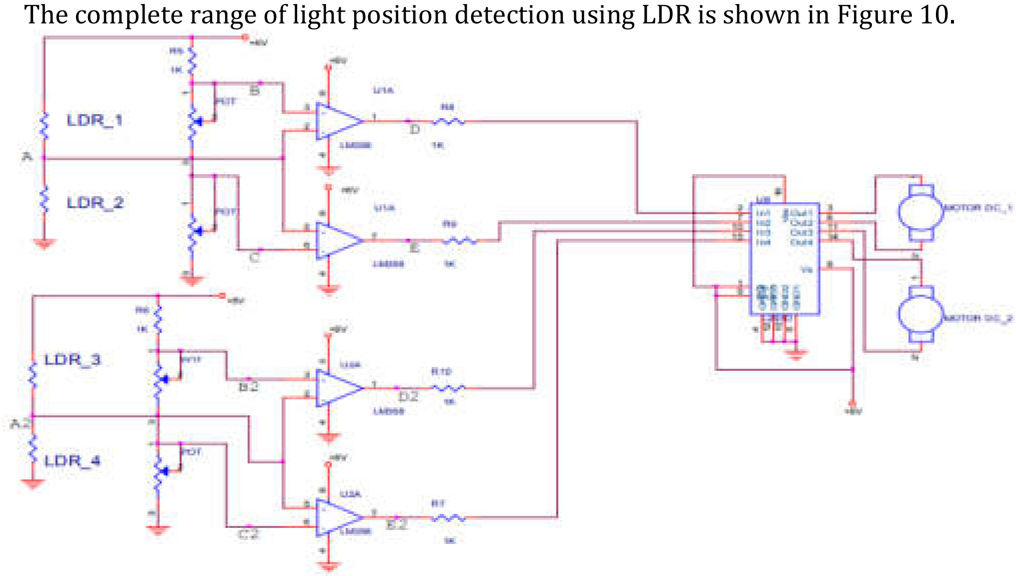

Figure 10. light position detection circuit and its test point

Detection of the position of light using an LDR is designed to be able to move and locate the light source. Tests were carried out at test points D, E, D2 and E2.

Table 3 data on detecting the position of the light when the motor is idle

test point	Op-Amp 1	Op-Amp 2
V- (volts)	5.37	4.12
V+ (volts)	5.25	5.35
Vo (volts)	4.67	4.67
Vmotor (volts)	0	0

The source voltage (Vcc) used is +6 Volts. When idle, the output voltage of the motor driver is zero. The results of the experimental data are as in table 3. At this quiescent state the output voltage (Vo) on both Op-Amps is the same so that there is no voltage difference. This will result in the output voltage of the motor driver being zero. Then the motor will be silent. If one of the LDRs is exposed to light, it will cause a voltage difference at the input of the Op-Amp which will cause the DC motor to move. The experimental data are as shown in table 4 below:

Table 4 . Data for detecting the position of the light when the motor is in motion

test point	To the top	Down	To the left	To the right
D (volts)	-0.02	4.63	0.02	0.03
E(volts)	4.60	-0.03	0.02	0.02
D2(volts)	0.02	0.02	-0.03	4.60
E2(volts)	0.03	0.03	4.63	-0.03
Vmotor (volts)	5.82	5.83	5.80	5.82

This light position detector moves the solar cell right, left, down and up. If LDR1 is exposed to light, then the active is Op-Amp 1. Judging from the experimental data, point B has a voltage of 4.6 Volts while for point E the voltage is close to zero, so it will move motor_1 to move up. On the other hand, if exposed to light is LDR2, the active is Op-Amp 2. From the experimental results, point D is close to zero and for point E the voltage is 4.6 volts, so it will move motor_1 down. If LDR3 is exposed to light, then the active Op-Amp 3. Judging from the experimental results, the voltage D2 is close to zero and E2 is 4.63 volts, then motor_2 will move to the right. Conversely, if exposed to light is LDR4 then the active is Op_Amp 4.

CONCLUSION

Based on the results of making tools and tests carried out the results of the design on how the tool works are the same as the test results, namely: Solar cells can work when getting direct sunlight, DC motors will move if the two outputs from the comparator window have a different voltage and battery charging current compared to inversely with the time required.

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