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Design of Solar Panel Utilization as a Mobile Phone Charger Station Box in Online Ojek Places

Muhammad Azhar Falachi[1*], Ayusta Lukita Wardani[2], Mahendra Widyartono[3], Reza Rahmadian[4]
[1*,2,3,4] State University of Surabaya, Surabaya, Indonesia

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ABSTRACT

One of the problems in the field of electrical energy is the limited source of coal energy which is the main source of energy from steam power plants in Indonesia. To reduce electricity dependence on this limited coal, a renewable energy source is needed. Solar panels are one of the producers of electrical energy sourced from sunlight that always shines and does not cause pollution. The use of solar panels is the best solution for current conditions as an alternative energy source to be utilized as a source of cellphone battery charging at online motorcycle taxi stations. This final project aims to design, manufacture and install a solar power plant as the main source on the handphone charger station box at the online motorcycle taxi place. The SOLAR POWER installation consists of 1 100 WP solar panel, 1 10A SCC, 1 12V 65Ah battery, 1 600W inverter, AC and DC MCBs, cables, power outlets, Arduino uno, relays, LCD, RFID, solenoid door lock.

INTRODUCTION

The development of technology is currently growing rapidly, especially in the field of electrical energy sources, where energy sources can be obtained from steam, gas, nuclear and geothermal power plants (Budianto, 2016; Meliala et al., n.d.; Mulyadi et al., 2023). These sources of electrical energy are non-renewable sources of electrical energy and the cost to operate them is very expensive. The growth of electrical energy and the rising price of fossil fuels trigger research on increasing the efficiency of renewable energy, especially on solar energy. In utilizing solar energy, it is necessary to develop a tool that is able to convert solar energy into electrical energy, this tool is usually referred to as a solar panel or collar cell. Electric energy consumption is increasingly needed, due to the rapid development of technology with a lot of sophistication that makes humans increasingly dependent on electronic devices, especially on cell phones in supporting daily work. Busyness with activities and high mobility has indeed become the lifestyle of some people. Cellphones obviously need a battery that functions as an energy source on the cellphone(Prayogo, 2019) (Awasthi et al., 2020; Charfi et al., 2018; Mursidan et al., n.d.). But it is unfortunate if the activities carried out outside the room must be hampered by the condition of the battery energy that runs out quickly, then we need to fill it up so we can use it again. Another obstacle that often occurs when the cellphone battery runs out is that when carrying a cellphone charger we don't easily find a source of electrical energy even though the energy source exists we feel uncomfortable charging the battery at a battery charging place in an unknown person's place.

Some research has been done to make battery charging by utilizing solar energy sources such as the Implementation Charger HP dengan panel surya, sistem Pembangkit listrik tenaga surya (SOLAR POWER) untuk *Charger* laptop dan HP di IST AKPRIND YOGYAKARTA(Budianto, 2016). Therefore, a practical and safe tool is needed in charging batteries that utilize solar energy sources. Based on the above background, the author took the final project with the title "Design of Utilizing Solar Panels as a Mobile Charger Station Box at Online Ojek Places". Which one day is expected to be used in various public facilities.

RESEARCH METHOD

This research is an experimental research. It is necessary to design and manufacture a solar power generation device as a service for providing electricity to the cellphone charger station box at the online motorcycle taxi place. Data collection in this study was carried out by observing the test equipment to determine whether the equipment used functions as designed and obtaining measurement data from each component used. Furthermore, analyze the experimental data as quantitative data by reviewing and displaying in tabular form. Furthermore, presenting the information obtained in the form of text that is easy to understand and basically aims to provide answers to the research questions studied.

1.1. Syestem Planning

At this stage determine several components and calculate the needs of the components that will be needed. The following are the steps that must be taken when designing a solar power system.

In calculating the number of watts of power that will used for charging the hanphone battery that will be supplied by the solar panel. by the solar panel. Discharging power can be calculated by using equation 1(Cahyono et al., n.d.; Jamaaluddin, 2021; Rizaldi et al., n.d.):

$$Wh = P \times h \quad (1)$$

Description:
Wh = Discharging power
P = Load power in use
H = Usage time

Daily load that will be supported by solar panels. Charger handphone charger with a maximum power of 15W amounted to 3 pieces with an estimated usage of 8 hours, one lamp with a power of 5W totaling 1 with an estimated 12 hours of use. So in get a power requirement of 420W

Calculate how many solar panels are needed will be used on the handphone Charger station box tool. Can calculated by equation 2(Suduri et al., 2021):

$$Wp\ Solar\ panel = Wh \div 5 \qquad (2)$$

Description:
Wp = Total energy
5 = Optimal solar time
Then the solar panel that will be needed in this research olar panels with a capacity of $Wp\ Solar\ panel = 420 \div 5$100Wp.

Determining battery capacity must take into account the battery efficiency and when using the battery should not be used until all the power in the battery runs out. Battery capacity the ideal battery capacity is 1,5 times the battery requirement Determining the battery needs can use equation 3(Suduri et al., 2021):

$$Ah = \frac{1{,}5 \times Wh}{V} \qquad (3)$$

Description:
Ah = Battery Capacity
Wh = Discharging power
V = Voltage on the battery
So the battery capacity used in this study that is with a capacity of $Ah = \frac{1{,}4 \times 420}{12}$ = 52.5Ah, then a 70 Ah battery is used which is common in the market

In determining the capacity of the SSC, you must first know the characteristics and specifications of the solar panel in order to know the needs of the solar charger controller, on the solar panel. there are the following specifications:

Pm = 100Wp
Vm = 17,8V DC
Imp = 5,62A
Vcc =21,8V
Isc =6,0A
After knowing the specifications and characteristics of solar panels, the capacity of the solar charger controller can be calculated using equation 4(Suduri et al., 2021).

$$ISCC = Isc\ Panel\ \times Total\ Panel \qquad (4)$$

Description:
ISCC = Current capacity of the SCC
Isc Paanel = Current on solar panel
Current capacity on SCC $ISCC = 6{,}0 \times 1 = 6A$. So that the SCC used is at least 6 A and in this research used an SCC of 10 A.
Determining the inverter that will be needed in this study can be used equation 5(Suduri et al., 2021) (Book, 2019; Julisman et al., 2017; Mulyadi et al., 2023; Ramadhan et al., n.d.):

$$Capacity\ Inverter = Demend\ Wh\ \times 1{,}25 \quad (5)$$

Description:
Demand Wh = Required load power
1.25 = Safety factor
So the inverter requirement in this research is $420\ x\ 1{,}25 = 525W$, so an inverter of 600Watt is used.

1.2. Solar and Microcontroller System Diagram

The design of the solar panel System in this study was carried outwiring in the circuit according to the design diagram so that the components used can run well (Gunoto & Sofyan, n.d.). The following is aschematic drawing of the design solar power seen in Figure 1:

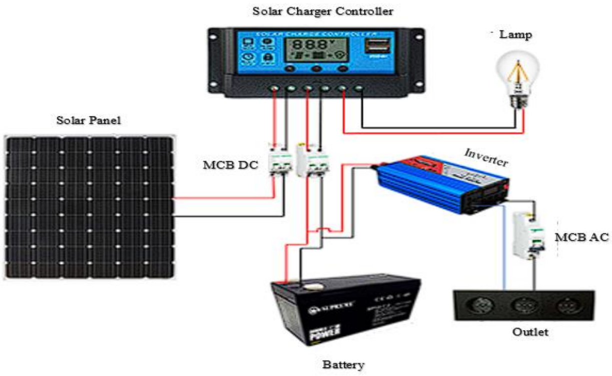

Figure 1. Solar Panel System
Source: Personal Documents

In the cellphone battery charging box security has several electronic components, namely RFID this circuit serves to identify the card that will be used for security on the box, LCD serves as to display data in character form, solenoid door serves to lock the door by using electrical voltage. The following is a table of tools and materials required.

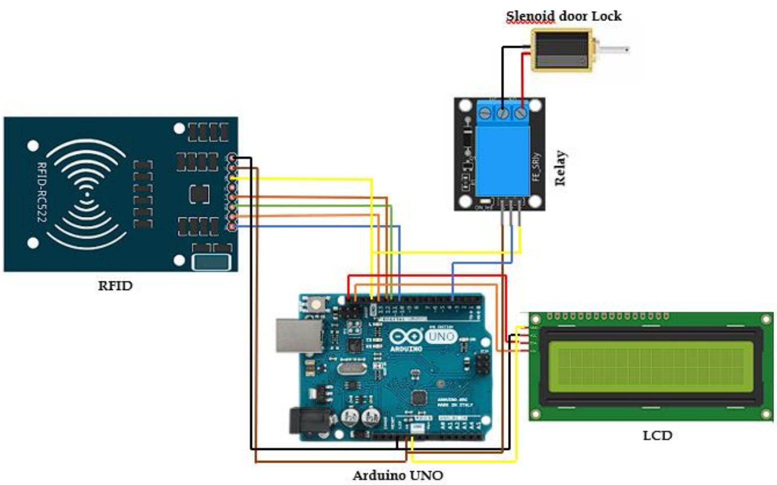

Figure 1. Microcontroller circuit on battery charging box

Source: Personal Documents

RESULTS AND DISCUSSION

This research test aims to determine and calculate the voltage, current and power generated in the solar panel component. In addition, it is also to determine the performance of the components used for locking the locker. In this research, sunlight acts as an alternative energy so that the use of conventional electrical energy can be minimized by switching to new and renewable energy through the use of solar panel.

1.3. Tool Testing

Testing solar panels with a capacity of 100WP to convert sunlight into direct current (DC) electrical energy. The testing process was carried out for 5 days starting from 08.00 WIB until it ended at 15.00 WIB.

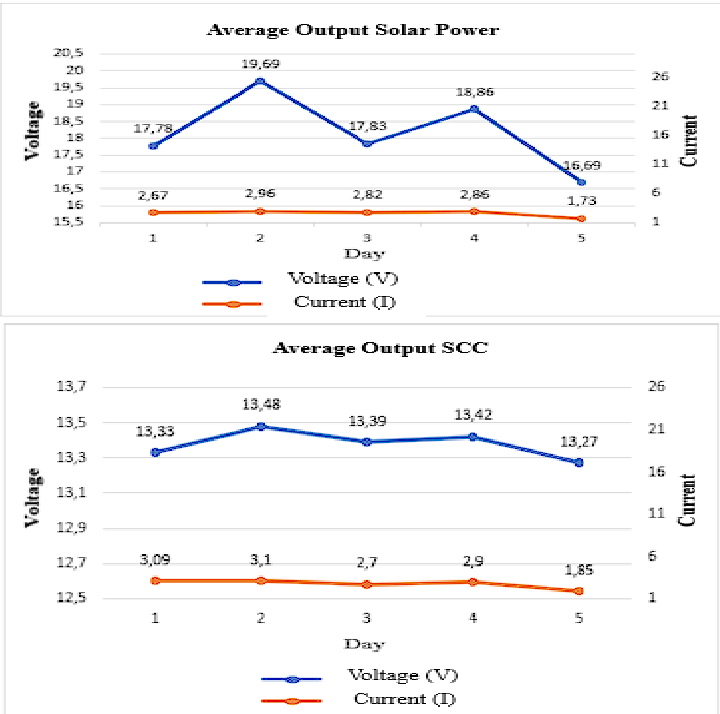

Figure 3. Average output of polar panel and charger controller in 5 days.
Source: Personal Documents

From the test data of the solar panel output and the solar charger controller output, it can be seen that the average voltage of the solar panel output is around 16.69 V - 19.69 V. But the average output of the solar charger controller is more stable, which is around 13.27-13.48 V. This situation is almost the same every hour. This happens because in the solar charger controller there are series to regulate the voltage and current therefore the battery charger when charging every hour will always be stable. The work process of solar panels is highly dependent on brightness conditions. If the solar panel gets bright sunlight, the voltage and current obtained will be large, on the contrary, if the weather is cloudy or the solar panel does not get bright sunlight, the voltage and current obtained decrease. As in Figure 3 where the voltage generated by the solar panel is the largest, namely 19.69V and a current of 2.96A. This is the highest average generated by solar panels in a day, but this is certainly different weather every day and greatly affects the power generated every day.

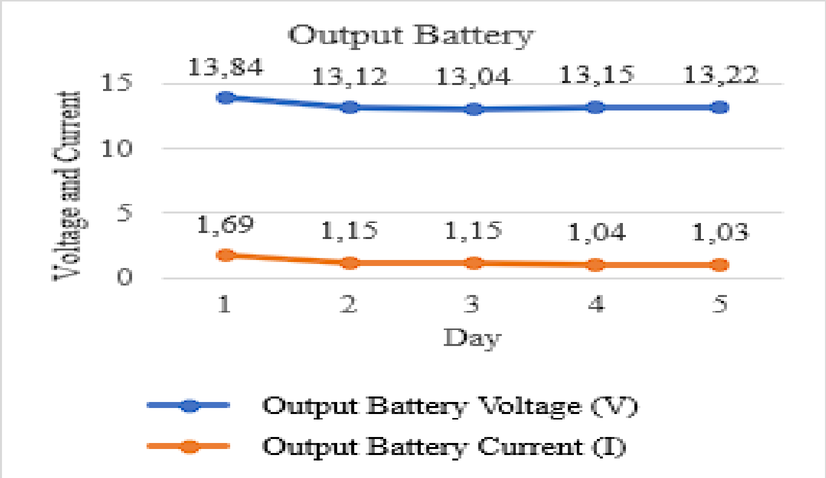

Figure 4. Average output of battery in 5 days.
Source: Personal Documents

IIn this test, it was carried out for 5 days and the battery output results were obtained with an average voltage and current value that fluctuated in 5 days of research as shown in Figure 4. This is due to the input voltage when charging is not maximized due to weather. Although the average battery voltage output is not stable, the battery is still able to meet the load requirements. The load used is a cellphone with a charging criteria of 15 watts.

From the average results of inverter testing can be seen in Figure 5. The figure shows the results of the inverter output for 5 days with a value of 221.44V - 218.9 V. for the resulting current has an average value of 0.11 A - 0.18 A.

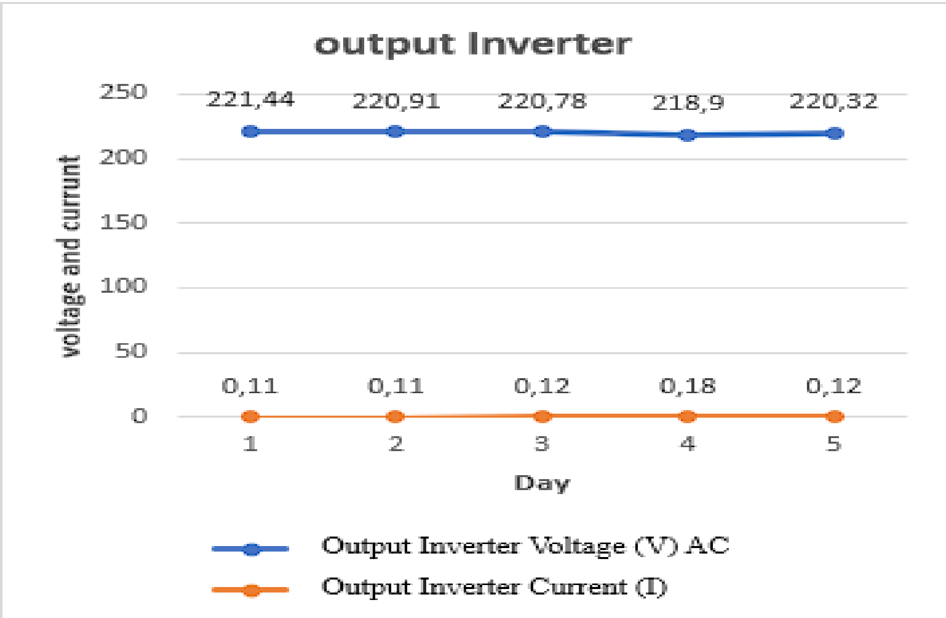

Figure 5. Average output of inverter in 5 days.
Source: Personal Documents

1.4. Sensor Test

Table 1. Sensor testing

NO	Time	Day	RFID Test		Solenoid Test	
			Successful	**Unsuccessful**	**Open**	**Close**
1	11.00	1	Successful	-	Open	-
2	13.00	1	Successful	-	Open	-
3	13.00	2	Successful	-	Open	-
4	15.00	2	Successful	-	Open	-
5	10.00	3	Successful	-	Open	-
6	13.00	3	Successful	-	Open	-
7	09.00	4	Successful	-	Open	-
8	11.00	4	Successful	-	Open	-
9	13.00	5	Successful	-	Open	-
10	15.00	5	Successful	-	Open	-

Source: Personal Documents

Table 1. Rfid is tested to determine the success rate of the rfid sensor against the card. Solenoid testing aims to determine the performance of the solenoid open / not open.test results of security on rfid and solenoid contained in the battery drain box as a safety box. Rfid is tested to determine the success rate of the rfid sensor against the card. Solenoid testing aims to determine the performance of the solenoid open / not open. For the percentage of success of the work of the cellphone battery charging box security system is 100% for the functioning of the doorlock solenoid, and 100% for the functioning of the RFID sensor. For cards that are in use that can use E-toll cards as a lock.

CONCLUSION

1. In this final project, the total load power required is 420 Wh, so that the capacity of each component unit is obtained, namely 1 unit of 100 WP solar panels, 1 unit of 10A SCC, 1 unit of 12 V 65 Ah battery, and 1 unit of 600 W inverter.
2. The highest average voltage, current, power obtained by solar panels occurred on day 2 of 19.69 V with a current of 2.96 A, the highest average power obtained by the inverter occurred on day 2 of 220.91 watts, and the lowest average voltage, current, power on solar panels is 16.69 V and 1.73 A occurred on day 5, the lowest average power obtained by the inverter occurred on day 5 of 220.32 Watts. The intensity of sunlight shining on solar panels affects the amount of voltage and current for charging batteries using loads.

3. For the percentage of success of the work of the cellphone battery charging box security system is 100% for the functioning of the doorlock solenoid, and 100% for the functioning of the RFID sensor.

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