PERFORMANCE ANALYSIS OF 20WP SOLAR PANEL AS A SOURCE OF ENERGY IN AUTOMATIC SINK

Zuraidah Tharo[1]*, Hamdani[2], Melly Andriana[3], Putra Andhika[4]
[1,2,4] Electrical Engineering Department, Universitas Pembangunan Panca Budi, Indonesia
[3] Architecture Department, Universitas Pembangunan Panca Budi, Indonesia

*Corresponding author: zuraidahtharo@dosen.pancabudi.ac.id

ARTICLE INFO

Date received : 21 Oct 2022
Revision date : 19 Nov 2022
Date received : 25 Nov 2022

Keywords:
Renewable energy
Automatic sink
Solar panels

ABSTRACT

Short-term and long-term energy needs and consumption in the supply and utilization of sustainable energy nationally, require direction and strategic steps to achieve. Fossil energy, which has been the mainstay of energy consumption, has had an impact on the depletion of non-renewable natural resources and increasing environmental damage. This encourages the emergence of various calls to reduce and limit the use of fossil energy and replace it with Renewable Energy. Solar energy is a source of energy that is widely available in nature and is relatively easy to use. Many innovations are made by utilizing sunlight, one of the innovations is by utilizing sunlight as an energy source in an automatic sink. With a 20 Wp solar panel, it can generate electricity of 150.66 Wh/day. This amount can supply an automatic sink which requires 81.18 Wh/day of energy. By carrying out a simple design and calculations and tests in order to obtain an innovation in the use of Renewable Energy.

INTRODUCTION

Indonesia as a country that has large natural resources, an area of around 1.9 million km² and a population currently reaching 267 million people with an average economic growth of 5% per year, is faced with a trend of increasing needs and energy consumption. Fossil energy, which has been the mainstay of energy consumption, has had an impact on the depletion of non-renewable natural resources and the increasing impact on environmental damage. This has prompted calls to limit the use of fossil energy and replace it with Renewable Energy. Utilization Renewable Energy which is clean and environmentally friendly energy (Clean Energy) has become a program of the Indonesian government and even the world. Indonesia has shown its commitment to reducing the impact of climate change by reducing the use of fossil energy and replacing it with Renewable Energy as stated in the KEN (National Economic Committee). Based on KEN, the Renewable Energy target is 23% in 2025 of the total primary energy of 400 MTOE and 31% in 2050 of the total primary energy of 1,000 MTOE. Advances and technological developments force us to think more creatively and innovatively, so that we can compete in realizing clean energy.

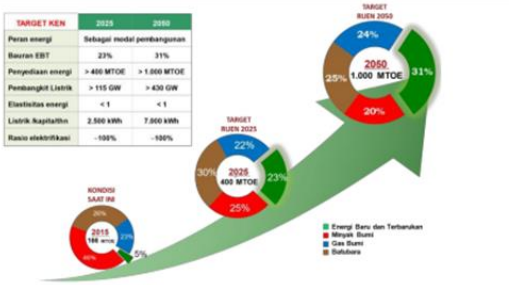

Figure 1. Primary Energy Mix Targets Based on KEN 2014

Keeping your distance, washing your hands, wearing a mask are the words we have heard the most in the last 2 (two) years, when a pandemic caused by the SARS-CoV-2 virus or commonly known as Covid-19 occurred. COVID-19 is a virus that easily spreads through the air and frequently touched objects. To prevent the spread of COVID-19 from becoming more widespread, the Indonesian government always urges the public to always do 3M. The public is expected to always wear masks, keep their distance and not always touch objects in public facilities, because there is a high possibility of spreading the virus through these objects.

Figure 2. Frequently Encountered Government Appeals

Based on data from covid19.go.id/id, the covid19 cases as of December 5 2022 in Indonesia were: 6,680,203 positive, 6,469,238 recovered and 159,978 died. Judging from the data and appeal above, it produces thoughts and ideas to help spread the disease.

If people make hand contact with public objects or make hand contact with other humans, it is hoped that they will wash their hands as soon as possible. This can prevent the spread of the virus to others and yourself. Common hand washing tools usually use a sink that always uses a water faucet, so it is also very likely that the virus can be spread by touching the water faucet. Based on the above, academics are moved to innovate touchless sinks with solar energy sources. By using solar panel media as a means of converting sunlight into electrical energy.

LITERATURE REVIEW

In this case the sink is said to be automatic because in its use there is no need to touch the water faucet, while the energy source is made using solar energy. The process of using an automatic sink is quite easy, just by bringing your hand closer to the sensor and water will immediately come out through the water faucet, if you move your hand away from the sensor, the water will no longer flow. This sink is an innovation in the utilization of Renewable Energy, especially Solar Energy.

Solar energy is a very potential renewable energy alternative, because the number of energy sources is unlimited and available in almost all parts of the world. Indonesia is a country located on the equator, including one of the countries that receives a lot of sunlight. So it is very possible if we take advantage of the sun's light source as a source of electrical energy

Solar panels are devices consisting of solar cells that convert sunlight into electricity. Solar panels produce direct current or DC electricity that can be used as a source of electricity. Solar panels are often called photovoltaic cells. Solar panels or PV cells depend on the photovoltaic effect to absorb solar energy and cause current to flow between two opposing charged layers. A solar panel is a semiconductor bed consisting of cells made of silicon material that can convert sunlight into electricity.

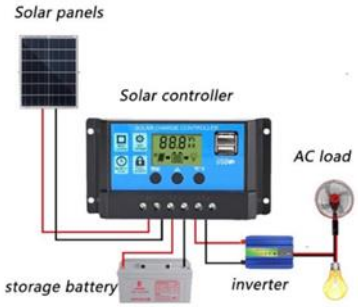

Figure 3. The process of converting solar energy into electrical energy

A silicon cell can generally produce a DC voltage of 0.5-1.0 volts with a very small current on the mA/cm2 scale. To produce a greater voltage, several silicon cells are combined in series to form a silicon cell circuit module. If several silicon circuit modules are recombined in parallel, you will get a solar panel that has a voltage and electric current with enough power to meet certain needs. The amount of power generated by a solar panel can be calculated by the following equation:

$$P = V . I$$

where : P = Power (W)
V = voltage (V)
I = Current (A)

The maximum power produced by solar panels is measured in wattpeak (Wp), which is converted to watthours (Wh) depending on the intensity of sunlight hitting the surface of the solar panel. Furthermore, the power generated by the solar panel is the power of the panel multiplied by the duration of irradiation. For example, if a solar panel with a capacity of 50 Wp is exposed to sunlight with maximum intensity for 8 hours, the power produced is 50 Wp times 8 hours, which is 400 Wh. In Indonesia the power (Wh) generated per day generally ranges from 3-5 times the maximum panel power (Wp), ie 3 times during cloudy weather and 5 times during hot, hot weather. So if the 50 Wp solar panel above can generate power for cloudy weather 3 times 50, which is 150 Wh, and hot/hot weather 5 times 50, which is 250 Wh. Solar panels can be arranged in series or parallel. Parallel circuits are used on panels with the same output voltage to obtain a larger total output current. To achieve a higher voltage and the same output current is obtained by assembling the panels in series. For example, to obtain an output of 12 volts and a current of 12 A, we can assemble 4 panels each with an output of 12 volts and 3 A in parallel. Meanwhile, if the four panels are connected in series, an output voltage of 48 volts will be obtained.

METHOD

The method used in data analysis is the Quantitative Research Analysis method, in which the data obtained is based on measurements and experiments conducted, and aims to develop mathematical models related to natural phenomena.

The research is based on designing and designing environmentally friendly automatic washbasins that are sourced from sunlight. Then do a performance analysis of the sink through the experiments and measurements made.

The Automatic Sink Design can be seen in the following figure:

Figure 4. Solar Energy-Based Automatic Sink Design

The materials needed in making an Automatic Sink are listed in the following table:

Table 1. Materials Required

No.	Component	Quantity
1.	Solar panel 20 Wp	1
2.	Battery 12v, 7,2AH	1
3.	Solar Charger Controller 10A	1
4.	Regulator DC Stepdown LM2596	1
5.	Modul Relay 1 channel 5 Volt	1
6.	Sensor infrared proximity (E18-D80NK)	1
7.	Water pump DC – 5 Volt	1
8.	Modul water level control	1
9.	Water level sensor	2
10.	Water Solenoid valve 12Volt DC	1
11.	Water barrel	1
12.	Water hose	2 meter
13.	Cables	5 meter

With Block diagram as follows:

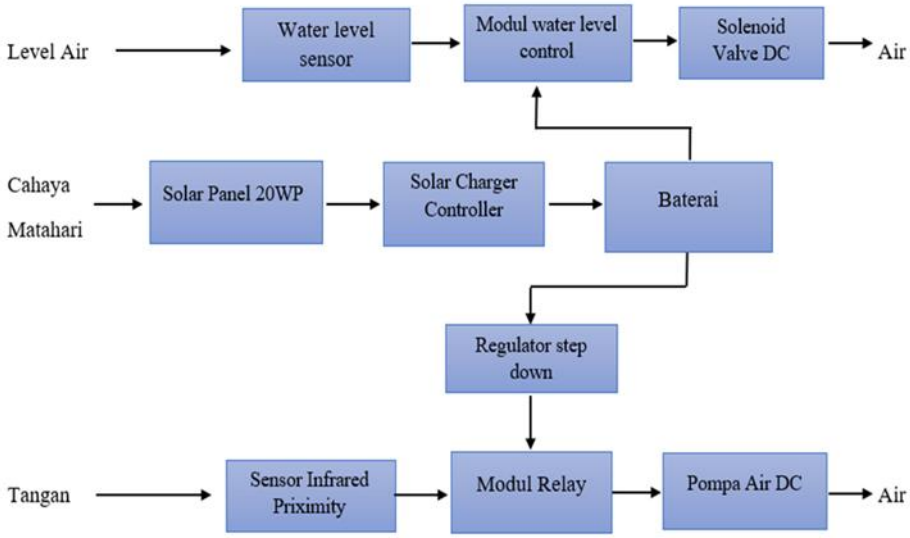

Figure 5. System Block Diagram

The picture above describes a solar-powered automatic sink design system. This tool is equipped with sensors as input, namely infrared proximity sensor and water level sensor. The two sensors each provide an input signal to each relay control. The input signal is read and responded to by the relay module to control the output. If a hand is brought closer to the range of the infrared sensor, the sensor will give a signal to the relay and the output pump will pump water and flow water to the water faucet.

And when the water in the water storage barrel runs out, the water level sensor will give a signal to the water lever control module and the output activates the solenoid valve to open the water channel which is already connected to the main water source. And the water will automatically stop when the water level sensor gives a signal back to the water level control module and turns off the solenoid valve, with a source of electric energy from sunlight.

RESULTS AND DISCUSSION

From the method and design obtained the following calculations:

1. Load Capacity On Automatic Sink
   a. Water pump
      Given: 1 time washing hands = 1 minute
      1 day = 100 people
      Power (P) = 4 Watts
      asked : Watthour ?
      Completion

1 day = 1 minute × 100 people
100 minutes →1.67 hours
1 day Pump = 4 Watt × 1.67 hour
= 6.68 Wh

b. Selenoid Valve

It is known that: 1 charge = 3 minutes
1 barrel = 17.66 Liters of water
Power (P) = 5 Watts
1 hand wash = 1.5 liters
Asked : Watthour ?
Completion
1 barrel of water = 17.66 liters ➔ 1.5 liters
= 11.77 11 people
1 day 100 people = 100 people ➔ 11 people
= 9.09 10 charging times in 1 day
1 day = 3 minutes × 10 charging times in 1 day
= 30 minutes = 0.5 hours
1 day = 5 Watts × 0.5 hour
= 2.5 Wh

c. LED Light

It is known that:
Power (P) = 6 Watt
Usage time = 12 hours (19.00 – 06.00)
Asked : Watthour ?
Completion = 6 Watts × 12 hours
= 72 Wh

The calculations above can be seen in the table below:

Table 2. Electrical Energy Needs

Electrical Load	**Quantity**	**Active Power (Watt)**	**Long Usage (jam)**	**Total Energy (Wh)**
Pompa air	1 Unit	4	1,67	6,68
Selenoid Valve	1 Unit	5	0,5	2,5
Lampu LED	1 Unit	6	12	72
Total				**81,18 Wh**

2. Generated Electric Power

Based on testing on solar panels, the following data is obtained:

Table 3. Generated Energy

Hour	**Voltage (Volt)**	**Current (Ampere)**	**Energiy (Wh)**
08.00	10,67	1,10	11,73
09.00	11,10	1,13	12,54
10.00	12,28	1,23	15,10
11.00	13,21	1,29	17,04
12.00	13,87	1,37	19,01
13.00	13,38	1,33	17,79
14.00	13,23	1,27	16,80

15.00	12,17	1,19	14,48
16.00	11,43	1,17	13,37
17.00	11,13	1,15	12,80

From the test data carried out for 10 hours. The solar panel generates 150.66 Wh. The energy generated is then stored in the battery. Furthermore, the solar panel is obtained by multiplying the voltage and current, namely:

P = V x I

P = 11.3 x 1.15
= 12.80 Watts

So the energy produced by solar panels is 12.80 W x 1 hour = 12.80 Wh

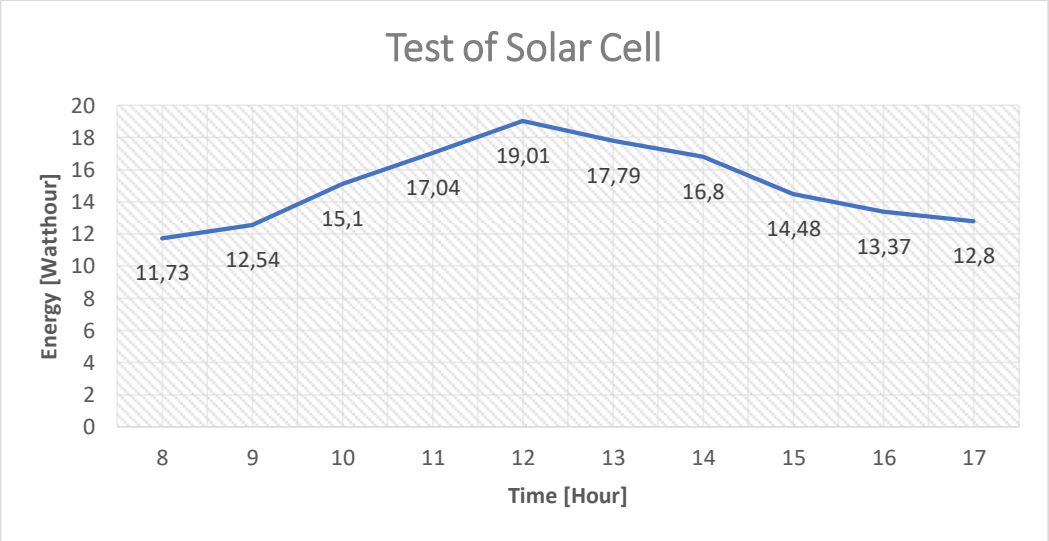

Figure 6. Generated Energy Graph

From the graph above, it can be seen that the greatest energy is generated at 12.00 with a voltage on the solar panel of 13.87 Volts and a current of 1.37 Amperes.

3. Proximity Sensor Testing (E18-D80NK)
   Proximity sensor is a sensor that can sense the presence of an object without touching it, namely by infrared. The sensor is used to detect the presence of a hand placed under a water faucet to trigger spraying of water on the hand. The sensor can only detect whether there is an object blocking it or not, the sensor cannot know how far the object is, but through experiments the distance of the object/hand to the sensor can be seen in the following table:

Table 4. Sensor Distance to Objects

Hand Distance to Sensor (cm)	Responsibility
20	No
19	No
18	No
17	Responses
16	Responses
15	Responses
14	Responses
13	Responses

12	Responses
11	Responses

From the table it can be seen that the sensor works up to a distance of 17 cm, and the rest of the sensor does not work

CONCLUSION

From the calculations and tests above, it can be concluded that:

1. Utilization of solar electric energy in an automatic sink is generated through the sun and then enters the solar panel, then the solar panel module will generate a DC current which is controlled by the charger controller to be stored in the battery, then the DC current that enters the battery will be used in the use of an automatic sink .
2. The sink works using a water pump and an infrared sensor. When the infrared detects a hand in front of the object at a maximum distance of 17 cm, the infrared sensor will automatically move the water pump to release water within 1 second.
3. A 20 Wp solar panel can supply an automatic sink with an hourly energy output of 12.80 Wh. So if the solar panels work up to 10 hours a day, they will produce energy of 12.80 multiplied by 10 to 120.80 Wh/day. Meanwhile, the sink only requires energy of 81.18 Wh/day.

REFERENCES

Aditya Nugraha & Agus Haris Abadi, (2020). Rancang Bangun Wastafel Portabel Otomatis Bertenaga Surya Sebagai Proteksi Pencegahan COVID-19, Jurnal Ilmiah Ilmu dan Teknologi Rekayasa | Volume 3 Nomor 2, September 2020 48-53 http://ejournal.polsub.ac.id/index.php/jiitr/article/view/84/62

Arief Dharmawan Hari, (2017). Mikrokontroler Konsep Dasar dan Praktis. UB Press. Malang.

Buku Bauran Energi Nasional 2020 https://www.den.go.id/index.php/publikasi/index/BauranEnergi

M. Hanifuddin Hakim, Rudi Irmawanto, Poniman, (2021). Rancang Bangun Wastafel dan Portal Otomatis dengan Mempertimbangkan Antropometri Guna Mencegah Penularan COVID19, Jurnal RESISTOR (Elektronika Kendali Telekomunikasi Tenaga Listrik Komputer) Vol. 4 No. 1 e-ISSN: 2621-9700, p-ISSN: 2654-2684 DOI: 10.24853/resistor.4.1.29-36

Rezky, Arina Safitri, & Bua', A. (2020). Rancang Bangun Kran Wastafel Otomatis Berbasis Arduino Nano Dan Sensor Ultrasonik Hc-Sr04 Pada Kampus Politeknik Amamapare Timika. Jurnal Teknik AMATA, 1(1), 20-23. https://doi.org/10.55334/jtam.v1i1.70

Zuraidah Tharo, Dharmawati, M. Alfi Syahri, (2020).Combination of Solar and Win Power to Create Cheap and Eco-Friendly Energy, IOP Conference Series: Materials Science and Engineering vol. 725, 21 January 2 **DOI:** 10.1088/1757-899X/725/1/012140
https://iopscience.iop.org/article/10.1088/1757-899X/725/1/012140/meta