Evolution in Electrical and Electronic Engineering Vol. 4 No. 2 (2023) 267-271
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Homepage: http://publisher.uthm.edu.my/periodicals/index.php/eeee
e-ISSN : 2756-8458

Micro Hybrid Power Generation Using Solar and Wave Energy

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DOI: https://doi.org/10.30880/eeee.2023.04.02.034
Received 03 July 2023; Accepted 12 August 2023; Available online 30 October 2023

Abstract: When we talk about renewable energy, what pops into your mind? Of course, you will think about unlimited resources of supply through nature. Recently there have been many cases of natural disaster due to the pollution that were caused by mankind. In order to overcome this problem, my first small step for this huge change is to create a device that can harness the energy of renewable energy from wave and solar energy. For the wave energy, the method to harness the wave energy is by applying the full wave rectifier circuit to make the stepper motor generate the energy with the rotation of the shaft motor. The wave energy that produces kinetic energy will cause the buoy to float up and down. Hence, the buoy is implemented with the gear slider. This action will make the gear slider slide the shaft motor so that it will generate energy by using wave kinetic motion. However, since the value generated was too small, the circuit will only be used to light up a bright LED to show it generates voltage. For solar panel was placed on top of the water container to harness the solar energy. For the safety of the process, a circuit was constructed suitable for the component used in the device. The wave and solar energy will be combined into one device. So, it will make a micro-hybrid power generation using waves and solar energy.

Keywords: Renewable Energy, Wave Energy, Solar Energy, Stepper Motor, Full Wave Rectifier Circuit, Buoy, Solar Panels, Led

1. Introduction

The energy crises and environmental pollution of today are progressively worsening [1]. Limits are being placed on the availability of the Earth's natural resources, such as oil, coal, and natural gas [1]. This is because of high demand from various industries, particularly the power sector. We anticipate an annual growth in primary energy supply, with total supply reaching about 23 billion tons of standard coal by 2030 and rising to 25-27 billion tons by 2050 [1]. Alternatives to the existing conventional energy can be found in the use of renewable energy sources including solar, wind, and ocean energy [2].

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Ocean wave energy is one of the potential-growing renewable energy sources to produce electricity, and it is entirely pollution-free. Previous research suggests that, given the country is almost entirely bordered by the shoreline, Malaysia has a great deal of potential to fully harness the energy from the ocean. [3]-[6]. There is a maximum capacity for annual wave power on Perhentian Island of 15.9 KW/min, while the optimal annual wave power available in the Malaysian Sea is 8.5 KW/m [6]. Therefore, the ocean waves were harnessed by the wave energy harvester and converted into electricity. A wave energy harvester is a device that converts the mechanical or electrical energy contained in the potential and kinetic energy of a moving ocean wave. Globally, businesses employ a wide variety of wave energy harvesters, including point-absorber devices, attenuators, terminators, overtopping devices, and an oscillating water column [7]-[9].

Other than that, Solar energy has gained abnormal attention in the past few years due to diverse reasons such as the awareness of public environmental issues, price reduction of solar panels (PV), supporting policies and subsidies taken by local government to support the renewable energy sectors. Malaysia is located on the South China Sea and lies between 1º and 7º in North latitude and 100º and 120º in East longitude which is located at the equatorial region [10]. Malaysia receives monthly solar radiation of approximately 400-600MJ/m² and it increases during the Northeast monsoon period and decreases during the Southwest monsoon [11]. Almost every country that receives this abundance of solar radiation utilizes this system either a static solar system or a solar tracker itself [11]. The top ten of the countries that leading the world in solar energy are South Korea, Belgium, Australia, Spain, France, the United States, Italy, Japan, and China and the top one is Germany with 38,250 MW. Almost all developed countries applied the solar system as their main generation of electricity because the level of awareness about limited resources is high and the other countries should take an example to save the earth. The usage of renewable energy should encourage all countries around the world.

When compared to other intermittent energy sources like wind, wave energy has many advantages, for example, the energy of the wind that blows across wide areas is concentrated in the form of wave energy, which has its advantages. In addition, this means that waves are more consistent and constant over time than winds. The waves will continue to come in for a while, even if the wind fades away. Solar energy also has the advantage of being widely available and the technology is increasingly affordable making it more accessible to a wider range of people.

2. Method

2.1 Block Diagram for Wave Generator

As shown in Figure 1, it is a working block diagram for a wave generator. For stage 1, a manual wave is created. Stage 2, the sway of the water makes the buoy float following the sway motion. Stage 3, the floating buoy that connects with the gear slider, moves up and down. Stage 4, the gear makes the shaft of the stepper motor rotate. Stage 5, the rotation of the shaft goes to a full-wave rectifier circuit that converts the kinetic energy to electrical energy. Stage 6, from the circuit, will be to step up the voltage from 2-3 volts to 4 volts. Stage 7, the energy that has stepped up will be directly connected to the load.

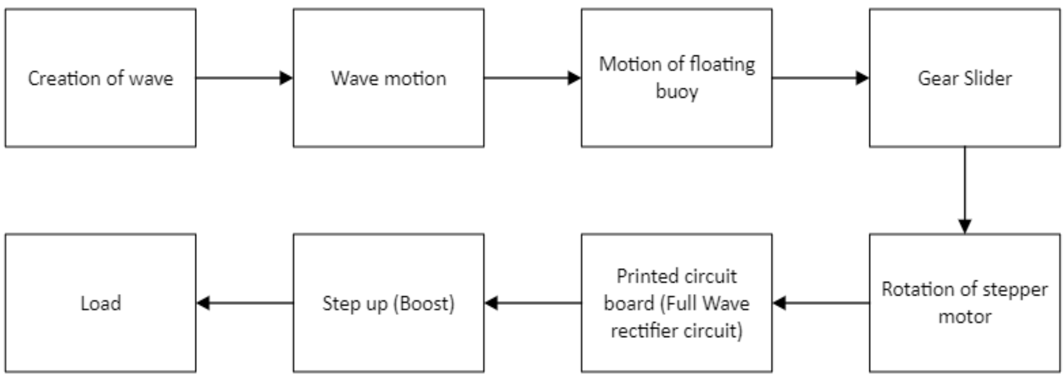

Figure 1: Block diagram for wave generator

2.2 Block Diagram Solar System

As shown in Figure 2 it is a stage for the working block diagram. For stage 1, the solar panel will harvest the energy from the sun. In stage 2, the power will be stepped down from 9 volts at peak to 4 volts. In stage 3, the power is directly connected to the load (4 volts).

Figure 2: Block diagram for solar system

3. Results and Discussion

3.1 System Implementation

The solar panel and wave power generator will be combined into a single prototype. By combining solar and wave energy, this integration hopes to produce a micro-hybrid power generation system. The prototype can optimize power generation and supply a sustainable and efficient source of electricity by combining these renewable energy technologies. The integrated system makes it possible to use solar and wave energy at the same time, improving overall performance and contributing to a greener and more diverse approach to energy generation. It is shown in Figure 3.

Figure 3: System Implementation

3.2 Test Result Output

3.2.1 Result from Wave Generator

Figure 4 shows the LED turn on when the wave generator moves the gear slider, and it shows the output value at the multimeter.

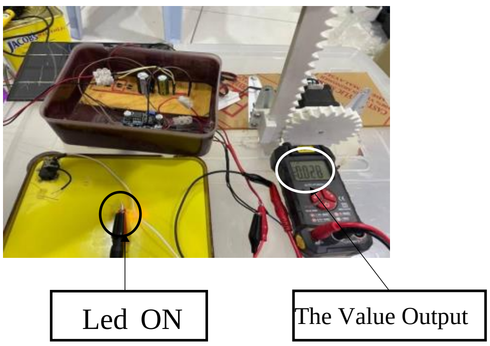

Figure 4: The output from the wave generator

3.2.2 Result from Solar Panel

Figure 5 shows the LED turn-on when the solar panels get the input, and it shows the output value at the multimeter.

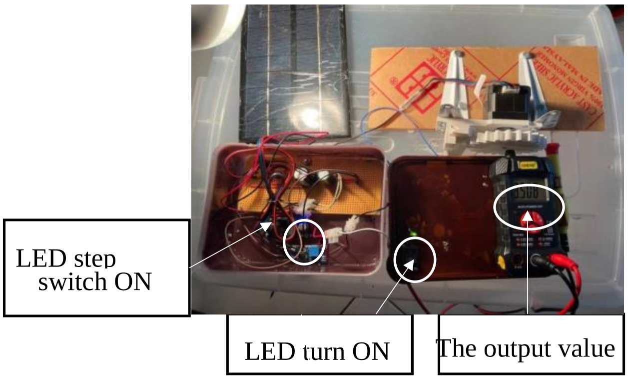

Figure 5: The output from solar panels

3.3.3 Result from Amalgamation Source

Figure 6 shows the LED turn-on when the wave generator and solar panels get the input, and it shows the output value at the multimeter.

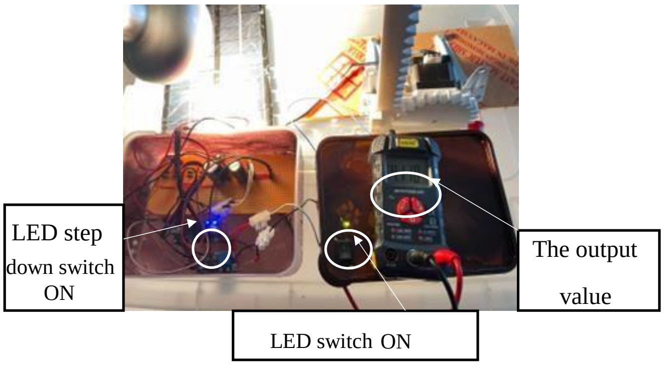

Figure 6: The output from the amalgamation source

3.3 Data the Output That Generated

Table 1 shows the result from the source that was generated.

Table 1: The generated output

Item	Source	Voltage (V)	Current (A)
1	Wave	2.54	0.028
2	Solar	3.51	0.058
3	Amalgamation	4.11	0.073

These revised values demonstrate an increase in both voltage and power output when integrating multiple energy sources, further enhancing the overall power generation potential of the system.

4. Conclusion

The project has successfully achieved its objectives of designing a reliable micro hybrid energy harvesting system and constructing a prototype for electrical power generation. The design phase involved careful planning and integration of components to create a robust system that combines solar and wave energy harvesting. Through thorough analysis and optimization, the system was developed to effectively capture and utilize both solar and wave energy sources. In the construction phase, a functional prototype was built, showcasing the integration of the designed micro-hybrid system. The prototype serves as a tangible representation of the project's objectives, demonstrating the feasibility and practicality of combining solar and wave energy to generate electricity. These achievements highlight the project's success in creating a micro-hybrid power generation system that efficiently harnesses renewable energy sources and showcases the potential for sustainable and reliable electricity generation.

Acknowledgement

The authors would like to thank the Faculty of Electrical and Electronics Engineering, Universiti Tun Hussein Onn Malaysia for its support.

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