OMNI POWER APPARATUS (O. P. A.): GENERATING A SUSTAINABLE ENERGY AS AN ALTERNATIVE POWER SOURCE

JB Balines[1, a], Ru-an Bueno[1], Ace Ilar[1], Christian Javier[1], Amiel Magat[1], CJ Narcida[1], Carl Olazo[1], Ashlee Rosca[1], Rave Tubog[1], Eric Awi[2, b], John Romy Delfin[2]

[1]Student, Senior High Student, Colegio de San Juan de Letran-Manila
[2]Faculty Member, Senior High Student, Colegio de San Juan de Letran-Manila

Correspondence: [a]jb.balines@letran.edu.ph, [b]eric.awi@letran.edu.ph

ABSTRACT

The Philippines is one of the countries that are inclined to calamities and crises as it belongs in the Pacific ring of fire. Power interruptions would be one of the significant impacts of calamities. We realize that power plays an essential part in the correspondence and communications of numerous individuals. Does sunlight based and mechanical vitality can be a substitute power supply as far as crises? Electric generators come with different forms. The generation of electricity comes from different forms of energy (mechanical, solar, etc.). The solar panel has also been discovered wherein it's the solar energy that is converted to electricity and this kind of generator is often present in tropical countries (Destreza, 2014). The quantitative study examines the output voltage of the fabricated generator. The objective of the study is to design and innovate a generator using a different kind of energy from mechanical, chemical, and solar energy as a source of energy that will provide electricity to charge smartphones, radio, and flashlights in times of emergencies for the Philippines is susceptible to natural calamities because of its location (Pacific Ring of Fire). Using an experimental approach in gathering data, the hypotheses are as follows: The principle and procedure for electromagnetic induction will be applied for mechanical and Photovoltaic for solar so that the O.P.A. will convert it into electricity; O.P.A can generate electricity in more than a week for about 9-10 voltage and can charge Smartphones, and Flashlights that are important in case of emergencies and; The O.P.A. will use recyclable and non-hazardous materials with regards to cleanliness upon making the project so the process and the product itself will be environmentally friendly. The gathered materials will be tested using a multi-tester. It will be assembled according to the design plan and the voltage output will be obtained using multi-tester. The result showed that the number of dynamos affects the amount of output voltage. The lesser, but more than one, the dynamo, the higher voltage it will produce. The added solar panel is helpful as it will be the source of energy aside from the chemical energy stored in the battery.

Keywords: generator, dynamo, O.P.A. (Omni Power Apparatus), multi-tester, mechanical energy, Photovoltaic, solar panel

INTRODUCTION

Two of the newly developed technologies for effective harvesting of energies such as ambient mechanical energy for self-powered systems are called piezoelectric and triboelectric nanogenerators. Nanogenerators (NGs) have resulted in a revolution in energy harvesting and sensing. Thus, it caused a sharp growth of publications and research collaborations were made in fields of research that are related to it. "Piezoelectric nanogenerators" is the term of the first idea of nanogenerators that was proposed in 2006. The abbreviated term for Piezoelectric nanogenerators was "PENGs". Six years after that, there came a new mechanism for energy harvesting, it was based on an event known as "triboelectrification effect" that was suggested. This novel technology was labeled as "triboelectric nanogenerators". While there were that so-called "PENGs" triboelectric nanogenerators also had its abbreviated name which is "TENGs". In complementary with PENGs the newly discovered technology and method for energy harvesting had attracted numerous researchers to apply it as a potent and viable path in various self-powered sensing instruments. The two nanogenerators so far were applied in distinct applications of different energy harvesting methods. Nanogenerators, specifically TENGs, had displayed a high-power density in comparison with other competing technologies like electro-magnetic generators (EMGs). Compared to EMGs, nanogenerators are advantageous in terms of high voltage, high efficiency at low frequency, low cost, low weight, multiple working modes, and material choices (Shao, Cheng, Chen, Xie, Sun, Shen, Zhu, Zhang, Liu, & Wen, 2018).

The motors need a special design that prevents the discharge of the higher voltage generated on one side. Since an efficient way cannot generate high voltages, it is necessary to use a transformer

to ease long-distance transmission. This transmission occurs once the low voltage converts to a much greater level necessary (Manney, 2017). The common power quality problems are voltage sag, voltage flicker, harmonics, and switching transients. Mostly these are caused by the intermittent nature of the non-conventional power generators, large industrial nonlinear loads, power system faults due to thunder attack, transients due to switching of the capacitor, and large load feeders.

Malfunction of devices and random failures of components are some results of power quality issues such as harmonics, voltage sags, flickering, and interruptions (Arulampalam, Ramachandaramurthy, Vigna & Pasupuleti, 2013).

China is presently the world's second-largest economy, the top energy client, and therefore the prime emitter of greenhouse gases; however, its energy potency remains low. Attributable to inflated global warming, the deterioration of the ecological setting and shortages in standard energy, the importance of developing renewable energy has achieved a global accord. In response to environmental demands and therefore the exhaustion of oil supplies, the development of renewable energy has become the core focus of China's energy policy. On January 1, 2006, China passed the Renewable Energy Law. The purpose of this law is to push the development and use of renewable energy, to extend the energy amount, to enhance the energy structure, to confirm energy security, to guard the surroundings, and to comprehend viable economic and social development. Renewable energy refers to wind energy, solar energy, hydropower, biomass energy, heat, ocean energy, and alternative non-fossil energy sources (Chen et al., 2016).

The objective of the study is to design and innovate a generator using renewable energy from mechanical and solar energy as a source of energy that will provide electricity to charge smartphones, radio, and flashlights in times of emergencies for the Philippines is susceptible to natural calamities, such as earthquakes and typhoons because of its location (Pacific Ring of Fire).

During calamities and plant emergency shutdowns, using this study, it helps to sustain the electricity that is provided by the O. P. A (Generator). Since the Philippines is located in the Pacific Ring of Fire, this will be the source of electricity and it can also help to communicate with the members of the family when calamities occurred in our country or a power plant shut down due to the damage of calamity and shortage of electricity.

THEORETICAL BACKGROUND

The Philippines is one of the countries that are prone to disasters and emergencies as it is in the Pacific ring of fire. Power interruption for a long time would be one of the major effects of disasters such as earthquakes and typhoons. We all know that electricity plays a vital role in the communication of many people. Can solar and mechanical energy be a substitute power supply in terms of emergencies? According to Grover and Ramalla (2014), "When a conductor is turned in a magnetic field, a voltage is initiated or induced in the conductor" wherein three (2) generators will convert mechanical into electricity and DC to DC to transport energy in the motor. Another one is using Solar energy for good environment situations.

Omni Power Apparatus (O. P. A.) Generator

Electric generators come with different forms. The generation of electricity coming from different forms of water like waterfalls has already been made. Wind energy can also be converted to electric energy and this is done on places where wind frequently blows. The solar panel has also been discovered wherein it is the solar energy that is converted to electricity and this kind of generator is often present in tropical countries (Destreza, 2014).

Sustainable energy offer remains the main demand of contemporary society to reply to the increased demand caused by the larger consumption and growth of the population. For a long time, the energy boom supported fossil fuels. Not solely that the supply of oil, coal, and fossil fuel is proscribed, however, there are also major pollution and environmental issues associated with such ancient energy sources. Renewable energy technologies are recognized as part of the most essential solutions for the future and the technologies are required to be further developed in the present century to regulate most of the energy production (Blaabjerg & Ionel, 2015).

Different energy conversion mechanisms naturally classify the energy technologies that were mentioned but converting the wasted environmental technology to electricity is the aim of all the harvesters specified. Scrutinizing the potentials of different energy sources specifically renewable, sustainable, and green energy sources is one of the extremely substantial and demanding issues as a result of air and water pollution, and oil depletion by the cause of using fossil fuels (Hossain et al., 2016).

Free energy is a non-existential thing. So, any electric power/energy that is converted from solar cells, wind, tidal, geothermal, and hydroelectric would only be free when people begin the process of generating electricity by providing some capital cost (Grover et al., 2014).

Mechanical Energy

The world is a storage facility for energy. According to the first law of thermodynamics, also known as the Law of Conservation of Energy, energy can nor be created nor be destroyed. However, it can be changed starting with one structure then onto the other. The investigation for the search for renewable sources of energy is presently a noteworthy concern worldwide as a substitution for the high demand for non-renewable energy sources. Interest in free electricity generators became popular. The idea of free energy is a misguided judgment, energy cannot be created. In any case, producing energy through the methods for promptly accessible resources, for example, the Sun, Wind, Tidal, Hydro-electric, and Geothermal turns out to be free after the underlying capital expense. The energy created is free up to the point that we do not need to pay for the generation of the electric power delivered by these non-conventional techniques for producing electrical power. Most of the power that is created utilizes Faraday's law, electromagnetic induction (David, 2017).

For a long time, simple magnets have been utilized for their magnetic field to create electric power. They are put inside the center of engines and generators. The fundamental guideline of power generation lies under the magnetic impact. It expresses that "When a conductor is turned in a magnetic field, a voltage is initiated or induced in the conductor" (Grover & Ramalla, 2014).

The voltage capacity of dynamos will depend on the maximum and minimum amount of voltage that a certain motor and generator can produce. Mechanical energy can produce a certain amount of voltage that can be applied for small domestic usage (Matiur et al.,2016). The voltage output will depend on the capacity of the dynamo. As for the study, the researchers use 24 volts of dynamo wherein it can produce 9-10 volts that can be used as a temporary supply of electricity in emergencies.

One of the sustainable sources accessible is mechanical energy and was being connected to those that utilized windmills. The wind turbine can convert the energy in the wind to mechanical energy which, thus, can be nourished into a generator to produce a large quantity of energy. This energy might be utilized to charge batteries or pump water (Shahzad, 2015). The actual concept is that the spinning shaft turns the electromagnets that are surrounded by heavy coils of copper wire inside generators. This creates a magnetic field, which causes the electrons in the copper wire to move from atom to atom, creating electricity. The voltage produced by a generator depends upon the number of turns in its coils, the strength of the magnet, and the rate at which the magnet turns. The more turns in the coils, the more voltage is produced (Gadkari, et al. 2014).

Solar Energy

Solar energy's alternative use as a power source is helpful in outdoor emergencies and the use of solar energy would circumvent the traditional way of waiting beside an electrical socket or outlets for charging. The use of solar energy as an effective alternative source of power for electrical energy could change the conventional way of charging due to its easy accessibility at any location to sunlight or an equivalent light source (Attia, 2014).

One of the most popular renewable energy sources is solar energy through solar panels. Solar panels convert solar energy to electrical energy through photons shooting out from the sun. Solar panels are made up of smaller units called solar cells which are made from silicon. Each silicon atom is connected to its neighbors by four strong bonds, which keep electrons in place. Photons shooting out from the sun strike the silicon cell with enough energy, it can knock an electron from its bond. The electrons are collected by thin metal fingers at the top of the cell and from there, they flow through an external circuit doing electrical work like powering a lightbulb. Twelve photovoltaic cells are enough to charge a cellphone, while it takes many modules to power an entire house. Electrons are the only moving parts in a solar cell and there's nothing to get worn out or used up so solar cells can last for decades (Komp, 2016).

Solar energy has a lot of advantages and benefits for the earth's population that consumes a lot of power and renewable energy is rapidly gaining importance as an energy resource. Solar energy relies on the sun's energy and heat and it is free and unlimited. Solar energy does not emit any greenhouse gases and harmful waste that could affect the environment and the population's health. Solar power is saving and perfect for power generation in remote areas or where the cost of expansion of the utility grid is high. Lastly, due to simple construction and low maintenance cost, solar energy systems are mainly used for generation purposes (Keskar, 2014).

Chemical Energy

Chemical energy is the energy stored in substances or materials and an example would be batteries. Batteries or renewable generated chemicals such as fuel cells are mainly constituted as chemical energy storage technologies. Batteries bring a great promise in a range of small-scale to large-scale applications as electrochemical energy storage. (Revankar, 2019).

The hypotheses of the study are as follows: The principle and procedure for electromagnetic induction will be applied for mechanical and Photovoltaic for solar so that the O.P.A. will convert it into electricity; O.P.A can generate electricity in more than a week for about 9-10 voltage and can charge Smartphones, Radio, and Flashlights that is important in case of emergencies and; The O.P.A. will use recyclable and non-hazardous materials with regards to cleanliness upon making the project so the process and the product itself will be environmentally friendly.

METHODS

Materials

Since the researchers used an experimental method, the researchers were able to design and make the O.P.A with the materials needed such as 2 dynamos (24 volts each) and 12 volts battery. These 2 dynamos served as the generator. Another material that the researchers needed was a PCB with the size of (2×3) or (6×6) inch that can hold a minimum input of 8 voltage. The PCB was where the wires and other components were attached as a medium to the outlet. Then, another PCB was used for mobile charging. The solar panel was also used. It will be one of the major sources of electricity that will produce 9-10 volts. The other equipment is Cable ties, Wires (black, red, and white), Recyclable amplifier case, Glue gun, Gears, Electric outlet, Mobile charger PCB, Multitester, and Soldering iron.

Sample

Figure 1 shows the actual design of the O. P. A. generator with its components mentioned in materials and the two-wire connections with the solar panel.

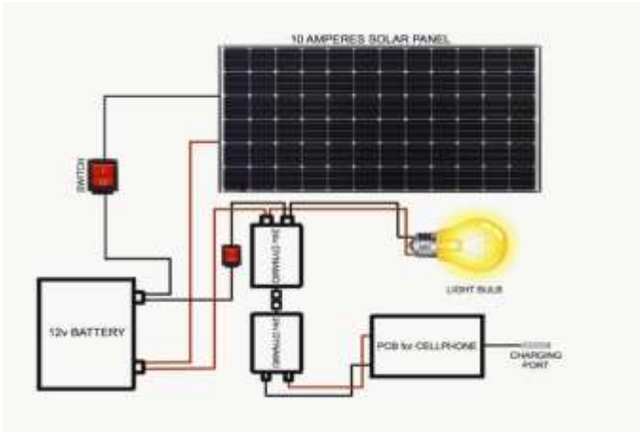

Figure 1. Design of the O. P. A. generator

Data Gathering Procedure

The researchers innovated a certain product that was useful in everyday life. At first, all the materials needed were assembled on the experimentation. Then, all the materials were tested if it is working or not by using a digital multi-tester. After that, 2 dynamos were connected through the gears using a soldering iron, then wires were placed on dynamos and connected to the battery. Again, with the use of soldering iron. And then wires on PCB were directly connected to the cell phone. After the wires were connected to the outlet, a multi-tester was used again to identify the product output of the O. P. A. (Omni Power Apparatus). After testing the electric outlet, a solar panel was attached and was connected to the battery. It was tested again if all the components were working using the multi-tester. Lastly, if all the components work, it was assembled in an amplifier casing with the solar panel on top.

Analytical Procedure

The study used a multi-tester to identify the output voltage of the O.P.A. The dependent variable was the voltage output of O.P.A and the independent variable was the voltage capacity of dynamos (generators) for mechanical energy and solar panels for solar energy. The results were compared to commercial power banks. Those significant differences were the major aspect to be considered in analyzing the result.

RESULTS

Voltage Output of Dynamo/s

Table 1. Voltage Output of Dynamo/s in Volts

Number of Dynamo Used	Trial 1 (Volts)	Trial 1 (Volts)	Trial 1 (Volts)	Average (Volts)
1	6.5	5	6	5.83
2	5	4	5	4.66
3	5	4	5	4.66
4	3	3	3	3

Table 1 presents the energy (in volts) output in different amounts of dynamos and was measured using a multi-tester. As seen on the table, there are differences in the output. The output voltage for one dynamo has 6.5 volts on the first trial, 5 volts on the second trial, and 6 volts on the third trial. One dynamo has an average of 5.83 voltage output. The output voltage for two dynamos has 5 volts for the first trial, 4 volts for the second trial, and 5 volts for the third trial. Two dynamos produce an average of 4.66 volts after the three trials.

For three dynamos, it produces an output of 5 volts for the first trial, 4 volts on the second trial, and 5 volts for the last trial. It was able to produce an average of 4.66 volts after the trials. As being observed, two dynamos and three dynamos have the same output throughout the trials and its average output.

And lastly, for the four dynamos, it produces an output voltage of 3 volts for the first, second, and third trials. Therefore, it has also an equal average output of 3 volts. The result of the experiment is greatly influenced by the amount of voltage and the quantity of the chemically stored battery.

Voltage Output of Dynamo/s with Solar Panel

Table 2. Voltage Output of Dynamo/s in with Solar Panels

Number of Dynamo Used	Trial 1 (Volts)	Trial 1 (Volts)	Trial 1 (Volts)	Average (Volts)
1	8	9	9	8.66
2	9	10	9	9.33

Table 2 indicates the amount of voltage output with different quantities of dynamo. At the first dynamo, the amount of the voltage is 8 volts for the first trial while the voltage of the second trial is 9 volts then the last trial is also 9 volts, which concludes the average voltage to become 8.66 volts for only one dynamo. Then, with two dynamos, the first trial has an output of 9 volts, while the second trial is 10 volts, then the third trial is 9 volts, which concludes the average voltage to become 9.33 volts. We can see that the voltage in every dynamo at the first table is being doubled at the second table by the help of the Solar Panel. Solar Panel helps the dynamo to convert electricity that can be used by the O.P.A. Generator. It depends on the amount of voltage of the chemical stored battery.

DISCUSSION

It is shown from the first result which comes from the voltage output of dynamo/s that the dynamo/s had different voltage outputs from each trial taken. And the voltage produced is decreasing as the quantity of the dynamo is raised. While from the second result, the trials also had different results. The quantity of dynamo also affects the voltage produced in the second experiment but there, as one dynamo was added, the voltage produced also increased. This means that the quantity of dynamo affects the production of the voltage in the experiment made. There was also a change in the amount of battery and its voltage. The battery voltage used was 12 volts. The experiment also showed that the output voltage of the dynamos depends on the amount of voltage used. Thus, the voltage output produced was only below 12 volts.

The results are related to the study of Blaabjerg and Ionel 2015. In their paper, it mentions that sustainable energy remains the main demand of contemporary society. Those types of technologies were considered as one of the most essential solutions for the future, although it still needs further developments. From the results, it can be inferred that the generator that was innovated is one of those technologies that

need further improvements. Therefore, as those technologies require more improvement, sustainable energy would remain as one of the main demands of contemporary society.

The results of the voltage output of dynamo/s with solar panels can also be correlated with the study of Attia 2014. According to the study, the use of solar energy as an effective alternative source of power could change the traditional way of charging as it is easy to access in any location within the sunlight's range or even an equivalent light source. From the experiment, when the solar panel was enforced with the generator, it gave a boost to the voltage output results of the dynamos. Thus, it could be claimed that the solar panel can boost the charging of emergency devices as it enhances the amount of voltage released of the dynamos.

The results gathered are significant as it would be the guide as to what devices are compatible with the generator made.

CONCLUSION

Producing enough voltage is not as easy as it is. It needs a main source for the motor and generator to regulate energy to produce a certain voltage. Aside from that, there are many things to consider such as the materials needed like a dynamo. To produce a large quantity of electricity, the dynamo and battery should be considered.

Therefore, 24 volts capacity of dynamo together with 12 volts battery can produce nine to ten (9-10) volts which is enough to run small devices that are used in daily activities. Since the battery was used, it produced 2 different output voltages, the first one is for chemical energy which is a direct current to the dynamo, and the other one is for mechanical energy which is from the output voltage of two-24 volts dynamo.

Lastly, solar energy is a direct current which needs storage to produce energy. It is very important because it cycles the energy and lessens the cost and the pollution itself, though it uses a battery, it will not be very harmful since the energy was recycled.

In this country that is vulnerable to many disasters, a small amount of voltage will be very important knowing the suspension of electric supply will be the major effect of it.

REFERENCES

AJ-bahadly, I. (2018). Portable multi-inputs renewable energy system for small scale remote application,56-73. Retrieve from https://doi.org/10.4236/jpee.2 018.62005

Attia, H. A., Getu, B. N., Ghadban, H., & Mustafa, A. K. A. (2014). Portable solar charger with controlled charging current for mobile phone devices. 7(1), 17–24. Retrieve from https://doi.org/10.5383/ijtee.07.01.003

Blaabjerg, F. & Ionel, D. (2015). Renewable energy devices and systems – State-of-the-Art Technology, Research and Development, Challenges and Future Trends, Electric Power Components and Systems, 43:12, 1319-1328. Retrieve from http://dx.doi.org/10.1080/15325008.2015.1062819

Brahim, S. P. (2014). Renewable energy and energy security in the Philippines. Energy Procedia, 52(Figure 2), 480–486. Retrieve from https://doi.org/10.1016/j.egypro.2014.07.101

Chen, Q., Dong, W., Liu Y., Tsai. S., Xue. Y., Zhang, J. & Zhou, J. (2016). Models for forecasting growth trends in renewable energy. Renewable and Sustainable Energy Reviews., Retrieve from http://dx.doi.org/10.1016/j.rser.2016.06.001

Destreza, F. (2016). Portable self-sustaining electric generator. (March 2014).

Emetere, M. E., Okoro, U., Etete, B., & Okunbor, G. (2016). Free energy option and its relevance to improve domestic energy demands in southern Nigeria. Energy Reports, 2, 229–236. Retrieve from https://doi.org/10.1016/j.egyr.2016.09.001

Gadkari, S., Kolte, K., Jasani, M., Vichare, A., & Beatrice, S. (2014). Generation of electricity from fans. 5(3), no. 3294–3297.

Grover, M., Kumar, B. L., & Ramalla, I. (2014). The free energy generator. 4(12), 4–7.

Ibrahim, H., Alinca, A., & Perron, K., (2007) Energy storage systems—Characteristics and comparisons. 1234

Lee, J., & Kim, J. (2016). All-in-one energy harvesting and storage devices. 4, 7983–7999.

Patrick, A., & David, J. (2018). Electro-magnetic induction: free electricity generator. (May 2017), 0–13.

Shahzad, U. (2017). The need for renewable energy sources. (May), 15–18.

Tabar, V. S., Jirdehi, M. A., & Hemmati, R. (2017). Energy management in microgrid based on the multi objective stochastic programming incorporating portable renewable energy resource as demand response option. Energy, 118, 827–839. Retrieve from https://doi.org/10.1016/j.energy.2016.10.113