Evolution in Electrical and Electronic Engineering Vol. 4 No. 1 (2023) 26-35
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EEEE

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/eeee
e-ISSN : 2756-8458

The Development of Solar Motor Generator for Stall Hawkers

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DOI: https://doi.org/10.30880/eeee.2023.04.01.004
Received 12 July 2022; Accepted 12 December 2022; Available online 30 April 2023

Abstract: The increase of demand for energy which stimulated by developing countries and consequent decrease of power sources that leads to an unsustainable future. These way renewable and clean energies are necessary to be practice in our daily life. For instance, an energy that produces through a movement or directly converted into electricity is known as kinetic energy. The present studies deal with the development of Solar Motor Generator for stall hawkers, an innovation of a generator that generates electricity which will help us to produce electricity through green way. This generator is a mini green energy power plant which converts the chemical energy into a usable electrical energy. The purpose of this generator is to produce both Alternating Current (AC) and Direct Current (DC) as the outputs. This generator will function as a normal motor generator where it will generate the current without any combustion process. This generator also consists of a solar panel which is singular axis mode to track the position of Sun. The evaluation of the parameter for the solar panel was verified and recorded. The following parameters were voltage (V) and current (I). The parameters' readings are obtained every 7 days and tabulated from table 2 to table 8. However, depending on the temperature and environmental circumstances, the average time to charge the battery is 3 to 5 hours. The solar radiation has reached its optimum range at 12 and 1 o'clock afternoon which has been analyzed and tabulate. This device is fully modular, which means it can be assembled and disassembled. Thus, it's free and saves electricity cost in our house and we can get much healthier foods from the night markets.

Keywords: Alternating Current, Direct Current, Green Energy, Solar Radiation

1. Introduction

As globally, most of the technology and infrastructure are giving importance towards the Industrial Revolution 4.0 (IR 4.0). This is because the Fourth Industrial Revolution has an enormous potential upon deciding the rise of a country's growth as in economically or the quality of life of the civilizations

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[1]. Looking at the current state of the technology has made unpredictable things into affordable and access able among the consumers. The IR 4.0 plants an important part upon the transformations of energy efficiency. "The three applications that suggest impending change are more powerful batteries for renewable energy, an intelligent drive that delivers real-time machine performance, and fuel cells for stationary power systems" [2]. There are many kinds of energy in the world, like the heat from the sun, the wind, and waterpower. This energy may be used to minimise the overall amount of power delivered. The major concern is that most of the countries has citizen among the middle-class malady group. For instance, in Malaysia, the middle-class group is widely known as B 40, “Bottom 40%” who barely meets the end making of daily income [3]. A year ago, this group of people was one of the COVID- 19 pandemic victims that strike nationwide. However, our government has developed an intensive plan to support this group [4]. The SME Corporation Malaysia is a platform for the B 40 people to generate a monthly income [5]. As an example, numerous stalls in the night market utilize gasoline generators, which might contaminate the food because of the carbon monoxide gas that is released by the generators. In addition, several household electrical equipment and lighting fixtures use a negligible amount of power. Using natural energy may help preserve the environment and money.

Recently in Malaysia, many people like having stalls to find some additional income for their living. Sometimes the stall operates during the day and sometimes do at night. Can we imagine what will happen if the entire stall that serves at a particular night market runs with a gasoline generator? In the presence of sunshine, the nitrogen oxides emitted by generators react with other chemicals to generate ozone, a major cause of asthma attacks and other health issues [6]. When gasoline or diesel generators are used in enclosed spaces, the carbon monoxide gas (CO) is being released out of the internal generator. This process is known as combustion when a highly flammable substances is being burned out to produces electricity which cannot be avoided [7]. The CO gas is so lethal it acts as an insidious killer. However, maintenance is an essential concern for any generator since it is required regularly to maintain the generator functioning efficiently. The fuel injection system and other components are more prone to failure, resulting in a lack of dependability and high replacement costs for spare parts and components [8]. Diesel engines are constructed of large and heavy components, which may make maintenance prohibitively costly.

The goal of this project is to construct a power generation system that is fully automated, requires a modest initial investment, and will gather kinetic energy and transform it into electrical energy that can be used to power some of the electrical devices that are found in houses and night market stalls. The device will also include a backup battery to store extra energy. Production costs will be given top priority in order to keep the project within the budget of the B 40. The low-cost mobile power generator's design makes it easy to transfer to regions where electricity supply is a concern.

2. Materials and Methods

In this study, choosing the components carefully is vital since the scale of the system will be dependent on those choices. Figure 1 depicts a Solar Motor Generator for your viewing pleasure. There are ten watts on the solar panel board. Utilizing a photovoltaic extension port enables an increase in the electricity generated by photovoltaics.

It is portable and has been constructed in such a manner that it leaves more room for storage than other similar products. Solar radiation may be converted into usable electricity via the use of photovoltaic panels. Monocrystalline solar panels, which have one of the highest efficiency percentage rates compared to other types of materials, were the kind of solar panels that were employed. Two lead acid batteries with a capacity of 40 AH each were used in the system. The solar generator has a minimal cost of maintenance since the only component that has to be replaced is the battery once every three to four years. The solar charge controller that was employed in the research had a voltage of 12 volts and a current of 5 amperes, and its primary functions were to charge the battery and safeguard the inverter.

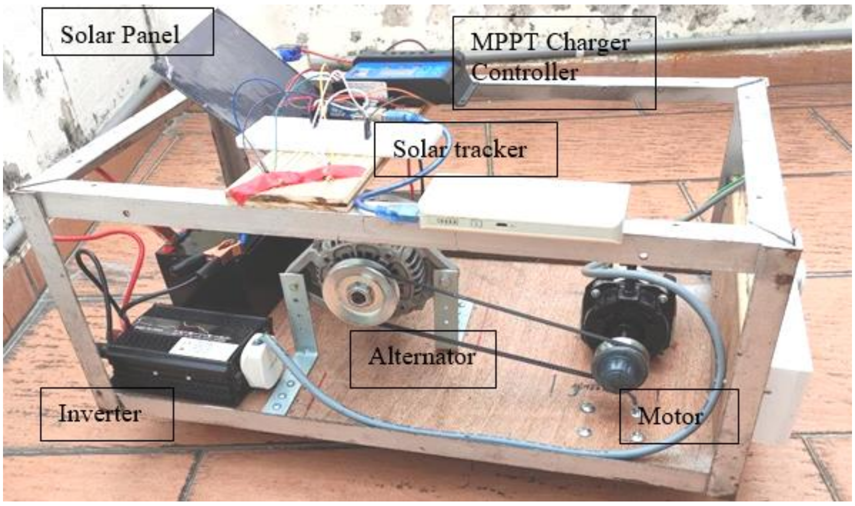

Figure 1: The prototype design of Solar Motor Generator

According to the summary of this study, the Solar Motor Generator is designed to gather solar energy and store it in a lead-acid battery that operates at a voltage of 12 volts. The power output of the system is capable of concurrently powering both the AC load and the DC load which uses direct current. The direct current output is 12 Vdc, while the alternating current output is a single phase 220 Vac. The battery and the inverter are both safeguarded by the main fuse, which has a current rating of 20A. The system may be charged with the help of the electric power that is generated by the AC motor if the amount of solar radiation that is received is too low due to inclement weather. The AC outputs are supplied by the inverter, which is linked to the switch socket outlets.

During this investigation, both the functionality of the solar generator and its most efficient mode of operation were analyzed. The experiment was carried out in two distinct stages. The first experiment was carried out so that the sun tracking system could be determined, and the second experiment was carried out so that the performance of the system could be determined. Voltage and current were used as the parameters to measure performance, and the results were analyzed accordingly.

The efficiency of solar panels may be affected by a variety of temperatures, which can lead to a reduction in the amount of electricity gained. Figure 2 is an illustration of the functioning of this project in the form of a simple block diagram for the purpose of providing a better understanding of how this project will work as a unit.

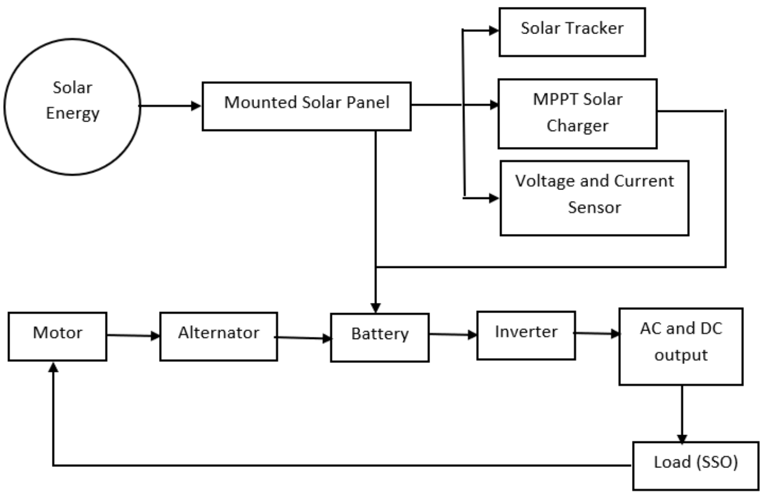

Figure 2: The block diagram of the proposed system

The hardware development phase explains how various components or kinds of material are included into the finished product of the gadget. At this point in the process, the responsibility for ensuring that the product functions as expected falls squarely on your shoulders. If the design phase comes to an end with a prototype that is not functional, the engineering phase will end with a prototype that is functional and that emphasizes the major characteristics of the product. Because of the complexity of hardware goods, it is common practice to construct prototypes by using many components. This is done to decide which method will be the most successful. The practice of iteratively developing hardware should become the standard. As shown above in Figure 2, the system initially can be operated with the existing chemical energy source from the battery. However, the system also uses the source of solar energy to charge the battery. The solar panel will extract the solar energy and simultaneously transmit it to MPPT Solar Charger Controller, solar tracker, voltage and current sensor and battery. Maximum Power Point Tracking (MPPT) is a technique for regulating the charge of your battery bank. Anyone who is familiar with the charging and discharging properties of a battery is aware that its voltage fluctuates with its charge content. The larger the flow of current as it goes from a high to a low potential as the voltage differential. The solar tracker is a singular axis-based tracker which allows the mounted solar panel to follow the direction of Sun to obtain the maximum energy can be consume at the time. The voltage and current sensors are to measure the evaluation parameter of the solar panel. As shown above, the system is constructed in a closed looped where the power source of motor is taken from the load. When the motor is running, it is attached to the alternator through a belt which will allows the alternator to generate electricity and charge the battery. The inverter is used in the system to produce alternating and direct current (AC & DC). The output source can be used through the switch socket outlet (SSO).

3. Results and Discussion

The design analysis for the proposed system was initially started with a normal motor generator where there will be an attachment of a solar panel. The design for the solar panel was crucial due to the fragility of the solar panel. As shown in Figure 3, the solar panel has a tracker device implement which will adhere to the direction of the Sun. The main components for the tracker system were constructed with Arduino, two LDR’s, servo motor. The coding was tested and verified using Arduino software. As shown in the figure 3a, the coding was compiled successfully as the LDR1 and LDR 2 was connected to the pin A0 and A1 in Arduino Uno board whereas the signal pin from the servo motor is connected to the pin 9 in Arduino Uno board. One-axis solar tracker systems use servo motors that allow them to move in two directions on a single axis, which is very useful. For example, if it is for the x-axis, it will move in both the +x and -x axes as necessary. In automated mode, the microcontroller transforms the analogue values of LDR sensors (pins A0 to A1) to digital values using the A0 to A1 digital converter. Then it uses Pulse-Width Modulation (PWM) signals on pins 9 to regulate the servomotor up and down to follow the sun. The rotational motions take place in the axis and azimuth directions, moving from east to west in accordance with the daily sun's journey.

(a) (b)

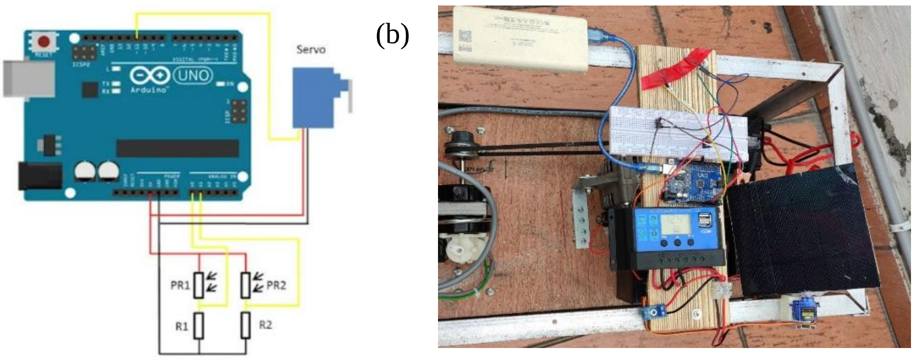

Figure 3: (a) The schematic diagram of the solar tracking system and (b) the solar tracking system

In the end, the goal of this thesis is to develop a household energy source that is both cost-effective and ecologically benevolent. It has been calculated how much load is being used at the night market, and this has been done to determine how much load is being utilized. The results were obtained through a field testing, the evaluation of the parameters for the proposed system required to be done outside. The horizontal single axis solar tracker system was tested in the open air to demonstrate its operation in the direction of the sun. On the month of May, 7 days were required for this evaluation process took place in Taman Dato Harun, Jalan Klang Lama, Petaling Jaya, Selangor and the weather plays an important role in this process. The data was collected and analysed from 08:00 a.m. to 17:00 p.m., throughout the period for every one hour the readings of voltage and current was collected. The data of output value from the solar panel has been recorded and tabulated in the Table 1 to Table 7 and Figure 4 to Figure 10. The power requirement for the load is calculated by using equation 1.

$$\text{Power} = \text{Voltage} \times \text{Current} \quad \text{(Equation 1)}$$

Table 1: The Evaluation of the parameter for Day 1

Time	Voltage (V)	Current (mA)	Power (W)
08:00 a.m.	6.12	23.6	0.14
09:00 a.m.	6.45	30.3	0.20
10:00 a.m.	6.82	38.4	0.26
11:00 a.m.	7.69	52.2	0.40
12:00 p.m.	8.05	58.7	0.47
01:00 p.m.	7.51	46.5	0.35
02:00 p.m.	6.65	31.6	0.21
03:00 p.m.	6.04	23.5	0.14
04:00 p.m.	5.78	17.8	0.10
05:00 p.m.	5.45	14.3	0.08

(a) (b)

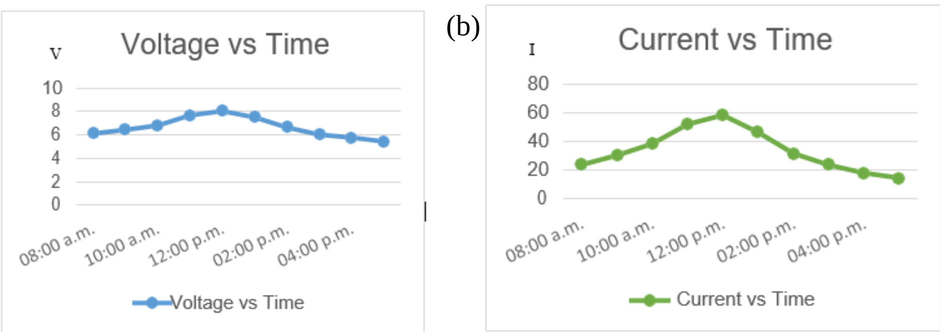

Figure 4: Day 1 graph. (a) Voltage against Time. (b) Current against Time

Table 2: Evaluation of the parameter for Day 2

Time	Voltage (V)	Current (mA)	Power (W)
08:00 a.m.	5.88	45.9	0.27
09:00 a.m.	6.63	52.2	0.35
10:00 a.m.	6.85	58.7	0.40
11:00 a.m.	6.97	37.0	0.25
12:00 p.m.	7.59	125.4	0.95
01:00 p.m.	6.47	110.4	0.71
02:00 p.m.	6.45	86.2	0.56
03:00 p.m.	6.22	71.2	0.44
04:00 p.m.	6.19	47.2	0.29
05:00 p.m.	5.73	39.6	0.23

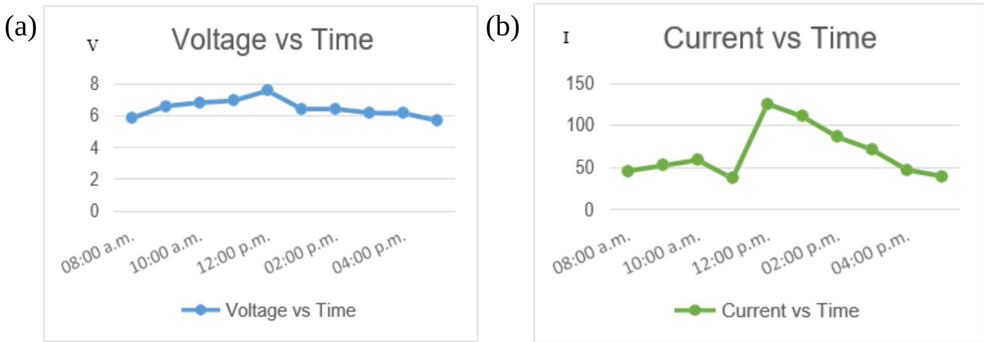

Figure 5: Day 2 graph. (a) Voltage against Time. (b) Current against Time

Table 3: Evaluation of the parameter for Day 3

Time	Voltage (V)	Current (mA)	Power (W)
08:00 a.m.	5.87	51.8	0.30
09:00 a.m.	6.63	80.5	0.53
10:00 a.m.	7.02	156.3	1.10
11:00 a.m.	7.33	178.7	1.31
12:00 p.m.	6.85	97.5	0.67
01:00 p.m.	6.60	87.2	0.58
02:00 p.m.	6.45	81.4	0.53
03:00 p.m.	6.33	54.0	0.34
04:00 p.m.	6.28	53.2	0.33
05:00 p.m.	5.94	48.7	0.29

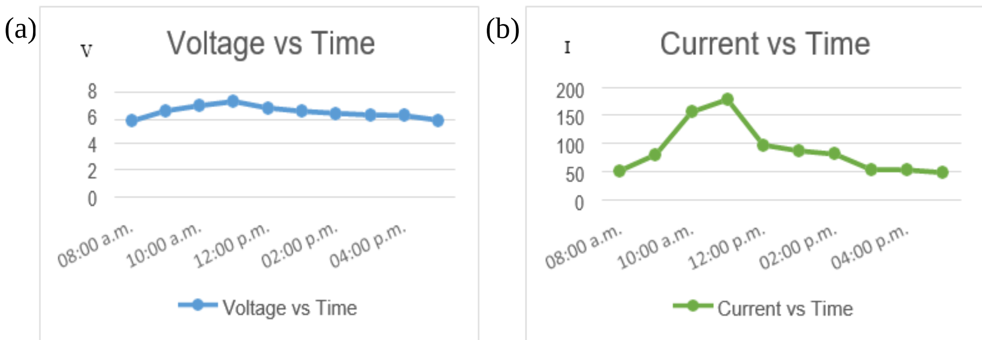

Figure 6: Day 3 graph. (a) Voltage against Time. (b) Current against Time

Table 4: Evaluation of the parameter for Day 4

Time	Voltage (V)	Current (mA)	Power (W)
08:00 a.m.	5.78	54.7	0.32
09:00 a.m.	6.12	59.2	0.36
10:00 a.m.	6.54	76.4	0.50
11:00 a.m.	6.38	57.8	0.37
12:00 p.m.	6.44	63.8	0.41
01:00 p.m.	6.69	56.0	0.37
02:00 p.m.	6.52	53.6	0.35
03:00 p.m.	6.48	49.2	0.32
04:00 p.m.	6.34	44.6	0.28
05:00 p.m.	6.17	30.8	0.19

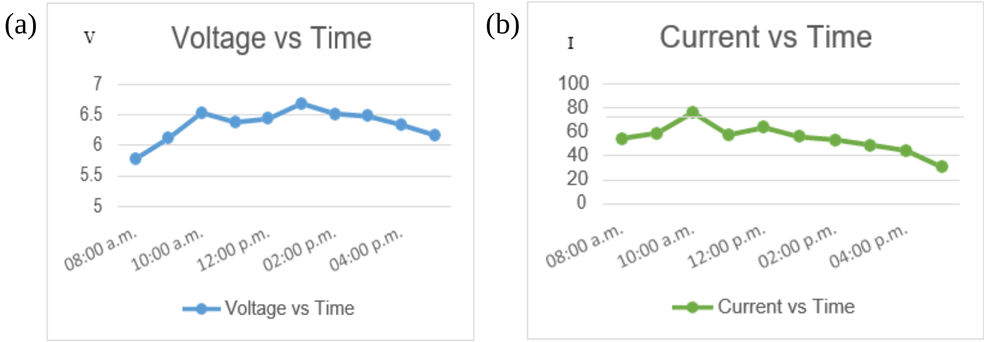

Figure 7: Day 4 graph. (a) Voltage against Time. (b) Current against Time

Table 5: Evaluation of the parameter for Day 5

Time	Voltage (V)	Current (mA)	Power (W)
08:00 a.m.	6.02	58.8	0.35
09:00 a.m.	6.25	72.5	0.45
10:00 a.m.	6.52	65.3	0.43
11:00 a.m.	6.94	78.7	0.55
12:00 p.m.	7.15	84.9	0.61
01:00 p.m.	6.81	73.5	0.50
02:00 p.m.	6.65	65.7	0.44
03:00 p.m.	6.54	58.2	0.38
04:00 p.m.	5.98	51.7	0.31
05:00 p.m.	5.75	45.8	0.26

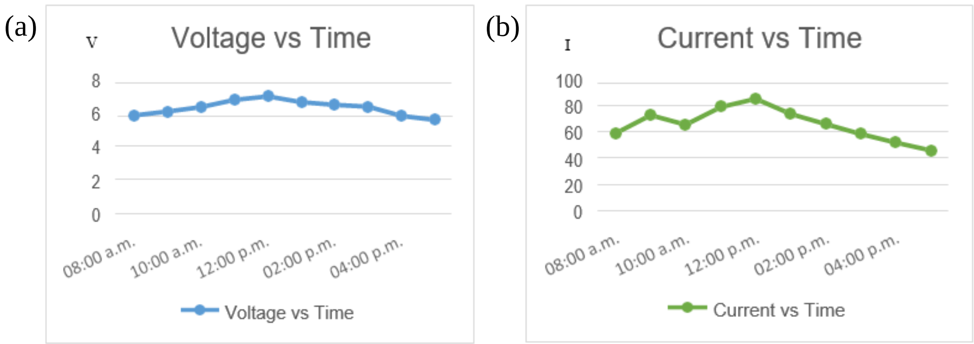

Figure 8: Day 5 graph. (a) Voltage against Time. (b) Current against Time

Table 6: Evaluation of the parameter for Day 6

Time	Voltage (V)	Current (mA)	Power (W)
08:00 a.m.	5.87	52.2	0.31
09:00 a.m.	6.28	58.7	0.37
10:00 a.m.	6.43	65.2	0.42
11:00 a.m.	6.56	87.5	0.57
12:00 p.m.	6.98	92.7	0.65
01:00 p.m.	6.85	89.4	0.61
02:00 p.m.	6.78	86.7	0.59
03:00 p.m.	6.63	72.5	0.48
04:00 p.m.	5.87	48.2	0.28
05:00 p.m.	5.56	39.7	0.22

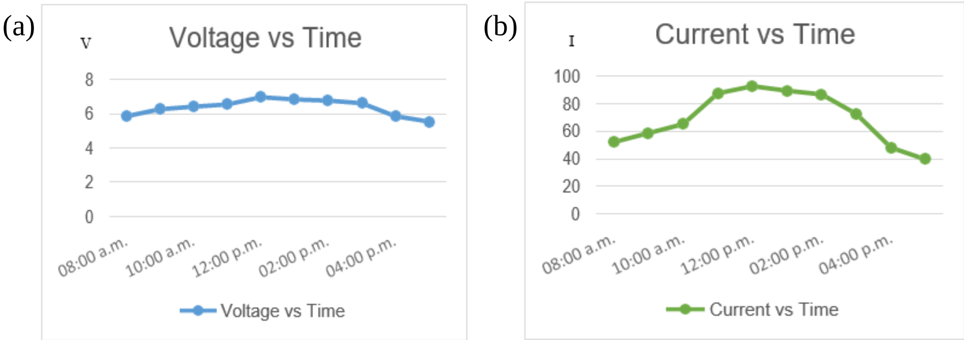

Figure 9: Day 6 graph. (a) Voltage against Time. (b) Current against Time

Table 7: Evaluation of the parameter for Day 7

Time	Voltage (V)	Current (mA)	Power (W)
08:00 a.m.	5.77	45.6	0.26
09:00 a.m.	6.17	54.2	0.33
10:00 a.m.	6.33	59.6	0.38
11:00 a.m.	6.22	57.8	0.36
12:00 p.m.	6.08	51.1	0.31
01:00 p.m.	6.35	55.0	0.34
02:00 p.m.	6.28	53.6	0.34
03:00 p.m.	6.12	49.2	0.30
04:00 p.m.	5.87	45.6	0.27
05:00 p.m.	5.76	36.8	0.21

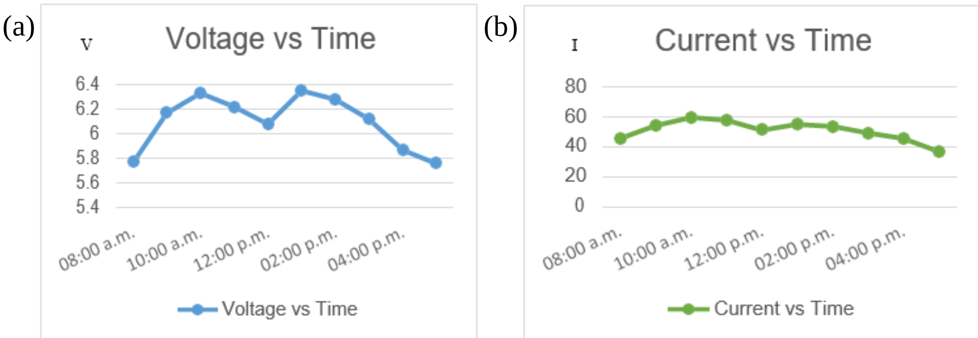

Figure 10: Day 7 graph. (a) Voltage against Time. (b) Current against Time

The electromagnetic radiation that is emitted by the sun is referred to as "solar radiation," but it is also often referred to as the "solar resource" or "sunlight." Solar radiation has the potential to be captured and turned into a variety of different forms of useable energy. Alterations in the quantity of accessible sunlight that occur hourly are also caused by the rotation of the Earth, which is responsible for both phenomena. Early in the morning and late in the afternoon are the times of day when the sun is at its peak, or lowest point, in the sky. In the early morning hours, when the sun is at its lowest point in the sky, the path that its rays take through the atmosphere is far longer than it is during the middle of the day. On days when the sky is clear, a solar collector will gather the greatest amount of solar energy around the middle of the day, around solar noon. The quantity of current that is generated by a solar panel is directly correlated to the amount of light that is received by the panel. When one panel is subjected to strong sunlight levels, a current of around 8 amps will be produced by that panel alone. The evaluation of the parameter for the system was conducting using the voltage and current sensors.

Both the sensors were placed after the mounted solar panel where it can be referred to Figure 2. Based on the climate and environmental factors the average time taken to charge the battery is approximately 3 to 5 hours. It also depends on the usage of the load and the balance amount of battery has been consumed. Nevertheless, the system can be supported for the stall hawkers to operate their business.

This current will have a voltage that is almost identical to the voltage that is needed to drive an inverter, and it will be able to do so. The measurements were taken using multimeter as shown in Figure 11. According to both the table and the graph, the parameter measurements for each of the seven days have produced a unique form of graph pattern. It's possible that this is because of the shadow effect that's being cast on the solar panel. For instance, as can be seen in the table and graph shown above, the optimal range for solar radiation is reached between midday and one in the afternoon. This phenomenon has been investigated. The results for Day 7 are shown in Table 7, and there are no high value readings. This is because to the weather. The seventh day brought with its gloomy skies and a strong breeze.

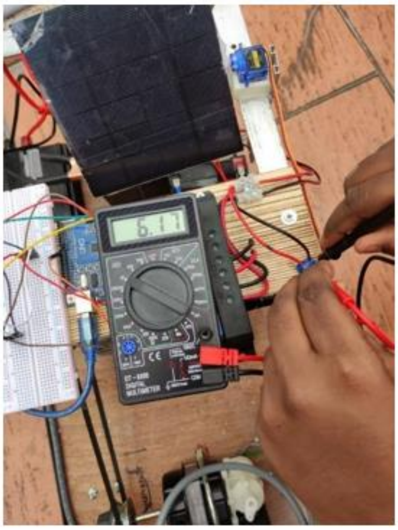

Figure 11: The reading of voltage was taken using multimeter

4. Conclusion

All the work that has been scheduled is successfully done within the time frame that has been set. The feasibility study for the manufacture of solar motor generator has now been completed. The study of the PV system's size has been completed. The prototype has been developed, built, and tested to ensure it meets all requirements. This kind of behavior contributes nothing to the notion of energy conservation. Furthermore, the amount of electricity produced by the grid system is always greater than the amount of electricity required. When it comes to lighting and powering small electrical appliances, portable solar generators have the potential to replace gasoline generators in the not-too-distant future. There is little upkeep required; the battery has only been replaced once every three to four years, which keeps the cost of ownership down. It is compact, lightweight, and portable, making it convenient to store and perfect for use at home, at the night market, or as a backup energy source, among other things. Considering the convenient of the product and makes use of solar energy to generate clean energy, this generator is an excellent alternative power source. The sun-tracking technology that is being employed offers the most energy possible for the generator.

However, the evaluation of the following parameters for the 10 days has the readings of similar values range when the measurements is taken for every one hour. The readings of the parameter were based on the sun and cloud troposphere. For example, the weather is hot, and the cloud is clear the value of the parameter can be observed at a high value whereas the weather is dull and cloudy the reading of the value will be below the par. As the observation of the parameter for 10 days, the average value has been computed to analyzed at a particular time. For example, morning 9 o'clock the average range of the reading for 7 days would be at 6.36V, 58.23mA and at 12 o'clock afternoon the average reading would be at 7.02V, 82.01mA.

Aerial documentation is utilized to record physical change whenever feasible since it is one of the most reliable sources of information. Despite this, monitoring aerial data in a systematic and reliable manner becomes time-consuming and wasteful. A first phase in which the night market variety is recognized in aerial data according to the established criteria would allow for a significant reduction in the number of comprehensive survey samples required, therefore lowering the amount of time required for data collection in comparable study. In the field of technology education, the following recommendations are given for relevant research in the field of technology; (i) the motor generator should be modest and compact in size so that it is easy to move and does not take up important space at night market booths, (ii) determine if the inclusion of a dual axis sun tracker will increase the generator's efficiency, (iii) would installing numerous solar panels enhance efficiency to a higher level?, and finally (iv) the owners would benefit from the implementation of an IoT system for the solar monitoring system.

Acknowledgement

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

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