Lighting system design using green energy from living plants

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Abstract. Green energy is the energy generated from nature such as water, wind, solar and wave that aimed to reduce environmental damage or destruction, sustain the use of energy and natural resources as well as promote the use of renewable energy. This study aimed to analyse the electrical energy generated by the three types of living plants selected at the parking area of the Faculty of Technical and Vocational Education and design a lighting system for the parking area by using living plants as the source of energy generation. This study consisted two phases, Phase I: Analysing the energy generated from the living plants; and Phase II: designing the lighting system for the parking area phase using living plants. The result of the analysis of the energy produced by living plants showed that the selected living plants are able to produce energy with the sufficient amount needed by the lighting system at the parking area. Based on the analysis of the generation of energy from living plants, the lighting system was designed by using step-up circuit and the charging circuit. In conclusion, living plants should be fully utilized as part of the energy resources to generate energy.

1. Introduction
Most of the publics’ knowledge of green technology is a technology which produces an electric power from resources such as water, wind, sunlight, and waves. According to [1], green technology is the use of products, equipment and systems that are intended to preserve nature and reduce the negatively impact on life. Basically, green technology is divided into several criteria, namely:

i. Reduce destruction or damage to nature.
ii. Has a low level of gas emissions
iii. Preserving energy and natural resources
iv. Promote the use of renewable resources

Green energy is a technology application in power generation system and minimize the adverse effects resulting from human daily activities to the environment [2]. In this rapid development society in Malaysia, the use of electricity is utmost important and become a must in daily life. This growing progress requires constant energy supply without any interruption. At the same time, the increase in electricity tariffs has also increased over time. Universities in Malaysia are also impressed and burdened by the increasing in electricity tariffs.
The previous research findings noted that the current problem facing by all the country around world is no sustainable source of energy that does not interfere with the country’s ecosystem [4]. According to a study by [5], 68% electricity generation nowadays relies on the fuel-burning which have long-term effects on the country’s ecosystem. Hence, it reinforces the reason why research on the generate electricity by using green resource has to be carried out and taken seriously as a source of energy-producing without severe side-effects. Many users are unaware of the importance and many consumers do not know about the advantages of living plants that can produce good and sustainable electricity. Therefore, a technical studies on harvesting electric energy from living plants was conducted. Harvesting energy form living plants is not a new things but only a small portion of people know about this technology. Living plants is one of the energy generator that do not require any high cost. Also, it is a green energy generation system without disturbing any ecosystem besides helping in the improvement of fresh air system at the particular area [3]. The previous studies in determining the electricity generated by living plants only being done on pulai tree, banana tree and aloe vera. The findings showed that these trees have produced voltage of 0.8V 0.913V and 0.945V each [6]. Basically, this study was aimed to:
   i. Analyze the electricity generated by living plants around the parking area at FPTV.
   ii. Design the lighting system for parking area in FPTV using green energy from living plants.

2. Experiment Details
This study was conducted to determine the level of electricity generated by the living plants found around the parking area at Faculty of Technical & Vocational Education, Universiti Tun Hussein Onn Malaysia (refer Figure 1). Based on the gathered information, a green energy-efficient lighting system was designed. There are three types of living plants around the parking were *garcinia subelliptica*, *gliricidia sepium* and *murraya paniculata* as showed in Figure 2.

Figure 1 : Parking Area at FPTV, UTHM
In order to determine the voltage and current generate by the living plants, copper rods and carbon steel rods were used as an electric absorber metal located around the roots of the tree. These two rods were then connected to a multimeter that proposed by [6] as showed in Figure 3. There were 13 times of data collection on the voltage and current readings for each types of the plants regardless the types of soil. In this study, factors that may influence the voltage and current generated by the living plants only focus on the temperature and the weather. Figure 4 showed an example of experiment being done to obtain the voltage and current generated by living plant.
3. Results
There were three types of living plants that found at the parking area of FPTV. The result of voltage and current generated by these three different types of plants were discussed in the following subtopics.
3.1. Voltage and current harvested from *garcinia subelliptica*

Table 1: Voltage and current generated by *garcinia subelliptica*

| NO | Time  | Temperature | Voltage  | Current | Weather |
|----|-------|-------------|----------|---------|---------|
| 1  | Morning | 25˚c | 0.621V | 0.01A | Sunny |
| 2  | Morning | 28˚c | 0.570V | 0.016A | Cloudy |
| 3  | Noon   | 32˚c | 0.632V | 0.010A | Raining |
| 4  | Noon   | 27˚c | 0.687V | 0.011A | Raining |
| 5  | Morning | 28˚c | 0.690V | 0.010A | Sunny |
| 6  | Noon   | 32˚c | 0.691V | 0.002A | Sunny |
| 7  | Morning | 25˚c | 0.676V | 0.013A | Sunny |
| 8  | Morning | 28˚c | 0.677V | 0.003A | Sunny |
| 9  | Noon   | 31˚c | 0.678V | 0.001A | Cloudy |
| 10 | Noon   | 31˚c | 0.676V | 0.013A | Sunny |
| 11 | Evening | 28˚c | 0.668V | 0.002A | Sunny |
| 12 | Morning | 22˚c | 0.602V | 0.005A | Cloudy |
| 13 | Evening | 28˚c | 0.583V | 0.007A | Cloudy |

Table 1 shows that the average voltage generated by *garcinia subelliptica* was 0.652V, and the average of current generated was 0.007A.

3.2. Voltage and current harvested from *gliricidia sepium*

Table 2: Voltage and current generated by *gliricidia sepium*

| NO | Time  | Temperature | Voltage  | Current | Weather |
|----|-------|-------------|----------|---------|---------|
| 1  | Morning | 25˚c | 0.510V | 0.01A | Sunny |
| 2  | Morning | 28˚c | 0.489V | 0.007A | Cloudy |
| 3  | Noon   | 32˚c | 0.680V | 0.010A | Raining |
| 4  | Night  | 27˚c | 0.681V | 0.002A | Raining |
| 5  | Morning | 28˚c | 0.681V | 0.004A | Sunny |
| 6  | Noon   | 32˚c | 0.682V | 0.013A | Sunny |
| 7  | Morning | 24˚c | 0.679V | 0.001A | Sunny |
| 8  | Morning | 28˚c | 0.679V | 0.011A | Sunny |
| 9  | Noon   | 30˚c | 0.681V | 0.013A | Cloudy |
| 10 | Noon   | 31˚c | 0.683V | 0.009A | Sunny |
| 11 | Evening | 28˚c | 0.680V | 0.011A | Sunny |
| 12 | Morning | 22˚c | 0.674V | 0.001A | Cloudy |
| 13 | Evening | 28˚c | 0.678V | 0.009A | Cloudy |

Table 2 shows that the average voltage generated by *gliricidia sepium* was 0.581V, and the average of current generated was 0.007A.
3.3. Voltage and current harvested from murraya paniculata

Table 3: Voltage and current generated by murraya paniculata

| NO  | Time  | Temperature | Voltage | Current | Weather |
|-----|-------|-------------|---------|---------|---------|
| 1   | Morning | 25˚c        | 0.574V  | 0.007A  | Sunny   |
| 2   | Morning | 26˚c        | 0.380V  | 0.006A  | Cloudy  |
| 3   | Noon   | 31˚c        | 0.424V  | 0.004A  | Raining |
| 4   | Night  | 27˚c        | 0.724V  | 0.001A  | Raining |
| 5   | Morning | 28˚c        | 0.728V  | 0.016A  | Sunny   |
| 6   | Noon   | 32˚c        | 0.730V  | 0.012A  | Sunny   |
| 7   | Morning | 25˚c        | 0.731V  | 0.014A  | Sunny   |
| 8   | Morning | 28˚c        | 0.731V  | 0.012A  | Sunny   |
| 9   | Noon   | 31˚c        | 0.734V  | 0.011A  | Cloudy  |
| 10  | Noon   | 31˚c        | 0.728V  | 0.003A  | Sunny   |
| 11  | Evening | 28˚c        | 0.726V  | 0.004A  | Sunny   |
| 12  | Morning | 22˚c        | 0.717V  | 0.009A  | Cloudy  |
| 13  | Evening | 28˚c        | 0.713V  | 0.011A  | Cloudy  |

Table 3 shows that the average voltage generated by murraya paniculata was 0.664V, and the average of current generated was 0.008A.

4. Lighting system design

Based on the data gathered on three types of living plants at parking area FPTV, murraya paniculata generated the highest voltage compared to another two types of plants. The existing lamp type at parking area are the conventional lamp which each of them need 60 watt and 240volt to operate. The lamps will switch on from 7pm to 7am each day. The energy consumed by each lamp is 0.66kWh (60watt x 11 hour). To allow the AC lamp to be switched on using the electricity produce by tree, the existing circuit needs to be adjusted. Figure 5 shows the block diagram for lighting system at parking area FPTV using murraya paniculata as power supply. Figure 6 shows the proposed wiring for the lighting system for the parking area. Meanwhile, Figure 7 shows the designed circuit for voltage booster and battery charger in order to generate the needed electricity by existing lamps at parking area FPTV.
Figure 5: Block diagram for lighting system at parking area FPTV using living plants as power supply

Figure 6: Proposed wiring for the lighting system for the parking area
5. Conclusion

In conclusion, studies related to the harvesting electric energy from living plants should be increased to create green energy consumption society. Finding of this study showed that living plants are able to produce high voltage and current as supply to the lighting system at the parking area in FPTV. However, the voltage generated among the trees are depend on the type of plants, temperature, weather and time [7]. During cloudy weather and raining, the voltage and current reading is lower than sunny weather. Further study on testing the designed lighting system for parking area at FPTV is recommended in order to investigate the functionality of the circuit. This study also showed an example and reference to researchers in the future especially those who are interested in studying green energy as well as to expose the public on generating electricity using living plants. Future research will be done is to test the functional of the proposed lighting system.

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![Figure 7: Voltage booster and battery charger circuit](image)