DEVELOPMENT OF SOLAR PV SYSTEM TOWARDS AWARENESS AND UNDERSTANDING OF RENEWABLE ENERGY AMONG SEBERANG PERAI POLYTECHNIC’S STUDENTS

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Abstract

Sustainable campus is a community with a common objective of improving the effectiveness of energy usage, sustaining resources and increasing the quality of environment. This can be achieved by sustainable development of education and implementing projects that contribute to a green campus. For the realization of the government's commitment towards reducing the greenhouse effect, the Department of Polytechnic Education (DPE) has launched POLYGREEN Blueprint in 2015 with ten (10) focus areas. One of the focus areas is Energy Management, which aims to maintain and improve energy efficiency and promote the use of renewable energy to reduce carbon emissions. In line with focus area 4, which involves the Energy Management, Seberang Perai Polytechnic (PSP) initiated the application of solar system to promote renewable energy (RE). Hence, it also fulfills certain curriculum requirement, which was introduced by Department of Polytechnic Education. The most common usage of electricity in Seberang Perai Polytechnic is to charge the mobile phones. The limited numbers of socket outlets create difficulty and inconvenience among the users to charge their phones. Solution is needed to cater to this problem and simultaneously will ease and save the users’ time. Consequently, the Solar PV (photovoltaic) Mobile Phone Charging System was designed and assembled at a strategic place in Seberang Perai Polytechnic. This system will act as a charging station cum one-stop learning centre for solar system. This project involved the design, fabrication and installation of Solar PV Mobile Phone Charging System and it is the first such project in the Malaysian Polytechnics. The system includes Solar Panel (PV), Distributor Board, Solar Regulator, Battery Bank, charging ports, and DC Load. The station is equipped with suitable lighting for the night use. Survey has been conducted involving 200 samples from all departments of Seberang Perai Polytechnic by using questionnaires. Data were analyzed using SPSS. From the findings, it was proven that the awareness and understanding of renewable energy among the respondents has improved. The project managed to nurture their interest and enhance their knowledge towards solar PV application. It also fulfilled the objective of POLYGREEN Blueprint goals and satisfied Course Learning Outcome (CLO 1) of DEG5122 Energy Efficiency and Management and DEE5081 Project 1 courses. Furthermore, this project also indirectly contributed towards energy saving and managed to save estimated of 294kWh energy consumption which equivalent to RM3240.00 electricity bill per year at Seberang Perai Polytechnic.

Keywords: Renewable Energy; Solar PV; Awareness.
Introduction

PSP faces high electricity consumption with monthly usage at the average of 391022 kWh, which costs RM182,100.00. These numbers lead to an estimated bill of RM2,185,200.00 per year or RM5986.85 per day. PSP’s population comprised of more than 4000 students and 400 staffs. Each of them possesses at least one mobile phone. Even though the mobile phones charging process is not considered as the major contributor to the daily electricity consumption, but by considering the large number of people using mobile phones in the campus, it will affect the overall consumption in the long run. Hence, the solution is by using the Solar Energy, which is more practical and applicable compared to fossil fuels. In line with Focus Area 4 of DPE’s PolyGreen Blueprint, this project is one of the initiatives to promote renewable energy as the alternative source of energy and at the same time towards achieving PSP as the sustainable campus in the future.

The purpose of this project is to build a Solar PV Mobile Phones Charging System that could contribute to energy saving and simultaneously facilitates the process of introducing renewable energy to PSP. Thus, this project was designed and assembled to demonstrate the concept and application of PV solar system. The system will cater the need to charge the mobile phones conveniently.

Literature Review

Energy demand in Malaysia increased from 41,476 kilo tonne of oil equivalent (ktoe) in 2010 to 53,222 ktoe in 2013 and increased to 57,123 ktoe in 2015. The demand for all energy sources is expected to have an average annual growth rate of 6.6% from 2011 to 2015. Utilizing solar PV energy resources is one of the ways of ensuring energy security through better management of resources [1]. Solar technology is a new technology and developing at a linear rate. It has been popularized since the application of this alternative energy source on a pocket calculator [2].

Practical use of solar energy as mobile phones charging systems has been developed in quite a number lately as in [3], [4] and [5] along with everybody’s needs of mobile phones these years. Most projects focused on the technical aspects such as improving the efficiency, complexity as well as reducing costs [3], designing practical positioning of solar cells and utilizing solar light to electrify the remote areas [4] and evaluating the acceptability of the station in terms of physical features, costs, durability and operation [5].

Based on the survey of the social acceptance and human interest in solar energy, 80 % of the respondents are highly interested in solar energy. Meanwhile, almost 80 % of the respondents believed that government incentives could best enhance solar energy usage nationwide. [6].

Methodology

Photo-Voltaic System and Design

The system is designed as a Direct Current (DC) only system, which supplies DC outputs and powers the light. The system consists of a (1) solar panel, (2) regulator or charge controller, (3) battery banks and the (4) charging station as shown in Figure 1.
The PV panel generates power supply to charge the battery bank. Regulator regulates and controls the amount of voltage and current including the charging process. Battery banks stores the charging current and deliver back to the load when required while the load could be any of the DC appliances. The system uses diode in order to prevent the current back flow to the solar or the PV panel. The fuse breaker will act as the protector to prevent current overload.

Figure 2 illustrates the connectivity in between components of the system.

Block diagram in Figure 3 demonstrates the whole system of Solar PV Mobile Phones Charging System.

Figure 3 Block Diagram of the Solar PV System
This system utilizes the concept of stand-alone solar system and powered by a solar array. For this project, it uses a 17V, 75W solar PV panel which converts the sunlight to the electric energy. The charging controller or regulator will prevent the battery from overcharging. It regulates the voltage and current, which flows from the solar panels to the battery. The expected output of the panel is 17 Volts. Therefore, the battery will be damaged from overcharging if there is no regulation. The system will be cut-off automatically when the battery is fully charged. The charging process starts when the battery voltage falls to 10.2V and is cut-off when the voltage reaches 12V. The green LED indicator light will be lighted on to indicate that the 12V DC electric energy has been converted and is flowing through the charge controller circuit. At this point, the rechargeable battery will be automatically charged. On the other hand, during the nighttime or if the sunlight is not present, the battery will start to supply to the DC load. The yellow LED indicator light will be turned ON to indicate this process. The actual system is shown in Figure 4.

![Figure 4 The Actual Solar PV System](image)

**Experiment for Teaching and Learning Purpose**

To facilitate the purpose of teaching and learning process, the kiosk is equipped with the laboratory sheet as guidance for the students to complete their experiment on Solar Photovoltaic System. These experiments introduce the students with the components and basic operation of the solar system. The lecturer in charge explains and supervises the learning session, which lasts for one hour.

**Data Collection and Analysis**

Questionnaires were distributed to 200 students from various departments at PSP. The data collected were analyzed using SPSS. The analyses were focused on the need, understanding and importance of the solar PV mobile charging system.
Findings

This project is the first of its kind in Malaysian Polytechnic. It was designed to be student friendly and easy to understand. All components are easily accessible for testing and educational purposes. The project is also suitable for final year students who are looking for the project, which is related to solar energy. Experiments were designed in such a way that students could perform the testing and familiarize with the system.

Figure 5 shows the students were referring to the lab sheet while testing the system using their mobile phones.

Figure 5 Students Performing the Experiment

Figure 6 displays a student taking some reading from the system.

Figure 6 Students Measuring the Current Flow
This is a pilot project, which provides solar system knowledge and creating awareness regarding the renewable energy among the students. The survey on the need and feasibility of the system were conducted. All the related information including the types of device used by the students and the frequency of charging per day are shown in Figure 7 and Figure 8.

Figure 7 Types of Device Used

<table>
<thead>
<tr>
<th>Device</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart Phone</td>
<td>80%</td>
</tr>
<tr>
<td>Tablet/iPad</td>
<td>10%</td>
</tr>
<tr>
<td>Normal Phone</td>
<td>10%</td>
</tr>
<tr>
<td>Battery Bank</td>
<td>4%</td>
</tr>
</tbody>
</table>

Figure 8 Frequency of Charging the Device

The system is always turned on throughout the year, thus the trend of using the system were recorded as shown in Figure 9 and Figure 10. Figure 9 depicts the duration of mobile devices using the system whilst Figure 10 shows the charging time of the system. Figure 11 shows the respond on need and feasibility of the system...
The system has been successfully developed and used as an educational tool to create awareness on renewable energy among Seberang Perai Polytechnic students. Solar energy was long known as renewable energy, but hardly used practically. With this project, students will have a clearer view on a solar PV system and have the opportunity to use and experiment with it. Knowledge gained could increase the awareness and acceptance of the renewable energy and this will provide the students with additional idea for their final year project. Furthermore, it is hoped that through
this project, the values of sustainability could be inculcated in the hearts of PSP’s family and the local communities.

As a pilot project, there is only one station that has been developed. The data gathered representing only one station. However it is expected to be impactful if the number of stations increased This project consists of 5 USB terminals with 5W each. With the estimation of 1 hour for each charging process, optimum usage of the system is able to save 5Wh for each terminal per day. By considering 2300 hostelite, this project could save 24.5 kWh, which equals to RM270 per month or RM3240 per year. Even though the amount is small, it is the first step towards energy saving and greener campus.

This project could be further improved by having additional inverter so that it could act as an Alternating Current (AC) power provider for electrical appliances which run on AC. This project has succeeded and served its purpose as a Solar PV Mobile Phone Charging System for users to charge their mobile devices. It also comes with multiple added values as an energy saving initiative and teaching and learning aids.

References


