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Voltage Fluctuation and Photovoltaic Power Generation

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Annotation
The weather station is the primary tool used to conduct the experiment in this research. One of the key renewable energy sources that is quickly becoming a viable substitute for fossil fuels is the solar cell. The purpose of a weather station is to harvest solar energy. Vantage Pro software is then utilized to obtain energy data from weather stations.. A solar radiation sensor was used to measure the amount of solar radiation. As an outdoor unit, it is designed with a diffuser element and housing that have an appropriate cosine response. Two pieces of housing reduced the radiation heating, allowed the sensor to cool, and stopped dust and water from accumulating. Measurements and solar radiation are provided indoors via the display console. This display console will serve as both a display device and a receiver, sending information to the CPU for raw external data.. The information was gathered and moved to the vantage pro2. Following that, the vantage pro2 connects to a computer to store the data and analyze it in order to determine the best PV module location. For the sake of explanation, the data was gathered, documented, and plotted on a graph over a thirty-one-day period. The PV generation findings indicate that the highest solar energy was generated on January 29 at 632.5 (watt/m^2), while the lowest solar energy was generated on January 14 at 341.8 (watt/m^2). Therefore, the number of days with sun energy below 400 watts per square meter is smaller than the number of days with solar energy above 400 watts per square meter. Thus, solar radiation and ambient temperature are the variables that influence the variation of solar energy. Thus, the results displayed in the above table demonstrate that the location is appropriate for the PV panel installation.

Keywords: Photovoltaic, over voltage, renewable power generation.

INTRODUCTION

Photovoltaic systems employ solar cells to transform solar energy into electrical power. One of the major renewable energy sources that is expanding quickly as a fossil fuel substitute nowadays

is solar [1]. In contrast to other sources of electrical generation, solar energy is relatively new, with the first photovoltaic demonstration occurring in the 1950s. First, photovoltaic research and development in general for satellite power supply. Since solar production technology was still in its infancy, solar cells were thousands of times more expensive back then than they are now. But after 10 years, solar generation technology has developed into an intriguing and fast-growing field, much like the quickly growing silicon transistor industry, which has a large market potential [2].

In 1980s, the development of solar energy generation has improvement. The silicon solar cell has increase its efficiency that makes the solar energy generation research is worth. For the decade, the silicon solar cell has achieved 20% efficiency. For the next decade, the silicon solar cell research again shows improvement that the efficiency increases until 38%. So, the solar cells nowadays have been recognized as significantly reduce the environmental damage produce by conventional fossil fuel electrical power generation which means supply green power and improve the quality of human life [3].

Photovoltaic and photothermal power generation are the two primary categories of solar power generation. Using solar photovoltaic cells, photovoltaic power generation uses the photovoltaic effect to directly transform sunlight into electrical power. An array of parabolic dishes gathers solar energy, which is then converted into steam via a heat exchanger to operate a turbine and produce electricity. This process is known as solar thermal power generation..[4] With the ongoing advancement of solar power generating technologies and a globally interconnected energy network, solar power—the most abundant energy source on Earth—will emerge as the most promising and rapidly expanding energy choice in the future. An estimated 160 TWh of solar power were generated worldwide in 2013, which accounted for 0.7% of global total electricity generation. The capacity of solar power is anticipated to increase to over 26,000 TWh by 2050, evenly divided between photovoltaic and photothermal power generation, based on a scenario for faster development of clean energy. By then, it is anticipated that over 36% of the world's electricity will come from solar sources..[5]

RELATED WORK

Based on importance of the environment today, photovoltaic (PV) module has become one of the major power generation sources and has been steadily becoming more affordable and reliable. The process of generate electricity by using sunlight have been discovered in 1839 [6]. But a century later, scientist have been discovered the photovoltaic effect that make of certain material produce electrical energy by converting from the solar energy. Sunlight energy is converted into electrical energy by a PV module is the basic concept that called photovoltaic effect. On a PV module, sunlight can be reflected, absorbed and pass through it. The sunlight that absorbed by PV module will convert to electricity [7].

The PV cells was developed using transistor technology in early 1950s. There are very thin layers of silicon that contain very little amount of another element in the PV cells. Small amount of electrical energy will produce when sunlight goes through it. Actually, the PV cell technology first was implement on the satellite that makes the PV cell price is very high. But now, it price has been reduce to make it affordable for powering houses and buildings.

Cells are the semiconductors device that will convert the solar energy to the electrical energy in direct current (DC). PV cells are combine in a circuit of environmentally protective laminate are called PV module that are PV system fundamental buildings blocks. PV panel consist of one or more than one PV modules connected as per-wired and field install-able unit as shown in figure (1). A combination any number of panels and PV modules is an PV array of complete power generating unit.

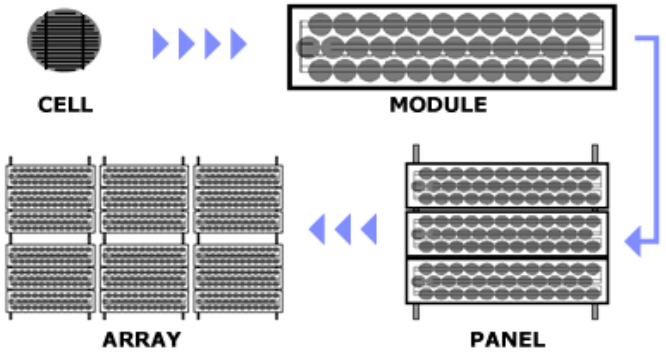

Fig 1: Photovoltaic Cell, Module, Panel and Array.

SOLAR RADIATION SENSOR

A solar radiation sensor was used to monitor the sun radiation in this study. Typically, this sun radiation sensor comes with a temperature, humidity, and anemometer. As an outdoor unit, it is designed with a diffuser element and housing that have an appropriate cosine response. To ensure that it matches the solar spectrum well, it incorporates a silicon photo diode. Two sections of housing reduce radiation heating, allow the sensor to cool, and keep dust and water from accumulating. The sun radiation sensor employed in this work is seen in Figure (2).

Fig 2: Solar Radiation Sensor.

To saving the recorded data, a personal computer is used. The data from the solar radiation sensor were recorded and save in this PC. Figure (3) below shows the personal computer that used has been used to record and save the collected data.

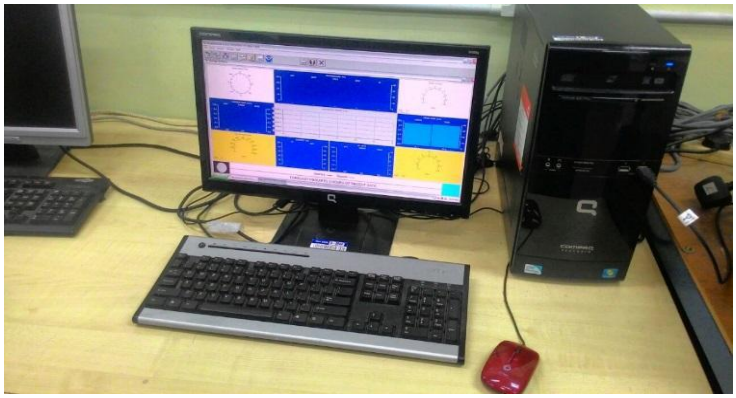

Fig 3: Recorded And Saved Data In The Computer (PC).

The display console is the indoor unit that provides display of solar radiation and other measurements. In this project, we only used the solar radiation reading. This display console will act the receiver and information processor for raw outside data and as a display unit. The console will display various information of weather on its screen. It comes with wireless and cable part as shown in figure (4).

Fig 4: Display Console.

The procedure of data record processing is done by the following steps. By using the solar radiation sensor, display console and personal computer such as in figures (2, 3 and 4) above, a set of data is collected. First, the solar radiation sensor will measure the solar radiation. Then, the display console will display the data while the PC will save the data. So a set of solar radiation data will be saved in the PC that will use to determine the photovoltaic power generation potential.

HARDWARE INSTALLATION

The steps that have been followed and taken to photovoltaic power generation potential from photovoltaic are shown in figures (5, 6, and 7)**.** This is an important part for completing this research as the whole process can be summarize to simple steps.

The data is received from weather station at Centre of Excellence for Renewable Energy (CERE), Kangar to consider and gather all necessary information related to the potential from photovoltaic data. Next step is to collect data from vantage pro2 and save the data in the computer. After that, all the data will be analyzed to see the potential and install the PV module to be suitable or not at the location.

Fig 5 : Weather station.

Fig 6 : Vantage pro2.

Fig 7 : Weather Link.

From the figures (5, 6) above, the function of weather station is to collect the data. The data has been collected and transferred to vantage pro2 to display the data as shown in figure (7). After that, vantage pro2 link with computer to save the data and will analyze to see the potential of PV module can be install at the location as shown in Figure (7).

RESULT AND DISCUSSION

The data is recorded start on date of 01/01/2025 to 31/01/2025 with the average solar energy daily. So, the total amount of the data collected is for 31 days as shown in table (1) and also plotted in graph for explanation purpose as shown in figure (8).

Table 1:COLLECTED DATA FOR ONE MONTH .

Day	Date	Average Solar Energy Daily (watt/m2)
1	1/1/2025	569.1
2	2/1/2025	452.4
3	3/1/2025	557.2
4	4/1/2025	586.2
5	5/1/2025	545.9
6	6/1/2025	434.9
7	7/1/2025	610.5
8	8/1/2025	611.2
9	9/1/2025	595.3
10	10/1/2025	554.1
11	11/1/2025	450.7
12	12/1/2025	596.9
13	13/1/2025	409.4
14	14/1/2025	341.8
15	15/1/2025	522.4
16	16/1/2025	597.7
17	17/1/2025	403.4
18	18/1/2025	508.2
19	19/1/2025	413.3
20	20/1/2025	617.0
21	21/1/2025	630.4
22	22/1/2025	553.0
23	23/1/2025	571.5
24	24/1/2025	515.0
25	25/1/2025	521.6
26	26/1/2025	385.2
27	27/1/2025	488.1
28	28/1/2025	526.9
29	29/1/2025	632.5
30	30/1/2025	513.4
31	31/1/2025	430.7

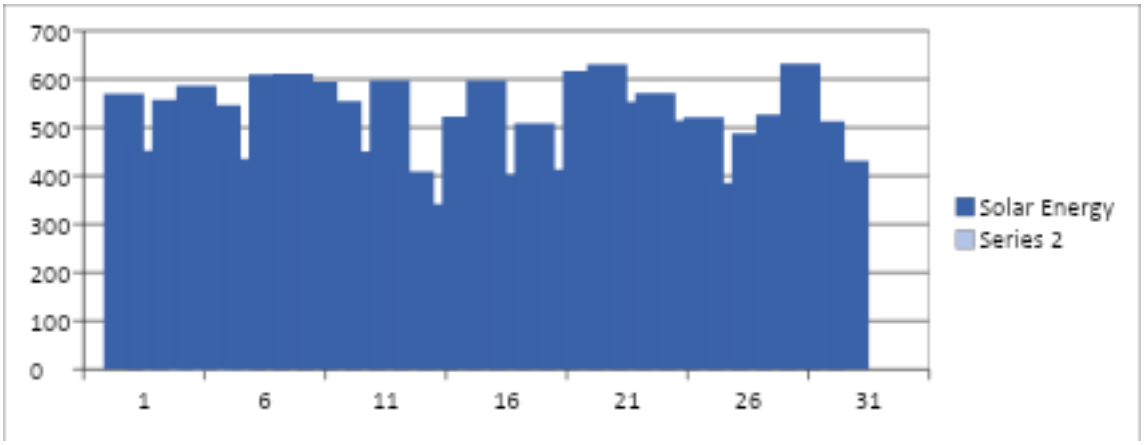

Fig 8: Collected Data for One Month.

According to the photovoltaic data generation's final result, the maximum solar energy was generated on January 29 at 632.5 (watt/m^2), while the lowest was generated on January 14 at 341.8 (watt/m^2).The number of days with solar energy below 400 watts per square meter is less than the number of days with solar energy above 400 watts per square meter.

The temperature of the surrounding environment and solar radiation are the two factors that influence the variation of solar energy. Thus, the results displayed in the above table demonstrate that the location is appropriate for the PV panel installation.

CONCLUSIONS

The main purpose for doing this project is to collect the energy basically for solar system panel. All this activity was doing based on schedule that has been decided. In this project, there are three basic things that used to run this project and make it clear in order to get the data that collected.

Solar-powered weather stations usually consist of multiple parts. During the day, the sensors are powered by the solar panels, which also recharge a battery pack that is connected to the sensors. After the sun sets, the battery pack is used to power the sensors.

Vantage Pro is the software that used by some professional energy auditor to convert energy that collected and transfer to the software to get the data. In this project, this software was used to get the energy data form weather station. After that, it would connect to the PC to show up all the data form Vantage Pro. Based on the result, the average energy that is collected just only 600W. Energy from weather station will restore to the battery basically in DC. After that, used the power inverter to convert it to AC source. 600W was very small energy. So, basically with this energy which is 600W, cannot use to the electrical equipment that consume more power such as air conditioned. The smallest rated for air conditioned is 1 hp is equal 760W. So, it is not enough to support. For this value it’s suitable for small load such as lamp and fan. Consider it one lamp is equal to 36W maximum fluorescent, so the total lamp can used for 600W is 16 unit for sure its suitable for housing or office.

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