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Monocrystalline Photovoltaic Test Set Design

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***Abstract*— The aim of this study, to give practical information to students in the Electrical Department of Afyon Kocatepe University Dazkırı Vocational School about the monocrystalline solar panel, which is the most used solar panel type in solar energy systems, providing the student with practical knowledge. The monocrystalline like other types of solar panels with higher performance and higher prices. The monocrystalline solar panels have more efficiency with respect to another expensive kind of panels. During this study which has done, the monocrystalline solar panel is consuming all the energy which has produced. Current and voltage sensors are used to measure the energy which have been generated. The analogue data from the current and voltage sensors are converted to digital data and a control card with USB output is made to send this data to the computer. Finally, the interface with the C # program was used to display the data from the control card on the computer.**

Keywords—component; monocrystalline solar panels, PIC18F4550, control card, C# interface

I. INTRODUCTION (*Heading 1*)

Mono-crystalline silicon batteries are the oldest and most expensive method of solar cell manufacturing techniques. However, today it has the highest productivity value. The yields of mono-crystalline silicon pillars present in the market vary between 15% and 18% [8]. This value differs from the use of the solar battery by the angle and the value of the sunlight it is exposed to.

The production method known as 'Czochralsi Metdotu' is used in mono-crystal silicon production. In this method, which was developed in 1971, Czochralsi puts the compound of silicon dioxide (SiO2) in a vessel and melts at very high temperature. Then a small graft crystal is immersed in the molten material and slowly pulled upwards towards the cold zone. As a result of this process, a long and single crystal cylinder was obtained.

The single crystal cylinder material, which is 30 cm in diameter and several meters in long, is sliced in the form of circular, rectangular or polygonal and 0.2-0.3 mm thick. The resulting layers are P-type semiconductor materials of solar batteries. The N-type semiconductor material has a lower thickness. The P-type and N-type semiconductor materials are bonded together and bonded together with special adhesives so that they are not separated.

In the last process, the antireflective glass sheet is glued to form the solar cell. The color of mono-crystalline silicone pills is a color in the dark blue-black range. Figure 1.1 shows the mono-crystalline silicon solar cell.

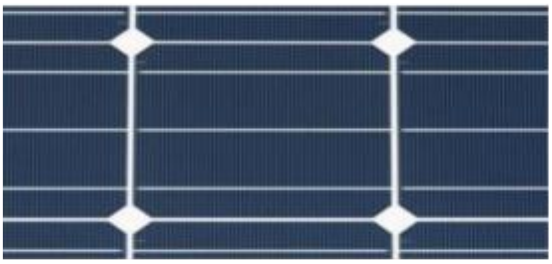

Figure 1.1. Mono-crystalline silicon solar cell

Much studies has been done on solar panels [1-18]. These studies are sometimes based on a single solar panel, sometimes using two or more solar panel types. The most used monocrystalline and polycrystalline solar panels were also has selected in the setting up the solar energy experiment set.

MATERIALS AND METHODS

The purpose of project is providing the students in the Electricity Department of Afyon Kocatepe University Dazkırı Vocational School, by giving them practical knowledge and application about solar panels. The system shown in Figure 1.1 is shown.

Figure 2.1. Solar energy experiment set

A. *Solar Panel*

In this study, the two types of solar panels, monocrystalline and polycrystalline, are used in the solar energy experiment set. Since the production methods of solar panels are different, the reactions of reflection of sun are different. Thus, so which kind of solar panel is more efficient has been determined in Afyonkarahisar Province. Figure 1.2 shows the solar panels used in the system.

Figure 2.2. Solar panels used in the system

The technical information of the solar panels used in the system is shown in table 1.

Power	20 Watt
Maximum Voltage	18,5 Volt
Maximum Current	1,08 Amps
Open Circuit Current	22,14 Volt
Short Circuit Current	1,16 Amps
Weight	2,3 kg

B. *Consumers*

To use all of the solar energy as electricity which generated by the solar panel, 20 Watt receiver is used.

C. *Control Card*

Control card; 220 Volt supply input, solar panel input, receiver output, USB output current and voltages. Figure 1.3 shows the control card used in the system.

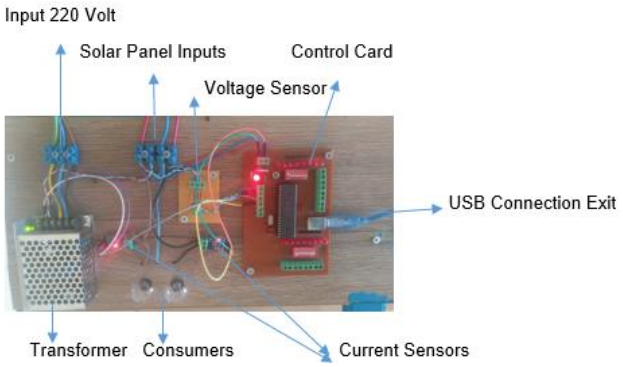

Figure 2.3. Control card used in the system

The control board has a voltage and current sensor. The analog data from the current and voltage converters are processed on the control card and converted into digital data. Digital data is sent to the computer via by USB connection.

The control card needs to be connected to an external power source for 24 hours so it can measure up to 24 hours. There is 220 volt input for this purposes, by adding power plant for the 220 volt input for supplying the necessary electricity which is needed for the sensors and control card in the system is provided.

In order to increase the sensitivity of the voltage sensors, the solar panels have been designed with the maximum voltage values being taken into consideration. The maximum voltage at which the voltage sensor is measured as 30 volts. The sensitivity of the current sensors is also increased by selecting max. 5 Amps in the same way.

D. *Interface*

An interface has been designed through the C # program so that all the data produced by the solar energy experiment set can be displayed on computer. This designed interface shows the voltage, current and power values of the monocrystalline solar panels. In addition, all data generated in the system are recorded in the access database at intervals of 10 seconds in order to make a comparison. Figure 1.4 shows the interface used in the system.

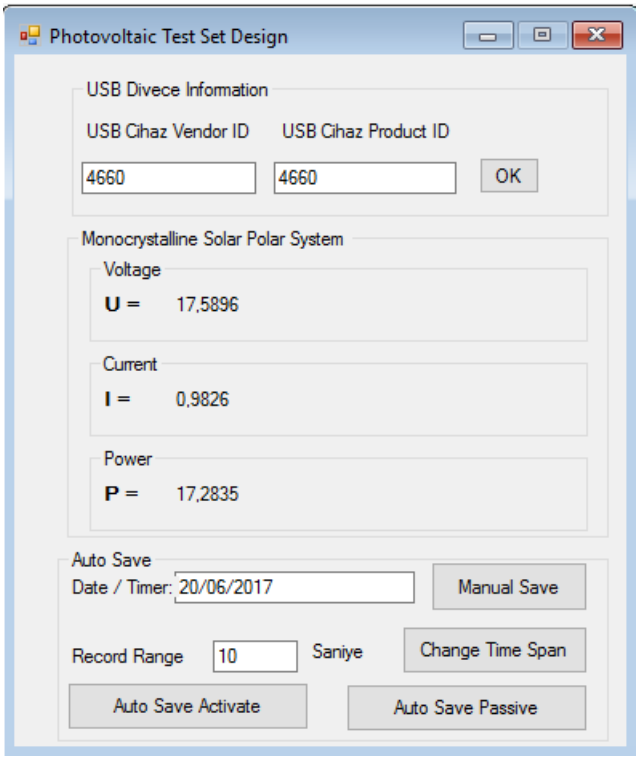

Figure 2.4. Interface used in the system.

RESULT

As a result of examining the current, voltage and power values produced by the solar energy experiment set, the following data were obtained. Figure 3.1 shows a daily voltage graph of 20/06/2017.

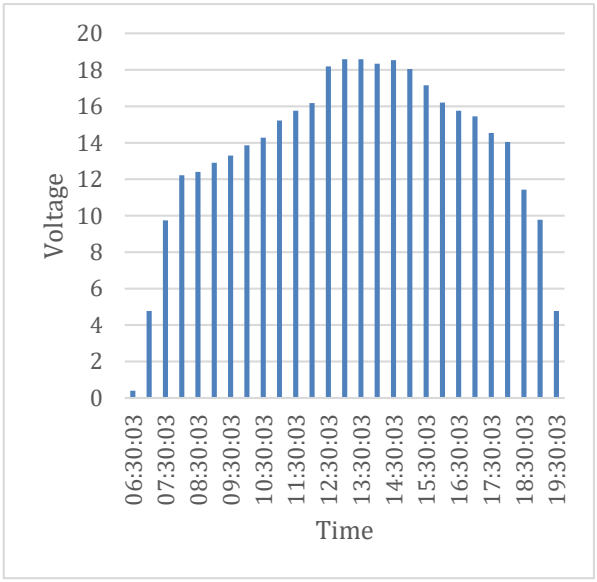

Figure 3.1. Voltage-time graph.

According to the voltage graph that the monocrystalline solar panel produced between 06: 00-20: 00 on 20/06/2017, electricity energy production is lowest in the early hours of the morning and late in afternoon. In the noon hours, when the sun's rays are at their vertical direction, the production of electricity energy reaches the max point.

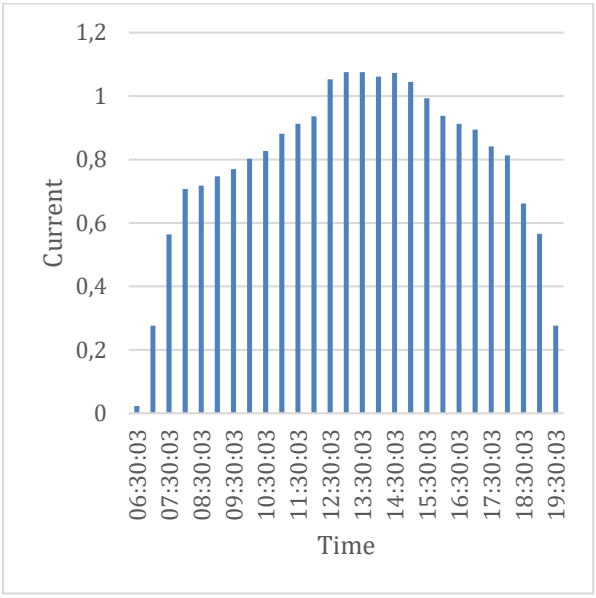

Figure 3.1. Current-time graph.

Since there is no production of electricity in the hours when there is no sun, those hours are not added to the graph. The chart covers the sunrise from 06:00 to sunrise at 20:00. A daily flow-time curve is shown in Figure 3.2.

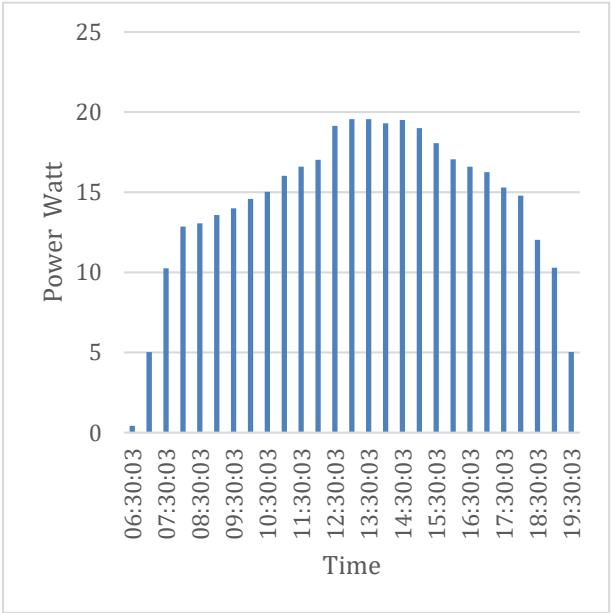

Figure 3.3. Power-time graph.

The monocrystalline solar panel yields effect by many factors like high sunlight, angle, ambient temperature, and many other factors. In some places and times, the monocrystalline solar panel may be more efficient, while the polycrystalline solar panel can be higher.

When a day's power chart is blurred, the power generated in the early hours of the morning stays at the limit of 5-10 watts, but reaches the limit of 20 watts at noon when the sun's rays become vertical. The energy that is produced after noon is gradually falling down.

CONCLUSION

The students of Afyon Kocatepe University Dazkırı Vocational School Electrical Department have been given the knowledge about solar panel set by practice.

Monocrystalline solar panel on 20/06/2017 194,9522 Wh of the energy production has been measured

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