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RESEARCH ARTICLE

THE PERFORMANCE OF MONOCRYSTALLINE SOLAR PANEL ESTABLISHED IN AFYONKARAHİSAR

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ABSTRACT

Electricity has an essential place in the life of humanity with the rapidly developing technology. It has been seen that the use of fossil fuels for electrical energy production harms the environment. People have turned to renewable energy sources that have the least damage to the environment in order to meet the needs of electricity. The systems that produce electricity from solar (photovoltaic systems) are the most preferred renewable energy sources. Because there is no the payment of fees to the raw energy sources and staff expenses are little during operation. Also the low maintenance costs due to the small parts are among the advantages. In this study, monocrystallinesolar panel installation was conducted in Afyonkarahisar. Solar panels have been placed at an angle of approximately 45o. The solar panel production data (voltage and power) were instantly monitored from the PC and recorded to Access database at 10 second intervals by the help of micro-controller control board and C# software. Energy production of the solar panels is determined using the one-year data.

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INTRODUCTION

Photovoltaics (PV) were first found in 1893 by Becquerel by observing that the voltage between electrodes immersed in electrolyte were depend on the light falling on the electrolyte (Rüstemli, 2011 and 1911). Although the photovoltaic systems have so much history, the use of them has been a rapid growth in the last quarter century. The energy costs increased at a high rate as a result of big oil crisis occurred in the 1970s (Czanderna and Ve Jorgensan, 1999 Mayer, 1997). In addition, it has been found that energy production using fuel results in environmental disasters such as environmental pollution, seasonal changes and global warming. Human beings have turned its attention to renewable energy sources for these reasons (Muntasser *et al.,* 2000; Al-Karaghouli and ve Al-Sabounchi, 2000). The monocrystallinesolar panels on the roof of Technology Faculty in Afyon Kocatepe University were installed with an angle of about 45^{o}. Electricity production of monocrystalline solar panel (volt-watt) examined instantaneously. The opportunity to display all the data on a computer screen was presented with the interface done by C # programs. All the data was recorded to Access database in the desired time interval with autosave.

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In this study, the time interval of 10 seconds is preferred. Data were recorded during the year. Daily energy production of solar panels has been determined using this data.

MATERIALS AND METHODS

In the carried out study, they were placed on the roof of Technology Faculty in Afyon Kocatepe University as inclined to receive the solar rays best. The panel was wall-mounted because there has been an insulation on the roof and the established system is seen in Figure 1. Monocrystallinepanel was used in the system.

Figure 1. The appearance of Monocrystallinesolar panels

Properties of monocrystalline solar panel used in the system shown Table 1.

Table 1. properties of monocrystallinesolar panels used in the system

The high voltage load	18,75 V
The high current load	5,35 A
The high open circuit voltage	22,35 V
Short circuit current	5.70 A
Operating temperature range	-40 - 85

a. VoltageSensor

The PIC microcontroller is used to measure the voltage produced by thin-film solar panels and transfer to the computer. This microcontroller can measure the voltage between 0V and 5V structurally. Therefore, the voltage divider circuit shown in Figure 2, is used for reducing the voltage generated by the solar panels to the limits of the microcontroller can measure. Two pieces of series resistance, 10KΩ and 470Ω, were connected to the ends of solar panels. The falling voltage on the 470Ω was applied to input end of the microcontroller.

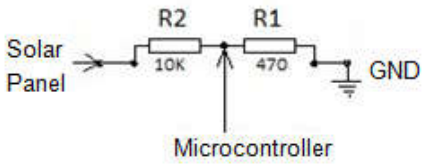

Figure 2. The voltage divider circuit

b. Current Sensor

LEM LA-55 P current sensor is used for measuring the current drawn from the solar panel. It can be measured up to 50 amps thanks to this current sensor. Conversion ratio is 1:2000. LEM LA 55-P current sensor is seen Figure 3.

Figure 3. LA 55-P LEM current sensor

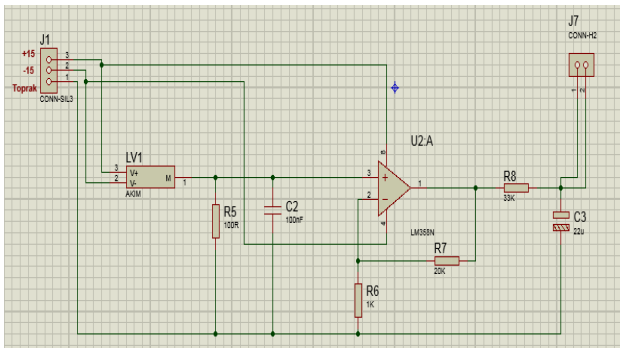

Figure 4. Flow sensor amplifier circuit

L-55 P LEM current sensor is produced by the company is designed to measure 55 Amps.But the high current of the thin-film solar panel is 1.11 amperes we use in our system.To increase the sensitivity of the system by the output current sensor amplifier circuit sensitivity is increased. In figure 4 current sensor amplifier circuits are shown.

c. Mikro-controller, USB ve Sensor Card

PIC18F4550 microcontroller is used to convert the analog data from voltage and current sensors to digital data and send these data to the computer. The designed and implemented micro-controller, USB and the sensor board are seen in Figure 5.

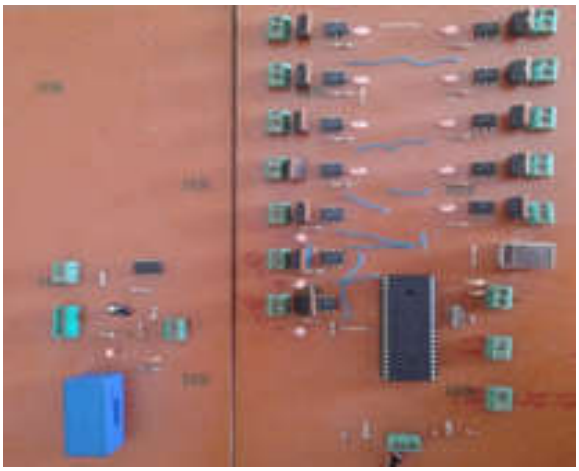

Figure 5. Microcontroller, USB and sensor card

d. Computer Interface

The interface prepared by C# program to display the digital data from the micro-controller on the computer screen is seen in Figure 6. The electrical data of solar panels and power measurements are displayed as instantaneously. The measured data can be recorded to the database manually or in set time intervals if requested. In this carried out application, the data obtained from the solar panel is recorded with intervals of 10 seconds.

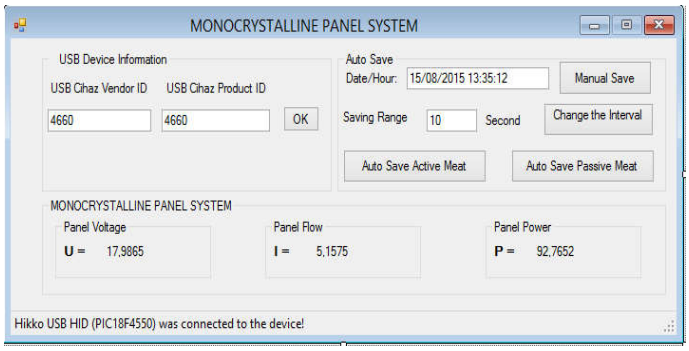

Figure6. C.# prepared by the interface program

RESULTS

There are many factors to influence the energy production of solar panels. The values of solar radiation at the beginning of these factors, the angle of incidence of solar radiation,

sunshine duration, temperature and atmospheric events comes. Especially cloudiness and snowfall in energy production of the solar panel or is not coming to its lowest level ever. May 1, 2014 and June 30, 2015. Among the energy production of monocrystalline solar panels ar was recorded 10 seconds intervals. Figure 7 daily total energy production of monocrystallinesolar panels waat / time are displayed in. Considering the total energy production on a daily basis; particularly the energy production in the winter months seem to rise with the onset of summer is low. The most important two factors; The values of solar radiation and sunshine duration is the increase occurring in.

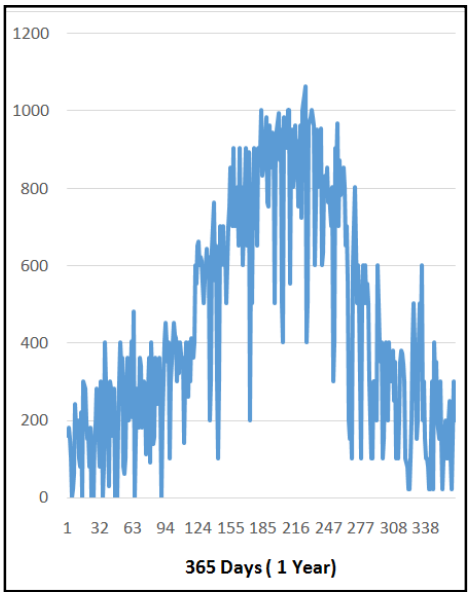

Figure 7. The total daily energy production of monocrystallinesolar panels (W/hr)

Although there is no fixed daily energy production of monocrystallinesolar panels, some days are very low while very high value on some days. This is much more variability, especially in winter. In order to produce the energy of the solar panel must be exposed to sunlight. The sun's rays due to atmospheric phenomena such as rain and snow in the winter are prevented from coming into the world. For this reason, it is much more variation in energy production, in the winter of monocrystallinesolar panels. The total energy produced on a monthly basis in Table 2 are shown.

Table 2. The total energy produced on a monthly basis

Monthly	The total power generated (W/hr)
January	4118,33
February	6223,39
March	7697.79
April	10608
Mav	16738.1
June	22561,3
July	25617,42
August	25186,7
September	19780.6
October	10508,7
November	7704
December	4502.03

The energy production of monocrystallinesolar panels examined on a monthly basis; 4118 W / h with cord Products has been in the sphere of my January. The highest energy production 25617 W / h is not occurring rile in July. A 622% increase in energy production seems percent between July and January. This rate is the biggest variable in the sun while not so great. In winter, Afyonkarahisar has an average duration of 2-3 hours of sun per day. In the summer time setting sun is as high as 11-12 hours. Monocrystallinesolar panels in the winter average of 5 000 W / h of energy production takes place in the summer months, this rate of 20000 W / h takes place in s. Figure 8 includes a graphical representation of the total energy production on a monthly basis.

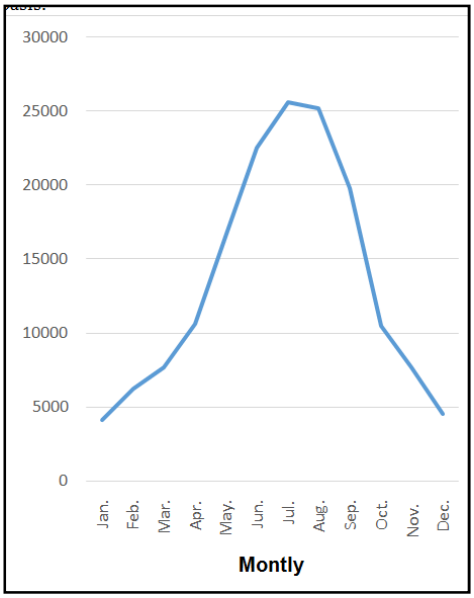

Figure 8. The total energy produced on a monthly basis

The sun's rays to produce energy the solar panel does not need to take pole. Energy production is carried out with the sun's rays fall on panel. Solar rays panel how other gelires energy production increases. Figure 9 Afyonkarahisar daily energy production of monocrystallinesolar panels installed on a monthly basis are shown in the province.

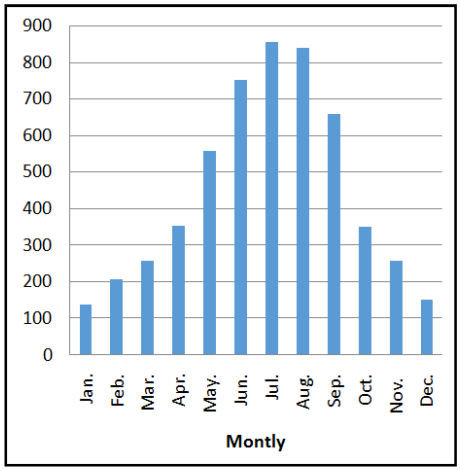

Figure 9 Afyonkarahisar daily energy production on a monthly basis of monocrystallinesolar panels that are installed in the province

Conclusion

In this study, monocrystallinesolar panels to be placed in Afyonkarahisar. Made microcontroller card, USB, sensor and software made in C # programs were monitored on the computer screen in real time with the parameters of monocrystallinesolar panels and energy production was recorded 10 second intervals. The production of monocrystalline solar panel energy were recorded for one year. The energy production of monocrystallinesolar panels examined on a monthly basis; 4118 W/hr with cord Products has been in the sphere of my January.

The highest energy production 25617 W / h is not occurring rile in July. A 622% increase in energy production seems percent between July and January. The energy production of monocrystalline solar panels examined on a seasonal basis; during the winter months of 5441 W / h is realized energy production, the summer months of 24445 W / HR. Spring and autumn months in monthly energy production and energy production in the spring, but approximately the same as 8716 W / h, while in autumn 12664 W / h, respectively.

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