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Solar Panel Monitoring System Using Smart Phone Technology

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ABSTRACT: Our paper a method for remote monitoring and analyzing of PhotoVoltaic panels using Internet of Things. Photo Voltaic Panel is a device which converts light energy into electricity. The proposed design is used for remote monitoring based on current and Voltage measurement. The transmission among the Photo Voltaic Panels and server is performed by internet of things. The current and Voltage data are processed by micro controller unit. The measured data are transferred to hosting server using wireless transmission. At first, the light energy from Photo Voltaic cell is converted into electricity power.Then measuring the current and voltage using sensor. In this real time monitoring systems in photo voltaic Power generation are very important and urgent in some cases. This paper proposes a real time monitoring system for solar panel using the ATMega 2560 arduino which is connected with voltage sensor, current sensor and temperature sensor. The arduino ATMega 2560 also connects with the wifi module as a connection to the smart phone to display the measurements of current, Voltage and power of solar panel and Ambient temperatures through the Blynk App. The system is tested for 7 days starting at 8 am to 4 pm. The designed monitoring system as a good degree of accuracy with an average error rate of monitoring results of solar panel output value below 10%. Monitoring the performance of solar panels using a smart phone based micro controller can be done in real time. The monitoring system can be developed for the larger PV systems.

KEYWORDS: PV,IOT,WI-FI

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I.INTRODUCTION

The market of energy has brought many emerging challenges in the last two decades. There are many cyber issues includes monitoring and management systems have also been extensively studied. Earlier system of monitoring of photovoltaic cell works as the light energy is converted into electrical energy with the help of light. The output of the Photo Voltaic panel is in voltage and current. The measured outputs are given to the Micro controller unit. The Micro controller is connected to an IOT module.

In our system the light energy from the Photo voltaic cell is converted into electrical energy using a light sensor which is analog form. The analog signal is converted into digital signal with the help of analog to digital converter.

Photo voltaic cells are made of silicon and extracted from the raw materialof quartzite gravel. During the process, the quartz is crushed to obtain silicon dioxide and the raw materials need toundergo substantial processing until it can be used to produce photovoltaic cells.

A PV is basically a p-n semiconductor junction. When exposed to light, a DC current is generated. PV offers several advantages such as: high reliability, low maintenance cost, no environmental pollution, and absence of noise. A residential PV power system enables the home owner to generate some or all of their daily electrical energy demand on their own roof, exchanging daytime excess power for future energy needs (i.e. night time usage). Photo Voltaic systems can also include battery backup or uninterruptible power supply capability to operate selected circuits in the residence

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forhours or days during a utility outage.In fact, growing of PV for electricity generation is one ofthe highest in the field of the renewable energies and thistendency is expected to continue in the next years. As an obvious consequence, an increasing number of new PV components and devices, mainly arrays and inverters, are coming on to the PV market.The output power generated from the conversion process is determined by some environmental conditions such as the intensity of sunlight, temperature, the direction of sunlight andthe spectrum of sunlight. Constantly changing environmental conditions at all times cause solar panel output power to also fluctuate .The monitoring system in PV power plant is very important and urgent in some cases for analyzing ,troubleshooting and in decision making issues.The main goal of this paper is to develop an equipment to measure the characteristics of solar panels in real time and send the measurement result parameters to android based smartphone.

Many monitoring systems have been designed for measuring performance parameters of solar panel. Solar panel performance monitoring designed with calibrated current and voltage measuring sensors, data acquisition systems integrated into Excel spreadsheets using PLX-DAQ application programs and memory cards for backup data storage, using a system based Arduino Atmega328P microcontroller and connected to the computer viaRS232 serial port.

A monitoring system was designed using a wireless ZigBee microcontroller on a PV-Grid system with monitored parameters of temperature, solar radiation, PV output power and grid output power.A wireless Zigbee microcontroller is used to monitor voltage, current and power with a low costand reliable performance monitoring system for small and large scale PV power plants .Online display of the power usage of solar energy as a renewable energy monitored through raspberry pi using flask framework .A simple yet effective approach implemented to build the IoTplatform for remote monitoring and sensing of data, home automation, industrial automation and many more. Above what the solar system can produce.

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II.PROPOSED METHOD

It is known that changes in operating temperature cause changes of current and voltage of PV cells and PV modules .Therefore remote monitoring system is designed to monitor the value of current and voltage generated by the solar panel and the ambient temperature via a smartphone using sensors connected to the arduino.

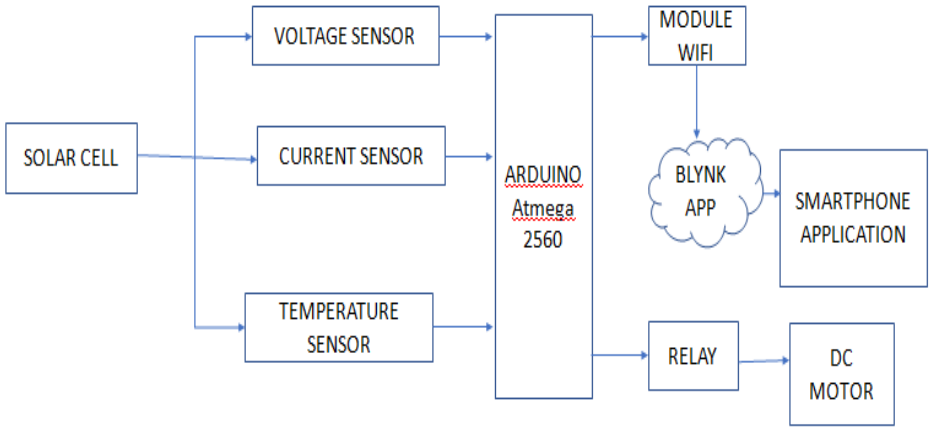

Fig 1:Block diagram of proposed method

The current and voltage generated by the 10Wp solar panel are monitored using ACS712 current sensor and voltage sensor. The ambient temperature around the solar panel is also measured using the DHT11 temperature sensor. The sensors are connected with the Arduino ATMega 2560 which is also connected to the ESP8266 Wifi module as a connection to the smart phone to display the results of measurement of ambient temperature, output current and output voltage of solar panel through Blynk application.

The solar panel is connected to the iron and the angle of the panel is 50 Deg Celsius. After the iron is to the panel, the iron is connected to a box that has been made as the iron holder and the storage of microcontroller and 12V DC lamp as

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the load for solar panel. The prototype was tested for seven days starting at 08.00 am to 04.00 pm. In the Blynk app, the voltage, current and power values generated by the solar panel, and also the ambient temperature are displayed real time .Timer on Blynk application must be set to monitor the value of solar panel power per hour starting at 08.00 am to 04.00pm. Analysis of monitoring results of solar panel output in the form of current, voltage and power values performed daily and weekly to determine the performance of monitoring systems that have been designed.

III. RESULT AND DISCUSSION

The comparison between the measured voltage values by the monitoring system and the voltage values measured by the multimeter on one of the test days is shown in fig 2.

From fig 2, it is known that the range of error values from the comparison result of measurement of solar panel voltage values is 0-1.26%.The comparison between the average voltage values measured by the monitoring system and the average voltage values measured by the multi meter for 7 days are shown in fig 2.

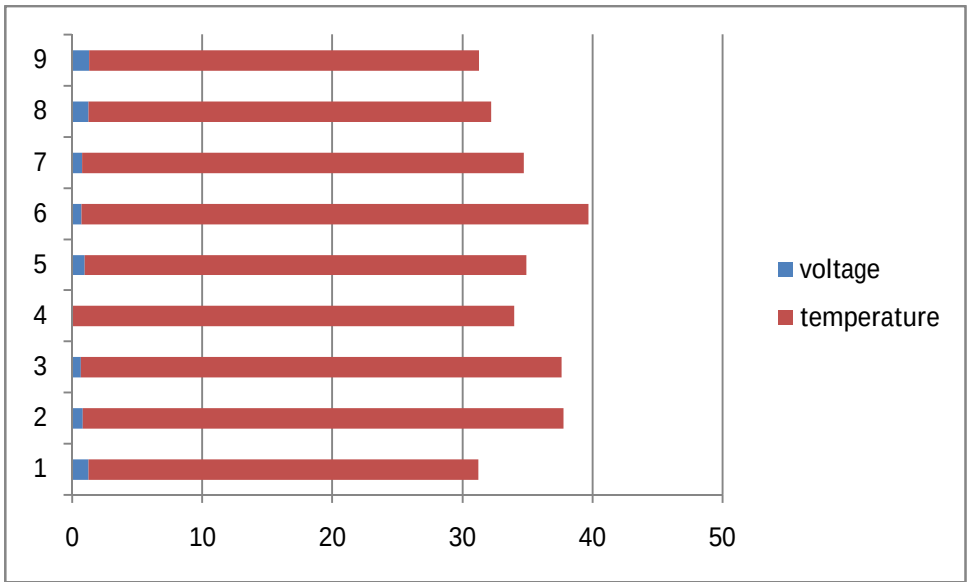

Fig 2:Magnitude of Voltage & Ambient Temperature

From the fig 3, it is known that the average value of errors from the comparison result of measurement of solar panel voltage values for 7 days is 0.96% where the highest error value is 1.18% which occurs on the first day.The comparison between the measured current values by the monitoring system and the current values measured by the multimeter on one of the test days is shown fig 4.

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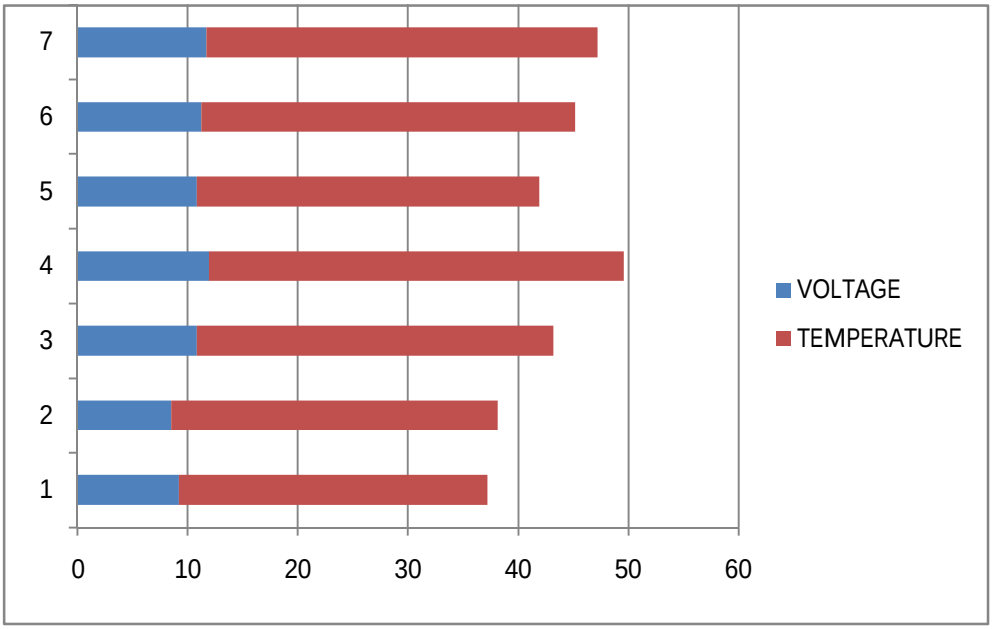

Fig 3.Magnitude of Voltage & Ambient Temperature

From the fig 4, it is known that the range values from the comparison result of measurement of solar panel current value is 1.75-22.2 % . The comparison between the average current values measured by the monitoring system and the average current value measured by the multimeter for 7 days are shown in fig 4.

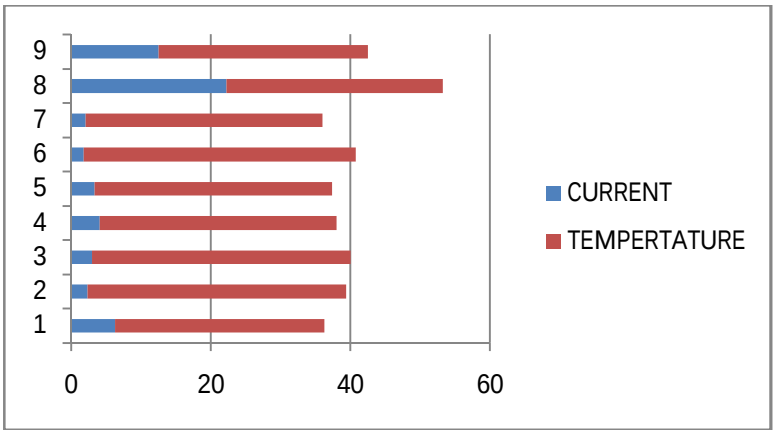

Fig 4.Magnitude of Current and Ambient Temperature

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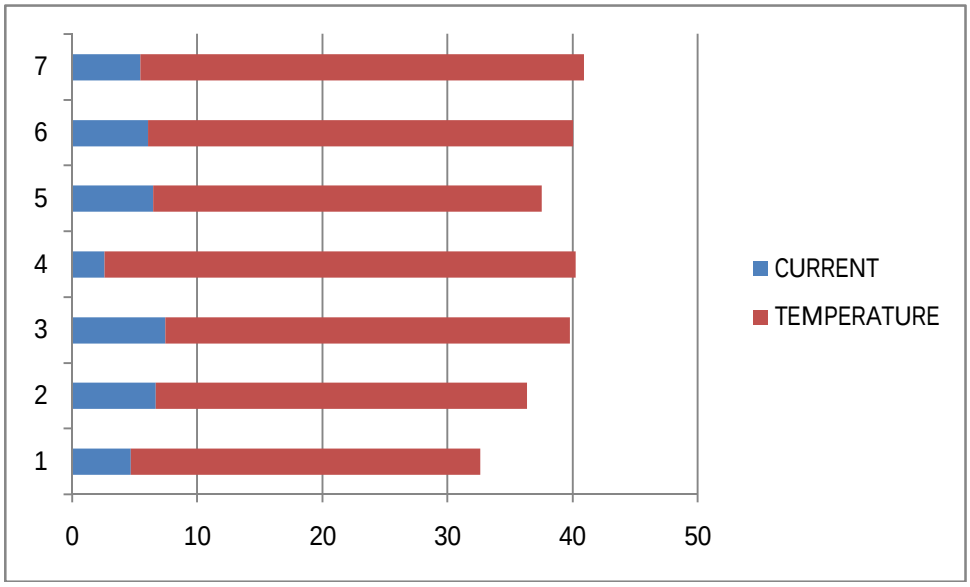

Fig 5.Magnitude of Current and Ambient Temperature

Based on fig 5, it is known that the average value oferrors from the comparison result of measurement of solarpanel current values for 7 days is 5.60% where the highesterror value is 7.41% which occurs on the third day.

The comparison between the measured power values by the monitoring system and the power values calculated based on current and voltage values measured by the multimeter on one of the test days is shown in fig 6.

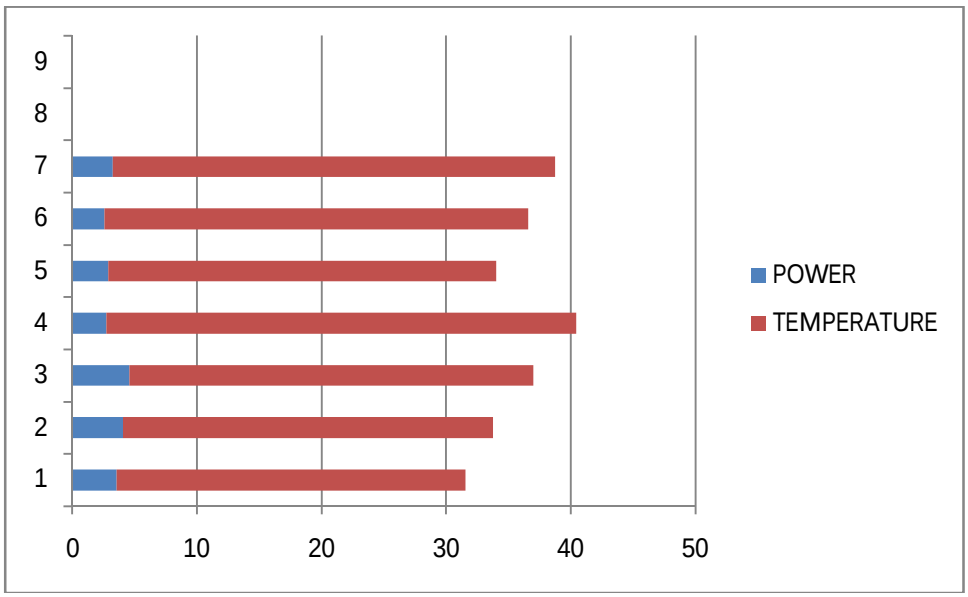

Fig 6.Magnitude of Power and Ambient Temperature

Based on fig 7, it is known that the range of error values from the comparison result of measurement of solar panel power values is 1.08-19.75%. The comparison between the average voltage values measured by the monitoring system and the average voltage values measured by the multi meter for 7 days are shown in fig 7.

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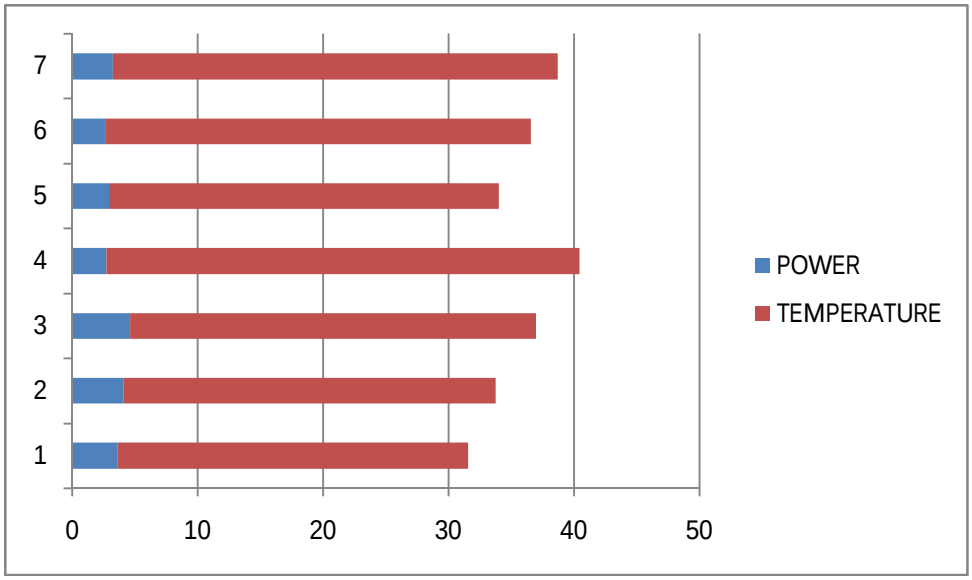

Fig 7.Magnitude of Power and Ambient Temperature

From the fig 7, it is known that the average value of errors from the comparison result of measurement of solar panel voltage values for 7 days is 3.38% where the highest error value is 4.58% which occurs on the third day.

Based on the comparison values in fig 2 to 7, it can be concluded that the designed monitoring system has worked well in monitoring the current, voltage and power values generated by solar panel in real time through Blynkapplication on smartphone.

IV. CONCLUSION

The main goal of this paper is to develop an equipment to measure the characteristics of solar panels in real time and send the measurement result parameters to android based smartphone. The testing results of the system monitoring system of solar panel output using arduinoATMega 2560 which is connected with sensors and wifimodule successfully displays the values of current, voltage and power generated by solar panel via Blynk app on smartphone. The average error rate of monitoring results of solar panel output values is below 10%. Monitoring the performance of solar panel using microcontroller-based smartphone can be done in real time.

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