SOLAR ENERGY MEASUREMENT SYSTEM USING PIC

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Abstract
The aim of this presented work is to measure solar cell parameters through multiple sensor data acquisition. In this paper, a solar panel is used that keeps monitoring the sunlight. Here different parameters of the solar panel like light intensity, voltage, current and the temperature are monitored and are sent to a remote PC using a RF 2.4 GHz serial link. Microcontroller used here is from PI, C16F8 family.
Keywords: Solar Panel (SP), PIC programmable industrial controller, LCD-liquid crystal display and LED-light emitting diode.

I. INTRODUCTION

Now a days the solar-energy market is one of the most rapidly expanding renewable energy markets in the world. Presently we have seen a significant increase in requests for remote monitoring and control equipment for solar-energy applications. Whether you are assessing a site's potential for solar power generation, monitoring performance of existing solar installations, or advanced solar monitoring, reliable and accurate measurements are crucial. They aid in decision making, product development, system maintenance and in many other ways. Common meteorological measurements including wind speed, wind direction, relative humidity, barometric pressure and precipitation, all have their use in solar applications. Of course, solar-radiation measurements are especially important and sensors are available for measuring all aspects of solar radiation.

The light intensity is monitored using a LDR sensor, voltage by voltage divider principle, current by series resistor and temperature by temperature sensor. All these data are displayed on a 16X2 LCD interfaced to PIC microcontroller and is also sent to a remote PC hyper terminal for display using a 2.4 GHz serial link.
The main objective of this project is to design a solar energy measurement system for measuring solar cell parameters such as voltage, current, temperature and light intensity through multiple sensors.

II. BLOCK DIAGRAM

The light intensity is monitored using an LDR sensor, voltage by voltage divider principle, current by series resistor and temperature by temperature sensor. All these data are displayed on a 16X2 LCD interfaced to PIC microcontroller and is also sent to a remote PC hyper terminal for display using a 2.4 GHz serial link.[4]

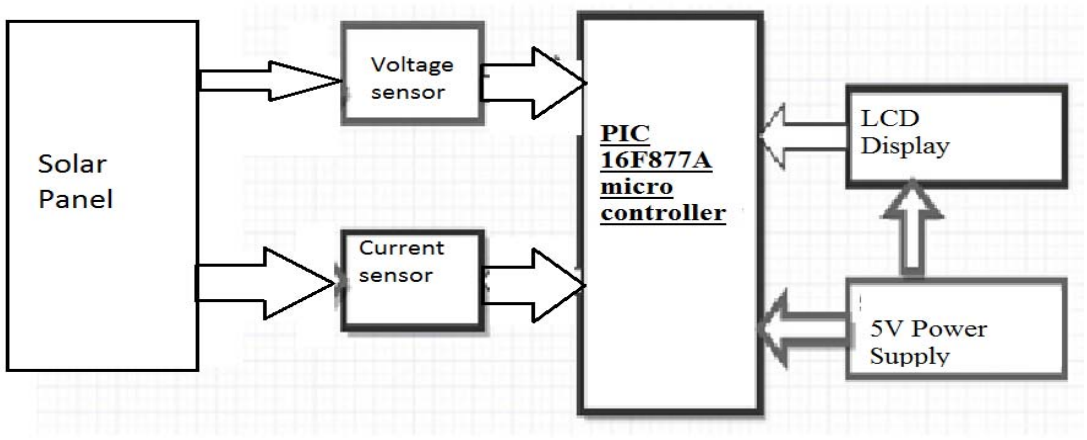

Fig. 1. Block diagram of solar energy measurement system

As shown in the block diagram above, voltage **sensor** and current **sensor** are used to measure voltage and current flowing to load from solar panel. As we know, solar panels are dc power sources. Liquid crystal display is used to display the value of current, voltage and power of solar panel. 5 volt **dc power** is used to provide operating voltages to microcontroller and liquid crystal display.[4]

III. CIRCUIT DIAGRAM:

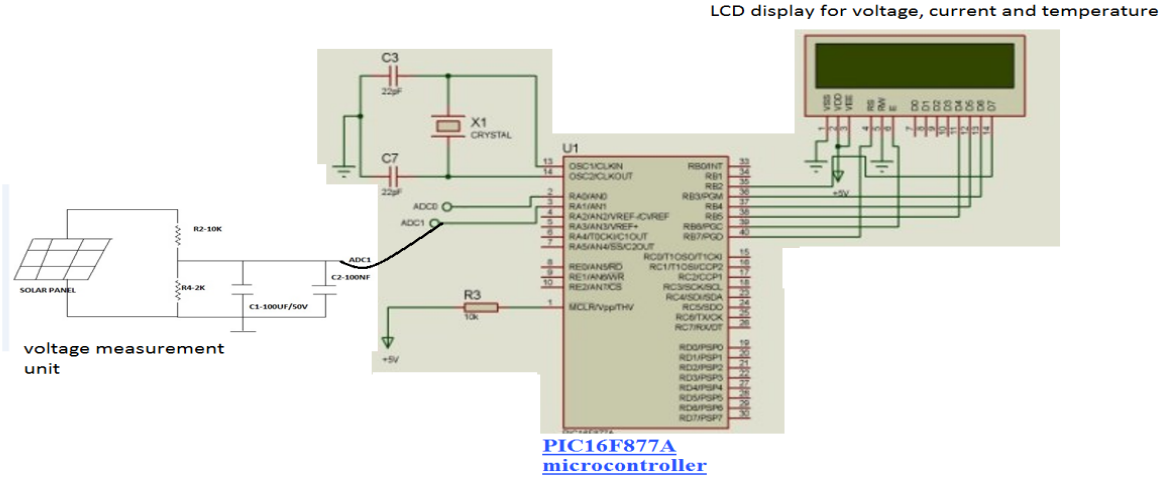

FIG. 2: Circuit diagram for solar energy measurement system

As shown in Fig 2.Circuit diagram, the voltage divider is used to divide voltage to lower than 5 volt. Because microcontroller cannot read voltage more than 5 volt. Therefore voltage divider is used to lower voltage less than 5 volt. Polar and nonpolar capacitors are used to remove harmonics and to provide constant voltage to ADC pin of microcontroller. Polar capacitor is used to avoid voltage fluctuation and non-polar capacitor is used to remove harmonics.[4]

We can use LM35 temperature sensor which is calibrated in Celsius over kelvin because in kelvin calibrated sensor there is a requirement of subtract a constant voltage from its output to is easy. The temperature sensor LM35 can be used with single power supply. The temperature range for operating is -55 to +150

Celsius. The LM35 sensor is suitable for remote applications. Operating voltage such sensor is varies from 4 to 30 V. When the intensity of light is increases then the resistance of LDR is decreases. This is also known as photoconductor. [3],[4].

The light dependent resistor (LDR) is made of a high resistance semiconductor when the falling light on the device is of enough frequency then the photons absorbed by the semiconductor. Thus in resulting free electron conduct electricity thereby resistance is decreases.

Voltage drop across shunt resistor used to measure current. Here shunt resistor of 0.05 ohm is used in series to load. Here shunt resistor is used as a transducers which converts current into voltage, as microcontroller cannot read current directly. Output of shunt resistor is fed to difference amplifier. Difference amplifier step up the voltage.

In case of very low current, small voltage will appear across shunt resistor and microcontroller cannot read voltage less than its resolution.

Followings are the main parts:

- **Current sensor,**
- **voltage sensor,**
- **PIC16F877A microcontroller,**
- **LCD display,**
- **Power supply**

I] AC VOLTAGE MEASUREMENT UNIT:

In the solar panel of 24 volt values of voltage divider resistors are R2 = 10K and R4 = 2K as per voltage sensor formula. The reason we can use voltage divider because the maximum input voltage to Analog to digital converter can never be greater than 5 volt. But we can calculate these resistor values according to 4 volt to increase accuracy of measurement and to insure protection of ADC in case of greater voltage fluctuation.[4], [1]

II] Current Sensor Circuit Diagram:

Below is a circuit diagram of current measurement circuit, where difference amplifier to amplify voltage appearing across shunt resistor. Because current value may be too high and too low in different timings and different voltage will generate across shunt resistor. So it is not possible to use voltage divider as we don't know the values of current.[4]

A current sensor is a device that detects and converts current to an easily measured output voltage, which is proportional to the current through the measured path.[4],[5]

Direct sensing is based on Ohm's law, while indirect sensing is based on Faraday's and Ampere's law. As current flows through a wire or in a circuit, voltage drop occurs. Also, a magnetic field is generated surrounding the current carrying conductor. Both of these phenomena are made use of in the design of current sensors. Thus, there are two types of current sensing: direct and indirect.

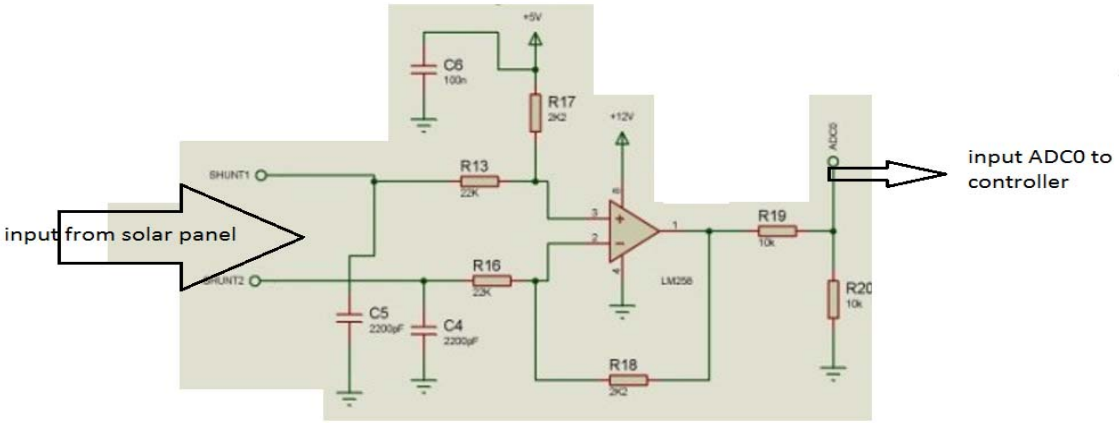

FIG.3: Shunt resistor in series to solar panel

IV. WORKING

The temperature sensor LM35 can be used with single power supply. The temperature range for operating is -55 to +150 Celsius. The LM35 sensor is suitable for remote applications. The temperature sensed can be calibrated in Celsius over kelvin because in kelvin calibrated sensor there is a requirement of subtract a constant voltage from its output to is easy. Operating voltage such sensor is varies from 4 to 30 V. [4]

When the intensity of light is increases then the resistance of LDR is decreases. This is also known as photoconductor. The LDR(light dependent resistor) is made of a high resistance semiconductor when the falling light on the device is of enough frequency then the photons absorbed by the semiconductor.

V. CONCLUSION

In this paperwe tried to measure parameters of solar panels such as Voltage, current, power, temperature and intensity of light using PIC16F877A microcontroller.

Digital display can be used to display values of these parameters. PIC microcontroller can be used to measure analog values of these sensed parameters and analog to digital to converter which is in built in PIC microcontroller can be used to measure values of these parameters.

There are many ways to sense voltage. But in this proposed work we can easily measure voltage of solar panel using voltage divider. Two capacitors are connect parallel to voltage measurement resistor to avoid voltage fluctuation and avoid harmonics to go into ADC of PIC microcontroller.

VI. REFERENCES

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