REAL TIME DATA MONITORING OF PV SOLAR CELL USING LABVIEW AND ARDUINO

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Abstract

Nowadays, the growing demands of energy, insecure energy resources and emission of hazardous gases have attracted the attention of the whole world towards the renewable energy. Thus, at this time, the entire world is concentrated on the renewable energy sources. Also, the evolution in software technology, we are able to monitor the data of any system in real-time manner. Monitoring solar panel output is the best way to track the working of the solar power system continuously. Solar monitoring software allows not just viewing how much electricity the solar panels are generating, but also it gives real-time updates. Our project is designed with the help of LabVIEW and Arduino. The solar panel is connected to the battery and then with sensors. We have connected four sensors with LabVIEW via Arduino hardware to acquire data. LabVIEW has shown a high performance in communicating with several devices simultaneously and high capability of displaying several variables behaviour at a time. Therefore, the proposed system develops a very simple, low cost, high reliable, photovoltaic data monitoring system using Lab-view software and Arduino hardware. The monitored data can be stored for further analysis. This project will be useful power for continually monitoring of solar energy at solar plant.

Keywords: LabVIEW, PV cell, Arduino, Real time data monitoring

1.Introduction

India is the seventh largest nation with an area of 3.287 million km^2. Also, it is a relatively rich and rapidly developing country where it receives more than 7 hours of direct sunlight each day throughout the year; for this reason demand for solar energy is growing on significantly annually. The capability of solar cell is that it can convert into electrical energy from the plentiful and free solar energy. Also, any adverse forms of pollution are not generated which may affect our atmosphere. So, India now tends to move to solar energy. Earlier, measuring data continuously was not an easy due to deficiency in advancement of software technology. But, LabVIEW is a national instruments product that we can used to monitor the data for real time.Laboratory Virtual instrumentation for Engineering Workbench is an abbreviation forLabVIEW.

1.1 Solarcell

A solar cell is an electrical apparatus that translates the light energy into electrical energy by the photovoltaic effect. When light falls on the solar cell, electrons are liberated in the p type region and holes are produced in the n-type region. This reduces the potential energy barrier at the junction, then current flows and set up an externalpotential difference.

1.2 Arduino

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output(I/O) pins that may be interfaced to various expansion boards or breadboards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++.

1.3 Lab VIEWsoftware

A Lab VIEW model is whereby the system equipments are simulated as virtual instruments interacted with functional blocks. In Lab VIEW, there are mainly two windows: Front panel and Block diagram. The functional block is constructed in the block diagram, while the output is seen in the front panel. Lab VIEW requires graphical block to make program instead of scripted words of line which does not require any coding knowledge. It also executes block in terms data flow programming, which is very convenient.

2.BlockDiagram

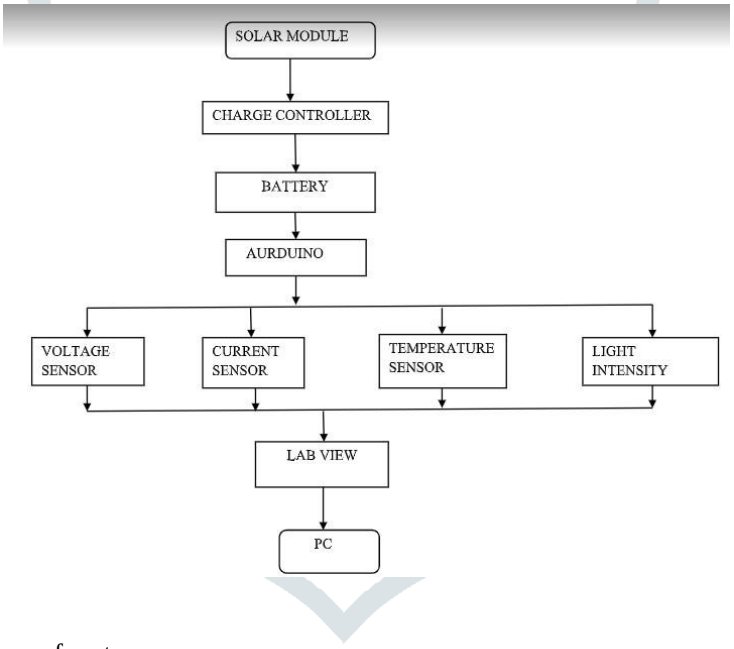


Figure 1: Block diagram of system

3. Objectives of thesystem

The main objectives of this project is to make a sensitive and economical real time system for continuous monitoring of the solar module parameters such as voltage, current, temperature, light intensity andto simulate the algorithm for real time data acquisition of a solar panel using LabVIEW tool. Also todevelop a very accurate and reliable system for data acquisition and continuous measurement.At present, LabVIEW application reach has covered industrial automation, test and measurement, embedded applications, motion control, image processing, computer simulation, FPGA and other fields. So, it has been applicable here.

4.Interfacing LabVIEW withArduino

STEP 1: Firstly, download the Virtual Instrument Software Architecture (VISA) to get access of the system.
STEP 2: Now, go to block diagram from VISA's pallete.
STEP 3:Build a code in Arduino with VISA block diagram
STEP 4: Now, click to the acquire signals and further on the Analog input.
STEP 5: You will see a list of different parameters. Select any one or more according to your requirement.
STEP 6: Now, select a USB device and a list of channels will appear there.
STEP 7: Choose the channel from A0 to A3 as per they actually connected.
STEP 8: A page will appear of different configurations. Make changes as per your requirement. By clicking Ok button, you are done.

5.ComponentsUsed

5.1 Charge Controller

The main function of charge controller is quite simple. It limits the rate at which the current drawn from or added to batteries. This prevents the batteries from overcharging or over discharging. This is how it extends the life span of battery. Charge controller gets signal from the solar module. It may also prevent draining completely a battery depending upon the battery technology to prevent the battery life.

The circuit consists of a relay (12 V, 10 A), Diode, Capacitor, Resistors, IC LM324, an LED, Transistor BC548x2 and connecting Wires. The output voltage coming out from this circuit is about 12 V if the input voltage is greater than 12 V. But if the input voltage is lower than 12 than the output voltage would be the same.

Figure2:Charge controller

5.2 Battery

An electric battery is a device consisting of one or more electrochemical cells with external connections. Batteries convert chemical energy directly to electrical energy. The battery which has been used in our project work has output voltage is about 12 V and output current is 4 A.

Figure3:Battery

5.3 Voltage sensor

A voltage sensor can in fact determine, monitor and can measure the supply of voltage. It can measure AC level or/and DC voltage level. The input to the voltage sensor is the voltage itself and the output can be analog voltage signals, switches, audible signals, analog current level, frequency or even frequency modulated outputs. That is, some voltage sensors can provide sine or pulse trains as output and others can produce Amplitude Modulation, Pulse Width Modulation or Frequency Modulation outputs.

Figure4:Voltage sensor

5.4 CurrentSensor

A current sensor is a device that generates a signal proportional to current passing through in it. We can then develop to present the measured current in an ammeter or else it can be used for advance laboratory analysis in a data acquisitionsystem.

It is a Hall Effect I-V Converter. For sensing of AC or DC current accurately and economically, ACS712 is the best device in communication system as well in industries. We can apply input connections at the blue part.

There are three output terminals. 1) Vcc, 2) GND and3) Out. We can apply +5 V supply to the Vcc from analog channels of Arduino. Output terminal gives to the Arduino analog I/O channel and ground terminal joins to the GND channel in Arduino.

Figure5:Current sensor

5.5 TemperatureSensor

Temperature sensor is a device, to measure the temperature through an electrical signal it requires a thermocouple or RTD (Resistance Temperature Detectors). The thermocouple is prepared by two dissimilar metals which generate the electrical voltage indirectly proportional to change the temperature. The RTD is a VARIABLE RESISTENCE , it will change the electrical resistance indirectly proportional to changes in the temperature in a precise, and nearly linear manner.LM35

is the sensor which is used to sense the temperature.

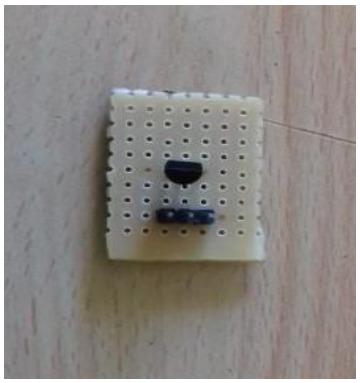


Figure 6: Temperature sensor

5.6 Light IntensitySensor

We have used this sensor to measure the intensity of light intensity. A Light Dependent Resistor (LDR) is also called a photoresistor or a cadmium sulfide (CdS) cell. It is also called a photoconductor. It is basically a photocell that works on the principle of photoconductivity. The passive component is basically a resistor whose resistance value decreases when the intensity of light decreases. This optoelectronic device is mostly used in light varying sensor circuit, and light and dark activated switching circuits.

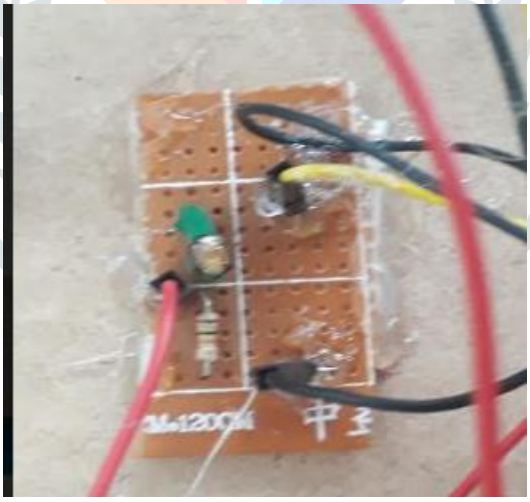


Figure7:Light intensity sensor

6. Working

First of all, the solar module is placed in the open ground for initial charging. After that, the charge is applied to the various sensors through battery and charge controller. Here, four sensors, voltage sensor, current sensor, temperature sensor and light intensity sensor are being used. Then, the output of these sensors is sent to the Arduino hardware, which converts the analog quantity into digital. Next, these data is interfaced with LabVIEW. That is showed on the front panel of LabVIEW. Temperature and light intensity is firstly obtained as voltage form, but after that from the equations, it is converted into their respective value.

7. Result

Voltage to temperatureconversion

Temp. In deg. Celsius = Vout x 100 deg celsius / Vin

Voltage to light Intensityconversion

Lux = Power/Area.

Power is calculated by acquiring voltage and current from the front panel.

Complete model

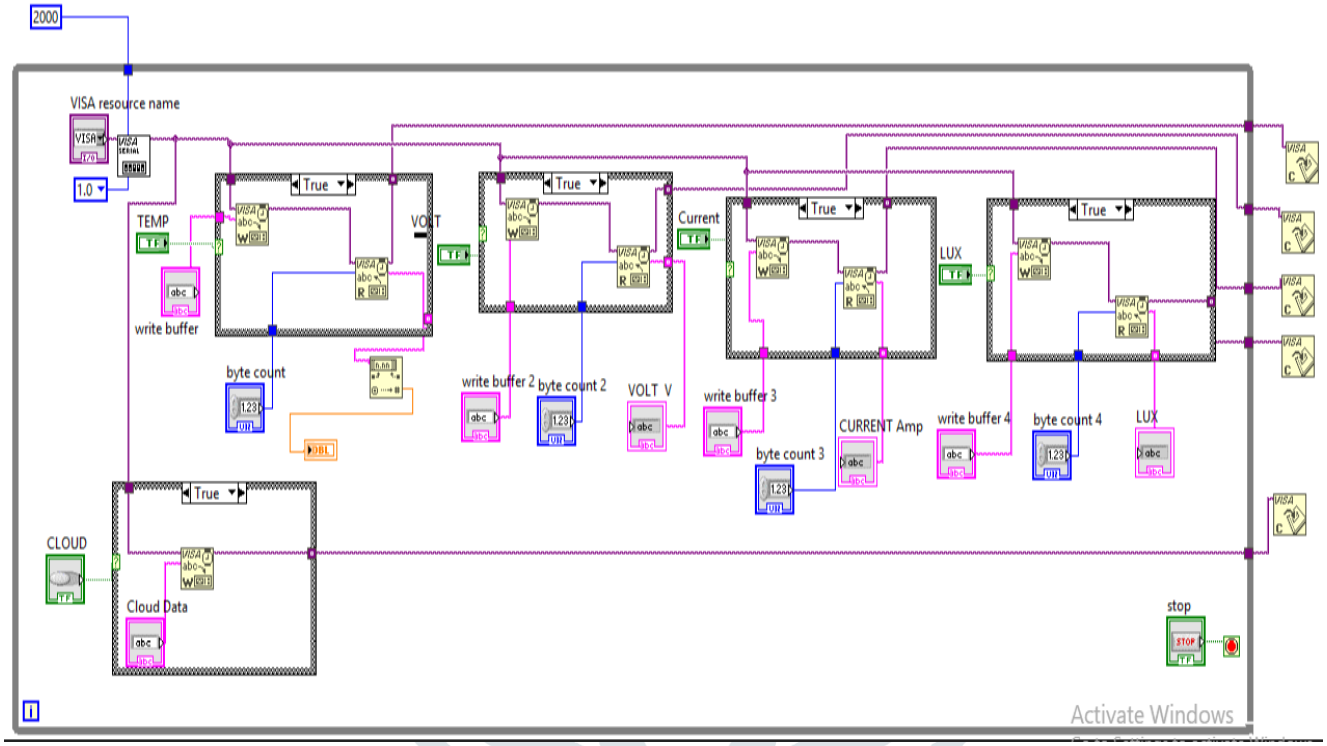


Figure 16:complete simulation model

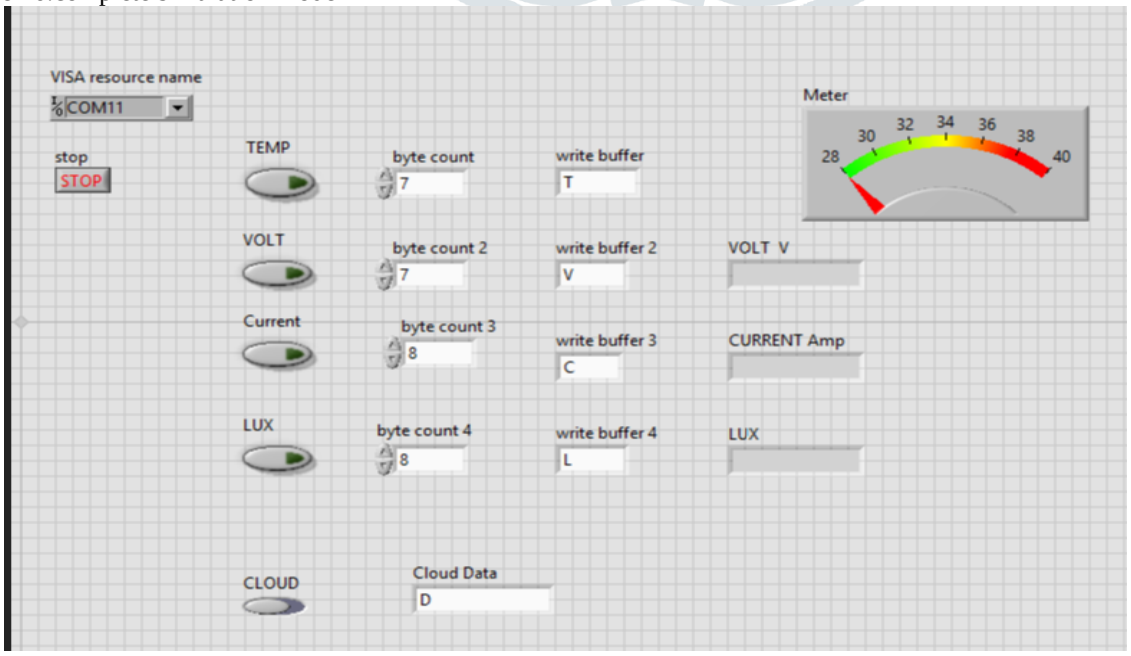
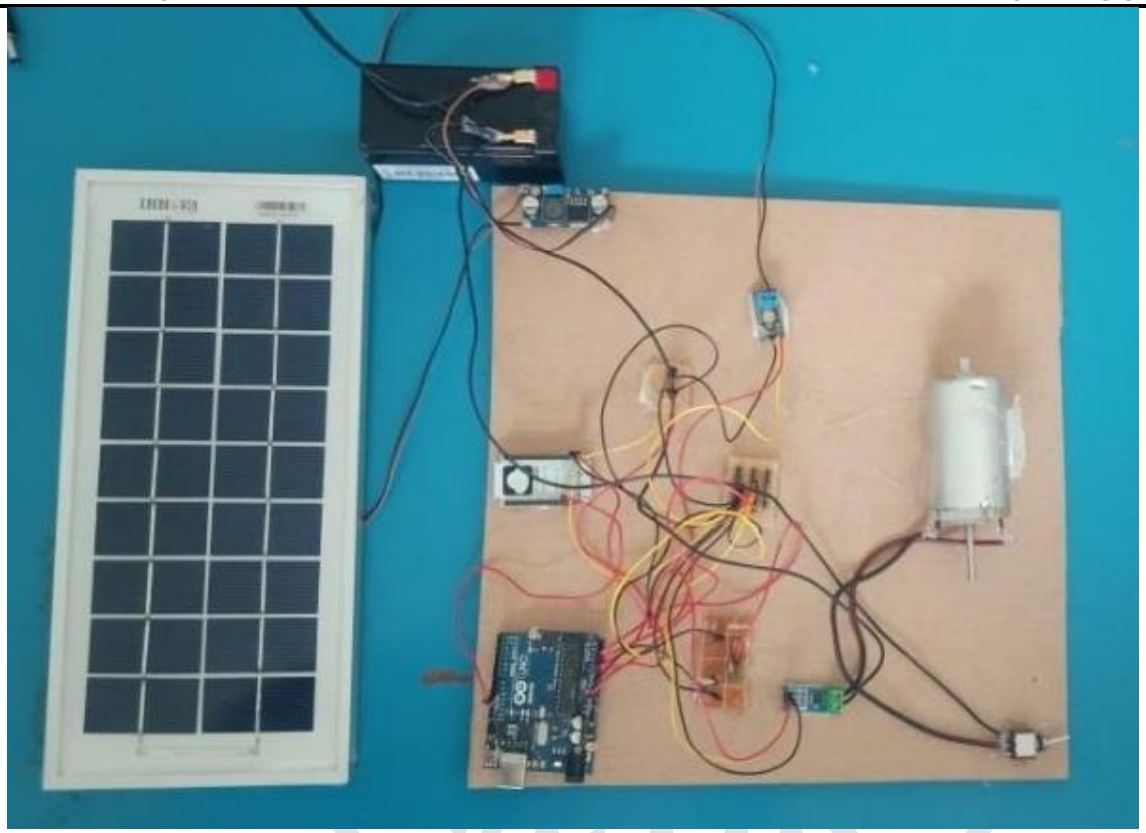


Figure 17:Front panel result



Figue 18:Hardware model

8. Discussion

From the above shown results, it can be apparently seen that the data from the sensors is easily captured and displayed by Lab VIEW software through Arduino. The measuring and monitoring for temperature; it is accomplished through measuring voltage continuously from the output side of the sensor. It is then converted to the temperature by an equation. The outputs can be obtained from Numeric indicator, Tank and Graph. The temperature shows the temperature of solar panels. Fig. 8 illustrates the front panel for the measurement of light intensity. Here, output voltage is converted to the light intensity. The importance of the findings is that we can understand about the sunlight for differentareas.

9. Conclusion

Although, charges of the renewable energy are higher than the non-renewable resources, these methods are constantly rising as the demand of renewable energy is rising due to global warming. Besides, day by day, the amount of the conventional resources diminishes and it becomes costly in price. So, more and more people are laying rooftop solar panels. So, it is vital to determine the output of the PV panels in order to achieve an accurate operation of the device and reduce the energy losses.

In the developed system, we have acquired the data from the solar module. So, we can obtain the data from any solar plant and sent it for the further analysis. This system is very accurate and reliable for data acquisition and continuouslymeasurement.

Future work, we have an idea to send the acquired data from one place to other remote area and also to make the highest efficient by attaching the stepper motor.

10. References

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