

Research Article

Real Time Data Monitoring of PV Solar cell using LabVIEW

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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 DAQ card. The solar panel is connected to the battery and then with sensors. We have connected four sensors with LabVIEW via DAQ 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 DAQ 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, Data acquisition, Real time data monitoring

1. Introduction

India is the seventh largest nation with an area of 3.287 million km². 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 applications. *Laboratory Virtual instrumentation for Engineering Workbench* is an abbreviation for LabVIEW.

1.1 Solar cell

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 external potential difference.

1.2 DAQ hardware

Data acquisition hardware (DAQ) can be used to acquire data captured by different paths at the same time. DAQ comprises both Analog-Digital converter & Digital to Analog converter. It interfaces the analog output of sensor. It is having 32 input/output pins in which eight single-ended analog inputs (AI) channels, two analog output (AO) channels, 12 DIO channels with a full-speed USB interface. AIx pins are the input channels where input analog quantities are to be given whereas AO pins are the output channels where the output is to be obtained (Hans-Petter Halvorsen, 2013).

1.3 LabVIEW software

A LabVIEW model is whereby the system equipments are simulated as virtual instruments interacted with functional blocks. In LabVIEW, 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. LabVIEW requires graphical block to make program instead of scripted words of line which does not require any

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coding knowledge. It also executes block in terms data flow programming, which is very convenient (LabVIEW, 2009).

2. Block Diagram

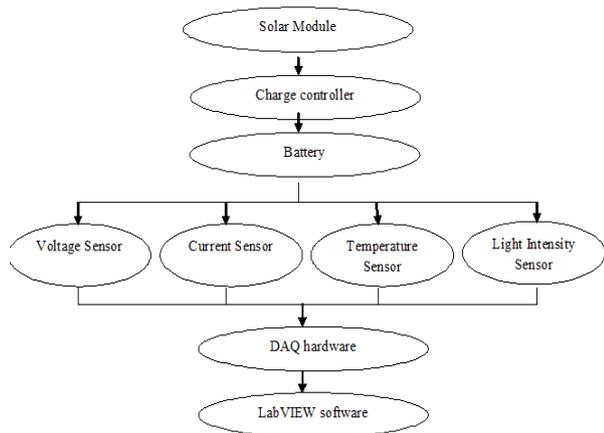


Figure 1: Block diagram of system

3. Objectives of the system

The aim of the particular work is to monitor the acquired data in real time manner of photo voltaic stand alone energy system.

The first objective of the project is to make a sensitive and economical real time system for continuously monitoring the solar module parameters. Also, design of a virtual instrument for measuring the electrical quantities via DAQ card and the interfacing between hardware and software.

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 with DAQ card

STEP 1: Firstly, download the Measurement and Automation Explorer (MAX) and driver software of NIDAQmX to get access of the system.

STEP 2: Now, go to 'Devices and Interfaces' and expand it by clicking.

STEP 3: Right click on the NIDAQmX devices and create a task.

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 ai0 to ai7 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. Components Used

5.2 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.

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.

5.3 Current Sensor

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 acquisition system.

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 and 3) Out. We can apply +5 V supply to the Vcc from digital channels of DAQ hardware. Output terminal gives to the DAQ analog I/O channel and ground terminal joins to the GND channel in DAQ card.

5.4 Temperature Sensor

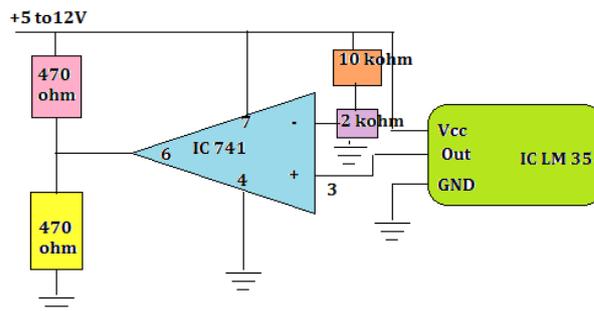


Figure 2: Temperature sensor

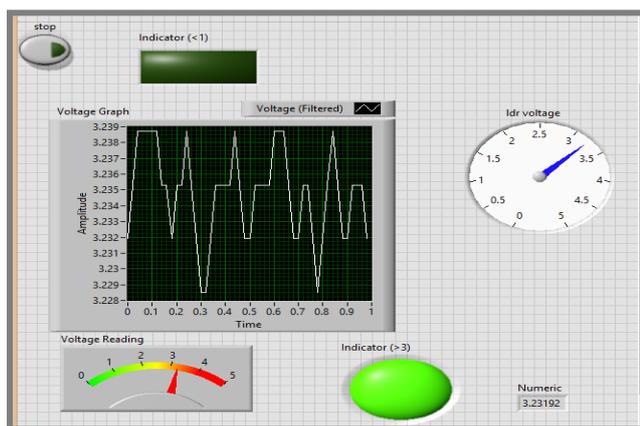


Figure 8: Front Panel for Light Intensity

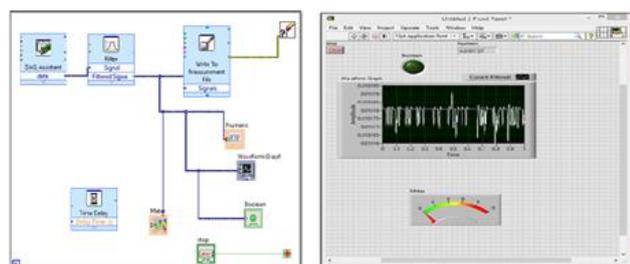


Figure 9: Block diagram for Current measurement

7.1 Equations

7.1.1. Voltage to temperature conversion

$$\text{Temp. In deg. Celsius} = V_{\text{out}} \times 100 \text{ deg celsius} / V_{\text{in}}$$

7.1.2. Voltage to light Intensity conversion

$$\text{Lux} = \text{Power}/\text{Area.}$$

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

8. Discussion

From the above shown results, it can be apparently seen that the data from the sensors is easily captured and displayed by LabVIEW software through DAQ card. Fig. 6 shows 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 different areas.

Fig. 9 depicts the current measurement, where the variable is changed from voltage to current for direct measurement of current to avoid further calculation.

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 continuously measurement.

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.

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