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STUDY OF SOLAR PHOTOVOLTAIC SYSTEM USING DATA ACQUISITION

N.Janaki,
Assistant professor,
Department of Electrical and Electronics Engineering,
Vels Institute of Science, Technology and Advanced Studies, Chennai-117Mail id:janakinarayanan4@gmail.com

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ABSTRACT:
Renewable energy resources are becoming one of primary sources of energy due to its abundance. Today, as civilization grows rapidly various challenges are occur in front of energy structure. Because of interest regarding pollution and global warming demand of renewable energy resources are increased. Solar energy is most promising source of renewable energy sources because of its abundance, versatility and environmental friendly nature. Evolution and utilization of this energy not only provide way to use of these resources but also produce efficient assessment to adjust resources in better way to overcome energy resource crisis. There are different environmental and geographical factors that affect resources, so measurement of solar resources under these factors make system cost effective and enhance usage rate of renewable solar energy. Data acquisition helps to measure status of solar systems under these factors. Accuracy of data acquisition system is also important because various instruments are used to obtain data from system and may produce different results that cause a serious impact on a large scale solar system. Usually, this data acquisition system uses a controller AT89C51, Analog to Digital converter ADC0831, and various communication modules. Some software modules also used to make data acquisition efficient and flexible.

1. Introduction

Solar Energy is radiant light and heat from the sun that is implemented using a range of evolving technologies such as photovoltaic, solar thermal energy, solar architecture, solar heating. It is an important source of renewable energy and its technologies are broadly characterized as either passive solar or active solar depending on how they capture and distribute solar energy or convert it into solar power. Active solar

techniques include the use of photovoltaic systems, concentrated solar power and solar water heating to harness the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favourable thermal mass or light-dispersing properties, and designing spaces that naturally circulate air. The spectrum of solar light at the Earth's surface is mostly spread across the visible and near-infrared ranges with a small part in the near-ultraviolet. Most of the world's population live in areas with isolation levels of 150–300 watts/m², or 3.5–7.0 kWh/m² per day. In 2011, the International Energy Agency said that "the development of affordable, inexhaustible and clean solar energy technologies will have huge longer-term benefits. It will increase countries' energy security through reliance on an indigenous, inexhaustible and mostly import independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating global warming, and keep fossil fuel prices lower than otherwise. These advantages are global. Hence the additional costs of the incentives for early deployment should be considered learning investments; they must be wisely spent and need to be widely shared.

2. Data Acquisition

Data acquisition (DAQ) is the process of measuring an electrical or physical phenomenon such as voltage, current, temperature, pressure, or sound with a computer. A DAQ system consists of sensors, DAQ measurement hardware, and a computer with programmable software. Compared to traditional measurement systems, PC-based DAQ systems exploit the processing power, productivity, display, and connectivity capabilities of industry-standard computers providing a more powerful, flexible, and cost-effective measurement solution.

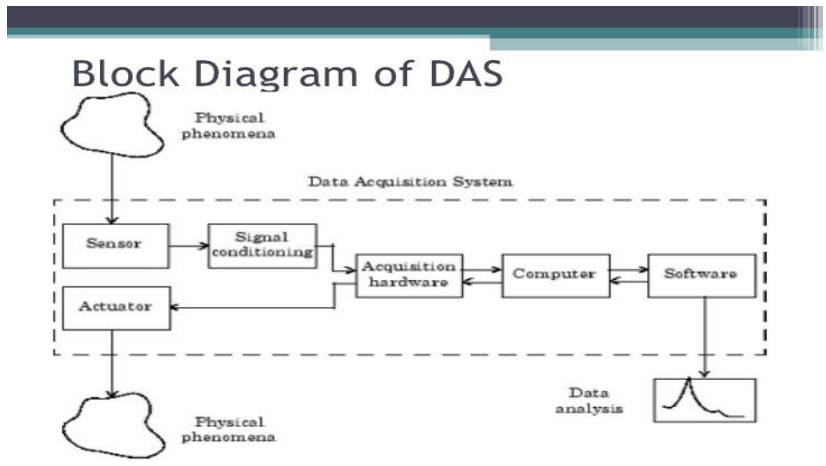

Figure 1 Simple Block Diagram of a DAQ/DAS

3. Structure of Solar Photovoltaic System

Solar energy is main part of renewable energy sources. Sun is an infinite source of solar energy that reduces the need of electric energy. To use this energy there is a list of components that provide a better way to generate and use of this solar energy, as photovoltaic cells, charge controller, inverter and any storage methods as battery. Photovoltaic cells also known as solar cells convert this solar energy into electricity by the photovoltaic effect. Solar cell or photovoltaic cells are constructed from material that uses to convert solar light into electric form. PV cells are made of composition of layers of any semiconductor material as silicon. When sun generated photons of light strikes a solar cell, energy generated that are then absorbed by semiconductor component. Generated power from a solar cell is much low as one or two watts. So to enhance system power a number of cells are group together over a plate also known as solar panel.

It is not possible to use solar energy in direct way because of its discontinuous nature or other environmental factors as dust, cloud, rain, etc. So there is a need of a mechanism to control the charge and storage that has capability of absorbing and delivering power. Charge controller works between battery and solar panel and maintains voltage of both components. If generated voltage through panel is higher Data Acquisition and Analysis of Solar Photovoltaic System 1455 than battery allow battery to charge and if voltage through panel becomes lower than cut off panel from battery. So it protects system from overcharge and reverse leakage. Battery energy storage methods can be used that abate solar power generation issues as ramp-rate, frequency or voltage issue.

A number of batteries are used through serial or parallel, this choice depends upon capacity of the components of solar cells. A DC-AC inverter used to convert DC power produced by panel into AC power to allow for electrical appliances. The data acquisition system consists of a microcontroller AT89C51 and some of its peripheral equipments as ADC analog to digital converter ADC0831, LCD (Liquid Crystal Display), and some communication modules as Zigbee and RS-232. Zigbee allows system to transmission of data wirelessly. RS-232 makes a bridge of communication between host computer and data acquisition modules. Host system contains some software modules as keil, proteus and visual basic 6.0 to allow collecting data and creating chart to take decisions .

3.1. Problem Statement

Measurement of the change of current generating from a Solar Panel and to store the values in a data sheet using Arduino Uno and a current sensor. For storing the values use PLX-DAQ data sheet.

3.2. Problem Definition

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Table 1.1 Components Table

Sl.No.	Component Name	Specification
1.	Arduino Uno	16 MHz
2.	Solar Panel	6 V
3.	LCD Display	16x2
4.	Resistor	0.22ohm/ 3W , 1 Kohmx2, 2.2 kohm ,10 kohm , 20 kohm
5.	Potentiometer	10 k ohm
6.	Capacitors	100nF x 2
7.	Switch	-
8.	Connecting wires	-
9.	DC Power Supply	12 V
10.	OP Amp	LM358
11.	Voltage Regulator	7805

Table1.2Software components

Sl. No.	Component Name
1	Arduino uno ide
2	Plx daq spread sheet

4. Simulation and Experiment Result

Simulation of complete acquisition in software system is designed in Proteus virtual system modeling tool This model comprises a microcontroller and its peripherals circuit. Input is applied at VIN(+) pin of ADC and output send to controller's P2 ports 1 pin. LCD is added at P1 port of controller that shows current status of solar system. RS-232 communication terminal is also added to transmit data to other terminal point as visual basic to draw a graph or chart. To get result to prove the system's condition for experiment are described as 4 solar panels are connected in parallel, where each panel has 36 cells in series. Open circuit voltage VOC of panel is 36V and short-circuit current ISC is 4A. So, total generated voltage through 4 panels are 36V maximum and current is maximum 8A. Through this calculation voltage of a single cell in a panel is 1V.

4.1. CIRCUIT DIAGRAM

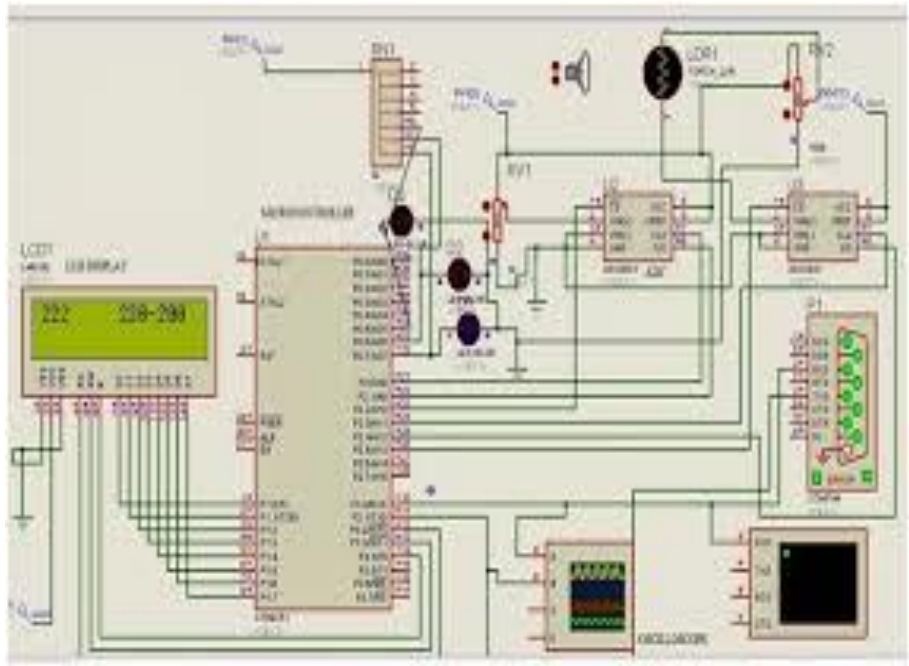

Figure 2Circuit Diagram

4.2. Outcome:

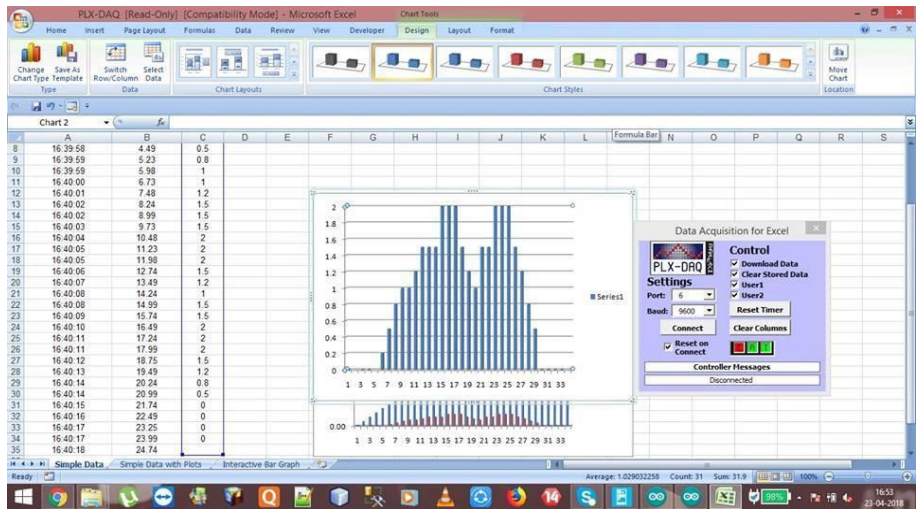

Figure 3 Stored Data in spreadsheet and obtained graph

Column A denotes the time, Column B denotes the time since measurement, column C denotes the data. A delay of 750ms has been added.

Thus we are able to show that each of the components are working perfectly. When the solar panel is connected the data has been logged but the output we are getting is not satisfactory. When it is connected to DC power supply it is working all fine. So, we can understand the data is logged and we have reached our aim.

5. Conclusion

Even though the costs of installations producing electric energy with PV panels are highcompared to the costs of conventional installations, the number of such systems iscontinuously increasing. It is very important to determine the output characteristics of thePV panels in order to achieve an accurate connection and operation of the device and reduceenergy losses. Monitoring activities follow the operation analysis by periodical reports, papers, synthesis, with the precise aim to make the most accurate decisions to produce electric energy usingunconventional sources.

To quantify the potential for performance improvement of a PV system, data acquisitionsystems has been installed. The importance of this chapter consists in the presentation of adedicated DAQ used in PV system analysis and real data measurements. The operation isperformed by simulations using Lab VIEW. The information obtained by monitoring parameters, such as voltage, current, power andenergies are fed to the PC via the DAQ for analysis. The control interface has beendeveloped by utilizing Lab VIEW™ software. The system has been in operation during thelast five

years and all its units have functioned well.

References

Gupta, V., Sharma, M., Pachauri, R.K. and Babu, K.D., 2020. A Low-Cost Real-Time IOT Enabled Data Acquisition System for Monitoring of PV System. Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, pp.1-16.

Lee, J., Lee, Y.C. and Kim, J.T., 2020. Migration from the traditional to the smart factory in the die-casting industry: novel process data acquisition and fault detection based on artificial neural network. Journal of Materials Processing Technology, p.116972.

Abud, A.A., Lehmann, G. and Sipos, R., 2020. Experience and performance of persistent memory for the DUNE data acquisition system. arXiv preprint arXiv:2011.01341.

Tolentino, E.V.N., Andaya, V.S., Cristobal, G.A.G., Ongtengco, R.S., Rosal, A.A., Ruzol, E.B. and Sacramento, J.C.A., 2020, March. Development of wireless data acquisition system for soil monitoring. In IOP Conference Series: Earth and Environmental Science (Vol. 463, No. 1, p. 012088). IOP Publishing.

Marcon, M., Tomiati, N. and Magnani, G., 2020, May. A Low-Cost Data Acquisition System for On-Road Experimental Activity. Symposium on the Dynamics and Control of Single Track Vehicles.

Lipski, M., James, M., Spachos, P. and Gregori, S., Low Power Data Acquisition System for Noise Pollution Monitoring. In 2020 IEEE Canadian Conference on Electrical and Computer Engineering (CCECE) (pp. 1-4). IEEE.

Low-cost data acquisition systems for photovoltaic system monitoring and usage statistics by S Fanourakis, K Wang, P McCarthy, L Jiao.