IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 4, April 2019

LabVIEW based Power Analysis of Solar Tracking System and its Implementation in Real Time (Single Axis)

Ms. Aayuti R. Betude[1], Prof. Poonam Soni[2]

PG Student, Electronics and Tele Communication Department,

Deogiri Institute of Engineering and Management Studies, Aurangabad, Maharashtra, India[1]

Assistant Professor, Electronics and Tele Communication Department,

Deogiri Institute of Engineering and Management Studies, Aurangabad, Maharashtra, India[2]

Abstract: The concern over the environment with respect to power and electricity, solar energy is used to orient various payloads towards the sun in order to the sun energy. Payload can be reflectors, photovoltaic cells, lenses or other optical devices. As the world population is increasing gradually the need for energy is increasing equally. Every day we depend on energy for the purpose of electricity, hot water and fuel for automobiles. Majority of this energy come from fossil fuels, such as coal, oil and natural gas. These are a non renewable energy source, which means that if we use them all up, we can never get more during our life time, so it is important that we use other energy sources, like renewable energy sources. These are energies that can be used again and again such as sunlight, water and wind. The main aim of this proposed system is to absorb maximum solar energy from the solar panel. Here the payload is photovoltaic cell. The solar tracker is the one which traces the sun's movement continuously, such that maximum amount of sunlight falls on the solar panel which we have designed.

Keywords: Three watt solar panel, At-mega328 microcontroller, DC motor, LabVIEW software, MPPT charge controller

I. INTRODUCTION

Solar energy, Wind Energy, Hydro Power, biomass, bio fuel, geo thermal energy are few of those non conventional energy sources which are available to human being all the time and are those energy sources which are available in infinite quantity. These are natural sources of energy and restorable in nature. Out of all mentioned non conventional energy sources solar is one of the most important renewable energy source that have been gaining increased attention from researchers in recent years. As mentioned earlier solar energy is available for undefined duration of the time more, so ever it has the greatest availability in India compared to other non conventional energy sources. The solar energy is clean and free of emissions, since it does not produce pollutants or by-products which are harmful to nature. The available solar energy can be utilized in many ways such as for generation of electricity, for heating water and cooking food using solar equipment, as a backup source and many more. Solar energy conversion can be done in two ways i.e. solar thermal and solar photovoltaic.

Need

The solar energy is one of the most important renewable energy sources for whole world. Because of electricity problems, the demand of different energies has rise up at an average of 3.6 % per annum over the past 30 years. In December 2018, the installed power generation capacity of non conventional energy in India stood at 74081.66 MW which also includes solar power generation of 25212.26MW.

Table 1 Non conventional Energy Generation in India

Small Hydro Power	Wind Power	Bio Power	Solar Power	Total Capacity
4517.45MW	35138.15MW	9213.8MW	25212.26MW	74081.66MW

In India due to geographical favorable conditions has got more sun light compared to other countries. The desert sides in the west involving Rajasthan, Gujarat and Madhya Pradesh are very rich in reception of solar energy. It is indeed a

IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 4, April 2019

key area of research for generation of electrical energy using photovoltaic cells. However most of these researches are done without considering the sun rays angle of incidence and more research in this area is a need of time. It will explore more possibilities of collecting solar energy effectively and efficiently and will drastically improve overall power generation.

II. LITERATURE SURVEY

Overview of Existing Systems

1. An Analysis on Arduino based Single Axis Solar Tracker by Prachi Rani, Omveer Singh and Shivam Pandey-
This paper proposes a study of a solar photovoltaic (SPV) cells based single axis tracking system on Arduino Uno platform for achieving maximum power during a day. The key idea of this article was to implement an automatic single axis solar tracking system. Alignment of solar panel with the Sunlight for getting maximum solar radiation was experimented. This system tracks the maximum intensity of light in terms of maximum power point (MPP). When light intensity decreases, its alignment changes automatically for catching maximum light intensity. This paper was utilized as a base paper for observing the implementation and analysis of single axis solar tracker. The proposed technique was able to identify axis quickly and aligned with sun rays in order to achieve MPP as the output regardless motor speed [1].

2. Design of single axis solar tracking system at photovoltaic panel using fuzzy logic controller by Abadi, A. Soeprijanto, and A. Musyafa-
This paper discusses the design and realization of a solar tracking system oriented to the PV conversion panels. In general, the electricity generated by the PV panels is influenced by the intensity of solar radiation and ambient temperature. They will generate maximum electrical power when the intensity of solar radiation received is also maximum, therefore the PV must be controlled so that its position is always perpendicular to the sun. The proposed single axis solar tracking system claims optimal energy conversion process of solar energy into electricity through appropriately orienting the PV panel in accordance with the real position of the sun. The mechanism of the experiment was based on a DC motor which was intelligently controlled by fuzzy logic controller that moves prototype according to the inputs received from LDR sensors. Overall the performance of the solar tracking system was experimentally investigated and represented in this paper. The designed system claims that it has power gain of 47% compared to the fixed system [2].

3. A Single-Axis Solar Tracking System and Monitoring Software by Ersan Kabalc, Yasin Kabalaci, Ayberk Calpbinici-
This paper discusses the application of a portable solar tracking system which is implemented to increase energy generation of the photovoltaic (PV) panels. This portable system provides the monitoring of the maximum solar radiation values and the creation of more efficient solar tracking system. This system continuously records and monitors the generated voltage, solar irradiation value and the panel position. The voltage, actual panel direction and irradiation data was recorded continuously by the control circuit and transmitted via Radio Frequency (RF) communication to the data collection card connected to the computer. The data received by the data acquisition cards was sent to the computer via Universal Serial Bus (USB) communication protocol. These data parameters were monitored through the interface coded in computer and also recorded in the database. Thus, the retrospective irradiation and voltage information obtained by monitoring system can be monitored by the mentioned system [3].

III. SYSTEM DEVELOPMENTS

A. Proposed System

The main impulsion is to design a high quality solar tracker. This system consists of two parts mainly hardware and software. It consists of three main constituent which are the inputs, controller and the output. A Light dependent resistor (LDR) is a light-controlled variable resistor. LDR is very useful especially in light/dark sensor circuits. Normally the LDR resistance is very high, up to 1000 000 ohms, but through illumination with light, resistance drops dramatically. LDR's are inexpensive and has a simple structure. A DC motor relies on the fact that like magnet poles repels and unlike magnetic poles attracts each other. The Dc motors can turn either clockwise or anticlockwise direction depending upon the sequence of the logic signals. The sequence of the logic signals depends on the difference of light intensity falling on the LDR sensors. The principle of the solar tracking system is done by Light Dependant Resistors. Two LDR's are connected to panel that acts as the input for the system.

B. Proposed Block Diagram:

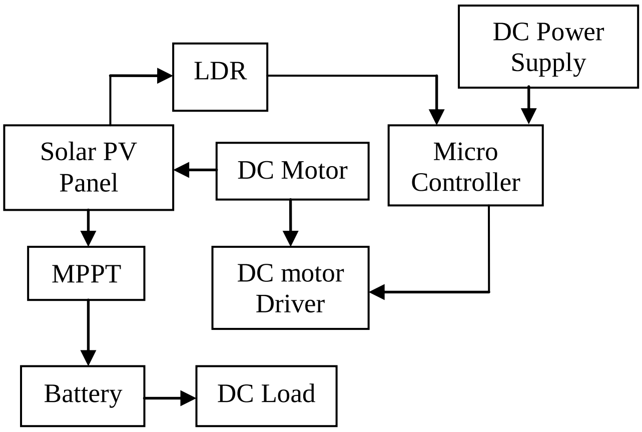


Fig 1 Block diagram of system

C. Circuit Description:

Solar cell is the basic unit of solar energy generation system where electrical energy is extracted directly from light energy without any intermediate process. The working of a solar cell solely depends upon its photovoltaic effect hence a solar cell also known as photovoltaic cell. A solar cell is basically a semiconductor device. A typical solar panel converts only 30 to 40 percent of the incident solar irradiation into electrical energy. Maximum power point tracking technique is used to improve the efficiency of the solar panel. According to Maximum Power Transfer theorem, the power output of a circuit is more when the venin impedance of the circuit (source impedance) matches with the load impedance. In the proposed system towards source side, we are using a boost convertor connected to a solar panel in order to enhance the output voltage so that it can be used for different applications including motor load. Maximum power point trackers may implement different algorithms and switch between them based on the operating conditions of the array [4].

1) Structures of Photovoltaic Cells: A photovoltaic (PV) cell converts sunlight into electricity, which is the physical process known as photoelectric effect. Light which shines on a PV cell, may be reflected, absorbed, or passed through however, only absorbed light generates electricity. The energy of absorbed light is transferred to electrons in the atoms of the PV cell. With their newfound energy, these electrons escape from their normal positions in the atoms of semiconductor PV material and become part of the electrical flow, or current, in an electrical circuit. A special electrical property of the PV cell, called “built-in electric field,” provides the force or voltage required to drive the current through an external “load” such as a light bulb. To induce the built-in electric field within a PV cell, two layers of different semiconductor materials are placed in contact with each other. One layer is an “n-type” semiconductor with an abundance of electrons, which have a negative electrical charge. The other layer is a “p-type” semiconductor with an abundance of holes, which have a positive electrical charge. Although both materials are electrically neutral, n-type silicon has excess electrons and p-type silicon has excess holes. Sandwiching these together creates a p-n junction at their interface, thereby creating an electric field. Figure: 3.3 show the p-n junction of a PV cell. When n-type and p-type silicon come into contact, excess electrons move from the n-type side to the p-type side. The result is the buildup of positive charge along the n-type side of the interface and of negative charge along the p-type side, which establishes an electrical field at the interface. The electrical field forces the electrons to move from the semiconductor toward the negative surface to carry current. At the same time, the holes move in the opposite direction, toward the positive surface, where they wait for incoming electrons [5].

2) Theory of I-V Characterization

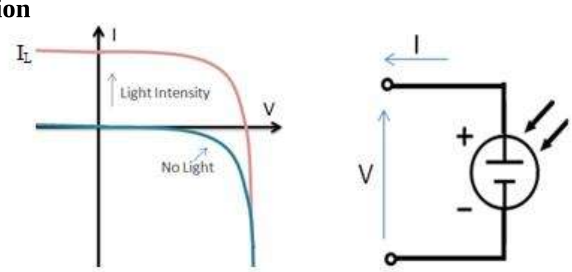


Fig 2 I-V Curve of PV Cell and Associated Electrical Diagram

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 4, April 2019

PV cells can be modeled as a current source in parallel with a diode. When there is no light present to generate any current, the PV cell behaves like a diode. As the intensity of incident light increases, current is generated by the PV cell, as illustrated in Figure

In an ideal cell, the total current I equal to the current I_ℓ generated by the photoelectric effect minus the diode current I_D, according to the equation:

$$I = Ie - Id = Ie - Io\left[e\frac{qv}{kI} - 1\right]$$

where I_0 is the saturation current of the diode, q is the elementary charge $1.6x10^{-19}$ Coulombs, k is a constant of value $1.38x10^{-23}$J/K, T is the cell temperature in Kelvin, and V is the measured cell voltage that is either produced (power quadrant) or applied (voltage bias). A more accurate model will include two diode terms; however, we will concentrate on a single diode model in this document.

Expanding the equation gives the simplified circuit model shown below and the following associated equation, where n is the diode ideality factor (typically between 1 and 2), and R_S and R_{SH} represents the series and shunt resistances.

$$I = Il - Io\left(\exp\frac{q(V + I.Rs)}{n.k.T} - 1\right) - V + I.RS/RSH$$

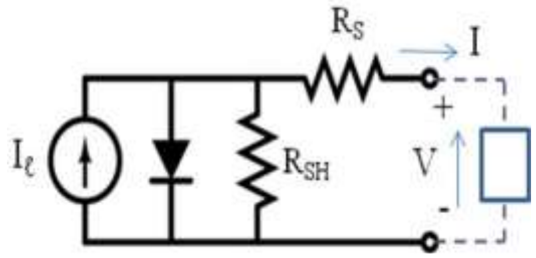


Fig 3 Simplified equivalent circuit model for a photovoltaic Cell

The I/V curve of an illuminated PV cell has the shape shown in Figure 3.7 as the voltage across the measuring load is swept from zero to V_{OC}, and many performance parameters for the cell can be determined from this data, as described in the sections below.

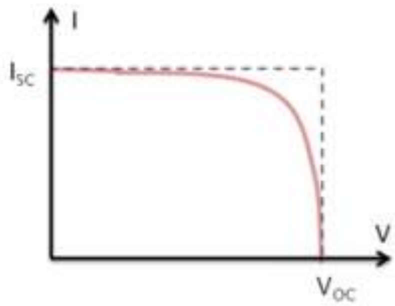


Fig 4 Illuminated I-V sweep curve

1) Short Circuit Current (I_{SC})

The short circuit current I_{SC} corresponds to the short circuit condition when the impedance is low and is calculated when the voltage equals 0.

I (at V=0) = I_{SC}

I_{SC} occurs at the beginning of the forward-bias sweep and is the maximum current value in the power quadrant. For an ideal cell, this maximum current value is the total current produced in the solar cell by photon excitation.

$I_{SC} = I_{MAX} = I_\ell$ for forward-bias power quadrant

2) Open Circuit Voltage (V_{OC})

The open circuit voltage (V_{OC}) occurs when there is no current passing through the cell.

V (at I=0) = V_{OC}

V_{OC} is also the maximum voltage difference across the cell for a forward-bias sweep in the power quadrant.

IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 4, April 2019

$V_{OC}= V_{MAX}$ for forward-bias power quadrant

3) Maximum Power (P_{MAX}), Current at P_{MAX} (I_{MP}), Voltage at P_{MAX} (V_{MP})

The power produced by the cell in Watts can be easily calculated along the I-V sweep by the equation P=IV. At the I_{SC} and V_{OC} points, the power will be zero and the maximum value for power will occur between the two. The voltage and current at this maximum power point are denoted as V_{MP} and I_{MP} respectively.

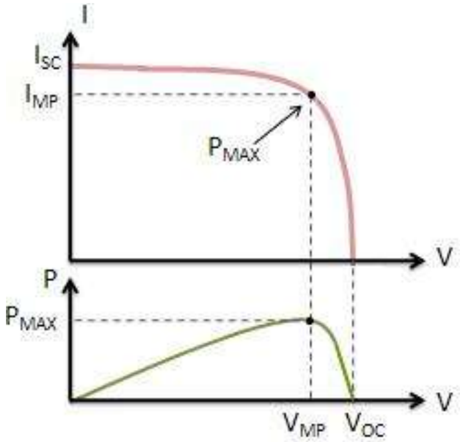


Fig 5 Maximum power for an I-V sweep

D. Maximum Power Point Tracking

For any given set of operational conditions, cells have a single operating point where the values of the current (I) and voltage (V) of the cell result in a maximum power output. These values correspond to a particular load resistance, R= V/I, as specified by Ohm's Law. The power P is given by P = V*I. From basic circuit theory, the power delivered from or to a device is optimized where the derivative of the I-V curve is equal and opposite the I/V ratio. This is known as the maximum power point (MPP) and corresponds to the "knee" of the curve.The load with resistance R=V/I, which is equal to the reciprocal of this value and draws the maximum power from the device is sometimes called the characteristic resistance of the cell. This is a dynamic quantity which changes depending on the level of illumination, as well as other factors such as temperature and the age of the cell. If the resistance is lower or higher than this value, the power drawn will be less than the maximum available, and thus the cell will not be used as efficiently as it could be. Maximum power point trackers utilize different types of control circuit or logic to search for this point and thus to allow the converter circuit to extract the maximum power available from a cell.

1. Methods of MPPT

Maximum Power Point Tracking (MPPT) is used to obtain the maximum power from these systems. In these applications, the load can demand more power than the PV system can deliver. There are different approaches to maximizing the power from a PV system, this range from using simple voltage relationships to more complexes multiple sample based analysis. There are conventional methods for MPPT few of them are listed here.

1. Constant Voltage method
2. Open Circuit Voltage method
3. Short Circuit Current method
4. Perturb and Observe method
5. Incremental Conductance method
6. Temperature method
7. Temperature Parametric method

2. Constant Voltage Method

The constant voltage method is the simplest method. This method simply uses single voltage to represent the V_{mp}. In some cases this value is programmed by an external resistor connected to a current source pin of the control IC. In this case, this resistor can be part of a network that includes a NTC thermistor so the value can be temperature compensated. For the various different irradiance variations, the method will collect about 80% of the available maximum power. The actual performance will be determined by the average level of irradiance. In the cases of low levels of irradiance the results can be better.

IJIREEICE
ISSN (Online) 2321-2004
ISSN (Print) 2321-5526
International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering
Vol. 7, Issue 4, April 2019

3. Open Circuit Voltage Method

An improvement on this method uses V_{oc} to calculate V_{mp}. Once the system obtains the V_{oc} value, V_{mp} is calculated by, $V_{mp} = kV_{OC}$
The k value is typically between to 0.7 to 0.8. It is necessary to update V_{oc} occasionally to compensate for any temperature change. Sampling the V_{oc} value can also help correct for temperature changes and to some degree changes in irradiance. Monitoring the input current can indicate when the V_{oc} should be re-measured. The k value is a function of the logarithmic function of the irradiance, increasing in value as the irradiance increases. An improvement to the V_{oc} method is to also take this into account.

Benefits:
1. Relatively lower cost.
2. Very simple and easy to implement.

Drawbacks:
1. Not accurate and may not operate exactly at MPP.
2. Slower response as V_{mp} is proportional to the V_{oc}.

4. Short Circuit Current Method
The short circuit current method uses a value of I_{sc} to estimate I_{mp}.

$$I_{mp} = kI_{SC}$$

This method uses a short load pulse to generate a short circuit condition. During the short circuit pulse, the input voltage will go to zero, so the power conversion circuit must be powered from some other source. One advantage of this system is the tolerance for input capacitance compared to the V_{oc} method. The k values are typically close to 0.9 to 0.98.

Benefits:
1. It is simple and low cost to implement.
2. This method does not require an input and in low insulation conditions, it is better than others.

E. DC-DC Converter

A DC-DC converter is an electronic circuit which converts a source of direct current (DC) from one voltage level to another. The DC-DC converters are widely used in regulated switch-mode dc power supplies and in dc motor drives applications. Often the input of these converters is an unregulated dc voltage, which is obtained by rectifying the line voltage, and therefore it will fluctuate due to changes in the line voltage magnitude. Switch-mode DC-DC converters are used to convert the unregulated dc input into a controlled dc output at a desired voltage level. The heart of MPPT hardware is a switch-mode DC-DC converter. MPPT uses the converter for a different purpose: regulating the input voltage at the PV MPP and providing load matching for the maximum power transfer.

F. Charge Controller

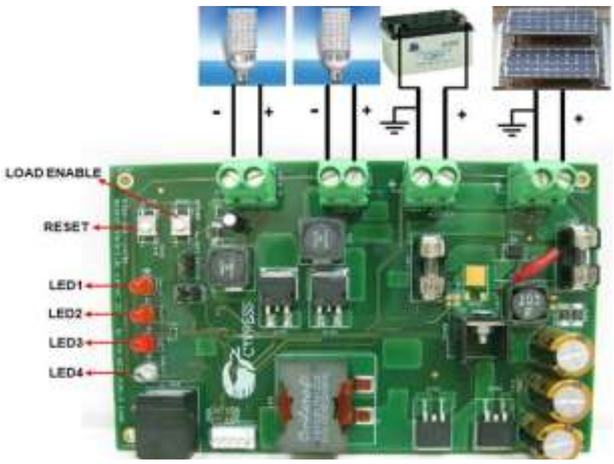


Fig 6 MPPT charge controller

IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 4, April 2019

A charge controller or charge regulator limits the rate at which electric current is added to or drawn from electric batteries. It prevents overcharging and may prevent against overvoltage, which can reduce battery performance or lifespan, and may pose a safety risk. It may also prevent completely draining ("deep discharging") a battery, or perform controlled discharges, depending on the battery technology, to protect battery life. In simple words, Solar Charge controller is a device, which controls the battery charging from solar cell and also controls the battery drain by load. The simple Solar Charge controller checks the battery whether it requires charging and if yes it checks the availability of solar power and starts charging the battery. Whenever controller found that the battery has reached the full charging voltage levels, it then stops the charging from solar cell. On the other hand, when it found no solar power available then it assumes that it is night time and switch on the load. It keeps on the load until the battery reached to its minimum voltage levels to prevent the battery dip-discharge. Simultaneously Charge controller also gives the indications like battery dip-discharge, load on, charging on etc. In this thesis we are using microcontroller based charge controller. Microcontroller is a kind of miniature computer containing a processor core, memory, and programmable input/output peripherals. The Functions of a microcontroller in charge controller are:

1. Measures Solar Cell Voltage, Measures Battery Voltage.
2. Decide when to start battery charging, decides when to stop battery charging.
3. Decides when to switch on the load, decides when to switch odd the load.

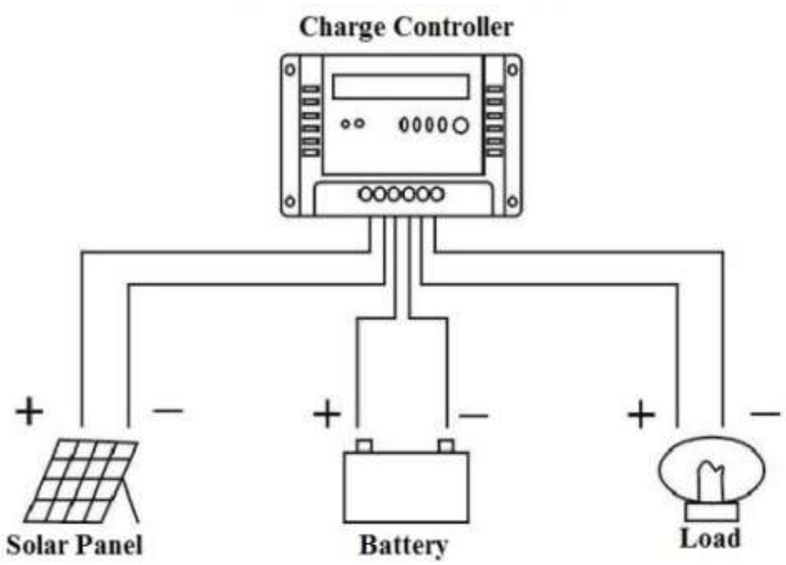


Fig 7 Circuit diagram of charge controller

F. Microcontroller Atmega328:

It is upgraded & more advanced chip. It is an 8 bit microcontroller. It has 28 pins. There are 20 pins which are works as I/O ports. It has 32k flash memory, 1k of EPROM, & 2K of internal SRAM. It has inbuilt ADC (10 bit ADC).For oscillator circuit two capacitor of 22pf and one crystal oscillator of 16MHz used. Crystal oscillator used for generating frequency. This circuit is used to reduce the noise of upper peak level and lower peak level.
Using this controller we interface all this devices to the microcontroller.

G. DC motor and Driving Circuit:

In this system DC Johnson motor is used, which can rotate at a speed of 10 rotations per minutes. Input voltage required to drive DC motor is 12V. To drive the DC motor, microcontroller provides the PWM signal whose duty changes according to the input. The microcontroller output current is small to boost the current an external motor diver L293D is used to drive the motor.

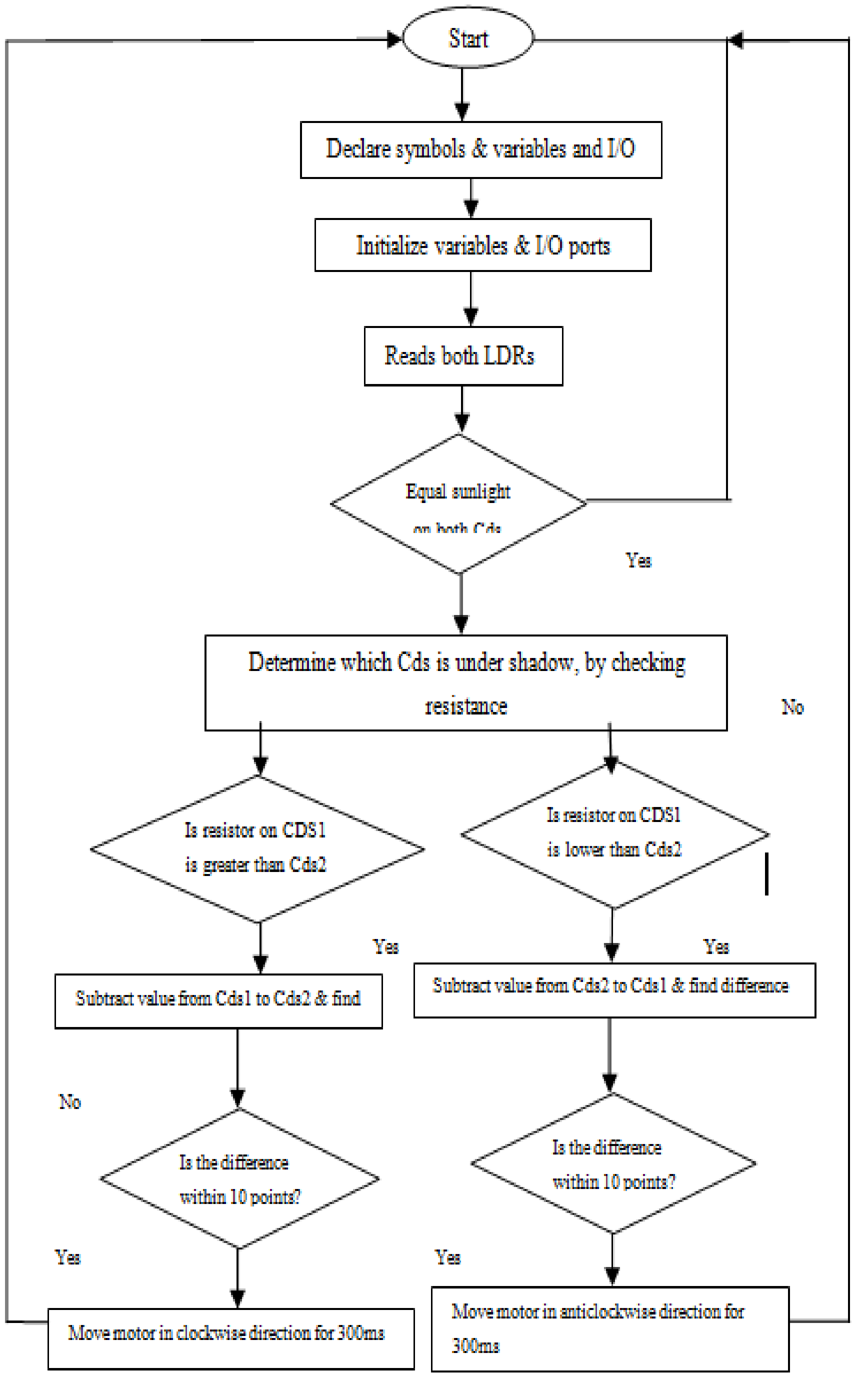
IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 4, April 2019

H. Flow chart:



IV. RESULT AND ANALYSIS

A. Parameter Analysis of System

The developed mechanism has tested by placing it in the sunlight for 6 hours that is from 9am to 3pm daily. At this time the intensity of sun light is high so it is a good time for testing. The collected data is represented in a table below. The sole purpose of the automatic single axis solar tracking system was to improve the efficiency of the solar photovoltaic cell. The developed prototype system is for the 3 watt solar panel. The overall size of panel is small so the system is tested on the roof to verify how the systems work. Here some of the output readings according to analysis of solar panel and analysis of MPPT.

IJIREEICE
ISSN (Online) 2321-2004
ISSN (Print) 2321-5526
International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering
Vol. 7, Issue 4, April 2019

Table 2 Reading of output power

Time	Voltage	Current	Power without MPPT	Power with MPPT
11.00 am	12.58	0.12	1.6	5.94
12.00 pm	14.2	0.13	1.8	3.72
1.00 pm	13.2	0.136	1.9	2.37
1.30 pm	13.5	0.147	1.96	1.98
2.00 pm	12.4	0.14	1.98	5
3.00 pm	11.2	0.8	1.6	5.94.
4.00 pm	10.2	0.11	1.13	5.24

The data is analyzed on the graph shows the current and voltage with respect to time. According to the variation of sun position the panel moves and collects light from sun. Maximum energy is generated during mid noon when sun rays are on peak of its intensity. The graph shows the characteristic of voltage increases along the time and decreases according to time.

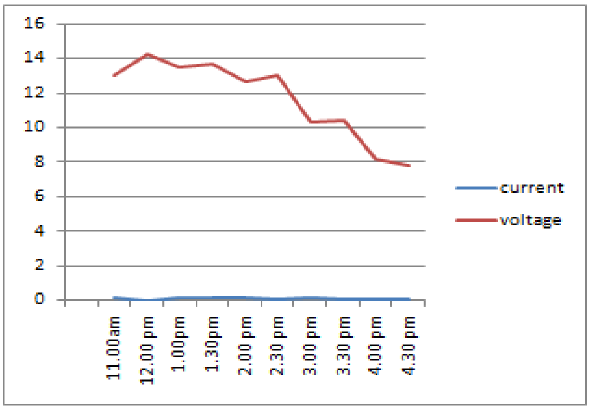


Fig 8 Plot of panel voltage and current with respect to time

B. Output of Solar Panel

Following graph shows the relationship between output power, panel voltage and current with respect to time without MPPT.

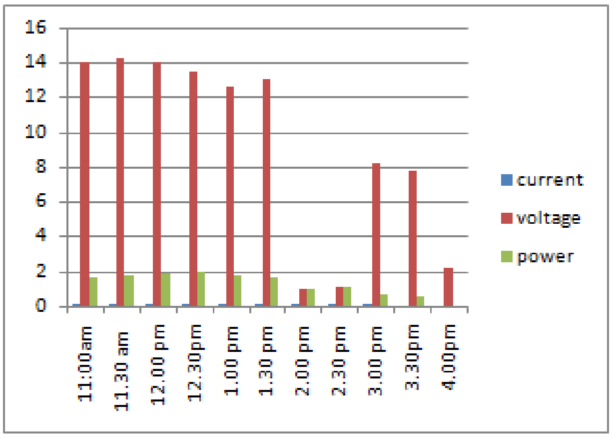


Fig 9 Graph of current, output voltage, total power

C. Output of Solar Panel with MPPT

Following plot shows that the relationship between current, voltage and panel output after tracking the system with maximum power point tracker by using DC-DC convertor. The graph shows that relationship between normal power of solar panel and power after applying MPPT on panel. It indicates that the power is generated using MPPT is more than power generated by solar PV system without MPPT.

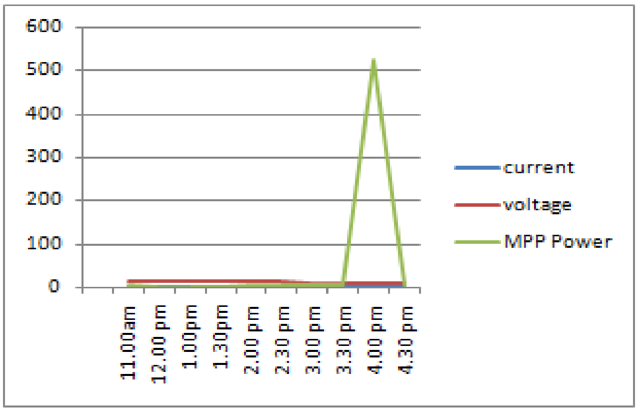


Fig 10 Plot of current, output voltage, total MPPT power

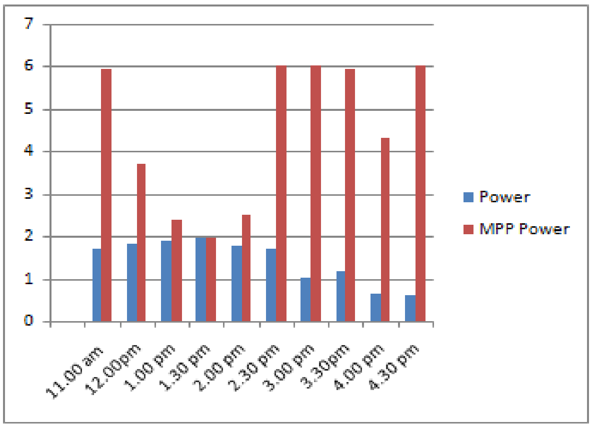


Fig 11 Graph of total power and MPPT power

D. IoT based data monitoring

In the internet of things the data can be send on the hardware device through the internet and that live data can be hosted on the web page. The values may change if light intensity changes and accordingly the reading in terms of power, voltage, and angle of x axis and y axis. The code of the web page can be created or developed in the HTML hypertext markup language, and with the help of PHP hyper text programming language. It helps us to check the live data about the project.

E. Output of solar panel in LabVIEW software

The solar module is placed in the open ground for testing. During test, the charge is applied to the various sensors. In this system four sensors are used namely voltage sensor, current sensor, temperature sensor and light intensity sensor. The output of these sensors is sent to microcontroller through RF module hardware, which converts the analog quantity into digital. The system data is interfaced with LabVIEW. The overall data analysis and representation is displayed on the front panel of LabVIEW.

IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 4, April 2019

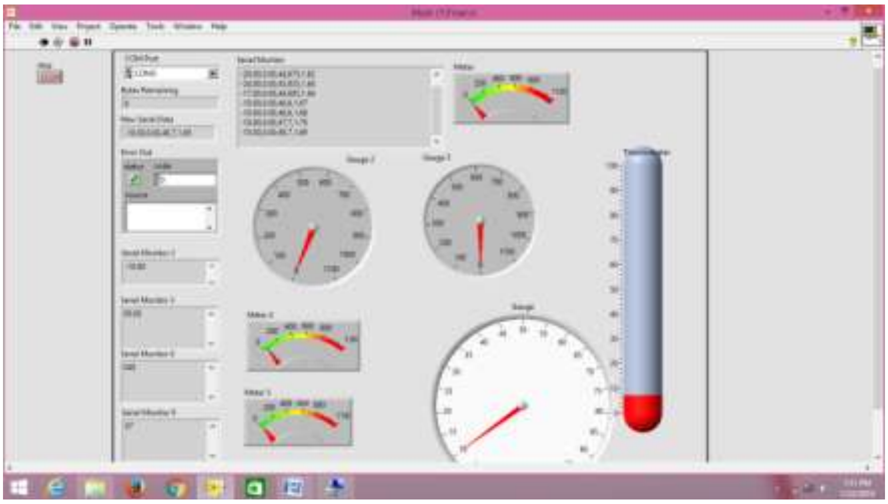


Fig 12 Front panel of labVIEW when intensity is less

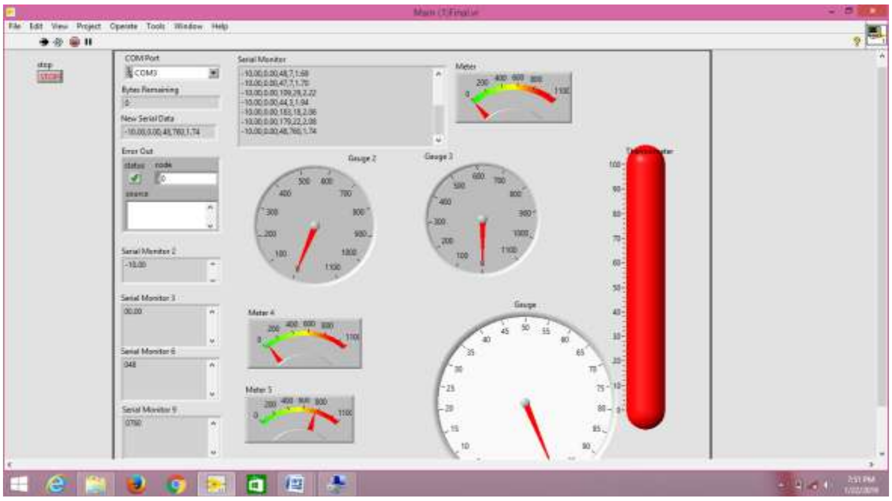


Fig 13 Front panel of LabVIEW when intensity is more

From the experiment solar panel power generation efficiency can be improved by 40%.

F. Mechanism of Proposed System

The proposed system was developed successfully as represented in figure. This system consists of two LDRs of 10KΩ each which are used to develop single axis solar system. These LDRs are connected to analog input channels. The principle of operation is when maximum amount of sunlight falls on an LDR its resistance will drop. This value is compared with the values of all the other LDRs. The LDR with minimum resistance is the one that is most in line with the sun hence the corresponding LED glows in the front panel.

Fig 14 Mechanism of system

IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 4, April 2019

Fig 14 Front view of panel

V. CONCLUSION

A. Conclusion

The LabVIEW based power analysis of sun tracking solar system is implemented to track sun for collection of maximum sun light available during day time. The system is developed using MPPT charge controller and single axis movement of the system. The system is tested for different surrounding conditions and based on the result and data collected, the system works successfully and tracks sun position during day time. The 180 degree solar tracker system tracks the sun light effectively and efficiently achieving maximum power collection using MPPT charge controller. The overall system is simulated in LabVIEW for analytical part. The testing and debugging of the system is executed in real time environment.

B. Advantages and Disadvantages of System

1. Trackers generate more electricity than their stationary counterparts due to increased direct exposure to solar rays. This increase can be as much as 10% to 25% depending on the geographic location of the tracking system.
2. There is much different kind of solar tracker, such as a single axis and dual axis tracker, all of which can be perfect fit for a unique jobsite. Installation size, local weather, degree of latitude and electrical requirements are all important considerations that can influence the type of solar tracker are best suited for a specific solar installation.
3. Solar trackers are slightly more expensive than their stationary counterparts, due to the more complex technology and moving parts necessary for their operation.
4. Some ongoing maintenance is generally required, though the quality of the solar tracker can play a role in how much and how often this maintenance is needed.

C. Future Scope

1. As the need of time is to increase the capacity generation of electricity, the renewable generation using solar PV is a potential option. It is crucial to find new ways to improve the collection of energy to compete with conventional energy resources such as coal.
2. This solar tacking system will be very useful in rural areas where developer can use high sensitive solar panels which can work in mild sun light also and by connecting number of solar tracker assemblies, users will be able to produce sufficiently large quantity of power.
3. Dual axis solar tracking or tracking using internet of things and visual monitoring of solar panel are few of the future prospective of LabVIEW based Single axis Solar PV System.

REFERENCES

[1]. Prachi Rani, Omveer Singh and Shivam Pandey, "A review paper published on arduino based single axis solar tracker system," 5th IEEE international conference 2018.
[2]. Abadi, a. Soeprijanto, a. Musyafa, "Design of single axis solar tracking system at photovoltaic panel using fuzzy logic controller "IEEE Xplore 5th Brunei International Conference on Engineering and Technology, BICET 2014.
[3]. Ersan Kabalc, Yasin KABALCI, Ayberk Calpbinici, "A Single-Axis Solar Tracking System and Monitoring Software," ECAI 2015 - international conference – 7th edition, Electronics, computers and artificial intelligence,25 June -27 June, 2015, Bucharest, Romania.
[4]. Aneesh Kulkarni, Tushar Kshirsagar, Akash Laturia, P. H. Ghare, "An Intelligent Solar Tracker for Photovoltaic Panels,"IEEE Xplore 2013 Texas Instruments India Educators Conference.
[5]. Asmarashid Ponniran, Ammar Hashim, Handy Ali Munir, "A Design of Single Axis Sun Tracking System,"The 5th International Power Engineering and Optimization Conference (PEOCO2011), Shah Alam, Selangor, Malaysia: 6-7 June 2011.