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Design and Development of Solar Tracker and Cleaning of PV System

Gyaneshwari Kirnake, Pranjali Dhamgaye, Abdehasan Chimthanawala, Sumit Yadav, Prof. Ruhi Uzma Sheikh
Department of Electrical Engineering, Anjuman College of Engineering and Technology, Sadar, Nagpur, Maharashtra, India

ABSTRACT

Solar energy is a form of renewable energy source and in the present scenario; it is the desideratum of the hour to efficiently utilize this energy source. The proposed work fixates on two mechanisms which can increase the efficiency of rooftop solar panels assembly. The two mechanisms employed are Solar tracker assembly and solar panel cleaning mechanism. Solar tracker assembly uses Light dependent resistor (LDR) to track and monitor the kineticism of sun. It sends the signal to arduino controller which then provides out signal to the tracker mechanism. It consists of a dc motor; the arrangement of tracker is predicated on a rope pulley mechanism which ascertains correct kineticism of the solar panel. Solar tracking mechanism ascertains maximum solar energy is absorbed by the solar panels. The solar panels are installed on rooftops or ascended platforms, there is no routine cleaning of these panels and dust gets accumulated over the time which decreases the absorption capacity of solar panels. Solar panel installation requires high initial investments and if these are not maintained it shall abbreviate the overall efficiency of solar panel systems. The proposed work presents a cleaning mechanism which ascertains the panels are cleaned routinely thus eschewing the accumulation of dust and minimization in Efficiency. These two mechanisms are employed in the project to have congruous utilization of renewable energy resource.

Keywords : Solar Tracker, Arduino, Solar Panel Cleaning.

I. INTRODUCTION

In very rudimental terms, a solar panel (PV module) is a contrivance that will engender a flow of electricity under sunlight. This electricity can be acclimated to charge batteries and, with the avail of an inverter, it can power mundane household electrical contrivances, or “loads”. PV modules can withal be utilized in systems without batteries. Most solar panels (felicitously called “modules”) are framed in aluminium, topped with tempered glass, and sealed by a waterproof backing. Sandwiched between the glass and backing layers are the photo-reactive cells themselves, often composed of silicon. On the back of the module is a junction box that may or may not have two cables emerging from it. If the junction box has no cables, it can be opened to access the electrical terminals where wires can be annexed to conduct the engendered electricity away from the module. If there are cables already in place, the junction box is customarily sealed and not utilizer-accessible. This paper presents solar panel cleaning and solar racking technique, hence paper is divided into two sections: namely solar panel racking mechanism and solar tracking mechanism. Solar panel tracking is an essential mechanism to absorb maximum power as sun does no remain static at one place. Earlier research works were limited to scope of using solar

energy but as solar energy has become a popular energy source and its usage has increased over the ears, it has become necessary to employ novel techniques that are suitable in the long run and also systems which increase the overall efficiency.

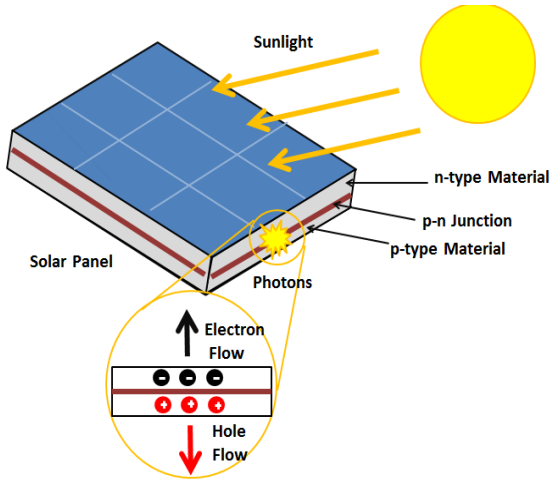


Figure 1 : Principle of Working

II. LITERATURE SURVEY

A) Solar Panel tracking:

There are two broad types of solar trackers:

i.Single axis

The single axis trackers can either have a horizontal or a vertical axis. The horizontal type is utilized in tropical regions where the sun gets very high at noon, but the days are short. The vertical type is utilized in high latitudes where the sun does not get very high, but summer days can be very long.

ii.Dual axis

The dual axis trackers have both a horizontal and a vertical axis and thus they have a wide range of tracking, which makes them utilizable in corner of the world. Dual axis tracking is profoundly paramount in solar tower applications.

Basic techniques employed for solar tracking mechanism with controller are as follows:

Tracking circuit using stepper motor

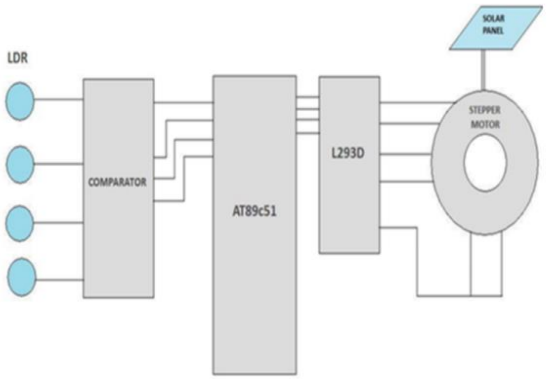


Figure 2 : Tracking circuit using stepper motor

In this mechanism, LDR provides signal to the controller and controller sends the signal to tracking mechanism accordingly to move the solar panel assembly.

Tracking circuit using DC motor

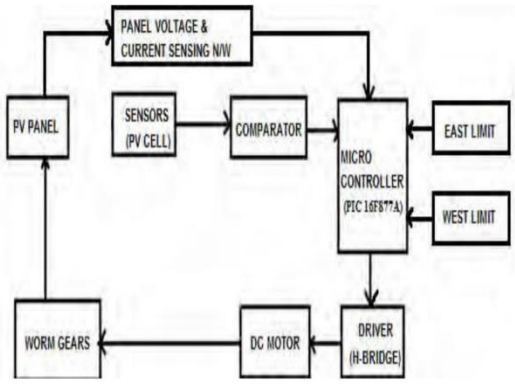


Figure 3 : Tracking circuit using DC motor

In this mechanism, solar panel is used as sensing element and provides signal to the controller and controller sends the signal to tracking mechanism accordingly to move the solar panel assembly [1].

B) Solar Panel Cleaning Mechanism

Solar panels are installed on heighted or elevated areas hence dust starts to get accumulated on it; in the long run it will cover the solar panel and affect its efficiency. Some of the mechanism employed to clean

the panels are using brushes, water sprinkles, roller heads etc [2]

Figure 4 : solar panel cleaning using roller brush.

III. METHODOLOGY

The working of this project is divided in two functionalities namely as solar panel tracking mechanism and solar panel cleaning mechanism

a) Solar panel tracking mechanism

The proposed design implements a fabricated design structure which helps to move the panel in two directions i.e., east & west direction.

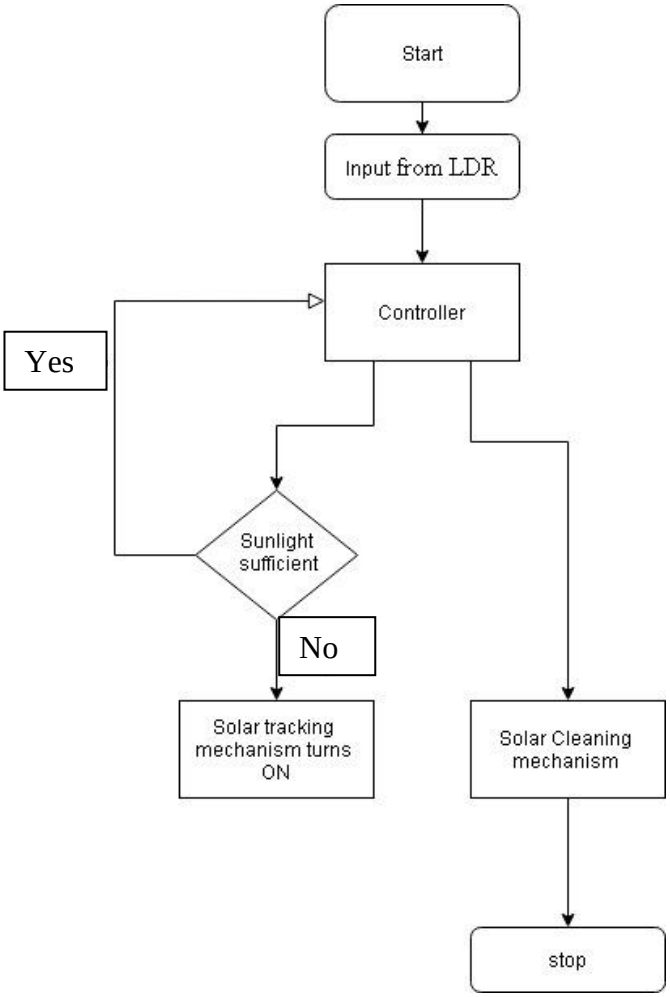
Figure 5 : solar panel tracking implementation

Figure 5 : Solar panel tracking using dc motor.

The pinion and gear system is used for the movement of solar panel assembly through dc motor. The sensing element used is LDR which shall check the intensity of light falling on it. Two LDR's are used for two directions; the signal of LDR is connected to the arduino controller and it provides signal to the dc motor for its movement in either of the directions according to the LDR values.

Flowchart:

The system is turned on and initially it will take input from LDR and depending on the values, controller will provide the signals to dc motor for its movement in either direction using rope pulley mechanism with the help of pinion and gear system. On a routine basis as programmed, the cleaning mechanism will turn on and clean the solar panels on routine basis which will help to clear out the dust accumulation and will help to improve the efficiency of system.



b) Solar panel cleaning mechanism

Stepper motor is used to clean the solar panels on a routine basis. The controller provides signal to the motor driver for stepper motor movement which is attached with a cleaning head.

Hardware & Software Description

A. Hardware Details

Components used are

- Arduino UNO
- LDR
- Motor driver
- Pinion & gear assembly
- Stepper motor
- Dc motor
- Frame design.

LDR: it is used as a sensing element for light detection to track the sun movements. Two LDRs are used for two directions. The change in light intensity gives a change in resistance.

Figure 6 : LDR

Arduino UNO: the controller is needed to take input from sensor and according to the values provide output signal to dc motor for solar racking purpose and also to stepper motor for routine cleaning of the solar panels. It is programmed using Arduino IDE.

DC motor: the dc motor is used for tracking purpose which can be rotated in either direction. It receives signal from motor driver for its operation in either direction. Generally a 12V motor is used for such applications.

Figure 6 : dc motor

L293D motor driver: to control the dc motor, a motor driver must be used which works on the basic principle of H bridge section which helps to control the direction of rotation of the motor in two directions.

Figure 6 : motor driver L293D

Stepper Motor: the cleaning mechanism in this project is based on routine cleaning which includes providing signal to the motor to rotate in steps to perform the particular task.

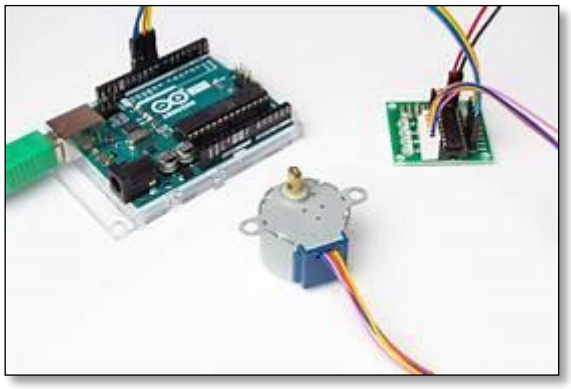


Figure 7 : stepper motor

Software

Arduino IDE: the arduino Uno is programmed using an open source software provided b arduino. It is integrated development environment which is compatible with all arduino boards.

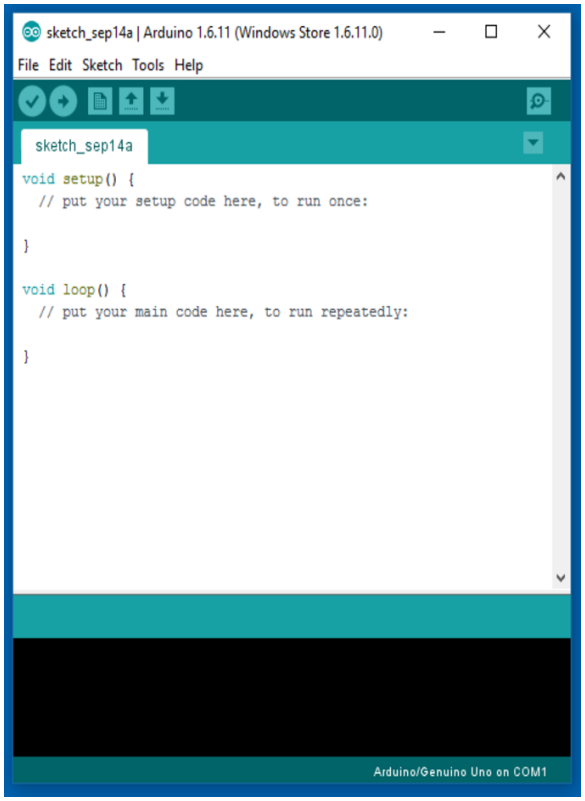


Figure 8 : arduino IDE

IV. RESULTS AND CONCLUSION

The project is designed as a novel approach to achieve two functionalities of solar panel tracking and solar panel cleaning. Solar panels are cleaned on a routine basis whereas the tracking process is carried out to achieve greater efficiency. LDR acts as the sensing element of the project. The fabrication part of this project is designed accordingly where the movement of dc motor helps to track the sun movements and absorption efficiency is increased thereby. Two figure below shows the ready design of project which ensures both functions are achieved efficiently. The LDR module is designed according to the three main positions of centre, east and west.

Figure 9 : LDR Module design

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