INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 5, Issue 2)
Available online at: www.ijariit.com

Implementation of automatic solar tracking and cleaning system

M. L. Thorat
rutuja.walimbe@gmail.com
RMD Sinhgad School of Engineering, Pune, Maharashtra

Rutuja Walimbe
rutuja.jupiter@gmail.com
RMD Sinhgad School of Engineering, Pune, Maharashtra

Aishwarya Patil
patilaishwarya4042@gmail.com
RMD Sinhgad School of Engineering, Pune, Maharashtra

Dhananjay Kulkarni
dhananjay.kulkarni16@gmail.com
RMD Sinhgad School of Engineering, Pune, Maharashtra

Supriya Thorat
thoratsupriya28@gmail.com
RMD Sinhgad School of Engineering, Pune, Maharashtra

ABSTRACT

With the growing requirement of electricity and concern for the environmental impact of fossil fuels, implementation of eco-friendly energy sources like solar power is rising. The solar PV modules are generally employed in dust environments which is the case in tropical countries like India. The dust gets accumulated on the front surface of the module and blocks incident light from the sun. The power output reduces as much as by 30% if the module is not cleaned for a month. Accumulation of dust on even one panel in an array reduces their efficiency in energy generation considerably and need to keep the panel surface as clean as possible. In this paper, we designed a system which not only tracks sun but also clean module automatically. This mechanism required an LDR for tracking the sun. While cleaning the solar panels, a mechanism consists of sliding brushes has been developed. In terms of daily energy generation, the present tracking -cum cleaning scheme provides about 30% more energy output as compared to the stationary PV module. This paper gives an idea about the combination of tracking and cleaning system.

Keywords— *Solar energy, Solar cleaning system, Single axis solar tracker, Environmental factors, Proteus software*

1. INTRODUCTION

PV system operates at best efficiencies if they are directly facing the sun with minimal/no obstruction and are maintained at a lower temperature (25^0 c). Dust once settled on a glass of the PV panel, generally hinders light from reaching the sell, thereby lowering overall efficiency. According to paper [1], that up to certain limit dust deposition at specific settlement densities could we beneficial for PV performance by a solving unwanted IR. Because PV panels convert only the visible spectrum into electricity rest of contribution to system heat. If the layer of dust increases beyond the threshold limit of $2gm/m^2$ then it makes a barrier to visible spectrum to reaching towards PV cell. Due to this, the panel requires maintenance and frequent cleaning. Dust accumulation depends on different parameters. Those are the inclination of the PV panel, kind of installation (standalone or on the tracker), wind direction, humidity, etc.

The sun is the primary source of energy. This is directly or indirectly, fuel for most renewable systems. Among all renewable systems, the photovoltaic system is the one which has a great chance to replace conventional energy resources. The solar panel is mainly made from semiconducting materials. Si used as the measure component of solar panels. The only way to increase the efficiency of the solar panel is to increase the intensity of light falling on it. Solar trackers are the most appropriate technology to increase the efficiency of solar panels by keeping the panels aligned with the suns position. Nowadays to harness solar energy in the most efficient way Solar trackers get popularized around the world.

In order to maximize efficiency, frequent cleaning is strongly recommended. In particular, both weather and design factors influence the dust accumulation process and related effects.

1.1 Necessity

Due to the growing costs of electricity and concern the environmental impact of fossil fuels, eco-friendly energy sources are necessary to implement. The main method for utilizing solar power mostly depends on the Solar panels by absorbing sun rays. Accumulation of dust on even one panel reduces their efficiency in energy generation. That is why we need to keep the panel's surface as clean as possible. Current labour based cleaning methods for Solar panels are costly in

time, water and energy usage. So we have to develop an automatic cleaning machine which can clean and easily move on the glass surface of panels which helps in improvement of efficiency.

In India desert sides like Rajasthan, Gujarat, Madhya Pradesh etc. they are very rich in solar energy. But most of these don't take into account the difference of sun's angle of incidence by installing the panels in a fixed orientation, which highly influences the solar energy collected by the panel the proposed model of single axis solar tracker is most compatible for obtaining maximum efficiency.

1.2 Objectives

There are various effects on the solar panel which affects the efficiency of the panel. Due to those effects, we get less output and therefore the main objective of this project is to increase the efficiency of the solar panel by using tracking and cleaning method also study the environmental effects on the solar panel efficiency.

2. DESIGN DEVELOPMENT

2.1 Cleaning system

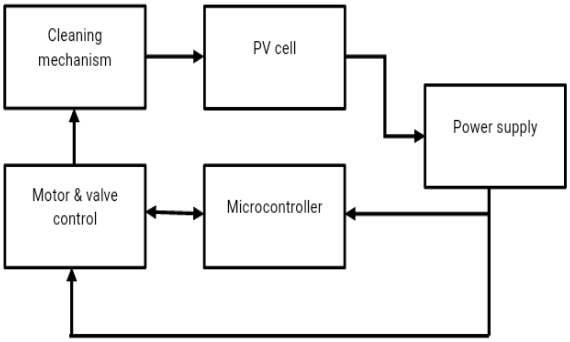

Fig. 1: Block diagram of the cleaning system

The main challenge is to maximize the capture of rays of the sun upon the solar panel, hence we use the cleaning system to maximize the output of electricity. By using the microcontroller the whole mechanism is controlled. In this system, we basically use sliding wiper to remove the dust saturated on the surface of the solar panel. This combination is mounted on the surface of the panel and for movement of mechanism; we use DC motor assembly which is controlled by a microcontroller. Water is required for cleaning the panel, so we use valves are connected for water supply and the dc water pump is for pumping the water. To detect the end of an array of solar panel we can also use a sensor like an ultrasonic sensor.

2.2 Tracking system

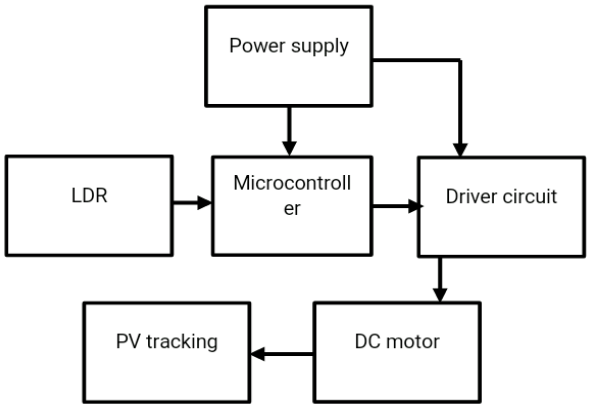

Fig. 2: Block diagram of the tracking system

Block diagram of the tracking system is as shown in figure it consists of LDR, a microcontroller driver circuit, dc motor, battery etc. When the light incident on the solar panel, the LDR sensor generates different voltages these analogue signal converted into digital signals and send to the microcontroller and it allows the motor driver to rotate the dc motor and track the movement of the sun.

3. IMPLEMENTED ALGORITHM

Algorithms for the proposed model are explained by using flow charts. There are two flowcharts one is for tracking system and another is for cleaning system

3.1 Flow chart for tracking the panel

The LDR sensors are used to track the maximum intensity of sunlight. The logic that works to deciding the direction of the motor to move by using the microcontroller. The logic is the microcontroller detects the sunlight on both LDR's and compares it based on the resistance of LDR's, if there are unequal sunlight then motor will move towards the direction of LDR which has less sunlight i.e. clockwise direction and anticlockwise direction respectively.

Figure 3 Shows flow chart for tracking system

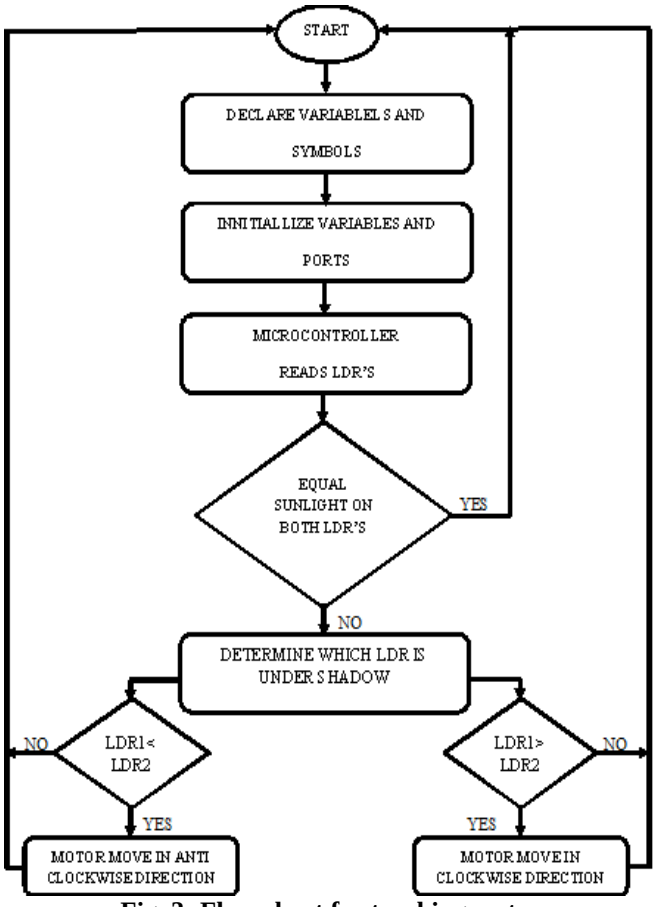

Fig. 3: Flow chart for tracking system

3.2 Flow chart for cleaning of the panel

Figure 4 shows the flow chart for cleaning mechanism in which it reads reading of ultrasonic sensor if it is above the permissible value then the motor will start and rod rotates in a clockwise direction and according to that our cleaning assembly will move on the surface of the panel. If ultrasonic sensor reading is less than the predefined value the motor will move in the reverse direction. The cleaning assembly will consist of wiper, brush and water valve etc.

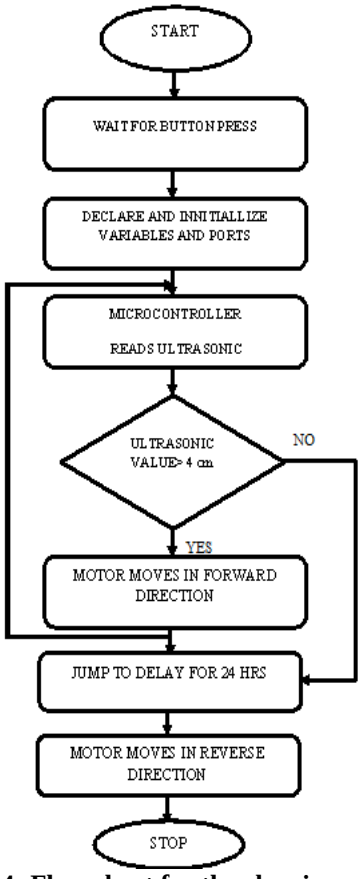

Fig. 4: Flow chart for the cleaning system

4. SIMULATION

The whole system is designed by using Proteus software. This contains LDR sensors, motors, ultrasonic sensor, microcontroller etc. By using those algorithms we have designed the program and it is built into the microcontroller. The simulation diagram of the proposed system is as shown in figure 5.

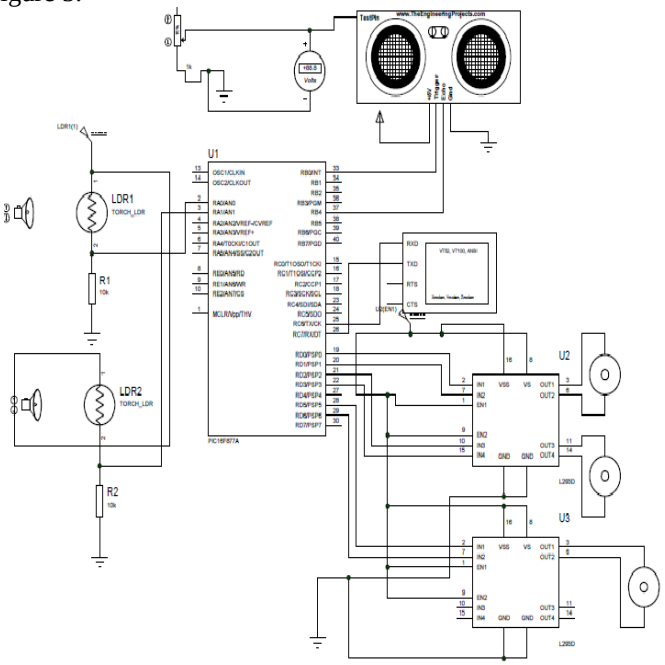

Fig. 5: Simulation diagram of the proposed system

According to the requirement, we have programmed the microcontroller. If the distance recorded by the ultrasonic sensor is less than 400 cm the motor will move into reverse direction if it is above 400cm then it is in the forward direction.

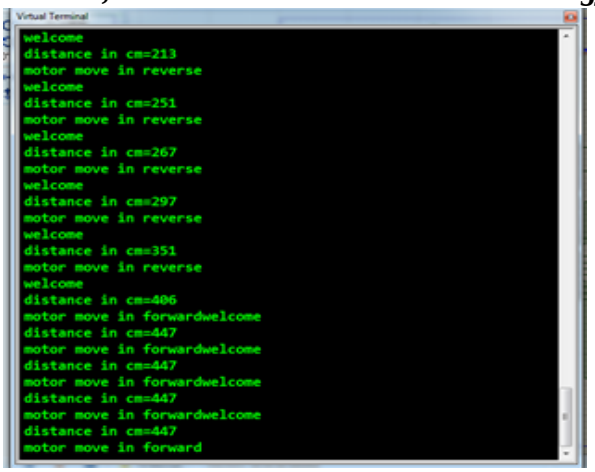

Fig. 6: Result of Simulation

5. CONCLUSION

This paper explains the study for solar panel tracking and cleaning system. This system is implemented for a single solar panel but the array system consists of a number of solar panels in a row. So this system can also be implemented for array system and it is extremely advantageous to increase efficiency. The implemented prototype is removable so it can easily mount on another array. Above system can be kept inclined in the north or south direction to achieve better energy for the solar panel the designed system is single axis tracking by rotating axis automatically as a motor direction change.

For further modification we can also use dust sensor to give the information about dust saturation on the panel surface depending upon this sensor working we can clean the panel automatically for a number of times and rotating brush can also be added into the system. Dual axis tracking has more advantages than single-axis tracking system hence for move efficiency we can implement this thing.

6. ACKNOWLEDGEMENT

The authors wish to thank the faculty of RMDSSOE for their assistance and guidance.

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