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Implementation of Automatic Solar Tracking and Cleaning System

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ABSTRACT

With growing requirement of electricity and concern for the environmental impact of fossil fuels, implementation of ecofriendly energy sources like solar power are 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 front surface of module and blocks incident light from sun. The power output reduces as much as by 30% if 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 track sun but also clean module automatically. This mechanism required a LDR for tracking sun. While cleaning the solar panels, a mechanism consists of a 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 stationary PV module. This paper gives idea about combination of tracking and cleaning system.

Keywords: Solar energy, Solar cleaning system, Single axis solar tracker, Environmental factors, proteus software.

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I. INTRODUCTION

PV system operate at best efficiencies if they are directly face the sun with minimal/no obstruction and are maintained at lower temperature (25^0 c). Dust once settled on 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 in to electricity rest of contribution to system heat. If the layer of dust increases beyond threshold limit of $2gm/m^2$ then it makes barrier to visible spectrum to reaching towards PV cell. Due to this, panel requires maintenance and frequent cleaning. Dust accumulation depends on different parameters. Those are inclination of the PV panel, kind of installation (stand alone or on 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, photovoltaic system is the one which has great chance to replace the conventional energy resources. Solar panel is mainly made from semiconducting materials. Si used as the measure component of solar panels. The only way to increase efficiency of solar panel is that to increase the intensity of light falling on it. Solar trackers are the most appropriate technology to increase the efficiency of solar panels through keeping the panels aligned with the suns position. Now a days to harness solar energy in most efficient way Solar trackers get popularized around the world.

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

A. Necessity

Due to growing costs of electricity and concern the environmental impact of fossil fuels, eco-friendly energy sources are necessary to implement. The main method for

utilize solar power are 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 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.

B. Objectives

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

II. DESIGN DEVELOPMENT

A. Cleaning system

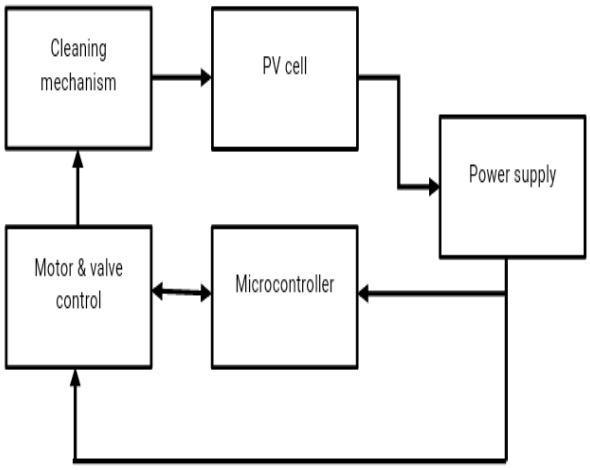

Fig. 1. Block diagram of cleaning system

The main challenge is that to maximize the capture of rays of the sun upon the solar panel, hence we use 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 surface of solar panel. This combination is mounted on the surface of panel and for movement of mechanism; we use DC motor assembly which is controlled by microcontroller. Water is required for cleaning the panel, so we uses valves are connected for water supply and dc water pump is for pumping the water. To detect the end of array of solar panel we can also use sensor like ultrasonic sensor.

B. Tracking system

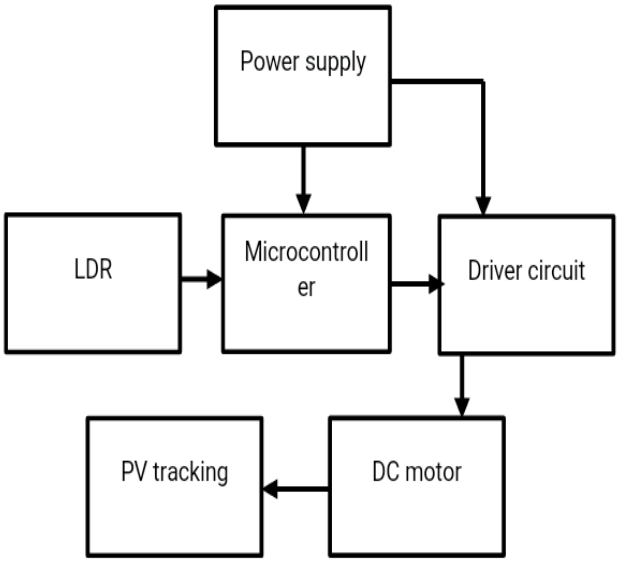

Fig. 2. Block diagram of tracking system

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

III. IMPLEMENTED ALGORITHM

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

A. Flow chart for tracking the panel

The LDR sensors are used to track the maximum intensity of sunlight. The logic that works for decide the direction of motor to move by using the microcontroller. The logic is the microcontroller detect the sunlight on both LDR's and compares it based on resistance of LDR's , if there are unequal sunlight then motor will move towards direction of LDR which has less sunlight i.e. clockwise direction and anticlockwise direction respectively. Fig. 3 Shows flow chart for tracking system

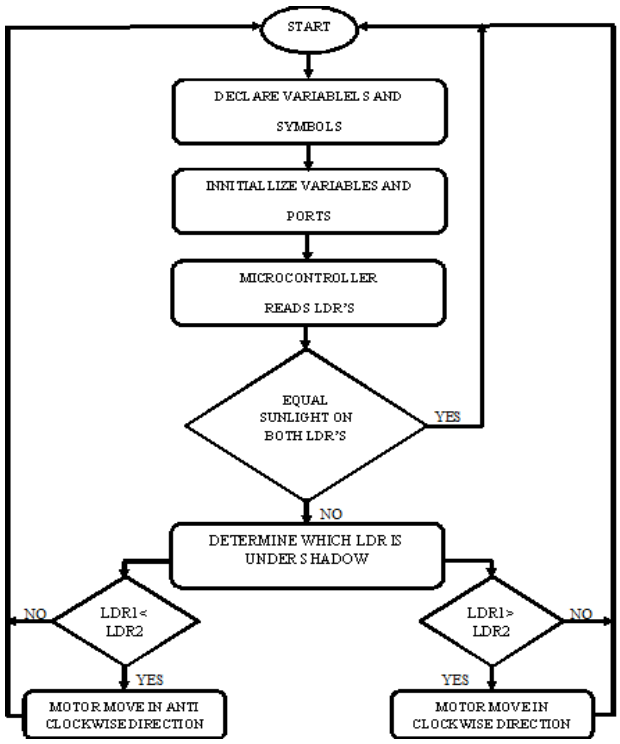

Fig. 3. Flow chart for tracking system

B. Flow chart for cleaning of 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 motor will start and rod rotate in clockwise direction and according to that our cleaning assembly will move on the surface of panel. If ultrasonic sensor reading is less than predefined value the motor will move in reverse direction. The cleaning assembly will consists of wiper, brush and water valve etc.

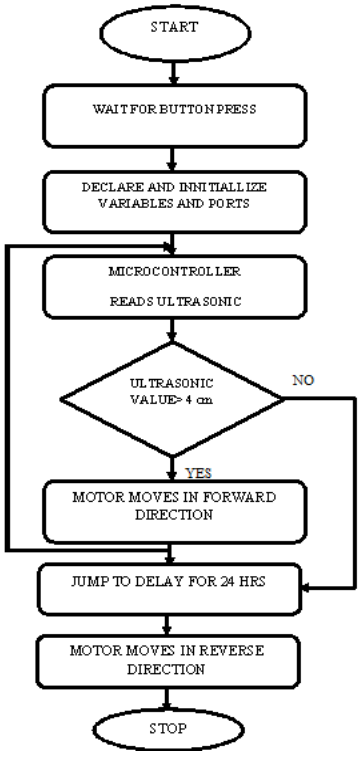

Fig. 4. Flow chart for cleaning system

IV. SIMULATION AND PROTOTYPE

A. Simulation and its result

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

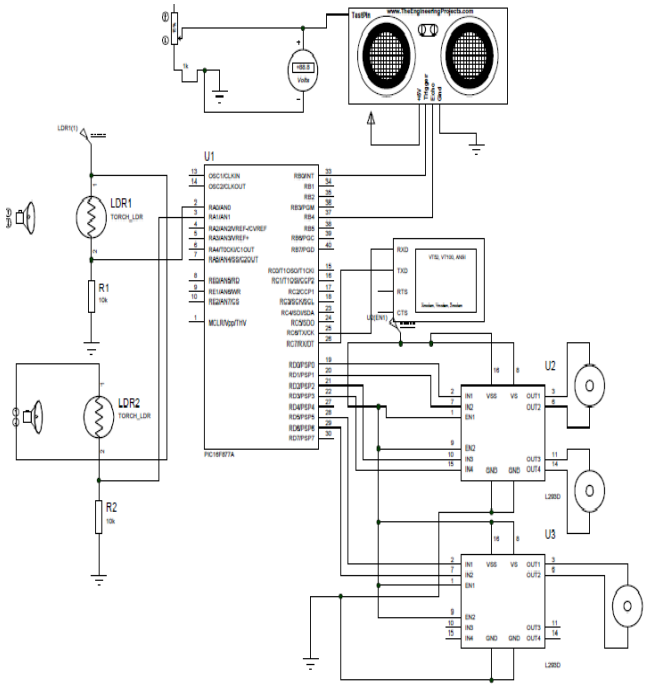

Fig. 5. Simulation diagram of the proposed system

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

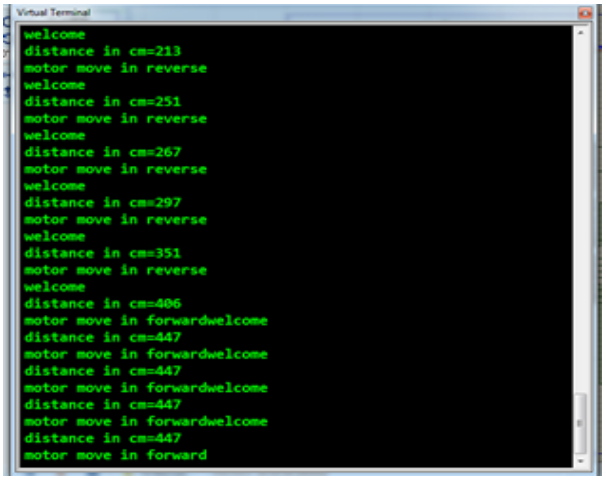

Fig. 6. Result of Simulation

B. Prototype

Fig. 7. Prototype for proposed model

The prototype for solar panel tracking and cleaning mechanism for the high efficiency power output is illustrated in the fig. 7.

This prototype consists of one dc motor of 60 rpm for tracking system and two dc motors for cleaning mechanism. These motors are controlled by the microcontroller pic16f877a. The wiper and brush which are placed on surface of panel for cleaning dust particles. For storing water for cleaning one reservoir tank is used. The dc water pump is used for pumping the water. Which has maximum lift 110 cm and its flow rate is 80-120 L/hr.

V. CONCLUSION

This paper explains study for solar panel tracking and cleaning system. This system is implemented for single solar panel but array system consists of number of solar panels in row. So this system can also be implemented for array system and it is extremely advantageous to increase the 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 solar panel the designed system is single axis tracking by rotating axis automatically as 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 number of times and rotating brush can also be added into the system. Duel axis tracking has more advantages than single axis tracking system hence for move efficiency we can implement this things.

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