"DUAL AXIS SUN TRACKING FOR SOLAR PV MODULES WITH AN AUTOMATED CLEANING SYSTEM"

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Abstract: The aim of this paper is to solve the problem of energy crisis which is considerably a serious issue in this era. The necessity of using renewable energy sources namely solar energy has increased as compared to conventional methods of energy generation . Maximum energy from solar energy is hardly achieved due to effect of various environmental factors acting on the solar PV modules. To overcome this problem of efficiency in the solar PV modules, we have designed a system which not only track sun but also clean the solar PV module automatically. Dual axis sun tracking helps in receiving maximum solar radiations from the sun and using an automated cleaning system, we can improve the reduced efficiency of the solar PV modules due to accumulation of dust particles over the solar PV modules.

Keywords: Dual axis solar tracker, Solar cleaning system, Solar energy, Solar PV modules.

I.INTRODUCTION

In this modern world, electricity is also one of the most basic needs in everyone's life. With the increasing demand of electricity, downfall in the supply of conventional sources used for energy generation has been observed. To balance out this scarcity in power generation, non-conventional energy sources for power generation are mainly adopted. Among all the non-conventional energy sources, power generation from solar energy is widely used. Since, solar energy is found quite abundant all around the earth.

Nowadays in India, frequent power cuts are very commonly observed. Hence consumer tend to adopt alternative measures to generate power. Power generation from solar energy comes with lots of pros and cons. One of the disadvantage of using solar energy as a method of power generation is that solar energy radiations coming from the sun to the earth varies according to the latitudes, longitudes, axis of rotation of the earth. Hence, construction of solar power plants are mainly done in those areas where solar radiations are expected to be received more (i.e. regions near the equator).

Output of the solar panels depends upon maximum intensity of sunlight falling on the solar panels. The system employed mainly concentrates on extracting maximum output from the solar panel. A Dual Axis Solar Tracker equipped with Automatic Cleaning System has been employed to ensure maximum efficiency from Solar PV modules.

II. RESEARCH METHODOLOGY

In this paper, use of different types of components to perform Sun tracking and

Cleaning of PV modules are being used. The main components that are being used are ATmega328, LDR, DC Servo motors, Solar panel (Flat plate collector), DC geared motor. The control of both the systems are performed separately by using ATmega328.

DESIGN IMPLEMENTATION

Tracking system

To develop this dual axis sun tracking system, light dependent resistor (LDR) is used to track the sun's movement. The resistance of LDR increases with decrease in the light intensity or vice-versa. Two 6 volt MG995 Servomotors are used here for rotating the solar panel in two different axes. In this dual axis sun tracking system, we are using four LDRs for detecting the light intensity. To track the movement of the sun accurately, a dual axis tracking system is necessary. With the sun always facing the panel such that radiations received are normal to the panel surface, the maximum energy can be absorbed as the panel operates at its greatest efficiency. The main objective of this paper is to improve the power gain of solar panel by accurate tracking of the sun. The daily motion of earth causes the sun to appear in east-west direction over the earth whereas the annual motion causes the sun to tilt at an angle of 23.5^0 while moving along east-west direction. So the maximum efficiency of the solar panel is not achieved if single axis tracking system is used.

Two pairs of light dependent resistors (LDR) are used to track the exact position of the sun. Out of the two pairs of LDR used, one pair senses the position of the sun in vertical axis and other pair in the horizontal axis. This information is then passed to the ATmega328. Atmega328 is the main control unit of this whole system. The output from the light comparison unit comes to the input of the microcontroller which determines the direction of the movement of the motors both in the horizontal and vertical axes. For this project ATmega328 microcontroller is used. The design of the light sensor is done on the basis of the use of the shadow. If the PV panel is not perpendicular to the sunlight radiations, this causes different light intensity to be received by the sensing device.

Cleaning system

The main challenge is to maximize the efficiency of the solar panel. In case, if the dust accumulated over the panels tends to pose hindrance for the sun radiations falling over the solar panel, the wipers over the panel will clean the dusty panels. when the value of output voltage drops below the set threshold value, the micro- controller will pass the signals to the cleaning system to start the cleaning operation. The whole cleaning operation is controlled using ATmega328. A 12 volt DC pump motor is used for provision of water for cleaning of the solar panels and a DC geared motor is provided for upward and downward movement vertically of the cleaning wipers.

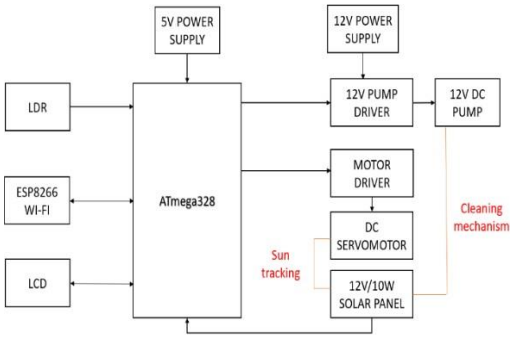

Fig.1. Block diagram of the proposed system

III. IMPLEMENTED ALGORITHM

Algorithms for the proposed model are explained by using flow charts. The following flowchart below shows both the operation of sun tracking and cleaning of the solar panel.

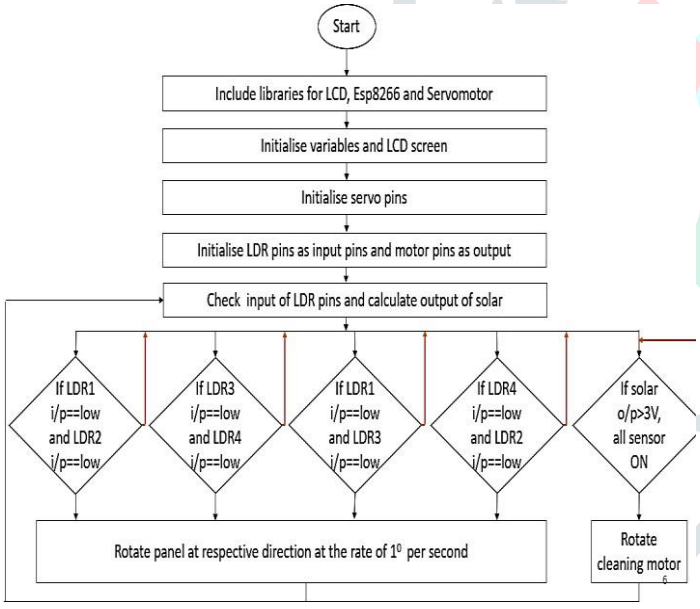

Fig.2. Flow chart of the proposed model

The LDR sensors are used to track the maximum intensity of sunlight. The logic works in such a way that the ATmega328 detects the sunlight on both the pairs of LDR and compares it based on resistance of the LDR. If there is unequal sunlight then the panel will rotate or move in such a way that equal radiations are falling over the solar panel.

For cleaning operation, when the output of the solar panel is found to be less than set threshold value, then the micro-controller will pass on the signal for the wipers to operate. The cleaning system includes the following components, they are DC geared motor, DC pump motor, wipers, etc

VI. . RESULTS AND DISCUSSION

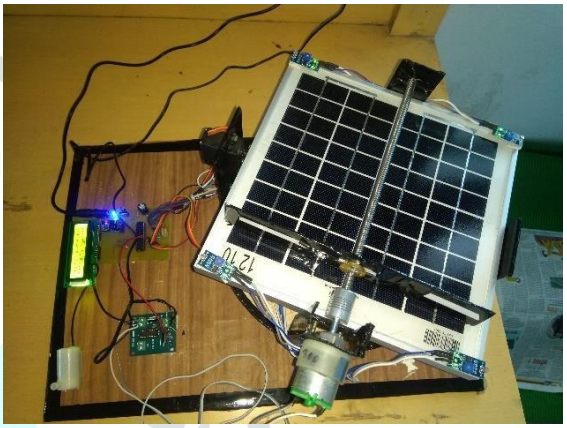

Fig.2. Final model

Using a dual axis solar tracker, the efficiency of solar panel is improved to 10- 15% more. With the provision of an automated cleaning system with a dual axis solar tracker improves the efficiency of the solar panel to 20% more.

To observe the effectiveness of tracking system employed with an automated cleaning system following experiments were conducted.

CASE 1 : When the solar PV module is kept stationary with manual cleaning.

CASE 2 : When the solar PV module is accommodated with tracking system and manual cleaning.

CASE 3 : When the solar PV module is accommodated with tracking cum automated cleaning system.

The comparison of energy output of the above Case 2 and Case 3 is done with Case

1. The percentage gain in energy output is found to be as shown in Table 1.

Case 2	Case 3
15.2	29.8

Table 1: Percentage gain in energy output for different situations.

VII.CONCLUSION

Solar tracker plays an important role in increasing the efficiency of the solar panels in these recent years, thus proving to be a better technological achievement. The major importance of dual axis solar tracker lies in its better efficiency and sustainability to give better output compared to fixed solar panel or a single axis solar tracker. The tracking system employed is designed such a way that it can trap the solar energy in all possible directions. In a single axis sun tracker that moves only along a single axis, tracking the maximum solar energy is somewhat not possible. In case of dual axis sun trackers, if the solar rays are perpendicular to panel throughout the year. Hence, maximum possible energy is trapped throughout the year. Thus, the increase in output indicates that the efficiency of dual axis sun tracker is more than a fixed solar panel (about 30 - 40% more) or a single axis tracker (about 6
-7% more).

VIII. REFRENCES

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