Sun Tracking Solar Panel with Automatic Cleaning System

Deepali Madhav Kasar [1], Sakshi Vinod Savale [2], Priyanka Tilabhai Patel [3]
[1,2,3]*Student, MVP's Karmaveer Adv. Baburao Ganpatrao Thakare College of Engineering*

***Abstract*- The aim of this paper is to solve the problem of energy crisis which is considerably serious issue in today's period. It is becoming essential to increase use of renewable sources of energy namely solar energy as compared to conventional sources for energy generation. A technology namely automatic smart sun tracking and cleaning system for solar panel using motor mechanism and arduino controller introduced to improve efficiency of solar cells by tracking and cleaning system sun's energy. It uses arduino microcontroller and stepper motor to move solar panel according to position of sun. Photo resistors are also used to detect light intensity.**

***Index terms*- Solar energy, Photo resistors, Solar panel and ARDUINO**

I. INTRODUCTION

As the range of applications for solar energy increases, so does the need for improved materials and methods used to harness this power source. There are several factors that affect the efficiency of the collection process. Major influences on overall efficiency include solar cell efficiency, intensity of source radiation and storage techniques. The materials used in solar cell manufacturing limit the efficiency of a solar cell. This makes it particularly difficult to make considerable improvements in the performance of the cell, and hence restricts the efficiency of the overall collection process. Therefore, the most attainable method of improving the performance of solar power collection is to increase the mean intensity of radiation received from the source.

There are three major approaches for maximizing power extraction in medium and large-scale systems. They are sun tracking, maximum power point tracking or both. The solar tracker, a device that keeps photo voltaic or photo thermal panel in an optimum position perpendicularly to the solar radiation during daylight hours, can increase the collected energy from the sun by up to 40%. Usually the fixed PV panels cannot follow the sun movement. The single-axis tracker follows the sun's East West movement, while the two-axis tracker follows the sun's changing altitude angle too. Sun tracking systems have been studied with different applications to improve the efficiency of solar systems by adding the tracking equipment to these systems through various methods. A tracking system must be able to follow the sun with a certain degree of accuracy, returns the panel to its original position at the end of the day, and also tracks during cloudy periods. 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.

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.

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. The Solar Tracker used to solve this problem consists of two essential parts

1. The solar panel cleaning system.
2. The tracking system

II. LITERATURE REVIEW

Ref. No	Year	Name of Reasearcher	Name of Paper
1.	2009	William F Taylor	Research on a conventional solar tracker employing controllable moveable solar pan- els to expose them continuously to the path of the sun both throughout the day and throughout the year
2.	2013	Ahmed Rhif.A.	"Position Control Review for a Photovoltaic System- Dual axis sun tracker."
3.	2018	Manju B Abdul Bari and Pavan C M	Automatic Solar Panel Cleaning System‖

III. BLOCK DIAGRAM

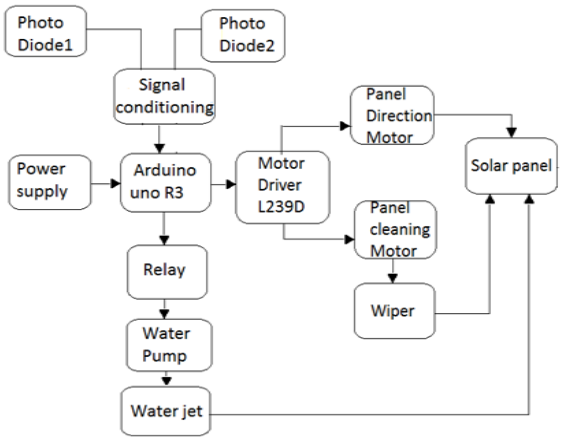
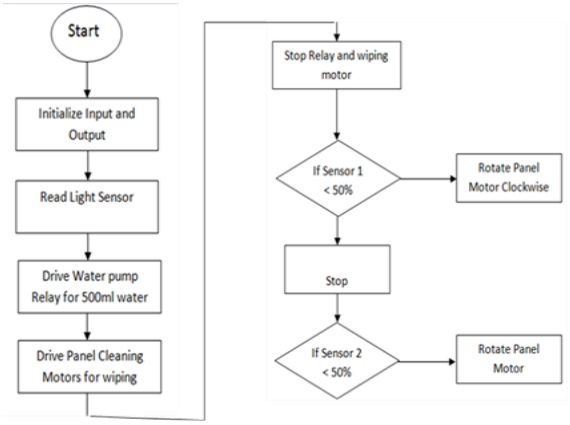


Fig 2 Block Diagram Uses ARDUINO Uno for Controlling Purpose

Motor 1 and 2 are connected to driver circuit, 12v DC supply is given to the driver circuit and also to the ARDUINO controller. The driver circuits are connected to ARDUINO controller. We have also connected 2 Photo diode sensors to ARDUINO and linked to the model. Whenever Photo diode will detect any light intensity, the motor will work as per program.

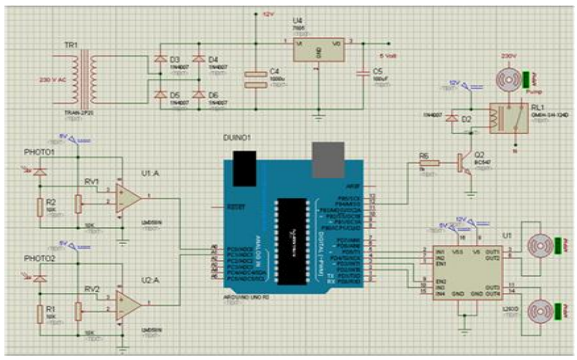
IV. FLOW CHART

First of all, we are initializing input and output pins of arduino Controller. Photo diodes are connected arduino and interface with motor through arduino Controller. Whenever value get at that time panel Tracking Motor and Panel cleaning Motor will run when Panel cleaning will get value from them



V. SIMULATION

The whole system is designed by using Proteus software. This contains Photo diode sensors, motors, Relay, Water pump, 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.



According to the requirement, we have programmed the microcontroller. If the panel senses the <50% of input it gives that input as output to Arduino controller then controller rotate motor clockwise and set panel perpendicular to sun if it is not then rotate motor anticlockwise to get it back to initial position.

V. SPECIFICATIONS AND PRIMARY RESULTS

A. Specifications

In order to demonstrate the efficiency of the proposed system, a control algorithm is generated as shown in table 1.

TABLE I CONTROL ALGORITHM

STEP	Action
1.	Install the small PV
2.	Put PV in initial position (0,0,0)
3.	Find the maximum sun light, using the photoresistors, and save the position of the PV
4.	Measure the current (I)
5.	If I < threshold value (minimum current); wait for 30 minutes and go to step 3, otherwise go to step 6
6.	Turn PV left for 3.5, measure the current; if it is greater then the previous current continue turning left until finding the maximum current in x and y axis; Otherwise turn right and do the same. after finding the maximum current turn up or down to get the
7.	Send the coordinates (x,y,z) to the heater or large panels wired or wireless.
8.	Goto step 3

B. Preliminary Results

In order to assess the efficiency of the proposed system, some measurements were taken during a sunny summer day. Table 2 shows the comparison between the maximum current using a fixed Photovoltaic panel (PV) and using the proposed system at different times.

TABLE II. COMPARISON OF THE CURRENT BETWEEN FIXED PV AND USING THE PROPOSED SYSTEM

Time	Current using a fixed PV (Amp)	Current using the proposed system (Amp)
8.00 AM	0.42	0.85
9.00 AM	0.55	0.90
10.00AM	0.75	0.92
11.00AM	0.81	0.95
12.00AM	0.92	0.99
1.00 PM	0.95	0.99
2.00 PM	0.88	0.99
3.00 PM	0.76	0.98
4.00 PM	0.42	0.95
5.00 PM	0.23	0.95
6.00 PM	0.15	0.92
7.00 PM	0.08	0.72
8.00 PM	0.01	0.25
Total	6.93	11.36

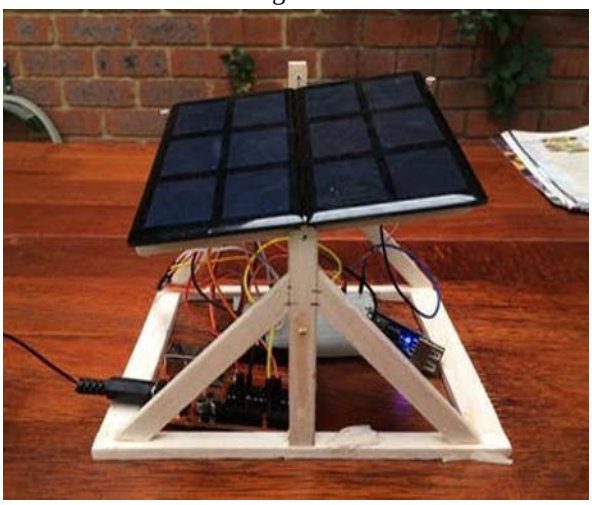
The efficiency of the proposed system can be calculated using the equation (1):

$$Efficiency \frac{(11.36 - 6.93) *100}{6.93} = 63.92\% \quad (1)$$

It seems that the efficiency of the proposed system can be increased around 64% on a summer sunny day. In addition the proposed system consumes little power to turn the PV panel using a small stepper motor instead of using large panel which consumes larger amount of power [10]. Moreover, this system can power itself from the PV panel using a 12 volt battery

VI. 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.



VII. ACKNOWLEDGMENT

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REFERENCES

[1] Dabhi Chirag and Gandhi Mayank―Design And Development of Solar Panel Cleaning Machine‖ International Journal of Advance Engineering and Research Development, Special Issue SIEICON-2017,April -2017.
[2] Hiroyuki Kawamoto and Takuya Shibata, ―Electrostatic Cleaning System for Removal of Sand From Solar Panels‖, Journal of Electrostatics, Volume 73, February 2015, pp. 65-70.
[3] Manju B Abdul Bari and Pavan C M, ―Automatic Solar Panel Cleaning System‖, International Journal of Advances in Scientific Research and Engineering, Volume 4, Issue 7 July – 2018.
[4] K.A. Moharram , M.S. Abd-Elhady, H.A. Kandil, H. El-Sherif,―Influence of cleaning usingwater and surfactants on the performance of photovoltaic panels‖Energy Conversion and Management , 2013, Volume.68, pp. 266-272
[5] Saravanan V. S., Darvekar S. K. ―Solar Photovoltaic Panels Cleaning Methods A Review‖, International Journal of Pure and Applied Mathematics, volume 18, May 2018, pp. 24-41.
[6] B. A. D. J. C. K. Basnayake, W.A.D.M. Jayathilaka, Y.W.R. Amarasinghe and R.A. Attalage, ―Smart Solar Tracking and On-Site Photovoltaic Efficiency Measurement System‖, Moratuwa Engineering Research Conference (MERCon) ,Sri Lanka,2016.
[7] Ashish Saini and AbhishekNahar.‖ Solar Panel Cleaning System‖. IJIR.2017; 3(5), pp. 1222-1226.
[8] SatishPatil, Mallaradhya h m.―Design and Implementation of Microcontroller based Automatic Dust Cleaning System for Solar Panel‖.Imperial Journal of Interdisciplinary Research,Vol-3, Issue-5, 2017, pp.1222-1226.
[9] Technology in Engineering and Science, Volume 4, Issue 6, 20