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Sun Tracking Solar Panel with Auto Dust Cleaning System

**Prof. Vishal.M.Joshi¹, Master. Rajesh Shamrao Chavhan², Master. Rohit Digambar Dabhade³,
Master. Vikram Bhausaheb Chaudhari⁴**

Professor, Department of Electrical Engineering, Adsul's Technical Campus Ahmednagar, Maharashtra, India¹.

UG Student, Department of Electrical Engineering, Adsul's Technical Campus Ahmednagar, Maharashtra, India².

UG Student, Department of Electrical Engineering, Adsul's Technical Campus Ahmednagar, Maharashtra, India³.

UG Student, Department of Electrical Engineering, Adsul's Technical Campus Ahmednagar, Maharashtra, India

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 PV modules, LDR, cleaning.

I.INTRODUCTION

The need for an alternative source of energy is rising fast. Until now, majority of power needs of the world relies upon the exploitation of the non-renewable fossil fuels. However recent estimates put the use of oil and coal up to 2030, after which the world will need to foster the need for a more efficient and wide spread use of technology. The search for a renewable source of energy that can satisfy our ever growing needs is the need of the hour. The generation of power from the reduction of fossil fuels is the biggest challenge for the next half century. The idea of converting solar energy into electrical energy using photovoltaic panels holds its place in the front row compared to other renewable sources. But the continuous change in the relative angle of the sun with reference to the earth reduces the watts delivered by solar panel. In this context solar tracking system is the best alternative to increase the efficiency of the photovoltaic panel. Solar trackers move the payload towards the sun throughout the day. In this paper tracking of solar based power generation systems are invented and their pros and cons are discussed in detail.

Nowadays the energy deficiency problems faced by the world, more especially the developed countries, are urging researchers to find an alternative energy source that would complement the conventional fossil fuel. The alternative energy sources include solar, nuclear and wind. Solar energy is the energy generated by harnessing the power of the solar radiation. It is the cleanest source of energy which can pollute the climate the least. The power from the sun. Intercepted by the earth is approximately 1.8×10^{11} MW, which is many thousands of times larger than the present consumption rate on the earth from all other in-use commercial energy sources.

The sun is the primary source of energy. This is directly or indirectly, fuel for most renewable systems. Among all utilize solar power are mostly depending 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

II. LITERATURE SURVEY

The very basics to understand a system is well defined in [1], the author had addressed in simple yet schematic way the very building blocks of "C" language. As Arduino IDE is based upon this very language, we have studied it in detail.[1]

The Basic electronics and building blocks essential for development of hardware circuit were introduced to us through this book [2].

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. [3]

Based on the simulation results and field tests obtained in by the authors, during 2019 and 2020, they conclude that the solar panels tracking is sufficiently stable throughout the year since the cloud density is moderate in Najaf, so the angle of incidence of the sunlight is stable. These results indicate that the use of the Open Loop Sun-tracking system, as opposed to the Closed Loop model, is appropriate for Najaf because the system is less complex and less costly.[4]

III.EXISTING SYSTEM

A. Existing system:

Solar panel is mainly made from semiconductor materials such as silicon (Si) and is used as the major component of solar panels, which is maximum 24.5% efficient. A solar cell panel, solar electric panel, photo-voltaic (PV) module or solar panel is an assembly of photo-voltaic cells mounted in a framework for installation. Solar panels use sunlight as a source of energy to generate direct current electricity. A collection of PV modules is called a PV panel, and a system of PV panels is called an array. Arrays of a photovoltaic system supply solar electricity to electrical equipment.

Photovoltaic modules use light energy (photons) from the Sun to generate electricity through the photovoltaic effect. Most modules use wafer-based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module can be either the top layer or the back layer. Cells must be protected from mechanical damage and moisture. Most modules are rigid, but semi-flexible ones based on thin film cells are also available.

The cells are usually connected electrically in series, with each other to the obtain desired voltage, and then in parallel to increase current generation. The power of the module is the mathematical product of the voltage (in volts) and the current (in amperes) of the module. The manufacturing specifications on solar panels are obtained under standard condition, which is not the real operating condition the solar panels are exposed to on the installation site.

B. Disadvantages of existing system

The main problem with the solar energy is its dilute nature. Even in the hottest regions on the earth, the solar radiation flux available rarely exceeds 1 KW/M, which is insufficient for technological utilization. This problem can be rectified by a device solar tracker which ensures maximum intensity of sun rays hitting the surface of the panel from sun-rise to sunset. Among all renewable systems, photovoltaic system is the one which has a great chance to replace the conventional energy resources. Solar panel directly converts solar radiation into electrical energy.

In order to maximize the amount of radiation collected by a solar collector, the tracker must follow the sun through the day. But, if the environmental conditions in which the solar PV modules are installed, like tropical climate around the equator, significant amount of dust gets deposited on PV modules. The regular cleaning of PV modules is required in tropical climate which adds to the cost of operation and maintenance of the PV systems. The settled dust, if not cleaned, affects the performance of the solar PV module by shading the front surface. It has been observed that the reduction in energy output from a PV panel with dust could be as much as 50%, when the module is not cleared for 30 days.

The performance of the modules lowers in the case of dust accumulation even though it is tracked. In order to take care of dust accumulation problem, a simple cleaning mechanism along with tracking system is designed.

IV. PROPOSED SYSTEM

The System we are implementing is discussed as follows:

A. Solar Tracker System

The main components in the solar tracking system are standard photovoltaic solar panels (PV), a deep cycle rechargeable battery, battery charger, stepper motor, signal conditioning circuits and a BasicX-24p microcontroller. A solar tracking system was proposed to generate more energy using solar energy throughout the day. In the proposed system, the panel is provided to follow the sun with the help of a direct current (DC) motor controlled using photosensitive sensors.

This designed system was operated in the same period with the system using fixed panels and their production was compared. In the results obtained, the authors concluded that the proposed system produces 1742.88-W energy, whereas the fixed system produces 829.6-W energy. The authors emphasized that the single-axis tracking system proposed is more efficient with the results analyzed. The main aim of the solar tracking systems is to direct the solar PV panels perpendicular to the sun. A microcontroller-based solar tracking system with a hybrid algorithm has been proposed to detect critical solar radiation with the help of sensors and mathematical models. In the results obtained, it was found that the hybrid algorithm system proposed in all weather conditions is more efficient than other classical algorithms. Thus it was predicted that this situation reduces carbon emissions and electricity costs.

B. Solar Panel auto cleaning System: -

Solar panels attract atmospheric dust and this dust can build up over time to compromise the panel's efficiency resulting in reduced power output significantly. At Solar bot, we recommend using automatic solar panel cleaners to maintain panel efficiency and achieve optimum power output. Automated systems are more convenient and affordable than wet cleaning, especially if the client has a large PV plant. The initial automatic solar panel cleaning system price might seem like a hefty investment but it would be absolutely worth the value if you consider it for long term. Solar bot's automated solar panel cleaning system is a result of comprehensive research, making sure the robots are suitable for real- life operating conditions in a Solar Power Plant.

This unique dry cleaning solution removes dust without causing any damage to the panels. It is highly efficient and doesn't require any water, which makes it an eco-friendly solution. Water-based cleaning isn't very effective because water and cleaning agents can leave behind mineral deposits on the panel surface. These deposits can obstruct the sun's rays and cause issues in the long run. Water is corrosive and continuous exposure can severely compromise the efficiency of solar panels. This is why our automatic solar panel cleaner utilizes dry cleaning method offering impressive cleaning outcomes.

V. SCHEME OF IMPLEMENTATION

The prototype model is produced through installation of the various equipment such as solar panel which provides 12 volts as output, an NodeMCU as microcontroller, a motor driver – with IC L293D, two LDR sensor module, a 10 r.p.m. simple DC motor, a current sensor and a 9 V battery. Construction of the said project is being built out of the wooden base installed at the ground of it, affixed with the iron rods on both the sides in a cross-shaped manner connected with a hollow cylindrical rod from both the sides

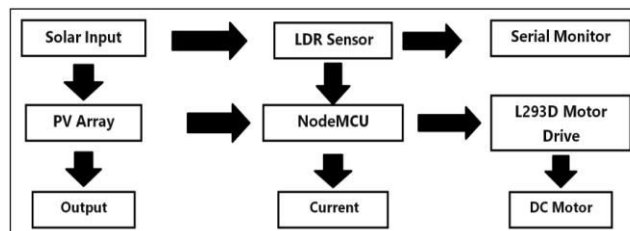


Fig: Block Diagram of Automatic Solar Tracking System

and the DC motor is clinging at one edge of the hollow rod. Three-fold sections into which the circuit of the solar tracking system is divided. The input stage has two LDR modules that are so arranged to form a voltage divider circuit, the microcontroller. is programmed through the software named Arduino IDE being decked up in the system and lastly the driving circuit that has the DC motor helps in rotating the solar panel. The motor driver is embraced with three

terminals- two for motor input/ output respectively and the third one for power input. The terminal for motor input is connected to 2 of the 14 digital input/output pins of Arduino UNO and subsequently, the motor output terminal is connected to the DC motor. The two LDR sensor modules are annexed to the scaffolding with NodeMCU analogue inputs. The light dependent resistors are then affixed along the length, on either side of the solar panel. Before being consolidated into one system, three independent stages are engineered independently. This approach, similar to stepwise refinement in modular programming, has been employed as it ensures an accurate and logical approach which is straight forward and easy to understand. This also ensures that if there are any errors, they are independently considered and corrected.

VI. SYSTEM OVERVIEW

While designing and preparation of scale down model, we had to conduct research about earth's rotation and revolution. The position of the sun changes continuously throughout the day. It is due to the motion of earth that we experience sun at different angles in the sky. Earth exhibit two types of motion. One is the motion of earth along its own axis, and the other is the earth revolving around the sun. The motion of the earth along its own axis, known as rotation, results in the phenomenon of days and nights. One rotation of the earth takes 23 hours and 56 minutes. On its own axis, the motion of the earth is west to east. Revolution that is the motion of the earth around the sun is responsible for the different seasons in the year. The earth takes 365 days to revolve around the sun. Earth revolves around the sun in an elliptical orbit and the plane covered by the earth during the revolution is known as an ellipse. The axis of rotation and ellipse makes an angle of 66.5 degrees between themselves. This is the explanation behind the summer/winter solaces and spring autumn equinoxes. Due to these motions of the earth, the amount of sunlight received throughout the year varies. Sunlight is the electromagnetic radiation from the sun expropriated by the earth. The total power given off by the sun into space is much more than that intercepted by the earth.

Sunlight is the electromagnetic radiation from the sun expropriated by the earth. The total power given off by the sun into space is much more than that intercepted by the earth. Within a given period of time, the emission of solar radiation is somewhat constant and the intensity this radiation hitting a unit area of the earth's crust is also constant, known as solar constant. The value of this solar constant can be expressed as,

$$\begin{aligned} \text{GSC} &= \sigma \cdot T^4 \cdot (4\pi R^2 / 4\pi D^2) \\ &= 1367 \text{ W m}^2 / \end{aligned}$$

In the above expression,

σ is termed as Stefan Boltzmann Constant with a value of $5.67 \times 10^{-8} \text{ W m}^2$.

R is known as the radius of the Sun.

D is the average distance between the Sun and the earth.

The absorption of solar radiation on the surface of the earth also varies with different parameters. Latitude and longitude are one of the prescribed parameters. Latitude the horizontal imaginary line, parallel to the equator, is the angle suspended by the arc linearly joins a person's position and the equator, at the center of the earth. On the contrary longitudes are the vertical imaginary lines, where longitude is the angle suspended by the arc joining the north-pole and south-pole as well as passing through the given location, linearly with the Greenwich meridian, at the center of the earth.

VII. CONCLUSION

The method overcomes the deficiency of existing system of fixed so

lar panels are discussed. The paper has presented a novel and a simple control implementation of a Sun tracker that employed a single axis AC motor to follow the Sun and used a stand-alone PV inverter to power the entire system. The proposed single motor design was simple and self-contained, and did not require programming and a computer interface.

A Scaled down prototype has been successfully built and tested to verify the effectiveness of the control implementation. Experiment results indicated that the developed system increased the energy gain up to 28.31% for a partly cloudy day. Two algorithms were studied one for cleaning and ne for tracking of the solar panel. The self-cleaning and tracking mechanism has been implemented. Several cases were experimentally implemented and came to the conclusion. By the above results it can be observed that the tracking is best suited then the fixed one, only when the dust on the panel is cleaned. If we implement the tracking system without cleaning the panel the efficiency is less than of the panel which is fixed and cleaned. Moreover, the efficiency of the panel is decreased by 50% even though it is tracking without cleaning. It is also concluded that from the Table V the efficiency of the panel has been improved when we are going with the tracking as well as cleaning system



VIII.ACKNOWLEDGEMENT

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REFERENCES

- [1] Let Us C-Fifth Edition authored by Yashavant P. Kanetkar.
- [2] Principles of Electronics authored by V. K. Mehta.
- [3] M. L. Thorat, Rutuja Walimbe, Aishwarya Patil, Dhananjay Kulkarni, Supriya Thorat, "Implementation of automatic solar tracking and cleaning system"
- [4] Karrar J. Alaameri¹, Ali J. Ramadhan and Alexander S. Maklakov "Design of dual-axis solar tracking system with integrated cleaning system: Case study of Najaf city, Iraq" AIP Conference Proceedings 2386, 050001 (2022); <https://doi.org/10.1063/5.0066840>.
- [7] Palve Nikhil, Nikam Akshay, Lahane Ankush, Nyaharkar Dhananjay, P.C. Bhavsar "Design and Development of Solar Tracking System & Cleaning System"

BIOGRAPHY



Rajesh Shamrao Chavhan

His higher studies were done in Government Polytechnic, Yawatmal. The trend he is interested in is Electrical Engineering. His Ambition is to work in Electric vehicle technology (R&D Department)



Rohit Digambar Dabhade

His UG is from Adsul's Technical Campus Ahmadnagar. The trend he is interested in is power systems. My ambition is to work in R&D (Research & Development) Department of RDSO.



Vikram Bhausaheb Chaudhari

His UG is from Adsul's Technical Campus. The trend he is interested in is Electrical Engineering. His Ambition is to work in Product Development Department.



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