JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Efficient Solar Power Generation

Prof. P R Rane, Komal Sadanshiv, Kalyani Wankhade, Shivani Shahu, Harshad Savale.

Department of Electrical Engineering, P R Pote Patil College of Engineering and Management , Amravati , Maharashtra.

Abstract:
The utilization of fixed-tilt solar panels has long been associated with a significant drawback: the inefficient harnessing of solar radiation. This inefficiency stems from the static orientation of fixed panels, leading to a substantial waste of available solar energy. Additionally, the accumulation of dust and debris further exacerbates the problem, causing a decline in the overall efficiency of solar power generation. In response to these challenges, our project proposes an innovative solution that integrates a single-axis solar tracking system and a self-cleaning mechanism. The single-axis solar tracking system enables dynamic adjustments of the solar panel's orientation throughout the day, maximizing the capture of sunlight and significantly improving energy yield. Simultaneously, a self-cleaning mechanism incorporating a wiper effectively addresses the issue of dust and debris accumulation. This mechanism ensures the optimal functioning of the solar panels by regularly clearing away any impediments that may hinder sunlight absorption. By combining these two technologies, our project aims to enhance the efficiency of solar panel systems, ultimately increasing their overall power generation capacity.

Keywords— *Solar tracker, Solar panel, Efficiency*.

I. INTRODUCTION

Solar panel tracking is used to improve the condition. The tracking mechanism moves and positions the solar array such that it is positioned for maximum power output. Others ways include identifying sources of losses and finding ways to migrate them. There are various types of trackers that can be used for increase in the amount of energy that can be obtained by solar panels. Dual axis trackers are among the most efficient, though this comes with increased complexity. Dual trackers track sunlight from box axis. They are the best option for places where the position of the sun keeps changing during the year at different seasons. A solar tracker is used in various systems for the improvement of harnessing of solar radiation. The problem that is posed is the implementation of a system which is capable of enhancing production of power by 30-40%.

The control circuit is implemented by the micro controller. The sun rays are falling perpendicularly on the solar panel to give the maximums solar energy. This is harnessed into electrical power. Maximum energy is obtained between 1200hrs and 1400hrs, with the peak being around mid-day. At this time, the sun is directly overhead. At the same time, the least energy will be required to move the panel, something that will further increase efficiency of the system. The method was designed to address the challenge of low power, accurate and economical micro controller-based tracking system which is implemented within the allocated time and with the available resources.

A solar tracker is a device which is used to track the position of the sun and controls the movement of the panel so that maximum radiation can be obtained. Solar Energy is extracted to the maximum level only when the sun rays are directly made to fall on the solar panel. For the maximum power-generation the solar panels must be placed perpendicularly to the sun rays. In case of deviation of the sun rays from the optimum angle, this results in decreasing the power output of the panel. In case of few degrees of dis-alignment of rays it decreases 1-5% reduction in output energy. On the other hand, the dis-alignment of 10^{0}-20^{0} of sun rays it results in decrease of energy generation up to 35%. The tracker uses motor to rotate the panel towards the maximum sun rays using Light Dependent Resistors (LDRs). Basically there are two possible ways to track the maximum sunlight namely, single axis and dual axis. The single axis solar tracker rotates along only one axis i.e. east to west or vice versa. The dual axis solar tracker rotates along two axis i.e. east to west and north to south. The single axis solar tracker is approximately 30% more efficient when compared with a static solar panel and the dual axis solar tracker is approximately 36% more efficient when compared with a static solar panel.

The performance of the solar panel is mainly reduced due to many external factors such as dust, dirt, shadows and bird's dropping pollen above the solar panel. In the dusty environment the output efficiency of the solar panel gets reduced. Hence it becomes very necessary to track and clean the solar panel at regular time periods. Hence cleaning of the solar panel also plays a major role.

II. FLOWCHART

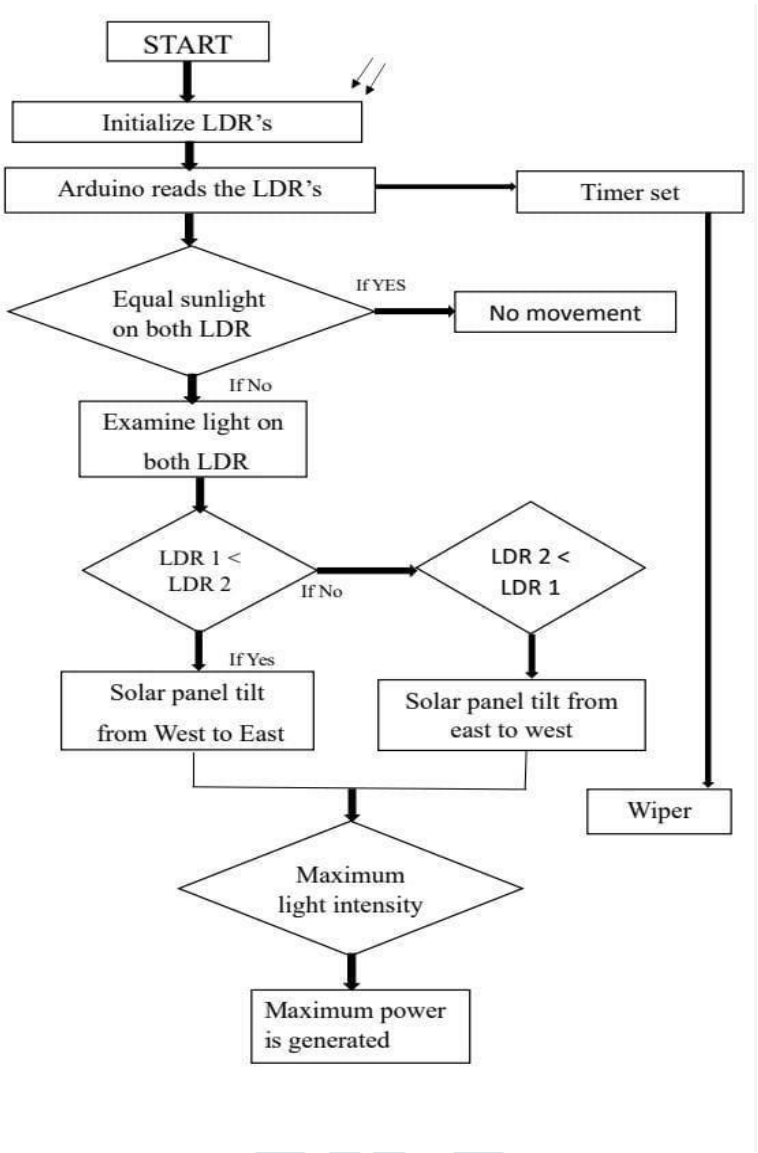

Figure 1. Flowchart of Solar Tracking and Cleaning.

III. METHODOLOGY

The circuit of the solar tracker and cleaning system is divided into three sections. There is a input stage that is composed of sensors. A program in embedded software in the microcontroller and lastly the driving circuit that has the motor. Whenever the sun light falls on the solar panel it accumulates the radiation and stores in it. It will send the message to the microcontroller about the power differences which stored in it. Microcontroller will receive this information and pass the message to the dc motor drive. As the time passes the panel rotates with the help of motor. In this proposed methodology light intensity sensors are placed on the solar panels. In this system, we are using two sensors to capture the light intensity according to angle variations. The solar panel rotates to the direction in which the intensity is detected with the help of the motors and gears attached to the solar panel frame. The motor is controlled using a microcontroller, the microcontroller collects the light intensity details from the two sensors using Analog channels and processes the data. When more intensity of light is observed by the sensor is detected then the microcontroller sends the signal to the motor to rotate the panel using a gear mechanism. Rotating according to sun direction is a secondary operation of the system. The primary operation of the system is to collect the solar power from the panel and store the power on the battery charge controllers and microcontroller. In this operation the microcontroller measures the input current from the solar panel and sends the details to the android app using wi-fi module. It will receive this information and display on LCD. then the solar panel is transferred to solar charge converter modules to convert the unregulated voltages to regulated voltage from to charge the battery.

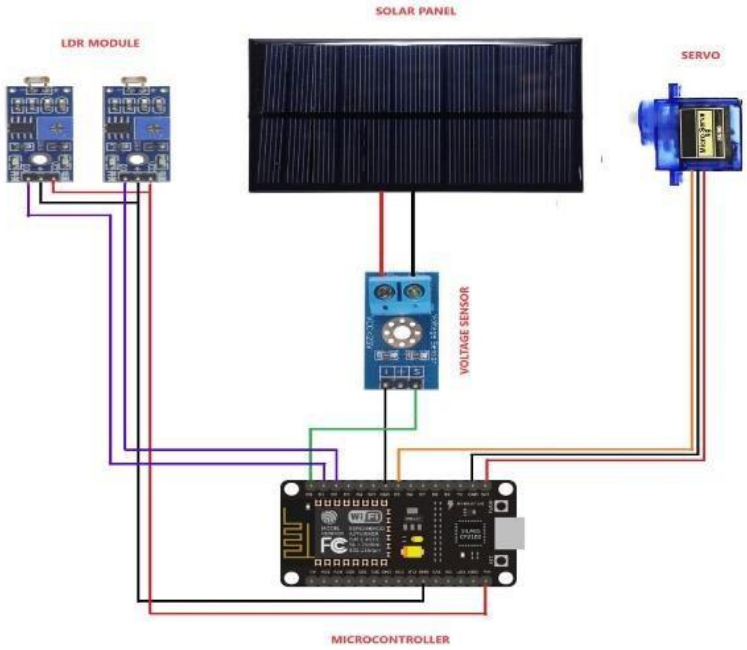

Figure 2. Circuit Diagram

IV. SCALABILITY AND FUTURE ENHANCEMENT

The modular design of the project allows for scalability and future enhancements. Additional sensors, communication protocols, or features can be integrated for further functionality and efficiency.
This theoretical overview outlines the fundamental concepts and components of your Efficient Solar Power Generation system, focusing on its purpose, key components, and functionalities. 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. The modular design of the project allows for scalability and future enhancements. Additional sensors, communication protocols, or features can be integrated for further functionality and efficiency

V. RESULT AND DISCUSSION

Time	Uncleaned w/o tracking	Cleaned w/o tracking	Uncleaned with tracking	Cleaned with tracking
6am	1.2	2.3	1.7	2.7
7am	1.4	2.5	2.6	3.0
8am	1.6	2.6	2.1	3.1
9am	1.7	2.7	2.2	3.2
10am	2.1	3.1	2.3	3.3
11am	2.2	3.2	2.54	3.4
12noon	2.4	3.5	2.49	3.5
1pm	2.3	3.3	2.4	3.49
2pm	2.1	3.1	2.3	3.42
3pm	1.9	2.8	2.0	3.2
4pm	1.5	2.5	1.9	3.1
5pm	1.3	2.5	1.8	3.0
6pm	1.2	2.4	1.73	2.7

Figure 3. Tabular representation of output in volts.

VI. CONCLUSION

Solar energy is one of the most promising energy sources for the future. The challenge now is to maximize the utilization of this solar energy by absorbing it. As this proposed system acts as a single system which includes both, tracking as well as self-cleaning mechanism which thereby increases the efficiency of solar panel by absorbing maximum solar radiation and maintaining regular cleaning process. By this, the life span of the solar panel also got increased.

Through the research conducted in this project, it has become evident that solar tracking with cleaning mechanisms not only enhances energy output and system reliability but also contributes to the long-term sustainability of solar power generation. The combination of these technologies addresses key concerns such as dust accumulation, shading, and performance degradation, thereby prolonging the lifespan of solar panels and maximizing their energy yield. Moreover, the economic feasibility and scalability of integrated solar tracking with cleaning systems make them a compelling choice for both commercial and residential applications. The potential for cost savings, coupled with the environmental benefits of reducing reliance on fossil fuels, underscores the importance of continued innovation and investment in solar energy technology.

VII. REFERENCES

[1] Zhang, Shun and Tiechao Wang "Maximum power point Tracking control of Solar power generation systems." Informative and cybernetics for computational social system (ICCSS). 3rd International Conference on IEEE,2016.

[2] R. Divya, K. Sheeba, J. Gayadhiri Dhevi, S. Sandhya, S. Vennila "Automatic Cleaning of Solar Panel with Maximum Power Tracking by using Arduino".

[3] P Rani, O. Singh and S. Pandey *An Analysis on Arduino based Single Axis solar Tracker* 2018 5th IEEE Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON), Gorakhpur, 2018, pp. 1-5, doi: 10.1109/UPCON.2018.8596874

[4] Bandam Abhilash, Ashish K Panchal, "Self-Cleaning and Tracking Solar Photovoltaic Panel For Improving Efficiency"2016IEEE

[5] M. Catelani1, L. Ciani1, L. Cristaldi2, M. Faifer2, M. Lazzaroni3, M. Rossi2, "Characterization Of Photovoltaic Panels: The Effects Of Dust"2012IEEE.

[6] Shashwati Rayl and Abhishek Kumar Tripathi "Design and Development of Tilted Single Axis and Azimuth-Altitude Dual Axis Solar Tracking Systems"2016IEEE