# DUAL AXIS SUN SOLAR TRACKER SYSTEM

**Arpit Mandal[*1], Vallabh Sathe[*2], Suraj Waghmare[*3], Brijesh Yadav[*4], Sudarshan Damahe[*5], Anup Gade[*6]**

[*1,2,3,4,5]Students, Department Of Information Technology, T.G.P.C.E.T, Nagpur, Maharashtra, India.

[*6]Prof., Department Of Information Technology, T.G.P.C.E.T, Nagpur, Maharashtra, India.

## ABSTRACT

In this paper, the construction of a Solar system is done through means of Dual axis solar trackers which associated with PV (photovoltaic) panels for maximum detection of Sun rays for generation of effective solar energy as compared to existing system i.e., single axis solar tracking system. The backbone of system is Arduino UNO which runs on Battery which handles solar plates. It commands both servos of solar PV plate to rotate according to position of sun light which known by means of LDR attached with the Arduino UNO. LDR sends signals to Arduino and Arduino sends Signals to change the position according of LDR signals which pointed towards Sun light. Potentiometers are there which manages the speed of rotation of solar plate manually as well as auto mode. In sunny condition according to whether sun changes its position daily and seasonally too, so that in case of this Dual axis solar tracking system gives a higher amount of solar energy by producing it through panel which placed on tracker which rotating vertically as well as horizontally respectively.

**Keywords:** Pv(Photovoltaic) Panel, Solar Plate, Arduino Uno, Ldr, Potentiometer.

## I. INTRODUCTION

Solar energy is renewable source of energy. Dual Axis solar tracker is all about to capture more sun rays as compared to single axis solar tracker. The aim of project is maximizing the production of renewable source of energy by keeping two solar panel perpendicular to sun a rotate according to position of sun as maximum sun rays are detected and produce huge amount of solar energy. Dual axis tracker has 2 degrees of freedom so that it can rotate in the direction of horizontally and vertically, so that ray captured by the axis is more and uses efficiently. According to survey, 35% of solar rays are does not contact with single axis solar plate which now a days everywhere used. By means of this solar plate sun rays are converted into solar energy and can be stored for further uses. This is the traditional way to generate solar energy from solar plate just need to keep that plate in a sun rays for a whole day it generates solar energy from that solar ray. This is how single axis solar tracker system works respectively. The Dual Axis Solar Tracker as its name suggest having dual axes I.e., Vertical axis and Horizontal Axis. By means of this two Axes a single solar plate can rotate in both direction for capturing more sun rays and being more efficient as compared to single axis solar tracker system. According to Dual axis tracker system ,74% of sun rays are captured means 9% of sun rays are more captured as compared to single axis solar tracker system. As per position of sun changes, dual axis also changes position of solar plate so that it can always be perpendicular to the sun so that capturing more sun rays. This is how a Dual Axis Solar Tracker System works respectively [1].

## II. LITERATURE REVIEW

**Paper [1]: Amsterdam: Elsevier B.V., "Review of dual axis solar tracking and development of its functional model (SMPM 2019)", Elsevier, vol. 1 (2015), ISSN: 2351-9789.**

The use of solar energy is in the upswing due to its environmental friendliness and abundance. That notwithstanding, efficiency remains a major problem in many of the applications. Mitigation is normally in the form of tracking systems. This paper therefore investigates dual axis solar tracking systems from two dimensions. Firstly, a review of extant literature was conducted to draw up a trajectory of where we are in the efficiency map.

Hence it was found that the current efficiency of dual axis tracking configuration is about 35-43%. Secondly, from the above review, a generic functional model of how an efficient and effective tracking system should be is presented. The two components, coevolving, shall be used to inform the design and development of an efficient solar tracker [2].

**Paper [2]: Ahmad Fazlizan, Ahmed Abdulmula, Akmal Naim Amran, Chin Haw Lim1 and Kamaruzzaman Sopian, "Performance evaluation of maximum light detection solar tracking system in the tropics (2019)", Springer, ISSN: 1973-3824.**

In this paper, a performance analysis of a photovoltaic (PV) tracking system is conducted, to evaluate its performance based on field data measurement. A dual-axis tracker with smart algorithms called maximum light detection (MLD) applied in the solar energy generation system is analyzed.

In a tropical country that having a massive cloud cover throughout the year, the sky condition is categorized as sunny, intermittent, and gloomy. The comparative results show that the system with MLD tracker improved the energy generation significantly all sky conditions [3].

**Paper [3]: Rajesh Singh, Suresh Kumar, Anita Gehlot, Rupendra Pachauri, "A review: An imperative role of sun trackers in photovoltaic technology (2018)", Oxford: Elsevier Ltd., ISSN:1879-0390.**

The efficiency of the photovoltaic (PV) system is directly proportional to the solar energy. The maximum efficiency from the PV systems can be achieved if the panel is kept perpendicular to the direction of the radiations of sun. The various methods of sun tracking system have been discussed which includes two axes, one axis, polar axis, open loop, closed loop, hybrid model, azimuth, and tilt roll mechanism.

The comparison of existing solar tracking systems and methods has also been discussed. In this paper, various existing solar tracking systems in terms of the controller used like PLC, microcontroller, FPGA to design the system and their economic assessment [4].

## III. PROBLEM DEFINITION

**Existing System:** The earlier solar tracking device has a number of drawbacks. The issue here is that solar panels are only used in fixed installations. As a result of this issue, the amount of electricity that can be created is limited. Another issue is that the cost of a solar tracking system is prohibitively expensive for families who use more energy than usual because it requires the installation of many solar panels to generate sufficient power. As a result, the goal of this project is to resolve the issue. A 180-degree rotation can be detected by this solar tracking technology. As a result, the amount of energy that a solar panel can generate here is far higher than when the solar panel can only generate in one direction.

## IV. METHODOLOGY

A single-axis tracker can only pivot in one direction: horizontally or vertically. The single-axis tracker may only pivot in one direction: horizontally or vertically. This makes it less complicated and, in general, less expensive than a two-axis tracker, but it also makes it less effective at harvesting the total solar energy available at a site.6Trackers use motors and gear trains to direct the tracker in response to the solar direction as directed by a controller. Because motors consume energy, they should only be used when necessary [5].

Single axis trackers are commonly implemented in a variety of ways. Horizontal single axis trackers (HSAT), horizontal single axis trackers with tilted modules (HTSAT), vertical single axis trackers (VSAT), tilted single axis trackers (TSAT), and polar aligned single axis trackers are examples of these devices (PSAT) [6].

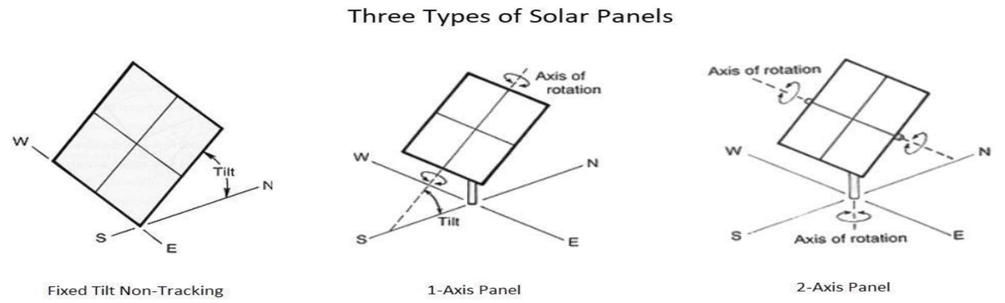


**Figure 1:** Three types of solar Panel

So, issue here is that the sun's position changes throughout the day. The direct beam's energy contribution decreases with the cosine of the angle between the incoming light and the panel.

### A. Proposed System:

Two degrees of freedom serve as rotation axes in dual axis trackers. These axes are usually orthogonal to one another. A primary axis is an axis that is fixed with respect to the ground. A secondary axis is an axis that is referenced to the primary axis. Dual axis trackers are commonly used in a variety of ways. The orientation of their primary axes with respect to the ground distinguishes them.

Tip-tilt dual axis trackers (TTDAT) and azimuth-altitude dual axis trackers (AADAT) are two common

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
Volume:03/Issue:06/June-2021 Impact Factor- 5.354 www.irjmets.com

implementations (AADAT). When modelling performance, the orientation of the module with respect to the tracker axis is critical. Modules on dual axis trackers are typically oriented parallel to the secondary axis of rotation. Due to their ability to follow the Sun vertically and horizontally, dual axis trackers provide optimal solar energy levels. Dual axis trackers can angle themselves to be in direct contact with the Sun no matter where it is in the sky [6].

## V. SOME COMMONLY USED COMPONENTS

### A. SERVO MOTOR

In closed-loop position control applications, a servo motor is a linear or rotary actuator that enables fast precise position control. A servo motor, unlike huge industrial motors, is not utilized for continuous energy conversion. Due to its low inertia, servo motors have a fast response time and are constructed with a small diameter and lengthy rotor length. Servo motors employ a servo mechanism to control the speed and final position of the motor using position feedback. A servo motor consists of a motor, feedback circuit, controller, and other electronic circuits on the inside [7].

**Types of Servo Motors**

1. AC servo motor
2. DC servo motor

The project was used only DC Servo motor.


**Figure 2:** Servo Motor

### B. LDR (Light Dependent Register)

Light dependent resistors, also known as photo resistors, are electronic components that detect light and change the operation of a circuit based on the light levels. A photo resistor, also known as a light dependent resistor, is a light-sensitive electronic component. When exposed to light, the resistance changes. The resistance of the LDR can change by many orders of magnitude, with the resistance decreasing as the level of light increases. It is not uncommon for an LDR or photo resistor's resistance to be several megohms in darkness and then fall to a few hundred ohms in bright light. With such a wide range of resistance, LDRs are simple to use, and there are numerous LDR circuits available. The sensitivity of light dependent resistors or photo resistors varies with incident light wavelength [8].

**Figure 3:** LDR

### C. ARDUINO UNO

The ATmega328-based Arduino Uno is a microcontroller board. It has 20 digital input/output pins (six PWM outputs and six analogue inputs), a 13 MHz resonator, a USB connection, a power jack, an in-circuit system programming (ICSP) header, and a reset button. It includes everything required to support the microcontroller. To get started, simply connect it to a computer via a USB cable or power it via an AC-to-DC adapter or battery. The FTDI USB-to-Serial driver chip is absent from the Uno, as it is on all preceding boards. Instead, it has an

ATmega13U2 that has been programmed as a USB-to-serial converter. As an auxiliary, we are using a microcontroller, which has its own USB boot loader and can be programmed by advanced users. The Arduino has a large support community as well as an extensive set of support libraries and hardware add-on "shields" (for example, you can easily make your Arduino wireless with our Weixel shield), making it an excellent introductory platform for embedded electronics [9].

**This is the third revision of the Uno (R3), and it includes the following changes:**

- The USB controller chip was renamed ATmega13U2 (13K flash) from ATmega8U2 (8K flash). This has no effect on the amount of flash or RAM available to sketches.
- There are three new pins, all of which are duplicates of previous pins. The I2C pins (A4, A5) have also been relocated to the board's side near AREF. An IOREF pin, that may be a duplicate of the 5V pin, is found next to the reset pin.
- The reset button is now located next to the USB connector, making it easier to reach when using a shield.

**Figure 4:** Arduino UNO

### D. SOLAR PANEL

An assemblage of thin-film solar cells makes up a thin-film solar panel. The photovoltaic effect is used to convert solar energy to electrical energy in these solar panels. A solar panel is a semiconductor device made up of several different solar cells/photovoltaic cells (PV). A mix of p-type and n-type materials are used to make each PV cell. P-type materials are electron-deficient, whereas n-type materials contain free electrons.

When sunlight strikes the panel, electrons become excited and flow across the p-n junction, generating a significant current. This electricity can then be transmitted straight to a building to power various appliances, or it can be stored in batteries for later use. Silicon is commonly utilized as the semiconducting element in classic solar panels [10].

**Figure 5:** Solar Panel interacted with sun rays

## VI. RESULTS AND DISCUSSION

**RESULT:**

When source light falls on the panel of this Dual Axis Solar Tracker, the panel changes its location according to the highest intensity of light falling perpendicular to it. The project's goal has been achieved. This was accomplished by employing light sensors capable of detecting the amount of sunshine that reaches the solar array. If there is a large discrepancy in the values produced by the LDRs, the panel is actuated using a servo motor to the point where it is approximately perpendicular to the sun's beams. This was accomplished using a system with three stages or subsystems. Each level has a distinct function. The stages were as follows: an input stage for converting incident light to a voltage; an output stage for converting incident light to a voltage; and an output stage for converting incident light to a voltage A control stage that oversaw actuation and decision-making. The servo motor is driven by a driver stage. It was responsible for the panel's real movement. The input stage is equipped with a potential divider circuit to provide the desired range of illumination in both bright and dim lighting conditions. To account for variations, the potentiometer was modified. Because their resistance fluctuates with light, LDRs were proven to be the optimum choice for this project. They are inexpensive and widely available. Temperature sensors, for example, would be expensive.

**DISCUSSION :**

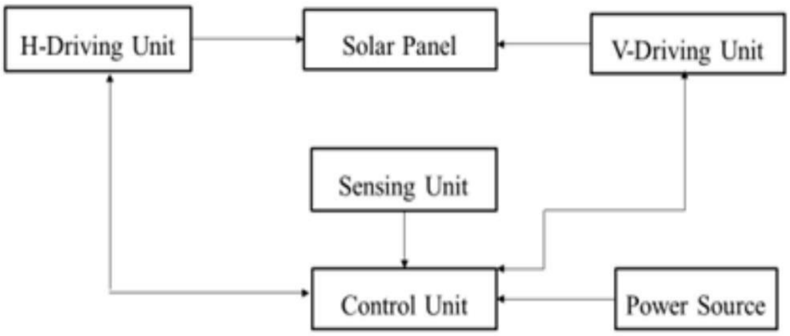


**Figure 6:** Block diagram of solar system

- To power up the Control Unit, i.e., Arduino UNO, we will first connect a 9V DC Power Supply.
- Next, two of the four LDR sense the Sun's light and its intensity, while the other two rotate the H or V – Driving Unit, i.e., Servo.
- Data from the LDR was supplied to the Control Unit, and the Arduino then sent the signals to the H or V-Driving Unit.
- Solar Panel will rotate horizontally or vertically based on Control Unit signals received from two LDR. Dual Axis Sun Tracking Solar Panel techniques will work in this manner.

## VII. CONCLUSION

We constructed a prototype model of a solar tracker in this project, Dual Axis Solar Tracker, to track the maximum intensity point of light source so that the voltage provided by the solar panel is maximum at that point. We've successfully completed our project after a lot of trial and error, and we're glad to have put in some work for our society. Now, like every other experiment, this project has couple of imperfection. A novel design of a dual axis solar tracking system using small solar cell sensor information and control technologies to improve the general efficiency of the photovoltaic system. The PID control technique was wont to stabilize the general closed loop system and to position the PV panels perpendicular to the sun's rays in real time. Finally, a real-time simulation and implementation of the sun tracking system was performed. The developed sun tracker structure was ready to align the solar array normal to the Sun for maximum power extraction, as indicated by simulation results.

(i) Our panel detects light within a sensing zone, after which it stops responding.

(ii) If the panel has many light sources (e.g., diffused light sources), it calculates the vector sum of the light sources and moves the panel to that position.

This project was implemented with minimal resources. The circuitry was designed to be basic, understandable, and easy to operate.

## ACKNOWLEDGEMENTS

With profound feeling of immense gratitude and affection, We would like to thank my **guide Prof. Anup H. Gade**, Designation and Department, for his continuous support, motivation, enthusiasm and guidance. His encouragement, supervision with constructive criticism and confidence enabled us to complete this project.

We, also wish to extend my reverences to the **Prof. Sarvesh Warjurkar HoD**, Department Of Information Technology for providing necessary facilities to complete our project.

We, are also thankful to all the **faculty members** and **all non-teaching staff** of the department & college for their cooperation throughout the project work. We, also put forth our deepest sense of gratitude towards the **Dr. Geeta Padole Principal**, TGPCET for constant motivation and providing necessary infrastructure.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
Volume:03/Issue:06/June-2021 Impact Factor- 5.354 www.irjmets.com

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