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Dual Axis Solar Tracking System with Weather Sensors

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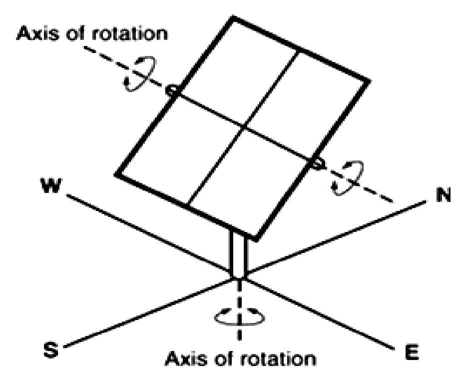
***Abstract*: In today's era, our life is dependent on energy. Nation's development is somehow associated with the availability of energy. Solar energy is the most eminent and renewable & cleanest sources of energy. It can be easily harnessed with the help of solar photovoltaic (PV) panels. But, we mainly observe that most of the solar panels are positioned at fixed angles. In order to maximize the amount of solar radiation collected by a solar panel, we use solar tracking device whose function is to follow the sun orthogonally throughout the day which enhances the energy capacity of the system. This paper comprises of development and design of dual axis solar panel tracking system & experimental study of dual axis solar tracker compared to fix position solar panel in terms of performance enhancement. The tracking mechanism of the sun requires light dependent resistor (LDR) as sensor to sense the maximum light availability & two DC motors for two axis movement (i.e., vertical and horizontal) to direct the position of solar panel. The software part is done by the help of written code using an Arduino Uno controller.**

***Keywords:* Dual Axis, LDR, Microcontroller, DC motors, Solar Tracker.**

1. Introduction

Solar power is the fastest growing means of renewable energy. The project is designed and implemented using simple dual axis solar tracker system. In order to maximize energy generationfrom sun, it is necessary to introduce solar tracking systems into solar power systems. A dual-axis tracker can increase energy by tracking sun rays from switching solar panel in various directions.This solar panel can rotate in all directions. This dual axis solar tracker project can also be used tosense weather, and it will be displayed on LCD. This system is powered by Arduino, consists of two DC motors, rain drop sensor, temperature and humidity sensor and LCD. This paper proposed a model of dual axis solar tracker with possible minimum complexities & more feasible in terms of cost and operation. It also provides the enhancement in the performance of energy harnessing through the PV panels by using solar tracker in compare to the fixed panels.

2. Description



The proposed system incorporates a DC motor which provide more torque at low speeds and provide better control for dual axis tracking purpose. In. PIC microcontroller is being used for controlling the PV panel. In solar tracking systems, solar panels are mounted on a structure which moves to track the movement of the sun throughout the day. There are three methods of tracking viz active, passive and chronological tracking. These methods can then be implemented either in single- axis or dual-axis solar trackers. In active tracking, the position of the sun in the sky during the day is continuously determined by sensors. The sensorswill trigger the motor or actuator to move the mounting system so that the solar panels will always face the sun throughout the day. In this project we used this active method of tracking. A passive tracker moves in response to an imbalance in pressure between two points. The imbalance is a result of the solar heat creating gas pressure on a low boiling point compressed gas fluid which then moves the structure accordingly. However, this method of sun-tracking is not accurate. A chronological tracker is a timer-based tracking system. The structure is moved at a fixed rate throughout the day. The motor or actuator is programmed to continuously rotate at an average rate of one revolution per day (15 degrees per hour).This

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method of sun-tracking is very accurate. However, the continuous rotation of the motor means more power consumption and tracking the sun on a very cloudy day is unnecessary

3. Working

The proposed tracking system tracks sunlight more effectively by providing PV panel rotation along two different axis.The tracker is composed of four LDR sensors, two stepper motors and PIC microcontroller. A pair of sensors and one motor is used to tilt the tracker in sun's east-west direction and the other pair of sensors and the motor which is fixed atthe bottom of the tracker is used to tilt the tracker in the sun's north-south direction.Two stepper motors are all in use in this system. Upper panel holder stepper motor tracks the sun linearly and base stepper motor tracks the parabolic displacement of the sun. These stepper motors and sensors are interfaced with amicrocontroller .The microcontroller gives the command tothe motors on the basis of sensor's input. LDR sensors sense the light and sends signal to microcontroller.

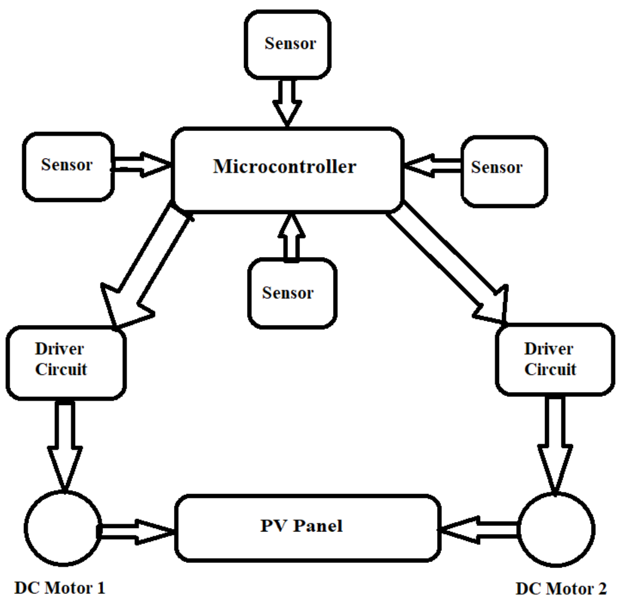


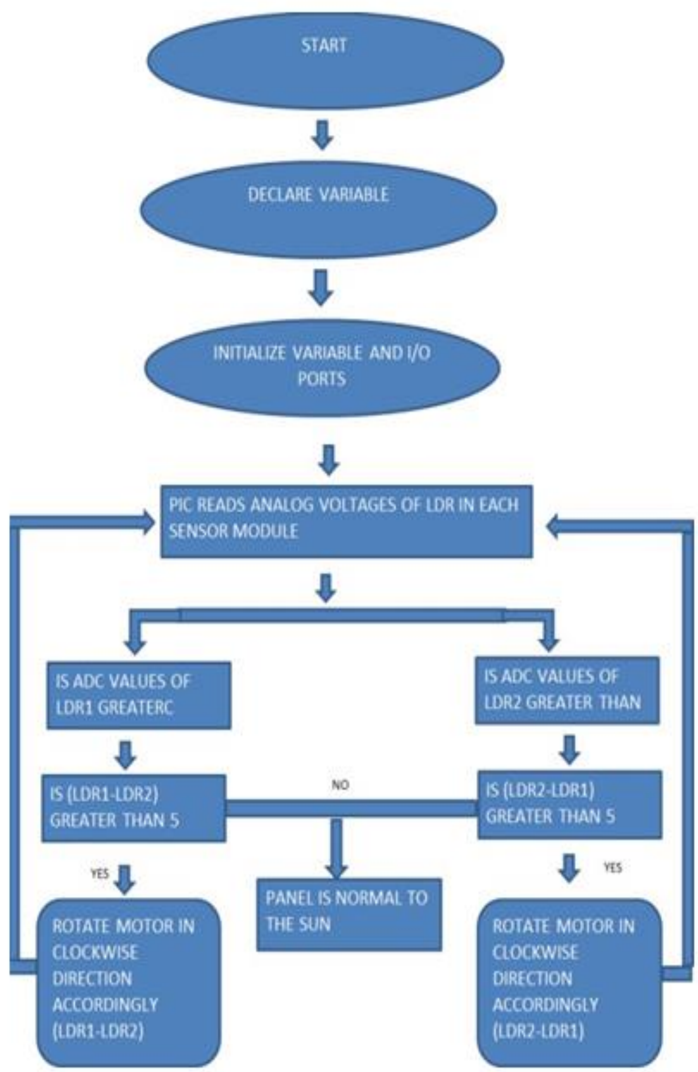
Fig. 2 Block Diagram

Microcontroller does the comparison of signals received from LDR sensors and on the basis of stronger signal it is deciding rotation direction of stepper motors. Microcontroller is an intelligent device which functions on the basis of input that it receives from the sensor thusactivating motor driver circuit. The controller activates driver circuits and moves DC motors to new positions where light falling on sensor pairs is same. If difference arises, then the motor moves the panel until the light falling on the sensor is same.

4. Algorithm

Algorithm takes data from the sensors. Analog signals from sensors are converted to digital signals using analog todigital converter (ADC).This ADC module has to be present in the microcontroller or has to be added externally.Digitized signals are forwarded to microcontroller. The step angle and movement direction of stepper motors is calculated once the digitized signal is received. From the algorithm it is known

that, microcontroller drives DC motors only if sensor light sensing is not equal to each other. Throughout this process the PV panel is adjusted in a position for optimum power that is normal to the sun. Voltage regulation is necessary in case of solar panels as it keeps varying. An algorithm can be used after the solar panel which regulates voltage coming from solar panel. Power generated from solar panel is used to energize tracker circuitry. This makes the project economical and cost effective too. The PV panel is adjusted in a position for optimum power.



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5. Experimental Result

Experiments results were performed by placing the designed system in open air. Table1 Observe the output power for PV systems (stationary module (without tracking) and dual axis tracking (with tracking)). These observations were performed on 24 April 2023 for two cases. The output power data is collected during 9:00 A.M. to 5:00 P.M. In table 2 Observe the comparison of output power for stationary module and dual axis tracking.

❖ **Dual Axis Solar Tracking System Model**

Table 1 -

Experimental Result for Without Tracking of Solar

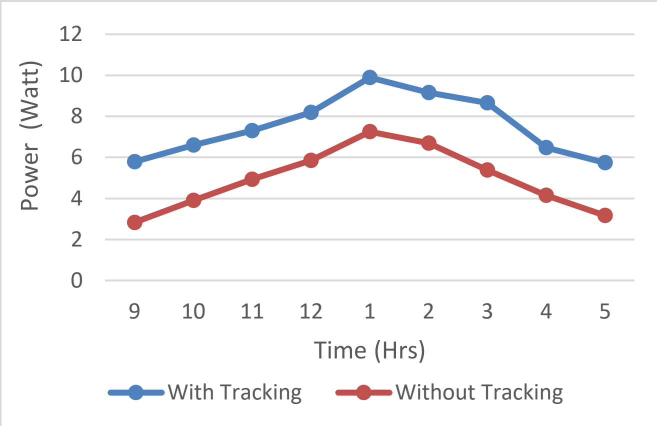
Time	Voltage (V)	Current (A)	Power (W)
9:00	10.1	0.28	2.83
10:00	12.6	0.31	3.90
11:00	14.5	0.34	4.93
12:00	15.8	0.38	5.85
01:00	18.1	0.40	7.25
02:00	17.6	0.38	6.69
03:00	15.7	0.34	5.38
04:00	14.3	0.29	4.15
05:00	12.2	0.26	3.17

Table 1 provides an experimental result when purposed hardware setup is fixed with standard latitude of the given region and Table 2 provides experimental result when purposed hardware setup is movable in order to track the sun. Comparison of Power in Without Tracking and With Tracking

Table 2 -

Experimental Result for With Tracking of Solar

Time	Voltage (V)	Current (A)	Power (W)
9:00	14.8	0.39	5.78
10:00	16.1	0.41	6.60
11:00	17.3	0.42	7.30
12:00	18.2	0.45	8.19
01:00	19.4	0.51	9.89
02:00	19.1	0.48	9.16
03:00	18.4	0.47	8.65
04:00	16.2	0.40	6.48
05:00	15.1	0.38	5.74



6. Conclusion

This project emphasizes on harnessing the maximum amount of solar energy from the solar panel with the help of two-axis tracking mechanism through the microcontroller as compare to the static solar panel, the method of two-axis solar tracking increase the share of solar power in the total power production from the non-conventional energy resources and thus tends to make our environment pollution free thus development is sustainable.Dual axis tracker perfectly aligns with the sun direction andtracks the sun movement in a more efficient way and has a tremendous performance improvement. The proposed system is cost effective also as a little modification in single axis tracker provided prominent power rise in system.

7. Acknowledgement

We would like to express our gratitude towards Prof. A. A. Malgave for providing us with great deal of help, support and for encouraging us to work diligently at every aspect of our project, His expertise, experience, and dedication have been invaluable in helping us, we understand the intricacies of the project and the concepts behind it.

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