Dual Axis Solar Tracking System

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Abstract- **As population is increasing globally; we are very concerned for Electricity. There are various ways of electricity generation like Hydro power plant, Nuclear power plant, Windmill plants and also Solar power plants. The former two are Non Renewable source of energy; hence we cannot depend only on such technology. Also Harnessing Energy from Hydro and Nuclear is equally difficult. The latter two are Renewable source of Energy; nowadays we have lots of power plants established on Solar and Wind Technology. Our project aims at Dual axis or Dual direction tracker. The Solar panel used in this system can adjust its direction both in X-Y co-ordinates. This helps better directivity with Sun rays, thus increasing the efficiency of the solar system.**

Keywords- Dual Axis, Stepper Motor, LDR Sensors, Declination Angle

I.INTRODUCTION

Electrical energy from solar panels is derived by converting energy from the sun rays into electrical current. The main challenge is to maximize the capture of the sun rays upon the solar panels, which in turn maximizes the output of electricity. There are two possible ways to enhance output power from solar energy based systems. Either one can use an efficient material in the manufacturing of the photo voltaic cell or use a solar tracker to follow the sun.

Why is it practically possible to install solar panel in India? The Earth is an obligated sphere, meaning that it is a sphere that is flattened at the poles and bulges around the equator. For solar power calculations it is sufficient to consider the Earth as a simple sphere with a diameter of approximately 12800km.Points on the Earth's surface are defined in terms of longitude and latitude. The Earth rotates around its axis every 24 hours and orbits the sun every 365.25 days (Approximately).The axis of rotation is tilted at an

Fig. 2: The autumnal and vernal winter equinoxes.

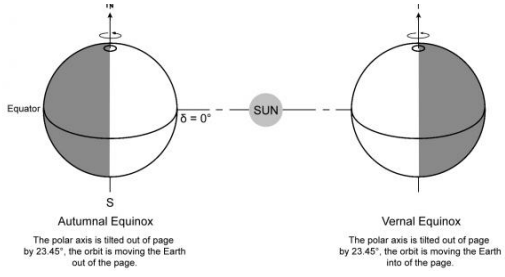
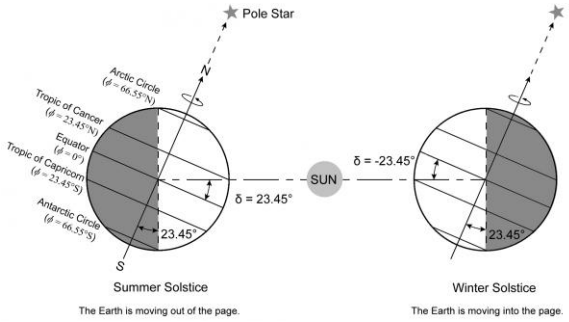


Figure 1: The summer and winter solstices. δ is the declination angle and φ is the latitude



angle of 23.45° with respect to the plane of the orbit around the Sun. The axis is orientated so that it always points towards the Pole Star .This accounts for the seasons and changes in the length of day throughout the year. The angle between a linejoining the centers of the Sun and the Earth and

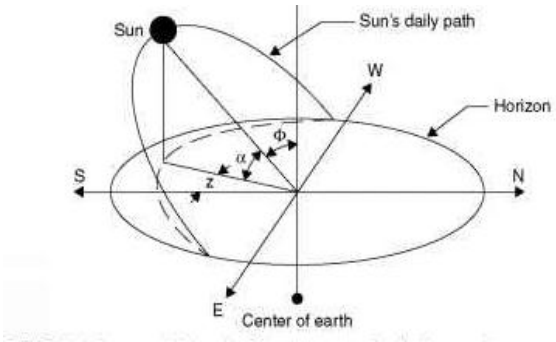


Fig. 3: Apparent daily path of the sun across the sky from sunrise to sunset

the equatorial plane is called the *declination angle* (δ). Because the axis of the Earth's rotation is always pointing to the Pole Star the declination angle changes as the Earth orbits the Sun [3].

India lies in the Tropic of cancer region .This makes it practically possible for implementing solar panel in our country compared to the countries located beyond23.45°.

The dual-axis solar tracker tracks the angular height position of the sun in addition to following the sun's east-west movement. The dual-axis works similar to single axis but it captures the solar energy more effectively by rotating its axis along vertical and horizontal axis [1].

II. DESCRIPTION

The proposed system incorporates a stepper 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

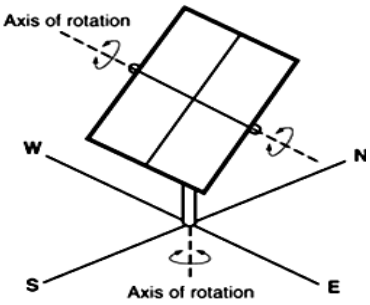


Fig. 4: Dual Axis

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 sensors will trigger the motor or actuator to move the mounting system so that the solar panels will always face the sun throughout the day.

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 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 [2].

III. 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 andthe motor which is fixed at the 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 a microcontroller .The microcontroller gives the command to the motors on the basis of sensor's input. LDR sensors sense the light and sends signal to microcontroller.

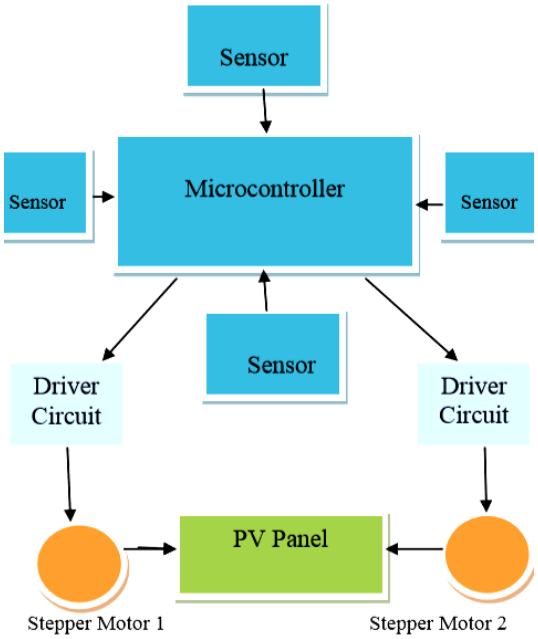


Fig. 5: Block Diagram

Microcontroller does the comparison of signals received from LDRsensors 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 thus activating motor driver circuit. The controller activates driver circuits and moves stepper 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.

Algorithm takes data from the sensors. Analog signals from sensors are converted to digital signals using analog to digital 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

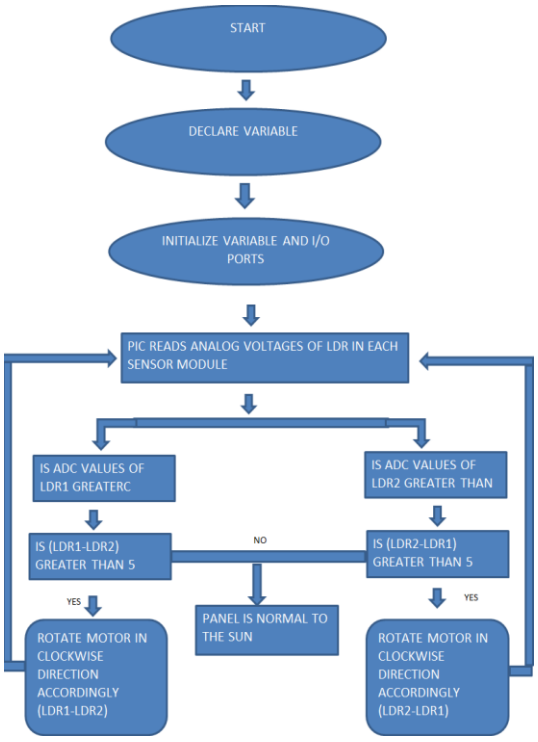


Fig. 6: Algorithm

algorithm it is known that, microcontrollerdrives stepper 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

IV. CONCLUSION

Dual axis tracker perfectly aligns with the sun direction and tracks 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 the system

V. ACKNOWLEDGMENT

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