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360° ROTATIONAL SOLAR TRACKING MECHANISM

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***Abstract*— Now a days we need a renewable energy source like solar energy for generation of electricity .To produce electricity from solar panel we need a proper solar tracking mechanism. In current scenario fixed solar panels are being used which are inefficient. To increase the efficiency of solar panel we need to trace the rays of sun in perpendicular direction to the solar panel. So we are making the mechanism which allows us to rotate the solar panel in two axis of rotation. Which allows sun rays to be incident on solar panel for maximum time which increases the efficiency.**

Keywords—solar panel, renewvable energy.solar tracker.

I. INTRODUCTION

Solar Panels are a form of active solar power, solar panels harvest sunlight and actively convert it to electricity. Solar Cells, or photovoltaic cells, are arranged in a grid-like pattern on the surface of the solar panel. Solar panels are typically constructed with crystalline silicon and the more expensive gallium arsenide, which is produced exclusively for use in photovoltaic solar cells. To get the most from solar panels, we need to point them in the perpendicular direction that captures the most sun rays.

We assume that the panel is fixed, or has a tilt that can be adjusted seasonally. (Panels that track the movement of the sun throughout the day can receive 15% (in winter) to 35% (in summer) more energy than fixed panels.

The next question is, at what angle from horizontal should the panels be tilted? Books and articles on solar energy often give the advice that the tilt should be equal to your latitude, plus or minus 15 degrees.

II. FIXED OR ADJUSTABLE

It is simplest to mount your solar panels at a fixed tilt and just leave them there. But because the sun is higher in the summer and lower in the winter, you can capture more energy during the whole year by adjusting the tilt of the panels according to the season. The following table shows the effect of adjusting the angle. Each option is compared with the energy received by the best possible tracker that always keeps the panel pointed directly at the sun. So we use the adjustable solar tracking mechanism.

III. LITERATURE REVIEW

Solar photovoltaic system or Solar power system is one of renewable energy system which uses PV modules to convert sunlight into electricity. The electricity generated can be either stored or used directly, fed back into grid line or combined with one or more other electricity generators or more renewable energy source.[9]

The efficient output of every high-concentration solar thermal and parabolic photovoltaic systems is directly

Proportional to the amount of solar energy acquired by the system, and it is therefore necessary to track the sun's position with a high degree of accuracy. Many systems have been proposed to facilitate this task over the past two decades. Accordingly, this section of the paper commences by providing a high level overview of the sun tracking system field and then describes some of the more significant proposals for closed-loop and open-loop types of sun tracking systems.[1]

If we consider solar sun tracking devices into a chronological order than we found that in 1975, the first significant automatic solar tracking systems was presented by McFee, in which an algorithm was developed to Compute total received power and flux density distribution in a central receiver solar power system. Than cones the reign of Closed-loop types of sun tracking systems which are generally based on feedback control principles. In these systems, a number of inputs are transferred to a controller from sensors which detect relevant parameters induced by the sun, manipulated in the controller and then yield outputs.[3]

The major achievement in the field of Close loop type solar sun tracker has been achieved and In 1986, In 1998, Khalifa and Al-Mutawalli developed a two-axis sun tracking system to enhance the thermal performance of a compound parabolic concentrator. The system was designed to track the sun's position every three to four minutes in the horizontal plane and every four to five minutes in the vertical plane.[2]

In 2004, Roth et al. designed and constructed a sun tracking system in which a pyrhelio-meter was used to measure the direct solar radiation. The system was controlled by a closed loop servo system consist of a four quadrant photo-detector to sense the sun's position and two small DC motors to drive the instrument platform in such a way that the sun's image remained at the center of the four -quadrant detector at all times. Same in this year in 2004, Abdallah and Nijmeh developed an electro-mechanical, two-axis tracking system in which the motion of the sun tracking surface was controlled by an open -loop control algorithm implemented using a PLC unit.[6]

In a recent study, Grena presented an algorithm for obtaining highly precise values of the solar position.
Taking the fractional Universal Time (UT), the date, and the difference between UT and Terrestrial Time (TT) as inputs, the algorithm computed the angular position of the earth with respect to the sun in the ecliptic plane and then used this angle and the inclination angle of the earth's rotational axis to calculate the position of the sun.[7]
The cam is assumed to rotate at a constant speed and the follower rotates over it. A complete revolution of cam is described by displacement diagram, in which follower displacement i.e. the movement of the trace point, is along y axis and is plotted against the cam rotation θ. [8]
When the motor shaft rotates the carrier rotates moving the gear in the threaded ring, thus the cam will rotate and there by the angle of the solar panel mounting plate changes in a spiral path dorm 0 to 30 degree (azimuth angles range within 0 to 18 degree for maximum solar panel power) which is necessary to place the job in shortest path as shown in figure above.[10]
The value of the torsional shear stress at any point in the structural member's cross-sectional area is calculated using the formula: $\tau = T*r/J$[11]
Angular contact ball bearings' contact regions are inclined from the start, and this enables them to be mounted in thermally stable configurations so they generally are used in high speed and high accuracy applications; however, a pair, at least, must be used in order to resist bi-directional thrust loads.[12]

IV. METHODOLOGY

(A) SOLAR TRACKER

Solar Tracker is a device which follows the movement of the sun as it rotates from the east to the west every day. The main function of all tracking systems is to provide one or two degrees of freedom in movement. Trackers are used to keep solar collectors/solar panels oriented directly towards the sun as it moves through the sky every day. Using solar trackers increases the amount of solar energy which is received by the solar energy collector and improves the energy output of the heat/electricity which is generated. Solar trackers can increase the output of solar panels by 20-30% which improves the economics of the solar panel project.

(B) SINGLE AXIS TRACKER

A single axis tracking system is the system where solar panel tracks the sun from east to west using a single pivot point to rotate. There are three classification of this system.
1) Horizontal single axis tracking system.
2) Vertical single axis tracking system.
3) Tilted single axis tracking system.
(1)Horizontal single axis tracking system:-
In this case, the axis of rotation is horizontal with respect to ground and the face of the module is oriented parallel to the axis.
(2)Vertical single axis tracking system:-
In this case, the axis of rotation is vertical with respect to ground and the face of module is oriented at an angle with respect to the axis of rotation.
(3)Tilted single axis tracking system:-
In this case, the axis of rotation is between horizontal and vertical axis and has a face of the axis of rotation.
The single axis tracking system has 1 degree of freedom system. This degree of freedom system acts on the axis of rotation. The axis of rotation is aligned along the north meridian. It consists of two LDR's placed on either side of the panel. Depending upon the intensity of sun rays one of the two LDR's will be shadowed and the other will be illuminated. The LDR with the maximum intensity of the sun's radiation sends signal to the controller which in turn sends signal to the motor to rotate the panel in the direction in which sun's intensity is max.

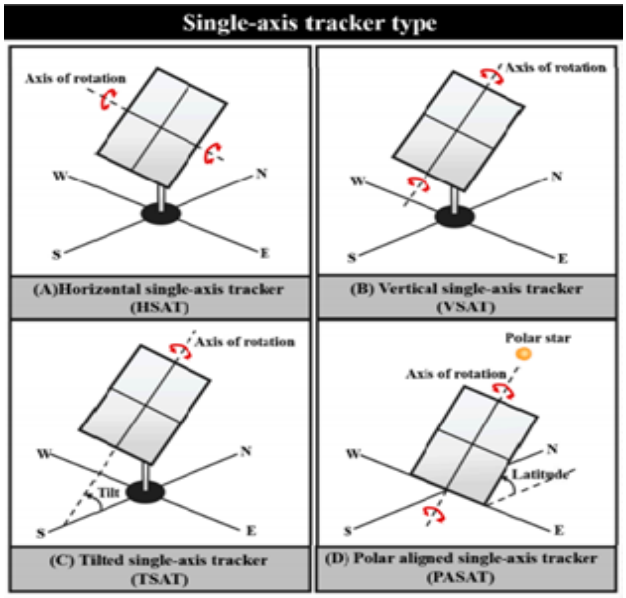

Fig.1 Single Axis Tracker

(C) DUAL AXIS SOLAR TRACKING SYSTEM

This system has 2 degree of freedom system .These degree of freedom system acts on the axis that are normal to each other. The axis that is fixed with respect to ground is known as primary axis, where as the other is known is secondary axis. It uses the solar panel to track the sun from east to west and north to south using 2 pivot points to rotate. This dual axis tracking system uses four CDR's 2 motors and a controller. The 4 LDR's are placed on different directions one set of sensors and one motor is used to-tilt the tracker in sun's east-west direction. Whereas the other set is used to tilt the tracker in north south direction. The controller detects the signals from the LDR's and commands the motor to rotate the panel.

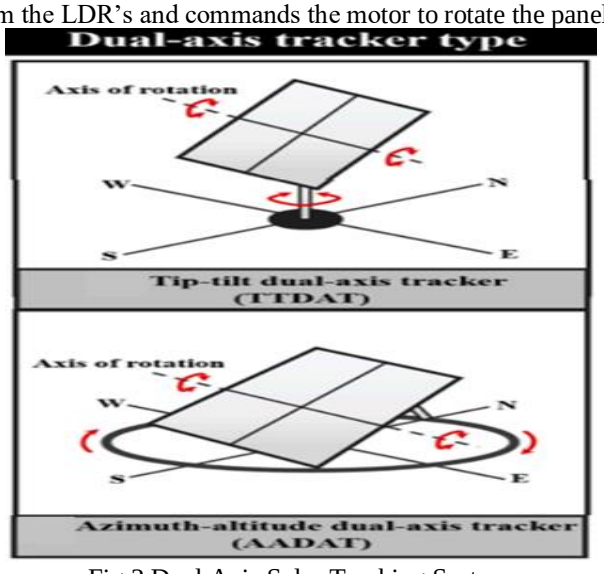

Fig.2 Dual Axis Solar Tracking System

V. DESIGN AND ARRANGEMENT

1) SOLAR PANEL :

Solar panel used in the design is 5w photovoltaic module. We need 12 volts as a output. So it does not matter whether 5w or 100w solar panel is. The base model design is depend on the weight of the solar panel. In this design we use 1 kg solar panel.

2) Motor:-

The motor is main part in the solar tracking mechanism.
The motor used for this is 60rpm 12v DC motor. It consists of 6mm output shaft with internal hole.

3) Carrier base:-

The part which attach to the motor shaft is carrier base. The bush is placed on the shaft of motor on bush the carrier base is placed. Bush fixed the connection in between motor n carrier base. The material used for carrier base is aluminium.

4) Cam:-

The cam is the important part in this mechanism. The design of cam is depend on forces and stresses applied on cam. In this design the shear, tortional stresses is negligible or not possible to develop in practical use. The material used to make cam is aluminium.

5) Gear:-

The cam is rotate when the gear arrange to the treaded ring rotate. The gear is connected to cam with the shaft. On gear shear stresses is applied.

6) Bearing :-

The bearing is the part used in it to move the shaft in smooth way. The ball bearing used is GE series bearing .material of this bearing is steel.

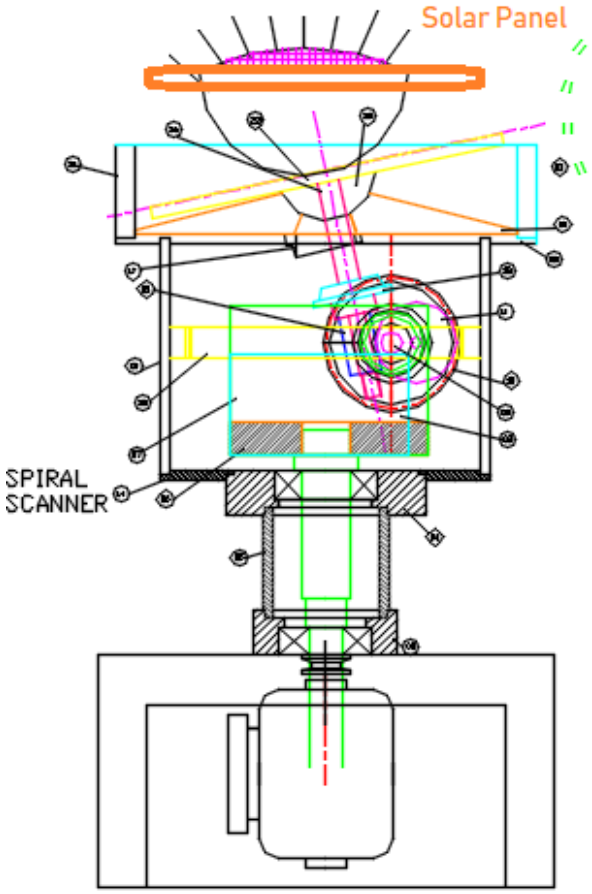

Fig.3 Schematic diagram

VI. CONCLUSION

The proposed arrangement single actuator solar tracker for better output is designed. This system will give us better results that the system available in the market today. Due to use of only one motor we save lot of energy than other system available in market. Design is compact as the part to operate actuation is less.

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