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Solar Tracker: An Essential Need of Solar Photovoltaic Energy Generation System

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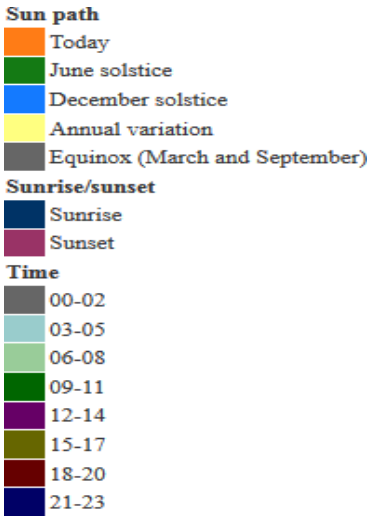
Abstract
Climate change becomes a threat to the living bodies on the planet earth. A great concerned step to save the environment is replacement of fossil fuels by renewable energy resources. Sun is a copious source of renewable energy. Solar cells tap the solar energy from sun. Solar cells convert the solar energy into plentiful utilizable form of energy. Solar cell provides more energy in response to normal fall of radiation otherwise less productive. To maximize the energy obtained from solar cell and increase the efficiency, solar tracking system tracks the movement of the sun. This scheme makes the energy more usable in domestic and commercial applications as a complementary source of power. The tracking system designed to respond in the normal direction of light in the shortest of time. Basics of solar tracking systems are discussed here for solar energy. Various Designs and components of solar tracker are technically mentioned in this paper.

Keywords: *Renewable Energy, Solar Energy, Solar Tracker*

I. INTRODUCTION

The solar panels absorb efficiently the solar emissions those directly fall upon panels.Sun based vitality usage is subject to the edge of frequency of the light from the source giving force (sun) to the sunlight based cell's surface .In the case of perpendicular incidence, greater the power collection is achieved. **)**. An assurance is needed in such a manner that the sun light would fall directly on the solar panels throughout the day without any loss of the energy due to partial or no incidence of sunrays.The tracking system is required to maintain and control the location of solar panel according to the instantaneous position of the sun, this system required the tracking of direction of maximum intensity of light. The main purpose of solar energy tracker is to help the solar panel in proficiently tapping solarenergy, which further converted in a constructive form for utilization. The tracking system designed as to responds in the shortest possible amount of time in a real-time system. It has ability to formulate the decisions for directional changes to increase the efficiency with assurance of its safety. It always target at a position, which maximize the irradiance.This procedure of detecting and following the situation of the sun is known as Solar Tracking. The consistent real time following is important to pursue the path of sun viably, considering that no outer information would be required in execution. The structure of the framework mechanically should be strong in such a manner it canbear the hazardous effects of winds, storms or serious temperature. The electronic parts are required to be grounded and protected to oppose lightning and lessen electromagnetic impedance [1]. A sun oriented tracker is a tool which situates a payload towards the sun's route subsequently guaranteeing that it is constantly exposed to the sun regardless of the time, day and areaof panel existence.. A perfect sun oriented tracker must guarantee that the PV cell is situated appropriately, considering the two changes elevation of the sun (for the day duration) and latitudinal of the sun (for seasonal changes) in addition to the changes in azimuth edge. It has been observed byvarious laureates that up to 40% additional power every year can be created utilizing a sunlight based tracking framework.



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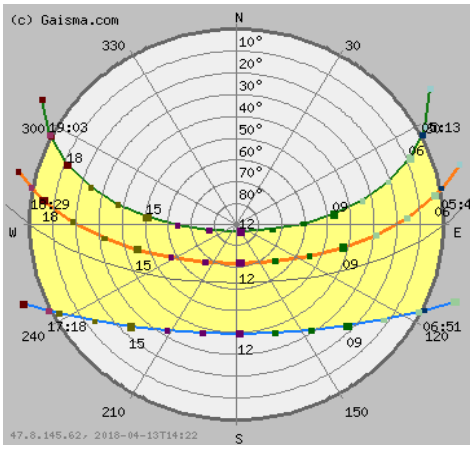

EARTH AND SUN ROTATIONTHE CONCEPT OF SOLAR SYSTEM IS WIDELY KNOWN IN CIRCLE OF RESEARCHERS .EARTH ROTATES AND REVOLVES AROUND THE SUN IN TWENTY-FOUR HOURS AND ONE YEAR. SEVERAL PHASES ON THE EARTH ARE OBSERVED DUE TO THIS SPECIFIC PLANETARY MOTION.A POLAR DIAGRAM IS A SCHEME TO DISPLAY THEPOSSIBLE PATHS OF THE SUN IN ENTIRE DURATION OF ONE YEAR FOR A SPECIFIC LOCATION. THISDIAGRAMMATIC DISPLAY ISA PROJECTION OF THE SOLAR PATHS ON A HORIZONTAL PLANE .THIS IS OBTAINED BY USING THE SOLARALTITUDE AND AZIMUTH ANGLE ON A GRAPH AS FUNCTION OF THE TIME AND THE DECLINATION, FIGURE 1.SUNPATH DIAGRAM OF LUCKNOW[2]

I. TYPES OF SOLAR TRACKERS

A. Active Solar Tracking

Active Solar Trackingsystem performs the constant and continuous monitoring of the solar position the whole daytime. Active Solartracker does not work when it subjected to darkness or during night. These trackers are inbuilt with a mechanism based on automatic control system. The automatic control system of active trackers is built up by electronic conceptualized circuits, which drives and operates the movement of panels. The electronic components of active tracker are either analog type or digital type. In analog tracking, system entire process depends on the data collected by sensor that recognizes the situation of the most sparkling position of sun powered radiation. In digitally controlthe entire process is executed by a microprocessorbasedalgorithm that decides the ideal position of the structure to boost the productivity of the PV frameworks [3].

B. Passive Solar Tracking System

Finster presents this framework in 1962 as a completely mechanical elucidation. Passive **Solar** trackers usually utilize a compressed gas fluid having low boiling point gas liquid headed to the other side that drive the tracker side by side because of imbalance brought about by a sun oriented heater. Consequently, they decide the sun's situation because of the imbalance made at the both ends of the tracker.

C. Chronological Solar Tracking

A sequential tracker is a clock-based framework that moves as per the revolving of the earth with respect to the sun around an axis at a similar speed as the earth. To achieve this, a basic rotational mechanism is formulated which empowers the framework to rotate for the duration of the entire day without considering the location of sun.. The framework turns at a consistent speed of one revolution for every day or 15 degrees for every hour.

D. Time based Solar Tracking

This basic **Tracking**system uses Real Time Clock and motor . This strategy has expanding power accumulation proficiency by developing a tool that tracks the path of sun, to keep the solar panel at a correct point towards required direction. An RTCbased IntegratedCircuit is used in this system formation. This Integrated Circuit functions in similar manner of a real time clock and will calculate the time as per the programming. This Solar TrackingTechniques will give the input for current time and comparison time.

E. LDR based Solar Tracking

Light Dependent Resistor (LDR) is a photo-resistor .It is a gadget whose resistivity is depends onincident electromagnetic radiation. A LDR works on the guideline of photoconductivity. Photoconductivity is an optical *event* where the materials conductivity is expanded when light is consumed by the material. A light sensor is the most widely recognized electronic segment, which can be effectively established. The least complex optical sensor is a photon resistor or photocell that is a light depended resistor.

F. Single Axis Trackers (SAT)

Single axis trackers pursue the predetermined way to pursue the sun-powered direction from east to west all over day. This type of tracking framework has single level of opportunity of revolution along the axis. In such a manner, solar panel is always oriented, towards perpendicular direction of solar radiation. Different sorts of single axis trackers are utilized according to the requirement vertical single hub trackers, even single axis tracker with tilted modules, flat single hub trackers, and polar adjusted single axis trackers (PSAT).

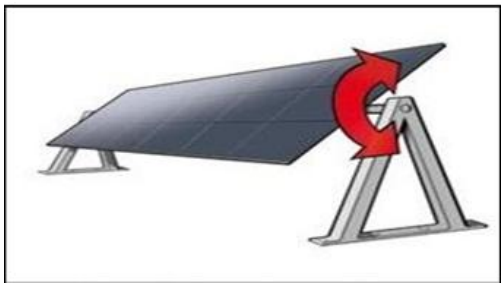

Figure 2: Single axis tracker[5]

F. Dual Axis Solar Tracking System

These trackers can be in motionin both east to west and north to south direction for maximum absorption of sunlight .These types of trackers have double level of freedom.Due to the presence of multiple actuators , Dual Axis trackers are more capable than single axis tracking system. The dual axis capability is essential since solar

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panels need to track the sun in a three-dimensional space using both azimuth and elevation drives.

Figure 2: Dual axis tracker[5]

G. Biaxial Solar tracker

These solar trackers are based on novel techniques like information and communication technologies (ICTs). Photovoltaic radiation availability is detected by information and communication technologies (ICTs), further digital system enabled in the tracker control the whole operation of biaxial solar digital tracking system for power applications.

H. Multidimensional Solar Tracker

Multidimensional Solar Trackerflawlessly arranges the panels in the line with solar direction. It tracks the solar movement in a more efficient way than other trackers and has a remarkable performance in efficiency improvement of solar panel. Multidimensional Solar Tracker Based on both LDR sensors and Time Based Scheme . This sun based tracker is utilizing the new rule of utilizing miniaturesolar cells to work as self-modifying light sensors, giving a variable sign of their relative point to the sun by distinguishing their voltage yield. By utilizing this technique, the sun powered tracker was effective in keeping up a sun powered panel at effectivelynormal to the sun.

II. DESIGNING AND WORKING

The structure of the sun oriented **Tracking** framework must be simple. It ought to be reasonable and something that can be gathered. The framework must follow the path of sun to retain the elevated quantity of sunlight based energy conceivable. It must permit movement in two directions.
the model can be improved further by slight change in its structural design, There some specified phenomenon used for designing of solar trackers .Light detecting sensors are basic approach for the solar tracking. Two light depending resistor (LDR) sensors those are situated normally at the ends of the photovoltaic module generally distinguish the sun position. A servo engine and a Real time clock (RTC) can be connect to improve its exhibition by making the sun powered board move alongside the direction and development of the sun.
In the digitally controlledsystem the signals generated by sensors are sustained into an electronic control framework that works with a low-speed DC engine to turn the PV modules. To create the reference (in azimuth and rise edge) for the advanced control calculation a Global Positioning System (GPS) by satellites is utilized which empowers the real time based geographic directions of the sun progressively. In active solar tracking systems sensors are used to detect light . Their voltage yield is placed into a microcontroller that drives actuators to modify the situation of the sun powered panel. Active tracking frameworks improve execution and energy creation. Such frameworks require movement elements and drive innovation, for example, slew driving actuator frameworks for portability.
To analyze the performance of a multi axis solar tracking system. The whole system consists of three main structures, input, controller and output. Input block consists of RTC (real time clock) and will calculate the time as per the programming. The three phases were structured separately before being joined into one framework this guarantees if there were any error, they were considered autonomously and redressed. A servo engine and a Real time clock (RTC) to improve its presentation bymaking the sunlight panel alongside the direction and movement of the sun during the day. The microcontroller then would send signals to the servo motors that would move the solar panel arrangement alongside the movement of sun. This would improve the proficiency of the sun-powered board.

III. ESSENTIAL PARTS OF A SOLAR TRACKING SYSTEM

A. Microcontroller

Microcontroller is a solitary chip miniaturized scale PC made through VLSI manufacture. The microcontroller is associated with RTC, which would check what time of day it is and would empower the framework to move alongside the situation of the sun anytime of the day. The microcontroller then would send sign to the servomotor that would move the sunlight based board arrangement alongside the movement of sun. This would improve the effectiveness of the solar panel.

B. Light sensor

A light sensor is the most widely recognized electronic segment, which can be effectively found. The most straightforward optical sensor is a photon resistor or photocell that is a light dependent resistor.A Light Dependent Resistor (LDR) or a photo resistor is a gadget whose resistivity dependson electromagnetic radiation. Photoconductivity is an optical phenomenon wherein the materials conductivity is lingering when light is consumed by the material.

C.Servomotor

A servomotor is a rotary machine that works for accurate control of angular location. This motor coupled to a sensor for location feedback, later on controlled by gearbox. Itnecessitates a moderatelycomplicated controllerwith devoted module designed exclusivelyfor servomotors. The electric motor and servomechanism both are fundamental blocks of mechanical segment of solar tracker.

D. STEPPER MOTOR

A stepper motor is a brushless type of dc motor that segregate a complete revolution into different partial sections compatible with display appliance. It is a device used in output section of tracker for presentation of data in visual or tactile form. The information data input is supplied as an electrical signal,the no of segregated section of rotation is displayed as steps movement onelectronic

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display. The actual position ofmotor is recorded after that it commanded to move and hold at next steps without any position detecting sensor for feedback.the motor is deliberatelyestimated to the application in regards to torque and speed.

E. Arduino Compiler

Arduino is an instrument used for sense and control by making computers more of the physical world. It's an open-source physical computing platform based on a microcontroller .Arduino Compiler provides the facility and surroundings for independent writing of own software on board. Arduino can be utilized to create intelligent objects. It can be taken Inputs from a range of switches or sensors, and controlling a range of lights, motors, and other physical outputs. a solar tracking system utilizing Arduino is structured and constructed. This system accumulate energy from the solar energy converts this energy to useable form and also stores it in the battery. This scheme is intended to respond in the shortest amount of time., temperature and some minor mechanical

DI. CONCLUSION

Present article discussed the necessity and the provision of proficient tracking system for solar generation system. This paper describes various aspects of solar tracking. There is a issue of feasibility and design of system which is deal here efficiently .The use of latest technologies in tracking of system are discussed in comparative manner.The basic mechanism related to electrical and mechanical machines concluded in better way.

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