Design and Fabrication of Solar Tracking System

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ABSTRACT

Photovoltaic solar technology may be a multi-billion dollar clean, green and renewable energy industry, powering everything from road signs to entire cities. Solar cells themselves are essentially big PN-junction semiconductors, there's plenty of advanced and rapidly evolving electronic engineering required to optimize the energy transfer from the roof top to the grid. This course covers the Fundamentals of grid-connected PV systems, with the aim of providing engineers with an honest overview of the technologies, topologies and electronics that structure such systems. Solar energy is extremely important means of expanding renewable energy resources. Solar may be a nonconventional source of energy, considering this we've developed solar panels in order that we will fulfil our electricity need. The problem above are often solved by our system by automatic tracking the solar power. The system architecture contains a LDR sensor senses max solar power. It is being given to the Microcontroller through the ADC. In which digitizes the LDR output. The Motor is employed to rotate the LDR to sense the max solar energy. A Solar Tracker is essentially a tool on to which solar panels are fitted which tracks the motion of the sun across the sky ensuring that the utmost amount of sunlight strikes the panels throughout the day. After finding the daylight, the tracker will attempt to navigate through the trail ensuring the simplest sunlight is detected. The objective is to development of an automatic solar tracking system whereby the system will caused solar panels. It will keep aligned with the daylight in order to maximize in harvesting solar power.

Keywords: Solar energy, tracking System, Photovoltaic cell.

1 Introduction

In remote areas the sun may be a cheap source of electricity because rather than hydraulic generators it uses solar cells to supply electricity. Output of solar cells depends on the intensity of sunlight and angle of incidence. It means to urge maximum efficiency; the solar panels must remain in front of sun during whole day. But rotation of earth those panels can't maintain their position always ahead of sun. This problem leads to decrease of their efficiency. Thus to urge a continuous output, an automatic system is required which should be capable to constantly rotate the solar battery. The Automatic Sun Tracking System (ASTS) was made to solve the problem. It is completely automatic and keeps the panel ahead of sun until that's visible. The unique feature of this technique is that rather than taking the world as its reference, it takes the sun as a guiding source. ASTS sensors continuously monitor the daylight and rotate the panel towards the direction where the intensity of sunlight is maximum. In case the sun gets invisible e.g. in cloudy weather, then without tracking the sun the ASTS keeps rotating the solar battery in other due to the rotation of earth. ASTS speed of rotation is same as that of earth's rotation. Due to this property when after a while e.g. half an hour when the sun again gets visible, the solar array is strictly ahead of sun.

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2 Theoretical background of solar tracker

2.1 The Earth: Rotation and Revolution

The position of the sun changes regularly throughout the day. It is due to the motion of earth that we experience sun at different angles in the sky. Earth exhibit two types of motion. One is that the motion of earth along its own axis, and therefore the other is that the earth revolving around the sun. The motion of the world along its own axis, referred to as rotation, leads to the phenomenon of days and nights. One rotation of the world takes 23 hours and 56 minutes. On its own axis, the motion of the world is west to east.

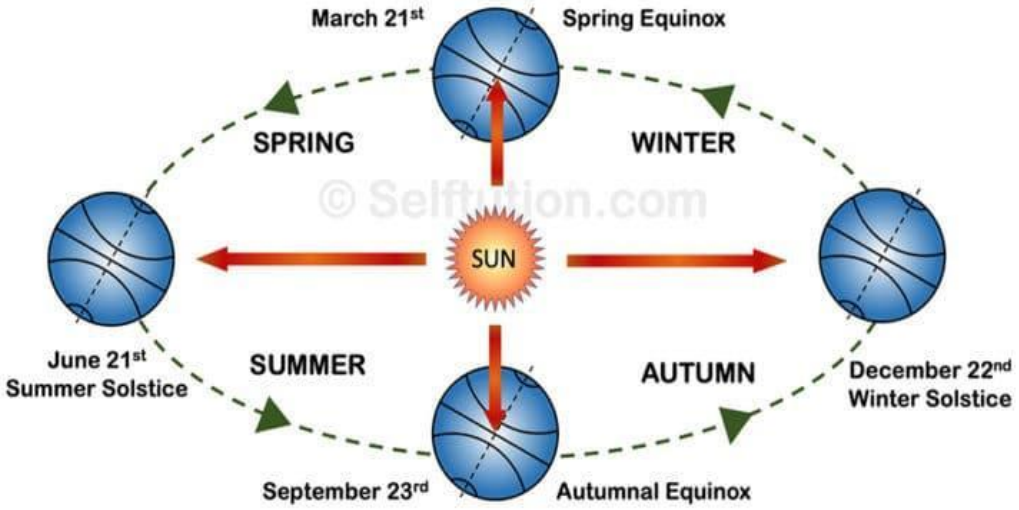

Figure 1: *Earth Rotation and Revolution (Source: Selftution.com)*

Revolution that's the motion of the world round the sun is liable for the various seasons within the year. The time taken by earth is three hundred and sixty five days to revolve round the sun. Earth revolves round the sun in an elliptical orbit and therefore the plane covered by the world during the revolution is understood as an ellipsis. The axis of rotation and ellipse is makes an angle of 66.5 degrees between themselves. This is the explanation behind the summer and winters solaces and spring autumn equinoxes. Due to these motions of the world, the quantity of sunlight received throughout the year varies. Sunlight is that the electromagnetic wave from the sun expropriated by the world. The total power given off by the sun in to space is much more than that intercepted by the earth within a given period of time, the emission of solar radiation is somewhat constant and therefore the intensity this radiation hitting a unit area of the earth's crust is additionally constant, referred to as rate

The sunlight is seen at different angles depending on the place on the earth and the angles of the sun. The sun's angle can be classified in to the following:-

•Elevation Angle

•Zenith Angle

•Azimuth Angle

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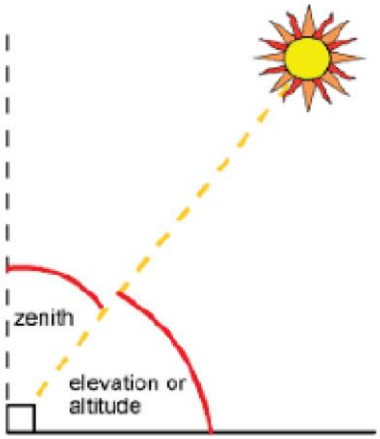

Figure 2: *Angle of elevation and zenith angle (Source: PV Education)*

3 Solar Tracking System

Solar energy is that the oldest primary source of energy. It is clean, renewable and an abundant in every part of the world. Almost all energies are derived from solar power. However, it is possible to convert solar energy in to mechanical or electrical energy with adequate efficiency. Sun tracking systems are designed to track the solar azimuth angle on one axis or to trace the solar azimuth and zenith angles on two axes. The east-west of the tracker is going to be called the "horizontal tracking" while the angular Height trackers are going to be mentioned as "vertical tracking".

A solar tracker is essentially a tool on to which solar panels are fitted which tracks the motion of the sun across the sky ensuring that the utmost amount of sunlight strikes the panels throughout the day. It was observed that at 37.6 degrees latitude 32.5% more energy is obtained from the Photo voltaic solar panels which tracks the sun. Sun tracking can increases the power output for Photo voltaic solar power plants by about 25% to 40%, depending on the geographic location. A single axis tracker will increase power output by 26% and dual axis tracker increases power by 32%.

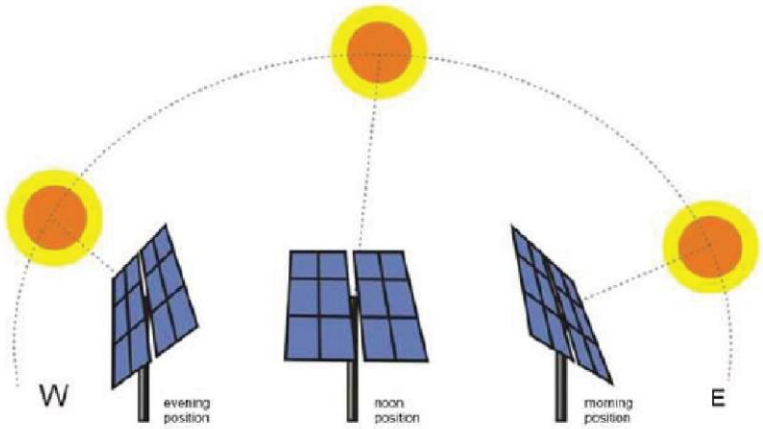

Figure 3: *Solar tracker positions (Source: Northgreen Energy)*

In these photo sensor systems, unstable states may exist under overcast and partly cloudy weather conditions when the photo sensors do not see the sun. According, it is anticipated that PV systems will become one of the main energy resources to fulfill the global energy requirement by the end of this century. Solar panels are usually set up to be in full direct sun shine at the middle of the day facing south in the Northern Hemisphere or north in the Southern Hemisphere.

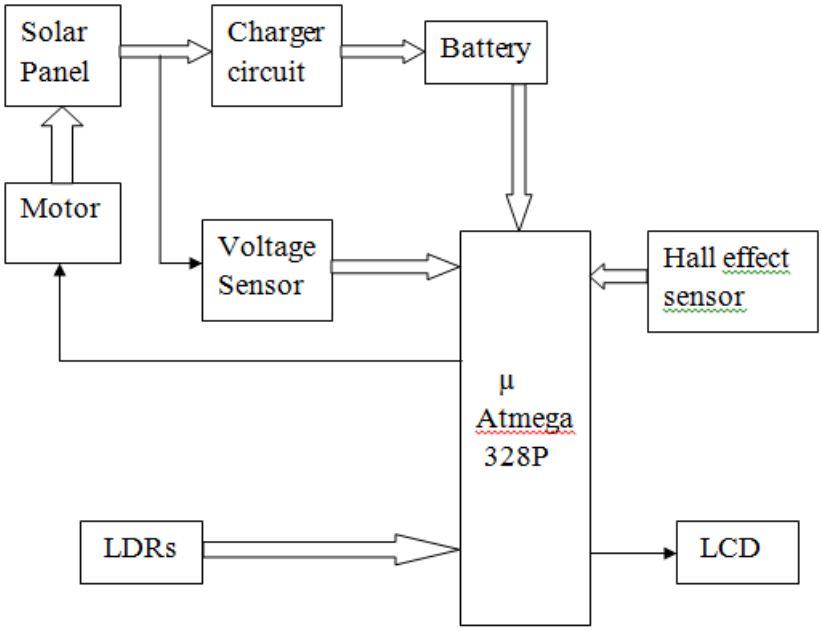

Figure 5: *Block diagram of solar tracker [5]*

Figure 6: *Manufacturing frame design*

Table 1: ***Material and its specifications***

Sr. No.	Material Name	Specification
1	Square pipe	1*1 inch
2	Shaft (MS)	Dia. 25 mm L=14inch
3	Flat steep (MS)	1.5*26inch

3.1 Solar Tracking Testing

Testing of solar tracker response

Apparatus: time watch, vertical platform strike, torch, angle measuring pendulum, etc.
Setup: clean the solar panel. Place the solar tracker on flat surface. Cheek all contacts. Press switch ON. Connect the external power to the Arduino; Cheek limits switches possession and contact.
Observation divided into two parts.

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1. Dry testing
2. Sun tracker testing

1. Dry testing

In this method we are test the sensor responds in indoor, lick room, hall, and lab. In this test we are use the torch for photons. Torch flash can be sense by sensor. We are focus on the both side on sensor and observe testing.

Table 2: *Dry testing results*

Sr. No.	Sensor side	Motor movement	Response time
1	Right side	Clockwise rotation	Medium
2	Left side	Anticlockwise rotation	High
3	Right side	Clockwise rotation	High
4	Left side	Clockwise rotation	High
5	Both side	Stop	High

2. Sun tracker testing

In this method we are test the solar tracker responds in outdoor. In this test we are the solar tracker in sun light.

This test starts at sun shine. In this observation the time watch set with world clock. Place the angle pendulum on center of tracker body. Measure the angle and calculate angle difference.

Ia–Aa = Ra,

Where,

Ia = initial Angle

Aa = after tracking angle.

Ra = response angle (final angle)

4 Conclusions

The Single Axis Solar Tracking System prototype model is developed. The designed system is focuses on designing controller part and the reform the main concern is to style appropriate circuits. Circuits alleged to be ready to control DC- gear motor rotation direction without considering motor speed. The system is in a position to trace and follow Sunlight intensity so as to gather maximum solar energy no matter motor speed. The unique of developed system, motor speed isn't critical consideration because the DC-geared motor offers low output rated speed and high output rated torque. Therefore, any sorts of DC-geared motor are often used for this technique no matter motor speed controller unit. The fabricated model can be applied in the residential area for alternative electricity generation especially for non-critical and low power appliances.

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