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Single Axis Solar Tracking System by BLDC Motor

Dr. Ajay K Datta
Professor, EE Department
Brainware Group of Institution-SDET
Dipankar Saha
Assistant Professor, EE Department
Brainware Group of Institution-SDET
Subhojit Mukherjee
Assistant Professor, EE Department
Brainware Group of Institution-SDET

ABSTRACT

The Sun, a typical G-types star, the radio emission from it is being studied to understand the mysteries of the sun and its corona, sunspot, solar flares, prominences and surges. The sensitivity of the radio astronomical receiving systems can now detect even the thermal emission of moon and other planet.

The Prototype of solar tracking system developed for the purpose is of utmost importance. The system demonstrated has a motor sensor less position control places the reflector in the desired position and angle.

KEYWORDS

Tracking system, equatorial system right ascension, declination, hour angle

INTRODUCTION

The sensor less position control of solar tracking system is developed. The aim is to receive the sun ray throughout the day by the radiometer. To achieve this we have to use a front plated very thin film reflector. As the position of the sun changes with respect to the earth, the reflector also move in synchronism with the sun.

For fixing the position of the sun , we have to use the equatorial system i.e, right ascension and declination or Hour angle and polar distance, or declination. In this system there are two co-ordinates. One is Hour angle and other is declination.

The sun rotates about an axis pointing towards the pole, from east to west during the day and during the seasonal and yearly motion from North to South. The Hour angle of the sun , regarded as the number of hours that has elapsed since the sun crossed the meridian. Hour angle is measured in degree as well as in hours.

360 degree equivalent to 24 sideralhour,

1 degree equivalent to 4 sideral minutes.

Conversely ,

1 sideral hour equal to 15 degree of angular measure

1 sideral minute equal to 15 minute of angular measure

1 sideral second equal to 15 second of angular measure

i.e., 15 degree Hour angle equal to 1 solar hour.

The maximum declination towards north is 23 ^{o} 27 ’ N on 21st. June and towards south is 23^{o}27 ‘ S on 22nd December.

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METHODOLOGY

Adjustment: The shaft of the whole system must be pointing towards the north and at an altitude which is the latitude of the place. Now since the angle of the sun changes very slowly throughout the year due to declination, so changing of the reflector once a day should be sufficient. This very slow motion can also be given by high geared down motor or manually by calibrated angular scale. The sun ray will reflect from the reflector, which is a very thin film reflector and move along the axis of the shaft. The reflected ray will remain in the same line throughout tracking of the sun. The Radiometer or PV cell can then be suitably positioned to receive the reflected ray throughout the day.

In this open loop pre- programmed sun tracking systems we are directing the axis of the system(i.e., axis of rotating shaft) towards the pole and at an altitude is 23 ^{o} 35 ’(with respect to horizon, i.e., the latitude of Calcutta) and giving two motions to the reflector.

a) In one motion the reflector will follow or track the sun from sunrise position to sunset position by preprogrammed control.

b) In second motion the reflector will change its angle in every day step to account for the declination, so that the reflected ray will move along the axis pointing towards the pole.

Now per day declination change is : (2x23 ^{o} 27 ’/(365/2))=15’

This is very less than the beam width of the conical lens of the radiometer. So, during a day , for a fixed declination, the rotation of the system about the axis through the pole star is sufficient for directing the ray towards the radiometer, which is again placed in that said axis.

So two BLDC motor are required for the dual axis motion. One for the rotation of the reflector about the axis through pole star and is in synchronization with the rotation of the sun’s daily motion, and the other for the rotation of declination co-ordination controlled per day basis. Per day declination angle is 15’. So one degree changes in four day. We have to change mechanically the reflector one degree at an interval of four days by proper angular degree measurement. In this way we made it as single axis programmed controlled BLDC motor drive.

The typical 4 pole BLDC motor are provided 12 steps per revolution i.e. each step angle is 30^{o} . We are reducing the step angle 30^{o} to1^{o}by proper worm gear arrangement.

The reflector rotate at a rate 1^{o} in 10 seconds of intervals. The declination is controlled by manually according to the declination angle.

FIGURES

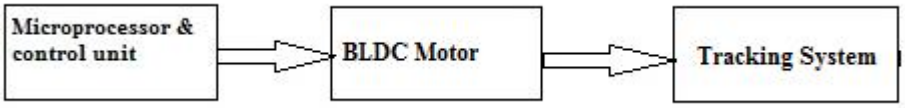

Fig 1: Image

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