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Automation in Dual Axis Solar Tracking System

V. T. Pawar, Tirupati Jaybhaye, Viraj Jadhav, Aditya Joshi

Assistant Professor, Dept. of Mechanical Engineering, SCOE, Pune, Maharashtra, India

UG Student, Dept. of Mechanical Engineering, SCOE, Pune, Maharashtra, India

UG Student, Dept. of Mechanical Engineering, SCOE, Pune, Maharashtra, India

UG Student, Dept. of Mechanical Engineering, SCOE, Pune, Maharashtra, India

ABSTRACT: The goal of this paper is to present the design and implementation of an automated dual axis solar tracking system. The system can track the sun in both the horizontal and vertical axis to maximize the amount of solar energy received by the solar panel. The system is based on the Arduino microcontroller programming and uses four infrared sensors, four LDR's, two servo motors and two 9 volts batteries. At the end of the project, a functional solar tracking system was designed and implemented.

KEYWORDS: Automation; Dual-Axis Solar Tracking; Renewable Energy; Energy Optimization

I.INTRODUCTION

Solar energy is a clean and renewable energy source that can help reduce greenhouse gas emissions and reduce climate changes. The efficiency of the solar energy systems can be improved by using solar tracking systems that follow the path of the sun across the sky. Dual axis solar tracking systems are particularly effective as they track the sun's movement in the both the horizontal and vertical axis. In this paper, we present the design and implementation of dual axis solar tracking system that maximizes energy efficiency.

Solar energy is referred to the energy harnessed from sunlight. The energy from sun is considered unlimited and hence energy acquisition from sun is considered the leading energy source for future. Radiant light and heat from the sun, is harnessed using a different type of technologies such as solar heating, solar photovoltaic, solar thermal electricity, solar architecture and artificial photosynthesis. It is calculated that earth receives at about 1000 Watts per square meter at noon and hence direct conversion from photon energy to electricity has already been done and solar power plants are now setting up on large scale. However, solar energy cultivation efficiency is not satisfactory. So it is desirable to extract as much energy as possible by reducing losses. Solar energy has advantages over all other sources of energy. Most important fact is, except the additional installation cost and negligible maintenance cost it is quite free of cost and with no energy limitation. It does not emit heat and carbon dioxide or radioactive particle and solar energy does not create any noise. Hence, it's completely environment friendly. Solar energy is a reliable source of energy in the hilly regions and isolated lands where transmission through cable is costly or impossible. Photovoltaic panels are used in rural areas for electrification. Also, urban electrification by street lighting by photovoltaic panel is becoming popular. Modern electric devices also have the facility to run with solar power. Recently electric vehicles, building integrated solar system and smart grid system have started adopting solar energy widely. Space shuttles and satellites that are sent to space for long time have no other alternative energy then solar. So, research has been made extensively in this regard.

The solar tracking system plays a major role in which it is used to capture the maximum power from the sunlight. The solar tracking system uses photovoltaic (PV) technology to convert the solar energy into electrical energy.

II.PROPOSED DEFINITION

Solar trackers are the devices that track the solar path throughout the daytime and used to align solar panels and concentration devices with the sun's position in the sky to maximize the collection of solar energy.

There are two primary types of solar trackers: -

- 1] Single axis,
- 2] Dual axis solar trackers.

Single axis solar trackers follow the sun's movement either horizontally or vertically, using only one axis of rotation. Horizontal single axis trackers are used in tropical regions with short days, while vertical single axis trackers are used in high latitude areas with long summer days. Single axis trackers are also used in concentrated solar power applications with parabolic and linear Fresnel mirror designs.

Dual axis solar trackers have two degrees of rotation and can track the sun both horizontally and vertically. Dual axis trackers can be used anywhere in the world and ensure maximum efficiency in collecting solar energy. Concentrated solar power (CSP) applications using dual axis tracking include solar power towers and dish systems. Dual axis tracking is essential for solar power tower applications because the angle error is crucial for longer distances between the mirror and the central receiver located in the tower structure. Dual axis tracking systems are more complex in design and consume more energy than single axis tracking systems, but for large scale solar energy production, dual axis tracking is more economic.

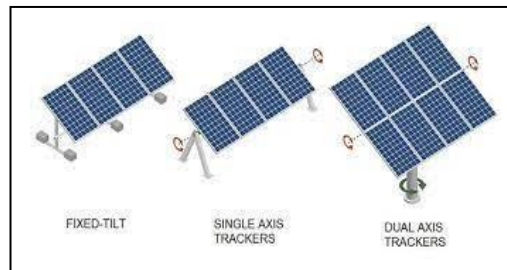


Fig. 1 Types of Trackers

III.METHODOLOGY

The methodology of a dual axis solar tracking system is to track the sun in two directions that is elevation and azimuth, a dual axis tracking prototype is developed to capture the maximum sun rays by tracking the movement of the sun in four different directions. One axis is azimuth which allows the solar panel to move left and right.

System consists of two units, mechanical and electrical unit.

The electrical units consist of microcontroller, sensors, motor driver, and battery.

The mechanical unit consists of servo motors, wooden panel, etc.

The methodology for designing a dual axis solar tracking system could be followed by general following steps: -

1. Defining the objectives:- This includes determining the energy output and choosing the solar panel to be used.
2. Selecting the components: - This includes selecting the right sensors and motors, and calculating the torque and power and then selecting the microcontroller.
3. Designing the system:- This includes the designing of the U shaped frame and creating a drafting diagram of all the components.
4. Building the system:- This includes assembling all the components.
5. Testing:- This includes the testing of the tracking system.

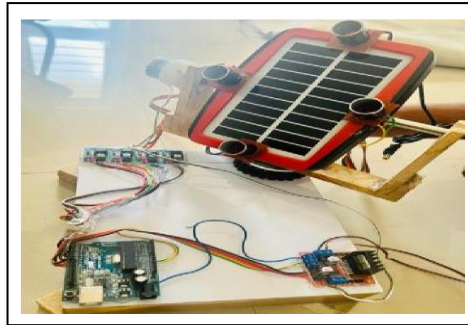


Fig. 2 Prototype Design

IV. DESIGNING

The system is based on the Arduino microcontroller platform, which is a low-cost and widely available platform. The system uses two servo motors to control the movement of the solar panel. The servo motors are connected to the Arduino board and are controlled by a program that calculates the position of the sun based on the time and location of the system. The program then sends commands to the servo motors to move the solar panel to the optimal position.

The system is designed to be low-cost and easy to construct. The solar panel is mounted on a wooden frame that is supported by two vertical poles. The servo motors are mounted on the frame and are connected to the solar panel using a linkage system. The Arduino board is mounted on the frame and is connected to the servo motors and a real-time clock module.

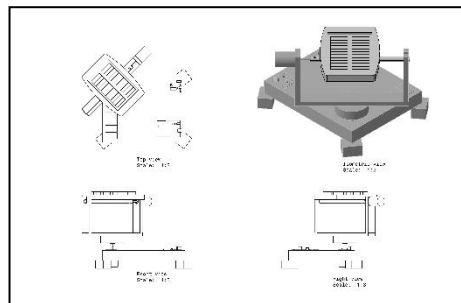


Fig. 3 Drafting using CATIA

Calculating system torque and power: -

Motor 1: (Horizontal direction -Bottom)

Motor 1 consists weight = U shaped frame + motor 2 (upper) + solar panel (including rotating rod)

Frame dimensions: Length: 0.23 m

Breadth: 0.03 m

Height: 0.12 m

Width: 0.01mm

Total length or radius to be lifted by the motor = Length/2 = 23/2 = 0.115 m i.e., r = 115 mm

Weight of U shape frame = 0.166 kg

Weight of motor 2 = 0.069 kg

Weight of solar panel = 0.280 kg

Weight of remaining accessories = 0.01kg

Hence, total weights to be considered,

$$F = (0.166 + 0.069 + 0.280 + 0.01) \times 9.8 = 5.145 \text{ N}$$

$$\text{Torque Required, } T = F \times r = 5.145 \text{ N} \times (11.5/100) \text{ m} = 0.5917 \text{ N m}$$

Speed of motor (N) = 100 rpm

Power requires to drive the system 1st,



$$(P1) = 2\pi NT/60 = 2\pi \times 100 \times 0.5917/60 = 6.19 \text{ watt}$$

Motor 2: (Vertical direction -Top)

Motor 2 consists weight = Solar panel (including rotating rod)

Total length or radius to be lifted by the motor = Length/2 = 23/2 = 0.115 m i.e., r = 115 mm

Weight of solar panel = 0.280 kg

Hence, total weights to be considered, F= (0.280) × 9.8 = 2.74 N

Torque Required, T = F × r = 2.74 N × (11.5/100) m = 0.3151 N m

Speed of motor (N) = 100 rpm

Power requires to drive the system 2nd,

$$(P2) = 2\pi NT/60 = 2\pi \times 100 \times 0.3151/60 = 3.29 \text{ watt}$$

Total power required to drive the system= power of system

1st+ power of system 2nd

$$P = P1 + P2 = 6.19 + 3.29 = 9.48 \text{ watt}$$

Total power required to drive the whole system is 9.48 watt

V.RESULT

The system was tested under various conditions and was found to be effective in tracking the sun's movement. The system was able to track the sun in both the horizontal and vertical axis, and the solar panel was always positioned at the optimal angle to receive maximum solar energy. The system was also found to be robust and reliable, and was able to withstand harsh weather conditions.

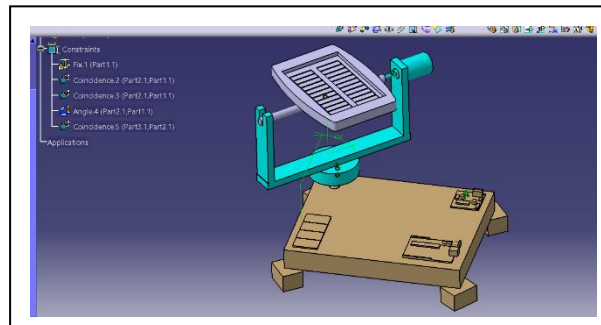


Fig. 4 Design using CATIA

VI. CONCLUSION AND FUTURE WORK

In this paper, we presented the design and implementation of a dual-axis solar tracking system that maximizes energy efficiency. The system uses light sensors and servo motors to track the sun's movement and adjust the angle of the solar panels. The system was found to be effective in maximizing the amount of energy produced by the solar panel. Future work could involve optimizing the program to improve the accuracy of the system and using more advanced sensors to improve the performance of the system.

Soon, we expect that the dual axis solar tracking system will increase the efficiency of collecting solar energy from sun by almost 10-12%. For future projects, we may consider the use of more efficient sensors, which should also be cost effective and consume little power. This would further enhance efficiency while reducing costs. This project is mainly done in large scale as it needs a lot of space



REFERENCES

1. M. A. Panait, T. Tudorache, "A Simple Neural Network Solar Tracker for Optimizing Conversion Efficiency in Off-Grid Solar Generators", ICREPQ Spain [2008]
2. O.R. Otieno, "SOLAR TRACKER FOR SOLAR PANEL", University of Nairobi [2009]
3. Md. Tanvir Arafat Khan, "Design and construction of an Automatic Solar Tracking System," International Conference on Electrical and
4. Computer Engineering, ICECE, pg. 326-27, December [2010] [4] S. M. Shrivastava, "Dual Axis Solar Tracker," Gautam Buddha
5. Technical University, Lucknow, May [2013]
6. J Pradeep, "Development of Dual-Axis Solar Tracking using Arduino with Lab VIEW," International Journal of Engineering Trends and Technology (IJETT), vol. 17, p.321, [2014]
7. Sadeque, "Design and implementation of automated solar tracking system" [2014].
8. N. Bali, P.Syed, Z.Huq], "Design and simulation of dual axis of solar tracking panel for rural areas" [2015]
9. C. Chang, Chapter 5 Tracking solar collection technologies for solar heating and cooling systems, "Advances in Solar Heating and Cooling", Woodhead Publishing, [2016]
10. S. Vichare, N. Vartekar, T. Kuniumon, "Dual Axis Solar Tracking System" [2017].
11. H. Kapale, Y.Bhole, M.Shirore, "Automation In Solar System By Using Trackers" [2018]
12. Juan Reca-Cardena, Rafael Lopez-Luque, Chapter 9- Design Principles of Photovoltaic Irrigation Systems, "Advances in
13. Renewable Energies and Power Technologies", [2018] [12] V. Kumar, S. K. Raghuwanshi, "Design and development of dual axis solar panel tracking system for normalized performance enhancement of



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