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Design and Development of Autonomous Dual Axis Multi-Purpose Solar Tracker for Heavysolar Collectors

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ABSTRACT: There has been a growing global demand for environmentally friendly energy for quite some time now and solar power is one of the definite answers. Tracking sun by the help of LDR sensor & both “Dual-Axis” it can be rotated. The solar sun tracker is a device that orients a payload towards the sun. The purpose of tracking mechanism is to be followed the sun as it moves across the sky. We have done some modification from exiting product like “**The heavy and large size system need a tracker that separate the load from the collector and transfer directly to the grounding structure**” This will free the tracker drive system from heavy load traction.

Our teammates noticed SMART INDIA HACKATHON 2022 have 103 Hardware statements & 460 software statements. Our team selected problem statement theme under Clean & Green Technology (PS - MA1218).

We have noticed some problem under agriculture issues of drying the harvesting product. The solar trackers are rising in popularity and solar panel tracking solutions are a more advanced technology for monitoring photovoltaic panels. However, they are not being used to its potential, even in solar power plants, due to drawbacks like low load bearing capacity of the existing system design.

The solar trackers are rising in popularity and solar panel tracking solutions are a more advanced technology for monitoring photovoltaic panels. However, they are not being used to its potential, even in solar power plants, due to drawbacks like low load bearing capacity of the existing system design. The tracker system are also least used in rooftop mounting of solar panels. Similarly, the solar tracker usage is very little in commercial solar drying solutions. The dryer or other collector are usually heavy, bulky, and large in size.

So we decided to increase the absorption heat energy from sun and utilise to dry the by-product like (grains, dry fruits, agriculture solar dryers, solar fish dryers, solar heater, desalination plant and solar Agri-tillage vehicles, etc.)

KEYWORDS: SIH, Heavy and large size system, Dry the by-products, Solar dryers.

I. INTRODUCTION

The creation of various solar tracking systems is a result of the rising demand for renewable energy sources. By aiming solar panels at the sun as it moves across the sky, solar tracking systems help solar panels operate more efficiently. The most effective solar tracking technology is a dual-axis solar tracker. They can monitor the sun both horizontally and vertically because to their two degrees of freedom.

The design and production of an autonomous dual-axis multi-purpose solar tracker for large solar collectors which withstand the heavy payload and that load was transferred to the ground is the goal of this report.

The solar tracker will be able to precisely track the sun's path, maximizing the amount of solar energy captured throughout the day. Large-scale solar energy projects can use the system because it is built to handle hefty solar collectors.

The design and manufacturing process, including the tools and software used, as well as the testing procedure, will be thoroughly explained in the report. The cost-effectiveness of the solar tracker and its prospective uses in the solar energy sector will also be covered in the paper. All things considered, the autonomous dual-axis multi-purpose solar tracker for large solar collectors is a creative way to maximize solar energy absorption and use full for the society.



II. RELATED WORK

The initial stage we are collected the existing methods to gather the fundamentals and product developed in the thesis. Then we are started in the design using CAD modelling software and analysis the components like clamps, motors, ropes, pin, joints and much more. We disused with industrial experts about our project for making it work in physical world. Then analysis it further using required software to check the strength, displacement, strain, stress, load carrying, required torque for motor and to study about the motion.

III. METHODOLOGY

Loading and Mounting Profile

It describes the types of solar trackers, such as horizontal and vertical axis, and their advantages and disadvantages. It also discusses the design and control of solar tracking systems, such as open loop and closed loop, and their components and features.

Tracker Specification

It lists solar tracker specifications such as type, axis, driving mechanism, control system, tracking accuracy, and power consumption. It also discusses solar tracker characteristics and uses, such as weather protection, wind load rating, tilt angle range, and mounting possibilities. The existing solar trackers are design with shaft that carry the entire pay load and are mounted on structure through bearings. Gear system or hydraulics are being used in the drive line.

The hydraulic operated tracker design addresses these issues, however, the hydraulic system itself adds complexity to the design and control of tracking. The mechanical structure of the proposed system is designed considering different requirements. The solar collectors considered are fish dryer bed, solar water heater and solar air heaters. The capacity of the solar fish dryer is about 250 sq.

Industrial solar heater selected for project is a Flat Plate Collector with a Size of 2014 X 1014 X 100 2mm that handle 40 K g/per m³.

UCF 206 Bearing

These square flanged ball bearing units are compliant with Japanese Industrial Standards . They consist of an insert bearing, with an extended inner ring and set screw locking, and are suitable for applications where the direction of rotation is constant or alternating.

Rope pulley

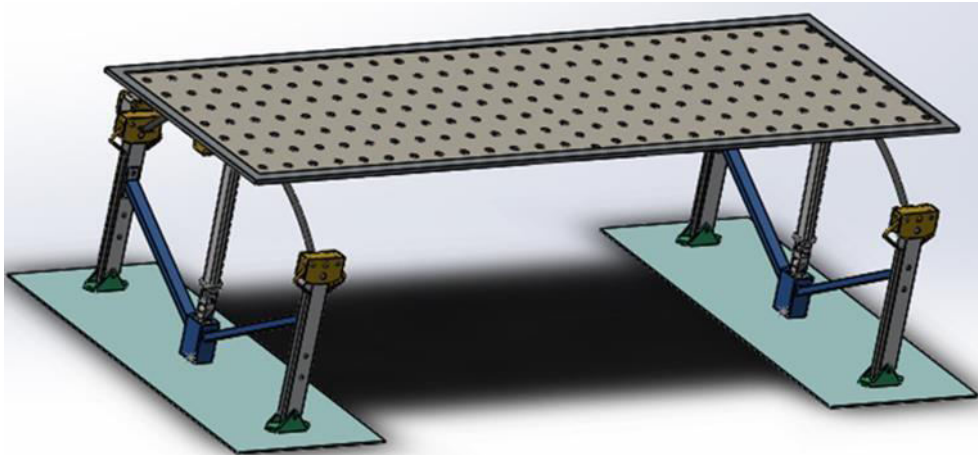
Rope pulleys are made up of a roller and a mounting structure that is attached to the beam on two sides of the side beam and one at the centre frame roller. These pulleys are linked all the way to three pulleys, with the end connected to the motor shaft.

Use encoder for position feedback

The feedback device is a sensor that measures the position, speed, or torque of the rotor and sends signals to a controller that adjusts the current to the stator coils accordingly. A drive line servomotor can offer high precision, efficiency, reliability, and durability compared to other types of motors.

FIRST DEVELOPED DESIGN

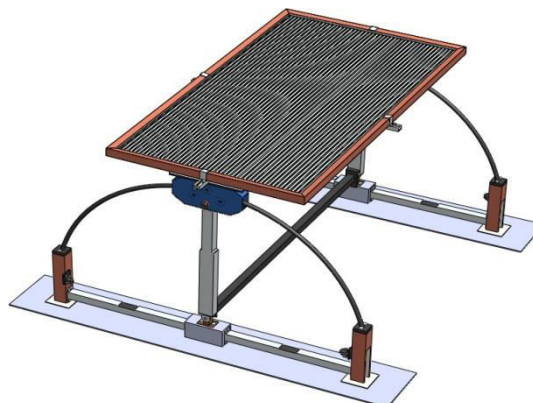
IV. EXPERIMENTAL RESULTS



Dual-axis solar multipurpose solar collector, in this model designed, and thus it was designed for moved in dual axis direction and withstand the heavy pay load carrying function, and it was applied to coastal areas for fish drying and agricultural drying products. We encountered a major issue in this design that caused the tracker to move slowly. The one axis that moves in the direction of north-south has been a major problem in moving; the east-west axis is easily moved according to our managed angle of 120 degrees. At the north-south axis, whose angles are 30 degrees, that didn't move because we attached a solar collector or solar panels to two structures. One was attached to one structure, and the other was attached to a second structure. The problems we identified are as follows: after discussion with the manufacturing expert while attending the internship, the arch that is placed in a north-south direction in either structure is not going to be moved at the given angle, and the object that was placed on top was not moved in an angular manner, but rather in left and right position. So, it was a failure of this design.

Single-Axis Design:

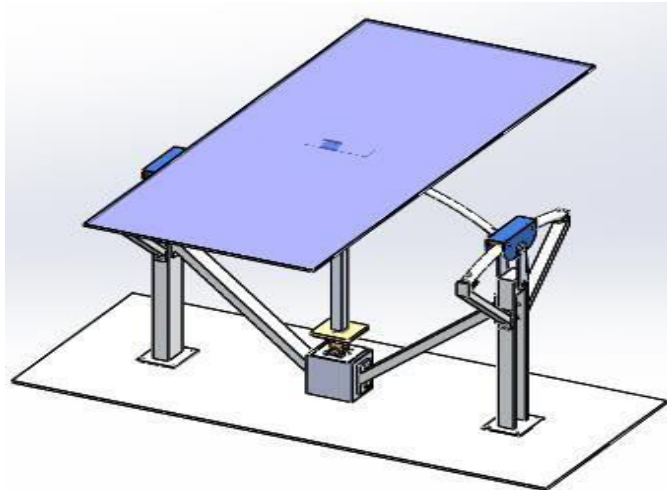
After more discussion with the industrial experts and discussion we finally come up with the design that works flawlessly. We deigned first single-axis movement in east-west direction only its for heavy dryers and collectors, added torsion bar and rope pulley to this new design for maximizes the stability and precise movement of 0.08 degree in every 5 minutes and these precise movement was done by using servo motor which the program need to be given to work accordingly.





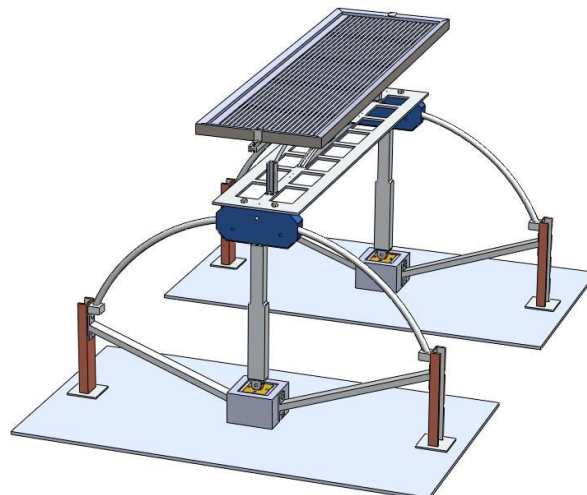
Dual-Axis with one structure design:

So, after identifying the issue in the first design, we used this design model for solar collectors such as PV panels, which were mounted on a single structural design. Because the structure was single and could not withstand heavy loads, it was used for low weight solar collectors, and proper balancing was not possible. Despite the fact that the forces from the payload are transferred to the arch as well as the radial arm and then to the ground.



Dual-Axis 2nd design:

It aids the tracker in moving from the North to the South axis. It was attached to the frames that moved the tracker from east to west. It was designed with one axis from east to west, similar to the previous model, and to move the dryer to another axis from north to south, which was fixed on the top of the one assembly structure and mounted on the frame.





V. CONCLUSION

The proposed tracker is commercially very viable and directly implementable. The social impact is in food production chain. A highly efficient, effective solar dryer system for agriculture produces, sea foods and desalination. It creates a value chain in solar mount part manufacturing and other associated products.

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