Gas-Piston-Driven Solar Panel Tracker

PRESENTED BY:

- Problem Statement ID – SIH1545
- Problem Statement Title – Development of a non-electrical device for tracking the movement of the sun for movement of the solar panels, increasing their efficiency.
- PS Category – Hardware
- Team ID –
- Team Name (Registered on portal)-

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Our idea

Detailed explanation of the proposed solution

The proposed solution is a non-electrical solar tracking system that uses gas pistons to adjust the angle of solar panels throughout the day. This system aims to optimize solar energy collection by keeping the panels oriented towards the sun, enhancing the efficiency of solar power generation without relying on electrical components.

How it addresses the problem.

Efficiency Improvement: By keeping the solar panels aligned with the sun throughout the day, the system significantly improves energy capture compared to fixed-position panels.

No Electrical Components: The system eliminates the need for electrical actuators and sensors, reducing the risk of electrical failures and simplifying maintenance.

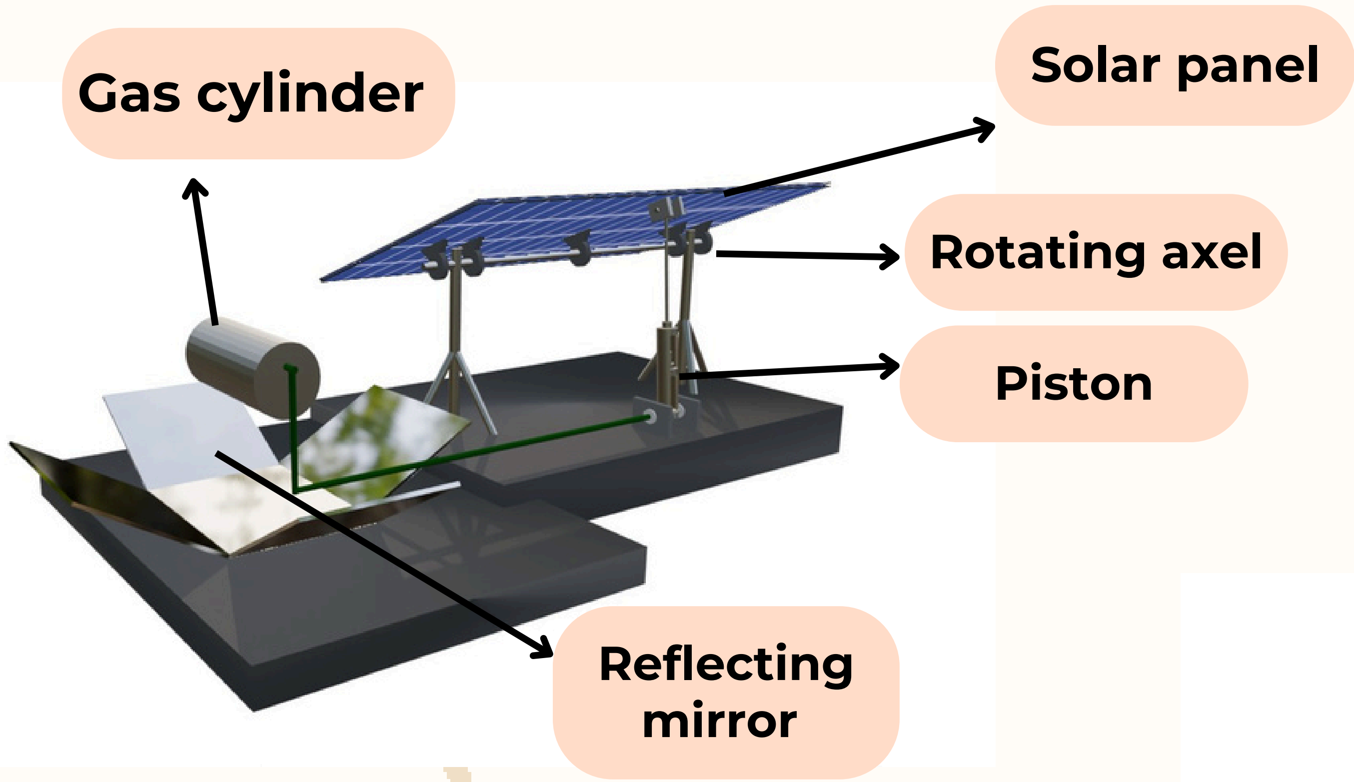
Cost-Effectiveness: Gas pistons are relatively low-cost and require minimal maintenance compared to electrical systems. This makes the system an affordable option for solar tracking.

Innovation and uniqueness of the solution.

Non-Electrical Tracking: The use of gas pistons for tracking solar panels is innovative as it replaces traditional electrical tracking systems with a purely mechanical solution. This approach leverages simple mechanical principles to achieve efficient solar tracking without electricity.

Technical Approach

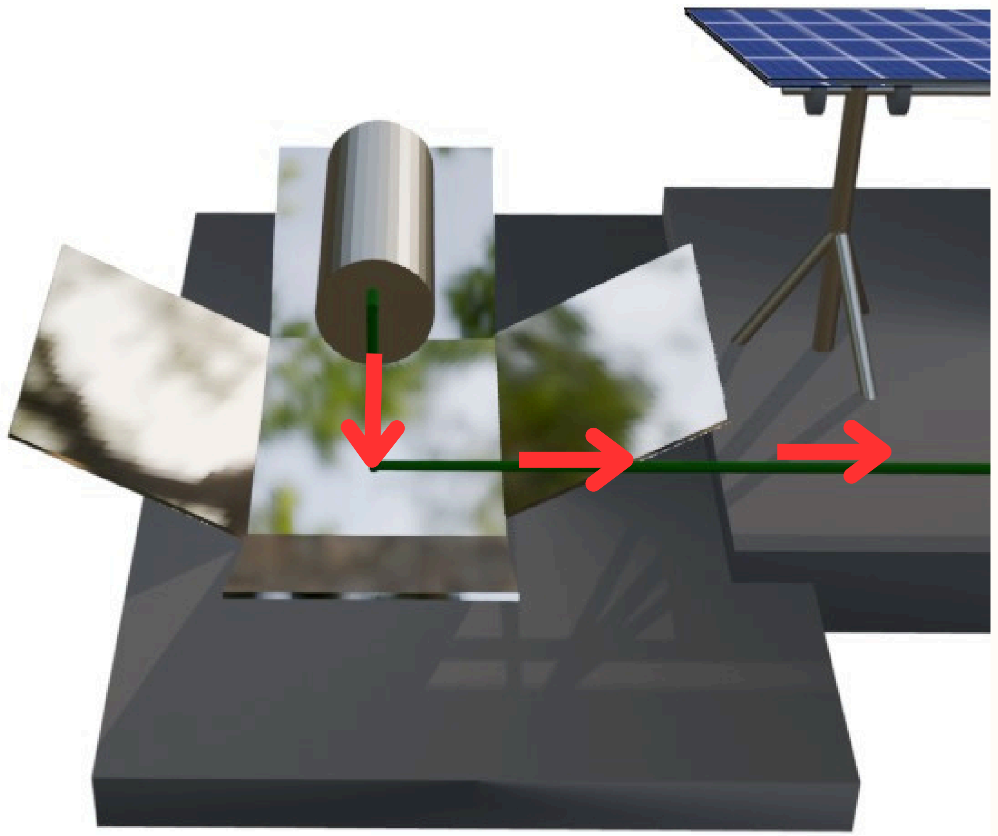
Rationale



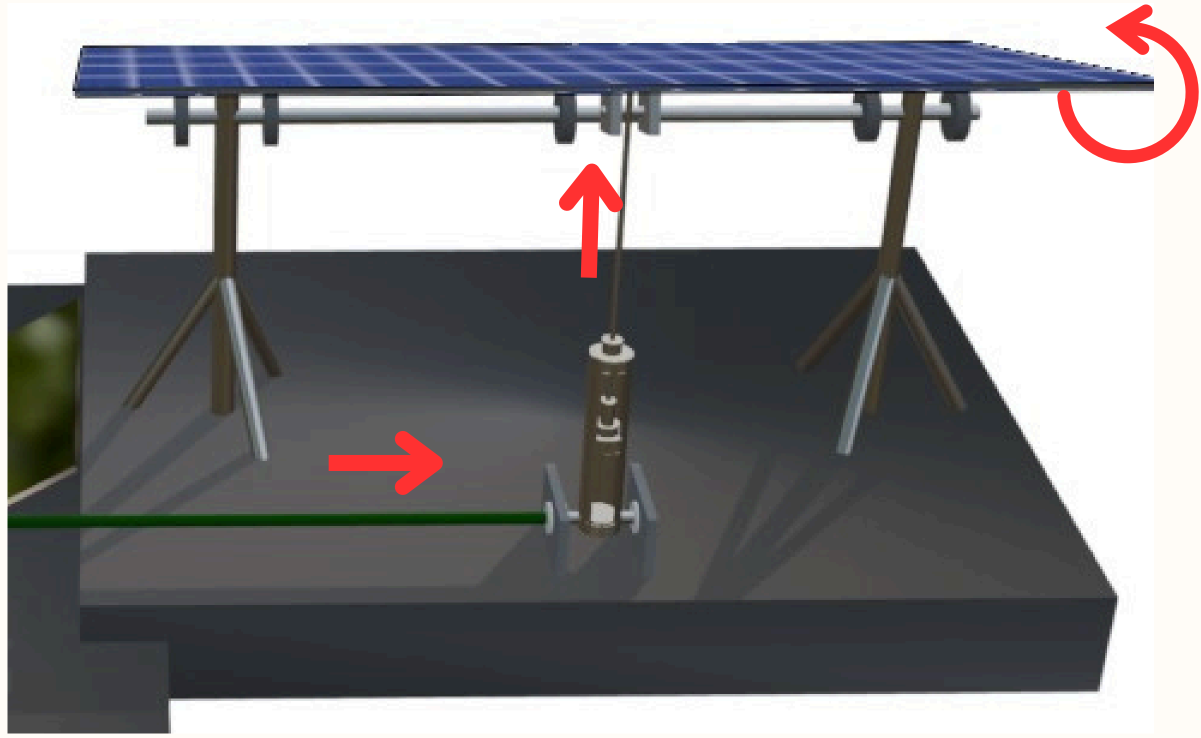
We opted for a heliotropic tracking mechanism instead of a time-based system to enable dynamic, real-time solar alignment, thereby maximizing photovoltaic efficiency and energy yield.

Concept

The system exploits the principles of thermal expansion of a confined gas when subjected to solar irradiation. As the gas absorbs thermal energy, its volumetric expansion increases, leading to a corresponding rise in internal pressure.



Operation



The resultant increase in gas pressure is harnessed to actuate the solar panels' orientation. This pressure-driven mechanism adjusts the azimuth and elevation angles in response to varying solar intensity throughout the day, ensuring optimal incident solar flux and enhanced energy capture.

Feasibility and Viability

01

Analysis of feasibility of Idea

Gas chamber mechanism is commonly used, so it can be implemented easily.

The movement of a piston due to gas expansion and contraction can be accurately modeled.

The model only requires maintaining an adequate gas level in the tank, allowing for low-maintenance operation to achieve a feasible system.

02

Potential Challenges and Risk

Helium cylinders could potentially explode under extreme temperature and pressure conditions.

Continued exposure to environmental conditions may degrade system lifespan.

The well-established presence of existing electrical solar tracking systems in the market poses a challenge for this new model.

03

Strategies for overcoming Challenges

Equip cylinders with pressure relief valves to safely release helium if internal pressure rises due to high temperatures.

Protective Coatings: Apply UV-resistant and anti-corrosion coatings to shield components from environmental damage.

Initial support through subsidies can help establish the model in the market, especially given its efficiency and cost-effectiveness.

Impact and Benefits

Potential impact on target audience

The model requires only installation costs and minimal maintenance fees, reducing indirect recurring expenses like electricity bills associated with the old system.

Social

Adopting this renewable solar model fosters learning and innovation in renewable energy, thereby promoting a culture of sustainability.

Economical

The overall cost of this model is lower than that of conventional electrical solar systems, making it a more cost-effective alternative to existing models.

Environmental

Non usage of electricity lessens the demand for coal consumption, making the model more environmentally friendly.

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Research Work

Considering the premium you pay for the advanced equipment and the extra costs of the installation materials, the total upfront investment of sun-tracking solar panels can add up very quickly. Often for homeowners, these expenses exceed the financial benefits of having more efficient solar power generation onsite.

The battery system you employ might need to have 10 to 20 times that amount of current stored as Charge -- rated in mAh or Ah.

You gave a 200 mA-6V number, lets say that's the *average* current per hour.

A battery Capacity of 10-20 times that amount may be enough for what you have in mind for run-time -- lets say 2000 mAh (10x discharge rate).

- 2000 mAh / 200 mA = 10h (10 hours) but you need to expect *less* (say 50% to be conservative).

So -- now you have a 2000 mAh store of Charge. And you're drawing current at 200 mA average per hour rate. You might expect 5-6 hours of operation (according to the math).

But what about *charging* the battery system. *I hate to tell you*, but batteries have charge efficiency problems that are pretty wasteful. It may take 2500 mAh of charging to fill your 2000 mAh battery back up with Charge. The Mfg. will tell you what limit in charge current is allowed. That affects how long it takes to recharge. You might only be able to charge at a 500 mA rate to get the full 2500 mAh charge completed!

So you can calculate your actual (average) current *use* in mA or Amps per hour. Then calculate your *run-time* against the Charge Capacity of the battery (specified as mAh or Ah). The actual run-time is likely *less* than the math indicates due to battery characteristics. And you should know how much *efficiency loss* you incur to recharge the batteries (by whatever means).

The servo motor will have the following specifications:

- Operating Voltage: 4.8V – 6V
- Free-run current 6V: 200mA
- Stall current 6V 600mA
- Speed (4.8V): 110RPM
- Speed (6V): 130RPM
- Stall torque (4.8V): 18oz-in / 1.3 kg-cm
- Stall torque (6V): 21oz-in / 1.51 kg-cm