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TITLE PAGE

- **Problem Statement ID – SIH1545**
- **Problem Statement -** Development of a non-electrical device for tracking the movement of the sun for movement of the solar panels, increasing their efficiency.
- **Theme-** Renewable / Sustainable Energy
- **PS Category-** Hardware
- **Team ID- 25370**
- **Team Name - SPECTRE_**

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MECHANICAL SOLAR TRACKING DEVICE (MSTD)

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PROPOSED SOLUTION

Step 1

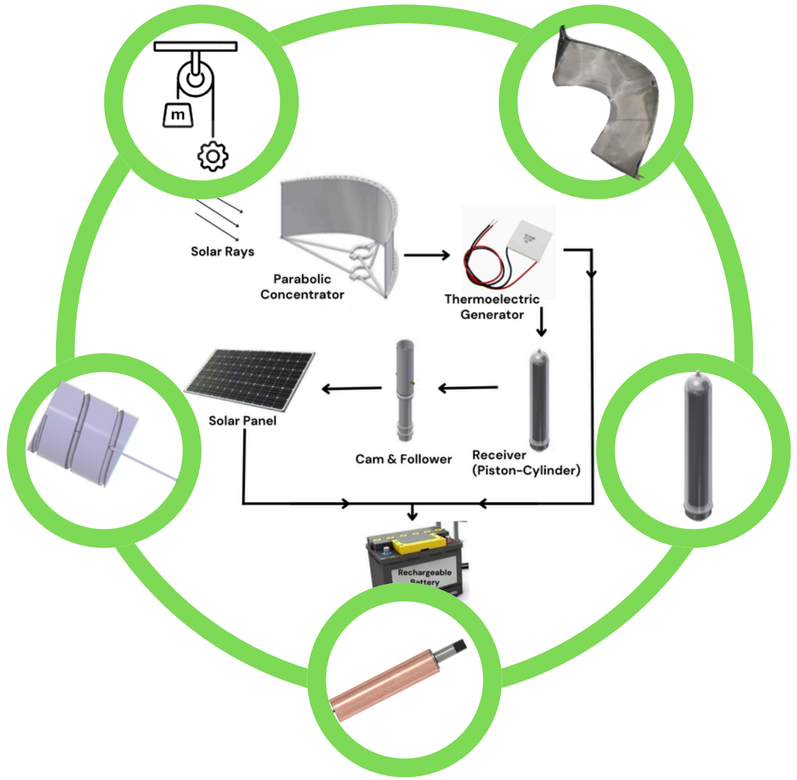
Our solution MSTD uses the principle of thermal expansion for actuation to rotate device for tracking sun's movement and thermoelectric generator (TEG) for generating electricity which will be used to rotate device when sun gets covered by clouds.

Step 2

Thermal actuation is generated by a concentrating solar radiation with a parabolic heliostat and a solar receiver.

Step 3

We use Paraffin Wax (PCM) that expands when heated, causing the piston in the receiver to move outward.



Step 4

Our Cam tube with helical slot and follower converts linear motion into rotational motion, rotating the parabolic concentrator and solar panel for tracking towards east to west.

Step 5

At day's end, the wax shrinks, retracting the piston, and gravity, assisted by a pulley system, returns the setup to face east.

UNIQUENESS AND INNOVATION

- Our device is suitable for **both off-grid and compact locations**.
- Uses the heat from the **thermoelectric generator(TEG)** to drive mechanical actuator (when the sun gets covered by the clouds).
- It **installs easily** on its own or with existing solar panel systems to boost **efficiency up to 22%.**
- It can rotate **multiple solar panels** using a **Parabolic Heliostat** with a ground-mounted cable drive.
- **Heat Powered clockwork mechanism** will be done with the help of TEG to **increase accuracy.**

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TECHNICAL APPROACH

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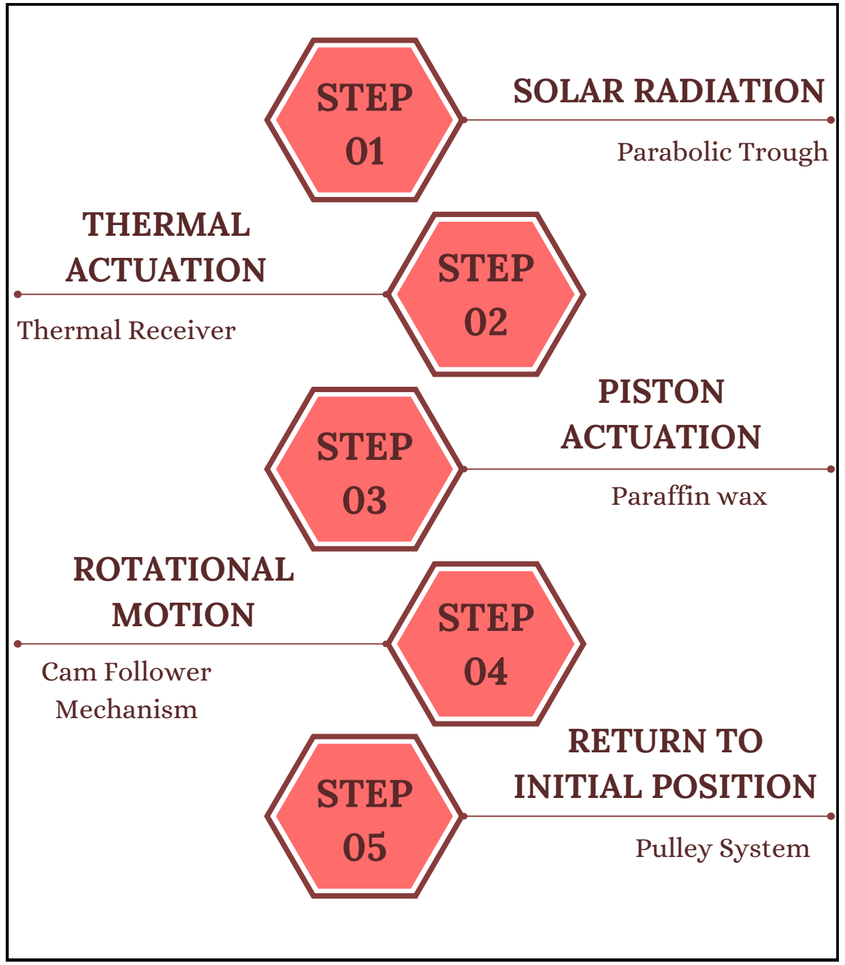

Methodology and process for implement

- **Solar Radiation Concentration:** Parabolic trough focuses sunlight onto the receiver for tracking.
- **Thermal Actuation:** Solar energy heats paraffin wax, expanding it and generating pressure.
- **Piston Actuation:** Hydraulic pressure moves a piston, engaging a cam tube with helical slot and follower.
- **Rotational Motion:** Linear piston movement turns the system, tracking the sun.
- **Return to Initial Position:** Gravity and pulleys with weight reset the system after the sun sets.
- **Seebeck Effect:** Thermoelectric generator utilizes it to generate voltage which drives electrical current and produces useful power.

Hardware Components


parabolic trough


solar receiver


Thermoelectric generator


pulley


paraffin wax


piston cylinder arrangement


pulley wire


Solar panel


weight

FEASIBILITY AND VIABILITY

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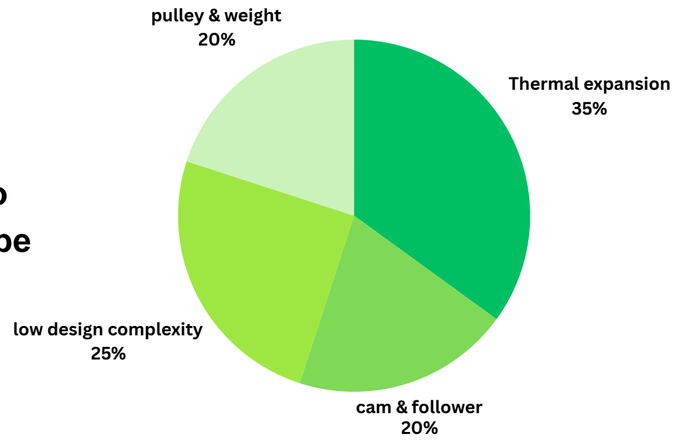
Analysis of the feasibility of the idea

Criterion	MSTD-our prototype (thermal expansion)	Electrical Solar Tracker	mechanical solar tracker (Gear train)
Design complexity	LOW	MEDIUM	HIGH
Cost effectiveness	LOW	HIGH	MEDIUM
Scalability	HIGH	HIGH	LOW
Maintenance	LOW	HIGH	MEDIUM

Factors contributing to feasibility of our prototype



Potential Challenges and Risk

- **Thermal Actuation:** PCM effectiveness can be limited in extreme temperatures, impacting performance.
- **Environmental Factors:** Wind, cloud cover, and weather changes may disrupt tracking accuracy.
- **Cost & Scalability:** Scaling the system for larger installations may increase costs and require more structural support.

Strategies for overcoming these challenges

- **PCM Optimization**: Select PCMs suited to local climate (e.g., higher melting points in hot climates).
- **Environmental Resilience**: Uses Thermoelectric generator(TEG) to generate electricity using stored heat in the Paraffin Wax.
- **Scalability**: Link multiple panels to a single tracker for cost-effective scaling.

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IMPACT AND BENEFITS

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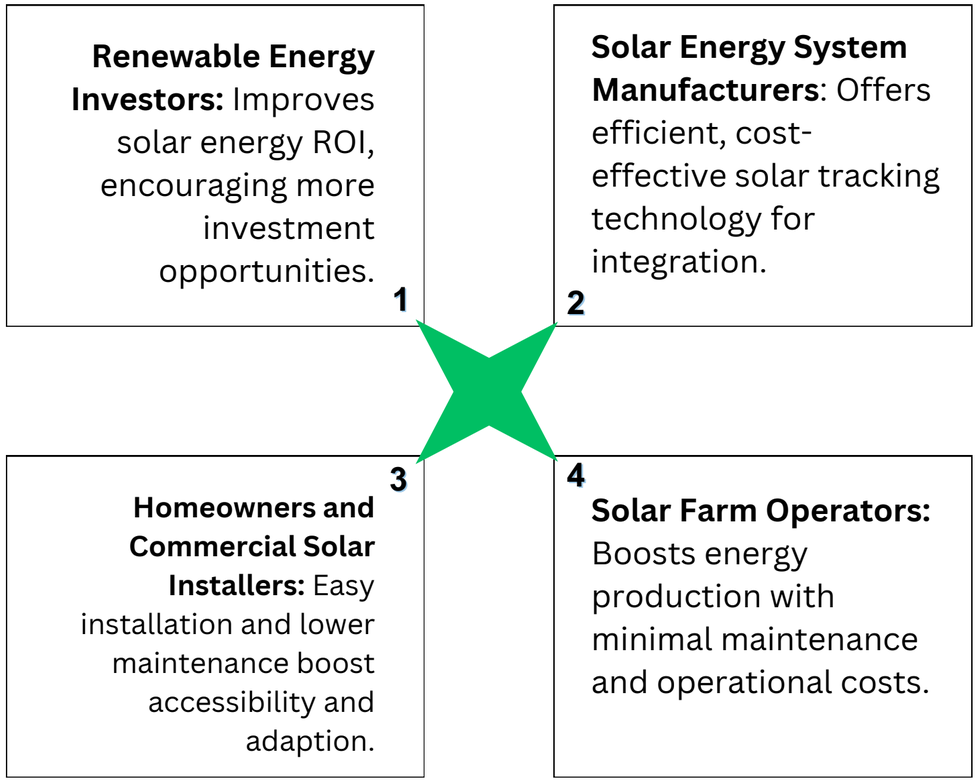
Potential impact on the target audience



Benefits of the solution

1

SOCIAL:

- Sustainable Future
- Awareness about use of Renewable Energy
- Deploy to off grid location

2

ECONOMIC:

- Low installation & maintenance cost
- Enhanced system reliability
- Installable to existing steady panels

3

ENVIRONMENTAL:

- Reduced Pollution
- No green house effect
- No contribution in climate change

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RESEARCH AND REFERENCES

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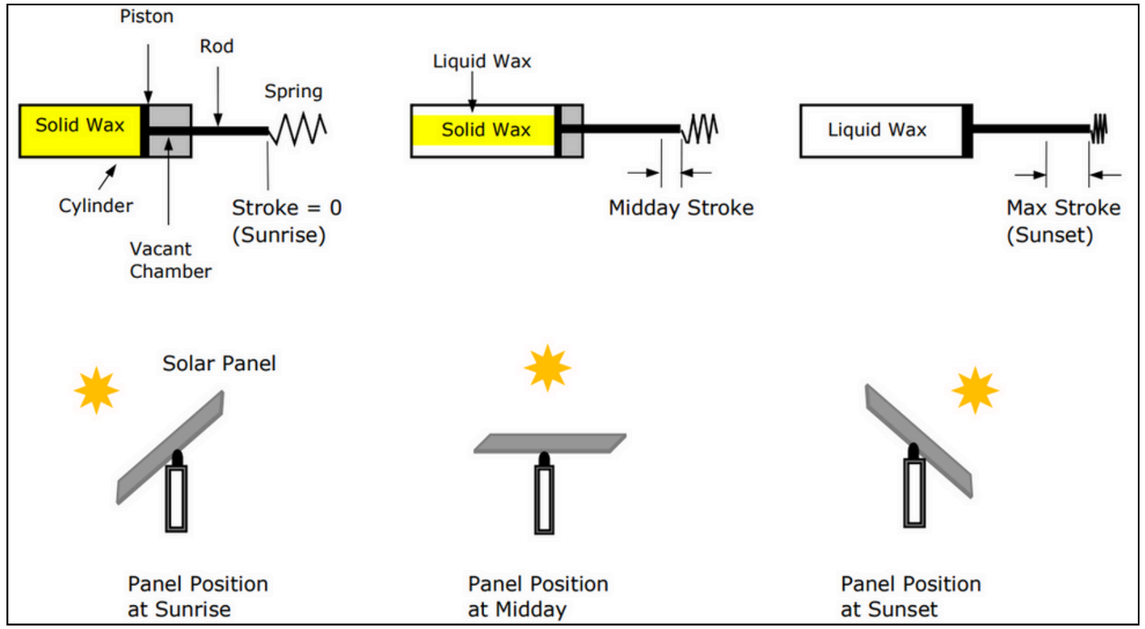
CAD Model Links

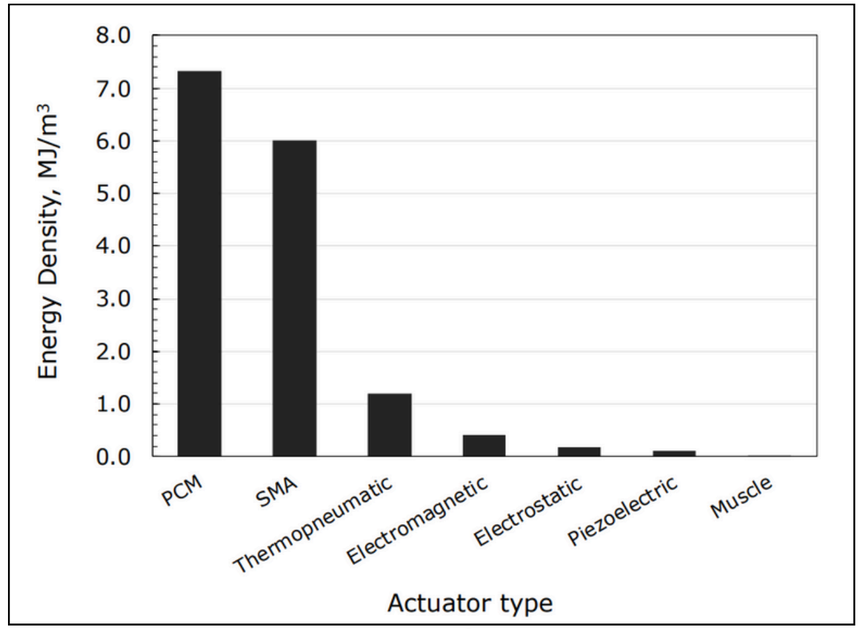
- Piston
- Piston & Cylinder
- Follower
- Cam & Follower
- Our Prototype (MSTD)

Research Paper

- Reference 1
- Reference 2
- Reference 3

From Reference 1





From Reference 1