Automated Solar Panel Tracker for Energy Efficiency

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RELIABLE SOLAR TRACKING FOR REMOTE, MOBILE, OR OFF-GRID INSTALLATIONS

GROUP 15

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01. Introduction

Fixed solar panels in off-grid setups often underperform due to static orientation, losing **up to 40%** or more of potential energy compared to sun-tracking systems.

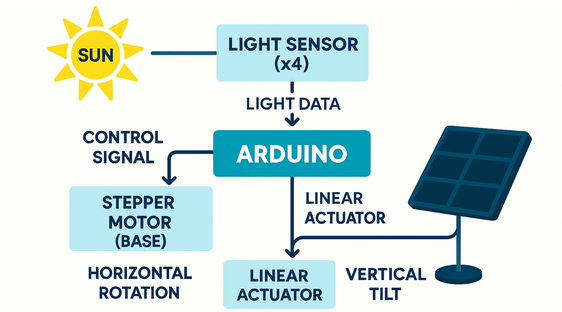
Our goal: design a dual-axis solar tracker that automatically aligns with the sun, increasing energy output using simple, affordable components.

02. Objective

- Increase solar panel efficiency in remote or mobile installation
- Use low-cost components and open-source control
- Design for compactness and off-grid independence
- Enable autonomous operation with no internet dependency

03. Methodology

- Rotation system: Stepper motor for horizontal movement
- Inclination system: Linear actuator for vertical tilt
- Sensors: Photoresistor array detects sunlight direction
- Control: Arduino R3 processes input and controls motion
- Power: 12V standalone setup (solar or battery)
- System includes 4 light sensors, 1 Arduino, 1 linear actuator, and 1 stepper motor

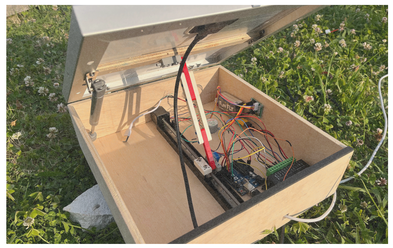


Control logic: sunlight is detected by photoresistors, processed by the Arduino, which then activates the motors to align panel.

04. Key Findings

- **Estimated +25–45 % more energy captured** compared to static panels
- Prototype passed continuous-tracking bench test
- Compatible with 12 V standalone systems (solar or battery)
- Real-world tests show promising performance during periods of low solar elevation

Final prototype: solar panel mounted for outdoor positioning tests



Control box: linear actuator, stepper motor and Arduino electronics

05. Analysis

Who benefits?
Remote households, agricultural sites, rural schools; Vanlife or camping setups

System	Cost	Automation	Portability
Fixed panel	Low	✗	✓
Comercial Tracker	High	✓	✗
Our Prototype	Medium-Low	✓	✓

Tests show promising results during critical hours when the sun is lower. These results contribute to the system's expected daily efficiency.

Time	Orientation	Sun's Angle	Voltage[V]	Current[A]	Power[W]	Gain[W]	Gain[%]
18:30	Horizontal	25°	6,84	0,35	2,394	--	--
18:30	Tilted	25°	14,15	0,66	9,339	6,945	290
19:30	Horizontal	16°	3,15	0,05	0,1575	--	--
19:30	Tilted	16°	8,99	0,33	2,9667	2,8092	1784

06. Conclusion

Our prototype captures significantly more energy than static panels using a dual-axis tracking system.
Next steps:

- Outdoor testing
- Auto-calibration tuning
- Compact sensor redesign

Estimated prototype cost: ~140€

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