TEAM 022

Solar Panels with Optimized Tilting Mechanism

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ICS EE 3 ME

Problem statement

- Solar panels in remote areas often experience significant efficiency loss due to dust accumulation and suboptimal alignment with the sun, leading to reduced energy output and increased maintenance challenges.

Objectives

- **Efficiency Optimization**: Automatically adjusts the panel angle to follow the sun and maximize energy output.
- **Automated Cleaning** :Uses wind and backup water spray to remove dust and reduce manual maintenance.

Project Impact

- **Economic Impact:** Lowers maintenance costs and boosts energy output.
- **Societal Impact** : Expands clean energy access and reduces manual labor.
- **Environmental Impact:** Conserves water, eliminates chemical use, and reduces carbon emissions through improved solar efficiency.

Constraints

- - Single-panel compatible
- - Stable tilting and lifting
- - Weather-resistant components
- - Accurate sensor readings
- - Net positive energy efficiency
- - Fast real-time data processing

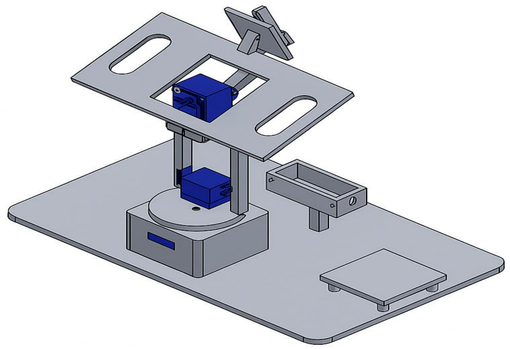
Specifications

- **Mechanical System:**
  - Dual-axis control with 2 motors (X & Y)
  - 180° rotation on both axes
- **Sensing & Data Collection:**
  - 4 LDR sensors for sunlight detection
  - Wind sensor detects direction (0–30 m/s)
- **Control & Interface:**
  - Real-time dashboard shows status, tilt angle, sunlight, and cleaning activity

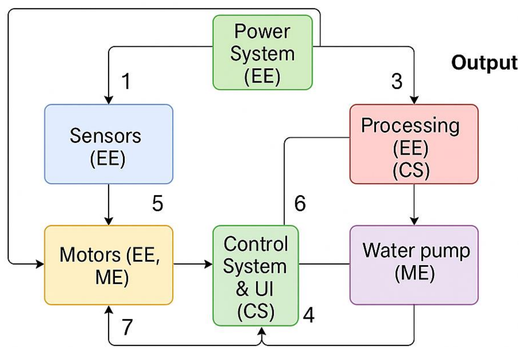
Design Prototype

- The prototype consists of a physical device with an automated tilting and cleaning system, along with a user interface that provides real-time monitoring and control of the solar panel's performance.

CAD DESIGN



Multidisciplinary Prototype



Testing / Validation

1. Motion and Structural Performance:
-Dual-Axis Movement: Servo motors achieved 180° rotation on both axes for sun tracking.
-Cleaning Mechanism Stability: Pump and nozzle functioned reliably without leaks
2. Sensor and Power Functionality:
-Environmental Sensor Accuracy: LDR and wind sensors gave consistent and accurate readings.
-Power Delivery and Efficiency: System operated smoothly using 7.4V and 12V batteries.
3. Control Logic and Monitoring:
-Automated Cleaning Logic: Cleaning method adjusted based on sensor data.
-Live System Interface: Dashboard displayed real-time status and sensor values.

Conclusion

- The prototype proved efficient, durable, and cost-effective, confirming its viability for enhancing solar panel performance in harsh environments.