AI-Smart Sun Tracker

Boosting Mini Solar Panel Output with Machine Learning

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Project Title : **AI-Smart Sun Tracker Boosting Mini Solar panel output with Machine Learning**

Participant Name : **J.ANIRUDH SAI**

School : **Sana Model School**

City & State : **Chennai, Tamil Nadu**

INTRODUCTION

This project combines renewable energy and artificial intelligence. Solar panels generate less energy when fixed at one tilt angle, since sunlight direction and sky conditions vary. An intelligent AI-driven solar tracker can maximize energy production by adjusting the tilt dynamically.

"The future is green energy, sustainability, renewable energy."

– Arnold Schwarzenegger

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2. AIM & HYPOTHESIS

Aim:
To design and test a low-cost AI system that predicts and sets the optimal tilt angle of a mini solar panel in real time to maximize electrical output.

Hypothesis:
An AI model trained on local sensor data can outperform fixed panels and match or exceed a naive sun-tracking approach, especially under cloudy conditions.

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3. BACKGROUND INFORMATION

Traditional trackers rely only on solar geometry, which works best under clear skies. However, real-world conditions such as clouds and diffuse light often reduce their efficiency. By using AI trained on real sensor data, the system can adapt to changing conditions in real time.

"AI is not just about machines thinking – it's about machines helping humans think better."

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4. METHODS

Hardware Components:

- Mini solar panel (5–10 W)
- Servo or geared motor
- Raspberry Pi
- Voltage/Current sensor (INA219)
- Light and temperature sensors
- Optional webcam
- Wooden or 3D printed frame

Data Collection Procedure:

Perform angle sweeps [0°, 15°, 30°, 45°, 60°, 75°] every 10 minutes from sunrise to sunset. Record voltage, current, power, light intensity, temperature, and optional cloudiness proxy. Repeat for multiple days across sunny and cloudy weather.

AI Model Training:

Use features (hour, light intensity, temperature, cloudiness) to predict the best tilt angle. Models include Decision Tree, Random Forest, or small neural network. Use train/test split of 80/20. Evaluate performance by accuracy or RMSE.

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5. SAMPLE DATA & EXPECTED RESULTS

Day	**Strategy**	**Total Energy (Wh)**	**Avg Power (W)**	**% Gain vs Fixed**
15-Sep-25	Fixed			
15-Sep-25	Naive			
15-Sep-25	AI			

Data Interpretation and Analysis to be done after Experiment

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6. ANALYSIS & METRICS

- Primary metric: Total daily energy (Wh)
- Percent gain compared to Fixed or Naive strategies
- Prediction accuracy for classification models
- RMSE for regression models
- Simulation of energy benefit based on predicted angles

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7. SAFETY PRECAUTIONS

- Work outdoors with adequate sun protection
- Use low-voltage DC circuits only
- Use fuse protection and secure frame
- Keep fingers clear of motors and moving parts

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8. DISCUSSION AND CONCLUSION

The AI-Smart Sun Tracker demonstrates how machine learning can optimize renewable energy capture in real time. By integrating low-cost hardware and AI, it improves efficiency and shows how sustainability and technology can combine effectively.
***"The best way to predict the future is to create it."* – Peter Drucker**

09. FUTURE SCOPE

- Household solar panel kits
- Classroom and educational demos
- Larger photovoltaic systems
- Sustainable community energy projects

10.BIBLIOGRAPHY

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