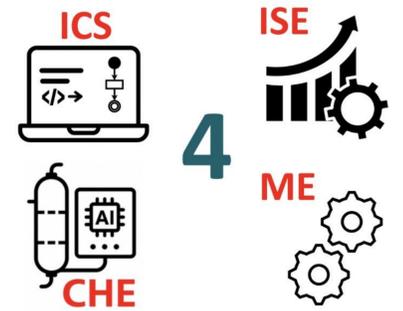


Autonomous RC Car for Solar Panel Cleaning with Piezoelectric Technology and Hydrogen Fuel Cell

Waleed Albalawi, Mohammed Aldakhil, Faris Altheyab, Fahad Alaqeel, Abdullah Alharbi
Coach: Dr. Ali Elkharzajai



Introduction

Problem Statement

Dust accumulation on solar can reduce energy output by up to 40%. Traditional water-based cleaning is unsustainable and labor-intensive.

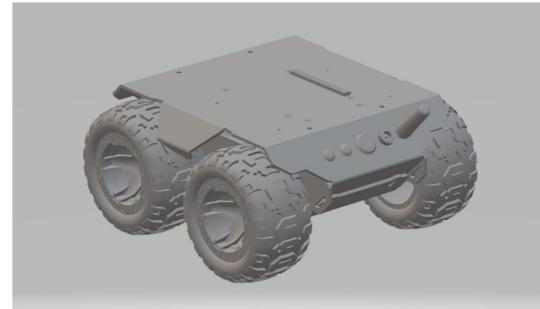
Solution

Develop a water-free, autonomous cleaning solution using a hydrogen fuel cell-powered RC car with piezoelectric actuators for efficient dust removal.

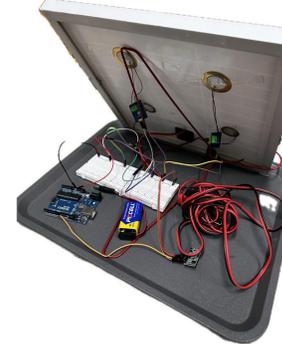
Prototype Design

The prototype is an autonomous RC car that uses AI vision and sensors for navigation and activates piezoelectric actuators to clean dusty solar panels without water. Powered by a hydrogen fuel cell charging station, it operates for over 3.5 hours and recharges in 42 minutes. The 9.6 kg design ensures efficient power usage rate.

RC Car Chasie



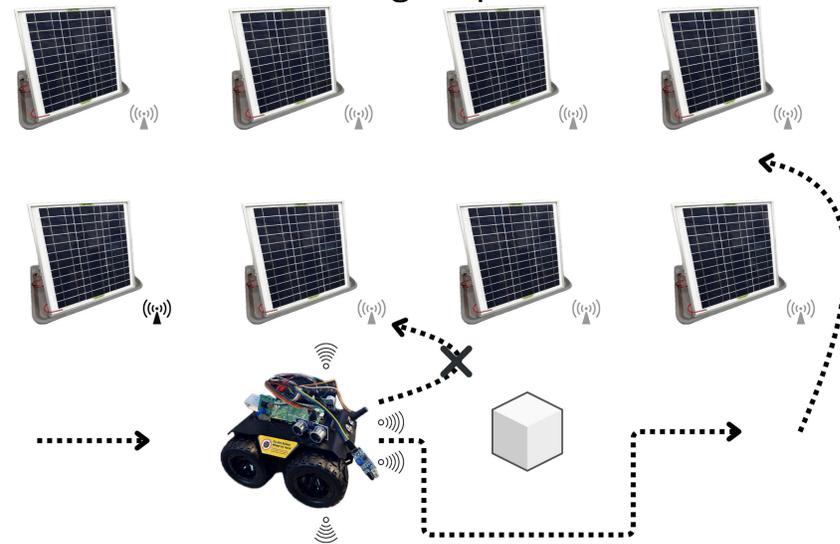
Cleaning Unit



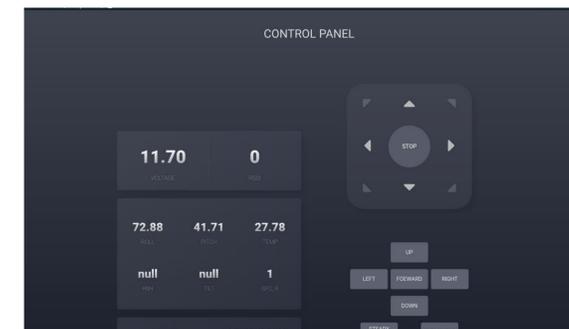
Recharging Station



Autonomous Cleaning Sequence



Manual Control Panel



T&V and conclusion

Testing & Validation

- **Cleaning Efficiency Test:** Achieved 87% dust removal within 8 minutes per panel
- **Navigation Accuracy Test:** ± 4.7 mm deviation on test layout
- **Endurance Test:** Operated for 3.5 hours continuously
- **Weight:** Final weight = 9.6 kg (within constraints)
- **Charging:** Refueling time ~ 42 minutes
- **Power Use:** ~ 22.3 W average under load

Conclusion

- Successfully delivered a waterless, autonomous solar panel cleaner
- Integrated cross-disciplinary systems for energy, navigation, and cleaning
- Met key KPIs (efficiency, endurance, safety, budget)
- Validated in controlled testing conditions

Constraints

Specification

Total project cost must not exceed 4,875 SR	Charging Time: 30–45 minutes
RC car weight must not exceed 10.3	Dust Removal Efficiency: 85–90%
Car must clean 90% of dust within 5 min/m	Computer Model Response Time (RT): < 1 s
Fuel cell must operate for at least 2 hours continuously	Vehicle positioning accuracy within ± 5 mm