

Intelligent Cleaning and Maintenance of Photovoltaic Panels

Can AI-integrated robotic systems improve solar panel performance?

This study proposes an AI-integrated autonomous robotic system combining real-time monitoring, predictive analytics, and intelligent cleaning for enhanced solar panel performance.

What is a robotic system used for cleaning solar panels?

Robot systems have been more commonly used for cleaning solar panels because they are efficient, scalable, and can be automated. Brush-based, water jet-based, and actuator-based robotic systems are generally deployed on land [21,22].

Can a solar-panel cleaning system be automated?

On the other hand, the automated solar-panel cleaning system proposed here also includes a robot equipped with an integrated water tank system capable of storing and distributing water in a controlled manner.

Can AI and IoT improve solar PV maintenance?

Integration of AI and IoT technologies into solar PV maintenance systems has several advantages over traditional methods. IoT-based systems collect real-time performance and environmental data, enabling proactive maintenance and optimizing resource allocation [35,36].

Abstract. The efficiency of solar panels depends on both photovoltaic technology and operating conditions, including cell structure, material properties, and system design. Monocrystalline ...

Photovoltaic (PV) systems play a pivotal role in the transition to renewable energy worldwide, yet their long-term performance and cost-effectiveness critically depend on robust ...

When large-scale photovoltaic power generation is put into use, it is necessary to consider how to keep photovoltaic panels as high as possible. However, the efficiency of photovoltaic panels ...

An Internet of Things-Based Photovoltaic Cleaning Robot Powered by Solar Panels | Proceedings of the 2025 4th International Conference on Intelligent Systems, Communications and ...

Solar photovoltaic (PV) systems, especially in dusty and high-temperature regions, suffer performance degradation due to dust accumulation, surface heating, and delayed maintenance. This ...

However, it is necessary to realize the unattended periodic cleaning, intelligent dust removal and snow removal of photovoltaic modules through low cost and high reliability, and improve the efficiency of ...

This paper presents a novel automated drone system designed for the efficient cleaning of solar panels. The drone, equipped with three rotors and advanced detection sensors, ...

Developed from prior research, this paper presents a comprehensive study on the effectiveness of the PV

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Nexus Cleaning Recommendation System (PNCRS), an intelligent cleaning ...

This research presents a robust and scalable AI-integrated autonomous robotic framework designed for real-time predictive maintenance and adaptive cleaning of solar photovoltaic (PV) panels.

A PID type control system also was tested where cleaning would go automatic when power loss was over 15%. This intelligent design led to an avoidance of redundant maintenance at ...

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