

Smart Solar-Powered Air Purifier System for Roadside Pollution Control

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Abstract: Rapid urbanization and the increasing number of vehicles on roads have led to severe air pollution, posing serious threats to human health and the environment. This research presents the design and development of a Smart Solar-Powered Air Purifier System aimed at mitigating roadside air pollution in a sustainable and cost-effective manner. The system operates using renewable solar energy, eliminating dependency on conventional power sources and enabling continuous operation in outdoor environments. It integrates high-efficiency HEPA and activated carbon filters for particulate and gaseous pollutant removal, combined with IoT-based air quality monitoring sensors to measure key parameters such as $PM_{2.5}$, PM_{10} , CO_2 , CO , and NO_2 levels in real time. The collected data is transmitted to a cloud platform for analysis and visualization, allowing for dynamic control of fan speed and filter operation based on pollution intensity. The proposed system demonstrates an innovative approach to green technology, combining clean energy utilization with smart automation. Experimental results indicate a significant reduction in pollutant concentration near roadside test areas, proving its potential for scalable deployment in urban and industrial regions. This project highlights the role of smart, solar-powered purification systems in promoting sustainable urban air quality management.

Keywords: Solar energy, Air pollution, $PM_{2.5}$ PM_{10} , Renewable energy, Sustainable Development, Air Purifier

