Urban Fresh: A Smart Solar-Powered Air Purification System With Multi-Stage Filtration in Urban Areas

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According to the World Health Organization (WHO), air pollution is responsible for around 7 million premature deaths each year. It remains a major risk to human health, especially in urban areas where traffic and industrial activity are intense. This project focused on the everyday problem of polluted air in cities, mostly from traffic emissions. The goal was to design a compact, solar-powered system that could detect when the air was unsafe to breathe and clean it automatically. An MQ-135 sensor was used to monitor air quality throughout the day. When pollution levels rose above a set threshold, small fans were activated to pull in the surrounding air. The air passed through a filtration system. Although the final design included HEPA, electrostatic, and activated carbon filters, initial testing in the prototype phase was conducted with the activated carbon filter only. Before being released, the air was exposed to UV-C light to help neutralize airborne germs. The whole system was powered by solar energy, with excess power stored in a rechargeable battery. An LCD screen displayed real-time air quality data. During testing, the device responded appropriately when pollution increased. The code functioned as expected, and power transfer from the solar panels to the battery was successful. The system activated automatically when air quality dropped below safe levels. Urban Fresh demonstrated that a solar-powered setup could contribute to improving urban air. Unlike many existing systems, Urban Fresh is compact, runs automatically, and fits into buildings without needing extra space or frequent maintenance—making it a smart choice for busy city environments. Its real-world applicability makes it a practical and sustainable solution for urban pollution control.

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