

TUNING SMOG INTO CLEAN AIR

STUDENTS

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GUIDE

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ABSTRACT:

Urban air pollution, particularly smog, poses severe environmental and health risks. To combat this, innovative technologies are being developed to actively convert smog into clean air. This paper explores a prototype system that integrates **photocatalytic materials**, **advanced filtration**, and **carbon capture technologies** to break down harmful pollutants. Using **titanium dioxide and UV light**, the system facilitates chemical reactions that neutralize nitrogen oxides (NO_x) and sulfur oxides. Additionally, **biofiltration methods and negative ion generators** further purify the air before release. The system is designed to be powered by **renewable energy sources** and can be deployed in high-smog urban areas. By leveraging these sustainable technologies, this approach offers a scalable and effective solution for improving air quality and reducing environmental pollution.

1.INTRODUCTION

Smog is a major air pollution problem in cities, caused by pollutants like vehicle exhaust, industrial emissions, and dust. Breathing in smog can lead to serious health issues such as asthma and lung diseases. Scientists and engineers are developing new ways to clean the air and reduce pollution.

One effective method is **photocatalysis**, which uses special materials like **titanium dioxide (TiO₂)**. When exposed to sunlight, these materials trigger chemical reactions that break down harmful gases like **nitrogen oxides (NO_x) and volatile organic compounds (VOCs)**, turning them into harmless substances [62].

Another approach is **biofiltration**, where tiny microbes (bacteria) are used in filters to absorb and break down pollutants naturally. This method is already used for cleaning water and can also help purify the air [63].

By combining these technologies, scientists hope to create **self-cleaning surfaces, air purification towers, and eco-friendly city designs** that can actively fight pollution and make the air healthier to breathe.

2.RELATED WORK

Two of the most effective methods studied are **photocatalysis** and **biofiltration**, both of which help remove harmful pollutants from the air. These methods are gaining attention for their potential to create cleaner urban environments.

Another promising approach is **biofiltration**, which relies on natural **microorganisms (bacteria and fungi)** to absorb and break down air pollutants. This method has been successfully used in **wastewater treatment** and is now being studied for air purification. Biofilters work by passing polluted air through a **filter medium** (such as activated carbon or sand) that hosts these microbes. The bacteria **consume harmful gases and**

convert them into less toxic substances before releasing clean air. Research is ongoing to make biofilters more efficient and cost-effective for large-scale urban applications.

biofiltration could lead to innovative solutions for smog control. Future developments may include **smart air purification systems** that use sensors to monitor air quality and adjust purification processes accordingly. Researchers are also exploring **hybrid systems** that integrate both methods to maximize pollutant removal while remaining energy-efficient. These technologies offer promising ways to improve air quality in cities and protect public health.

3.PROPOSED APPROACH

The proposed approach focuses on **filtration-based air purification** to effectively remove pollutants from the air. This system combines **HEPA filtration, activated carbon filtration, and biofiltration** for comprehensive air cleaning. **HEPA filters** capture fine particulate matter (PM_{2.5} and PM₁₀) that contribute to smog, while **activated carbon filters** absorb harmful gases like nitrogen oxides (NO_x) and volatile organic compounds (VOCs). Additionally, **biofiltration** uses natural microorganisms to break down pollutants into harmless byproducts. To improve efficiency, **smart sensors** will monitor air quality, detect pollution levels, and optimize filtration performance in real time. This combined filtration approach ensures **cleaner air, reduced health risks, and a sustainable solution for urban environments.**

3.layout diagram

This system is designed to monitor air quality using an MQ-135 gas sensor and take necessary actions to purify the air if pollution levels exceed a certain threshold. The core of the system is an Arduino microcontroller, which processes sensor data and controls other components such as a DC fan, filter, and LCD display.

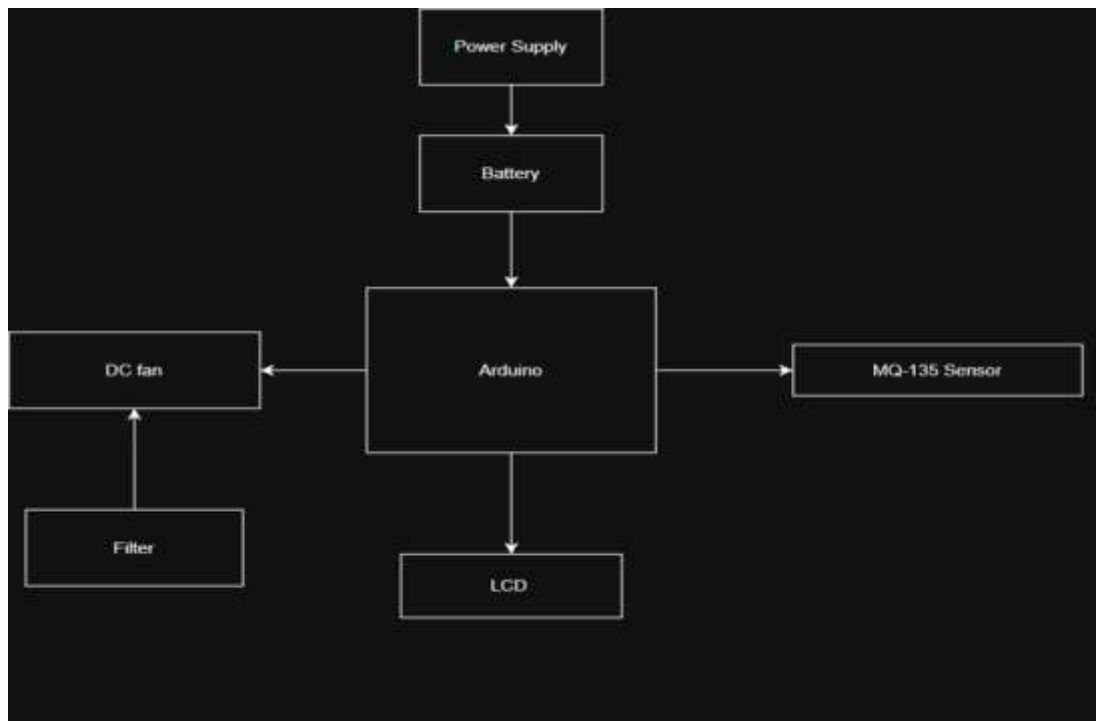
The power supply provides electrical energy to the system, ensuring continuous operation. A battery is also included to store energy and supply power in case of outages, making the system more reliable.

The MQ-135 gas sensor is responsible for detecting harmful gases such as carbon dioxide (CO₂), ammonia (NH₃), benzene, and smoke. It continuously sends real-time data to the Arduino, which processes the information and determines whether air purification is necessary.

If the detected air pollution level is beyond a safe limit, the Arduino takes action by activating the DC fan. The fan helps circulate air through a filter, which removes harmful particles and improves air quality before releasing clean air back into the environment.

At the same time, the LCD display shows real-time air quality readings. This allows users to monitor pollution levels and be aware of any deterioration in air quality.

This system is particularly useful in indoor spaces such as homes, offices, or factories, where maintaining good air quality is essential for health and comfort. The automated nature of the system ensures that air purification occurs without the need for manual



3.2 Design of Electronic Circuit

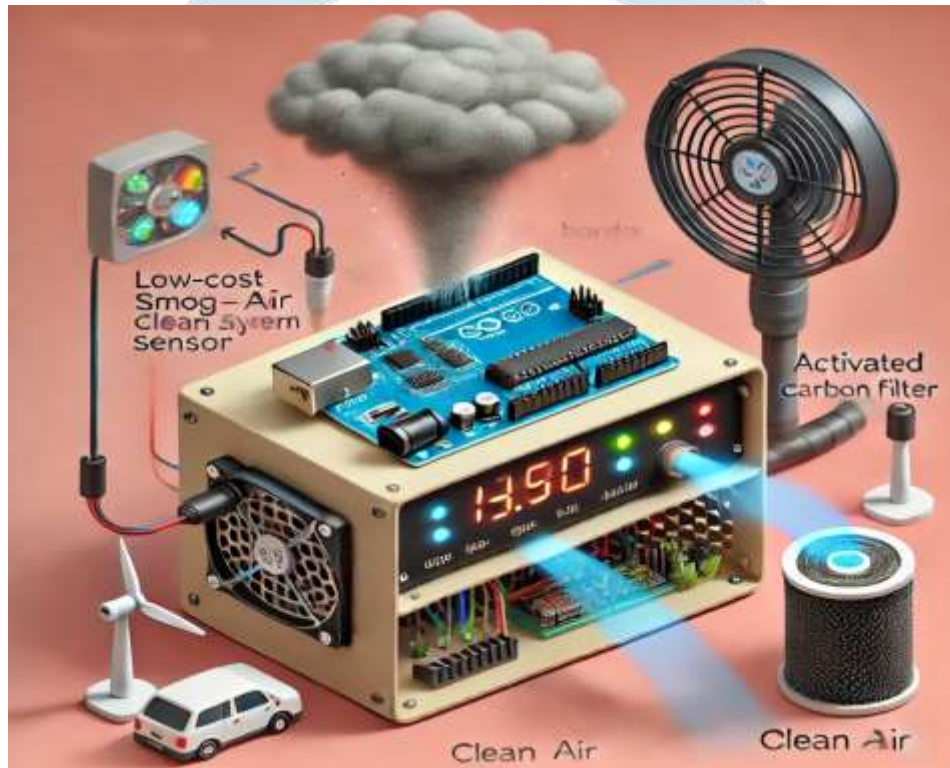


This low-cost smog-to-clean air system works by detecting air pollution and filtering harmful particles to release cleaner air. The **MQ-135 sensor** continuously monitors air quality and detects pollutants such as CO₂, smoke, and harmful gases. When pollution levels exceed a set threshold, the **Arduino board** processes the data and activates the **fan**, which pulls in polluted air. This air is then passed through an **activated carbon filter**, which absorbs toxins and removes particulate matter. The filtered, cleaner air is then released back into the environment.

A **LED indicator** signals when the system is operating, providing a visual cue for air purification in progress. The system runs on **5V DC power**, making it energy-efficient and cost-effective. With simple components and easy integration, this project can be used in homes, offices, and urban areas to improve air quality by reducing smog and airborne contaminants.

4.RESULT

Projects aimed at turning smog into clean air have shown positive results, including improved air quality, better public health, and innovative air-purifying technologies. Cities using smog towers, green infrastructure, and advanced filtration systems have seen a reduction in pollution levels. These efforts also help lower carbon emissions and promote sustainable urban planning. Additionally, such projects have raised awareness and influenced stronger environmental policies. While challenges remain in scaling these solutions, they prove that cleaner air is possible with the right mix of technology, policies, and public support.



5.CONCLUSION

The conclusion of turning smog into clean air highlights the effectiveness of innovative technologies, sustainable policies, and environmental awareness in combating air pollution. By utilizing methods such as advanced filtration, catalytic converters, and carbon capture, along with enforcing stricter emission regulations and promoting green energy sources, we can significantly reduce smog levels. This transformation not only improves public health and air quality but also contributes to a more sustainable and liveable environment. However, continued research, investment, and collective efforts from governments, industries, and individuals are essential to maintaining long-term success in air purification and pollution.

6. REFERENCES

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