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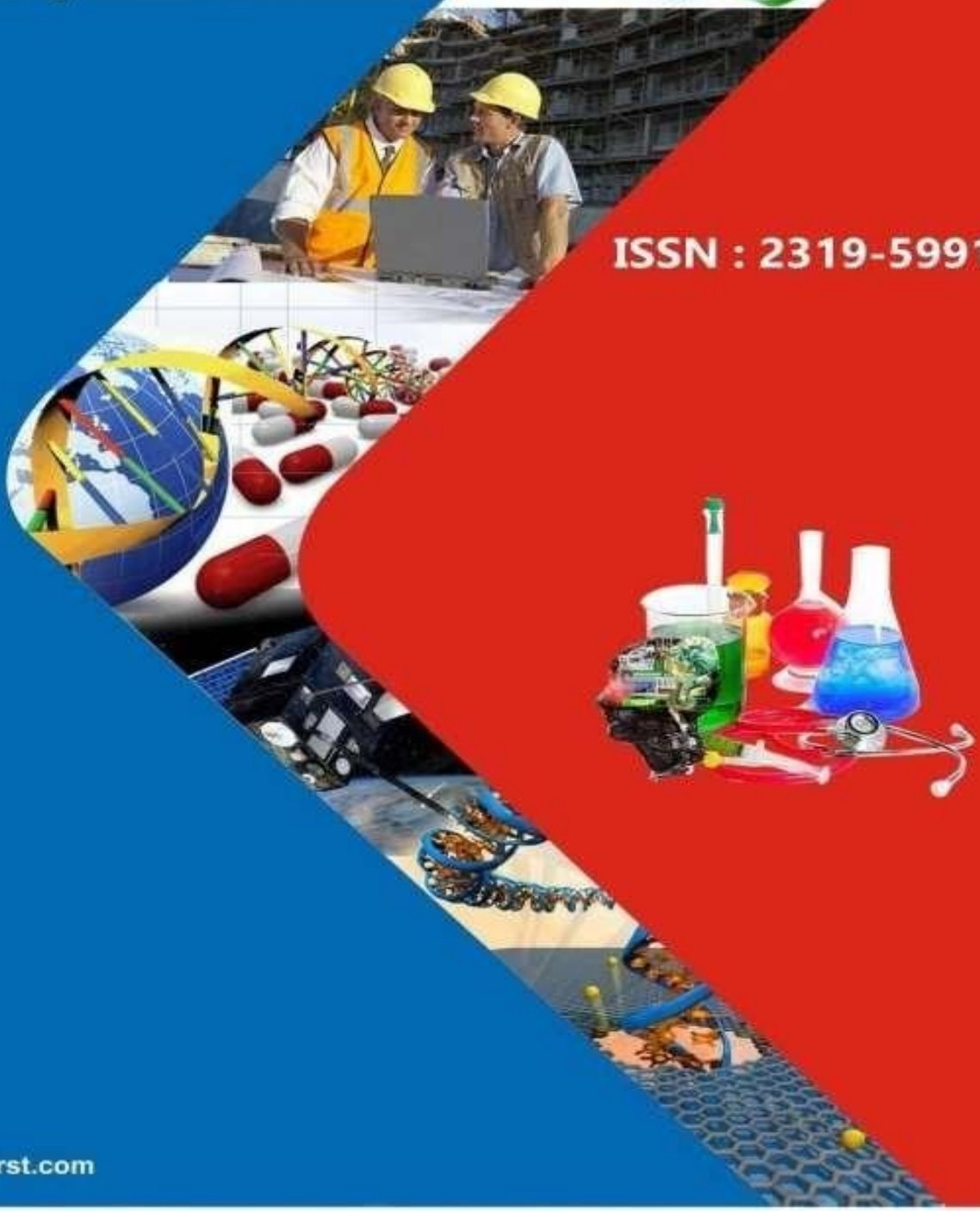

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INTELLIGENT POLLUTION CONTROL SYSTEM

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ABSTRACT

Vehicular air pollution is a growing environmental and public health concern, with carbon monoxide (CO) emissions being one of the most hazardous pollutants. High concentrations of CO contribute to air quality deterioration and pose severe health risks, including respiratory issues and cardiovascular diseases. Addressing this challenge, this project proposes an Intelligent Pollution Control System designed to monitor and regulate CO emissions from vehicle exhaust in real time.

The system employs a CO sensor to detect carbon monoxide levels from the vehicle's silencer. When the CO concentration exceeds a predefined safety threshold, the system initiates a two-step response mechanism. First, an audio alert is activated via a speaker module to notify the driver, prompting immediate action. Simultaneously, a relay module is triggered to cut off the vehicle's ignition, preventing further emissions until corrective measures, such as maintenance or repairs, are taken.

This integrated approach ensures an automated and proactive pollution control system, encouraging vehicle owners to maintain their engines efficiently and minimize excessive emissions. The proposed system is compact, cost-effective, and easy to implement in both existing and new vehicle models, making it a viable solution for reducing urban air pollution. By enforcing timely intervention, this technology not only promotes eco-friendly transportation but also contributes to healthier living conditions and sustainable urban environments.

INTRODUCTION

Air pollution has become a major global concern, with vehicular emissions being one of the leading contributors. Among these pollutants, carbon monoxide (CO) is particularly hazardous due to its colorless, odorless, and highly toxic nature. Prolonged exposure to CO can lead to severe health problems such as respiratory disorders, cardiovascular diseases, and even fatalities in extreme cases. Additionally, excessive CO emissions contribute to environmental degradation, leading to issues like smog formation, poor air quality, and climate change.

Modern vehicles are equipped with emission control systems, but inefficient engine combustion, poor vehicle maintenance, and outdated exhaust systems can lead to dangerously high CO emissions. Many vehicle owners remain unaware of excessive emissions from their vehicles until serious mechanical problems arise or regulatory checks identify the issue. There is a need for an automated and real-time monitoring system that can detect high CO emissions and take immediate corrective actions.

This project proposes an Intelligent Pollution Control System that detects elevated CO levels from a vehicle's silencer and takes automatic action to prevent excessive emissions. The system consists of a CO sensor that continuously monitors the exhaust gases. When the CO concentration exceeds a predefined safety threshold, the system triggers an audio alert to notify the driver. If the pollution levels remain dangerously high, the system

activates a relay module to cut off the vehicle's ignition, ensuring that the emission source is stopped until maintenance is performed.

By integrating sensor-based monitoring and automated response mechanisms, this system encourages timely vehicle maintenance and reduces the environmental and health impact of vehicular pollution. The proposed solution is compact, cost-effective, and easily implementable in both existing and modern vehicles. With increasing awareness of environmental sustainability and the need for stricter emission regulations, this system can serve as a crucial step toward promoting cleaner and healthier transportation.

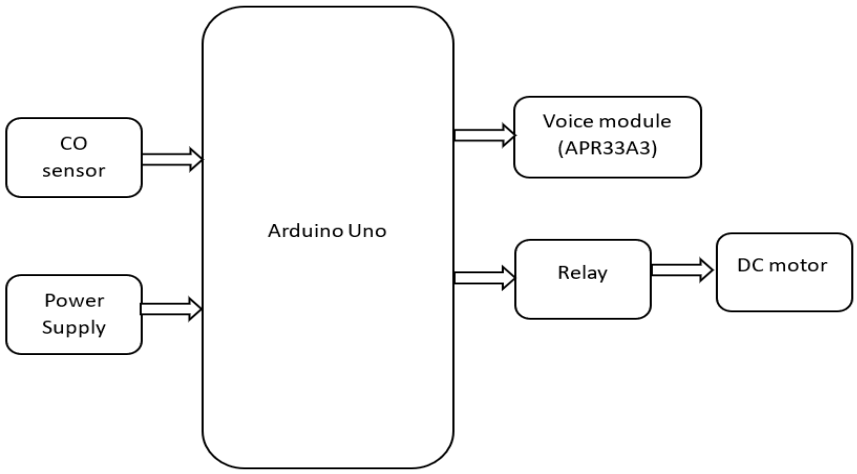

Figure.1 Block Diagram

LITERATURE SURVEY

1. Kumar, S., et al. (2020). *"Real-Time Monitoring and Control of Air Pollution Using IoT and Machine Learning."* International Conference on Smart Environments and Connectivity, Springer.
    - This research focuses on a machine learning-based approach to predict air pollution levels and optimize control strategies. The study discusses the effectiveness of data-driven pollution management in urban areas.
2. Sharma, A., & Verma, P. (2021). *"AI-Enabled Smart City Pollution Control Framework Using Wireless Sensor Networks."* International Journal of Environmental Monitoring, 10(4), 88-97.
    - The authors propose an AI-driven pollution control framework that utilizes wireless sensor networks (WSNs) to collect and analyze pollution data. The system predicts pollution trends and suggests appropriate mitigation strategies. The study emphasizes the importance of integrating AI in smart city planning.
3. Patil, R., & Gupta, S. (2022). *"IoT-Based Smart Air Pollution Monitoring and Control System."* IEEE Sensors Journal, 22(6), 14532-14540.
    - This study presents an IoT-based air quality monitoring system that collects real-time pollution data using gas sensors. The system processes the data and automatically activates air purifiers

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or emission control mechanisms if pollution levels exceed a threshold. The research highlights the role of automation in reducing environmental hazards.

PROPOSED SYSTEM

The intelligent pollution control system detects and responds to hazardous carbon monoxide (CO) levels using an integrated network of sensors, a microcontroller, and an alarm mechanism. The MQ-7 gas sensor continuously monitors CO concentrations and transmits data to the Arduino Uno via its analog input pin. If the detected CO level exceeds a predefined threshold, the Arduino processes the signal and triggers appropriate warning responses.

Upon detecting dangerous CO levels, the Arduino Uno activates the APR33A3 voice module, which plays a pre-recorded alert through a connected speaker. Simultaneously, the system engages an alarm mechanism consisting of a BC547 transistor, a 12V relay, and an external alarm speaker. The relay is controlled via the Arduino's digital output pin, ensuring immediate activation of the alarm system. A protective diode (1N4007) prevents voltage spikes from damaging the circuit. This setup provides a reliable and automated warning system to mitigate carbon monoxide exposure risks.

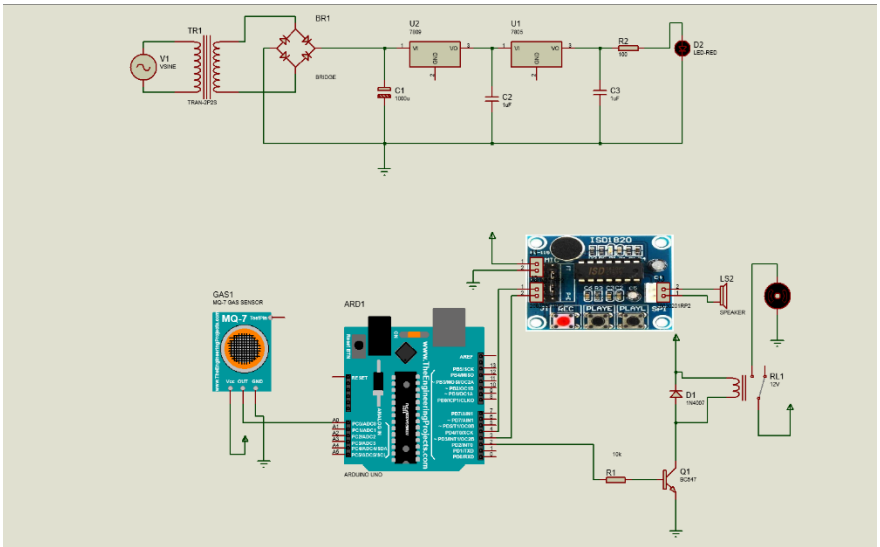
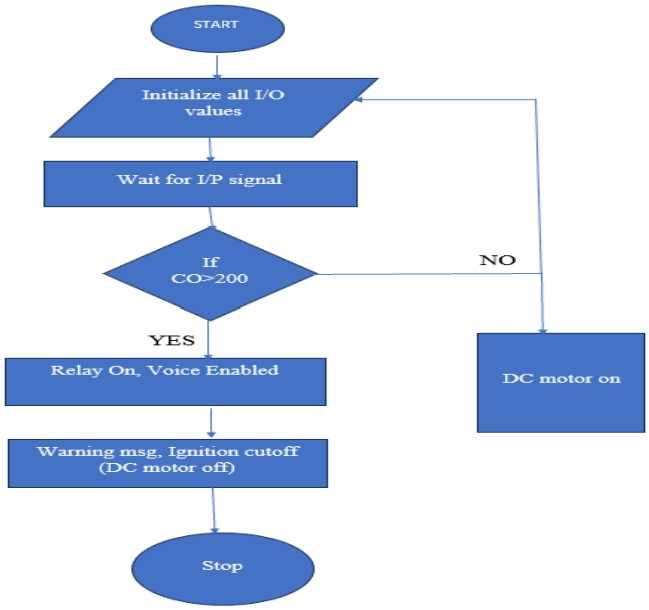


Figure.2 Schematic Diagram

Flow chart



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RESULTS

Normal Condition (Idle State - System Ready for Operation)

In its idle state, the system is fully powered and all components, including the Arduino board, CO sensor, relay module, motor, and alarm, are properly connected. The microcontroller continuously monitors the environment for any changes in CO levels. At this stage, no active operations are taking place, and the system is in standby mode, waiting for a trigger condition. The circuit remains in an operational state, ensuring that all components are ready to respond when required. The CO sensor passively detects the air quality while the LCD (if included) may display a "System Ready" or similar message.

When the CO concentration in the environment exceeds the predefined threshold (e.g., 200 PPM), the sensor immediately detects the rise in gas levels. The system then activates an automated response mechanism to mitigate the risk.

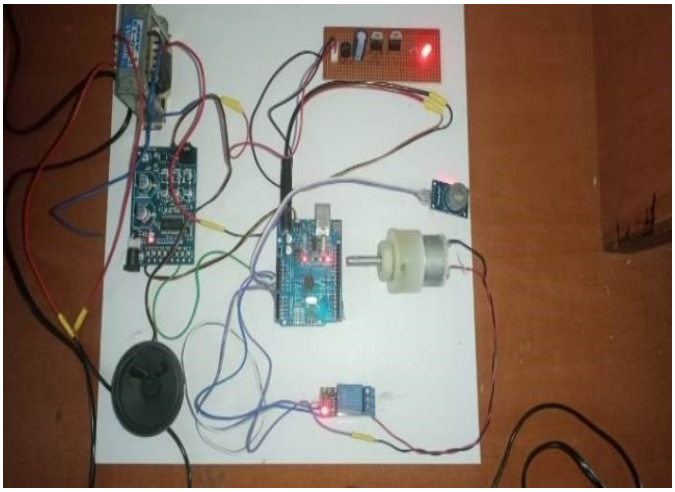

Figure.4 circuit board

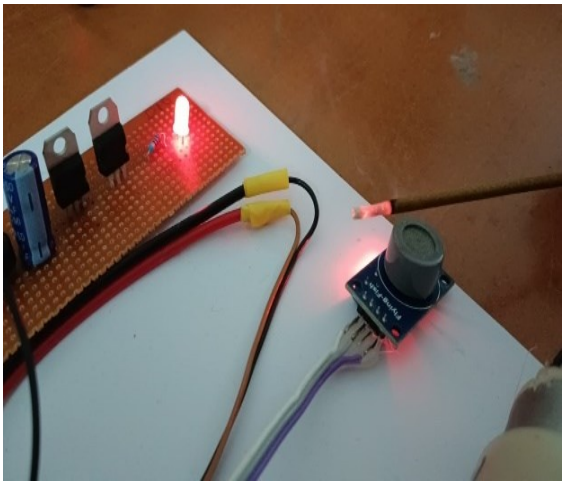

Figure.5 CO Measuring

This system efficiently ensures safety by continuously monitoring and responding to critical conditions. The automated response minimizes manual intervention, providing real-time safety assurance. If the CO level remains dangerously high for an extended period, the system keeps alerting users and may initiate additional safety measures, depending on configuration. By integrating sensors, actuators, and microcontroller-based decision-making, the project successfully implements an intelligent safety solution, balancing real-time monitoring with effective response mechanisms.

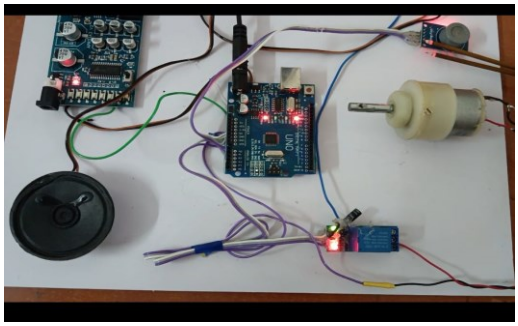

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Figure.6 Pollution indication

ADVANTAGES

1. **Early Detection of Pollution –** Continuously monitors air quality and provides timely alerts to prevent hazardous exposure.
2. **Automated Warning System –** The system automatically triggers alarms and voice alerts when CO levels exceed safe limits.
3. **Low Power Consumption –** Uses an energy-efficient microcontroller and sensor setup, making it suitable for continuous operation.
4. **Cost-Effective Solution –** Affordable components and simple circuit design ensure economical implementation.
5. **Scalability –** Can be expanded to detect multiple pollutants by integrating additional sensors.
6. **User-Friendly –** Provides clear visual and audio alerts, making it easy to use in various environments.

APPLICATIONS

1. **Industrial Safety –** Ensures worker safety in factories and industrial sites with high CO emissions.
2. **Home and Indoor Air Quality Monitoring** – Detects pollution levels in homes, garages, and enclosed spaces to prevent CO poisoning.
3. **Smart Cities and Environmental Monitoring –** Can be integrated into urban air quality monitoring systems to track pollution levels.
4. **Automobile Emission Monitoring –** Helps in checking vehicle emissions and enforcing pollution control regulations.
5. **Public Spaces and Offices –** Installed in public places like malls, hospitals, and offices to maintain healthy air quality.
6. **Mining and Tunnels –** Used in underground environments where CO buildup can be hazardous to workers.

CONCLUSION

The intelligent pollution control system successfully detects and controls excessive carbon monoxide (co) emissions from vehicles. by integrating a co sensor, microcontroller, buzzer, and relay module, the system provides real-time monitoring and automatic responses to high pollution levels. the buzzer alerts the driver when emissions exceed safe limits, and the ignition cutoff prevents further environmental damage.

this system is cost-effective, compact, and easily implementable in modern vehicles. it encourages vehicle owners to maintain their vehicles regularly, contributing to a cleaner and healthier environment. the implementation demonstrates the effectiveness of automated pollution control, reducing human intervention while ensuring road safety.

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Future Scope

Integration with IOT (internet of things):

•The system can be enhanced with wi-fi or gsm modules to transmit pollution data to cloud platforms for remote monitoring.

• Authorities can receive real-time pollution reports and take necessary actions.

Integration with smart traffic management systems:

• vehicles exceeding pollution limits can be automatically reported to traffic control authorities for smart regulation enforcement**.**

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