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AIR POLLUTANTS TRACKING AND ALERTING SYSTEM IN VEHICLES USING EMBEDDED SYSTEM

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Abstract :The main objective of this project is to identify and track down vehicles that are releasing pollutants, which will enable them to recover more quickly. When all vehicles are fitted with this technology, it will be an invaluable tool for traffic authorities. It's especially important for taxis, whose owners need to be informed of potential engine damage caused by gasoline tampering like kerosene mixing. It does this by automatically sending the locations and details of contaminated vehicles to designated mobile phones. The system finds and recognises vehicles that are polluted by using GSM and GPS modules. GSM transmits data while GPS provides real-time position data. Every component, including an air pollution sensor, is interfaced with by the central processor, an Arduino Uno board. An alarm is triggered and vehicle position data is relayed when pollution levels surpass a predetermined threshold. When there is pollution, GPS follows cars continuously. Data is sent while the car is moving every minute to ensure continuous monitoring. Identified mobiles receive latitude and longitude information for prompt action. To improve efficiency and usability, real-time global position data is provided by an LCD display that is integrated with the main processor. The system's high-power rechargeable battery, which it uses to ensure continuous operation even in the absence of mains power, is part of its portability design. The battery ensures continuous operation and can be recharged as needed.

Key Terms **- Arduino processor, GSM module, GPS module, LCD, Alarm, MQ series air pollution sensor .**

I. INTRODUCTION

Vehicle emissions are a major cause of environmental pollution, especially in countries with a high number of vehicles on the roads. India, in particular, has seen a significant increase in vehicle pollution due to its growing population. Passenger vehicles, in particular, contribute to pollution with their emissions of nitrogen oxides, carbon monoxide, and other pollutants. This pollution is a significant problem in large cities, causing various health issues and visibility problems. To address this issue, a system is designed to detect highly polluting vehicles and send information to authorized mobile phones. The system is currently designed for one vehicle but can be expanded to include all vehicles for practical implementation. Presently, vehicle owners are required to obtain Pollution Under Control (PUC) certificates every 6 months, but many ignore this requirement, leading to increased pollution levels. PUC certificates validate that a vehicle's emissions comply with government regulations and help control overall pollution levels. The system uses Arduino Uno, GSM, and GPS modules to track the position of highly polluting vehicles and transmit this information to concerned authorities. By integrating GPS technology, stolen vehicles can also be tracked. The system is efficient for outdoor applications and can be used globally.

The pollution sensor circuit detects toxic gases and triggers the transmission of location data through the GSM module. GPS coordinates are used to locate the vehicle accurately. The use of GSM technology ensures that the data can be acquired globally without range restrictions. When a vehicle emits high pollution levels, the system activates a buzzer/alarm and sends a message to the registered mobile number. Vehicle tracking systems, utilizing GPS and GSM technologies, are becoming increasingly popular worldwide. In India, the use of vehicle tracking systems is expected to grow in the coming years. The project work primarily utilizes Arduino as the main processing unit, along with GPS, GSM, LCD, pollution sensor, and buzzer components. The Arduino microcontroller is serially interfaced with the GSM modem and GPS receiver to provide real-time location information.

II. LITERATURE SURVEY

This paper describes an Internet of Things (IoT) indoor air quality monitoring system with a "Smart-Air" device and a web server to go along with it. This platform allows for real-time indoor air quality monitoring from any location by utilising cloud computing and Internet of Things technology. Using a microcontroller, pollution detection sensors, and an LTE modem, Smart-Air leverages Internet of Things technologies to effectively monitor and send data on air quality to a web server. The gadget, which has been verified for dependability in accordance with guidelines established by the Korean Ministry of Environment, measures aerosol, volatile organic compound (VOC), carbon monoxide (CO), carbon dioxide (CO2), and temperature and humidity in order to evaluate the quality of the air. An application that allows authorised workers to conveniently monitor air quality data is coupled with the web server to facilitate cloud computing for the analysis and classification of data according to

Ministry requirements. Data is stored in the cloud for additional analysis; Hanyang University in Korea has successfully implemented this strategy, demonstrating the platform's viability.

In the paper "Monitoring Vehicular Pollution By Using Embedded System," Dr.Nitin Dhote, Nagraj Bongirwar, and Shubham Urkude emphasise how harmful air pollution is to the ecosystem and to all living things. Cars are responsible for a considerable amount of carbon monoxide emissions, almost 75 percent. Between 50% and 90% of the total air pollution levels in metropolitan areas are caused by automobile emissions. Even though total emission reduction is still unfeasible, pollution detection technologies make it possible to monitor and regulate pollutants. Acceptable emission limits are set by government regulations, such as the Bharat Stage criteria. However, high pollution levels are frequently the consequence of inadequate vehicle maintenance. When a vehicle's emissions go over safe limits, the owner is notified right away. If the owners don't fix the problem, the pollution control agency gets the relevant data, which includes the position of the car. By enabling authorities to take appropriate action against the owners of the vehicles and reduce pollution, this data helps identify which automobiles are causing pollution in a particular area. Timely intervention is made possible by the system's guarantee of real-time data transfer to the pollution regulation body. Vehicle pollution is efficiently monitored and controlled by microcontrollers, which also supervise the synchronisation and execution of the entire operation.

In their discussion of the paper "A Comprehensive Review of Vehicular Pollution Monitoring Through IoT," Sampada N. Lolge and Ms. S.B. Wagh, discuss how the complex interactions between natural and manmade environmental elements are causing the deterioration of air quality in metropolitan areas. Excessive emissions of harmful gases and particulate matter are made worse by industrialization, urbanisation, and the underutilization of catalytic converters. Monitoring the amount of air pollution along roadsides and identifying cars that exceed set pollution standards are the main goals of this project. Increased vehicle usage is a persistent problem that calls for a review of the many systems used to track vehicle pollution. The article promotes the use of Internet of Things (IoT) technology as a potential remedy. In order to provide real-time monitoring of vehicle pollution levels that is accessible from any place, the suggested methodology integrates Toxic Gas Sensors with an RFID tagging system.

III. EXISTING SYSTEM

In addition to being the main means of transportation, motor vehicles are also the main cause of pollution. More than thirty percent of the dangerous gases released into the environment are a result of these motor vehicles. Although the amount of pollution outside is the main worry, the air quality inside the car also matters a lot. Because the vehicle's cabin is small, any suspended particulate matter - such as dust, fumes, or smokes—that enters through the windows or ventilation system could seriously harm the occupants' health. These particulate matter may have different effects on human health than both acute and long-term ones. The negative health effects range from mild eye and upper respiratory irritation to heart disease, chronic respiratory disorders, lung cancer and even death.

The air cabin filters that are installed within the car to lessen the impact of the undesirable particle cannot effectively regulate it, even if the vehicle has them. Even if the manufacturers of different cars focus primarily on these safety measures, end users' or drivers' negligence about the state of the vehicle may seriously harm both the vehicles and human lives. Such that a slight irritability of the eyes might cause a motorist to lose focus on the road, which could result in catastrophic accidents. Therefore, it's necessary to monitor a number of gases in order to solve these kinds of issues.

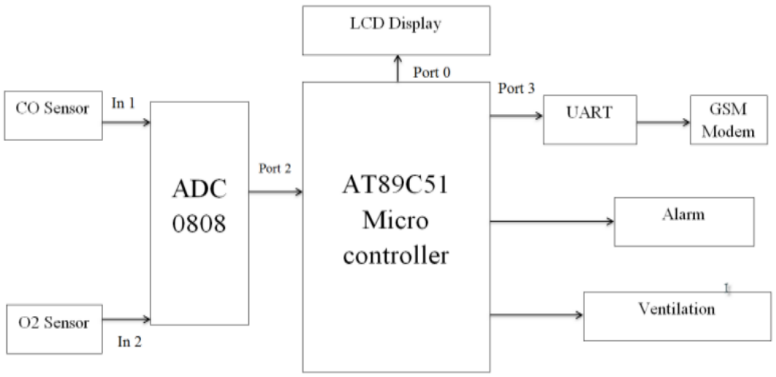

Fig 1.1. Block diagram of existing system

The AT89C51 micro controller is connected to the Analog to digital converter such that the input from the sensors are converted into digital input and then sent to the microcontroller it then displays the result through LCD. If a critical situation is experienced then an alarm is given for alerting the diver and ventilation is provided as an exhaust and as a remedy measure. A text message is sent to the authorized user indicating the critical situation of the vehicle. The block diagram of the proposed system is shown in fig 1.1

IV. PROPOSED SYSTEM

The air pollutant tracking and alerting system in vehicles involves several critical components. At its core is the main processing unit, powered by an Arduino processor, which operates as the central control hub. This unit orchestrates the operation of all other components seamlessly. Integrated with a GSM module, the system gets the power to communicate wirelessly, enabling it to deliver alerts and data regarding air pollutant levels detected within the car. Additionally, a GPS module plays a pivotal role in pinpointing the vehicle's precise location, facilitating the correlation of pollutant levels with specific geographical areas. A user-friendly Liquid Crystal Display (LCD) provides real-time visualization of crucial information, such as pollutant concentrations and vehicle coordinates, ensuring easy monitoring for occupants.

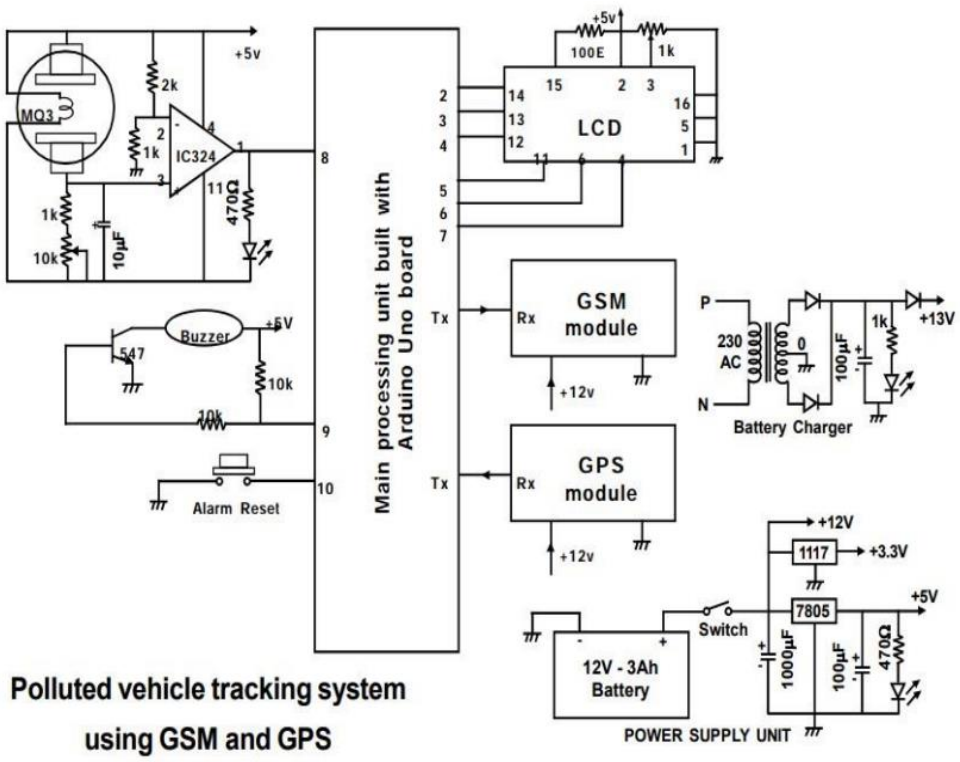

Figure 1. Circuit Diagram of Proposed System

Moreover, an alarm system functions as a proactive warning mechanism, generating alarms when pollutant levels above predefined criteria, thus notifying vehicle occupants and appropriate authorities swiftly. The heart of the system rests in the MQ series air pollution sensor, which continuously analyses air quality within the vehicle, identifying various contaminants such as carbon monoxide and volatile organic compounds. The LM324 op-amp IC amplifies the sensor's output signal, improving data accuracy and dependability for use by the Arduino unit. The system is powered by a rechargeable battery, which can be replenished via a specific charger. In operation, the sensor continually analyses air quality, providing data to the main processing unit. Upon detecting elevated pollution levels, the system raises the alarm, activates the GSM module to transmit alerts, and records the vehicle's location via GPS. Simultaneously, the LCD shows real-time pollutant statistics and coordinates, giving occupants with essential information for educated decision-making. The system's autonomous functionality ensures continuous monitoring and timely alerts for air quality conditions as the vehicle travels through various environments. Overall, this comprehensive system improves safety and environmental awareness by effectively tracking and alerting drivers to potential air pollution hazards within their vehicles.

V. RESULTS AND DISCUSSION

The hardware components in the air pollution tracking and alerting system rely on an embedded system to function properly. The system includes a MQ-3 gas sensor that detects alcohol and combustible gases, providing important analog signals for air quality. Complementing this, a GPS module is utilized to ascertain the real-time location of the vehicle, allowing for precise mapping of pollution levels with geographical coordinates.The GSM module serves as a communication interface, enabling the system to send alarms and messages to designated users or authorities when elevated pollution levels are detected. At the core of the system is the Arduino Uno microcontroller, responsible for data collection, processing, and decision-making based on predefined thresholds.

It seamlessly integrates with other hardware components and orchestrates system functionality. The vehicle's LCD display provides occupants with real-time air quality information, making it easy to use. The inclusion of a buzzer as an audible alert mechanism ensures immediate awareness when pollutant concentrations surpass predetermined thresholds. To maintain practicality, a alarm reset mechanism is incorporated, deactivating the buzzer and resetting the system after air quality improves or user acknowledgment. These hardware components work together to create a system that monitors real-time air quality and notifies drivers, resulting in a safer and more informed driving experience.

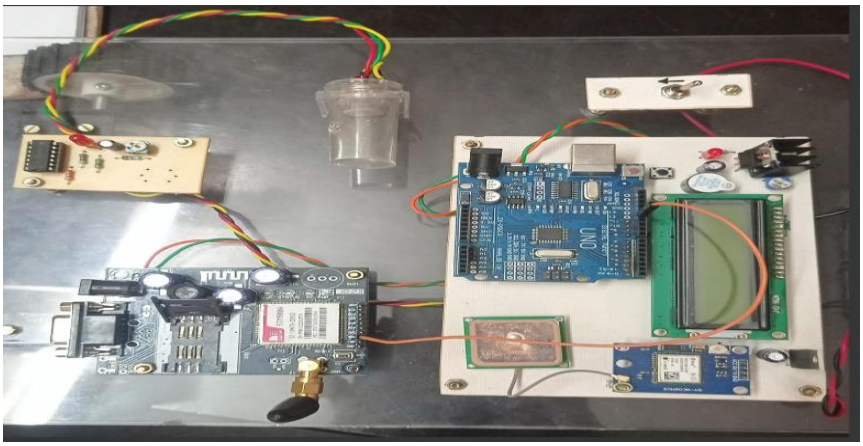

Figure 2.Prototype of the project

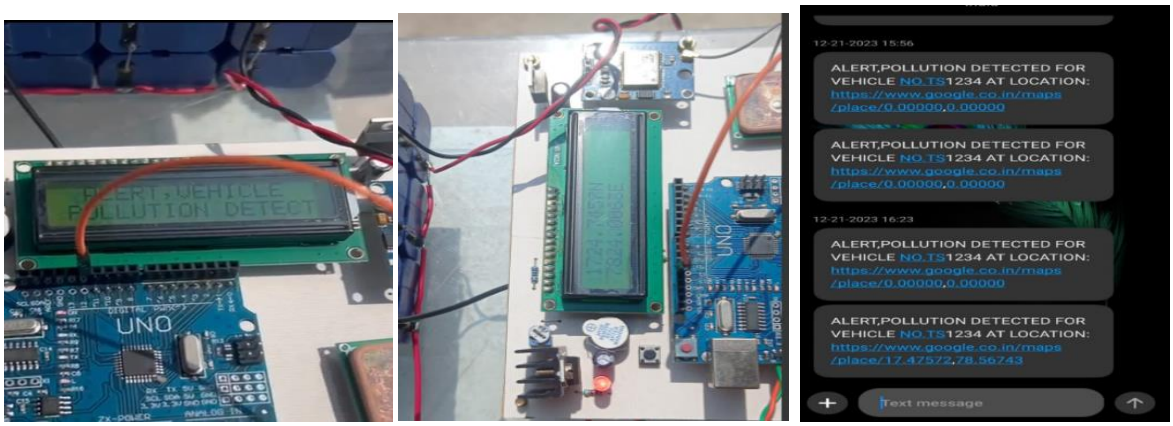

Figure 3. Output of the proposed system

VI. CONCLUSION

Embedded vehicle systems have the potential to track and alert air pollutants, addressing environmental and health concerns. As global environmental awareness grows, incorporating these systems into automobiles is projected to become an essential component of sustainable transportation solutions. The combination of regulatory pressures on emission standards, advancements in sensor technologies, and the need for smart city development creates a fertile ground for the widespread adoption of these systems. In the future, vehicles with embedded air pollutant tracking capabilities are likely to play an important role in ensuring regulatory compliance and contributing to a comprehensive, interconnected ecosystem that actively monitors and manages air quality. As consumers become more environmentally conscious, manufacturers may prioritize the integration of such systems to align with evolving consumer preferences for eco-friendly features. Additionally, the collaboration between automotive industry stakeholders and public health initiatives is expected to highlight the importance of these systems in promoting overall well-being. Ultimately, the future of Air Pollutants Tracking and Alerting Systems in vehicles using embedded systems is characterized by a convergence of technological innovation, regulatory imperatives, and societal demands for a cleaner, healthier environment.

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