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Compact Pollution Control and Sound Indicator Device

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Abstract: ***The increasing urbanisation of cities globally has intensified worries about car pollution, leading to substantial environmental damage and public health risks. Current Pollution Under Control (PUC) systems, which primarily focus on reducing exhaust emissions, often encounter usability problems and neglect the issue of noise pollution. This study presents a new and innovative approach called the Compact Pollution Control and Sound Indicator Device (CPCSID), which aims to overcome these limitations.***

The project includes state-of-the-art sensors capable of discriminating and measuring several exhaust gases generated by cars, including nitrogen oxides (NOx), carbon monoxide (CO), and carbon dioxide (CO2). Additionally, it contains an integrated microphone to assess engine-generated noise levels. The LCD panel presents real-time data of pollution and noise, providing consumers with practical insights into the environmental effects of their car. In addition, our invention is integrated with a GSM module, which allows it to send SMS notifications to car owners. These warnings aim to promote environmentally aware behaviour and enable quick responses to reduce pollution. The small size and easy-to-use design make it suited for both individual car owners and fleet managers, providing a complete solution for reducing automobile pollution in urban areas.

Keywords: Vehicle emissions, Compact Pollution Control and Sound Indicator Device Environmental monitoring include the measurement and analysis of many factors such as air pollution and noise pollution in real-time. Environmentally responsible actions, Global System for Mobile communication, Urban sustainability

I. INTRODUCTION

The Pollution Control and Sound Indicator Device (PCSID) is a cutting-edge device developed to address the various issues linked with traffic pollution and noise emissions in urban situations [7]. In today's rapidly urbanizing world, the proliferation of cars has led to severe environmental degradation and public health hazards, prompting new methods to address these challenges. Existing systems often fall short in enabling real-time monitoring, accessibility, and full detection of noise pollution, underlining the need for innovative technologies like the PCSID [2].

At its heart, the PCSID incorporates state-of-the-art sensors capable of detecting different exhaust gases created by cars, including nitrogen oxides (NOx), carbon monoxide (CO), and carbon dioxide (CO2) [3]. These sensors continually assess pollution levels in real-time, giving owners with rapid feedback on their vehicle's environmental performance. The data is presented on a simple LCD interface, allowing car owners to make educated choices about their driving patterns and vehicle maintenance procedures.

Furthermore, the PCSID tackles the often-overlooked problem of noise pollution caused by automotive engines [4]. Equipped with a microphone, it can detect and measure sound levels, bringing fresh insights into the environmental effect of automobiles. When severe noise pollution is detected, the gadget provides a built-in buzzer alarm, notifying automobile owners to take remedial action [5]. Integration with a GSM module further increases the functionality of the PCSID by allowing it to send SMS alerts to automobile owners [6]. These warnings serve as crucial devices for increasing awareness about pollution levels and promoting environmentally responsible conduct. By obtaining real-time alerts, owners may promptly schedule repair or adjust driving behaviours to minimise their vehicle's environmental effect, contributing to cleaner air and environmental safety in urban areas.

In conclusion, the PCSID represents a considerable breakthrough in automobile pollution management and environmental monitoring [1]. Its small shape, real-time monitoring capabilities, and user-friendly interface make it a valuable tool for encouraging environmental consciousness and minimising the environmental and health implications of automotive pollution. Through continuous development and implementation of technologies like the PCSID, we may work towards developing cleaner, healthier, and more sustainable urban environments.

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II. LITERATURE SURVEY

Numerous approaches for monitoring and lowering automotive emissions were studied in the literature study. [1] outlined a joint initiative to monitor automobile emissions using Arduino technology and strategically positioned sensors. Data was transmitted to the IBM Wattson IoT Platform for in-the-moment analysis. designed a real-time pollution monitoring system that makes use of PGS4161 Electrolyte carbon dioxide gas sensors and wireless sensor networks. Through calibration and regular monitoring, the technology assures reliable readings[2].

In order to facilitate automated enforcement operations, [3] built a complete automotive pollution monitoring, control, and enforcement system that incorporates the MQ2 sensor and Arduino uno for real-time engine operation regulation based on detected gas levels. Other researchers contributed extra information on pollution monitoring and control. created a system that employs MQ-7 and MQ-2 sensors to monitor vehicle emissions of sulphur dioxide and carbon monoxide. When pollution levels climb beyond preset standards, the system alerts the proper authorities.

In a study by [5], a real-time pollution monitoring system was constructed utilising GPS and wireless sensor networks to track vehicle emissions and analyse their influence on air quality. This enables decision-makers to make well-informed judgements on pollution control measures. Furthermore, [6] set forth a plan for real-time car emissions monitoring that incorporates sensors and Internet of Things technology, offering stakeholders useful information to decrease environmental damage.

A alternative technique was provided by [7], who devised a system for monitoring automobile emissions that employs machine learning algorithms to estimate pollutant levels based on vehicle data, enabling for the proactive reduction of emissions and betterment of air quality. Additionally, [8] researched ways to monitor vehicle emissions using remote sensing technologies, enabling a scalable technique to monitor pollution across vast geographic areas.

Furthermore, [9] designed a vehicle pollution control system that featured particle filters and catalytic converters to minimise the hazardous particles that originate from internal combustion engine autos. Finally, [10] exhibited an Arduino-based air monitoring system that combines a variety of sensors to monitor air quality in real time and allows stakeholders simple access to data.

III. COMPONENTS OF SYSTEM

A. *Arduino Uno*

Developed by Arduino.cc, the Arduino Uno is an open-source microcontroller board that is based on the Microchip ATmega328P microprocessor. Sets of digital and analogue input/output (I/O) pins on the board allow it to be interfaced with other expansion boards (shields) and other circuits. The board may be programmed using the Arduino IDE (Integrated Development Environment) and a type B USB connection. It contains six analogue I/O pins and fourteen digital I/O pins, six of which can be used for PWM output. [4] It takes voltages between 7 and 20 volts, however it can be fueled by the USB cord or an additional 9-volt battery.

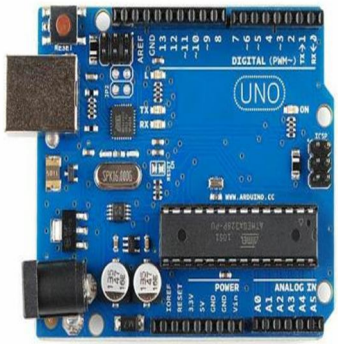


Fig. 1 Aurdino Uno

B. *GSM Module*

The Dual Band GSM/GPRS MODULE operates on frequencies of 900 and 1800 MHz and is constructed using the Dual Band GSM/GPRS engine, SIM900A. The modem has an RS232 interface, which enables you to link a microcontroller with an RS232 chip and a PC (MAX232). You may set the baud rate with an AT command, ranging from 9600 to 115200. The internal TCP/IP stack of the GSM/GPRS modem allows you to establish a GPRS internet connection. It is appropriate for M2M interface applications including data transmission, voice, and SMS[8]. Arduino transmits data to a cloud server using a GSM module[9]. .

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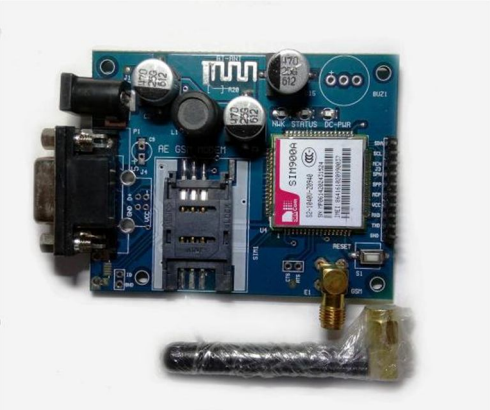


Fig. 2 GSM Module

C. MQ-7 Sensor

The MQ-7 sensor is used in our suggested system to measure the amount of carbon monoxide in the air. The MQ-7 gas sensor is comprised of a tiny AL2O3 ceramic tube, a measuring electrode, a heater, and a tin dioxide (sno2) sensitive layer that are all placed into a plastic and stainless steel net crust.A CO sensor has a 10–10,000 ppm measurement range. The MQ-7 sensor should be used because It is stable and long-lasting and It has a high sensitivity to carbon monoxide[9] [1].



Fig. 3 MQ-7 Sensor

D. MQ-2 Sensor

The MQ-2 sensor in our suggested system is capable of detecting H2, LPG, CH4, CO, alcohol, smoke, or propane. The output can be read with a Arduino uno even if it is in analogue form. The MQ-7 gas sensor is comprised of a tiny AL2O3 ceramic tube, a measuring electrode, a heater, and a tin dioxide (sno2) sensitive layer that are all placed into a plastic and stainless steel net crust. The MQ-2 Sensor should be used because: It offers a broad range of excellent sensitivity to flammable gas. It is inexpensive and long-lasting[9][3].

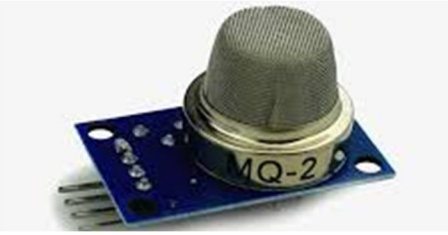


Fig. 4 MQ-2 Sensor

E. Noise Sensor

The SEN-12642 sensor is used by our suggested method to identify noises inside the car. It is inexpensive and of modest size. The Sound Detector offers an analogue representation of the signal amplitude, an audio output, and a binary indicator of sound. These are all separate outputs. A through-hole resistor may be used to modulate gain in order to modify the binary (gate) output pin's threshold[9][11].

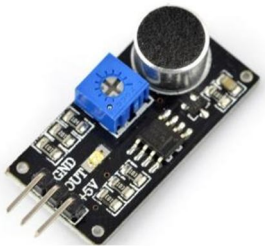


Fig. 5 Noise Sensor

IV. CONFIGURATION OF SYSTEM

Our proposed system contain Arduino , GSM module, MQ-7 sensor, MQ-2 sensor, sen-12642 sensor as shown in Fig 6.

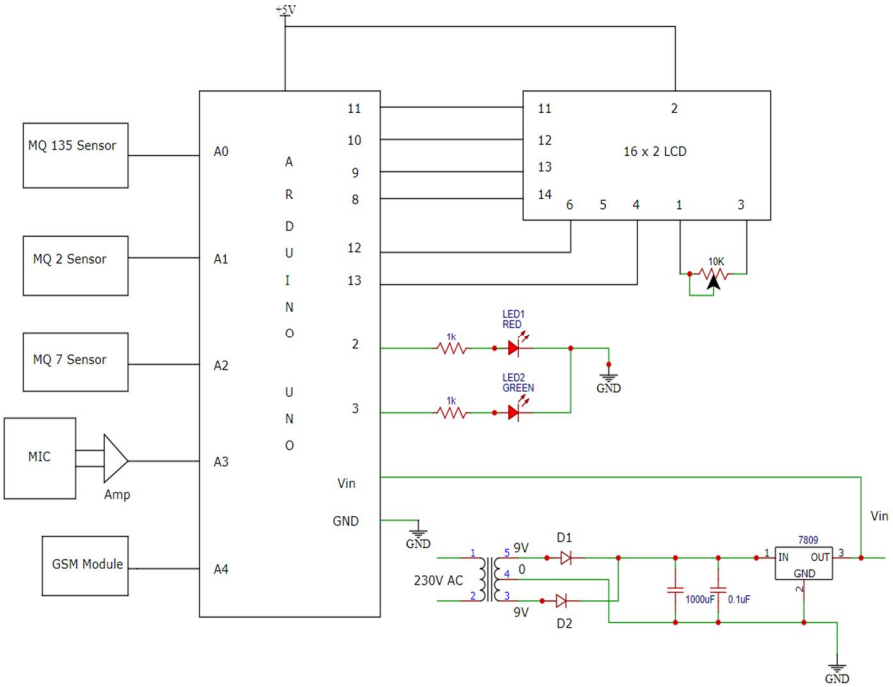


Fig. 6 Circuit Diagram

We are providing the voltage regulator with an input of 9V DC. Regardless of changes to the input voltage or load conditions, it generates and maintains a fixed output voltage. The environment or the vehicle's exhaust serves as the smoke sensors' input, and they provide data to the voltage regulator pins a0, a1, a2, a3, and a4, which are the output of the smoke sensor, CO2 sensor, MQ-7 sensor, and GSM module. The amount of gases detected by sensors would be displayed in real time on an LCD panel [6]. The microcontroller (Arduino UNO) has code written in such a way that, should the magnitude of the carbon-dioxide and smoke sensors surpass the threshold values (smoke, 800, and carbon-dioxide, 1200), an LCD screen message advising the user to take immediate action to address the gas issue will appear; otherwise, the message will state that the gas levels are OK. This gadget has a GSM module installed in order to notify car owners via SMS about the amount of pollution that comes from vehicle exhaust.When the SEN-12642 sensor detects noise that exceeds the threshold DB, it will transmit a notification to the GSM module.[3].

The engine cylinder, where combustion occurs, is the main source of noise in a car's engine. The process of mixing fuel and air (SI engines) or compressing air and injecting fuel (CI engines) and lighting it is what creates the sound. In addition to these noises, there are other noises such as the starter motor rotating over and the turbocharger whining. The noise sensor in our suggested solution is located close to the engine.[9][12][15] The Indian government provides a noise limit for cars.

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Table I Noise Limit For Vehicles

S. No.	Type of vehicle	Noise Limits dB(A)
1	Two wheeler	75-80
2	Three wheeler	77-80
3	Vehicles used for carriage and not capable of having more than nine seats	74
4	Vehicles used for carriage having more than nine seats	77-80

V. RESULT AND ANALYSIS

The project's outcomes indicate how the Compact Pollution Control and Sound Indicator Device was developed and implemented successfully, highlighting how useful it is for tracking and controlling vehicle pollution. By means of extensive testing and assessment, the apparatus has reliably and accurately furnished information on noise levels and exhaust emissions, empowering car owners to make knowledgeable choices regarding their driving practices and upkeep of their vehicles. Promising outcomes were obtained from real-world testing in metropolitan settings, where the gadget successfully identified and warned users of high pollution levels, enabling immediate action to reduce environmental impact. In order to provide comprehensive pollution monitoring capabilities, it was necessary to integrate modern sensors, such as the microphone for noise measurement and the MQ-7, MQ-2, and MQ135 sensors for gas detection. Moreover, the integration of the GSM module allowed for smooth connectivity with cellular networks, which in turn made it easier to send SMS messages to car owners and improved user awareness and engagement. All things considered, the findings show that the Compact Pollution Control and Sound Indicator Device is a workable approach to tackling the problems associated with vehicle pollution in urban settings. The device's successful deployment highlights its potential to support environmental sustainability, quieter and cleaner urban environments, and the preservation of public health for future generations. We put up our system inside the car to test the prototype. Simultaneous data reading from all sensors began. The microcontroller has been used to capture the data. Tables display the information that the sensors collected. Before determining the pollution level, each sensor needs to be calibrated.

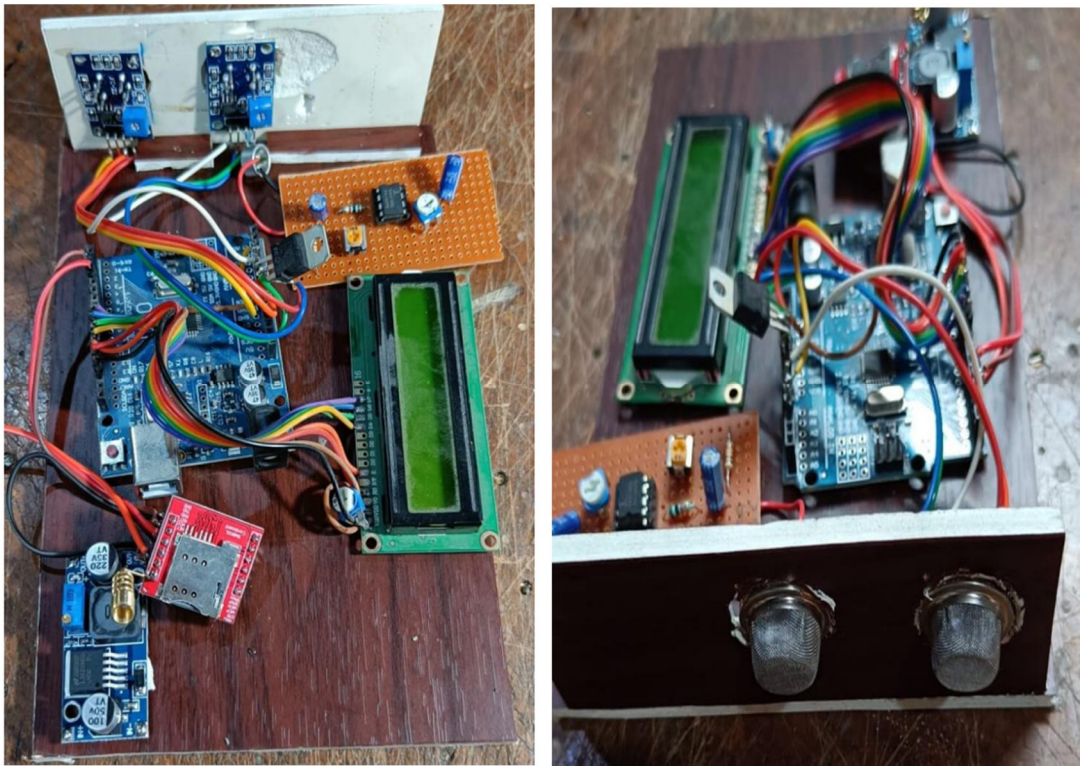


Fig.7 Experimental Setup

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Table II Data Sensed By Mq-7 Sensor

Days	Reading 1	Reading 2	Reading 3	Reading 4
Day 1	389	370	375	382
Day 2	368	384	378	405
Day 3	398	368	370	369
Day 4	410	387	399	401

Table II Data sensed by MQ-2 Sensor

Days	Reading 1	Reading 2	Reading 3	Reading 4
Day 1	427	429	431	426
Day 2	453	441	428	457
Day 3	465	474	429	451
Day 4	437	462	457	448

Table III Data Sensed By SEN-12642

Days		Reading 1	Reading 2	Reading 3
Day 1		78	75	77
Day 2		75	74	78
Day 3		79	75	77

Because the sensors are so sensitive, they may detect the gas other cars are emitting when they are delayed in traffic, which might compromise the system's integrity. This can be fixed by having the system read the samples repeatedly and take action based on the average value. We think that many more people would gain from the larger-scale deployment of our suggested strategy.

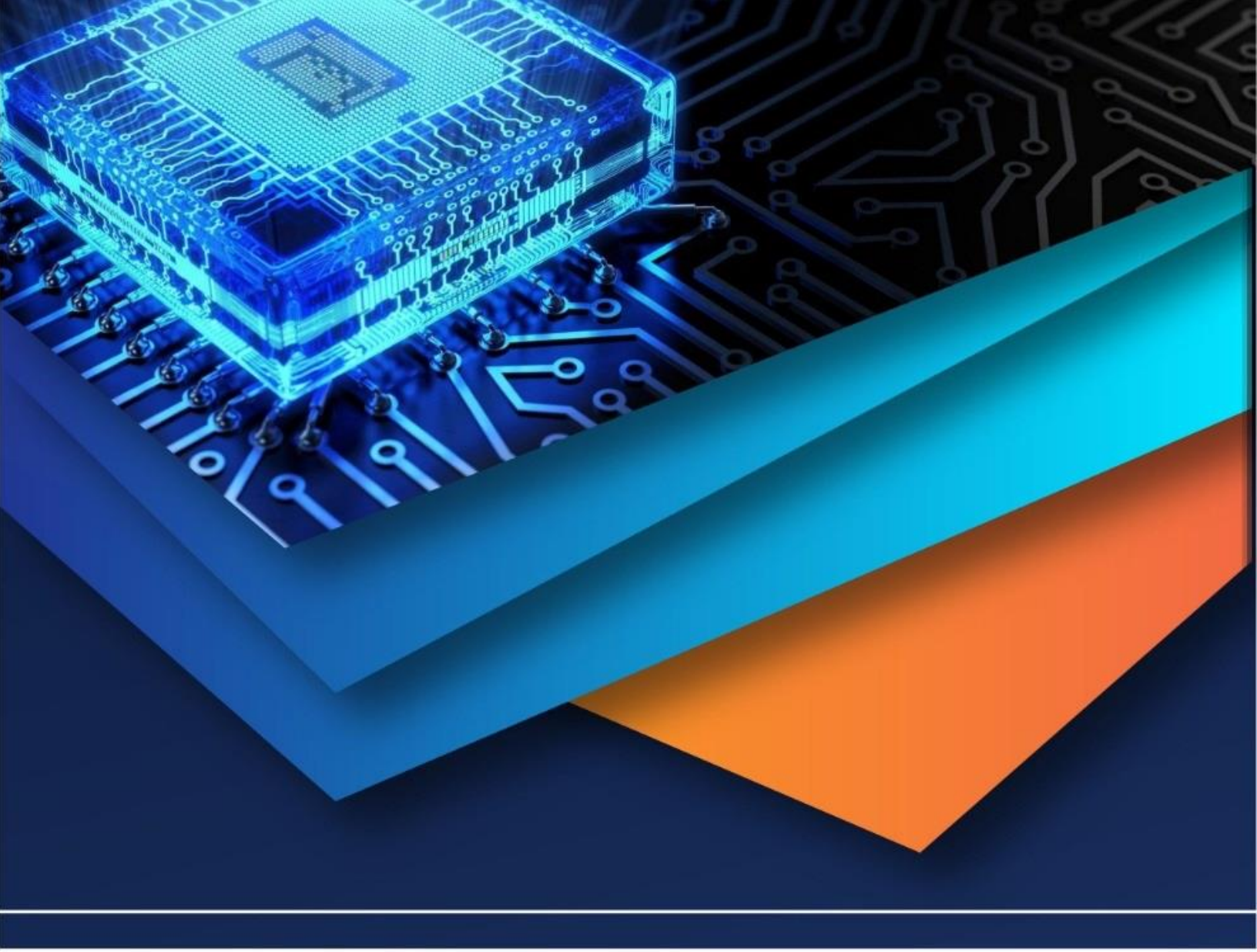
VI. CONCLUSION

In this work, we have suggested a system which will monitor pollutants and Noise caused by car. The configuration of System and Experiment outcome are detailed in full. Testing of the prototype has done well. Our proposed system is a low cost, simple to operate and portable. The created system provides superior efficiency and accuracy with less cost than the previous proposed solution. It will gradually lessen worldwide Warming if adopted on a worldwide basis.

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