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***Research Paper***



# Intelligent vehicle pollution monitoring using IoT

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## Abstract

The major source of air pollution is vehicles. The vehicular pollution is increasing day by day and smoke emission from Automobile is causing pollution and also becoming hazardous to people health. An Arduino based prototype is developed to monitor and send the information about the pollution emitted by a vehicle to competent authority. Simultaneously, if the pollution level is high then the vehicle ignition will automatically off by the system. IoT technology has made it possible to send the information about the pollution level in the form of SMS.

***Keywords***: *Automobile; Arduino; Gas Sensor; IoT; SMS.*

## 1. Introduction

### 1.1. Concept orientation

The term "Internet of things" was defined by Kevin Ash- ton of Procter & Gamble, later MIT's Auto-ID Center, in 1999 [1]. IoT Technology has been improved with the services and infra- structures to provide the basic requirements in the towns. With the enhancing IoT technology we are equipping their device with Internet of Things (IoT). IoT cuts crosswise over various applica- tion area verticals extending from non-military personnel to barri- er segments. These areas incorporate horticulture, space, medici- nal services, fabricating, development, water, and mining, which are by and by changing their inheritance framework to help IoT. Today it is conceivable to imagine inescapable network, stockpil- ing, and calculation, which, thusly, offers ascend to building dis- tinctive IoT arrangements. IoT-based applications, for example, inventive shopping framework, foundation administration in both urban and country regions, remote well-being observing and crisis notice frameworks, and transportation frameworks, are bit by bit depending on IoT based frameworks. Along these lines, it is es- sential to take in the basics of this developing innovation [2].

### 1.2. Motivations

Air contamination happens when hurtful pollutants and natural particles are brought into earth's environment. It may cause sever- al disorders in humans. It also causes harm to other living things on the earth like animals, crops and may spoil the natural calami- ties. Some of regular procedures and human exercises can create contamination noticeable all around and other normal assets like water...etc.

The real wellspring of air contamination is vehicles. There are 57. 53 lakhs of Motor vehicles in various classifications in Andhra Pradesh province of India. The vehicular contamination is expanding step by step and smoke discharge from Automobile is causing contamination and furthermore getting to be risky to individual health.

The aggregate vehicular contamination stack (VPL) in twin urban areas of Hyderabad and Secunderabad alone is 1500 T/day. Different toxins discharged into environment are definite beneath in TableI [3]. Contamination stacked by various classes of vehicles is said beneath Table 2.

The contamination benchmarks for vehicles have been specified under control 115(2). This is of Central Motor Vehicles Rules in 1989 and given in Table 3 [4]. The oil retailers introduced the BS- IV Norms [5] in India in April 2017.

**Table 1:** Different Types of Pollutants Released from Vehicles [3]

| | |
|---|---|
| CO Content | 61.4% |
| HC Content | 34.00% |
| NOx Content | 3.85% |
| SO2 Content | 0.54% |
| SPM Content | 0.18% |
| Lead Content | 0.023% |

**Table 2:** Pollution Loaded by Several Kinds of Vehicles [3]

| | |
|---|---|
| Two Wheeled | 56.2% |
| Three Wheeled | 34.00% |
| Four Wheeled Petrol | 12.00% |
| Four Wheeled Diesel | 2.00% |
| By Trucks | 18.85% |
| By Buses | 1.54% |
| Others | 0.26% |

**Table 3:** Pollution Standards of Vehicles [4]

| Vehicle Type | CO % | HC [ppm] |
|---|---|---|
| 2&3-Wheelersbefore 31/3/2000) | 4.5 | 9000 |
| 2&3-Wheelers after 31/3/2000) | 3.5 | 6000 |
| 2&3-Wheelers after 31/3/2000) | 3.5 | 4500 |
| 4- wheelers as per pre BS- II | 3.0 | 1500 |
| 4- wheelers as per pre BS- II | 0.5 | 750 |

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## 2. Intelligent vehicle pollution monitoring system

### 2.1. Working principle

The MQ135 sensor is suitable detector for detection of pollution in air. This sensor is fixed to the Arduino board. It gives the output in the form of analog signal which is proportional to the pollution level of gases. This analog signal is converted into digital by using the ADC converter.
When the ppm level in air exceeds the 1000ppm limit immediately, the intelligent vehicle pollution monitoring system sends SMS to concern authorities informing the pollution level and the location of vehicle. [6]

### 2.2. Hardware development

With the development of IoT technology we can develop a vehicle pollution monitoring system. The hardware unit to monitor the vehicle pollution is fitted in the vehicle. Whenever the vehicle starts emitting the smoke having the pollutants more than the spec- ified safe limit then the vehicle pollution monitoring system will send the SMS to nearest transport office. [7]
The offending vehicle position can be tracked by the GPS module MQ-135 benzene, alcohol, smoke MQ-2 LPG, propane, hy- drogen Air quality detector Gas leakage Identifier of the vehicle pollution monitoring system.
The block diagram of vehicle pollution monitoring system is shown in Figure 1.
The description of various hardware components required for the MQ-3 alcohol, ethanol Car alcohol alarm, breath analyzer development of vehicle pollution monitoring system is as follows:

i) GSM Module - A GSM modem is interfaced through the level MQ-5 LPG, natural gas, coal gas Gas leakage Identifier shifter IC Max232 to MC properly. The SIM card which is em- bedded in the GSM modem is used to send SMS. [8].
ii) GPS Module – This module is used to track the location of the vehicle.
iii) Arduino Board - Arduino is an open source stage and simple to utilize equipment and programming. It consists of Atmel 328p Microcontroller, Power USB, Power jack, Voltage regulator, Crystal oscillator and Reset buttons, Digital I/O, TX and RX LEDs and analog pins. In this we can program on readymade Software called Arduino IDE. These boards are read the different signals from different sensors like temperature, humidity and pres- sure. We can control the board by sending set of instructions to the microcontroller [9].
iv) MQ135 Multi Gas Sensor – This is the multi-gas sensor used monitoring air quality Monitor System. It is sensitive for benzene, alcohol, smoke. It has adjustable sensitivity and fast response and recovery. The output voltage boosts when the concentration of the measured gases increases. The specifications of MQ135 multi gas sensor is as follows:
    a) Power: 2.5V ~ 5.0V
    b) Dimension: 40.0mm * 21.0mm c. Mounting holes size: 2.0mm
v) MQ7 CO Sensor - This semiconductor gas sensor distinguishes the nearness of Carbon Monoxide at focuses from 10 to 10,000 ppm [10].This sensor identifies the groupings of CO no- ticeable all around and yields its perusing as a simple voltage. The sensor can work at temperatures from - 10 to 50°C and expends under 150 mA at 5 V [11].

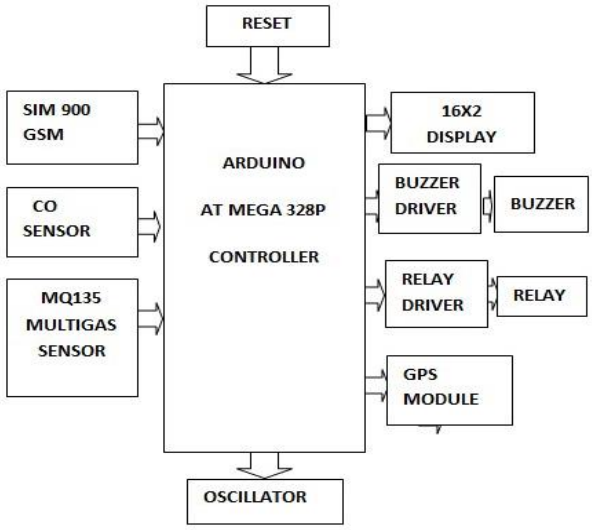



**Fig. 1:** Block Diagram of Vehicle Pollution Monitoring System.

The different gas sensors and its applications are given in Table 4.

**Table 4:** Selection of Sensors [6]

| Sensor ID | Senses Gas | Application for this sensor |
|---|---|---|
| MQ-135 | benzene, alcohol, smoke | Air quality detector |
| MQ-2 | LPG, propane, hy- drogen | Gas leakage Identifier |
| MQ- 3 | Alcohol, ethanol | Car alcohol alarm, breath analyzer |
| MQ-5 | LPG, natural gas, | Gas leakage Identifier |
| MQ-7 | ccoalgaarbon monox- ide | Carbon monox- ide Detector |

## 3. Lab environment

The operational flow chart for the development of software for intelligent vehicle pollution monitoring system is shown in Figure 2.

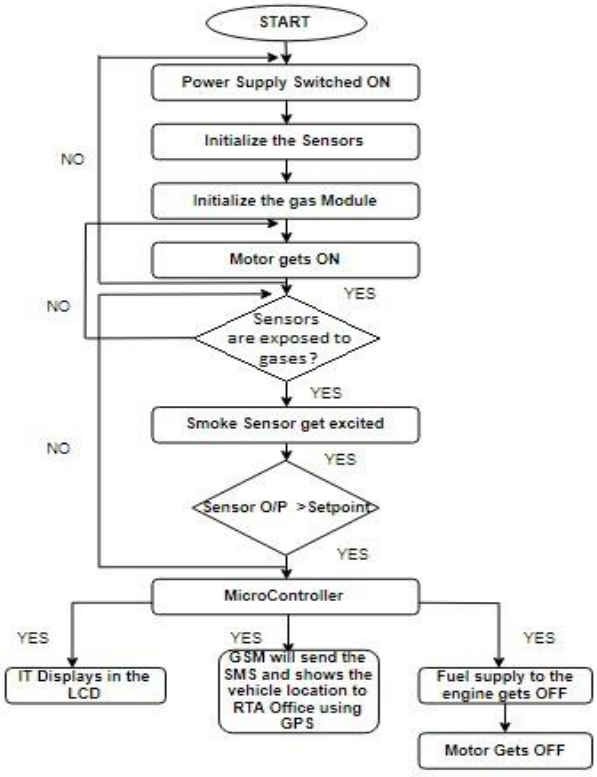



**Fig. 2:** Operational Flow Chat for Intelligent Vehicle Pollution Monitoring System.

The various states in which the system transition takes place while performing the desired operation are described in following steps:
Step-1: First we start the power supply ON. By this it initializes the Sensors and Gas modules that are present in the system. Then the motor gets ON.
Step-2: If the motor does not ON. Then, it again goes to the STEP-1
Step-3: If the motor is in ON state then sensors are exposed to the gases. If not again goes to STEP-2.
Step-4: If it is done smoke sensors are active.
Step-5: Now these sensors start compared to given ppm value. If not again goes to STEP-3.
Step-6: This message is send to the controller then the controller does three tasks simultaneously

a) This level is displayed on LCD.
b) Message will send to the given mobile number with the help of GSM Module.
c) Finally the motor gets OFF and the position and location is send to the RTA Pollution Control Board.

## 4. Results

The prototype of intelligent vehicle pollution monitoring system is shown in Figure 3.
The prototype is developed in IoT lab of Department of Electronics and Computer Engineering at K L University, Guntur, Andhra Pradesh (India).
The source code developed for the intelligent vehicle pollution monitoring system is available with the authors.

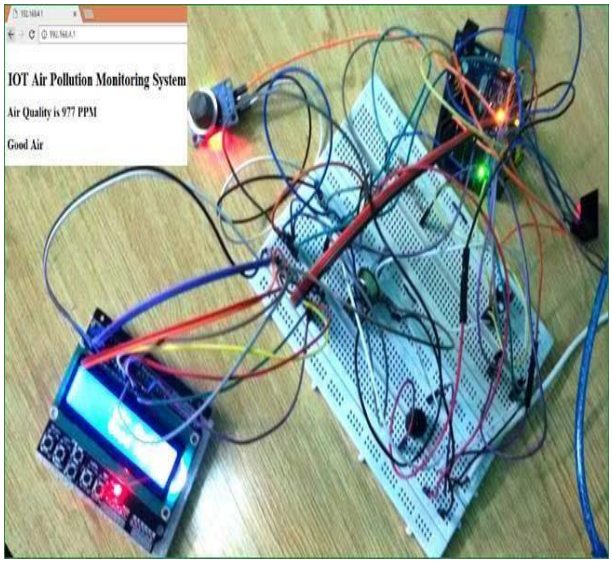



**Fig. 3:** The Prototype Model of Intelligent Vehicle Pollution Monitoring System.

## 5. Conclusion

It has been tested when the pollution level crosses the limit of 1000ppm, an SMS message is sent displaying the pollution level and location of the vehicle. Simultaneously the ignition of the vehicle is off.
There are enormous populations, who don‟t look out of the pollution from their vehicles seriously. Therefore proposed system will be extremely helpful in bringing the pollution emission level and exact location of the vehicle to the authorities.

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