

Smart IoT Based System For Vehicle Noise And Pollution Monitoring

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Abstract

According to population Reference Bureau, the current world population is 7.4 Billion. At present, a total number of the vehicle is 1.2 Billion according to survey and it will be 2 Billion up to 2035. Transportation contributed more than half nitrogen oxide and carbon monoxide and a quarter of the hydrocarbon emitted in air. Cars and trucks turn out pollution throughout their life, as well as pollution get emit throughout the vehicle operation, refueling, producing, and disposal. Due to heavier traffic and powerful engines, noise level in cities is rapidly increasing. Our proposed system provides the solution to these problems with the help of internet of things. Our system Monitor the pollution and noise created by vehicle and if any vehicle crosses its threshold value then it will get reported to the traffic department and agencies of national environment.

Keywords: Internet of Things, Noise, Sensors, Vehicle, Pollution Measurement, Radio frequency identification

1. Introduction

The main source of air pollution and noise pollution is transportation. About 100000 premature adult deaths attributable to air pollution occur each year in. Some 40 million people in the 115 largest cities in the European Union (EU) are exposed to air exceeding WHO air quality guideline values for at least one pollutant[1]. Transport is the fastest growing source of fossil-fuel CO₂ emissions, the largest contributor to climate change. In the 25 EU countries in 2004, transport accounts for approximately 35% of total energy consumption, resulting in a 20% net increase in greenhouse-gas emissions over the past decade, due to a rise in transport volumes that outweighs improvements in vehicle efficiency[1]. Gases Emitted by vehicles are Carbon monoxide, nitrogen oxide, and sulphur dioxide. Our proposed system provides the solution to this problem with the help of internet of things.

The Internet of Things is the internetworking of physical devices, buildings, vehicles and other items embedded with electronics, sensors, software, actuators and network connectivity that enable each object to collect and exchange Data. In this paper, the semiconductor sensors have been used to detect the pollutant level. Our proposed model Concentrates mainly on two things:-

A) Pollution generated by vehicle

B) Noise Generated by vehicle

Our proposed system uses an MQ-7 and MQ-2 sensor to detect carbon monoxide and sulphur dioxide. Our system uses microcontroller name raspberry pi to compares the level of Pollutants with the stipulated level allowed by the Government. When pollutant level exceeds the fixed threshold value, traffic department and agencies of national environment will get notify. Due to heavier traffic and powerful engines, noise level in cities is rapidly increasing. Vehicle makes the noises because of trying to start the car with bad battery, valves tapping, Engine running without oil, Engine seizing up, lifter adjustment, piston slapping, and tranny slipping. Combustion engines are used by most of the vehicles on the road. It creates a sound of 16.7 Hz fundamental frequency and many harmonics. Loud noises have the foremost visible impact in terms of stress, loss of hearing and anxiety. Our proposed system also measure the Noise generated by vehicle using the SEN-12642 sensor.

2. Related Work

Author introduced a system which is capable of detecting vehicles causing pollution on the city roads and measures various types of pollutants, and its level in the air. After collecting data about air quality data will be forwarded to environmental agencies[2]. System proposed by author measures the gas level of air contamination in the cities. In their proposed work

MANET(Mobile Ad Hoc Network) routing algorithm is used. It has nearly 28 mobile nodes. It provide a coverage area of 300 meters around the city[3]. Author proposed a Distributed emission monitoring system. This system we will automatically detect volume, type, and speed of automobile by using the camera[4] .Author deployed WSN nodes for constant monitoring of the air pollution around the city and the moving public transport buses and cars[5]. The author proposed system is used to monitor air pollution on roads and track vehicles which cause pollution over a specified limit. Increasing number of automobiles is a serious problem that has been around for a very long time[6].

3. Components of System

3.1 Raspberry Pi 3

The Raspberry Pi is a series of credit card-sized single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries[7]. As compared to raspberry pi2 it has

- A 1.2ghz ARM v8 CPU
- Bluetooth 4.1
- 802.11n Wireless LAN
- Bluetooth Low Energy (BLE)

3.2 GSM Module

SIM900A Dual band GSM /GPRS MODULE is built with Dual Band GSM/GPRS engine- SIM900A, works on frequencies 900/ 1800 MHz The Modem is coming with RS232 interface, which allows you connect PC as well as microcontroller with RS232 Chip(MAX232). The baud rate is configurable from 9600-115200 through AT command. The GSM/GPRS Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. It is suitable for SMS, Voice as well as DATA transfer application in M2M interface[8]. Raspberry pi uses GSM module to send data to cloud server.

3.3 MQ-7 Sensor

Our proposed system uses the MQ-7 sensor to detect carbon monoxide concentration in air. The MQ-7 gas sensor is composed of the micro AL2O3 ceramic tube, Tin Dioxide (sno2) sensitive layer, measuring electrode and heater are fixed into a crust made of plastic and stainless steel net.CO sensor can measure a concentration of 10 to 10,000ppm.

The reason to choose MQ-7 sensor is

- It has high sensitivity to carbon monoxide.
- It is stable and has a long life.

3.4 MQ-2 Sensor

Our proposed system uses the MQ-2 sensor to detect H2, LPG, CH4, CO, Alcohol, Smoke or Propane. The output is in the analog form but it can be read using a raspberry pi. The MQ-7 gas sensor is composed of the micro AL2O3 ceramic tube, Tin Dioxide (sno2) sensitive layer, measuring electrode and heater are fixed into a crust made of plastic and stainless steel net.

The reason to choose MQ-2 Sensor:

- It has good sensitivity to combustible gas in a wide range.
- Its cost is low and has a long life.

3.5 Noise Sensor

Our proposed system uses the SEN-12642 sensor to detect a noise in the vehicle. It's small in size and cost is low. The Sound Detector provides an audio output, a binary indication of sound, and an analog representation of its signal amplitude. All these outputs are independent. Gain can be adjusted with a through-hole resistor, to change the threshold of the binary (gate) output pin as well.

3.6 RFID Reader And Tag

Our proposed system uses EM-18 RFID reader and tags. Radio frequency identification is a technology which uses tags as a component in a solution set. RFID tags contain a chip which holds an electronic product code(EPC)number that point to additional data detailing the contents of the package. Readers identify the EPC number at a distance, without line f sight scanning or involving physical contact. Middleware can perform initial filtering on data from the readers[9].

3.7 Cloud Server

A cloud server is a logical server that is built, hosted and delivered through a cloud computing platform over the Internet. Cloud servers possess and exhibit similar capabilities and functionality to a typical server but are accessed remotely from a cloud service provider[10].

4. Configuration of System

Our proposed system contain raspberry pi3, GSM module, MQ-7 sensor, MQ-2 sensor, sen-12642 sensor, RFID reader and tag and cloud server as shown in Fig 1.

When the vehicle gets the start, the actuator will power ON raspberry pi. Raspberry pi will initialize all sensors and convert the analog data. Each car will have one unique ID associated with it. We have set threshold time as 20minutes.After every threshold time, Raspberry pi will send information sensed by the sensor to the traffic department and agencies of national environment. All information sensed by the sensor is stored in a cloud server.Our system will use GSM module to send the data.RFID tag will be assigned to each car. Whenever the car passes through a sensor node, RFID reader will detect the vehicle.RFID reader will be fixed at each traffic signal pole.

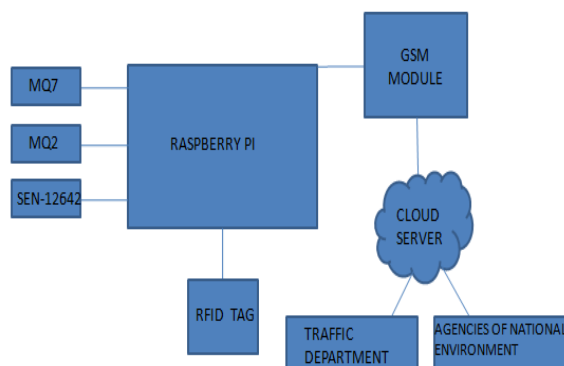


Fig. 1.Configuration of System

Our proposed system uses the LED and Display Screen at the backside of the car. If the gas emitted by car crosses the threshold value then that LED will turn into RED otherwise it will be green. Gas sensed by MQ-7 and the MQ-2 sensor will be displayed on Display screen. The noise level of the car will also be displayed on display screen.

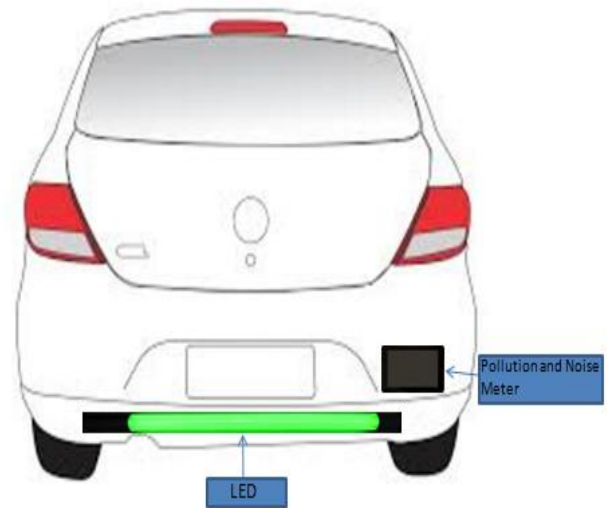


Fig. 2.Sensor Indicator

The primary source of sound in a vehicle's engine is the engine cylinder where the combustion takes place. The fuel and air are mixed together (SI engines) or the air is compressed fuel is injected into it (CI engines) and ignited which is instrumental in producing the sound. Apart from these sounds, there are various other sounds like the whine of the turbocharger, turning over of the starter motor etc. In our proposed system, Noise sensor is fixed at Near the Engine. Noise Limit for vehicles provided By Government of India:-

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

5. Experimental Analysis

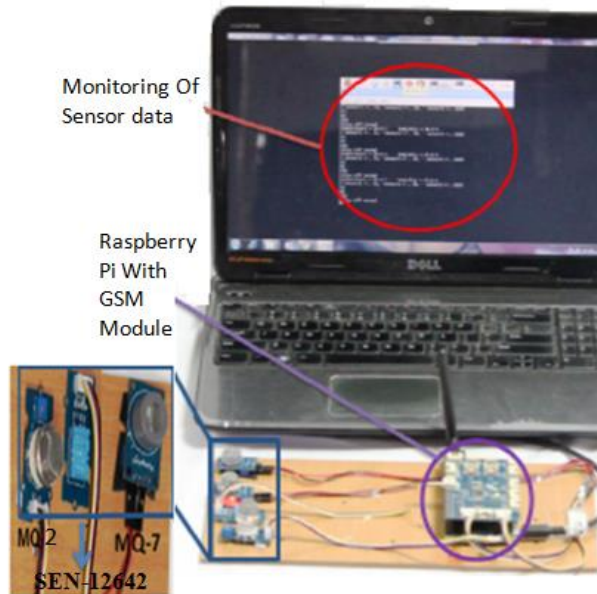


Fig. 3.Experimental Setup

To test the prototype, we deployed our system setup in the vehicle. All sensors started reading data simultaneously. The data has been collected by using the microcontroller. The data gathered by sensors are shown in tables. Some calibration is required for each sensor before obtaining the pollution level.

TABLE I 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

The Sensors are very sensitive that it can sense the gas emitted from other vehicles while stuck in Traffic which can disturb the integrity of the system. This can be overcome by reading the samples over a period of time and then based on the average value the system will take an action. We believe that implementation of our proposed system on a larger scale would benefit a large number of people.

6. Conclusion

In this paper, we have proposed a system which will monitor pollution and Noise created by vehicle. The configuration of System and Experiment result are discussed in length. Testing of the prototype has done successfully. Our proposed system is a low cost, simple to operate and portable. The developed system provides better efficiency and accuracy with low cost than the existing proposed system. It will gradually reduce Global Warming if implemented on a global scale.

7. References

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