



IOT based Vehicle Emission Monitoring System using Raspberry Pi

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ABSTRACT: This paper presents automated control system for air pollution detection in vehicles. In present day modern Vehicles have become a part of every one's life. Every vehicle has its own emission of polluting gases, but the problem occurs when the vehicles do not get serviced regularly and the emission is beyond the standardized value. As the usage of vehicles is more in these days, pollution is increasing drastically. As a solution to the above problem we aim to build an integrated system for controlling the pollution in vehicles. The main side effects are being air pollution. Each and Every vehicle will have emission but the main problem occurs in the case when it is beyond the standardized values fixed by the pollution control board of India. The main reason behind this breach of emission level being the incomplete combustion of fuel supplied to engine, which is due to the improper maintenance of vehicles. This emission from vehicles cannot be completely avoided but, it definitely can be controlled.

KEYWORDS: Air Pollution, GPS, GSM, Raspberry Pi, Sensors

I. INTRODUCTION

The beginning of the 21st century was the time when importance for Environmental awareness was instigated. One of the major concerns regarding the environment is air pollution which is a major problem that the mankind is facing [3]. In many urban areas, motor vehicles are the single largest contributor to ground-level ozone which is a common component of smog. Pollutants cause coughing; wheezing and shortness of breath; also, the pollutants from the vehicles are known to damage lung tissue etc. So, in order to mitigate this problem, it becomes quite mandatory to detect these gases and keep a regular check on the pollutants that are being emitted from the vehicles. The release of these pollutants such as oxides of carbon and nitrogen can be detected with the help of smoke sensors. [1] Tracking systems are widely used to keep an eye on the moving objects. In India public transportation vehicles are the primary mode of transportation. The public transportation vehicles are always vulnerable targets for various crimes. It is required to monitor such antisocial activities. It can be done by using surveillance systems such as global positioning system. GPS system can observe the vehicle activities twenty-four-seven. Most of the vehicle tracking applications are developed using GPS technology. [2] GPS technology is widely used to verify the status of a moving object on which GPS receiver is mounted. This system uses GPS and GSM technologies. [5] This system tracks the pollution levels using Smoke sensor and the data from GPS module is sent to the server using TCP/IP protocol so that the location of the vehicle can be traced by the RTO (Cloud). The paper includes the hardware part which comprises of GPS, GSM, Raspberry Pi, ADC (MCP3008 CHD), 16x2 LCD.

II. RELATED WORK

The paper [1], describes a vehicle tracking system is an electronic device designed with the computer software enables the owner or a third party to track the vehicle location. A location defined using GPS technology is almost



accurate to obtain the real vehicle location. Vehicle monitoring system can be implemented using GPS technology; therefore, it effectively reduces the vehicle management cost. This paper provides a solution for tracking and monitoring the public transportation vehicles. In this method GPS technology is used to obtain the location of the vehicle using the space-based navigation system. Raspberry Pi processing board is used which processes the received values and gives the final output. This method explains a way to monitor the public transportation vehicle from the location A to location B. Raspberry Pi processor compares the passenger specified values with the current location values therefore if the result is not the same then passenger is informed about the same.

The paper [2], describes a GPS is one of the technologies that are used in a huge number of applications today. One of the applications is tracking your vehicle and keeps regular monitoring on them. This tracking system can inform you the location and route travelled by vehicle, and that information can be observed from any other remote location. It also includes the web application that provides you exact location of target. This system enables us to track target in any weather conditions. This system uses GPS and GSM technologies. The paper includes the hardware part which comprises of GPS, GSM, Atmega microcontroller MAX 232, 16x2 LCD and software part is used for interfacing all the required modules and a web application is also developed at the client side. Main objective is to design a system that can be easily installed and to provide platform for further enhancement.

The paper [3], describes in present day modern world Vehicles have become an part and parcel of every one's life. Situations and circumstances have their predominant role in the usage of vehicles in this modernized urban life. As to consider both sides of the coin, this has its own effects, one of the main side effects being air pollution. Each and Every vehicle will have emission but the main problem occurs in the case when it is beyond the standardized values fixed by the pollution control board of India. The main reason behind this is breach of emission level being the incomplete combustion of fuel supplied to engine, which is due to the improper maintenance of vehicles. This emission from vehicles cannot be completely avoided but, it definitely can be controlled. With the evolvment of semi-conductor sensors for detecting the various gases, this paper aims at using those semi-conductor sensors at the emission outlets of vehicles which detects the level of pollutants and also indicates this level with a meter. When the pollution/ emission level shoots beyond the already set threshold level, there will be a buzz in the vehicle to indicate that the limit has been breached and the vehicle will stop after a certain period of time, a cushion time given for the driver to park his/her vehicle. During this time period, the GPS starts locating the nearest service stations. After the timer runs out, the fuel supplied to the engine will be cut-off and the vehicle has to be towed to the mechanic or to the nearest service station. The synchronization and execution of the entire process is monitored and controlled by a micro controller. This paper, when augmented as a real time project, will benefit the society and help in reducing the air pollution.

The paper [4], describes Wireless sensors are used in most of the in real time applications for collecting physical information. The impossible measurements in typical ways have currently become attainable using the wireless technology. In this technology, the measurement of air quality is one of the difficult areas for the researchers. The main source of atmosphere pollution happens due to vehicles. The high in flow of vehicles in urban areas causing more air pollution and decreasing air quality that leads to severe health diseases. The main objective of the paper is to introduce vehicular pollution monitoring system using Internet of Things (IoT) which is capable of detecting vehicles causing pollution on the city roads and measures various types of pollutants, and its level in air. This paper also reports the status of air quality when ever needed to the environmental agencies. The proposed systems also assure the existence of wireless sensors for vehicle pollution system that specialize in a straight forward accessibility of real time data through internet using IoT. The measured data is also shared to vehicle owner, traffic department and agencies of national environment. This system is a low cost and provides good results in controlling the air pollution especially in the urban areas.

III. PROPOSED SYSTEM

The proposed system [5] for the given paper mainly consists of following components:

1. Raspberry Pi
2. GPS
3. GSM
4. Smoke Sensor
5. LCD (16*2)
6. Motor Driver
7. ADC (MCP3008 CHD)



Firstly, the detector will detect the smoke level and send the values to the microcontroller, then an alarming message will be displayed in the screen and owner's mobile that the vehicle is going to stop after 1KM. Then after the vehicle has stopped the GPS will track the GPS values and it will be sent to the RTO (Cloud).

3.1 HARDWARE DESIGN

1. **Raspberry pi:** Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games. It is a small, inexpensive, and programmable computer created by the Raspberry Pi Foundation. It has the ability to interact with the outside world, and has been used in a wide array of digital maker projects. Raspberry Pi 3 consists of 4 USB ports, Ethernet port, 3.5 mm audio output and composite video, CSI (Camera Serial Interface), HDMI (High-Definition Multimedia Interface), Micro USB Power Input, Red Power LED, Green Activity LED, DSI (Display Serial Interface), Bluetooth/WIFI Antenna, 40 GPIO (General Purpose Input / Output) pins.



Fig.1: Raspberry Pi

2. **GPS:** A GPS antenna is a device that boosts the received signal to a GPS unit, whether it is a standalone unit or an embedded unit. GPS antenna can transmit and receive signals. It can contact the positioning satellites in the sky through the transmitting signals so that the satellites will be able to know the situation of the user. Often a GPS antenna is used in a situation where the GPS unit itself is somehow removed from a line of sight to the sky. The GPS antenna simply receives the electromagnetic signals from the satellites. To convert the electromagnetic signals to digital values we need a GPS receiver unit. This GPS receiver unit stores the GPS data onto an SD card.



Fig.2: GPS sensor



3. **GSM:** Whenever the GPS starts showing the location, then the GSM module automatically sends the GPS values on the server. This happens only when the fuel supplied to the engine stops and the car cannot move further. The GSM module also sends two warning messages to the driver before the fuel supplied to the engine is cut off. The values received on TCP/IP server is an alerting message for the RTO to keep a track on the vehicles emitting pollutants. In this paper, GSM SIM800 is used. This GSM Modem accepts any GSM network operator SIM (Subscriber Identity Module) card having strong network thus behaving like a mobile phone as it has its own unique number. It uses an RS232 port for serial communication. It is a wireless modem which is developed for the communication between the computer and the GSM/GPRS network. A GSM MODEM can perform the following operations:
 - a. Receive, send or delete SMS messages in a SIM.
 - b. Read, add, search phonebook entries of the SIM.
 - c. Make, Receive, or reject a voice call.



Fig.3: GSM module

4. **Smoke Sensor:** A Smoke Sensor is a device that senses smoke, typically as an indicator of fire. Commercial security devices issue a signal to a fire alarm control panel as part of a fire alarm system, while household smoke detectors, also known as smoke alarms, generally issue a local audible or visual alarm from the detector itself or from a number of detectors if there are multiple smoke detectors interlinked.



Fig.4: Smoke sensor

5. **LCD (16*2):** LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors and instrument panels.



Fig.5: LCD display

6. **Motor Driver:** A motor controller is a device or group of devices that serves to govern in some predetermined manner the performance of an electric motor. A motor controller might include a manual or automatic means for starting and stopping the motor, selecting forward or reverse rotation, selecting and regulating the speed, regulating or limiting the torque, and protecting against overloads and faults.

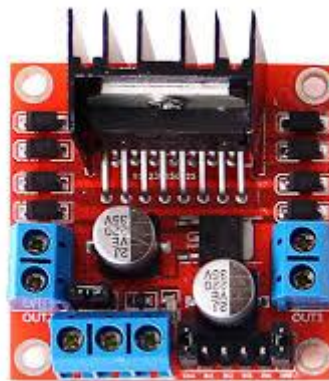


Fig.6: Motor Driver

7. **ADC (Analog to Digital converter):** Analog to Digital converter is a system that converts an analog signal, such as a sound picked up by a microphone or light entering a digital camera, into a digital signal. An ADC may also provide an isolated measurement such as an electronic device that converts an input analog voltage or current to a digital number representing the magnitude of the voltage or current. Typically the digital output is a two's complement binary number that is proportional to the input, but there are other possibilities.

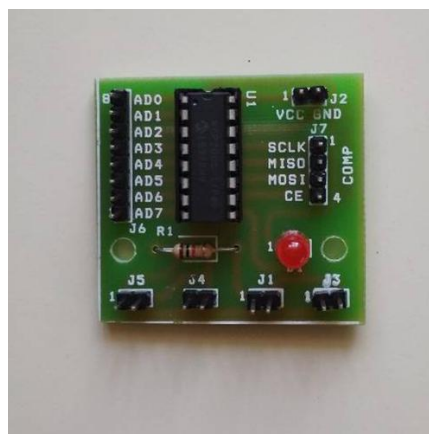


Fig.7: ADC module



3.2 SOFTWARE DESIGN

1. **Raspbian Operating System:** Raspbian is a free Operating system for Raspberry Pi board. Raspbian has all the necessary packages to run the Raspberry pi board. The operating system for Raspberry Pi is stored in a well- formatted SD card. This SD card is connected to the SD port of Raspberry Pi in order to load the Operating System when power supply is ON. Raspberry Pi can run on both windows and Linux Operating systems.
2. **Putty:**Putty is a free and open-source terminal emulator, serial console and network file transfer application. It supports several network protocols, including SCP, SSH, Telnet, rlogin, and raw socket connection. It can also connect to a serial port. The name "PUTTY" has no official meaning.
3. **Python language:**Python is an interpreted, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991, Python's design philosophy emphasizes code readability with its notable use of significant whitespace. Its language constructs and object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects.

IV. SYSTEM ARCHITECTURE

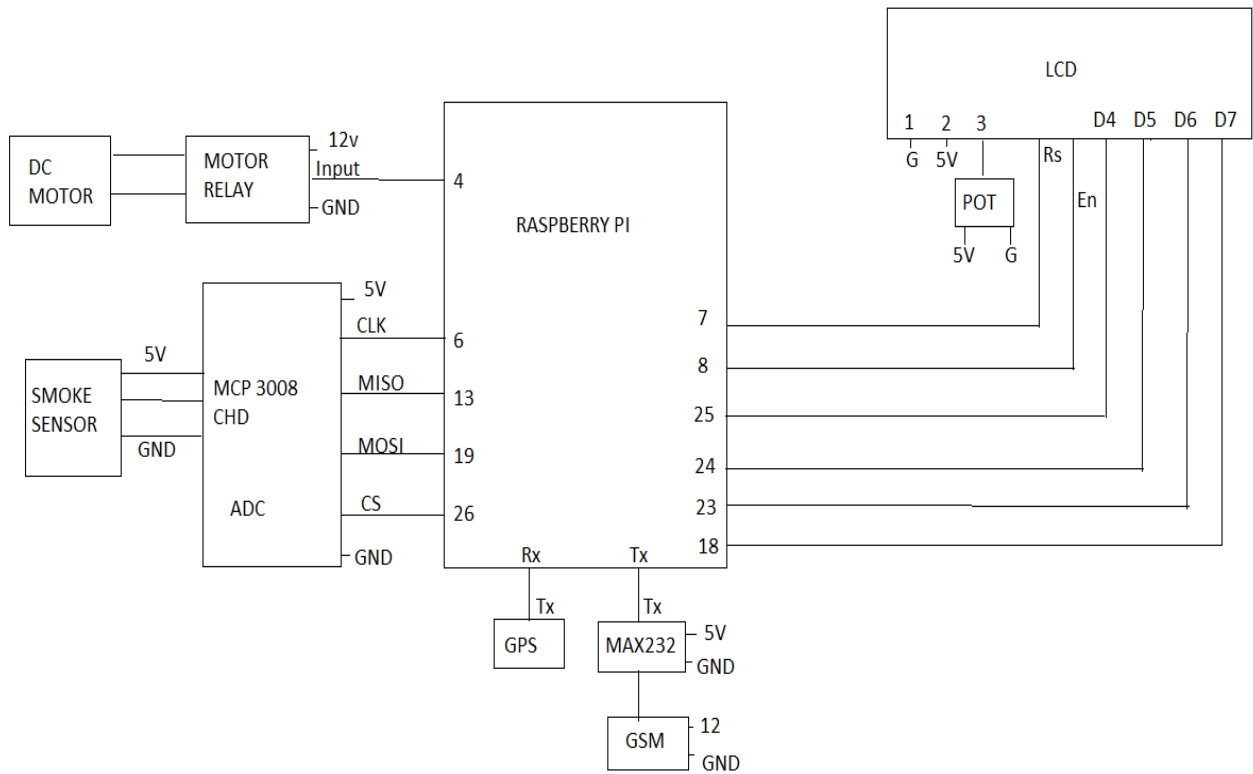


Fig.8: System Architecture

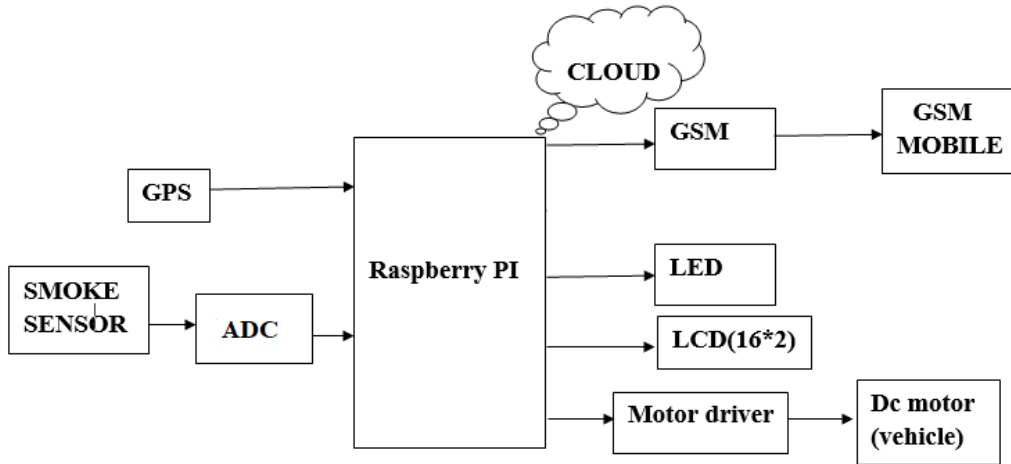


Fig.9: Block diagram of the proposed system

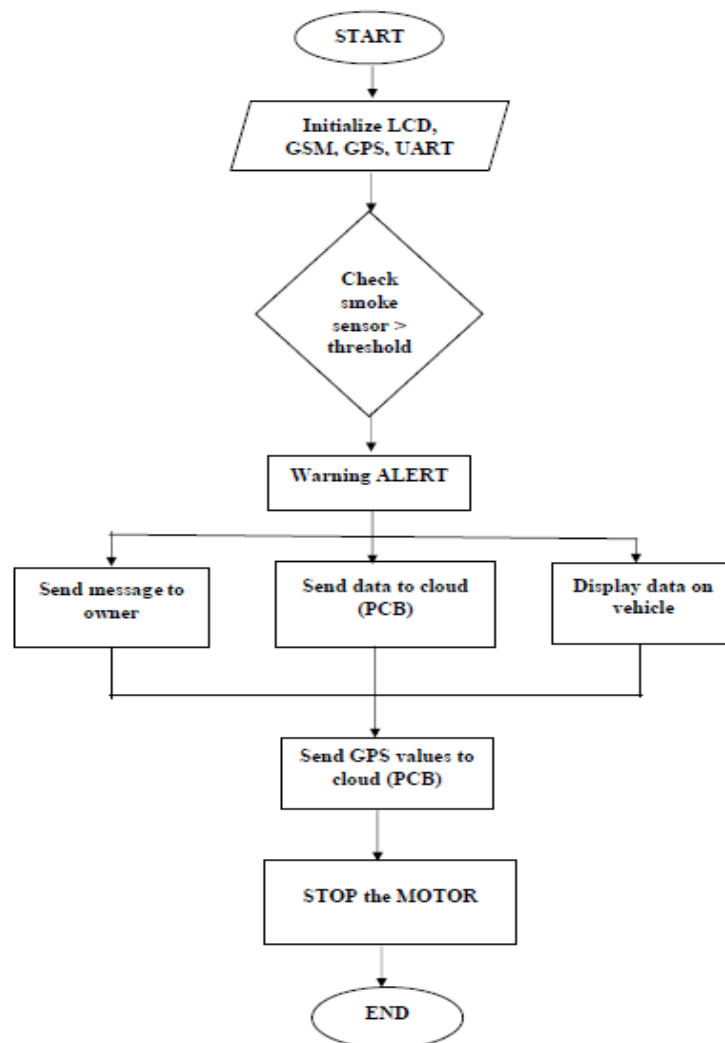


Fig.10: Flow chart of the system

The software implementation of the proposed system is developed using the flowchart as shown in Fig 9 based on architecture as shown in Fig 8.



V. RESULTS

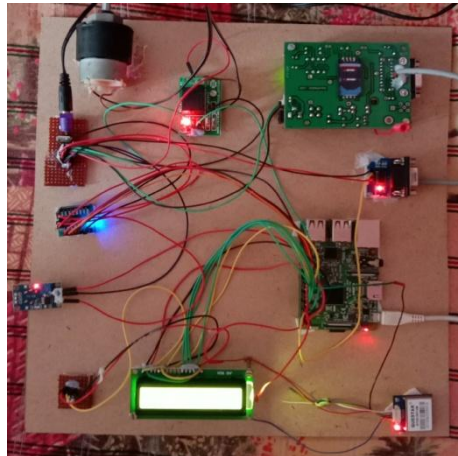


Fig.11: Overall view of the system



Fig.12: Power supply given to Raspberry Pi



Fig.13: LCD display when system starts



Fig.14: Smoke sensor readings displayed on LCD



Fig.15: Warning Message On LCD Screen



Fig.16: Final Warning Message on LCD Screen

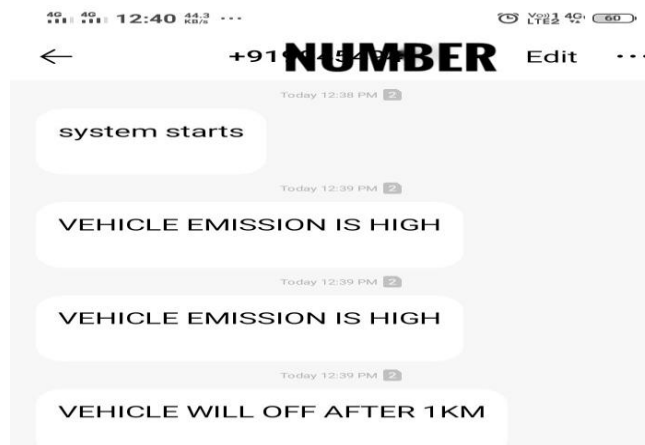


Fig.17: Warning Messages sent to users phone number

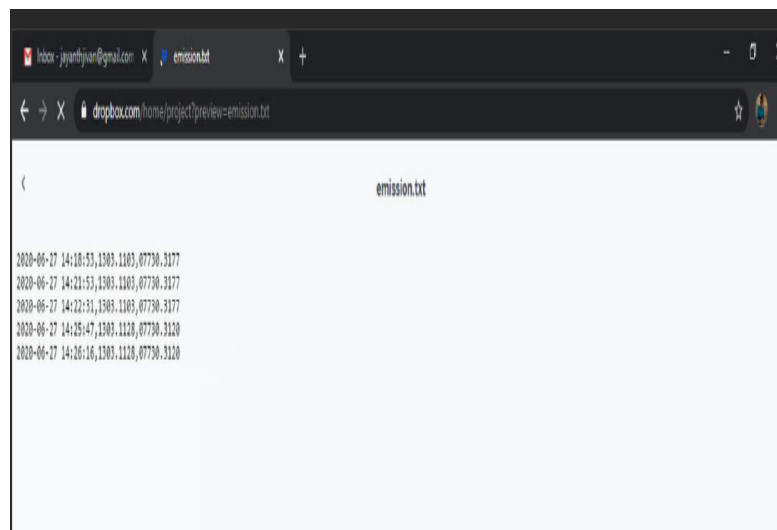


Fig.18: GPS values sent to Cloud

VI. CONCLUSION

There has been an increase in the level of air pollution over the past decades, and tremendous use of vehicles emitting pollutants is one of the main causes for the rise in pollution. So, this proposed system will help us to mitigate this problem which in turn will result in maintaining eco-friendly environment. This paper broadens the horizons in all aspects of engineering as its various facets deals with Embedded system, Wireless Communication and Networking. Having achieved the desired objective, the system can be very useful as it curbs the problem by creating an awareness regarding this issue amongst the people. The environmental pollution caused due to the emission of gases like carbon monoxide and nitrogen oxide emitted from vehicle exhaust need to be reduced in order to save our environment. The proposed system provides the best solution to monitor the gases emitted from the vehicle exhaust to increase the life of the vehicle and to reduce environmental pollution. This whole project mainly focuses on two things. The First thing is the concept of detecting the Pollution and indicating it to the driver. There is an increase in the level of Pollution over the last couple of decades, leading to several Environmental problems. So, this system will be highly beneficial in curbing this problem. The second reason is that this system will be one of the greatest improvements in technology to keep the Environment free from vehicular emission and bring it to a halt if the Pollution level is more than the Standards mentioned by the Government.

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