IoT based vehicle emission monitoring system

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ABSTRACT

In the world, there are many problems regarding to the pollution. One of the major problems is air pollution. The air pollution has been increasing because of more uses of the vehicle. Through the vehicle CO (Carbon Monoxide), HC (Hydrocarbon) are emitted which leads to global warming and it also affects animals and human health. If the vehicle is not maintaining properly then the amount of smoke will get increase, which leads to increase in pollution. For this problem the solution is, we have developed a system i.e. Vehicle Emission Monitoring System that monitors the pollution exhausted from the vehicle. This system is based on IoT (Internet of Things). This system will be placed in the vehicle and starts monitoring when the vehicle's engine get starts. The threshold value will be set according to the threshold value of PUC (Pollution Under Control) Center. When the exhaust value crosses about the threshold value alert message is send to the owner of the vehicle. The system consists of Arduino Mega 2560, CO sensors, HC sensors, air quality, GSM.

Keywords— Arduino Mega 2560, GSM, LCD, Sensors, Buzzer

1. INTRODUCTION

In today's world we are facing a lot of problems of air pollution. Due to more uses of the vehicles, pollution has been increasing. Various types of toxic gases emitted from the vehicle, which are harmful for our environment. More than 50% of carbon monoxide in the atmosphere comes from transportation. Carbon monoxide in the atmosphere reduces the capability of blood in carrying oxygen. Hydrocarbon affects the brain, heart, kidney and bone marrow. NOx affects the lung and causes a respiratory problem. In the era of urbanization due to the rapid increase in an automobile vehicle, it is difficult to inspect all the vehicles. It requires a lot of man force to inspect all those vehicles. IoT is a new technology which is used in industry and in education level. IoT technology has evolved from the convergence of wireless technologies, microelectromechanical systems, micro services and the internet. This paper specially designs to operate the system which will monitor the vehicle emission through sensors. When the value of the smoke exhausted from user's vehicle goes above the threshold value, then alert message will go to the user as well as the buzzer will ring. Then the user should do repairing of the vehicle otherwise the emitted gases will affect the environment. If the user does not repair his vehicle after sending messages for more than two times, then the third time message will go to user as well as pollution control board.

2. METHODOLOGY

In order to develop the vehicle emission monitoring system (VEMS) we are focusing on overcoming the environmental issue. That will help the user to know the reading of smoke emitted by the vehicle. The VEMS contains CO sensor, Hydrogen sensor, NO sensor placed at the vehicle exhaust, monitor the hydrocarbon, monoxide and nitrogen oxide value emitted from the exhaust. The analog value is received from the sensors is processed by the controller with wifi connection to the internet. The value obtained from the sensors is continuously updated and seen on LCD display. When the value from the sensor reaches the threshold limit, the controller will alert to the user through alert message to the vehicle owner. When the vehicle owner ignores two or three times, the alert message will be shared with the pollution control board.

3. PROPOSED SYSTEM

The Vehicle Emission Monitoring System mainly consists of Arduino, Sensors, GSM module, LCD, Pollution Control Board, Wi-Fi module, etc. Arduino is used for controlling overall system architecture. The Sensor will sense the amount of smoke emitted by the vehicles. Different sensors like the gas sensor, CO sensor, H2 sensor sense the amount of gas emitted from vehicles. Further, this information is forwarded to Arduino. If gas limit cross threshold value then Arduino sends the alert message to the respected user as well as the buzzer

gives the alarm to the user. LCD is used for displaying overall readings.
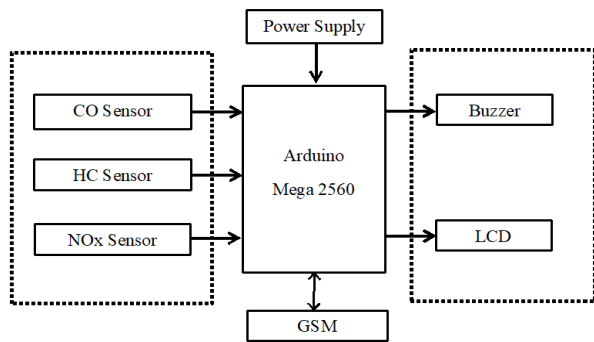

Fig. 1: Architecture Diagram

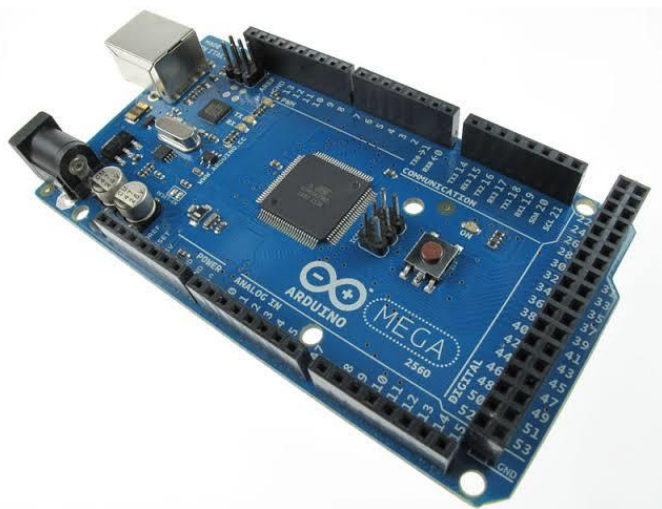### 3.1 Arduino Mega 2560

Fig. 2: Arduino Mega 2560

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila.

3.2 GSM/GPRS

Fig. 3: GSM/GPRS

This module Global System for Mobile Communication uses as verity of TDMA (Time Division Multiple Access) and is the three digital wireless technology such as TDMA, CDMA. It digitizes and compresses data and operates at either 900MHz or 1800MHz frequency band. GSM is used to send the message for users as well as government transport policy.

3.3 Hydrocarbon Sensor

Fig. 4: MQ-2 (Hydrocarbon Sensor)

MQ-2 sensor detects the presence of HC (hydrocarbon gases) (methane, propane and n-butane) at concentrations from 3000 to 10,000 ppm. measuring hydrocarbon gases is important for pollution monitoring. It has 4 pins power, ground, digital and analog output. The sensitivity of the sensor can be varied by the on-board trimmer. The sensor can operate at temperatures from -20 to 50-degree Celsius.

3.4 Carbon Monoxide Sensor

Fig. 5: MQ-7 (Carbon Monoxide Sensor)

MQ-7 sensor is used to detect CO (Carbon Monoxide) from 20 to 2000 ppm. the sensitivity of the sensor can be adjusted by using a potentiometer. It has 4 pins (power, ground, digital and analog output). The output is directly proportional to the density of Carbon monoxide gas. The data from the sensor is in terms of analog output.

3.5 Air Quality Sensor

Fig. 6: MQ-135 (Air Quality Sensor)

SnO2 is a sensitive material used in MQ135 gas sensor. Which has lower conductivity in clear air, when the concentration of gas gets increase its conductivity also gets increase. It has high sensitivity to Sulphide, Ammonia, Benzene steam and also sensitive to smoke. It is used to detect gases from a concentration of 10 to 10,000 ppm.

4. REQUIREMENTS
Following would be the technical requirement to develop our system:

Software:
• Operating System- Windows 10(64bit)
• IDE Android Studio: 3.2.1
• Arduino Software
• Language- Embedded C Language

Hardware:
• Arduino Mega 2560
• Sensors:
    (a) CO Sensor (Carbon monoxide)
    (b) HC Sensor (Hydro-carbon)
    (c) NOx Sensor (Air Quality)
• GSM Module
• Buzzer
• LCD Screen

5. CONCLUSION
Vehicle Emission Monitoring System not only efficiently takes a advance in environmental quality, but it also helps vehicle owner to save a lot of unnecessary troubles compared to the traditional emission test. This system shows all the value of gases exhausted from the vehicle to the owner.

6. REFERENCES
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