Pollution Free Smart Cities using Smart Monitoring System by Employing WSN on Vehicles

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Abstract- *Today all parts of the globe are under threat from air pollution which occurs due to CO, NOx and HC. These pollutants are the major degradation factor of the environment. In order to reduce the pollution, a pollution-control system is an idea to counter the negative effects of the vehicular pollution.*

The objective of this paper is to measure the percentage of pollutants emitted by an automobile and monitor it by attaching a monitoring device on a vehicle which will provide live feedback to any smart device. In this way the owners of the vehicles will have access to the pollutant levels being emitted by each individual vehicle. On a city level scale this approach would curb the pollutant levels on a large scale. Each vehicle that crosses a threshold limit set will trigger a notification to the users smart device (owner) informing them to get the vehicle checked. This is the monitoring system that will be employed on vehicles to minimize the pollution in cities.

This device informs the vehicle owners as well as the concerned authorities via mobile network about emission levels beyond the permissible limit. The idea being presented is to collect real-time data of emission levels of vehicles and store them in systematic profiles of individual users on an online utility platform which can be accessed by means of an application.

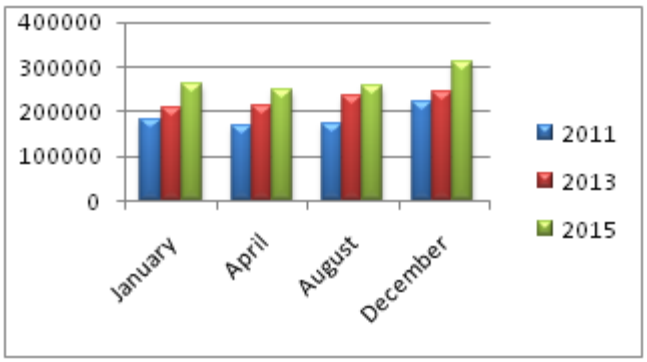
Keywords- Sensors, Monitoring System, Smart Cities, Live Feedback, Pollution Control.

I. INTRODUCTION

The 21st century saw a large expansion in the automobile industry. In 2013 India was the sixth largest motor vehicle manufacturer in the world. 23.4 million motor vehicles were produced in 2014-2015 (April-March).1.88 million passenger cars were sold in India in 2014-15 which is more than the 1.77 million sold the year before. The Indian automotive component industry achieved a turnover of USD 35 billion in 2013-2014 while on the other hand the increase in vehicles on the road lead to higher pollution levels within society. The rise of vehicle sales has a large advantage for the country but on the other hand the direct effect of these numbers is the levels of pollutants that are emitted from each one of these vehicles. At the rate at which the level of vehicles is expanding the need of the hour is to effectively and efficiently keep a check on vehicular pollution. The main pollutant emissions from petrol, diesel and alternative fuel engines are carbon monoxide (CO), oxides of nitrogen (NOx), un-burnt hydrocarbons (HC) and particulate matter. Modern cars in good conditions would produce small quantities of air pollutants on the other hand emissions from large number of cars add to significant air quality problem.

The effects of the exhaust gases are :
CO - Reduces bloods oxygen carrying capacity which may reduce availability of oxygen to key organs.
NOx - Respiratory problems , long term exposure may affect lung function. Contributes to smog formation, acid rain, can damage vegetation, contributes to ground level ozone formation.
HC – Damage the human respiratory system, some are carcinogenic and indirect greenhouse gases
Particulate Matter (PM) - Fine particles may affect human health, respiratory and cardiovascular problems.

Table: 1.1 : Car Registrations in India from the years 2011 to 2015



II. EXISTING SYSTEM

The Central and State Governments in India have been developing strategies for mitigation measures to improve the urban air quality and make cities greener and cleaner. The norms under the PUC Certification system are stated in the table.

Table: 1.2: First PUC norms in India

Type of Vehicle	Emission	Limit
Gasoline 4 wheeler	CO	3%
Gasoline 2/3 wheeler	CO	4.4%
Diesel vehicle	Smoke	65HSU

Note: HSU - Hartidge Smoke Unit

The vehicle emission norms have been tightened and

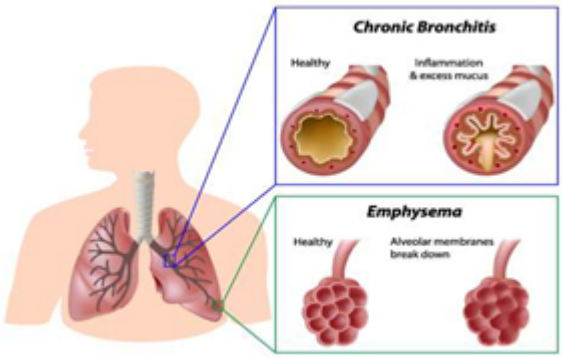


Figure: 1.1: Respiratory Diseases caused due to air pollution

a computerized model for emission check has been developed. Respiratory diseases are caused due to the various air pollutants and thus a monitoring system should be dispatched.

The system of a PUC that is currently being used, comprises a digital camera that covers the image of the number plate of the automobile. A gas analyser is attached to the exhaust system of the vehicle with the engine switched on. The gas analyser is attached to a computer system through which with a printer the receipt with the readings is printed and handed to the customer. The PUC norms are taken into consideration with respect to idling emission standards for CO and HC in the case of petro vehicles and for diesel vehicles the smoke density is taken into consideration.

Table: 1.3: PUC Norms for in-use Petrol/CNG/LPG driven Vehicles

Vehicle Type	CO(%)	HC (ppm)
2&3 wheelers (2/4 stroke)	4.5	9,000
2&3 wheelers (2-stroke)	3.5	6,000
2&3 wheelers (4 -stroke)	3.5	4,500

III. PROPOSED SYSTEM

In this portion we would like to present an effective use of the system to address the issue of vehicular pollution. The system comprises of a small kit that would be placed on an individual automobile which comprises of four sensors. Each sensor carries out a different purpose. One sensor will be used to detect the smoke levels emerging from the vehicle. Another sensor will be used as a threshold limit checker to monitor the levels of heat. Another sensor is for alcohol detection which will have a connection with the ignition of the vehicle. The last sensor is a safety mechanism which is a seat belt notification sensor. All of the sensors will have a live feedback and will be able to be viewed with the help of a mobile application. The user mobile device will be connected to the system with the help of Bluetooth while the readings of the vehicle will be accessed via the internet and to the device.

IV. PROCESS

The hardware components that will be in use to create the prototype are a 28pin ADC, MAX 232 IC (16 pin), ULN (16 pin), a DB9 connector, IC 89C51 (40 pin) and the sensors.

The software portion comprises of the user logging into the android system by entering the username and password into the application through the internet. The device will be connected to the system via Bluetooth connectivity. The concept of cloud computing will be a big factor in this project as the android application will have a back end programming of a Netbeans and will be using a glassfish server. The use of MySQL will work as the database to keep all the entries of the various users for the monitoring purpose. The final aim is to construct a low-cost, portable, monitoring device by combining sensor units, central processing unit, power unit, GSM unit, and RF unit. The sensor unit will measure the air quality, the central processing unit for data acquisition and processing, the GPS unit to track the position of the RF-sensor in real time and the RF unit for the wireless transmission and reception of the data.

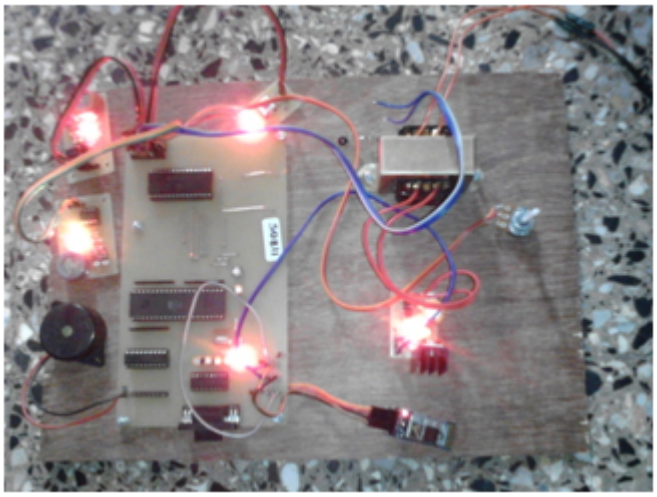


Figure 1.2 : PCB Hardware interface to monitor vehicular pollution

The hardware interfaces we will be using are RS-232 which is a standard for serial communication transmission of data,an analog to digital converter that converts a continuous physical voltage to a digital number that represents the quantity's amplitude. MAX 232 is an IC that converts signals from a serial port to signals suitable for use in TTL compatible digital logic circuits. ULN2003 is a high voltage and high current IC. It contains 7 open collector Darlington pairs with common emitters. DB-9 Connector is a common type of electrical connector named for their characteristic D-shaped metal shield. IC 89C51 is a low power , high performance 8-bit microcomputer allows program memory to be reprogrammed by combining 8-bit CPU on a chip and provides highly flexible and cost effective solutions to embedded controller applications.Ethernet is a family of computer networking technologies for local area networks (LANs) and metropolitan area networks(MANs) Wifi is a local area wireless computer networking technology that allows electronic devices to network, mainly using the 2.4 gigahertz (12 cm) UHF and 5 gigahertz (6 cm) SHF ISM radio bands. The software interface that will be used is SOAP(Simple Object Access Protocol) is a protocol specification for exchanging structured information in the implementation of web services in computer networks. It uses an XMLInformation Set for its message format, and relies on other application layer protocols, most notably Hypertext Transfer Protocol (HTTP) or Simple Mail Transfer Protocol (SMTP), for message negotiation and transmission.Glassfish is an open source application server project for Java EE platform and is called Glassfish Server. It uses apache tomcat as the servlet container for serving web content with an added component called Grizzly which uses Java New I/O for scalability and speed. Java servlet is a Java program that extends the capabilities of a server, they most commonly implement applications hosted on Web servers. Servlets may be packaged in a WAR file as a web application.Netbeans is a software platform written in Java which allows applications to be developed from a set of modular software components called modules. Applications based on the Netbeans environment can be extended by third party developers.Object serialization used in computer science, in the context of data storage, serialization is the process of translating data structures or object state into a format that can be stored and reconstructed later in the same or another computer environment. When the resulting series of bits is reread according to the serialization format, it can be used to create a semantically identical clone of the original object.

V. WORKING

The figure below demonstrates the working of the system.

Figure 1.5 : Working Model

The working of this device in real time will work as follows.

The hardware consisting of the sensors that we will be using is configured and connected to the vehicle. The mobile device is usually always with the user so when the user is in the vehicle the cellular device is connected to the hardware through the Bluetooth medium. The cellphone is also connected to the internet for GPS tracking.The phone is connected through WiFi to the base station.The base station is connected to the database. Behind the database is the administrator PC where the admin will be controlling and monitoring the data on the system.

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