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Air Pollution Control and Safety System for Vehicles Using Embedded System

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Abstract- Metropolitan cities have the largest population in our country. Many people move out of their native places or villages to cities owing to the numerous benefits that cities can offer. Commutation is one major advantage of urban life. The number of private and public vehicles is increasing year after year to match the transportationneeds of the people. Every vehicle will have emission but the problem occurs when it is beyond the standardized values.This emission from vehicles cannot be completely avoided but, it definitely can be controlled. The semi- conductor sensors at the emission outlets of vehicles detect the level of pollutants and a meter is used to indicate this level. 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 supply 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. The system with GPS is also used for the security purpose. The GSM/GPRS modem in this system receives the messages sent by the user and replies for that message such as locations etc. This paper, when augmented as a real time project, will benefit the society and help in reducing the air pollution and the theft of vehicles.

Keywords- Air Pollution, Sensors, Threshold Level, GPS, Micro Controller.

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. Air pollution contributes to the green houses gases, which causes the green house effect, whose side effects are now well known to all of us after the findings about the hole in the ozone layer. Air pollution is not only harmful to the environment but, also to all other living beings on earth. Air pollutants that are inhaled have serious impact on human health affecting the lungs and the respiratory system; they are also taken up by the blood and pumped all round the body. These pollutants are also deposited on soil, plants, and in the water, further contributing to human exposure and also affecting the sea life. Vehicles are one of the major contributors to air pollution apart from industries. The main pollutants from vehicles are the oxides of carbon and nitrogen, which can be easily detected these days with the help of semi conductor gas sensors. Therefore, in this paper an idea is suggested, which would be very helpful in reducing the amount of pollution from vehicles. The first emission norms were introduced in India in 1991 for petrol and 1992 for diesel vehicles. These were followed by making the Catalytic converter mandatory for petrol vehicles and the introduction of unleaded petrol in the market. On April 29, 1999 the Supreme

Court of India ruled that all vehicles in India have to meet Euro I or India 2000 norms by June 1, 1999 and Euro II will be mandatory in the NCR by April 2000. Car makers were not prepared for this transition and in a subsequent judgment the implementation date for Euro II was not enforced. The standards, based on European regulations were first introduced in 2000. Progressively stringent norms have been rolled out since then. All new vehicles manufactured after the implementation of the norms have to be compliant with the regulations. Since October 2010, Bharat stage III norms have been enforced across the country. In 13 major cities, Bharat stage IV emission norms are in place since April 2010.

The phasing out of 2 stroke engine for two wheelers, the stoppage of production of various old model cars introduction of electronic controls have been due to the regulations related to vehicular emissions. The standardized values for the emission levels are referred as given in [1]. The sensing of the emitted gases is done using various sensors and devices. The past decade, has seen several research activities that have been taking place to develop semiconductor gas sensors [2]. In the paper [3], the quality of air in the car cabin was analyzed using semiconductor (MOS) gas sensors. In this paper, the semiconductor sensors have been used to detect the pollutant level of the vehicles. This paper concentrates mainly on three blocks; smoke detector, microcontroller and fuel injector. The smoke detector detects the pollutants (CO, NOx, etc.) continuously. The microcontroller compares the level of pollutants with the stipulated level allowed by the government. When the pollutant level exceeds the standardized limit, it sends a signal to the fuel injector. On receiving a signal from the controller, the fuel injector stops the fuel supply to the engine after a particular period of time.

II. PROPOSED SYSTEM

The overall block diagram of the proposed system is given in figure 2.1.

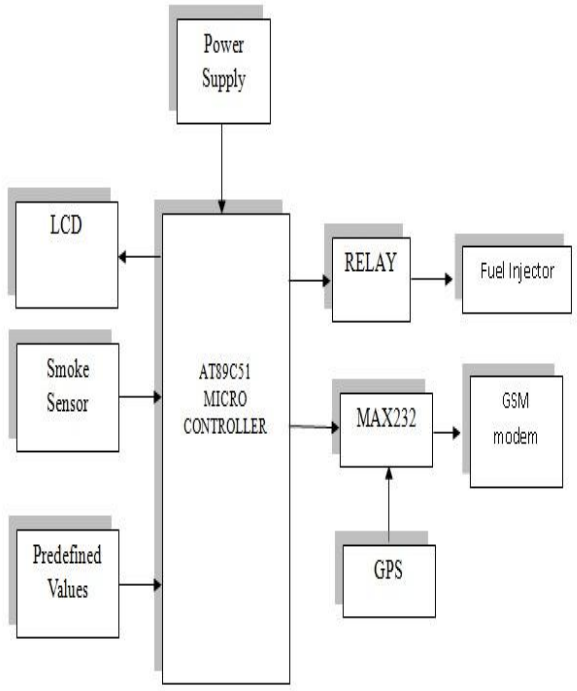

Figure.2.1 Block Diagram

A. Detector

The detector consists of three sub-blocks namely smoke sensor, transducer and ADC. The smoke sensor is the main component of the detector block which is embedded onto the exhaust of the vehicle. The sensor senses the amount of emission from the vehicle and feeds the data to the microcontroller through the transducer and the analog to digital converter at regular intervals of time. The transducer is used to convert the output of the sensor into an electrical signal. The analog electrical signal is then converted into a digital signal using an ADC, so that it can be compared with the predefined values, in the microcontroller.

In this paper, carbon monoxide sensor (MQ-7) which can measure CO concentrations ranging from 10 to 10,000 ppm is considered. This sensor basically finds usage in sensing carbon monoxide concentrations (ppm), in the exhaust of cars as shown in figure.2.3 and gives an analog output. The MQ-7 gas sensor is mainly made up of SnO2, whose conductivity varies with the cleanliness of air i.e. it has a lower conductivity in clean air and vice versa. A simple circuit as shown in figure.2.2 is used to map the changes in conductivity to the corresponding output signal of the gas concentration. The main advantage of the MQ-7 gas sensor is that it has high sensitivity to Carbon Monoxide. Additionally, it has a very long life time and is available at a low cost. Also it can be used for a wide range of applications.

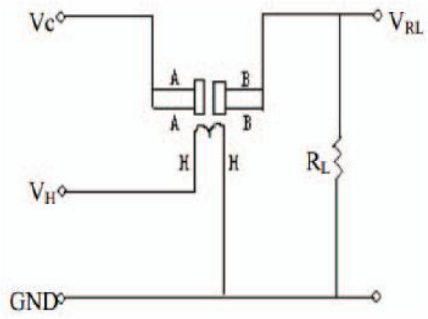

Figure.2.2 Equivalent Circuit of MQ-7

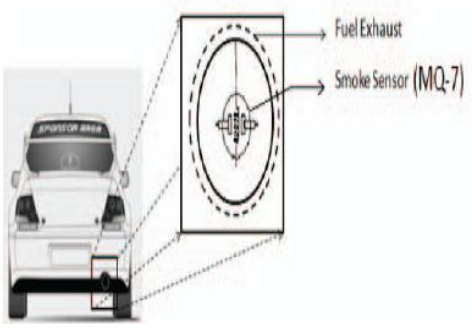

Figure.2.3 Smoke Sensor

B. Microcontroller

In this paper, ATMEL 89C51 is used, which is an 8bit micro controller. It consists of two 16-bit timers/counters which will be used for the timer configuration.

The microcontroller is programmed to do three functions namely comparison, timer and triggering circuit. The microcontroller takes in two inputs; one from the smoke sensor's output and another being the pre-defined threshold value specified by the government. When the smoke sensor output is more than the threshold value, the microcontroller triggers the timer circuit and an alarm is set off to inform the driver of the vehicle, about the same and also indicate that the vehicle will come to a halt as soon as the timer runs out. Apart from the timer being triggered, a trigger is also given to the GPS, which helps in locating the nearest service station. Once the timer runs out, a trigger pulse is generated by the microcontroller which is fed to the fuel injector, which in turn stops the flow of fuel to the engine, as a result of which, the vehicle comes to a halt.

C. Fuel Injector

The main function of the fuel injector is to cut the supply of fuel to the engine, when the pollution limit is breached.

The relay circuit shown in the figure.2.4 is used to control the on and off position of the fuel pump. In this paper, the engine control unit is programmed in such a way that, when the microcontroller sends a trigger pulse after the timer runs out, relay should get back to its original position, that is the fuel cut off switch, is on. Then the fuel supply from the pump will be stopped.

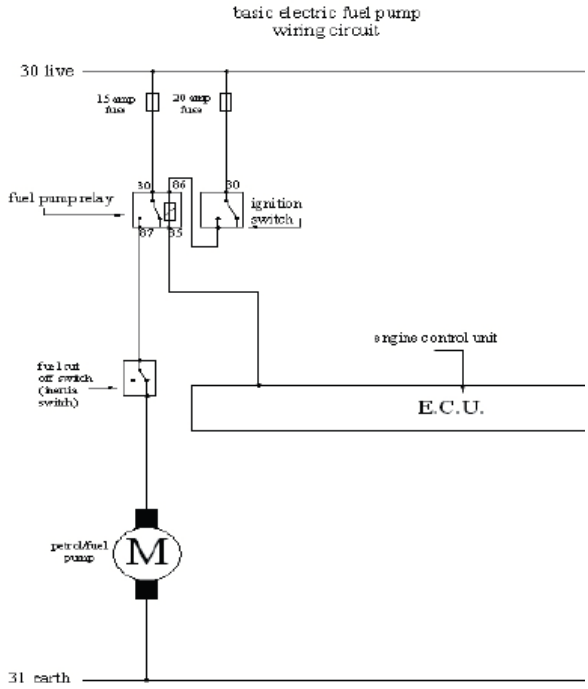

Figure.2.4 Fuel pump wiring circuit

D. Global Positioning System (GPS)

When the pollution level reaches the maximum limit, a trigger pulse is given to GPS by the microcontroller. The GPS is programmed in such a way that, when it receives a trigger pulse, it shows the nearest service stations where the vehicle can be taken for maintenance.

E. GSM/GPRS modem

The GSM/GPRS modem is used to alert the user in the form of SMS as well as through WebPages. It is also used the find the location of the vehicle by gathering information from the GPS sending the location to the user.

III.RESULTS AND DISCUSSION

The signals acquired from the smoke sensor are compared with the user defined set point and when it crosses the threshold limit the pollution level gets displayed in the LCD and when it exceeds the set point it gives a buzzer indication following the motor gets off. GSM/GPS available in the vehicle could also help the vehicle owners to find them in case of theft.

The table below shows the sample of results obtained from the system:

Pollution Level	Voltage (V)	Motor Condition
300 ppm	0	ON
350 ppm	0.5	ON
400 ppm	0.95	ON
450 ppm	1.35	ON
500 ppm	1.79	ON
550 ppm	2.30	ON
600ppm	3.0	ON
650 ppm	3.45	ON
700 ppm	3.88	ON
750 ppm	4.4	ON
800 ppm	4.98	OFF
850 ppm	5.38	OFF

Table 1:Monitoring the Pollution Level

IV. CONCLUSION

This whole paper mainly focuses on two things. The first thing is the concept of detecting the level of 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. There will be a huge population, who do not take the pollution from their vehicles seriously, which has already resulted in several environmental problems such ozone layer depletion and so on. So, this system will be highly beneficial is 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. The fact that this system is just an add-on, as it does not change the configuration of the engine by any means, will make it easier to employ this system in the existing vehicles. The same concept can also be extended to enable a check on the emission limit by industries. The second thing is the security system and user can track their own vehicle using the available GPS and the GSM modems.

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