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Air Pollution Monitoring & Control System For Vehicles

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***Abstract*-** This paper is intended to provide a model for detecting the air pollution that is occuring from vehicles. For that intention there is a semi-conductor gas sensor at the exaust of vehicles which detects the level of pollutants. When the emission level goes beyond the already set threshold level,by using GSM,a messege will be send on the drivers mobile number also there will be a buzzer in the vehicle to indicate that the limit has been crossed and the vehicle will stop automatically after a particular time period some time given to the driver for parking vehicle. During this time, the GPS starts locating the nearby service stations. After the counter of timer runs out, the fuel supplied to the engine of vehicle will be cut-off by using fuel injector circuit and the vehicle has to be towed to the mechanic or to the nearest service station. A microcontroller moniters and controls the syncronization and execution of the entire process.. This project, will benefit the society and help in reducing the air pollution. when implemented as a real time project.

***Keywords*-** *ARM 7, Sensors, GPS, GSM, Fuel injector*

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I. INTRODUCTION

Emissions from an individual car are generally low, relative to the smokestack image many people associate with air pollution. But in numerous cities across the country, the personal automobile is the single greatest polluter, as emissions from millions of vehicles on the road add up. Driving a private car is probably a typical citizen's most "polluting" daily activity. The power to move a car comes from burning fuel in an engine. Pollution from cars comes from by-products of this combustion process (exhaust) and from evaporation of the fuel itself.

The main pollutants from vehicles are nitrogen oxide, carbon monoxide, hydrocarbons, which can be easily detected with the help of semiconductor gas sensors. Therefore in this paper a scheme is suggested which will reduce the amount of pollution from vehicles. In this system smoke detector is used to detect percentage of the carbon monoxide in smoke released by vehicles due to combustion of fuel in it. Smoke detector is set at the end of exhaust of vehicle from where smoke is released into the surroundings. The smoke detector detects carbon monoxide and gives it to microcontroller to check the maximum percentage of carbon monoxide content in smoke released by vehicles and if it is more than the threshold level of carbon, the system module sends SMS about this to the driver through GSM and it also sends location of vehicle through GPS system [7]. The rest of the paper is organized as part II gives the literature review and a brief note about the various research activities, on gas sensors and monitoring systems. Part III discusses about the various blocks of the proposed system. Part IV concludes the paper with an idea to implement the same as a real time project.

II. DEVELOPMENT OF SYSTEM

The main pollutants from vehicles are the oxides of carbon and nitrogen, which can be easily detected these days with the help of semiconductor gas sensors. The existing system has air pollution detection and indicates the vehicle using GPS so that the traffic authority can detect the vehicle and seize. The process of working of this project is explained as follows. The total equipment of this project is placed inside a vehicle. Here we have GPS (Global Positioning System) module by which we can get the location of the vehicle; the location values are displayed on the LCD (Liquid Crystal Display). In this project we have two sensors which are interfaced to the micro controller. Those are temperature sensor and CO sensor through which we can measure the temperature and amount of CO released from the vehicle. These values are also displayed on LCD. Here ADC (Analog to Digital Converter) is used to convert the analog data from the sensors to digital form. Whenever these values exceed the threshold then intimation is given to the RTA including vehicle's exact position. The overall block diagram of the proposed system is given in figure 3.1

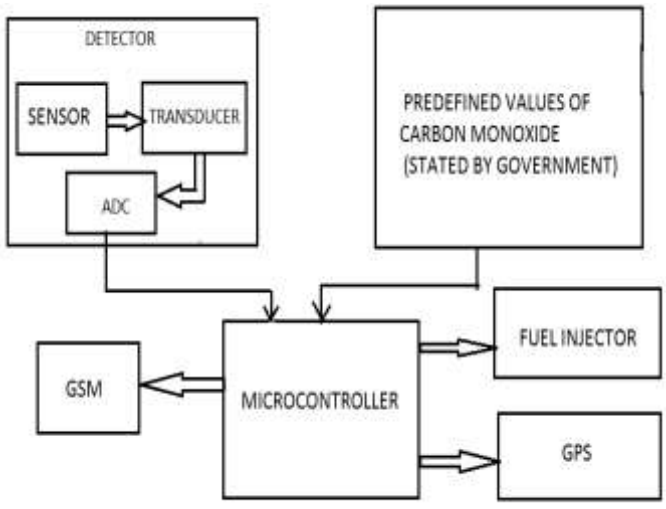

Figure 3.1 Block diagram

B. ARM 7 Controller

In this design, we chose an ARM7TDMI-S core based microcontroller called LPC2148, which is the production of NXP Semiconductors. The LPC2148 microcontroller is high-performance 32-bit RISC Microcontroller with Thumb extensions ,it has 512KB Flash Memory and 40KB Static RAM, it use 12.00MHz Crystal, so it can process data with the maximum high speed at 60MHz when using it with Phase-Locked Loop (PLL) internal MCU. It has Real Time Clock circuit with 32.768 KHz XTAL and Battery Backup. Support In- System Programming (ISP) and In-Application Programming (IAP) through On-Chip Boot-Loader Software via Port UART-0 (RS232), circuit to In this paper, LPC2148 is used which is an 16/32 bit micro controller [13].

To make pollution detection faster, system should be used with advanced microcontroller to decrease computational complexity. It does not have an operating system and simply runs the program in its memory when it is turned on. This microcontroller deals with a keil programming code. Microcontroller operates at +3.3V which can be regulated using the voltage regulator (L7805). +5V input power is converted to 3.3V using 1117 IC. Crystal oscillator is used to execute the programming code.

A. Smoke Detector

In this paper, carbon monoxide detecting sensor (MQ-7) is used as shown in figure 3.2 that can measure carbon monoxide concentrations ranging from 10 to 10,000 ppm is used. The advantage of the MQ-7 gas sensor is that it has high sensitivity to Carbon Monoxide. Also, it has a long life time and is available at a low cost.

Figure 3.2 Carbon monoxide sensor

Connecting 5V across the heating (H) pins keeps the sensor hot enough to function correctly. Connecting 5V at either the A or B pins causes the sensor to emit an analog voltage on the other pins. A resistive load between the output pins and ground sets the sensitivity of the detector. The resistive load should be calibrated for particular application using the equations but a good starting value for the resistor is 10k.

EPA carbon monoxide limits [1]

1. PEL (Permissible) - 50ppm
2. REL (Recommended) – 35ppm to 200ppm
3. ID(Immediate Danger) – 600ppm to 1200ppm

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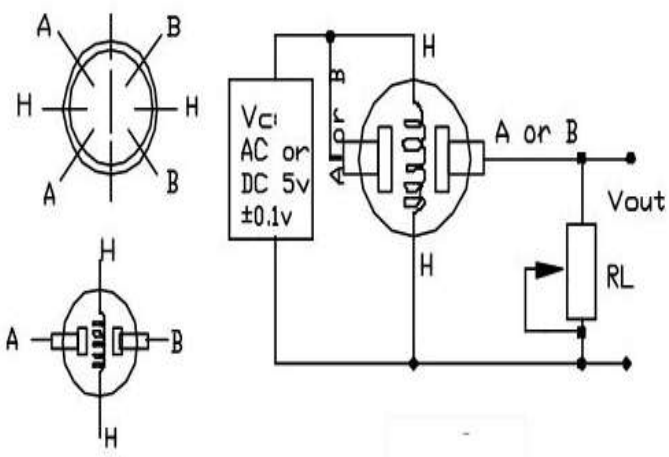

Figure 3.3 Internal configuration of Smoke sensor[7]

C. Fuel Injector

The fuel injector is an electromechanical device, which is fed by a 12 volt supply from either the fuel injection relay or the ECM. [4] A fuel injector must spray fuel as a mist because it's easier for vehicle's engine to burn the fuel. When driver step on gas pedal, vehicle's throttle valve which is a valve that opens and lets air enter into engine, works in conjunction with your fuel injectors.

D. Global Position System for Mobiles (GSM)

This GSM Modem can work with any GSM network operator SIM card just like a mobile phone with its own unique phone number. Benefit of using this modem will be that for communication its RS232 port can be used and for developing embedded applications. The modem can either be connected to PC serial port directly or to any microcontroller through MAX232. The SIM900A is a complete Dual-band GSM/GPRS solution in a SMT module [16]. This module can be embedded in the customer applications allowing benefit from small dimensions and cost-effective solutions. Featuring an industry-standard interface, the SIM900A delivers GSM/GPRS 900/1800MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mm x 24mm x 3 mm, SIM900A can fit in almost all the space requirements. GSM module will send the message to the drivers mobile number indicating that pollution limit has been crossed when the smoke value excides the pre-defined value.

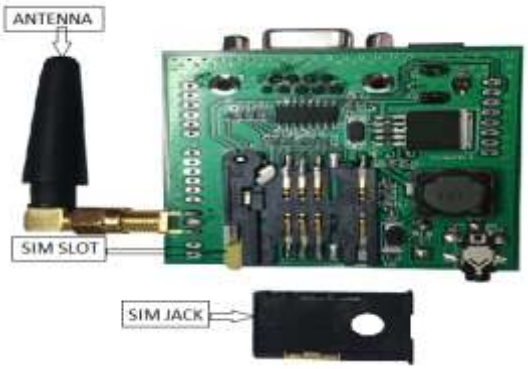

Figure 3.4 GSM Module

E. Global Positioning System (GPS)

When standardized the pollution level is crossed, a trigger 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 vehicle service stations where the vehicle can be taken for maintenance.

GPS GR87 is a highly incorporated smart GPS module with a ceramic GPS patch antenna. The antenna is connected to the module via an LNA [15]. The module is with 51 channel acquisition engine and 14 channel track engine, which be capable of receiving signals from up to 65 GPS satellites and transferring them into the precise position and timing information that can be read over either UART port or RS232 serial port. Small size and high-end GPS functionality are at low power consumption, Both of the LVTTL-level and RS232 signal interface are provided on the interface connector, supply voltage of 3.6V~6.0V is supported. To indicate the location and to send SMS on the driver's mobile number it is necessary to interface GPS and GSM module with the microcontroller. Figure 3.5 shows the interfacing diagram of LPC2148 with GPS and GSM.

MAX 232 IC is used to convert the TTL/CMOS logic levels to RS 232 logic levels during serial communication of microcontroller with PC. The controller works at TTL (0-5V) while serial communication in PC works at RS 232 standards (-25V to +25V). The intermediate link between LPC2148 and module is provided by the MAX 232 IC.

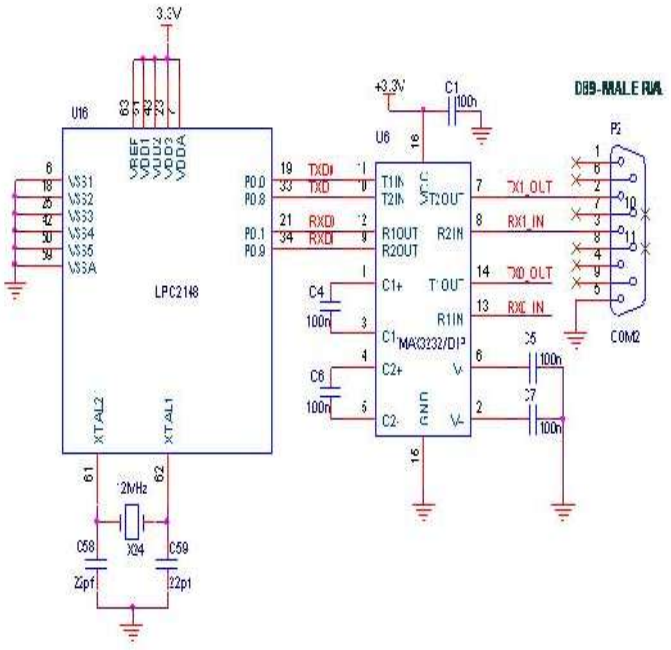

Figure 3.5 Interfacing Diagram of microcontroller with GPS and GSM

F. LCD

LCD displays the value of carbon monoxide gas in ppm.

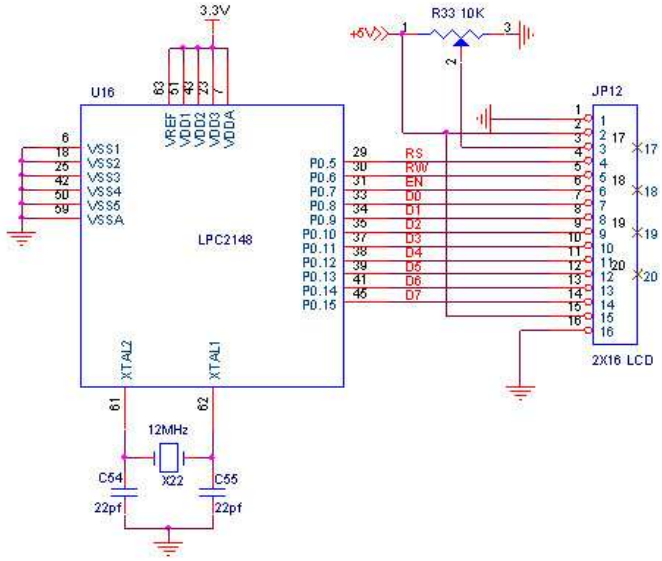

Figure 3.6 Interfacing diagram of lpc2148 microcontroller to LCD

III. PERFORMANCE ANALYSIS

A. Software Requirements

- Keil compiler- Keil Micro Vision 3 IDE
- Application Language -Embedded C
- Flash Magic Software

B. Results

The signals acquired from the smoke sensor are compared with the user defined set point crossing 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. The table below shows the sample of results obtained from the system:

Pollution levels	Motor condition
300ppm	ON
383ppm	ON
400ppm	ON
436ppm	ON
500ppm	ON
645ppm	OFF

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699ppm	OFF
742ppm	OFF
899ppm	OFF

Table: 1 monitoring the pollution levels.

B. Operation

When the embedded system for air pollution detection is implemented it is observed that motor stops when the emission of carbon monoxide gas crosses predefined limit i.e. 600ppm. Following figures show the exact working of the project.

Figure 3.7 LCD Displaying 383ppm value of carbon monoxide gas

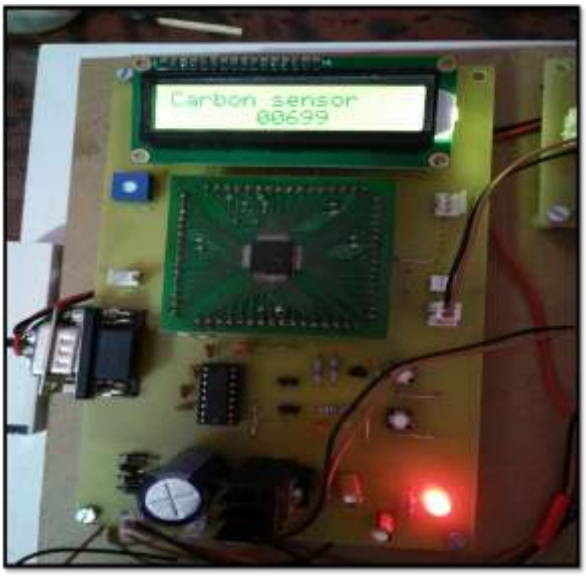

Figure 3.8 LCD Displaying 699ppm value of carbon monoxide gas

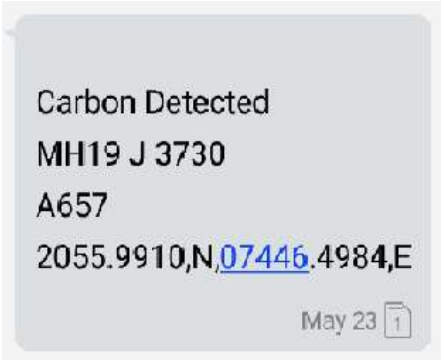

Figure 3.9 SMS send by the GSM on the drivers mobile number showing carbon detected along with vehicles number, amount of CO gas, and coordinates of location of vehicle

IV. CONCLUSION

An embedded system for air pollution detection has been implemented. Here only carbon monoxide gas has been detected as vehicle's exhaust gases contains maximum of 42% of CO gas. The gas sensors and the critical level of the relevant gas should be recognized, and then this system can be implemented for detecting various gases either in domestic area such as places of residential and industrial areas which avoids endangering of human lives. This system provides quick response and the dispersal of the critical situation can be made faster than the manual methods.

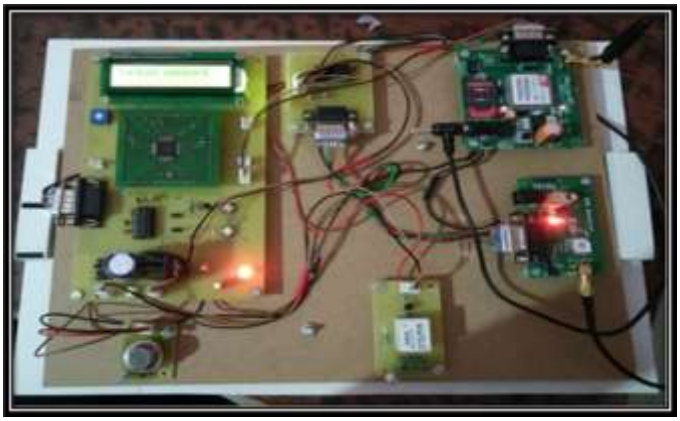

Figure 3.10 Prototype of air pollution detection system

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