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Embedded System Based Air Pollution Detection in Vehicles

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Abstract: Air pollution is one of environmental issues that have been often discussed. A system is developed to reduce air pollution. The proposed system consist of carbon monoxide (CO) sensor, liquid petroleum gas (LPG) sensor, buzzer, global positioning system (GPS), global system for mobile (GSM). CO sensor is placed at the emission outlets of the vehicle to monitor the level of CO emission, LPG sensor placed near gas supply pipe of the vehicle to detect LPG leakage. The buzzer in the system alerts, when the emission level or leakage of gas exceeds threshold value. The GPS finds current location of the vehicle and transmit to the microcontroller. The entire process controlled and monitored by ATmega328 microcontroller. The microcontroller search for nearest service station by comparing with already stored locations in the memory. GSM sends service request message to nearest service stations. The proposed novel system helps in reducing the air pollution.
Keywords: CO, LPG, ATmega328 microcontroller, GPS, GSM, parts per million (PPM), threshold value (TV).

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I.   INTRODUCTION

Air pollution is one of the critical ecological issues that have a direct impact on human health and ecological balance. It is also a major reason for many unexpected deaths. Air pollution is not only affecting people's health but affecting environment which leads to acid rain, smog, deterioration of the ozone layer and global warming [1]. Besides the health effects, air pollution also contributes to tremendous economic losses, especially in the sense of financial resources that are required for giving medical assistance to the affected people. The poor are often the most affected segment of the population as they do not have adequate measures to protect themselves from air pollution [2]. Air pollution is a risk factor for different health conditions, including eye and skin diseases, irritation of the nose, throat and eyes. Air pollution additionally causes genuine conditions like heart stroke, lung cancer, pneumonia, bronchitis, trouble in breathing and coughing because of asthma. As the quantity of vehicles has increased year by year, car deplete contamination on urban air quality effect of a growing pollutant level into the atmosphere. To enhance the environment and air quality, we ought to take dynamic and powerful pollution control measures [3]. So, it is very crucial to monitor and control the air pollution. The most ideal approach to control air pollution is to monitor exceeded levels of air pollutants and need to take suitable activities to control it.

II. PROPOSED AIR POLLUTION DETECTION IN VEHICLES

The proposed air pollution system detects emission level of CO and LPG from vehicle. It also alerts the driver when emission level of CO and LPG exceeds threshold value. By tracking coordinates from the satellites GPS locates current location of the vehicle by communicating with microcontroller, then the microcontroller search for nearest service station by comparing with already stored locations in the memory. After finding nearest service stations, GSM send service request message to nearest service stations.
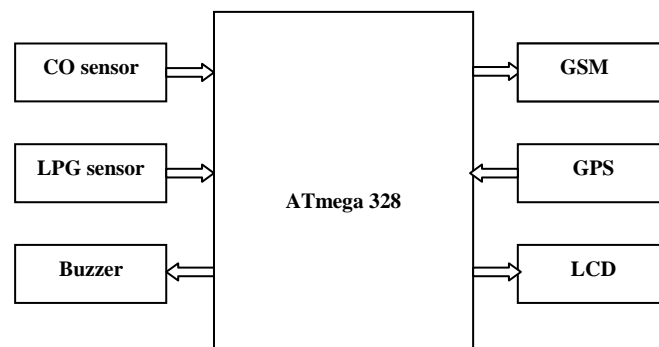

Figure 1: Block Diagram of embedded system based air pollution detection in vehicles

CO sensor: The CO (Carbon Monoxide) sensor continuously sense pollutant level of emission from the vehicle. This sensor consists of transducer. The sensor detects smoke in the analog form the transducer converts it

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into the electrical signal and Analog to Digital Converter (ADC) in microcontroller converts the electrical signal into digital value, and then converts pollution level to PPM, and that will be displayed on LCD.

LPG sensor: The LPG (Liquid Petroleum Gas) sensor senses the LPG gas in analog form in the case of gas leakage and transducer convert it into electrical signal and then ADC in microcontroller convert it into digital value, concentration of the gas will be displayed on LCD by converting it into PPM.

Buzzer: The buzzer will give an alert, when detection range of smoke or leakage of gas exceeds threshold level.

GPS: The GPS (Global Positioning System) tracks latitude and longitude values of current location, and then finds nearest service station by comparing with stored locations in the device.

GSM: The GSM (Global System for Mobile communication) send message to the nearest service stations.

LCD: The LCD (Liquid Crystal Display) shows the notifications of the entire process.

ATmega 328: The entire process is controlled and monitored by ATmega 328 microcontroller.
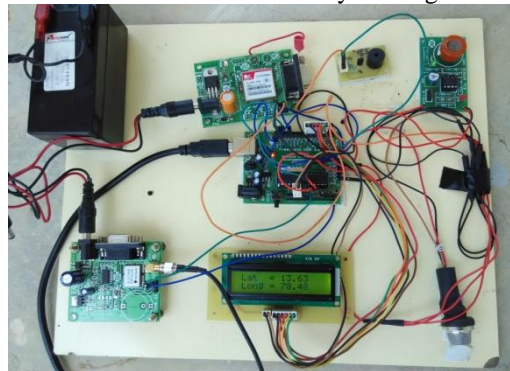

Figure 2: Proposed air pollution detection system.
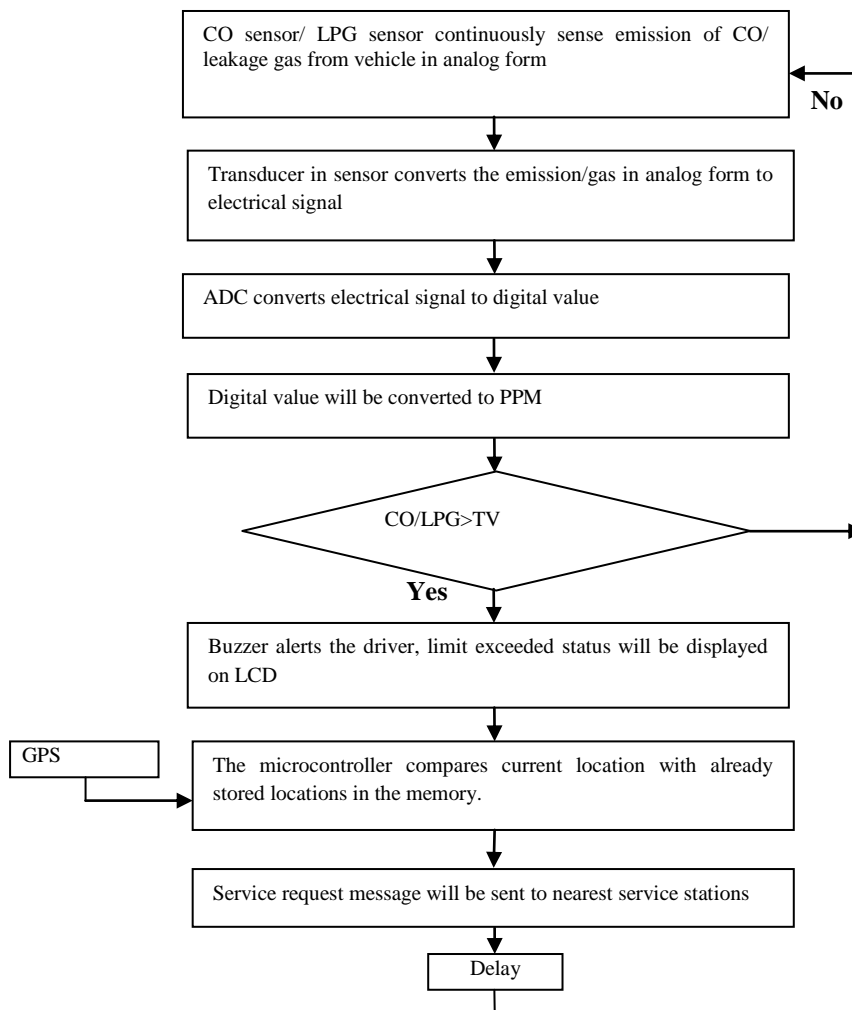
III. FLOW CHART

Figure 3: Flow chart

Formulas used are:
- To calculate sensors voltage

$V_L = V_c*(R_s/R_s+R_L)$
- To calculate digital value

$DV = (V_L/V_c)*1024$ [4]
- To calculate PPM

$ppm = (in- in_{min})*((out_{max}-out_{min})/(in_{max}-in_{min}))+out_{min}$ [5].

IV. SOFTWARE TOOLS

Software tools used to develop the proposed air pollution system is arduino-1.5.5-r2 software. Arduino-1.5.5-r2 is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments [5].
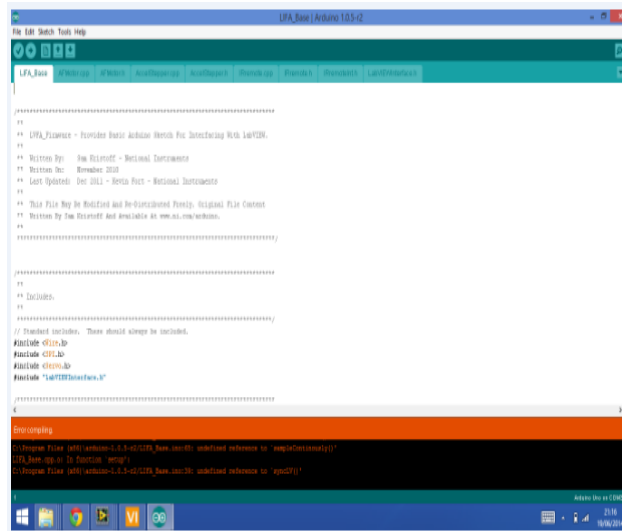

Figure 4: arduino-1.5.5-r2 compiler window

V. RESULTS

The output of the CO sensor is obtained by following steps.
1. Calculate voltage, digital value
2. PPM of the sensor theoretically.

The voltage levels are based on PPM values of the sensor. Table.1 shows the theoretical and practical values of voltage levels.

Table 1: Voltage to PPM conversion for CO sensor

Theoretical values		Practical values	
Voltage (V_L)	CO (PPM)	Voltage (V_L)	CO (PPM)
0.83	20	0.12	20
1.15	278	1.06	278
1.42	487	1.34	487
1.66	676	1.52	676
1.87	842	1.68	842
2.05	985	1.86	985
2.22	1120	2.01	1120
2.36	1232	2.16	1232
2.5	1343	2.3	1343
2.61	1428	2.42	1428
2.72	1517	2.51	1517
2.82	1594	2.6	1594
2.91	1664	2.69	1664
3	1737	2.8	1737

The output of the LPG sensor is obtained by following steps.

1. Calculate voltage, digital value
2. PPM of the sensor theoretically.

The voltage levels are based on PPM values of the sensor. Table.2 shows the theoretical and practical values of voltage levels of PPM.

Table 2: Voltage to PPM conversion for LPG sensor

Theoretical values		Practical values	
Voltage (V_L)	LPG (PPM)	Voltage (V_L)	LPG (PPM)
1.93	1303	2.21	1303
2	1568	2.27	1568
2.09	1928	2.36	1928
2.18	2269	2.44	2269
2.28	2648	2.56	2648
2.39	3084	2.64	3084
2.5	3519	2.73	3519
2.64	4050	2.87	4050
2.78	4599	2.93	4599
2.95	5262	3.17	5262
3.13	5963	3.34	5963
3.34	6777	3.49	6777
3.58	7705	3.71	7705
3.85	8747	3.98	8747

VI. DISCUSSION

Air pollution detection system [1] use only CO sensor. The automated control system [1] for air pollution detection is not useful for the automobiles having LPG supply. Paper [6] discussed monitoring of air pollution in urban. The limitation of air pollution system in [6] is it sends sensor information to another place by using Zig-Bee. The proposed novel air pollution system practically read pollutant level of CO and LPG. Additional features of the proposed system are it finds nearest service stations by using GPS, LPG sensor (to detect gas leakage) and message sending.

VII. CONCLUSION & FUTURE SCOPE

The proposed air pollution detection system helps users to keep vehicle in good condition; it alerts the user and finds the nearest service stations when the emission of CO/leakage of gas exceeds the threshold value. It helps to control the cause of vehicular air pollution. The future scope of the proposed system is to receive service reply message from the service station and to implement the proposed work for industrial applications.

REFERENCES

[1]   Siva Shankar Chandrasekaran, Sudharshan Muthukumar and Sabeshkumar Rajendran, 2013, Automated Control System for Air Pollution Detection in Vehicles, 4th International Conference on Intelligent Systems, Modeling and Simulation.
[2]   http://www.cpcb.nic.in/
[3]   Umesh M. Lanjewar, J. J. Shah, December-2012, Air Pollution Monitoring & Tracking System Using Mobile Sensors and Analysis of Data Using Data Mining, International Journal of Advanced Computer Research.
[4]   Microcontrollers and embedded systems using assembly and C by Muhammad Ali Mazidi.
[5]   www.arduino.org
[6]   P. Rachelin Sujae, 2014, Implementation of Zigbee Hardware for Application of Air Pollution Monitoring, Middle-East Journal of Scientific Research.