Volume 5, Issue 1, January 2015 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Monitoring and Controlling of Hazardous Gases inside Vehicle and Alerting Using GSM Technology

Sandip S. Patil, Prof. Jaykaran Singh
RGPV University, Department of Electronics and Communication Engineering,
SSSIST, Sehore, M.P., India

Abstract: In Modern world, passenger vehicles are the main source of transportation. These vehicles produce toxic gases (mostly CO) due to incomplete combustion of fuel. These Toxic gases are very harmful for humans. In today's world safety and security plays a vital role.So there should be good safety and security. This paper designs an GSM enabled embedded system for a vehicle, which senses the gases like carbon monoxide (CO), monitors them and display their contents on LCD which is inside vehicle.If the level of the CO increases than the normal level, then an alarm is generated automatically and also ventilation is provided immediately. A warning messageSMS is sent to the authorized user via GSM.The system also monitors Temperature for analyzing effect of temperature.The advantage of this automated detection and alerting system over the manual method is that it offers quick response time and accurate detection of an emergency and therefore leading faster diffusion of the critical situation.

Keywords: Microcontroller, Gas detecting sensors, GSM modem,Temperature Sensor ADC, Alarm, VehicleSafety.

I. INTRODUCTION

Though there is increase in the development of technology and human race but we have been failed to take care about the surroundings in which we live in. Thus we polluted the environment and thereby reducing the quality of theair in the place we liveinto. One suchexample is Motor Vehicles.Approximately 25% of the hazardous gases that are released into air due to motor vehicles. Outdoor environment pollution levels are the key concern, but the quality of air inside the vehicle plays a major part. As thisarea inside vehicle cabin is small, any particulate entering such as smoke, dust, fumes, gases in to it through either ventilation, leakage or through windows can cause serious health problems to the person inside. Carbon monoxide (CO) is odorless,colorless, and tasteless, but also highly toxic on nature.The excess content of CO in air is poisonousfor human.The most common symptoms of carbon monoxide CO poisoning may resemble other types of poisonings and infections, including symptoms such as headache, vomiting, fatigue, and a feeling of weakness and also some of the effect includes visual disturbance, confusion, disorientation, syncope and seizures.The manufacturer of vehicle installs air filter to prevent hazardous or unwanted particulate entering into vehicle. The cabin air help to prevent pollen, bacteria, dust and exhaust gases that may find their way into a vehicle's air conditioning and heating and ventilation systems. The filter also to trapleaves bugs and other debris from entering the heating, ventilating and air-conditioning (HVAC) system.But this is not they reliable solution to control it. Even if the producers of motorvehicles mainly try to focus on these safety precautions and design that way considering safety measures. Dueto the carelessness of the end users or the driver's no proper maintain ace of vehicle is done.It may cause serious damage to the vehicles and also to the human lives.Consider one situation where the content of CO in vehicle is above the normal level and it is causing minor effect like Eye irritation to driver. Due to which he may losehis concentration on the road, which may result to serious accidents. Hence to avoid these types of problems there is a need to take precautions.

This paper designs an embedded system for toxic gas CO detection inside the vehicle cabin and to develop a sensing system using a sensor array and microcontroller. If the detection unit detects that toxic gas reaches the maximum allowable level then, an alarm is generated immediately and the ventilation will be provided automatically. And then an SMS is send to the authorized user via the GSM module. If there is any accidental situation occurs it alerts to the Traffic control department and Ambulance.

II. RELATED WORK

In year 2010,R. Al-Ali, Member, IEEE, Imran Zualkernan, and FadiAloul, Senior Member, IEEE, "A Mobile GPRS-sensors array for Air Pollution Monitoring" vol.6, pp.410-422, Oct.2010.,the paper describe An online GPRS-Sensors Array for air pollution monitoring has been designed, implemented, and tested. The Proposed system consists of a Mobile Data-Acquisition Unit (Mobile-DAQ) and a fixed Internet-Enabled Pollution Monitoring Server (Pollution-Server).In the year of 2008, LIU zhen-ya, WANG Zhen-dong and CHEN Rong, "Intelligent Residential Security Alarm and Remote Control System Based On Single Chip Computer", the paper focuses on, Intelligent residential burglar alarm, emergency alarm, fire alarm, toxic gas leakage remote automatic sound alarm and remote control system, which is based on 89c51 single chip computer. The system can be automatic alarm, automatic calling the police hotline number. It can be used voice alarm and show alarm occurred address. It can set up and modify user password. It can be recordable and voice suggestion. It can be used telephone remote control electrical power .In the year of 2008, Chen Peijiang and Jiang Xuehhua, "Design and

implementation of Remote Monitoring System Based on GSM", this paper focuses on the wireless monitoring system, because the wireless remote monitoring system has more and more application, a remote monitoring system based on SMS of GSM is presented. Based on the total design of the system, the hardware and software of the system is designed. In this system, GSM network is a medium for transmitting the remote signal. The system includes two parts which are the monitoring Centre and the remote monitoring station. The monitoring consists of a computer and a TC35communication module of GSM. The computer and the TC35 are connected by RS232. There mote monitoring station includes a TC35 communication module of GSM, a MSP430F149MCU, a display unit, various sensors, data gathering and processing unit. The software of the monitoring center and the remote monitoring station is designed by using VB. The result of demonstration shows that the system can monitor and control the remote communication between the monitoring center and the remote monitoring station, and the remote monitoring function isrealized. In the year of 2006, Ioan Lita, Ion Bogdan Cioc .

III. HARDWARE DESCRIPTION

3.1. Block Diagram

The block diagram of system includes 89V51RD2 microcontroller,GSM , CO and temperature sensor, 16X2 LCD, buzzer, Power supply, ADC. The AT89V51RD2 micro controller is connected to the Analog to digital converter such that the input from the sensors are converted into digital input and then sent to the microcontroller it then displays the result through LCD. If a critical situation is experienced then an alarm is given for alerting the diver and ventilation is provided as an exhaust and as a remedy measure. A text message is sent to the authorized user indicating the critical situation of the vehicle.

3.1.1. Health effects of Carbon Monoxide (CO)

CO is a colorless, odorless and tasteless compound produced by incomplete combustion. It is often referred to as "Silent killer" because it is virtually undetectable without using detection technology. CO is found in combustion fumes produced by vehicles, gasoline engines, stoves and heating systems, people and animals in these CO enclosed spaces can be poisoned by breathing it. Even loss of consciousness and death can be caused due to high level inhalation of CO.

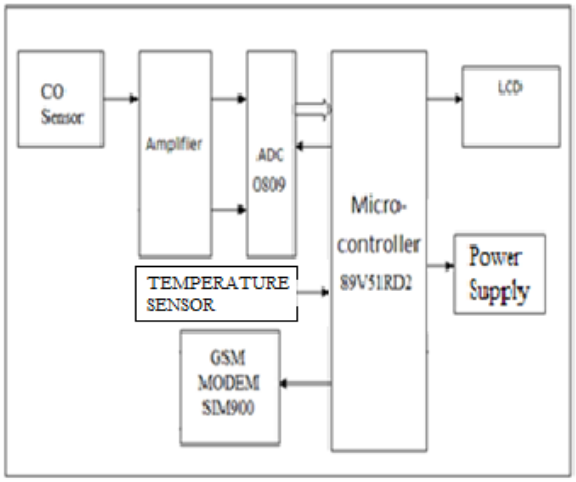


Fig 1. Block Diagram of the Proposed System

CO poisoning can be difficult to diagnose and hence People who are sleeping or intoxicated can die from CO poisoning before ever experiencing symptoms. Elevated levels of CO can be dangerous to human depending on the amount present and length of exposure. Smaller concentration can be harmful over longer periods of time. People with chronic heart disease, anemia, or respiratory problems and unborn babies, infants are more susceptible to its effects. CO emissions and concentrations in urban and roadside air are often much higher during the winter months than in the summer. Low levels of CO relative to the levels of oxygen, in inhaled air can be highly toxic and can alter hemoglobin so that it is no longer able to deliver oxygen to organs and tissues. CO disperses quickly in the air, so moderate and high levels of the gas are usually detected only in areas with significant motor vehicle traffic or within enclosed spaces where it may accumulate. The interior CO concentrations of automobiles driving in numerous cities around the world are measured by the researchers and have considered such variables as road type, traffic conditions, vehicle speed, and time of day. The average vehicle cabin CO concentrations are ranging from 9.1 to 22.3 ppm (Parts per Million). The researchers compared it to an average ambient air CO level, calculated from measurements at fixed stations near the commuter routes, of between 2.2 and 2.3 ppm. Typically the vehicle cabin levels were about seven times higher than those at the remote sites.

3.1.2. Carbon Monoxide (CO) sensors

When the vehicle with the closed doors is entangled in a traffic jam or in a traffic signal, the CO from the exhaust of other nearby vehicles will be easily pulled in to the vehicle cabin which can create the major disaster to the persons inside the cabin. The proposed system has an embedded system which detects the presence of CO inside the vehicle cabin. A CO sensor is a device that detects the presence of the CO gas in order to prevent the CO poisoning.

Fig 2. Carbon Monoxide Sensors

Fig2. shows the MQ-7 Carbon Monoxide sensor. Sensitive material of MQ-7 gas sensor is SnO2, with lower conductivity in clean air. It make detection by the method of cycle high and low temperature, and detects CO when low temperature (heated by 1.5V) and the sensor's conductivity is higher along with the gas concentration rising. When high temperature (heated by 5.0V), it cleans the other gases adsorbed under low temperature. The specifications of the MQ-7 sensor are shown below. Figure 3 A simple electronic circuit is used which converts the change of conductivity to its corresponding output signal of gas concentration. MQ-7 gas sensor has high sensitivity to Carbon Monoxide. The sensor could be used to detect different gases contains CO and is a low cost and suitable for different applications.

MQ7 sensor Features:

- High sensitivity
- Detection Range: 10-1000 ppm of CO
- Response time :< 150s
- Heater voltage: 5.0V
- Dimensions: 16 mm diameter, 10 mm high excluding pin, pins-6 mm High.

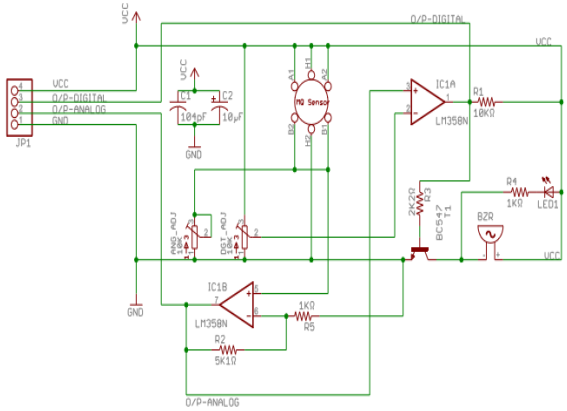


Fig 3. MQ 7 circuit diagram

3.1.2. 89V51RD2microcontroller

The P89V51RB2/RC2/RD2 are 80C51 microcontrollers with 16/32/64 kB flash and 1024 B of data RAMS.A key feature of the P89V51RB2/RC2/RD2 is its X2 mode option. The design engineercan choose to run the application with the conventional 80C51 clock rate (12 clocks permachine cycle) or select the X2 mode (six clocks per machine cycle) to achieve twice thethroughput at the same clock frequency. Another way to benefit from this feature is to keepthe same performance by reducing the clock frequency by half, thus dramatically reducingthe EMI.The flash program memory supports both parallel programming and in serial ISP. Parallelprogramming mode offers gang-programming at high speed, reducing programming costsand time to market. ISP allows a device to be reprogrammed in the end product undersoftware control. The capability to field/update the application firmware makes a widerange of applications possible.The P89V51RB2/RD2 is also capable of IAP, allowing the flash program memory tobereconfigured even while the application is running.

3.1.3. A/D Converter

The ADC0809 data acquisition component consist monolithic CMOS device with an 8-bit analog-to-digital converter, 8-channel multiplexer and microprocessor compatible control logic. The 8-bit A/D converter uses successive approximation as the conversion technique. The ADC0809 offers high speed, high accuracy, minimal temperature dependence, excellent longterm accuracy and repeatability, and consumes minimal power. These make the device ideally suitable for application processes and machine control to consumer and automotive applications.

The ADC0809 consists of an analog signal multiplexer, an 8-bit successive-approximation converter, and related control and output circuitry.

3.1.4. Alarm Circuit

Safety alarms are electronic alarms designed to alert the user to a specific danger. The hazardous gas like carbon monoxide leaks or its presence is potentially identified by means of various sensors. An audible alarm is usually employed with these sensors to alert people when a dangerous gas has been detected. Sensors are connected to a control

unit via low-voltage wiring or a narrow band RF signal which is used to interact with a response device. The proposed system produces alarm whenever the carbon monoxide exceeds the normal level.

3.1.5. Liquid Crystal display

Liquid Crystal Displays (LCD) have materials, which combine the properties of both liquids and crystals. LCD is a flat electronic visual display. Light modulating properties of liquid crystals are being used for the video display in the LCD. An LCD consists of two glass panels, with the liquid crystal materials sand witched between them LCD are more reliable and energy efficient. Its low power energy consumption makes it to be used in battery powered electronic devices.

Fig 4. 16 * 2 LCD

LCD consists of array of small pixels. Each pixel of an LCD consists of a layer of molecules aligned between two transparent electrodes, and two polarizing filters, the axis of transmission is perpendicular to each other. With no actual liquid crystal between the polarizing filters, light passing through the first filter would be blocked by the second (crossed) polarizer. The Liquid Crystal Display is intrinsically a passive device it is a simple light valve. The managing and control of the data to be displayed is performed by one or more circuits commonly denoted as LCD drivers. The toxic level of carbon monoxide and the oxygen level inside the cabin will be displayed each and every second in the LCD.

3.1.6. GSM modem

GSM (Global System for Mobile Communications: originally from Group Special Mobile) is the most popular standard for mobile telephony systems in the world. The GSM association has its promoting industry trade organization of mobile phone carriers and manufactures, estimate that 80% of the global mobile market uses this standard. A GSM modem is wireless modem that works with a GSM wireless network. GSM modem requires a SIM card from a wireless carrier in order to operate. A GSM available service like SMS (Short Message Service) represents alternative modalities to make remote measurements and control. SMS service is suited for remote control applications that requires small amount of data and rare activation, like sending alarms, or emergency commands. The system can be interconnected with the car alarm system and alert the owner, on his mobile phone. The system is composed by a microcontroller and a GSM phone.

Fig5. GSM MODULE SIM900

IV. IMPLEMENTATION

The level of the toxic gas CO is continuously sensed by the sensor MQ-7. The level is displayed in the LCD continuously for each and every second. When the level of the toxic gas CO exceeds the normal level then the microcontroller proceeds with an alarm. The GSM modem inside the vehicle sends a message to the authorized user about the alarming situation inside the cabin with the levels of thegases monitored by the sensors. Then ventilation is provided, so that the level of the toxic gases can be lowered as early as possible. This provides an immediate response to the situation which is an added advantage of the system

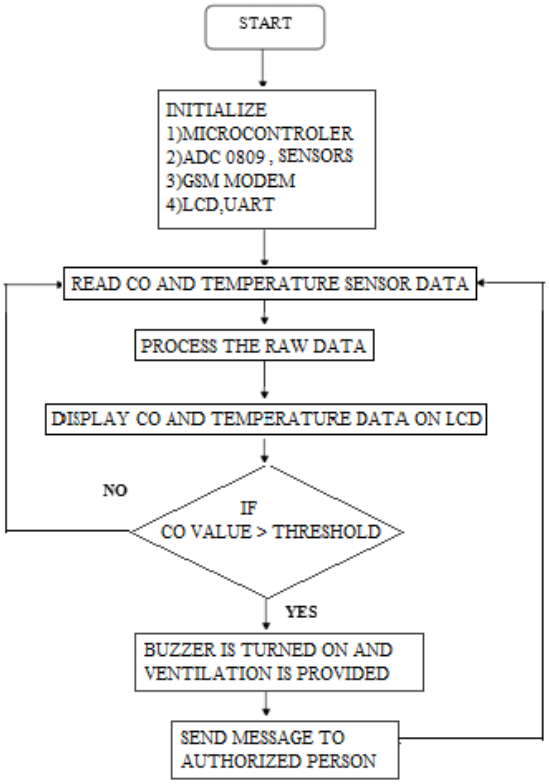
4.1 MQ-7 sensor relationship with the sensor resistance and concentrationof CO gas

CO gasPower law:**R = K*(C) ^-n**

Where, R= Rs/R0

K= Measurement constant of the sensor material.

C=Carbon monoxide concentration in parts per million/ parts per million (ppm).
n= has values between 0.3 and 0.8.
Where, Rs= sensor electrical resistance, Ro= sensor electrical resistance at zero ppm in the air mathematically,
log (Rs/R0) = log (K*C^-n) ,
log (Rs/R0) = log (k) + Log(c) ^-n ,
log (Rs/R0)= log (k) – n*log(C)---------- (1)
According to the "Development of Low Cost Adjustable Gaseous Exhaustanalyzer for Runtime Characterization, by G. Pradip et.el." considering theNormal Temperature and Pressure (NTP),
-1.4 + log (Rs/R0) = -0.7 *log(C) ---------- (2)
Comparing the equation 1 and 2 at NTP, we get
n= 0.7
log (k) = 1.4
K=$\log^{-1}$ (1.4)
K=25.12
From the power law,
R = K*(C) ^-n
(Vc/Vout) – 1 = K *C^-n ,
(5.00/Vout) -1 = 25.12*(C) ^-0.7 ,
(C)^-0.7 = [(5.00/Vout) -1]/ 25.12 ,
C = [{(5.00/Vout)-1}/25.12]^-1.43 ,
C = 100.468*[(5.00/Vout)-1] ^-1.43 ,
Thus, the relationship between the sensor resistance(R) and the carbon monoxide concentration (C)
C (ppm) = 100.468*[(5.00/Vout)-1] ^-1.43.
Flow Chart:



V. SPECIFICATION AND RESULT

At Temperature = 23C

Table 1. Voltage at output and CO concentration in ppm

Sr No	Voltage	Concentration ppm
1	0.1	0.235524108
2	0.2	0.708503456
3	0.3	1.368229722
4	0.4	2.204708373
5	0.5	3.218190341

6	0.6	4.414157436
7	0.7	5.801661257
8	0.8	7.392683511
9	0.9	9.201923539
10	1	11.24680985
11	1.1	13.54765547
12	1.2	16.12792489
13	1.3	19.01460253
14	1.4	22.23866535
15	1.5	25.83567064
16	1.6	29.84647754
17	1.7	34.31812846
18	1.8	39.30492555
19	1.9	44.86974814
20	2	51.08567151
21	2.1	58.03796552
22	2.2	65.82657716
23	2.3	74.56923402
24	2.4	84.40535274
25	2.5	95.501
26	2.6	108.0552442
27	2.7	122.3083638
28	2.8	138.5525633
29	2.9	157.1461184
30	3	178.532272
31	3.1	203.2648138
32	3.2	232.0432077
33	3.3	265.7616079
34	3.4	305.578472
35	3.5	353.0173893

VI. CONCLUSION

An embedded system is designed and tested for toxic gas detection inside a vehicle cabin using PHILIPS 89V51RD2 microcontroller. Toxic gas like CO is less sensible by human which endangers the human lives. This critical situation can beavoided by implementing the sensors for sensing the level of CO is displayed on LCD. When the CO level exceeds normal level then the designed system provides an alarm and also the warning message to the authorized user. Ventilation is immediately provided in the cabin, whenever this critical situation occurs. This prototype can also be used at Home, Educational and Working Institutions for monitoring the indoor air quality which intern enhance the quality of working environment and provides safety.

REFERENCES

[1] LIU Zhen-ya, Wang zhen-dong, Chen Rong, "Intelligent Residential Security Alarm and Remote Control System Based on Single Chip Computer", vol. 42, pp.143-166, 2008.

[2] Chen Peijiang, Jiang Xuehua, "Design and implementation of Remote monitoring system based on GSM", vol. 42, pp. 167-175, 2008.

[3] Ioan, Lita, Ion Bogdan Cioc, Daniel Alexandru Visan, "A New Approach Of automobile Localization System Using GPS and GSM/GPRS Transmission", vol. 8, pp. 415-422, 2006.

[4] K. Galatsis, W. Wlodarsla, K. Kalantar-Zadeh and A. Trinchi, "Investigation of gas sensors for vehicle cabin air quality monitoring," vol. 42, pp. 167-175, 2002.

[5] K. Galatsis, W. Wlodarski, Y.x. Li and K. Kalantar-zadeh, "Vehicle cabin air quality monitor using gas sensors for improved safety," pp. 143-164, 2000.

[6] K. Galatsis, W. Wlodarsla, K. Kalantar-Zadeh and A. Trinchi, "Investigation of gas sensors for vehicle cabin air quality monitoring," vol. 42, pp. 167-175, 2002.

[7] W. Chung and C. H.Yang, "Remote monitoring system with wireless sensors module for room environment," Sens. Actuators B, vol. 113, no. 1, pp. 35–42, 2009.

[8] Ben Gaid, M.; Kocik, R.; Sorel, Y.; Hamouche, R. A methodology for improving software design lifecycle in embedded control systems. In Proc. of Design, Automation and Test in Europe (DATE), Munich, Germany, March 2008.

[9] A.R.Ali, E. Imran Zualkerman, and Fadi Aloul, "A Mobile GPRS-Sensors Array for Air Pollution Monitoring", vol. 8, pp. 415-422, 2010.

[10] F.-S. Bai, Y.-L. Liu, "Design of Fault Monitoring Alarm System for Networks Based on GSM SMS," pp. 45-67, 2010.

