Design and Implementation of Vehicle Gaseous Fuel Leakage Detection System using GS

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Abstract—In this paper, a new method of designing and development of a microcontroller based toxic gas detection system is proposed. If the toxic gas or fuel leakage has been detected, the system automatically alerts the driver through buzzer, opens the car door automatically and transmits the warning message to the authorized user through the GSM module attached. User can send SMS and receive SMS through GSM Modem, based on that message User can control some appliances in host section. This system aims to modify an existing safety model employed in automotive field. It can be used in any Vehicle like Car, Bus Van etc. The advantage of this automated detection/alarm system is that, it offers faster response time and accurate detection of an emergency in turn leading to faster diffusion of the situation, compared to manual methods. This is a very compelling reason that justifies designing such a safety system.

Key words: Global System for Mobile Communication (GSM), LPC 2148 Microcontroller (ARM7), Fuel Detection System.

I. INTRODUCTION

Safety plays a major role in today's world and it is necessary that good safety system be implemented in places of travelling in a car. One of the most serious problems that one could have with the vehicle is a fuel leak. When leaking of fuel from any area of the car happens, it presents a very serious danger that could result in a catastrophe. If we suspect that there is a fuel leak in the car, you should consider using a fuel leak detector to find out exactly where the leak is occurring so that we can begin to repair the issue before it becomes a disaster.

Here a new automated system is proposed. The advantage of this automated detection/alarm system is that it offers faster response time and accurate detection of an emergency in turn leading to faster diffusion of the situation, compared to manual methods. This is a very compelling reason that justifies designing such a safety system [1].

There are no. of applications of vehicle safety outlined in many areas such as military, environmental, health, home, commercial, and the industrial. Particularly, the vehicle safety solutions for real time monitoring of nuclear power plant [2].

II. BLOCK DIAGRAM OF THE PROPOSED SYSTEM

The hardware used in this system design is explained as block diagram and its description also given. The important components and modules used in hardware design are explained.

The block diagram of Fig.1 shows the interface of gas leakage detection, GSM, and high speed microcontroller (LPC2148)

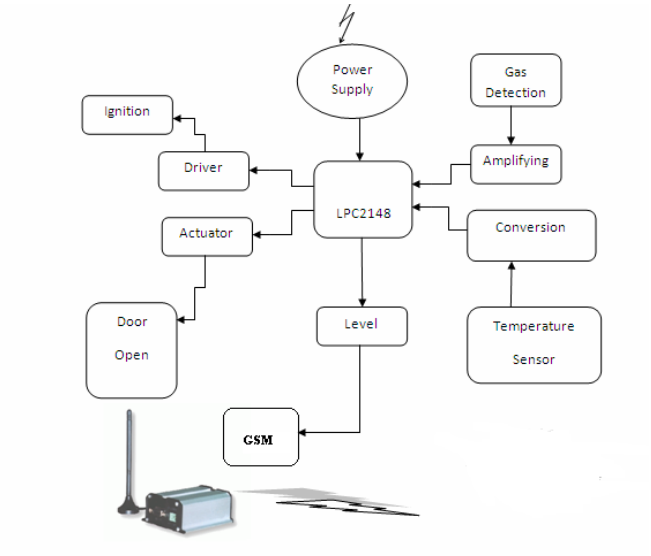

Fig. 1: Block Diagram of the fuel detection system

When powered on the equipment the stepper motor will be running state. The gas and the temperature sensor continuously checks for the temperature change or any fuel is leaked. The controller keeps on monitoring the values of the temperature and gas sensor. The value of the sensor exceeds the predefined values stored in the microcontroller. In such a condition, the controller will send the specified message to the user whose no is stored in the controller.

This is done by the serial communication RS-232 driven by a MAX-232 level converter, in this is the inter face between controller and the GSM module and it is controlled by the controller through AT commands. The GSM module when received the particular command sends the predefined message to the number stored from the sim card placed in the socket provided in the module. The message received by the user who is in remote location will contain information regarding the temperature and voltage values when fuel leakage occurs, it will alerts the user by led (LM-35) indicator if he is in the car.

The detection unit reaches the maximum threshold level, at the same detects any toxic gas it send an SMS through GSM Modem. User can send SMS and receive SMS through GSM Modem, based on that User can control some appliances in host section.

III. TECHNOLOGY AND HARDWARE

A. GSM Technology

GSM is a cellular network which means that mobile phones connect to it by searching for cells in the immediate vicinity. There are five different cell sizes in a GSM network—macro, micro, pico, femto and umbrella cells. The coverage area of each cell varies according to the implementation environment. Macro cells can be regarded as cells where the

base station antenna is installed on a mast or a building above average roof top level. Micro cells are cells whose antenna height is under average roof top level; they are typically used in urban areas. Picocells are small cells whose coverage diameter is a few dozen metres; they are mainly used indoors. Femtocells are cells designed for use in residential or small business environments and connect to the service provider's network via a broadband internet connection. Umbrella cells are used to cover shadowed regions of smaller cells and fill in gaps in coverage between those cells[4].

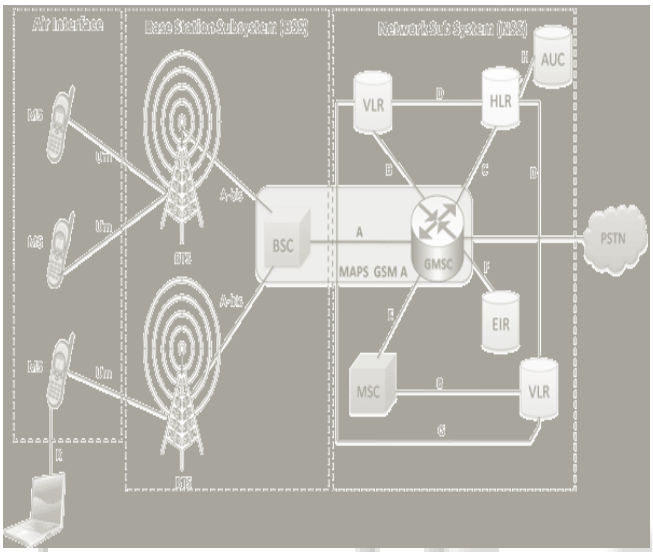

Fig. 2: GSM architecture

To achieve important information of cars, one GSM module is added into the car security system. SIM300 GSM modem can quickly send SMS messages to appointed mobile phone or SMS server. So the owner and the police can be informed at the first time.

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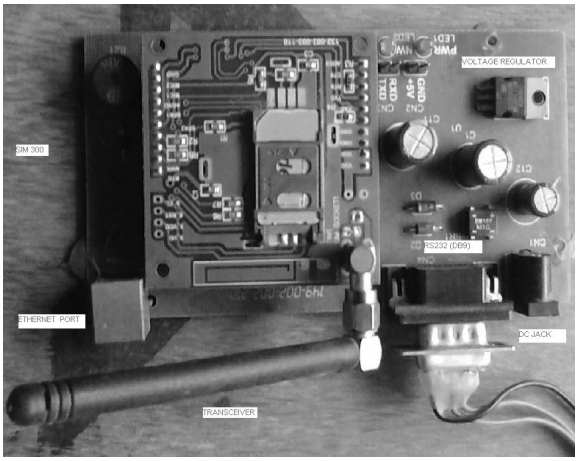

Fig. 3: GSM Module

1) Interfacing SIM300 module with Microcontroller

The LPC2148 provides two UARTs that are controlled and accessed by SFRs. Each UART has an address that is used to read and write the value contained in the UART. The same address is used for both read and writes operations and the read and writes operations are distinguished by the instruction. Its own SFR control register controls each UART.

But the serial port and the debug port don't support the RS_232 level and it only supports the CMOS level. It should add the level converter IC between the DCE and DTE.

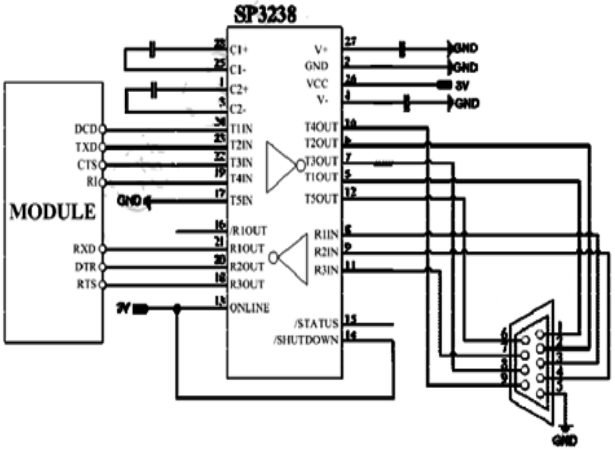

Fig. 4: Interface Microcontroller with GSM module

B. Gas Sensor

Gas sensor used to detect various combustible gases there is a sensing element inside the stainless steel mesh. Resistance of the sensing element reduces rapidly There is a heating element inside the sensor.

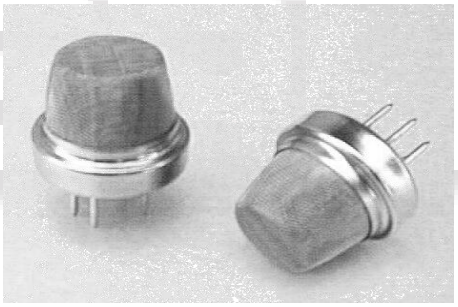

Fig. 5: Gas Sensors

The heater terminals should be connected to 5V DC. The sensor can be wired using a general purpose op-amp such as 741 in comparator mode. Also by using a variable resistor, the sensitivity can be adjusted very easily.

C. LM35 Temperature Sensor

The LM35 can be applied easily in the same way as other integrated-circuit temperature sensors. It can be glued or cemented to a surface and its temperature will be within about 0.01§C of the surface temperature.

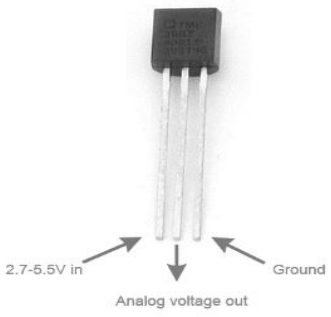

Fig. 6: LM35 Temperature sensor

This presumes that the ambient air temperature is almost the same as the surface temperature, if the air temperature were much higher or lower than the surface temperature, the actual temperature of the LM35 die would be at an intermediate temperature between the surface temperature and the air temperature.

D. ARM7 (LPC2148)Module

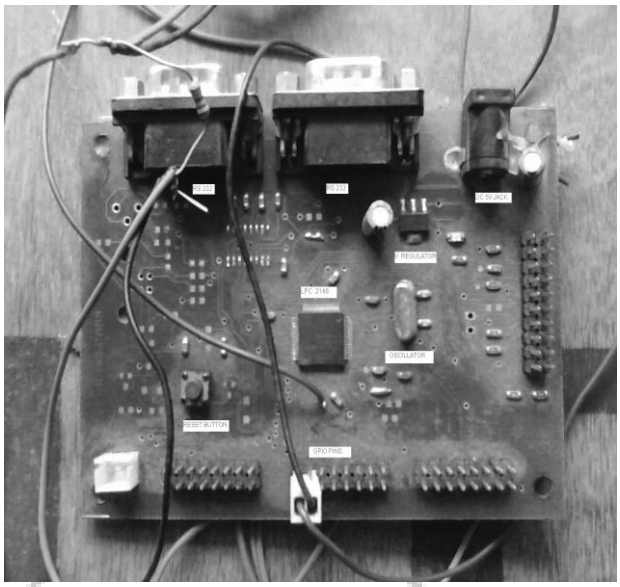

Fig. 7: ARM7 (LPC2148) Board

The LPC2141/42/44/46/48 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty [5].

Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 8 kB up to 40 kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems.

The ARM Controller board is operated on 5v power supply. In this board each component operates on 5v supply except controller. Controller operates on 3.3v supply. The LM317 regulator converts 5v supply into 3.3v.The current drawing of the board is depend on the size of the code, as the code length increases current drawing of the board is also increases. The maximum current capability of the board is 1.5A.

IV. SOFTWARE FLOW CHARTS

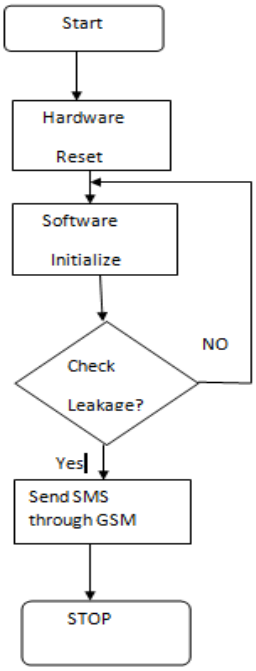

Fig. 8: Software Flow chart for GSM

The Software Flow chart for GSM is shown in the above Fig.8. The system continuously checks for the leakage. If the leakage is found, it sends the message to the user and alerts when he is in a remote place.

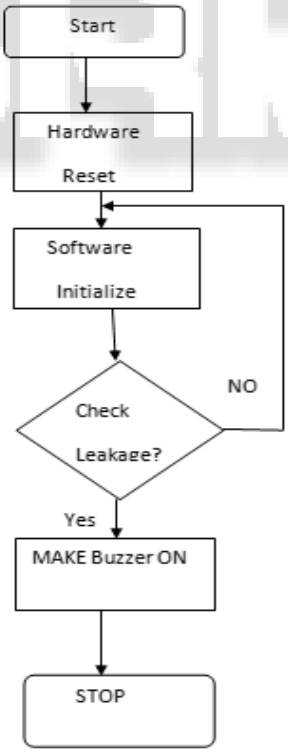

Fig. 9: Software flow chart of the buzzer

The Software Flow chart for Buzzer is shown in the above Fig.9. The system continuously checks for the leakage. If the leakage is found, it alerts driver in the car with the buzzer indication.

V. RESULTS AND DISCUSSIONS

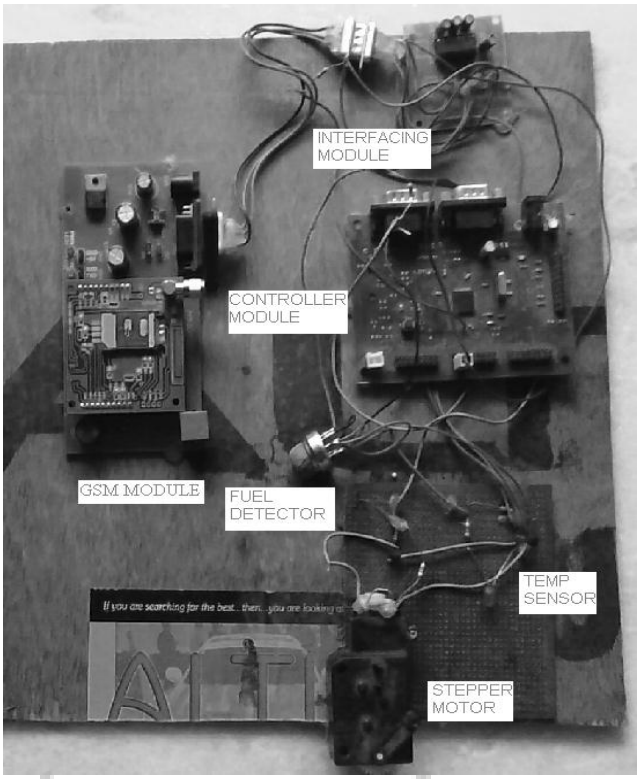

Fig. 10: Photograph of Vehicle Fuel Leakage Detection System.

The Photograph of Vehicle Fuel Leakage Detection System is shown in the Fig.10. It shows the interface of the various modules in the design.

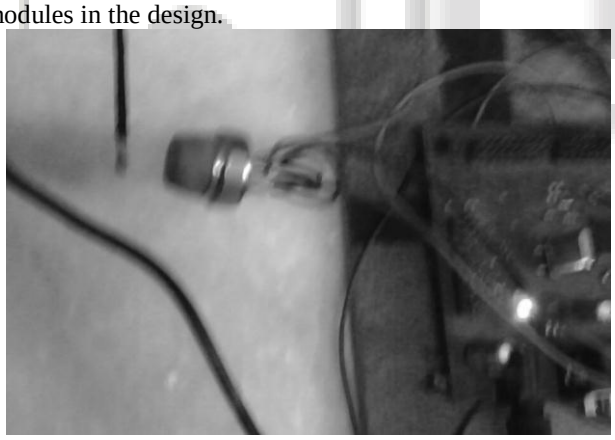

Fig. 11: Smoke Detection

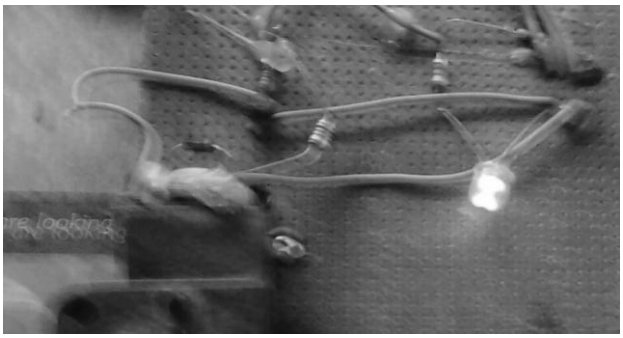

Fig. 12: Alert shown by LED on Gas Leakage (Buzzer)

When the gas leakage has been detected, the driver in the vehicle is alerted by the LED indication as shown in the above Fig. 12.

Fig. 13: Screenshot 3 of Real time debugging.

The above Fig.13 shows the messages received by the two different mobile phone numbers through the Flash magic terminal. Data consists of service number, pulse count, no. of units and amount fields.

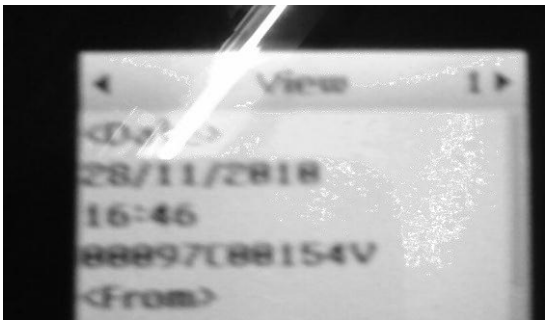

Fig. 14: Message output

The message received by the user is shown in the above Fig.14. We can observe service number, pulse count, no. of units and amount fields in the message

VI. CONCLUSION

The implementation of interface between GSM, and Gas detection sensor with LPC2148 is done successfully. The interface is properly done without any collision among GSM, Leakage module is done. The design and realization of interface between GSM modem and GSM network for data transmission done successfully. Therefore, the car is monitored periodically by the sensors and the an SMS will be sent to the user when there is an gaseous fuel is detected in the car or vehicle and also Indicator will glows indicating the persons in the car. The results of the Keil software have been obtained by compiling the code and equipment is tested practically by placing it near the Engine Control Module. The designed system provides a real time and low cost solution to the fuel leakage problem and prevents many accidents.

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