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LPG Leakage Monitoring and Multilevel Alerting System

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Abstract

Liquefied Petroleum Gas (LPG) is an inevitable one in day-to-day life. LPG is used as a fuel in a range of applications including in heating and cooking appliances, industrial applications, in vehicles and as a propellant and refrigerant. Due to leakage of LPG, it produces hazardous and toxic impact for human beings and also for other living creatures. To overcome this predicament, we need quittance. Thereby, we speculate some solutions to detect the LPG Gas leakage and make alert to the users who are using LPG Gas. In this paper we are using LPG gas sensor for sensing the leakage and produce the result in audio and visual formats also alerts human via Short Message Service (SMS). The sensor has excellent sensitivity combined with a quick requital time. The sensor has also sense iso-butane, propane and cigarette smoke. This paper provides design approach on both software and hardware.

Keywords: GSM (Global System for mobile communications), Microcontroller, LPG Gas Sensor.

Introduction

LPG consists of mixture of propane and butane which is highly flammable chemical. It is odorless gas due to which Ethanethoil is added as powerful odorant, so that leakage can be easily detected [3]. There are other international standards like EN589, amyl mercaptane and tetrahydrothiophene which are most commonly used as odorants. LPG is one of the alternate fuels used now days. LPG is also used as an alternate fuel in vehicles due to soaring in the prices of petrol and diesel.

Some people have low sense of smell, may or may not respond on low concentration of gas leakage. In such a case, some high security systems become an essential and help to protect from gas leakage accidents [1]. Bhopal, Chernobyl, Okishima gas tragedy was an example of gas leakage accident in India, Russia and Japan. This was world's worst gas leakage industrial accident. Gas leakage detection is not only important but stopping leakage is equally essential. We designed a system which sniffs LPG leakage and emphraxis by the measures such as Spinning the Exhaust fan, SMS, Call, Beep sound, LED Blink. This paper provides a cost effective and highly accurate system.

Methodology Used

The functionality of system is divided into three main steps. In the initial step, the gas leakage is detected by the gas sensor MQ-5. This detects the gas leakage and gives the signal to the microcontroller. After that in second step the microcontroller receives the signal, which sends by gas sensor. It sends activation signal to other external devices attached with it such as Exhaust fan, Buzzer, LED (Light Emitting Diode), GSM module [4]. In the last step, many tasks have been performed such as buzzer activates simultaneously Light emitting diode blinks, GPRS module activated, which send warning SMS to the user.

A. MQ-5 Gas Sensor

MQ5 is a semiconductor type gas sensor which detects the gas leakage. The sensitive material of MQ-5 is tin dioxide (SnO_2). It has very low conductivity in clean air. This Gas sensor not only has sensitivity to propane and butane but also to other natural gases, low sensitivity to cigarette smoke and alcohol. The MQ-5 gas sensor is shown in fig. 1. This sensor can also be used for detection of other combustible gas such as methane

Fig.1.MQ-5 Gas Sensor

The concentration range of MQ-5 gas sensor is 300-1000 ppm. This sensor is available in 6 pins package, out of which 4 pins are used for fetching the signals and other 2 pins are used for providing heating

current. This sensor has fast response time. The power need by the sensor is 5V. This sensor has different resistance value in different concentration.

Table i. Specifications of lpg gas sensor

Model No	MQ 5
Sensor Type	Semi conductor
Sensing Resistance	10KΩ - 60KΩ (1000ppm LPG)
Detection Gas	Isobutene, Butane, LPG
Concentration	300-1000ppm (Butane, Propane, LPG)
Standard detecting condition	Humidity: 65%±5%

Fig.2. Sensitivity characteristics of the MQ -5 gas sensor for several gases.

Resistance value of MQ-5 is difference to various kinds and various concentration gases. So, when using these components, sensitivity adjustment is very necessary. We recommend that you calibrate the detector for 1000ppm H2 or LPG concentration in air and use value of Load resistance (RL) about 20 KO(10KO to 47KO). When accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence [6].

B. Arduino Microcontroller

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators.

Fig.3.Arduino Microcontroller

The microcontroller on the board is programmed using the Arduino programming language and the Arduino development environment. Here this Arduino gets the sensed information from LPG gas sensor and sends it to the GPRS shield to alert the user via SMS and Call and as well as glow the LED and switch on the fan.

An Arduino board consists of an Atmel 8-bit AVR microcontroller with complementary components to facilitate programming and incorporation into other circuits. An Arduino microcontroller is also pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory, compared with other devices that typically need an external programmer. Arduino boards are programmed via USB, implemented using USB-to-serial adapter chips such as the FTDI FT232.
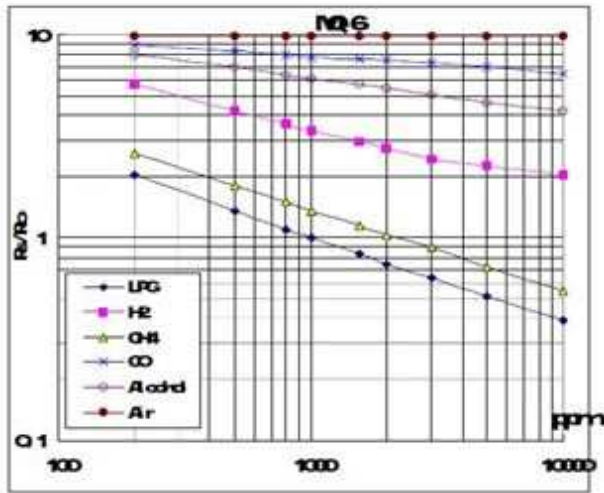
Microcontroller	ATmega328 (8-bit)
Operating voltage	5V
Input voltage	7-12V
Digital I/O pins	14(6 provide PWM output)
Analog Input pins	6
DC current per I/O pin	40Ma
Clock speed	16 MHz
PC connection	USB
External power jack	Yes

An on-board LED attached to digital pin 13 for fast an easy debugging of code. 32 KB of flash memory for storing your code. 13 digital pins and 6 analog pins. These pins allow us to connect external hardware to the Arduino. An ICSP connector for bypassing the USB port and interfacing the Arduino directly as a serial device. This port is necessary to re-boot load your chip if it corrupts and last, but not least, a button to reset the program on the chip.

C. GSM Module

GSM SIM 900 Quad-band GSM/GPRS engine, works on frequencies 850MHz, 900MHz, 1800MHz. It is very compact in size and designed with RS 232 level converter circuitry, which allows you to directly interface PC Serial port. GSM uses a combination of Time Division Multiplexing and Frequency Division Multiplexing. The baud rate can be configurable from 9600-115200 through AT command. Initially Module is in Auto band mode. This GSM/GPRS RS232 Module is having internal TCP/IP stack to enable you to connect with internet via GPRS. Using this module, we will be able to send & read SMS, Connect to internet via GPRS through simple AT commands. The suitable operating voltage level is 5V-12V DC. When the gas leakage is detected by the gas sensor, microcontroller sends a signal to GSM module in which one of the tasks is to send the text SMS as well as call. GSM module requires one SIM card. This module is capable to accept any network SIM card [7].

Fig.4.GPRS Shield

This module has a unique identity number like mobile phones have. These module works on 12V DC supply we can send SMS and also send a voice message. These SMS or voice messages are saved in the microcontroller memory. Multiple SMSs can also be sends to user, police and fire station etc. This GPRS Shield contains low cost GSM SIM 300 Module [8]. This reconfigurable Quad Band module supports all GSM operator SIM cards. It shares its applications in various streams such as SMS based remote control alerts, Security applications, Sensor monitoring and GPRS mode remote data logging.

Working Principle

This Gas leakage detection module consists of small LPG gas sensor, Arduino UNO board, GPRS Shield, Alarm unit, LED and Exhaust fan that fit into a small place. One portion of the Gas sensor is connected to the power supply. In the next portion, the central heat coil is connected to the Ground. One of the remaining two pins is connected to the Microcontroller's analog pin.
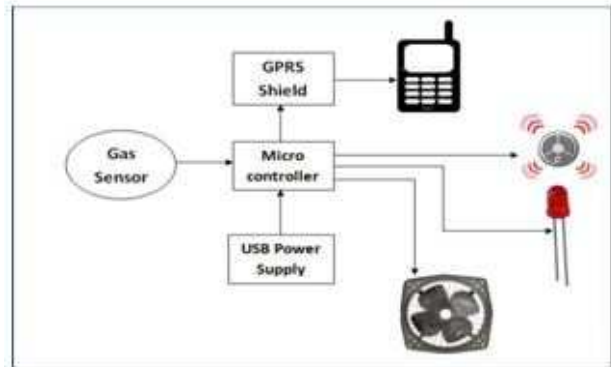

Fig.5.Block diagram of LPG gas leakage security system

The last pin is connected to the ground via 10KΩ load resistance. In this way the sensor communicates with the microcontroller. Parallely, alarm is connected to a digital pin. GPRS shield is embedded on Arduino controller board that reads the information (data) from Sensor process it & sends an SMS & a call to the user via radial link. The GPRS Shield includes the GSM sim 900 module that reads and sends message through AT commands. Multiple users can be added to the SIM card. LED indication visually alerts the hearing impaired people. Alarm provides the long beep to help the visually impaired people to protect themselves. Instead of leaving voice alert, long beep has higher frequency range that travels long distance.

Result

The prototype of leakage system has been tested by sensing a small amount of LPG gas near to the sensor. MQ-5 gas sensor detects the LPG gas and sends a signal to the microcontroller
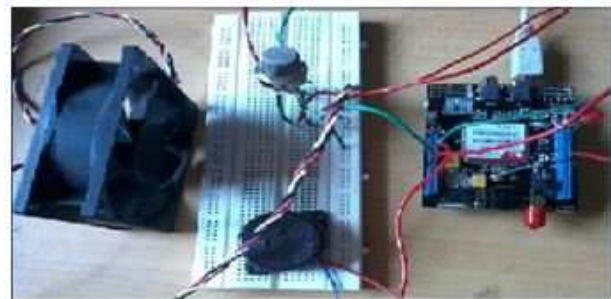

Fig.6. Five ways alert LPG Gas Sensor Kit

After that microcontroller send an active signal to other externally connected devices. As a result a buzzer rings and a Light Emitting Diode blinks. When

reset button is pressed, the system refreshes itself and whole system regains its initial position.

Conclusion

In this system we have describe a new approach for gas leakage detection system at a low concentration. The leakage is detected with the help of MQ-5 gas sensor. Sensor sends a signal to microcontroller. In the next step microcontroller sends an active signal to other externally connected devices. Th efficiency an d memory of t hen Microcontroller can beincreased ifATME28P microcontroller is used in place of PIC multiple SMS can be sent by changing programming GSM module. To change the SIM card we have to make changes in program. In future we will add automatic door opening application, and as well as automatic closing of cylinder valve when ever gas leakage is detected.

Acknowledgement

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