SMART GAS CYLINDER USING EMBEDDED SYSTEM

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Abstract: The design of a wireless LPG leakage monitoring system is proposed for home safety. This system detects the leakage of the LPG and alerts the consumer about the leak by SMS and as an emergency measure the system will turnoff the power supply, while activating the alarm. The additional advantage of the system is that it continuously monitors the level of the LPG present in the cylinder using load sensor and if the gas level reaches below the threshold limit of gas around 2kg so that the user can replace the old cylinder with new in time and automatically books the cylinder using a GSM module .The device ensures safety and prevents suffocation and explosion due to gas leakage. This project is implemented using ARM 7 processor and simulated using keil software.

Keywords: LPG, gas cylinder monitoring, gas leakage detection and prevention, GSM, Alarm

I. INTRODUCTION

LPG, first produced in 1910 by Dr. Walter Snelling is a mixture of Commercial Propane and Commercial Butane having saturated as well as unsaturated hydrocarbons. Because of the versatile nature of LPG it is used for many needs such as domestic fuel, industrial fuel, automobile fuel, heating, illumination etc and the demand for LPG is on an exponential raise day by day. The liquefied petroleum gas is finding wide usage in homes, industries and in automobiles as fuel because of its desirable properties which include high calorific value, produces less soot, produces very less smoke and does not cause much harm to the environment.

Natural gas is another widely used fuel in homes. Both burn to produce clean energy, however there is a serious threat about their leakage. The gases being heavier than air do not disperse easily and may lead to suffocation when inhaled; also the leaked gases when ignited may lead to explosion. The number of deaths due to the explosion of gas cylinders has been increasing in recent years. There is a need for a system to detect and also prevent leakage of LPG.

Before the development of electronic household gas detectors in the 1980s and 90s, gas presence was detected with a chemically infused paper that changed its colour when exposed to the gas. Since then, many technologies and devices have been developed to detect, monitor, and alert the leakage of a wide array of gases. Today, booking an LPG cylinder is now just a text message away. Petroleum companies have launched the customer-friendly service called as IVRS (Interactive voice Response) technique for their customers.

The proposed system reduces the customer burden. Now-a-days, big problem in our houses are to refill the cylinder. In fact, most of the time peoples hand over old cylinder to the delivery men without knowing the exact quantity of the gas left in it. LPG weighing machine is used to overcome this problem. It will monitor and display the quantity of gas level in the cylinder, when gas level reaches below the threshold limit of around 2kg it sends SMS alert to the user as well as gas refill agency. It uses a MQ5 gas sensor which can detect different combustible gases with low cost, and a PIC microcontroller to alert when the levels of gas detected is beyond safety limit and also to take emergency measures to turns off the power supply, when the leakage is detected. The alert mechanism in the proposed system includes an LED indication, buzzer and an SMS sent to the stored numbers with the help of GSM. The device is designed for use in homes which use Liquefied Petroleum Gas or natural gas; however it can be used in industries and other applications involving the gas cylinders.

II.LITERATURE SURVEY

Sunithaa.Jet al[1]The design of a wireless LPG leakage monitoring system is proposed for home safety. The system detects the leakage of the LPG and alerts the consumer about the leak and as an emergency measure the system will switch on the exhaust fan and also checks the leakage. An added feature of the system is that the approximate consumption is indicated in terms of the total weight. The proposed system makes use of GSM module in order to alert about the gas leakage via an SMS. Whenever the system detects the increase in the concentration of the LPG it immediately alerts by

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activating an alarm and simultaneously sending message to the specified mobile phones. The exhaust fan is switched on and an LPG safe solenoid valve fitted to the cylinder is given a signal to close avoiding further leakage. The device ensures safety and prevents suffocation and explosion due to gas leakage.

V.Ramyaet al [2]Safety plays a major role in today's world and it is necessary that good safety systems are to be implemented in places of education and work. This work modifies the existing safety model installed in industries and this system also be used in homes and offices. The main objective of the work is design in microcontroller based toxic gas detecting and alerting system. The hazardous gases like LPG and propane were sensed and displayed each and every second in the LCD display. If these gases exceed the normal level then an alarm is generated immediately and also an alert message (SMS) is sent to the authorized person through the GSM. 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 in turn leading faster diffusion of the critical situation.

SagarShindeet al[3[The former systems can not react in time, even cannot obtain data from an accident and locate accurately. This system gives real time detective of potential risk area, collect the data of leak accident and locate leakage point. This system having protection circuitry consists of exhaust fan and an Liquefied Petroleum Gas Safe Solenoid Valve. The hazardous gasses like Liquefied Petroleum Gas and Propane were sensed and displayed each and every second in Liquid Crystal Display. If these gasses exceed normal level then alarm is generated immediately. In this system MQ-6 gas sensor used to sense poisonous gas and has high sensitivity to LPG and also response to natural gas. This work modifies the existing safety model installed in industries. It offers quick response time and accurate detection.

Mahalingam et al [4] Gas leakage is a major concern with residential, commercial premises and gas powered transportation vehicles. One of the preventive measures to avoid the danger associated with gas leakage is to install a gas leakage detector at vulnerable locations. The objective of this work is to present the design of a cost effective automatic alarming system, which can detect liquefied petroleum gas leakage in various premises. In particular, the alarming system designed has a high sensitivity for primarily butane, which is also individually sold bottled as a fuel for cooking and camping. The proposed system is designed to meet UK occupational health and safety standards. Test results are demonstrated for an USB powered gas leakage detection system and it gives early warning signals under less severe conditions and activates a high pitched alarm in case of emergency situations to safeguard the users.

S.Rajitha et al [5] The aim of this project is to monitor for liquid petroleum gas (LPG) leakage to avoid fire accidents providing house safety feature where security has been an important issue. The system detects the leakage of the LPG using gas sensor and alerts the consumer about the gas leakage by sending SMS. The proposed system uses the GSM to alert the person about the gas leakage via SMS. When the system detects the LPG concentration in the air exceeds the certain level then it immediately alert the consumer by sending SMS to specified mobile phone and alert the people at home by activating the alarm which includes the LED, Buzzer simultaneously and display the message on LCD display to take the necessary action and switch on the exhaust fan to decrease the gas concentration in the air.

III.HARDWARE DESCRIPTION

The system proposed consists of three major modules namely, leakage detection module, GSM module with PIC microcontroller, protection circuitry. It uses ATMEGA168, which is an 8 bit microcontroller. It finds wide application due to its features and low power. The block diagram of the proposed system is shown in figure 1.

The leakage detection module consists of the MQ-5 gas sensor and the associated circuitry to detect the amount of combustible gas present in the surrounding .The sensitivity of the gas sensor can be adjusted using external circuitry. The sensor is insensitive to air. The output of sensor module is connected to ADC of the microcontroller.

The microcontroller digities the voltage and checks if the concentration is within safe levels. If the concentration of the combustible gases is beyond safe levels (the safety level is programmable) the microcontroller immediately activates an alarm and the LED's and turns off the power supply, then sends alert SMS about leakage to the stored numbers via GSM and further it is interfaced with the load cell to implement additional functionality of displaying the weight of the cylinder approximation of the percentage of total weight is displayed using an LCD .
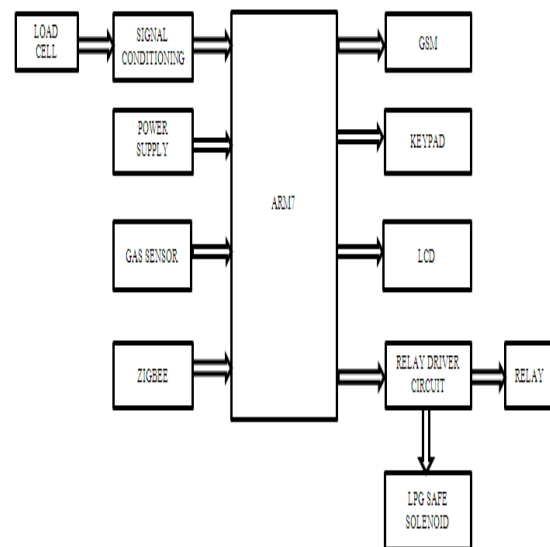

Fig 1: Block diagram of ARM LPG leak detection and prevention system.

A. GAS LEAK DETECTION AND GSMMODULE

The main function of the detection module is to detect changes in concentration of combustible gas and activate an audio-visual alarm and send an SMS to the consumer. A solid state gas sensor MQ5 is used. Tin di oxide SnO2 is the sensitive material of MQ-5 gas sensor, this has lower conductivity in clean air but when the target combustible gas exists in the environment, the sensor's conductivity increases, resistance of sensor changes with the concentration of combustible gases. Figure 2 shows the gas leakage sensing circuitry. A simple electronic circuit can be used to convert the change in resistance to change in terms of concentration of combustible gases.MQ-5 gas sensor has high sensitivity to Methane, LPG and coal gas. Low cost and long life are the advantages of using this sensor. For the sensor to function properly the sensor needs to be heated for specific amount of time called the preheat time. The sensor works with 5volt power supply.

The resistance of the sensor is given by equation(1)

Rs=(Vc/VRL-1)×RL (1)

whereRs is the sensor resistance
Vc is the supply voltage to load cell
VRL is the voltage across load resistance
RL is the load resistance

The GSM module is used to send short messages about the possibility of gas leak and as an added feature indicate that it may be due to book a refill cylinder or can program the device to automatically book the cylinder via SMS. Any number of mobile numbers can be included to which SMS must be sent about the above mentioned details. This wireless module is used to alert the consumer even when they are away from home . An audio-visual alarm including the buzzer and LED's are provided to immediately alert the people at home.

As added feature indication about the approximate weight of the cylinder is given as full, medium or empty. This measurement is done by interfacing a load cell with microcontroller. The load cell will produce an analog voltage corresponding to the change in weight this is in terms of milli volts a suitable circuitry is used to amplify and filter this analog voltage . This will be displayed in a Liquid Crystal Display interfaced with the microcontroller. If found empty an indication SMS will be sent to the consumer also the device can be programmed to automatically book after specified amount of time.

The microcontroller forms the heart of the entire system controlling all processes that take place. A real time clock can be interfaced to display the current date and time in the LCD display.

B. PROTECTION CIRCUITRY

The protection circuitry consists of the exhaust fan, an LPG safe solenoid valve and the associated microcontroller interfaces. Suitable driver circuits have to be designed for activating the valve and exhaust fan using relays. An additional inverter may be required to interface domestic exhauster so that it can operate in parallel with it even during power failure and eliminates need for two exhaust fans.

Whenever the level of combustible gas is beyond safe levels the PIC will switch on the exhaust fan so that the gases are sent out. A point to note is that exhaust fan does not produce spark, so it is absolutely safe. This is followed by energising the normally open LPG safe solenoid valve so that it is closed and no more gas leaks. Mostly the condition will be back to normal but the exhaust fan will remain on to ensure safety. If leakage is detected system will turns off the power supply so that fire accident can be avoided.

IV.SYSTEM OPERATION

In this prototype, gas leakage detection has been given a highest priority. MQ6 placed in the vicinity of the gas cylinder. In the advent of leakage, the resistance of the sensor decreases increasing its conductivity. Corresponding pulse is fed to microcontroller and simultaneously switches on the buzzer and exhaust fan which we can reset by a manual reset switch, and automatically turns off the power supply to avoid the fire accidents.Also a logic high pulse (+5 V) is given as an interrupt to INT0 pin of ATMega16 Microcontroller. Microcontroller sends a message "EMERGENCY ALERT: LPG gas leakage found in your home" to required cell numbers via GSM module and the same will be displayed on LCD.

In automatic Gas booking system, LCD continuously monitors the weight of the gas in cylinder and displays it on seven segment display. When the weight of the gas is less than or equal to 2 Kg, a logic high pulse is fed to a port pin of microcontroller. As this pin goes high, microcontroller will send a booking message to distributor of format, "REG_AMARGAS_12345". At the same time, the message will be displayed on LCD as "Booking Cylinder".

V.SOFTWARE DESCRIPTION

Keil development tools, designed for ARM processor-based microcontroller devices, support every level of developer from the professional application engineer to the student just learning about embedded software development. The industry-standard Keil C/C++ Compilers, Macro Assemblers, Debuggers, Real-Time Kernels, and Single-board Computers support ALL ARM-compatible derivatives and help you in getting your projects completed on schedule.

Embedded C is a set of language extensions for the C Programming language by the C Standards committee to address commonality issues that exist between C extensions for different embedded systems. Embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations. In 2008, the C Standards Committee extended the C language to address these issues by providing a common standard for all

implementations to adhere to. It includes a number of features not available in normal C, such as, fixed-point arithmetic, named address spaces, and basic I/O hardware addressing.

A. ALGORITHM

1. Select Project - New Project.
2. Select a directory and enter the name of the project file.
3. Select Project - Select Device and select an 8051, 251, or C16x/ST10 device from the Device Database™.
4. Create source files to add to the project.
5. Select Project - Targets, Groups, Files. Add/Files, select Source Group1, and add the source files to the project.
6. Select Project - Options and set the tool options. Note when you select the target device from the Device Database™ all special options are set automatically. You typically only need to configure the memory map of your target hardware. Default memory model settings are optimal for most applications.
7. Select Project - Rebuild all target files or Build target.

Figure 3: Flow chart

The system prototype is constructed and when a Small amount of LPG is brought near the system, the system sensor detects the leakage and sends the SMS to housemates and activates the alarm and switches on the exhaust fan, turns off the power supply. Also system prototype continuously monitors the LPG level of the cylinder and books the cylinder automatically.

Fig 4: Prototype of smart gas cylinder

VI.CONCLUSION

The gas leakage detection system was proposed, designed and successfully implemented in this paper for home safety and industrial applications. This system detects the leakage of the LPG and alerts the consumer about the leak by SMS and as an emergency measure the system will turnoff the power supply, while activating the alarm. . Along with gas leakage detection, this system gives a fully automated approach towards the gas booking. Real time weight measurement of the gas and its display on LCD makes it an efficient home security system and also can be used in industries and other places to detect gas leaks. This project is implemented using the ARM 7 processor and simulated using the Keil software. The cost involved in developing the system is significantly low and is much less than the cost of gas detectors commercially available in the market.

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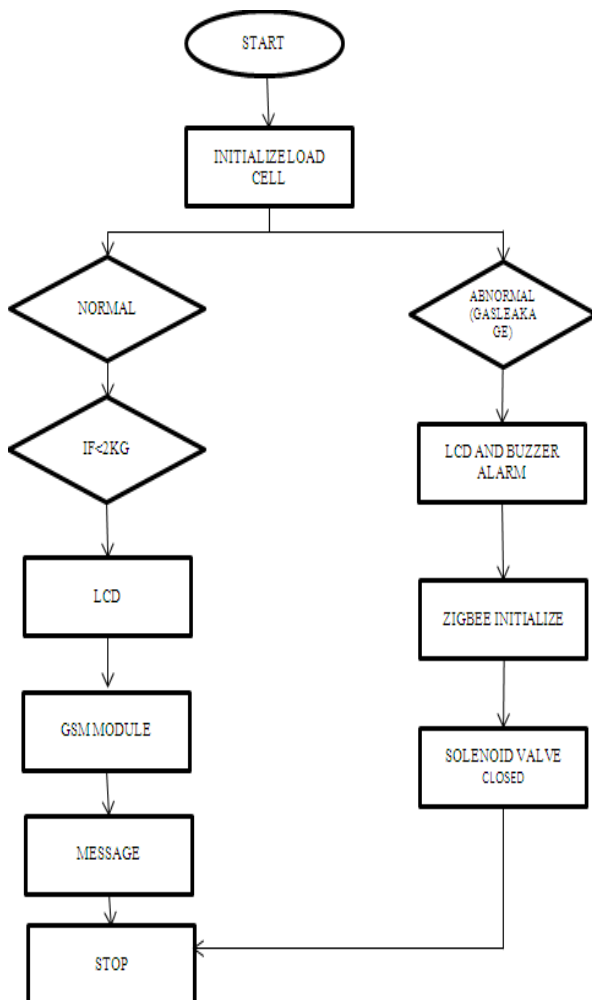[8] A. CheSoh, M.Sc.; M.K. Hassan, M.Eng.; and A.J. Ishak, M.Sc. " Vehicle gas leakage detector"

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