Habitual Booking System for LPG with Leakage and Fire Sensing Sanctuary

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Abstract—The design of a wireless LPG leakage monitoring system is proposed for home safety. The aim of this paper is to monitor for LPG leakage to avoid fire accidents providing house safety feature where security has been an important issue and alerts the consumer about the leak by SMS and as an emergency measure the system will turn off the power supply, while activating the alarm. In this paper we proposed 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. We have also included DC battery in the system to operate even when the power goes off due to the power cut.

Keywords— Monitoring System, LPG leakage, Fire Sensing, GSM Module, DC battery, Booking System.

I. INTRODUCTION

The use of liquefied petroleum gas (LPG) is rapidly increasing in developing countries as it produces low smoke and less soot. The LPG is a flammable mixture of hydrocarbon gases like propane and butane [3]. Gas pipe lines (that feed domestic cooking systems) are safe but they are prone to gas leakage due to mishandling, accidents and over filling of the gas cylinder. Explosions resulting from domestic cooking gas leakage can be fatal causing loss of property and injuries or even deaths.

The current systems available are not so portable and are costly and difficult to implement. Because of without fire sensors and more security issues. So an embedded system is designed using PIC 16F877 Microcontroller, for the purpose of detection of hazardous gas leakage, which in turn avoids the endangering of human lives [1]. The primary objects of the present project to provide a novel means for safely detecting any malfunction of a pressurized gas system in order to prevent accumulation of combustible gases so that damage or explosion due to such an accumulation of gases is prevented. Yet another object of the present invention is to provide a novel gas detection and monitoring system which is economical to manufacture and which may be readily installed. Ideal sensor for use to detect the presence of a dangerous LPG leak in our home.

II. RELATED WORKS

2.1 Embedded system for Hazardous Gas detection and Alerting

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 designing 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. *[V.Ramya, B. Palaniappan, et Al 2012]*

2.2. Design and Development of Kitchen Gas Leakage Detection and Automatic Gas Shut off System

Gas leakages resulting into fatal inferno has become a serious problem in household and other areas where household gas is handled and used. Gas leakage leads to various accidents resulting in financial loss as well as human injuries and/or loss. The work aims at designing a system that detects gas leakage and alerts the subscriber through alarm and status display besides turning off the gas supply valve as a primary safety measure. The shutting off of the supply valve stops further gas flow to the cooker to prevent fire outbreak arising from attempt at igniting of the cooker. The system more like a first Aid, automatically uses a normally closed solenoid valve for

the shutting off of the gas valve before calling for help via visual display and audible alarm to those within the environment. The system is an intelligent system, as it does not create a noise nuisance by continuously sounding alarm but the alarm stops beeping once the concentration of the gas in the atmosphere after leakage goes below the set point and opens the valve again for normal operations. This work will minimize injuries/losses occasioned by explosions due to gas leakages and improve safety of life and property while using domestic cooking gas.

2.3. GSM Based Gas Leakage Detection System

Gas leakage is a major problem with industrial sector, residential premises and gas powered vehicles like CNG (compressed natural gas) buses, cars. One of the preventive methods to stop accident associated with the gas leakage is to install gas leakage detection kit at vulnerable places. The aim of this paper is to present such a design that can automatically detect and stop gas leakage in vulnerable premises. In particular gas sensor has been used which has high sensitivity for propane (C_3H_8) and butane (C_4H_{10}). Gas leakage system consists of GSM (Global System for mobile communications) module, which warns by sending SMS. However, the former gas leakage system cannot react in time. This paper provides the design approach on both software and hardware.

2.4. Automatic LPG Leakage Detection And Hazard Prevention For Home Security

A cost-effective, automatic Liquefied Petroleum Gas (LPG) booking, leakage detection and real time gas monitoring system is proposed in this paper. In this system, the LPG leakage is detected through the sensor and information is sent to the user by Short Message Service (SMS) and simultaneously alerts the customer using a GSM module, while activating the alarm and exhaust fan. The additional advantage of the system is that it continuously monitors the level of the LPG present in the cylinder using load cell and automatically books the cylinder using a GSM module.

2.5. LPG Detection, Measurement and Booking System

In this paper we present how to detect the leakage using a gas sensor and book a new cylinder automatically by sending a message to agency. The gas sensor MQ-5 is very sensitive to methane and propane which are main constituents of LPG. A load cell is used to measure the weight of cylinder continuously. The weight of cylinder is displayed continuously and some 4-5 MQ-5 sensors will be placed in different place of room, output of sensor will become high when there is LPG leakage is present. When the sensor output is high buzzer will be switched on and a message will be sent to customer and nearest gas agency via GSM. When the weight of cylinder equal to threshold

value a message will be sent to agency to book new cylinder. The same system is implemented using Lab VIEW, and a statistical analysis of gas sensor and load cell is done.

2.6. Smart Gas Cylinder Using Embedded System

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 turn off 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.

2.7. C-Leakage: Cylinder LPG Gas Leakage Detection for Home Safety

Home Fires have taken a growing toll in lives and property in recent years. LPG is highly inflammable and can burn even at some distance from the source of leakage. Most fire accidents are caused because of a poor-quality rubber tube or when the regulator is not turned off. The supply of gas from the regulator to the burner is on even after the regulator is switched off. By accident, if the knob is turned on results in the gas leaks. This paper deals with the detection, monitoring and control system of LPG leakage. Using relay DC motor the stove knob is automatically controlled. Along with safety measures the system has additional advantage of automatic rebooking of cylinder when the level of gas goes below the normal weight of cylinder.

2.8. Automated unified system for LPG using microcontroller and GSM module

A cost-effective, Automated Unified System for Liquefied Petroleum Gas (LPG) booking, leakage detection, real time gas monitoring system and automatic controlling of LPG regulator is proposed in this paper. The aim of this paper is to monitor for 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 MQ5 and alerts the consumer about the gas leakage by sending SMS using GSM module and simultaneously activating the alarm and exhaust fan. The system additionally provides the automatically controlling of LPG regulator. To avoid the blast this system will disconnect the main power supply using relay. The additional advantage of the system is that it continuously monitors the level of the

LPG present in the cylinder using weight sensor and automatically books the cylinder using a GSM module.

III.   PROPOSED METHODOLOGY

This paper proposes a habitual and innovative approach for LPG leakage detection, prevention and automatic booking for refill. In advance, the system provides the automatic controlling of LPG regulator also if fire is detected by the system will automatically turn off the main switch of power supply and sends the exact location of the fire incident to the fire emergency station, this helps to reach the place as soon as possible. In this paper we overcome all the drawbacks of the former works and make our project works on even when the power goes off by extending a backup battery.

From our advanced methodology we focus on two things

1. *To control the corruption by selling the LPG gases illegally.*
2. *The exact location of the fire accident will send to the fire emergency station to reach there as soon as possible.*

IV.   SYSTEM ARCHITECTURE

System block diagram comprises of following parts shown in figure 1. It consists of microcontroller (PIC 16F877A), gas sensor (MQ5), load sensor, GSM module (SIMCOM 900), and LED display(s). Microcontroller PIC16F877A is the base of the system. The inputs given to the PIC 16F877A are the output of gas sensor MQ-5, relay and load cell LED. The output of PIC 16F877A are given to the SIMCOM 900 and LCD 16×2 display.

4.1. Microcontroller

A very efficient and fast working controller is needed to continuously sense the LPG gas and its level (weight) sensor's output. Also a fast reply is desired when leakage is found. Along with this a system must possess capacity to store some information which can be used for further processing. Hence above operations require a very fast, single cycle execution rate microcontroller like PIC 16F877A.Peripheral Interface Control (PIC 16F887A) is a 40 pin microcontroller with 8k program memory. It is widely used due to its low cost, high application support and wide availability. Microcontroller is the heart of the proposed system and is responsible for performing various tasks starting form processing all the sensor inputs to alerting the driver. As shown in above figure 1, the microcontroller is at the centre of the system The LCD module connected to port B of PIC 16F877A in 4-bit mode is used to display the required messages. GSM module using AT commands connected to Rx and Tx pins of port D of PIC 16F877A are used to receive and transmit messages to desired family members and distributor. The load sensor module output taken from

relay circuit is connected to pins of port A which is used to continuously monitor gas level. The relay is connected to the port C of PIC 16F877A is used to controlling the main power supply switch in the home.
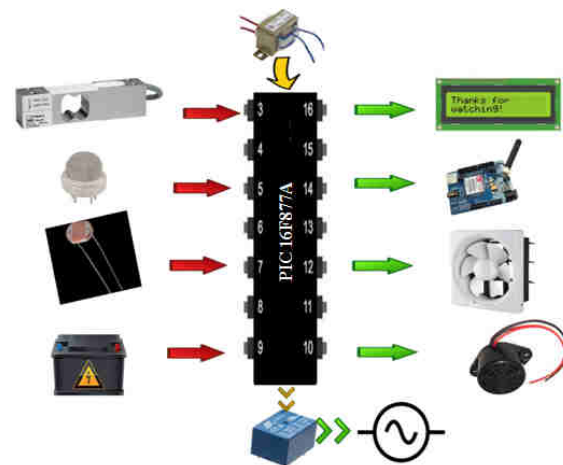

Fig 1: PIC   with Functional Unit

4.2. Gas Sensor

This is a simple to use LPG Gas Sensor Module which can sense the presence of combustible gases mainly LPG, isobutane, and propane in the air. The module uses our MQ-6 sensor. It simplifies interface to the odd pin spacing of the sensor and provides interface through 4 0.1" header pins. It provides both an analog output corresponding to the concentration of the gases in the air and an easy to use digital output. The onboard potentiometer can be used to set the maximum gas concentration beyond which the digital output gets triggered. Just power the module with 5V, set the threshold and you may get the output! An onboard LED signals the presence of any gas. The digital output can be easily interfaced to microcontrollers and other circuits. The analog output can be hooked up to an ADC of a microcontroller to get a wide range of sensor reading.

4.3. Fire sensor

LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1000 000 ohms, but they are illuminated with light resistance drops dramatically. when a light level of 10 lux (very low light level) is directed towards it, the resistance has risen dramatically to 10.43M (10430000 ohms).When the light level is low the resistance of the LDR is high. This prevents current from flowing to the base of the transistors. Consequently the LED does not light. However, when light shines onto the LDR its resistance falls and current flows into the base of the first transistor and then the second transistor.

4.4. Load Sensor

For booking of refill from a distributor, we must be aware in advance of amount of gas in the cylinder, and for this purpose the level of gas present in the cylinder has to be monitored continuously. The load cell having required weighing capacity for domestic cylinder is used and for calibration purpose the weight sensor module is used along with the load cell. LED weight sensor module is implemented in the system. The load cell output drives a relay circuit which gives two logic pulses (for <=7 kg and<= 0.5 kg) which are further connected to microcontroller port pins to detect the gas level.

4.5. GSM Module

Gas sensor detects the presence of gas, weight sensor gives the gas level in cylinder, and microcontroller will take corrective or necessary actions. The status of all these happening has to be conveyed to the owner of system or house mates. GSM module is used to send an SMS to the user cell phone. 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. GSM module requires one SIM card. This module is capable to accept any network SIM card. The GSM module used is SIMCOM 900 which uses SIM memory to store the number of system owner or housemates and distributor or to whoever the messages have to be forwarded. It requires very less memory to send and receive text messages and operates on simple 12 Volt

4.6. Displays

As the system performs controlling and monitoring operations, it is primary requirement to put a display in the system which shows various message such as gas leakage detection, fire detection, booking number of cylinder in case of refill of cylinder and also will display actions taken by microcontroller. The system requires two Liquid Crystal Display (LCD) one of 16X2 characters operating on +5 Volt supply and operated in 4-bit mode is implemented for the task of displaying required messages. And another is seven segment display to display monitored weight of LPG. Interfacing with PIC 16F877A and short code of programming makes it very useful to make system more users friendly.

V. GAS LEAKAGE DETECTION AND PREVENTION

The system mainly consists of LPG leakage detection system, Microcontroller with GSM module and protection circuitry. The main function of gas leakage detection module which consist of gas sensor to continuously detect the gas leakage in the air. For the gas leakage detection MQ5 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 results in simultaneously switches on the buzzer and exhaust fan which we can reset by a Manual reset switch. MQ5 gas sensor which offers many advantages like long lifetime, low cast, reliable and high sensitive to LPG. Also a logic high pulse (+5 V) is given as an interrupt to INT0 pin of PIC16F877A Microcontroller.

Microcontroller sends a message "EMERGENCY ALERT: LPG gas leakage found" to required cell numbers via GSM module and the same will be displayed on LCD. And with the help of Relay the main power supply switch in home will turned OFF. Also the backup battery will be turned ON for the sensor to work continuously .In gas sensors Tin dioxide is the most common material, when any specified gases leak in the air, the electrical resistance in the sensor decreases. MQ5 gas sensor has less sensitivity to air but high sensitivity to combustible gases.

VI. FIRE DETECTION AND PREVENTION

The main function of fire detection module which consist of LDR to continuously detect the fire explosion .For the fire detection LDR used, they are illuminated with light resistance drops dramatically. when a light level of 10 lux (very low light level) is directed towards it, the resistance has risen dramatically to 10.43M (10430000 ohms).When the light level is low the resistance of the LDR is high. This prevents current from flowing to the base of the transistors. Consequently the LED does not light. However, when light shines onto the LDR its resistance falls and current flows into the base of the first transistor and then the second transistor. The Corresponding output pulse of the LDR is fed to microcontroller and results in simultaneously switches on the buzzer and exhaust fan .

Microcontroller sends a message "EMERGENCY ALERT: Fire explosion found" and with exact location of the accident to the fire station and to required cell numbers via GSM module and the same will be displayed on LCD. And with the help of Relay the main power supply switch in home will turned OFF.

VII. AUTOMATIC GAS BOOKING

In automatic Gas booking system, Load sensor LED continuously monitors the weight of the gas in cylinder and displays it on seven segments LCD. When the weight of the gas is <=7 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 gas agency of format,"REG_AMANGAS_12345". At the same time, the message will be displayed on LCD as "Booking Cylinder". When the weight of the gas goes below 1 kg another logic high pulse is fed to another port of microcontroller through a relay circuit. As this port pin

goes high, microcontroller will send a message as "Less LPG, Please Refill your Cylinder" through a GSM module to the customer's cell number and the message "Cylinder Empty, Please Refill" is displayed on the LCD display. The output of gas sensor MQ-5, relay and load cell , LED are given to the microcontroller. The output of PIC 16F877A is given to the SIMCOM 900 and LCD 16×2 display. The gas output of MQ5 is given to the INT0 pin of PIC 16F877A as far as the highest priority is given to the leakage detection. The output of LED is amplified and digitized by A/D converter and is given to the port pins PA0 and PA1 of PIC 16F877A.

VIII.   CONCLUSION

A cost-effective habitual booking system for LPG with leakage and fire sensing system was proposed, designed and successfully implemented in this paper. Along with gas leakage detection and prevention, this system gives a fully automated approach towards the gas booking and fire sensing. 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. The cost involved in developing the system is significantly low. It is designed in such a way that the system can be made compatible not alone for home safety but also in various industries and the gas leak can be detected with the help of GPS.

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