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LPG Gas Monitoring System

ARUN RAJ
Final year B.Tech student
Dept of Applied Electronics and Instrumentation
Adi Shankara Institute of Engineering and Technology

ATHIRA VISWANATHAN
Final year B.Tech student
Dept of Applied Electronics and Instrumentation
Adi Shankara Institute of Engineering and Technology

ATHUL T S
Final year B.Tech student
Dept of Applied Electronics and Instrumentation
Adi Shankara Institute of Engineering and Technology

Abstract— **The design of LPG leakage monitoring system is proposed for home safety. The accidents due to the explosion of LPG is increasing now days which became a threaten to human life. In this system, the gas sensor detects the leakage of the LPG and alert the owner about the leak by sending SMS to his personal mobile and activate the alarm. In additional to this, the system continuously monitors the level of the LPG in the cylinder using load sensor and if the level is below the threshold limit the system inform them by SMS and also by the LCD display. So that the user have an idea about the max time the LPG lasts. An automatically booking of the cylinder using a GSM module is also used in this proposed system. The device ensures safety and prevents suffocation and explosion due to gas leakage.**

Keywords— **LPG- Liquid Petroleum Gas LCD-Liquid Crystal Display**

GSM- Global System for Mobile Communications

ETSI- European Telecommunications Standards Institute

1G- First Generation 2G- Second Generation 3G- third Generation 4G- Fourth Generation

GPRS- General Packet Radio Services

EDGE- Enhanced Data rates for GSM Evolution LCD- Liquid Crystal Display

INTRODUCTION

These days the usage of the liquid petroleum gas(LPG) is widely used in many fields, especially in household purposes. As the usage of the LPG increases, the accidents occur by these LPG explosion is also increases. The leakage of the LPG may lead to high explosion. So it's necessary to have a system which continuously monitor the LPG and alarming. The aim of this proposed system is to monitor the LPG in house hold applications and leakage detection. The system shows remaining time of LPG cylinder can be used in full flame. The gas sensor used to detect the amount of LPG in atmosphere and alerts the consumer about the gas leakage if any by sending SMS to a particular mobile number. Now a days the booking of the LPG cylinders is by sending SMS to the booking agent. In this system the GSM module which automatically books the cylinder by SMS to the agent booking number. This will help the owner to get the new cylinders in time without any fail.

SYSTEM OVERVIEW

The system block diagram comprises of parts as shown in figure 1. It consists of microcontroller (PIC 16F877A), gas sensor, weight sensor (Load Cell-L6D), GSM module (SIMCOM 300), and display(s).

MICROCONTROLLER

To monitor the LPG, an efficient and fast working microcontroller is required. The microcontroller also controls the working of the gas sensor and load sensor output. The microcontroller used in this is PIC 16F877A. If the sensor sense a leakage then the microcontroller must make a fast response. The microcontroller is the central part of the system. It has an operating frequency of 20 MHz. it also have 3 timers and 5 input output ports.

GAS SENSOR

This is a simple-to-use LPG sensor, suitable for sensing LPG (composed of mostly propane and butane) concentrations in the air. The MQ-6 can detect gas concentrations anywhere from 200 to 10000ppm.

This sensor has a high sensitivity and fast response time. The sensor's output is an analog resistance. The 1drive circuit is very simple; all you need to do is power the heater coil with 5V, add a load resistance, and connect the output to an ADC.

WEIGHT SENSOR MODULE

The weight sensor we used is the load cell module. A load cell is described as a "weight measurement device necessary for electronic scales that display weights in digits." However, load cell is not restricted to weight measurement in electronic scales.

Load cell is a passive transducer or sensor which converts applied force into electrical signals. They are also referred to as "Load transducers". Load cells use different operating principles, viz.

- Load Cells based on fluid pressure
- Load Cells based on elasticity
- Load Cells based on magnetostriction effect or piezoelectric effect

However, the only load cells which are prevalent are the load cells based on strain gages. Hence, the term 'load cell' means 'strain gage-based load cells'. The reason behind the wide adoption of strain gage- based load cells is their characteristics

1) Highly precise and linear measurements
2) Little influence due to temperature changes.
3) Small size compared with other types of load cells.
4) Long operating life due to lack of moving parts or any parts that generate friction.
5) Ease in production due to small number of components.
6) Excellent fatigue characteristics

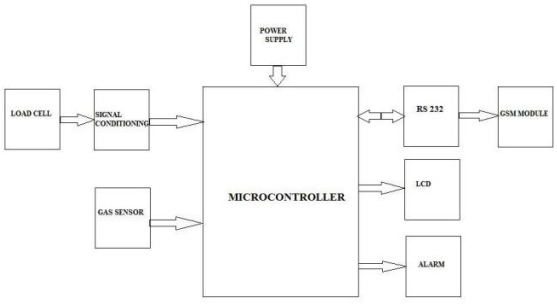

Fig.1. Basic block diagram of the proposed model of the system

i. GSM Module

GSM is a standard developed by the ETSI to describe protocols for 2G digital cellular networks used by mobile phones. It is the default global standard for mobile communications with over 90% market share, and is available in over 219 countries and territories. The GSM standard was developed as a replacement for 1G analog cellular networks, and originally described a digital, circuit- switched network optimized for full duplex voice telephony. This was expanded over time to include data communications, first by circuit-switched transport, then packet data transport via GPRS and EDGE. Subsequently, the 3GPP developed 3G UMTS standards followed by 4G Advanced standards, which are not part of the ETSI GSM standard.

ii. Displays

Here we use an LCD screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

SYSTEM OPERATION

An 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. Above operations require a very fast, single cycle execution rate microcontroller like PIC 16F877A as shown in above figure 1, the microcontroller is at the centre of the system. It is having features like 16Kb internal RAM making easy storage of entire code in microcontroller itself, also the 1 MIPS per MHz instruction cycle execution rate enhanced overall system performance. 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 weight sensor module output taken from relay circuit is connected to pins of port A which is used

to monitor gas level continuously.

The LPG gas consists of isobutene, propane, methane, etc. A sensitive, efficient gas sensor is required that senses only LPG gas contents and is less sensitive to other gases like cooking fumes, cigarettes, etc. Sensitive material of MQ- 6 gas sensor is SnO2, which has lower conductivity in clean air and its sensitivity increases with the concentration of gas, also it avoids gases like cooking fumes. It requires a voltage of 0-5 volts which is low and safe as per as the gaseous environment is considered .This sensor continuously senses the gas, and if concentration level goes above danger level then it turns relay ON which gives interrupt to microcontroller and alternately switches on buzzer and exhaust fan.

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 housemates .The technology making it very easy to send and receive messages using GSM module works on simple AT commands which can be implemented by interfacing it to the microcontroller Rx and Tx pins. The GSM module used is SIMCOM 300 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 adapter.

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, booking number of cylinder in case of refill of cylinder and also will display actions taken by microcontroller.

Liquid Crystal Display (LCD) of 16X2 characters operating on +5Volt supply and operated in 4-bit mode is implemented for the task of displaying required messages. Interfacing with PIC16F877A and short code of programming makes it very useful to make system more user friendly.

EXPERIMENTAL SETUP

PIC 16F877A is the base of the system. The inputs given to the PIC 16F877A are the output of gas sensor MQ-6 and load cellL6D .The output of PIC 16F877A are given to the SIMCOM 300 and LCD 16×2 display.

The gas output of MQ6 is given to the INT0 pin of PIC 16F877A as far as the highest priority is given to the leakage detection. The output of L6D is amplified and digitized by A/D converter and is given to the port pins PA0 and PA1 of PIC 16F877A as per the truth table.

PA0	PA1	Conditions
0	0	Full Cylinder
1	0	Booking Cylinder(≤10 Kg)
1	1	Empty Cylinder(≤0.5 Kg)

fig 2. level of LPG is measured using load cell approximation

The Rx and Tx pins of GSM are connected to the Tx and Rx pins of PIC 16F877A respectively. The output is shown by the LCD display which is operated in 4 bit mode. The higher data pins D4-D7 are connected to the PB0-PB3 pins and control pins R/s, R/W and Enable pins of LCD are connected to PIC 16F877A.

The output of the MQ6 drives the relay circuitry which eventually switches on the alarm and exhaust fan as soon as the gas is detected and both are reset by a manual reset switch.

RESULT

The system prototype is constructed and when a small amount of LPG is leaked near the system, the system sensor detects the leakage and sends the SMS to housemates and activates the alarm. Also system prototype continuously monitors the LPG level of the cylinder and books the cylinder automatically.

CONCLUSION

A cost-effective gas leakage detection system was proposed, designed and successfully implemented in this paper. 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. 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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