Smart Liquefied Petroleum Gas System

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Abstract— *The motivation for our project is the need to save fuel. LPG is a non-renewable source of energy, hence it is important that we need to use it judiciously. It is observed that a single household sometimes has multiple gas connections. This is simply because they are not aware of their fuel consumption rate. Our idea addresses this problem. The proposed idea aims to make the household consumer aware of their usage and thereby helping to reduce the LPG consumption. The number of deaths due to explosion of gas cylinders has been increasing in recent years. Thus there is need for a system to detect and also prevent leakage of LPG. The proposed project also implements leak detection and intimates the house owner of the same.*

Keywords— Microcontroller, GSM Module, Sensors, Front-End Amplifier.

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 leaked gases when ignited may result in explosion.

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 color 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 just a text message away. Petroleum companies have launched the customer-friendly service called IVRS (Interactive voice response) technique for their customers.

Hence the requirement of an efficient system to measure and display the level of LPG is inevitable, which may be used for domestic purposes. Here we intend to propose a microcontroller based system where a gas sensor (MQ6) is used to detect dangerous gas leaks. This unit is incorporated into an alarm unit, to sound an alarm or give a visual indication of the LPG leakage. The sensor has good sensitivity combined with a quick response time at low cost. If leakage is detected, message to the authorized person or family member using cellular network called GSM is sent automatically. It estimates how many days the LPG cylinder will run. If the number of days remaining goes less than 10 days it automatically books the cylinder by sending a text message to the dealer and it also informs the user to refill the cylinder when less than 2 days are left.

II. SYSTEM OVERVIEW

The proposed system uses Arduino Uno as the base of the system. The consumption of LPG is monitored using load cell with a front end amplifier (HX711).The gas leak is detected using a MQ6 gas sensor which is sensitive to propane and butane. Intimation and automatic gas booking is done using SIM900A.

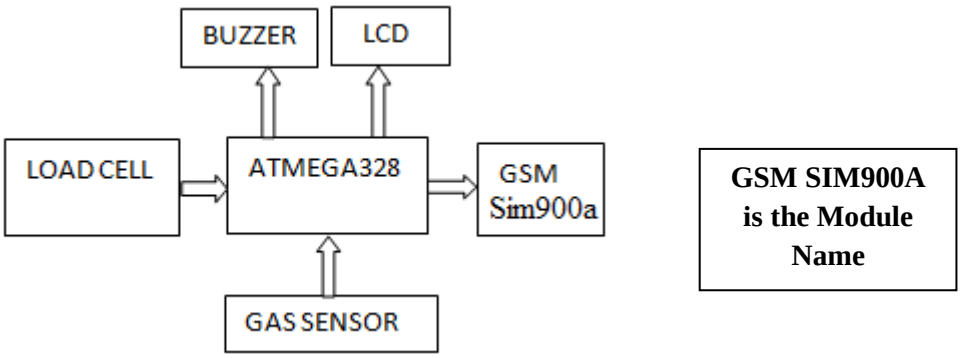

FIG 1. BLOCK DIAGRAM OF PROPOSED SYSTEM

2.1 Microcontroller

An efficient and fast working controller is needed to continuously sense the LPG gas and its weight sensor 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 ATmega328P. As shown in above figure 1, the microcontroller is the heart of the system. It has features like 32 KB flash memory. Thus the entire code can be stored in the microcontroller.

The LCD module connected to port D and port B of ATmega328P is used to display the required messages. GSM module using AT commands connected to Rx and Tx pins of port B of ATmega328P are used to receive and transmit messages to desired family members and distributor. The weight sensor output taken from HX711 module is connected to pins of port A which is used to monitor gas level continuously.

2.2 Gas Sensor

The gas sensor used is MQ6 which is highly sensitive to propane and butane which are the main constituents of LPG. The sensor can detect gas concentrations anywhere between 200 to 10000ppm. The material that is sensitive to LPG in MQ6 gas sensor is Tin di-oxide. As the concentration of target gas changes, the resistance of the sensitive component changes accordingly. This unit can be easily incorporated into an alarm circuit/unit, to sound an alarm.

2.3 Weight Sensor

The weight sensor used is a load cell which is basically a transducer which converts the mechanical force applied into an electrical signal. The load cell with required weighing capability is chosen for the continuous LPG consumption monitoring. Since the output of the load cell is in the range of millivolts, an instrumentation amplifier is used at the front end. HX711 breakout board is used for the purpose which has 24 bit precision.

2.4 GSM Module

Gas sensor detects the presence of LPG in the air and the weight sensor gives the amount of LPG remaining in the cylinder in terms of weight. The microcontroller governs the operation of these sensors.

A text message is sent to the consumers regarding his consumption rate of LPG. Also, in extreme situations of gas leakage, an alert is sent to the consumer as well his distributor. This is implemented using the SIM900A technology which works on AT commands.

The SIM memory is used to store the telephone number of the consumer and distributor. It requires very less memory to send and receive text messages and operates on simple 12 Volt adapter.

2.5 Display

For the purpose of user intimation, a 16x2 Liquid Crystal Display (LCD) is used to display the amount of LPG concentration in air and the amount of LPG remaining for user consumption.

The operational voltage of 16X2 LCD is 5 volts and is operated in 4 bit mode.

III. RESULTS AND DISCUSSION

The prototype designed has two main features namely LPG consumption monitoring and gas leak detection.

A real time consumption monitoring of the LPG is done using load cell with HX711 as the analog front end part and the percentage amount remaining is displayed on the Liquid Crystal Display. The weight of the empty cylinder needs to be initialized in prior for necessary calculations. A threshold level is set in the program and when the LPG level reaches the threshold limit automatic gas booking is done.

Whenever the LPG concentration in air is greater than 200 ppm, the output LED of the gas sensor glows indicating gas leak in the vicinity. The microcontroller receives the gas sensor output and does necessary calculations and displays the percentage amount of LPG in the atmosphere on the LCD.

The buzzer is turned on simultaneously alerting the owner of the house. A gas leak alert message is also sent to the authorized person using cellular network called GSM.

Additional features like app implementation are also done to make it easier for the consumers. This system can be used both for domestic as well industrial purposes as it is a cost effective product.

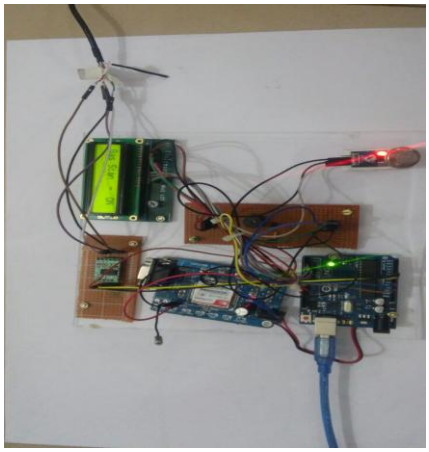

FIG 2. HARDWARE SETUP OF THE SYSTEM

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