



“Safety System to Avoid LPG Leakage”

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Abstract- The system proposed in this paper deals with Liquid Petroleum Gas (LPG) leakage detection and actuation of safety mechanism. The main aim of this paper is to avoid fire accidents due LPG leakage. In this system PIC Microcontroller is used as processing unit. The system detects gas leakage using phenomenon of weight reduction of gas cylinder below set limit. Then safety mechanism actuates and turns off regulator. Fire sensor and buzzer are also used. Weight of the cylinder is displayed on LCD.

Index Terms- LPG, gas leakage detection, safety mechanism, weight reduction, fire sensor, buzzer, LCD.

I. INTRODUCTION

The mixture of Commercial Propane and Commercial Butane having saturated as well as unsaturated hydrocarbons known as Liquefied Petroleum Gas commonly known as LPG. Ethanethoil is added as powerful odorant, as LPG is odorless gas, so that leakage can be easily detected. Central heating, hot-water, gas fires, cooking and in mobile heaters for leisure activities such as boats, caravans and barbecues are the application of LPG. This energy source is primarily composed of propane and butane which is highly flammable chemical compounds. Dr. Walter Snelling is producer of LPG in 1910. As it has flammable properties and explosive potential when stored under pressure so that it is classified as hazardous material. 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. [6][9]

The unwanted reduction in weight of the gas cylinder is a sign of gas leakage. With the help of weighing machine we can send signal to the controller. The main inputs for safety mechanism are fire sensors and reduction in weight of gas cylinder. The weight of the newly installed gas cylinder should be set as the reference weight for weighing machine by using TARE key. The weight limit of the cylinder is to be set approximate value of regular consumption (for example 0.5 kg/day).

The fire sensor and weighing machine are the inputs for the system. They will send the signals to the PIC controller with respect to situation. Safety mechanism, display and buzzer are the outputs of the system. They will work as per the signals given by the inputs. Power supply is given to the PIC and weighing machine. [10][11]

II. LITERATURE SURVEY

LPG is mixture of butane and propane gas. These both gases are odorless; initially it was become very difficult to detect it. Hence some additives are added to make them typically smelled. For this purpose Ethyl Mercaptan is normally use as stanching agent for this purpose. The amount to be added should be sufficiently to allow detection in atmosphere 1/5 of lower limit of flammability or odour level 2. [1]

Timothy G. Brown [2] mentioned in his paper that, the invention of flame ionization (FI) technology 45 years ago was a major revolution in the methodology to detect leaks in gas transmission and distribution networks. Detection sensitivity in the parts per million (PPM) range was the key to the success of the FI technology, allowing gas companies to detect even small leaks from the surface. This was a major breakthrough over the existing method of sub-surface testing at specified intervals. Recent technological developments have launched a new revolution in leak detection instruments. The introduction of optical and laser-based technologies has proven to be the first major improvement in 40 years.

The laser-based remote instruments offer significant gains in leak detection productivity because they can detect leaks in the PPM range from up to 30 meters (100 feet) away from the source. With traditional FI instruments, the operator must place the probe or the cart directly in the leak plume (cloud) in order to detect the leak.

Ultrasonic gas leakage detection, as its name implies, is technology that uses acoustic sensors to detect changes in noise within an environment that is outside the scope of human hearing. The sensor and electronics are able to identify these ultrasound frequencies (25KHz -100KHz), while excluding audible frequencies. This detector “hears” the leak, rather than measuring accumulated gases. [3]

Sunithaa J [4] mentioned 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 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.

Majid Bahrepour [5] said that, Automatic fire detection is important for early detection and promptly extinguishing fire. There are ample studies investigating the best sensor combinations and appropriate techniques for early fire detection. In the previous studies fire detection has either been considered as an application of a certain field (e.g., event detection for wireless sensor networks) or the main concern for which techniques have been specifically designed (e.g., fire detection using remote sensing techniques). These different approaches stem from different backgrounds of researchers dealing with fire, such as computer science, geography and earth observation, and fire safety.

III. SYSTEM COMPONENTS

The PIC microcontroller is heart of the system. It is to be situated inside of the weighing machine panel. Heat sensors are mounted near burner at the significant distance. Safety mechanism is mounted on cylinder to control the regulator. The outputs of different components are connected to PIC controller.

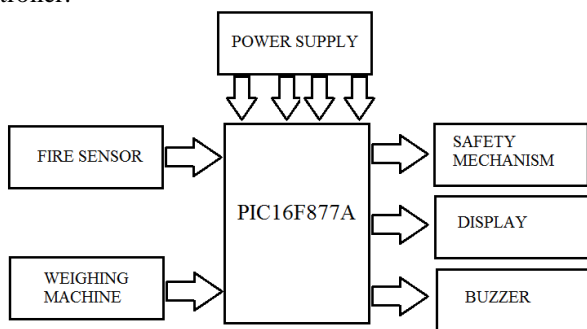


Fig. 1 Block Diagram of the system

1. PIC Microcontroller

The PIC (founded by Microchip) 16F877A is a CMOS-FLASH based High-performance 8-bit RISC Microcontroller. This powerful (200 nanosecond instruction execution) yet easy-to-program (only 35 single word instructions) microcontroller packs Microchip's powerful PIC architecture into a 40 pin package. The PIC16F877A features 256 bytes of EEPROM data memory, self-programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital converter, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire

Serial Peripheral Interface (SPI) or the 2-wire Inter-Integrated Circuit (I²C) bus and a Universal Asynchronous Receiver Transmitter (USART). [18]

2. Fire sensor

A fire detector is a sensor designed to detect and respond to the presence of a fire or flame. Responses to a detected fire depend on the installation, but can include sounding an alarm, deactivating a fuel line (such as a propane or a natural gas line), and activating a fire suppression system. When used in applications such as industrial furnaces, their role is to provide confirmation that the furnace is properly lit; in these cases they take no direct action beyond notifying the operator or control system. A fire detector can often respond faster and more accurately than a smoke or heat detector due to the mechanisms it uses to detect the fire. [8]

3. Weighing machine

Basic principle of system is to detect reducing weight of cylinder while leakage of gas occurs. Weighing machine is to be used to detect changes in weight of cylinder. It consists of numeric pad, display, on/off switch and tare switch. Maximum capacity of weighing machine is 40 kg.

The person using the burner has to set the approximate maximum amount of gas to be used on weighing machine by using numeric pad. Tare switch/button is used to equal the weight of cylinder to zero.

In case of sudden requirement of more gas than the set value, then the user can set new value again.

4. Safety Mechanism

The main function of safety mechanism is to control the movement of regulator. It will receive signal from PIC controller and turn off regulator at extreme condition.

The mechanism will also actuate at the time user forgot to switch OFF the regulator.

5. Buzzer (SD1209T3-A1)

Many times happens that, regulator pin is not working properly. This causes leakage of gas.

The buzzer is used to notify the user that regulator is faulty while knobs of burner are closed. The buzzer work on the minimum 3 V, the frequency is of 2048 Hz. It has the terminal construction of pin terminal. [7][11]

6. Power Supply

Minimum voltage required to the system is 5 V. To provide this much voltage dry cells are used.

IV. SYSTEM WORKING

There are some conditions which can cause LPG cylinder blast with their remedies that can be avoided by this system: Different conditions to be settled,

- 1) While consumer is using gas, at this situation regulator and burner is ON and there is no gas leakage.
- 2) Consumer is not using gas, burner knob is OFF but consumer forget to turn off regulator knob and no gas leakage.

- 3) Consumer is not using gas burner knob is OFF but consumer forget to turn off regulator knob and there is gas leakage through hoses, pipe, etc.
- 4) Burner knob and regulator knob both are ON but there is no fire at burner.
- 5) Burner knob and regulator knob both are OFF but there is gas leakage due to faulty cylinder pin.

The system is supposed to providing the remedies that to avoid above conditions respectively:

- 1) While consumer is using gas, fire sensor will sense flame at burner and weighing machine will show reducing weight of the cylinder on LCD.
- 2) If the burner is OFF and consumer forget to turn off the regulator there will no flame at fire sensor, hence it will not send signals to PIC. At such conditions the timer is to be set for definite time, after completing this time cycle, the mechanism will turn OFF the regulator.
- 3) At the same situation as above, but this time there is gas leakage through hose or joints. In this situation the weight of the cylinder will reduce at same time there will be no flame at burner. On the account of the reducing weight of the cylinder the PIC will send signal to the safety mechanism to turn OFF the regulator.
- 4) Sometime it happens, that because of the airflow, the fire at the burner get extinguish. It causes leakage of gas through the burner as fire is absent there. At this situation the weight of the cylinder will reduce at the same time there is no flame at burner. On the account of the reducing weight of the cylinder the PIC will send signal to the safety mechanism to turn OFF the regulator.
- 5) It happens in many rare cases, that regulator and burner knob is OFF and faulty cylinder pin is causing gas leakage. At this situation reducing weight of the cylinder will tend PIC to turn ON the buzzer.

Buzzer will indicate to the family members or people nearby, that gas is leak in the room. It also means that the buzzer gives the caution alert. [12][13][14]

V.CONCLUSION

Day by day accidental deaths due to LPG cylinder blast are increasing in dangerous value. In which female deaths are more. It has become necessary to design a safety provision for it. From the above paper, we can conclude that, it will be possible to design a safety mechanism working on the basis of weight reduction of the cylinder. At the same time the system provides display for showing a weight of the cylinder.

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