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GSM BASED VEHICLE LEAKAGE DETECTION WITH GASEOUS FUEL AUTOMATIC SAFETY AND WARNING SYSTEM

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Abstract: In this paper, we have proposed a Liquefied Petroleum Gas (LPG) monitoring and leakage detection system. With the large demand and use of LPG, this system would be helpful to monitor the usage of LPG on a regular basis and to alert about any hazards that may occur due to LPG leakage. We have designed a system that alerts the user of the amount of LPG left so that appropriate measures can be taken. Since LPG is a highly hazardous and inflammable gas, we have also designed a system to alert the user with an alarm when there is a leakage of LPG so that measures are taken to avoid an explosion.

Keywords: Liquefied Petroleum Gas, Hazards, Monitoring, Leakage Detection.

I. INTRODUCTION

LPG is an odourless gas which is a mixture of propane and butane. It contains both saturated and unsaturated hydrocarbons. Ethyl Mercaptan is the stanching agent which is used to impart odour to the odourless LPG. LPG is liquefied under moderate pressure and has replaced many conventional fuel systems in household and commercial sectors. Though it is one of the most commonly used fuels, it has an explosive range of 1.8%–9.5% volume of gas in air. It is packed into 3 categories according to the weight of the LPG in the cylinder: Household, Commercial and Industrial. The Household category of LPG cylinder contains 14.2 kg LPG in the cylinder. Similarly, the Commercial and Industrial categories of LPG cylinders contain 19 and 35 kg of LPG respectively. The LPG is filled only up to 85% in these cylinders above which will be vapours. This is due to the expansion property of the LPG and consequently, contributes as a safety precaution to avoid any hazards. For every 1° rise in temperature, the pressure of LPG inside the cylinder will increase by 15 kg/cm^3. This makes LPG a very hazardous and extremely inflammable gas.

II. EXISTING METHOD

With the rising demand for LPG, users have to pre book their LPG cylinder at least a month prior to the delivery of the new LPG cylinder. Most of the times, users find it difficult to figure out how much of LPG is left within the cylinder and this causes a lot of trouble to them. In such a situation, an efficient method to monitor the level of LPG in the cylinder is required, so that the users are aware of the LPG level within the cylinder. They can take necessary steps in booking a new cylinder [1], [2]. The increased use of LPG has also led to a rise in LPG related hazards. In this era, where everything is powered by electricity, a small spark in the premises during LPG leakage is more than enough to cause an explosion. So, it is highly necessary that the users are aware of the necessary precautions to be taken during an LPG leakage.

A large amount of research has been going on based upon the monitoring and leakage detection of LPG, its fee searches have been carried out to design a system that combines the detection of LPG leakage as well as monitoring its usage. This was the inspiration behind implementing the proposed system. From existing research on this field it was observed that each system uses different components mainly, a microcontroller, weight sensors etc. At first, 555 timers were used for the timing process in such systems [3]. Later on, many systems used AT89C51 microcontroller as the basis of computing and programming [4]. However, as time progressed, more efficient microcontrollers came into existence and the former started to be replaced by Atmega 328, LPC2148 etc.

III. METHODOLOGY

Initially, the systems were proposed and implemented mostly for the leakage detection considering the various hazards due to explosion of LPG. But as the demand for LPG increased, the scarcity of LPG started to become a common phenomenon. Hence it paved the way for research around the implementation of systems that monitor the level of LPG in a cylinder instantaneously [5].

The above research and talks with eminent engineers from various industries laid the foundation for gathering information about the proposed system. The proposed system is an effective combination of these features which are manufactured in a cost effective way.

The paper discusses the need for the proposed system. It is followed by brief description of the components and their working. The system operation and experimental results are dealt in later sections, with a closing note on how the system can be improvised in the future.

LPG MONITORING AND LEAKAGE DETECTION SYSTEM

The proposed LPG monitoring and leakage detection system comprises of two sensors, a microcontroller, an LCD display, relay and a buzzer which is being powered by a power supply. Refer to Fig. 1 for the block diagram of the proposed system.

The proposed system is powered using a 230 V AC supply, which is converted into a rectified 12 V DC supply. Using a voltage regulator IC7805, the 12 V supply is lowered to 5 V and is used in the proposed system.

MQ-6, a sensor specialized in the detection of LPG and gases whose constituents are propane and butane is used in the proposed system [6]. Being a highly sensitive sensor, it detects,

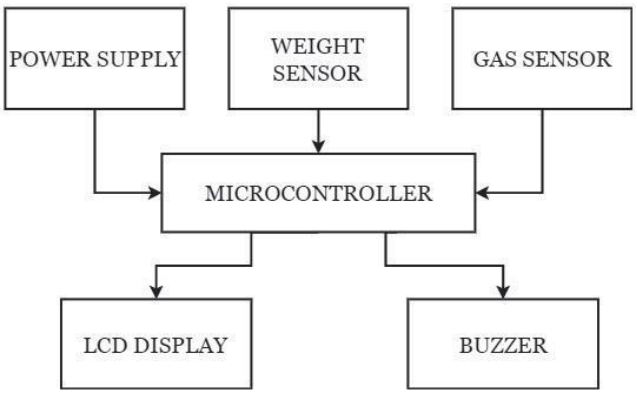

Fig. 3.1. Block diagram.

the presence of LPG in concentrations from 200–10000 ppm. It has an outer membrane coated with Tin Dioxide (SnO_2).

Upon contact with the components propane and butane, in LPG, this coating reacts with them and results in an output which is converted into an electrical voltage. This electrical voltage is further processed using a microcontroller for obtaining the digitized value. The digitized value serves as the output to alert the user. A load cell is a transducer that produces an electrical signal whose magnitude is proportional to the force that is being measured. The load cell works on the principle that, an applied force on it changes the value of resistance. The change in resistance results in a corresponding voltage as a result of the unbalance of the Wheatstone bridge. The load cell used in the proposed system is CZL-601, which is of the strain gauge type.

PIC 16F877A is the microcontroller used in the proposed system. It receives the digital output from the MQ-6 gas sensor and sends a signal to manipulate the buzzer and also display the status on the Liquid Crystal Display panel (LCD).

As the output of the weight sensor is digital in nature, the difference between the weight of the full cylinder and current weight of the cylinder is calculated and the remaining quantity of LPG in the cylinder is displayed on the LCD as percentage [9]. The relay used in this project is SRD-12VDC-SLC. It is a simple magnetic relay circuit which has a small size and a current carrying capacity of 10 A. The main function of the relay is to shut the circuit in case of LPG leakage above a specific concentration of 200 ppm so as to prevent any kind of hazards due to electric spark.

LCD is used to display the results after the operation in the microcontroller. The LCD screen used in the proposed system is JHD 162A, which is a 16×2 LCD. It is used in the 4-bit mode and it is given the task of displaying the output from the microcontroller in both the LPG leakage detection as well as LPG monitoring. A buzzer is a device which can be mechanical, electromechanical or piezoelectric in nature and is used to alert the user in case of LPG leakage.

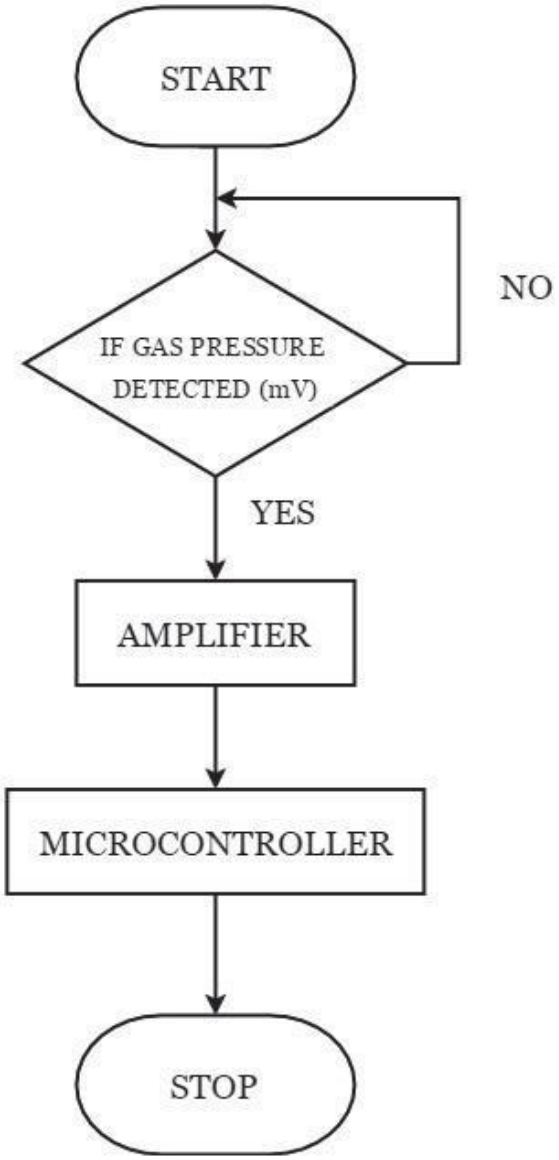

Fig. 3.2. Flowchart of LPG leakage detection.

IV. RELATED WORKS

The operation of the proposed system can be depicted as two parts -a leakage detection system and a monitoring system.

A. Gas Leakage

The flowchart depicting the operation of leakage detection in the proposed system is shown in Fig. 2.

For the purpose of gas leakage, the gas sensor used is MQ-6. The diaphragm of the gas sensor is made up of Tin dioxide, SnO_2. It reacts with propane and butane in LPG and the chemical output produced is converted to a corresponding electrical voltage. This electrical voltage is then given to the microcontroller after amplification, an interrupt is produced which triggers the buzzer. The buzzer beeps until

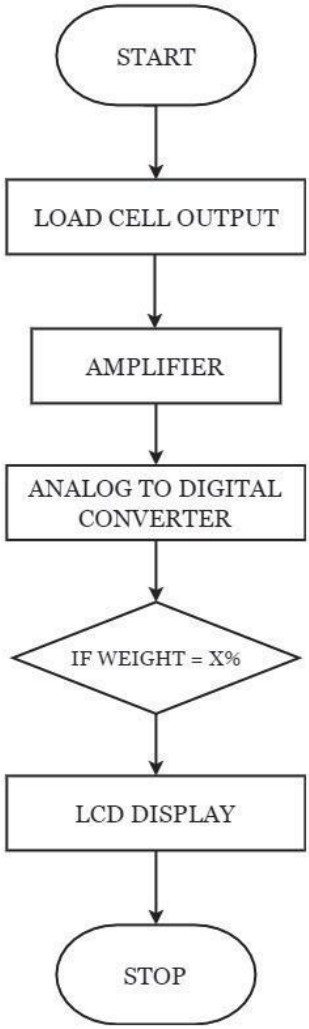

Fig. 4.1. Flowchart of LPG monitoring.

the concentration of LPG falls to the minimal value. The gas leakage message is also displayed on the LCD panel.

B. LPG Monitoring

For the purpose of the LPG monitoring of the proposed system the flowchart can be represented as shown in Fig. 3.

For the purpose of monitoring of LPG, load cell CZL-601 is used. This load cell produces an output which is amplified by an instrumentation amplifier and is then given to the microcontroller. The microcontroller

processes this information and corresponding output is converted to ASCII codes which are displayed on the LCD screen.

V. EXPERIMENTAL RESULTS

The prototype of the proposed system was implemented to monitor the level of LPG left in the cylinder and to detect leakage of LPG. The prototype and display of the proposed system is shown in Figs. 4, 5 & 6.

The system prototype shows the detection of LPG leakage when a small amount of LPG is brought near the MQ-6

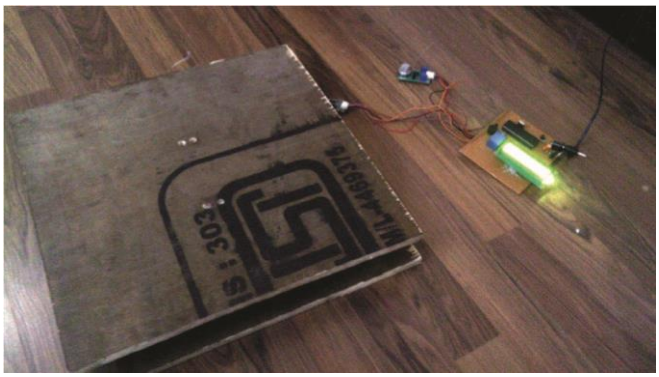

Fig. 4. Prototype.

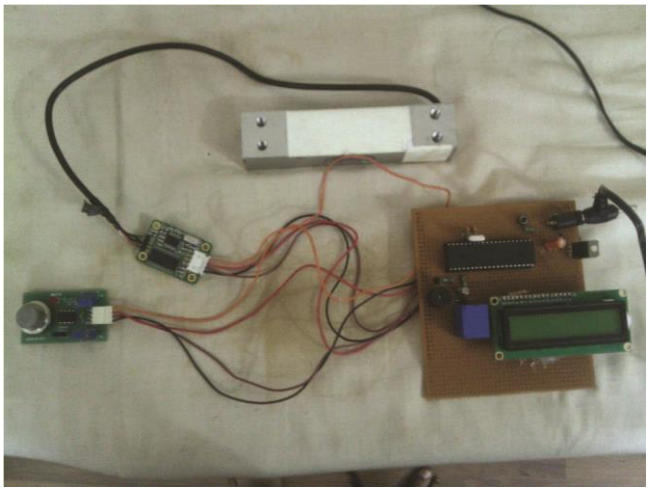

Fig. 5.1. Internal system.

Fig. 5.2. LCD display.

gas sensor. It displays "GAS LEAKAGE" in the LCD screen at the time of LPG leakage. The system prototype also monitors the level of LPG is the cylinder and displays "X% LPG" on the LCD screen where *X* is the amount of LPG left in the cylinder expressed in terms of percentage.

VI. CONCLUSION

The proposed LPG monitoring and leakage detection system is mainly intended for household purposes where the user can be notified of the amount of LPG remaining in the cylinder so that necessary actions can be taken to pre-book a new cylinder without any hurdles. Also, the proposed system alerts the user about any LPG leakage so as to take preventive measures to avoid an explosion. This system can be expanded to the next level by addition of a GSM module for an automatic LPG cylinder booking. The GSM module can also be used to alert the fire station and the nearest hospital in case of an LPG leakage. This system can also be expanded to the commercial sector such as shops, hotels etc.

VII. REFERENCES

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