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Wireless Auto Power Trip during Gas Leakage

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Abstract

It's a known fact that LPG leakage during domestic usage is a disaster, especially when we switch on any electric switch or appliances because it may produce a spark which causes sudden loud explosion of the gas filled room. In our nation there is an increase in such accidents and casualties related to it in the recent times. Our main idea is to implement security system for detecting leakage of gas in closed environment using sensors. Once the gas leakage is detected depending on the level of gas immediately the wireless systems will trip of the power supply so as to avoid explosion.

Keywords: LPG leakage, Gas sensors, Wireless systems.

1. Introduction:

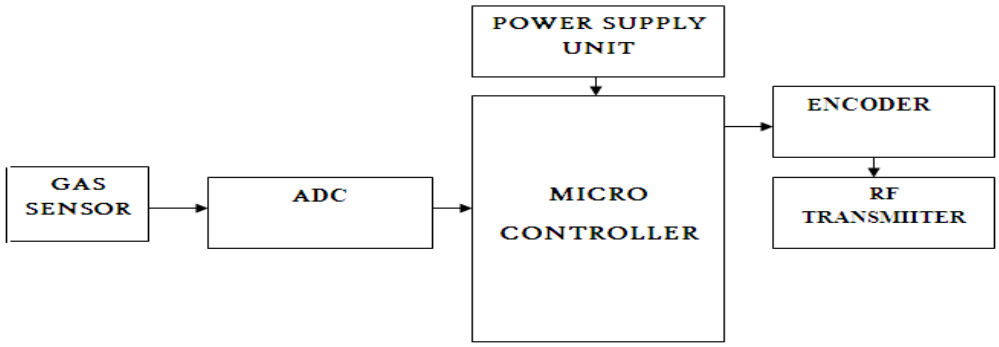
LPG is indispensible part of our life as it is an important source of fuel for cooking and also used in automobiles as an alternative to petrol and diesel. Although it is a clean fuel it poses a threat as it is highly combustible. As the LPG's are available either in pressurized cylinders or as in pipeline supply there is high chance of leakage. So if leakage occurs there is a high chance of an explosion even when any electrical sparks occurs which may result in causalities and loss of property.

As more and more households have started using LPG there is an increase in the number of accidents being reported owing to gas leakage. So our work aims at reducing accidents related to gas leakage in household as well as in industries. Wireless technology been adapted gives the module more mobility and reliability

2. Implementation:

The proposed wireless gas leakage system is composed of two major modules: the gas leakage detection and transmission module, and the receiver module. The gas leakage detection and transmission module detects the change in concentration of LPG and natural gas and activates an audiovisual alarm when it exceeds a certain threshold. Furthermore, it sends another alarm message through a radiofrequency (RF) system to the receiver module. The receiver module is a mobile unit that could be placed anywhere within the premises of the house so that the alarm can be detected and heard at a distance from the place of gas leakage. A block diagram for the proposed system is shown in Figure 1.

Transmitter Module:



Receiver Module:

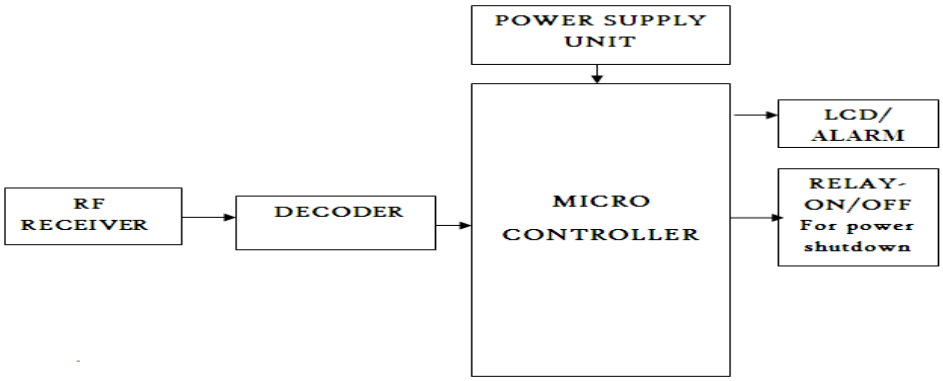


Figure 1: Block diagram for the gas leakage detection and power trip system.

3. Gas Leakage Detection- Transmission Module

The main functions of this module are to detect changes in gas concentration, and transmit a signal to the receiver unit. Transmitting Consists of a gas detection sensor, a sensing circuit, a microcontroller, and an RF transmission system. The gas detection is

done using a solid state gas sensor that is sensitive to LPG, natural gas and other gases such as CO and H_2 but not sensitive to air; therefore the reading is not affected by the presence of air. The sensing part is made from Tin Dioxide (SnO_2) layer, which is a resistive element with a resistance (*Rs*) that changes with the change of concentration of gases like LPG, CH4, CO, and alcohol. Figure 2 shows MQ-6 gas sensor and the sensitivity characteristics. The sensor can detect small concentrations of the above mentioned gases as small as 0.1 mg/L, which makes it suitable for gas leak detection. It is worth mentioning that the sensor is also sensitive to room temperature and humidity. The driving circuit of the gas sensor, requires a DC power supply of 5 Volts and a load resistance (*RL*). The sensor needs to be heated to function properly, which is done through a heating element of a fixed resistance (*RH*). This means that the sensor should be switched on for a specific period of time before measurements are made. The heating power supply is done through the same power supply of the sensing circuit.

The output voltage *V*o from the sensing circuit is given by:

$$V_o(Rs) = \frac{R_L}{R_s + R_L} Vc$$

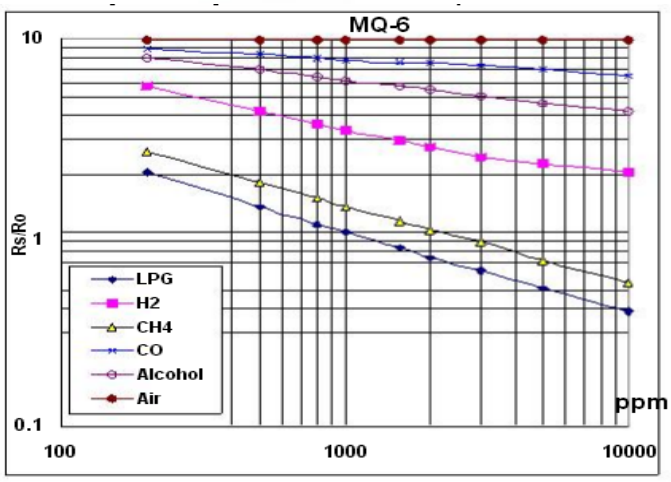


Figure 2: MQ-6 gas sensor and its sensitivity characteristics.

and is fed into a microcontroller where it is digitized .The microcontroller reads the voltage from the sensor and uses it to calculate change in concentration. Under normal conditions, the microcontroller starts with a calibration stage where it reads the sensor voltage under normal conditions and considers it as the zero value. The microcontroller continuously reads the voltage from the sensor and compares the reading with the calibration value. If the reading of the sensor voltage exceeds the predetermined threshold, the microcontroller sends a message to the receiver module. This is done by the microcontroller by sending out a USART encoded packet through I/O port into the input pin of the RF transmitting module. The RF transmitting module is a low power frequency modulation (FM) one way link that can reach a distance up to 200 m outdoor and approximately 30 m indoor.

4. Gas Leakage Detection- Receiving module:

The receiver module is a mobile unit that receives state events from the gas detection and transmitting module. It consists of an RF receiver and a microcontroller (PIC-16F877A Or INTEL 8051). After receiving the data from the transmitter, the RF receiver sends it to the microcontroller. The microcontroller reads the data, decodes it, and displays it onto the output devices (LED, buzzer, and LCD display). Apart from indication relay switch is used to trip the power supply off which will prevent electrical sparks.

5. Results:

The wireless gas sensing and power trip system was implemented and its working depends on the distance of receiver and the concentration of the gas present in the air. Furthermore the system has a calibrated threshold concentration value so when again the concentration drops below the threshold value automatically the power trip will be reversed and the alarm will go off.

6. Conclusiom and Scope for Further Improvement:

This works represents a prototype for wireless gas leakage systems that can be used mainly in household safety and many other applications in the industry and environment. For example it can be used in facilities where gas cylinders are stored. Any leakage can be recognized through the receiver module. The use of a sensor that is sensitive to small changes of concentration provides an excellent tool to detect a gas leak as it can detect small concentrations down to 100 ppm. The sensitivity of the entire system can be adjusted by changing the load resistor of the sensor which provides the flexibility to externally calibrate. Measuring the actual concentration of a certain gas cannot be easily done with this sensor, since it can detect many gases at the same time and has a non-linear sensitivity curve. Further improvement can be introduced to the system by including a temperature measurement system to be used

for temperature compensation, which can be done through the microcontroller to reduce the number of false positives and false negatives. We can also implement silicon control rectifier (SCR) instead of a electromagnetic relay coil for power trip which will be more effective and further reduce sparks while tripping power.

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