

Portable Wireless Liquid Petroleum Gas leakage Detection System for Home and Industrial Automation

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Abstract:

Near about all chemical and manufacturing industries uses harmful and highly flammable gases with high risk of leakage of such gases. Any such leakage can cause vast damage for industry, human lives, and also surrounded ecosystem. Such damages are hard to recover and have long term impacts on environment. Gas leakages are not completely avoidable, because of various factors such as technological limitations as well as human errors. But impact of leakage can be minimized by detecting such gas leakages as early as possible and taking necessary actions. This highlights importance of accurate and timely gas leakage detection in such systems. Using modern technology such gas leakages can be effectively detected and alarms can be generated at distant remote control units. Normally Chemical and manufacturing industries are have big size and typically have harsh environments. In such large sized industries wiring and maintenance of sensor cables is very tedious job. Such environments require wireless long distance reliable solution for gas leakage detection and such prevention and automation. This paper discusses the implementation of wireless LPG gas leakage detection system for industrial and home automation applications, as the LPG gas is most commonly used in homes and small scale industries. LPG leakage is very dangerous to human life as its highly flammable nature. The system specified in this article detects ranges from 10 to 10000 ppm of gas concentration and can send data remotely over long distance.

Key words: MSP 430 Microcontroller, Gas Sensor, wireless

1. INTRODUCTION

Today Many Chemical industries uses hazards chemicals and gases for manufacturing and other processes. Today's many small scale industries also use some of the hazardous gases for humans like SO₂, H₂S, CO, NO. Due to faults and accidents many times such gaseous get liked and possess great threat to human lives if properly not detected and handled. Due to exposure to these hazardous gases human can face many physical mental problems like breathing difficulties, burning in the esophagus, dizziness, throat pain, vision loss, body weakness, unconsciousness, vomiting (with blood), abdominal pain, bloody stools mention to few. Many times these gas leaks at large amount and in be in small amount which can not detected by humans directly still possesses great threats to living things and environmental conditions. Some of these gases has green house effects and have bad impact on environmental conditions. In 2012 professor Nathan Phillips and others from Boston University do one experiment by attaching gas sensors to car and drove along all 785 miles of Boston roads identifying 3300 different gas leaks[1]. Today such small amount of gas leakages are not being detected which are still harmful to our

society. If large amount of gas leakage occur there is need of system which can alarm to the people to evacuate the place for safety. Bhopal gas disaster is worst gas disaster incident in India, considered the world's worst Industrial disaster in 1984 [2]. Commercially available discrete gas sensors can be used for sensing and measure the concentration of gases like LPG, Propane, Iso-butane And real time data can be send through sub 1 GHz wireless technology using CC1200 chip. CC1200 is advanced low power and high performance chip designed with high receiver sensitivity providing improved long range communication [6].

Such System should be affordable and can be easily implemented in the chemical industries, plants, offices and in residential areas where gas leakage can be possible, which can be possibly surrounded by the chemical industries, mine or plants, to avoid any endangering to human lives. The system also supports real-time monitoring and detection of concentration of the gases present in air. The detection range of MQ-6 sensor is 10-1000 ppm. This sensor is highly sensitive to LPG, propane, and to Iso-butane [6]. Gas detection systems are essential components in the chemical and residential areas where the gas detection system

ensure quick and reliable detection of different types of flammable gases [7].

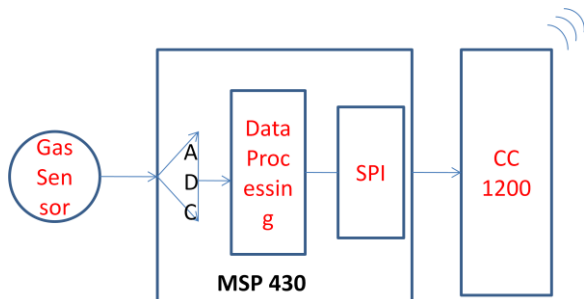


Figure:1 LPG Gas Detection System, block Diagram of Transmitter

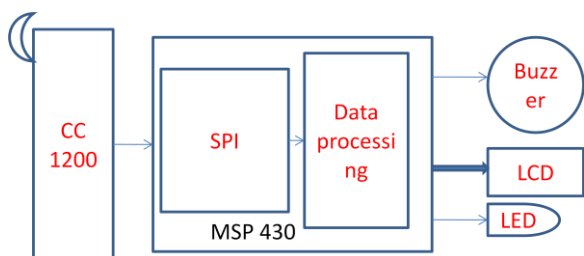


Figure2: LPG Gas Detection System, Block Diagram of Receiver

This system deals with detect the combustible gases in the present environment.

The developments in embedded system technology largely satisfy the needs of real time systems for various applications, gas detection and monitoring is one of the beneficiaries.

Gas sensors are very important part of detection, monitoring and control such systems like as compare to human nose. Gas sensors spontaneously react to the gas present in environment, thus keeping the system updated about any alterations that occur in the concentration of molecules at gaseous state Combustible gas detection has been one of the key issues in most of the security system in chemical industry, coal mine, car/vehicle and any type of chemical reactive plants. As system is targeted for portable applications and with battery power we decided to use of ultra low power MSP430 microcontroller as it operates from 1.2V to 3.3V, and is more reliable for battery base application. MQ-6 sensor senses multiple types of combustible (explosive) hazards gases in present environment but the gas sensor heater is operated on 5V ac or dc voltage. It requires another power

supply rail. The system provides highly secured and reliable data collected over the air. it takes real time data of gas concentration profile in the environment and sends back to receiver. If it detects any harmful gases in the ambience, the system will trigger an alarm to user.

2. LPG Gas Detection Sensor MQ-6:

The main function this module is to detect the change of concentration of LPG the air. MQ-6 gas sensor sense the various gases like Butane, LPG, propane as well as other combustible gases. It has Tin Dioxide (SnO_2) material based sensing technology. It has high sensitivity to these combustible gases. It is low cost and suitable for different combustible gas detection applications. It is used in gas leakage detecting equipments in industries and household security, for detection of LPG, iso-butane, propane, LNG [8].

3. CC1200:

The CC1200 is a TIs manufactured wireless device which is a fully integrated single-chip radio transceiver. All necessary filters are integrated, thus removing the need for costly external SAW and IF filters [9]. It is very high performance, very low-power, low-voltage operating, cost-effective wireless system. This device uses the ISM (Industrial, Scientific, and Medical) and SRD (Short Range Device) frequency bands at 164–190 MHz, 410–475 MHz, and 820–950 MHz

The CC1200 is a device with better hardware support for packets handling as well as data buffering, link quality indication, clear channel assessment and weak on radio. The device is controlled via SPI interface.

4. Operation of the system

The ultra low power MSP430 microcontroller is an extremely versatile platform which supports ranges of embedded applications. It has very low power consumption and can also operate on battery. Any combustible gas detected by the MQ-6 sensor providing voltage output with resistor. This voltage is buffered through rail to rail Op-Amp TLV 2475. The output of this buffer is fed to the microcontrollers ADC input. ADC reads this signal digitizes it and this digitized signal is sent to receiver over radio for further processing. By using

this signal receiver generates an appropriate audio-visual alarm. The outputs from the LPG gas sensor is in analog form thus an Analog to Digital converter (ADC) converts these values into corresponding digital values. The microcontroller receives a voltage signal proportionate to the extent of gas concentration detected (low or high) and drives the alarming system based on the set value in microcontroller connected with LEDs and buzzers.



Figure 3: Implementation of system

In this system main purpose to detect hazards, combustible gas concentration in the air medium and provide alarm to the user. The MQ-6 gas sensor senses combustible (flammable) hazards gases in the environment or particular medium. If the concentration level of the gas such as LPG or propane increases the point sensor conductivity also increases means resistance of sensor decreases with increase in the gas concentration. At any time gas detected then this change in voltage detected by the microcontroller, so it immediately activates the buzzer and Displays alarm message on LCD. This buzzer provides the alertness to the people who are within the organization. This system also provides visual alertness to the user through the LCD and LED.

5. System hardware design:

System hardware design composed of LPG gas leakage detection module, microcontroller and analog front end circuitry. LPG gas sensor with voltage divider resistor provides input signal to the microcontroller. As the output impedance of LPG gas sensor is high it is comparable with the input impedance of ADC, so this interfacing requires buffering of signal before feeding signal to the input of adc through OPAMP. This buffered signal is read by ADC and compared with pre-set value of gas concentration in memory and generates alarm when high gas concentration detected.



Figure 4: Output Display of receiver providing visual indication.

6. Conclusion:

Combustible gas detection system based on MSP430 microcontroller seems to be more appropriate and provide highly secured and reliable data collected over the radio and it detect LPG, propane, butane and other combustible gases. Thus, same system can detect wide range of combustible gas sensing. This system is smart, low power and having low maintenance. This System gives quick response, proper detection & monitor continuously. It is used to provide early warning of combustible gas leaks from plant containing combustible/flammable gases or chemical vapors, or for monitoring concentrations of such gases and vapors within plant. Same system can also be useful to detect LPG leakages in buildings, offices, cars, and coal mines without any change providing alarms over long range without any need of cabling.

7. Feature Scope:

This system has been implemented for the LPG leakage detection at home and Industry. System provides reliable data and accurate leakage location. The system can also be modified and used for different types of gas detections by replacing and calibrating different types of gas sensors.

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