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Development of Movable Gas Tanker Leakage Detection Using Wireless Sensor Network Based on Embedded System

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Abstract
The former systems can not react in time, even cannot obtain data from an accident and locate accurately. This system gives real time detective of potential risk area, collect the data of leak accident and locate leakage point. This system having protection circuitry consists of exhaust fan and an Liquefied Petroleum Gas Safe Solenoid Valve. The hazardous gasses like Liquefied Petroleum Gas and Propane were sensed and displayed each and every second in Liquid Crystal Display. If these gasses exceed normal level then alarm is generated immediately. In this system MQ-6 gas sensor used to sense poisonous gas and has high sensitivity to LPG and also response to natural gas. This work modifies the existing safety model installed in industries. It offers quick response time and accurate detection.

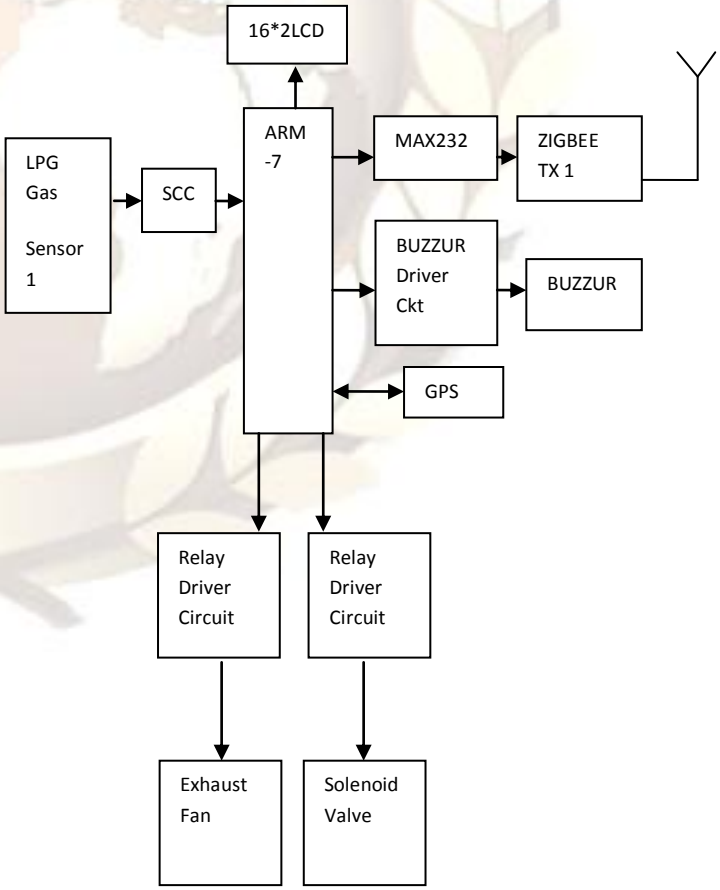
Key Words—Gas leak detection, Gas leak detection and location, Sensors, Zigbee, Protection Circuitry.

I. INTRODUCTION

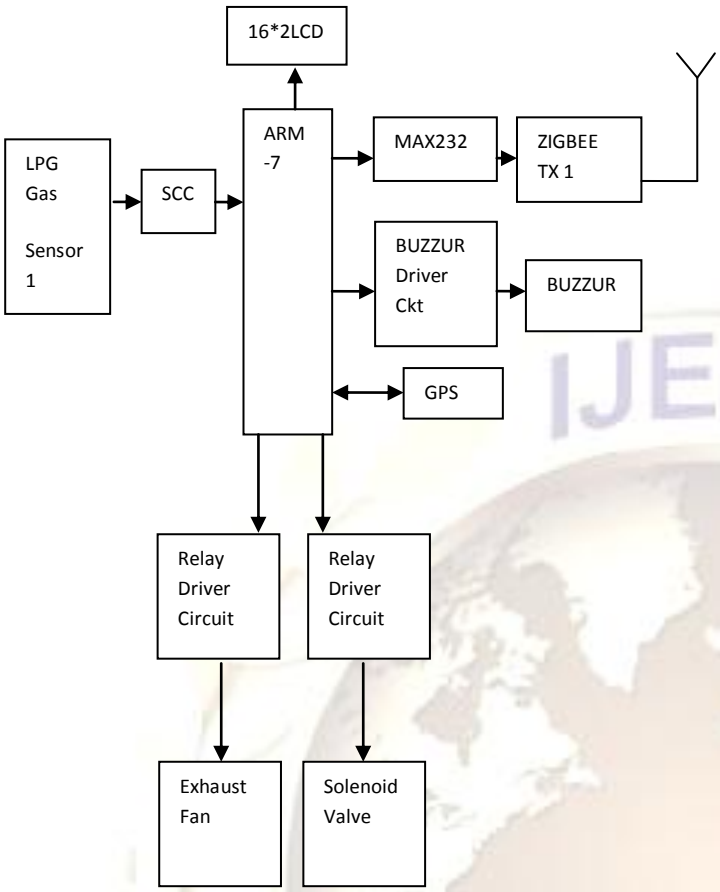
Poisonous gases are one that causes serious environmental pollution. Air polluted acts as a serious aspects as the soil, water pollution can detected visually and by taste but polluted air cannot be detected as it can be odorless, tasteless and colorless. The poisonous gases causes' serious health impacts so have to be monitored. The Liquefied Petroleum Gas and Natural Gas burn to produce clean energy, however, there is a serious threat about their leakage. The gases may lead to suffocation and may lead to explosion. However; there are still some shortcomings on real time monitoring and on data transmission and accurate location of leakage point when accident happens. These problems can be solved with help of developing embedded system using wireless sensor Network. It can be give real time detective of potential risk area, collect the data of leak accident and locate leakage point. The System is affordable and can be easily implement in the chemical industries and in residential area which is surrounded by the chemical industries or plants, to avoid endangering of human lives. The system also supports to provide real-time monitoring of concentration of the gases which presents in air. As this method is automatic the information can be given in time such that the endangering of human lives can be avoided.

II. STRUCTURE OF THE SYSTEM

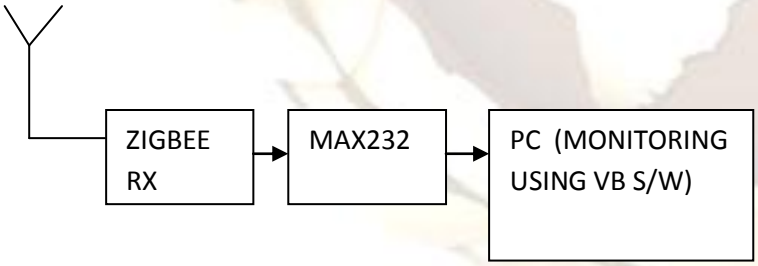
THE GAS LEAK DETECTION AND LOCATION SYSTEM CONSISTS OF TWO MODULES NAMELY, GAS LEAKAGE DETECTION MODULE AND GPS RECEIVER MODULE WITH ARM CONTROLLER. THE ARM-7 FINDS ITS APPLICATION DUE TO ITS LOW POWER CONSUMPTION. THE SYSTEM STRUCTURE IS SHOWN IN FIGURE 1 USING THE CONCEPT OF MULTIPLE TRANSMITTER AND SINGLE RECEIVER.



Transmitter Section - I



Transmitter Section - II



Receiver Section

Figure 1 Multiple Transmitter & Single Receiver

Leak detection module consists of MQ-6 gas sensor to detect amount of combustible gas present in the surrounding. As the leakage detects the ARM 7 controller sends the message to LCD which displays "Gas Leakage Detected". The ARM 7 controller checks the concentration of gas is within safe level if it beyond safe level (safety level is programmable) then ARM 7 controller not only immediately activates buzzer but also switch on the exhaust fan so that the gases are sent out and GPS receiver gives altitude location of gas leakage. Exhaust fan does not produce spark, so it is absolutely safe. This is followed by energizing the normally open LPG safe solenoid valve so that it is close and no more gas leaks. Mostly the condition will be back to normal but the exhaust fan will be remain ON to ensure safety

A. Gas Leak Detection

The Main Function of Gas Leak detection module is to detect the changes in concentration of LPG gas, then ARM-7controller Immediately activates Buzzer.MQ-6 gas sensor Shown in Figure 2 is used to sense the poisonous gas and has high sensitivity to LPG and also response to Natural Gas. It is portable gas detector which has long life with low cost.

Figure 2.MQ-6 Sensor

III. System Design

A. Hardware Design

The specification of LPG Gas sensor MQ-6 is shown in below.

Table 1.Specification of LPG Sensor

Model No.	MQ-6
Sensor Type	Semiconductor
Standard	Bakelite (Black Bakelite)
Detection Gas	Isobutene, Butane, LPG
Concentration	300-1000 ppm

The data transmission based on IEEE802.15.4.In order to reduce cost of system, shorten product development cycle and lower the difficulty, the factors including power consumption, transmitting power, receiving sensitivity, chip cost, protocol stack costs and number of peripheral components the chip need mainly considered when choose the chip. Finally, TI's zigbee chip CC2430 with free protocol stack Zigbee-2006 is picked out. The CC2430 having transmitting power is 1mW,

receiver sensitivity is -94dBm when the symbol error ratio is 1% current loss is 0.6µA when system is in standby mode. The Zigbee CC Chip CC2430 Shown Below

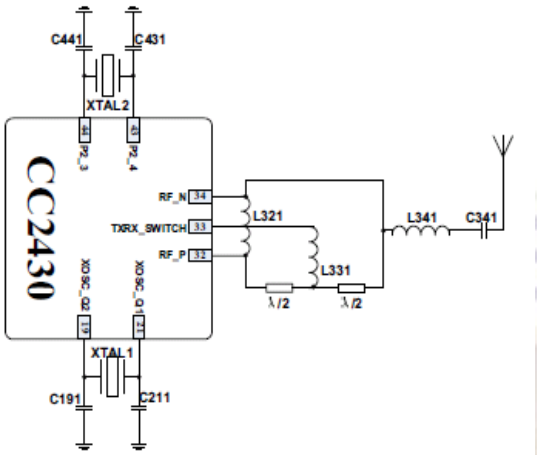


Figure 3. Zibee Chip CC2430 Schematic

VPN1513GPS Receiver Module

The VPN1513 GPS Receiver Module provides a fully open source and customizable GPS Receiver solution for microcontroller projects. The VPN1513 uses a SiRF Star III chipset capable of tracking up to 20 satellites. The module supports both "raw" output mode for raw NMEA 0183 strings and the default "smart" mode for specific user-selected data through a serial interface.

The VPN1513 GPS Receiver Module also features a Propeller co-processor for easy interface with any BASIC Stamp 2 module. The Propeller is also fully reprogrammable and includes access to all 32 IO pins, allowing the GPS Receiver Module to be easily transformed into a standalone device.

Key Specifications**:**
Power requirements: 4.5 to 12 VDC; 80 mA @ 5 V.Communication: Asynchronous serial, 9600 bps.Dimensions: 1.85 x 1.80 x 0.35 in (4.7 x 4.57 x 0.90 cm).Operating temp range: -22 to +185 °F (-30 to +85 °C)

Figure 4. VPN1513GPS Receiver

B.Protection Circuitry

The Protection Circuitry Consists of the exhaust fan, an LPG safe solenoid valve and the associated ARM-7 Controller interfaces, Suitable driver circuits have to be designed for activating the valve and exhaust fan using relays. An additional inverter may be required to interface domestic exhauster so that it can operate in parallel with it even during power failure and eliminates need for two exhaust fan

IV. CONCLUSION

Movable Gas Tanker leak detection, location and Protection compromises sensitive sensors, Zigbee and GPS Receiver which is smart, low cost, low power and low Maintenance. System gives quick response rate, accurate detection; monitors gas leakage, Collect the data from a scene of accident and locate the leakage point.

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