

## Quadcopter Based Gas Detection System

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**Abstract:** Gas leakage is a major problem with industrial sector, residential premises and gas powered vehicles like CNG (compressed natural gas) buses, cars etc.. One of the preventive methods to stop accident associated with the gas leakage is to install gas leakage detection kit at vulnerable places. The aim of this paper is to present such a design that can automatically detect and take initial steps to stop gas leakage in vulnerable premises by alerting them. In particular gas sensor has been used which has high sensitivity for methane (CH<sub>4</sub>) and LPG. Quadcopter system consists of Gas leakage detection module, which warns by sending information and by alarm. However, the former gas leakage system cannot react in time. This paper provides the design approach on both software and hardware.

**Keywords:** CNG (compressed natural gas), LPG (Liquefied petroleum gas), Gas sensor MQ-6, Driver unit, Microcontroller (AT328p), LCD (Liquid crystal display), KK Multirotor Controller (MPU 6050), XBee(ZigBee) module, Decoder HT12D, Encoder HT12E.

### I. Introduction

LPG consists of mixture of propane and butane which is highly flammable chemical. It is odourless gas due to which Ethanoil is added as powerful odorant, so that leakage can be easily detected. There are other international standards like EN589, amyl mercaptane and tetrahydrothiophene which are most commonly used as odorants. LPG is one of the alternate fuels used now days. Sometimes liquefied petroleum gas is also known as LPG, LP gas, Auto gas etc. This gas is commonly used for heating appliances, hot water, cooking, and various other purposes also. LPG is also used as an alternate fuel in vehicles due to soaring in the prices of petrol and diesel. Some people have low sense of smell, may or may not respond on low concentration of gas leakage. In such a case, gas leakage security systems become an essential and help to protect from gas leakage accidents. A number of research papers have been published on gas leakage security system. Embedded system for Hazardous gas detection and Alerting has been proposed in literature. Where the alarm is activate immediately, if the gas concentration exceeds normal level[4].in India. This was world's worst gas leakage industrial accident. The new technique what we implementing in this is mount king the gas detection module to the Quadcopter for sensing the gas leaking at different places and different altitude levels.

### II. Methodology Used

The functionality of system is divided into two main steps. The figure. 1 shows the block diagram of gas leakage security system and Quadcopter driver section.

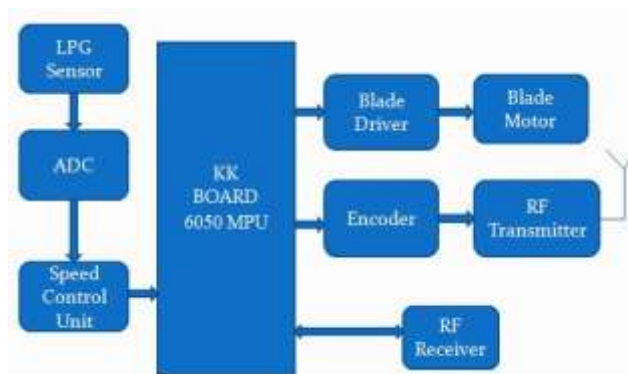


Figure. 1 Block diagram of gas leakage security and quadcopter system.

In the initial step, the gas leakage is detected by the gas sensor MQ-6. This detects the gas leakage and gives the signal to the microcontroller with the help of ADC. After that in second step the microcontroller

receive the signal, send by gas sensor. It sends activation signal to other external devices attached with it. Such as two stepper motor IC (ULN 2003A), buzzer, LCD (Liquid crystal display), and to Xbee. In the last step, many tasks have been performed such as buzzer activates simultaneously message display on liquid crystal display screen, At the end, when the gas leakage is successfully stopped then with the help of reset button the whole system reached to the initial stage.

**A. MQ-6 Gas Sensor**

MQ6 is a semiconductor type gas sensor which detects the gas leakage. The sensitive material of MQ-6 is tin dioxide (SnO<sub>2</sub>). It has very low conductivity in clean air [4]. This Gas sensor not only has sensitivity to propane and butane but also to other natural gases, low sensitivity to cigarette smoke and alcohol. The MQ-6 gas sensor is shown in figure. 2. This sensor can also be used for detection of other combustible gas such as methane [4].



Figure. 2 MQ-6 gas sensor

The concentration range of MQ-6 gas sensor is 300-1000 ppm. This sensor is available in 6 pins package, out of which 4 pins are used for fetching the signals and other 2 pins are used for providing heating current. This sensor has fast response time.

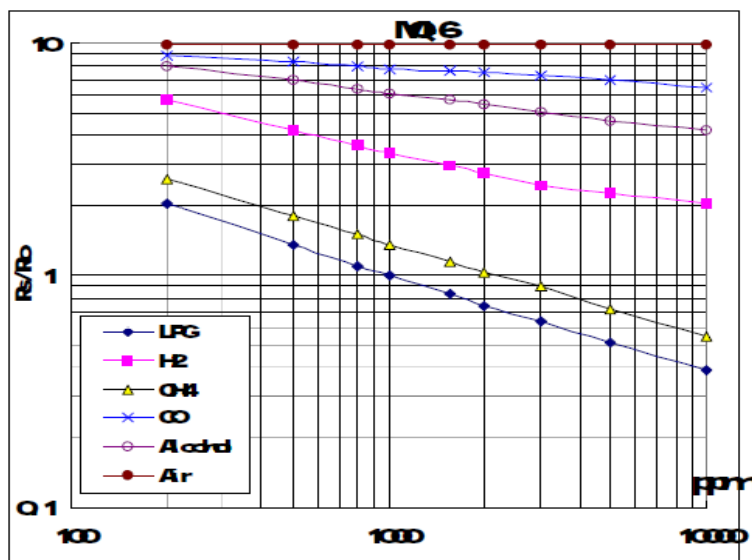


Figure 3 shows the typical sensitivity characteristics of the MQ-6 gas sensor for several gases.

The power need by the sensor is 5V. This sensor has different resistance value in different concentration. For an example, if we calibrate the MQ-6 gas sensor to the 1000ppm of propane concentration in air, then the resistance value would be approximately 20kΩ. The change in the resistance value with respect to the concentration as discussed above is shown in figure 3.

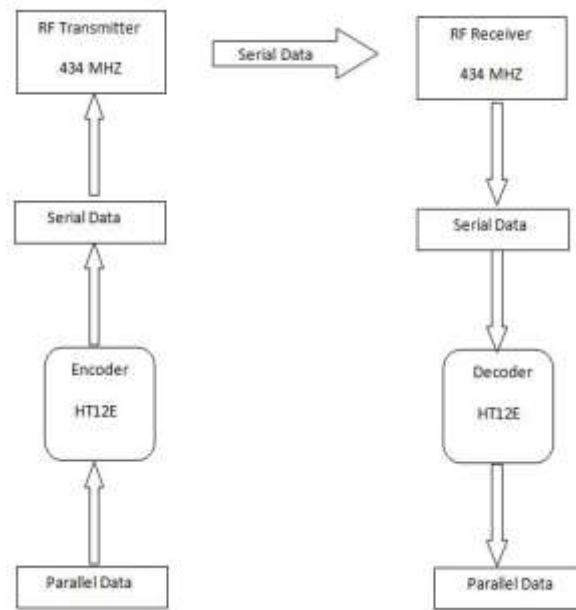
**B. Stepper motor Driver**

Two stepper motor has been used, both are connected to the stepper motor driver IC (ULN 2003A). A 12V external DC supply has been given to the stepper motor. The main purpose of the stepper motor is to turn off the main power and Gas supply. One motor is used to turn off the main power supply. Motor is attached to a main switch in such a way that when a motor rotates 60o, then immediately power supply turn off. Now on the

other hand, the second motor turns off the main gas supply. A mechanically coupled stepper motor to main gas knob, so that when motor rotates 180o then immediately the knob gets close.

**C. Radio Frequency**

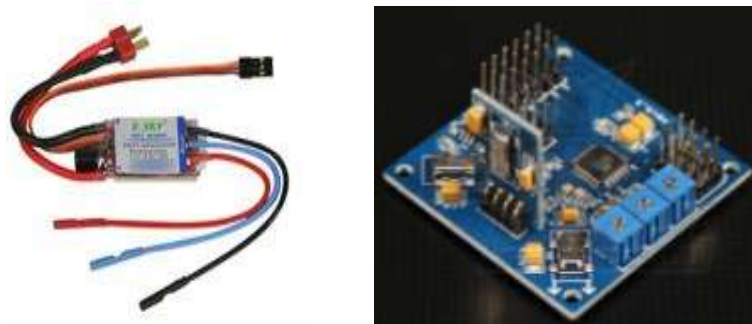
RF transmission system composed of Amplitude Shift Keying (ASK) with the transmitter/receiver (Tx/Rx) pair, operating at frequency of 434 MHz. Transmitter module takes serial input and transmits it through RF. Receiver module receives signals which are transmitted by transmitter module placed away from it. The RF module has been used with a set of four channels Encoder/Decoder ICs. HT12E & HT12D have been used as encoder and decoder ICs respectively. The encoder converts the parallel inputs into serial signals. These signals are serially transferred through RF. The decoders are used after the receiver to decode the signal and obtain the original signals as an output. These outputs can be easily observed on the corresponding LEDs. The block diagram of RF transmission is shown in figure. 4.



**Figure. 4 Block diagram of RF transmission system**

**D. KK Board**

KK Board is also known as Multi -Rotor controller is a flight controller board for multi -rotor aircraft (Tricopters, Quadcopters, Hexacopters etc). Its purpose is to stabilize the aircraft during flight. To do this it takes the signal from the 6050 MPU gyro/acc (roll, pitch, and yaw) then passes signal to the Atmega 644PA IC. The Atmega 644 Pa IC unit then process these signals according the users selected firmware and passes controlled signals to the installed Electronic Speed Controllers (ESCs) Figure 5. These signals instruct the ESCs to make fine adjustments to the motors rotational speed which in turn stabilizes the multi rotor craft.



**Figure. 5 Electronic Speed Controller and KK Board**

**III. Result**

The prototype of the gas leakage security system has been shown in figure. 6. This system has been tested by taking a small amount of LPG gas near to the sensor. MQ-6 gas sensor detects the LPG gas and sends

a signal to the microcontroller. After that microcontroller send an active signal to other externally connected devices. As a result a buzzer rings and a message is display on LCD screen. With the help of quadcopter we can use this application at different levels of environment



Figure. 6 Prototype model of proposed system

#### IV. Conclusion

In this system we have describe a new approach for gas leakage detection system at a low concentration. The leakage is detected with the help of MQ-6 gas sensor. Sensor sends a signal to microcontroller. In the next step microcontroller sends an active signal to other externally connected devices. Through this prototype we can reduce the loss of human life in place of underground drainage system and in mine areas.

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