

# IOT BASED SMART GAS MANAGEMENT SYSTEM

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**Abstract**— The problem of gas leakage and fire is often encountered in our day-to-day life. LPG, Liquefied Petroleum Gas, is highly flammable gas used as fuel in heating appliances. Leakage of this gas raises the risk of building fire, suffocation or an explosion. The mentioned problem can be solved with the development of reliable techniques to detect gas leakage. As soon as gas leakage will be detected, user will be notified via SMS and call so that he/she can turn off gas valve from anywhere in his work place. The issue of flame and fire at kitchen can be monitored with the help of fire sensor. The buzzer starts beeping whenever fire is detected. In addition to these, it is often found that a person forgets to book gas cylinder due to his/her busy schedule. The main aim of this paper is to design an IOT based Smart Gas Management System that will be able to detect gas leakage and fire. With the help of load sensor, automatic booking of a gas cylinder is also facilitated. Notification is sent to the booking agency to book a gas cylinder whenever load cell detects that the weight of gas cylinder has reached below a threshold value. At the same time, user will be notified about gas cylinder going empty.

**Keywords**— Fire Sensor, Gas Sensor, GSM Module, IOT (Internet of Things), Load Cell, LPG (Liquefied Petroleum Gas), Voice Module

## I. INTRODUCTION

LPG (Liquefied Petroleum Gas), simply called as propane or butane, is highly flammable gas that is often used as fuel for cooking purposes. Due to the flammable nature of LPG, its leakage can cause damage to life and property. It is very important to be sure that gas leakage has not occurred in our kitchen. LPG, being heavier than air, does not disperse easily and leads to suffocation when inhaled. The ignition of leaked gas leads to explosion [1]. It is also important to be sure that kitchen has not been caught with fire. It is often found that a person forgets to book gas cylinder due to his/her busy schedule.

The proposed topic "IOT (Internet of Things) based Smart Gas Management System" deals with three major issues, gas leakage detection, fire detection and automatic booking of gas cylinder. This system makes use of gas sensor, fire sensor and load cell to detect the gas leakage, fire and continuously monitor the amount of gas in cylinder respectively. Buzzer starts beeping on detection of gas leakage and fire. Automatic booking of gas cylinder is facilitated by notifying booking agency to book a gas cylinder whenever load cell detects that the weight of gas in cylinder has reached below a threshold value [2]. User will also receive message stating that gas in

cylinder is about to get completed. On detection of either gas leakage or fire, user will be alerted via an SMS or a phone call. The alert message recorded will be played back as soon as he/she receives the call.

Arduino UNO is the microcontroller used for this purpose. All the input devices such as Gas Sensor, Fire Sensor and Load Cell along with output devices like Buzzer and LCD Display are interfaced into it. A SIM inserted into GSM Module makes phone call and SMS; code for which is written as AT commands. Voice Module is used to record alert message in the form of speech. Whenever any mishap takes place, call is sent to the registered mobile number and recorded speech is played back as soon as call is received.

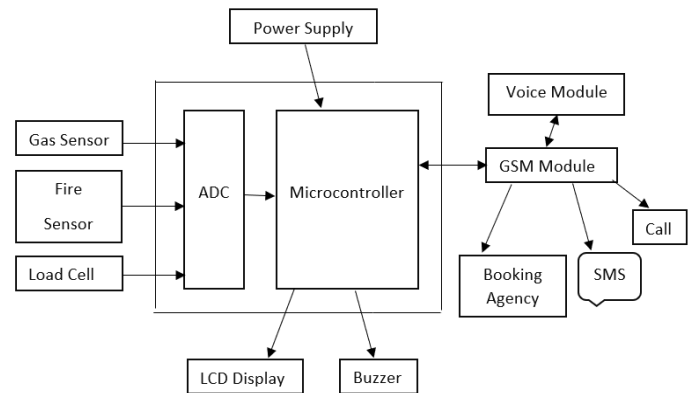


Fig. 1. Conceptual Diagram

## II. RELATED WORK

Various models have already been designed to meet our requirement. All of them have their own advantages and disadvantages.

### A. ARM Processor

This system detects gas leakage by using gas sensor. On the detection of gas leakage, alarm system is activated, power supply will be turned off and SMS will be sent to the user to notify about leakage. Load cell will continuously monitor weight of gas in cylinder and if its weights reaches below threshold value of around 2kg, SMS will be sent to user to refill the cylinder. The main advantage of this system is it

detects gas leakage by using Gas Leakage and Temperature Sensor [3]. The paper has been implemented by the help of ARM 7 processor and simulated by using Keil software. Its disadvantage includes that the system makes use of processor instead of controller.

### B. WIFI MODULE

This system detects gas leakage and gas wastage by using MQ-2 Sensor and GP2D120 Sensor. Load cell measures weight of gas in cylinder. User is notified about leakage of gas and fire in kitchen along with action required to replace gas cylinder through an SMS. In addition to this, buzzer will start beeping. It makes use of WIFI module to give microcontroller an access to WIFI network [1]. This paper is designed and implemented by using Arduino UNO ATmega328 and simulated by using Proteus Design Suite.

### C. AT89s52 MCU

This system detects gas leakage by using gas sensor and monitors temperature of surrounding by using temperature sensor. Load Cell facilitates automatic booking of gas cylinder. Siren is triggered when gas leakage and fire is detected [4]. The result of different sensors can be displayed in LCD Display. This paper is designed and implemented by using AT89s52 MCU.

## III. PROPOSED METHODOLOGY

In the proposed system, Gas Sensor (MQ2 Sensor), Load Cell and Fire Sensor are interfaced to the microcontroller ATMEGA328. These sensors act as input to the system. The interfaced GSM module is capable of connecting to Internet through mobile data network. Gas Sensor detects gas leakage. As soon as leakage of gas is detected, user is notified about it so that he/she can turn off the gas valve. Load cell continuously monitors the weight of gas in cylinder and on detection of its weight below some critical value, a notification will be sent to booking agency and house owner to book a gas cylinder. Fire sensor detects fire and on detection of fire, buzzer starts beeping to alert user about the mishap going on in their home. The response of all these sensors can be viewed in LCD-Display. APR33A3 voice module is used to record alert voice message and it is interfaced with the GSM Module so that the recorded voice is played when a user attends the call. GSM Module makes use of AT commands for sending phone calls and SMS [5].

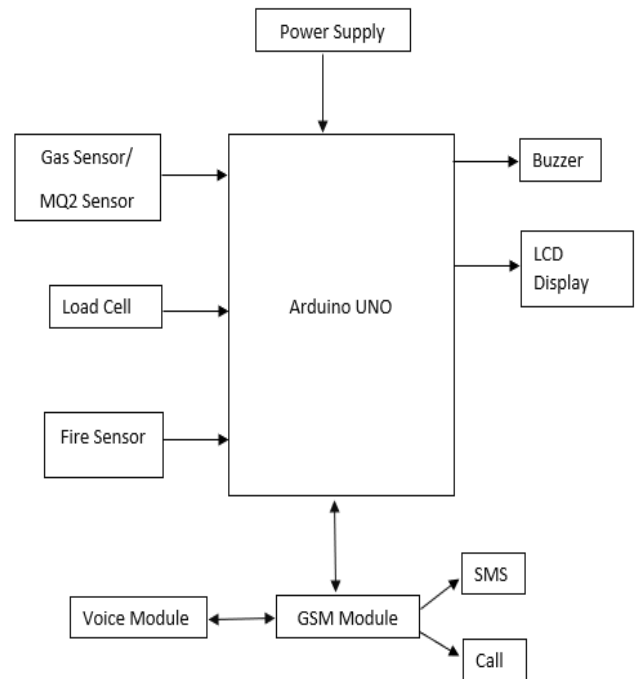


Fig. 2. Block Diagram for the system

## IV. COMPONENTS DESCRIPTION

### a) MQ-2 Sensor



Fig. 3. MQ-2 Sensor

MQ-2 Gas Sensor is a gas sensor having high sensitivity to LPG, Propane and hydrogen. That's why, it is most widely used for the purpose of gas leakage detection. Potentiometer can be used to adjust its sensitivity. The main features of MQ-2 Sensor is that having high sensitivity and fast response time, measurements can be taken as soon as possible. It is capable of detecting natural gas concentrations in the range of 300-1000ppm [6].

### b) Fire Sensor

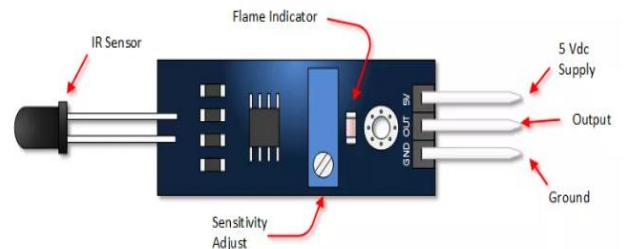


Fig. 4. Fire Sensor

Fire sensor is the device used to detect presence of flame or fire in the area where it is placed. Immediately after an area has been caught with fire, there will be significant increase in temperature of surrounding area and concentration of carbon-dioxide and carbon monoxide increases in the atmosphere [7]. User can then cause several actions to happen based on their requirement by interfacing it to several other components. A buzzer can be made to beep on detection of fire. Similarly, a fuel line can be made to deactivate and fire suppression system can also be activated.

#### c) Load Cell



Fig. 5. Load Cell

Load cell is a type of transducer that converts mechanical force into a measurable electrical output. Anything that needs to be weighted probably uses it for that purpose. Among the various varieties of load cells, strain gauge-based load cells are mostly used [8]. It works on the principle that the strain gauge deforms when the material of the load cells deforms appropriately. It is available in different shapes and sizes. Appropriate one among them can be selected and added to different machinery and weighing equipment. The major features of load cell include its stiffness, good resonance values and tending to have long life cycles in application.

#### d) Arduino UNO



Fig. 6. Arduino UNO

The Arduino UNO is a microcontroller board which is based on the Microchip ATmega328P microprocessor. This board consists of 14 digital pins and 4 analog pins. It can be programmed with the Arduino IDE by means of a type B USB cable [9]. It is operated at the voltage of 12V.

#### e) SIM900A GSM Module



Fig. 7. SIM900A GSM Module

In this project, GSM module is interfaced with Arduino UNO which is capable of connecting to Internet through mobile data network. It is able to communicate with controllers by use of AT commands. A SIM can be inserted into it allowing the features such as making phone calls and sending SMS [10]. The major features of GSM module include international roaming, improved spectral efficiency, uses encryption to make phone calls more secure, speech with high quality and compatibility with ISDN (Integrated Services Digital Network).

#### f) APR33A3 Voice Module



Fig. 8. APR33A3 Voice Module

APR33A3 voice module allows us to record the voice and playback voice recorded in it. It has 8 channels, named as M0 to M1, with 1.3 minutes of recording time for each channel i.e. the total recording time offered is 11 min [11]. It does not require battery backup to operate. It makes use of non-volatile flash memory technology. Voice can be recorded with the help of on-board microphone. In this project, voice module is used to record alert messages and these messages are played whenever user receives call that is made through GSM Module.

### g) Buzzer



Fig. 9. Buzzer

Buzzer, often called as beeper, is an audio signaling device that may be either mechanical, electromechanical, or piezoelectric. It makes use of transistor and capacitor to convert electrical energy into sound energy [12]. The most popular applications of buzzer include alarm devices, timers, and confirmation of user input (for e.g. mouse click or keystroke). It starts beeping when some action has been performed. (Ex: In our proposed topic, the buzzer starts beeping when no vessel is detected over gas burner even after specified time period).

### h) LCD Display

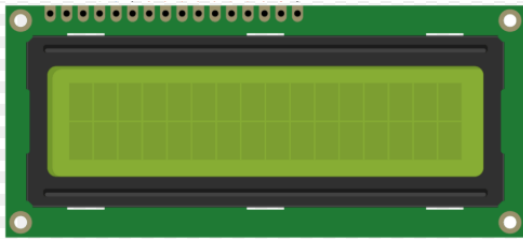


Fig. 10. LCD Display

The use of LCD Display is to display the response of different sensors like gas sensor (MQ-2 sensor), fire sensor and load cell.

## V. SYSTEM FLOW CHART

When we turn on the power supply, MQ2 Sensor reads gas concentration value. Fire Sensor will detect if the surrounding area has been caught with fire. Load cell will continuously monitor weight of gas in cylinder. Immediate actions such as sending SMS and phone call and beeping buzzer are carried out on detection of gas leakage and fire. Message is sent to booking agency and user to book gas cylinder for mentioned address whenever load cell detects that gas in cylinder has reached below 3 kg. The complete flow chart of how the system works is shown in fig 11.

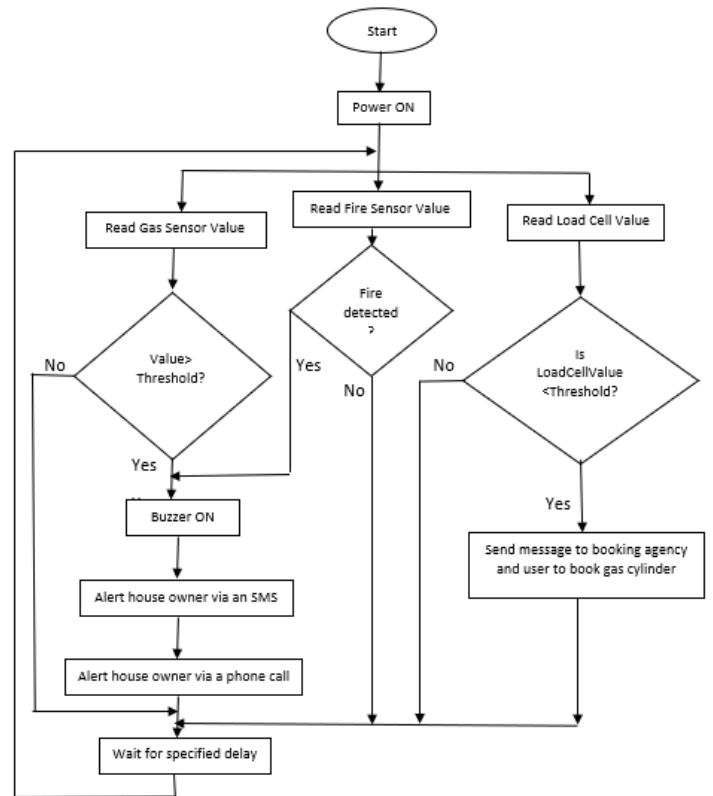


Fig. 11. Flow Chart for the proposed system

## VI. RESULTS

The experimental setup of the system is shown in fig 12. The result of all sensors can be viewed in LCD display. As soon as gas leakage and fire are detected, SMS and call are sent to the registered mobile number. Buzzer starts beeping at the same time. Whenever the weight of gas inside cylinder reaches below a threshold value, booking agency is notified to book a gas cylinder.

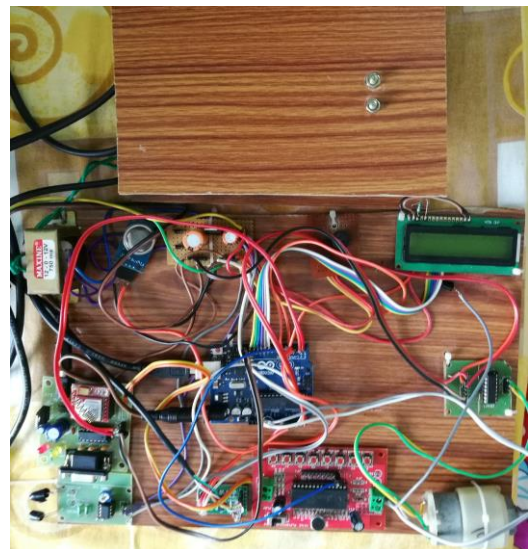


Fig. 12. Experimental setup for proposed system

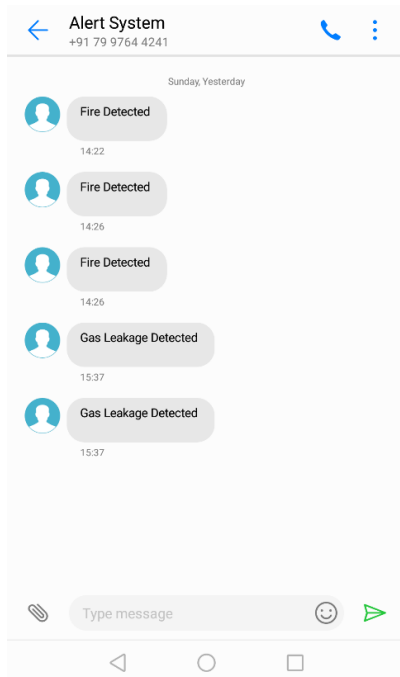


Fig. 13. Alert message for gas leakage and fire detection

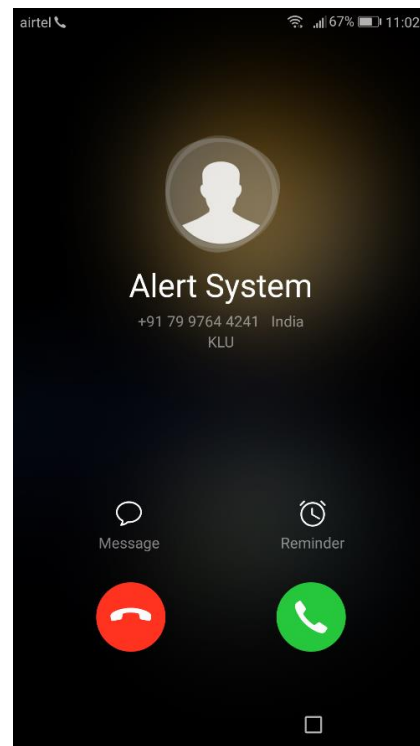


Fig. 15. Call alert on detection of Gas leakage and fire

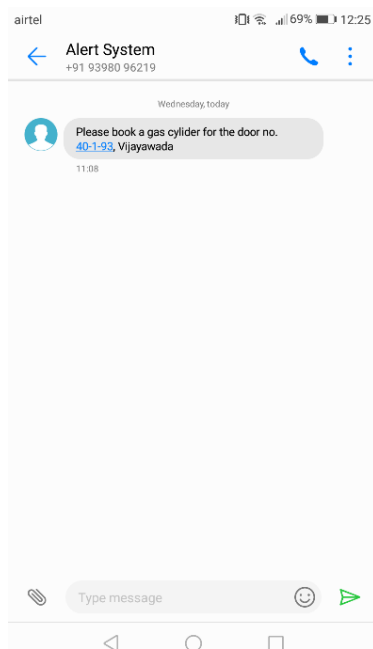


Fig. 14. Message sent to booking agency and user to book gas cylinder

## VII. COCLUSION

As the use of LPG gas is increasing day-by-day, the risk of its leakage and damages caused by this leakage is also increasing in same ratio. Smart Gas Management system monitors leakage and fire. In either case, alert message and call will be sent to the house owner so that he/she can turn off gas valve on time before much damages are caused by leakage. It also sends notification to gas cylinder booking agency and user in case it is found that the weight of gas in cylinder reaches below threshold value. The result of every module can be viewed in LCD display. Buzzer starts beeping if leakage or wastage of gas has been detected. Thus, the damages caused due to gas leakage can be minimized by use of IOT based Smart Gas Management System.

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