IOT Mini Project Report on

“LPG Gas Detection Alarming System”

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Abstract

Nowadays gas leakage and gas detection is a major problem in our daily lives. LPG gas is highly flammable and can inflict damage to life and property. To avoid such situations, a considerable amount of effort has been devoted to the development of reliable techniques for detecting gas leakage. Here we have developed an Arduino based LPG gas detector alarm. If gas leakage occurs, this system detects it and makes an alert by buzzing the buzzer attached with the circuit. Our aim is to reduce the risks in Kitchen using Internet of Things. Gas sensor are used to detect gas leakages in a kitchen. This project aims at detecting any Gas Leakage in homes and raise the usual sound and light alarm by using the IoT oriented Gas Leakage Detection System.

1. Introduction

Liquefied petroleum gas is a flammable mixture of hydrocarbon gases used as a fuel in heating appliances and vehicles. Varieties of LPG bought and sold include mixtures that are primarily propane (C3H8), primarily butane (C4H10) and, most commonly, includes both propane and butane, depending on the application .Unlike natural gas, LPG is heavier than air, unlike natural gas, and thus will flow along floors & tend to settle in lower spots, such as basements.

The two main dangers from this

- Possible explosion if mixture of LPG & air is right & if there is an ignition source.
- Suffocation due to LPG displacing air, causing a decrease in oxygen concentration

1.1 Background

Liquefied petroleum gas (LPG) is currently the most used gas in our home for cooking purposes. LPG gas is a flammable gas, if leaked it can cause major damage to life and property. Therefore it should be used in safe handling manner and additional care has to be taken in order to prevent any leakage possible. The main features of LPG is that being heavier than air, it do not disperse easily and may lead to suffocation when inhaled. The leaked gases when ignited may lead to explosion. The number of deaths due to the explosion of gas cylinders has been increasing in recent years.

1.2Properties of LPG

Gas	Formula	%LEL	%UEL	Ignition Temperature	Flash point in ℃
Propane	C_3H_8	2.2	9.5	470	97
Butane	C_4H_{10}	1.8	8.4	365	152

The properties of LP Gas are shown in above table.

The explosion happens when the below three conditions are fulfilled

- The concentration of gas is between LEL.
- A sufficient amount of Oxygen exists.
- There is a source of ignition

1.3Motivation

- To reduce risks to human life and property.
- To provide an alert about the leakage situation so that necessary action can be taken.
- Gas leakage is a common issue, so to prevent it an alarm system is used.
- The people in crowded places can be made aware of gas leakage with the help of LCD panels.
- Displaying gas outflow status that signifies if the gas is in normal stage or not.

2. Literature Survey

The proposed alarm system is mainly meant to detect LPG leakage, which is most commonly used in residential and commercial premises. The system detects not only the presence of gas (gas leak), but also the amount of leakage in the air, and accordingly raises an appropriate audio visual alarm. The objective of the system is to detect LPG gases such as propane and butane. The allowed UK level for butane is 600 ppm. The detection of LPG/CNG gases has become a main issue due to more wellbeing policy wide-reaching.

These sensors can be used for various applications, e.g. monitoring and controlling of the explosive level of concentration of gases, finding of various harmful, dangerous, toxic gases, industrial automation etc. In recent years, the biggest advancement made in the sensor tools is the detection of liquefied petroleum gas and has become tip of the iceberg because outburst accidents force to be happened when it leaks excessively. Therefore, the research work particularly, in the area of wireless sensor network and earlier gas leakage detection (alert system) is imperative.

To work against the dangerous effects of gas leakage, significant efforts was carried out in manipulative and miniaturizing the gas leak sighting technique. The occurrences of gas leak-related incidents are studied by several researchers and have published statistical data incidents. In 2012, Somov et al reported “Energy-Aware Gas Sensing Using Wireless Sensor Networks” focusing on a sensor node, a relay node, a wireless actuator and a network coordinator. The network coordinator is the main unit of the WSN. It supports the network operation by wireless communication based on the IEEE 802.15.4 standard and the ZigBee specifications.

3. Proposed Work

3.1 Problem Definition

To design and implement IOT based LPG gas leakage detector. The detection system also includes an alarm and also an LCD panel to alert the users. The system is implemented as Arduino LPG based gas detector alarm.

3.2 Features

- Safety Measures
- Alerting Alarm System
- Prevention of damage to life and property.
- Study based on properties of LPG.
- Reliability, usability, portable

3.3 Objectives

- The principal objective for the detection of gas releases is to reduce the likelihood of fires and/or explosions and prevent excessive property damage, interruption to plant production, injury, and loss of life.
- An additional consideration is the toxicity hazard created by a leak of a gas with both toxic and combustible properties.
- The objective of the proposed Gas Leakage Detection System is to provide a solution by designing an automatic system which can detect the leakage of liquefied petroleum gas (LPG) at home.

3.4 Scope

- It can be used in day to day life.
- This project defines the minimum mandatory requirements considering the concentration of LPG in terms of Lower Explosive Limit(LEL).
- Can be installed and put to use in every household.
- Alert people who are nearby thus ensuring that the user need not always be present on the site of leakage.

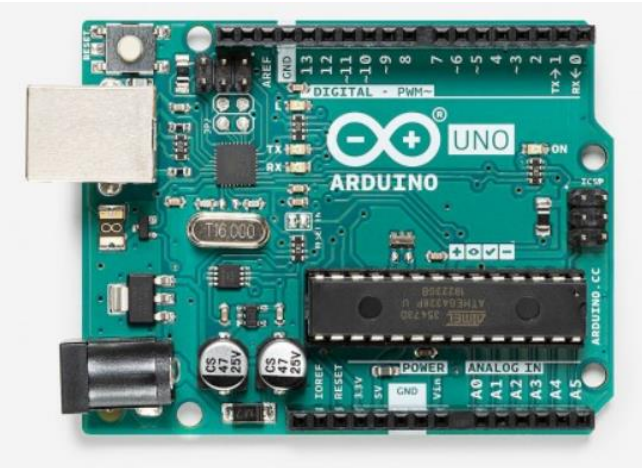
4. Project Design

4.1 Components Required :

- ***Arduino UNO R3***
- ***LPG Gas Sensor Module***
- ***Buzzer***
- ***BC 547 Transistor***
- ***16X2 LCD***
- ***Bread board***
- ***9 Volt Battery***
- ***Connecting wires***

4.1.1 Components Description :

1. **Arduino UNO R3 :** Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.



Technical Specifications :

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)

Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm
Weight	25 g

2. LPG Gas Sensor Module (MQ3) :

This module contains a MQ3 sensor which actually detects LPG gas, a comparator (LM393) for comparing MQ3 output voltage with reference voltage. It gives a HIGH output when LPG gas is sensed. A potentiometer is also used for controlling sensitivity of gas sensing. This module is very easy to interface with microcontrollers and arduino and easily available in market by name “LPG Gas Sensor Module”. We can also build it by using LM358 or LM393 and MQ3.

Features

- Sensor Type - Semiconductor
- Easy SIP header interface
- Compatible with most of the microcontrollers
- Low-power standby mode
- Requires heater voltage
- Good sensitivity to alcohol gas
- Fast response and High sensitivity
- Long life and low cost
- Requires simple Drive circuit

MQ-3 Sensor Module

Pin Name	Description
VCC	This pin powers the module, typically the operating voltage is +5V
GND	Used to connect the module to system ground
Digital Out (DO)	You can also use this sensor to get digital output from this pin, by setting a threshold value using the potentiometer
Analog Out (AO)	This pin outputs 0-5V analog voltage based on the intensity of the gas

MQ 3 Sensor Module

3. Buzzer

Piezo buzzers are simple devices that can generate basic beeps and tones. They work by using a piezo crystal, a special material that changes shape when voltage is applied to it.

In simplest terms, a piezo buzzer is a type of electronic device that's used to produce a tone, alarm or sound. It's lightweight with a simple construction, and it's typically a low-cost product.

Features

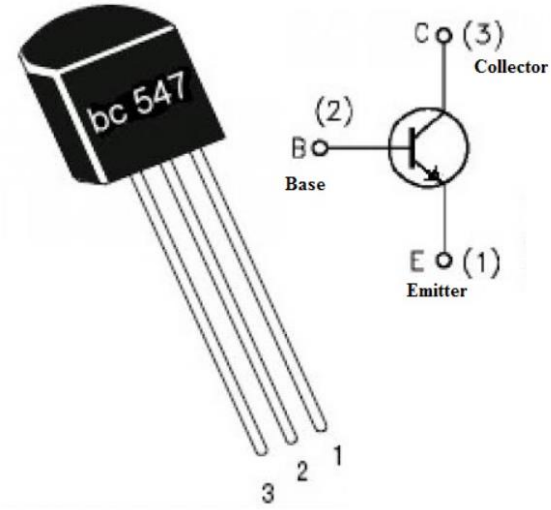
- Rated Voltage: 6V DC.
- Operating Voltage: 4-8V DC.
- Rated current: <30mA.
- Sound Type: Continuous Beep.
- Resonant Frequency: ~2300 Hz.
- Small and neat sealed package. Breadboard and Perf board friendly

4. BC 547 Transistor

BC547 is a NPN transistor hence the collector and emitter will be left open (Reverse biased) when the base pin is held at ground and will be closed (Forward biased) when a signal is provided to base pin. BC547 has a gain value of 110 to 800, this value determines the amplification capacity of the transistor.

Features

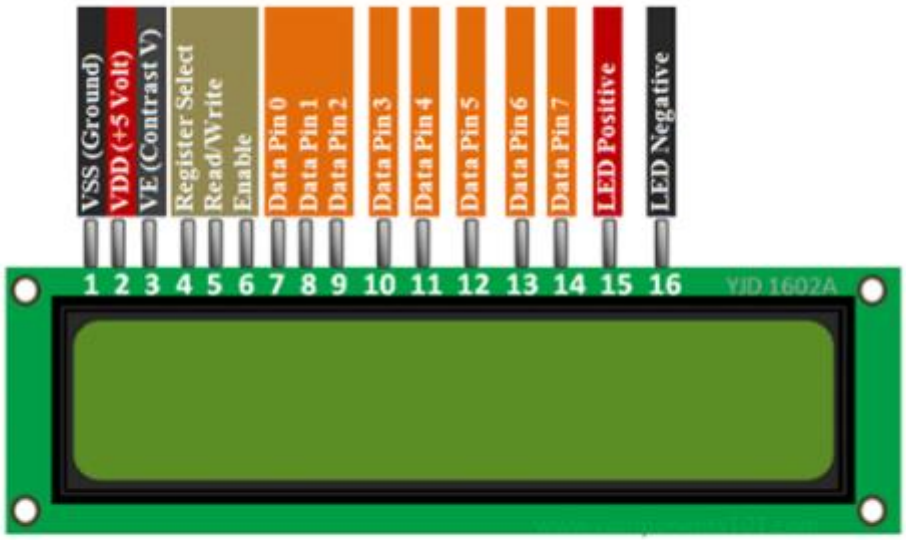
- Bi-Polar NPN Transistor
- DC Current Gain (hFE) is 800 maximum
- Continuous Collector current (IC) is 100mA
- Emitter Base Voltage (VBE) is 6V
- Base Current(IB) is 5mA maximum
- Available in To-92 Package



5. LCD PANEL

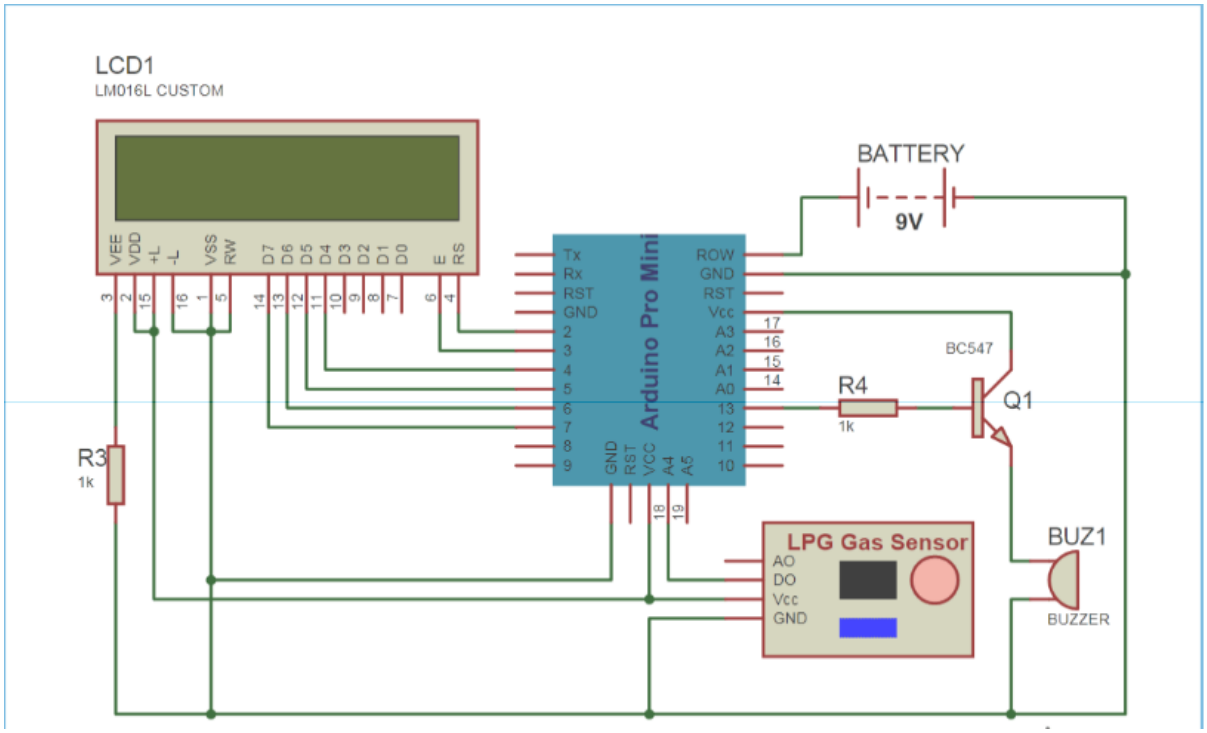
Features

- 16×2 lcd display Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight Alphanumeric LCD display module, meaning can display alphabets and numbers.
- Consists of two rows and each row can print 16 characters.
- Each character is build by a 5×8 pixel box Can work on both 8-bit and 4-bit mode.
- It can also display any custom generated characters Available in Green and Blue Backlight.



All other components are the standard components used in Electronics and IOT.

4.2Circuit Schematic

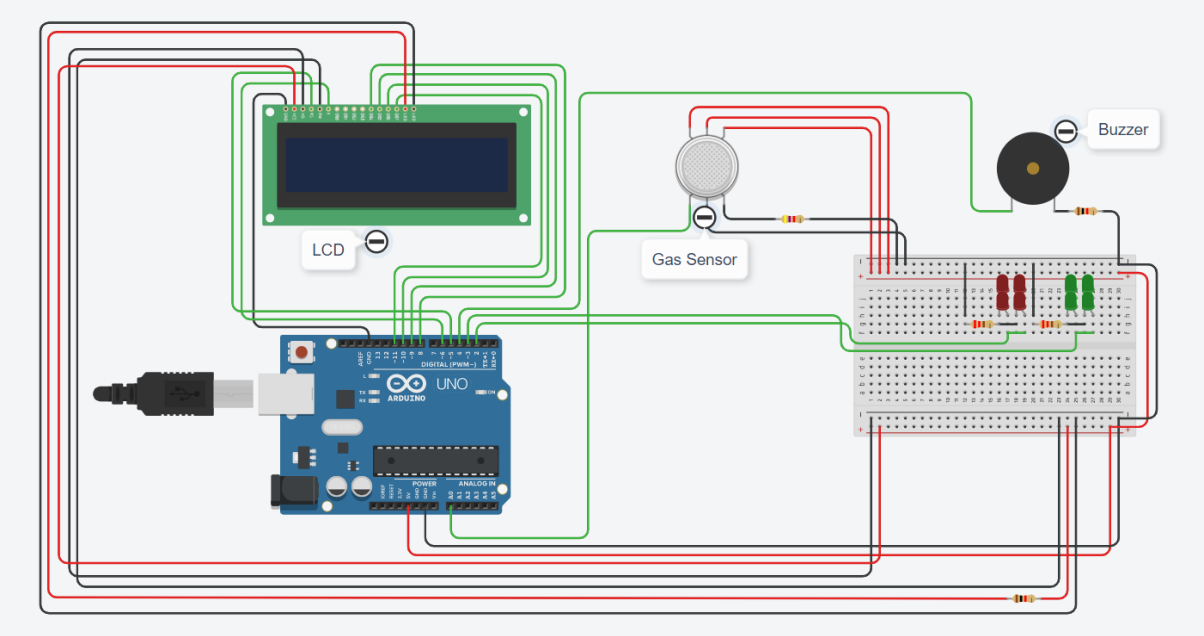


4.2.1 Working

As shown in the schematic diagram above, it contains Arduino board, LPG GAS Sensor Module, buzzer and 16x2 LCD module. Arduino controls the whole process of this system like reading LPG Gas sensor module output, sending message to LCD and activating buzzer. We can set sensitivity of this sensor module by inbuilt potentiometer placed on it. LPG gas sensor module's DO pin is directly connected to pin 18 (A4) of Arduino and Vcc and GND are connected to Vcc and GND of arduino. LPG gas sensor module consist a MQ3 sensor which detects LPG gas. This MQ3 sensor has a heater inside which needs some heater supply to heat up and it may takes up to 15 minute to get ready for detecting LPG gas. And a comparator circuit is used for converting Analog output of MQ3 in digital. A 16x2 LCD is connected with arduino in 4-bit mode. Control pin RS, RW and En are directly connected to arduino pin 2, GND and 3. And data pin D0-D7 are connected to 4, 5, 6, 7 of arduino. A buzzer is connected with arduino pin number 13 through a NPN BC547 transistor having a 1 k resistor at its base

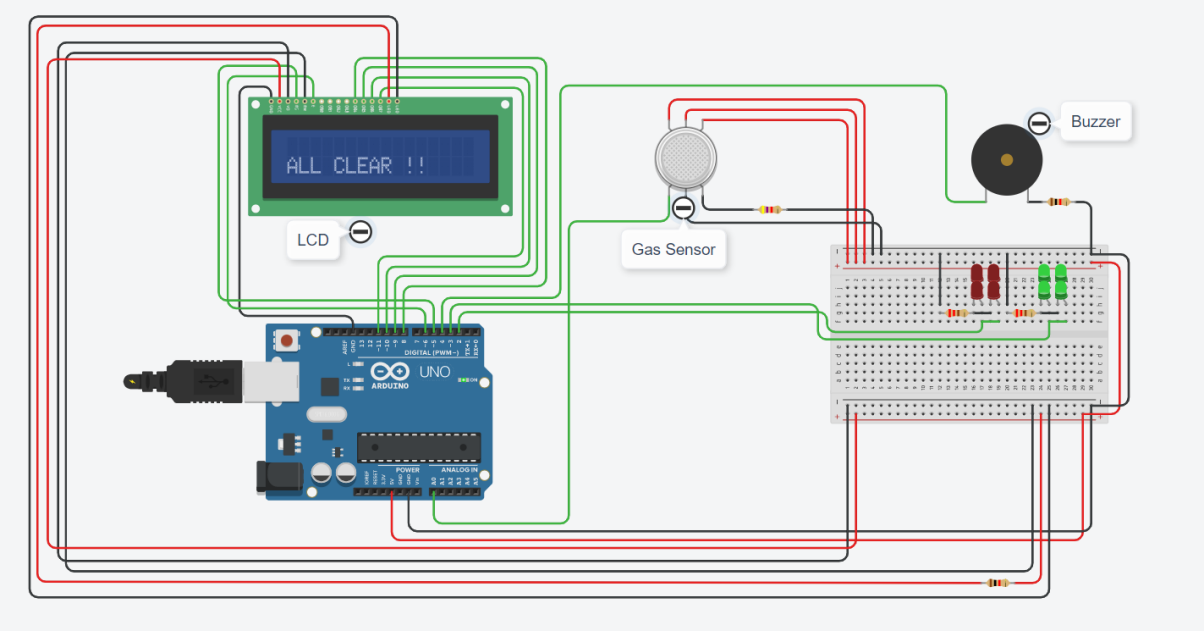
4.3System Architecture

- The gas sensor (B1 pin) is connected to A0 pin of Arduino.
- The +ve of the piezo buzzer is connected to D4 of the Arduino.
- The enable pin of LCD is connected to D6 of Arduino.
- The register select pin of LCD is connected to D5 of Arduino.
- The read /write and contrast pins of LCD are grounded.



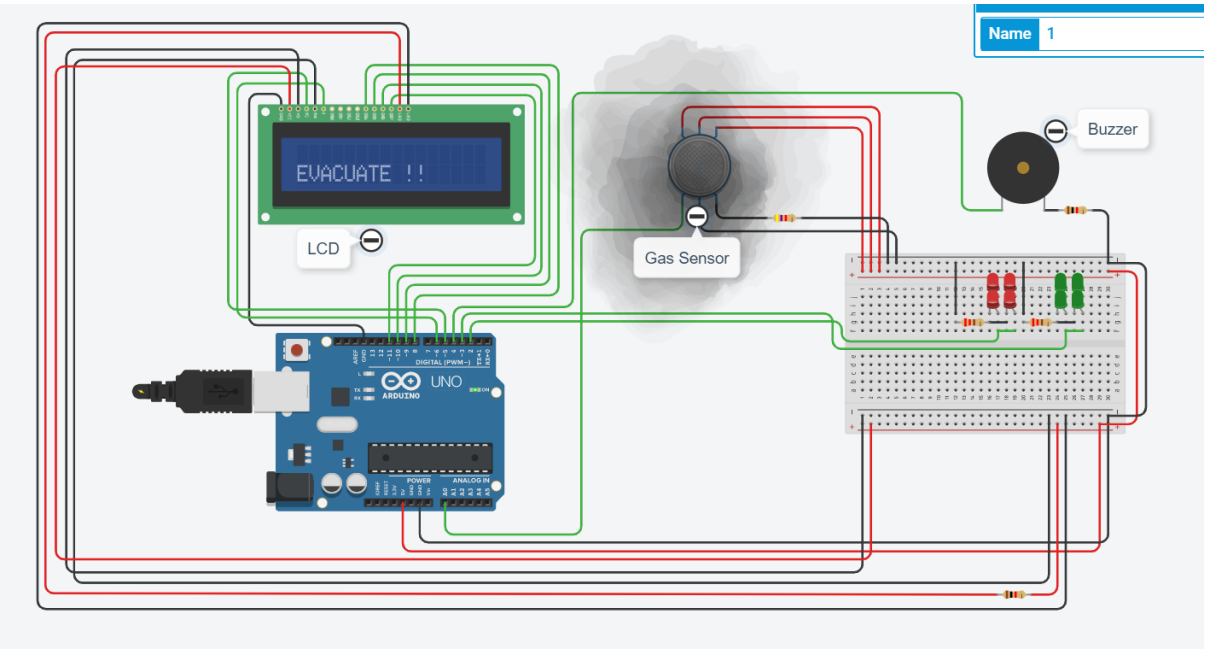
Scenario I:

In this scenario the gas has not leaked. Hence, the sensor doesn't detect any gas leakage. The buzzer does not buzz and the green LEDs are on indicating that there is no gas leakage. The LCD Panel shows "No gas leakage " and "All Clear !! ".



Scenario II :

In this scenario the gas has leaked. Hence, the sensor will detect the gas leakage. The buzzer will buzz and the red LEDs are on indicating that there is a gas leakage. The LCD Panel shows “Gas leakage ” and “Evacuate !!”.



5. Conclusion and Future Work

The above implemented system and its extensions can help successfully detect gas leakages, thus ensuring that the damage caused by the gas leakages can be minimized. Implementation of gas detection with the help of IOT has introduced newer and effective ways to tackle the problem of gas leakage and its detection.

This project can be advanced due to requirement of the consumer. Though this device targets domestic need, it is possible to make it advanced by using more sensors according to the industrial needs. As an advance modification this device may include several gas sensors such as carbon monoxide nitrogen dioxide etc. since those sensors do not consume much current comparing to LPG sensor.

This monitoring system can be further enhanced by using ESP8266 WiFi module to send the data collected from gas sensor and temperature sensor to the nearest fire fighting station via alert messages.

Addition of load cell can also be used as pressure sensor which detects the amount of gas in the cylinder and also detects high pressure gas in cylinder pipe, displaying the alert messages via SMS and LCD displays.

6. References

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[6] https://github.com/asmita-varma/GasLeakage