# Project Report Format

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| Team ID | PNT2022TMID16001 |
| Project Name | Project – Gas leakage monitoring and alerting system for industries |

1. **INTRODUCTION**

**1.1 Project Overview**

The advantage of this simple gas leak detector is its simplicity and its ability to warn about the leakage of the LPG gas. This system uses GSM technique to send alert massage to respective person if no one is there in the house and then gas leaks occurs, GSM module is there to send immediate messages to the respective person regarding the gas leak. The main advantage of this system is that it off the regulator knob of the cylinder automatically when gas leakage detected.

**1.2 Purpose**

The sensor enabled solution helps prevent the high risk of gas explosions and affecting any casualties within and outside the premises. The gas sensors help detect the concentration of the gases present in the atmosphere to avoid hazardous consequences like fire breakouts. Personal Gas Monitor - a device worn by a person that measures airborne gases and provides a warning when alarm levels of hazardous gases are reached. Portable Gas Monitor -is equipment used to test the condition of air prior to entering an area that could have a hazardous atmosphere.

2. **LITERATURE SURVEY**

**2.1 Existing problem**

The system provides constant monitoring and detection of gas leakage along with storage of data in database for predictions and analysis. The IOT components used helps in making the system much more cost effective in comparison with traditional Gas detector systems.

**2.2 References**

1.TITLE: Gas leakage detection and alerting system using Arduino Uno
AUTHORS: Syeda Bushra Shahewaz and Ch. Rajendra Prasad
YEAR: 2020

This system monitors the gas, smoke by sensor 1, sensor 2 and sensor 3. If any gas is detected the signal of sensors goes low and activate the Arduino UNO. Which send signals to the LCD (GAS DETECTED AT ZONE) Buzzer and GSM to alert the people about danger and if no gas is detected then LCD displays “NO GAS DETECTED” in its 16x2 display.

2.TITLE: IOT Based Industrial Plant Safety Gas Leakage Detection System
AUTHORS: Ravi Kishore Kodal, Greeshma, R.N.V, Kusuma Priya Nimmanapalli,Yatish Krishna Yogi Borra
YEAR: 2018

The change in analog resistance is converted to voltage through a signal conditioning circuit. This voltage is read by the micro-controller. The micro-controller measures this data and compares with threshold. If the measured concentration levels cross the safe levels, an SMS is sent to the concerned person through IFTTT. Buzzer gets on to alert the workers about the leakage and LEDs will be made to glow to specify the gas which is currently leaking.

3.TITLE: LPG Gas Leakage Detection and Alert System
AUTHORS: Jebamalar Leavline, Asir Antony Gnana Singh, Abinaya, H. Deepika
YEAR: 2017

The gas sensing layer of MQ-6 gas sensor is made of Tin Dioxide ($SnO_2$) and gold (Au) electrodes. The output of the gas sensor is given to LM358 dual operational amplifier where it is compared with the threshold value for gas density which is set using preset potentiometers and amplified. If the sensed voltage is greater than the preset threshold voltage, the operational amplifier output fires the driver circuit for LED and Buzzer. As a result, the LED will glow and the buzzer starts to produce alarm sound.

4.TITLE: Gas Detector Alarm System
AUTHORS: Falohun A.S., Oke A.O., and Abolaji B.M
YEAR: 2016

The intention to ensure that the event of gas is intelligently detected, promptly notified and interactively managed. It is built around a timer to accept input from the gas sensor, MQ-9, and activate a buzzer and set of led that alerts in the event ofgas. The sensor used is the MQ9 and from the datasheet, it specializes in gas detection equipment for carbon monoxide and $CH_4$, LPG family and any other relevant industry or car assemblage.

5. TITLE: Design and Development of Gas Leakage Monitoring System usingArduino and ZigBee
AUTHORS: Huan Hui Yan and Yusnita RahayuYEAR: 2014

The graph is used to display the gas concentration versus time in every minute and the sensor's voltage output waveform. Besides, there is voltmeter to show the voltage output from the gas sensor and the gas tank to indicate the concentration ofleakage gas. Furthermore, the STOP button is used to stop the whole system duringthe emergency period. On the other hand, the Visa resource panel is used toindicate the VISA configuration, and data transfer interfacing between the Zigbee and Lab VIEW, VISA configuration serial ports are required.

**Problem Statement Definition**

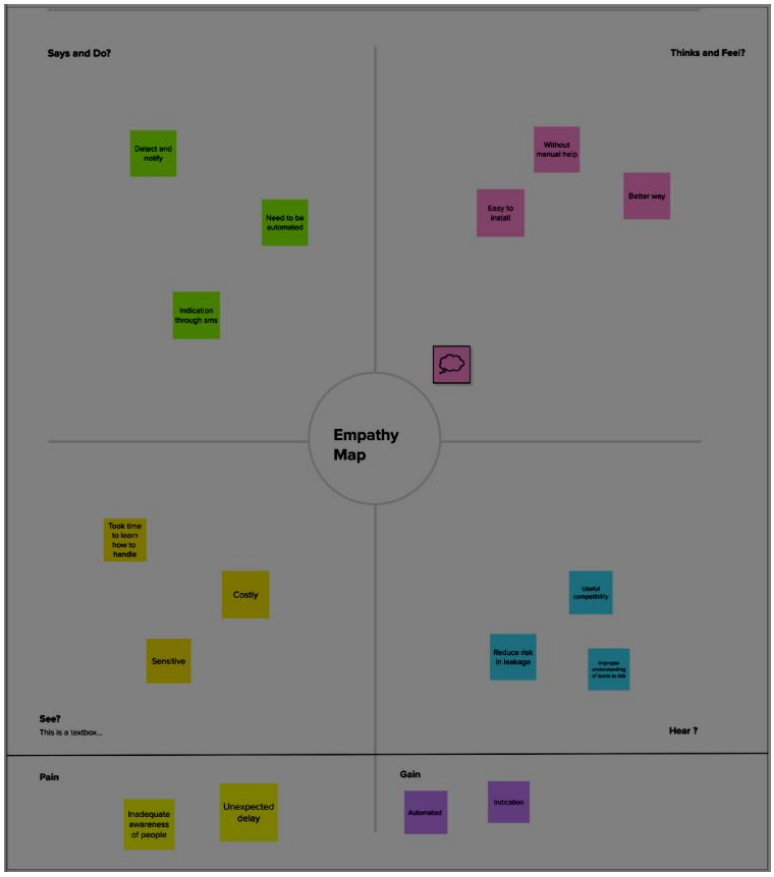
Liquid Petroleum Gas (LPG) is a highly flammable chemical that consists of mixture of propane and butane. LPG is used for cooking at home, restaurant, and certain use for industry. They have certain weaknesses that make the gas leakage occur. The leakage of gases only can be detected by human nearby and if there are no human nearby, it cannot be detected. But sometimes it cannot be detected by human that has a low sense of smell. Thus, this system will help to detect the presence of gas leakage. Furthermore, gas leakage can cause fire that will lead to serious injury or

death and it also can destroy human properties. This system was developed by using IoT to give real-time response to the user and the nearest fire station.

## 3. IDEATION & PROPOSED SOLUTION

### 3.1 Empathy Map Canvas

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviors and attitudes. It is a useful tool to helps teams better understand their users. Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.




### 3.2 Ideation & Brainstorming

There have been many incidents like explosions and fire due to LPG gas leakage. Such incidents can cause dangerous effects if the leakage is not detected at an early stage. Arduino and IOT based LPG leakage detection system is a project which will help in determining gas leakage in the surrounding and send data to an IOT module.

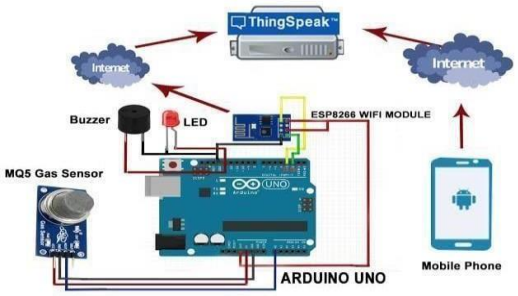
We can sense the leakage using gas sensor, when the leakage is detected location will be shared through application which is used to prevent from various dangers. Internet of Things (IoT) is the networking of 'things' by which physical things can communicate with the help of sensors, electronics, software, and connectivity. These systems do not require any human interaction and same is the case with IOT based gas detection system. It does not require human attention.

In the proposed system, the sensor which is used to sense many gases is MQ-2 sensor. After the detection of leakage in the gas, the sensor sends the signal to the Arduino UNO for the further process where other hardware components are connected to each other. Through Arduino UNO, it sends the signal to the LCD display for displaying the alert message as GAS Detected, accordingly, the buzzer be on so that the surrounding people will the alerted.

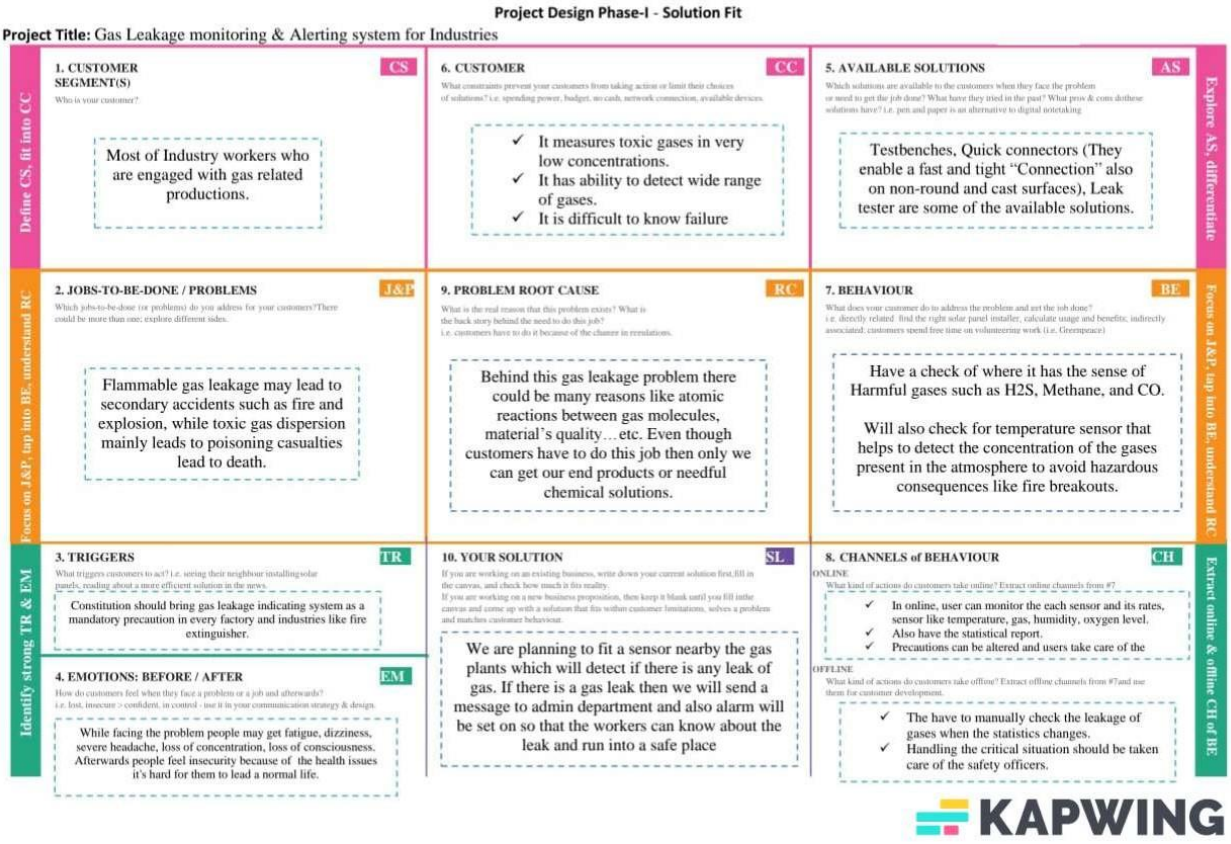
When the gas/air level in a room exceeds 50, the detection system's buzzer and servo motor will be activated. With the use of the IFTTT (If That Then This) services, user will receive the message via Node MCU

### 3.3 Proposed Solution

| S.No. | Parameter | Description |
|---|---|---|
| 1. | Problem Statement (Problem to be solved) | To detect the gas leakage to alert the user through notification |
| 2. | Idea/Solution description | In order to have a control over such conditions we proposed system that uses sensors which is capable of detecting the gases such as LPG, CO2, CO and CH4. This system will not only able to detect the leakage of gas but also alerting through audible alarms. |
| 3. | Novelty/Uniqueness | • Ability to predict the hazardous situation<br>• Low cost |
| 4. | Social Impact/ Customer Satisfaction | • This model is vital for the society as there is lot of people unable to detect the gas leakage prior the fire accident.<br>• We have used the IoT technology to make a Gas Leakage Detector for society which having Smart Alerting techniques involving sending text message to the concerned authority and an ability performing data analytics on sensor readings. |

| | | |
|---|---|---|
| 5. | Business Model(Revenue Model) |  |
| 6. | Scalability of the Solution | Develop a proposed system which include some safety factors. |

### 3.4 Problem Solution fit



## 4. REQUIREMENT ANALYSIS

### 4.1 Functional requirement

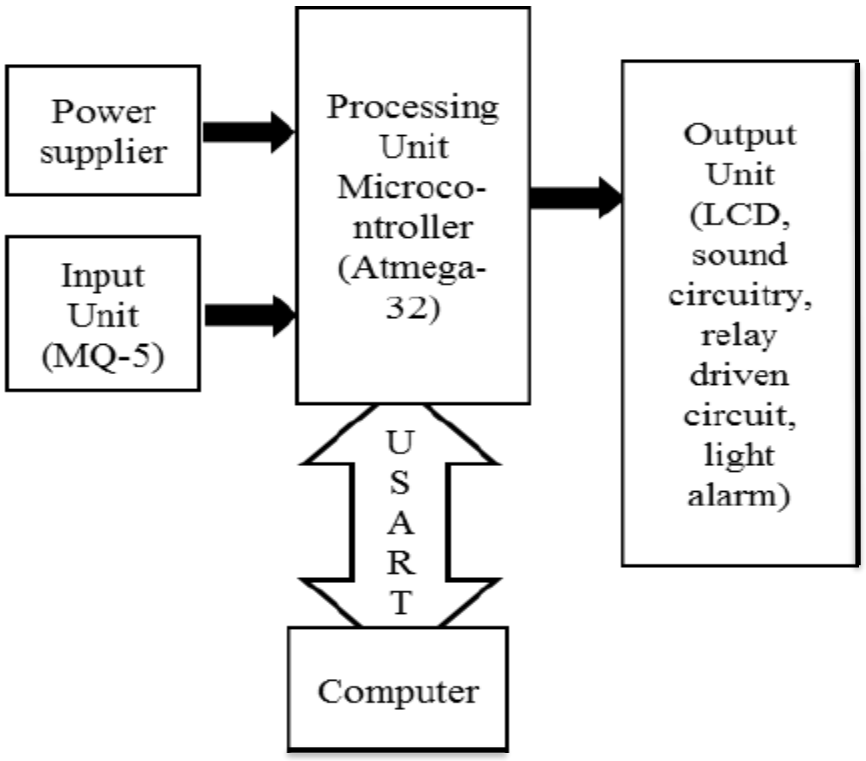
| Business Requirements | User Requirements | Product Requirements |
|---|---|---|
| The said system can be deployed in homes, hotels, factory units, LPG cylinder storage areas, and soon. The main advantage of this IoT and Arduino-based application is that it can determine the leakage and send the data over to a site. It can be monitored, and preventive measures can be taken to avoid any disaster. | The gas leakage detection system can be optimized for detecting toxic gasses along with upgrading them with smoke and fire detectors to identify the presence of smoke and fire. Ensuring worker safety is important but making using of the right technology is even more vital. | Detecting gasses is necessary regardless of your business role or individual purpose. Certain technologies at play make such IoT devices what they are, and if you want to indulge in IoT application development, you must know what they are and what purpose they can fulfill. |

### 4.2 Non-Functional requirement

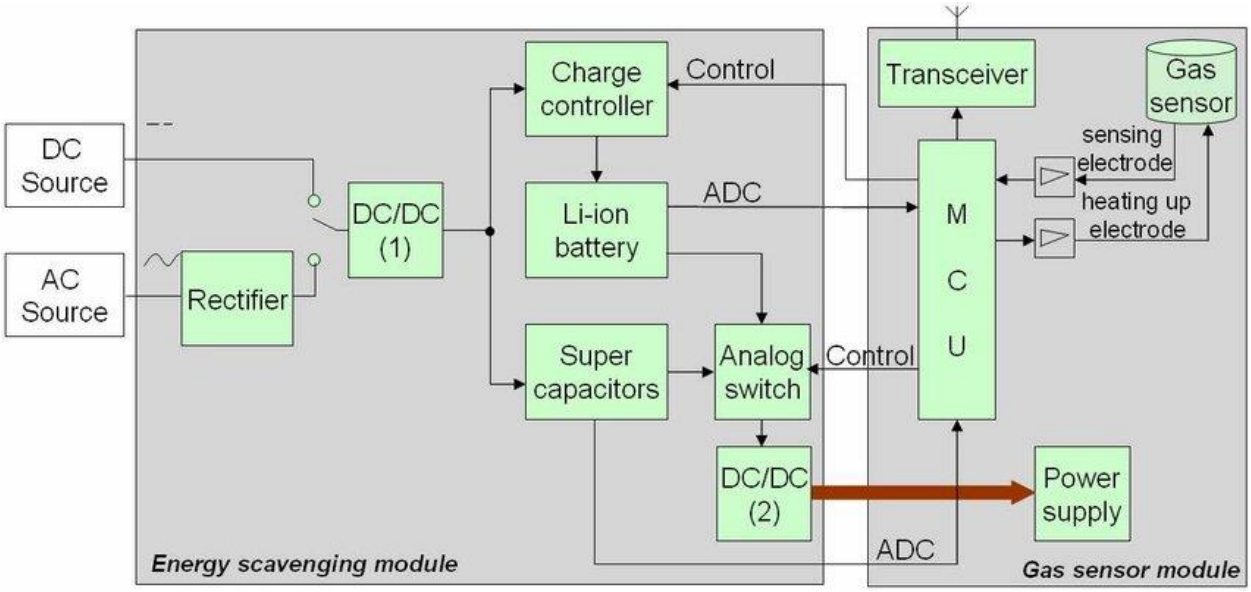
| FR No. | Non-Functional Requirement | Description |
|---|---|---|
| NFR-1 | **Usability** | System design should be easily understood and user friendly to users. Furthermore, Senior citizen users of all skill levels should be able to access or use it without any problems |
| NFR-2 | **Security** | The system should automatically be able to authenticate all users with their unique username and password. |
| NFR-3 | **Reliability** | The database is maintained as per the health of the user and have a backup storage of it. |
| NFR-4 | **Performance** | Should reduce the delay in information when hundreds of requests are given. The required pills will be provided within specified instance of time. |
| NFR-5 | **Availability** | Information is restricted to each users limited access Personal Data like Medical Records are maintained with Authentication and Authorization. |
| NFR-6 | **Scalability** | The system should be capable of handling 100 users accessing the site at the same time. |

## 5. PROJECT DESIGN

### 5.1 Data Flow Diagrams




### 5.2 Solution & Technical Architecture



## 6. PROJECT PLANNING & SCHEDULING

### 6.1 Sprint Planning & Estimation

Sprint planning is an event in scrum that kicks off the sprint. The purpose of sprint planning is to define what can be delivered in the sprint and how that work will be achieved. Sprint planning is done in collaboration with the whole scrum team. In scrum, the sprint is a set period of time where all the work is done. However, before you can leap into action you have to set up the sprint. You need to decide on how long the time box is going to be, the sprint goal, and where you're going to start. The sprint planning session kicks off the sprint by setting the agenda and focus. If done correctly, it also creates an environment where the team is motivated, challenged, and can be successful. Bad sprint plans can derail the team by setting unrealistic expectations.

### 6.2 Sprint Delivery Schedule

The main event during agile methodology is the sprint, the stage where ideas turn into innovation and valuable products come to life. On one hand, agile sprints can be highly effective and collaborative. At the same time, they can be chaotic and inefficient if they lack proper planning and guidance. And for this reason, making a sprint schedule is one of the most important things you can do to ensure that your efforts are successful. If you're looking to schedule your next sprint, you've come to the right place. Keep reading to learn everything you need to know about sprint scheduling, including some tips to drive the best results.

### 6.3 Reports from JIRA

One part of ensuring the success and smooth operations of your projects in JIRA is reporting. It involves gaining the knowledge about the health, progress and overall status of your JIRA projects through Gadgets, report pages or even third-party applications. The goal of this guide is to provide an overview of the tools available to JIRA users today and how they can be used to fulfill the different types of reporting needs that users face today. JIRA offers reporting in a number of different formats. Project reports that are available from the home screen of the selected project, Gadgets that can be added and arranged in Dashboards and for each filter, the issue navigator offers various output formats that can be used in third party reporting software.

## 7. CODING & SOLUTIONING (Explain the features added in the project along with code)

### 7.1 Feature 1

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random



#Provide your IBM Watson Device Credentials
organization = "pi0ywk"
deviceType = "Gas_Leakage_Detector"
deviceId = "Kayal107"
authMethod = "token"
authToken = "87654321"
# Initialize GPIO
def myCommandCallback(cmd):
   print("Command received: %s" % cmd.data['command'])
   status=cmd.data['command']
   if status == "alarmon":
      print ("Alarm is on please all Evacuate Fans On")
   elif status == "alarmoff":
      print ("Alarm is off and Fans Off")
   elif status == "sprinkleron":
      print ("Sprinkler is On Evacuate Faster")
   elif status == "sprinkleroff":
```

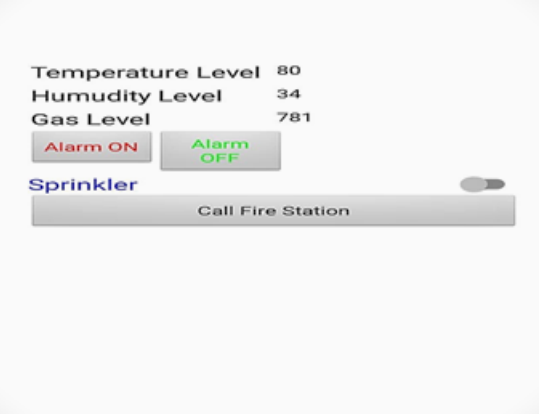
```
        print("Sprinkler is Off")
    else:
        print("Please send proper command")
    #print(cmd)
        try:
            deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method": authMethod, "auth-token": authToken}
            deviceCli = ibmiotf.device.Client(deviceOptions)
            #.....
        except Exception as e:
            print("Caught exception connecting device: %s" % str(e))
            sys.exit()
        # Connect and send a datapoint "hello" with value "world" into the cloud as an event of type "greeting" 10 times
        deviceCli.connect()
        while True:
            #Get Sensor Data from random function
            temp=random.randint(0,120)
            Humid=random.randint(0,100)
            gas=random.randint(0,1500)
            data={'temp':temp,'Humid':Humid,'gas':gas}
            #print data
            def myOnPublishCallback():
              print (" Published Temperature = %s C" % temp, "Humidity = %s %%" % Humid, "Gas_Level = %s ppm" %gas, "to IBM Watson")
            success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0, on_publish=myOnPublishCallback)
            if not success:
```

```
    print("\n Not connected to IoTF")
  if temp>60 :
    print("\n Fire Detected due to gas Leak ! Alarm ON! Sprinkler ON! Call The Fire Police \n")
  elif gas>350:
    print("\n Gas is Leaking \n")

  time.sleep(10)
  deviceCli.commandCallback = myCommandCallback
deviceCli.disconnect()
```

### 7.2 Feature 2

We have developed the application in MIT app inventor which can monitor the temperature, humidity and gas leakage. It also has the features like sprinklers and alarm which will indicate. If the situation is uncontrollable, we can call the fire station through the Call fire Station button.




## 8. TESTING

### 8.1 Test Cases

All Passed

### 8.2 User Acceptance Testing

The preferred and primary method for leak detection is a direct reading instrument with a sensor that uses thermal conductivity different from that of the ambient air for detection, such as the Matheson Leak Hunter Plus Model 8066 or its equivalent. This type of detector is highly sensitive and can locate leaks too small to bubble quickly with a liquid solution leak detector. Gases and vapors with thermal conductivity different from air can be detected with this method.

An alternate method, if the primary method cannot be used, is liquid solution leak detection such as the Matheson Detect-A-Leak™ or equivalent that meets or exceeds MIL-L-25567D Type I and II specifications.

## 9. RESULTS

### Performance Metrics

Below image represents the result of node red dash board


The next Image below here represents the output of MIT-inventer :

## 10. ADVANTAGES & DISADVANTAGES

Advantages -sensor-enabled solution helps prevent the high risk of gas explosions and affecting any casualties within and outside the premises. The gas sensors help detect the concentration of the gases present in the atmosphere to avoid hazardous consequences like fire breakouts.

Disadvantages -disadvantages are that it cannot measure the energy of the radiation (no spectrographic information), it will not measure high radiation rates due to dead time and sustained high radiation levels will degrade fill gas.

## 11. CONCLUSION

When designing a combustible gas safety monitoring system for oil and gas petrochemical or other application, a thorough analysis of application's unique field environments needed to ensure optimal performance, safety, reliability and cost-effectiveness. A quick decision, of course, can lead to poor detector choices as well as safety, performance, maintenance, and life-cycle cost consequences. As student is doing continuous research on infrared technologies and its application, she believes that gas detection method using infrared is one of reliable method to be used as a precaution to danger that can be caused by gas leakage. The implementation of automated safety systems such as shutdown valve and alarm system will enhance the effectiveness of this method to users. The integrated infrared circuit has been constructed and tested until this period of time. Future works that has to be done in this project is to fabricate the gas chamber as well as combining the alarm circuit into the integrated infrared circuit. The analysis to measure the reliability of the infrared circuit also has to be improvised so that this gas detector become immune to any extern.

## 12. FUTURE SCOPE

The proposed gas leakage detector is promising in the field of safety. The attempt while making this prototype has been to bring a revolution in the field of safety against the leakage of harmful and toxic gases to minimize and hence nullify any major or minor hazard being causeddue to them. Nevertheless there is always scope of improvement and some of the features thatwill improve the system and make it even better and reliable have been mentioned below:

A.Extended Features of System

The behavior of the gases is dependent on the temperature and humidity of the air around. A gas at certain concentration might not be flammable at low temperature but might have explosive nature at high temperature. For this reason, addition of a Temperature and Humidity Sensor will be very helpful.

B. Performing Big Data Analytics on the sensor readings

Analytics could be performed on the sensor readings. The readings from sensors could be used for forming predictions of situations where there can be a mishap. Instead of straightaway alarming when the concentrations have gone high, algorithms could be worked upon which could determine such situations prior to their occurrence. Combining the gas sensor readings with the readings from temperature and humidity sensor would increase the precision of the system. The cases of false alarms being raised will reduce down to very small percentages.

C. Dedicated Application for System

A dedicated mobile application could be made for the system. The features of the application would

be:

1.Getting the details of the concentration levels of the house within a tap of a button.
2.Since it is a safety device it is important for it to be perfectly calibrated and maintained at alltimes. The app can make sure to send reminders about getting the system checked every oncein a while.
3.The user can add or remove the recipients who will receive the information of leakage whenever they require

## 13. APPENDIX

### Source Code

```
import time

import sys

import ibmiotf.application

import ibmiotf.device

import random

#Provide your IBM Watson Device Credentials

organization = "pi0ywk"

deviceType = "Gas_Leakage_Detector"

deviceId = "Kayal107"

authMethod = "token"

authToken = "87654321"

# Initialize GPIO

def myCommandCallback(cmd):

   print("Command received: %s" % cmd.data['command'])

   status=cmd.data['command']

   if status == "alarmon":

      print ("Alarm is on please all Evacuate Fans On")

   elif status == "alarmoff":

      print ("Alarm is off and Fans Off")

   elif status == "sprinkleron":
```

```
        print ("Sprinkler is On Evacuate Faster")
    elif status == "sprinkleroff":
        print("Sprinkler is Off")
    else:
        print("Please send proper command")
    #print(cmd)
        try:
            deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method": authMethod, "auth-token": authToken}
            deviceCli = ibmiotf.device.Client(deviceOptions)
            #.....
        except Exception as e:
            print("Caught exception connecting device: %s" % str(e))
            sys.exit()
        # Connect and send a datapoint "hello" with value "world" into the cloud as an event of type "greeting" 10 times
        deviceCli.connect()
        while True:
            #Get Sensor Data from random function
            temp=random.randint(0,120)
            Humid=random.randint(0,100)
            gas=random.randint(0,1500)
            data={'temp':temp,'Humid':Humid,'gas':gas}
            #print data
            def myOnPublishCallback():
              print (" Published Temperature = %s C" % temp, "Humidity = %s %%" % Humid, "Gas_Level = %s ppm" %gas, "to IBM Watson")
```

```
        success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)

        if not success:

           print("\n Not connected to IoTF")

        if temp>60 :

           print("\n Fire Detected due to gas Leak ! Alarm ON! Sprinkler ON! Call The Fire Police \n")

        elif gas>350:

           print("\n Gas is Leaking \n")

        time.sleep(10)

        deviceCli.commandCallback = myCommandCallback

    deviceCli.disconnect()
```

**GitHub Link**

https://github.com/IBM-EPBL/IBM-Project-14410-1659585243

**Project Demo Link**

https://drive.google.com/file/d/1y52BSsrgfBH7wJvDoEMtaa2vJE0IJv3n/view?usp=share_link