Team ID	PNT2022TMID53629
Project Name	Gas Leakage Monitoring and Alerting System for Industries
Team Members	Kathirvel R Pon Sai Raam V Ragul T Rajesh Kumar R

1. INTRODUCTION

Safety plays a major role in today's world and it is necessary that good safety systems are to be implemented in places of education and work. This work modifies the existing safety model installed in industries and this system also be used in homes and business premises. One of the preventive measures to avoid the danger associated with gas leakage is to install a gas leakage detector at vulnerable locations. A gas detector is a device that detects the presence of gases in an area, often as part of a safety system. Gas Detector where it can sound an alarm to operators in the area where the leak is occurring, giving them the opportunity to fix or leave. This type of device is important because there are many gases that can be harmful to organic life, such as humans or animals. Containment into any area where the gas should not be present must be avoided. Because a small leak may gradually build up an explosive concentration of gas, leaks are very dangerous. Nowadays, existing gas detector is less effective in usage because the user can only detect the gas leakage when they test by using gas detector. It is dangerous since gas leakage must be identified from early of the leak. That is why the Gas Leakage Detector with Notifier System was invented to avoid the fire or explosion occur in the houses or premises. This kind of gas detector will detect the gas continuously as long as there is power supply.

1.1 PROJECT OVERVIEW

The main purpose of this project is to achieve a successful working prototype that is capable to detect the presence of gas leakage. The device should also perform automatic response with the implementation of an alarm system. The essential part of this project is to detect the occurrence of leakage and this is done by comparing the intensity difference of the infrared radiation. Once this condition is true, this will lead to the alarm triggering. Further research is especially done to comprehend in some infrared radiation detector knowledge, Harmful Gas characteristics, alarm and relay circuits. As a conclusion, this project has given the opportunity for students to integrate theories into solving the problems related with the engineering scope of work.

1.2 PURPOSE

In most industries, one of the key parts of any safety plan for reducing risks to personnel and plant is the use of early-warning devices such as gas detectors. These can help to provide more time in which to take remedial or protective action. They can also be used as part of a total, integrated monitoring and safety system for an industrial plant. Rapid expansion of oil and gas industry leads to gas leakage incidents which are very serious and dangerous. Solutions need to be find out at least to minimize the effects of these incidents since gas leaks also produce a significant financial loss. The challenges are not only to design a prototype of the device that can only detect but also automatically respond to it whenever the leakage occurs.

2 LITERATURE SURVEY

In this chapter will provide a review about the previous research and existing project that has been made by using reference sources and guidelines as journals, internet, article writing, blog and scientific studies to get an idea about the project design, conception and any information that related to improve the project. With a differences concept and design, there are other creation and innovation of projects done by the other people. The research that is related to this project also covered in this chapter.

2.1 EXISTING GAS DETECTOR ISSUES

Faulty gas detection instruments can be fatal. There are many factors in the workplace that can cause a gas detector to fail. Here are the issues:

1. Environmental

Dirt, dust and water impact. These physical affects can block gases and vapours from entering the sensor chamber preventing detection of the gases. This can be either within the sensor area, sampling pump or sample lines.

2. Physical Affects

Dropping and other abuse can damage the instrument from working properly or at the least change the ability of the detector from measuring accurately.

3. Gas Exposure

High gas exposure will change the calibration curve of the sensors causing false or inaccurate readings. Extremely high concentrations can kill the sensor's ability to measure gas. Further, many sensors can fail but not provide a warning that they have failed. In fact,

many provide a zero (0) indication on the meter reading which suggests they are working correctly when they are not.

4. Temperature Affect

Storing instruments in environment which is either too cold or too hot can affect the ability of the sensors to measure accurately.

5. Moisture

Moisture condensing on or in sensor: this can happen to oxygen sensors when moisture condenses in the capillary tube in the sensor. It will cause the sensor to fail.

6. Calibration Drift

All sensors from all manufacturers drift over time. Calibration brings the sensor back into equilibrium and provides accurate readings.

2.2 REFERENCES

Gas detectors measure and indicate the concentration of certain gases in an air via different technologies. Typically employed to prevent toxic exposure and fire, gas detectors are often battery operated devices used for safety purposes. They are manufactured as portable or stationary (fixed) units and work by signifying high levels of gases through a series of audible or visible indicators, such as alarms, lights or a combination of signals.

While many of the older, standard gas detector units were originally fabricated to detect one gas, modern multifunctional or multi-gas devices are capable of detecting several gases at once. Some detectors may be utilized as individual units to monitor small workspace areas, or units can be combined or linked together to create a protection system.

1. Denis Spirjakin .A. M. B, “Internet connected wireless combustible gas monitoring system for apartment buildings,” Proceedings of the Conference on Computer Science and Information Systems, Vol. 11, 2018.

2. Gupta .A, “LPG leakage detector and auto shut-off system using Arduino UNO ATmega328,” International Journal of Innovative Research in Science, Engineering and Technology, Vol. 6, 2017. 10.

3. Jolhe. N. S. G. B. D. and Potdukhe P.A, “Automatic LPG booking, leakage detection and real time gas measurement monitoring system,” International Journal of Engineering Research & Technology (IJERT), vol. 2, April-2013.

4. Kasar M.S, Rupali Dhaygude, Snehal Godse and Sneha Gurgule,” Automatic LPG Gas Booking and Detection System”, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, ISSN 2278-8875, Vol. 5, Issue 3, pp. 1250-1253, March 2016.

5. Naresh Nuke .S. K. K. T. K. R. R, Siva Nagendra Reddy .P, “Arduino based LPG gas monitoring, automatic cylinder booking with alert system,” IOSR Journal of Electronics and Communication Engineering (IOSR-JECE), Vol. 11, 2016. 8.

6. Pruthvi M.R, “Centralized LPG cylinders theft detection system with security alerts,” 12. International Journal of Computer Science and Information Technology Research 8, vol. 4, 2016.

7. Sivajothi Kavitha .S and Senthilkumar .S, "A Wireless Gas Leakage & Level Detection with Auto Renewal System ".

1. **Portable Multi Gas Detector (XA-4400II)**

It is a multi-gas detector which can monitor combustible or flammable gases including LPG and methane, hydrogen sulphide/sulfide, carbon monoxide, and oxygen. This comes with an attachable pump.

2. **Super Sensitive Portable Gas Leak Detector (XP-702III Series)**

These portable gas detectors are highly sensitive, making them an effective tool when it comes to locating trace gas leaks in a rather shorter time and offer a remarkably more sensitive solution to any leak detection liquid. This is equipped with a built in gas sampling pump, and depending on the specific model you choose, these detectors are available in both dual and single gas applications. The types of gas these can monitor include combustible or flammable gases and refrigerant gases or CFC.

SUMMARY

In this chapter, it is an explanation on how literature reviews were done and the reasons why this project has been selected. There are many of case study stated and related to our project regarding to improve gas detector. Since existing gas detectors are expose to contaminants such as dirt and dust, the gas sensor will work less efficient.

The existing gas detectors are not protected compare to our project. The risk of broken down possibly occur if the gas detector expose to high temperature or humid air for too long. These factors will cause the sensor fails to operate well. Therefore, in chapter 3 there

will be explanations of the methodology of project on how the project are made and assembles.

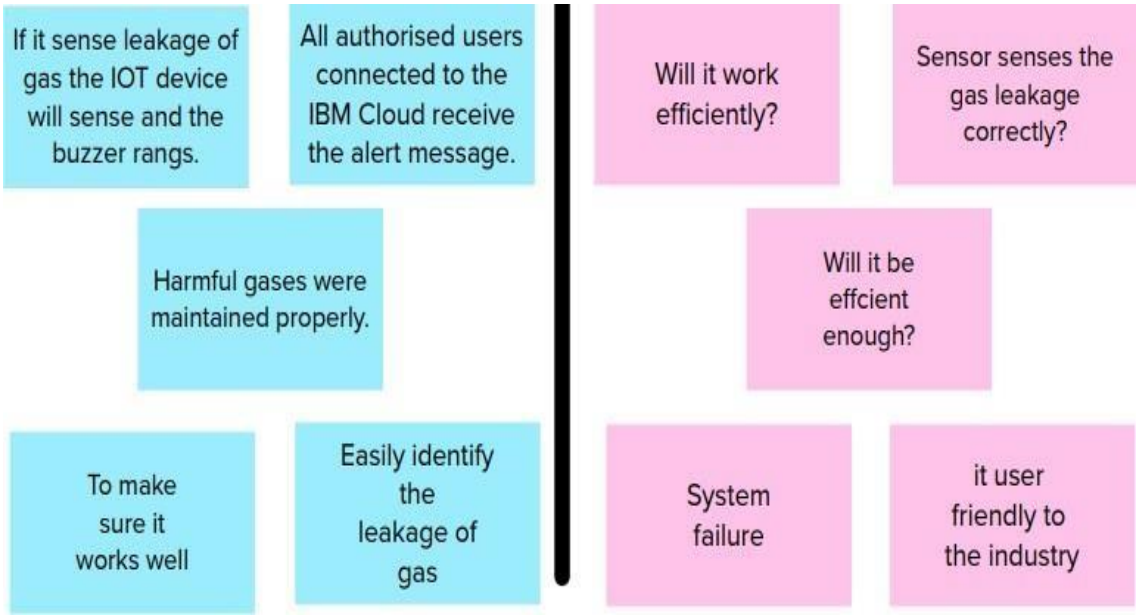
2.3 PROBLEM STATEMENT DEFINITION

Gas Leakage Detector with Notifier System is the innovation from existing Gas Detector communicate with the user by sending an alert through SMS. This kind of gas detector is more efficient as the user will get the information faster and the detection of gas is continuous.

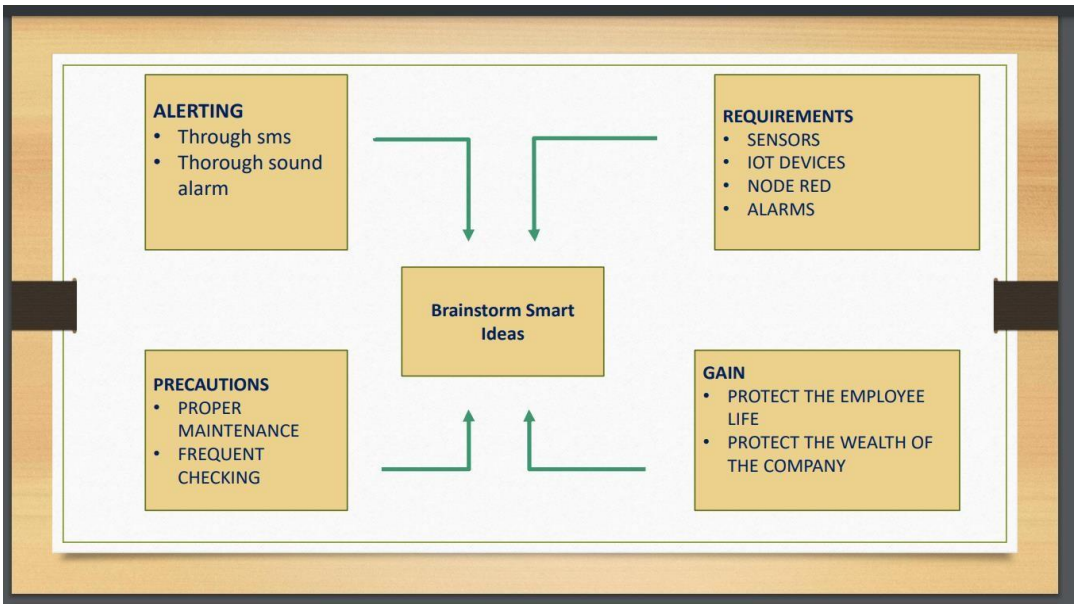
In our system we are implemented a module to overcome these issues faced by the society LOBO is a system which is incorporated with gas sensor to sense the gas outflow. If the sensor senses the gas outflow level and compare this with the threshold value which is already set in the software. If it exceeds the fixed threshold value means buzzer gets activated and relay which is connected to the circuit also switched on. Then the total power supply will be dripped off.

3. IDEATION & PROPOSED SOLUTION

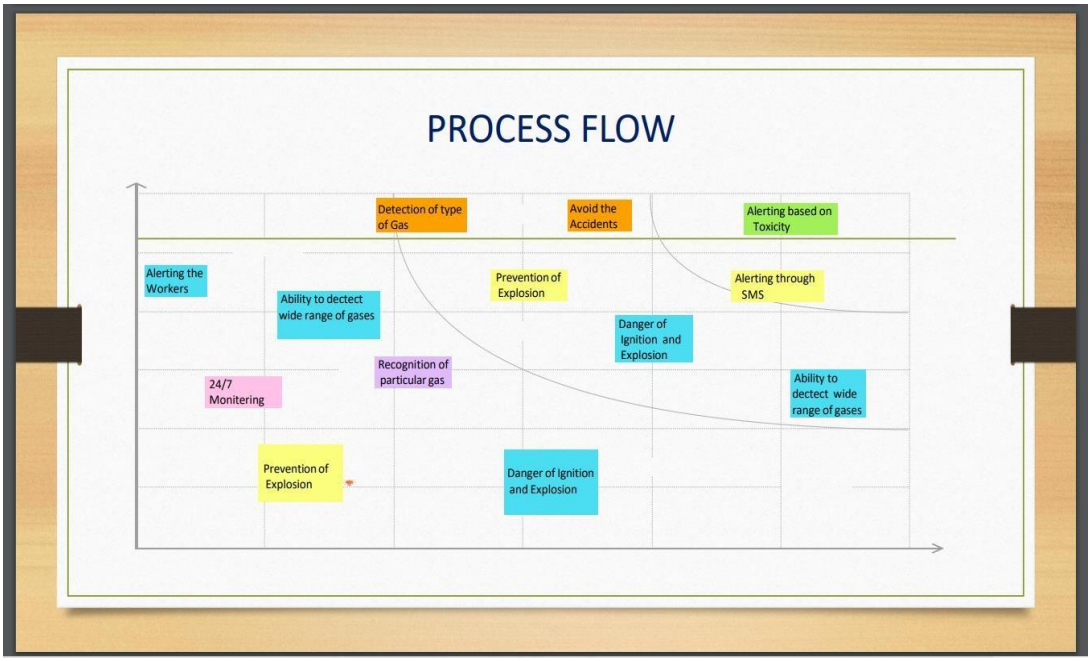
3.1 Empathy Map Canvas



3.2 IDEATION AND BRAINSTORMING



PROCESS FLOW DIAGRAM



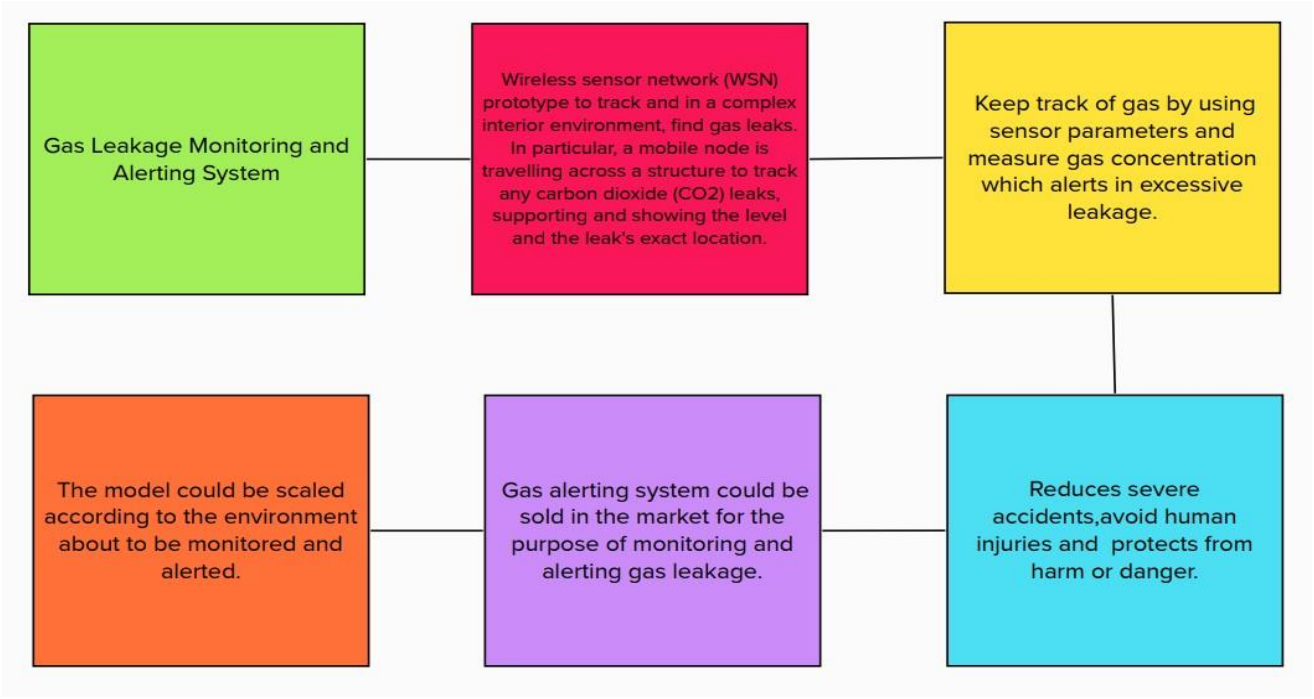
3.3 PROPOSED SOLUTION

In our system able to measure the usage of the gas per day by continuous measurement of the weight can be done using load cell. The same is displayed in the LCD, by using gas leakage sensor the leakage of the gas is sensed, it alerts the user through buzzer and also shut down the total power supply.

The following are the components used in this system

Components:

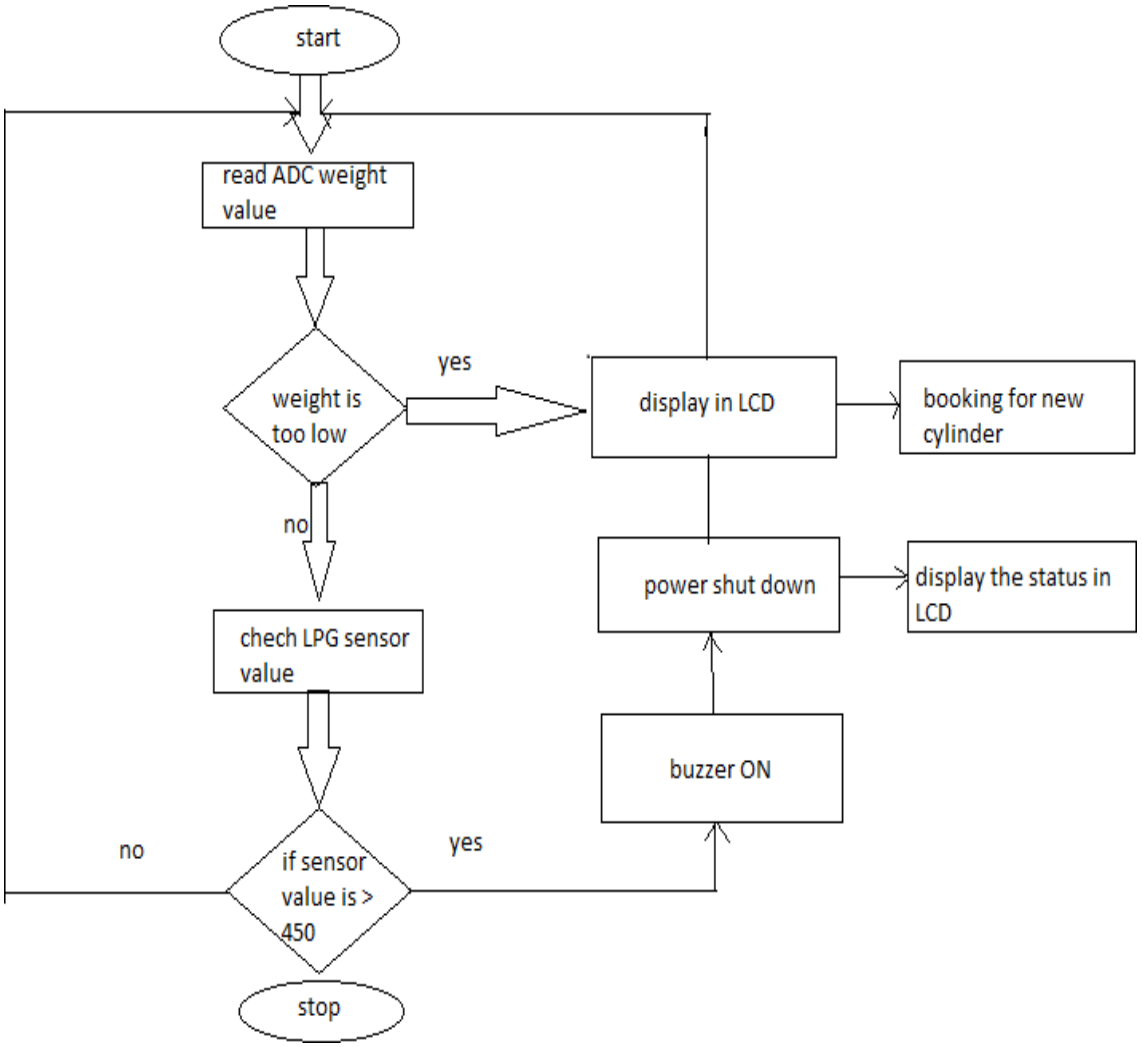
Microcontroller: A microcontroller (MCU for microcontroller unit, or UC for μ-controller) may be a tiny laptop on one microcircuit. It is a compact microcircuit designed to control a selected operation in associate embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on one chip. It contains one or a lot of CPUs (processor cores) beside memory and programmable input/output peripherals. Program memory within the type of ferroelectric RAM is additionally typically enclosed on chip, furthermore as a tiny low quantity of RAM.



Load cell: A load cell is a transducer that is used to convert a force into electrical signal. This conversion is indirect and happens in two stages. Through a mechanical arrangement, the force being sensed deforms a strain gauge. The strain gauge measures the deformation (strain) as an electrical signal, because the strain changes the effective electrical resistance of the wire.

Power supply:

Power supply is a device that converts one voltage to another more convenient voltage while delivering power. Power supplies are designed from the output back to the input.



Flow Diagram

In our system we are implemented a module to overcome these issues faced by the society LOBO is a system which is incorporated with gas sensor to sense the gas outflow. If the sensor senses the gas outflow level and compare this with the threshold value which is already set in the software.

If it exceeds the fixed threshold value means buzzer gets activated and relay which is connected to the circuit also switched on. Then the total power supply will be shut down. Now a day the peoples are unaware of the usage of the gas per day it leads to be delay in refilling the LPG cylinder. Our LOBO has one more module to overcome this kindof difficulties.

Load sensor is used to continuously monitoring the level of the gas; Output of the load cell is connected to the microcontroller.

Microcontroller manipulates that data weight of the gas cylinder, level of the gas leakage, usage the gas per day are displayed in LCD. If the level of the gas cylinder gets critically low the new cylinder is booked automatically and the status is uploaded to the userthrough the Wi-Fi module.

Some of the advantages are:

- This paper deal with the concept of monitoring a gas cylinder.
- Here the consumption level is continuously monitored.
- It also detects gas leakage and shuts down the power.

In our LOBO system there are two important modules are there they are

- Gas outflow detection with brownout
- Gas level monitoring with automatic booking.

Modules:

Gas level monitoring with automatic booking:

- **Load cell:** It is a force transducer. It converts a force into an electrical signal that can be measured. As the force applied to the load cell increases, the electrical signal changes comparatively. The most common types of load cell used are strain gauges, pneumatic, and hydraulic.
- In our system able to measure the usage of the gas per day by continuous measurement of the weight it can be done using load cell. The load cell is connected to the microcontroller. The operations which are performed by themicrocontroller are send to the LCD. In LCD there are four major things are there. They are weight of the gas cylinder, usage of the gas per day, level of the gas leakage: The gas leakage level is exceed the fixed value means microcontroller send the signal to the buzzer and the buzzer get activated after that relay gets switched on and the total power supply will be shut down in a particular place, status of the gas cylinder: If the level of the gas is normal then it displayed the status as “normal”, If the level of the gas gets reduced it display the status as “reduced”, If the level of gas gets reduced to the critical level then it displays the status as “empty”. And also new cylinder is booked automatically through Wi-Fi module

Gas outflow detection with brownout:

- **Gas Sensor:** This detects the presence of gases in the environment. Based on the concentration of the gas the sensor produces a consequent potential difference by varying the resistance of the material inside the sensor, which can be measured as output voltage. Based on this voltage value the type and concentration of the gas can be predictable. The various types of gas sensors based on the sensing elements that are generally used in various applications:

Metal Oxide based gas Sensor, Optical gas Sensor, Electrochemical gas Sensor, Capacitance-based gas Sensor, Calorimetric gas Sensor, Acoustic based gas Sensor.

- In our LOBO system the gas sensor is used to detect the gas outflow from the cylinder. The gas sensor output is integrated with buzzer as well as relay. The sensor senses the gas outflow level and compares that with the threshold value

which is specified in the source code. If the out-flow level is high then the buzzer is switched on after that the relay also gets on. This works is needed to brownout the total power in a particular place.

- **LCD**: LCD includes some microwatts for show compared to some mill watts. Liquid crystal display could be a combination of 2 states of matter, the solid and therefore the liquid. Liquid is employed to provide a comprehensible image in liquid crystal display. The liquid crystal display works on the principle of obstruction lightweight. When compared to LED and cathode ray tube, LCD is thinner. Blocking light principle is used for the working of LCD. This is used to display the weight of the gasoline content.
- **Microcontroller:** A microcontroller (MCU for microcontroller unit or UC for µ-controller) may be a tiny laptop on one microcircuit. It's a compact microcircuit designed to control a selected operation in associate embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on one chip. It contains one or a lot of CPUs (processor cores) beside memory and programmable input/output peripherals. Program memory within the type of ferroelectric RAM is additionally typically enclosed on chip, furthermore as a tiny low quantity of RAM.

3.4 PROBLEM SOLUTION FIT

4. REQUIREMENT ANALYSIS

4.1 Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Detection of Leakage of Gases	Detection of gases through sensor. Detect how much amount of gas has leaked. Detect which gas has been leaked and what is the permissible level and has much has it crossed the level.
FR-2	Alerting the user.	Notification via EmailNotification via SMS
FR-3	Notification to the admin.	Notification via E-mail or SMS Notifying the exact location where the incident has occurred. Update the person with route to the location.
FR-4	Creation of web application	Update the website with location of place where leakage has happened. Update the level of leakage in the particular industry.

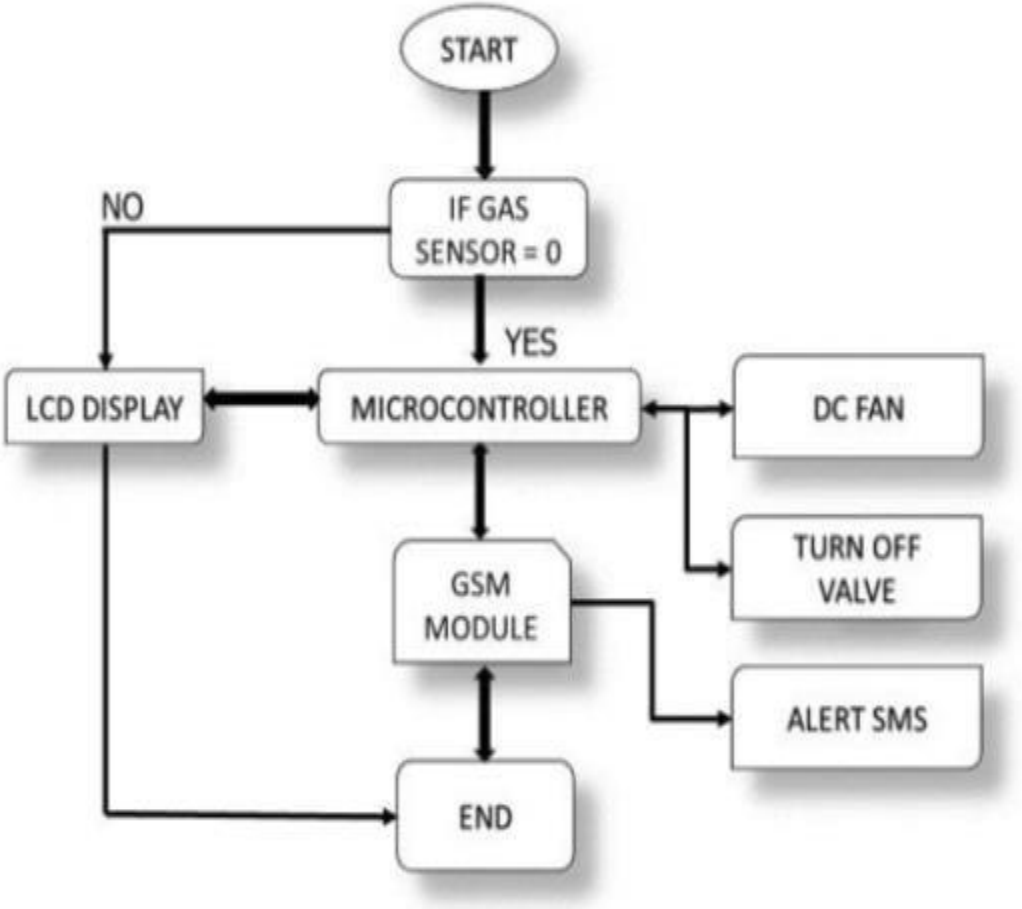
4.2 Non-Functional Requirements

Following are the non-functional requirements of the proposed solution.

NFR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The user who has basic knowledge in operating smart phones and internet. The user who knows about the harmfulness of gases.
NFR-2	**Security**	The web application should be accessed by users and admins only through protected login credentials.
NFR-3	**Reliability**	The user must be notified at the correct time so that damage can be prevented. The admin must be notified about the exact location along with the route.
NFR-4	**Performance**	The user and admin must be alerted through notification immediately within seconds to prevent damage.
NFR-5	**Availability**	Once the notification reaches the admin, he must check if some person is available so that he can be sent to the place where leakage has occurred. If not, he must atleast inform the user about how long it will take to reach them.
NFR-6	**Scalability**	There must be at least 20-30 people to address the problem immediately once notified. Leakage must be detected simultaneously at many places.

5. PROJECT DESIGN

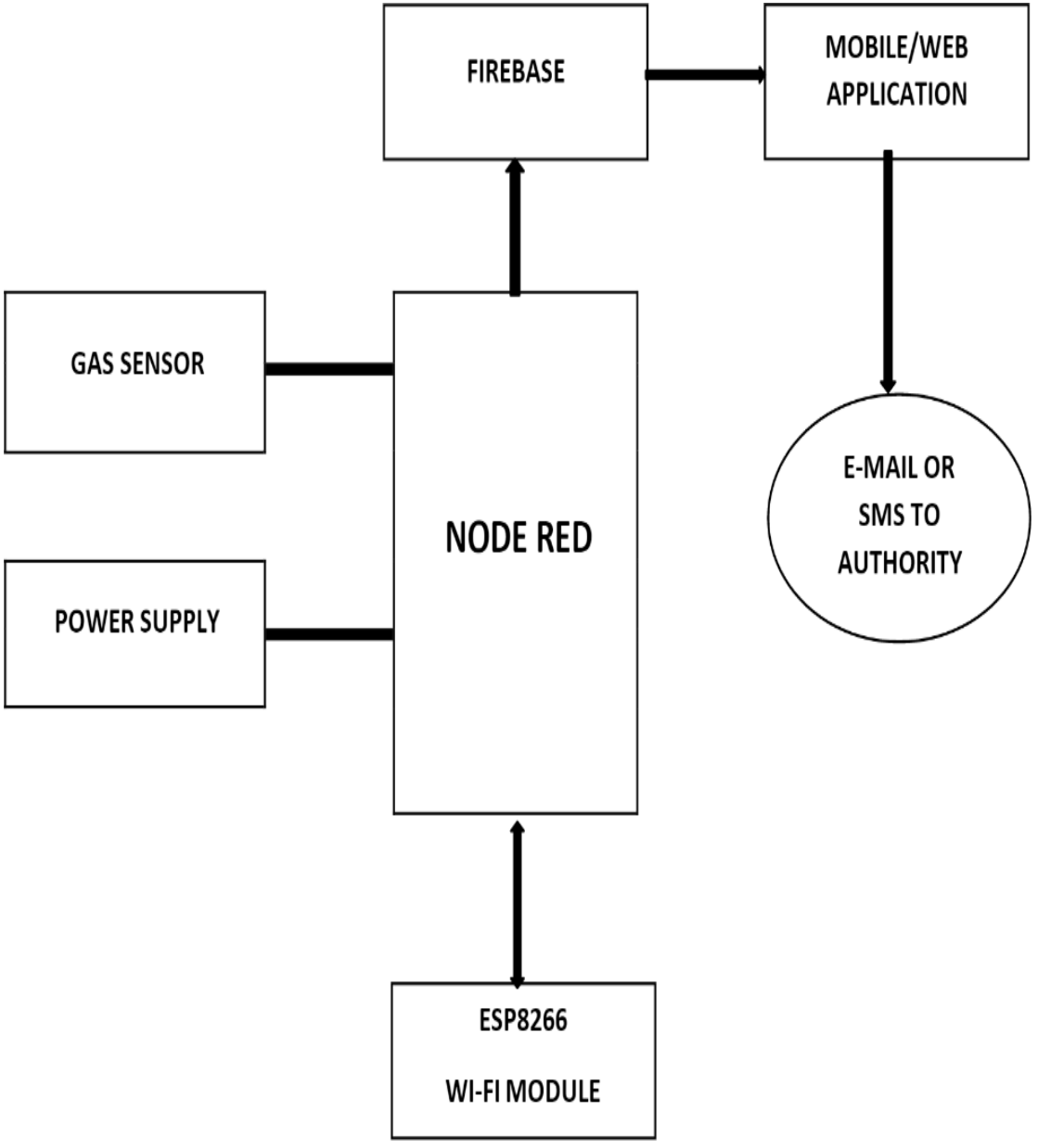
5.1 Data Flow Diagrams



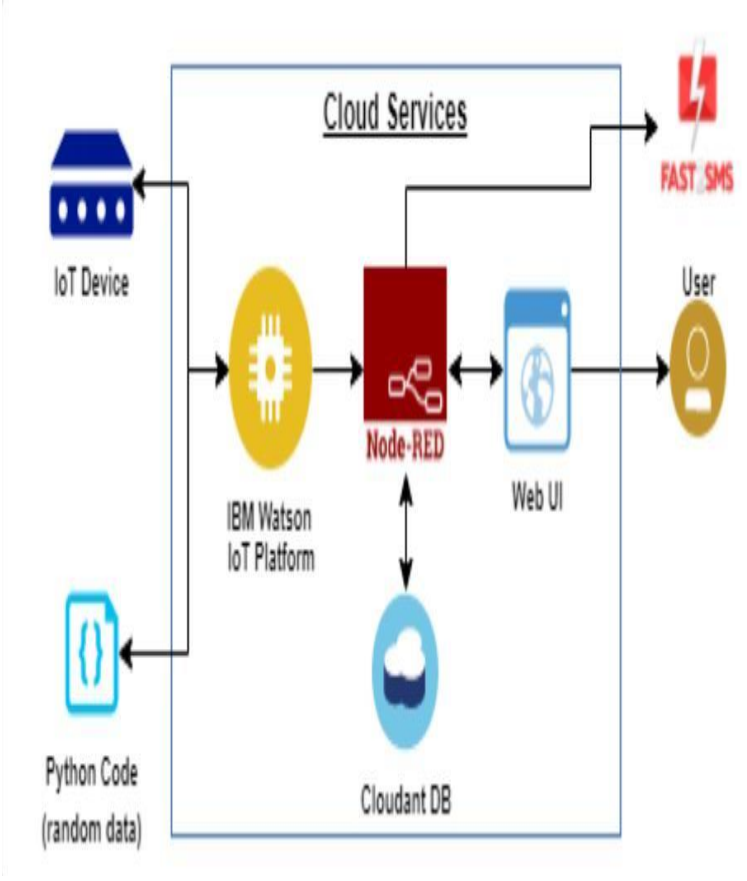
Above data flow diagram give a brief process how thegas is detected upon leakage. As you see, here gas acts as input. When there is a gas leak in the working environment, the gas sensor detects the disturbance. A red light is integrated to indicate the state of emergency. Also alert message is sent to the workers , so workers can get notified immediately and turn off the valve and turn on the dc fan with help of microcontroller when they are so busy that they ignore checking the LCD lights. Based on the circumstances, necessary precautions will be taken in order to be safe from explosions or any other effectscaused by the gas leakage.

5.2 Solution & Technical Architecture

5.2.1 Solution Architecture:


FIREBASE
MOBILE/WEB APPLICATION
GAS SENSOR
NODE RED
E-MAIL OR SMS TO AUTHORITY
POWER SUPPLY
ESP8266 WI-FI MODULE

5.2.2 Technical Architecture:



5.3 USER STORIES

User type	Functional requirements (Epic)	User Story Number	User Story/ Task	Acceptance criteria	Priority	Release
Customer	Gas detection and level monitoring	USN-1	As a user, I can get the gas leakage alert when gas leaking.	I can notice gas leakage	HIGH	SPRINT-1
		USN-2	As a user, I can get the different gas level when gas leaking	I can observe the level of gas leakage	MEDIUM	SPRINT-1
	Exhaust	USN-	As a user, I	I can	MEDI	SPRI

	fan on	3	can turn on exhaust fan	operate exhaust fan anytime	UM	NT-2
		USN-4	As a user I can turn on exhaust fan when gas leaking	I can turn on fan when there is a leakage ofgas	HIGH	SPRI NT-2

	Node-Red Creation	USN-5	As a user, I can receive gas leaking levels with send to alert message.	I can receive alerting message when there is a gas leak	HIGH	SPRI NT-3

		USN-6	As a user, I can receive gas leaking levels with alerting messages	I can receive message instantly when there is a gas leak	MEDIUM	SPRINT-3
	Documentation	USN-7	As user, I can get gas level and documentation	I can receive documentation With gas levels.	MEDIUM	SPRINT-4
			As a user, I can receive alert message and documentation	Documentation with Gas leak levels and amount of gas leak.	HIGH	SPRINT-4

6 PROJECT PLANNING AND SCHEDULING

6.1 Sprint planning & estimation

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Preparation & Data Visualization	USN-1	As a user, I provide Safety to the customers.	5	High	Rajesh Kumar R
Sprint-1		USN-2	As an Analyst, I collect the data & Provide meaningful insights through IBM Cloud	3	High	Pon Sai Raam V
Sprint-2	Dashboard	USN-3	As a user, I want to make sure the safe environment.	3	High	Kathirvel R
Sprint-2		USN-4	As an Analyst, I will upload the data in IBM Cloud to createa interactive dashboard.	3	Medium	Ragul T
Sprint-3	Report	USN-5	As a user, I want to secure the lives and data of each employee that report a particular event.	3	Medium	Rajesh Kumar R
Sprint-3		USN-6	As an Analyst, I will use IBM Cloud to generate a report.	3	Medium	Pon Sai Raam V
Sprint-4	Story	USN-7	As a user, I can only understand the Analysis in animated presentation of dataset	5	Medium	Kathirvel R
Sprint-4		USN-8	As an Analyst, I use IBM to create an animated presentation (Story) of the dataset	3	High	Ragul T

Project Tracker, Velocity & Burndown Chart: (4 Marks)

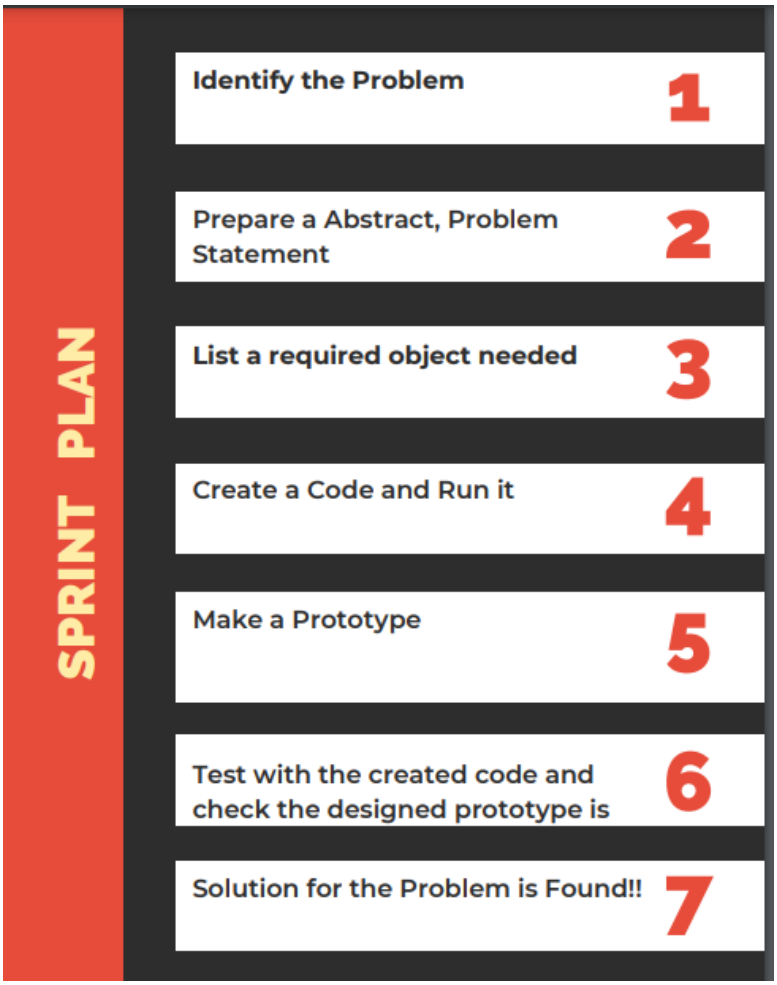
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as onPlanned End Date)	Sprint Release Date (Actual)
Sprint-1	5	6 Days	24 Oct 2022	29 Oct 2022	5	29 Oct 2022
Sprint-2	5	6 Days	31 Oct 2022	05 Nov 2022	5	05 Nov 2022
Sprint-3	5	6 Days	07 Nov 2022	12 Nov 2022	5	12 Nov 2022
Sprint-4	5	6 Days	14 Nov 2022	19 Nov 2022	5	15 Nov 2022

Velocity:

We have a 6-day sprint duration, and the velocity of the team is 4 (points per sprint). To calculate the team's average velocity (AV) per iterationunit (story points per day)

$$AV = \frac{\text{SPRINT DURATION}}{\text{VELOCITY}} = \frac{6}{4} = 1.5$$

6.2 Sprint delivery schedule



7. CODING AND SOLUTIONING:

This is the code that was run in python idle version 3.7(64-bit), this code is used to simulate the gas values, and acts as the input for the project.

In this python code we simulate the levels of five gases Propane, carbon monoxide. LPG ,methane, Hydrogen, the units used is ppm. These values are integers and they are published as a d object to the website.

```
import time

import sys

import ibmiotf.application

import ibmiotf.device

import random


#Provide your IBM Watson Device Credentials

organization = "s0uwr0"

deviceType = "weather_device"

deviceId = "vpsr_weather"

authMethod = "token"

authToken = "9mMbsPkwZ-NtBMUAPc"


# Initialize GPIO

def myCommandCallback(cmd):

    print("Command received: %s" % cmd.data['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 DHT11

        Propane =  random.randint(0, 2000);

        Carbon_Monoxide = random.randint(0, 100);

        LPG= random.randint(0, 2000);

        Methane = random.randint(0, 1000);

        Hydrogen= random.randint(0, 5000);

        data = {"d":{

    "Propane": Propane,

  "Carbon_Monoxide": Carbon_Monoxide,

  "LPG": LPG,

   "Methane": Methane,

    "Hydrogen":Hydrogen

}

}
```

```
        #print data
        def myOnPublishCallback():
            print ("Published Propane = %s ppm" % Propane, "LPG = %s ppm" % LPG, "to
IBM Watson")


        success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
        if not success:
            print("Not connected to IoTF")
        time.sleep(1)
        deviceCli.commandCallback = myCommandCallback


# Disconnect the device and application from the cloud
deviceCli.disconnect()
```

This code connects to the device in the ibm iot platform, which is inturn connected to Node red. The gas levels can also be viewed at Node red.

7.1 FEATURE 1:

- Here the Gas level is continuously monitored in real time using an app with negligible delay.

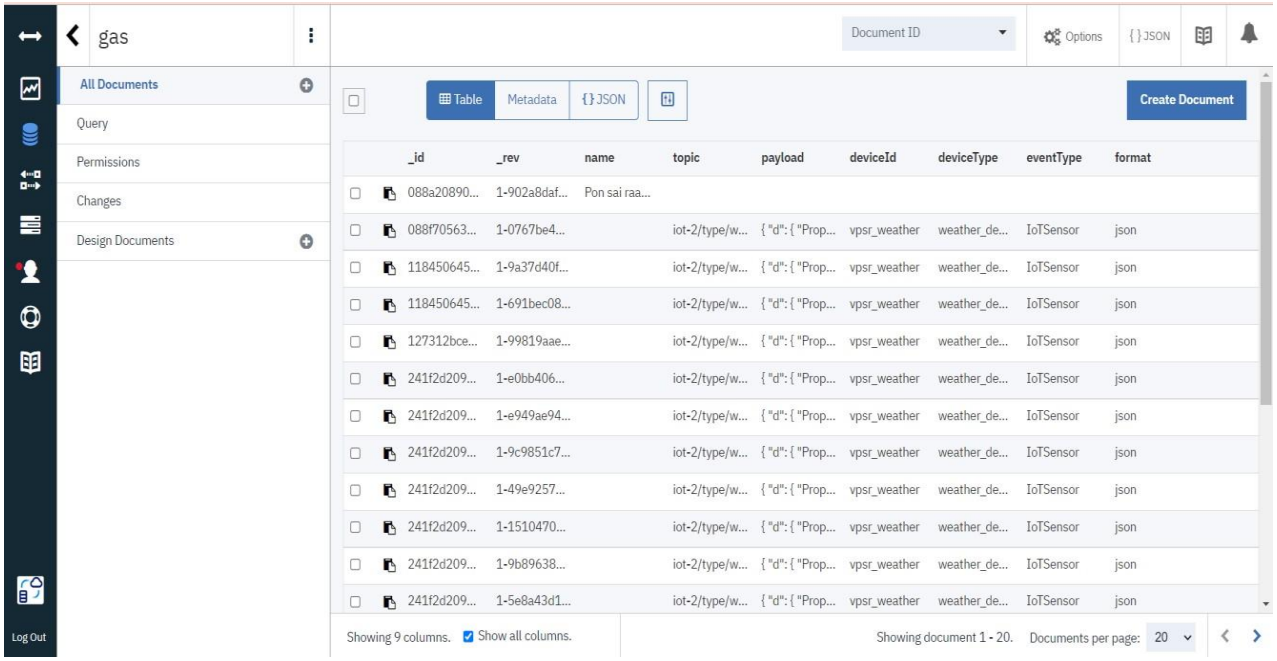
- High sensitivity to the five gases s Propane, carbon monoxide. LPG ,methane, Hydrogen
- Long life of the system, easy to monitor and maintain
- Detection threshold for the gases in ppm
  1. Propane 1,000 ppm.
  2. Carbon Monoxide 50 ppm.
  3. LPG Harmful level 2,000 ppm
  4. Methane 1,000 ppm
  5. Hydrogen 4,100ppm
- If the detection threshold is breached,then the user is alerted.

7.2 FEATURE 2:

- This project helps the industries in monitoring the emission of harmful gases from any location (i.e any part of the world).
- The inspectors don't necessarily have to be in the factory/ plant, so they don't have to get exposed to these harmful gases.
- In several industries, the leakage of gases can cause , economic loss to the company , which can be minimized using this system.
- In the web application, admins can view the sensor parameters and the gas levels.

7.3 DATABASE SCHEMA:

The table in the database named gas:-



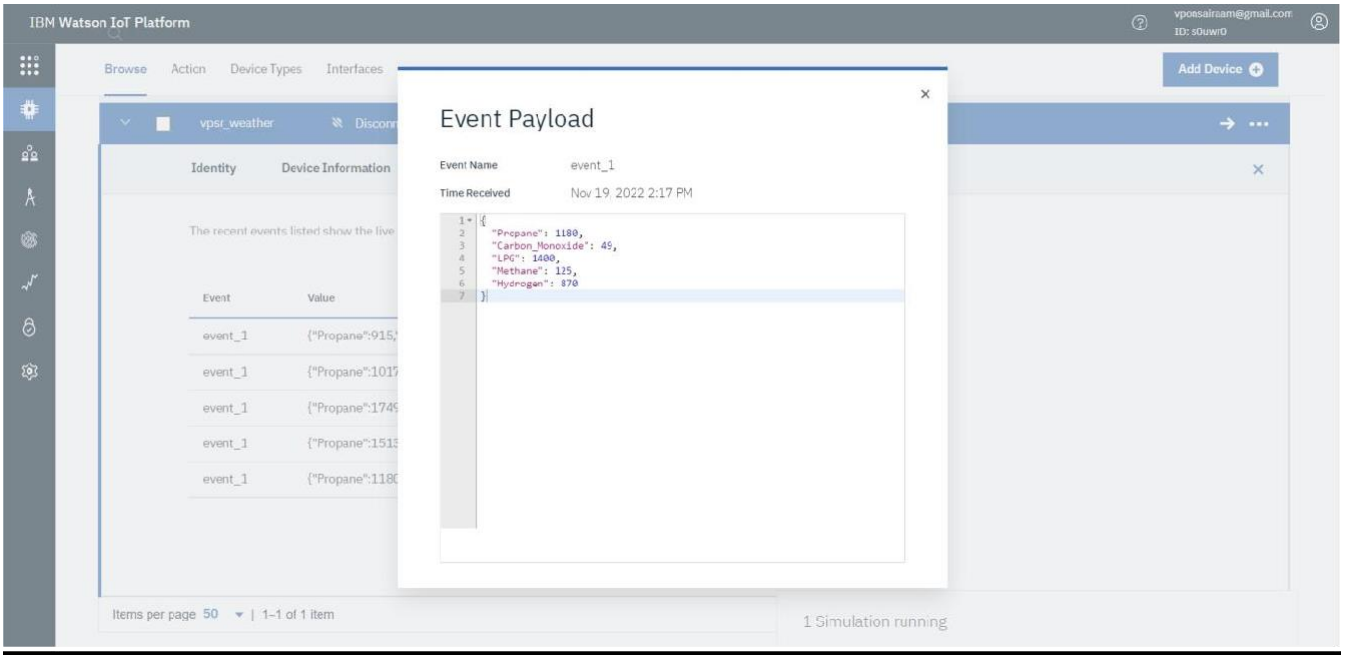
8.TESTING

8.1 Test cases:

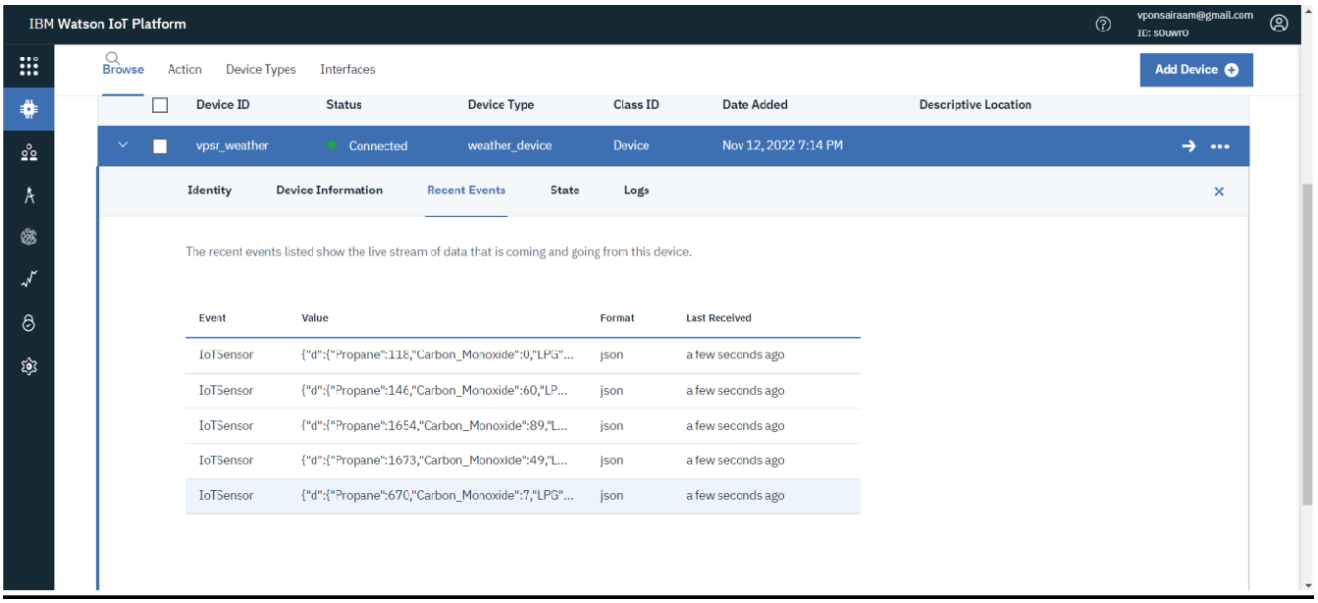
Mit app:

IBM Watson platform output:

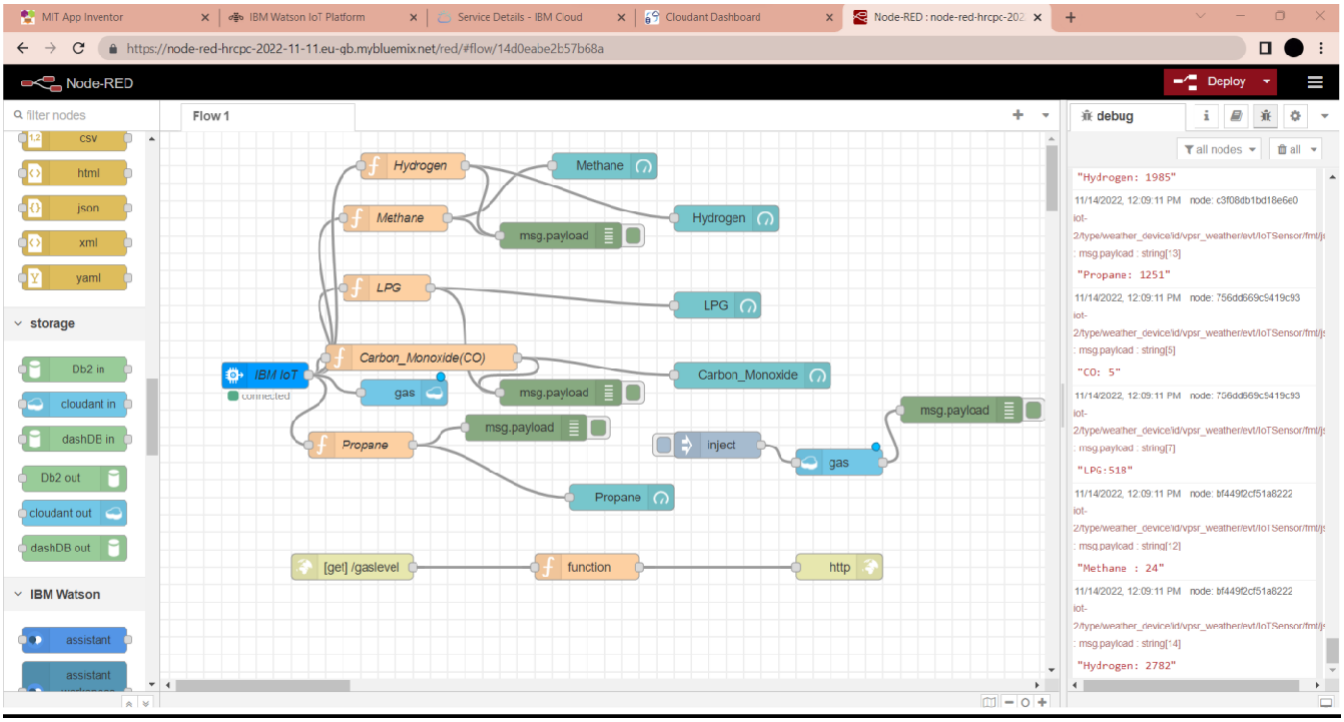
Values simulated by the device in ibm platform



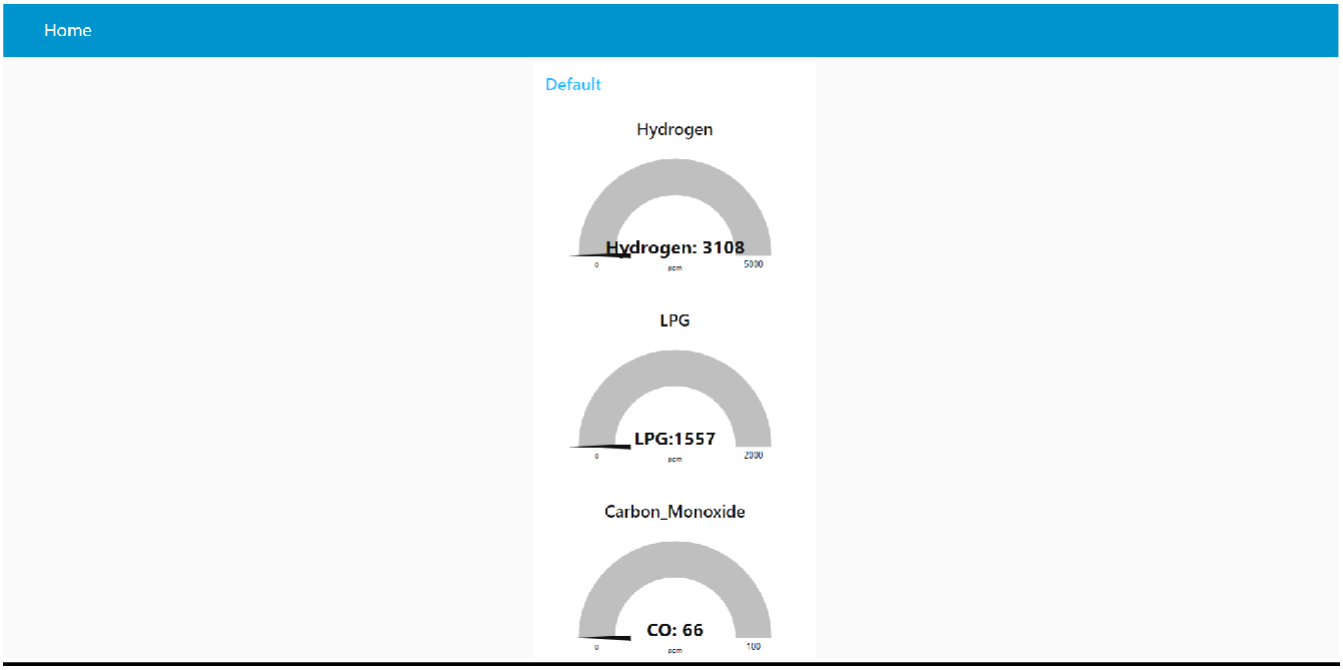
Values simulated by python code in IBM platform

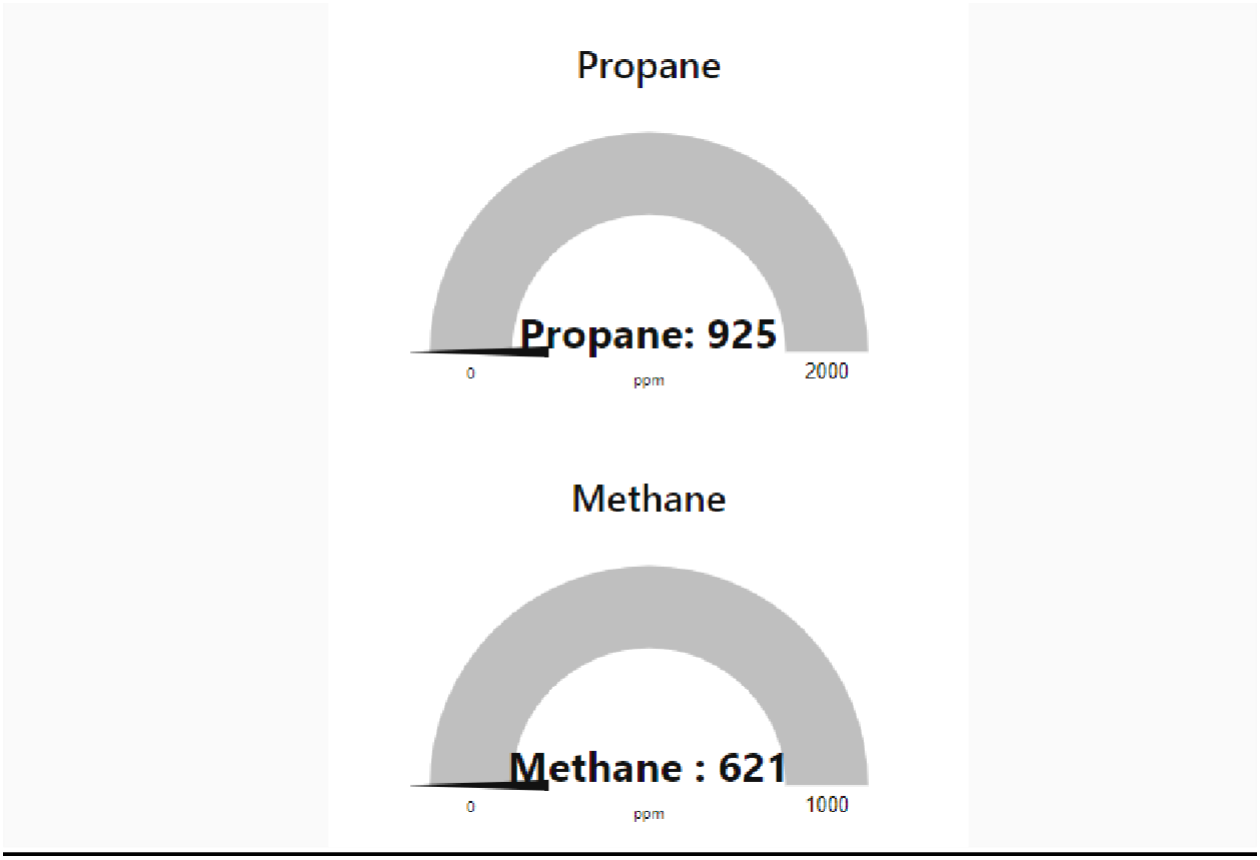


NODE Red output

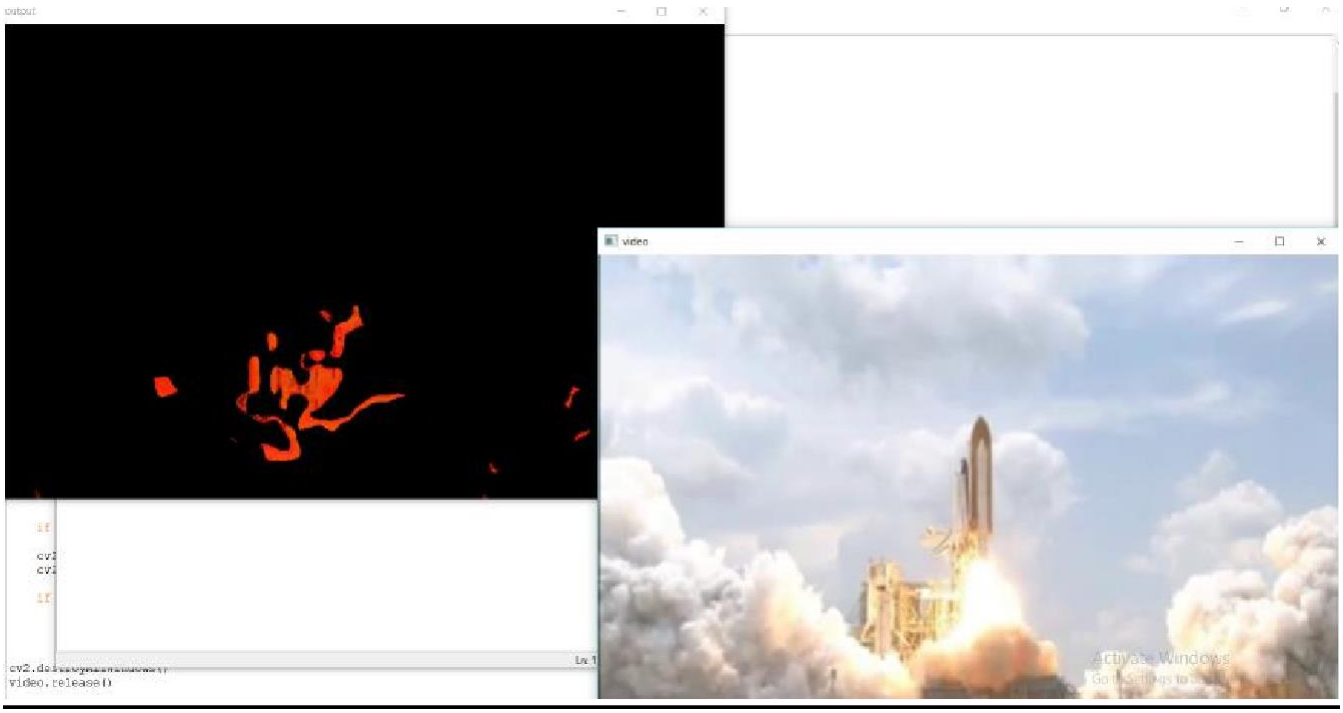


Web ui output





Open cv output:



8.2 User Acceptance testing

Detecting fire in a live video.

9 Results

9.1Performance Metrics

S.no	Name of the Phase	Tasks Performed	Performance Metrics
1	Development of Problem statement	The underlying problem analyzed and a rough idea of the solution was planned	The problem statement was developed
2	Ideation Phase	Extracting use and test case	Empathy map, Ideation and literature survey were formulated.
3	Project design phase-1	Proposed solution Problem solution fit Solution architecture	The same was written and uploaded in git hub.
4	Project design phase 2	Customer journey Functional requirements Dataflow diagrams Technology architecture.	Customer journey Functional requirements Dataflow diagrams Technology architecture were made
5	Project planning phase	Prepare milestone and activity list Sprint delivery plan	Prepare milestone and activity list Sprint delivery plan were prepared
6	Project development phase	Project development delivery of sprint-1 Project development delivery of sprint-2 Project development delivery of sprint-3 Project development delivery of sprint-4	The four sprints were successfully completed

10ADVANTAGES & DISADVANTAGES:

10.1 ADVANTAGES:

- Get real-time alerts about the gaseous presence in the Factory/plant.
- Very useful in preventing fire hazards and explosions.
- Supervise gas concentration levels.
- Ensures worker's health and safety.
- Real-time updates about leakages.
- Cost-effective installation.
- Get immediate gas leak alerts.

10.2 DISADVANTAGES:

- When any problem occurs **Poor stability and greater environmental impact** in particular, the selectivity of each sensor is not proper and the output parameters cannot be determined.
- Proper internet connection is important for the functioning of the system, In case of poor internet connection, or weak signals the system may not display the accurate gas value on time.

11. CONCLUSION:

Gas leakage leads to severe accidents resulting in material losses and human injuries. The main causes of gas leaks are poor maintenance of facilities and lack of awareness of people. Thus the system provides safety and control measures helping the workers.

12. FUTURE SCOPE:

- The system can be integrated with GSM to provide alerts through SMS.
- Electricity can be shut down when hazardous gas is detected.
- Additional inverter LED bulbs can be fixed in the rooms in case of power
- Shut down due to gas leakage and for fixing of leaked valves.
- The Exhaust fan can be turned ON when hazardous gas is detected.
- Additional valve can be attached to the opening of the gas cylinder, if in case

13. APPENDIX

OpenCV Code:

```
import time

import sys

import cv2

import numpy as np

import smtplib

import threading

Fire_Reported = 0

video = cv2.VideoCapture("Rocket Launch - 228.mp4") # If you want to use a webcam use

Index like 0,1.

while True:

(grabbed, frame) = video.read()

if not grabbed:

break

frame = cv2.resize(frame, (850, 540))
```

```
    blur = cv2.GaussianBlur(frame, (21, 21), 0)
    hsv = cv2.cvtColor(blur, cv2.COLOR_BGR2HSV)
    lower = [110, 50, 50] # threshold value for fire colour
    upper = [130, 255, 255]
    lower = np.array(lower, dtype="uint8")
    upper = np.array(upper, dtype="uint8")
    mask = cv2.inRange(hsv, lower, upper)
    output = cv2.bitwise_and(frame, hsv, mask=mask)
    no_red = cv2.countNonZero(mask)
    if int(no_red) > 15000:
    Fire_Reported = Fire_Reported + 1
    cv2.imshow("output",output)
    cv2.imshow("video",frame)
    if cv2.waitKey(1) & 0xFF == ord('q'): #For killing the program
    break
    cv2.destroyAllWindows()
    video.release()
```

GITHUB LINK : https://github.com/IBM-EPBL/IBM-Project-12752-1659460963

PROJECT DEMO LINK:
https://drive.google.com/file/d/1Rn2P0tVe1UmoijFnYM-S-geRom8RoyH-/view?usp=sharing

Scan the qr code below:-