Gas Leakage monitoring & Alerting system for Industries

(INTERNET of THINGS)

In fulfillment of project in IBM-NALAYATHIRAN 2022

SUBMITTED BY

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INDEX

TESTING

- Test Cases
- User Acceptance Testing

RESULTS

- Performance Metrics

ADVANTAGES & DISADVANTAGES

CONCLUSION

FUTURE SCOPE

APPENDIX

- Source Code
- GitHub & Project Demo Link

Introduction

Now a days the home safety detection system and in industry plays the important role for the security of people. Since all the people from the home goes to work on daily bases, it makes impossible to check on the appliances available at home specially LPG gas cylinder, wired circuits, Etc. Since last three years there is a tremendous hike in the demands of liquefied petroleum gas (LPG) and natural gas. To meet this access amount of demand for energy and replace oil or coal due to their environmental disadvantage, LPG and natural gas are preferred. These gases are mostly used on large scale in industry, heating, home appliances and motor fuel. So as to track this leakage gas, the system includes MQ6 gas sensor. This sensor senses the amount of leak gas present in the surrounding atmosphere. Through this, explosion or getting affected by the leakage of gas could be avoided.

Project Overview :

The design of a sensor-based automatic gas leakage detector with an alert and control system has been proposed.This is an affordable, less power using, lightweight, portable, safe, user friendly, efficient, multi featured and simple system device for detecting gas. Gas leakage detection will not only provide us with significance in the health department but it will also lead to raise our economy, because when gas leaks it not only contaminates the atmosphere, but also wastage of gases will hurt our economy. The need for ensuring safety in workplaces is expected to be the key driving force for the market over the coming years.

Purpose:

Gas leakage is nothing but the leak of any gaseous molecule from a stove, or a pipeline, or cylinder etc. This can occur either purposefully or even unintendedly. As we are aware that these kinds of leaks are dangerous to our health, and when it becomes explosive it could cause great danger to the people, home, workplace, industry and the environment. Few of the major incidents that took place due to gas leakage include the Bhopal Disaster and the Vizag Gas leak. The Bhopal disaster is known to be the worst industrial accident ever. Approximately 45 tons of Methyl Isocyanate was leaked from this insecticide plant. Methyl Isocyanate is an organic compound and a chemical that could come from the carbamate pesticides. This

colorless, poisonous and flammable liquid is something that human beings have to be away from. Vizag Gas leak was a resultant of the escape of styrene that were unattended for a long period. This colorless oily liquid can spread in fumes. So, a detector must be made in such a way that could detect any kind of gas, fume, leak, smoke etc. However harmful and dangerous it can be, the detector could be attached with certain parameters that could help to prevent the issue.

LITERATURE SURVEY

In our daily life we may face many chances to face fire accidents because of gas leakage. This can be occur in places like apartments,houses,gas industry,chemichal industry, food industry,gas pump.welding shops.hospitals.schools and college laboratories. This can be ignored by some safety measures like installing gas leakage monitering and alerting system this will moniter the gas leakage and alert when the gas leakage occurs. Gas leakage can cause global warming and some toxic gases are harmful to health and some gases are dreadful gases like carbon mono oxide.some flammable gases are able to get fire and get burst easily by a single spark of fire.some gases are harmful to lungs and some aare harmful to asthma patients. In hospitals gases like helium oxygen are stored in a cylinder and also stored in a large sized cylinder. and in some chemical reaction harmful gases formed by reaction. and the acetelyne gas used in welding is combustible gas that can cause fire accident.To avoid these situations and to avoid these fire accidents an monitering system must me installed everywhere. wherever the gas leakage may be takes place.they must be monitered to protect people and other workers. In this busy world people don't have time to notice and moniter everything on their own. that leads to gas leakage and it causes to fire accident by gas combustion. The gas monitering and alerting system helps people to be aware and let them know when gas leakage occurs. This will protect them from fire accidents. This is the most essential system in the places where gas leakage or gas storage occurs. In the year of 2008, LIU zhen-ya, WANG Zhen-dong and CHEN Rong, "Intelligent Residential Security Alarm and Remote Control System Based On Single Chip Computer", the paper focuses on, Intelligent residential burglar alarm, emergency alarm, fire alarm, toxic gas leakage remote automatic sound alarm and remote control system, which is based on 89c51 singlechipcomputer. The system can perform an automatic alarm, which calls the police hotline number automatically. It can also be a voice alarm and shows alarm occurred address. This intelligent security system can be used control the electrical power remotely through telephone. In the year of 2008, Chen Peijiang and Jiang Xuehhua, "Design and implementation of Remote Monitoring System Based on GSM", this paper focuses on the wireless monitoring system, because the wireless remote monitoring system has more applications a remote monitoring system based on SMS through GSM In the year of 2002,

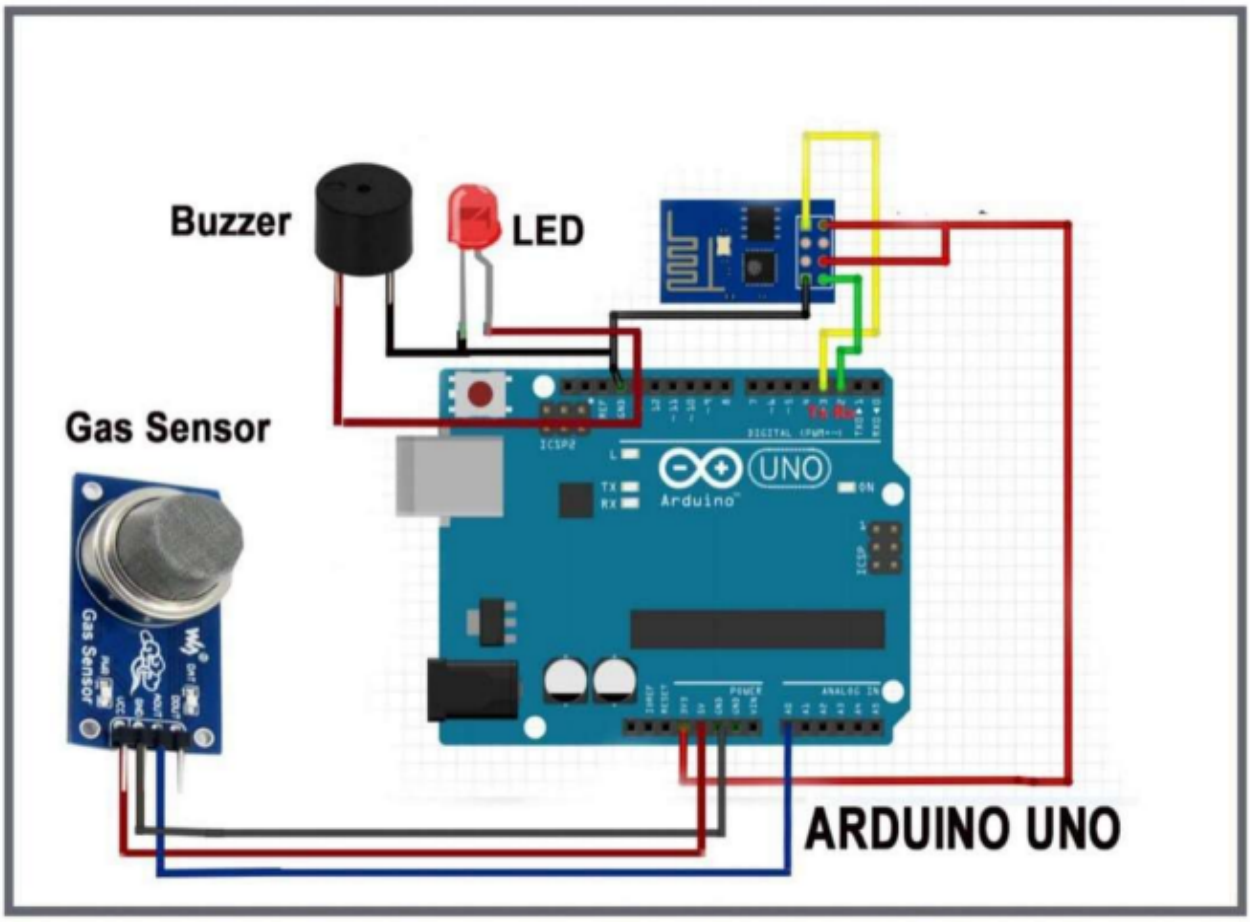
K. Galatsis, W. Wlodarsla, K. Kalantar-Zadeh and A. Trinchi, "Investigation of gas sensors for vehicle cabin air quality monitoring", this paper focuses on, car cabin air quality monitoring can be effectively analyzed using metal oxide semiconducting (MOS) gas sensors. In this paper, commercially available gas sensors are compared with fabricated Moo3 based sensors possessed comparable gas sensing properties. The sensor has response 74% higher relative to the hest commercial sensor tested. A number of reviews on the subject of gas leakage detection techniques were done in the past either as part of research papers/technical reports on a certain leak detection method and other gas related subjects **A.Mahalingam,R. T. Naayagi, N. E. Mastorakis** they introduce design and implementation of an economic gas leakage detector.

Problem Statement:

A homemaker trying to detect the gas leakage, but manual detection of leakage may not be accurate. Because it requires an alerting and monitoring mechanism. Which makes them feel that could cause a field accident.

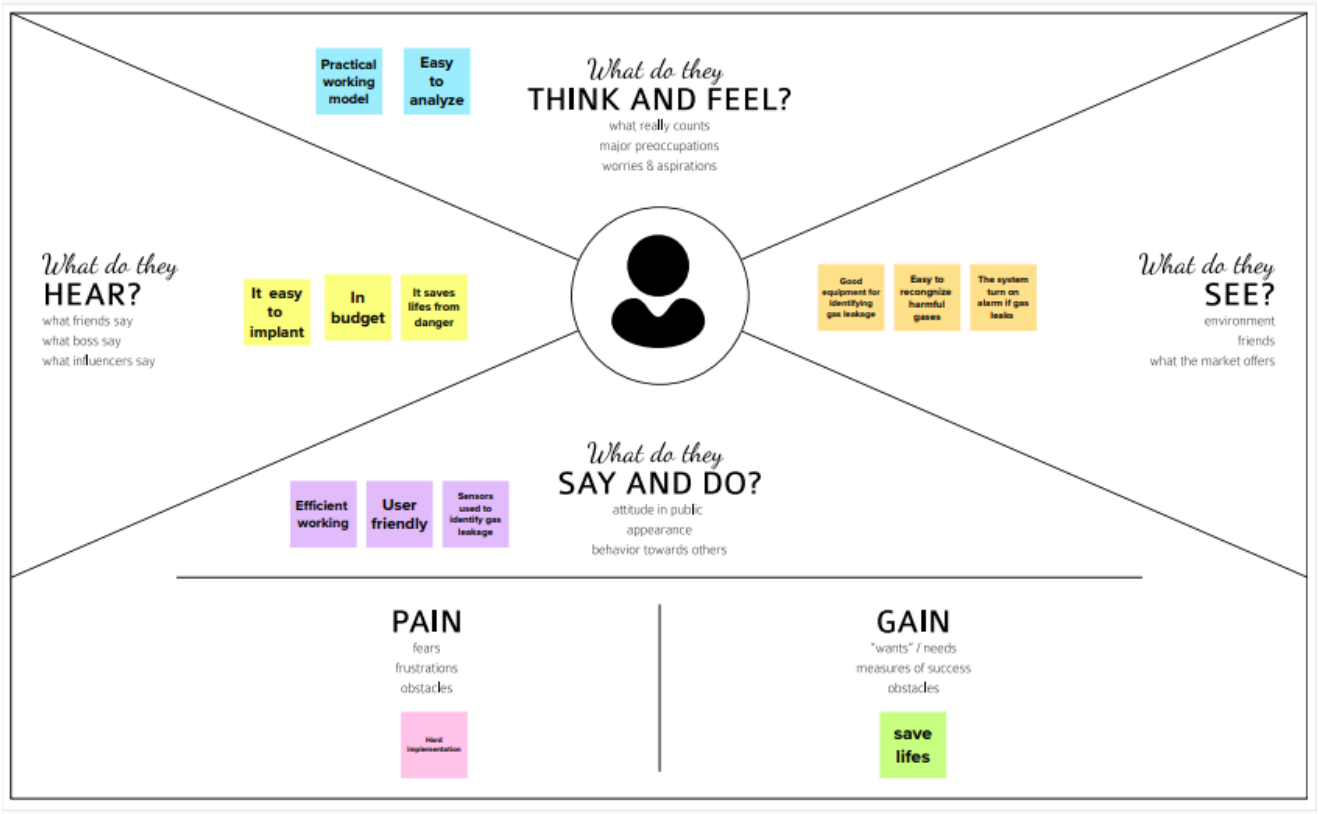
IDEATION & PROPOSED SOLUTION

System consists of gas detector sensors, Arduino board, ESP8266 and Cloud server. One Society authority person can register the all flat member user to our system. Society admin can add the details of per flat user such as user name, mobile number, per user flat sensor details information. Society admin can configure the threshold value of each sensor. System hardware can be deployed on each flat. Sensors can sense the value per time. System can send the values to cloud server.



Server can Check that the sensor values was existed the threshold value. If sensor value can cross the limit the server can send the command to hardware for buzzing the alarm. Server also sends the notification message to user.

Empathy Map:



Ideation &Brainstorming:

Step-1:

Team Gathering, Collaboration and Select the Problem Statement. We have followed the first step of brainstorming, we have discussed as a team to decide a problem statement.

As per the guideline the following is done

- TEAM GATHERING
- COLLABORATION
- DECIDING THE PROBLEM STATEMENT

Step-2:

Brainstorm, Idea Listing and Grouping

Brainstorming is done to have a discussion on how we solve the problem as with many people we can have wider perception rather figuring it alone, so we had a discussion to in order to have an overview of our perception of the problem.

Step-3: Idea Prioritization:

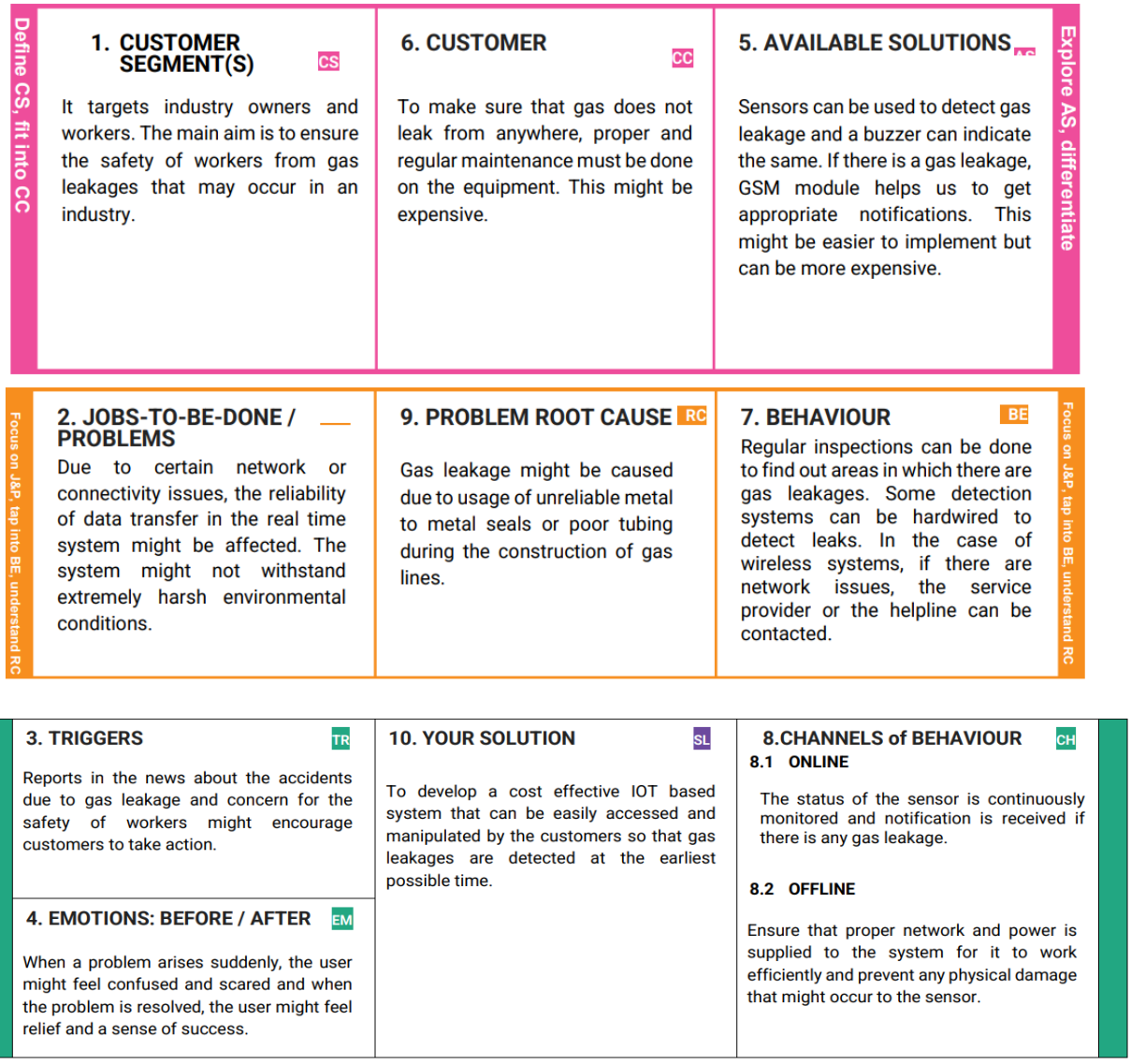
1) Using gas sensor in order to detect the gas leakage.
2) The sensor is connected to IOT application in order notify the farmers
3) If necessary, use additional sensors to detect the fire
4) Using automation without the knowledge of user

Proposed Solution :

S.NO	Parameter	Description
1	Problem Statement (Problem to be solved)	Gas leakage in industries can be very dangerous as certain gases can be poisonous while others can be explosive. So, system can be designed to monitor, detect and alert the workers in the case of a gas leakage in a timely manner.
2	Idea / Solution description	Gas sensors can be placed at strategic locations in an industry that is prone to accidents due to gas leakage. These sensors can be interfaced with the cloud using a microcontroller. When the level of gas passes a threshold value, the sensor can send an alert via the cloud and also a buzzer can be made to give an alert sound to alert the workers on site. By using GSM module, SMS can also be sent to the required people or helpline. It enables us to monitor gas levels remotely and in real time
3	Novelty / Uniqueness	Here wireless communication system using either Wi-Fi or ZigBee can be used.
4	Social Impact / Customer Satisfaction	Easy to install, lesser cost and reduction in accidents due to gas leakage.

5	Business Model (Revenue Model)	Due to inflammatory or poisonous gases being used in many industries, the rate of accidents and deaths increased. The gas leakage detection model can help prevent accidents so as long as there are workers in industries, this model is a necessity and production will not be stopped.
6	Scalability of the Solution	Even if there is a large volume of gas leakage, the product will sense the accurate value and alert the users. In the case of accident or extreme leakage, the respective authorities or helplines can be notified almost immediately with the fast communication that is provided

Probelm Solution:



Requirement Analysis

Functional Requirements :

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Business Requirements	This system can be implemented in homes Industries. 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.
FR-2	User Confirmation	Send the details through message.
FR-3	Future Requirements	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.
FR-4	Product Requirements	Detect the gas is necessary regardless of your business role or individual purpose. Certain technologies 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 fulfil.

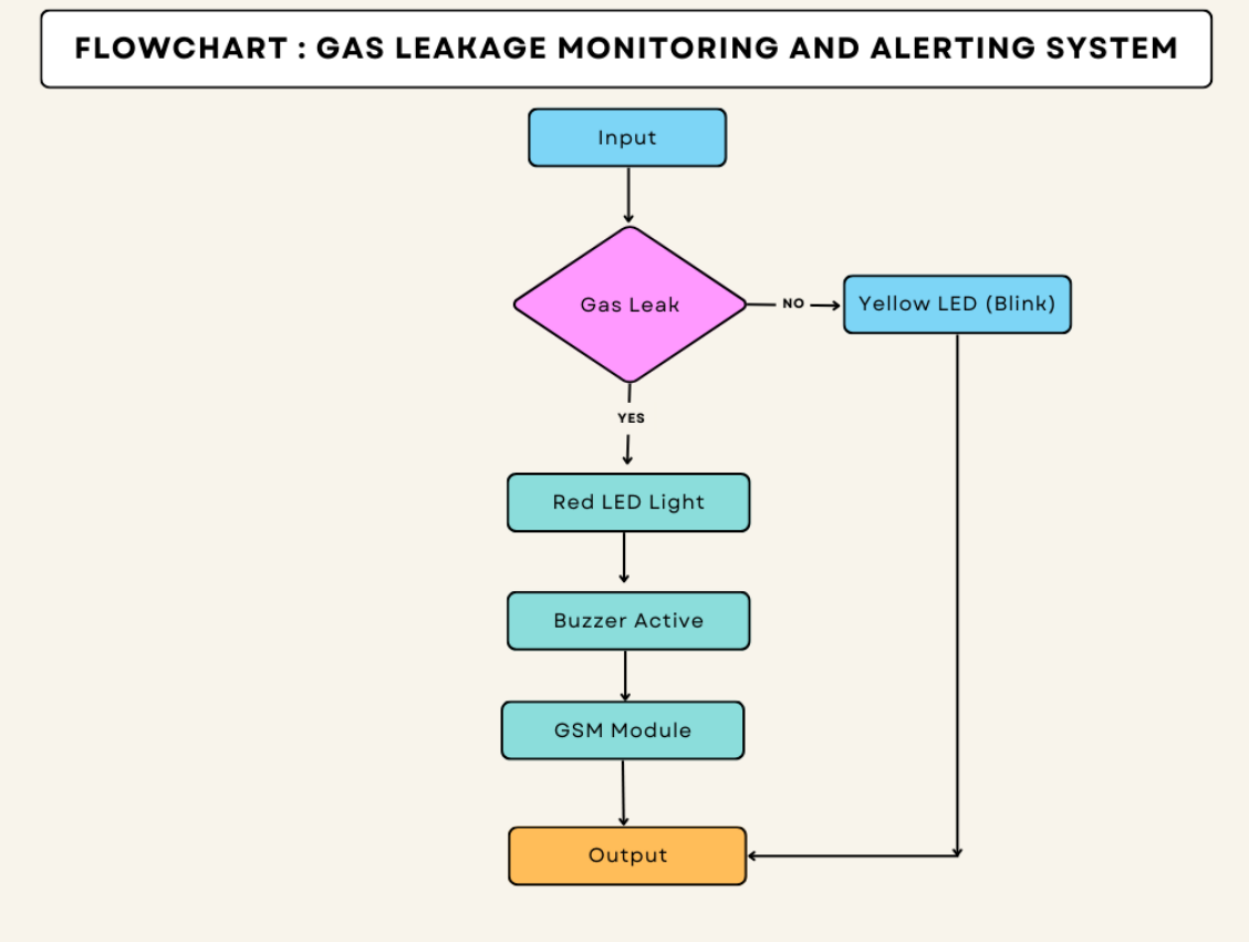
Non-functional Requirements:

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

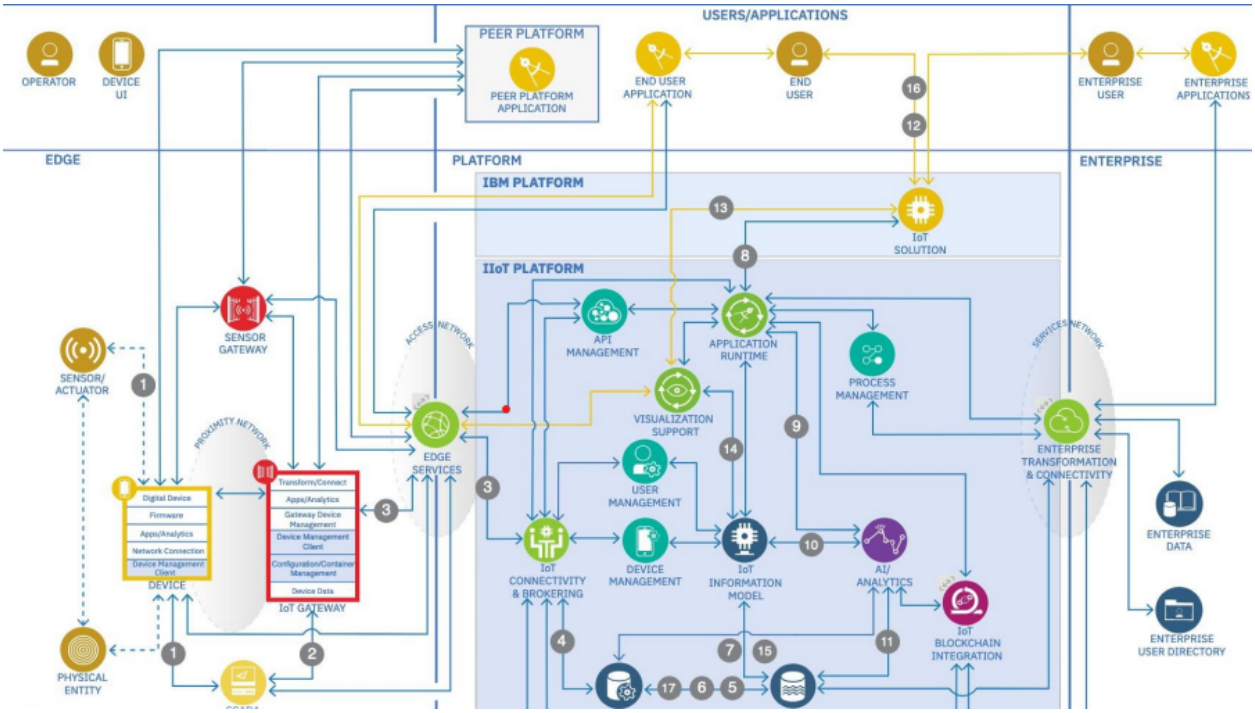
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The system must be able to detect and update whenever & wherever required.
NFR-2	Security	Select a software option that securely backs your data up nearly every second, onto safe and reliable servers, with real-time database application
NFR-3	Reliability	We using application for monitoring the data software takes an hour to run a basic report if it can run reports but you get an error message half of the time, there's a reliability problem.
NFR-4	Performance	The system should be able to detect properly at times of fatal conditions and provide necessary driving measures.
NFR-5	Availability	Under a given set of environmental conditions how the operational element performed in a set of time.
NFR-6	Scalability	The system should be compatible with developed specifications and also be open for future upgradation.

Project Design

Data Flow Diagram :



Solution Architecture:



Technological architecture:

Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g. Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript / Angular Js /React Js etc
2.	Application Logic-1	Logic for a process in the application	Java/Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
6.	Infrastructure (Server / Cloud)	Application Deployment on Cloud	Local, Cloud Foundry, Kubernetes, etc.

Table-2: Application Characteristics:

S.No	**Characteristics**	**Description**	**Technology**
1.	Scalable Architecture	We can implement in Industries, Hotels, Publicplaces	IOT
2.	Availability	To detect leakage 24/7 for uninterrupted serviceswe have implemented in distributed servers (cloud)	IBM cloud
3.	Performance	If we implemented in industries, it needs many gassensors to detect	

PROJECT PLANNING AND SCHEDULING

Sprint-1	To find thegas leakage	USN-1	The business owner takes the required precautions to protect his employees or a person who wishes to protect their family from anexplosion.	2	High	E. HARIKRISHNAN A. AJAYSHAWAK K. ABHISHEK P.JAY
Sprint-1	Preventing from explosion	USN-2	Explosions caused by gas leaks, which couldresult in many fatalities.	1	High	E. HARIKRISHNAN A. AJAYSHAWAK K. ABHISHEK P.JAY
Sprint-2	To detect the gas leakage	USN-3	To detect the gas leakage we may usethe gas	2	Low	E. HARIKRISHNAN A. AJAYSHAWAK K. ABHISHEK P.JAY

			sensors and alerting system.			
Sprint-3	Testing and training of themodel device	USN-4	By using the dataset as training data, the programmer can createa model for gas leak detection	2	Mediu m	E. HARIKRISHNAN A. AJAYSHAWAK K. ABHISHEK P.JAY
Sprint-4	Alerting system	USN-5	The model's ability to detect gas leaks allows for an alarming system .	1	High	E. HARIKRISHNAN A. AJAYSHAWAK K. ABHISHEK P.JAY

Sprint Delivery Schedule

TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	Literature survey on theselected project & gathering information byreferring the, technical papers, research publications etc.	19 SEPTEMBER 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the userPains & Gains, Prepare listof problem statements	19 SEPTEMBER 2022
Ideation	List the by organizing the brainstorming session andprioritize the top 3 ideas based on the feasibility & importance.	19 SEPTEMBER 2022

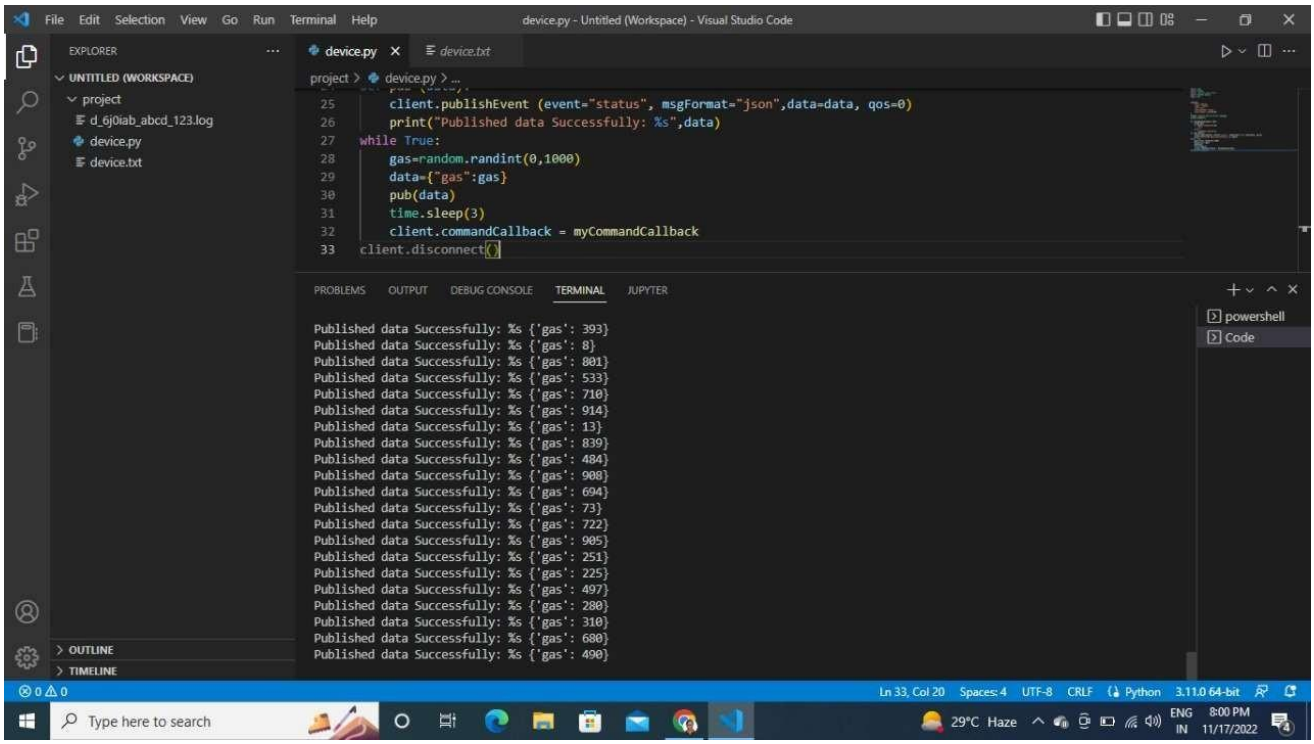
Proposed Solution	Prepare the proposed solutiondocument, which includes the novelty, feasibility of idea, business model, social impact,scalability of solution, etc.	19 SEPTEMBER 2022
Problem Solution Fit	Prepare problem - solution fitdocument.	19 SEPTEMBER 2022
Solution Architecture	Prepare solution architecturedocument.	19 SEPTEMBER 2022
Customer Journey	Prepare the customer journey maps to understand the user interactions & experiences with the application (entry to exit).	3 OCTOBER 2022
Functional Requirement	Prepare the functional requirement document.	3 OCTOBER 2022
Data Flow Diagrams	Draw the data flow diagrams and submit for review.	3 OCTOBER 2022
Technology Stack	Prepare the technology architecture diagram.	3 OCTOBER 2022
Prepare Milestone & Activity List	Prepare the milestones & activity list of the project.	1 NOVEMBER 2022

Project Development - Delivery of Sprint-1, 2, 3 & 4	Develop & submit the developed code by testing it.	19 NOVEMBER 2022

Coding and Solution:

```
import time
import random
#import ibmiotf.application
import ibmiotf.device
import sys
config={
 "org":"6j0iab",
 "type" :"abcd",
 "id":"123",
 "auth-method":"token",
 "auth-token":"123456789"
}
client= ibmiotf.device.Client (config)
client.connect()
def myCommandCallback (cmd):
 a=cmd.data
 if len(a["command"])==0:
 pass
 else:
 print(a["command"])
def pub (data):
 client.publishEvent (event="status", msgFormat="json",data=data, qos=0)
 print("Published data Successfully: %s",data)
while True:
 gas=random.randint(0,1000)
 data={"gas":gas}
```

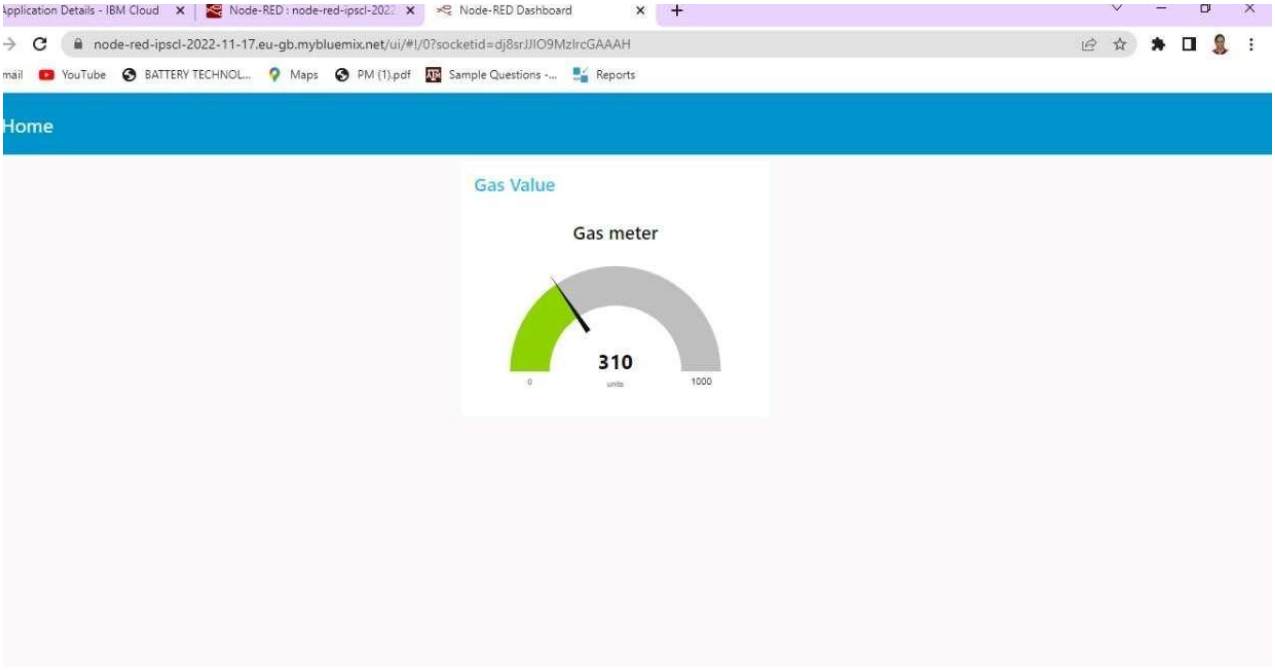
```
pub(data)
time.sleep(3)
client.commandCallback = myCommandCallback
client.disconnect()
```



FEATURES:

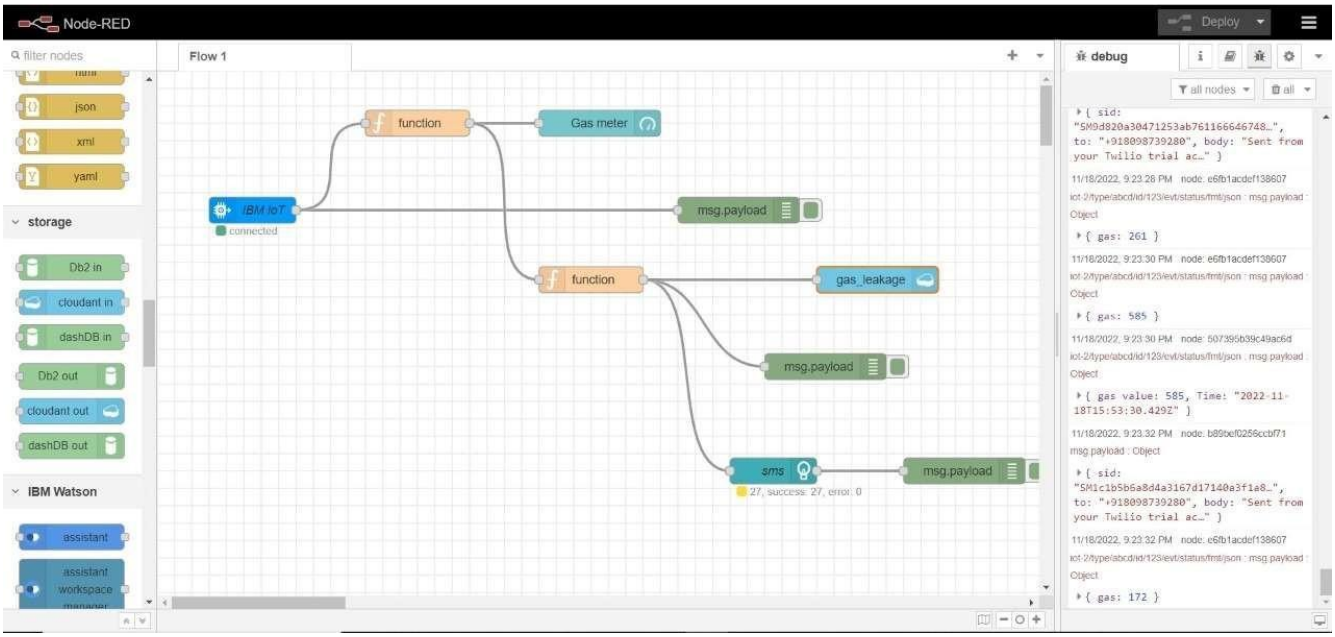
FEATURE 1:

The first feature is the use of web application inorder to indicate the gas value



Testing&Use

Cases Test Cases:



Result:

Advantages&Disadvantages:

Advantages:

- The sensor-enabled solutions helps prevent the high risk of gas explosion and affecting any casualties within and outside the premises.
- Prevent fire hazards and explosions.
- Ensure worker's health.
- Real-time updates about leakages.
- Get immediate gas leak alerts.

Disadvantages:

- Poor stability.
- Only one gas can be measured with each instrument.
- Greater environmental impact.
- It can be poisoned by lead, chlorine and silicon.
- It requires more user expertise.

8. Conclusion :-

After this project performance, can conclude that detection of the LPG gas leakage is incredible in the project system. Applicable usefully in the industrial and domestic purpose. In danger situations we are able to save the life by using this system. An alert is indicated through the message.A sensor node senses gas like CO2, oxygen, propane. The estimated range of transmission and consumption of power is obtained. The simple procedures and Arduino UNO Micro controller area used to build the sensor.

9. Future Scope:

Future scope could be including a Automatic Shut-off device which will turn off the gas supply whenever it will detect any gas leakage. This system can be implemented in Industries, Hotels and wherever the LPG cylinders are used. The system can be taken as a small attempt in connecting the existing primary gas detection methods to a mobile platform integrated with IoT platforms. The gases are sensed in an area of 10m radius of the rover and the sensor output data's are continuously transferred to the local server. The accuracy of sensors are not up to the mark thus stray gases are also detected which creates an amount of error in the outputs of the sensors, especially in case of methane. Hence in the future we have to come up with better solutions for these Problems.

10. Appendix:

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


config={
   "org":"6j0iab",
   "type" :"abcd",
   "id":"123",
   "auth-method":"token",
   "auth-token":"123456789"
}
client= ibmiotf.device.Client (config)
client.connect()

def myCommandCallback (cmd):
   a=cmd.data
```

```
if len(a["command"])==0:
        pass
    else:
        print(a["command"])
def pub (data):
    client.publishEvent    (event="status",    msgFormat="json",data=data,
qos=0)
    print("Published data Successfully: %s",data)
while True:
    gas=random.randint(0,1000)
    data={"gas":gas}
    pub(data)
    time.sleep(3)
    client.commandCallback = myCommandCallback
client.disconnect()
```