

PROJECT REPORT

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GAS LEAKAGE MONITORING AND ALERTING SYSTEM FOR INDUSTRIES

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1.INTRODUCTION

1.1 PROJECT OVERVIEW

Now a days the home safety detection system 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.

More than the lifetime Arduino has been a reason that thousands of projects from everyday bodies to complicated scientific mechanism. Worldwide societies of scholars, performers, programmers, and specialists have assembled around this open-source program. Their knowledge about the said matter contributions a lot to help the society in this subject area. The project entitled “Gas Leakage Monitoring and Alerting System For Industries using Arduino with SMS Alert and Sound Alarm”, will be a great help in terms of preventing any danger caused by gas leakage. The purpose of this project is to detect the presence of gas leakage as a part of a safety system. Apart from sound alarm, an SMS alert will inform the authorized person and the solenoid valve will be triggered to shut down the gas supply to prevent any harmful effects due to gas leakage. Descriptively, we use a gas sensor to monitor the gas, if the gas leak reaches beyond the normal level. This proposed project will trigger the sound alarm. In addition, the authorized person will be informed about the leakage via SMS alert and the gas supply will be automatically shut down. The people can be saved from a potential explosion caused by gas leakage.

1.2 PURPOSE

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.

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 colourless, 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 colourless 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.

Aside from that, the system also has a cloud storage capability. The usage of gas for each user each day may be tracked with the aid of this cloud storage solution. At the end of the day, this procedure will assist in detecting per user natural gas usage. The system has been tested and it is able to monitor gas wastage, leakage and send a SMS to the user. The resulting performance indicated its effectiveness toward saving a significant portion of the wasted gas in domestic.

2.LITERATURE SURVEY

2.1 EXISTING PROBLEM

Industrial processes increasingly involve the use or manufacture of highly dangerous substances, particularly toxic and combustible gases. Inevitably, occasional escapes of gas occur, which create a potential hazard to the industrial plant, its employees and people living nearby. Worldwide incidents involving asphyxiation, explosions and loss of life are a constant reminder of this problem.

While life safety is a major benefit of gas detection, don't forget that gas monitors also contribute to worker health, property protection and operational productivity, all of which impact the bottom line.

The industrial hygienist, as a proactive safety leader of the workplace, needs timely, accurate warnings of a gas leak so that building occupants can be evacuated in time, if necessary, to a safe place, and so that gas leaks can be mitigated quickly to prevent the overtaking or destruction of property.

2.2 REFERENCES

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2.3 PROBLEM STATEMENT DEFINITION

Natural gases such as Liquefied Petroleum Gas (LPG) are widely used in the whole world. LPG is used for cooking in home or hotel. It is also used in certain gas based industry. Although the procedure of installing LPG-based system is very tight, it could not give 100% guaranteed that the LPG-system will not having leakage. Even though human still have certain weakness. Human cannot detect the presence of natural gases as fast as the sensor do. Thus, the use of gas sensing system is hugely needed to give real-time monitoring of the gas system. In certain cases, gas leakage can cause fire that will destroy human property.

The large scale of fire also could contribute to serious injury or death. This is due to the fire station got delay information about the fire occurred. The current products that are in the market are function as gas detector. It will only detect a gas and trigger an alarm. The main problem is that even the alarm is triggered but if the user is not at home or premise, the user will not get to know the leakage of gas occur. Therefore, this project shall be able to resolve the problem stated. This is because this project "GAS LEAKAGE MONITORING AND ALERTING SYSTEM FOR INDUSTRIES" is able to sense the presence of LPG. Besides that, it give information more efficient as it is also capable to send out an SMS to the owner.


3.IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP AND CANVAS



3.2 IDEATION AND BRAINSTORMING

Template



Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

- 15 minutes to prepare
- 1 hour to collaborate
- 2-3 people recommended

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1

Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

PROBLEM

GAS LEAKAGE MONITORING AND ALERTING SYSTEM FOR INDUSTRIES

Key rules of brainstorming

To run an smooth and productive session

Step to help: Encourage wild ideas

Order judgment: Listen to others

Go for volume: If possible, be vocal

2

Brainstorm

Write down any ideas that come to mind that address your problem statement.

15 minutes

Person 1

Person 2

Person 3

Person 4

3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than on sticky notes, try and see if you can break it up into smaller sub-groups.

20 minutes

Category1

Category2

Category3

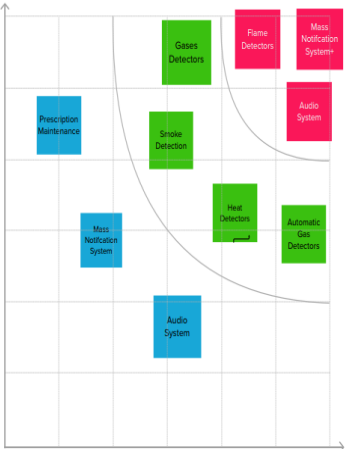
Category4

4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes



Feasibility

Regardless of the importance, all ideas are more feasible than others (Good ideas often outcompete, etc.)

3.3 PROPOSED SOLUTION

S.NO	PARAMETERS	DESCRIPTION
1.	Problem Statement (Problem to be solved)	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. Furthermore, gas leakage can cause fire that will lead to serious injury or death and it also can destroy human properties
2.	Idea / Solution description	When the gas leakage is detected, it will alert the user by alarm/buzzer It can send the SMS to the user also We can also make the exhaust fan on while during the gas leakage Detection of the gas leakage is important and halting leakage is important equally
3.	Novelty / Uniqueness	<ul style="list-style-type: none"> • instant detection of gas leakage • send SMS to the concerned user • easy to access and operate
4.	Social Impact / Customer Satisfaction	<ul style="list-style-type: none"> • Cost efficient • Easy to access and operate • Easy installation and detect the gas leakage fast • Prevent fires and explosions
5.	Business Model (Revenue Model)	<ul style="list-style-type: none"> • This project is mainly for Industries so we can visit to the industries and explain them about the benefits of our project and make aware about the gas leakage also. • We can also use this in household as well as industries
6.	Scalability of the Solution	<ul style="list-style-type: none"> • Our end -to -end wireless gas monitoring system uses wireless sensors to detect the presence of toxic gases. The solution can hence be scaled up for flexible functionality and offer great extendibility for multi -purpose usage. • We can also upgrade it in future like making exhaust fan on while gas is detected (or) like making automatically close the valve of gas cylinder when the gas is start to leak.

3.4 PROBLEM SOLUTION FIT

Project Title: **GAS LEAKAGE MONITORING AND ALERTING SYSTEM FOR INDUSTRIES**

Project Design Phase-I - Solution Fit Template

Team ID: **PNT2022TMD28556**

Define CS, fit into CC	1. CUSTOMER SEGMENT(S) CS Who is your customer? i.e. working parents of 0-5 y.o. kids The industrialists who use gases for their manufacturing.	6. CUSTOMER CONSTRAINTS CC What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices. High budget in installing other products make them to move far from modern technologies.	5. AVAILABLE SOLUTIONS AS Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros & cons do these solutions have? i.e. pen and paper is an alternative to digital notetaking Then 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.	Explore AS, differentiate
	2. JOBS-TO-BE-DONE / PROBLEMS J&P Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides. Most of gas explosions are caused by undetected gas leakage in the pre-detection condition. so that, gas leakage monitoring and altering system is needed. The purpose of this system is to detect gas leakage, neutralize it, and prevent the explosion.	9. PROBLEM ROOT CAUSE RC What is the real reason that this problem exists? What is the back story behind the need to do this job? i.e. customers have to do it because of the change in regulations. When the workers failed to monitor properly, the gas can cause high risk to their health or the properties of the industry.	7. BEHAVIOUR BE What does your customer do to address the problem and get the job done? i.e. Directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace) Using manpower as the source of monitoring the leakage causes high hazards. if the gas leaked is heavily toxic, there is a chance of causing hereditary health issues too.	
Focus on J&P, tap into BE, understand RC	3. TRIGGERS TR What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news. Most of gas explosions are caused by undetected gas leakage in the pre-detection condition. so that, gas leakage monitoring and altering system is needed.	10. YOUR SOLUTION SL If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality. If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour. Develop an efficient system & an application and alter the workers.	8. CHANNELS of BEHAVIOUR CH 8.1 ONLINE What kind of actions do customers take online? Extract online channels from #7 8.2 OFFLINE What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development. ONLINE: Promoting through social media with the help of social media entrepreneurs/influencer. OFFLINE: Newspaper advertisements.	Identify strong TR & EM
	4. EMOTIONS: BEFORE / AFTER EM How do customers feel when they face a problem or a job and afterwards? i.e. lost, insecure > confident, in control - use it in your communication strategy & design. Before: the heavy losses due to the leakage made them feel of guilt due to reduced reputation of their products. After: increased the level of confidence and feel.			

4.REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

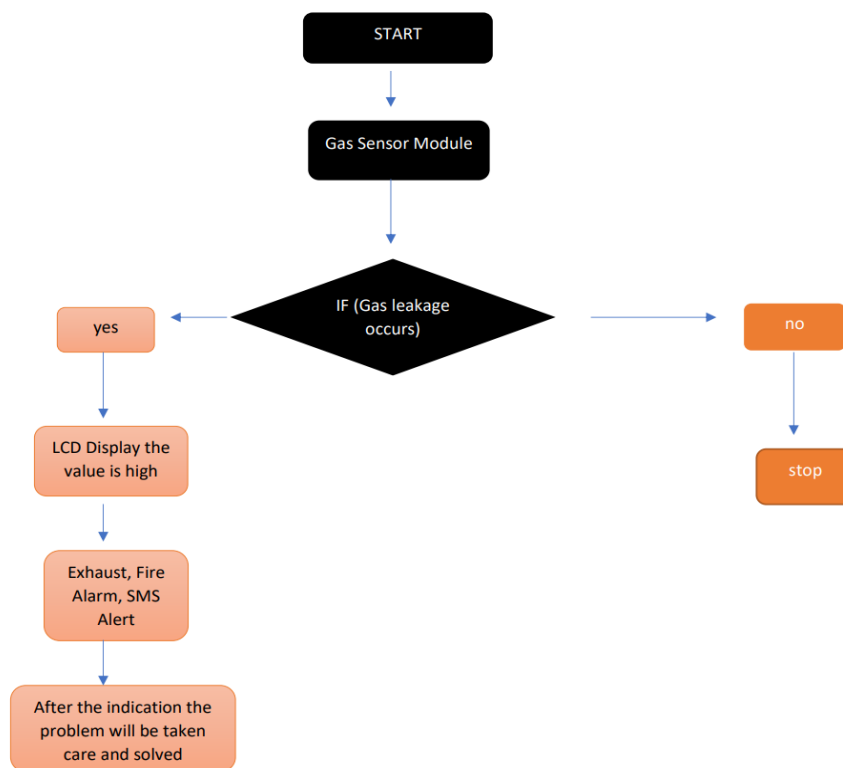
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Monitoring	Level of gas is monitored using sensor and if there is any leakage, alert can be sent through messages and with a buzzer sound.
FR-2	User Reception	The data like the level of gas can be send through messages
FR-3	User Understanding	The user can monitor the level of gas with the help of the data. If there is an increase in gas level then the alert will be given by message or buzzer sound.
FR-4	User Performance	When the user gets notified, they could take precaution steps like turning the gas off, turn on the exhaust fan/sprinkler and avoid serious accidents.

4.2 NON-FUNCTIONAL REQUIREMENT

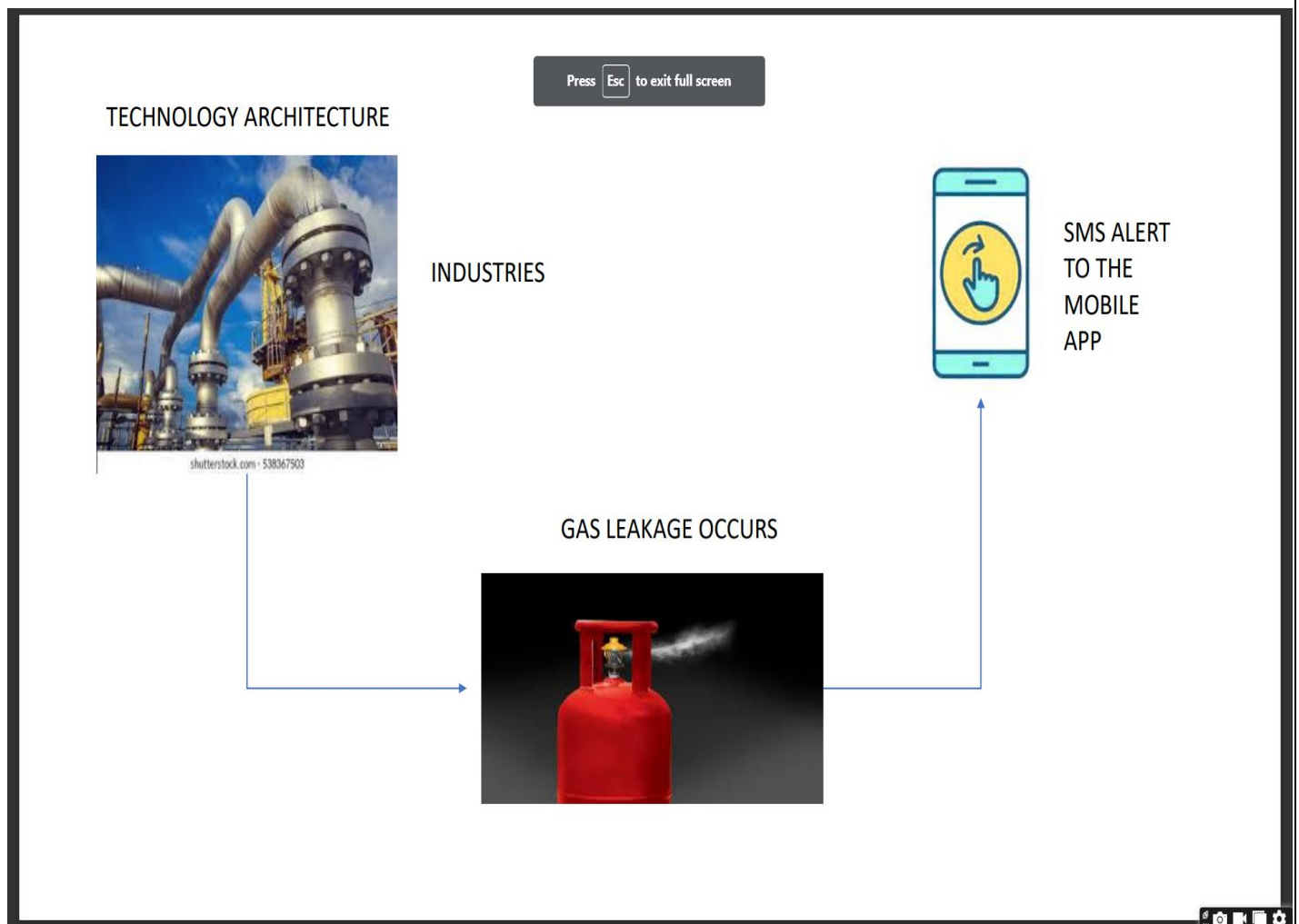
NFR No.	Non-Functional Requirement	Description
NFR-1	Usability	It updates the data regularly as well as protects the workers.
NFR-2	Security	As a result of emergency alert, we can be able to protect both the humans and properties. Precaution steps could be taken.
NFR-3	Reliability	Can be able to provide accurate values. It might have a capacity to recognize the smoke accurately and does not give a false.
NFR-4	Performance	Sprinklers and exhaust fans are used in case of emergency.
NFR-5	Availability	24/7 service
NFR-6	Scalability	Sensors can be replaced every time it fails.

5.PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS



5.2 SOLUTION AND TECHNICAL ARCHITECTURE



User Stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer(family member/industry owner)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
Customer	confirmation	USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
Customer (fire service 101)	Safety measure register	USN-3	As a register I can register the application in owner/family members mobile phone	I can register & access the dashboard with GMAIL/Facebook Login	Low	Sprint-2
Customer (mobile user)	Mobile application	USN-4	As a user I can register by mobile application	I can register for gas detection device with owners mobile number and the alert message will be send by SMS	Medium	Sprint-1
Customer (credential)	Login	USN-5	As a user, I can log into the application by entering email & password	Mail address and passwords are default	High	Sprint-3
Customer (Web user)	Notification	USN-6	As a user when there is a critical situation regarding gas explosion the alert notification will be received through GSM module	Alert message is sent to owners mobile as an SMS	High	Sprint-4
Customer care Executive	Network Connectivity	USN-7	When there is a gas leakage is detected in the surrounding	Sensor detect the leakage and notifies the owner via message and through buzzer	High	Sprint-3
Administration	Accessing	USN-8	When there is an issue in accessing the device	Admin/Device operator's advice should be undertaken	High	Sprint - 4

6.PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING AND ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Sensitivity of the Gas sensor	USN-1	This is the primary requirement for sensing gas leakage.	2	High	Dineshkumar.S Krishnamurthy.RE
Sprint-1	The next important thing for this is the microcontroller	USN-2	This is also the first stage in which it controls all the activities of the gas leakage sensor.	1	High	Karthi.S Ananthan.A
Sprint-2	Alerting the Authourised person	USN-3	An alert message will be sent to the person when there is a leakage of gas, who has the access to the gas leakage detection application.	2	High	Dineshkumar.S Ananthan.A Karthi.S Krishnamurthy.RE
Sprint-1	Cloud database management	USN-4	The datas about the gas flow and the leaks are monitored and stored in a cloud based system for	2	High	Dineshkumar.S Ananthan.A Karthi.S Krishnamurthy.RE

6.2 SPRINT DELIVERY SCHEDULE

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	20 Oct 2022	30 Oct 2022	20	27 Oct 2022
Sprint-2	20	6 Days	27 Oct 2022	31 Oct 2022	20	28 OCT 2022
Sprint-3	20	6 Days	09 Nov 2022	13 Nov 2022	20	30 OCT 2022
Sprint-4	20	6 Days	16Nov 2022	20 Nov 2022	20	01 NOV 2022

7. CODING AND SOLUTIONING

7.1 FEATURE 1

S.NO	FEATURES	FUNCTIONS
1.	TECHNOLOGY	Gas Leakage monitoring
2	SENSORS	To detect the leakage of gas and temperature.
3	CLOUD DATABASE	To collect the data's of the flow of gas through the pipelines.
4	EFFICIENCY	Easy to access and it sends message to the user immediately.
5	TRACKING SYSTEM	Route planning for gas leakage through the sensors.
6	OPTIMIZATION	Overview of scheduled and executed route.
7	PROGRESS	Data base of industry reports.

FEATURES OF GAS LEAKAGE MONITORING AND ALERTING SYSTEM FOR INDUSTRIES

The purpose of the system is to detect gas leakage, neutralize it and prevent the explosion.

It effectively detects the presence of hazardous gases like propane and methane and other gases, it alerts the plant authorities, preventing the premises from unexpected ignition. Moreover a gas monitoring solution uses gas analyzers to generate alerts regarding the temperature increase.

Gas detection and monitoring systems are used as safety devices to alert workers of the potential danger of poisoning by toxic gas exposure , asphyxiation due to lack of oxygen or explosion caused by combustible gases.

7.2 FEATURE 2

CODE FOR GAS LEAKAGE.

```
#IBM Watson IOT Platform
#pip install wiotp-sdk import
wiotp.sdk.device import time
import random myConfig = {
    "identity": {
        "orgId": "yf0dyy ",
        "typeId": "Kumaran ",
        "deviceId":"12345"
    },
    "auth": {
        "token": "VJTDPRX@f&4Vuox8ms "
    }
}
def myCommandCallback(cmd):
    print("Message received from IBM IoT Platform: %s" %
        cmd.data['command']) m=cmd.data['command'] client =
        wiotp.sdk.device.DeviceClient(config=myConfig,
        logHandlers=None)
client.connect()

while True:
    gas=random.randint(0,100)

    temp=random.randint(0,100) hum=random.randint(0,100)
    pre=random.randint(0,100) myData={'Hazardous Gas':gas,
    'Temperature':temp, 'Humidity':hum,
    'Pressure':pre } client.publishEvent(eventId="status", msgFormat="json",
    data=myData, qos=0, onPublish=None) print("Published data Successfully: %s",
    myData) client.commandCallback = myCommandCallback time.sleep(2)
client.disconnect()
```

8. TESTING

8.1 TEST CASES

- To predict the leakage of the gas.
- To send a alert message to the user.
- To collect the data and store it in the cloud data base.

8.2 USER ACCEPTANCE TESTING

- To access the dashboard and to login using the login credentials given to particular individuals.
- To monitor the gas level using the mobile web application.
- To alert the user through the alarm and as well as send a alert message through SMS.

9.RESULTS

9.1 PERFORMANCE METRICS

After this project performance can conclude that the detection of the LPG gas leakage is incredible in the project system. Applicable usefully for industrial and domestic purposes. In dangerous situations, we can save the life by using this system. An alert is indicated by the GSM module. A sensor node senses gas like CO₂, oxygen, and 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.

10.ADVANTAGES

- Get real-time alerts about the gaseous presence in the atmosphere.
- Prevent fire hazards and explosions.
- Supervise the gas concentration levels.
- Ensure worker's health.
- Real-time updates about leakage.
- Cost-effective installation.
- Data analytics for improved decision.
- Measure oxygen level accuracy.
- Get immediate gas leak alerts.

DISADVANTAGES

- Non-linear response
- It requires air or oxygen to work
- It can be poisoned by lead, chlorine and silicon
- It gets reacted due to heating of wire
- It is difficult to know failure modes unless very advanced methods of monitoring are used.
- All the gases do not have infrared absorption.
- Sequential monitoring is slower on multi-point analyzers.
- It requires more user expertise.
- It is susceptible to contaminants and changes due to environment conditions.
- Non-linear response affects sensor complexity.

11.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 by the GSM module. A sensor node senses gaslike 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.

12.FUTURE SCOPE.

- The Smart Home application, which includes a gas monitoring system, is being promoted by major Indian cities.
- The Internet of Things transforms a drone into a gas detection sensor, enhancing industrial safety. Including an Automatic Shut-Off device, which will shut off the gas supply whenever it detects gas leakage, is another significant future possibility.
- This system can be used in hotels, industries, and anywhere else that uses LPG cylinders. Applications like furnaces, boilers, gas welding, gas cutting, steel plants, metallurgical industries, food processing, glass, plastic, pharmaceuticals, and aerosol manufacturing can all benefit from this system.
- This system can be used to track all of the cylinders that are used in hospitals because they need to be as safe as possible for patients. Oxygen, carbon dioxide, and nitrogen oxide cylinders are some of the cylinders used.
- The risk of accidents is high because so many students are naive.
- As a result, schools and colleges can also benefit from our system.
- There are numerous well-established laboratories at colleges, including chemistry and pharmaceutical laboratories with gas burners. Gas cylinders are required for numerous medical equipment.

13.APPENDIX.

The presence of hazardous LPG gas leakage in a domestic, work place, also, stored gases container gas which exhibits ideal characteristic is use. For that sake, an alarm unit is used to vibrate an alarm which is buzzer. Buzzer gives an audible sign of the presence of LPG volume. The sensors are widely used to detect essence of propane, iso-butane, LPG and even smoke. The sensor has an advantage to combine a sensitivity response time. If the LPG sensor senses gas leak from work place or home, sensor output goes to active low (logic-0) condition. Arduino UNO is used in the project; low signals are overlooked by the Arduino and gas leakage is been noticed by the Arduino. The Arduino UNO turns on the LCD and buzzer. It even turns on the GSM modem after that, it continues to send messages SMS to mobile number specifically mentioned in the program of the source code for alerting danger to the people.

SOURCE CODE

```
#include <LiquidCrystal.h>

LiquidCrystal lcd(5,6,8,9,10,11);


int redled = 3;
int greenled = 2;
int buzzer = 4;
int sensor = A0;
int sensorThresh = 400;


void setup()
{
  pinMode(redled, OUTPUT);
  pinMode(greenled, OUTPUT);
  pinMode(buzzer, OUTPUT);
  pinMode(sensor,INPUT);
  Serial.begin(9600);
```

```
lcd.begin(16,2);
}

void loop()
{
  int analogValue = analogRead(sensor);
  Serial.print(analogValue);
  if(analogValue>sensorThresh)
  {
    digitalWrite(redled,HIGH);
    digitalWrite(greenled,LOW);
    tone(buzzer,1000,10000);
    lcd.clear();
    lcd.setCursor(0,1);
    lcd.print("ALERT") ;
    delay(1000);
    lcd.clear();
    lcd.setCursor(0,1);
    lcd.print("EVACUATE");
    delay(1000);
  }
  else
  {
    digitalWrite(greenled,HIGH);
    digitalWrite(redled,LOW);
    noTone(buzzer);
    lcd.clear();
    lcd.setCursor(0,0);
    lcd.print("SAFE");
    delay(1000);
    lcd.clear();
  }
}
```

```
    lcd.setCursor(0,1);  
    lcd.print("ALL CLEAR");  
    delay(1000);  
}  
  
}
```

PROJECT DEMO LINK

https://drive.google.com/drive/folders/1WloAeNmWVzba3KdmXOaLMYc7FjdY3VXq?usp=share_link

GITHUB LINK

<https://github.com/IBM-EPBL/IBM-Project-27550-1660059757.git>