Team Id: PNT2022TMID14261
Team Members: Jawahar, Chandru, Gokul Prasath, Mithun Sanjai.
(Electronics and Communication Engineering)

Gas Leakage Monitoring and Alerting System

Abstract :-

Leakage of any kind of gas has been a concern in recent years, whether it is in a residential setting, a business, a cafe, or a canteen. In this paper development of an IoT based gas wastage monitoring, leakage detecting and alerting system is proposed. This paper elaborates design such an intelligent system that will help save gas and smartly prevent accidents. The system needs to be integrated with the cooker. The technology includes ultrasonic sensors that determine if the cooker is being utilized for cooking purposes or not. If it is discovered that the cooker is not in use, the system uses an automatic switching off mechanism to cut off the gas supply. The moment gas leakage will probably be recognized, users will be informed via SMS through GSM, and so that user can solve the issue as soon as possible. The system will monitor flame and fire through flame sensor. When a fire is detected, the buzzer begins to sound. 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 portionof the wasted gas in domestic.

1.Introduction :-

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.

1.1 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.

1.2 Purpose:-

Huge industries, especially oil refineries are severely exposed to harmful explosions and human risks even with a slightest of the gas leak. Moreover, the expenses due to gas leakages are enormous. This ranges from the production loss in food industries to the infrastructure losses by flammable gas leaks including the healthcare costs to treat the patients injured by gas poisoning. In the USA alone, the treatment costs linked to carbon monoxide intoxication is over $1.3 billion and the death losses due to this are over 2000 per year. Hence, advanced level gas sensors or gas monitoring systems help the manufacturers to procure accurate and real-time information regarding accidental gas leaks.

2. LITERATURE SURVEY:-

Whenever there is an occurrence of gas leakage in a particular place the robot immediately read and sends the data to android mobile through wireless communication like Bluetooth. We develop an android application for android based smartphones which can receive data from robot directly through Bluetooth. The application warns with an indication whenever there is an occurrence of gas leakage and we can also control the robot movements via Bluetooth by using text commands as well as voice commands. The previous mobile robots are based on heterogeneous technologies like GSM, GPS, internet based etc., but the main disadvantage of those prototypes were the absence of communication in particular areas. So, with the rapid developments and tremendous changes in technology we have lots of techniques to eradicate previous problems. Wireless communication protocols play a vital role in present trends. Bluetooth, WI-Fi, Zigbee etc., we use one of the best feature of smartphone, i.e., the Bluetooth technology to control and monitor parameters driven by a robot

2.1 Existing problem:-

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.

2.2 References

[1]. Johansson, A.; Birk, W.; Medvedev, A., “Model-based gas leakage detection and isolation in a pressurized system via Laguerre spectrum analysis”, Proc. of IEEE International Conference on Control Applications, pp. 212-216, 1998.

[2]. C.Selvapriya, S.Sathyaprabha, M.Abdulrahim," LPG leakage monitoring and multilevel alerting system", published in 2013.
[3]. Ch. Manohar Raju, N. Sushma Rani, "An android based automatic gas detection and indication robot. In International Journal of Computer Engineering and Applications. 2014;8(1).
[4]. Zhao Yang, Mingliang Liu, Min Shao, Yingjie Ji Research on leakage detection and analysis of leakage point in the gas pipeline system. In Open Journal of Safety Science and Technology; 2011.

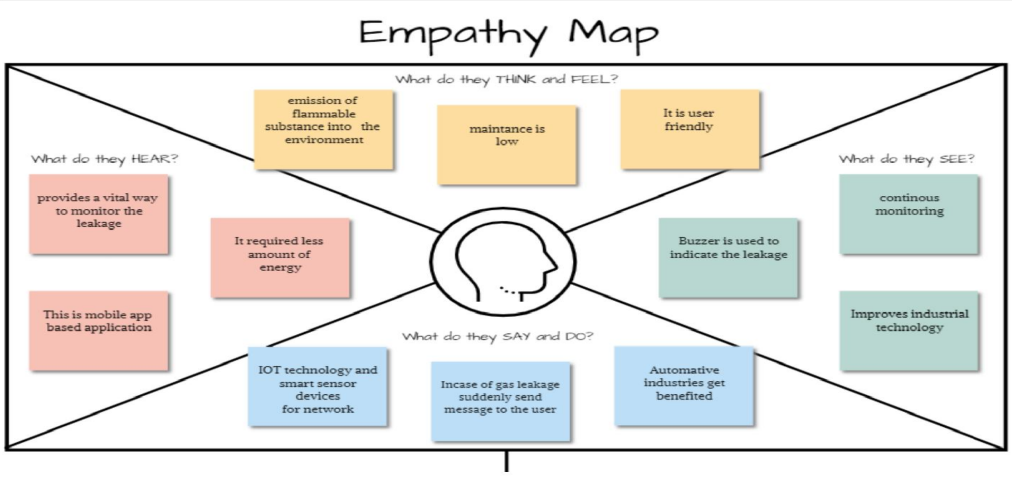
2.3 Problem statement definition:-

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 AND PROPOSED SOLUTION

3.1 Empathy map canvas

Empathy Map on gas leakage monitoring and alerting system



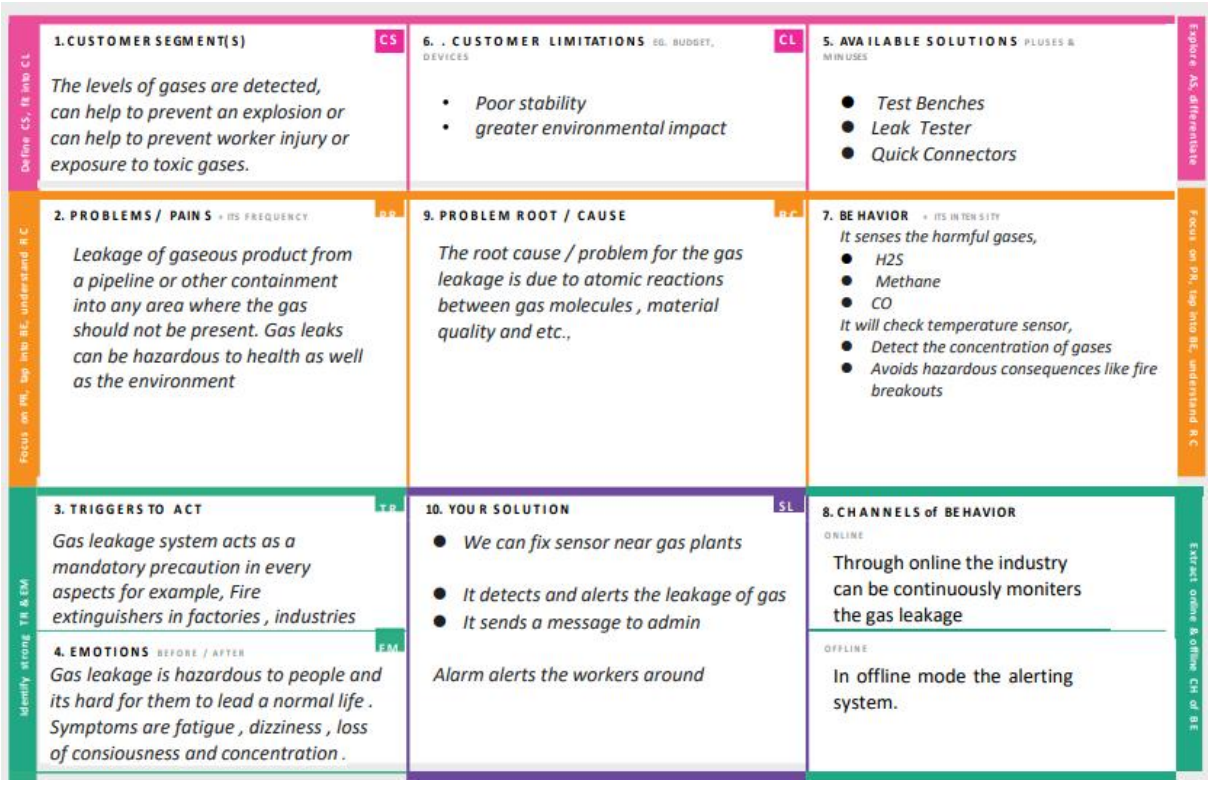
3.2 Ideation and brainstorming

The leakage of LPG gas is detected by the MQ6 gas sensor. The analog output from the gas sensor is given to the micro controller, which converts it into digital form using its in-built ADC. It consists of predefined instruction set. Based on this, the exhaust fan is switched on. So, the concentration of gas inside the room gets decreased. Then, the stepper motors are rotated for closing the knob of the cylinder and the main power supply. Because of this process, the leakage of gas the flow of current are stopped. The relay is switched to off the power supply of the house. The buzzer produces an alarm to indicate the gas leakage.

3.3 Proposed Solution

S. No	Parameter	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. Thus, this system will help to detect the presence of gas leakage.
2.	Idea / Solution description	Workers who are engaged with a busy industries packed with gas either harmful or harmless needs a way to monitor their gas pipelines continuously and detect early if there is any leakage of gas in their surroundings so that they can work efficiently on major crises rather than worrying about monitoring or leakage of gas, this will indeed reduce the manpower of that industry and create a peaceful environment.
3.	Novelty / Uniqueness	Some of the solutions are only detecting some particular gases where some others failed to alert the main department and other solutions are with some delays. Our solution not only notify the industry person but also notify the fire fighters so that can take control over the situation and our solution will alert the workers even there is a small leak of gases.
4.	Social Impact / Customer Satisfaction	Through this project the workers mental pressure will be reduced so that they can concentrate on other works or by relaxing them

3.4 Proposed Solution Fit



4.REQUIREMENT ANALYSIS

4.1 Functional Requirement

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User convenience	Through message notification we can easily get data of gas level and in case of gas leakage, it can directly send notification to nearby hospitals and police station
FR-2	User visibility	Gas level can be monitored by users if there is any leakage and they will be receiving alert notification.
FR-3	User reception	The notification for the gas level and leakage can be send through messages.
FR-4	User understanding	User can monitor the level of gas with help of the data. If there is an increase in gas level then the alerts will be given
FR-5	User performance	When the user gets notified ,they could turn on the water sprinkler or exhaust fan.

4.2 Non-Functional Requirement

Non-functional Requirements:

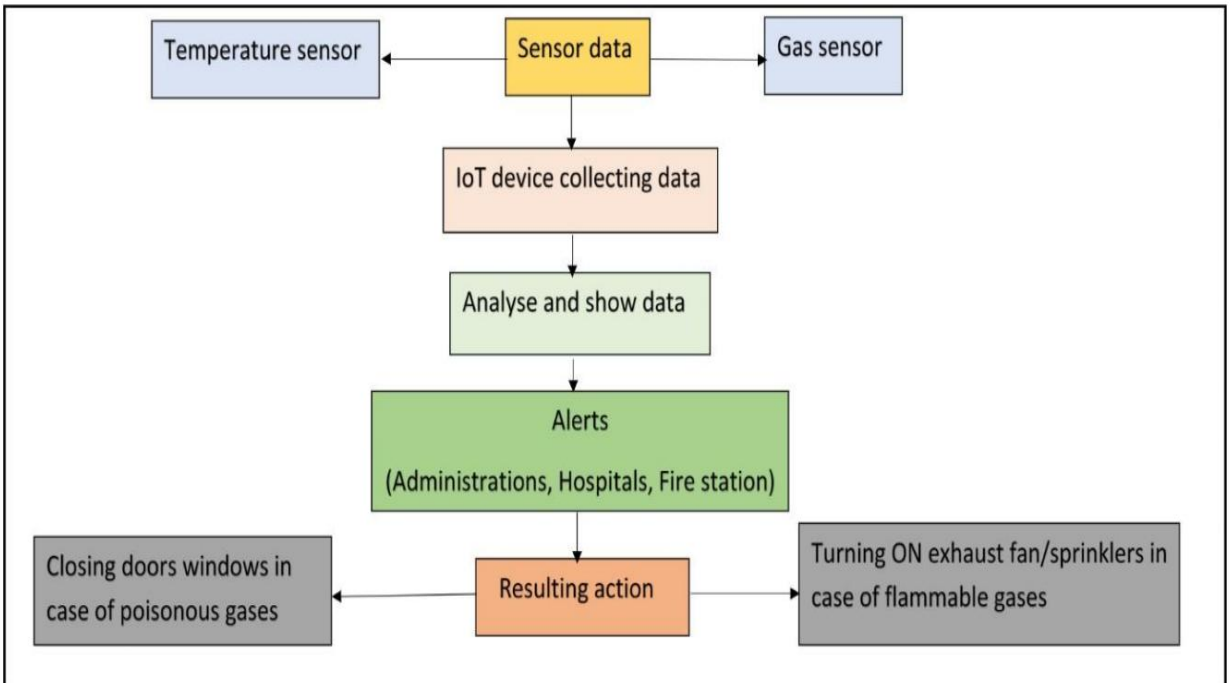
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	It updates data periodically and protects the workers in industries.
NFR-2	**Security**	In case of emergency alerts, industrial properties and human beings are protected from fire accidents.
NFR-3	**Reliability**	It will provide most accurate information and have Capacity to recognize the hazardous gas which is true or not.
NFR-4	**Performance**	During fire, water sprinklers and exhaust fans are used .
NFR-5	**Availability**	It can be accessed both day and night.
NFR-6	**Scalability**	Once the sensor got fails it can be easily replaced.

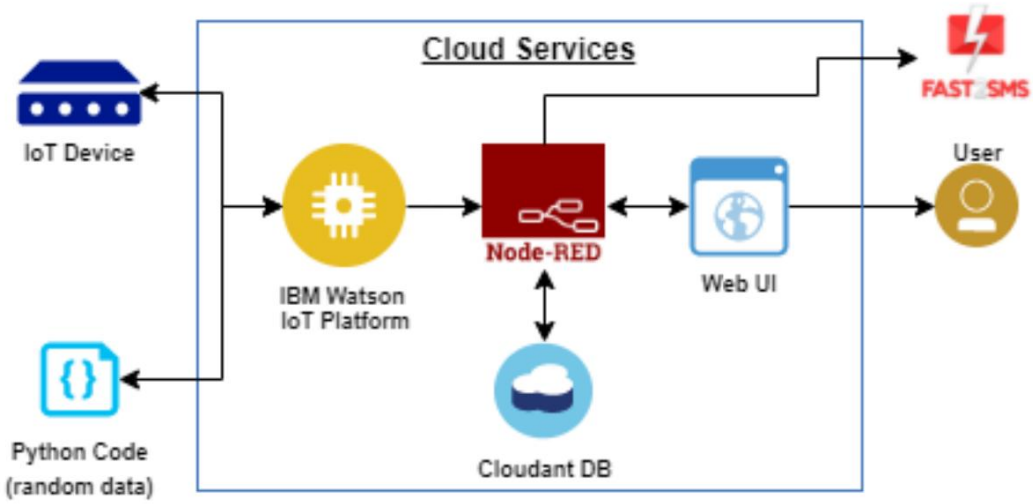
5.PROJECT DESIGN

project design includes data flow daigram,solutional architecture for the project based on IoT that gives a proposed solution for respective problem statement.

5.1 Data Flow Diagram



5.2 Solution and Technical Architecture



5.3 User Stories

	STAGE 1	STAGE 2	STAGE 3	STAGE4	STAGE5
OBJECTIVES	Write a goal or activity	This system alerts the user from the environmental exposure to the harmful gases	This system comprises of sensors which alerts the micro-controller for the leakage of gases that will alert the user by displaying warning information.	Gas leakage detection is the process of detecting the environmental exposure of harmful gases and alerting the user by the notification	The alarm management system is the main role in this system that will notify the user in case of any gas leakage
NEEDS	Write a need that you want to meet	Hazardous gas leakage	Fire hazard preventing	Oxygen level monitoring	Prompts leakage alerts
FEELINGS	Write an emotion that you expect from the customer	Happy for the solution	Using the system and feels no complexity	Happy and excited	Encourage the solution and giving good feed backs
BARRIER	Sad Write the challenges to your objectives	Higher officials	Company managements	Government towards this implementation	Harmful gases that may cause unconsciousness to the people

6.PROJECT PLANNING & SCHEDULING

6.1sprint delivery and estimation

Sprint	Functional Requirement (Epic)	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Resources Initialization	Create and initialize accounts in various public APIs like OpenWeatherMap API.	1	LOW	Jawahar Chandru Mithun Sanjai Gokul prasath
Sprint-1	Local Server/Software Run	Write a Python program that outputs results given the inputs like weather and location.	1	MEDIUM	Jawahar Chandru Mithun Sanjai Gokul prasath
Sprint-2	Push the server/software to cloud	Push the code from Sprint 1 to cloud so it can be accessed from anywhere	2	MEDIUM	Jawahar Chandru Mithun Sanjai Gokul prasath
Sprint-3	Hardware initialization	Integrate the hardware to be able to access the cloud functions and provide inputs to the same.	2	HIGH	Jawahar Chandru Mithun Sanjai Gokul prasath
Sprint-4	UI/UX Optimization & Debugging	Optimize all the shortcomings and provide better user experience.	2	LOW	Jawahar Chandru Mithun Sanjai Gokul prasath

7.CODING AND SOLUTIONING

```
#include
<LiquidCrystal.h>
                    LiquidCrystal
                    lcd(5,6,8,9,10,11);
                    int redled = 2;
                    int greenled = 3;
                    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");
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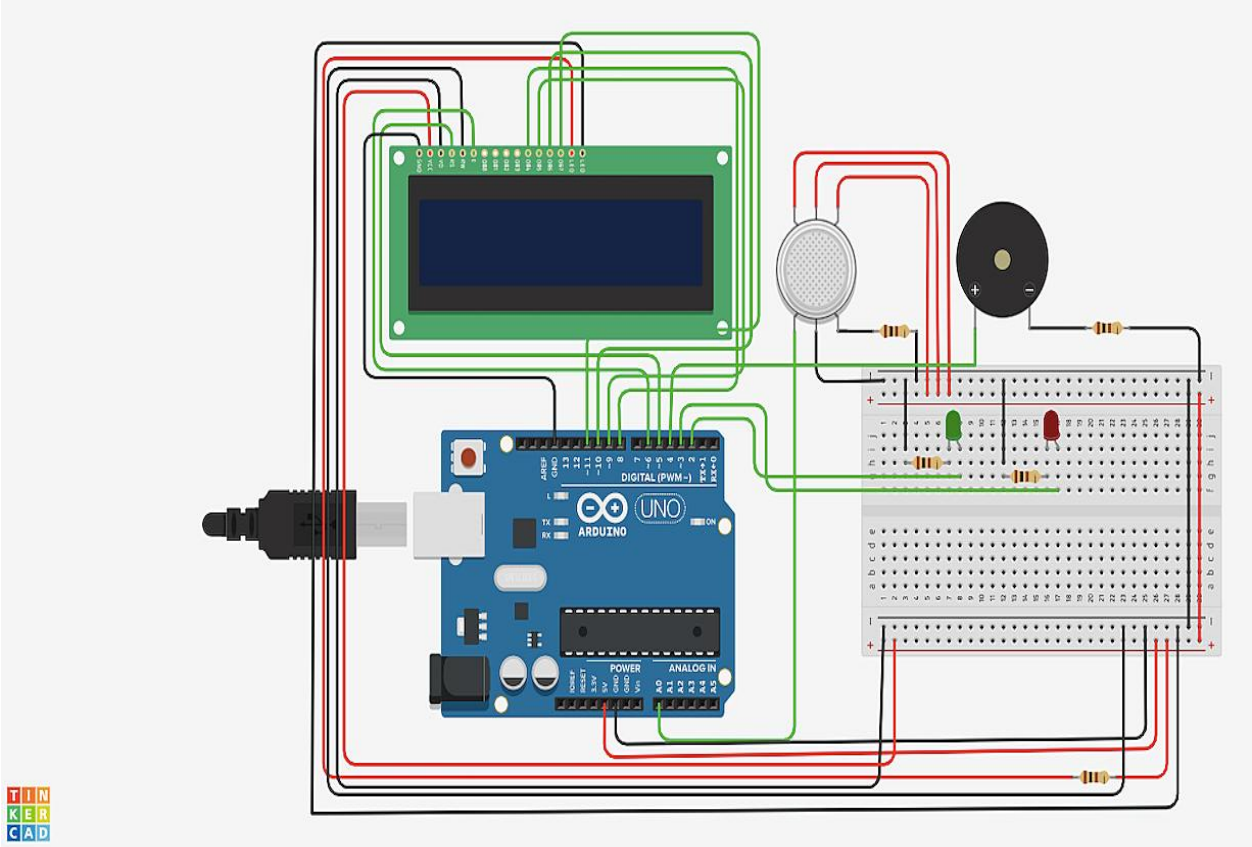
8.TESTING

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	24	14	13	26	77

9.RESULTS



10.ADVANTAGES & DISADVANTAGES

Advantages:

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

Disadvantages:

- It requires air or oxygen to work
- It gets reacted due to heating of wire.
- It can be poisoned by lead, chlorine and silicon
- t is affected due to ambient light interference.

10. 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 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.

12.FUTURE SCOPE

Major cities of India are pushing Smart Home application, gas monitoring system is a part of Smart Home application. Enhancing Industrial Safety using IoT. IoT turns drone into gas detection sensor. Another major 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. This system can be used in industries involving applications such as Furnace, Boilers, Gas welding, Gas cutting, Steel Plants, Metallurgical industries, Food processing Industries, Glass Industries, Plastic industries, Pharmaceuticals, Aerosol manufacturing. As hospitals require to provide maximum possible safety to patients, this system can be used to keep track of all the cylinders used in it. Some of the cylinders used are Oxygen cylinder, Carbon dioxide cylinder, Nitrous oxide cylinder. As many students are naïve the risk of causing accidents is high. Hence, our system can also be used in schools, colleges. Many colleges have well established labs including chemistry lab and pharmaceutical labs where gas burners are used. Plenty of medical equipment requires gas cylinders.

13.APPENDIX
SOURCE CODE:

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GITHUB LINK

https://github.com/IBM-EPBL/IBM-Project-9793-1659075664.git