GAS LEAKAGE MONITORING AND ALERTING SYSTEM

PROJECT REPORT

Submitted by

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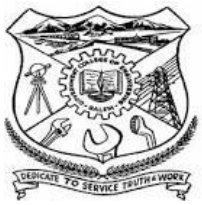

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Project Report

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

7.1 Feature 1

7.2 Feature 2

7.3 Database Schema (if Applicable)

8. TESTING

8.1 Test Cases

9. RESULTS

9.1 Performance Metrics

10. ADVANTAGES & DISADVANTAGES

11. CONCLUSION

12. FUTURE SCOPE

13. APPENDIX

Source Code

GitHub & Project Demo Link

1.INTRODUCTION

1.1 Project overview

Gas leakage in the industries has been a concern in the recent years. In this Project, development of an IoT based gas leakage monitoring and alerting system is proposed.It elaborates the design such as an intelligent system that will help to detect gas and smartly prevent explosions and accidents. This will detect the harmful gases in environment and alerting to the society member through alarm and sending notification. The moment the gas leakage will probably be recognized,users will be informed through a SMS alert through GSM as well as be displayed in the LCD board with a buzzer alarm and so that the user can solve the issue as soon as possible. The system will monitor flame and fire through gas sensor. When a gas is detected, the buzzer begins to sound. Aside from that, the system also has a cloud storage capability. The usage of gas for each industry each day may be tracked with the aid of this cloud storage solution. 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 towards preventing explosions and saving the lives of people.

1.2 Purpose

Even though most of the industries have fire safety mechanism, it can be used only after the explosions. In order to have a control over such conditions, we have proposed a system that uses sensors which is capable of detecting the gases such as LPG, CO2, CO and CH4 etc.., This system will not only be able to detect the leakage of gas but also alert through audible alarms and SMS message when there is a presence of excess amounts of harmful gases..

2.LITERATURE SURVEY

2.1 Existing problem

If a person wants to detect gas in industry/home, so that gas leakage can destroy the entire industry/home even if there occurs a small flame due to gas leakage. So one needs to know about the gas leakage when they are in outdoor to avoid explosion when they are away. In order to govern the gas when no one is available in the industry like off time of the industry, we have to monitor the gas leakage in the company to avoid explosion which causes more damages around the company.

2.2 References

1. Mahalingam, A., R. T. Naayagi, and N. E. Mastorakis. "Design and implementation of an economic gas leakage detector." Recent Researches in Applications of Electrical and Computer Engineering, pp. 20-24, 2012.

2. Attia, Hussain A., and Halah Y. Ali. "Electronic Design of Liquefied Petroleum Gas Leakage Monitoring, Alarm, and Protection System Based on Discrete Components." International Journal of Applied Engineering Research, vol. 11, no. 19, pp. 9721-9726, 2016.

3. Apeh, S. T., K. B. Erameh, and U. Iruansi. "Design and Development of Kitchen Gas Leakage Detection and Automatic Gas Shut off System." Journal of Emerging Trends in Engineering and Applied Sciences, vol. 5, no. 3, pp. 222-228, 2014.

4. T.Soundarya, J.V. Anchitaalagammai, G. Deepa Priya, S.S. Karthick kumar, “C-Leakage: Cylinder LPG Gas Leakage Detection for Home Safety,”

IOSR Journal of Electronics and Communication Engineering, vol. 9, no. 1, Ver. VI, pp. 53-58, Feb. 2014.

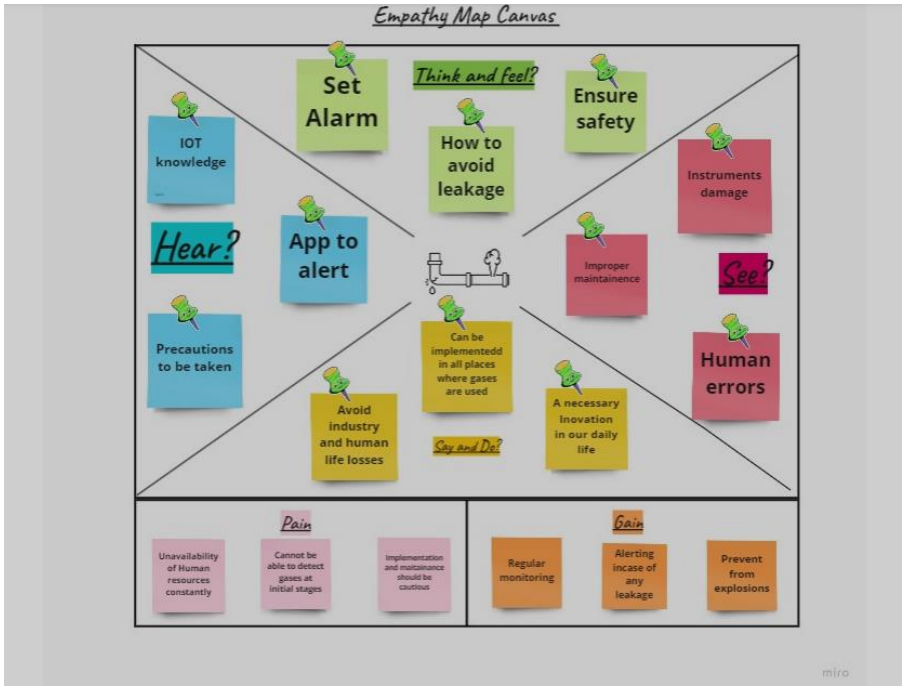
5. Ashish Shrivastava, Ratnesh Prabhaker, Rajeev Kumar, Rahul Verma, "GSM based gas leakage detection system." International Journal of Emerging Trends in Electrical and Electronics, vol. 3, no. 2, pp. 42-45, 2013.

2.3 Problem Statement Definition

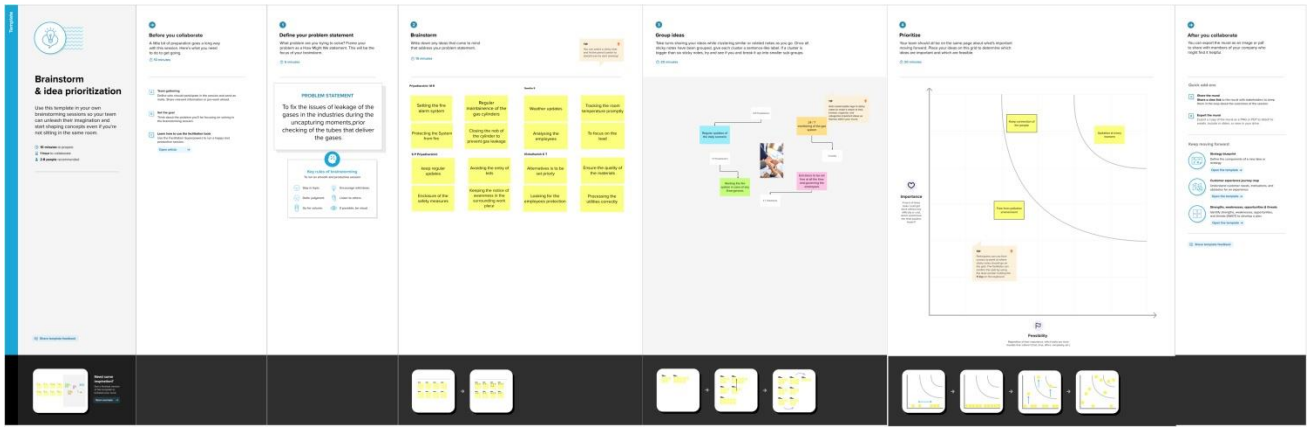
Gas leakage detection techniques were done in the past either as part of research papers/technical reports on a certain leak detection method and other gas related subjects. The proposed alarm system is mainly meant to detect LPG leakage, which is most commonly used in residential and commercial premises. The system detects not only the presence of gas (gas leak), but also the amount of leakage in the air, and accordingly raises an appropriate audio visual alarm. The objective of the system is to detect LPG gases such as propane and butane. The allowed UK level for butane is 600 ppm above which it is considered to be of high level and poses a danger. The proposed system ensures a continuous monitoring of the gas levels. If the gas level increases above the normal threshold level of 400 ppm butane (LPG), the system starts to issue early warning alarms at 100ms interval, which implies low level gas leakage. If the leakage level increases to 575 ppm of butane (LPG), the system activates high severity audio alarms at 50 ms intervals warning the occupants to run to safety.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



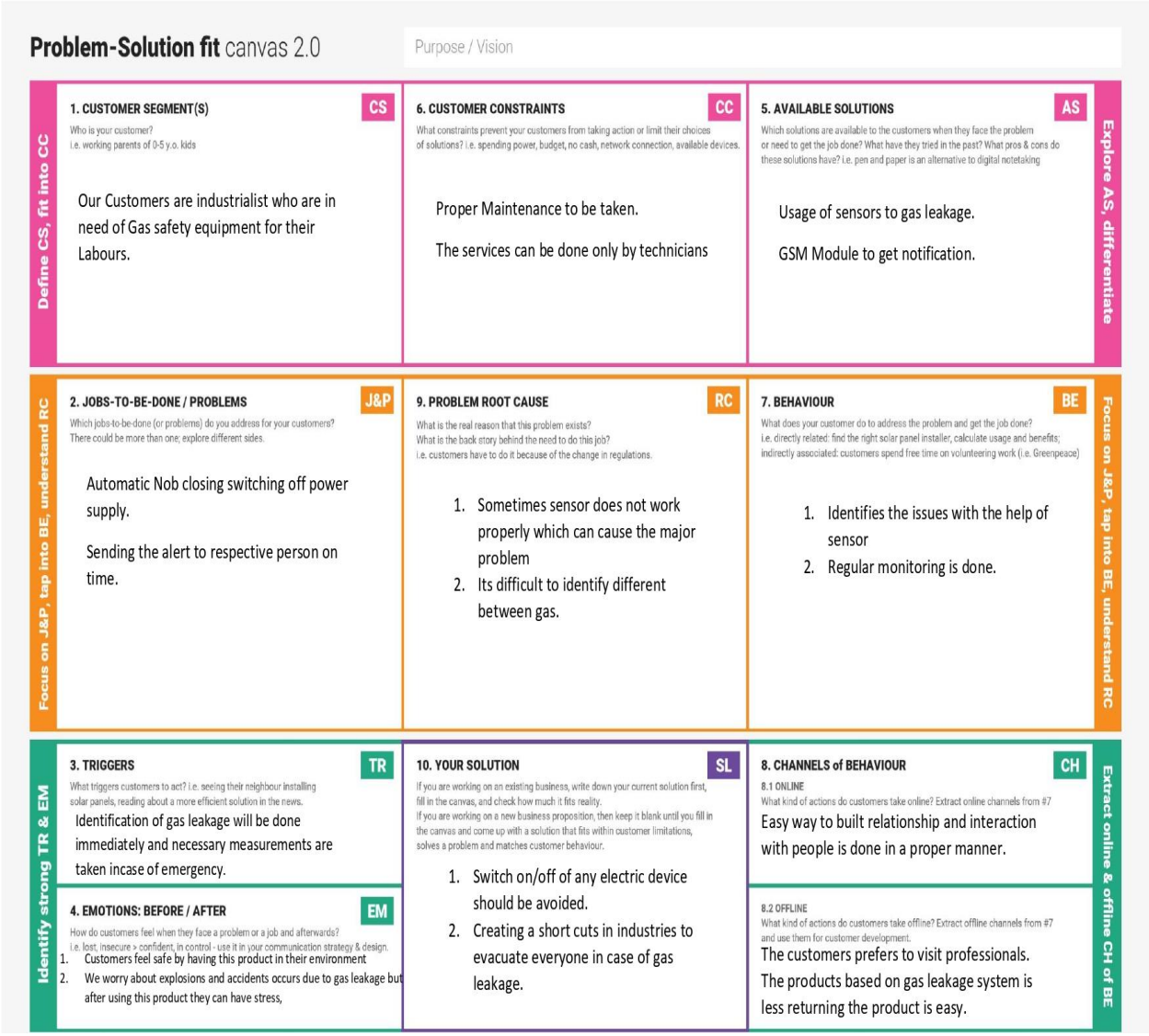
3.2 Ideation & Brainstorming



3.3 Proposed Solution

Fires due to gas leakage have been taking place frequently and the threat to human lives and properties is growing in recent years.Therefore, developing the gas leakage alert system is very essential. Hence, this project presents a gas leakage alert system to detect the gas leakage and to alarm the people onboard. The solution could detect gas leakage, send an alert to the end-user via an SMS or a buzzer, and feature an exhaust fan that gets activated once the gas or fire is detected. We have used the IOT technology to make a Gas Leakage Detector for society which having Smart Alerting techniques involving sending text message to the concerned authority and an ability performing data analytics on sensor. This system will be able to detect the gas in environment using the gas sensors. This will prevent form the major harmful problem. Get real-time alerts about the gaseous presence in the atmosphere helps to prevent fire hazards and explosions,supervise gas concentration levels,ensure worker's health,real-time updates about leakages,cost-effective installation and get immediate gas leak alerts. With a machine-to-machine interaction, the chemical industry is empowering its potential in dealing with productivity. IoT is a data-driven concept that utilizes the information for predicting future trends, enabling better business growth. The assistive technology segment leads the Internet of Things in the chemical industry with effective costs. The developed system provides an effective monitoring system and can be used in a wide range of applications such as gas leaks, fires, and mining applications and if converted for use in an outdoor environment, applications such as agriculture biomass burning emissions and chemical and biological agent detection studies.The system could be used in conjunction with ground sensors and integrated into an extensive gas monitoring system.

3.4 Problem Solution fit



4. REQUIREMENT ANALYSIS

4.1 Functional requirement

- **DC Motor** – With the help of the DC motor we can automatically close the knob of the cylinder whenever gas leakage is detected.
- **Sensor** - MQ6 sensor helps us to sense gas leakage leave.It can detect gas concentrations from 200 to 10000 ppm.
- **LCD Display** - It continuously shows the reading of the gas level in the environment.
- **Raspberry pi** - Receives the input light on the sensor and without any delay it starts activating the DC motor and sends notification messages to the owner.
- **GSM Module** - By using GSM module we can able to alert the user by sending warning messages.
- **Buzzer** - By fixing buzzers in industries we can able to alert the workers when there is a gas leakage is detected in their surroundings.

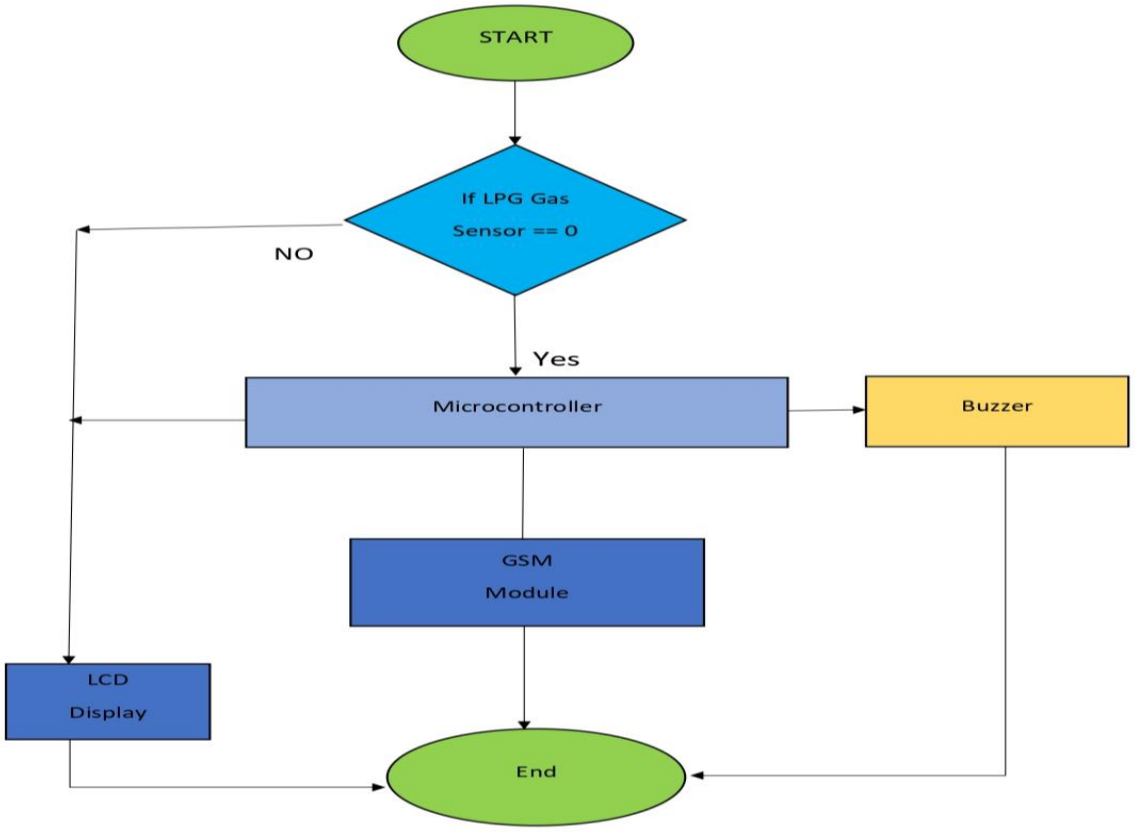
4.2 Non-Functional requirements

- **Usability** - DC motor to close the knob of the cylinder whenever gas leakage is detected. Sensors to sense gas leakage and the gas level is simultaneously shown in LCD board.
- **Security** - GSM module is installed to send alert notifications message to the user. Buzzers are used to indicate and alert users.
- **Reliability** - It helps to monitor the gas level regularly by which we can able to avoid explosions. Buzzers are used to indicate and alert users.

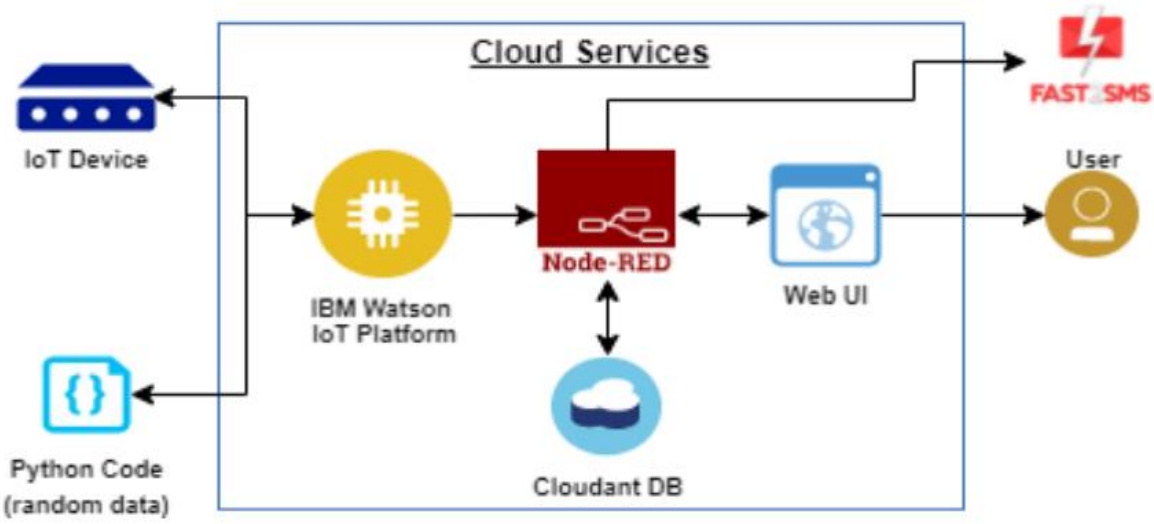
- **Performance** - Action are taken immediately after detection.Alert notifications are send to the user.
- **Availability** - It has MQ6 sensor that is highly sensitive to gas leakage.
- **Scalability** - We can even use stepper motor which gives a better performance and does not require human help.

5. PROJECT DESIGN

5.1 Data Flow Diagrams



5.2 Solution & Technical Architecture



5.3 User Stories

A.Mahalingam and N. E. Mastorakis introduce design and implementation of an economic gas leakage detector. They gave the formulation of many problems in previous gas leakage detectors. They told that several standards have been formulated for the design of a gas leakage detection system such as IEEE, BS 5730, and IEC. The proposed alarm system is mainly meant to detect LPG leakage, which is most commonly used in residential and commercial premises. The system detects not only the presence of gas (gas leak), but also the amount of leakage in the air, and accordingly raises an appropriate audio visual alarm. The allowed UK level for butane is 600 ppm above which it is considered to be of high level and poses a danger. The proposed system ensures a continuous monitoring of the gas levels.

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story/ Task	Story points	Priority	Team members
Sprint-1	Analysing the gas leakage	USN-1	The owner who wants to save his employees or a person who wants to save their family from explosion takes necessary actions	2	High	M.R.Priyadharshini S.P.Priyadharshini S.Swetha K.T.Vishalharish
Sprint-1	Preventing from explosion	USN-2	The fire officers worries about any explosions due to gas leakage which may cause many death	1	High	M.R.Priyadharshini S.P.Priyadharshini S.Swetha K.T.Vishalharish
Sprint-2	To detect the gas leakage	USN-3	The owner can take necessary steps by deploying gas detectors in their surroundings	2	Low	M.R.Priyadharshini S.P.Priyadharshini S.Swetha K.T.Vishalharish
Sprint-3	Testing and training of the model device	USN-4	The programmer can design an gas leakage detection model by training the dataset	2	Medium	M.R.Priyadharshini S.P.Priyadharshini S.Swetha K.T.Vishalharish
Sprint-4	Notification	USN-5	The gas leakage detected by the model can be notified using SMS or alarming system	1	High	M.R.Priyadharshini S.P.Priyadharshini S.Swetha K.T.Vishalharish

6.2 Sprint Delivery Schedule

Sprint	Total story points	Duration	Sprit start date	Sprint end date(planned)	Story points completed (as on planned end date)	Sprint release date(actual)
Sprint-1	20	6 days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

7. CODING & SOLUTIONING

7.1 Feature 1

The NodeMCU ESP32 is connected to the gas sensor to detect the presence of gas when it exceeds the threshold voltage of 400.When the gas is detected,it alerts the user through a buzzer notification.The buzzer is used inorder to indicate and alert the user that the gas has been detected and the adequate steps has to be taken, so that we can prevent it from explosions and can save the lives of people.

In addition to the buzzer indication,this system also provides us with a LCD display showing alert messages while the gas exceeds its threshold value and displays the safety notification when none of the gas s being detected.

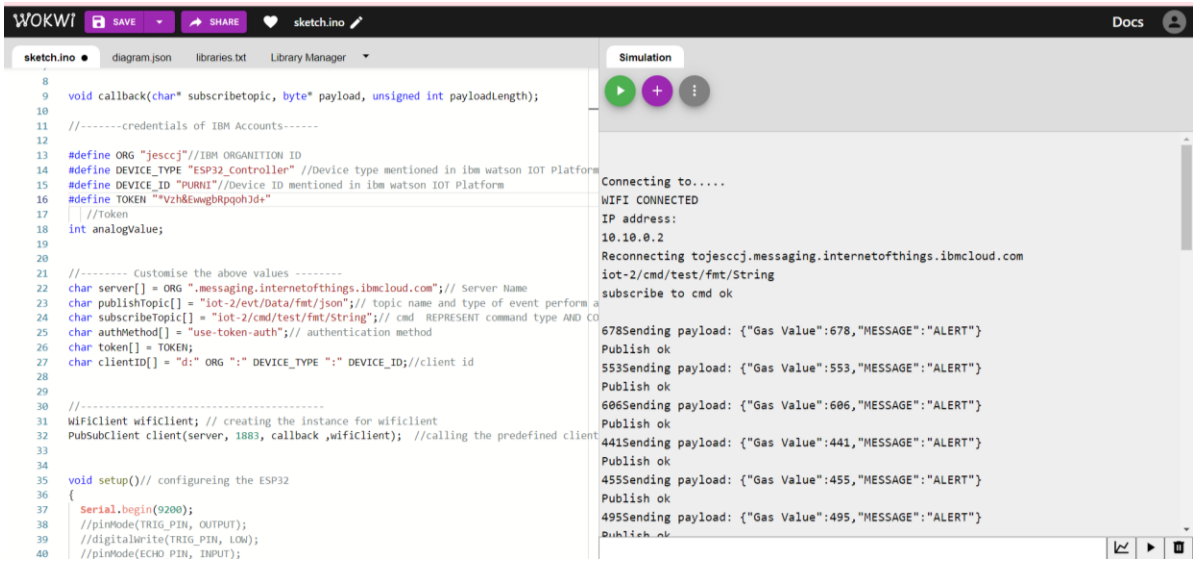
7.2 Feature 2

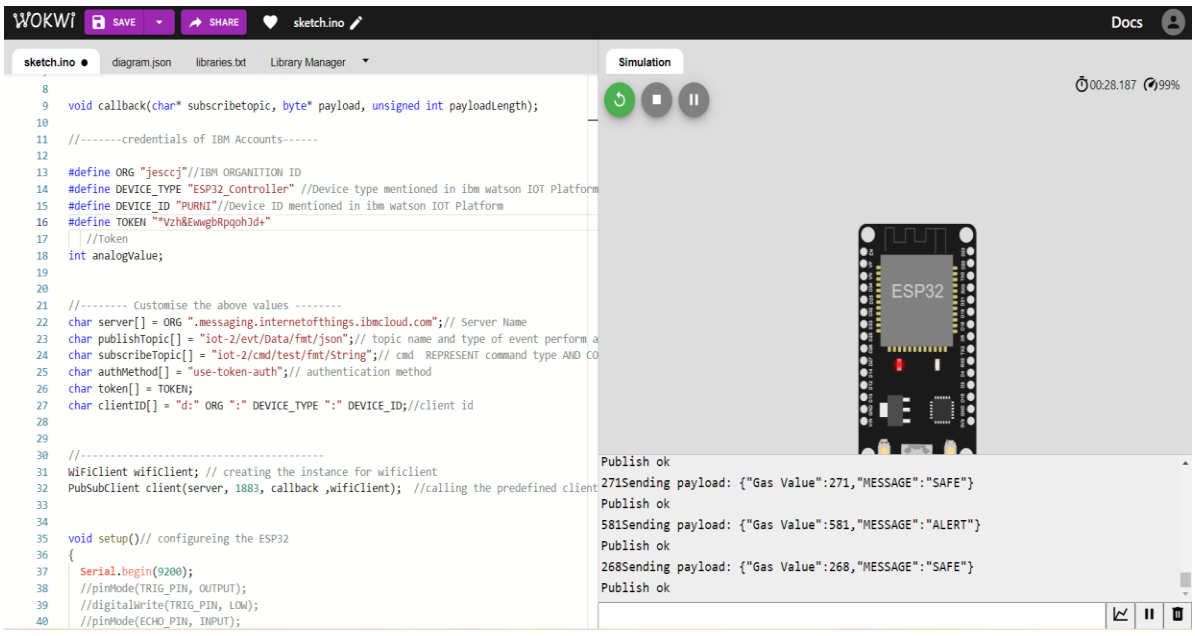
This system also provides us with a feature of being connected to the IBM cloud and dashboard notification. Along with the Buzzer activity with beep(siren) sound that has been made and an alert SMS to the in charge of the plant whose number is saved in SIM card by using GSM modem, an alerting message is sent to the IBM cloud when the gas is detected and also appears on the dashboard.

This feature helps to monitor the gas even when we far away from the place since it has been connected to the cloud. The alert message received in the IBM cloud depends upon the leakage of gas in the detection area of the sensor.

8. TESTING

8.1 Test Cases

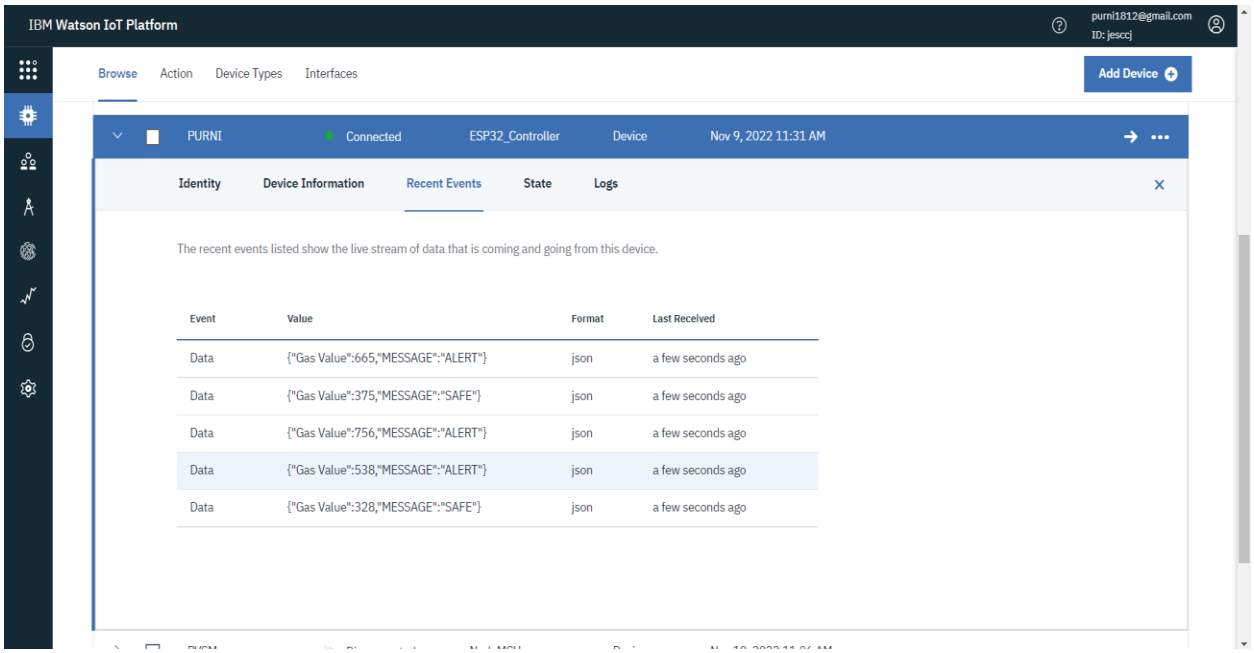




9. RESULTS

9.1 Performance Metrics

The system can be taken as an 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 1m radius of the rover and the sensor output datas are continuously transferred to the local server. The accuracy of sensors are not upto 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. Further the availability and storage of toxic gases like hydrogen sulphide also creates problems for testing the assembled hardware. As the system operates outside the pipeline, the complication of system maintenance and material selection of the system in case of corrosive gases is reduced. Thus the system at this stage can only be used as a primary indicator of leakage inside a plant.



10. ADVANTAGES & DISADVANTAGES

Advantages

- To identify the presence of toxic gases such as CO2, CO, NOx in the industrial facilities.
- Prevents the high risk of gas explosions and affecting any casualties within or outside the premises.
- Detect the concentration of the gases present in the atmosphere to avoid hazardous consequences like fire breakouts.
- Monitors a real-time check on gas production and leakage.
- Cost-effective installation.
- Data analytics for improved decisions.
- Measure oxygen level accuracy.
- Get immediate gas leak alerts.

Disadvantages

- Only one gas can be measured with each instrument.
- When heavy dust, steam or fog blocks the laser beam, the system will not be able to take measurements. This is also the case when a person or vehicle blocks the path.
- It gets reacted eve due to the heating of the wire.
- It is difficult to know failure modes unless very advanced methods of monitoring are used.

11. CONCLUSION

After this project performance, we can conclude that detection of the gas leakage is incredible in the project system. It is 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 a notification by the GSM module. A sensor node senses gases like CO2, oxygen, propane. The estimated range of transmission and consumption of power is obtained. The simple procedures and Arduino UNO microcontroller area used to build the sensor. The developed system accurately measures the concentration of gases in atmosphere. The sensor has been integrated with IoT framework which has efficiently been used to measure and monitor the gases in real time. The datas are automatically stored in the database.This information can be used by the authorities to take prompt actions.

It also helps the normal people to know about the amount of gases in their industry. It also notifies the user through SMS if the gas concentration is more than normal condition it also shut off the valve when concentration reaches to dangerous level without further damage. It is able to successfully detect temperature and humidity which can be used for further study. This system is portable with battery power so that user can carry it to any place. System is reliable in handling hazards within the concerned area. User can find out the air quality at any location it is also included with GPS module. So if user takes readings at different locations it can be used compare air quality among different locations. It also gives access to the user to keep an eye on the hazardous location where frequent manual check is not possible.

12. FUTURE SCOPE

The purpose of this article is to have awareness & importance of Industrial Gas leak detectors in industrial market segment. By implementing gas detectors in industries even if one plant save during crisis, the objective of this paper would be served.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.

This system is monitoring only ten gases and hence can be expanded by considering more parameters that cause gas explosion especially in the industries. By uploading on the webpage for the common man, it helps them to know about the gases used in their industry. Gas detectors are categorized by the type of gas they detect: combustible or toxic. Within this broad categorization, they are further defined by the technology they use: catalytic and infrared sensors detect combustible gases and electrochemical and metal oxide semiconductor technologies generally detect toxic gases. This system consumes more power, by replacing the power source with an solar power then it will definitely improve the reliability of the system.

13. APPENDIX

Source Code

```
#include <WiFi.h>//library for wifi
#include <PubSubClient.h>//library for MQtt
//#define TRIG_PIN 13
//#define ECHO_PIN 12
int sensorThresh=400;

void callback(char* subscribetopic, byte* payload, unsigned int payloadLength);
//-------credentials of IBM Accounts------
#define ORG "jesccj"//IBM ORGANITION ID
#define DEVICE_TYPE "ESP32_Controller" //Device type mentioned in ibm watson IOT Platform
#define DEVICE_ID "PURNI"//Device ID mentioned in ibm watson IOT Platform
#define TOKEN "*Vzh&EwwgbRpqohJd+"
//Token
int analogValue;
//-------- Customise the above values --------
char server[] = ORG ".messaging.internetofthings.ibmcloud.com";// Server Name
char publishTopic[] = "iot-2/evt/Data/fmt/json";
// topic name and type of event perform and format in which data to be send

char subscribeTopic[] = "iot-2/cmd/test/fmt/String";// cmd REPRESENT command type AND COMMAND IS TEST OF FORMAT STRING
char authMethod[] = "use-token-auth";// authentication method
```

```
char token[] = TOKEN;
char clientID[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;//client id
//----------------------------------------
WiFiClient wifiClient; // creating the instance for wificlient
PubSubClient client(server, 1883, callback ,wifiClient);  //calling the predefined client id by passing parameter like server id,portand wificredential

void setup()// configureing the ESP32
{
  Serial.begin(9200);
  //pinMode(TRIG_PIN, OUTPUT);
  //digitalWrite(TRIG_PIN, LOW);
  //pinMode(ECHO_PIN, INPUT);
  Serial.println();
  wificonnect();
  mqttconnect();
}
void loop()// Recursive Function
{
  //digitalWrite(TRIG_PIN, HIGH);
  delayMicroseconds(10);
  //digitalWrite(TRIG_PIN, LOW);
  //float distance = 0.017 * duration_us;
  analogValue=random(200,800);
  Serial.print(analogValue);
  if(analogValue > sensorThresh)
  {
```

```
    PublishData(analogValue,"ALERT");
  }else{
    PublishData(analogValue,"SAFE");
  }
  delay(1000);
  if (!client.loop()) {
    mqttconnect();
  }
}

//.....retrieving to Cloud...../
void PublishData(int d,char s[]) {
  mqttconnect();//function call for connecting to ibm
  /*
     creating the String in in form JSon to update the data to ibm cloud
  */
  String payload = "{\"Gas Value\":";
  payload+=d;
  payload+=",";
  payload+="\"MESSAGE\":";
  payload+="\"";
  payload+=s;
  payload+="\"";
  payload+="}";
  Serial.print("Sending payload: ");
  Serial.println(payload);
```

```
  if (client.publish(publishTopic, (char*) payload.c_str())) {
     Serial.println("Publish ok");// if it sucessfully upload data on the cloud then it will print publish ok in Serial monitor or else it will print publish failed
  } else {
    Serial.println("Publish failed");
  }
}
void mqttconnect(){
  if(!client.connected()){
    Serial.print("Reconnecting to");
    Serial.println(server);
    while(!!!client.connect(clientID, authMethod, token)){
     Serial.print(".");
     delay(500);
    }
     initManagedDevice();
     Serial.println();
  }
}
void wificonnect(){
  Serial.println();
  Serial.print("Connecting to");

  WiFi.begin("Wokwi-GUEST","",6);
  while(WiFi.status()!=WL_CONNECTED){
    delay(500);
```

```
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WIFI CONNECTED");
  Serial.println("IP address:");
  Serial.println(WiFi.localIP());
}

void initManagedDevice(){
  if(client.subscribe(subscribeTopic)){
    Serial.println((subscribeTopic));
    Serial.println("subscribe to cmd ok");
  }else{
    Serial.println("subscribe to cmd failed");
  }
}

void callback(char* subscribeTopic, byte* payload, unsigned int payloadLength){
  Serial.print("callback invoked for topic:");
  Serial.println(subscribeTopic);
  for(int i=0; i<payloadLength; i++){
   analogValue += (char)payload[i];
  }
}
```

GitHub & Project Demo Link

GitHub link - https://github.com/IBM-EPBL/IBM-Project-20330-1659717345

Project Demo link - https://vimeo.com/772519892