

GAS LEAKAGE MONITORING AND ALERTING SYSTEM

VELAMMAL ENGINEERING COLLEGE

CHENNAI -600 066

PROJECT REPORT

TEAM ID: PNT2022TMID23485

Project Report Format

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GAS LEAKAGE MONITORING AND ALERTING SYSTEM

ABSTRACT:

Safety plays a critical role in today's world and it is vital that certain solutions are implemented in places of work and living. Whether it is electricity or oil and gas, working or living in hazardous conditions demand certain safety protocols. Liquefied Petroleum Gas (LPG) is a type of natural gas liquified under extreme pressure and contained in a metal cylinder. LPG is extremely sensitive to fire and causes a great disaster if exposed to any fire source without precaution. LPG is more widely available than any other natural gas and is primarily used for cooking. Unfortunately, its broad use makes the event of gas leakage or even a blast standard. Therefore, there is a need to develop a gas leakage detection and monitoring system. The system will monitor flame and fire through flame sensor. When a fire is detected, the buzzer begins to sound. The system has been tested and it is able to monitor gas wastage, leakage and notify the user. The resulting performance indicated its effectiveness toward saving a significant portion of the wasted gas in domestic.

INTRODUCTION:

Nowadays, home safety detection systems play a significant part in people's security. Since everyone in the household works every day, it is impossible to check on the household appliances, particularly the LPG gas cylinder, wired circuits, etc. Liquefied petroleum gas (LPG) and natural gas demand has significantly increased during the past three years. LPG and natural gas are recommended to meet this high level of energy demand and to substitute oil or coal due to those fuels' negative environmental effects. Large-scale applications for these gases include industry, heating, home appliances, and motor fuel. The system has a MQ6 gas sensor to monitor this leakage gas. This sensor detects how much leak gas is there in the environment around it. Explosions or being harmed by gas leaks could be avoided in this way.

LITERATURE SURVEY:

To detect and quantify methane gas in the vicinity of flammable gas stockpile locations, a technology was developed. The instrument measures the quality of the air and water, taking into account every parameter that could deviate due to a gas leak in the water or the air. While the temperature, pH, and electrical conductivity of the water are being monitored, the sensors measure the amount of CH₄ and CO₂ gas in the air. The system is managed by an Arduino UNO microcontroller, which sends measured data to the Raspberry Pi 3 database. There have been several improvements in pipeline leak detection proposed. This comprises infrared thermography, ground penetrating radar, optical fibre sensors, acoustic emission, and vapour sampling. For data gathering, a system with sensors attached to an Arduino uses LabVIEW as the GUI (graphical user interface).

A thorough list of sensors for flammable, poisonous, and combustible gases has been compared, along with any potential benefits and drawbacks. One such illustration is the SB-95 sensor, which successively monitors variations in the concentrations of methane and carbon monoxide gas and changes its resistance as necessary. Variations in voltage on the load resistor are conveyed together with variations in filament resistivity. Metal oxide sensors have a lengthy reaction time as well as an even longer recovery period. For the purpose of measuring the gas concentration, these sensors must remove the gas by drilling a hole in the pipe. Making holes could put you in danger by allowing hazardous gas to seep or explode.

On the other hand, ultrasonic sensors don't have the aforementioned drawbacks and can measure gas concentration quickly with a low cost and small size. A thorough investigation has been conducted on the potential health effects of gases such hydrogen sulphide, carbon monoxide, and

methane. The operation of the sensor and how optical alarms and buzzers are activated when the sensed values of the SB-95 sensor rise above the threshold are described in detail. The table provides information on the sources and maximum flammable concentrations of hydrocarbons and hydrogen sulphide gas. Although both forms of gas leaks have frequent sources, hydrocarbon leaks are more prone to explosions because of their shorter range of flammability than hydrogen sulphide. The toxicity of hydrogen sulphide is estimated to be 50 ppm, which can seriously affect people's health and potentially result in death from prolonged exposure.

PROPOSED SOLUTION:

IDEATION PROPOSED SOLUTION:

The Internet of Things aims to simplify life by automating all of the little tasks that we encounter. As much as IoT aids in task automation, its advantages can also be extended to improve current safety requirements. Safety has always been a top consideration when planning a home, a building, an industry, or a city. It can be exceedingly dangerous for some gases to be present in the environment at higher concentrations. These gases may be hazardous after surpassing the stated concentration limits, combustible under specific temperature and humidity circumstances, or even contribute to local air pollution issues like smog and poor visibility, which can lead to serious accidents and have a negative impact on people's health. The majority of societies have fire safety measures. But it can be used even after a fire has started. We developed a system using sensors that can detect gases like LPG, CO₂, CO, and CH₄ in order to have control over such situations. This system will be able to identify gas leaks and alert users via audible alarms as well. This system can alert the user if there are excessive amounts of harmful gases present in the environment. System can send a message to society administrators informing them of the situation before an accident occurs.

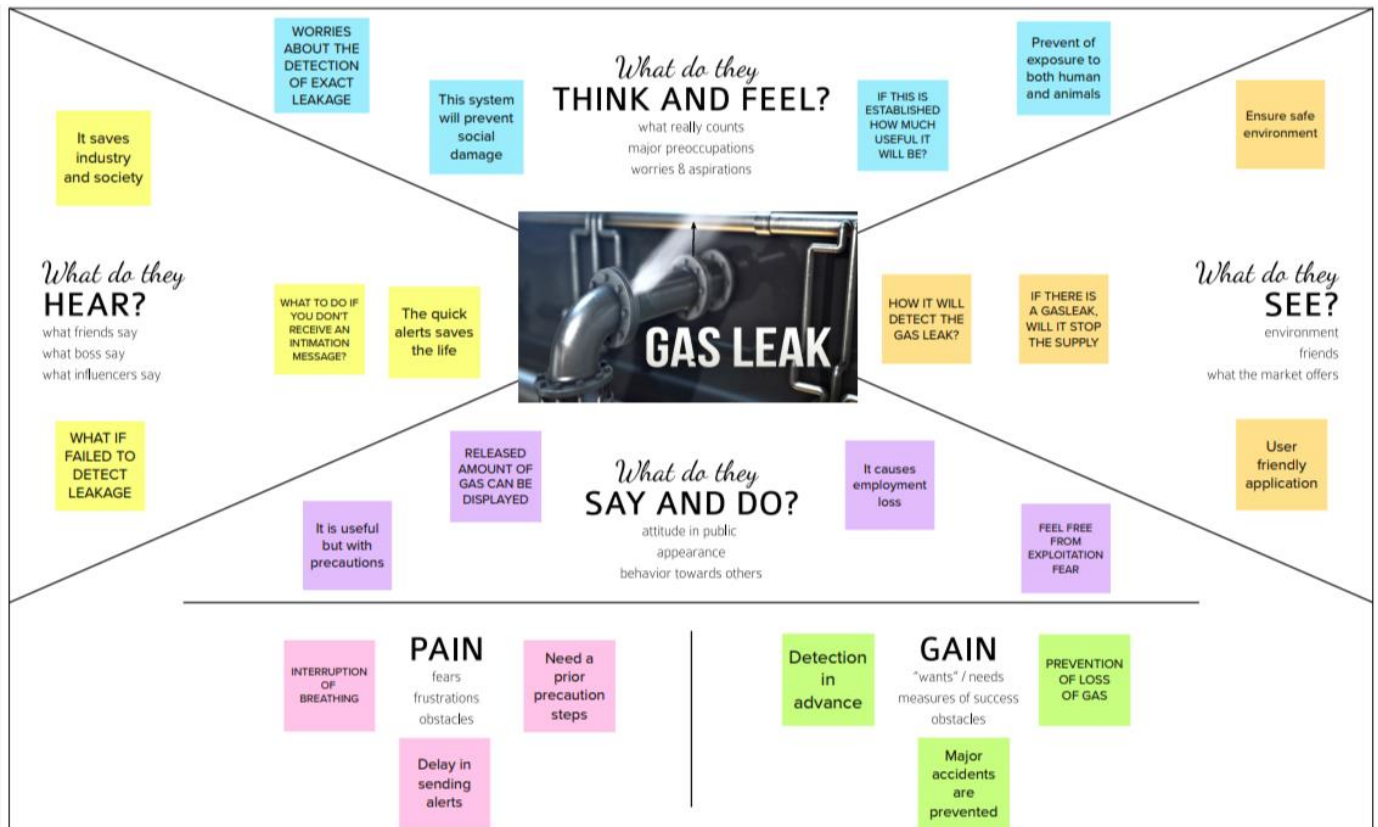
PROPOSED METHOD:

The core component of the system, the Arduino UNO (Atmega-328), carries out the following functions. The output signal of the sensor, which serves as input to Arduino, performs signal conditioning. Results of the detection were shown on LCD. warns individuals of risk at work, in factories, and at home. There is buzzer activity and a beep (siren) sound. Additionally, using a GSM modem, send an alarm SMS to the plant manager whose phone number is saved on the SIM card. The SMS you receive is based on whether there is a gas leak in the sensor's field of detection.

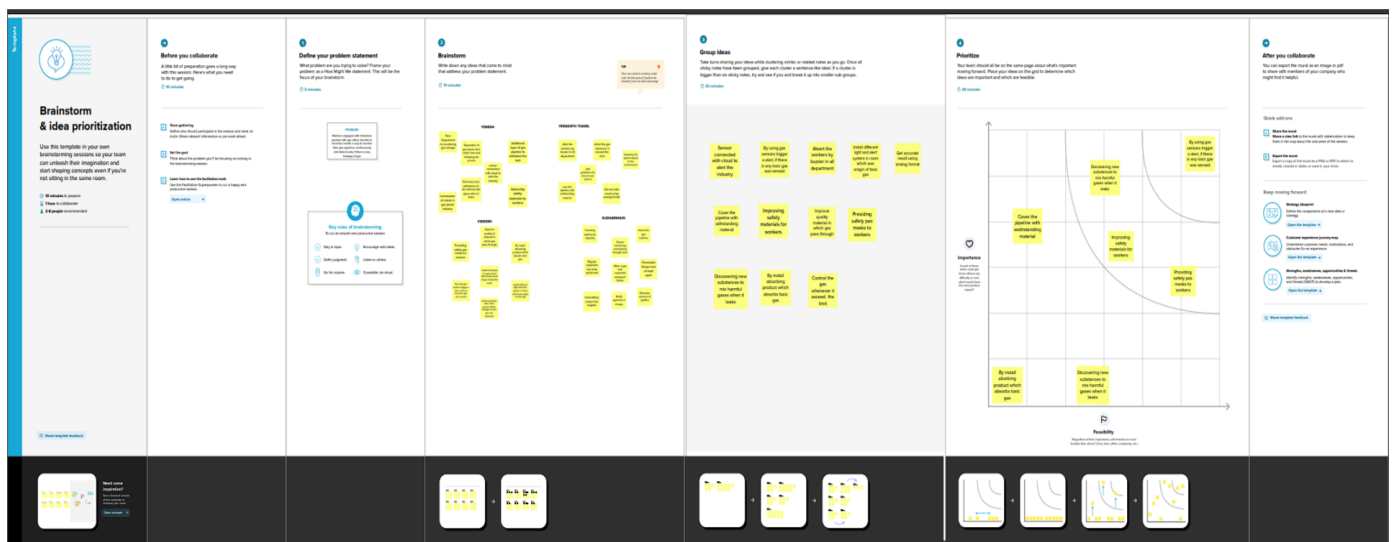
EMPATHY MAP CANVAS:

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes.

- It is a useful tool to help teams better understand their users. Creating an effective solution requires understanding the true problem and the person who is experiencing it.
- The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.



IDEATION AND BRAINSTORMING:



PROPOSED SOLUTION FIT:

Project Design Phase-I - Solution Fit

Project Title: Gas Leakage monitoring & Alerting system for Industries

Team ID: PNT2022TMD23485

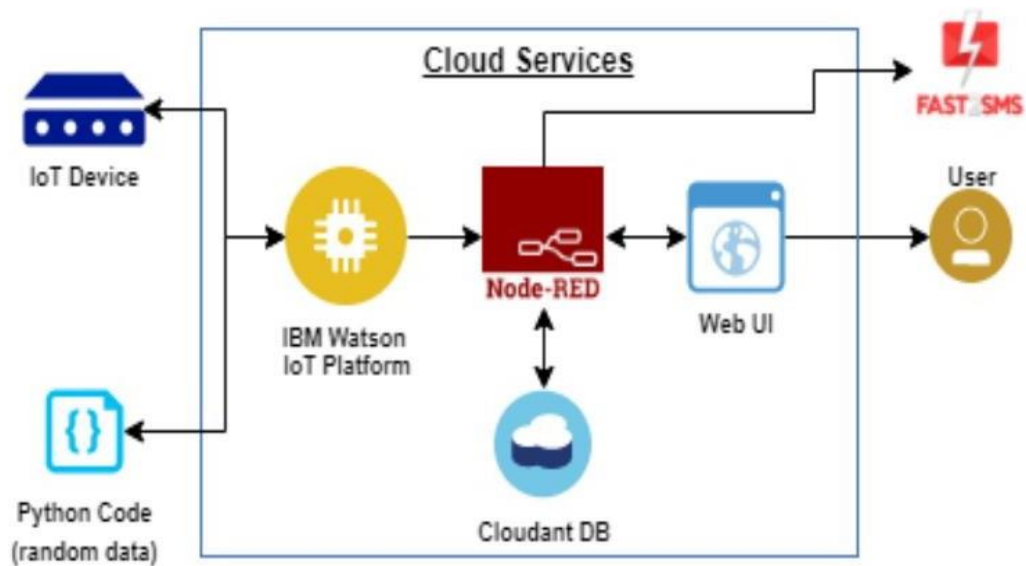
Define CS, fit into CC	1. CUSTOMER SEGMENT(S) CS Who is your customer? <div>Most of Industry workers who are engaged with gas related productions.</div>	6. CUSTOMER CC What constraints prevent your customers from taking action or limit their choices of solutions? <u>i.e.</u> spending power, budget, no cash, network connection, available devices. <div> <ul style="list-style-type: none"> ✓ It measures toxic gases in very low concentrations. ✓ It has ability to detect wide range of gases. ✓ It is difficult to know failure </div>	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 <u>do they</u> solutions have? <u>i.e.</u> pen and paper is an alternative to digital notetaking <div>Testbenches, Quick connectors (They enable a fast and tight "Connection" also on non-round and cast surfaces), Leak tester <u>are</u> some of the available solutions.</div>	Explore AS, differentiate
	2. JOBS-TO-BE-DONE / PROBLEMS J&P Which jobs-to-be-done (or problems) do you address for your <u>customers</u> could be more than one, explore different sides. <div>Flammable gas leakage may lead to secondary accidents such as fire and explosion, while toxic gas dispersion mainly leads to poisoning casualties lead to death.</div>	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? <u>i.e.</u> customers have to do it because of the change in regulations. <div>Behind this gas leakage problem there could be many reasons like atomic reactions between gas molecules, material's quality...etc. Even though customers have to do this job then only we can get our end products or needful chemical solutions.</div>	7. BEHAVIOUR BE What does your customer do to address the problem and get the job done? <u>i.e.</u> directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greentrance) <div> Have a check of where it has the sense of Harmful gases such as H2S, Methane, and CO. Will also check for temperature sensor that helps to detect the concentration of the gases present in the atmosphere to avoid hazardous consequences like fire breakouts. </div>	
Focus on J&P, tap into BE, understand RC	3. TRIGGERS TR What triggers customers to act? <u>i.e.</u> seeing their <u>neighbors</u> installing solar panels, reading about a more efficient solution in the news. <div>Constitution should bring gas leakage indicating system as a mandatory precaution in every factory and industries like fire extinguisher.</div>	10. YOUR SOLUTION SL If you are working on an existing business, write down your current solution <u>that fit</u> 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 <u>up the</u> canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer <u>behavior</u> . <div>We are planning to fit a sensor nearby the gas plants which will detect if there is any leak of gas. If there is a gas leak then we will send a message to admin department and also alarm will be set on so that the workers can know about the leak and run into a safe place</div>	8. CHANNELS OF BEHAVIOUR CH ONLINE What kind of actions do customers take online? Extract online channels from #7 <div> <ul style="list-style-type: none"> ✓ In online, user can monitor <u>the each</u> sensor and its rates, sensor like temperature, gas, humidity, oxygen level. ✓ Also have the statistical report. ✓ Precautions can be altered and users take care of the </div> OFFLINE What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development. <div> <ul style="list-style-type: none"> ✓ The have to manually check the leakage of gases when the statistics changes. ✓ Handling the critical situation should be taken care of the safety officers. </div>	Focus on J&P, tap into BE, understand RC
	4. EMOTIONS: BEFORE / AFTER EM How do customers feel when they face a problem or a job and afterwards? <u>i.e.</u> lost, insecure > confident, in control - use it in your communication strategy & design. <div>While facing the problem people may get fatigue, dizziness, severe headache, loss of concentration, loss of consciousness. Afterwards people feel insecurity because of the health issues it's hard for them to lead a normal life.</div>			
Identify strong TR & EM				Extract online & offline CH of BE

PROPOSED SOLUTION:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To detect the gas in the industry and prevent from making hazardous damages.
2.	Idea / Solution description	To detect the gas in the industry and prevent from making hazardous damages.
3.	Novelty / Uniqueness	Sensor automatically restores the gas and saves the data in IoT cloud.
4.	Social Impact / Customer Satisfaction	Customer feel great about this invention because, huge damage is prevented.
5.	Business Model (Revenue Model)	The cost is very low for manufacturing this product.
6.	Scalability of the Solution	It is more reliable and flexible.

SOLUTION ARCHITECTURE:

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 1m radius of the rover and the sensor output data are continuously transferred to the local server. The accuracy of MQ 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.



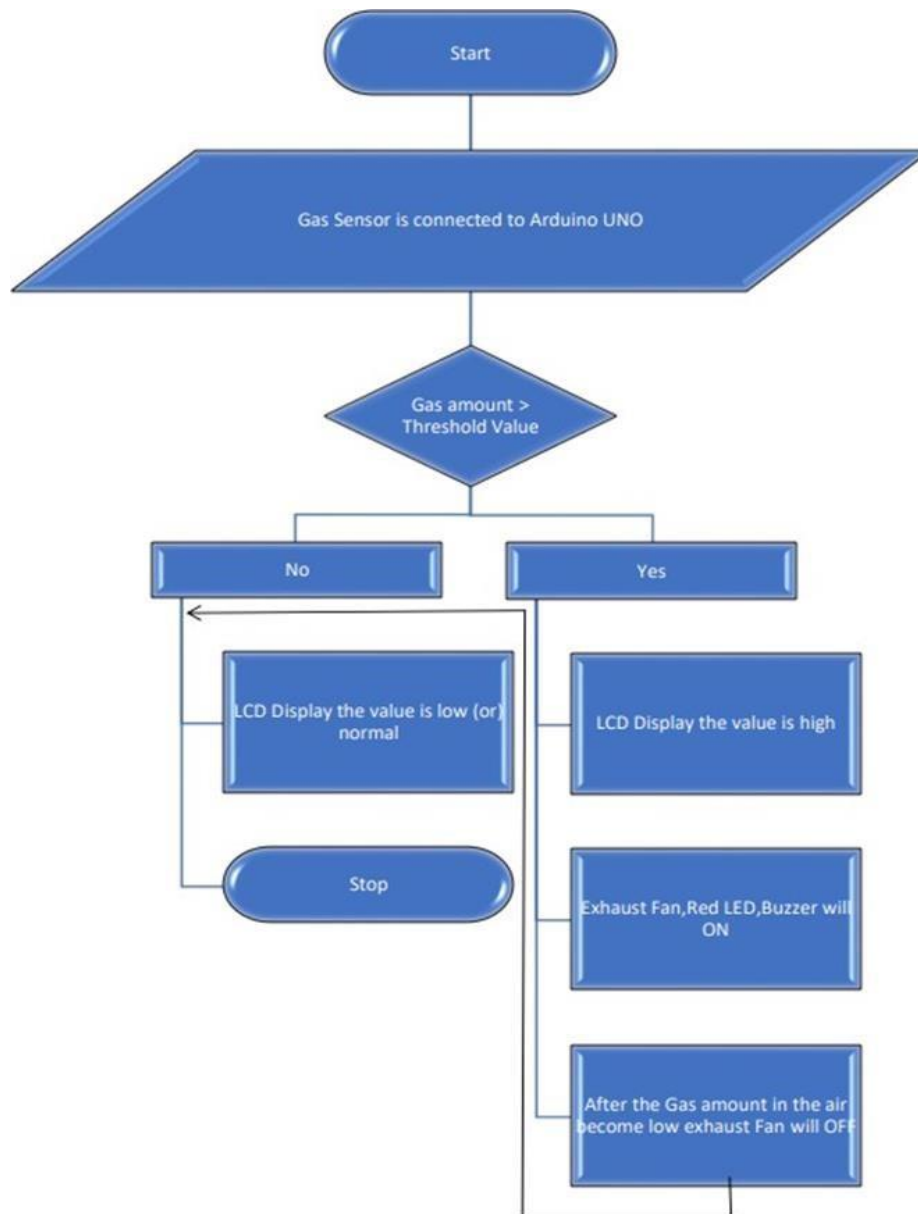
REQUIREMENT ANALYSIS

FUNCTIONAL REQUIREMENT:

Business Requirements	User Requirements	Product Requirements
The mentioned system is usable in residences, hotels, industrial settings, LPG cylinder storage places, etc. The ability to detect leakage and transmit the information to a location is the primary benefit of this IoT and Arduino-based application. It is observable, and precautions can be taken to avert any catastrophe.	The gas leakage detection system can be upgraded with smoke and fire detectors to add on as being optimised for detecting dangerous gases. Although ensuring worker safety is critical, adopting the appropriate technology is even more crucial.	Regardless of your professional position or personal goals, gas detection is essential. Such IoT devices are what they are due to certain technologies in use, therefore understanding these technologies and the functions they can serve is necessary if you want to engage in IoT application development.

PROJECT DESIGN:

DATA FLOW DIAGRAM:



PROJECT PLANNING & SCHEDULING:

SPRINT PLANNING AND ESTIMATION



CODING AND SOLUTIONING:

CODE FOR IBM Watson IoT Platform:

```
import time

import sys

import ibmiotf.application

import ibmiotf.device

import random

#Provide your IBM Watson Device Credentials

organization = "jjrtf7"

deviceType = "ESP32"

deviceId = "1234"

authMethod = "token"

authToken = "12345678"

# Initialize GPIO

def myCommandCallback(cmd):

    print("Command received: %s" % cmd.data['command'])

    status=cmd.data['command']

    if status=="switchon":

        print ("Switch is on")

    else :

        print ("Switch is off")

    #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

temp=random.randint(0,100)

Humid=random.randint(0,100)

gasconcentration=random.randint(0,100)

data = { 'temp': temp, 'Humid': Humid, "gasconcentration":

gasconcentration}

#print data

def myOnPublishCallback():

print ("Published Temperature = %s C" % temp, "Humidity = %s %% " %

Humid, "gasconcentration = %s %% " % gasconcentration, "to IBM Watson")

success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,

on_publish=myOnPublishCallback)

if notsuccess:

print("Not connected to IoT")

time.sleep(1)

deviceCli.commandCallback = myCommandCallback

# Disconnect the device and application from the cloud

deviceCli.disconnect()

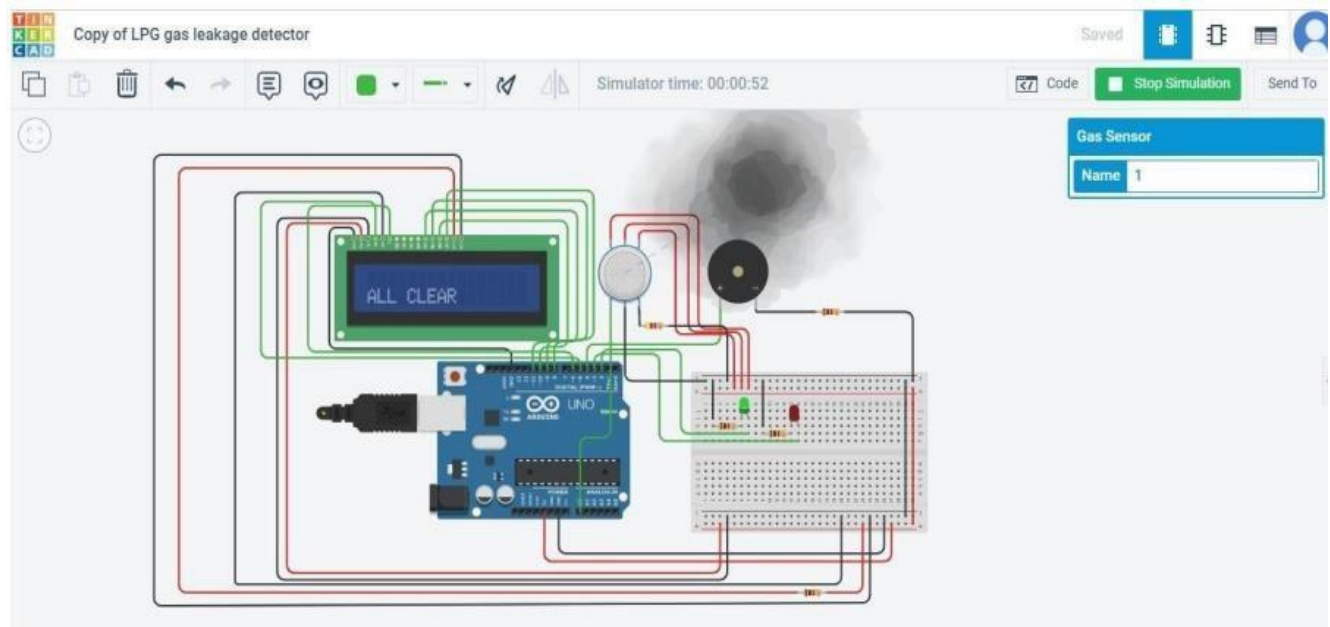
```

SOLUTION STATEMENT:

The system might be viewed as a modest attempt to link up the principal gas detection techniques now in use with a mobile platform coupled with IoT platforms. One meter around the rover, the gases are detected, and the sensor output data is continually sent to the nearby server. Stray gases are also detected because of the sensors' subpar precision, which introduces some inaccuracy into their results, particularly in the case of methane. Additionally, the storage and availability of hazardous gases like hydrogen sulphide makes it difficult to test the integrated gear. The complexity of system maintenance and material selection for the system in the event of corrosive gases is reduced because the system operates outside the pipeline. The system can only be used as a primary indicator of leakage inside a plant at this point.

TESTING & RESULTS:

TINKERCAD:



PYTHON CODE EXECUTION:

```
code.py - C:\Users\bala\AppData\Local\Programs\Python\Python36-32\code.py
File Edit Format Run Options Window Help
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random

# Provide your IBM Watson Device Credentials
organization = "s9wrcm"
deviceType = "ESP32"
deviceId = "1234"
authMethod = "token"
authToken = "12345678"

# Initialize GPIO

def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="sprinkleron":
        print ("Sprinkler is on")
    else :
        print ("Sprinkler is off")
    #print(cmd)

try:
    deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-
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
deviceCli.connect()

While True:
    #Get Sensor Data from DHT11
    temperature, humidity = dht11.read()
    #Send data to cloud
    deviceCli.publish("hello", "world", "temp: %s, humidity: %s" % (temperature, humidity))
    time.sleep(10)
```

```
*Python 3.6.0 Shell*
File Edit Shell Debug Options Window Help
Python 3.6.0 (v3.6.0:41df79263a11, Dec 23 2016, 07:18:10) [MSC v.1900 32 bit (I
ntel)] on win32
Type "copyright", "credits" or "license()" for more information.
>>>
-- RESTART: C:\Users\bala\AppData\Local\Programs\Python\Python36-32\code.py --
2022-11-16 02:20:17,409 ibmiotf.device.Client INFO Connected successf
ully: d:s9wrcm:ESP32:1234
Published Temperature = 88 C Humidity = 59 % gasconcentration = 78 % to IBM Wat
son
Published Temperature = 28 C Humidity = 99 % gasconcentration = 87 % to IBM Wat
son
Published Temperature = 32 C Humidity = 60 % gasconcentration = 8 % to IBM Wats
on
Published Temperature = 41 C Humidity = 54 % gasconcentration = 67 % to IBM Wat
son
Published Temperature = 81 C Humidity = 64 % gasconcentration = 17 % to IBM Wat
son
Published Temperature = 51 C Humidity = 93 % gasconcentration = 38 % to IBM Wat
son
Published Temperature = 5 C Humidity = 1 % gasconcentration = 79 % to IBM Wats
on
Published Temperature = 44 C Humidity = 88 % gasconcentration = 69 % to IBM Wat
son
Published Temperature = 76 C Humidity = 54 % gasconcentration = 27 % to IBM Wat
son
Published Temperature = 37 C Humidity = 78 % gasconcentration = 10 % to IBM Wat
son
Ln: 5 Col: 0
```


RECENT EVENTS IN IBM WATSON IOT PLATFORM:

The screenshot displays the IBM Watson IoT Platform interface. The top navigation bar includes 'Browse', 'Action', 'Device Types', and 'Interfaces'. A sidebar on the left contains various icons for navigation. The main content area is titled 'Recent Events' and shows a table of live data streams. The table has columns for 'Event', 'Value', 'Format', and 'Last Received'. Below the table, there is a status bar indicating '1234' and 'Disconnected'.

Event	Value	Format	Last Received
IoT Sensor	{"temp":17,"humid":97,"gasconcentration":12}	json	a few seconds ago
IoT Sensor	{"temp":61,"humid":49,"gasconcentration":48}	json	a few seconds ago
IoT Sensor	{"temp":91,"humid":49,"gasconcentration":77}	json	a few seconds ago
IoT Sensor	{"temp":51,"humid":79,"gasconcentration":43}	json	a few seconds ago
IoT Sensor	{"temp":52,"humid":52,"gasconcentration":57}	json	a few seconds ago

1234 Disconnected python Device 2 Simulations running

The screenshot displays the IBM Watson IoT Platform interface with a line chart titled 'gas leakage'. The chart shows three data series: 'temp' (blue), 'Humid' (orange), and 'gasconcentration' (green). The x-axis represents time, with labels '01:54' and '01:54:30'. The y-axis represents values from 0 to 100. A legend at the bottom identifies the series. The status bar at the bottom indicates '2 Simulations running'.

gas leakage

Line chart

100 80 60 40 20 0

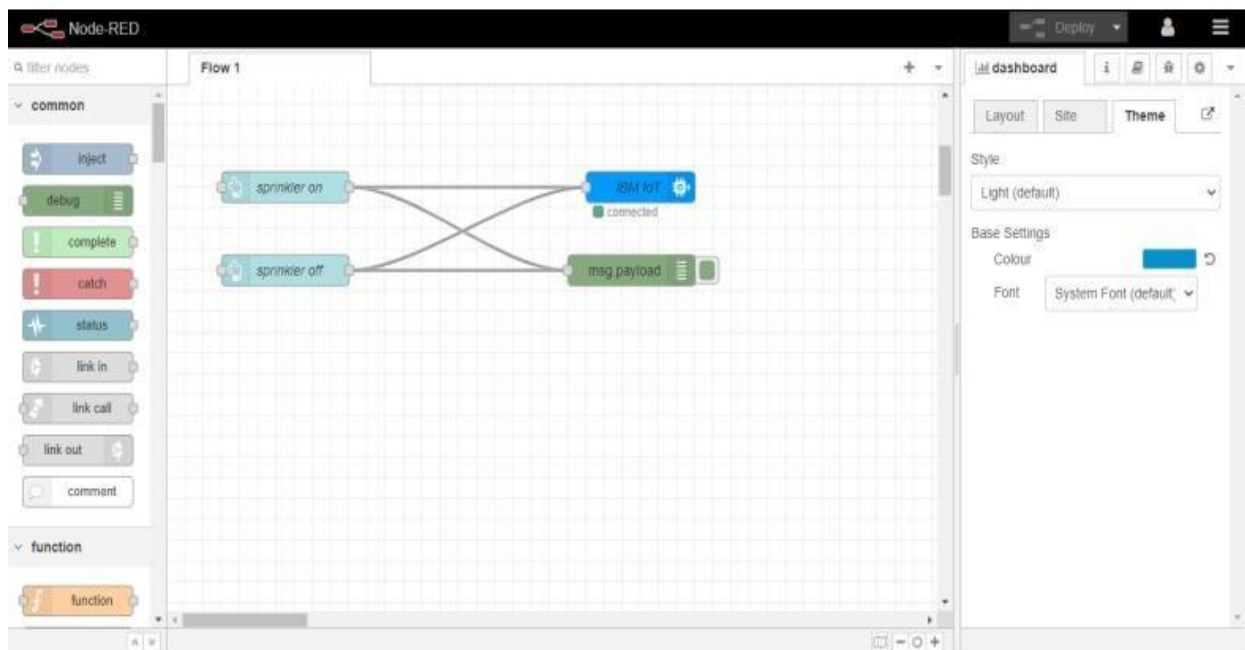
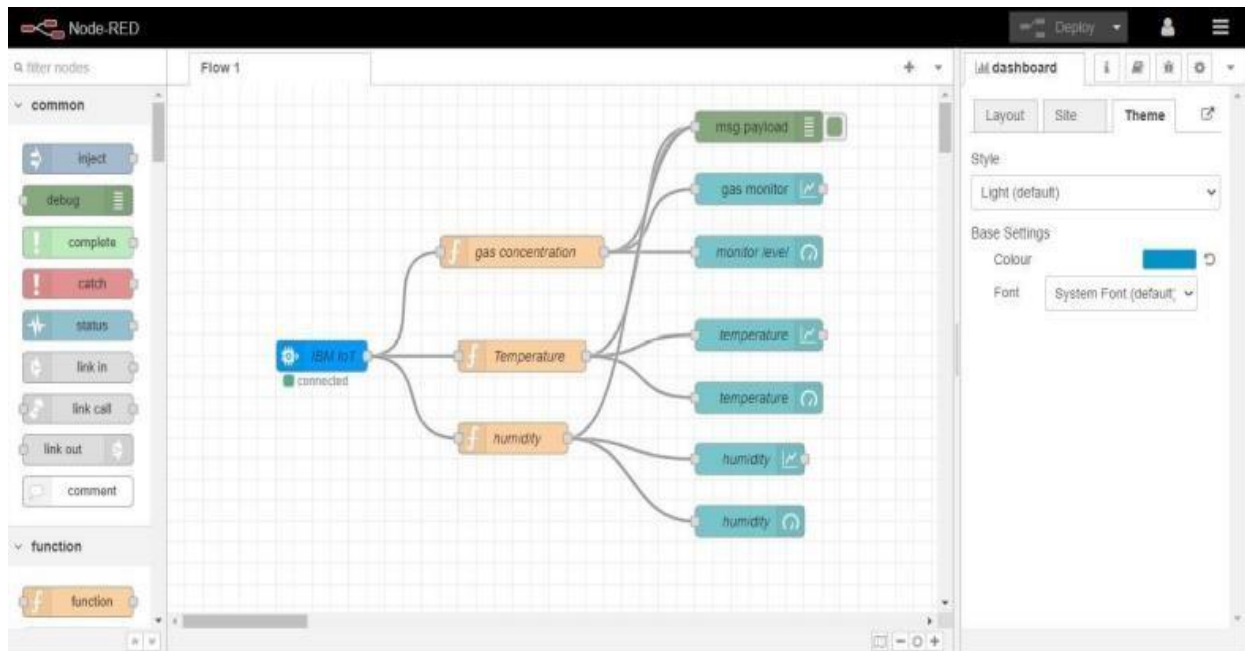
01:54 01:54:30

1 minute now

temp Humid gasconcentration

2 Simulations running

NODE RED FLOW:



DASHBOARD CREATED USING NODE:



CONCLUSION:

We can conclude from the project's performance that the system's detection of LPG gas leakage is remarkable. Useful for both residential and commercial purposes. We can use this technique to save lives in dangerous situations. The GSM module indicates an alert. Propane, CO₂, and other gases are detected by a sensor node. Power usage and transmission range estimates are made. The sensor was constructed using straight forward techniques and an Arduino UNO Micro controller.

APPENDIX:

SOURCE CODE:

```
#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");

    delay(1000)

}

}
```

GITHUB LINK:

<https://github.com/IBM-EPBL/IBM-Project-22989-1659863835>

PROJECT DEMO LINK:

https://drive.google.com/file/d/1xKSqm9nZeI_CJoI2oYEMMRb1JF5pV0rc/view?usp=drivesdk