

PROJECT REPORT ON

Gas Leakage monitoring & Alerting system for Industries

TEAM ID: PNT2022TMID42672

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1. INTRODUCTION:

1.1 PROJECT OVERVIEW:

In today's world, safety is of the utmost importance, and certain measures must be taken at both work and home to ensure it. Working or living in a dangerous environment necessitates specific safety measures, whether the subject is electricity or oil and gas. A type of natural gas known as "Liquified Petroleum Gas" (LPG) is compressed under high pressure and stored in a metal cylinder. LPG is extremely vulnerable to fire and can result in catastrophic damage if left unprotected near any fire source. LPG is primarily utilized for cooking and is more readily available than any other natural gas. Sadly, its widespread use makes gas leakage or even a blast a common occurrence. As a result, a system for detecting and monitoring gas leaks is required. Through a flame sensor, the system will keep an eye on fire and flame. The buzzer begins to ring when a fire is detected. Tests have shown that the system can keep track of the wastage of gas and leaks and notify the user. The performance that was produced showed that it was successful in reducing the amount of domestic gas that was wasted.

1.2 PURPOSE:

Nowadays the home safety detection system plays an important role in the security of people. Since all the people from the home goes to work on a daily bases, it makes it impossible to check on the appliances available at home especially LPG gas cylinder, wired circuits, Etc. In the last three years, there is a tremendous hike in the demand for 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 a large scale in industry, as heating, home appliances, and motor fuel. To monitor this gas leak, the system includes an MQ6 gas detector. This sensor detects the amount of leaking gas present in the surrounding atmosphere. In this way, the consequences of an explosion or gas leak can be avoided.

2.LITERATURE SURVEY:

2.1 EXISTING PROBLEMS:

The Internet of Things aims towards making life simpler by automating every small task around us. As much as IoT helps in automating tasks, the benefits of IoT can also be extended to enhancing the existing safety standards. Safety, the elementary concern of any project, has not been left untouched by IoT. Gas Leakages in open or closed areas can prove to be dangerous and lethal. The traditional Gas Leakage Detector Systems though have great precision, fail to acknowledge a few factors in the field of alerting people about the leakage. Therefore, we have used IoT technology to make a Gas Leakage Detector for society which has Smart Alerting techniques involving sending a text message to the concerned authority and the ability to perform data analytics on sensor readings. Our main aim is to propose a gas leakage system for a society where each flat has gas leakage detector hardware. This will detect the harmful gases in the environment and alerting to society members through the alarm and sending notifications.

2.2 REFERENCE:

Prof. M.Amsaveni, A.Anurupa, R.S.Anu Preetha, C.Malarvizhi, M.Gunasekaran; they told in their research paper on “GSM-based LPG leakage detection and controlling system” the leakage of LPG gas is detected by the MQ-6 gas sensor. Its analog output is given to the microcontroller. It consists of a 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 motor is rotated thus closing the knob of the cylinder. Because of this process, the leakage of gas is stopped. The relay is switched to off the power supply of the house. The buzzer produces an alarm to indicate the gas leakage. Then, the user is alerted by SMS through the GSM module. They proposed their methodology that the system takes an automatic control action after the detection of 0.001% of LPG leakage. This automatic control action provides a mechanical handle for closing the valve. We are increasing the security for humans by means of a relay which will shut down the electric power to the house. Also, by using GSM, we are sending an alert message to the users and a buzzer is provided for alerting the neighbors about the leakage.

P.Meenakshi Vidya, S.Abinaya, G.Geetha Rajeswari, N.Guna, “Automatic LPG detection and hazard controlling “ published in April 2014 proposed the leakage

detection and real-time gas monitoring system. In this system, the gas leakage is detected and controlled by means of the exhaust fan. The level of LPG in the cylinder is also continuously monitored.

Srinivasan, Leela, Jeya bharathi, Kirthik,Rajasree; in this research paper they told about gas leakage detection and control. In this paper, the gas leakage resulting in fatal inferno has become a serious problem in households and other areas where household gas is handled and used. It alerts the subscriber through the alarm and the status display besides turning off the gas supply valve as a primary safety measure.

Hitendra Rawat, Ashish Kushwah, Khyati Asthana, Akanksha Shivhare, in the year 2014 planned a framework, they gave security issues against hoodlums, spillage, and fire mishaps. In those cases, their framework sends an SMS to the crisis number given to it

B. B. Did paye, Prof. S. K. Nanda; in this paper, they talked about their research on leakage detection and review of “Automated unified system for LPG using microcontroller and GSM module”. Their paper proposed an advance and innovative approach for LPG leakage detection, prevention, and automatic booking for a refill. In advance, the system provides the automatic control of the LPG regulator also if leakage is detected the system will automatically turn off the main switch of the power supply. Hence it helps to avoid explosions and blasts.

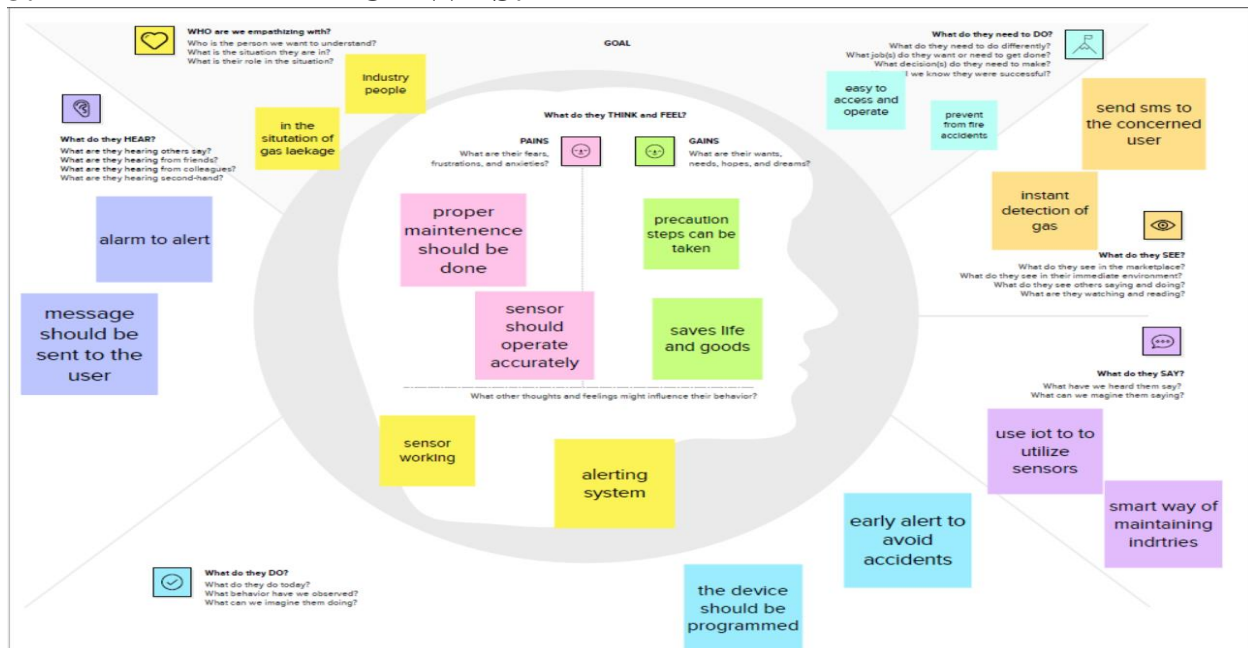
Pal-Stefan Murvaya, Ioan Sileaa, 2008, they told in their survey on gas leak detection and localization techniques various ways to detect gas leakage. They introduce some old or new techniques to detect the gas. The proposed techniques in this paper are nontechnical methods and hardware-based methods which include acoustic methods, optical methods, and active methods. In their survey they told a wide variety of leak-detecting techniques is available for gas pipelines

2.3 PROBLEM STATEMENT DEFINITION:

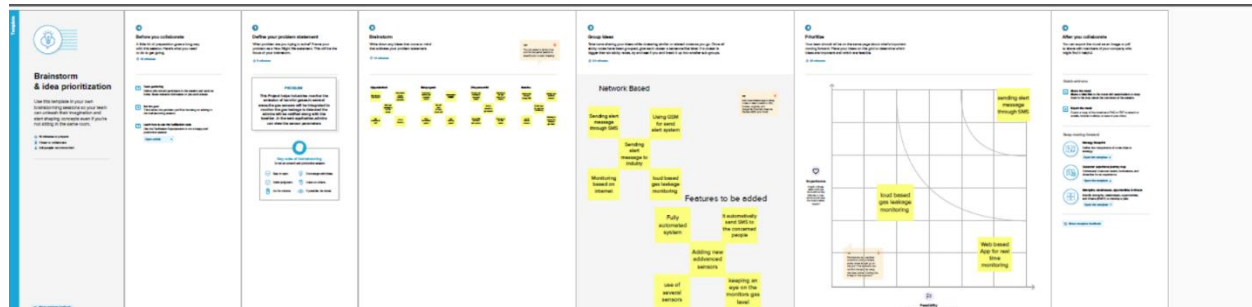
Gas leakage is nothing but the leak of any gaseous molecule from a stove, or a pipeline, or cylinder etc. This can occur either purposefully or even unintendedly. As we are aware that these kinds of leaks are dangerous to our health, and when it becomes explosive it could cause great danger to the people, 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 Gasleak. 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.

3.IDEATION AND PROPOSED SOLUTION:

3.1 EMPATHY MAP CANVAS:



3.2 IDEATION AND BRAIN STROM:



3.3 PROPOSED SOLUTION:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	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.

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	Even though there are many existing solutions for this problem they failed to satisfy the needs of customer. 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	Our solution will be very helpful for the workers and the society which is associated or located nearby the industries. Our solution will prevent great disasters like Bhopal Gas Tragedy so that so many lives can be saved. Through this project the workers mental pressure will be reduced so that they can concentrate on other works or by relaxing them.
5.	Business Model (Revenue Model)	The main target of our solution is Industries so we have planned to visit industries and explain them about the benefits of our products. So that they can aware of the importance of this solution and use it.
6.	Scalability of the Solution	Our solution can be integrated for further future use because the solution we have provided will be lay on the basic or initial stage of any upgraded version.

3.4 PROPOSED SOLUTION FIT:

Project Design Phase-I - Solution Fit			
Project Title: Gas Leakage monitoring & Alerting system for Industries			
Define CS, fit into CC	1. CUSTOMER SEGMENT(S) CS Who is your customer? Most of Industry workers who are engaged with gas related productions.	6. CUSTOMER 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. It measures toxic gases in very low concentrations. It has ability to detect wide range of gases. It is difficult to know failure	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 monitoring Testbenches, Quick connectors (They enable a fast and tight "Connection" also on non-round and cast surfaces), Leak tester are some of the available solutions.
	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. 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.	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 chance in regulations. 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.	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) 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.
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. Constitution should bring gas leakage indicating system as a mandatory precaution in every factory and industries like fire extinguisher.	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 further canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour. 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	8. CHANNELS of BEHAVIOUR CH ONLINE What kind of actions do customers take online? Extract online channels from #7 In online, user can monitor the each 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 OFFLINE What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development. 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.
	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. 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.		
Identify strong TR & EM			Extract online & offline CH of BE

4. REQUIREMENT ANALYSIS:

4.1 FUNCTIONAL REQUIREMENT:

Arduino UNO is the main unit of the system which performs the following tasks. Signal conditioning of the Arduino UNO is done by the output signal of the sensor, provided input to Arduino. The detection results are displayed on LCD. Indicates the people of danger in the workplace, factory, and home. Buzzer activity with a beep(siren) sound is made. Also, send alert SMS to the in charge of the plant whose number is saved in a SIM card by using a GSM modem. The SMS received depends upon the leak of gas in the detection area of the sensor.

4.2 NON FUNCTIONAL REQUIREMENTS:

Data Gathering: Using multiple sensors, we are going to gather the necessary data.

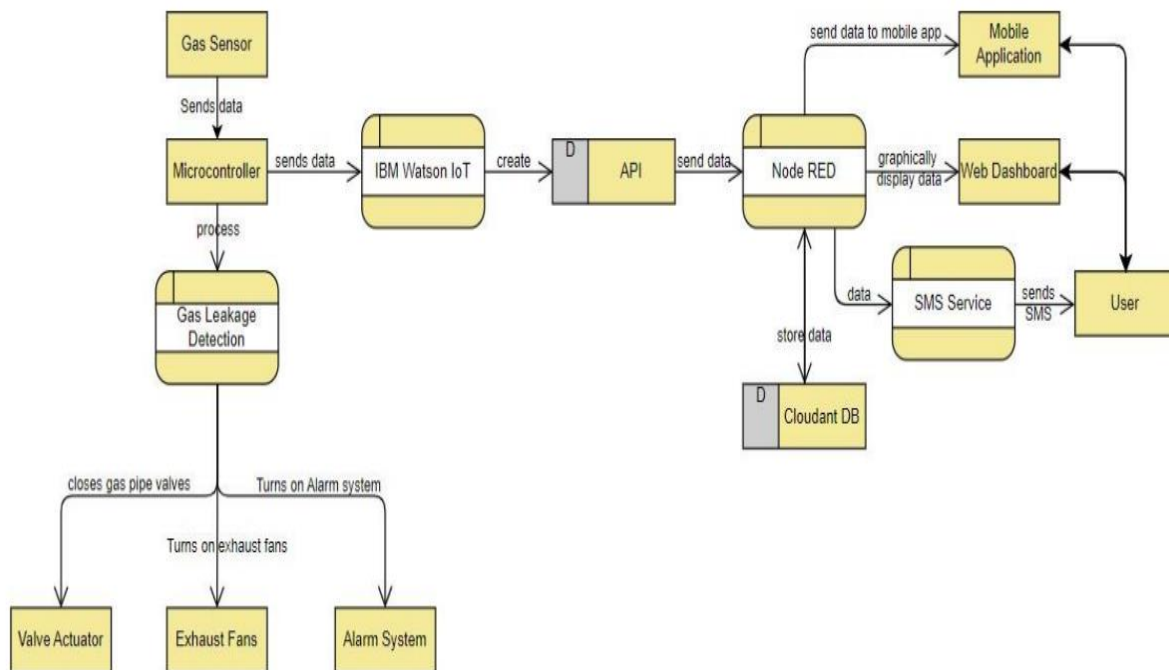
Data Store: Collected data is stored in Cloud and Necessary databases.

Data Analysis: Data from the store must be analyzed for raising alerts in case of necessity.

Data Monitoring: Gathered data must be displayed to the user for monitoring.

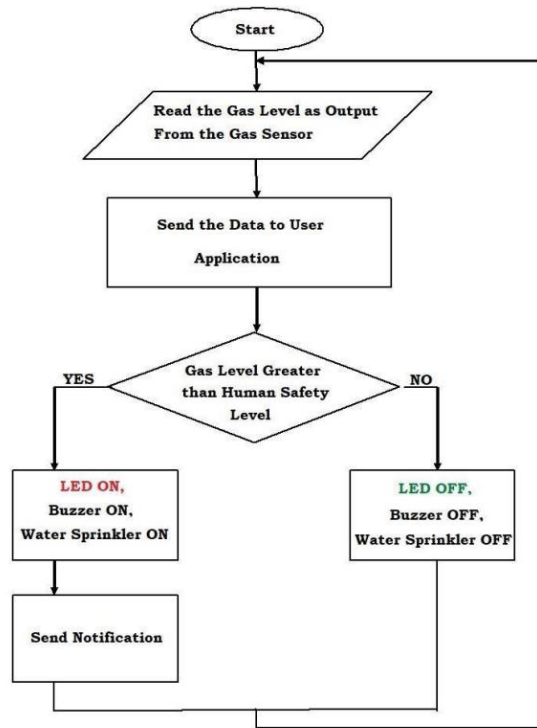
5. PROJECT DESIGN:

5.1 DATAFLOW DIAGRAM:



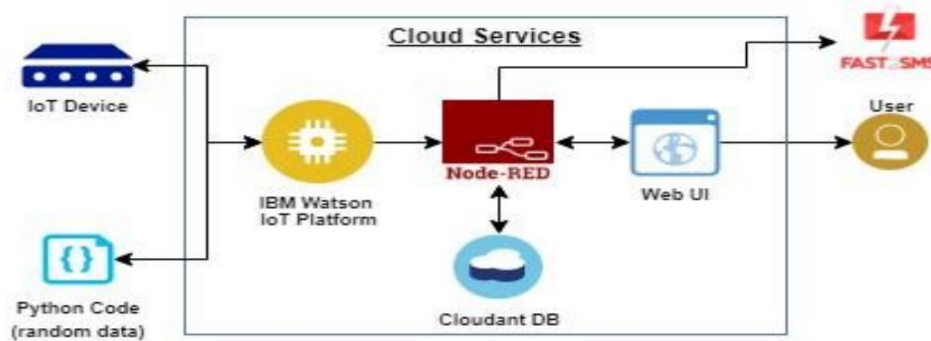
FLOWCHART:

GAS LEAKAGE DETECTION AND ALERTING SYSTEM



5.2 SOLUTION AND TECHNICAL ARCHITECTURE:

Technical Architecture:



5.3 USER STORIES:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority
Sprint-1	Monitor the gas leakage	USN-1	The Industrialist have own industries so the industry owner must take of workers.The workers have family so the industries give security assurance of workers.	2	High
Sprint-2	Detect the gas	USN-3	We have monitor the gas by 24/7 hrs. To avoid leakage,the industry have quality pipes to transfer the gas and proper maintenance service once in a month. The industry must take care of what are the necessary process to avoid the gas leakage.	2	Low
Sprint-3	The model is trained and tested by sample dataset.	USN-3	The programmer design the model to detect the gas leakage.	2	Medium
Sprint-4	Warning message	USN-4	Incase any gas leakage occur, the device give the alarm and alert message to concerned user within a minute.	1	High

6. PROJECT PLANNING AND SCHEDULING:

6.1 SPRINT PLANNING AND ESTIMATION:

Sprint	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

6.2 SPRINT DELIVERY SCHEDULE:

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	19 Nov 2022

7.CODING AND SOLUTIONING:

71.SOURCE CODE

SIMULATION CREACTION USING WOKWI:

CODE:

```
#include <time.h>  
#include <WiFi.h>  
#include <PubSubClient.h>  
bool exhaust_fan_on = false;  
bool sprinkler_on = false;  
float temperature = 0;  
int gas_level = 0;  
int flame = 0;  
String flame_status = "";  
String accident_status = "";  
String sprinkler_status = "";  
void setup() {  
Serial.begin(99900);  
}  
void loop() {  
//setting a random seed  
srand(time(0));  
//initial variable  
temperature = random(-  
20,125);  
gas_level = random(0,1000);  
int flamereading =  
random(200,1024);  
flame =  
map(flamereading,0,1024,0,  
2);  
//set a flame status  
Serial.print("Temperature : ");  
Serial.println(temperature);  
Serial.print("Gas_level : ");  
Serial.println(gas_level);  
Serial.print("Flame : ");  
Serial.println(flame);  
switch (flame) {  
case 0:  
flame_status = "No Fire";  
Serial.println("Flame Status : "+flame_status);  
break;
```

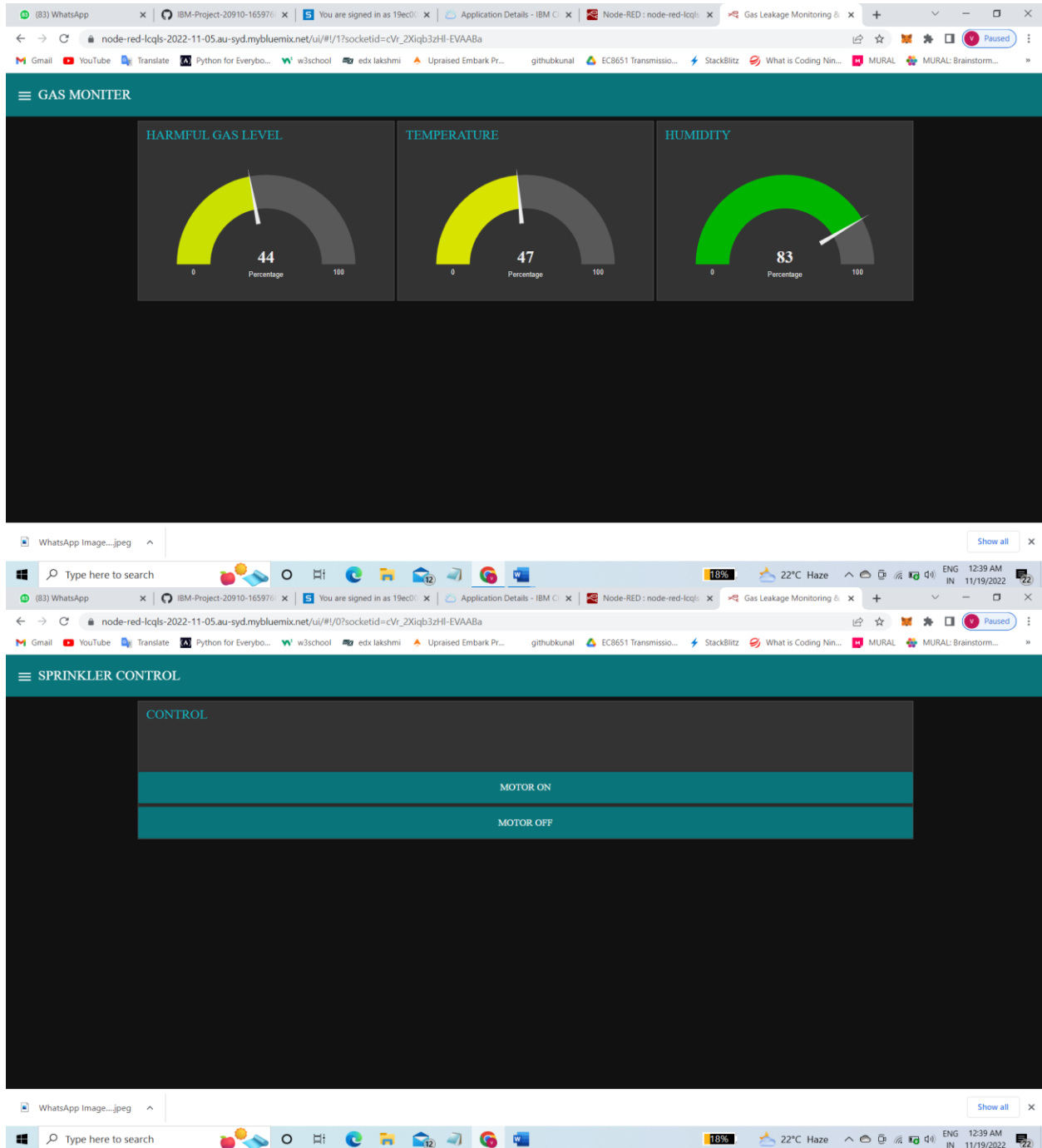
```

case 1:
flame status = "Fire is Detected";
Serial.println("Flame Status : "+flame_status);
break;
}
//Gas Detection
if(gas_level > 100){
Serial.println("Gas Status : Gas leakage Detected");
}
else{
exhaust_fan_on = false;
Serial.println("Gas Status : No Gas leakage Detected");
}
//send the sprinkler status
if(flame){
sprinkler_status =
"Sprinkler ON";
Serial.println("Sprinkler Status : "+sprinkler_status);
}
else{
sprinkler_status = "Sprinkler OFF";
Serial.println("Sprinkler Status : "+sprinkler_status);
}
//toggle the fan according to gas
if(gas_level > 100){
exhaust_fan_on = true;
Serial.println("Exhaust fan Status : Fan ON");
}
else{
exhaust_fan_on = false;
Serial.println("Exhaust fan Status : Fan OFF");
}
Serial.println("");
Serial.println("");
Serial.println("-----#####-----");
Serial.println("");
Serial.println("");
delay(1000);
}

```

8.RESULTS:

OUTPUT ON WEB UI:



OUTPUT IN IBM IOT PLATFORM:

The screenshot displays the IBM Watson IoT Platform interface. The top navigation bar includes 'Browse', 'Action', 'Device Types', and 'Interfaces'. The main content area shows a list of devices, with device ID 1234 selected. The device details panel for 1234 shows it is 'Disconnected' and of type 'ESP32'. Below this, the 'Recent Events' tab is active, displaying a table of events.

Event	Value	Format	Last Received
event_1	{"Gas Level":5,"Humidity":60,"Temp":49}	json	a few seconds ago
event_1	{"Gas Level":43,"Humidity":73,"Temp":36}	json	a few seconds ago
event_1	{"Gas Level":72,"Humidity":18,"Temp":19}	json	a few seconds ago
event_1	{"Gas Level":55,"Humidity":25,"Temp":31}	json	a few seconds ago
event_1	{"Gas Level":60,"Humidity":62,"Temp":3}	json	a few seconds ago

0 Simulations running

OUTPUT IN CLOUDANT:

The screenshot shows the Cloudant dashboard for the 'gasmonitor_db' database. The left sidebar contains navigation options like 'All Documents', 'Query', 'Permissions', 'Changes', and 'Design Documents'. The main area displays a table of documents with columns 'id', 'key', and 'value'.

id	key	value
02105e0e7483256f3d9454b6721ef60f	02105e0e7483256f3d9454b6721ef60f	{ "rev": "1-d3162ddba6ceb8ca43786..." }
02105e0e7483256f3d9454b67223b5...	02105e0e7483256f3d9454b67223b5...	{ "rev": "1-14a77531dc5cc744c7094..." }
02105e0e7483256f3d9454b67224cb...	02105e0e7483256f3d9454b67224cb...	{ "rev": "1-60d3cb6ba1c543ff967b09..." }
02105e0e7483256f3d9454b67224fa...	02105e0e7483256f3d9454b67224fa...	{ "rev": "1-ab091c75d85d3b2fb6790..." }
02105e0e7483256f3d9454b672284e...	02105e0e7483256f3d9454b672284e...	{ "rev": "1-707007af60f6ee86a34219..." }
02105e0e7483256f3d9454b6722876...	02105e0e7483256f3d9454b6722876...	{ "rev": "1-fc8a4900e8b835bb12d47..." }
04917f2365d1f680db461b98b0395f48	04917f2365d1f680db461b98b0395f48	{ "rev": "1-5c519fa45b00678909ad9f..." }
04917f2365d1f680db461b98b03b3a0a	04917f2365d1f680db461b98b03b3a0a	{ "rev": "1-c759ef73900eac5d1dbf7ff..." }
04917f2365d1f680db461b98b04075...	04917f2365d1f680db461b98b04075...	{ "rev": "1-6cc691c3c4f57986c448b5..." }
04917f2365d1f680db461b98b045c65c	04917f2365d1f680db461b98b045c65c	{ "rev": "1-87a40f2b8fd1bde870466e..." }
04917f2365d1f680db461b98b0497d...	04917f2365d1f680db461b98b0497d...	{ "rev": "1-5c5b63535e1d78dea1e2d..." }

Showing document 1 - 20. Documents per page: 20

OUTPUT IN WOKWI SIMULATION PLATFORM:

The screenshot displays the Wokwi simulation platform interface. On the left, a code editor shows a C++ sketch for a fire detection system. The sketch includes libraries for time, WiFi, and PubSubClient. It defines variables for exhaust fan status, sprinkler status, temperature, gas level, flame, and flame status. The setup function initializes serial communication at 999000 baud. The loop function sets a random seed, initializes variables, and generates random values for temperature, gas level, and flame. It then maps the flame reading to a flame status (0 for No Fire, 1 for Fire is Detected) and prints the current state to the serial monitor.

```
1 #include <time.h>
2 #include <WiFi.h>
3 #include <PubSubClient.h>
4
5 bool exhaust_fan_on = false;
6 bool sprinkler_on = false;
7 float temperature = 0;
8 int gas_level = 0;
9 int flame = 0;
10 String flame_status = "";
11 String accident_status = "";
12 String sprinkler_status = "";
13 void setup() {
14   Serial.begin(999000);
15 }
16 void loop() {
17   //setting a random seed
18   srand(time(0));
19   //initial variable
20   temperature = random(-
21     20,125);
22   gas_level = random(0,100);
23   int flamereading =
24     random(200,1024);
25   flame =
26     map(flamereading,0,1024,0,
27       2);
28   //set a flame status
29   Serial.print("Temperature : ");
30   Serial.println(temperature);
31   Serial.print("Gas_level : ");
```

On the right, the 'Simulation' tab shows the output of the sketch. The output is divided into two sections by a dashed line. The first section shows the initial state where no fire is detected. The second section shows the state after a fire is detected, where the sprinkler turns on.

Simulation controls (play, stop, reset) and a timer (00:07.864) are visible above the output. The output text is as follows:

```
Temperature : 67.00
Gas_level : 42
Flame : 0
Flame Status : No Fire
Gas Status : No Gas leakage Detected
Sprinkler Status : Sprinkler OFF
Exhaust fan Status : Fan OFF

-----#-----
Temperature : 93.00
Gas_level : 27
Flame : 1
Flame Status : Fire is Detected
Gas Status : No Gas leakage Detected
Sprinkler Status : Sprinkler ON
Exhaust fan Status : Fan OFF
```

The bottom of the image shows a Windows taskbar with the system clock at 9:43 PM on 18/11/2022.

OUTPUT IN MOBILE BY USING MIT APP:



HARMFUL GAS 53

TEMPERATURE 19

HUMIDITY 14

MOTOR ON

MOTOR OFF

9 . ADVANTAGE:

This project helps the industries in monitoring the emission of harmful gases

In several areas, the gas sensors will be integrated to monitor the gas leakage

If in any area gas leakage is detected the admins will be notified along with the location

In the web application, admins can view the sensor parameters.

DISDAVANTAGE:

The sensor should work properly in all situations .the data should be continuously recorded in the database.In case of malfunctioning of the circuit the system will get collapsed.

10.CONCLUSION:

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.

