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PROJECT REPORT

GAS LEAKAGE MONITORING AND ALERTING SYSTEM FOR INDUSTRIES

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CHAPTER – 1

INTRODUCTION

1.1 PROJECT OVERVIEW:

Leakage of gas is a major issue in the industrial sector, residential buildings, and gas-powered vehicles, one of the preventive methods to stop accidents associated with gas leakage is to install gas leakage detection devices. The focus of this work is to propose a device that can detect gas leakage and alert the owners to avert problems due to gas leakages. The system is based on a microcontroller that employs a gas sensor as well as a GSM module, an LCD display, and a buzzer. The system was designed for gas leakage monitoring and alerts with SMS via an Arduino microcontroller with a buzzer and an MQ2 gas sensor. The circuit contains a Microcontroller MQ2 gas sensor, buzzer, LCD display, and GSM module, when the sensor detects gas leakage it transmit the information to the Microcontroller while the microcontroller makes a decision and then forwarded a warning message to the user as SMS to a mobile phone for decision to be taken accordingly. The output of this research will be significant in averting problems associated with gas leakages now and in future.

1.2 PURPOSE:

Inhaling concentrated gas can lead to asphyxia and possible death.To overcome these disasters, we designed a system for monitoring and alerting the leakage of those harmful gases. This makes the industrialists get rid of the fear of any disasters caused bythe gases

CHAPTER – 2

LITERATURE SURVEY:

2.1 EXISTING PROBLEM:

The number of sensors is unpredictable and the positioning of equipmentisimproper and also the affordable of the system is high and the systems are sometimes causing heavy disasters.

2.2 REFERENCES:

Hema, L. K., Murugan, D., & Chitra, M. WSN based Smart system for detection of LPG and Combustible gases. In National Conf. on Architecture, Software systems and Green computing-2013.

Ramya, V., & Palaniappan, B. Embedded system for Hazardous Gas detection and Alerting. International Journal of Distributed and Parallel Systems (IJDPS), 2012; 3(3):287-300.

Deepak, N., Rajendra Prasad, C., & Sanjay Kumar, S. Patient health monitoring using IOT. International Journal of Innovative Technology and Exploring Engineering, 2018; 8(2):454–457.

https://doi.org/10.4018/978-1-5225- 8021-8.ch002

2.3 PROBLEM STATEMENT:

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 itbecomes explosive it could cause great danger to the people, home, workplace, industry and the environment.

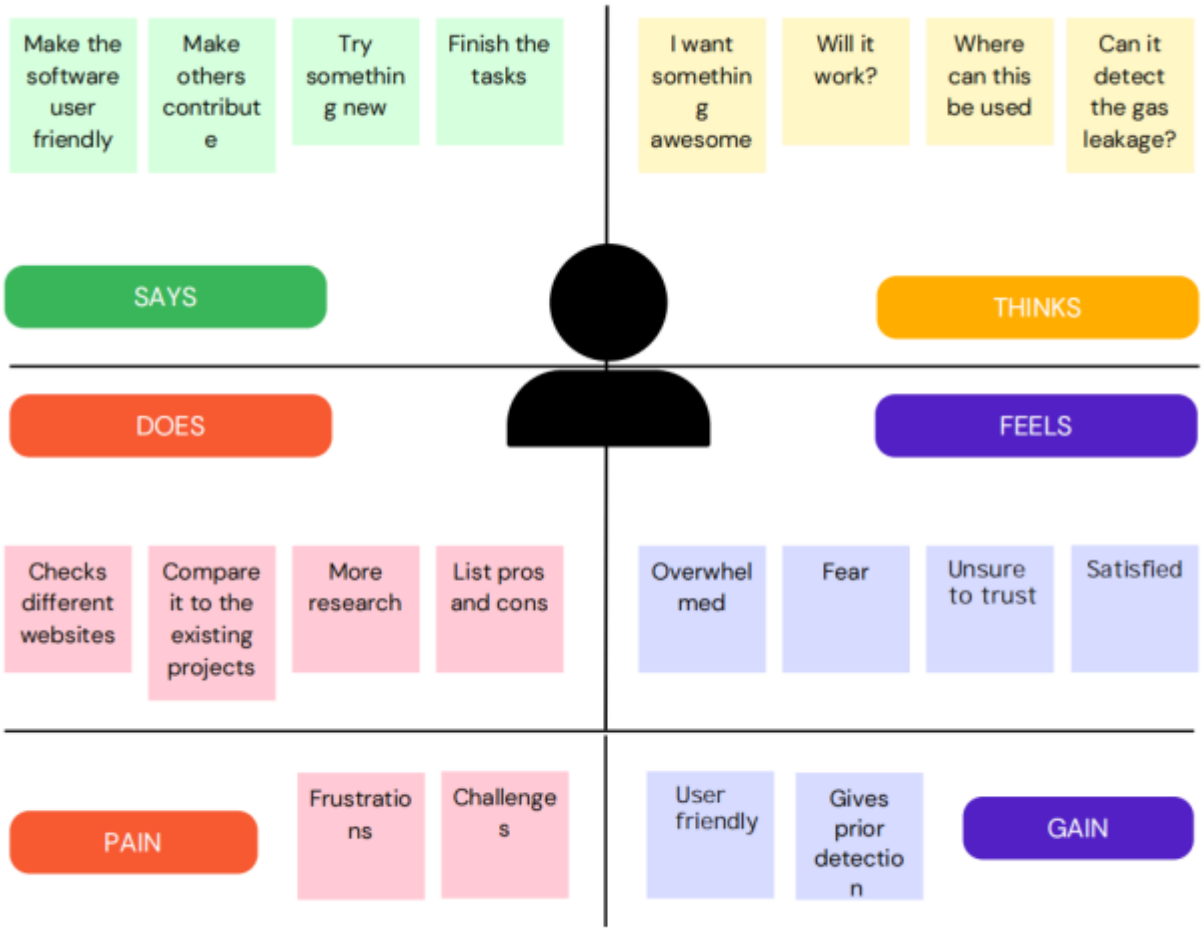
Few of the major incidents that took place due to gas leakage include the Bhopal Disaster and the Vizag Gas leak. The Bhopal disaster is known to be the worst industrial accident ever. Approximately 45 tons of Methyl Isocyanate was leaked from this insecticide plant. Methyl Isocyanate is an organic compound and achemical 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 beattached with certain parameters that could help to prevent the issue.

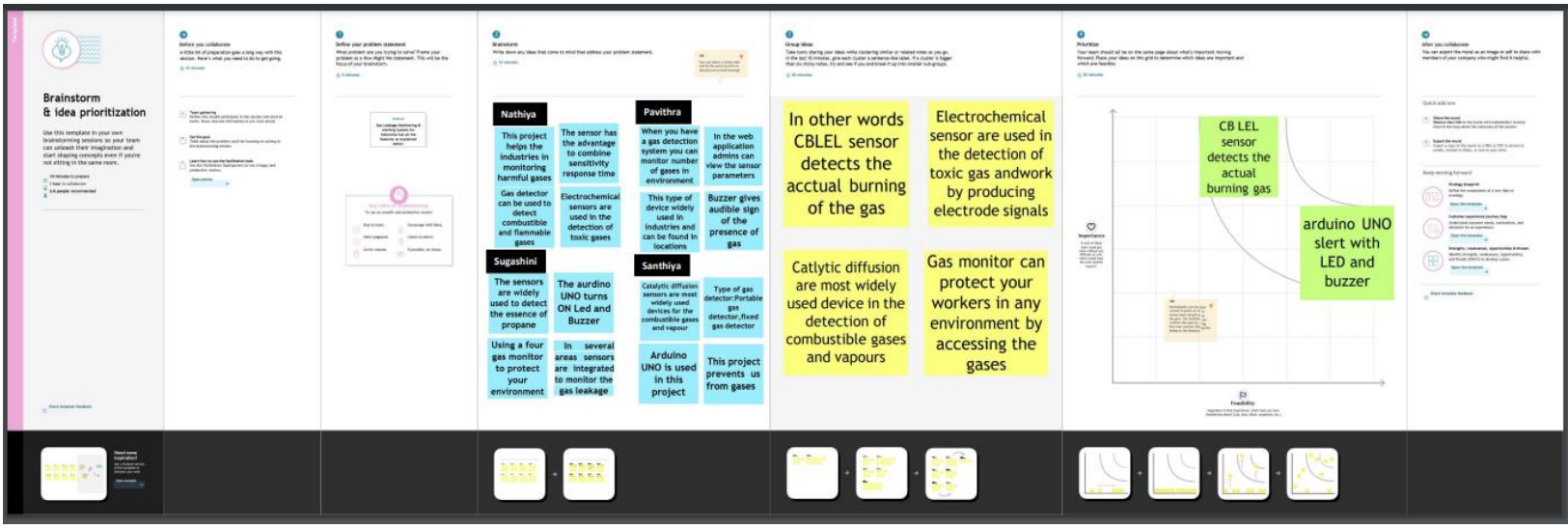
CHAPTER - 3

IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS:



IDEATION & BRAINSTROMING:



2.3 PROSPOSED SOLUTION :

S.No.	Parameter	Description
1.	Problem Statement	Develop an efficient system & an application that can monitor and alert the users(workers)
2.	Idea / Solution description	This product helps the industries in monitoring the emission of harmful gasesIn 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 locationIn the web application, admins can view the sensor parameters.
3.	Novelty / Uniqueness	Fastest alerts to the workers User friendly
4.	Social Impact / Customer Satisfaction	Cost efficient Easy installation and provide efficient results Can work with irrespective of fear

5.	Business Model (Revenue Model)	The product is advertised all over the platforms. Since it is economical, it even helps small scale industries from disasters.As the product usage can be understood by everyone, it is easy for them to use it properly for their safest organization.
6.	Scalability of the Solution	Since the product is cost-efficient, it can be placed in many places in the industry. Even when the gas leakage is more, the product senses the accurate values and alerts the workers effectively.

2.4 PROPOSED SOLUTION FIT:

Project Title: Gas Leakage Monitoring and Alerting System

Team ID: PNT2022TMID30897

1. CUSTOMER SEGMENT(S) CS

- Oil, Gas, Polymer Industries
- Hospitals
- Safety Control Personals
- Mining

6. CUSTOMER CONSTRAINTS CC

- Network Connection
- Complexity in Installation
- High budget in installing other products make them to move far from modern technologies

5. AVAILABLE SOLUTIONS AS

- Upgrading to a premium network plan.
- Availing network connection from a reliable Service provider.

2. JOBS-TO-BE-DONE / PROBLEMS J&P

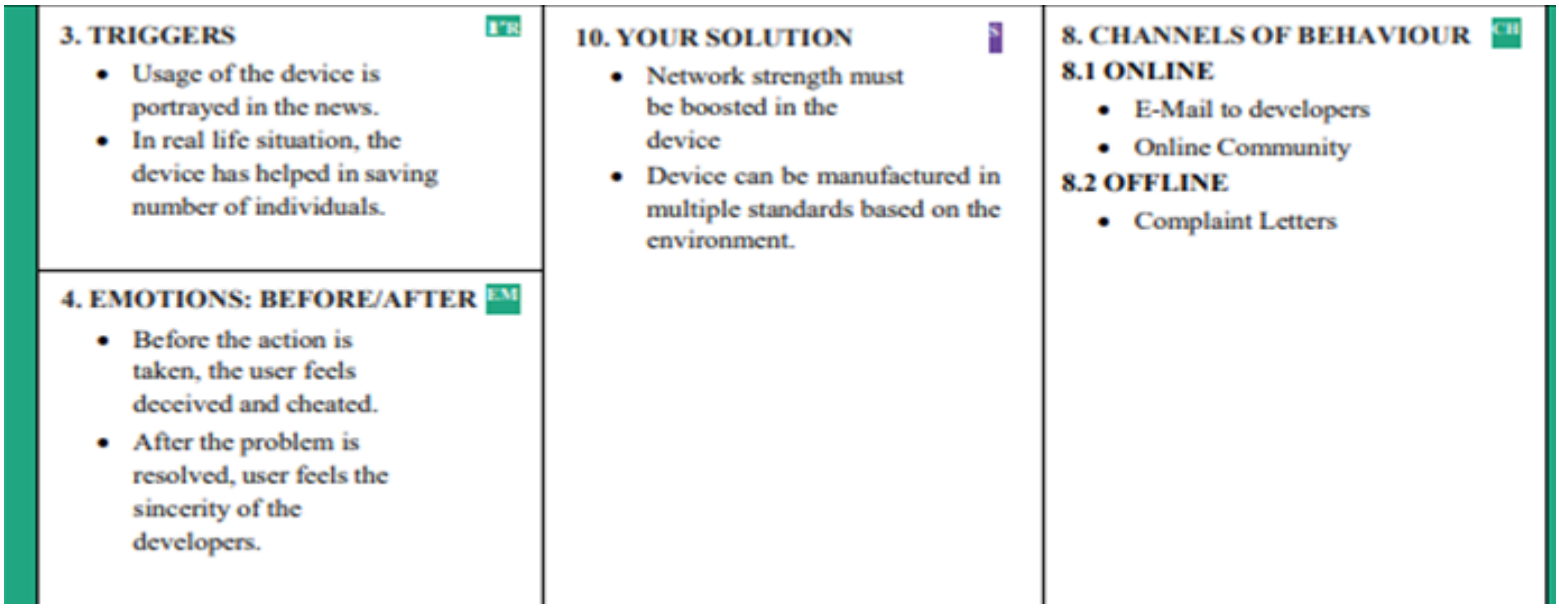
- Suffering from many losses due to gas leakage.
- Having no proper system for controlling or monitoring the leakage.
- Facing heavy budget problems in buying and installing a system for monitoring and controlling

9. PROBLEM ROOT CAUSE RC

- Quality of the material using which the device is made up of plays a vital role in the capability of the device to work in harsh environment.
- Location of the device installation and the network plan used by the user are the cause of Network issue.

7. BEHAVIOUR BE

- Harsh environment is prevailing only on certain industry; thus, the frequency of the said problem is low. In such a case the customer complaints multiple times to get the attention.
- Network issue is very common as most of the industries are located at the country side. Here the contact both the developers and the service providers



CHAPTER – 4

REQUIREMENT ANALYSIS

FUNCTIONAL REQUIREMENT:

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Online Payment for the service
FR-2	User Access	Access the details using web browser Access the details using mobile application
FR-3	User Alert	Gets alert as an SMS message Gets alert alarm in the working area.

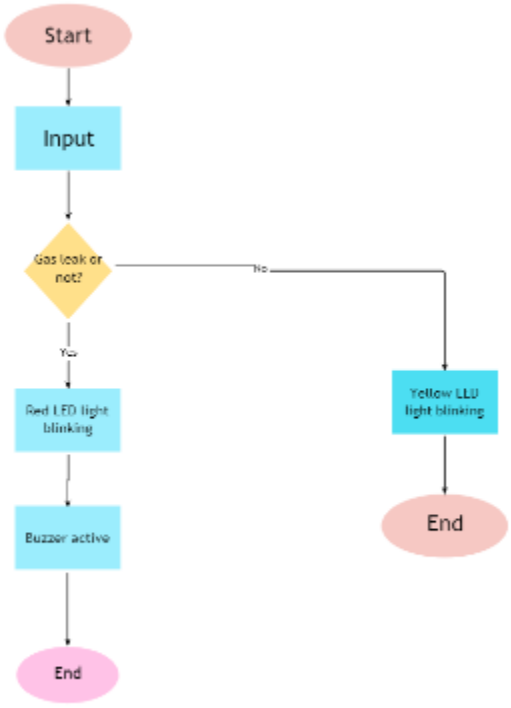
4.2 NON FUNCTIONAL REQUIREMENT :

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The device must be usable by the customer anywhere
NFR-2	Security	Data from the sensors are stored securely and away from other data
NFR-3	Reliability	Data can be retrieved anytime and no data is discarded without customer knowledge
NFR-4	Performance	No performance delay in case of large number of data or more parameters.
NFR-5	Availability	The device doesn't fail even under harsh conditions. Device continues to send parameters, even after an alert situation.
NFR-6	Scalability	Device must be capable of measuring conditions even in a larger industry

CHAPTER - 5

PROJECT DESIGN

5.1 DATA FLOW DIAGRAM:



5.2 SOLUTION AND TECHNICAL ARCHITECTURE:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g. Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript
2.	IOT Application Logic-1	Device Should be connected to System Using python code.	Python
3.	IOT Application Logic-2	NODEMCU device is connected with IBM Watson Platform.	IBM Watson STT service
4.	IOT Application Logic-3	It is connected with Web UI and alert the user through messages.	IBM Watson Assistant
5.	Cloud Database	Database Service on Cloud. Data can be any format based on user.	IBM DB2, IBM Cloudant etc.
6.	File Storage	File Should be named and it contains details of file type, date and time of file is created, memory space.	IBM Block Storage or Other Storage Service or Local Filesystem
7.	External API-1	It is used in device through Wifi communicating and allotting operation efficiency.	Aadhar API, etc.
8.	Machine Learning Model	IOT and machine learning delivers insights otherwise hidden in data for rapid automated response and improved decision making	Object Recognition Model and Danger prediction model etc.

5.3 USER STORIES :

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer(Mobile user)	Registration	USN-1	User can enter into the web application	I can access my account /dashboard	High	Sprint-1
		USN-2	Users can register their credentials like email id and password	I can receive confirmation email and click confirm	High	Sprint-1
	Login	USN-3	User can log in to the application by entering email and password	I can login to my account	High	Sprint-1
	Dashboard	USN-4	User can view the temperature	I can view the data given by the device	High	Sprint-2
		USN-5	User can view the level of gas	I can view the Data given by the device	High	Sprint-2
Customer (Web user)	Usage	USN-1	User can view the webpage and get the information	I can view the data given by the device	High	Sprint-3

Customer	**Working**	**USN-1**	**User act according to the alert given by the device**	**I can get the data work according To it**	**High**	**Sprint-3**
		USN-2	**User turns ON the exhaust fan/sprinkler when the leakage occurs**	**I can get the data work according to it**	**High**	**Sprint-4**
Customer Care Executive	**Action**	**USN-1**	**User solve the problems when someone faces anyusage issues**	**I can solve the issues when someone fails to understand the procedure**	**High**	**Sprint-4**
Administrator	**Administration**	**USN-1**	**User stores every information**	**I can store the gained information**	**High**	**Sprint-4**

CHAPTER - 6

PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING AND ESTIMATION:

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
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	Nathiya S Pavithra S Santhiya J Sugashini S
Sprint-2	Avoid From Disaster	USN-2	The gas leakage occur at the time fire service will take care to protect the people from the disaster.	1	High	Nathiya S Pavithra S Santhiya J Sugashini S
Sprint-3	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 maintanence service once in a month. The industry must take care of what are the necessary process to avoid the gas leakage.	2	Low	Nathiya S Pavithra S Santhiya J Sugashini S

Sprint-4	The model is trained and tested by sample dataset.	USN-4	The programmer design the model to detect the gas leakage.	2	Medium	Nathiya S Pavithra S Santhiya J Sugashini S

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-5	Warning message	USN-5	Incase any gas leakage occur, the device give the alarm and alert message to concerned user within a minute.	1	High	Nathiya S Pavithra S Santhiya J Sugashini S

6.2 SPRINT DELIVERY SCHEDULE:

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	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
Sprint-5	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

CHAPTER – 7

CODING AND SOLUTIONING:

7.1 FEATURE 1:

The sensor-enabled solution helps prevent the high risk of gas explosions and affecting any casualties within and outside the premises. The gas sensors help detect the concentration of the gases present in the atmosphere to avoid hazardous consequences like fire breakouts.

7.2 FEATURE 2:

The gas leak detector has 5 LEDs that inform the gas intensity. The gas leak detector PCE-GA 12 is a very easy-to-use measuring device. This gas leak detector detects combustible gases and emits a vibrating alarm as well as an audible alarm once a combustible gas has been detected by the gas leak detector.

CHAPTER – 8

TESTING

8.1 TEST CASES:

8.2.1 Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the [Gas Leakage Monitoring And Alerting System For Industries] project at the time of the release to User Acceptance Testing (UAT)

8.2.2 Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how theywere resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	5	4	2	3	14
Duplicate	1	0	3	0	4
External	2	3	2	1	8
Fixed	5	2	4	9	20
Not Reproduced	0	0	0	0	0
Skipped	1	1	1	1	4
Won't Fix	0	0	0	0	0

Total : 14 10 12 14 50

8.2.3 TEST CASE ANALYSIS:

This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	10	0	0	10
Client Application	75	0	0	75
Security	8	0	0	8

Outsource Shipping	2	0	0	2
Exception Reporting	10	0	0	10
Final Report Output	5	0	0	5

Version Control : 10 0 0 10

CHAPTER – 10

RESULTS

10.1 PERFORMANCE AND METRICS:

NFT - Risk Assessment

Project Name	Scope/Feature	Functional Changes	Hardware Changes	Software Changes	Load/Volume Changes	Risk Score	Justification
Alarm ON/OFF	Existing	Low	No Changes	Low	>5 to 10%	GREEN	Changes occurs less
Fast SMS	New	No changes	No Changes	Low	>5 to 10%	GREEN	Changes occurs hardly
Sprinkler ON/OFF	Existing	Low	No Changes	Low	>5 to 10%	GREEN	No changes occurs
Sensor values	Existing	Moderate	No Changes	Moderate	>10 to 30%	ORANGE	Some changes occurs

NFT - Detailed Test Plan

S.No	Project Overview	NFT Test approach	Approvals/SignOff	
1	Python script	Python coding		Depend on the delivered code
2	Node Red	Sensor & command values		Sensor values
3	MIT Inventor	Alarm/Sprinkler/Sensors notification		Notifications

End Of Test Report

Project Overview	NFT Test approach	NFR-Met	Test Outcome	GO/NO-GO decision	dentified Defects (Detected/Closed/Open	Recommendations	Approvals/SignOff
Python Code	Python coding	Met	Pass	GO	Closed	Efficient code	
Node Red	Sensors&command values	Met	Pass	GO	Closed	Sensing the values perfectly	
MIT Inventor	Alarm/Sprinkler/Sensors notification	Met	Pass	GO	Closed	Notifies the users at correct time	

CHAPTER – 10

ADVANTAGES AND DISADVANTAGES

10.1 ADVANTAGES:

- Detect the concentration of the gases
- The sensor-enabled solution helps prevent the high risk of gas explosionsand affecting any casualties within and outside the premises.
- 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

10.2 DISADVANTAGES :

- Only one gas can be measured with each instrument.
- When heavy dust, steam or fog blocks the laser beam, the system will notbe able to take measurements**.**

CHAPTER - 11

CONCLUSION

Gas leakage leads to severe accidents resulting in material losses andhuman injuries .Gas leakage occurs due to poor maintenance of equipment and inadequate awareness of the people. Hence, gas leakage detection is essential to prevent accidents and to save human lives. This paper presented LPG leakage detection and alert system. This system triggers buzzer and notification to alert people when gas leakages detected. This system is basic yet reliable.

CHAPTER - 12

FUTURE SCOPE

Major cities of India are pushing Smart Home application, gas monitoringsystem is a part of Smart Home application. Enhancing Industrial Safety using IOT. This systemcan be implemented in Industries, Hotels and wherever the gas cylinders are used. This systemcan be used in industries involving applications such as Furnace, Boilers, Gas welding, Gas cutting, Steel Plants, Metallurgical industries, Food processing Industries, Glass Industries, Plasticindustries, 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.

CHAPTER - 13

APPENDIX

13.1 SOURCE CODE:

```
#include <LiquidCrystal.h>

LiquidCrystal lcd(6, 7, 8, 9, 10, 11);
float gasPin = A0;
float gasLevel;
int ledPin = 2;
int buttonPin = 3;
int buzzPin = 4;
int buttonState;
int fan = 5;

void setup(){
  pinMode(ledPin, OUTPUT);
  pinMode(buttonPin, INPUT);
  pinMode(gasPin,INPUT);
  pinMode(fan,OUTPUT);
  Serial.begin(9600);
  lcd.begin(16, 2);
  lcd.setCursor(0,0);
  lcd.print(" Welcome");
  lcd.setCursor(0,2);
  lcd.print("GAS LEAKAGE SYSTEM");
  delay(500);
  lcd.clear();
}

void loop(){
```

```
  // Read the value from gas sensor and button
  gasLevel = analogRead(gasPin);
  buttonState = digitalRead(buttonPin);

  // call the function for gas detection and button work
  gasDetected(gasLevel);
  buzzer(gasLevel);
  exhaustFanOn(buttonState);
}

// Gas Leakage Detection & Automatic Alarm and Fan ON
void gasDetected(float gasLevel){
  if(gasLevel >= 300){
  digitalWrite(buzzPin,HIGH);
  digitalWrite(ledPin,HIGH);
 digitalWrite(fan,HIGH);
  lcd.setCursor(0,0);
  lcd.print("GAS:");
 lcd.print(gasLevel);
 lcd.setCursor(0,2);
 lcd.print("FAN ON");


   delay(1000);
   lcd.clear();
  }else{
   digitalWrite(ledPin,LOW);
   digitalWrite(buzzPin,LOW);
   digitalWrite(fan,LOW);
   lcd.setCursor(0,0);
   lcd.print("GAS:");
   lcd.print(gasLevel);
   lcd.setCursor(0,2);
   lcd.print("FAN OFF");
   delay(1000);
   lcd.clear();
  }
}
//BUZZER
void buzzer(float gasLevel){
if(gasLevel>=300)
  {
  for(int i=0; i<=30; i=i+10)
  {
  tone(4,i);
  delay(400);
  noTone(4);
```

```
  delay(400);
  }
  }
}
// Manually Exhaust FAN ON
void exhaustFanOn(int buttonState){
  if(buttonState == HIGH){
  digitalWrite(fan,HIGH);
  lcd.setCursor(0,0);
  lcd.print("Button State:");
  lcd.print(buttonState);
  lcd.setCursor(0,2);
    lcd.print("FAN ON");
    delay(10000);
    lcd.clear();
  }

 }
```

13.2 **GITHUB AND PROJECT DEMO LINK :**

https://github.com/IBM-EPBL/IBM-Project-28405-1660111716

https://drive.google.com/file/d/104epGqH_opyfQKR6rjLbAebrFpxnDig8/view?usp=drivesdk