IBM FINAL REPORT ON

GAS LEAKAGE MONITORING & ALERTING SYSTEM FOR INDUSTRIES

PNT2022TMID4963

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1.INTRODUCTION

1.1 Project Overview

The Internet of Things is an emerging topic of technical, social, and economic significance. Consumer products, durable goods, cars and trucks, industrial and utility components, sensors, and other everyday objects are being combined with Internet connectivity and powerful data analytic capabilities that promise to transform the way we work, live, and play. Projections for the impact of IOT on the Internet and economy are impressive, with some anticipating as many as 100 billion connected IoT devices and a global economic impact of more than $11 trillion by 2025.The Internet of Things (IoT) is an important topic in technology industry, policy, and engineering circles. This technology is embodied in a wide spectrum of networked products, systems, and sensors, which take advantage of advancements in computing power, electronics miniaturization, and network interconnections to offer new capabilities. The large-scale implementation of IoT devices promises to transform many aspects of the way we live. For consumers, new IoT products like Internet-enabled appliances, home automation components, and energy management devices are moving us toward a vision of the “smart home’’, offering more security and energy efficiency. IoT systems like networked vehicles, intelligent traffic systems, and sensors embedded in roads and bridges move us closer to the idea of “smart cities’’, which help minimize congestion and energy consumption. IoT technology offers the possibility to transform agriculture, industry, and energy production and distribution by increasing the availability of information along the value chain of production using networked sensors. Safety plays a major role in today’s world and it is necessary that good safety systems are to be implemented in places of education and work. This work modifies the existing safety model installed in industries and this system also be used in homes and offices. The main objective of the work is designing microcontroller based toxic gas detecting and alerting system. The hazardous gases like LPG and propane were sensed and displayed and notify each and every second in the LCD display. If these gases exceed the normal level then an alarm is generated immediately and also an alert message (Email) is sent to the authorized person through the INTERNET and used ARM development board. The advantage of this automated

detection and alerting system over the manual method is that it offers quick response time and accurate detection of an emergency and in turn leading faster diffusion of the critical situation.

1.2 Purpose

An overall conclusion IOT based toxic gas detector, or IOT technology has come a long way since it was conceptualized two decades ago. It has become more efficient, more applicable to today's applications and smarter. The work presented in this project was directed towards pushing IOT technology to the next level. The work has presented solutions to several problems and issues that have not been addressed in previous work. The principle of operation of Operation of IOT based gas leakage and monitoring system was shown by operating the Raspberry pi 3 model attached with embedded system with required input and output gas level with the help of gas sensors. This results in a more efficient in operation because it is connected to a common web page specially built to notify or email the responsible authority automatically so reduces the stress of constant monitoring. The choice of using a real time gas leakage monitoring and sensing the output levels of gas has been clearly observed by the help of this system.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEMS

It [1] proposes a system that uses an MQ-2 sensor which is capable of detecting gases such as H2, LPG, CH4, CO, Alcohol, Smoke and Propane. This system is not only capable of detecting the leakages and hence presence of excess amounts of harmful gases and alerting through audible alarms but also, with the help of IOT, alerting the concerned authority about the condition before any mishap takes place through a personal call and message using GSM module, an e-mail about the details of the area using an Ethernet Shield. The system cuts off the main power supply of the house or building when the concentration of gas is about to reach its Lower Explosion Limit (LEL) which is done with the help of relays. The Gas Leakage Detector System also sends the sensor reading to cloud so that analytics could be carried out on the readings for increasing the precision of the system.

In this paper [2] the hazardous gases like LPG and propane were sensed and displayed and notify each and every second in the LCD display. If these gases exceed the normal level then an alarm is generated immediately and also an alert message (Email) is sent to the authorized person through the INTERNET and used ARM development board. The advantage of this automated detection and alerting system over the manual method is that it offers quick response time and accurate detection of an emergency and in turn leading faster diffusion of the critical situation.
A Web page is built to show the status to the user monitoring it. The web page gives a notification via mail of the Gas leakage. The LCD screen shows the status. The system puts on the buzzer when the level of gas crosses the set limit. Thus this system helps to keep by informing about gas leakages by providing danger position of the gas leakage via a web page.

It [3] describes that once gas is leaked from the surroundings, a physical alert in the form of a buzzer and a led is indicated to the user for preventive action before harm to surrounding. Also, a notification to the mobile/laptop from push bullet is sent to the user. This output is monitored in our computers/mobiles where the stored values are sent for analysis and storage in the database through the cloud. A lighter is used to release gas for the MQ5 gas sensor to detect the gas leaked and alert the user. The data is sent through the cloud for receiving notifications from the internet to our mobile phones/laptop using the application.

This paper [4] purposed that the presence of hazardous LPG gas leakage in a domestic, work place, also, stored gases container gas which exhibits ideal characteristic is use. For that sake, an alarm unit is used to vibrate an alarm which is buzzer. Buzzer gives an audible sign of the presence of LPG volume. The sensors are widely used to detect essence of propane, iso-butane, LPG and even smoke. The sensor has an advantage to combine a sensitivity response time. If the LPG sensor senses gas leak from work place or home, sensor output goes to active low (logic-0) condition. Arduino UNO is used in the project; low signals are overlooked by the Arduino and gas leakage is been noticed by the Arduino. The Arduino UNO turns on the LCD and buzzer. It even turns on the GSM modem after that, it continues to send messages SMS to mobile number specifically mentioned in the program of the source code for alerting danger to the people.

The LPG leakage detection and alert system presented in this paper [5] is battery operated and hence portable. It is designed in such a way that it can also be operated with ac power supply. To support the latter case, it has a bridge rectifier with a capacitor filter. This is followed by a regulator designed with IC7805 which provides +5V regulated power supply. To detect the LPG, MQ-6 gas sensor is employed. The sensitivity of this sensor is very high and it has quick response time. It can detect the LPG concentration in the range of 200-10000ppm. The output of the gas sensor is given to LM358 dual operational amplifier where it is compared with the threshold value for gas density which is set using preset potentiometers and amplified. If the sensed voltage is greater than the preset threshold voltage, the operational amplifier output fires the driver circuit for LED and Buzzer. As a result, the LED will glow and the buzzer starts to produce alarm sound.

2.2 REFERENCES

[1] Varma, A., Prabhakar, S., & Jayavel, K. (2017, February). Gas leakage detection and smart alerting and prediction using IoT. In *2017 2nd International Conference on Computing and Communications Technologies (ICCCT)* (pp. 327-333). IEEE.

[2] Pandey, R. C., Verma, M., Sahu, L. K., & Deshmukh, S. (2017). Internet of things (IOT) based gas leakage monitoring and alerting system with MQ-2 sensor. *International Journal of Engineering Development and Research*, *5*(2), 2135-2137.

[3] Subramanian, M. A., Selvam, N., Rajkumar, S., Mahalakshmi, R., & Ramprabhakar, J. (2020, January). Gas Leakage Detection System using IoT with integrated notifications using Pushbullet-A Review. In *2020 Fourth International Conference on Inventive Systems and Control (ICISC)* (pp. 359-362). IEEE.

[4] Shahewaz, S. B., & Prasad, C. R. (2020). Gas leakage detection and alerting system using Arduino Uno. *Global Journal of Engineering and Technology Advances*, *5*(3), 029-035.

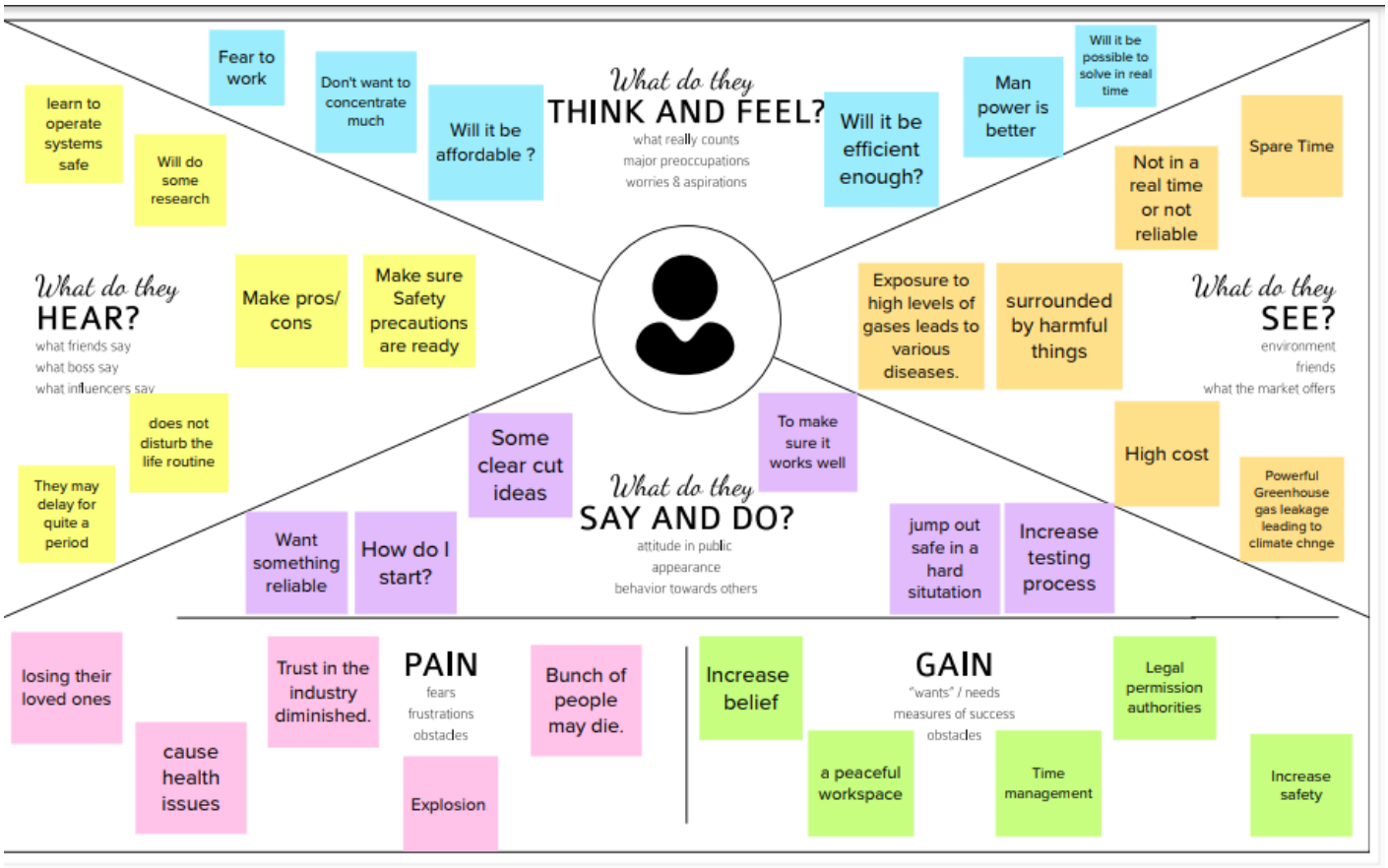
[5] Leavline, E. J., Singh, D. A. A. G., Abinaya, B., & Deepika, H. (2017). LPG gas leakage detection and alert system. *International Journal of Electronics Engineering Research*, *9*(7), 1095-1097.

2.3 PROBLEM STATEMENT DEFINITION

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. IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS



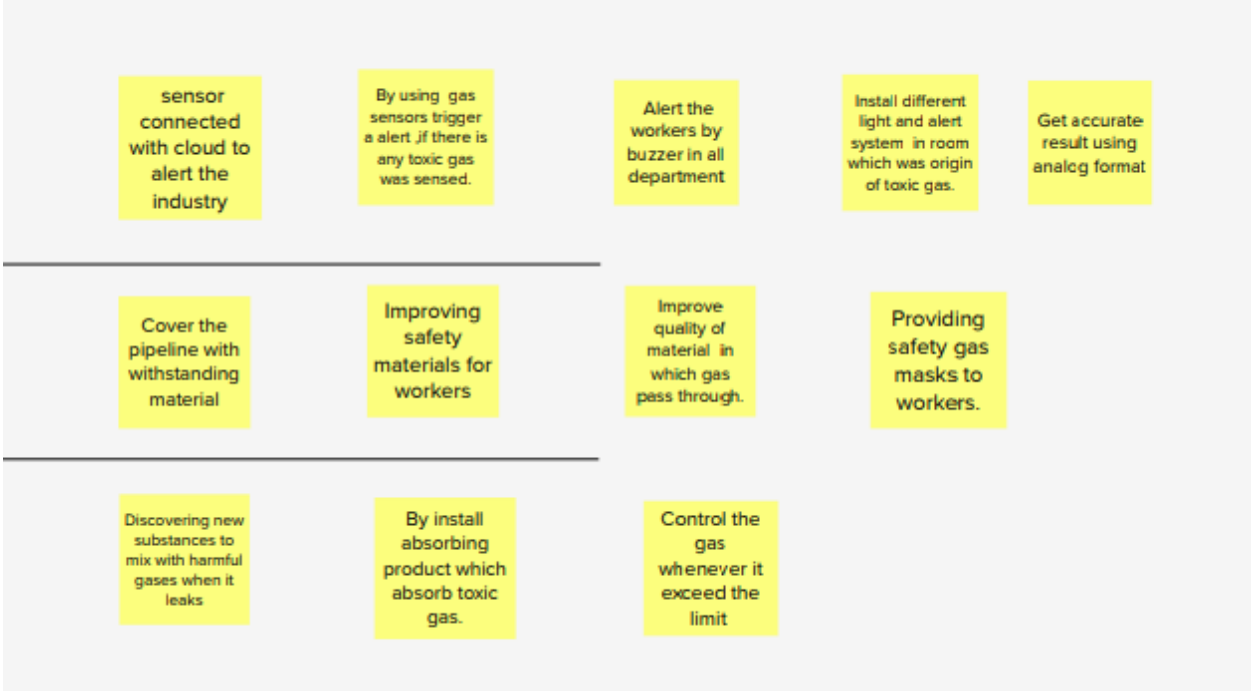
3.2 IDEATION AND BRAINSTORMING

3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes



4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

3.3 PROPOSED SOLUTION

We are planned to fit a sensor in the gas plants to monitor it. If there is any slight leak of gas then we will notify the admin department and fire fighters about the leakage and also alert the workers through an alarm sound to move out of the place where the gas pipe / plant are leaking. As a future scope we planned to lay additional layer of pipe (material which carries/contains the gas) in case of leak occurrence to cover the leakage place which will help the workers to fix the problem and work without any worries.

3.4 PROBLEM SOLUTION FIT

Project Design Phase-I - Solution Fit

Project Title: Gas Leakage monitoring & Alerting system for Industries

Team ID: PNT2022TMID4963

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 notetaking

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.

Explore AS, differentiate

Focus on J&P, tap into BE, understand RC

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 change 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

Identify strong TR & EM

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.

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.

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 in the 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.

Extract online & offline CH of BE

4. REQUIREMENT ANALYSIS

4.1 Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail / Industry mail Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User Login	Login as Industry Workers Login as Disaster Management Login as Industry Admin Department
FR-4	Industry Map	Map of the Industry displaying the prominent feature of the industry (available for Industry Workers and Admin Department)
FR-5	Zone Safety	Alert message is provided in this story if gas leakage occurs
FR-6	Sensor Parameters	Only Admin Department can view the sensor parameters which shows the recorded values of particular sensor.

4.2 **Non-functional Requirements:**

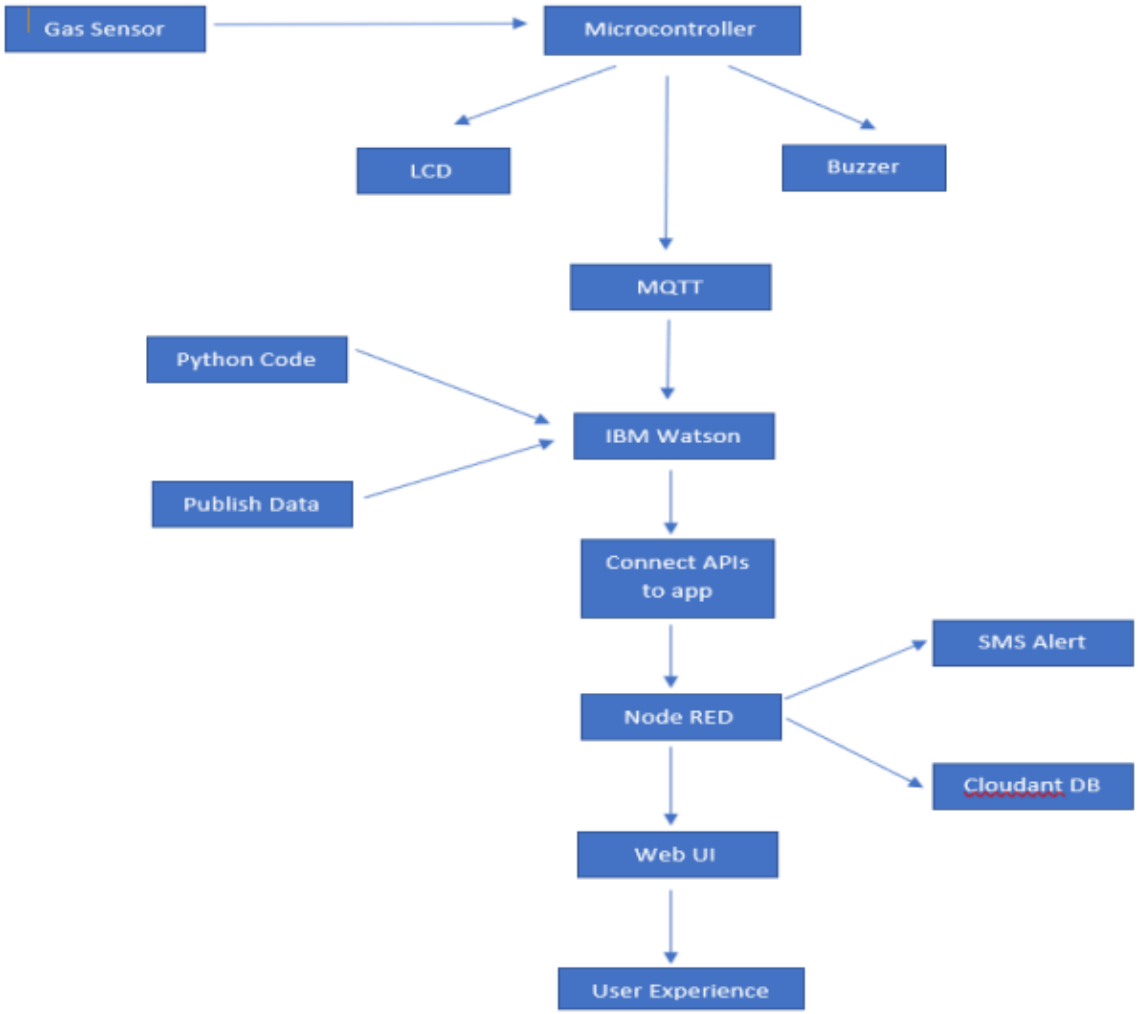
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The sensor-enabled solution helps prevent the high risk of gas explosions and affecting any casualties within and outside the premises.
NFR-2	**Security**	The device is intended for use in Industry and also in household safety where appliances and heaters that use natural gas and liquid petroleum gas (LPG)

		maybe a source of risk.
NFR-3	**Reliability**	Gas Leakage Detection system(GLDS) can detect leakage at homes, commercial premises or factories. GLDS detects the leakage soon after it happened and sends users an immediate alarm on the incident.
NFR-4	**Performance**	The gas leakage detector is a wall mounted device fitted close to the floor level with an alarm setting at 20% of lower explosive limit. Whenever there is a leak, the built-in sensor detects and alerts the user in less than 5 minutes, much before it can cause any accidents.
NFR-5	**Availability**	The circuit for an LPG leakage detector is readily available in the market, but it is extremely expensive. Presented here is a low cost circuit for a Gas leakage Detection that you can build easily.
NFR-6	**Scalability**	The system proves the need for gas detection alarm systems to be 100% reliable. A backup power supply can be included in the system design to augment for power failure condition. Also, calibration of the gas sensor can be done in other for a specific gas to be sensed instead of the LPG numerous gases.

5. PROJECT DESIGN

5.1 DATA FLOW DIAGRAM



5.2 SOLUTION AND TECHNICAL ARCHITECTURE

Components & Technologies:

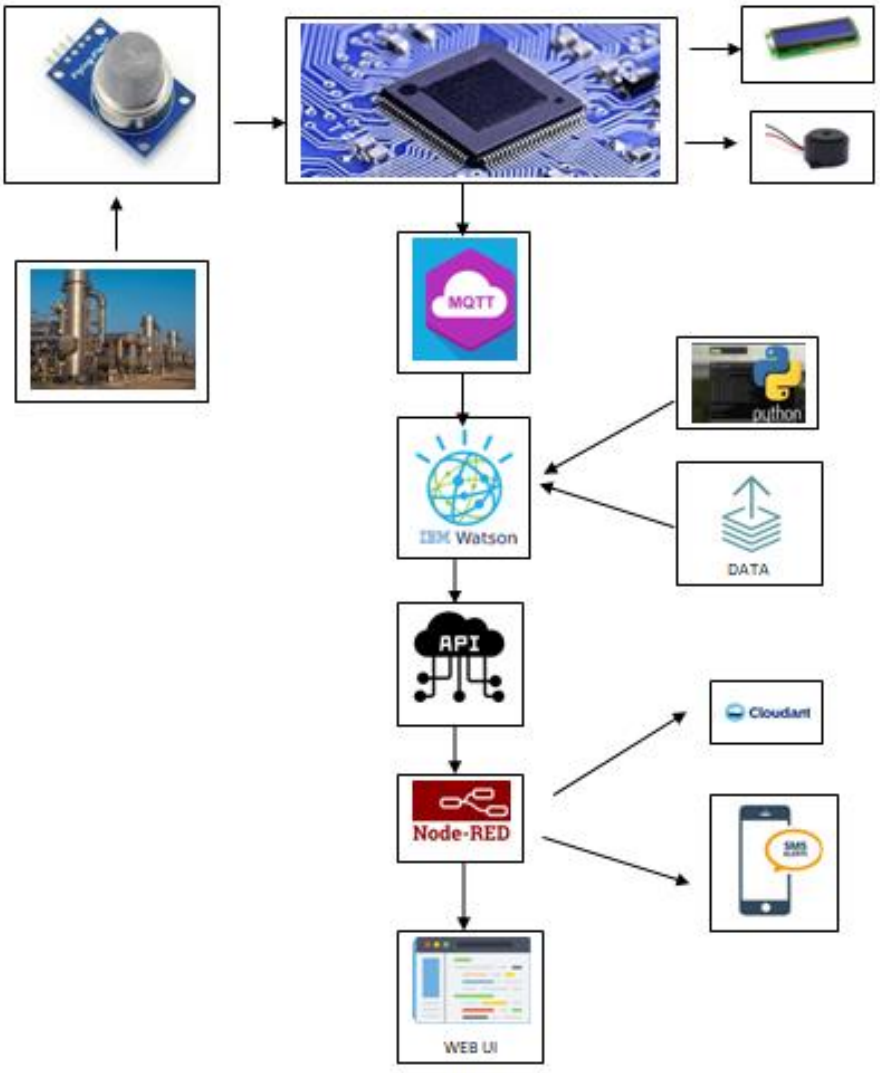
S.No	Component	Description	Technology
1.	User Interface	Web UI	HTML, CSS, JavaScript / Angular Js / React Js etc.

2.	Application Logic-1	Logic for a process in the application	Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
6.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
7.	External API-1	Purpose of External API used in the application	IBM Weather API
8.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration :	Local, Cloud Foundry, Kubernetes, etc.

Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	NodeRed, IBM Simulator, Python	IOT
2.	Security Implementations	security / access controls implemented	Encryptions
3.	Scalable Architecture	Raspberry pi: Specifications Soc: rspi ZERO W CPU: 32- bit computer with 1GHz ARMv6 RAM: 512 MB	IOT
4.	Availability	Gas sensor is used to measure the value of the gas emitted from the gas pipe. Through that we can send alert message.	IOT

S.No	Characteristics	Description	Technology
5.	Performance	No.of Request : RPI manages to execute 129-139 read request per second. Use of Cache: 512 MB Use of CDN's: Real Time	IOT / WEB APP



5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (workers)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail	I can register through my Gmail and get access to dashboard	Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password	I can see the dashboard which shows industry safety details.	High	Sprint-1
	Dashboard	USN-6	As a user, Iable to see industry name and green	I can check whether the industry is		

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
			symbol/red symbol.	safe or not		
Customer (Disaster Department)	login	USN-7	As a user, I can log in through Gmail	I can access dashboard.		
	dashboard		I able to see industry name, safety and location details.	I can monitor the industry Safety conditions.		
Customer (Administrator)	Registration	USN-8	As a user, I can register through industry email.	I can receive a confirmation email and click confirm.		
	login		I can log into the application through registeredGmail	I can access my dashboard.		
	dashboard		I can monitor the industry and see every sensor details.	I can control the access of the workers dashboard.		
			Dashboard shows the sensor parameters.	If sensor value increase certain value it will enable alert notification to worker mobile.		

6 PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING AND EXECUTION

S.NO	ACTIVITY TITLE	ACTIVITY DESCRIPTION	DATE
1	Literature Survey & Information Gathering.	Literature survey on the selected project & gathering information by referring the, technical papers, research publications etc	25 September, 2022
2	Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements	27September, 2022
3	Ideation	List the by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	29 September, 2022
4	Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	29 September, 2022
5	Problem Solution	Prepare problem -	3 October, 2022

	Fit	solution fit document	
6	Solution Architecture	Prepare solution architecture document.	20 October, 2022
7	Customer Journey Map	Prepare the customer journey maps to understand the user interactions & experiences with the application (entry to exit).	24 October,2022
8	Functional Requirement	Prepare the necessary technology and needs to accomplish a function of product	24October,2022
9	Data Flow Diagrams	Draw the data flow diagrams and submit for review	24October,2022
10	Technology Architecture	Prepare the technology architecture diagram.	8 November,2022
11	Prepare Milestone & Activity List	Prepare the milestones & activity list of the project.	8 November,2022
12	Project Development - Delivery of Sprint-1, 2, 3 & 4	Develop & submit the developed code by testing it.	13 November,2022

6.2 SPRINT DELIVERY SCHEDULE

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Point	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	Deepika.K Vaibhava lakshmi.G
Sprint-1	Confirmation	USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	P.Rithika H.Indhuja
Sprint-1	Login	USN-3	As a user, I can log into the application by entering email & password	1	High	Vaibhava Lakshmi.G P.Rithika
Sprint-1	Dashboard	USN-4	As a user, I can access all resources in the dashboard	2	Medium	K.deepika H.Indhuja
Sprint-1	Monitoring	USN-5	As a user, I can monitor the gas valve.	1	High	G.vaibhava Lakshmi H.Indhuja
Sprint-2	Cloud configure	USN-6	Create and configure the IBM Cloud	2	High	K.Deepika P.Rithika

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Point	Priority	Team Members
			services which are being used in this project.			
Sprint-2		USN-7	Connect the IoT device to the IBM cloud, create a device in the IBM Watson IoT platform and get the device credentials	3	Medium	H.Indhuja G.vaibhava Lakshmi
Sprint-2		USN-8	Develop a python script to publish random sensor data such as , gas sensor and GSM/GPS to the IBM IoT platform	4	Medium	P.Rithika
Sprint-3	Creates and maintains	USN-9	As an admin, I can create and maintain all information about the gas valve	2	Medium	Deepika.K
Sprint-3	Provide credentials	USN-10	As an admin, I can provide or revoke login credentials to the disaster	1	Low	Deepika.K

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Point	Priority	Team Members
			departments and workers			
Sprint-4	Alerting	USN-11	As a user, I can alert the information about gas leakage to workers via SMS and Gmail	3	High	Rithika. P Indhuja. H
Sprint-4	Add/Remove/Update workers	USN-12	As an admin, I can add, remove or update any Worker informationinto the system.	2	Medium	Deepika.K

Project Tracker, Velocity & Burndown Chart

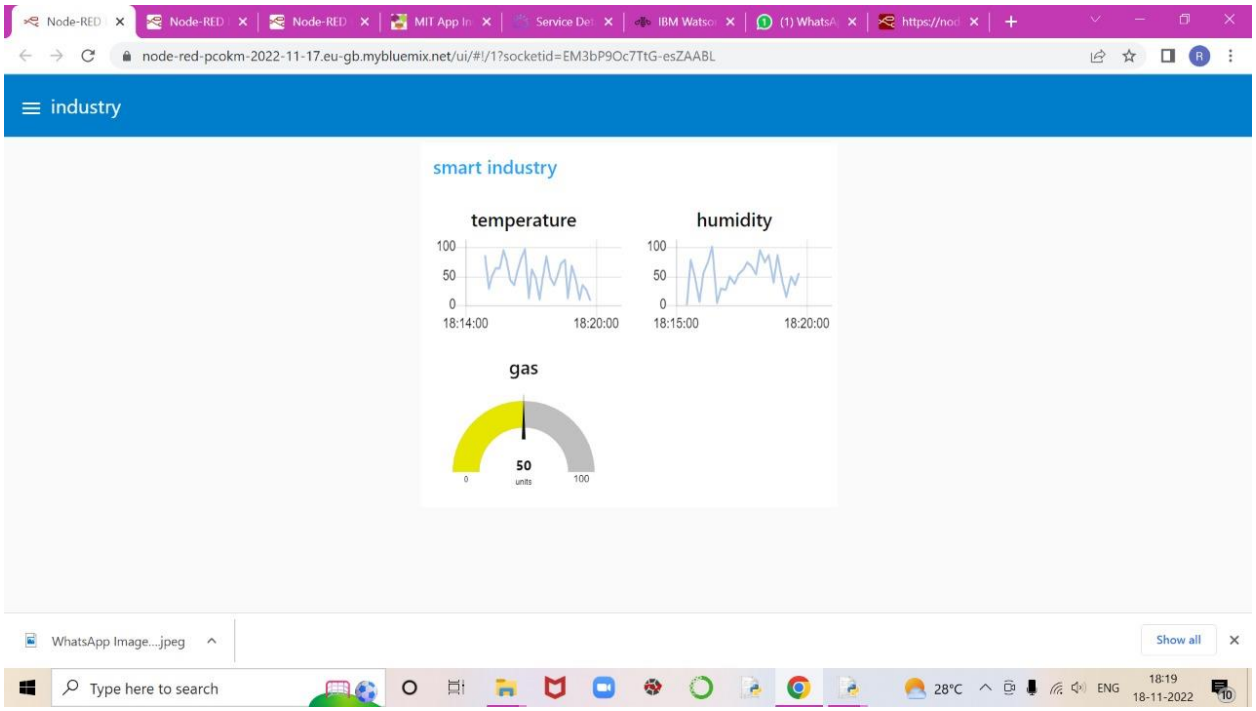
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022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

6.3 REPORTS FROM JIRA

7 CODING & SOLUTIONING

7.1 FEATURE 1

Our environment contains different gases which could be hazardous beyond certain limits. It is essential to monitor gas levels for the safety of human beings, animals and plants. There are various gas sensor technologies for detection of these different gases. We have developed a web application, which allows a user to monitor the value of temperature, humidity and gas values remotely with the help of sensors. User can monitor the values in any location and any device. We have created a cloud account which collects a real time data of sensors .In addition to that ,we had use node red open source service it will shows a graphical representation of temperature, humidity, gas values.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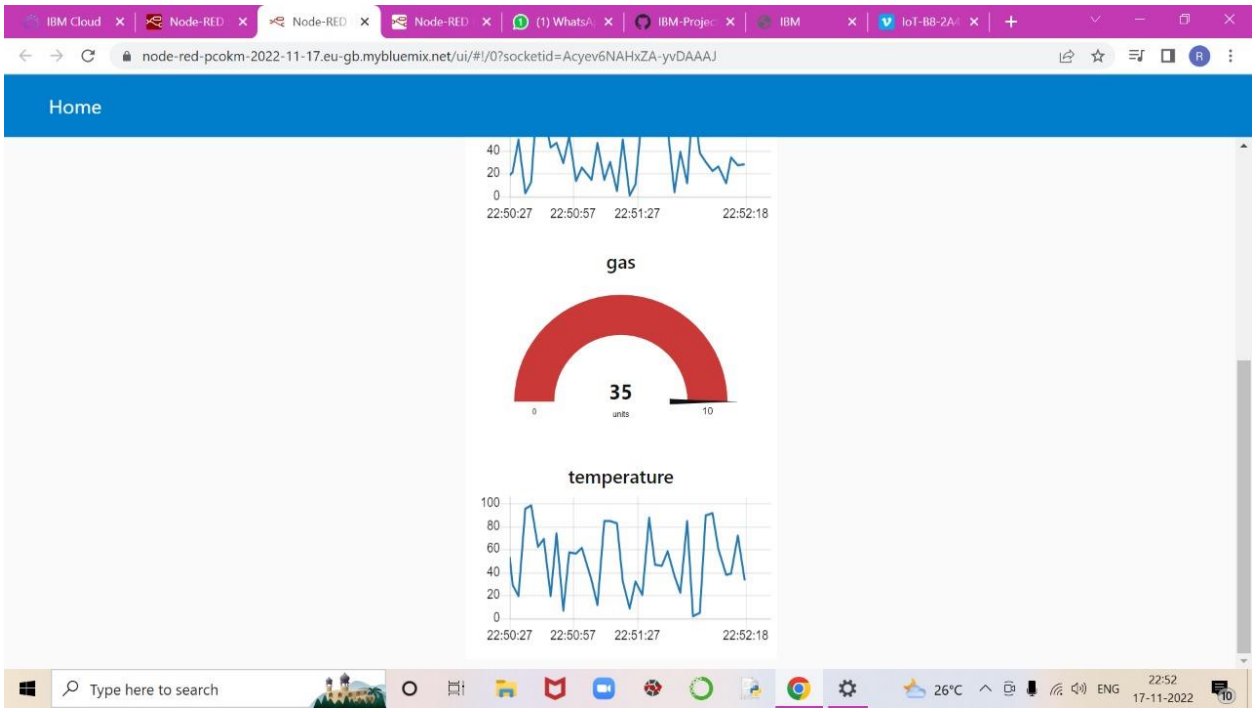
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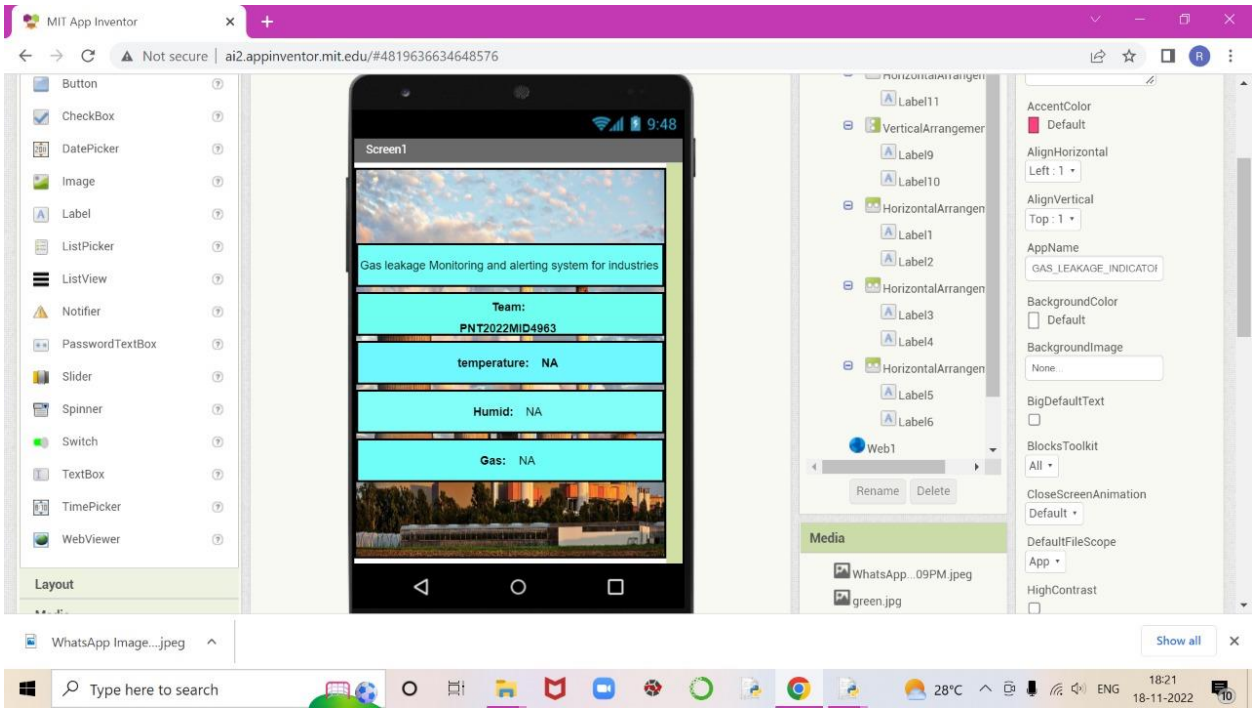
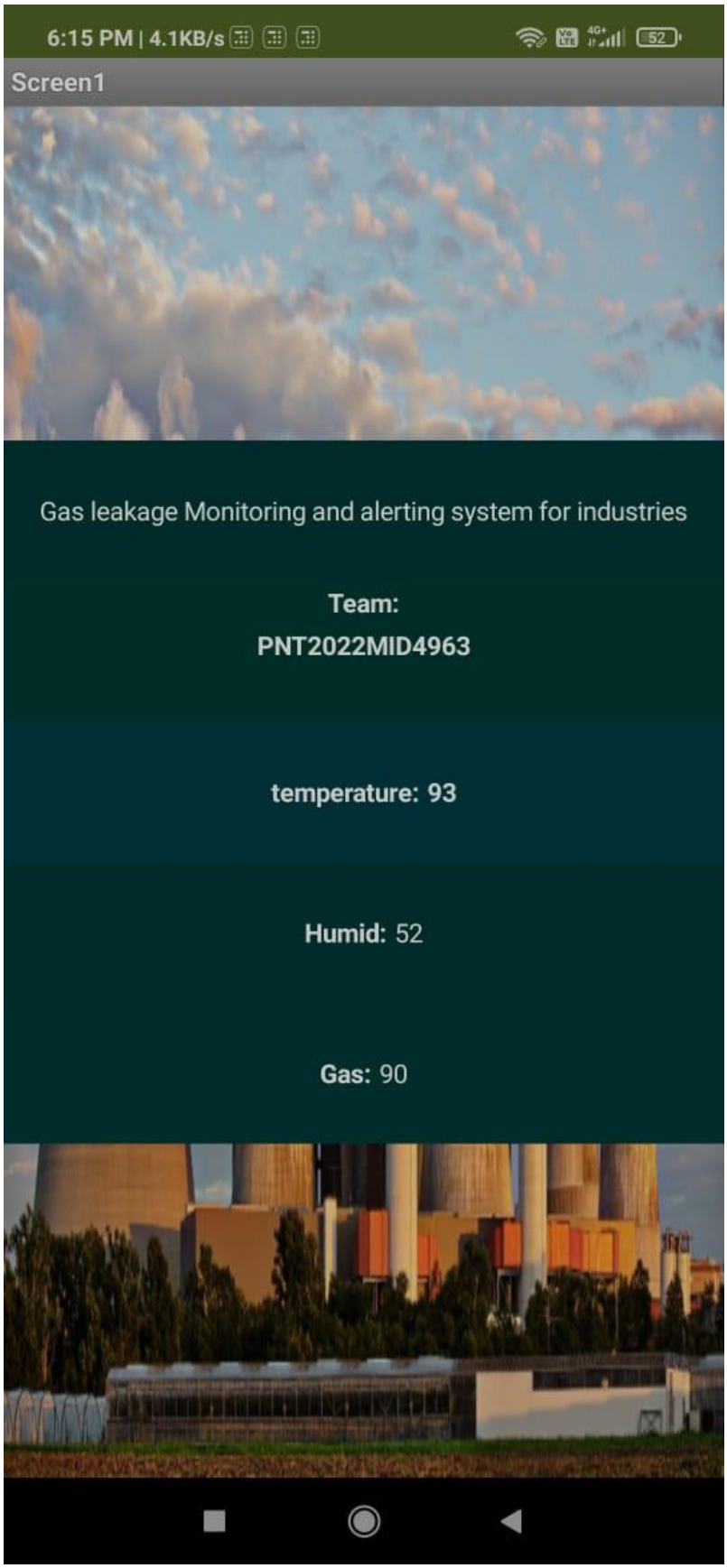
17-11-2022

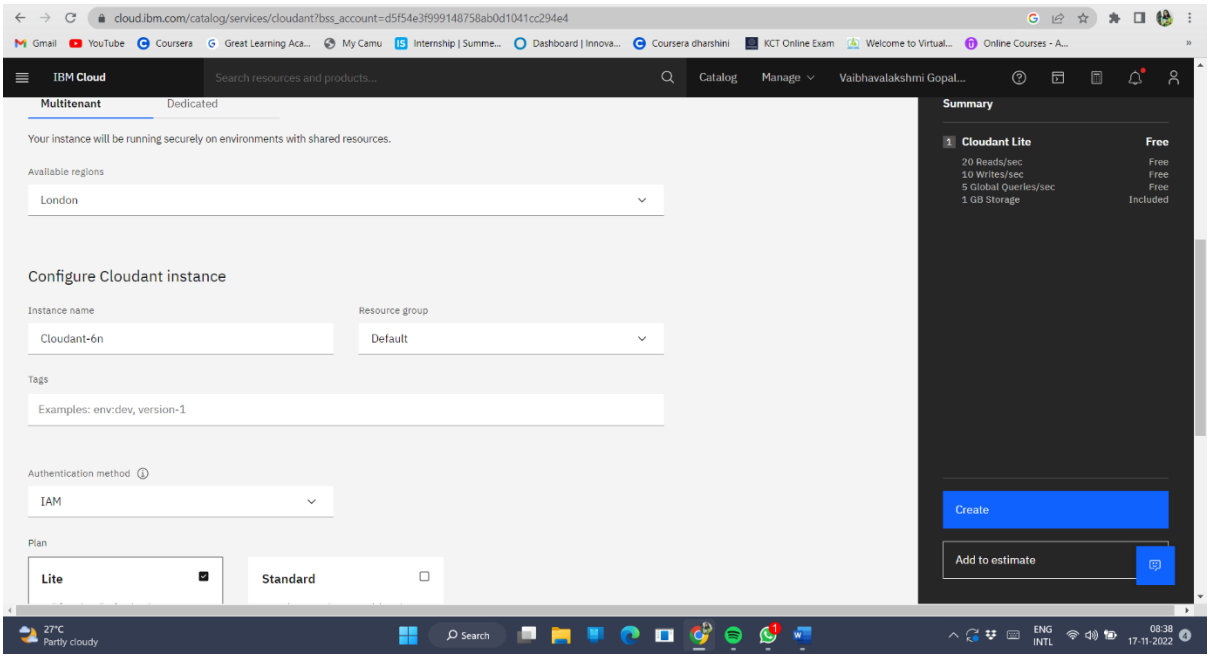
7.2 FEATURE 2

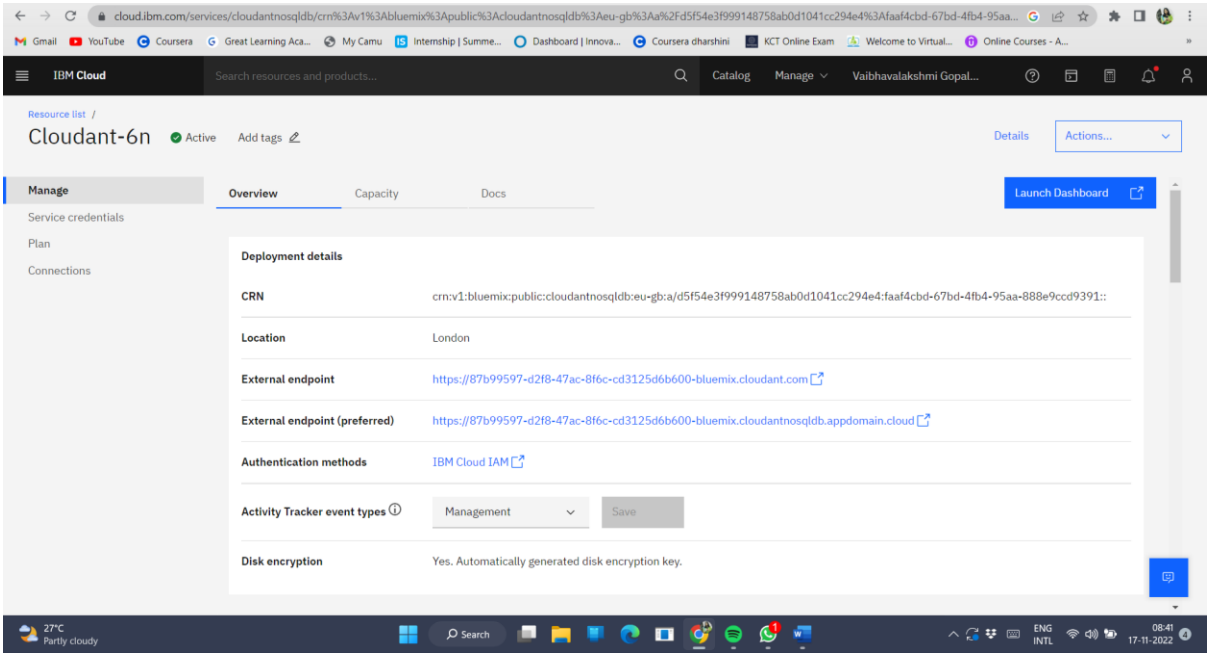
We have created a Android application which indicate The user about gas leakage via, SMS. The importance of Android application in our everyday life and activities is undeniably unending. This is so because there is ongoing tremendous transformation in that mobile phones are no longer the ordinary communication device it used to be. To use this application user need to login using Gmail. Application will collects data from cloud. Also it shows an exact numerical value of temperature, humidity and gas.

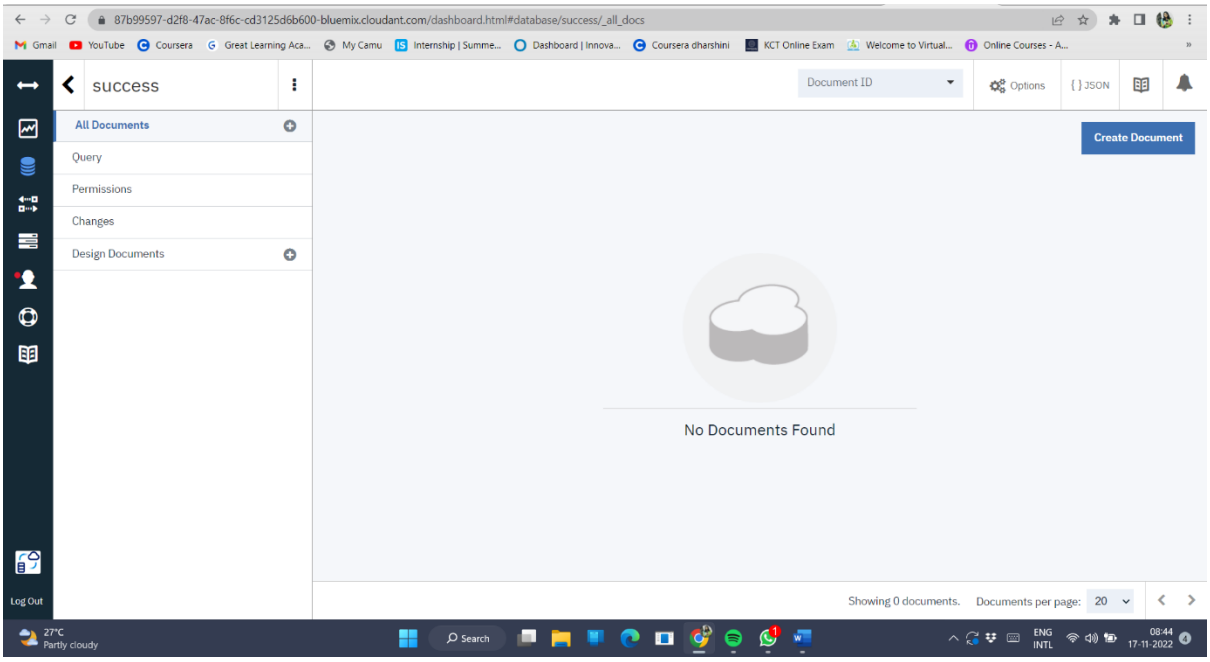



6:15 PM | 4.1KB/s
Screen1
Gas leakage Monitoring and alerting system for industries
Team:
PNT2022MID4963
temperature: 93
Humid: 52
Gas: 90

7.3 DATABASE SCHEMA







8 TESTING

8.1 TEST CASE

Test case ID	Feature Type	Component	Test Scenario
HomePage_TC_OO1	Functional	Home Page	Verify the gas leakage scenario by the user is able to see the Temperature, Humidity, Gas values will popup by My Account
HomePage_TC_OO2	UI	Home Page	Verify the UI elements in Value Added elements popup

HomePage_TC_OO3	Functional	Home page	Verify user is able to see the update values added element with Valid results
HomePage_TC_OO4	Functional	Home page	Verify user is able to see the update values added element with Invalid results

Steps To Execute	Test Data	Expected Result	Actual Result	Status
1.Enter URL and click go 2.Click on My Account 3. Displayed Values		Values popup should display	Working as expected	Pass
1.Enter URL and click go 2.Click on My Account 3.Display with below UI elements: a.Temperature b.Humidity c.Gas		Application should show below UI elements: a.Temperature b.Humidity c.Gas	Working as expected	Pass
1.Enter URL and click go 2.Click on My Account 3.Check Valid Values of each features in text box 4.Display Alert when values exceeded	Temperature : 78 Humidity: 43 Gas: 25	User should able to see features of gas alerting		

1.Enter URL(https://shopenzer.com/) and click go 2.Click on My Account dropdown button 3.Enter InValid username/email in Email text box 4.Enter valid password in password text box 5.Click on login button	Temperature : 78 Humidity: 43 Gas: 25	Application should show 'Incorrect values ' validation message.		

8.2 USER ACCEPTANCE TESTING

Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the Gas leakage monitoring & Alerting System for Industries project at the time of the release to User Acceptance Testing (UAT).

Defect Analysis

This reports how number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	9	3	2	3	17
Duplicate	0	1	4	1	6
External	1	0	3	1	5
Fixed	10	2	3	20	25
Not Reproduced	0	1	0	0	1
Skipped	1	0	0	1	2
Won'tFix	2	4	0	1	7

Totals	22	11	12	27	63

Test Case Analysis

This reports how the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Gas Alert system	8	0	0	8
Client Application	48	0	0	48
Security	3	0	0	3
Exception Reporting	7	0	0	7
Final Report Output	4	0	0	4
Version Control	1	0	0	1

9 RESULTS

9.1 PERFORMANCE METRICS

The Nalaiya Thiran has introduced us into a new field associated with the help of IBM. Through this project we have learned about the various features of IBM application. Finally we have created a mobile application and web application which displays the gas pipeline location area and the measurement of the humidity and temperature which is measured by the gas sensor placed at the particular place. Using Node Red application we have integrated the sensor with our web and mobile application. Our application will displays the measured humidity and temperature value of the gas pipelines placed in the industry and remote areas. Through this project we can able to prevent from huge disaster and also save the lives of many industry workers and surrounding people.

10. ADVANTAGES & DISADVANTAGES

- This project has application in our home we can also use this project in Industries, offices and Colleges
- It gives the remote indication to the user about the gas leakage with the help of message.
- To enhance this project we can add a GPS Modem to this system
- Also we can add other sensor like smoke, alcohol sensor along with the detector circuit.
- Even we can add light sensor depends on the application we need.
- Through this project we can save the life of many people and also save the industry.
- This system enables monitoring of gas leakages in remote locations and there by leads to a faster response time in the event of a leakage condition.
- The main disadvantage is that it doesn't identify very small leakages.
- Accuracy of location is also need to be verified carefully is also a disadvantage
- It's sensitivity depends on the humidity and the temperature is also considered as an disadvantage.
- It increases the cost of digital system.
- Installation of this project will be simpler.

11. CONCLUSION

In this paper we have proposed a simple solution for the monitoring of gas pipes and alert the Industry people and disaster management team if any gas leak occurs. We have achieved the alert through a mobile application and web application with the help of IBM MIT App Inverter. Early detection of toxic gases such as H2S, methane, and CO is important for avoiding dangerous, unwanted leakages leading to poisoning or explosions. Through this project we could save the life of many industry workers and the peaceful minds of their families.

12. FUTURE SCOPE

In the future we are planning for dual structure for every gas plants presented in the industry. Repeated Inspection of the industry could also reduce the impact of gas leakage. We have done the measurement of temperature, humidity and gas level. For the next upgraded release we are planned to build a map of industry in the application which will be easier for the fire fighters and disaster management department to control the situation. Also we can integrate the mobile application with household. Because the household too face the difficulties of gas explosion through the cooking cylinder (LPG), if we alert them during the LPG leak it will save the life of a home.

13. APPENDIX

Source Code

```
#TEAM ID=PNT2022TMID4963
#pip install wiotp-sdk
import ibmiotf.application
import ibmiotf.device
import time
import sys
import random


#Provide your IBM Watson Device Credentials
organization = "pox0qm"
deviceType = "123456"
deviceId = "4699"
authMethod = "token"
authToken = "12345678"

# Initialize GPIO
def myCommandCallback(cmd):
    print("command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="lighton":
        print("led is on")
    elif status == "lightoff":
        print("led is off")
    else:
        print("please send proper command")



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

        temperature=random.randint(0,100)
        Humidity=random.randint(0,100)
        gas=random.randint(0,100)

        data = { 'temperature' : temperature, 'Humid':
Humidity, 'Gas':gas }

        #print data
        def myOnPublishCallback():
            print ("Published Temperature = %s C" %
temperature, "Humidity = %s %%" % Humidity, "Gas
Concentration = %s" % gas," to IBM Watson")

        success = deviceCli.publishEvent("IoTSensor",
"json", data, qos=0, on_publish=myOnPublishCallback)
        if not success:
            print("Not connected to IoTF")
        time.sleep(10)

        deviceCli.commandCallback = myCommandCallback

# Disconnect the device and application from the cloud
deviceCli.disconnect()
```

GitHub & Project Demo Link:

https://github.com/IBM-EPBL/IBM-Project-11000-1659251744