Gas Leakage monitoring & alerting system for Industries

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Project Report

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1. INTRODUCTION:

Nowadays Industrial growth is very rapid and continuous in terms of innovations and technology .Simultaneously safety issues should also be concentrated especially in risky working areas. Lack of safety measures results in adverse effects and small negligence may result in secure destruction equipment and workers. Hence real time monitoring of the equipments for any leakages of gaseous material should be mandatory to avoid the unnecessary accidents and provide healthy environment. Industries are not advanced and lagging in technology to identify the exact and accurate of gas leakage point.

a Project Overview

Gas leakage is the major problem that need to be solved. However we might not be able to prevent the gas leakage, but at least we have to prevent the consequences of it. Whenever a flammable gas leaks, it has the chances of getting fired and leads to a massive explosion of an Industry in which lots of labours will lose their lives and it also affects the environment as well the industry growth. If the gas leaks are harmful gases, it may cause several damages to the workers who are exposed to it, and will lead to the chance of death. The solution is to monitor the gas pipelines, containments etc., by Using gas sensors near the area at where the gas leak is most likely to occur. If gas leakage happens, the sensors detects the leakage and send notification along with the exact location of where the gas leakage take places and it also alert the labours at those sectors by an Emergency alerting system.

b Purpose

Our solution has the Uniqueness of showing information related to if any fire take place at the leakage area with the help of a sensor it may be a temperature or flame sensor etc.,. It helps the admin to know if there is any incipient fire occurred, and our web app has the command of enabling the fire suppression system so the admin can turn it on and it will help to control the fire.

2 LITERATURE SURVEY:

LITERATURE SURVEY

S.NO	TITLE/YEAR	AUTHOR'S	TECHNIQUES	RESULT
1.	Gas Leakage Detection System using IoT /2020	M Athish Subramanian Naveen Selvam, Rajkumar S, R Mahalakshmi , J Ramprabhakar	This paper is idealized with an objective for detection of gas leakage using IoT and smart alert using push bullet for quick notifications to provide safety for residential and industrial sectors in a cheap and reliable way.	This paper 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	Gas Leakage Detection Based on IOT/2019	Suma V, Ramya R Shekar, Akshay Kumar A	In this system, the gas leakage is detected by MQ 5 sensor which is interfaced by Arduino, when the gas leakage is detected motor gets on and lights gets off with buzzer alarm and displaying alert message in LCD display.	This proposed system can be useful in marketing sectors like hotels, shop etc. The main intention of this work is to ensure safe and easier was gas leakage detection to avoid disasters that may occur due to negligence
3.	Gas Leakage Detection and Alert System using IoT/2019	Sayali Joshi, Shital Munjal, Prof. Uma B. Karanje	The main aim of this project is developing a system that can detect gas leakage. The main aim of this project is developing a system that can detect gas leakage.	GSM module is there to send immediate messages to the respective person regarding the gas leak. The main advantage of this system is that it off the regulator knob of the cylinder automatically when gas leakage detected.
4.	Gas leakage detection and smart alerting system using Iot/2018	Shital Imade, Priyanka Rajmanes, Aishwarya Gavali , Prof. V. N. Nayakwadi	The current major method of leak detection is the compensated volume balance method. This method essentially measures the "volume in" and subtracts the "volume out".	This system will be able to detect the gas in environment using the gas sensors. This will prevent form the major harmful problem.
5.	IOT Based Industrial Plant Safety Gas Leakage Detection System/2018	Ravi Kishore Kodali, Greeshma, R.N.V., Kusuma Priya Nimmanapalli, Yatish Krishna Yogi Borra	This system output the value of the respective gas concentrations in PPM via their analog output pin after proper calibration. IFTTT runs that applet and sends the message to the person concerned the message to the person concerned.	The proposed leakage detection with warning message to the single user can be reached out to send calls/SMS to multiple people and can also be linked directly to the fire station as well.

a Existing problem

Smart Gas Level Monitoring, Booking & Gas Leakage Detector over IoT This project proposed the most common problem experienced in our dayto- day lives that is regarding GAS container going empty. We bring this paper to create awareness about the reducing weight of the gas in the container, and to place a gas order using IOT. The gas booking/order is being done with the help IOT and that the continuous weight measurement is done using a load cell which is interfaced with a Microcontroller (to compare with an ideal value). For ease it is even has been added with an RF TX & Rx module which will give the same information LM 35 (temp. sensor) For the sensors, if any fire is to be happened then the temperature sensor will sense a high change (positive change) in temperature and will send an pulse to microcontroller which intern will send an update to the internet through IoT, and as well it will trigger an siren alarm in the RF Rx kit (sub board).

A. MQ-2 (Gas Sensor) MQ 2 sensor is basically an LPG (liquefied petroleum gas) which is composed of propane & butane, so when a gas leakage is sensed by the sensor it will send a high pulse to the Mc which will update it in the IoT, and even a buzzer is heard in the RF Rx kit. And the problem can be sorted & solved. Thus, the overall components & sensors play role in the paper as explained above.

2. Cloud Connected Smart Gas Leakage Detection and Safety Precaution System The project design and develop a cloud connected smart LPG gas cylinder platform, acting as a safety device for detecting LPG gas leak at low levels to avoid any possible accidents. It is also capable of sensing fire breakout in the area and weight of the gas in order to provide real time monitoring and alert over Internet. If an abnormal condition is detected, the device sends an alert to the smartphone app of the user and generates an alert e-mail to other authorities. In addition to this upon detecting a gas leakage or a fire breakout, the device automatically takes safety precautionary measures, like gas valve closing, ventilation opening, fire sprinkler activation and home electrical power supply cutoff. The device connects to the internet via Wi-Fi and thus increasing the mobility of the platform within the premises of the house. A Wi-Fi capable ARM Cortex-M4 microcontroller is used to implement the system. This device offers a complete, low cost, powerful and userfriendly way of real-time monitoring and remote control of gas leakages and prevention mechanisms in household and industrial areas.

b References
1. Gas Leakage Detection and Alert System using IoT Sayali Joshi, Shital Munjal, Prof. Uma B. Karanje
2. GAS LEAKAGE DETECTION AND SMART ALERTING SYSTEM USING IOT Shital Imade, Priyanka Rajmanes, Aishwarya Gavali , P
3. Gas Leakage Detection Based on IOT Suma V, Ramya R Shekar, Akshay Kumar A
4. Gas Leakage Detection System using IoT with integrated notifications using Pushbullet-A Review M Athish Subramanian , Naveen Selvam, Rajkumar S, R Mahalakshmi , J Ramprabhakar
5. IOT Based Industrial Plant Safety Gas Leakage Detection System, Ravi Kishore Kodali, Greeshma, R.N.V, Kusuma Priya Nimmanapalli, Yatish Krishna Yogi Borra

PROBELEM STATEMENT:

Problem Statement

Mr. Surya is an Industrial Labour Who works on Oil & Gas Industry. He needs an Monitoring System for the Emission of harmful gases like H_2S, CO, SO_2, NO_2 ,etc.,. So that he feels safe on work.

Who does the problem affect?

-Industrial labours

Where is the issue occuring?

-Organizational level, Industries.

What is the issue ?

-Gas leakage.

-Whenever there is any leakage occurs, The Major problem arises in finding the exact location of the Gas leakage. The User can't able to know where the exact location.

- The harmful gases on industry may cause lungs dysfunction, often feel a burning sensation on their Skin & eye, etc..

- It may leads to Explosion of the industry in which lots of Labours loses their lives.

When does this issue occurs?

-Due to some of the reasons like: Unreliable metal-to-metal Seals.

-Poor tubing Selection/preparation

-Poor ventilation or Malfunctioned Exhaust fans.

Why it is Important that we fix the problem?

-By fixing this problem we can save lots of labour life's also we can able to prevent the Organisation Loss.

3 IDEATION & PROPOSED SOLUTION

a) 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 helps 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.
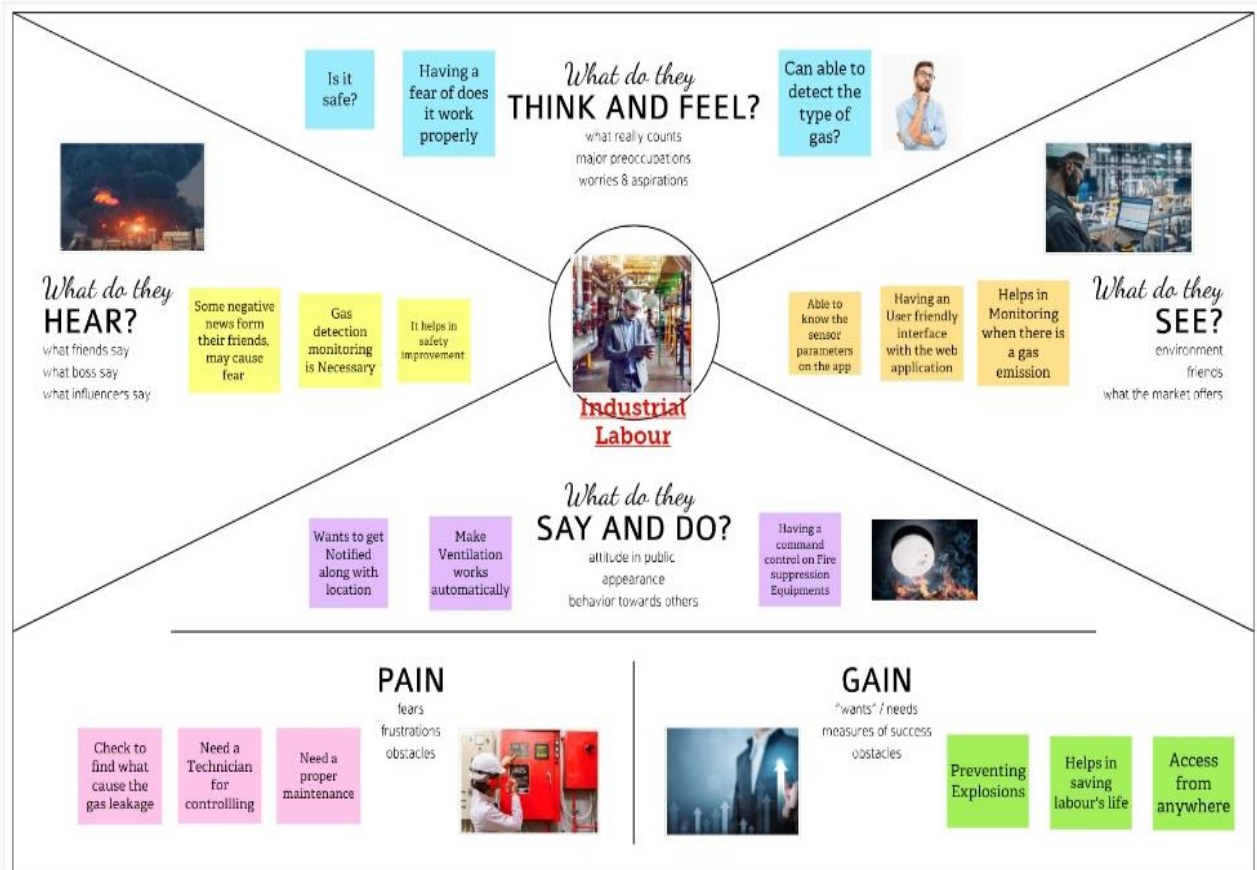
b Ideation & Brainstorming

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving

C) Proposed Solution

S.No	Parameter	Description
1.	Problem Statement (Problem to be solved)	Gas leakage is the major problem that need to be solved. However we might not be able to prevent the gas leakage, but at least we have to prevent the consequences of it. Whenever a flammable gas leaks, it has the chances of getting fired and leads to a massive explosion of an industry in which lots of labours will lose their lives and it also affects the environment as well the industry growth. If the gas leaks are harmful gases, it may cause several damages to the workers who are exposed to it, and will lead to the chance of death.
2.	Idea / Solution description	The solution is to monitor the gas pipelines, containments etc., by Using gas sensors near the area at where the gas leak is most likely to occur. If gas leakage happens, the sensors detects the leakage and send notification along with the exact location of where the gas leakage take places and it also alert the labours at those sectors by an Emergency alerting system.
3.	Novelty / Uniqueness	➤ Our solution has the Uniqueness of showing information related to if any fire take place at the leakage area with the help of a sensor it may be a temperature or flame sensor etc.,. It helps the admin to know if there is any incipient fire occured, and our web app has the command of enabling the fire suppression system so the admin can turn it on and it will help to control the fire. ➤ Also our web app will have the feature of Indicating information whenever a sensor is damaged or not in working condition. This will help the admin to easily know about when a sensor is damaged.
4.	Social Impact / Customer Satisfaction	By implementing this solution, it ensures a better occupational health. It helps for the workers in monitoring the gas leaks and makes them feel secured.
5.	Business Model (Revenue Model)	Now a days, the gas leakage detection system is mostly needed and it's mandatory for an Industrial safety. So we can get revenue by Selling this to the Industries with an affordable price and also we can able to make revenue by promoting any industry relatable needs at different section on the web app.
6.	Scalability of the Solution	The user can able to detect the type of gas using different gas sensors. This model will fits for different gas sensors, so any gas sensor can be used, according to the gas used on their Industry. Also Multiple number of gas sensors can be placed at multiple areas and those can be able to link with the web app for monitoring.

d Problem Solution fit

1. CUSTOMER SEGMENT(S) — CS

Industrial labours who works on gas industry and also who works with gases on their production & manufacturing process.

6. CUSTOMER CONSTRAINS — CC

The sensors should be placed at areas where the gas leaks are most likely to occur, the placement of detectors should be determined with the advice of experts. And keep in consider about the possible damages caused to the Sensors was important.

5. AVAILABLE SOLUTOIONS — AS

- Some of the available solutions are:
- Portable leak detectors like refrigerant leakage detectors.
- Ultrasonic industrial imager.
- Service teams and also the monitoring could be done by the man power.

Explore AS, differentiate

Define CS, fit into CC

2. JOBS-T0-BE-DONE/PROBLEMS — J&P

Leakage of Gas is the major problem that need to be focused in these gas or gas using industries. It may leads to explosion of an industry and includes the loss of lives.

The leakage of hazardous gas creates health related issues on the labours who are exposed to it. Causes skin irritation, Eyesore, Nausea and some gases tends to cancer.

9. PROBLEM ROOT/CAUSE — RC

- Not having a regular maintenance and service.
- Due to some unreliable metal-to-metal seals and poor tubing selection.
- Improper monitoring and labour inactive behavior by stress and pressure on work

7. BEHAVIOR — BE

- Perform regular inspection and maintenance.
- Detect the location where the gas leaks from the data on web app and try to fix the leakage immediately (Always wear air respirators at the time of gas leakage)
- If explosion happens, do the necessary procedure to control the fire and evacuate all.

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

3. TRIGGERS — TR

- The Loss happened by the damages caused by gas leak explosion. The insecure feeling of the labour's life.
- To ensure better occupational Health and eliminate potential hazards for optimum safety.

4. EMOTIONS: BEFORE / AFTER — EM

Having some fear and pressure on work
Physical and mental health damages
Industrial loss may also happens

Feels secured.
Keeps health in good condition.
Possibilities of saving industries from losses an mainly for saving labours life is High.

Identify strong TR & EM

10. YOUR SOLUTION — SL

The solution is placing multiple gas sensors strategically across the areas at where the gas leaks are most likely to occur. We planned to create a web app that is linked with those sensors. If any gas leakage happens, the sensor placed at those point sends notification to the control room (Safety in charge of the industry) along with the location of where the gas leaks take placed and also alert the workers who all are working at those sectors by an Emergency sound system like fire alarms, buzzers.

8. CHANNELS of BEHAVIOR — CH

Online
- Monitor the sensor parameters.
- Know the location at where the gas leakage occurred.

Offline
- Try to fix the leakage of the gas and to find the cause for the gas leakage.
- The number of sensors and the areas where they are to be fixed are determined carefully. Take some considerable guidance is available from standards such as EN50073 etc.
- Have a regular inspection on the sensor and other detection devices.

Extract online & offline CH of BE

4 REQUIREMENT ANALYSIS

a Functional requirement

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Detection System	Safety related detectors such as gas sensor, Temperature/Heat/Flame sensor, pressure sensor, helps to detect the gas leakage and incipient fire.
FR-2	Alerting System	-Alert the workers using emergency alerts such as buzzer, alarms on those sectors the gas leakage occurred. -Also Alert the User admin via sending notification alerts to the web application "leak D-det".
FR-3	Cloud connection	The device sends the data to the Cloud (IBM) that is linked with the web application. Thus, an user can receive the data & if any alert notifications, etc.
FR-4	User Registration	Product – Place orders through our Website or Other E-Shopping Apps.
		APP -Registration through Web application (or) Mobile application.
FR-5	User Confirmation	Confirmation via Email Confirmation via OTP
FR-6	User Authentication	Verification through User ID & Password.
FR-7	User Accessibilities	➢ Visualize Data about the sensor parameters and the Emergency Alerts. ➢ Import or Export Data reports. ➢ Customize View & Profile account. ➢ Multi-device synchronization. ➢ For finding of Data -Search Tab & Sorting of data is made available.
FR-8	User Permissions	To Turn ON the fire suppression Tools. Storage space permission for Data reports & others.

b Non-Functional requirements

Following are the non-functional requirements of the proposed solution

Non-functional Requirements:

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

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Our product helps to monitor their environmental performance, Ensures better occupational health and also helps the workers to feel secured.
NFR-2	Security	Product- Our Product is designed & protected in a way to withstand the environmental conditions.
		App- Authorized user can only able to login on the app using the valid user ID and password. (Also we had planned to add other verifications like 2-steps verification in future to ensure better safety.)
NFR-3	Reliability	Our products has the capability of receiving multiple Data without delayed response time and it helps the safety in charge to take timely corrective actions.
NFR-4	Performance	It provides a range of single parameters from the safety detectors. By setting appropriate threshold values, it triggers the notification and the alarms. It provides the exact location of where the gas leakage occurred.
NFR-5	Availability	It constantly monitors the data from the sensors. Our products available at the E-commerce apps.
NFR-6	Scalability	◇ Cost-Effective installation. ◇ Data analytics for improved decisions ◇ Get immediate gas leak alerts ◇ Multiple sensors can be placed strategically across the industries, helps to detect the leakage more easily.

5 PROJECT DESIGN

a Data Flow Diagrams

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored

Data Flow Diagrams:
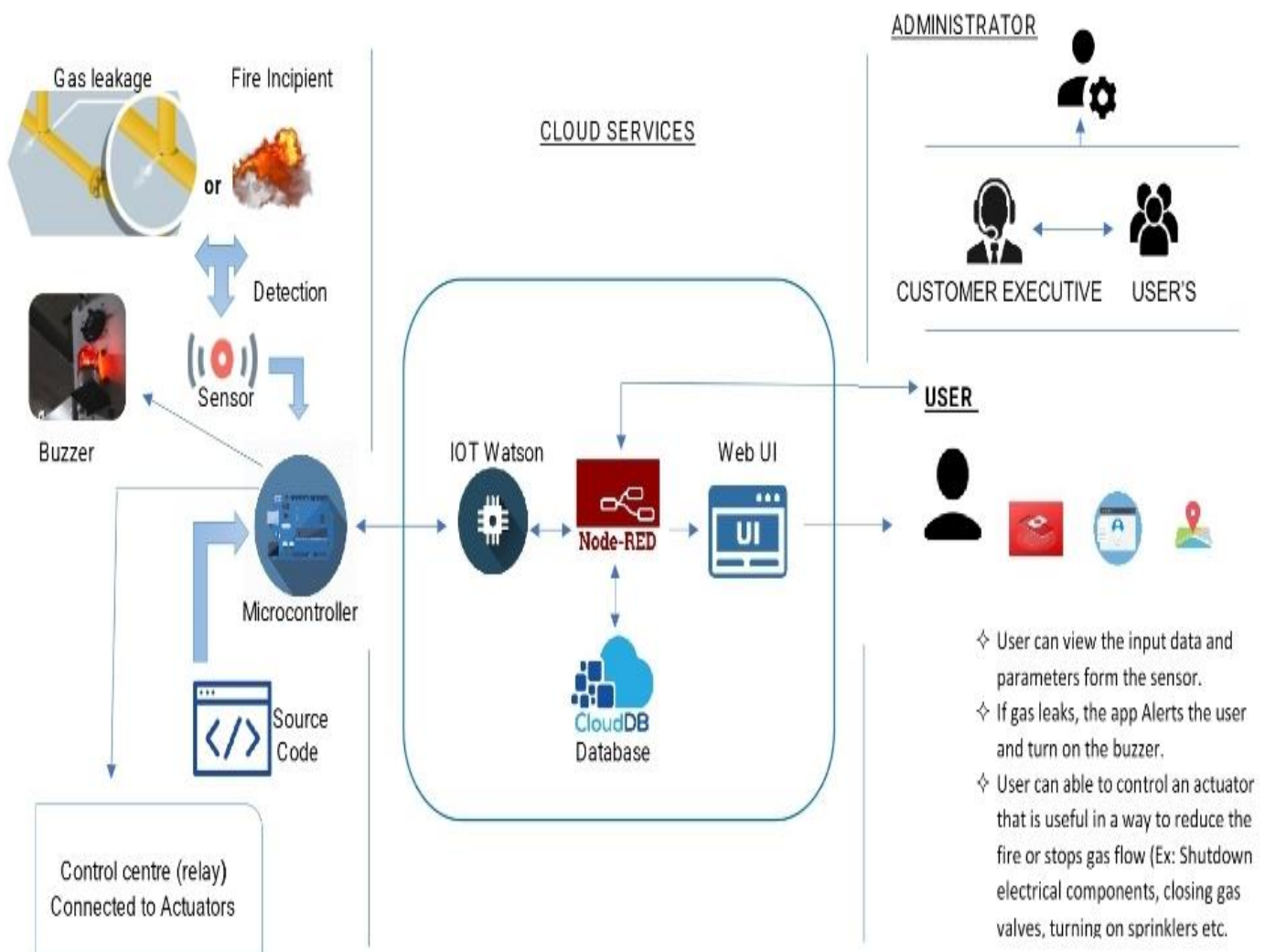
b Solution & Technical Architecture

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- Find the best tech solution to solve existing business problems.

- Describe the structure, characteristics, behaviour, and other aspects of the software to project stakeholders.

- Define features, development phases, and solution requirements.

Provide specifications according to which the solution is defined, managed, and delivered

Solution Architecture Diagram
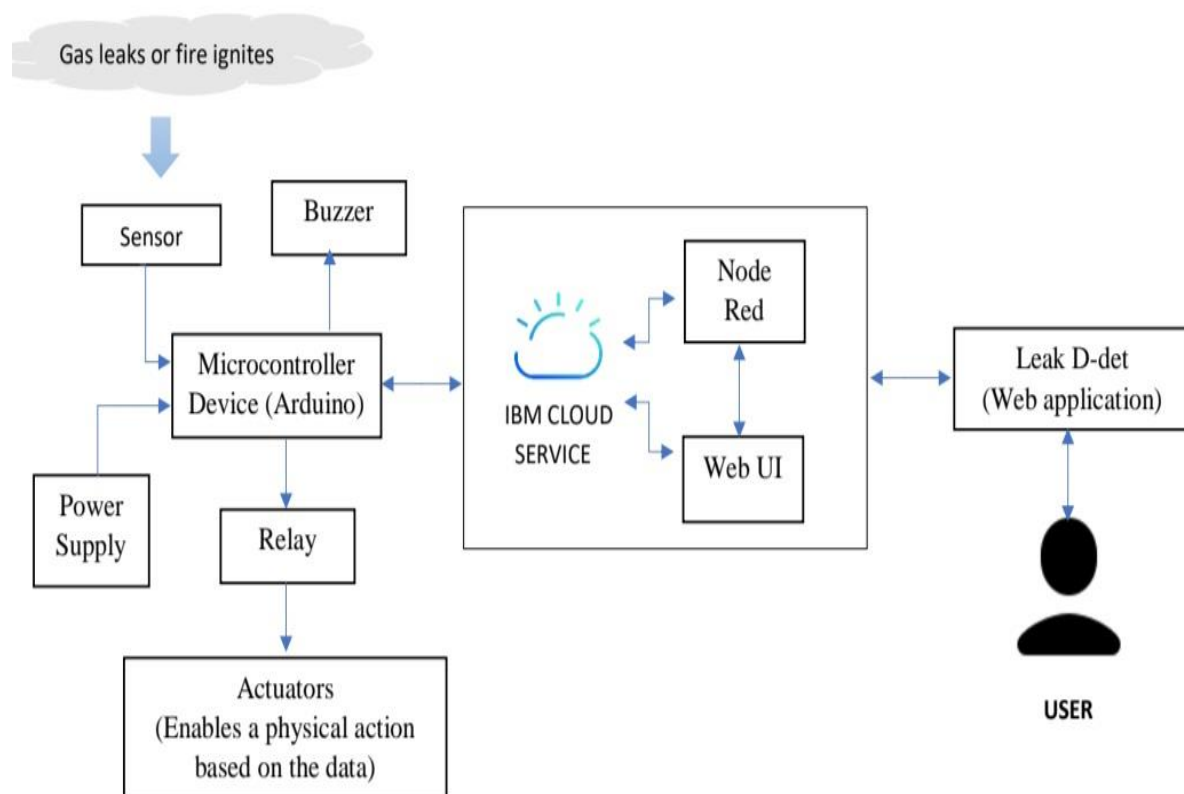
Architecture diagram of the Gas leakage detector product

Technical Architecture

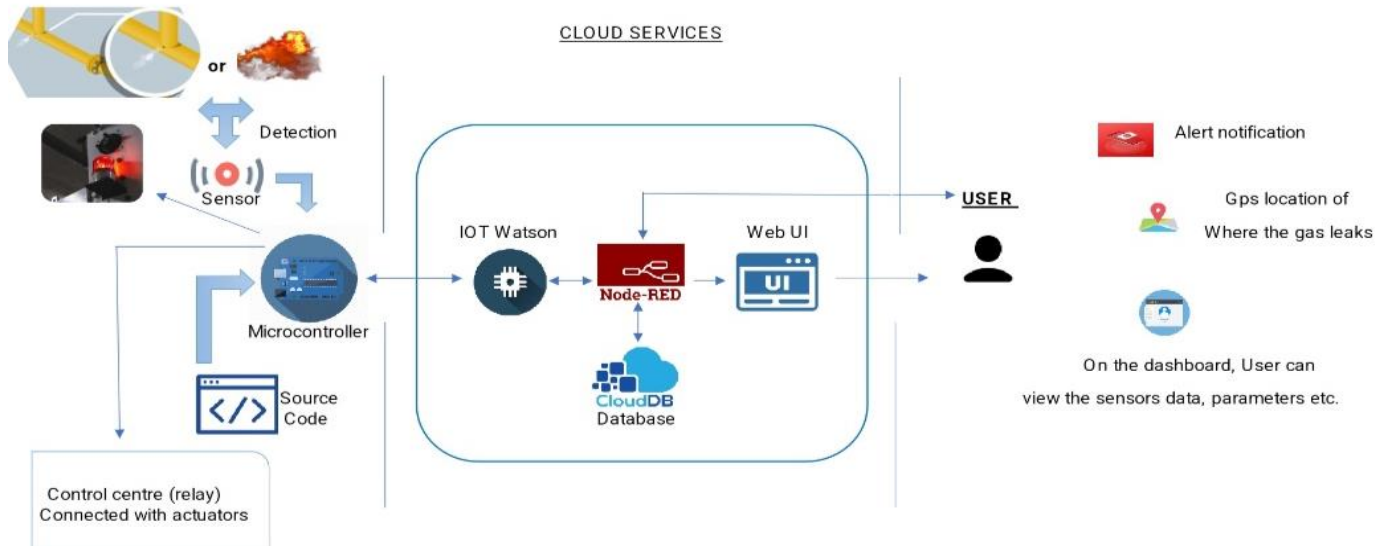**Technical Architecture:**

Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	Web browser, Mobile App.	HTML, CSS, JavaScript
2.	Application Logic-1	Logic for a process in the application	Python
3.	Application Logic-2	Logic for a process in the Watson IOT platform	IBM Watson IOT service
4.	Application Logic-3	Logic for a process in the Node red & Web UI	IBM Node Red
5.	Database	Data Type, Configurations etc.	NoSQL database
6.	Cloud Database	Database Service on Cloud	IBM Cloudant
7.	File Storage	File storage requirement is needed for Data Reports	IBM Block Storage or Other Storage Service
8.	External API	Purpose of External API used in the application	No external API
9.	Infrastructure (Server / Cloud)	Cloud Local Server Configuration: Cloud Server Configuration :	Cloud Foundry

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks used	MIT App inventor, IBM cloud services.
2.	Security Implementations	List all the security / access controls implemented, use of firewalls etc.	Confirmation OTP, Encryptions, IAM Controls, OWASP etc.
3.	Scalable Architecture	Justify the scalability of architecture (3 – tier, Micro-services)	Microcontroller, Task paralysation.
4.	Availability	Justify the availability of application (e.g. use of load balancers, distributed servers etc.)	Cloud database Server
5.	Performance	Design consideration for the performance of the application (Multiple inputs at one time) etc.	Internet of Things

c User Stories

User Stories

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority
Any User	Registration for the product (Gas leakage detector).		As a user, I can register for the product by an E-shopping App or in the product website.	I can place order through the official website of the product or in a E-shopping app.	
			As a user, mention the delivery address for the product need to be delivered and select the payment option and confirm the product order.	Mention the Delivery address and Confirmation the placing of order.	
Customer (Mobile user)	User-Registration	USN-1	As a user, I can register in the application by entering mobile number/email, password and confirming my password.	I can access my account / dashboard.	High
		USN-2	As a user, I will have to verify the email, mobile number by entering the received confirmation OTP.	I can receive OTP & enter the OTP on the app.	High
		USN-3	As a user, I have to read and click confirm the Terms & conditions.	Accept the privacy policy terms and condition.	High
		USN-4	As a user, I can register for the application through Gmail.	I can register the application with my Gmail account.	Low
	Login	USN-5	As a user, I can log into the application by the User Id and password which I have entered/used on the registration process.	I can login through the app by my User Id (email/mobile number) and password.	High
	Dashboard	USN-6	As a user, I have to enter my details on the User account and can able to customize my account.	I can edit my User account profile.	low
		USN-7	As a user, Explore the app and know about the features.	I can go through the instructions about the app.	High
		USN-8	Configure the Sensors and other features related to your application.	I can get help from the service team.	High

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority
Customer (Web user)	User-Registration	USN-9	As a user, I can register in the application by entering Mobile number/Email, password and confirming my password.	I can access my account / dashboard	High
			As a user, I will have to verify the email, mobile number by entering the received confirmation OTP.	I can receive OTP & enter the OTP on the app.	High
			As a user, I can register for the application through Gmail.	I can register the application with my Gmail account.	Low
			As a user, I have to read and click confirm the Terms & conditions.	Read & accept the privacy policy terms and condition.	High
	Login	USN-10	As a user, I can log into the application by the User Id and password which I have entered/used on the registration process.	I can login through the app by my User Id (email/mobile number) and password.	High
	Dashboard	USN-11	As a user, I have to enter my details on the User account and can able to customize my account.	I can edit my User account profile.	Low
			As a user, Explore the app and know about the features.	I can go through the instructions about the app.	High
			Configure the Sensors and other features related to your application.	I can get help from the service team.	High
Customer Care Executive	Registration	USN-12	As a customer care executive, I have to register through the company (Product) mail and password that is given to me.	Registration using Company mail.	High
	Login	USN-13	I can login through the registered mail Id and password.	Enter the company mail and password.	High
	Dashboard	USN-14	As a customer care executive, I receive the complaints and Service request form our product users.	Go through the complaints and helps the user to resolve	High
			As a customer care executive, I have to give answer for the user queries related to our product.	Help the user to clear off about the queries.	High
Administrator	Dashboard	USN-15	As an administrator, I have the full authority of the Web app (and the product), a range of tasks related to Tech support, troubleshooting, finding & fixing bugs, maintains server & users data, Enable new ID's as well as Disable ID's etc.	I have the complete access and needs to maintains the User Data etc.	High

6 PROJECT PLANNING & SCHEDULING

a Sprint Planning & Estimation

We done the sprint planning & Scheduling by using the project planning jira software. The Sprint planning details was on the planning document that is attached on the github.

Velocity:

We have a 6-day duration for each sprint, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

Average Velocity = Sprint Backlog/Velocity = 20/6= 3.333

i.e.) AV = 3-4 Story points per day for each sprint

Burndown Chart:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.

Sprint - User Stories	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Sprint 1(24-29 Oct)	20	2	4	2	2	3	4
Sprint 2(31 Oct-05 Nov)	20	3	2	2	0	4	9
Sprint 3(07-12 Nov)	20	4	1	1	5	2	7
Sprint 4(14-19 Nov)	20	2	0	4	5	3	6
Remaining Effort	80	69	62	53	41	29	3
Ideal Effort Plan	80	66.66667	53.33333	40	26.66667	13.33333	0
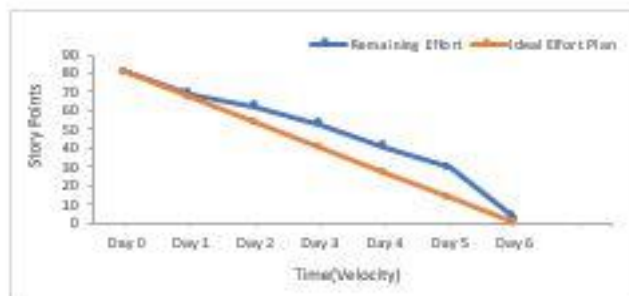
b Sprint Delivery Schedule

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

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

a *Feature 1*

```python
from geopy.geocoders import Nominatim
import wiotp.sdk.device
import time
import random
myConfig = {
    "identity": {
        "orgId": "x390n3",
        "typeId": "Publish",
        "deviceId":"9442432"
    },
    "auth": {
        "token": "123456789"
    }
}
a=[3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,40,41]
b=[3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,40]

def myCommandCallback(cmd):
    print("Message received from IBM IoT Platform: %s" % cmd.data['command'])
    m=cmd.data['command']

client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
client.connect()

while True:
    temp=random.randint(-20,125)
    hum=random.randint(0,100)
    g1=random.choice(a)
    g2=random.choice(b)
    f="EMERGENCY"
    loc = Nominatim(user_agent="GetLoc")
    getLoc = loc.geocode("kanchipuram")
    getLoc1= loc.geocode("chennai")
    lat=getLoc.latitude
    log=getLoc.longitude
    lat1=getLoc1.latitude
    log1=getLoc1.longitude

    myData={'temperature':temp, 'humidity':hum,'gas_1':g1}
    if g1 > 40:
        myData={'alert gas_1':f,'latitude':lat,'longitude':log}
    else:
        myData={'temperature':temp, 'humidity':hum,'gas_1':g1}
    if g2 > 40:
        myData1={'alert gas_2':f,'latitude':lat1,'longitude':log1}
    else:
        myData1={'temperature1':temp, 'humidity1':hum,'gas_2':g2}

    client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0, onPublish=None)
```

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8 TESTING
User Acceptance Testing

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the [ProductName] project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis

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

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	9	6	1	1	17
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	2	3
Won't Fix	0	5	0	1	6
Totals	23	16	10	25	74

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	7	0	0	7
Client Application	51	0	0	51
Security	2	0	0	2
Outsource Shipping	3	0	0	3
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	2	0	0	2

9 RESULTS

a Performance Metrics:

The overall performance of the IOT Device and the application is much developed by overcoming the issues on testing. We had tried our best for the performance development of the web application and the Gas leakage detector.

10 ADVANTAGES & DISADVANTAGES

Advantages
- 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
- Data analytics for improved decisions

Disadvantages
- Installation cost can be high.
- Poor stability and greater environmental impact

11 CONCLUSION

After this project performance, can conclude that detection of the LPG gas leakage is incredible in the project system. Applicable usefully in the industrial and domestic purpose. In danger situations we are able to save the life by using this system. An alert is indicated by the GSM module. A sensor node senses gas like CO_2, oxygen, 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

12 FUTURE SCOPE

Future scope includes the upgradation of the system to a prediction level using Big Data analytics. This can also help in predicting the location of the leak with the analyzed values, which in turn will be much useful to avoid hazards caused due to leaks. Further development can be made in the part of improving the accuracy of the gas sensing, speed control of the rover and can also give some control actions when detected with a leak, like automation of the plant's HVAC system.

13 APPENDIX

GitHub link: https://github.com/IBM-EPBL/IBM-Project-2186-1658465494

Project Demonstration Link:

https://drive.google.com/file/d/18E45Z_HbwbOLTrZp_WIVSwxwgxjXbR_a/view?usp=share_link

(Sorry for the noise and watermark on the Video)