Project Report

SARANATHAN COLLEGE OF ENGINEERING,TRICHY

HAZARDOUS AREA MONITORING FOR INDUSTRIAL PLANT POWERED BY IOT

Submitted by

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In partial fulfilment of award of the degree
OF
BACHELOR OF ENGINEERING
IN
ELECTRONICS AND COMMUNICATION ENGINEERING

1. **INTRODUCTION**

1.1 Project Overview

In the list of most threatening causes that led to global warming are fire hazards. Hazards can be resolved by the adaption of new and growing technologies which also help in better living. Applications in monitoring and control are performed by the wireless multisensory network are characterized by small, low power and cheap devices which are integrated with limited computation, sensing, and remote communication. It impacts enormously on fire emergency. Temperature sensors are installed in fire endangered areas which allow a person to manually provide temperature information on fire extinguishing website email or landline number. The process of accessing information from the website may be time-consuming and it may cause some amount of delay in the response to the fire extinguisher. IOT is a wireless technology. Use of IOT is in combination with fire fighting for hazard source monitoring, fire fighting rescue, fire early warning, preventing and early disposal. It is effectively used for the enhancement of fire brigade fire fighting and emergency rescue capabilities.

1.2 Purpose

There is an increase in productivity of automation and a decrease in data rate failure by using technologies in wireless sensor network Arduino and wireless communication is used in the project for industrial process monitoring. Wireless multisensory networks have met their applications in medical, military, industrial,agriculturaland environmental monitoring; current voltage, temperature and water level are the traceable parameters. Harmful gases like carbon mono-oxide, methane, etc can be detected by the Smoke sensors which may be harmful for the workers that can cause various lung diseases like asthma, pneumonia etc. Humidity is the amount of water vapors in the air, the sensor monitors the amount of humidity in the surroundings inside a plant and then alerts the workers regarding the changes in humidity which can lead to high pressure in the atmosphere and hence can cause hazards by radioactive chemicals present in power plants.

2. **LITERATURE SURVEY**

2.1 Existing problem

The need to industrialize to compete with global standards is a complete requisite to realize a booming economy.However, there is no question that it has wreaked havoc on the environment caused industrial emissions of dangerous chemicals. This study aimed to create a system that will allow Industrial plants and factories to monitor the emission of the smoke stacks. But leakage can take place through pipes or regulators or knobs which may cause accidents like suffocation, uneasiness or sometimes.The existing system in gas leakage detection is done using microcontroller.This system contains only few application like gas leakage detection and producing an alarm signal whenever gas leakage is detected

2.2 References

Reference 1

Name of the paper:lnternational Research Journal of Modernization in Engineering Technology and Science.

Published year:2022
Author:
Hemlata Yadav,
Naomi Oyiza,
Sarfaraz Hassan,
Dr. Suman Lata,
K. Jaya Chitra
Topic:lOT BASED INDUSTRIAL MONITORING SYSTEM

Reference 2
Name of the paper:lnternational Journal of Engineering Research & Technology (IJERT)
Published year:2016
Author:
P.Ragavi,
Dr.K.R.Valluvan
Topic:lOT BASED INDUSTRIAL MONITORING SYSTEM

Reference 3
Name of the paper : Eurasian Journal of Engineering and Technology.
Published year: May 2022
Author:
Hritik Biswa,
Atharva Ghodvaidya,
Madan Gughe,
Prof. A.M.Suryawanshi
Topic: IOT BASED INDUSTRIAL PARAMETERS MONITORING AND CONTROLLING SYSTEMS.

Reference 4
Name of the paper : International Reaserch Journal of Engineering and Technology.
Published year: August 2021
Author:
Kishore Kumar R,
Nishanth N,U.G Scholar,
Suriya Prakash S K,
Dhanush Anand S B
Topic: IOT BASED INDUSTRIAL MONITORING SYSTEMS USING ARDUINO.

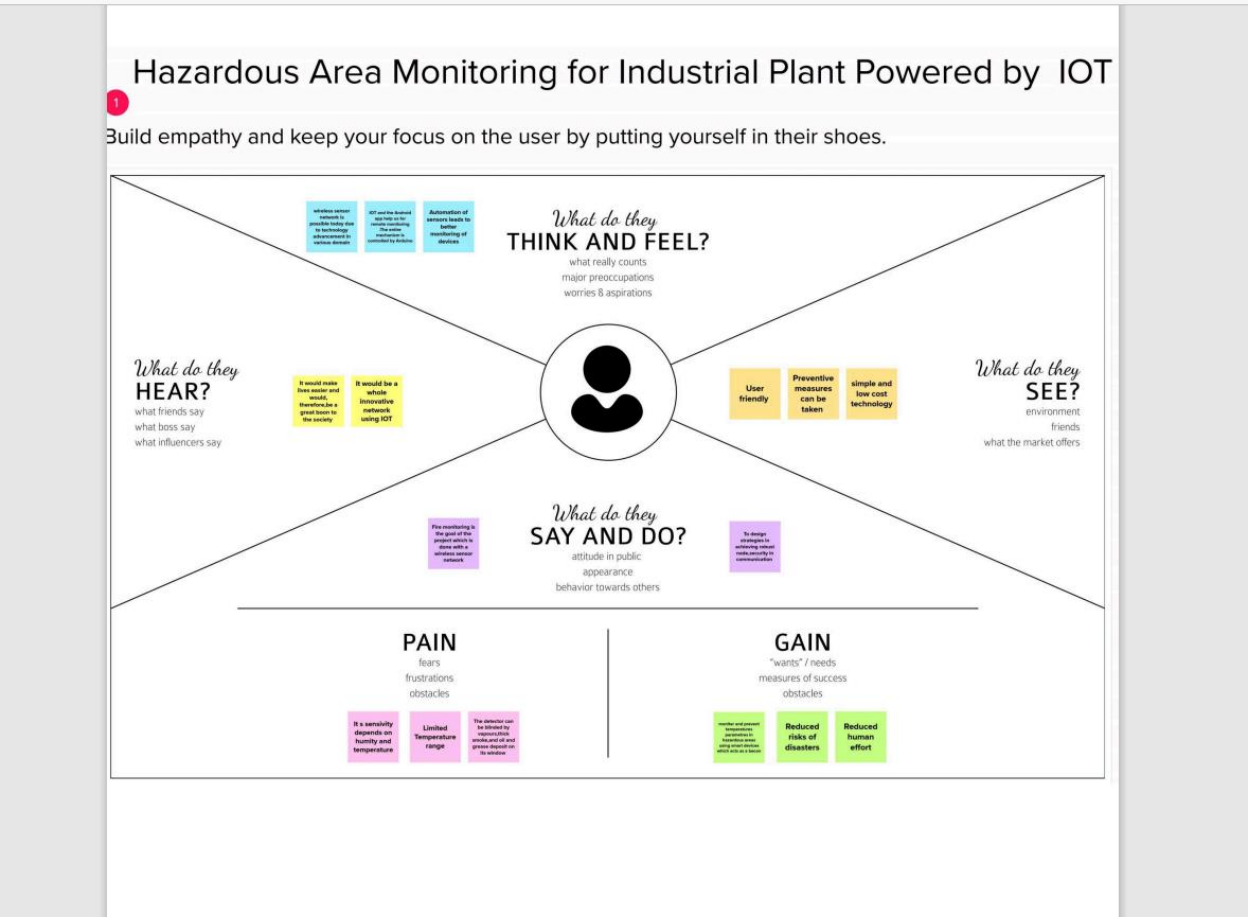
Reference 5
Name of the paper : International Journal of Safety and Security Engineering
Published year: August 2021
Author:
Neelam Sanjeev Kumar,
Gokul Chandrasekaran,
Karthikeyan Panjappagounder Rajamanickam.
Topic: An Integrated System for Smart Industrial Monitoring System in the Context of Hazards Based on the Internet of Things.

2.3 Problem Statement Definition

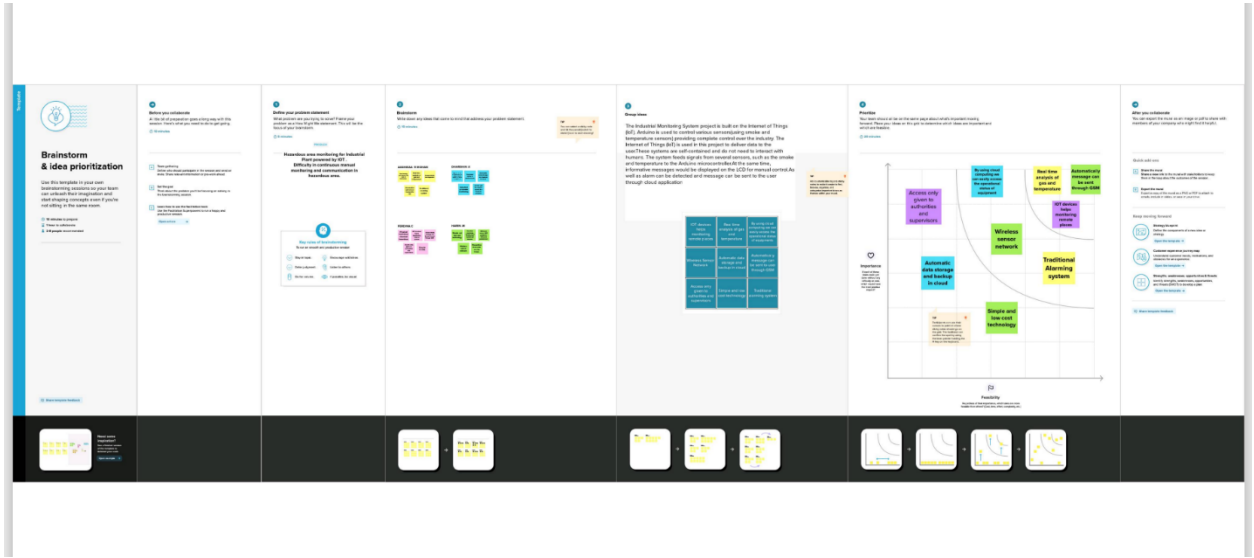
Difficulty in continuous manual monitoring and communication in Hazardous area

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming



3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Industrial plans are the one that contain both hazardous and non-hazardous area .The monitoring of the hazardous area in industrial plants in important from time to time.If the damage that occurs in hazardous areas can result in the loss of property or lives.So monitoring for Industrial plants is a project that focuses on the necessity of the monitoring of hazardous area in industrial plants .There can be smart devices integrated at the hazardous area that can help in detecting any fishy things that can occur in the particular area.The software needs to monitor the temperature parameters of the hazardous area in industrial plants.
2.	Idea / Solution description	In industrial areas fire accidents can be prevented by fire detection using temperature and gas sensors. Harmful or toxic gas leakages can identified. By the use of wireless technology, information from these sensors can be broadcasted to the particular individual. Alert message are sent via an application and buzzer sound is enabled.
3.	Novelty / Uniqueness	The uniqueness of our application we will get live updates of temperature,humidty and radiation in and around the workers environment using IoT
4.	Social Impact / Customer Satisfaction	This application has a powerful impact not only on the people but also on the environment.By using this application ,individuals are alerted incase of danger or threat.Thereby environment as well as thousands of life can be saved which inturn causes contentment.
5.	Business Model (Revenue Model)	We can introduce product-based approch to earn a good revenue.The more number of features attracts the end users to use our application
6.	Scalability of the Solution	This is very much reliable as it monitors continuos and sends real time analysis of the particular area. Also it provides hands on solution to the problem.

3.4 Problem Solution fit

Project Title: Hazardous Area Monitoring for industrial plant powered by IoT **Project Design Phase-I - Solution Fit** **Team ID:** PNT2022TMID32725

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

- Employees.

6. CUSTOMER CONSTRAINTS CC

- Accuracy,Speed,Reliability.
- Limited Budget.
- Lack of time.
- Workers and Industrial Plant

5. AVAILABLE SOLUTIONS AS

- Smart Area Monitoring Sensors.
- Provide proper personal protective equipment.

Explore AS, differentiate

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

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

- To ensure the safety of the workers.
- Early Warning message.
- Continuous monitoring of Hazardous Area.

9. PROBLEM ROOT CAUSE RC

- High Temperature.
- Combustible gases.
- Fire Accidents electrical short circuiting.

7. BEHAVIOUR BE

- It intimate alret message to safety control board of Industry.
- To protect workers during non routine operation and emergencies.

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

Identify strong TR & EM

3. TRIGGERS TR

- Inorder to avoid accidents and to protect environment,triggers its use.

4. EMOTIONS: BEFORE / AFTER EM

Before:

- Anxious.
- Curious.
- Confused.
- Fear of Health Issue.

After:

- Feel secure and protected.
- Real-Time Indusrial Plant monitoring reduced risks of disaster .

10. YOUR SOLUTION SL

- Hazardous Area monitoring using IoT.
- Receive alert to the mobile through SMS.

8.CHANNELS of BEHAVIOUR CH

ONLINE :

- ALL data will be stored in cloud and sent to mobile application.Hence Superior person in the industry can refer the details from it.

OFFLINE :

- While detecting the hazardous substances alarm will be intimated.
- LED and Buzzers used to avoid Hazards by alerting the workers

Identify strong TR & EM

4. REQUIREMENT ANALYSIS

4.1 Functional requirement

Project Design Phase-II

Solution Requirements (Functional & Non-functional)

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-I	User Registration	Registration through Form Registration through Gmail Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR_3	User Login	Login through Registered Email Login through Registered Mobile Number Login through individual id/password
	User Verification	Verification through Email login Two-step verification
FR-5	User Dashboard	Access via Mobile Application
FR-6	User Authentication	Authenticate signin of unknown devices via email

4.2 Non-Functional requirements

Non-functional Requirements:

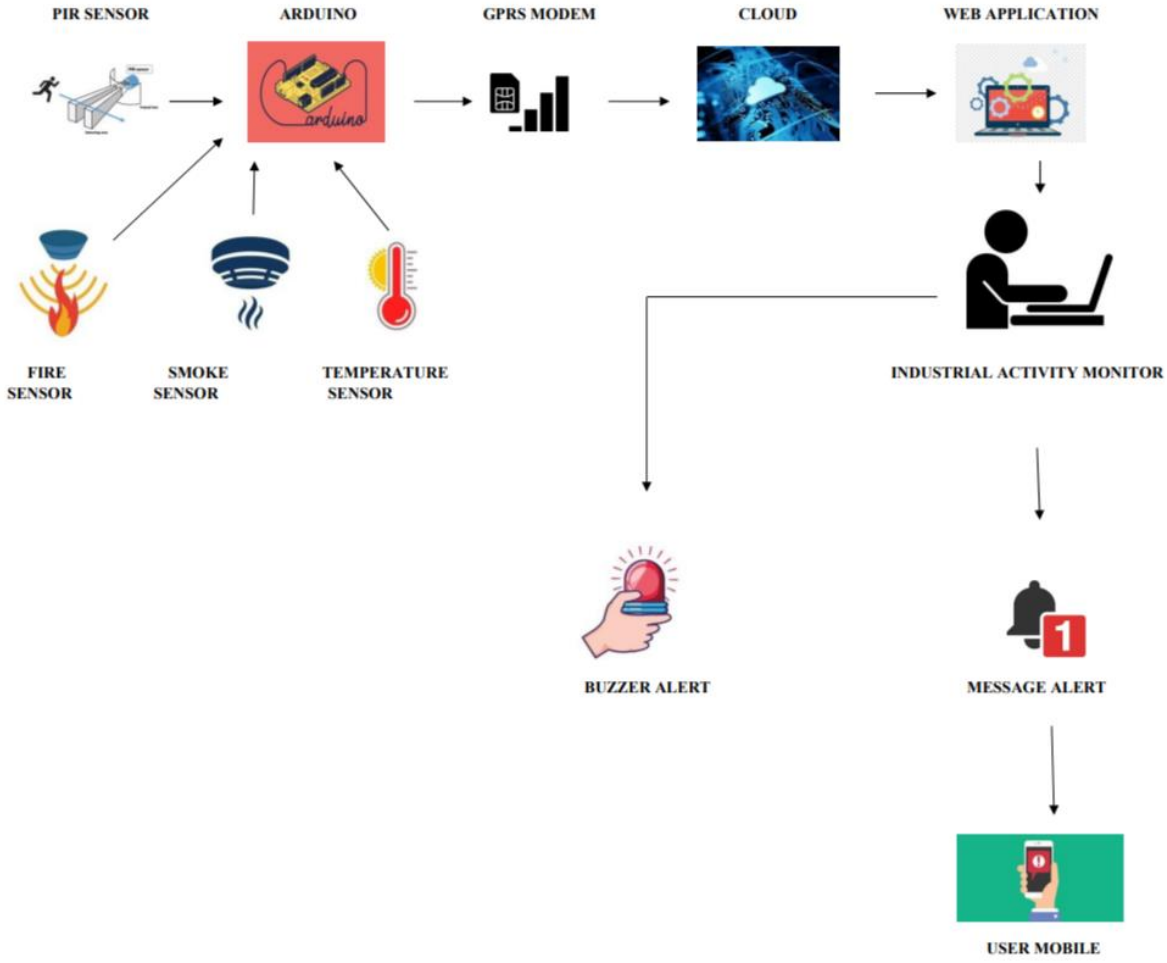
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	There are different kinds of usability criteria. Such as Efficiency,Satisfaction.Our solution allows a user to know about the industrial environment.Like temperature level,toxic gases,flame produced by burning.And it sends messages to alert the user whenever it needs.

NFR-2	**Security**	**Security** is preventing all the data inside the system.It prevents the internal parts of a system and they need to be protected against unauthorized access.To secure the data our solution provides necessary data flow and it describes the user actions.
NFR-3	**Reliability**	**Reliability** is an aspect of performance that refers to how consistently the project does what it's supposed to do.Our solution is very much reliable as it monitors continuously and sends real time analysis of the particular area.
NFR-4	**Performance**	**Performance** describes the efficiency of the product.Product performance is described as the response of a product to external actions in its working environment.Our solution explains how long a user must wait before the target operation happens(the page renders,errors etc.,)given the overall number of users at the moment.
NFR-5	**Availability**	**Availability** explains how likely the system is available to a user.It describes the accessibility of a user at a certain time.You may also define it as a percentage of time the system is accessible for operation during some time period.
NFR-6	**Scalability**	**Scalability** defines the ability of a computing process to be used or produced in a range of capabilities.Our solution ensures the safety of each and every worker working in the industry by alarm and sending alert messages.It provides access to multiple users and they can receive the alert messages simultaneously in case of any emergency.

5. PROJECT DESIGN

5.1 Data Flow Diagrams and Solution Architecture



5.2 User Stories

User Stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Industrial Owner)	Registration	USN-1	As an Industrial Owner, I can register into the application by entering email & password	I can access my account / dashboard	High	Sprint-1
	Data Modules	USN-2	As an Industrial Owner, I can get message about the temperature and humidity	I can receive confirmation email & click confirm	High	Sprint-1
	Login	USN-3	As an industrial Owner, I can login into my account through email and Password	I can access my account	Medium	Sprint-2
	Dashboard	USN-4	As an Industrial Owner, I can monitor of temperature	I can access the dashboard with individual Login id/password	High	Sprint-1
Customer (Industrial Worker)	Registration	USN-1	As an Industrial Worker, I can register into the application by entering email & password	I can access my account / dashboard	High	Sprint-1
	Data Modules	USN-2	As an Industrial Worker, I can get message about the temperature and humidity	I can receive confirmation email & click confirm	High	Sprint-1
	Login	USN-3	As an industrial Owner, I can login into my account through email and Password	I can access my account	Medium	Sprint-2
	Dashboard	USN-4	As an Industrial Owner, I can get alert high temperature	I can access the dashboard with individual Login id/password	High	Sprint-1

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Temperature monitoring	USN-1	As a user, I need to know the temperature of the Industrial plant.	4	High	Dharshini,Aashikaa, Ferdina,Harini.
Sprint-1	Gas Monitoring	USN-2	As a user, I need the gas composition and/or concentration around me.	2	Medium	Dharshini,Aashikaa, Ferdina,Harini.
Sprint-1	Fire Monitoring	USN-3	As a user,I need to identifiy the presence of flame in the industry.	4	High	Dharshini,Aashikaa, Ferdina,Harini.
Sprint-1	PIR Monitoring	USN-4	As a user,I need to know about security and motion detection.	2	High	Dharshini,Aashikaa, Ferdina,Harini.
Sprint-2	IOT dashboard interfacing	USN-5	As a user, I must be able to view the data using internet.	4	High	Dharshini,Aashikaa, Ferdina,Harini.
Sprint-3	Web UI	USN-6	As a user, I must be able to access data from a website.	1	Low	Dharshini,Aashikaa, Ferdina,Harini.
Sprint-4	Mobile UI	USN-7	As a user, I can view the data log in a Mobile application.	1	Low	Dharshini,Aashikaa, Ferdina,Harini.

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	6	
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	4	
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	2	
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	2	

6.3 Reports from JIRA

Burndown Chart:

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

7.1 Feature 1

```
import time
import sys
import random
import ibmiot.application
import ibmiot.device
organization = "o86xnz"
deviceType = "Sensor"
deviceId = "123456"
authMethod = "auth"
authToken = "Ferdina22"

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()
```

```
deviceCli.connect()
while True:

    temp=random.randint(0,100)
    Humid=random.randint(0,100)
    Gas=random.randint(0,100)

    data = { 'temp' : temp, 'Humid': Humid, 'Gas':gas }

    def myOnPublishCallback():
        print ("Published Temperature = %s C" % temp, "Humidity = %s %%" %Humid, "Gas Concentration = %s" %Gas  )
    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

deviceCli.disconnect()
```

8. TESTING

8.1 Test Cases

TestCaseAnalysis

Thisreportshowsthenumberoftestcasesthathavepassed,failed,anduntested

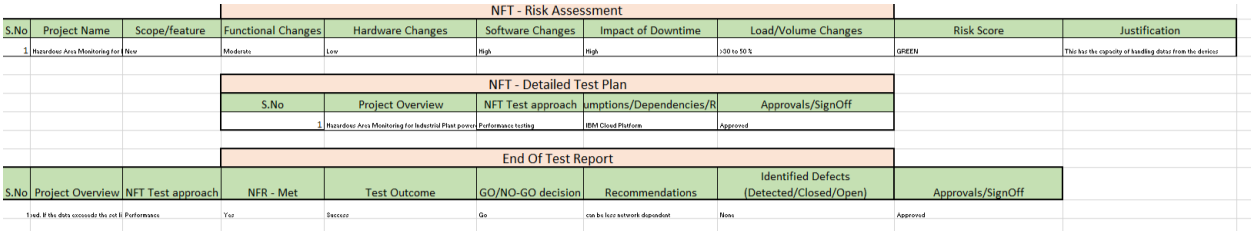
Security	1	0	0	1
OutsourceShipping	0	0	0	0
ExceptionReporting	0	0	0	0
FinalReportOutput	0	0	0	0
VersionControl	2	0	0	2

8.2 User Acceptance Testing

Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Commnets	TC for Automation(Y/N)	BUG ID	Executed By
LoginPage_TC_OO 1	Functional	IoT End Device	Verify whether the data collected from sensor is properly read in to the End device[ESP32]	ESP32 device and proper interface connections.	1.Connect the sensors with End Device 2.Run the simulation 3.Vary the inputs and check whether correct output is displayed in serial monitor	https://wokwi.com/projects/348749061043520082	The output must match with the input	Working as expected	Pass	Nill	Yes	NA	Dharshini K Harini M Aashikaa R Mohan Ferdina C
LoginPage_TC_OO 2	Functional	IBM IoT Cloud Platform	Verify whether the databis received from the IoT end device to Cloud(IBM Watson)	IBM Watson Internet of Things Platform	1.Enter URL for IBM watson 2.Generate data to send to cloud 3.Verify the received data by logging in to the IBM Watson	https://mecal4.internetofthings.ibmcloud.com/dashboard/devices/browse	The data sent from End device must be received in the dashboard.	Working as expected	Pass	Nill	Yes	NA	Dharshini K Harini M Aashikaa R Mohan Ferdina C
LoginPage_TC_OO 3	User Interface	Web UI Dashboard	Verfiy the dashboard functions properly	Dashboard is configured	1.Enter URL 2.Run the Wokwi simulation 3.Vary the simulation conditions 4.Check whether the data is displayed correctly. 5.Click the button and verify its functionality.	http://169.51.207.33:32028/ui	The data must be displayed properly and button functions must work correctly.	Working as expected	Pass	Nill	Yes	NA	Dharshini K Harini M Aashikaa R Mohan Ferdina C
LoginPage_TC_OO 4	User Interface	Mobile App UI	Verify whehter user can use the app to view data and buttons	Monile app is built and deployed.	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	http://ai2.appinventor.mit.edu/#6193494222569472	The app must be installed properly and the desired functions are performed correclty	Working as expected	Pass	Nill	Yes	NA	Dharshini K Harini M Aashikaa R Mohan Ferdina C

9. RESULTS

9.1 Performance Metrics



NFT - Risk Assessment

S.No	Project Name	Scope/feature	Functional Changes	Hardware Changes	Software Changes	Impact of Downtime	Load/Volume Changes	Risk Score	Justification
1	Hazardous Area Monitoring for	New	Moderate	Low	High	High	>30 to 50 %	GREEN	This has the capacity of handling datas from the devices

NFT - Detailed Test Plan

S.No	Project Overview	NFT Test approach	umptions/Dependencies/R	Approvals/SignOff
1	Hazardous Area Monitoring for Industrial Plant power	Performance testing	IBM Cloud Platform	Approved

End Of Test Report

S.No	Project Overview	NFT Test approach	NFR - Met	Test Outcome	GO/NO-GO decision	Recommendations	Identified Defects (Detected/Closed/Open)	Approvals/SignOff
1	ind. If the data exceeds the set li	Performance	Yes	Success	Go	can be have network dependent	None	Approved

10. ADVANTAGES

To detect the exact direction of the fire source.
The capability of sensing accurately with increased flexibility. Reduce human effort.
Reliable and economical.
If any of the sensor output will be high, Voice module will produce the sound for intimating the condition to others.
To detect fire in the disaster-prone area.
Also extinguishes the fire on detection.
Reduces the level of destruction.
Simple and low cost technology.
Measures flammability of gases.
It has robust and simple construction.
Automation of sensors leads to better monitoring of devices.

DISADVANTAGES

It measures toxic gases in very low concentrations.
It is difficult to know failure modes unless very advanced methods of monitoring are used.
It gets reacted due to heating of wire.
It causes suffocation, in case of leakage as it heavier than air.
It is hazardous as it inflammable gas.
It is consumed more as it has low energy density.
It does not provide power to the vehicle in mountains or rough terrains.
It is costlier than CNG.

11. CONCLUSION

WSN is possible today due to technological advancement in various domains. Envisioned to be an essential part of our lives design constraints need to be satisfied for a realization of sensor networks. Similarly other actions will to be taken by the system. If the voltage and current go above the threshold value and leakage of gas are detected by gas sensors and the voice module plays an audio note which gives an alert message to the factory workers for the gas and

detected. IOT and the Android app help us for remote monitoring. The entire mechanism is controlled by Arduino.

12. FUTURE SCOPE

Another major future scope could be including a Automatic Shut-off device which will turn off the gas supply whenever it will detect any gas leakage. This system can be implemented in Industries, Hotels and wherever the LPG cylinders are used.

1)Fast Speed of response.
2)Immune to catalytic poisons.
3)High Reliability & Repeatability.
4)Heated optics eliminates condensation.
5)Ability to operate in the absence of oxygen or in enriched oxygen

As detectors measure a specified gas concentration, the sensor response serves as the reference point or scale. When the sensors response surpasses a certain preset level, an alarm will activate to warn the user. There are various types of detectors available and the majority serves the same function: to monitor and warn of a dangerous gas level. However, when considering what type of detector to install, it is helpful to consider the different sensor technologies.

13. APPENDIX

Source Code:

```
import time
import sys
import random
import ibmiot.application
import ibmiot.device
organization = "o86xnz"
deviceType = "Sensor"
deviceId = "123456"
authMethod = "auth"
authToken = "Ferdina22"

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()

deviceCli.connect()
while True:

   temp=random.randint(0,100)
   Humid=random.randint(0,100)
```

```
    Gas=random.randint(0,100)

    data = { 'temp' : temp, 'Humid': Humid, 'Gas':gas }

    def myOnPublishCallback():
       print ("Published Temperature = %s C" % temp, "Humidity = %s %%" %Humid, "Gas
Concentration = %s" %Gas  )
    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

deviceCli.disconnect()
```

GitHub & Project Demo Link:

https://github.com/Harini6206