PROJECT REPORT

DATE	18 November 2022
TEAM ID	PNT2022TMID43363
PROJECT NAME	Project - Hazardous Area Monitoring for Industrial Plant powered by IoT

ABSTRACT:

The proper operation of the industrial process depends in large part on the core area of industrial safety. To ensure that the goods are safe and effective, it is critical to evaluate the status of the sector. An IoT-based industrial monitoring system with intelligent sensors is what this study aims to build. There may be a benefit to the industrial industry from this endeavour. Any manufacturing business that incorporates technology will guarantee the public's safety and well-being and prevent accidents.

INTRODUCTION:

The Industrial Monitoring System project uses the Internet of Things (IoT) as its foundation. Arduino is utilised to control a variety of sensors (using smoke and temperature sensors), giving the industry total control. This project uses the Internet of Things (IoT) to give users access to data. The Internet of Things (IoT) is a system of interconnected "things" that enables physical objects to exchange data via sensors, electronics, software, and networking. These autonomous systems can function without human interaction. The continuous monitoring sensors alert the in charge of the area by sending an alert message as well as with an alarm. The sensors continuously monitor the temperature, leakage of gases and humidity and take necessary measures to ensure the safety of the workers in the industry.

LITERATURE SURVEY:

1. **IoT Based Industrial Pollution Monitoring System**

Doma Harsha Vardhan Reddy, Arun Gowda K, V Kalyan Kumar, Dr Jeevan K M Journal of Xi'an University of Architecture & Technology, Volume XII, Issue V, 2020

This study proposes a remote embedded enrollment structure for an IoT-based system to monitor pollution levels in mechanical condition or a specific region of interest. The system uses an interface between the transmitter and recipient made of an Arduino Uno and a Blynk server.

2. **IoT- Based Air Pollution Monitoring and Forecasting System**

Chen Xiaojun published a paper “IoT- Based Air Pollution Monitoring and Forecasting System” in the year 2015.

An IoT-based system for tracking and predicting air pollution In their article titled "Urban Air Pollution Monitoring System With Forecasting Models," Khaled Bashir Shaban et al. made a recommendation for a low-cost air pollution monitoring system. The data could be received, stored, and preprocessed by the system. It has the ability to transform the data into insightful knowledge.

3. **IoT Based industrial Monitoring system**

Hemlata Yadav, Naomi oyiza, sarfaraz hassan, Dr.sumam lata,K. Jaya chitra

This proposes the idea to reduce industrial risks in prominent factories, monitor power plant yield, guarantee security in quickly developing industries, and access nuclear safety levels.

4. **Wireless gas sensor network for detection and Monitoring of harmful gases in utility areas and industries**

Dr.p.c.jain,Rajesh Kushwaha

This proposal to control manufacturing processes, or outdoor Monitoring the environment due to WSN’s simplicity, wireless connectivity, and low power consumption.The WGSN detects not only the presence of gas but the amount of leakages in the air, and accordingly raises an appropriate audiovisual alarm.

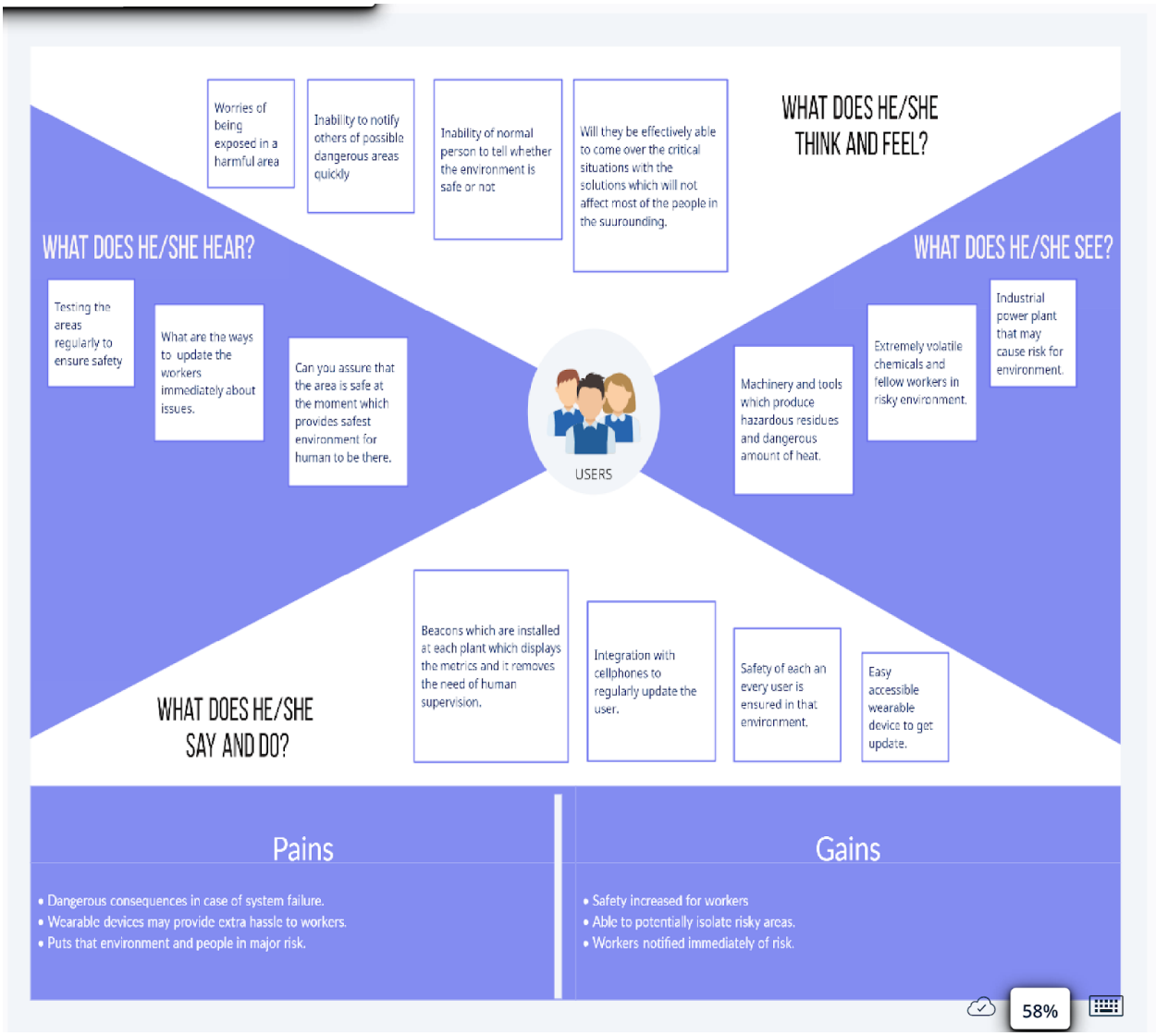
5. **FPGA-GSM based Gas Leakage Detection System**

Arpitha .T, Divya Kiran, V. S.N. Sitaram Gupta, and Punithavathi Duraiswamy

This proposal based on FPGA – GSM gas leakage detector with a warning call initiating feature to the first response team is presented. The FPGA detects the leakage and initiates a warning call through a GSM module.

IDEATION AND PROPOSED SOLUTION:

1. Empathy Map



2. Proposed Solution Fit:

Project Design Phase – I Problem Solution Fit **Team Id:** PNT2022TMID43363

Project Title: Hazardous Area Monitoring for Industrial Plant powered by IoT

3. Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	● Hazardous Area Monitoring for Industrial Plant Powered by IoT
2.	Idea / Solution description	● Using sensors to read the required parameters such as temperature, and humidity that can be monitored ● If the sensor readings exceed the safety threshold, the alert message is sent to users via SMS using services. ● These sensor values are stored in the cloud and can be viewed from a mobile device.
3.	Novelty / Uniqueness	● If a parameter is violated, the system sends an immediate notification to a set of preset list of users on their smartphones and continues logging and monitoring data for further analysis to suggest improvements in the safety regulations of the industry. ● The sensors used in this model can be modified with industry requirements whenever the need arises.

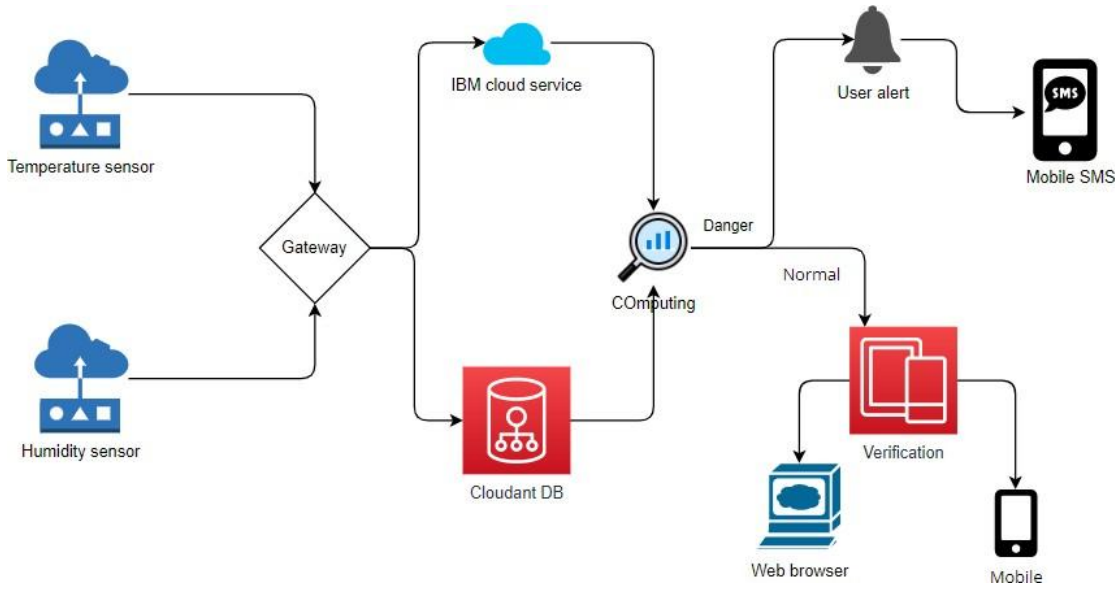
4.	Social Impact / Customer Satisfaction	• The system requires just minimum components to run and runs with minimal space and resource requirements. • It is configured in such a way that it recovers and reconnects itself after a crash and can resume working immediately • Notification parameters and user access control can be adjusted to suit your requirements. • Cost-effective model

5.	Business Model (Revenue Model)	• Device has day-to-day applications where it is used in domestic to industrial and this yields more attraction among the industry people. • The device can be obtained by paying for the IBM cloud/Watson subscription. • It can be yearly or monthly.
6.	Scalability of the Solution	The project scope can be expanded such that emissions, radiation and weather conditions can also be monitored.

SOLUTION ARCHITECTURE:

Solution Architecture:

Solution architecture includes sensors, cloud services, apps, databases and hardware modules.



These components include a Temperature and humidity sensor, IBM Watson platform, Rasberry pi, Cloudant DB, Web Browser, SMS services and mobile applications.

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Data Gathering	The smart beacon must be able to detect the temperature of a particular area in rea
FR-2	Location Detection	The smart beacon must be able to detect when a wearable device has entered an area near it
FR-3	Beacon Data Syncing	The smart beacon must be able to share its stored data with both the wearable device and admin dashboard through the cloud.
FR-4	Wearable Device Display	The wearable device must be able to display the temperature of the area where the worker is currently present.
FR-5	SMS Notification	If the temperature of the area is found to reach dangerous levels, the workers should be informed via SMS to their phone instructing them to leave the area.
FR-6	Admin Dashboard	If the temperature of the area is found to reach dangerous levels the admin is informed via the dashboard and must take the necessary precautions.

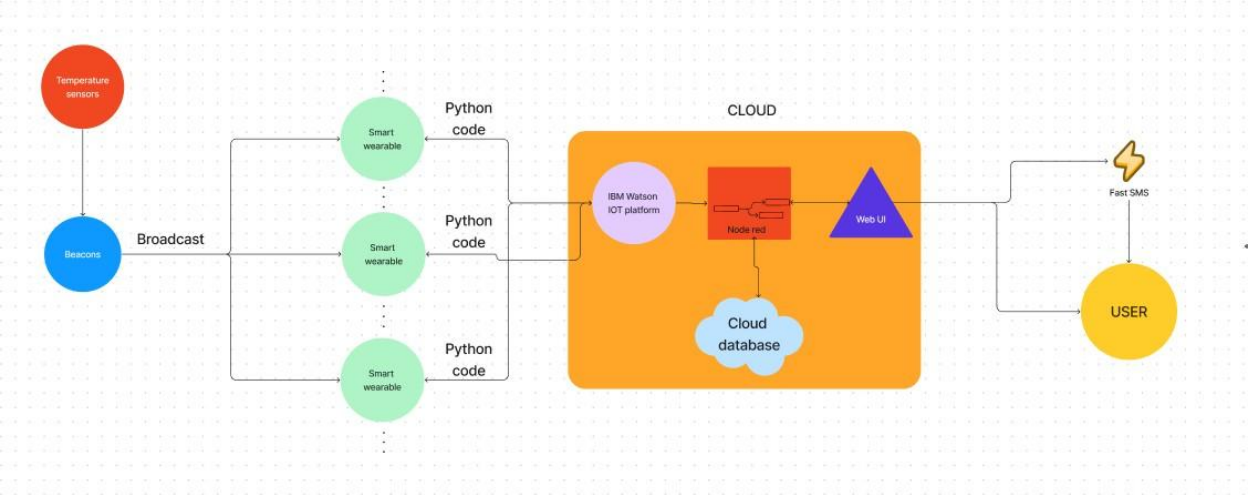
Non-functional Requirements:

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

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The wearable device should be slim and not annoy or disturb the workers who are wearing them. They should also reliably display the temperature without large delays and notifications should be clear in cases of detected danger.
NFR-2	**Security**	The connection of the beacons to the cloud and wearable devices should be secure. The security of the database housing all the temperature data shouldalso be bolstered
NFR-3	**Reliability**	The wearable device should be able to function without any faults even at dangerous temperatures. If a fault is detected it should notify the user and the admin to be immediately repaired and replaced. The beacons should also be regularly maintained to ensure reliability.
NFR-4	**Performance**	The device should update temperature readings in real time and requires high-end sensors and processors to do so. The time to send data to the cloud and other devices should also be made as small as possible.
NFR-5	**Availability**	The user should be able to check the temperature of the area no matter where or at what time they are in the plant. The dashboard should be constantly active so as to ensure safety precautions can be executed whenever

		danger is detected.
NFR-6	**Scalability**	If the area that needs to be monitored needs to be increased all one has to do is install new smart beacon devices and connect them to the same system as the previous beacons. It can also be replicated in different plants with different factors to be monitored giving it high scalability.

Dataflow Diagram:



TECHNOLOGY (Stack and Architecture):

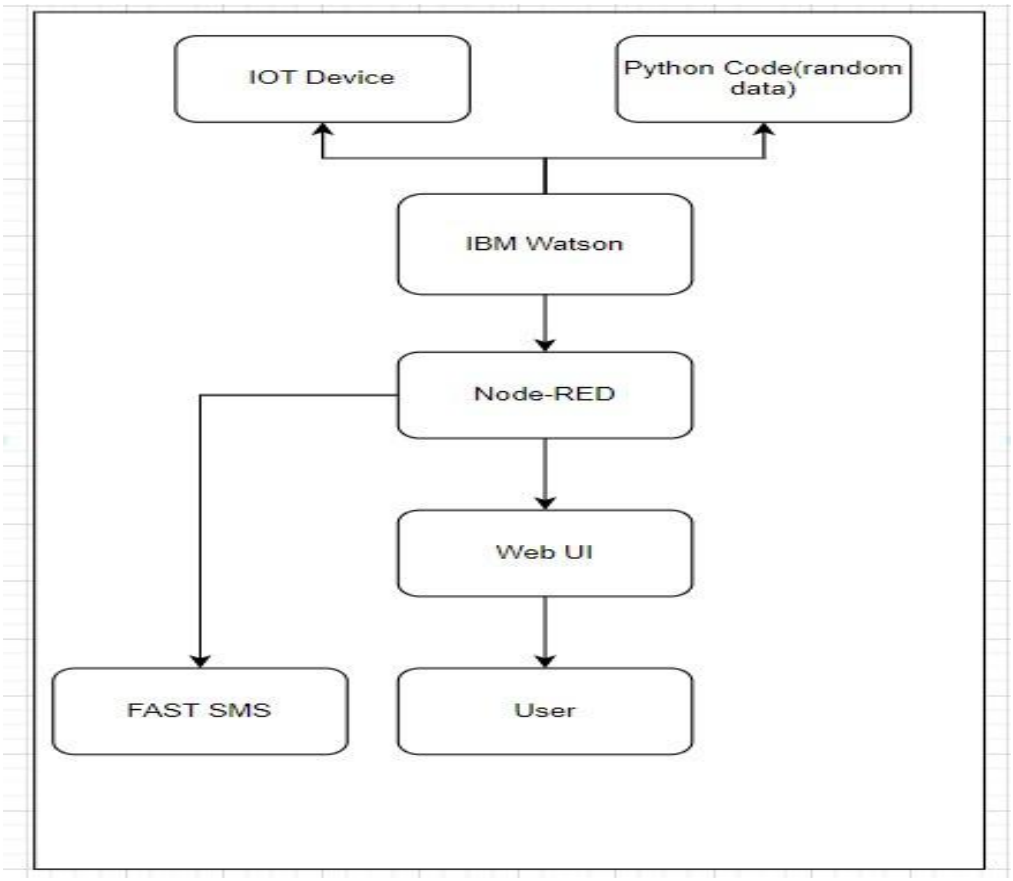


Table-1: Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	Web UI, Mobile App	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Application Logic-1	Logic for a process in the application	Java / 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.	Database	Data Type	MySQL, NoSQL
6.	Cloud Database	Database Service on Cloud	IBM Cloudant etc.

7.	File Storage	File storage requirements	IBM Block Storage
8.	Machine Learning Model	Purpose of Machine Learning Model	Object Recognition Model, etc.
9.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration :	Local, Cloud Foundry, Kubernetes, etc.

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	The open-source frameworks used	Chrome
2.	Security Implementations	The security / access controls implemented, use of firewalls etc.	IBM cloud Encryptions
3.	Scalable Architecture	The scalability of architecture (3 – tier, Micro-services)	IBM cloud architecture
4.	Availability	The availability of application (e.g. use of load balancers, distributed servers etc.)	Web application can even be used by the workers in the industry
5.	Performance	The performance of the application (number of requests per sec, use of Cache, use of CDN's) etc.	Since the web application is high efficient, it can be used by the workers irrespective of time.

User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Technician	Installation	USN-1	As a user, I must install the smart beacons at points to ensure the entire area of the plant is covered.	A beacon can be found in every area of the plant.	High	Sprint-1
	Data Gathering	USN-2	The beacons obtain the temperature of their respective area using sensors.	The temperature of areas within the plant is obtained.	High	Sprint-1
	Data Sync	USN-3	The beacons send their data to the cloud in the real-time which is in turn sent to nearby wearable devices and the administrator's dashboard	Data is sent to the cloud successfully and synced with and other devices.	High	Sprint-1

Mobile User	Registration	USN-4	As a user, I can register for the application by entering my email, and password and confirming my password.	I can access my account/ dashboard.	High	Sprint-1
		USN-5	As a User, I will receive a confirmation email once I have registered for the application.	I can receive a confirmation email & click confirm	High	Sprint-1
	Login	USN-6	As a User, I can login to the application by entering email & password	I can register and access my account	High	Sprint-1
	Dashboard	USN-7	As a User, I can monitor the temperature and humidity.	I can access the account for monitoring the hazardous area	Medium	Sprint-2
End User	Alerting through message	USN-8	I can receive message in the form of visual notification and voice message.	I can detect the hazard and receive notification	High	Sprint-1
	SMS Notification	USN-9	I can get the alert message if the area has any Hazards.	I can be alerted through the SMS notification	Medium	Sprint-2

Web User	Monitoring	USN-10	As a Web User, I can detect the hazard through the website.	I can monitor the hazards like temperature, humidity, toxic gases.	High	Sprint-1
Customer care executive	Maintenance	USN-11	As an executive, I manage a team of representatives offering customer support.	I need a team of workers to manage the data.	Low	Sprint-3
Administrator	Admin Dashboard	USN-12	As an Administrator, I can able to access the data through the cloud.	I can access the data sent by the beacon sensor	High	Sprint-2
	Dashboard Customization	USN-13	As an Administrator, I can customize the dashboard to suit their personal requirements and priorities.	The admin can customize the UI for their dashboard.	Medium	Sprint-2

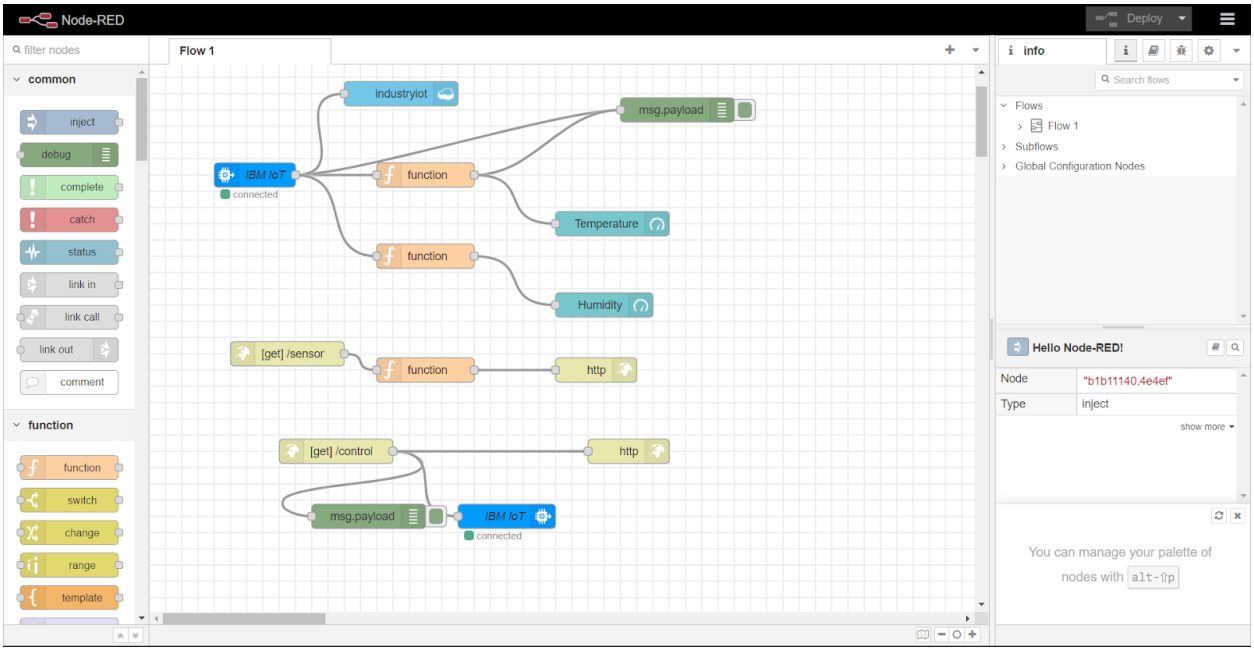
SPRINT PLAN SCHEDULE:

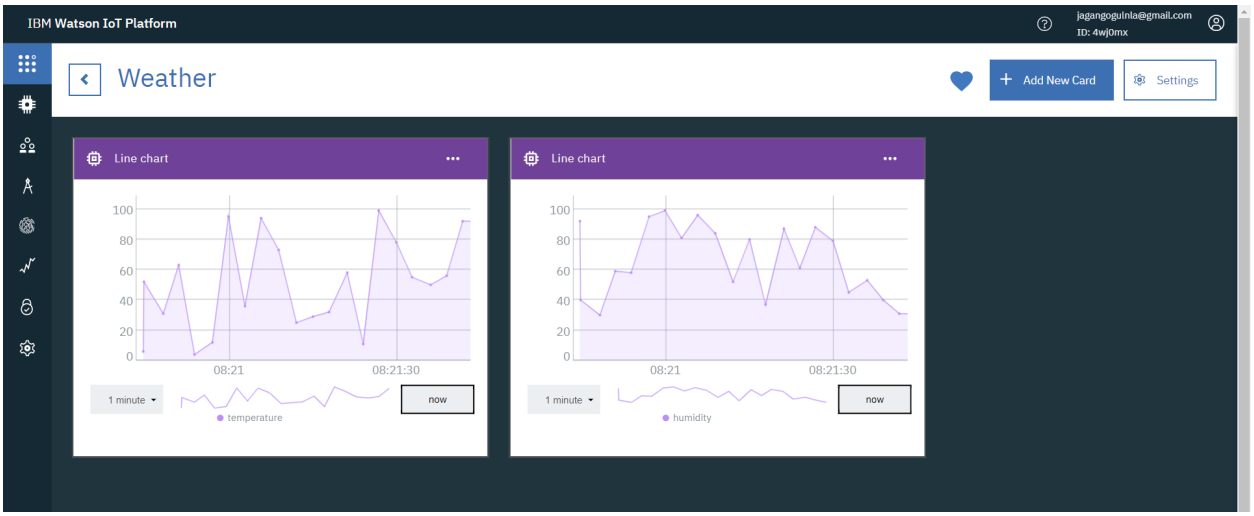
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Cloud Setup (Cloud Sevices)	USN-1	The smart beacons are connect with IBM cloud services for real-time data transfer	20	High	Dharanitharan S Harinandhan R Jaganaath A Mukil S
Sprint-2	Admin Dasboard Setup/ Web UI (Cloud Services)	USN-2	The web UI is developed and deployed for connecting the user to the cloud	20	High	Dharanitharan S Harinandhan R Jaganaath A Mukil S
Sprint-3	Mobile and wearable device setup (Users)	USN-3	Mobile applications are created using fast SMS API to send alert SMS message and also the watch display mechanism is developed	20	High	Dharanitharan S Harinandhan R Jaganaath A Mukil S
Sprint-4	Installation of Beacons(External)	USN-4	The technician should install the smart beacon devices at vital points to increase the data sensing range	20	High	Dharanitharan S Harinandhan R Jaganaath A Mukil S

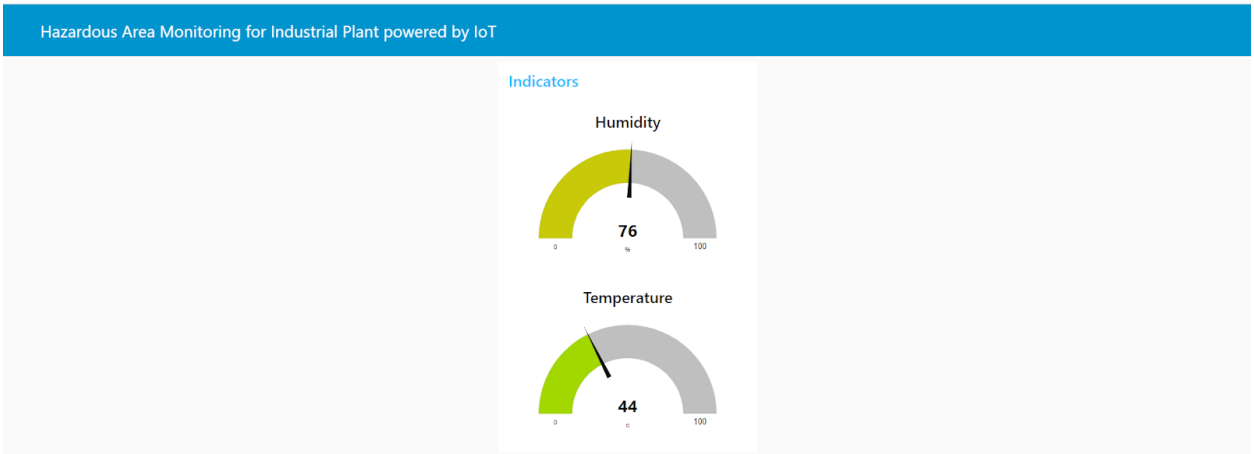
Project Tracker:

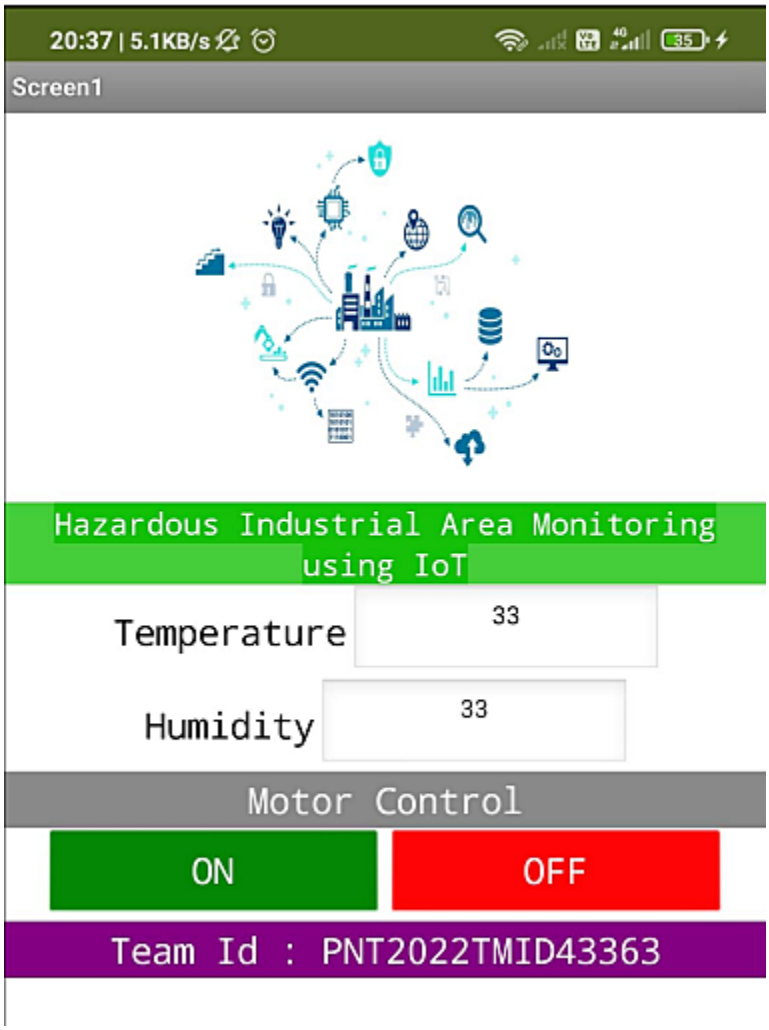
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	5 Days	2 Nov 2022	6 Nov 2022	20	6 Nov 2022
Sprint-2	20	4 Days	7 Nov 2022	10 Nov 2022	20	10 Nov 2022
Sprint-3	20	5 Days	11 Nov 2022	15 Nov 2022	20	15 Nov 2022
Sprint-4	20	4 Days	16 Nov 2022	19 Nov 2022	20	19 Nov 2022

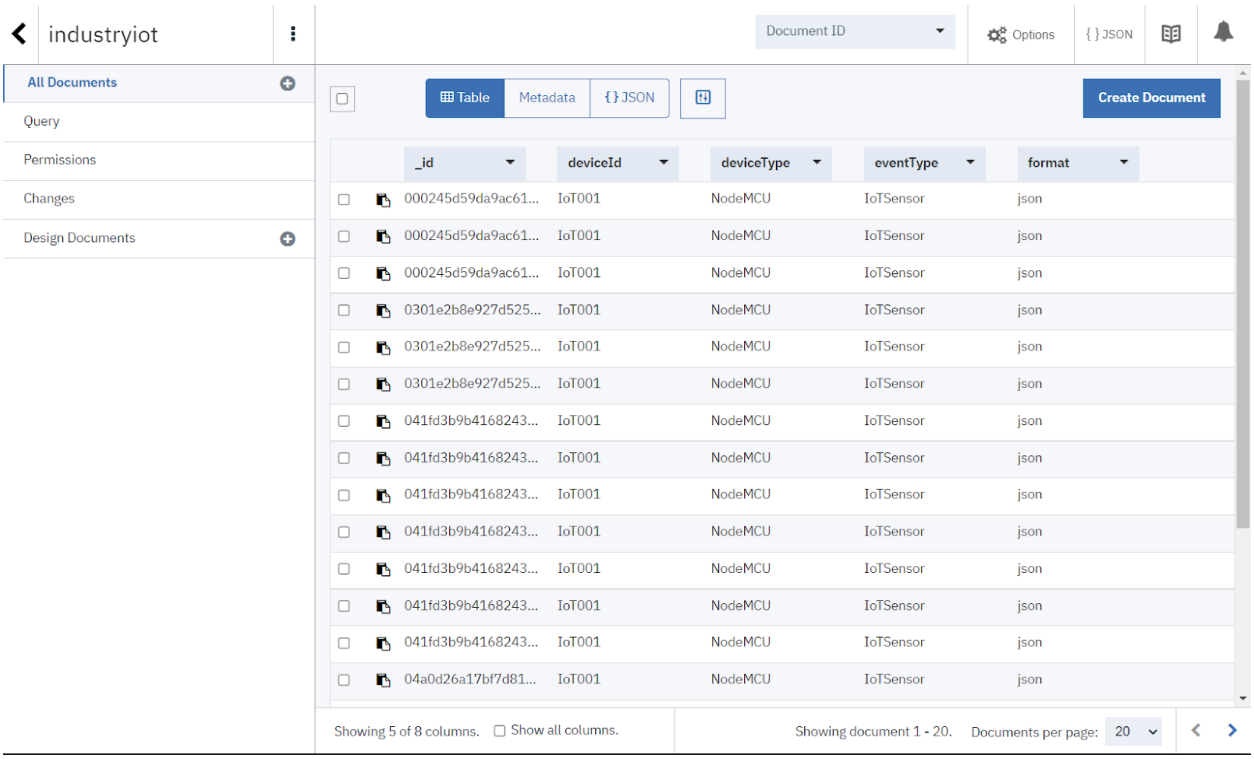
CODING AND RESULTS:




IBM Watson IoT Platform
jagangogulnla@gmail.com
ID: 4wj0mx
Weather
Add New Card
Settings
Line chart
100
80
60
40
20
0
08:21
08:21:30
1 minute
now
temperature
Line chart
100
80
60
40
20
0
08:21
08:21:30
1 minute
now
humidity


Hazardous Area Monitoring for Industrial Plant powered by IoT
Indicators
Humidity
76
%
0
100
Temperature
44
c
0
100


20:37 | 5.1KB/s
Screen1
Hazardous Industrial Area Monitoring using IoT
Temperature
33
Humidity
33
Motor Control
ON
OFF
Team Id : PNT2022TMID43363

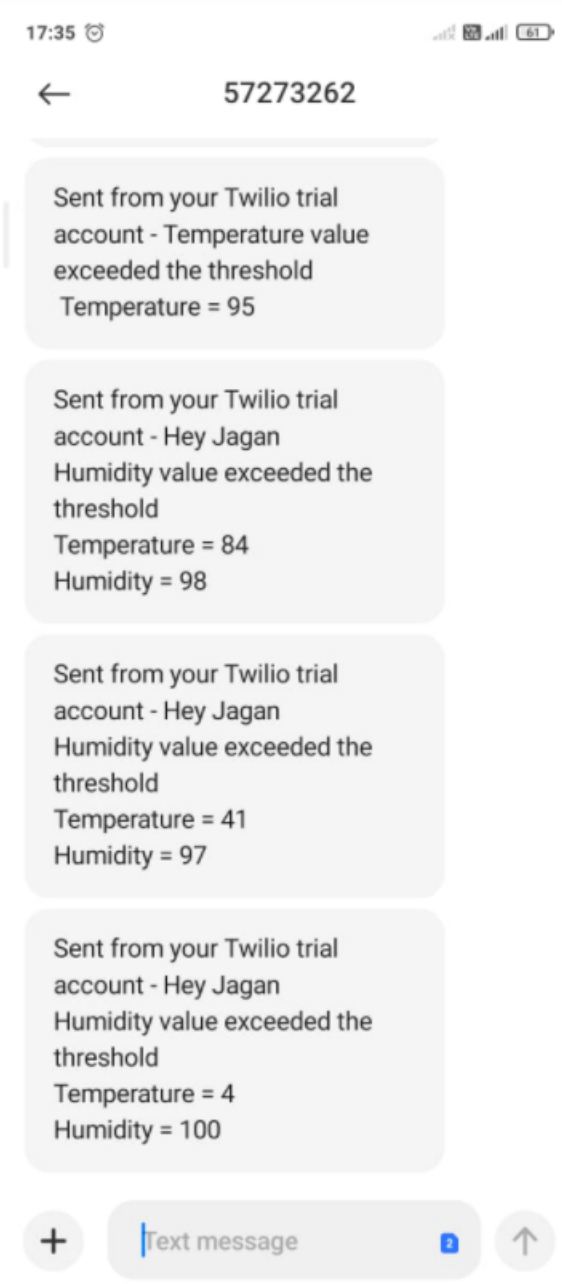


SMS alert

```
while True:
  # Get Sensor Data from DHT11
  temp = random.randint(0, 100)
  humid = random.randint(0, 100)
  data = {'temp': temp, 'humid': humid}
  if temp>90:
    message = client.messages.create(
      body='Hey Jagan\nTemperature value exceeded the threshold \nTemperature = {temper}\nHumidity = {humidity} '.format(temper=temp,humidity=humid),
      from_='+19852384465',
      to='+919344546421'
    )

    print(message.sid)
  if humid>90:
    message = client.messages.create(
      body="Hey Jagan\nHumidity value exceeded the threshold \nTemperature = {temper}\nHumidity = {humidity} ".format(temper=temp,humidity=humid),
      from_='+19852384465',
      to='+919344546421'
    )

    print(message.sid)
```



ADVANTAGES:

- IoT technology provides the most economic and budgeted solutions for the users.
- IoT is a fostering innovation.
- IoT powered level will be an improved supply chain.

- IoT provides a smart level monitoring end-to-end solutions.
- It ensures the industrial productivity and improved strategies through advanced analytics.
- The risk prevention must be teach to the staffs. o IoT is a real-time supervision.

DISADVANTAGES:

- Misuse of privacy and data.
- Expense.
- Communication channel disconnection occurs oftern.
- Complex uses.

CONCLUSION:

IoT is currently prevalent and gaining ground in many industries, with industrial applications being one of the most significant. The Internet of Things (IoT) offers a plethora of opportunities for enterprises to enhance productivity, lower costs, and boost sector growth. However, in industrial regions, danger monitoring and mitigation are frequently disregarded.

Therefore, the purpose of this project is to use IoT to actively monitor and analyse different aspects of a typical heavy industrial zone, such as temperature and levels of environmental gases. If the aforementioned parameters are more than the advised safe values. The system is able to monitor repeated issue alerts. Additionally, the data produced in real-time can offer crucial information about how well the work is progressing in various

zones.

This system can be used in a variety of industrial settings, including heavy part production lines, underground factories, metal refineries, automatic welding factories, and mining. It will assist in creating a secure and effective working environment in these locations while also opening up new avenues for enhancing their security measures.

FUTURE SCOPE:

There are the top applications of IIoT that aid the future Scope of Industrial Monitoring:

1. Firstly, providing service engineers and manage remote access to industrial machines.

2. Secondly, allowing web-based virtual network connection to manage and observe HMI

functions on the IOT platform.

3. In addition, it offers predictive analytics for maintaining machines and identifying potential

Problems.

4. Most importantly, it controls, monitors, and manages data from multiple systems in various

locations. Simultaneously storing the collected data at a central cloud application. Hence, realtime machine data and analysis are easily accessible using industrial communication networks.

APPENDIX

Source code

Python Script IOT.py - C:\Users\91934\Downloads\Python Script IOT.py (3.7.0)

File Edit Format Run Options Window Help

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random

#Provide your IBM Watson Device Credentials
organization = "4wj0mx"
deviceType = "NodeMCU"
deviceId = "IoT001"
authMethod = "token"
authToken = "1234567890"

# Initialize GPIO
def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status =="motoron":
        print("motor in on")
    else :
        print ("motor is off")
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
        temp=random.randint(0,100)
        humid=random.randint(0,100)
        data = {'temp' : temp, 'humid' : humid}
        #print data
        def myOnPublishCallback():
            print ("Published Temperature = %s C" % temp, "Humidity:%s" %humid)

        success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0, on_publish=myOnPublishCallback)
        if not success:
            print("Not connected to IoTF")
        time.sleep(1)
        deviceCli.commandCallback = myCommandCallback

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

Ln: 46 Col: 21

```
========== RESTART: C:\Users\91934\Downloads\Python Script IOT.py ==========
2022-11-18 20:59:00,384   ibmiotf.device.Client      INFO    Connected successfully: d:4wj0mx:NodeMCU:IoT001
Published Temperature = 7 C Humidity:71
Published Temperature = 96 C Humidity:20
Published Temperature = 69 C Humidity:8
Published Temperature = 32 C Humidity:11
Published Temperature = 64 C Humidity:26
Published Temperature = 94 C Humidity:71
Published Temperature = 51 C Humidity:10
Published Temperature = 58 C Humidity:46
Published Temperature = 94 C Humidity:27
Published Temperature = 93 C Humidity:52
Published Temperature = 85 C Humidity:63
Published Temperature = 55 C Humidity:44
Published Temperature = 36 C Humidity:76
Published Temperature = 34 C Humidity:54
Published Temperature = 35 C Humidity:34
Published Temperature = 60 C Humidity:14
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Published Temperature = 69 C Humidity:73
Published Temperature = 32 C Humidity:80
Published Temperature = 41 C Humidity:89
Published Temperature = 93 C Humidity:57
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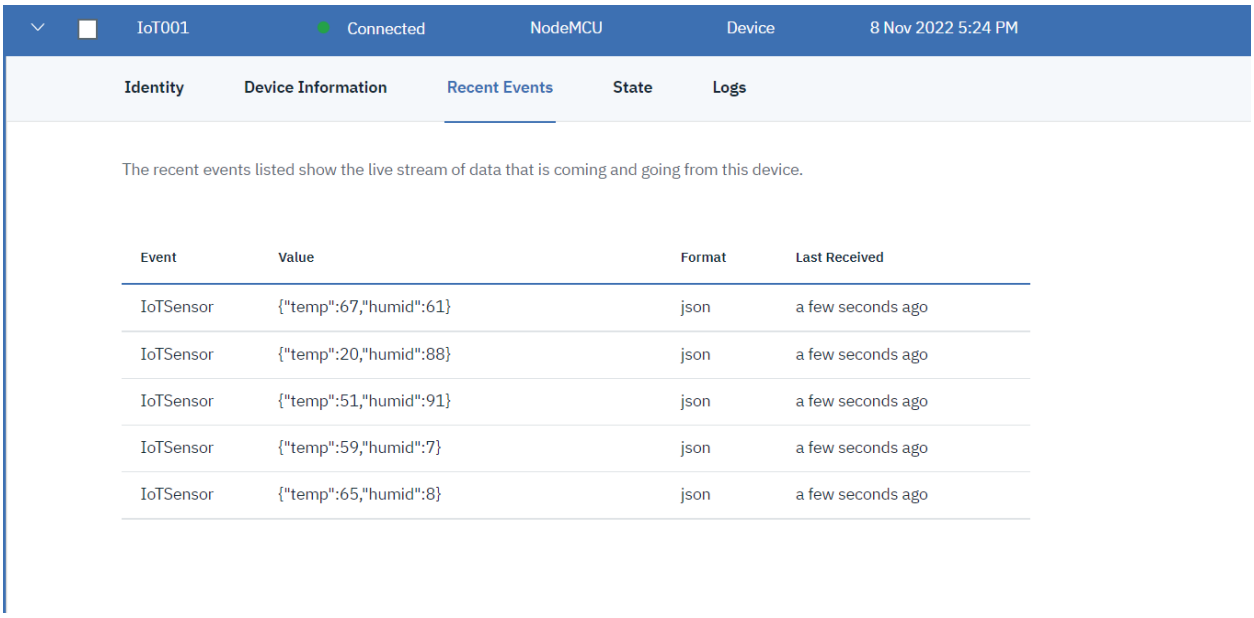

TEAM ID : PNT2022TMID43363

Github link: https://github.com/IBM-EPBL/IBM-Project-42639-1660672536