A PROJECT REPORT ON

Hazardous Area Monitoring for Industrial Plant powered by IoT

Domain : Internet of Things

Team ID : PNT2022TMID31893

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1. INTRODUCTION

1.1 PROJECT OVERVIEW

Internet of Things (IoT) represents a general concept for the ability of network devices to sense and collect data from the world around us, and then share that data across the Internet where it can be processed and utilized for various practical purposes in different aspects of life. The reach of IoT based systems in industrial areas is still limited, but it has huge potential. In this project, we create an IoT based hazard monitoring system specifically suited to requirements of mining, refining and manufacturing industries. The system actively records, processes and analyzes the temperature of sur- roundings, which is a prime safety parameter in areas where molten metal is processed, manufacturing is done or welds are made. Also, it keeps track of high levels of dangerous gases present in the environment (LPG/Natural Gas). 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 moni- toring data for further analysis to suggest improvements in the safety regulations of the industry. The sensors used in this prototype model can be modified with industry requirements (for example more robust temperature sensor may be required in very harsh conditions) whenever the need arises.

1.2 PURPOSE

In some industrial plants, there are some areas which are to be monitored time to time. Sometimes the conditions may become critical which may lead to loss of property and also human loss. To monitor the conditions we can integrate the smart devices in the areas which are needed to be monitored. Every device will be acting as beacon and

it is connected to temperature sensors. We can broadcast the temperature data along with the location of that particular area through beacons. The persons who generally monitor these places will be given a wearable device which will be acting as a beacon scanner. Whenever the person enters the desired area then he can view the required parameters and can be alerted, these are sent to cloud.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

Industrial accidents are as old as industry itself and so are preventive measures. These standards for explosive areas or atmospheres have also has evolved diversely worldwide, based on the local needs of the industries for the overall safe operation of the plants. Explosion and an fire are two of the major constituents of these mishaps. Depending upon the environment, these can be termed 'Accidents' or fade away as simple the 'Incidents' or 'Near Misses' in the safety officers statistics. The first step to logically is to start defining and understanding some of the terms used in the whole scope of the loss prevention in accidents due to explosion and fire.

2.2 REFERENCES

Ganga, D., & Ramachandran, V. (2018). IoT-based vibration analytics of Electrical Machines. IEEE Internet of Things Journal, 5(6), 4538– 4549. https://doi.org/10.1109/jiot.2018.2835724

Dai, B. (2019). Design of complex wind power generation parameter control system based on embedded control combined with internet of things. Web Intelligence, 17(2), 131–139. https://doi.org/10.3233/web-190407

Wang, X., & Cai, S. (2020). An efficient named-data-networking-based IOT Cloud Framework. IEEE Internet of Things Journal, 7(4), 3453– 3461. https://doi.org/10.1109/jiot.2020.2971009

Saha, S., & Majumdar, A. (2017). Data Centre temperature monitoring with ESP8266 based wireless sensor network and cloud based dashboard with Real Time Alert System. 2017 Devices for Integrated Circuit (DevIC). https://doi.org/10.1109/devic.2017.8073958

2.3 PROBLEM STATEMENT DEFINITION

Industrial hazards consists of four principle hazards. This is because industries employ many different processes involving a wide range of different raw materials, intermediates, waste products and final products. The hazards encountered are fire, explosion, toxic release and environmental damage. An area in which the atmosphere contains, or may contains in sufficient quantities, flammable or explosive gases, dust or vapours. In such an atmosphere a fire or explosion is possible when three basic conditions are met. Examples, **Gas wells, gas processing plants and gas-fired generators** are common areas that contain hazardous areas due to the natural gas that is released in different sections of the plant in concentrations that can be considered as a flammable mixture. The National Electrical Code (NEC) defines hazardous locations as those areas "where fire or explosion hazards may exist due to **flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings**." Examples of physical hazards include **slips, trips, falls, exposure to loud noises, working from heights, vibrations, and unguarded machinery**. Every occupation places certain strains on a worker's body.

3. IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

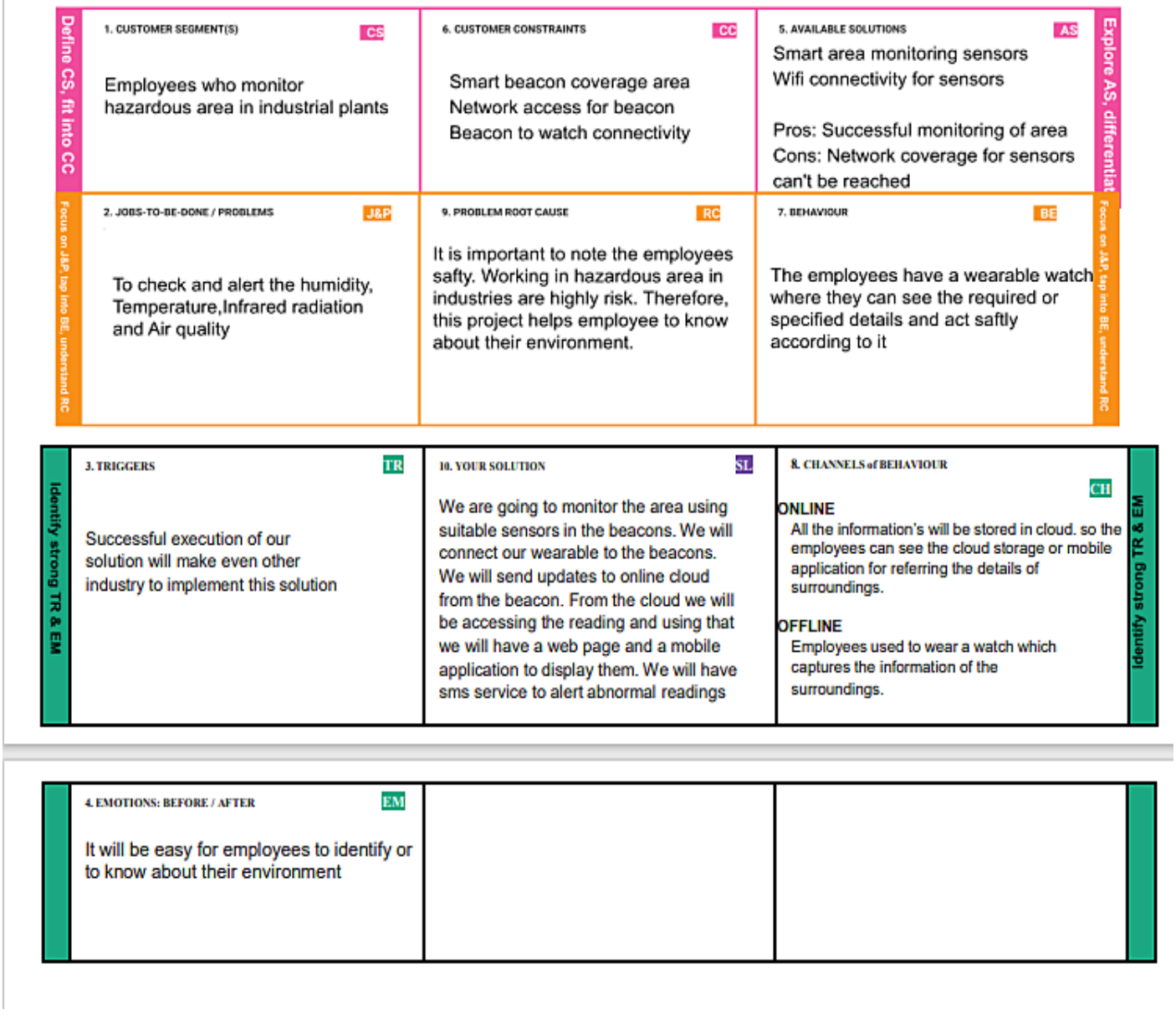
3.2 IDEATION AND BRAINSTORMING

3.3 PROSPOSED SOLUTION

S.NO	PARAMETERS	DESCRIPTION
1.	Problem Statement (Problem to be solved)	To improve the safety management system in industries. Improving the safety management system against the industrial accidents.
2.	Idea / Solution description	To implement the safety management in industry based on IOT using Arduino uno board with temperature detection . And using humidity sensor with GPS tracking system.
3.	Novelty / Uniqueness	An Integrated system of temperature monitoring automatically fire extinguisher with accuration of information about locations and response through SMS notification and call.
4.	Social Impact / Customer Satisfaction	It early prevents the accident cost by fire in industries.Nearby locations so maximum extend more accurate reliability,Compatability design integrated system

5.	Business Model (Revenue Model)	This product can be utilized by a industries .this can be thought of as a productive and helpful item as industries great many current rescuing people and machine from the fire accident. 
6.	Scalability of the Solution	It is trying to execute this technique as we need to introduce an arduino gadget which was modified with an Arduino that takes received signals from sensors .Easy operatability and maintenance.Required low time for maintain.Cost is reasonable value.

3.4 PROBLEM SOLUTION FIT



4 REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through gmail Registration through form Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Conformation via otp
FR-3	Actuation function	Turning ON buzzer
FR-4	Notification	Sending notification high leveltemperature indication

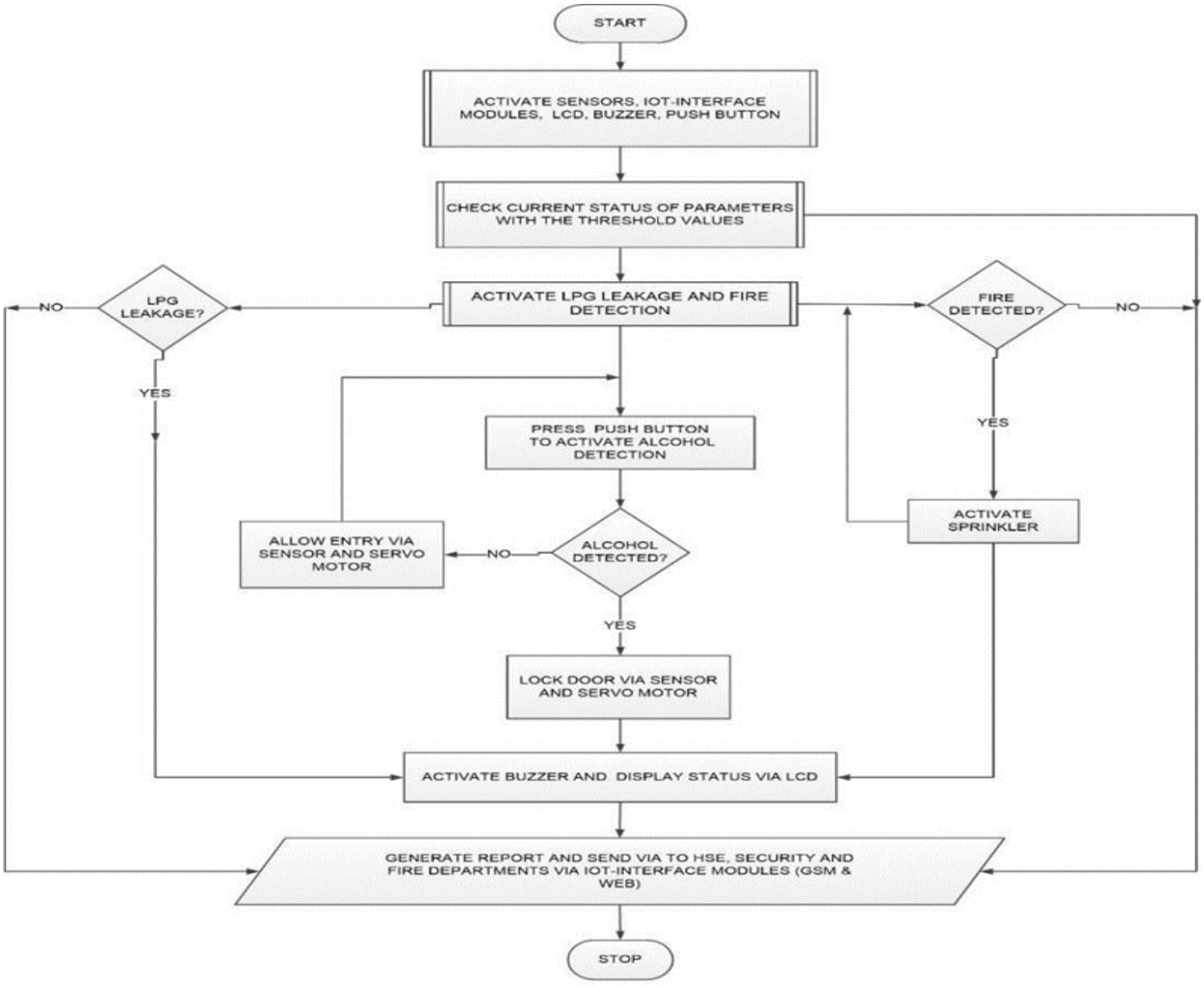
4.2 NON FUNCTIONAL REQUIREMENT

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Ease of use and longevity of the system.
NFR-2	**Security**	Software remains secured in the faceof attacks.
NFR-3	**Reliability**	High accuracy.

NFR-4	**Performance**	Faster response.
NFR-5	**Availability**	Availability of the systems for institutions, restaurants and other public places.
NFR-6	**Scalability**	It accommodates easy modification for various requirements.

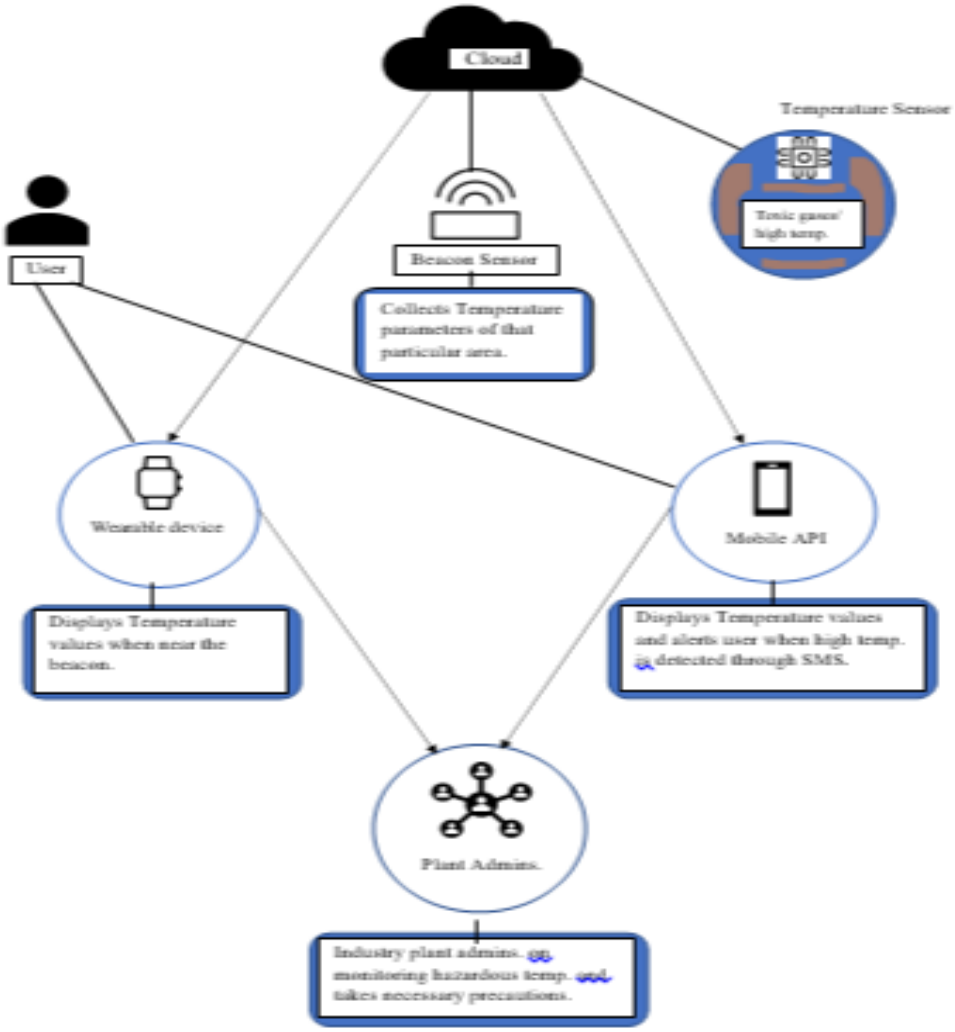
5 PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS

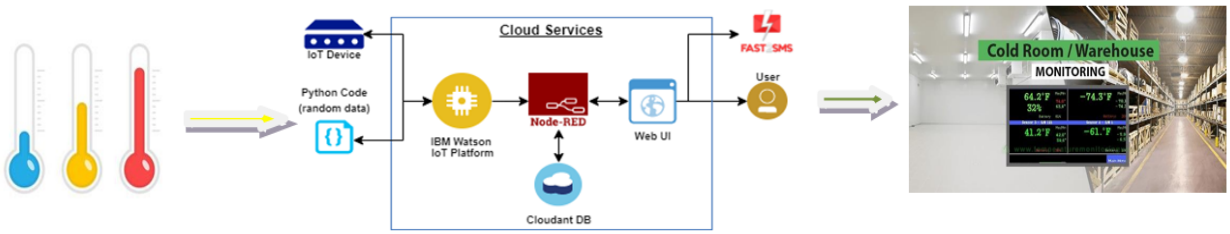


5.2 SOLUTION AND TECHNICAL ARCHITECTURE

SOLUTION ARCHITECTURE



TECHNICAL ARCHITECTURE



5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Name	User Feedback	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	User_01	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
	Registration	User_02	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
Customer (Web user)	Registration	User_03	As a user, I can register for the application through Facebook	I can register & accessthe dashboard with Facebook Login	Low	Sprint-2
	Registration	User_04	As a user, I can register for the application through Gmail		Medium	Sprint-1
	Registration	User_05	As a user, I can log into the application by entering email & password		low	Sprint-1

6. PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

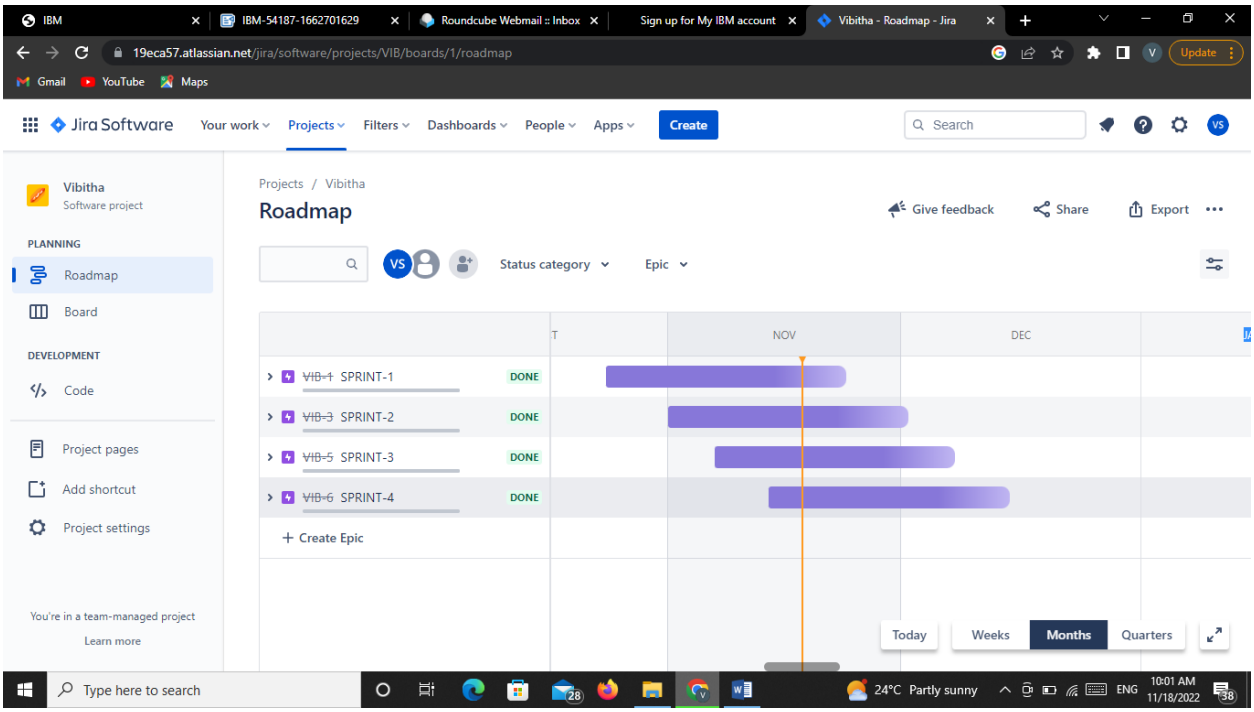
SPRINT	FUNCTIONAL REQUIREMENT(EPIC)	USERSTO RYNUMB ER	USER STORY / TASK	STORY POIN TS	PRIOR ITY	TEAM MEMBERS
Sprint-1	Temperature monitoring	USN-1	As a user, I need to knowthe temperat ure ofthe Industrial plant.	4	High	Haripriya, Nandhini, Priya,Vibit ha
Sprint-1	Gas Monitoring	USN-2	As a user,I need the gas composition and/or concentrati on aroundme.	2	Medi um	Haripriya, Nandhini, Priya,Vibit ha
Sprint-1	Fire Monitoring	USN-3	As a user,I need to identifiy the presence offlame in the industry.	4	High	Haripriya, Nandhini, Priya,Vibit ha
Sprint-1	PIR Monitoring	USN-4	As a user,I need to knowabout security andmotion detection.	2	High	Haripriya, Nandhini, Priya,Vibit ha
Sprint-2	IOT dashboard interfacing	USN-5	As a user, I must be able to view the data	4	High	Haripriya, Nandhini, Priya,Vibit ha

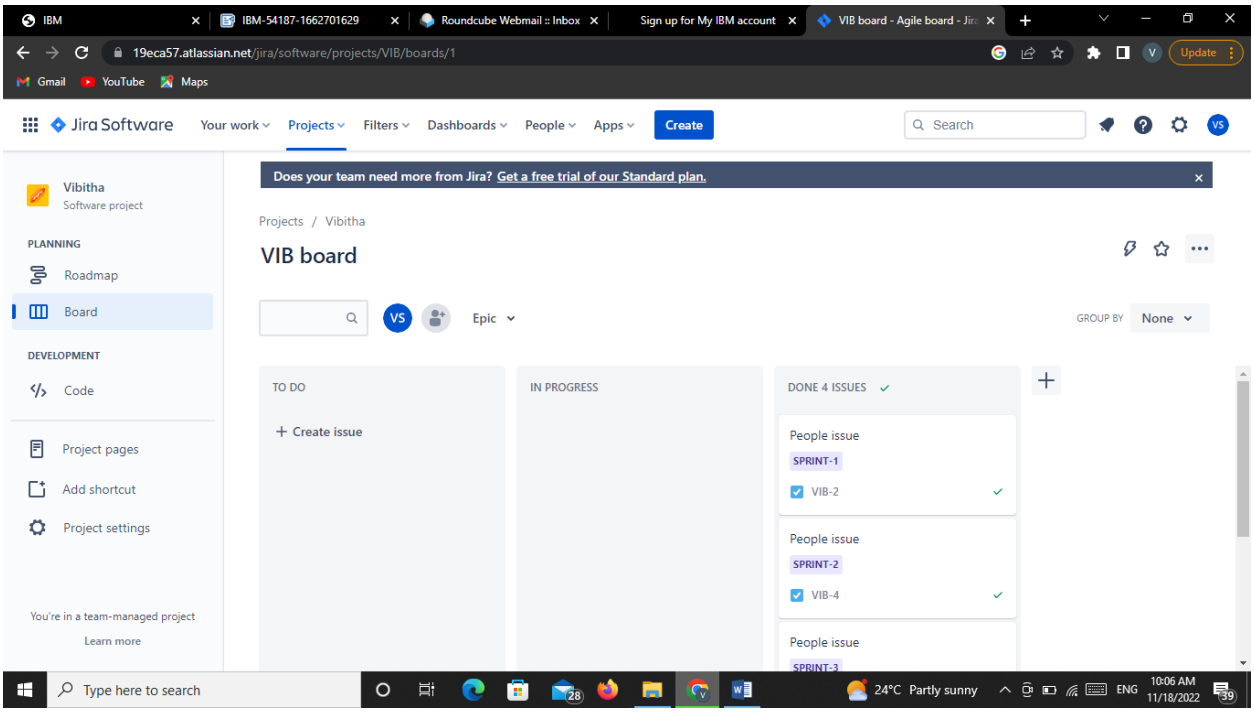
			using internet.			
Sprint-3	Web UI	USN-6	As a user, I must be able to accessdata from a website.	1	Low	Haripriya, Nandhini, Priya,Vibitha
Sprint-4	Mobile UI	USN-7	As a user,I can view the data log in a Mobileapplication.	1	Low	Haripriya, Nandhini, Priya,Vibitha

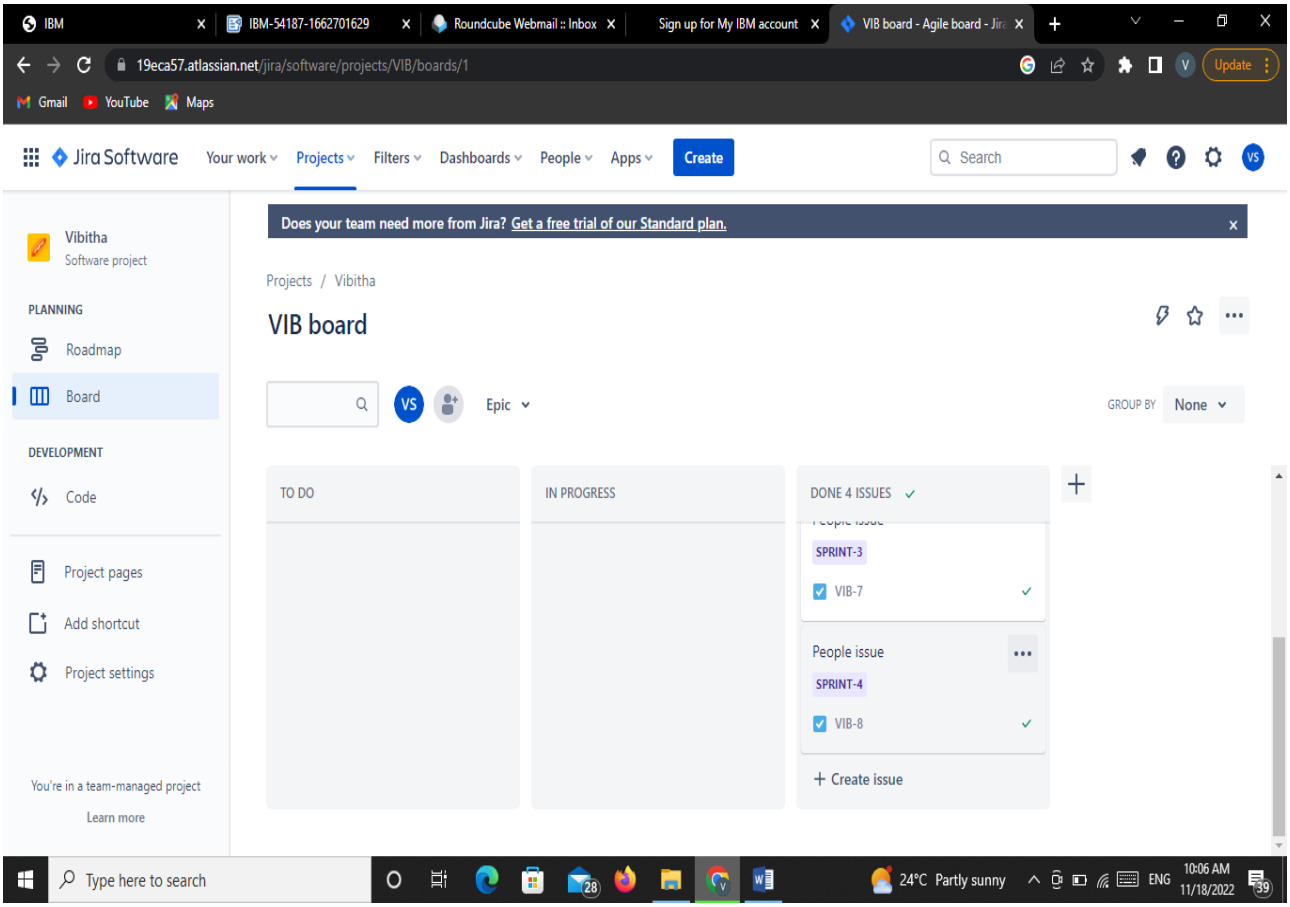
6.2 SPRINT DELIVERY SCHEDULE

SPRINT	**TOTAL STORYPOINTS**	**DURATION**	**SPRINT START DATE**	**SPRINT END DATE(PLANNED)**	**STORY POINTS COMPLETED (AS ON PLANNED END DATE)**	**SPRINT RELEASEDATE(ACTUAL)**
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	6	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	4	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	2	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	2	19 Nov 2022

6.3 REPORTS FROM JIRA







7. CODING & SOLUTIONING

7.1 FEATURE 1

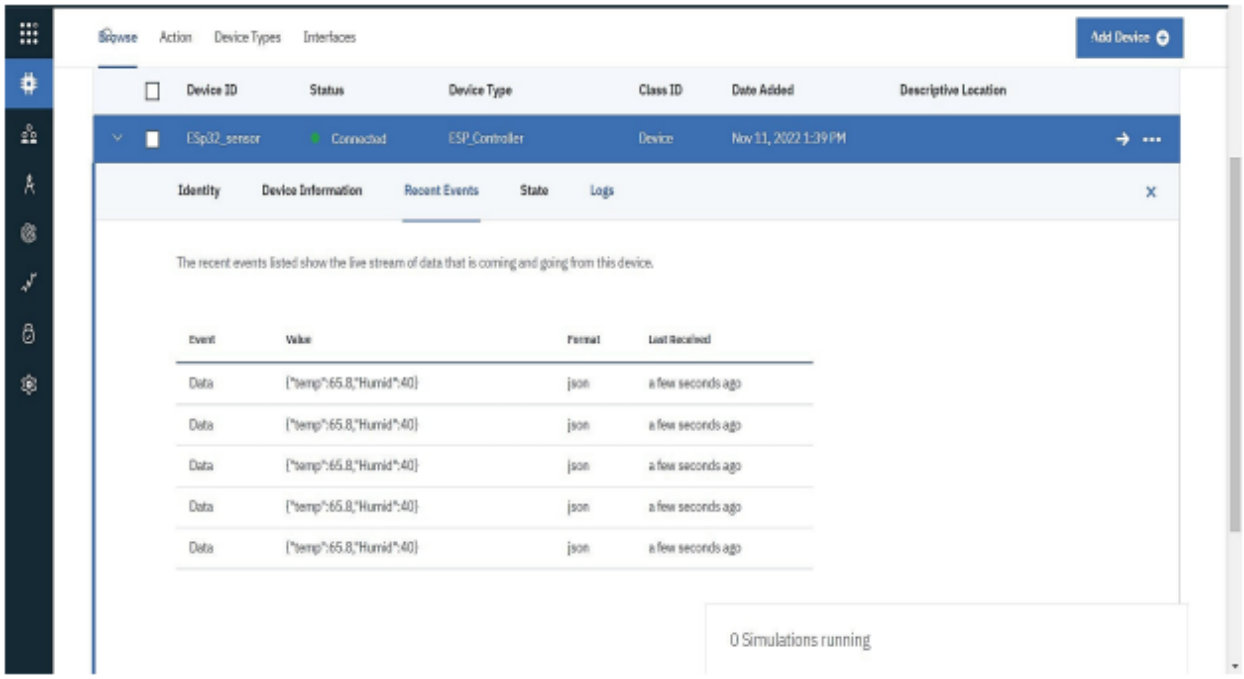
Hazardous Area Monitoring for Industrial Plant powered by IoT

Languages : C++, Python

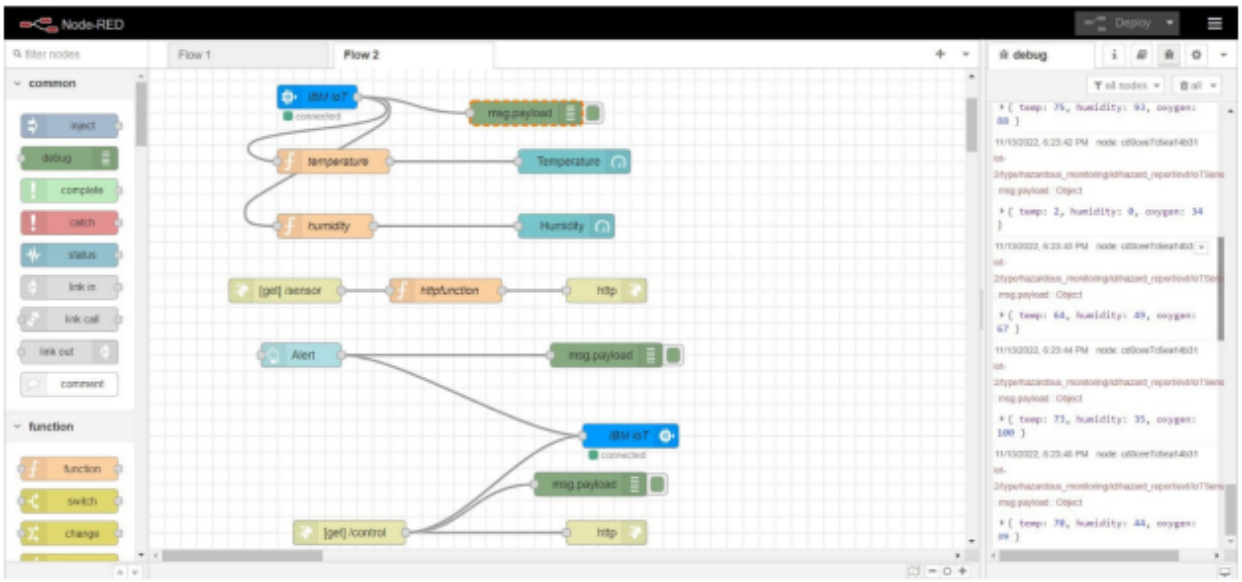
Tools/IDE : WOKWi, IBM Watson, Node-RED, IBM Cloudant DB, Python 3.7.4, MIT Invertor.

7.2 FEATURE 2

INDEX



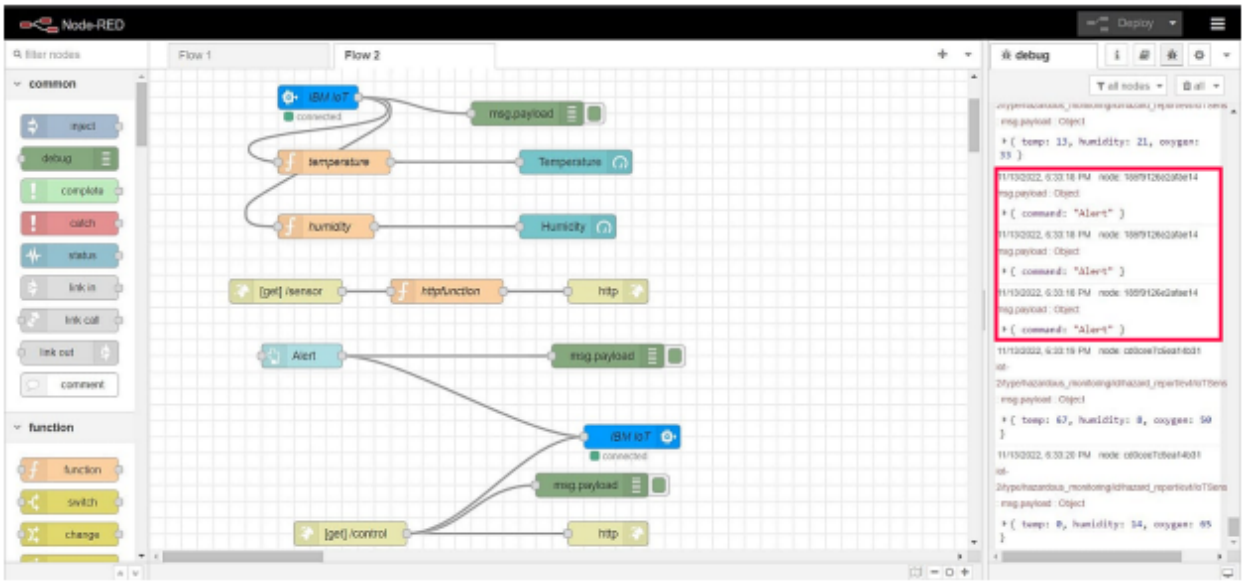
7.3 DATABASE SCHEMA



8. TESTING

8.1 TEST CASES

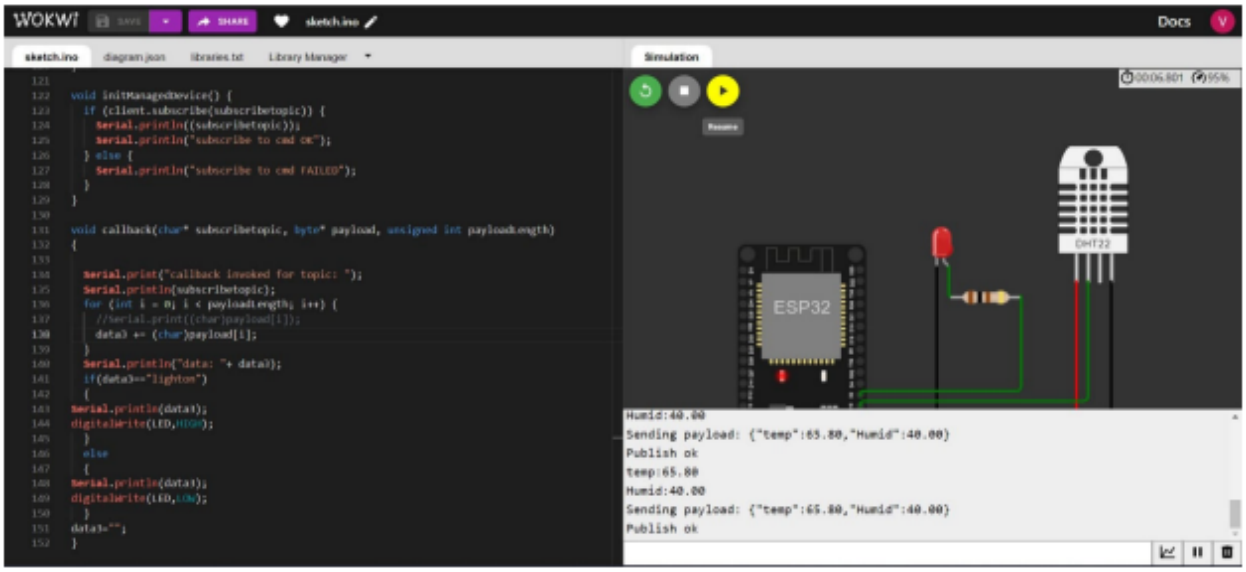
8.2 USER ACCEPTANCE TESTING



9. RESULTS

9.1 PERFORMANCE METRICS

SENSOR PERFORMANCE



10. ADVANTAGES & DISADVANTAGES

10.1 ADVANTAGES

- Real-time plant monitoring
- Reduced risks of disasters
- Automated detection
- Excellent customer experience
- Improved asset utilization
- Enhanced revenue

10.2 DISADVANTAGES

- Risk of equipment damage
- Risk of personal injury
- Expensive equipment being damaged
- The lives being put in danger

11. CONCLUSION

Currently, IOT is present and gaining more traction in a IOT of fields,and one of the most important field is industrial applications. There are a large number of ways in which indutries can make use of IOT to improve working conditions, efficiency, cutting cost and improving the overall growth of the sector. Hazard monitoring and mitigation is often overlooked in industrial areas.

Therefore, this project specifically aims to make use of IOT to actively monitor and analyse various factors in a typical heavy industrial zone like temperature and levels of gases in the environment. So that system can track the same and issue alerts also the data generated in real time can provide important information about how smoothly the work is going on in different zones.

12. FUTURE SCOPE

IoT is bound to be an effective technology in the future, and IoT enabled devices are likely to be all-pervasive, from industry to households. The **future scope of IoT** is bright and varied, and it is only a matter of time before the above applications of the technology are realized.

While wearable technology allows patients to self monitor their health in real-time, the sensors and variants used in the healthcare industry are significantly more sophisticated. As sensors' accuracy and precision based on IoT increases, the share of manual errors in taking medical readings will decrease.

13.APPENDIX

SOURCE CODE

Code for connecting sensor and IBM Cloud:

```
#include <WiFi.h>//library for wifi

#include <PubSubClient.h>//library for MQtt

#include "DHT.h"// Library for dht11

#define DHTPIN 15 // what pin we're connected to

#define DHTTYPE DHT22 // define type of sensor DHT 11

#define LED 2

DHT dht (DHTPIN, DHTTYPE);// creating the instance by passing pin and typr of dht connected

void callback(char* subscribetopic, byte* payload, unsigned int payloadLength);

//-------credentials of IBM Accounts------

#define ORG "0vbvyp"//IBM ORGANITION ID

#define DEVICE_TYPE "ESP_Controller"//Device type mentioned in ibm watson IOT Platform

#define DEVICE_ID "ESp32_sensor"//Device ID mentioned in ibm watson IOT Platform
```

```
#define TOKEN "Q6w0Y9DwRfU1DWMJry"

String data3;

float h, t;

//-------- Customise the above values --------

char server[] = ORG ".messaging.internetofthings.ibmcloud.com";// Server Name

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char publishTopic[] = "iot-2/evt/Data/fmt/json";// topic name and type of event perform and

format in which data to be send

char subscribetopic[] = "iot-2/cmd/command/fmt/String";// cmd REPRESENT command type

AND COMMAND IS TEST OF FORMAT STRING

char authMethod[] = "use-token-auth";// authentication method

char token[] = TOKEN;

char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;//client id

//-------------------------------------

WiFiClient wifiClient; // creating the instance for wificlient

PubSubClient client(server, 1883, callback ,wifiClient); //calling the predefined client id by

passing parameter like server id,portand wificredential

void setup()// configureing the ESP32

{

Serial.begin(115200);

dht.begin();

pinMode(LED,OUTPUT);

delay(10);
```

```
Serial.println();
wificonnect();
mqttconnect();
}
void loop()// Recursive Function
25
{
h = dht.readHumidity();
t = dht.readTemperature();
Serial.print("temp:");
Serial.println(t);
Serial.print("Humid:");
Serial.println(h);
PublishData(t, h);
delay(1000);
if (!client.loop()) {
mqttconnect();
}
}
/.....retrieving to Cloud...../
void PublishData(float temp, float humid) {
mqttconnect();//function call for connecting to ibm
/*
creating the String in in form JSon to update the data to ibm cloud
*/
```

```
String payload = "{\"temp\":";

payload += temp;

payload += "," "\"Humid\":";

payload += humid;

payload += "}";

Serial.print("Sending payload: ");

Serial.println(payload);

if (client.publish(publishTopic, (char*) payload.c_str())) {

Serial.println("Publish ok");// if it sucessfully upload data on the cloud then it will print publish

ok in Serial monitor or else it will print publish failed

} else {

Serial.println("Publish failed");  }

}

void mqttconnect() {

if (!client.connected()) {

Serial.print("Reconnecting client to ");

Serial.println(server);

while (!!!client.connect(clientId, authMethod, token)) {

Serial.print(".");

delay(500);

}

initManagedDevice();

Serial.println();   }

}
```

```
void wificonnect() //function defination for wificonnect {

Serial.println();

Serial.print("Connecting to ");

WiFi.begin("Wokwi-GUEST", "", 6);//passing the wifı credentials to establish the connection

while (WiFi.status() != WL_CONNECTED) {

delay(500);

Serial.print(".");

}

Serial.println("");

Serial.println("WiFi connected");

Serial.println("IP address: ");

Serial.println(WiFi.localIP());

}

void initManagedDevice() {

if (client.subscribe(subscribetopic)) {

Serial.println((subscribetopic));

Serial.println("subscribe to cmd OK");

} else {

Serial.println("subscribe to cmd FAILED");  }

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}

void callback(char* subscribetopic, byte* payload, unsigned int payloadLength) {

Serial.print("callback invoked for topic: ");

Serial.println(subscribetopic);
```

```
for (int i = 0; i < payloadLength; i++) {
//Serial.print((char)payload[i]);
data3 += (char)payload[i];
}
Serial.println("data: "+ data3);
if(data3=="lighton")  {
Serial.println(data3);
digitalWrite(LED,HIGH);
}
else  {
Serial.println(data3);
digitalWrite(LED,LOW);
}
data3="";
}
```

GITHUB&PROJECT : https://github.com/IBM-EPBL/IBM-Project-54187-1661767031

DEMOLINK : https://drive.google.com/file/d/1HoLdAYKMIv-_asWw_V9Tb-PTTPqO9oQ3/view?usp=sharing