Team ID : PNT2022TMID11820

Project Report

1. INTRODUCTION

1.1 Project overview

In industrial firms in which flammable substances are used, combustible gases are produced due to natural or chemical reactions, monitoring the temperature and humidity is essential to ensure safe working conditions. Thus, the values got using DHT22 sensor and viewed in mobile app. If the values exceed the set threshold an alert SMS is sent to the admin.

1.2 Purpose

The industrial workers working in hazardous areas and the admin can monitor the conditions inside the industry. This project provides a solution for safe evacuation of the lone workers in the industry by sending an alert.

2. LITERATURE SURVEY

2.1 Existing problem

In industries the gases such as SO_2, NO_2 and CO are monitored using smoke sensor which is sent to an IOT webpage using GPRS and when the values exceed a threshold, buzzer is turned on [1]. The location of the hazardous area can be found using GPS and notification is sent to the admins or other workers in nearby area to alert them [2]. This provides a solution to efficiently evacuate the workers. The temperature is monitored with the help of infrared thermal image [3]. The drawback mentioned is that the surface temperature can only be viewed.

2.2 References

[1] T. Porselvi, Sai Ganesh CS, Janaki B, Priyadarshini K, Shajitha Begam S. Iot Based Coal Mine Safety And Health Monitoring System Using LoRaWAN. 2021 3rd International Conference on Signal Processing and Communication (ICPSC) (13 – 14 May 2021)

[2] Yashvin Munsadwala, Pankti Joshi, Pranav Patel. Identification and visualization of hazardous gases using IOT. (IEEE 2019)

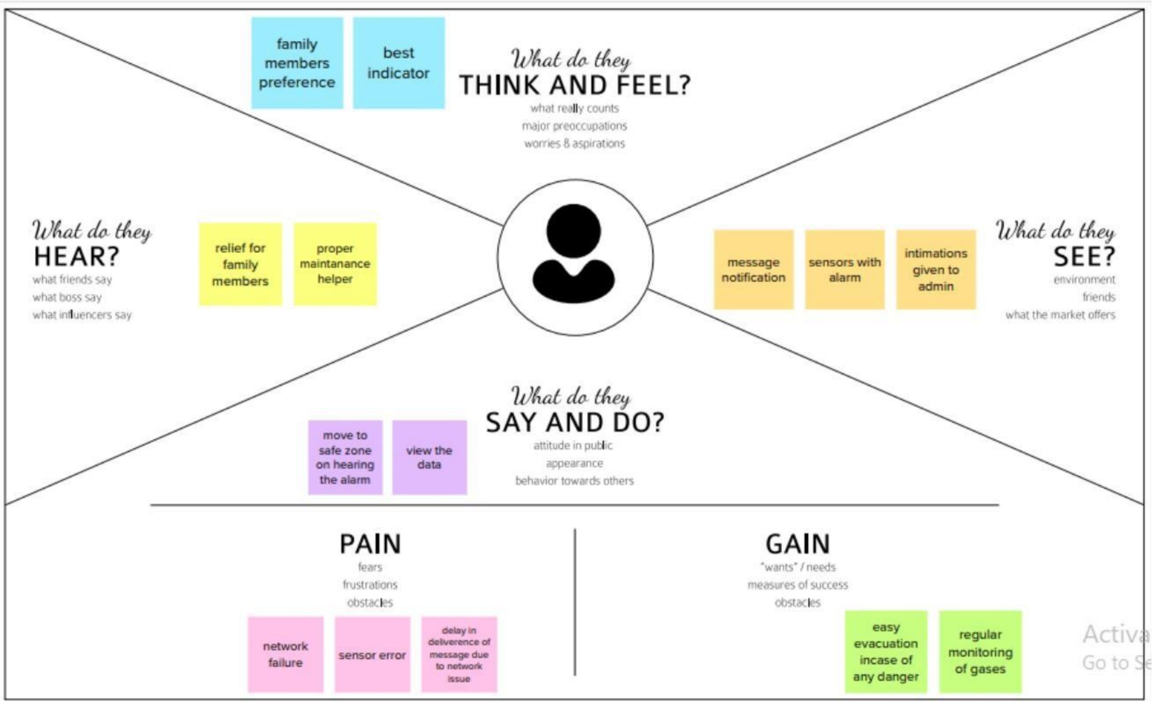
[3] Ching-Hsun Chuang, Chun-Yu Chiang, Yu Chen, Chieh-Yu Lin, Yao-Chuan Tsai. Goose surface temperature monitoring system based on deep learning using visible and infrared thermal image integration. IEEE Access, Volume 9 (Sept 16,2021)

[4] Elia Landi, Lorenzo Parri, Ada Fort, Marco Mugnaini, Valerio Vignoli, Dinesh Tamang, Marco Tani. A Hazardous Area Personal Monitoring System For Operators In Gas Depots And Storage Tanks. The Italian Association of Chemical Engineering, (2022)

[5] Arunkumar S , Mohana Sundaram N. Temperature Sensing Wrist Band For Covid-19 Crisis. 2021 International Conference on Advancements in Electrical, Electronics, Communication, Computing and Automation (ICAECA) ,IEEE Explore

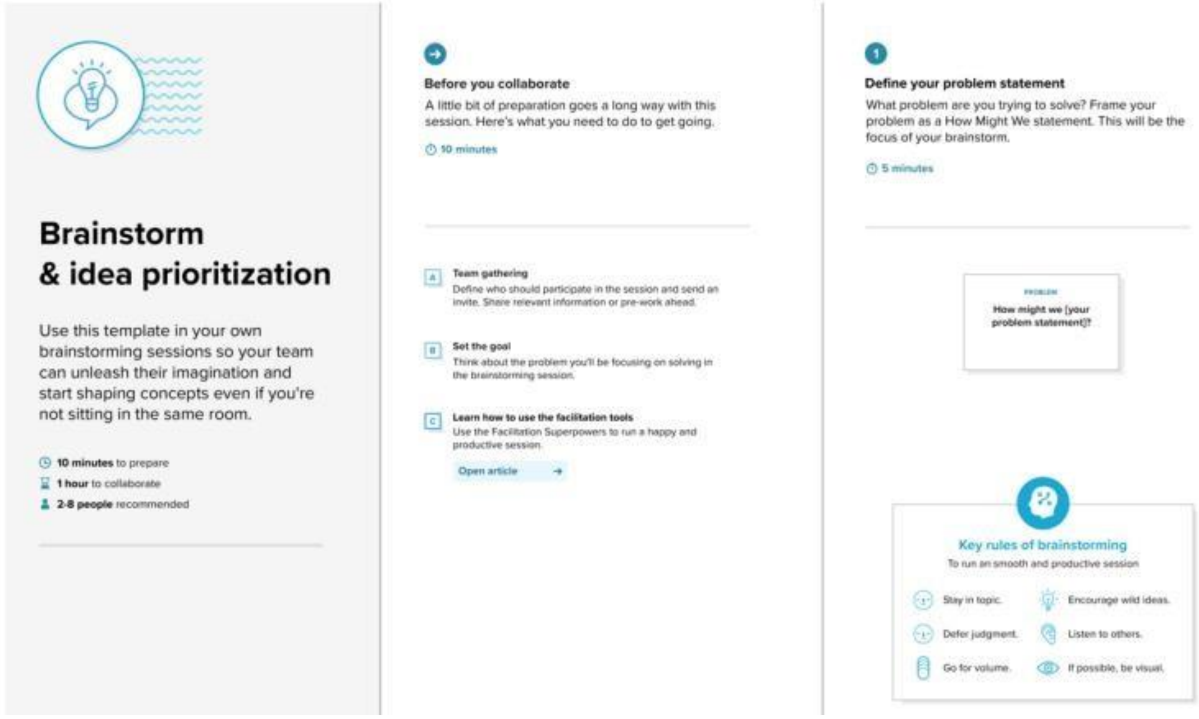
3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming

Step-1: Team Gathering, Collaboration and Select the Problem Statemen



Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

10 minutes to prepare

1 hour to collaborate

2-8 people recommended

Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes

A **Team gathering**
Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.

B **Set the goal**
Think about the problem you'll be focusing on solving in the brainstorming session.

C **Learn how to use the facilitation tools**
Use the Facilitation Superpowers to run a happy and productive session.

Open article →

1 **Define your problem statement**

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

PROBLEM

How might we [your problem statement]?

Key rules of brainstorming

To run an smooth and productive session

Stay in topic.

Encourage wild ideas.

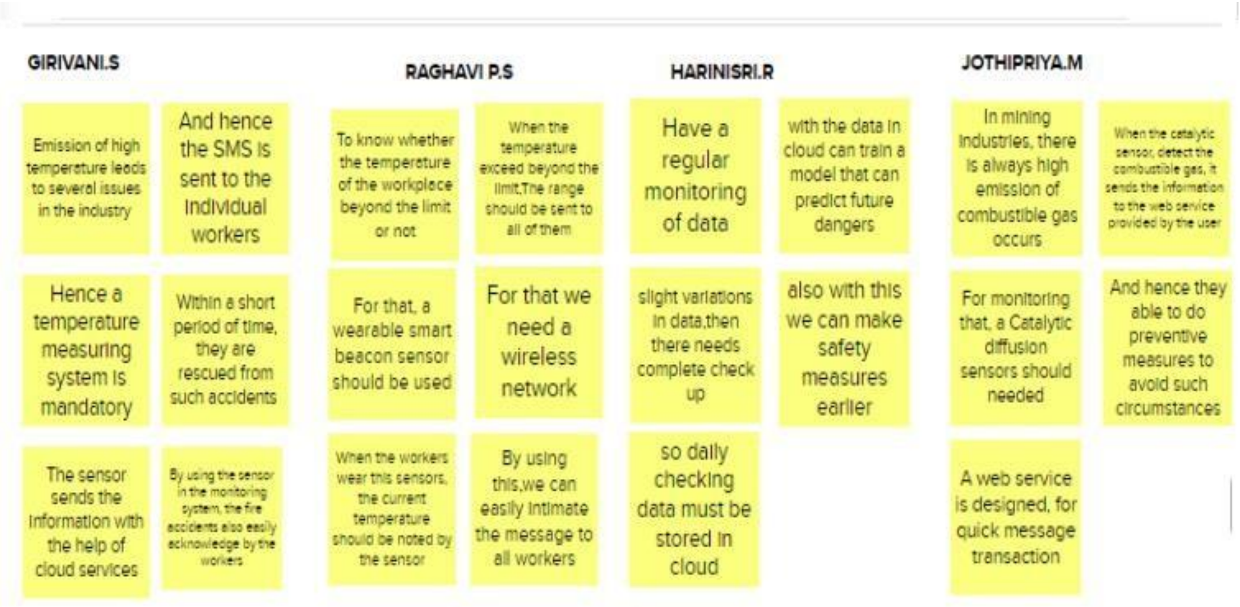
Defer judgment.

Listen to others.

Go for volume.

If possible, be visual.

Step-2: Brainstorm, Idea Listing and Grouping



GIRIVANI.S

Emission of high temperature leads to several issues in the industry

And hence the SMS is sent to the individual workers

Hence a temperature measuring system is mandatory

Within a short period of time, they are rescued from such accidents

The sensor sends the information with the help of cloud services

By using the sensor in the monitoring system, the fire accidents also easily acknowledge by the workers

RAGHAVI P.S

To know whether the temperature of the workplace beyond the limit or not

When the temperature exceed beyond the limit.The range should be sent to all of them

For that, a wearable smart beacon sensor should be used

For that we need a wireless network

When the workers wear this sensors, the current temperature should be noted by the sensor

By using this,we can easily intimate the message to all workers

HARINISRI.R

Have a regular monitoring of data

with the data in cloud can train a model that can predict future dangers

slight variations in data,then there needs complete check up

also with this we can make safety measures earlier

so daily checking data must be stored in cloud

JOTHIPRIYA.M

In mining industries, there is always high emission of combustible gas occurs

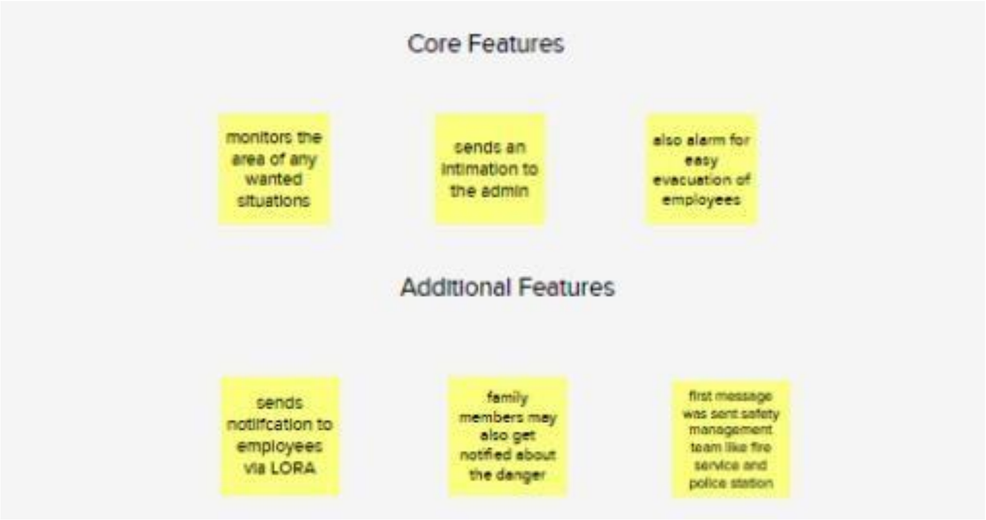
When the catalytic sensor, detect the combustible gas, it sends the information to the web service provided by the user

For monitoring that, a Catalytic diffusion sensors should needed

And hence they able to do preventive measures to avoid such circumstances

A web service is designed, for quick message transaction

Step-3: Idea Prioritization



Core Features

monitors the area of any wanted situations

sends an intimation to the admin

also alarm for easy evacuation of employees

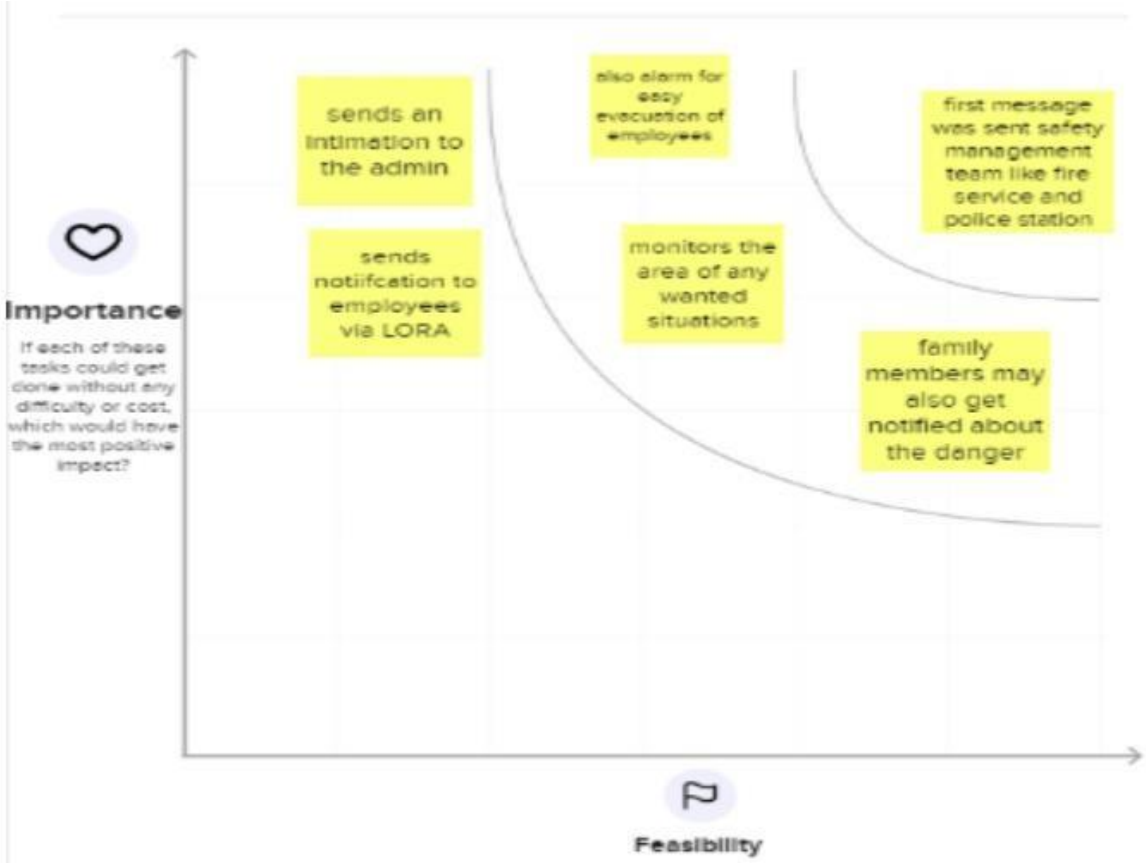
Additional Features

sends notiifcation to employees via LORA

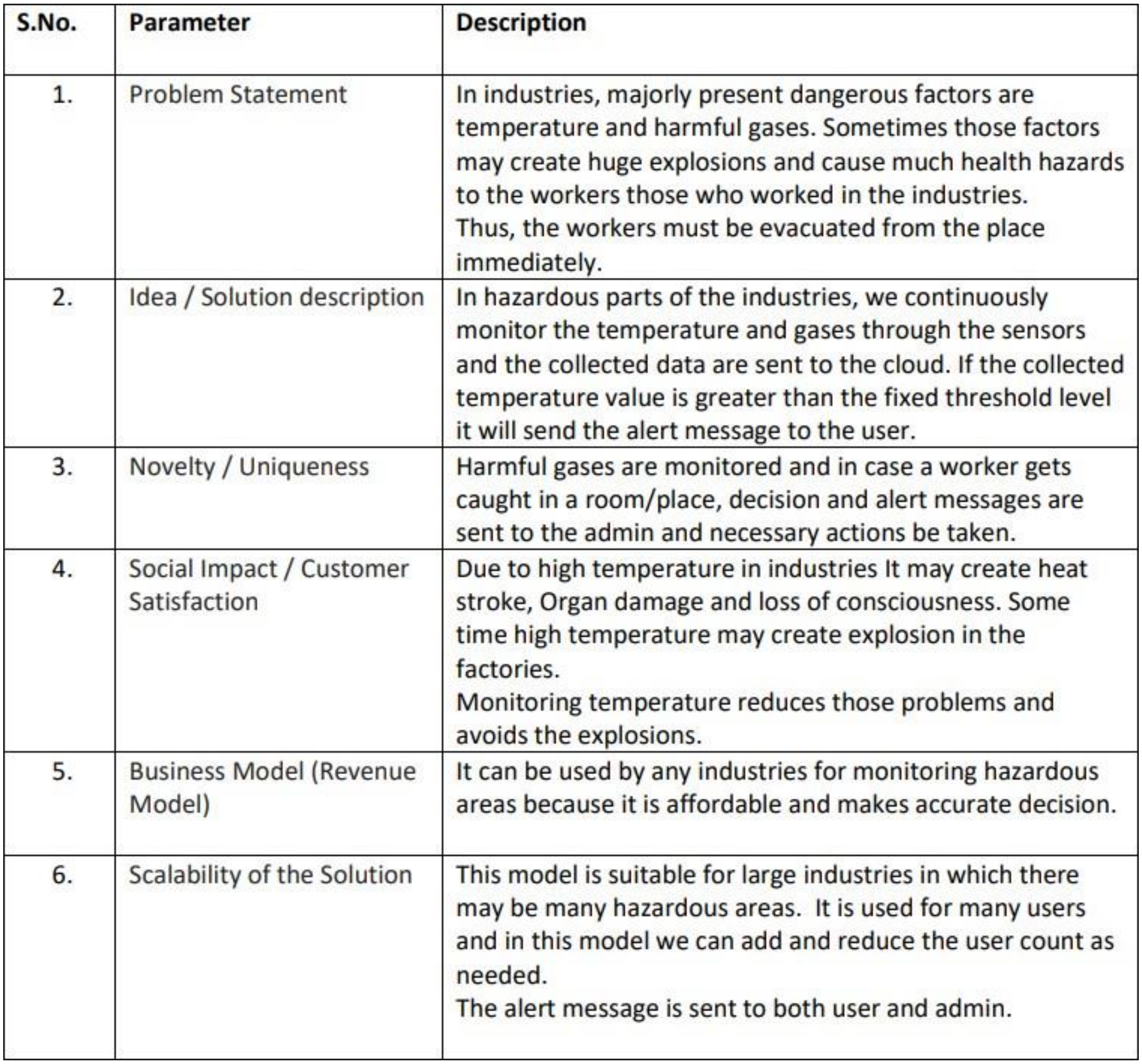
family members may also get notified about the danger

first message was sent safety management team like fire service and police station

Step 4: Prioritize

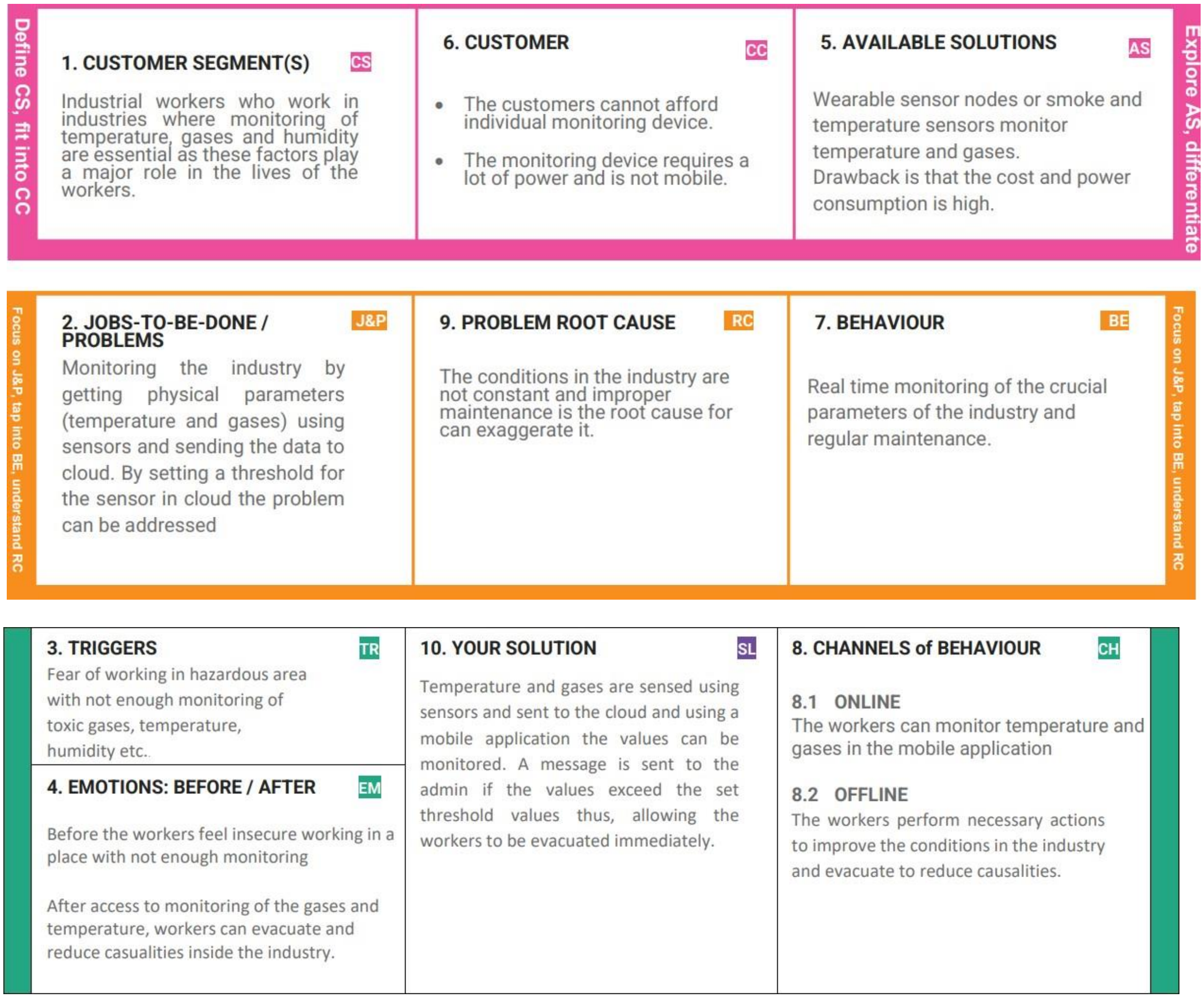


3.3 Proposed Solution



S.No.	Parameter	Description
1.	Problem Statement	In industries, majorly present dangerous factors are temperature and harmful gases. Sometimes those factors may create huge explosions and cause much health hazards to the workers those who worked in the industries. Thus, the workers must be evacuated from the place immediately.
2.	Idea / Solution description	In hazardous parts of the industries, we continuously monitor the temperature and gases through the sensors and the collected data are sent to the cloud. If the collected temperature value is greater than the fixed threshold level it will send the alert message to the user.
3.	Novelty / Uniqueness	Harmful gases are monitored and in case a worker gets caught in a room/place, decision and alert messages are sent to the admin and necessary actions be taken.
4.	Social Impact / Customer Satisfaction	Due to high temperature in industries It may create heat stroke, Organ damage and loss of consciousness. Some time high temperature may create explosion in the factories. Monitoring temperature reduces those problems and avoids the explosions.
5.	Business Model (Revenue Model)	It can be used by any industries for monitoring hazardous areas because it is affordable and makes accurate decision.
6.	Scalability of the Solution	This model is suitable for large industries in which there may be many hazardous areas. It is used for many users and in this model we can add and reduce the user count as needed. The alert message is sent to both user and admin.

3.4 Problem Solution fit



Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

Industrial workers who work in industries where monitoring of temperature, gases and humidity are essential as these factors play a major role in the lives of the workers.

6. CUSTOMER CC

- The customers cannot afford individual monitoring device.
- The monitoring device requires a lot of power and is not mobile.

5. AVAILABLE SOLUTIONS AS

Wearable sensor nodes or smoke and temperature sensors monitor temperature and gases.
Drawback is that the cost and power consumption is high.

Explore AS, differentiate

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

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

Monitoring the industry by getting physical parameters (temperature and gases) using sensors and sending the data to cloud. By setting a threshold for the sensor in cloud the problem can be addressed

9. PROBLEM ROOT CAUSE RC

The conditions in the industry are not constant and improper maintenance is the root cause for can exaggerate it.

7. BEHAVIOUR BE

Real time monitoring of the crucial parameters of the industry and regular maintenance.

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

3. TRIGGERS TR

Fear of working in hazardous area with not enough monitoring of toxic gases, temperature, humidity etc..

4. EMOTIONS: BEFORE / AFTER EM

Before the workers feel insecure working in a place with not enough monitoring

After access to monitoring of the gases and temperature, workers can evacuate and reduce casualities inside the industry.

10. YOUR SOLUTION SL

Temperature and gases are sensed using sensors and sent to the cloud and using a mobile application the values can be monitored. A message is sent to the admin if the values exceed the set threshold values thus, allowing the workers to be evacuated immediately.

8. CHANNELS of BEHAVIOUR CH

8.1 ONLINE
The workers can monitor temperature and gases in the mobile application

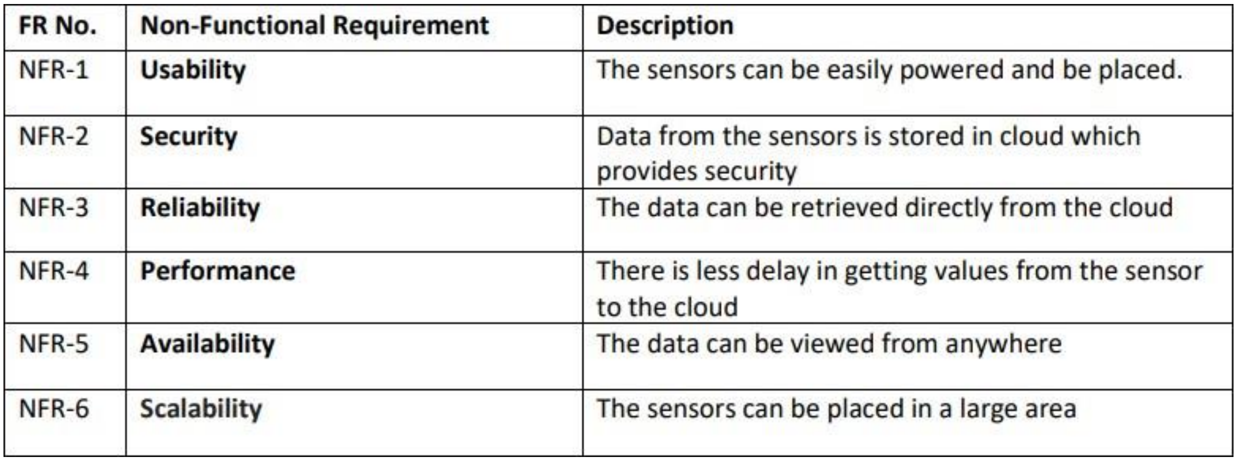
8.2 OFFLINE
The workers perform necessary actions to improve the conditions in the industry and evacuate to reduce causalities.

4. REQUIREMENT ANALYSIS

4.1 Functional requirements

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Data gathering	Gathering temperature and gases values using sensors interfaced with ESP32 or Arduino and sending to the cloud.
FR-2	Dashboard	The admin can monitor the values from the IBM cloud dashboard through mobile application.
FR-3	SMS notification	If the sensor values exceed the set threshold, then a SMS is sent to the admin

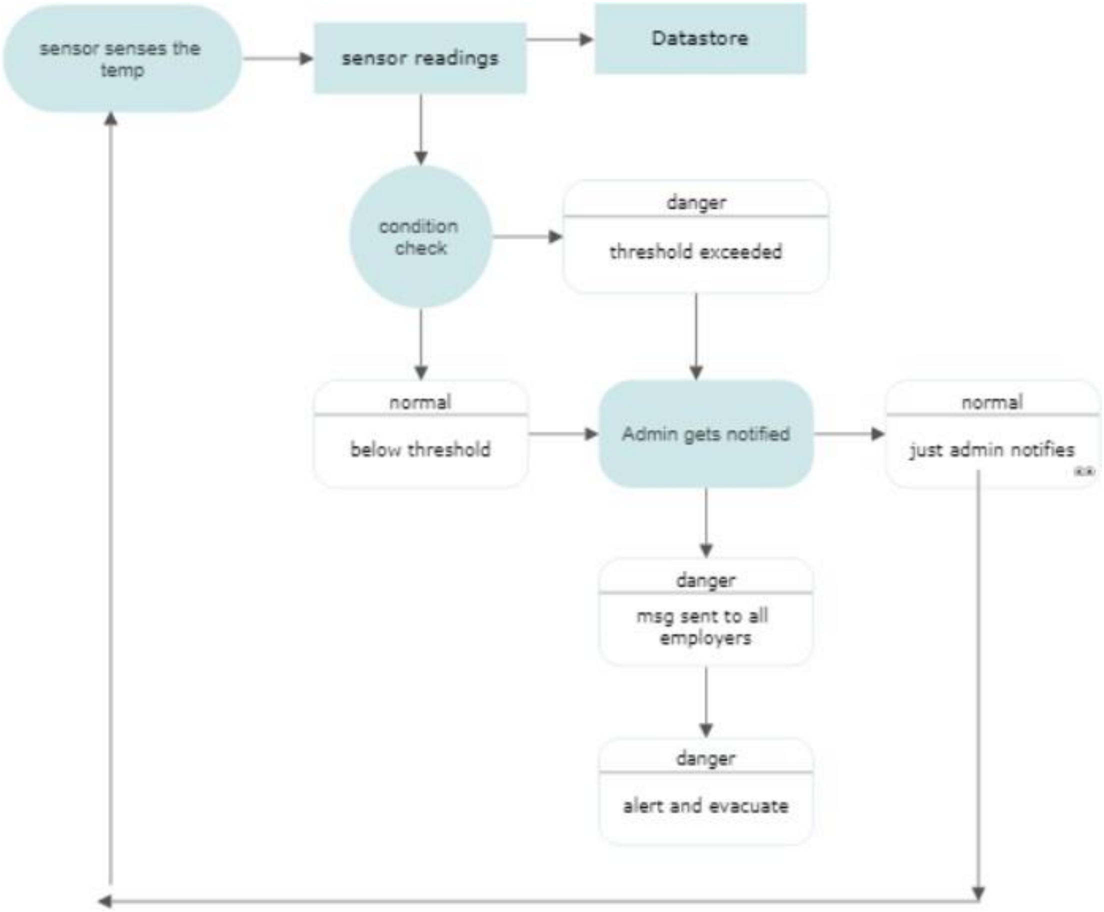
4.2 Non-Functional requirements



FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The sensors can be easily powered and be placed.
NFR-2	**Security**	Data from the sensors is stored in cloud which provides security
NFR-3	**Reliability**	The data can be retrieved directly from the cloud
NFR-4	**Performance**	There is less delay in getting values from the sensor to the cloud
NFR-5	**Availability**	The data can be viewed from anywhere
NFR-6	**Scalability**	The sensors can be placed in a large area

5. PROJECT DESIGN

5.1 Data Flow Diagrams



5.2 Solution & Technical Architecture

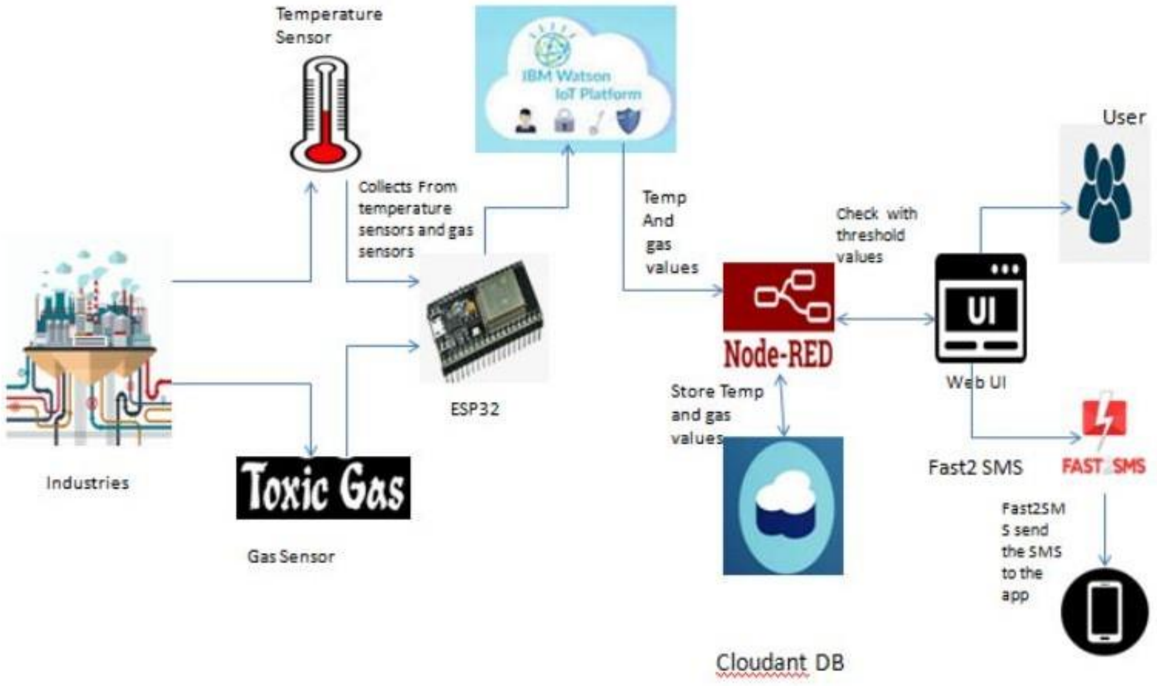


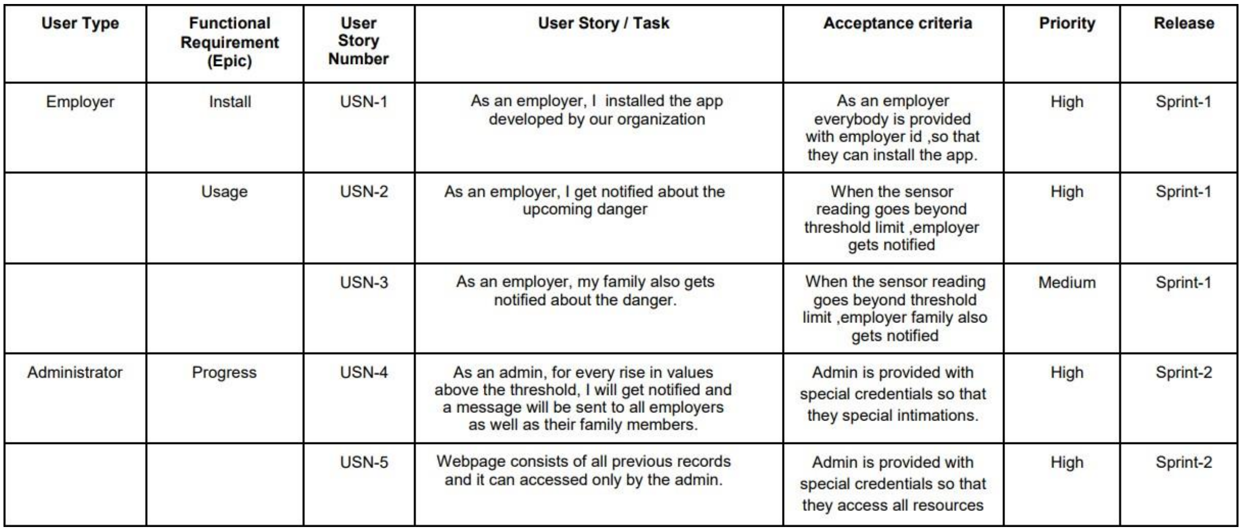
Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	Mobile App/Web UI, SMS service	MIT App Inventor,Fast2SMS,
2.	Application Logic-1	Getting data from the Sensors interfacing with arduino/ESP32	C/C++
3.	Application Logic-2	Collected data send to the cloud services,store the data and check the data with threshold value	Node Red,IBM Watson IOT platform, Cloudant DB
4.	Application Logic-3	The data display to the user and send the alert message to the user and admin	Web UI,Mobile App, Fast2SMS
5.	Cloud Database	Database Service on Cloud	IBM Cloudant DB
6.	External API-1	To send the SMS to the user.	Fast2SMS.
7.	Nodes	For collecting the data from the industrial environment.	Gas and Temperature Sensors, Microcontroller.
8.	Infrastructure (Server / Cloud)	Application Deployment on Cloud	IBM cloud

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Node Red open source is used to connect the web UI and IBM Watson IOT platform	NODE-RED
2.	Scalable Architecture	We can store the data come out from different hazardous areas this area may be increased or reduced according to the situations.	Cloudant DB.
3.	Availability	The web UI/Mobile app is available at anywhere. It is used by anyone.	MIT app inventor.
4.	Performance	By Providing the login credentials to the user and user's family the security performance of the application is high.	Cloudant DB,MIT app inventor.

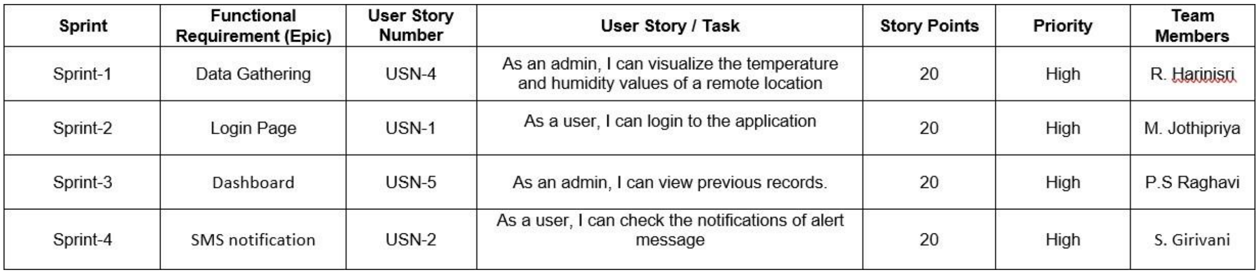
5.3 User Stories



User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Employer	Install	USN-1	As an employer, I installed the app developed by our organization	As an employer everybody is provided with employer id ,so that they can install the app.	High	Sprint-1
	Usage	USN-2	As an employer, I get notified about the upcoming danger	When the sensor reading goes beyond threshold limit ,employer gets notified	High	Sprint-1
		USN-3	As an employer, my family also gets notified about the danger.	When the sensor reading goes beyond threshold limit ,employer family also gets notified	Medium	Sprint-1
Administrator	Progress	USN-4	As an admin, for every rise in values above the threshold, I will get notified and a message will be sent to all employers as well as their family members.	Admin is provided with special credentials so that they special intimations.	High	Sprint-2
		USN-5	Webpage consists of all previous records and it can accessed only by the admin.	Admin is provided with special credentials so that they access all resources	High	Sprint-2

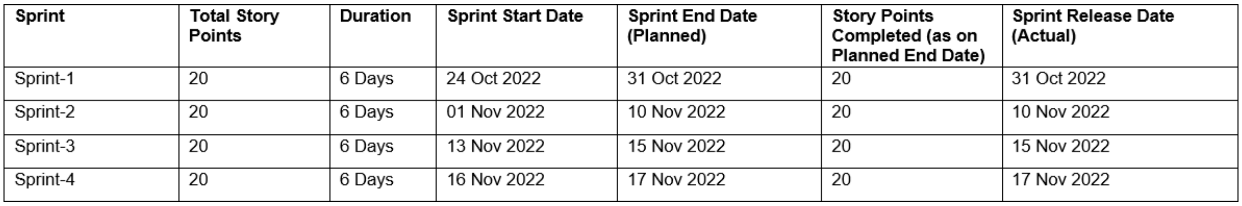
6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation



Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Gathering	USN-4	As an admin, I can visualize the temperature and humidity values of a remote location	20	High	R. Harinisri
Sprint-2	Login Page	USN-1	As a user, I can login to the application	20	High	M. Jothipriya
Sprint-3	Dashboard	USN-5	As an admin, I can view previous records.	20	High	P.S Raghavi
Sprint-4	SMS notification	USN-2	As a user, I can check the notifications of alert message	20	High	S. Girivani

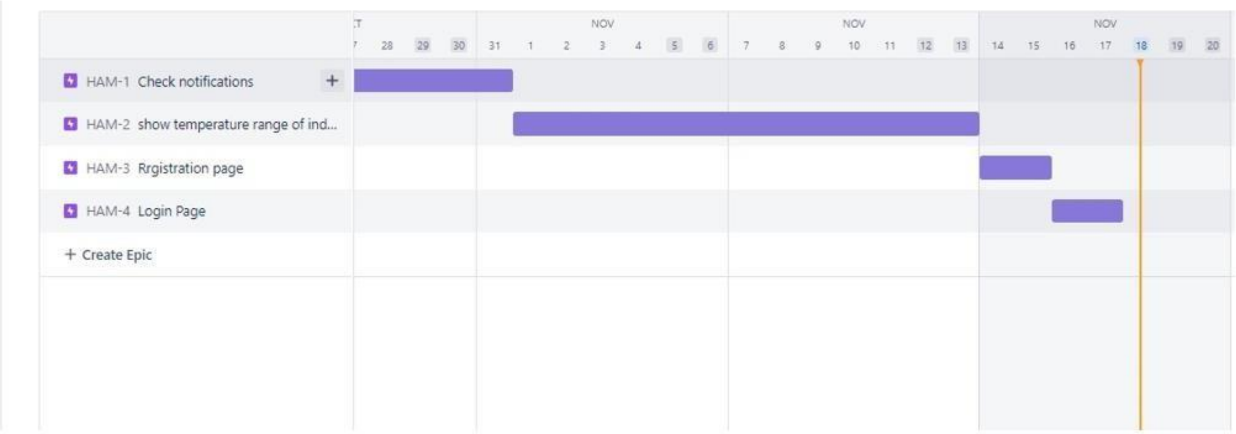
6.2 Sprint Delivery Schedule



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	31 Oct 2022	20	31 Oct 2022
Sprint-2	20	6 Days	01 Nov 2022	10 Nov 2022	20	10 Nov 2022
Sprint-3	20	6 Days	13 Nov 2022	15 Nov 2022	20	15 Nov 2022
Sprint-4	20	6 Days	16 Nov 2022	17 Nov 2022	20	17 Nov 2022

6.3 Reports from JIRA

JIRA Roadmap and board



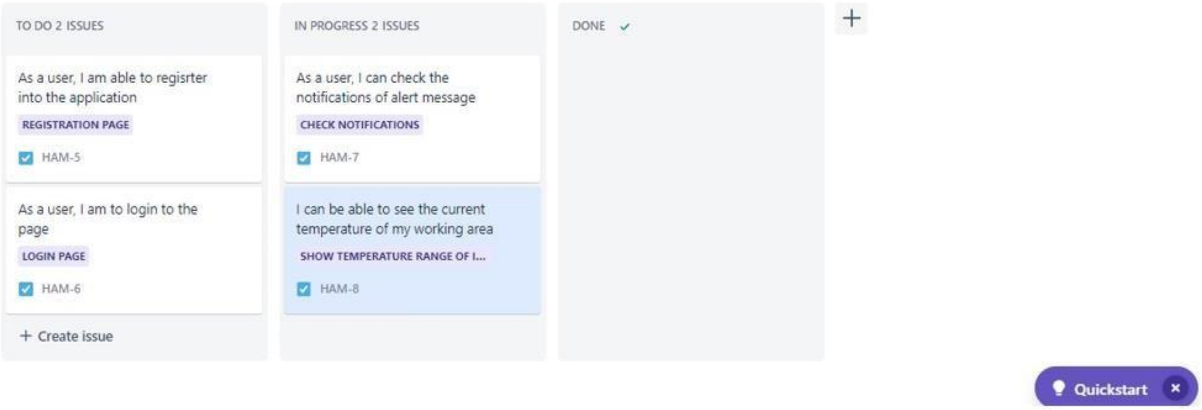
HAM-1 Check notifications

HAM-2 show temperature range of ind...

HAM-3 Rrgistration page

HAM-4 Login Page

+ Create Epic



TO DO 2 ISSUES

As a user, I am able to regisrter into the application

REGISTRATION PAGE

HAM-5

As a user, I am to login to the page

LOGIN PAGE

HAM-6

+ Create issue

IN PROGRESS 2 ISSUES

As a user, I can check the notifications of alert message

CHECK NOTIFICATIONS

HAM-7

I can be able to see the current temperature of my working area

SHOW TEMPERATURE RANGE OF I...

HAM-8

DONE ✓

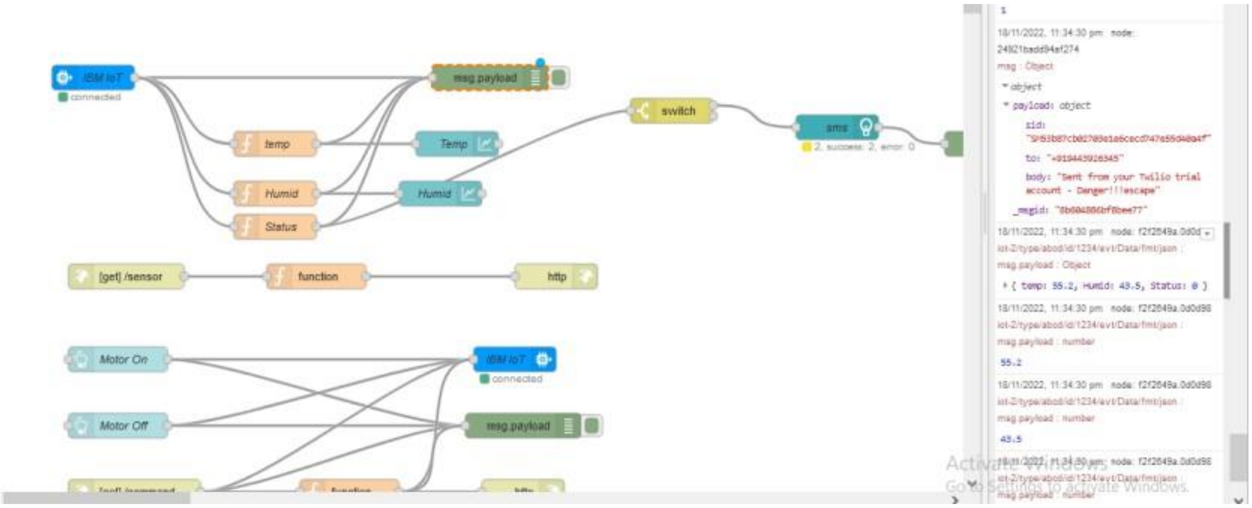
7. CODING & SOLUTIONING

7.1 Data gathering from wokwi

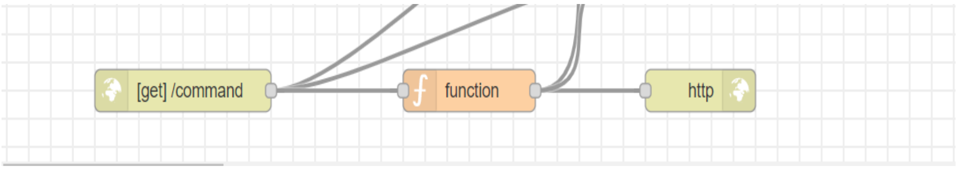
```
#include <WiFi.h>//library for wifi
#include <PubSubClient.h>//library for MQtt
#include "DHT.h"// Library for dht11
#include <Stepper.h>
#define DHTPIN 15     // what pin we're connected to
#define DHTTYPE DHT22   // define type of sensor DHT 11

#define DIRPIN 4
#define STEPPIN 5
#define DELAY_US 2000
```

```
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 "k1o3f1"//IBM ORGANITION ID
#define DEVICE_TYPE "abcd"//Device type mentioned in ibm watson IOT Platform
#define DEVICE_ID "1234"//Device ID mentioned in ibm watson IOT Platform
#define TOKEN "12345678"     //Token
String data3;
float h, t ,s;
;


//-------- Customise the above values --------
char server[] = ORG ".messaging.internetofthings.ibmcloud.com";// Server Name
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 ,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(DIRPIN, OUTPUT);
  pinMode(STEPPIN, OUTPUT);
  delay(1000);

  Serial.println();
  wificonnect();
  client.setCallback(callback);
  mqttconnect();
  client.setCallback(callback);
}

void loop()// Recursive Function
{

  h = dht.readHumidity();
  t = dht.readTemperature();
  s=0;
  Serial.print("temp:");
  Serial.println(t);
  Serial.print("Humid:");
  Serial.println(h);

  PublishData(t, h,s);
  delay(1000);
  if (!client.loop()) {
    mqttconnect();
  }
}



/*.....................................retrieving to
Cloud. ............................. */

void PublishData(float temp, float humid,float status) {
  mqttconnect();//function call for connecting to ibm
  /*
     creating the String in in form JSon to update the data to ibm cloud
  */
  if (temp>50 && humid>60){
   status=1;
  }
  String payload = "{\"temp\":";
  payload += temp;
  payload += "," "\"Humid\":";
  payload += humid;
  payload += "," "\"Status\":";
  payload += status;
  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);
    client.setCallback(callback);
    while (!!!client.connect(clientId, authMethod, token)) {
      Serial.print(".");
      delay(500);
    }
  }
     initManagedDevice();
     client.subscribe("cmnd/command/motoron");
 //    client.subscribe("cmnd/GarageDoor/POWER2");
     Serial.println();

}
void wificonnect() //function defination for wificonnect
{
  Serial.println();
  Serial.print("Connecting to ");

  WiFi.begin("Wokwi-GUEST", "", 6);//passing the wifi 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.print(client.subscribe(subscribetopic));
    callback(subscribetopic,0,1);
    Serial.println("subscribe to cmd OK");
  } else {
    Serial.println("subscribe to cmd FAILED");
  }
}

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];
  }
  data3 = "motoron";
  Serial.println("data: "+ data3);
  if(data3=="motoron")
  {
Serial.println(data3);
Serial.print("Motor running");
digitalWrite(DIRPIN, HIGH);
for (int i = 0; i < 200; i++) {

    digitalWrite(STEPPIN, HIGH);
    delayMicroseconds(DELAY_US);
    digitalWrite(STEPPIN, LOW);
    delayMicroseconds(DELAY_US);
  }
  }
  else
  {
Serial.println(data3);
digitalWrite(DIRPIN, LOW);
  }
data3="";
}
```

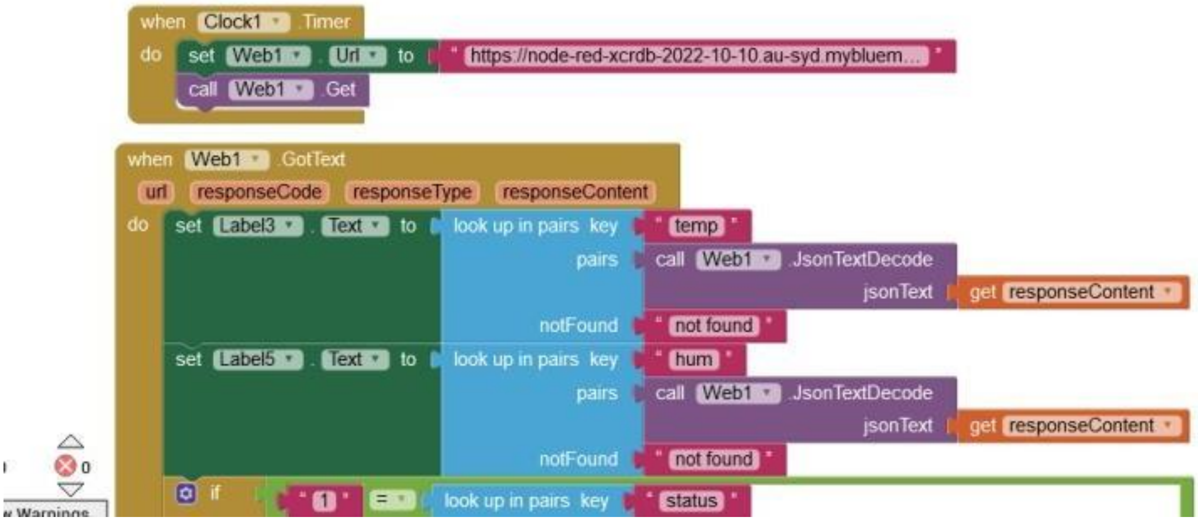
7.2 Node red



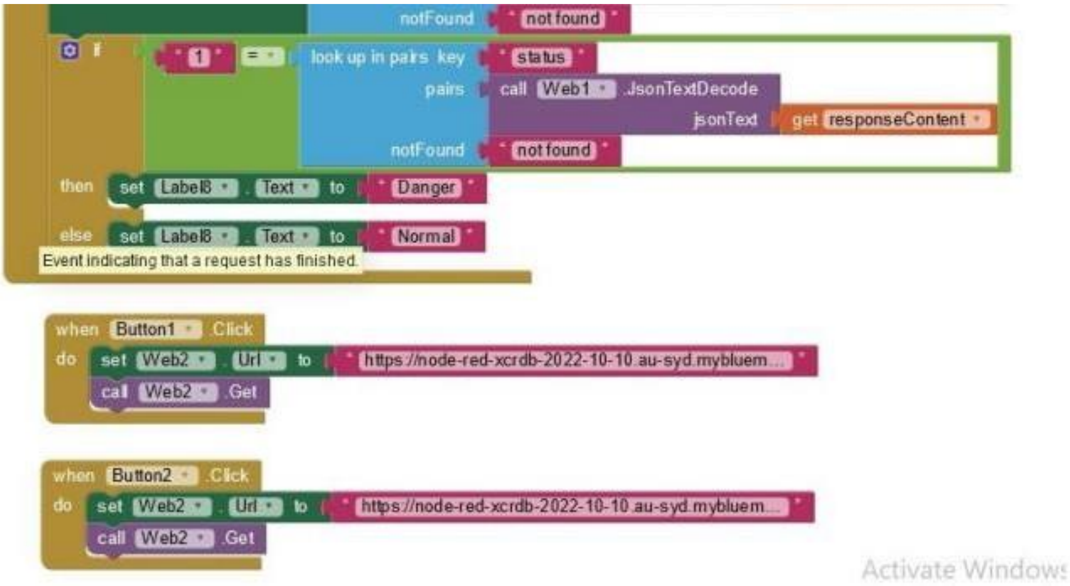
```
1
18/11/2022, 11:34:30 pm  node:
24921badd94af274
msg : Object
▾object
 ▾payload: object
   sid:
   "SM53b87cb027d3e1a6cecd747a55d40a4f"
   to: "+919443926345"
   body: "Sent from your Twilio trial
   account - Danger!!!escape"
 _msgid: "5b604886bf8bee77"
18/11/2022, 11:34:30 pm  node: f2f2649a.0d0d
iot-2/type/abod/id/1234/evt/Data/fmt/json :
msg.payload : Object
▸{ temp: 55.2, Humid: 43.5, Status: 0 }
18/11/2022, 11:34:30 pm  node: f2f2649a.0d0d98
iot-2/type/abod/id/1234/evt/Data/fmt/json :
msg.payload : number
55.2
18/11/2022, 11:34:30 pm  node: f2f2649a.0d0d98
iot-2/type/abod/id/1234/evt/Data/fmt/json :
msg.payload : number
43.5
18/11/2022, 11:34:30 pm  node: f2f2649a.0d0d98
iot-2/type/abod/id/1234/evt/Data/fmt/json :
msg.payload : number
```



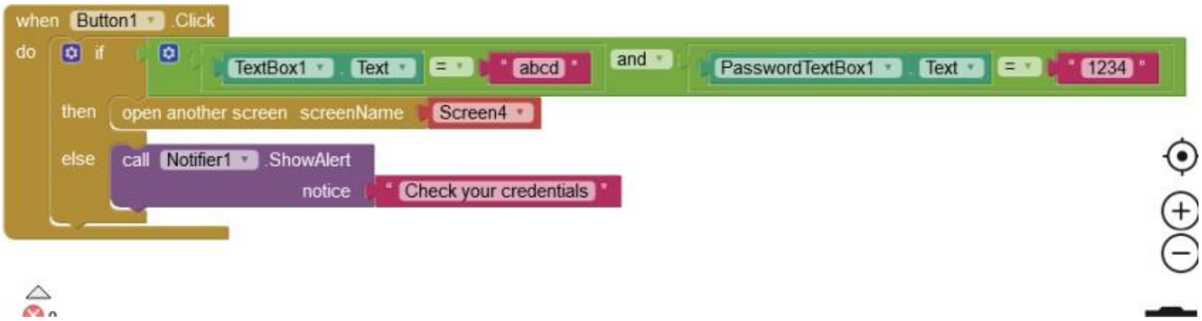
7.3 Mobile application



```
when Clock1 . Timer
do  set Web1 . Url to " https://node-red-xcrdb-2022-10-10.au-syd.mybluem... "
    call Web1 . Get

when Web1 . GotText
  url  responseCode  responseType  responseContent
do  set Label3 . Text to  look up in pairs  key " temp "
                                           pairs  call Web1 . JsonTextDecode
                                                              jsonText  get responseContent
                                        notFound " not found "
    set Label5 . Text to  look up in pairs  key " hum "
                                           pairs  call Web1 . JsonTextDecode
                                                              jsonText  get responseContent
                                        notFound " not found "
    if  " 1 " = look up in pairs  key " status "
```



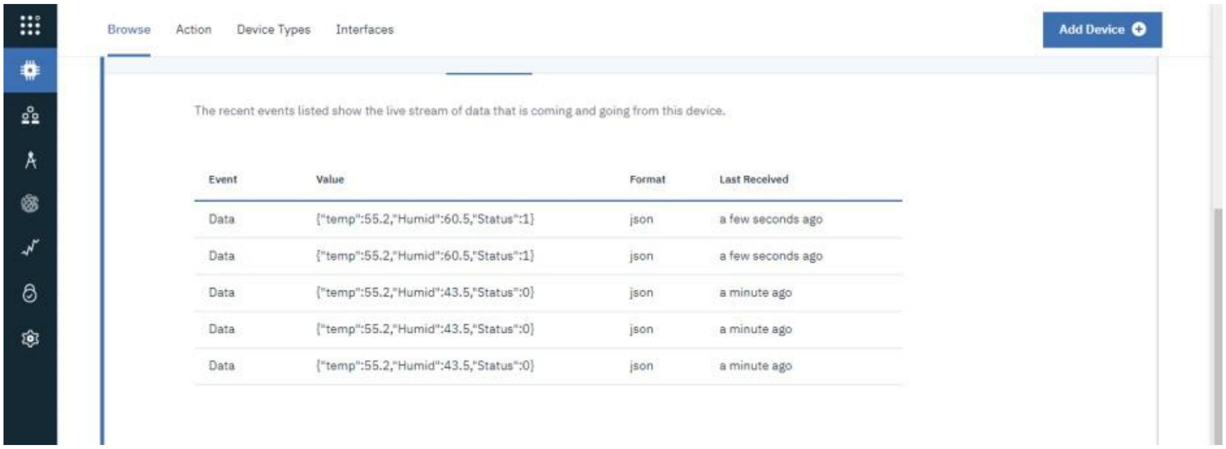
```
notFound  "not found"
if  "1" = look up in pairs key "status"
          pairs  call Web1.JsonTextDecode
                     jsonText  get responseContent
          notFound  "not found"
then  set Label8.Text to "Danger"
else  set Label8.Text to "Normal"
Event indicating that a request has finished.

when Button1.Click
do  set Web2.Url to "https://node-red-xcrdb-2022-10-10.au-syd.mybluem..."
    call Web2.Get

when Button2.Click
do  set Web2.Url to "https://node-red-xcrdb-2022-10-10.au-syd.mybluem..."
    call Web2.Get
```



```
when Button1.Click
do  if  TextBox1.Text = "abcd"  and  PasswordTextBox1.Text = "1234"
    then  open another screen  screenName "Screen4"
    else  call Notifier1.ShowAlert
              notice "Check your credentials"
```

8. RESULTS

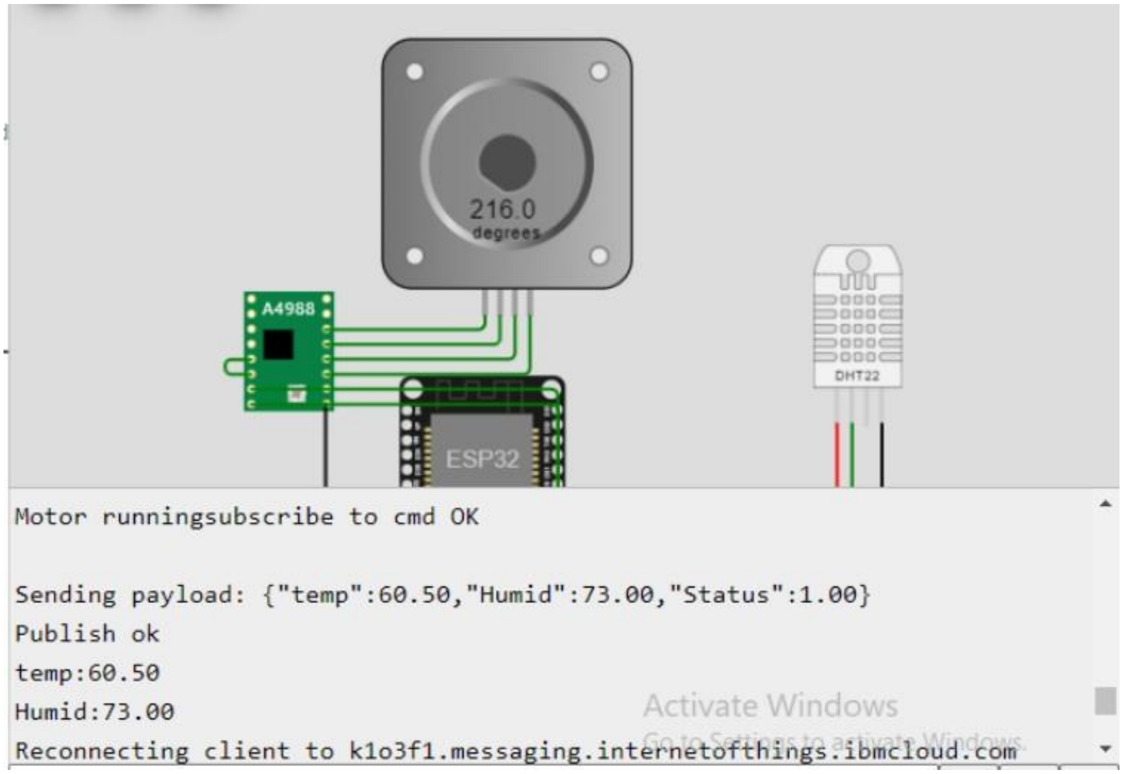
Data published from wokwi to IBM IOT platform



The recent events listed show the live stream of data that is coming and going from this device.

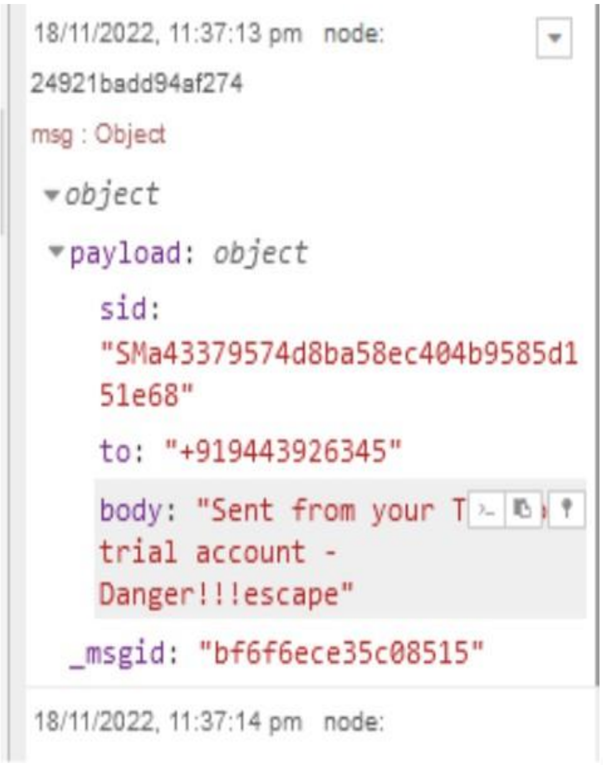
Event	Value	Format	Last Received
Data	{"temp":55.2,"Humid":60.5,"Status":1}	json	a few seconds ago
Data	{"temp":55.2,"Humid":60.5,"Status":1}	json	a few seconds ago
Data	{"temp":55.2,"Humid":43.5,"Status":0}	json	a minute ago
Data	{"temp":55.2,"Humid":43.5,"Status":0}	json	a minute ago
Data	{"temp":55.2,"Humid":43.5,"Status":0}	json	a minute ago

Data gathering in wokwi

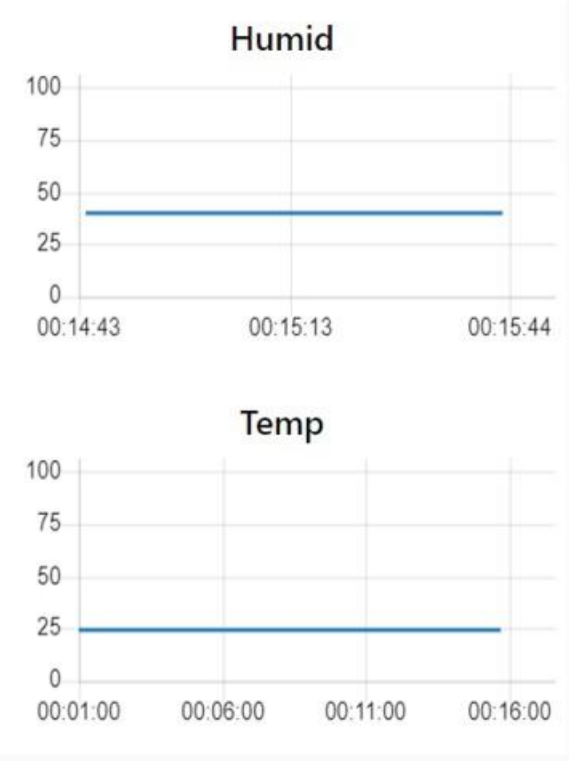


```
Motor runningsubscribe to cmd OK

Sending payload: {"temp":60.50,"Humid":73.00,"Status":1.00}
Publish ok
temp:60.50
Humid:73.00
Reconnecting client to k1o3f1.messaging.internetofthings.ibmcloud.com
```

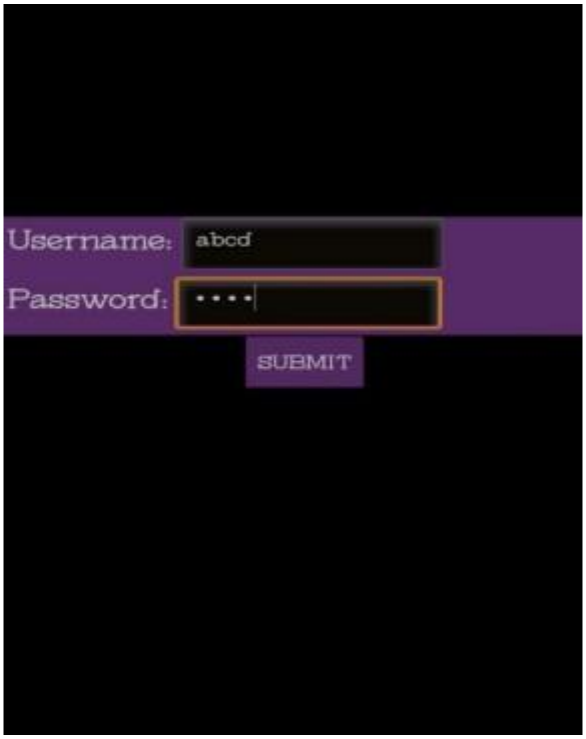
Node RED results and dashboard



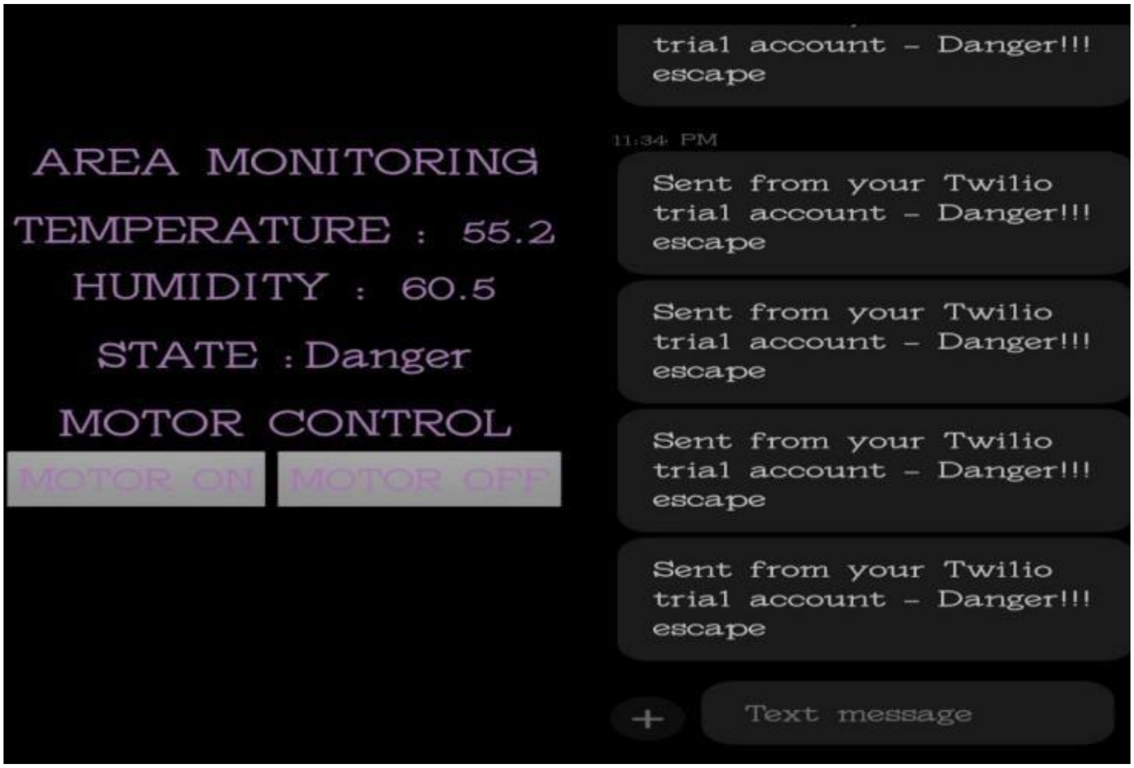
```
18/11/2022, 11:37:13 pm  node:
24921badd94af274
msg : Object
▾object
 ▾payload: object
    sid:
    "SMa43379574d8ba58ec404b9585d1
    51e68"
    to: "+919443926345"
    body: "Sent from your T
    trial account -
    Danger!!!escape"
  _msgid: "bf6f6ece35c08515"
18/11/2022, 11:37:14 pm  node:
```



Mobile Application and SMS notification


Username: abcd

Password: ••••


AREA MONITORING

TEMPERATURE : 55.2

HUMIDITY : 60.5

STATE : Danger

MOTOR CONTROL

trial account - Danger!!! escape

11:34 PM

Sent from your Twilio trial account - Danger!!! escape

Sent from your Twilio trial account - Danger!!! escape

Sent from your Twilio trial account - Danger!!! escape

Sent from your Twilio trial account - Danger!!! escape

9. ADVANTAGES & DISADVANTAGES

This project provides a low cost and scalable solution for worker working in hazardous areas to evacuate safely. However, the power consumption for monitoring and maintenance is high.

10. CONCLUSION

The DHT22 sensor is interfaced with esp32 to get the temperature and humidity values. The values are sent using MQTT protocol to the IBM IOT platform. Using node red, the values are visualised and dashboard is created. The values can also be viewed in the mobile application by the admin by entering the credentials. And a SMS is sent to alert the admin is the values exceed a threshold.

11. FUTURE SCOPE

The exact locations of the workers can be visualized with the help of wearable devices and GPS. The power consumption can be reduced by using efficient devices and protocols

12. APPENDIX

Github

https://github.com/IBM-EPBL/IBM-Project-606-1658309696