A PROJECT REPORT ON

HAZARDOUS AREA MONITORING FOR INDUSTRIAL PLANT POWERED BY IoT

Domain: Internet of things.

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1. INTRODUCTION

a. Project Overview

Wounds, characteristic impact, and materials mischief, these types of accidents may be a direct result of the mechanical method, some essentialness related issues or transport works out. They are generally associated with either enormous inventory of ignitable, flimsy or very open gases or of standard risky manufactured substances in method organization or smaller measure of uncommonly hurtful. The causes arise out of unsafe situational and climatic conditions and assortments. These may fuse over the high temperature and humidity. It prompts different going of people and various misfortunes.

Reaction of smooth extreme hurting greater exposure. These smart industries will be additionally evolved and modified as differentiated and existing ones and able to monitor just as controlling of different industrial application. IoT is used for transmission and gathering of information. These systems are used to screen mechanical application by realizing industry standard shows using IoT.

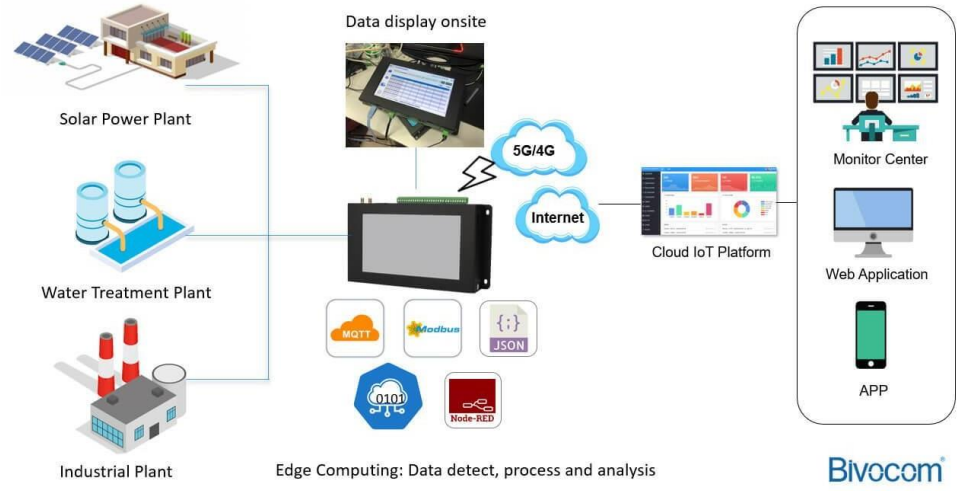


Fig: IoT based monitoring system environment

b. Purpose

Through this we can monitor the temperature and humidity parameters of the hazardous area in industrial plants. Every person working in those areas will be given a smart device for monitoring the random temperature and humidity values. We develop the web application for viewing the temperature and humidity data using Node-RED and if the temperature is higher than 60, then the admin of the industrial plant will receive the high temperature alert message or else admin will receive the temperature reset message through email using Application programming interface (API) then the admin will take the necessary precautions if required.

2. LITERATURE SURVEY

a. Existing Solutions

Research in [1] proposed an **IoT-based smart agriculture monitoring system**. Their work focused on devices and tools to manage and monitor temperature, humidity, soil moisture, atmospheric moisture, and intruders by using a wireless sensor network (WSN) system. The monitoring system is performed by two methods which are via hardware by using the LCD and android application. Any parameters exceed the threshold value, an alert system will send a message to the user via GSM.

According to [2], **Hazardous area safety monitoring system based on wireless sensor network** can effectively and accurately reflect dynamic situation monitored with help of **computer based virtual instrumentation technique**. Agent based wireless local positioning system with Zigbee technology is implemented. A cost effective Zigbee based wireless safety monitoring system with early-warning intelligence on temperature, radiation, flammable and poisonous gas and fire and smoke in hazardous areas. With virtual instrumentation software, the safety system is obtained.

Android user via C2DM Service [3] presents a WSN prototype for remote room temperature monitoring, which can be used for fire operations, via an android platform. The proposed system provides an Android user interface for registered users to access the current temperature and a flash/beep message in case of fire.

Authors in [4] use an embedded controlling device (Raspberry Pi), which gathers and processes the data generated by sensors like temperature sensors and gas detectors. A cloud platform is used to visualize and analyse the generated and also thereby enabling us to perform real time tracking and possibly implement a warning system, say notifications through the cloud or an audible alarm.

Research in [5], proposed an **IoT Based Industrial Parameter Monitoring System**. They introduced an Arduino module that operates with solar energy and uses battery charger circuit, it is operating nighttime also. This module is interfaced with different sensors. Data acquired from each sensor is collected in the Arduino module and is displayed in (16x2 LCD) which is used as their output module. The in-built analog to digital (ADC) converter is used to measure the voltageand current. The water pump releases when there is fire. The voice module gives voice output of various requirements. The LED glows when there is some gas leak or some problem.

According to the existing solutions, users have limited access to the monitoring system to monitor parameters of industrial hazardous area at anytime and anywhere. Most monitoring systems only provide fault alarms without indicating the type of parameters including the value of the parameters.

b. References

[1] Dr. N. Suma, Sandra Rhea Samson, S. Saranya, G. Shanmugapriya and R. Subhashri, "IoT Based Smart Agriculture Monitoring System," International Journal on Recent and Innovation Trends in Computing and Communication, vol 5, issue 2, pp 177-181, Feb 2017.

[2] Sureshkumar A, S Muruganand, S Siddharthy, Manikandan N. "A Study on Computer Based Monitoring System for Hazardous Area Safety Measurement Using Virtual Instrumentation." International Conference on Inter Disciplinary Research in Engineering and Technology (2015): 187-191. Print.

[3] http://www.ijsmc.com/docs/papers/June2013/V216201313.pdf

[4] https://www.slideshare.net/AyushChhangani/industrial-hazard-monitoring-using-iot

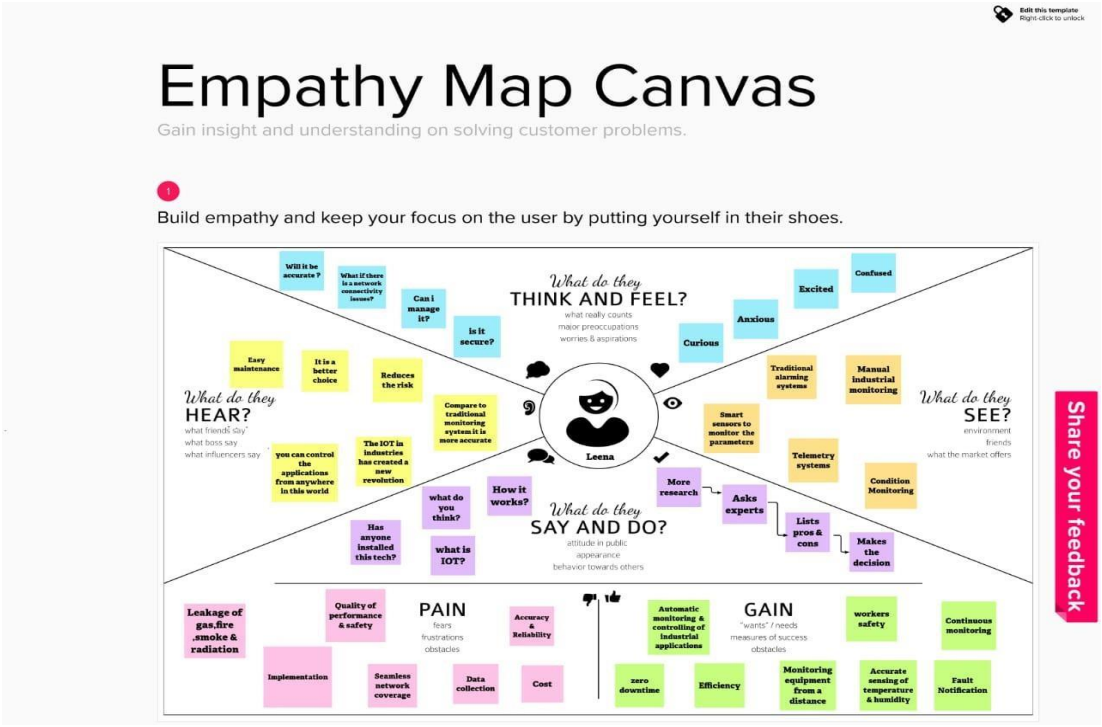
[5] Prof. Nitin Ahire, Shreya Bandodkar, Kanchan Gupta, Yasar Farooqui "IOT Based Industrial Parameter Monitoring System" vol 9, issue 2, 2019.

c. Problem Statement Definition

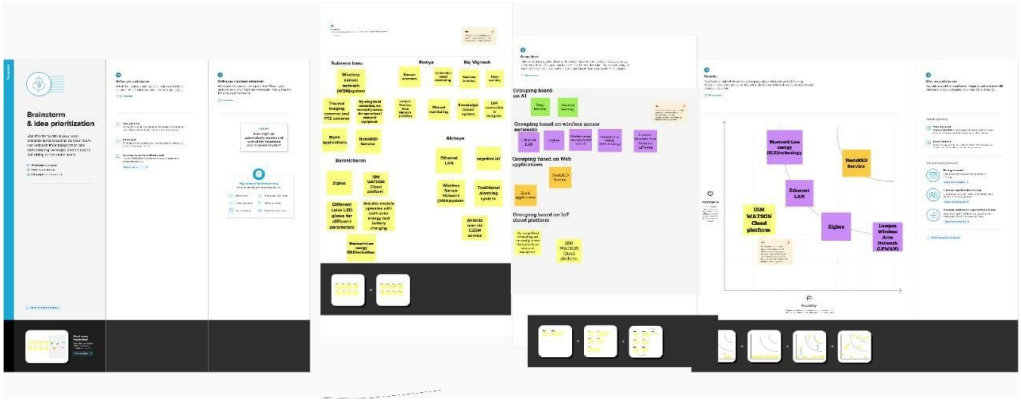
- Now-a-days, industries require advanced technology to monitor and control the parameters in hazardous areas (i.e., pressure, temperature, gas, electrostatic, vibration etc...) at anytime and anywhere. The sensing devices aroused to sense those parameters.
- In case the parameters are not monitored and controlled properly at the time of emergency, it leads to harmful situation. So, the method of monitoring the parameters in hazardous area through a single computer and a concept of automatic control will reduce the high manpower requirement, downtime, risk and cost. Fault notification showing what kind of parameters and value of parameters is also important for the user to be notified because they can take earlier action if the failure occurs.

3. IDEATION & PROPOSED SOLUTION

a. Empathy Map Canvas



b. Ideation & Brainstorming



c. Proposed Solution

(a) Problem statement:

Hazardous area monitoring for industrial plants powered by IoT.

(b) Idea /solution description:

- Beacon scanners for temperature indication.
- Receive Alerts to the mobile through email.

(c) Novelty/ Uniqueness:

Bluetooth low energy module in IoT.

(d) Social impact / customers satisfaction:

- Continuous monitoring of Industrial Hazardous area.
- Reliable communication between workers and Fixed base stations.

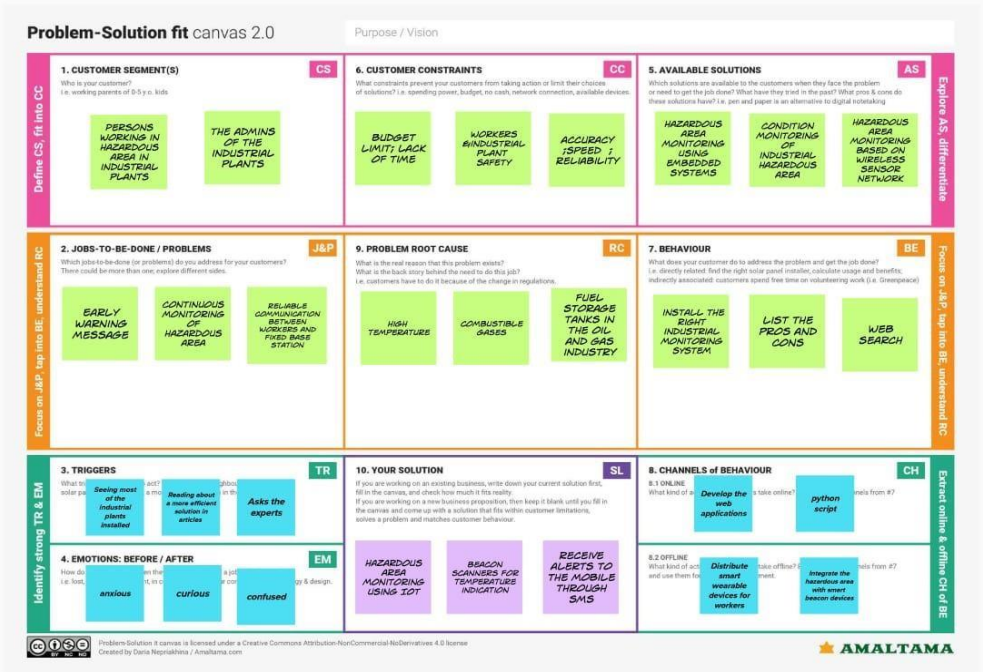
(e) Business model (Financial Benefit):

- Low power consumption
- Cost effective
- Easy portable
- Handy

(f) Scalability of solution:

Scalable

d. Problem Solution fit



4. REQUIREMENT ANALYSIS

a. Functional Requirements

Following are the functional requirements of the proposed solution

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	➢ Registration through Form ➢ Registration through Gmail ➢ Registration through LinkedIn
FR-2	User Confirmation	➢ Confirmation via Email ➢ Confirmation via OTP
FR-3	Monitoring	➢ To monitor the condition of area ➢ To monitor the temperature and humidity ➢ To monitor these places the workers will be given a smart device which will act as a beacon scanner.
FR-4	Remote Temperature monitoring	➢ Using LM35 Sensor and Intimate ➢ Using DHT22 Sensor and Intimate
FR-5	Module	➢ Arduino module is displayed in(16x2LCD) ➢ Analog to digital (ADC) converter is used to measure the Voltage and current. ➢ LED glow when there is some gas leak ➢ Alert message through email

b. Non-Functional Requirements

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

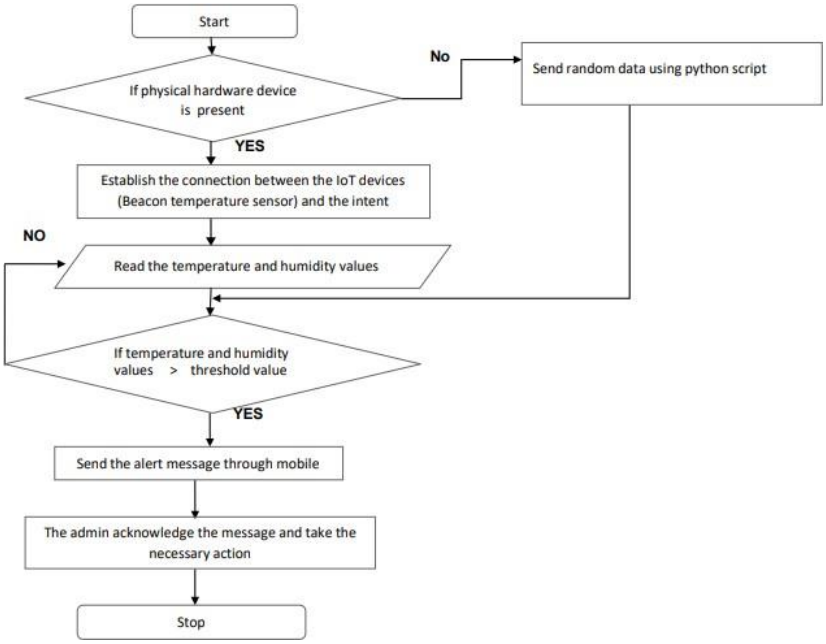
NFR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Area monitoring is a great tool that can be used to see whether temperature hazards are on your place.
NFR-2	**Security**	More secure and receive alert to the mobile through email.
NFR-3	**Reliability**	Reliable communication between workers and fixed base station.
NFR-4	**Performance**	Model will achieve high accuracy with good potential.
NFR-5	**Availability**	Hazardous area monitoring using Embedded system and WSN.
NFR-6	**Scalability**	Scalable

5. PROJECT DESIGN

a. Data Flow Diagrams

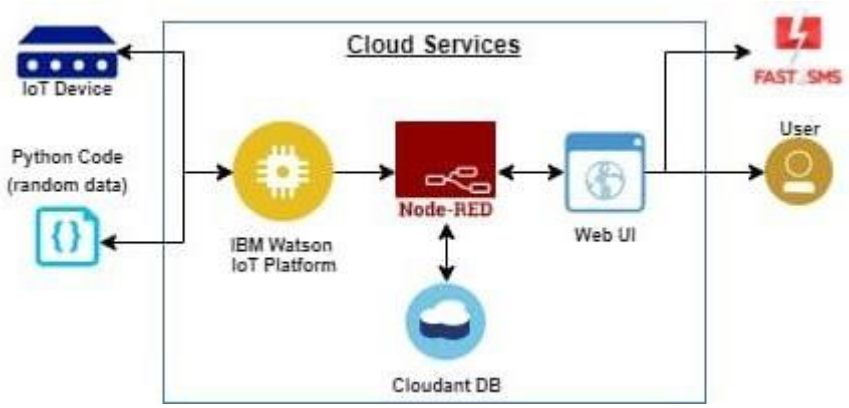
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

DFD for hazardous area monitoring of industrial power plant powered by IoT:

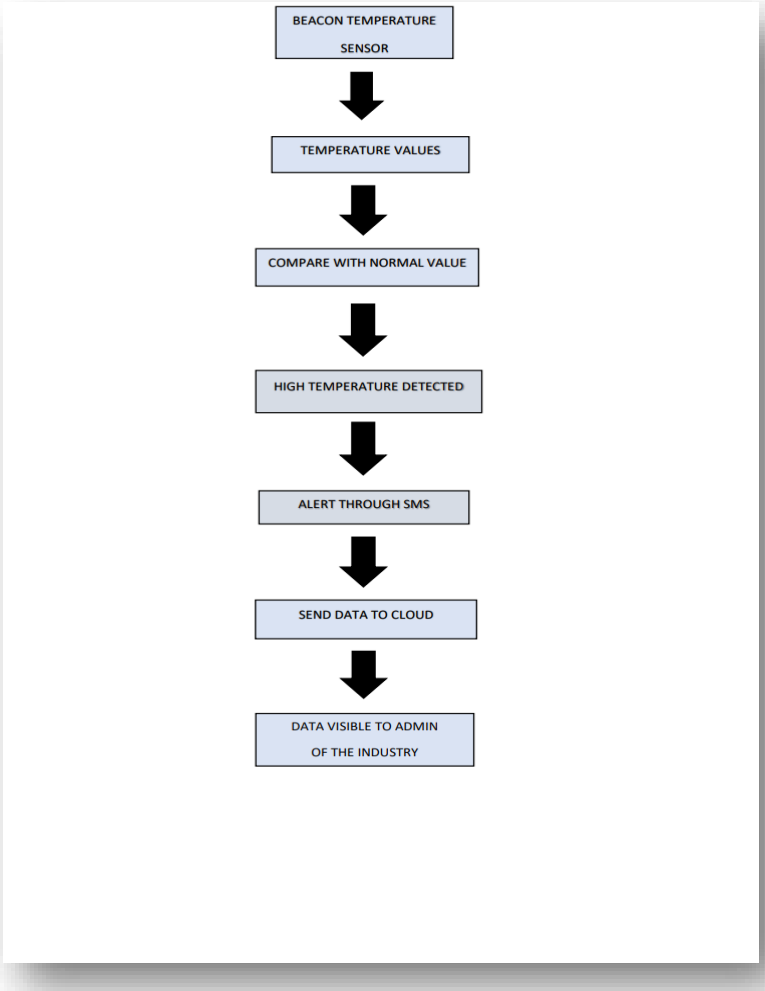


b. Solution & Technical Architecture

Technical Architecture



Solution architecture



c. User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (admins of the industrial power plants)	Installation	USN-1	As a user, I can install IoT devices such as beacon temperature sensor.	I can view the temperature of the hazardous area	High	Sprint-1
		USN-2	As a user, I can send the python script (random data) to the IoT platform.		High	Sprint-1
		USN-3	As a user, I can receive SMS using API.	I can receive the alerts through mobile.	High	Sprint-2
		USN-4	As a user, I can download the web application.		Medium	Sprint-1
	Login	USN-5	As a user, I can login to the application by email and password.		High	Sprint-1
	Dashboard					
	Database	USN-6	As a user, I can store all the data in the IBM cloud database.			
Customer (Workers in the hazardous area)						

6. PROJECT PLANNING & SCHEDULING

a. Sprint Planning & Estimation

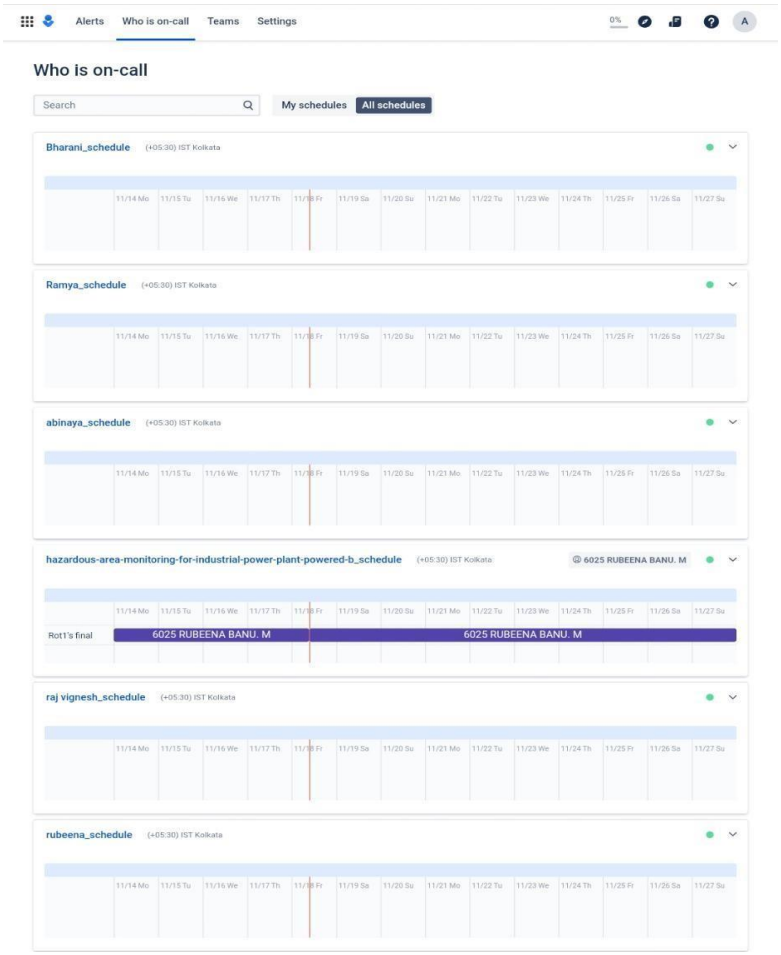
Sprint	Functional Requirement (Epic)	Versions	User Story Number	User Story / Task	Reporter	Story points	Priority
Sprint-1	Installation	Version 1	USN-1	As a user, I must install the IoT device simulators (i..e quick emulator for raspberry pi.	RAMYAVANI R	5	High
Sprint-1			USN-2	As a user, I can configure the Quick Emulator (qemu).	J RUBY	5	Low
Sprint-1	Coding	Version 1	USN-3	I can write code to generate random temperature and humidity values.	SUMITHRA A	5	Medium
Sprint-1	Debugging	Version 1	USN-4	I can debug and rewrite the code if there is an error.	BAKKIYA P	5	Medium
Sprint-2	Owner	Version 1	USN-5	As a user, I must buy the cloudant database.	RAMYAVANI R	5	High
Sprint-2	Login	Version 1	USN-6	As a user, I can login to the IBM Watson IoT platform with the help of username and password.	RAMYAVANI R	5	High
Sprint-2	Connection	Version 1	USN-7	I can connect the devices to the IBM Watson IoT platform.	RUBY J	5	High

Sprint-2	Installation	Version 2	USN-8	I can install and place the nodes on Node-RED.	RUBY J	5	Medium
Sprint-3	Node-RED	Version 2	USN-9	As a user, I can view the data in Node-RED.	SUMITHRA A	5	Medium
Sprint-3	APP developing	Version 2	USN-10	I can develop web applications.	BAKKIYA P	5	High
Sprint-3	Downloading	Version 2	USN-11	As a user, I can download the web application.	RUBY J	5	High
Sprint-3	Login	Version 2	USN-12	As a user, I can login to the web applications.	BAKKIYA P	5	High
Sprint-4	Admin	Version 2	USN-13	As a user, I can view the temperature and humidity values.	RUBY J	10	Medium
Sprint-4		Version 2	USN-14	As a user, I can receive alert messages.	SUMITHRA A	10	High

b. Sprint Delivery Schedule

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	4 Days	01 NOV 2022	04 NOV 2022	20	01 NOV 2022
Sprint-2	20	4 Days	05 NOV 2022	08 NOV 2022		
Sprint-3	20	4 Days	09 NOV 2022	12 NOV 2022		
Sprint-4	20	4 Days	13 NOV 2022	16 NOV 2022		

c. Reports from JIRA



7. CODING & SOLUTION

Language: Python.

Tools/IDLE: Python 3.9.6, IBM Watson IoT platform, Node-RED, Email,Cloudant DB.

#connecting the python to IBM watson IoT platform

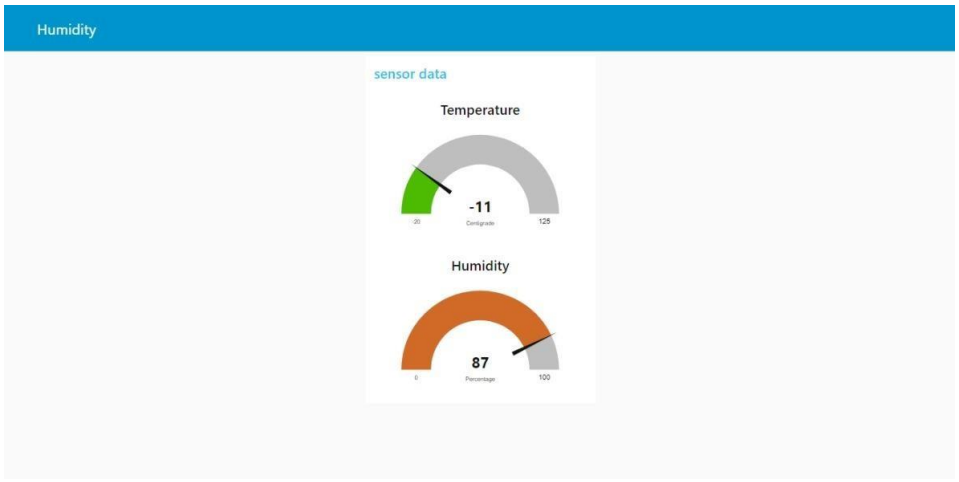
```
import wiotp.sdk.device
import time
import random
myconfig = {
    "identity":{
        "orgId":"zvvqaf",
        "typeId":"IoT_devices",
        "deviceId":"12345"
        },
    "auth":{
        "token":"qagOTm?(qV+deBQ*j*"
        }
    }
def myCommandCallback(cmd):
    print("Message received from IBM IoT platform: %s" % cmd.data['command'])
    m=cmd.data['command']

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

```
while True:
        temp=random.randint(-20,125)
        hum=random.randint(0,100)
        myData={'temperature':temp, 'humidity':hum}
        client.publishEvent(eventId="status", msgFormat="json",data=myData,qos=0,onPublish=None)
        print("Published data Successfully: %s",myData)
        client.commandCallback =myCommandCallback
        time.sleep(2)
    client.disconnect()
```

8. TESTING

a. Test Cases



b. User Acceptance Testing

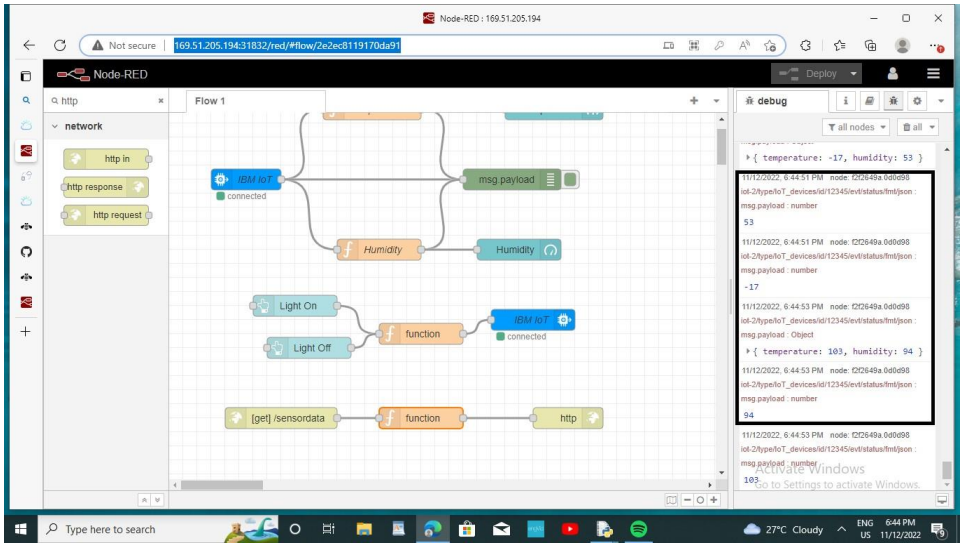


Fig. Screenshot of node-RED connections

9. RESULTS

a. Performance Metrics

Fig. Screenshot of mobile application

10. ADVANTAGES & DISADVANTAGES

ADVANTAGES

- Quickly Finding Any Issue in Production Line.
- Keeping Records of Raw Materials & Accuracy.
- Predict what problem might occur.
- Decrease the deaths in Accidents.
- Ensuring safety and comfort.
- No Need for Routine Survey.

DISADVANTAGES

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

11. CONCLUSION

The Internet of Things has a broad perspective in shaping tomorrow's world. Even though the IoT system has some demerits, its merits like saving consumer's time and money outstand its cons. It is predicted that soon IoT applications will be installed and used equally in both domestic and industrial areas. Companies are working hard to shoot back IoT disadvantages and making this futuristic technology more beneficial for the betterment of humanity.

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

a. Source code

```
#connecting the python to IBM watson IoT platform
import wiotp.sdk.device
import time
import random
myconfig = {
    "identity":{
        "orgId":"zvvqaf",
        "typeId":"IoT_devices",
        "deviceId":"12345"
        },
    "auth":{
        "token":"qagOTm?(qV+deBQ*j*"
        }
    }
def myCommandCallback(cmd):
    print("Message received from IBM IoT platform: %s" % cmd.data['command'])
    m=cmd.data['command']


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

```
while True:
    temp=random.randint(-20,125)
    hum=random.randint(0,100)
    myData={'temperature':temp, 'humidity':hum}
    client.publishEvent(eventId="status",
msgFormat="json",data=myData,qos=0,onPublish=None)
    print("Published data Successfully: %s",myData)
    client.commandCallback =myCommandCallback
    time.sleep(2)
client.disconnect()
```

b. Video demonstration links:

- Video demonstration link for web application and alert messages: https://youtu.be/Vqj2MTZHJXA
- Video demonstration link for mobile application:https://drive.google.com/file/d/1CUMWAdgoaAYCwIDJftD7AGXI9IzLuoOI/view?usp=drivesdk