Hazardous Area Monitoring for Industrial Plant powered by IoT

Team id: PNT2022TMID49366

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1) Introduction

The concept of a network of smart devices was introduced in 1982, with modified coke machine that becomes the first internet connected appliance. Between 1982 to 1999 many companies are working on IOT. But in 1999 IOT is introduced by British technology pioneer Kevin Ashton coined the term in his work at Procter and gamble. But the term IOT did not step up till 2011 later in 2014 it reached mass market. IOT allow the objects that will connect through the internet with RFID (Radio Frequency Identification) communication method that include wireless technology and sensors which can identify themselves uniquely. In the world of internet information play important role in everyone life. Agriculture is speedily becoming a data intensive industry, where farmers can collect and evaluate a large amount of information from a different device (i.e. sensors) in order to become more efficient in production. In India 83% of water is consumed by agriculture. If there are no plan for the usage of water in farms, then it causes wastage of water. So we need a system which will efficiently supply water. Arduino Uno is a microcontroller along with the moisture, temperature and humidity sensor can monitor soil content and accordingly it irrigates the field as when needed. The proposed system uses microcontroller ATMEGA328P on Arduino Uno and IOT which enable farmers to remotely monitor the status of motor installed on the farm by getting approximate information from sensor thereby, making the farmers' work much easier as they can do other farm activities. And mostly this technique is driven by electrical power and on/off scheduling controlled.

1.1 Project Overview

As we can see in today's world only some devices like PC's and mobiles are connected to internet. Now-a-days world is fully overtaken by the internet and internet of things. Internet is use for basic need of all human beings. The Internet of Things (IOT) is the network of physical objects. It simply means to monitor a physical device or machine or it is inter-networking of physical devices which is embedded with electronics, sensors, and software and network connectivity to enable it to achieve greater value and services by exchanging data with the manufacturer IOT permits objects to be sensed or controlled remotely across the network infrastructure. The result improves accuracy, economic benefits, efficiency and reduces intervention of human. In this paper we are going to deal with basic and important concepts of IOT and its scope in upcoming future. This paper studies the need of IOT in day to day life for different applications and gives brief information about IOT. IOT contributes significantly toward revolutionary farming methods. So we are trying to demonstrate IOT in Automatic watering system. Automatic watering system monitors and maintain the approximate moisture content in soil. Arduino UNO is used as microcontroller to implement the control unit. The set up uses the temperature sensor, moisture sensor and humidity sensor which measure the approximate temperature, moisture and humidity in the soil. This value enables the system to use appropriate quantity of water which avoids over/under irrigation. IOT, Moisture, Temperature, Humidity.

1.2 Purpose

Through this, we can monitor the temperature parameters of the hazardous areas in industrial plants.

- The area is integrated with smart beacon devices which will be broadcasting the temperature of that particular area.
- Every person working in those areas will be given smart wearable devices which will be acting as beacon scanners.
- Whenever the person goes near the beacon scanners he can view the temperature on his wearable device and if the temperature is high, he will receive the alerts to the mobile through SMS using API.
- Through this wearable device, the data is sent to the cloud and through the dashboard, the admins of that particular plant can view the data and take necessary precautions if required.

2) Literature Survey

1. A Cloud Based Condition Monitoring System for Industrial Machinery with Application to Power Plants

Authors:-Eslam Elazab & Hassan Elgamal

Novelty

The cloud based condition monitoring application gives early warning signs before critical machine failure occurs. The vibration level is the main sign of the machine's health, the machines are monitored for these signs and the required maintenance is planned before the risk of failure is too high, then the greatest life is realized from the machine, and the maintenance cost is reduced.

Pros

• Predict the failure, and act ahead of time.

• The applied cloud based condition monitoring system for industrial machinery proves high performance and flexibility where the total elapsed time directly after the offline measurements didn't exceed a few minutes.

Cons

• The speed of data transfer depends only on the internet speed of the power station LAN (Local area Network) and the size of the transferred files.

2. Bluetooth based Sensor Monitoring in Industrial IoT Plants (IEEE-2019)

Authors: - Rahul N. Gore, Himashri Kour, Mihit Gandhi, Deepaknath Tandur & Anita Varghese

Novelty

This paper presented Bluetooth based autonomous sensor device monitoring systems for industrial plants. Bluetooth was used as local communication for sensor data capturing. the performance of BLE as local communication technology for sensor data capture was measured using a test bed.

Pros

• The analysis indicated that the Bluetooth fares well the industrial plant sensing application up to 20 meters range with minimal or acceptable deviation in performance.

• Bluetooth also performs well in other performance indicators due to low communication Latency and low power consumption.

Cons

• Various other parameters such as bandwidth, node density, effective usage of Zone/backbone, storage etc. are not considered for this study.

• Security is becoming increasingly important and so also for industrial plant IoT.

• The performance was satisfactory in an environment where they typically found few tens of external devices that can interfere with Bluetooth communication performance.

3. Mobile-Cloud Driven Conditional Monitoring System (IEEE-2015)

Authors: - Manasvi Jain, Seshu Babu Tolety, Hemadri Pavan Kumar, Pinku Hazarika &
Sanath Shenoy

Novelty

Conventionally the critical parameters of the plant are available to the users within the premise in the standalone computers. A better solution is to have the conditional monitoring system be migrated to the cloud so that the monitoring of the industrial plant can be done from any part of the world with the help of cloud services and the smart mobile phones available in the consumer market. This concept would revolutionize the perspective of industrial conditional monitoring.

Pros

• The rapid advancements in mobile hardware and platform have enabled creation of rich
And powerful mobile applications.

• The mobile device can be leveraged for innovative means of visualizing the plant data
Like graphical representation, 3D visualization of the different plants and plant states,
Replay of plant error scenarios in an animated model etc.

• The applications derived from this mobile cloud collaboration have certainly brought
Industry much closer to our everyday life with increased accessibility.

Cons

• Being a critical mobile solution, the application should be robust, responsive, and fast and Should possess accurate plant data.

• The application has been tested under various extreme conditions.

4. IoT Based Intelligent Industry Monitoring System (IEEE-2015)

Authors: - Kavitha.B.C & Vallikannu.R

Novelty

This paper deals with the development of pollution monitoring systems with deployment of intelligent sensors. Monitoring the gas leakage level from any part of the globe can be achieved by integration of big data to the Google Cloud via web servers. Analysis of the data is simplified thereby enabling ease of monitoring. Alerts can be triggered in case of drastic deterioration of air quality. The proposed method finds application in industry and also in monitoring of pollution caused by vehicles.

Pros

• The proposed design can help to prevent industry related accidents due to gas and fuel
Leakage by proper identification and alerting the people around.

• The proposed design can also be made suitable for detecting the pollution level from
Vehicles and to keep a check on the smoke outlet from factories.

• The design can be modified to detect the level of gases inside pit holes so that precious Lives can be saved.

• The light weight system can be embedded in Jacket, Helmet and Wrist watches which Can be worn by workers to explore the features of Wearable Technology.

Cons

• Predictive maintenance is an upcoming industrial need, for which the proposed model can be improvised.

• In case of gas leakage the concentration of gas varies from point to point which has to be analyzed further.

• The gases diffusing out during leakage may also combine among themselves producing other byproducts

• Which have to be dealt in detail.

5. Toxic environment monitoring using sensors based on IoT (IJRTE-2019)

Authors- R.Rajalakshmi, J.Vidhya

Novelty

Four gas sensors (CO, CH4, H, flammable gas) are used to monitor the pollutants in toxic places. Collected sensors data are to be given to the Arduino analog inputs. The Arduino converts the analog values into digital values. The Arduino board functions are controlled by the set of instructions through the Arduino IDE software. The data is sent to the cloud through Wi-Fi modules.

Pros

• The Data upgraded from the enforced system is accessible within the web from anyplace
In the world

Cons

• In this system there are no alerts or notifications to the concerned authorities or users.

• There is no prediction for increase or decrease in levels based on current data.

• Wireless sensor networks are not used. The sensors are connected to pins of the
Microcontroller.

6. Sensing Harmful Gases in industries using IOT and WSN (IEEE-2017)

Authors- Ajitkumar Khachane, Anam Mir

Novelty

IOT and WSN technology are used to achieve better connectivity and to create good sensing areas. Switching actions shall be incorporated in order to achieve multiple observations of different sensors used. Different harmful gases CO_2, NH_3, Benzene, and Sulphur Dioxide etc. shall be taken into consideration for obtaining optimized data for visualization.

Pros

• The small rugged, inexpensive and low powered WSN node consisting of sensors and ARM-7 will bring the IOT to even the smallest objects installed in any kind of environment.

• Use of both IOT and WSN technology reduces complexity of devices and also reduces Overall cost of the system.

Cons

• In this system there are no alerts or notifications to the concerned authorities or users.

• There is no prediction for increase or decrease in levels based on current data.

7. IOT based Hazardous Gas Detection system using AVR Microcontroller (IRJET-2017)

Authors- Akship Agrawal, Lalit Kumar, Pavneet Kumar, Vikas Kumar Jha

Novelty-

The hazardous gases like LPG and combustible gas were sensed by the MQ-6 sensor and are monitored by the microcontroller and displayed in the LCD. In critical situation, that is when the LPG exceeds from normal level i.e., above 1000ppm and in the same way when the propane exceeds the normal level of 1000ppm the alarm is generated and a SMS is sent to the authorized user as an alerting system, which helps i faster diffusion of the critical situation.

Pros-

• GSM (Global System for Mobile) wireless module is most popular and fastest growing Wireless platform in wireless communication.

• The inspection is performed without any interruption of plant operation or any personnel Responsibilities.

• The time required to carry out the inspection is reduced, reducing the cost.

• This project is easy to use and it gives remote indication to user.

Cons-

• The detection of gas is viable only when the gas is in the close proximity to the detector or within a pre-defined area. Due to changing wind conditions and faster dispersion of gas the detector fails to efficiently detect the gas.

8. The development of remote wireless radiation dose monitoring system (IEEE-2015)

Authors:- Jin-Woo Lee, Kya-Hwan Jeong, Jong-Il Kim, Chae-Wan Im

Novelty

The system uses three main components namely a smart phone, Beacon and a radiation survey meter. The communication between the components uses Wi-Fi or Bluetooth technology. The information gathered by the radiation survey meter is automatically transferred through the beacon module to the private APP i.e., an application program in a cellular phone in real time at the radiation zone. Additionally, it is sent back to the server administrator to accumulate the personal dose to provide radiation protection administration.

Pros

• It provides an efficient analysis over the real-time data sent through to the administrator

• Using beacon messaging, real time monitoring of the workers to radiation exposure can be monitored

Cons

• The data communicated should be accurate for analysis and raising alert without any loss and inconsistency.

2.1 Existing system

The existing system for controlling and monitoring appliances is either a manual or remote Control process.

- Manually, industrial appliances like Gas, Temperature, Humidity, Etc. are controlled by human beings.
- Lots of energy wastage.
- Time consumption.
- Lots of wastage in electricity.
- t is outdated now.
- Makes use of Arduino and GSM.

Disadvantages of the existing system

- The existing infra-red (IR) or Blue-tooth remote controls present in the market are in general
- Appliance specific and the same cannot be used interchangeably.

2.2 References

(PDF) IoT Based Plant Monitoring System (researchgate.net)

Monitoring Industries Using IoT - Hackster.io

Smart Plant Monitoring System Using IoT Technology: Computer Science & IT Book Chapter | IGI Global (igi-global.com)

IOT Project on Hazardous Area Monitoring for Industrial Plants Archives - Parthenium Projects

IoT Based Industrial Monitoring System (researchgate.net)

Industrial IoT in hazardous areas - Microtronics

IOT Project on Hazardous Area Monitoring for Industrial Plants Archives - Parthenium Projects

[1] Eslam Elazab & Hassan Elgamal, "A Cloud Based Condition Monitoring System for Industrial Machinery with Application to Power Plants", IEEE, 2017

[2] Rahul N. Gore, Himashri Kour, Mihit Gandhi, Deepaknath Tandur & Anitha Varghese, "Bluetooth based Sensor Monitoring in Industrial IoT Plants", IEEE, 2019

[3] Manasvi Jain, Seshu Babu Tolety, Hemadri Pavan Kumar, Pinku Hazarika & Sanath Shenoy, "Mobile-Cloud Driven Conditional Monitoring System", IEEE, 2015

[4] Kavitha.B.C & Vallikannu.R, "IoT Based Intelligent Industry Monitoring System", IEEE, 2015

[5] R.Rajalakshmi, J.Vidhya, "Toxic environment monitoring using sensors based on IoT", IJRTE, 2019

[6] Ajitkumar Khachane, Anam Mir, "Sensing Harmful Gases in industries using IOT and WSN", IEEE, 2017

[7] Akship Agrawal, Lalit Kumar, Pavneet Kumar, Vikas Kumar Jha, "IOT based Hazardous Gas Detection system using AVR microcontroller", IRJET, 2017

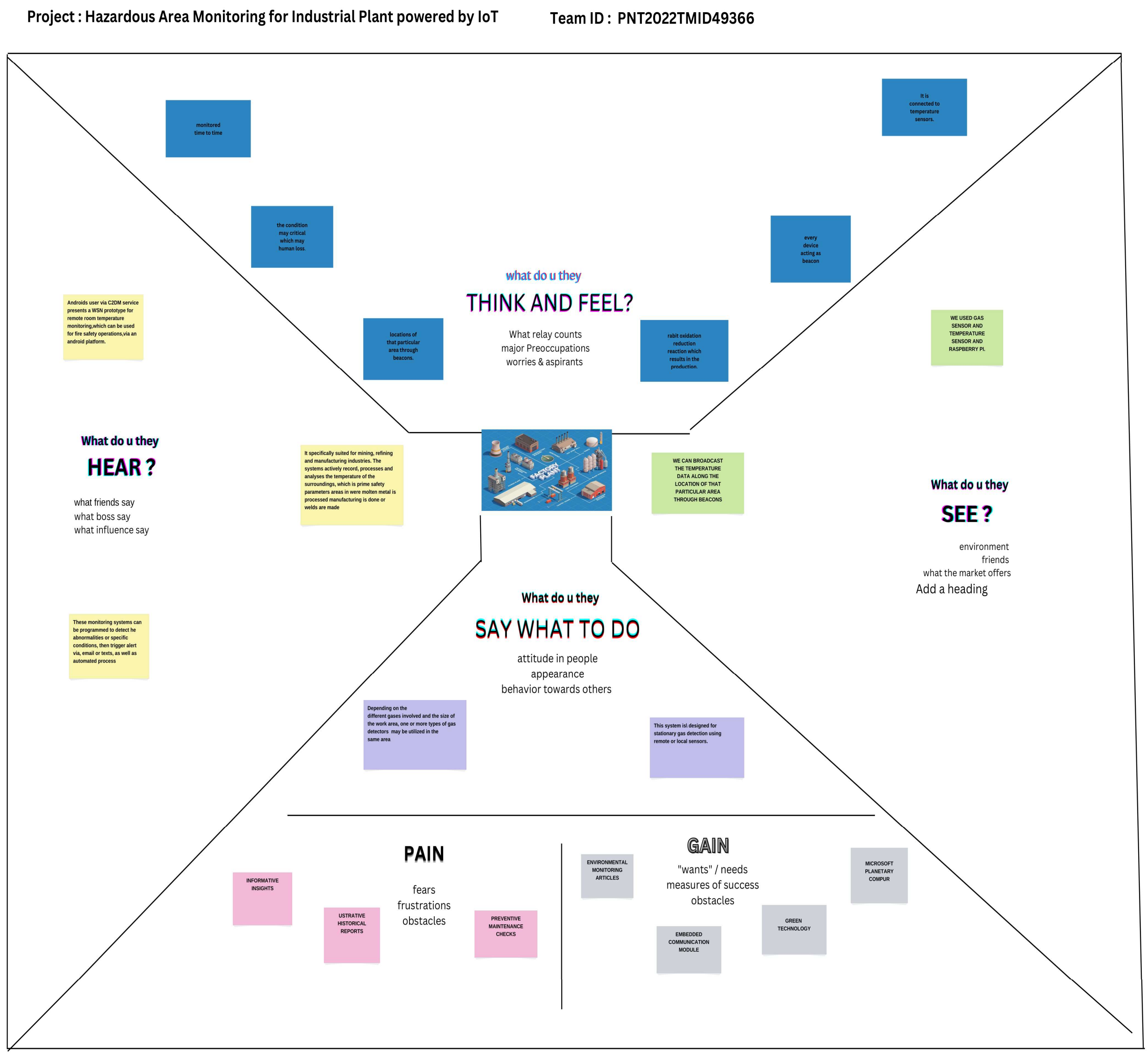
[8] Jin-Woo Lee, Kyu-Hwan Jeong, Jong-Il Kim, Chae-Wan Im, "The development of Remote wireless radiation dose monitoring system", IEEE, 2015

2.3 Problem Statement Definition

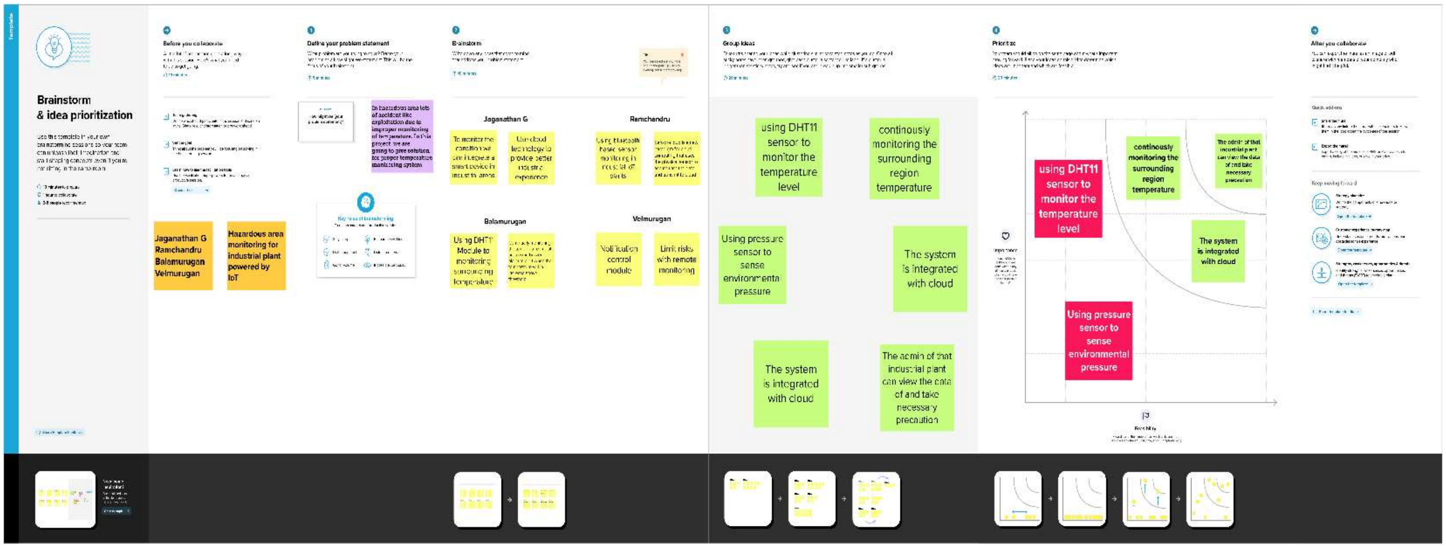
- **Continuous Monitoring** - ability to provide machine operators and IT professionals easy access to Bluetooth Low Energy sensor data in real-time.
- **Seamless Coverage** - Cassia's ATX2000 Bluetooth gateway provide seamless coverage for large outdoor hazardous area environments allowing operation staff to move freely and safely throughout a location while equipment is continuously monitored.
- **Easy Deployment / Management** - Cassia's IoT controller software platform allows for easy setup and management of Bluetooth gateways and monitoring of end devices.
- **Long-Range Connectivity**– extend Bluetooth connectivity up to 400 meters for Bluetooth 4.0 and up to 1 km using Bluetooth 5.0 in open spaces.
- **Multiple Device Asset Tracking & Monitoring** - connect and control up 40 Bluetooth Low Energy devices per gateway simultaneously and/or listen to hundreds of devices in Broadcast mod.
- **Low Cost** - one-time cost of hardware and low monthly software controller (device management) fees
- **Security** - Integrated TPM chip for end-to-end security.
- **Bluetooth Locationing** - track device failure and receive alerts in the event a device will fail, reducing equipment downtime.
- **Data Collection** - collect critical data from equipment without the need of a machine operator being present.

3) IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming



3.3 Proposed Solution

1) Problem Statement (Problem to be solved):

To monitor and alert the Industrial workers the risk of toxic or hazardous gases present within the area of an industry, ensuring the safety of the workers.

2) Idea/Solution description:

Providing a wearable device which collects the data (temperature) via beacon sensors and display it. An alert message is also sent to mobile whenever high temperature or toxic gas are detected within the area through SMS using API. Ensuring precautions and safety of the workers. Providing them with an electronic wristwatch can help them escape from a hazardous environment such as a hazardous area or a toxic gas.

3) Innovation / Uniqueness

- ➢ Makes it easy for the worker to know the temperature (or) hazardous gases in the area without having to constantly perform manual checks.
- ➢ Provides various solutions to ensure safety of workers.
- ➢ Wearable devices display the current temperature in the area at all times.
- ➢ Alerts via SMS to workers' mobiles when high temperature is detected.

- Alerts occur simultaneously on both the wearable device and the mobile app to prevent worker entry into hazardous areas.

4) **Social Impact / Customer Satisfaction**
   - Ensures safety.
   - Saves lives of workers.
   - Comfortable & User-friendly.
   - Simple and reliable.
   - Helps in taking necessary precautions to avoid the risk of endangering human lives.
   - Necessary updates and more functions can be added to the mobile application to make it easier to use.
5) **Business Model (Revenue Model)**
   - Through our mobile application the revenue can be made in the form of pop-up advertisements, overlay ads from third party services.
   - Wearable devices can be priced and sold by the industry to the workers.
6) **Scalability of the Solution**
   - Large number of people can be supplied with the wearable devices to ensure their safety.
   - Beacon sensors cover large amount of area and supplies data accurately and more readily.
   - Multiple users can receive alert messages and notifications simultaneously regardin hazardous gases without any delay.
   - Each user has individual wearable device and mobile devices which provide information accordingly.
   - It ensures the safety of each and every worker working in harmful gases and high temperature environment.

3.4 Problem Solution fit

★ Project design phase -1

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

Team id:PNT2022TMID49366 ★

Define CS, fit into CC	1.Customer Segment (S) CS Employess who monitor hazardous area in industrial plants	5. Available solutions AS Smart area monitoring sensors wifi connectivity for sensors Pros: Successful monitoring of area Cons: Network coverage for sensors can;t be reached	6.Customer Constraints CC Smart beacon coverage area Network access for beacon . Beacon to watch connectivity .	Explore AS, differential
Focus on J&P, tap into BE, understand RC	2. Jobs to be done / Problems J&P To check and alert the humidity, Temperature, Infrared radiation and Air quality	7. Behaviour BE The employees have a wearable watch where the can see the required or specified details and act saftly according to it	8. Channels of Behaviour CH 8.1 ONLINE All the informations will be stored in cloud. so the employees can see the cloud storage or mobile application for referring the deatils of surroundings. 8.2 OFFLINE Employees used to wear a watch which captures the informations of the surroundings.	Focus on j&P,tap into BE, Understand RC
Identify strong TR & EM	3.Triggers TR Successful execution of our solution will make even other industry to implement this solution.	9. Problem root cause RC It's important to note the employees safty. Working in hazardous area in industries are highly risk. Therefore, this project helps employee to know about their environment .	10. Your Solution SL We are going to monitor the area using suitable sensors in the beacons. We will connect our wearable to the beacons. We will send updates to online cloud from the beacons. From the cloud we will be accessing the raading and using that we will have a web page and a mobile application to display them. We will have sms serice to alert abnormal readings.	Identify strong TR & EM
	4. Emotions: Before/After EM It will be easy for employees to identify or to know about their environment			

4) REQUIREMENT ANALYSIS

4.1 Functional requirement

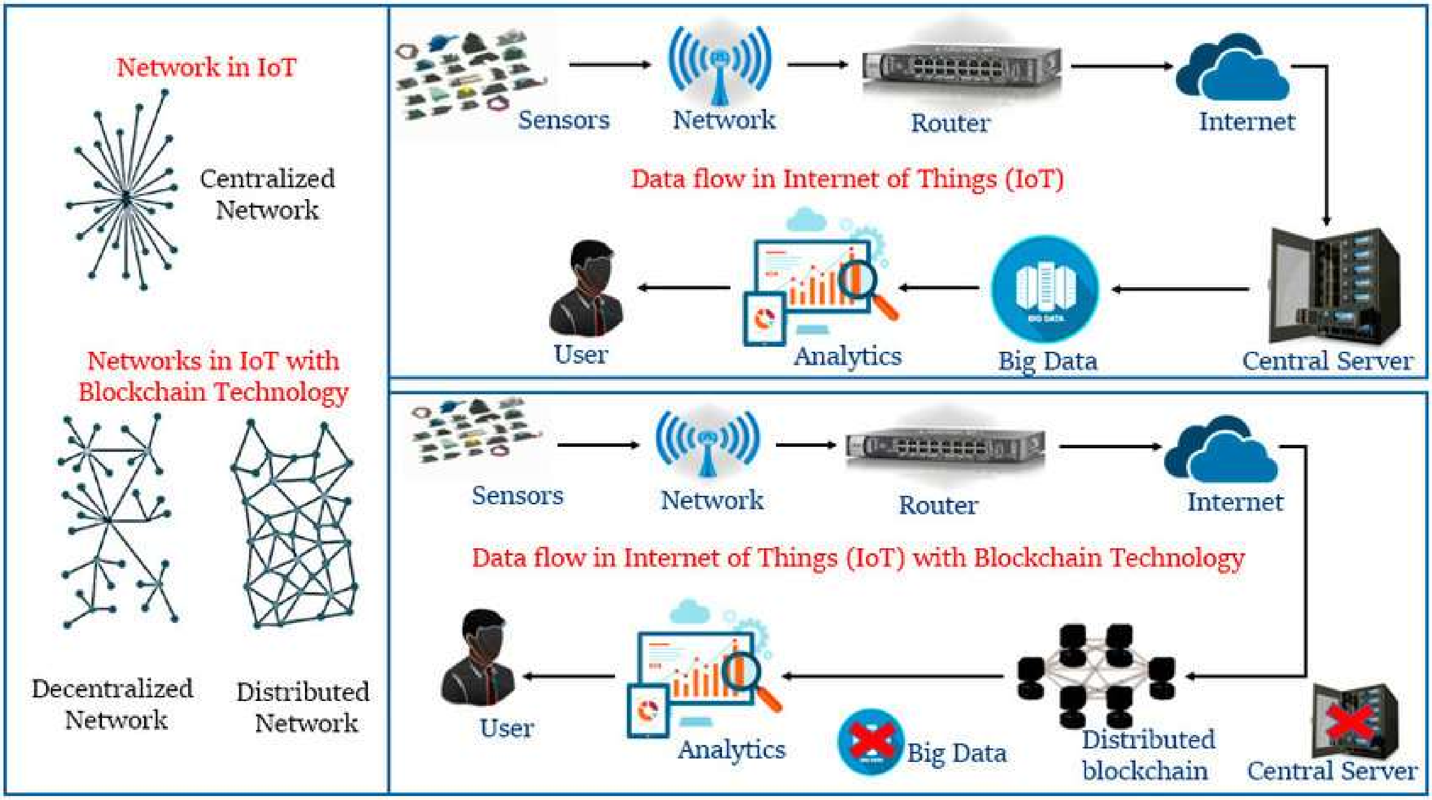
S.No.	Functional Requirements (Epic)	Sub Requirements (Story/Sub/Task)
1	Alarm	To alarm the specialists within the adjacent segments.
2	Smart wearable's	To inform the client around the temperature of the zone.
3	Beacons	To broadcast the information.
4	Cloud storage	To store and get to the information.
5	Temperature sensors	To identify the temperature of a specific region.
6	Mobile Application	To caution the clients in the event that the temperature is expanded beyond a certain restrain.

4.2 Non-functional Requirements:

S.No.	Non-Functional Requirement	Description
1	**Usability**	Accessibility of the user-friendly wearable Gadgets.
2	**Security**	It'll be secure for the specialists by installing the devices within the industry
3	**Reliability**	Information is spared within the secured server so they don't provide any escape Clauses for the programmers.
4	**Performance**	No server crash or server down.
5	**Availability**	Data is accessible through wearable gadgets and portable application.
6	**Scalability**	No server crash or server down.

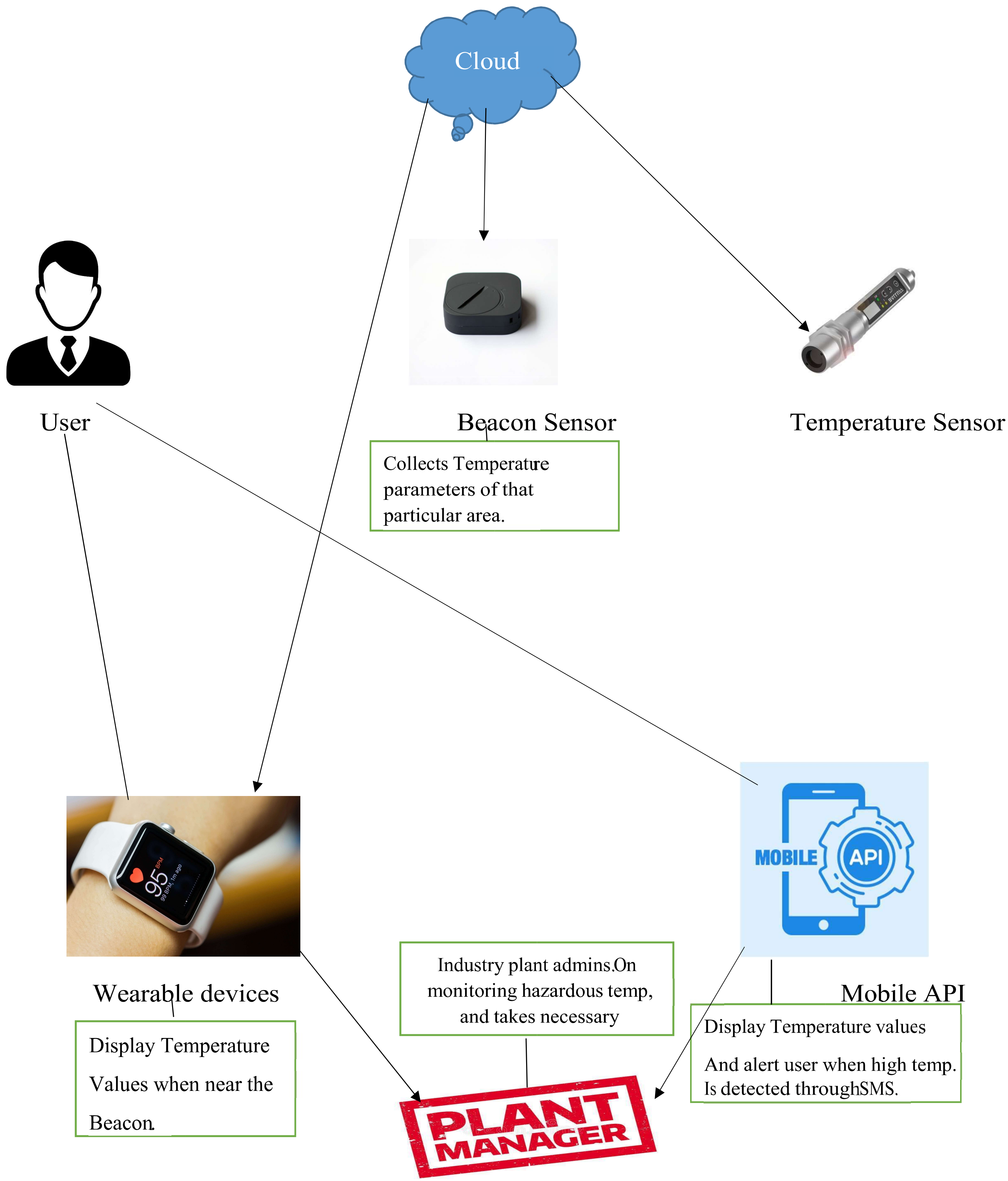
5) Project Design

5.1 Data Flow Diagrams



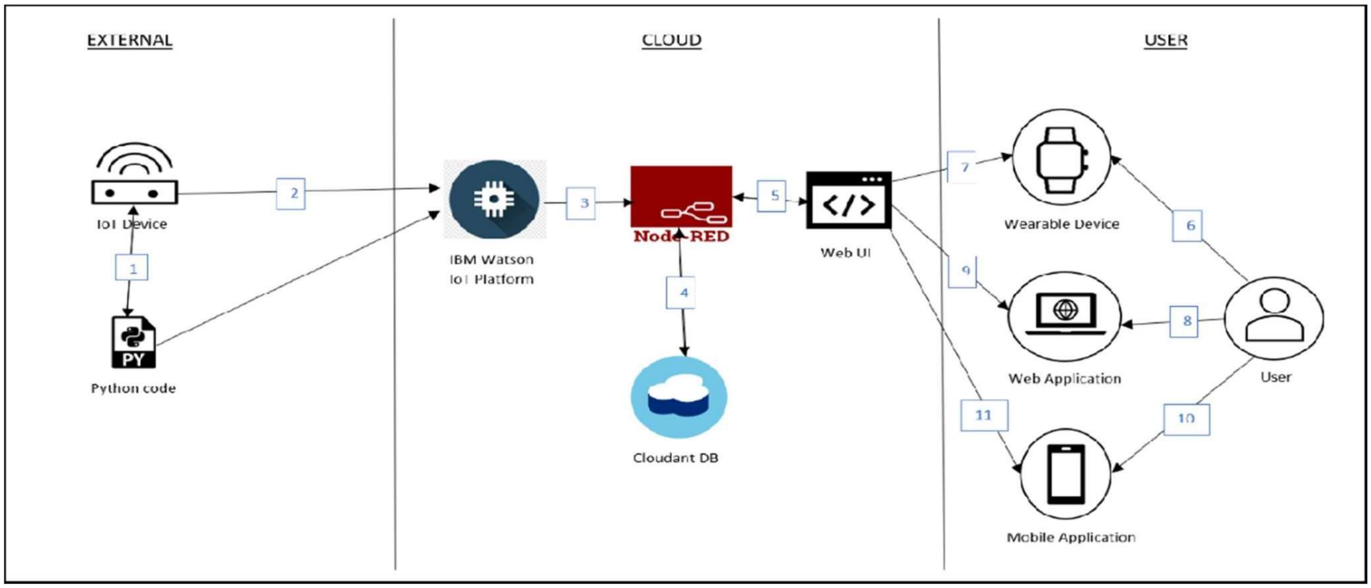
5.2 Solution & Technical Architecture

Solution Technical Architecture



Technical Architecture

1. Include all the processes (As an application logic / Technology Block)



1. Provide infrastructural demarcation (Local / Cloud)
   - ➢ microcontroller used is an Arduino UNO rev3 or Pegboard
   - ➢ Wi-Fi module to upload all the data to the cloud
   - ➢ a Miniaturized MOS sensor for monitoring the gaseous fuel level

2. Indicate external interfaces (third party API's etc.)
   - ➢ Node Red is used of design the circuit of device
   - ➢ App Inventor to develop application

3. Indicate Data Storage components / services
   - ➢ IBM's Cloudant DB is used for storing data in cloud

Table-1: Components & Technologies:

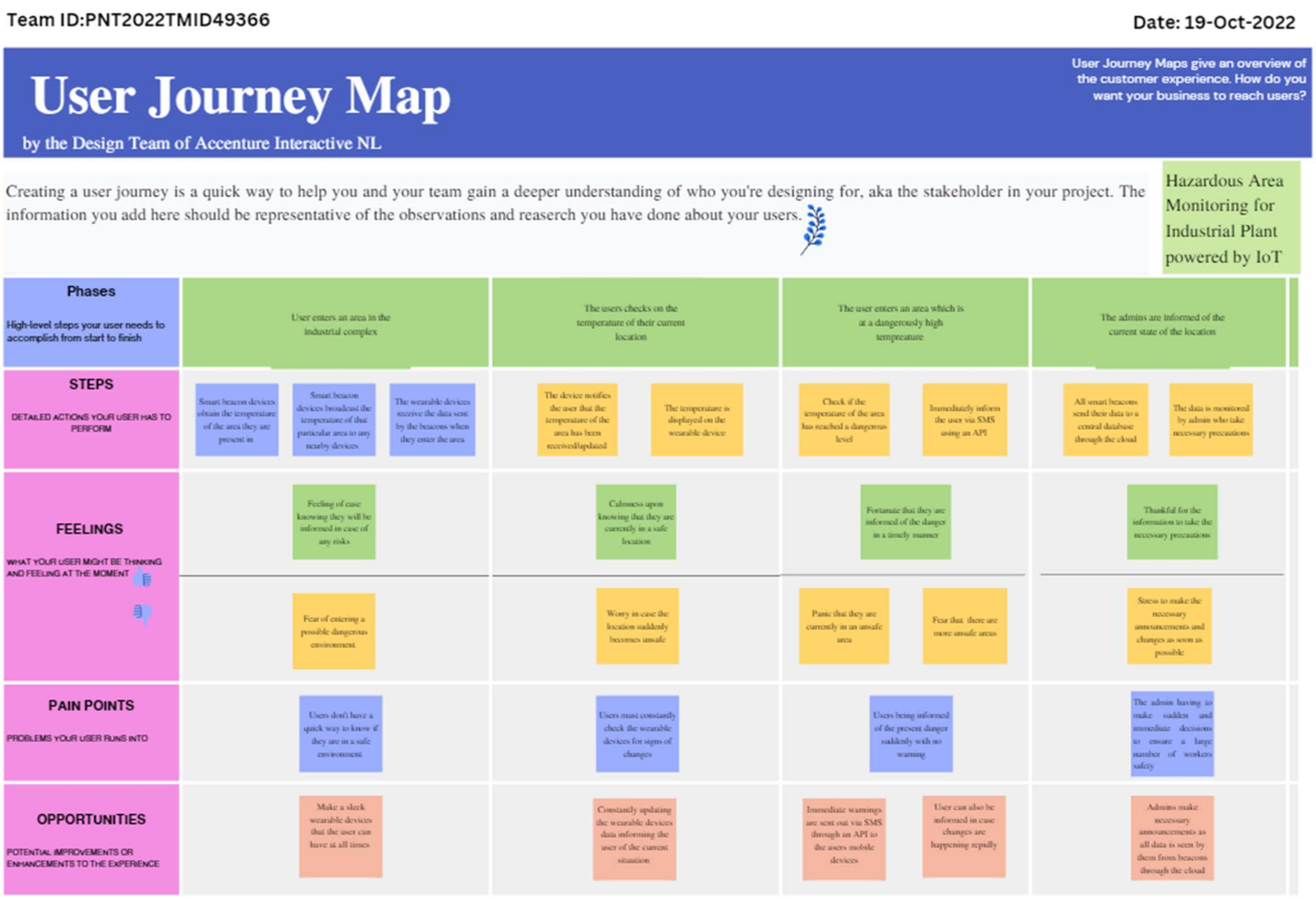
S.No	Component	Description	Technology
1	User Interface	User can interact with device using web application and through SMS	HTML, CSS, Java

2	Application Logic-1	Get the temperature using sensor and send it to the microcontroller for analysis and compare with standard values	Java / Python
3	Application Logic-2	Provide solution to monitor data and control the machine and units and provide API between user and devices	IBM Watson STT service
4	Database	The data will be temperature value at regular interval of time and the combustible gas levels	MySQL
5	Cloud Database	The measured data is sent to the cloud service using Wi-Fi module	IBM Cloudant
6	File Storage	Require an encrypted storage service among industry, workers and officers	IBM Block Storage, or Drop box ,aws
7	External API-1	Purpose of External API used in the application	IBM Weather API, etc.
8	External API-2	Purpose of External API used in the application	Aadhar API, etc.
9	Machine Learning Model	Purpose of Machine Learning Model	Object Recognition Model, etc.

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1	Open-Source Frameworks	To create web application and circuit designing	App Inventor and Node-Red
2	Security Implementations	Each user should have their own credential to access data servers	Email and respective password
3	Scalable Architecture	Industrial 4.0, Internet of Things	Data Analytics, web service
4	Availability	1. microcontroller with integrated Wi-Fi module to upload all the data to the cloud 2. Temperature sensor 3. monitoring the gaseous fuel level	Arduino UNO Wi-Fi or Pyboard or ESP8266 Infrared Miniaturized MOS sensor
5	Performance	Makes use of advanced sensors Distributed data service High efficient microcontrollers	Lower power consumption Longer range communication High speed data transfer

5.3 User Stories



6) PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	Literature survey on the selected project & gathering of information by referring the technical papers, research publications etc.	09 October 2022

Prepare Empathy map	Prepare the list of problem statements & create the empathy map about the pains and gains of user.	23 October 2022
Ideation	Brainstorming about the project and prioritize the top 3 ideas based on the feasibility & importance.	23 October 2022
Proposed solution	Prepare the proposed solution which includes feasibility of idea, business model, social impact, scalability of solution, etc.	23 October 2022
Problem Solution Fit	Prepare the problem solution fit document for the project.	23 October 2022
Solution Architecture	Preparing the solution architecture for the project.	23 October 2022
Customer Journey	Prepare the customer journey maps to understand the user interactions & experience with the application	23 October 2022
Functional Requirement	Prepare the functional requirement document.	23 October 2022
Data flow diagram	Create the data flow diagram for the selected project.	26 October 2022
Technology Architecture	Prepare the technology architecture for selected project based on the technologies needed.	26 November 2022

Prepare Milestone & Activity list	Prepare the milestones & Activity list of the selected project.	08 November 2022
Project Development – Delivery of sprint-1, 2, 3 & 4	Develop the code for project and submit it for review / testing.	17 November 2022

6.2 Sprint Delivery Schedule

Sprint	Functional Requirements (Epic)	User Story Number	Description/Task	Story Points	Priority	Team Members
Sprint-1	Planning	USN-1	• Define the specification • Draw user flows • Brainstorm solution • Start sketching the app • Plan the promotional Strategy • Working together.	2	High	Jaganathan G RamChandru.S
Sprint-2	Designing	USN-2	• Get the app idea for the paper • Do competitive market research • Make design mock ups of the app • Write out the features for the app • Create the app graphic design	1	High	Velmurugan M Balamurugan S
Sprint-3	Developing And coding	USN-3	• Filter the IOT content • Do user interface on the app • Easy offline access • Social media integration • The app also include premium content	2	High	Jaganathan G RamChandru.S

Sprint-4	Testing	USN-4	☐ Documentation testing ☐ Function testing ☐ Usability testing ☐ User interface testing ☐ Compatibility testing ☐ Performance testing ☐ Security testing ☐ Recovery testing	2	High	Jaganathan G RamChandru.S Balamurugan S Velmurugan M

Project tracker, Velocity & Burndown Chart:

Sprint	**Duration**	**Sprint Start Date**	**Sprint End Date (Planned)**	**Sprint Release Date (Actual)**
Sprint – 1	3 Days	08 Nov 2022	11 Nov 2022	11 Nov 2022
Sprint – 2	3 Days	12 Nov 2022	14 Nov 2022	14 Nov 2022
Sprint – 3	3 Days	15 Nov 2022	17 Nov 2022	17 Nov 2022
Sprint – 4	3 Days	18 Nov 2022	20 Nov 2022	18 Nov 2022

7) CODING & SOLUTIONING

7.1 Feature 1

Solution


mymodule.py - C:\Users\Mr Jagan\OneDrive\Desktop\mymodule.py (3.7.0)

File Edit Format Run Options Window Help

```python
import time
import sys
import random
import ibmiotf.application
import ibmiotf.device
organization = "d43fm6"
deviceType = "Ultrasonic"
deviceId = "5545"
authMethod = "use-token-auth"
authToken = "0987654321"
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()
```

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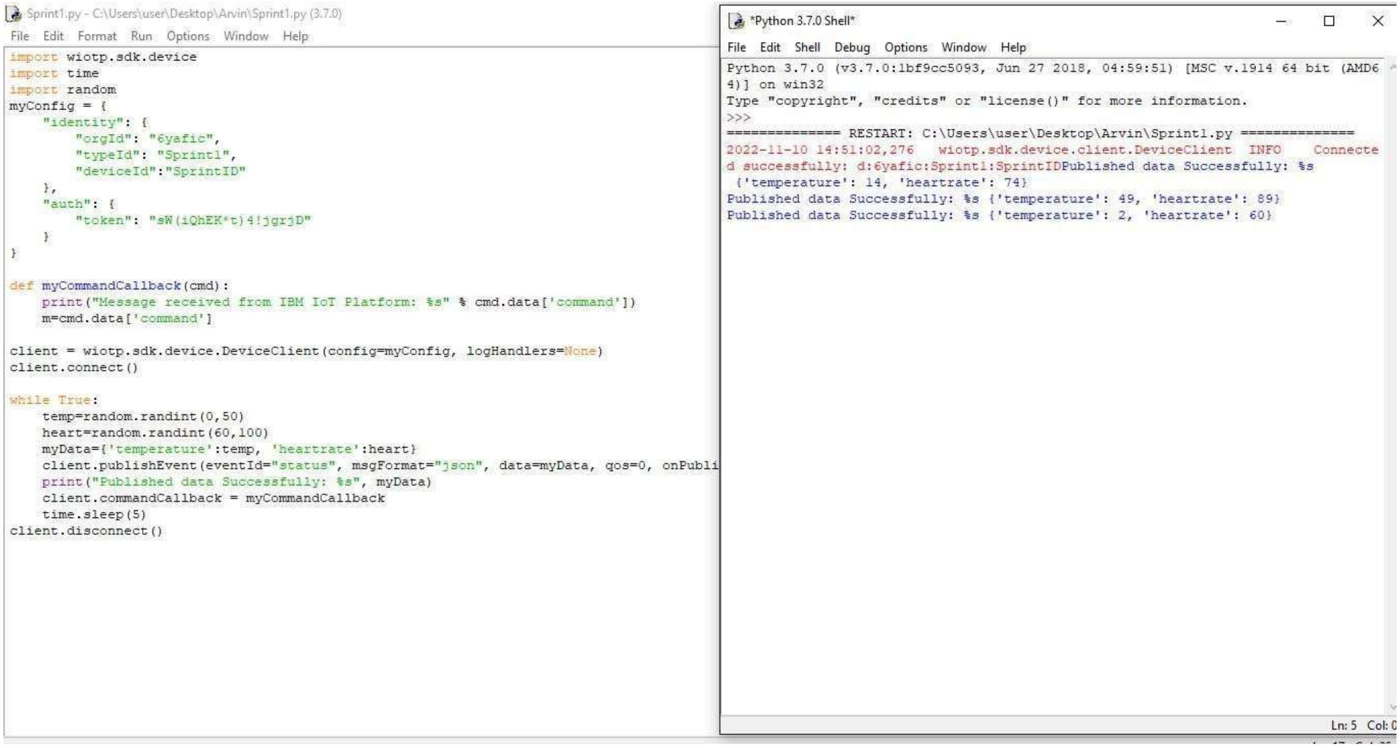
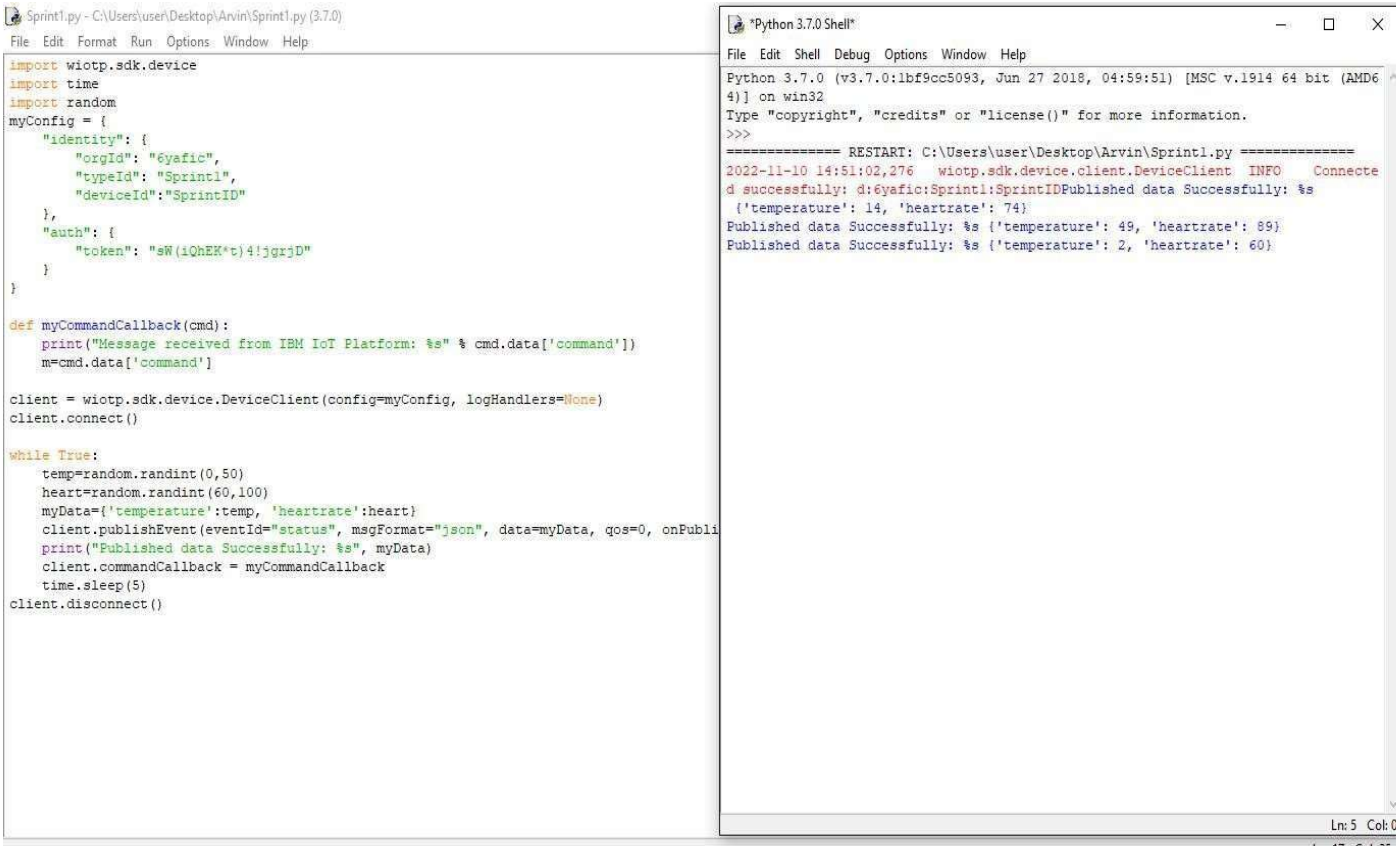
7.2 Feature 2

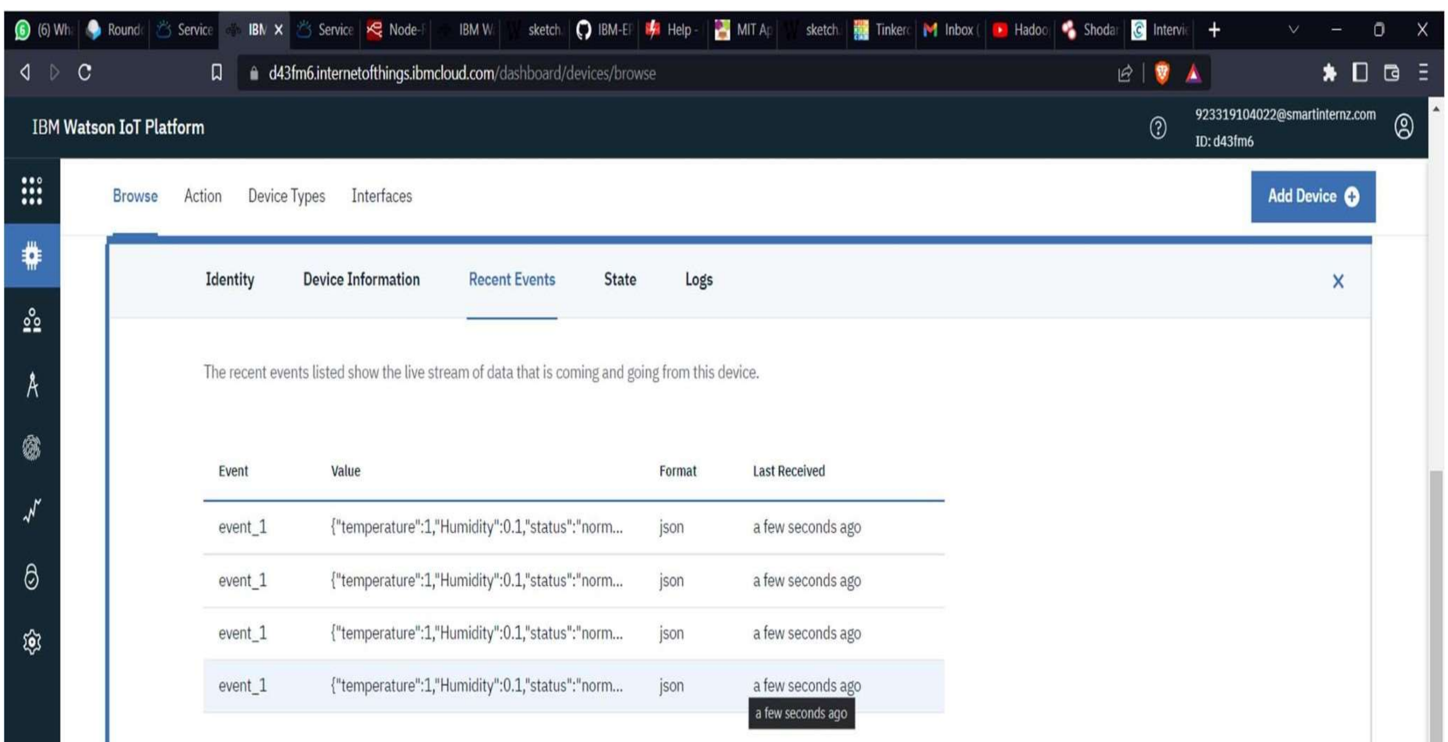
Solutioning



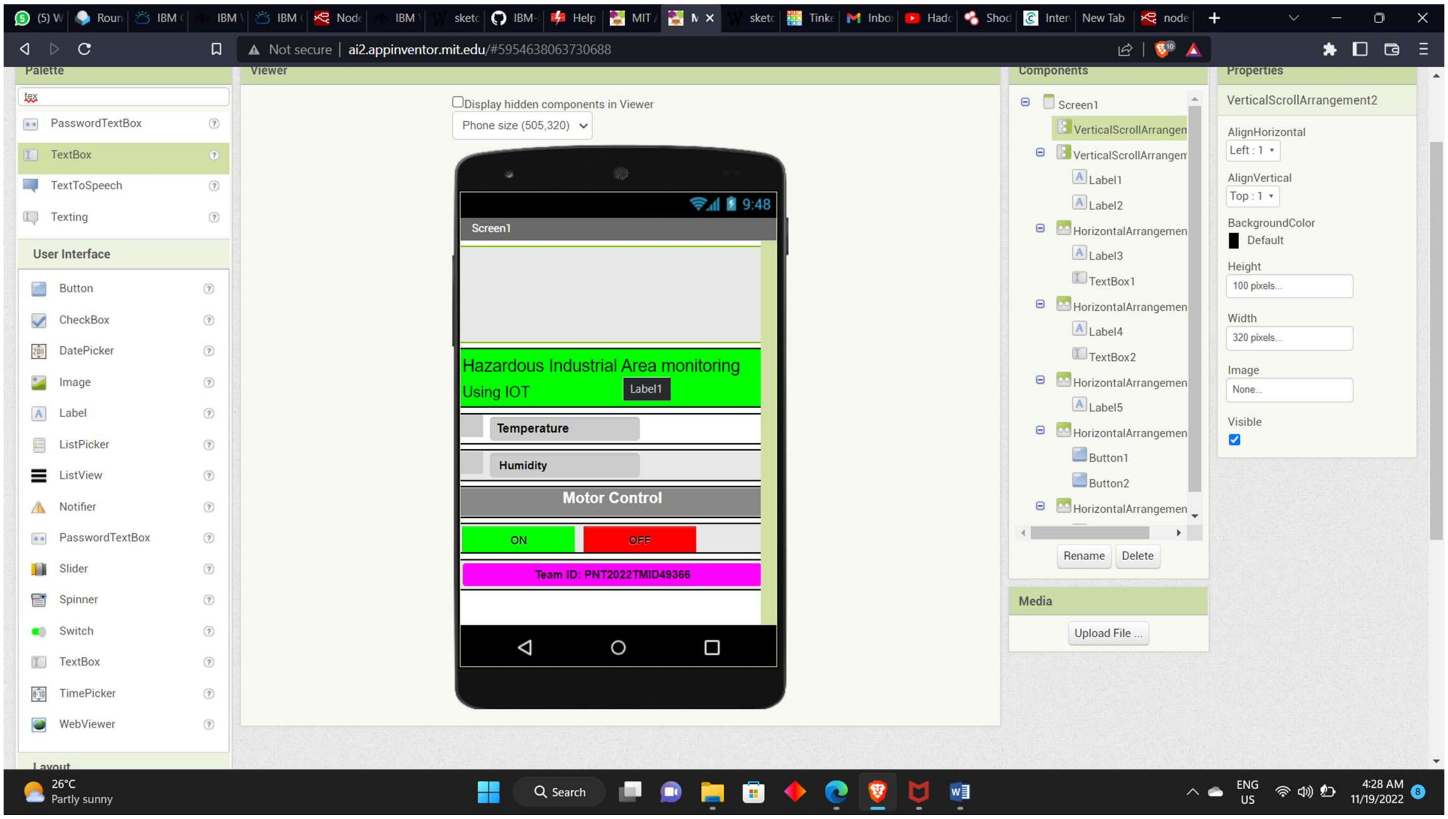
8) TESTING

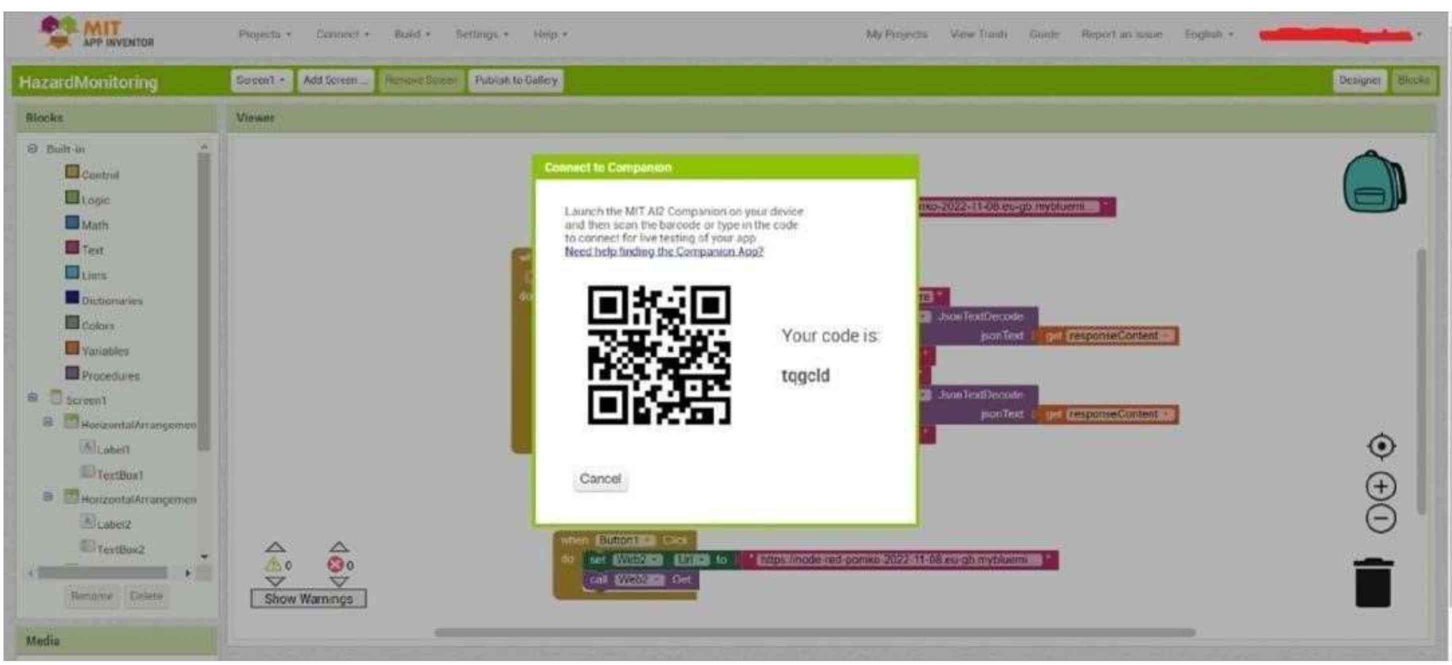
8.1 Test Cases

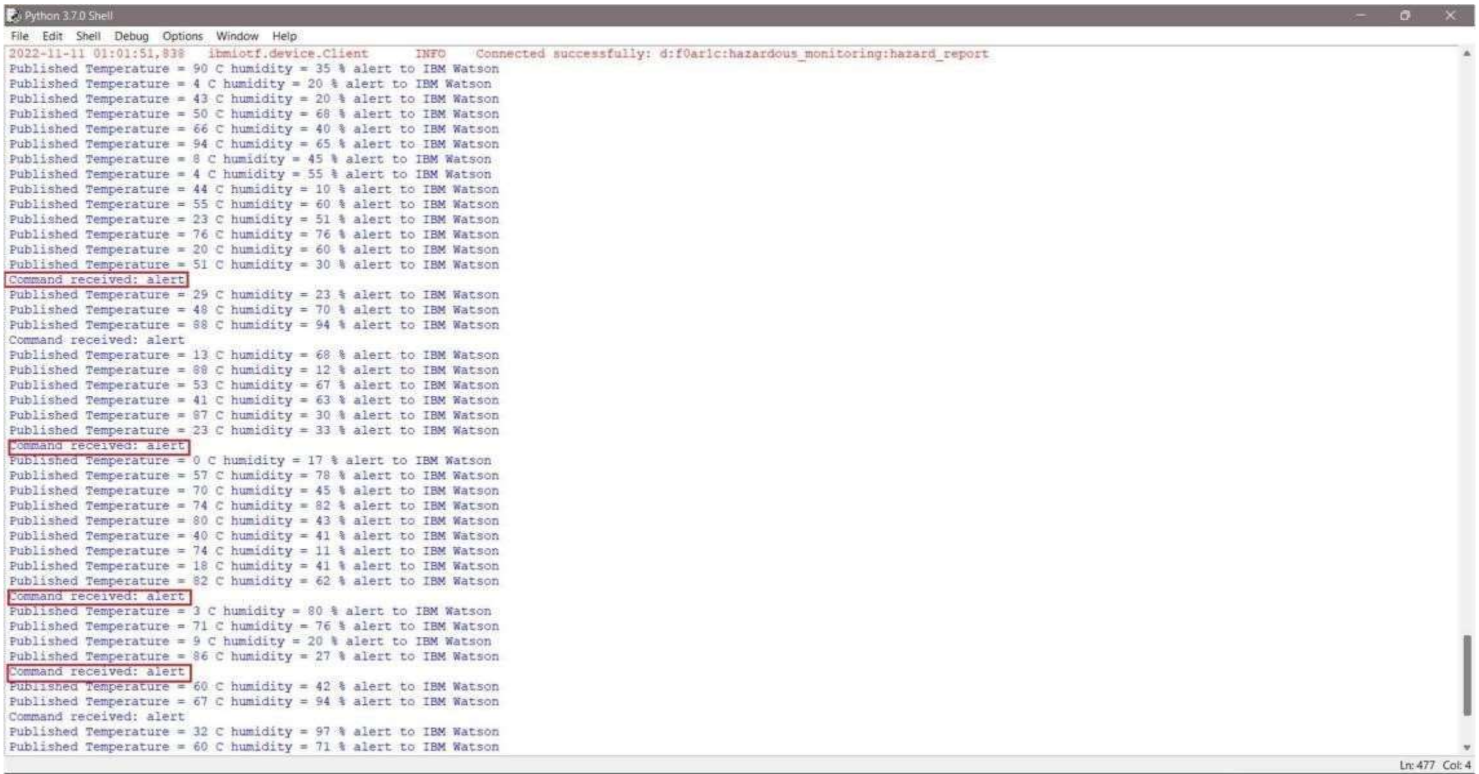




8.2 User Acceptance Testing





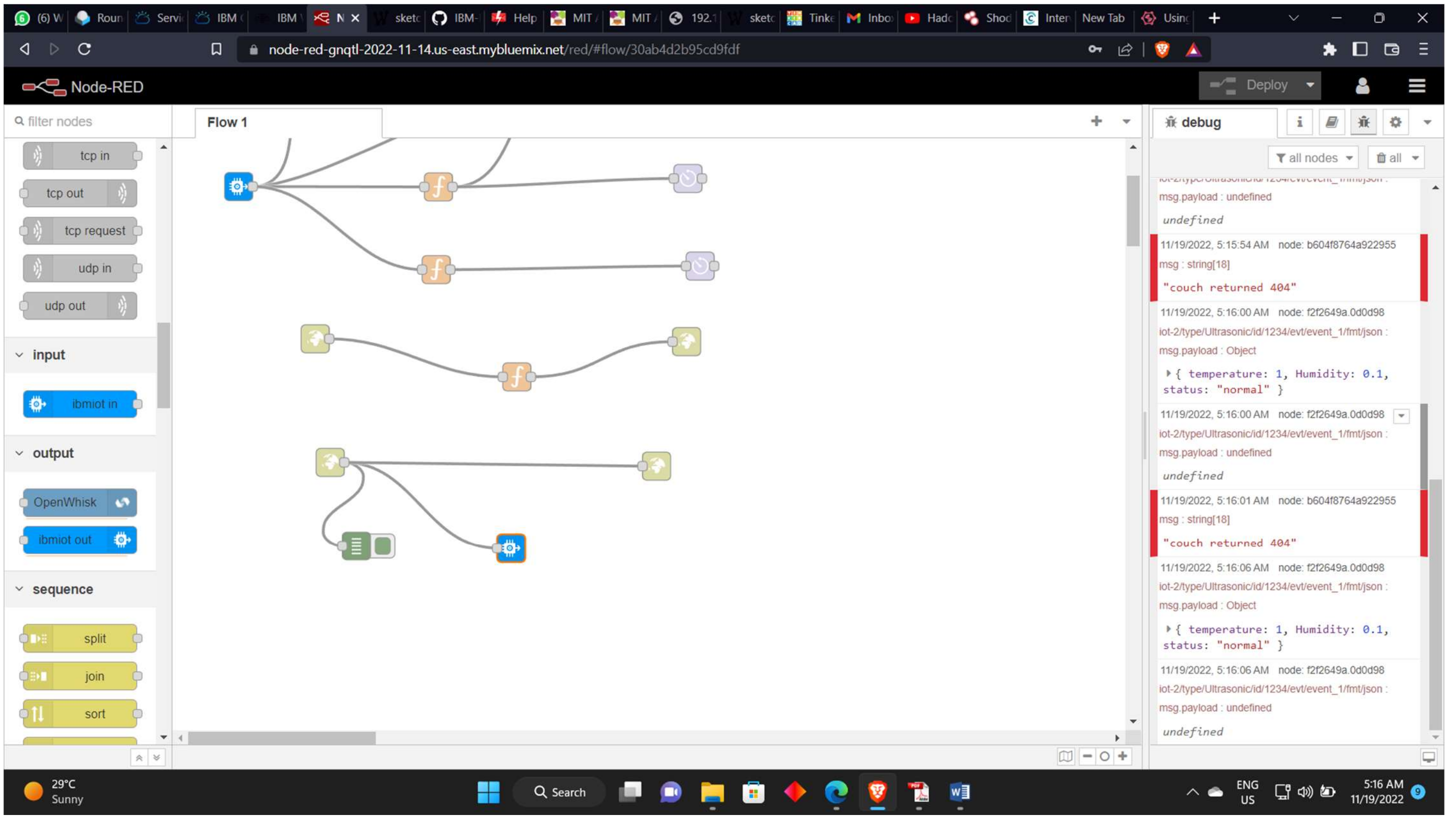


```
Python 3.7.0 Shell
File Edit Shell Debug Options Window Help
2022-11-11 01:01:51,838   ibmiotf.device.Client      INFO    Connected successfully: d:f0ar1c:hazardous_monitoring:hazard_report
Published Temperature = 90 C humidity = 35 % alert to IBM Watson
Published Temperature = 4 C humidity = 20 % alert to IBM Watson
Published Temperature = 43 C humidity = 20 % alert to IBM Watson
Published Temperature = 50 C humidity = 68 % alert to IBM Watson
Published Temperature = 66 C humidity = 40 % alert to IBM Watson
Published Temperature = 94 C humidity = 65 % alert to IBM Watson
Published Temperature = 8 C humidity = 45 % alert to IBM Watson
Published Temperature = 4 C humidity = 55 % alert to IBM Watson
Published Temperature = 44 C humidity = 10 % alert to IBM Watson
Published Temperature = 55 C humidity = 60 % alert to IBM Watson
Published Temperature = 23 C humidity = 51 % alert to IBM Watson
Published Temperature = 76 C humidity = 76 % alert to IBM Watson
Published Temperature = 20 C humidity = 60 % alert to IBM Watson
Published Temperature = 51 C humidity = 30 % alert to IBM Watson
Command received: alert
Published Temperature = 29 C humidity = 23 % alert to IBM Watson
Published Temperature = 48 C humidity = 70 % alert to IBM Watson
Published Temperature = 88 C humidity = 94 % alert to IBM Watson
Command received: alert
Published Temperature = 13 C humidity = 68 % alert to IBM Watson
Published Temperature = 88 C humidity = 12 % alert to IBM Watson
Published Temperature = 53 C humidity = 67 % alert to IBM Watson
Published Temperature = 41 C humidity = 63 % alert to IBM Watson
Published Temperature = 87 C humidity = 30 % alert to IBM Watson
Published Temperature = 23 C humidity = 33 % alert to IBM Watson
Command received: alert
Published Temperature = 0 C humidity = 17 % alert to IBM Watson
Published Temperature = 57 C humidity = 78 % alert to IBM Watson
Published Temperature = 70 C humidity = 45 % alert to IBM Watson
Published Temperature = 74 C humidity = 82 % alert to IBM Watson
Published Temperature = 80 C humidity = 43 % alert to IBM Watson
Published Temperature = 40 C humidity = 41 % alert to IBM Watson
Published Temperature = 74 C humidity = 11 % alert to IBM Watson
Published Temperature = 18 C humidity = 41 % alert to IBM Watson
Published Temperature = 82 C humidity = 62 % alert to IBM Watson
Command received: alert
Published Temperature = 3 C humidity = 80 % alert to IBM Watson
Published Temperature = 71 C humidity = 76 % alert to IBM Watson
Published Temperature = 9 C humidity = 20 % alert to IBM Watson
Published Temperature = 86 C humidity = 27 % alert to IBM Watson
Command received: alert
Published Temperature = 60 C humidity = 42 % alert to IBM Watson
Published Temperature = 67 C humidity = 94 % alert to IBM Watson
Command received: alert
Published Temperature = 32 C humidity = 97 % alert to IBM Watson
Published Temperature = 60 C humidity = 71 % alert to IBM Watson
Ln: 477 Col: 4
```

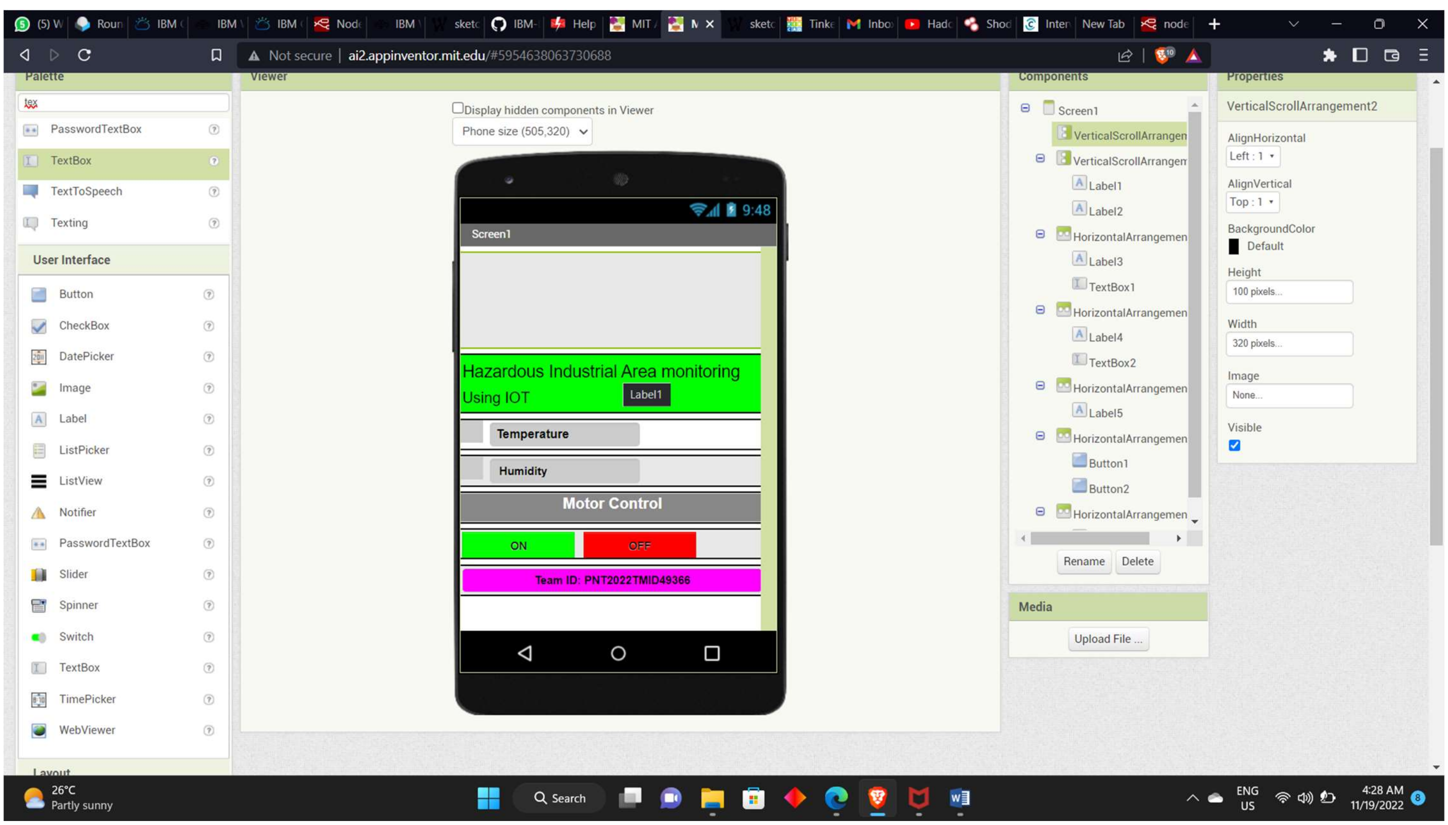
9) RESULTS

9.1 Performance Metrics

```
*Python 3.7.0 Shell*
File Edit Shell Debug Options Window Help
Python 3.7.0 (v3.7.0:1bf9cc5093, Jun 27 2018, 04:59:51) [MSC v.1914 64 bit (AMD64)] on win32
Type "copyright", "credits" or "license()" for more information.
>>>
 RESTART: C:/Users/New/AppData/Local/Programs/Python/Python37/ibmproject/hazard.py
2022-11-12 11:05:12,626   ibmiotf.device.Client      INFO    Connected successfully: d:pyflre:hazard:231099
Published Temperature=98 C Noise:61 db Gas_leakage:63 J/Kg Radiation:45 rad  to IBM Watson
Published Temperature=19 C Noise:4 db Gas_leakage:97 J/Kg Radiation:73 rad  to IBM Watson
Published Temperature=70 C Noise:0 db Gas_leakage:85 J/Kg Radiation:64 rad  to IBM Watson
Published Temperature=74 C Noise:61 db Gas_leakage:54 J/Kg Radiation:97 rad  to IBM Watson
Published Temperature=47 C Noise:77 db Gas_leakage:50 J/Kg Radiation:91 rad  to IBM Watson
Published Temperature=78 C Noise:0 db Gas_leakage:33 J/Kg Radiation:27 rad  to IBM Watson
Published Temperature=17 C Noise:6 db Gas_leakage:99 J/Kg Radiation:78 rad  to IBM Watson
Published Temperature=7 C Noise:38 db Gas_leakage:98 J/Kg Radiation:69 rad  to IBM Watson
Published Temperature=5 C Noise:79 db Gas_leakage:91 J/Kg Radiation:50 rad  to IBM Watson
Published Temperature=20 C Noise:35 db Gas_leakage:21 J/Kg Radiation:4 rad  to IBM Watson
Published Temperature=35 C Noise:73 db Gas_leakage:11 J/Kg Radiation:27 rad  to IBM Watson
Published Temperature=61 C Noise:73 db Gas_leakage:55 J/Kg Radiation:68 rad  to IBM Watson
Published Temperature=99 C Noise:76 db Gas_leakage:62 J/Kg Radiation:32 rad  to IBM Watson
Published Temperature=40 C Noise:28 db Gas_leakage:1 J/Kg Radiation:97 rad  to IBM Watson
Published Temperature=10 C Noise:24 db Gas_leakage:83 J/Kg Radiation:76 rad  to IBM Watson
Published Temperature=50 C Noise:18 db Gas_leakage:95 J/Kg Radiation:95 rad  to IBM Watson
Published Temperature=60 C Noise:21 db Gas_leakage:43 J/Kg Radiation:0 rad  to IBM Watson
Published Temperature=60 C Noise:25 db Gas_leakage:5 J/Kg Radiation:3 rad  to IBM Watson
Published Temperature=51 C Noise:40 db Gas_leakage:18 J/Kg Radiation:19 rad  to IBM Watson
Published Temperature=0 C Noise:8 db Gas_leakage:91 J/Kg Radiation:58 rad  to IBM Watson
Published Temperature=41 C Noise:17 db Gas_leakage:90 J/Kg Radiation:95 rad  to IBM Watson
Published Temperature=5 C Noise:30 db Gas_leakage:40 J/Kg Radiation:13 rad  to IBM Watson
Published Temperature=29 C Noise:97 db Gas_leakage:9 J/Kg Radiation:46 rad  to IBM Watson
Published Temperature=6 C Noise:84 db Gas_leakage:64 J/Kg Radiation:80 rad  to IBM Watson
Published Temperature=54 C Noise:73 db Gas_leakage:73 J/Kg Radiation:46 rad
Ln: 5 Col: 0
```



node-red-gnqtl-2022-11-14.us-east.mybluemix.net/red/#flow/30ab4d2b95cd9fdf
Node-RED
Deploy
Flow 1
debug
tcp in
tcp out
tcp request
udp in
udp out
input
ibmiot in
output
OpenWhisk
ibmiot out
sequence
split
join
sort
11/19/2022, 5:15:54 AM node: b604f8764a922955
msg : string[18]
"couch returned 404"
11/19/2022, 5:16:00 AM node: f2f2649a.0d0d98
iot-2/type/Ultrasonic/id/1234/evt/event_1/fmt/json :
msg.payload : Object
{ temperature: 1, Humidity: 0.1, status: "normal" }
msg.payload : undefined
undefined



ai2.appinventor.mit.edu/#5954638063730688
Palette
Viewer
Components
Properties
Display hidden components in Viewer
Phone size (505,320)
Screen1
Hazardous Industrial Area monitoring Using IOT
Label1
Temperature
Humidity
Motor Control
ON
OFF
Team ID: PNT2022TMID49366
User Interface
Button
CheckBox
DatePicker
Image
Label
ListPicker
ListView
Notifier
PasswordTextBox
Slider
Spinner
Switch
TextBox
TimePicker
WebViewer
VerticalScrollArrangement2
AlignHorizontal
Left : 1
AlignVertical
Top : 1
BackgroundColor
Default
Height
100 pixels...
Width
320 pixels...
Image
None...
Visible
Rename
Delete
Media
Upload File ...

Published for MIT Application

```
Python 3.7.0 Shell
File  Edit  Shell  Debug  Options  Window  Help
2022-11-11 01:01:51,838   ibmiotf.device.Client      INFO    Connected successfully: d:f0ar1c:hazardous_monitoring:hazard_report
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Published Temperature = 94 C humidity = 65 % alert to IBM Watson
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Published Temperature = 55 C humidity = 60 % alert to IBM Watson
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Command received: alert
Published Temperature = 29 C humidity = 23 % alert to IBM Watson
Published Temperature = 48 C humidity = 70 % alert to IBM Watson
Published Temperature = 88 C humidity = 94 % alert to IBM Watson
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Published Temperature = 13 C humidity = 68 % alert to IBM Watson
Published Temperature = 88 C humidity = 12 % alert to IBM Watson
Published Temperature = 53 C humidity = 67 % alert to IBM Watson
Published Temperature = 41 C humidity = 63 % alert to IBM Watson
Published Temperature = 87 C humidity = 30 % alert to IBM Watson
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Published Temperature = 74 C humidity = 11 % alert to IBM Watson
Published Temperature = 18 C humidity = 41 % alert to IBM Watson
Published Temperature = 82 C humidity = 62 % alert to IBM Watson
Command received: alert
Published Temperature = 3 C humidity = 80 % alert to IBM Watson
Published Temperature = 71 C humidity = 76 % alert to IBM Watson
Published Temperature = 9 C humidity = 20 % alert to IBM Watson
Published Temperature = 86 C humidity = 27 % alert to IBM Watson
Command received: alert
Published Temperature = 60 C humidity = 42 % alert to IBM Watson
Published Temperature = 67 C humidity = 94 % alert to IBM Watson
Command received: alert
Published Temperature = 32 C humidity = 97 % alert to IBM Watson
Published Temperature = 60 C humidity = 71 % alert to IBM Watson
                                                                  Ln: 477  Col: 4
```

10) ADVANTAGES & DISADVANTAGES

Advantage:

- **Continuous Monitoring -** ability to provide machine operators and IT professionals easy access to Bluetooth Low Energy sensor data in real-time
- **Seamless Coverage -** Cassia's ATX2000 Bluetooth gateway provide seamless coverage for large outdoor hazardous area environments allowing operation staff to move freely and safely throughout a location while equipment is continuously monitored.
- **Easy Deployment / Management** - Cassia's IoT controller software platform allows for easy setup and management of Bluetooth gateways and monitoring of end devices
- **Long-Range Connectivity**– extend Bluetooth connectivity up to 400 meters for Bluetooth 4.0 and up to 1 km using Bluetooth 5.0 in open spaces
- **Multiple Device Asset Tracking & Monitoring -** connect and control up 40 Bluteooth Low Energy devices per gateway simultaneously and/or listen to hundreds of devices in Broadcast mode
- **Low Cost** - one-time cost of hardware and low monthly software controller (device management) fees
- **Security -** Integrated TPM2 chip for end-to-end security
- **Bluetooth Locationing -** track device failure and receive alerts in the event a device will fail, reducing equipment downtime
- **Data Collection -** collect critical data from equipment without the need of a machine operator being present

Disadvantage:

- Not a direct displacement or stress measurement
- Event parameters interpretation is needed for displacement and stress measurements
- Still an evolving technology
- Interpretation techniques are largely empirical
- Uncertainty in interpretation

11) CONCLUSION

A system to monitor temperature, humidity, moisture levels in the soil was designed and the project provides an opportunity to study the existing systems, along with their features and drawbacks. Agriculture is one of the most water-consuming activities. The proposed system can be used to switch the motor (on/off) depending on favorable condition of plants i.e. sensor values, thereby automating the process of irrigation. Which is one of the most time efficient activities in farming, which helps to prevent over irrigation or under irrigation of soil thereby avoiding crop damage. The farm owner can monitor the process online through an android App. Though this project can be concluded that there can be considerable development in farming with the use of IOT and automation.

12) FUTURE SCOPE

Hazardous substances, particularly flammable or toxic, are increasingly used or produced in industrial processes. This involves many risks such as gas leaks, which can be harmful and even fatal to humans. Therefore, it is necessary to monitor the occurrence and concentration of various gases.

One of the programs that helps keep industrial facilities protected is area monitoring. This solution improves worker and worksite safety for temporary, high-risk deployments & semi-permanent monitoring. Besides, it can be used in confined spaces or remote locations.

The Rugged and Reliable Performance Matter

Because gas detectors are designed to help protect workers and worksites, sensor performance and particularly response time are essential, as is the ability to monitor multiple gases simultaneously.

Facilitating Connectivity

With the advent of connectivity technology and network scalability, health and safety professionals can simultaneously monitor jobs of any size, in multiple working sites and locations, locally or remotely. Both onsite and remote safety managers can capture the readings of the devices and take necessary actions including sending the evacuation from a control room.

Meet the Future of Area Monitoring

MSA is bringing a breakthrough area monitoring solution to the market – the ALTAIR® io360 Gas Detector which combines a compact rugged design with months of battery life and the ability to effortlessly create connected work sites. It features an intuitive installation process and a dedicated mobile application that guides the system set up so that you can be confident you did the job right. The ALTAIR io360 is also equipped with a strong magnet as well as a D-ring so you can mount it almost anywhere inside an industrial facility. It is designed to effortlessly connect worksites of any size while offering the simple usability of a smart-home product.

13) APPENDIX

Source code

Connect and data receiving from IBM IoT Watson

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

#Provide your IBM Watson Device Credentials
organization = "bxobbs"
deviceType = "b5ibm"
deviceId = "b5device"
authMethod = "token"
authToken = "b55m1eibm"

# Initialize GPIO
def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
```

```
    if status=="lighton":
        print ("led is on")
    else :
        print ("led is off")

    #print(cmd)
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, "to IBM Watson")

    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()
```

Temperature and Humidity data share for the Wokwi to IBM Watson and Cloud database

```
import wiotp.sdk.device
import time
import random
myConfig = {
    "identity": {
        "orgId":"17lsro"
        "typeId" :"Ultrasonic"
        "deviceId":"12345"
        }
    "auth": {
        "token": "a-d43fm6-s6antsnhzd"
        }
    }

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, longHandlers=None)
client.connect()

while True:
    temp=random.randint(0,50)
    heart=random.randint(60,100)
    myData={'temperature':tmep, 'humidity':heart}
    client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0, onPublish=None)
```

```
    print("published data Successfully: %s", myData)
    client.commandCallback = mycommandCallback
    time.sleep(5)
client.disconnect()
```

GitHub & Project Demo Link

https://github.com/IBM-EPBL/IBM-Project-5188-1658750513.git

https://drive.google.com/file/d/1bvWHRKueNkbUsmbJMC6zs_Ve9DNjtgVj/view?usp=share_link