A PROJECT REPORT ON

Hazardous Area Monitoring for Industrial Plant powered by IoT

Domain : Internet of Thing

Team ID : PNT2022TMID41953
College name:Selvam College Of Technology.
M.Rajaganapathy.(622519106034).
S.Prasanth.(622519106032).
G.Dhanush.(622519106010).
R.Sutharsan.(622519106044

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1. INTRODUCTION

a. Project Overview

- ✓ The Industrial Internet of things or IoT has gained recognition due to the advancement it has made in communication technology. Industrial IoT is an application of IoT that enables control of industries over the Internet using smart devices and sensors. The two main entity which ensures effectiveness in any field is monitoring and control.
- ✓ It is the Gain knowledge of Watson IoT Platform.
- ✓ Connecting IoT devices to the Watson IoT platform and exchanging the sensor data. ✓ Gain knowledge on Cloudant DB.Creating a Web Application through which the user interacts with the device.

b. 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 wearabledevice, 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

a. Existing problem

The main objectives of the proposed work are To provide low cost effective environmental radiological monitoring system. To develop an early warningsystem in NuclearPower plants and submarines.Whenever the nuclear radiationis released to the open environment, due to presenceof radioactive elementspresent in the radiation, environmental parameters such as temperature, pressure, sound, smoke and carbon monoxide levels various rapidly. Due to breakdownof radioactive elementstemperature increases rapidly and humidity decreases. By these variations we can detect the

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presence of nuclear radiation. All these variations of atmospheric parameters are sensed by the incorporated sensor module and it'sdisplayed by things speak web server. So radiation leakage in nuclear power plant can be detected. By the tremendous variation of atmospheric parameters, all the operators can be easily came to know about the radiation leakages. The Architecture of sensor module, abstract architecture of sensor nodes used in wireless Sensor network

b. References

1)Ashwini S R , Dr. Shivashankar

,2) Karthik R

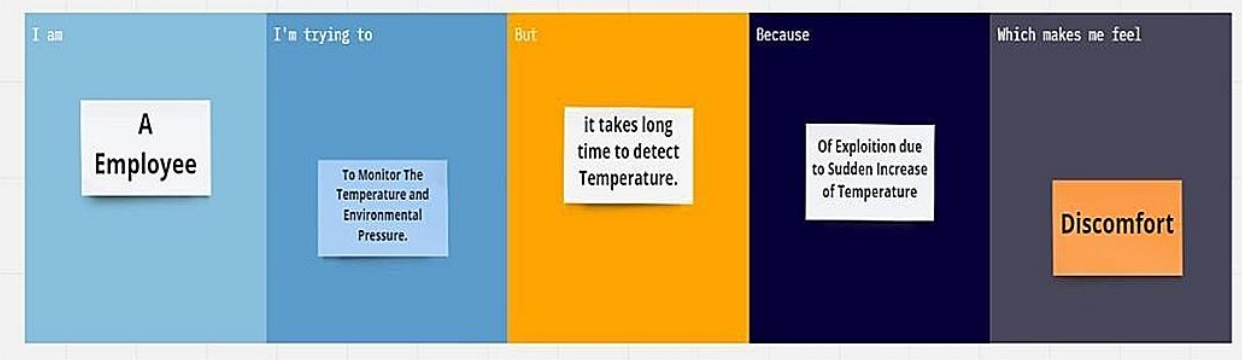
3)Harish B R

4)Karan D Bafna

c. Problem Statement Definition

Create a problem statement to understand your customer's point of view .The Customer Problem

Statement template helps you focus on what matters to createexperiencespeople will love. A well-articulated customer problem statement allows you and your team to find theideal solution for the challenges your customers face. Throughout the process, you'llalso be able to empathize with your customers, which helps you better understandhowtheyperceive your productor service



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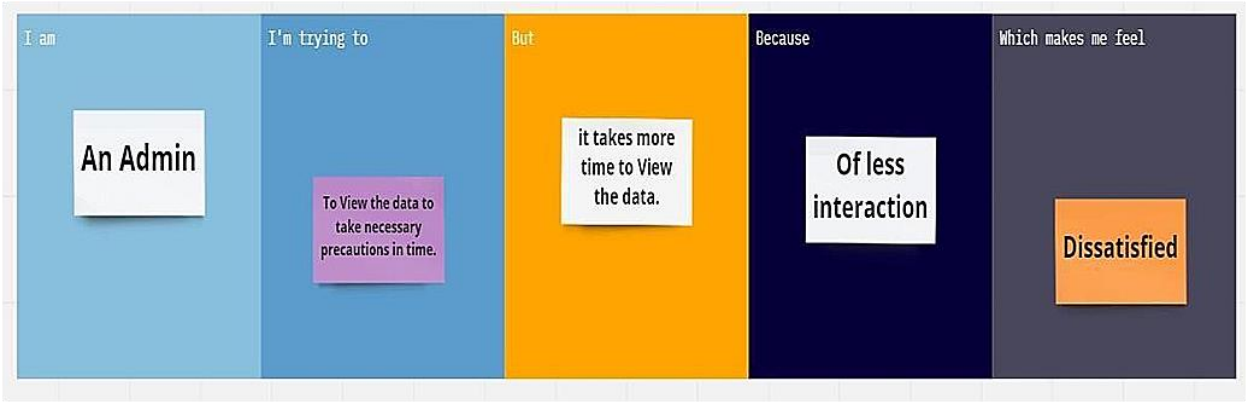

Problem Statement (PS)	**I am (Customer)**	**I'm trying to**	**But**	**Because**	**Which makes me feel**
PS-1	A Employee	To Monitor the temperature and environment pressure	It takes long to detect Temperature	Of exploitation to sudden increase of Temperature	Discomfort
PS-2	An Admin	To view the data to take necessary precaution in time	It takes more time to view the data	Of less interaction	Dissatisfied

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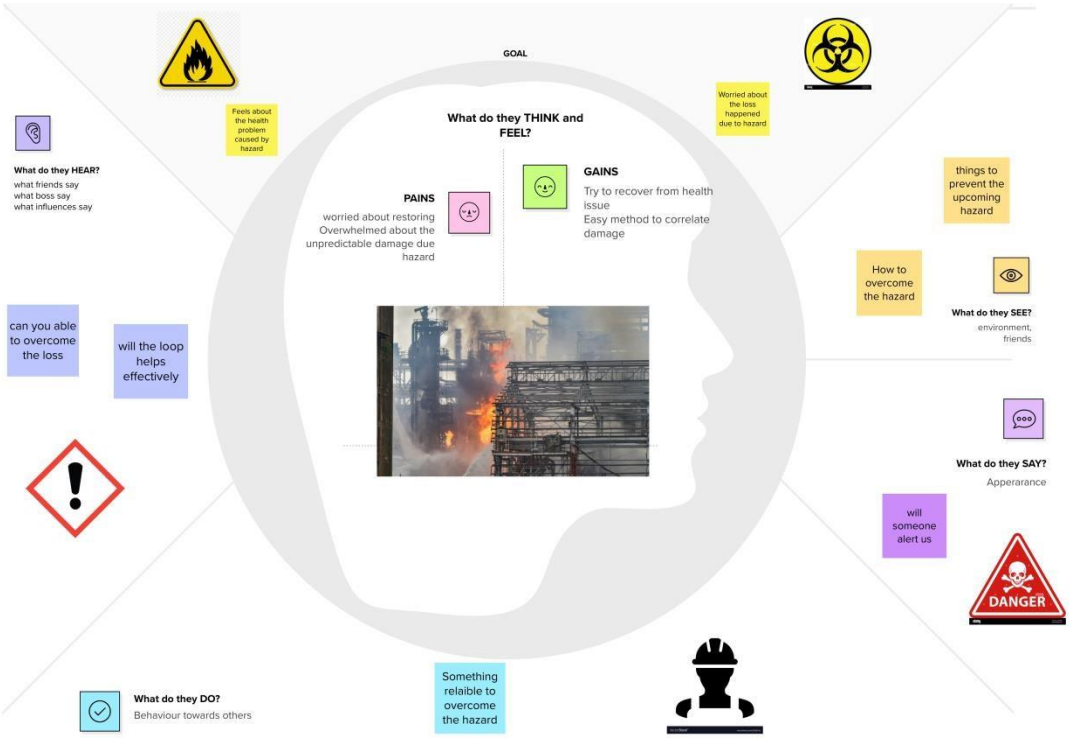
3.IDEATION & PROPOSEDSOLUTION

a. Empathy Map Canvas



b.

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c. Ideation & Brainstorming

d. **IDEA 1:**

Here, we create an IoT based hazard monitoring system specifically suited to requirements of mining, refining and manufacturing industries. The system actively records, processes and analyzes the temperature of surroundings, which is a prime safety parameter in areas where molten metal is processed, manufacturing is done or welds are made. Also, it keeps track of high levels of dangerous gasses present in the environment. If a parameter is violated, the system sends an immediate notification to a set of preset list of users on their smartphones, and continues logging and monitoring data for further analysis to suggest improvements in the safety regulations of the industry. The sensors used in this prototype model can be modified with industry requirements (for example more robust temperature sensor may be required in very harsh conditions) whenever the need arises.

2. IDEA 2:

The operations of various industrial equipment are affected by the change in temperature and a physical characteristic of the surroundings hence monitoring the changes in temperature is very crucial. The computer consists of an embedded microcontroller chip for different parameters; The Arduino has a collection of all the code burned into it. Each code represents its own parameter i.e. air, temp, pressure, humidity. The power system, intelligent industrial remote monitoring, intelligent warehouse monitoring etc.., can be implemented with the systems platform. Integration of IOT with

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voice module and monitoring system can be done. It senses changes in temperature, senses smoke, _lame etc.., and sends it to the control station by android app.

3. IDEA 3:

The Internet of Things (IoT) is a new sector that aims to connect "things," "people," and "machines" to the internet. Modernization and automation are sweeping the globe, with IoT-based industrial monitoring solutions at the forefront. The importance of assessing the state of the industry is vital to the safety and ef_iciency of the products.In this system, we plan to create an IoT-based industrial monitoring system with intelligent sensors. Because of the integration of big data, the Blynk app can be used to monitor status from anywhere on the planet. Data analysis has been streamlined, allowing for easier IoT monitoring. The proposed technology could be bene_icial to manufacturing industries. Adding technology to any kind of manufacturing industry will assure the safety and well-being of the people as well as prevent accidents. Using automation technology reduces the chances of loss and accidents in the machinery world.

4. IDEA 4:

In this model an Arduino Mega which is the main microcontroller is connected with a Wi-Fi module for internet connectivity, a barometer sensor for temperature and pressure, a humidity sensor for sensing the humidity and a gas sensor which detects the smoke and harmful gasses. These components are utilized to build a monitoring system. Apart from these components several other sensors are used to keep a check on the temperature, gas leakage, pressure, humidity, etc. in the work environment to ensure the workers safety. In case of any incident this monitoring system warns the workers by an alarm and sends information to the registered user via Blynk App. The chief purpose of this research is to sum up e. the signficant role of IoT

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f. Proposed Solution

1. Problem Statement(Problem to be solved)

Difficulty in continuous manual monitoring of temperature ,workerssafety and communicating to othersin hazardous areas

2.Idea / Solution description

The hazardous area is integrated with smart temperature beacon devices which will be sensing and broadcasting the temperature of that specific 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 beacons, he can view the temperature on his wearable deviceand if the temperature is high, he will receive the alerts to the mobile through SMS using API.

By this wearable device, the data is sent to the cloud database and through which the dashboard, the admins of that particular plant can view the data and take necessary actions if required.

3.Novelty / Uniqueness

Smart wearable devices are used.

Advanced monitoring throughbeacon devices

4.Social Impact/ Customer Satisfaction

Due to safe environment, workers can work efficiently.

More focus on work withoutany fear. Industrial accidents can be avoided.

5.Business Model (Revenue Model)

Can be implemented in different hazardousareas.

Can make the wearables more advanced and customizable to ones need.

6.Scalability of the Solution

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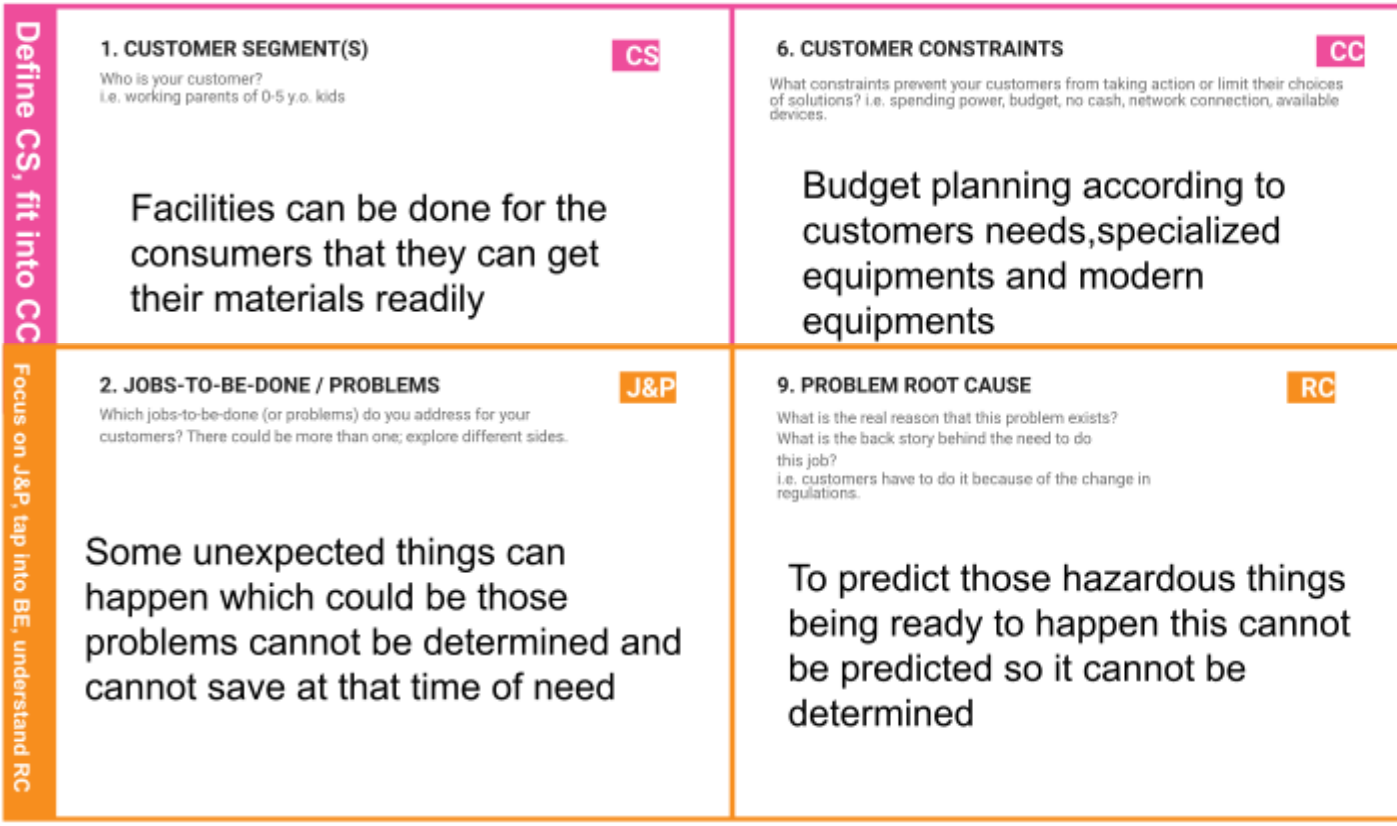
By increasing the numberof devices, this can be implemented in a commercial level.

In future, other elements like radiation and gases can also be monitored.

c. Problem Solution fit



4. REQUIREMENT ANALYSIS

a. Functional requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)

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FR-1	Data Gathering	The smart beacon devices must be able to detect and measure the temperature of a particular areain real.
FR-2	Location Detection	The smart beacon must be able to detect when a wearable device has entered into an particular area.
FR-3	Beacon Data Syncing	The smart beacon must be able to share its stored data or information for both the wearable deviceand admin dashboard through the cloud.
FR-4	Wearable Device Display	The wearable device must viewable to display the temperature of the area where the workeris currently present.
FR-5	SMS Notification	If the temperature of the area is found to reach dangerous levels, the worker should be alertedvia SMS to their phoneinstructing them to leave the area.
FR-6	Admin Dashboard	If the temperature of the area is found to reach dangerous levels the adminis informed via the dashboard and must take the necessary precautions.

b. Non-Functional requirements

FR No.	**Non-Functional Requirement**	**Description**

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NFR-1	**Usability**	The wearable device shouldbe slim andcomfort mode but not annoy or disturbthe workers who are wearingthem. They should also reliably display the temperature without large delays and notifications shouldbe clear in cases of detected danger.
NFR-2	**Security**	The connection of the beacons to the cloudand wearable devicesshould be secure. The security of the database housingall the temperature data should also be bolstered.
NFR-3	**Reliability**	The wearable device shouldbe able to function without any faults even at critical situation and dangerous temperature. If a faultis detected it should notifythe user and the admin to be immediately about repaired and replaced. The beacons should also be maintained regularly to ensure reliability.

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NFR-4	**Performance**	The device should update temperature readings in real timeand requires high endsensors and processors to do so. The time to send data to the cloud and otherdevices should alsobe made as small aspossible.

NFR-5	**Availability**	The user should be able to check the temperature of the area no matter where or at whattime they arein the plant. The dashboard shouldbe constantly activeso as to ensure safety precautions canbe executed whenever danger is detected.
NFR-6	**Scalability**	If the area that needs to be monitored needs to be increased all one has to do is install new smart beacon devices and connect them to the same system as the previous beacons. It can also be replicated in different plantswith different factors to be monitored giving it highly scalability.

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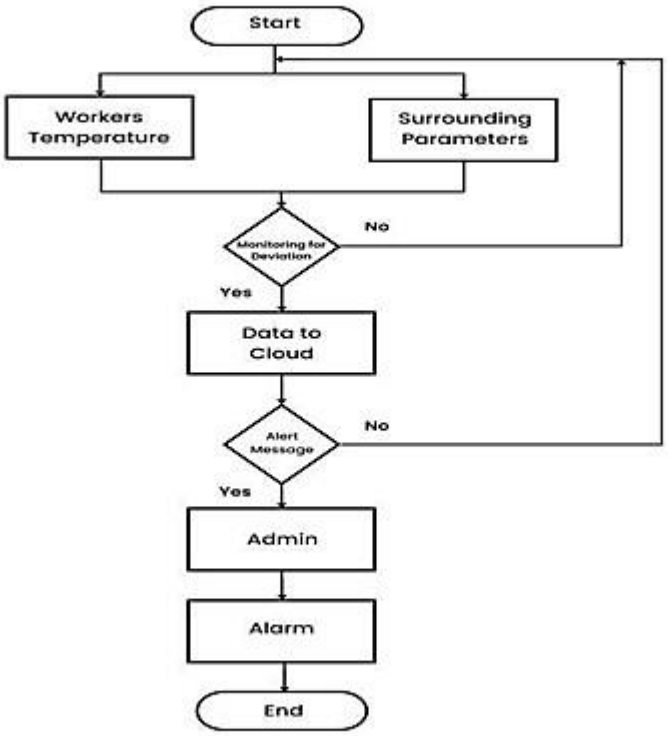
5. PROJECT DESIGN

a. Data Flow Diagrams

Data Flow Diagrams:



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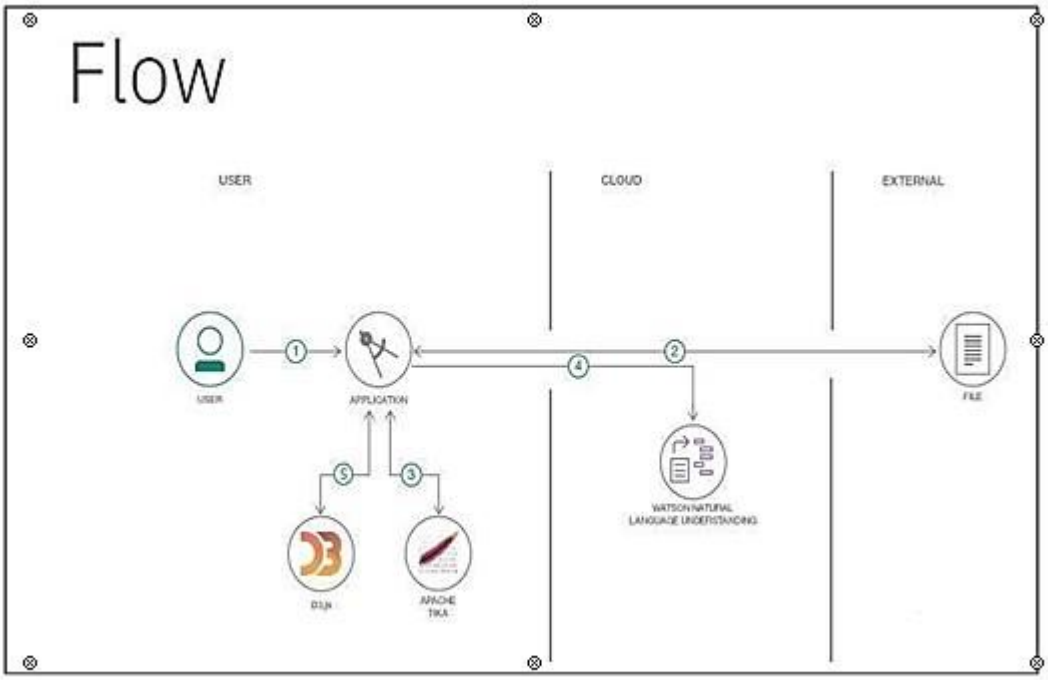

b. Solution & Technical Architecture

SOLUTION ARCHITECTURE :

Solution architecture bridgesthe gap between business problemand technology solution.It is a complex processwith many sub processes. Its goal are :

- Monitor the real time industrial conditions using various sensors.
- Pass the information using General packet radio service modem and store those information in the cloud which can be viewed by the industrial system.
- This system activelyrecords and analyzethe conditions to ensure safety of the workers and the environment around workers.
- When the conditions becomes critical beyondthe safety limits,alert message are sent to industrial system and also buzzer sound is activated.
- This provides specifications according to which solution is defined and managed.
- Gives the best technology solutionto solve the problem.

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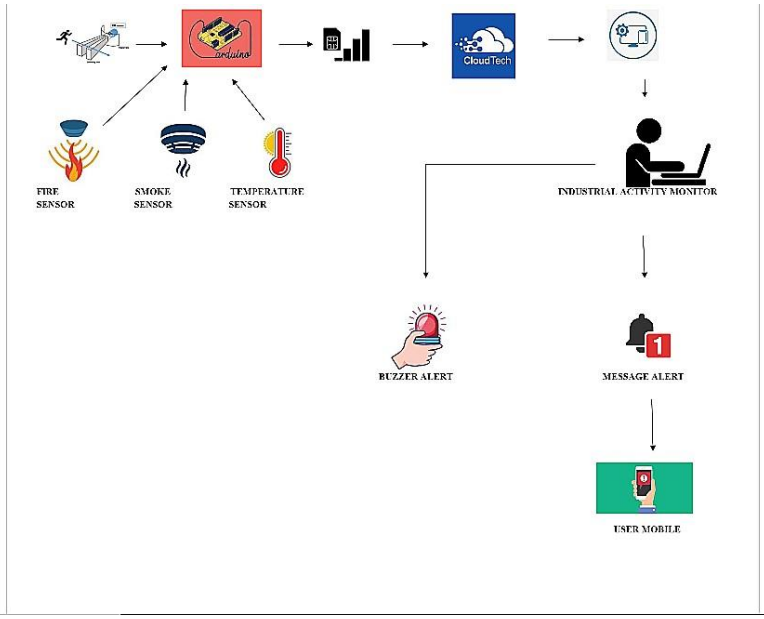
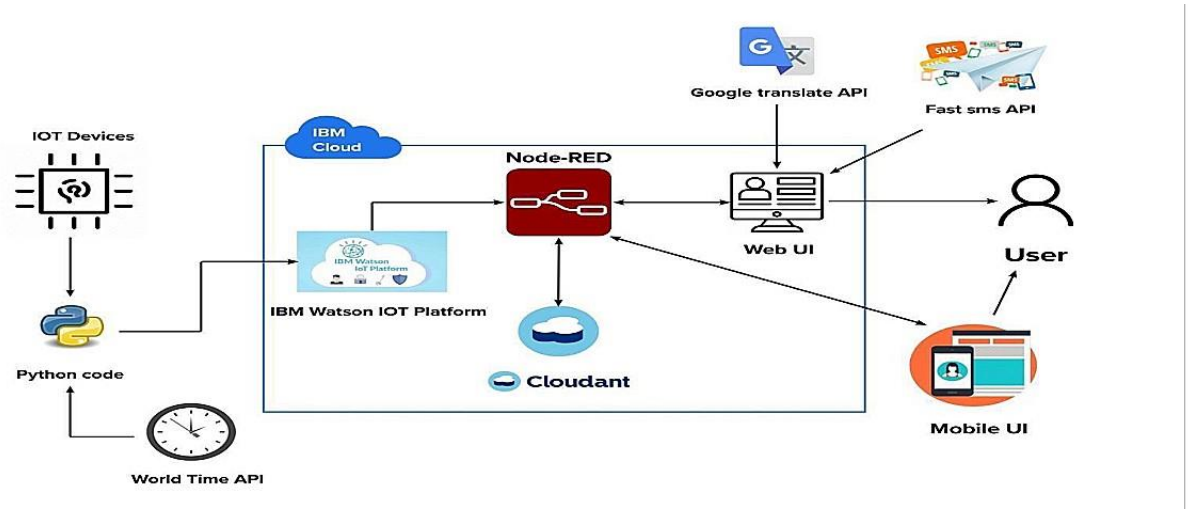


Technical Architecture



a.Sprint Planning & Estimation

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Spri nt	Functional Requirement (Epic)	User Story Number	User Story/ Task	Story Points	Priority	Team Member
Sprint-1	Registration	USN-1	As a user,I can register for the application by entering thecredentials given by the industry	3	High	M.Rajaganapathy.
Sprint-2	Monitoring (Temperature, gas, humidity, etc.)	USN-2	As a user,I need to know the critical parameters around me inside the plant to safeguard myself	3	High	G.Dhanush
Sprint-2	IoT Dashboard Interfacing & Web UI	USN-3	As a user, I should be able to view the measured critical parameters in the plantusing the employee dashboard and thewebsite	1	Medium	R.Sutharsan.

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Sprint-3	Cloud Setup (Cloud Services)	USN-4	The smart sensors should connect with IBM cloud services for real-time data monitoring of critical parameters inside the plant	1	Medium	S.Prasanth.
Sprint-4	Mobile application and wearable devicesetup	USN-5	As a user, I should be able to access the data log throughthe mobile application and the wearable device and receive timely alerts	2	High	MRajaganapathy.

b.Sprint Delivery Schedule

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Sprint	Total Story Points	Durati on	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint1	20	6 Days	24 Oct 2022	29 Oct 2022		Oct 2022
Sprint2	20	6 Days	31 Oct 2022	05 Nov 2022		Oct 2022
Sprint3	20	6 Days	07 Nov 2022	12 Nov 2022		Oct 2022
Sprint4	20	6 Days	14 Nov 2022	19 Nov 2022		Oct 2022

7. CODING & SOLUTIONING:

a.Feature 1:

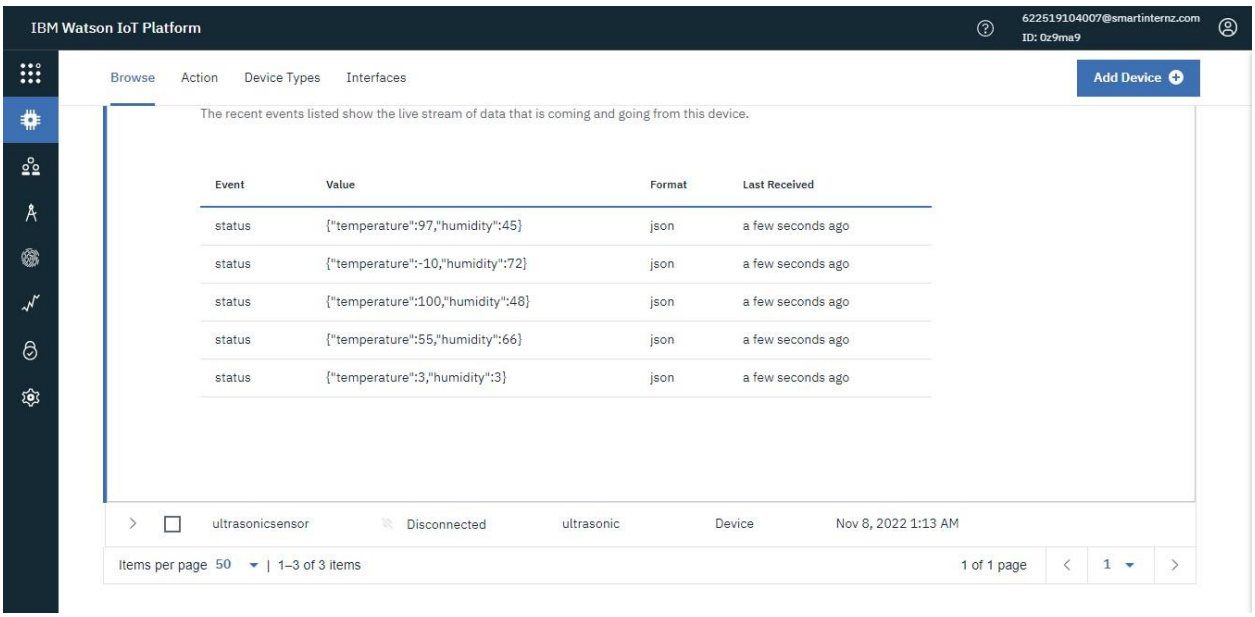
Hazardous Area Monitoring for Industrial Plant powered by IoT

Languages :C++, Python

Tools/IDE :WOKWi, IBM Watson, Node-RED, IBM Cloudant DB,

Python 3.6.5, MIT Invertor.

b.Feature 2:



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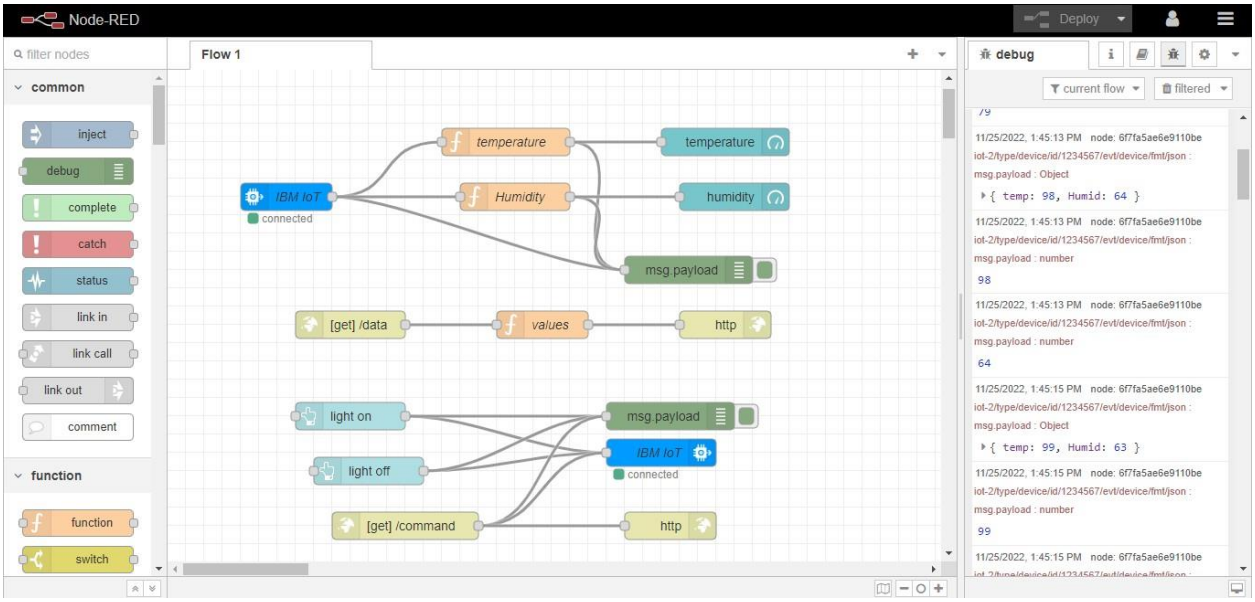
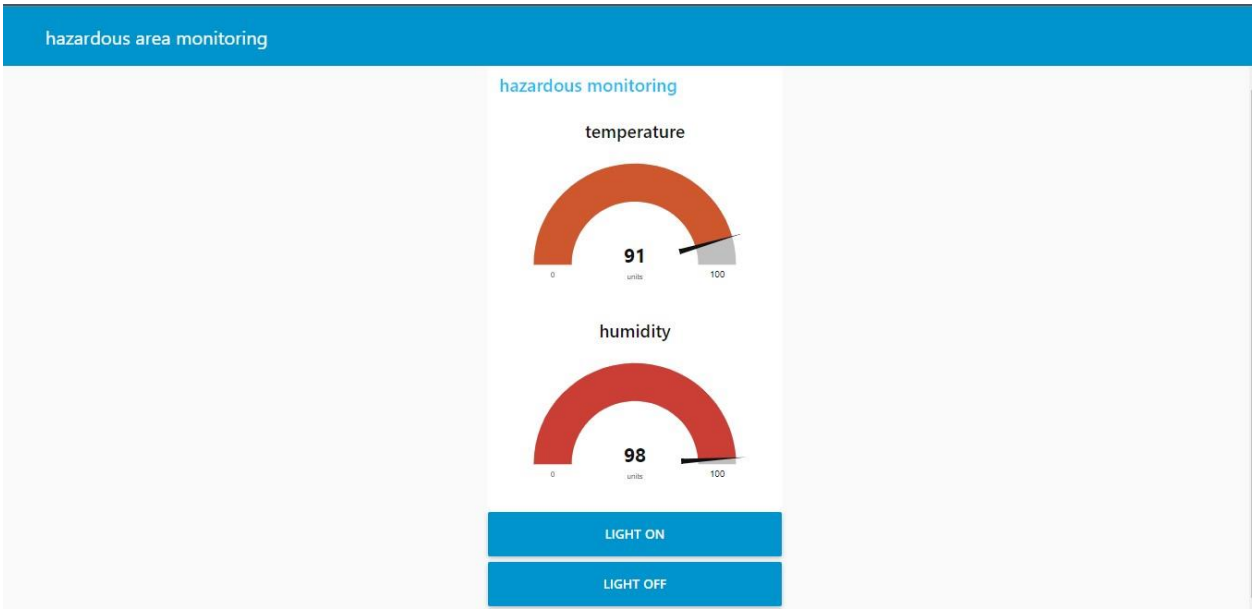
c.Database Schema



TESTING

a.Test Cases



b.User Acceptance Testing

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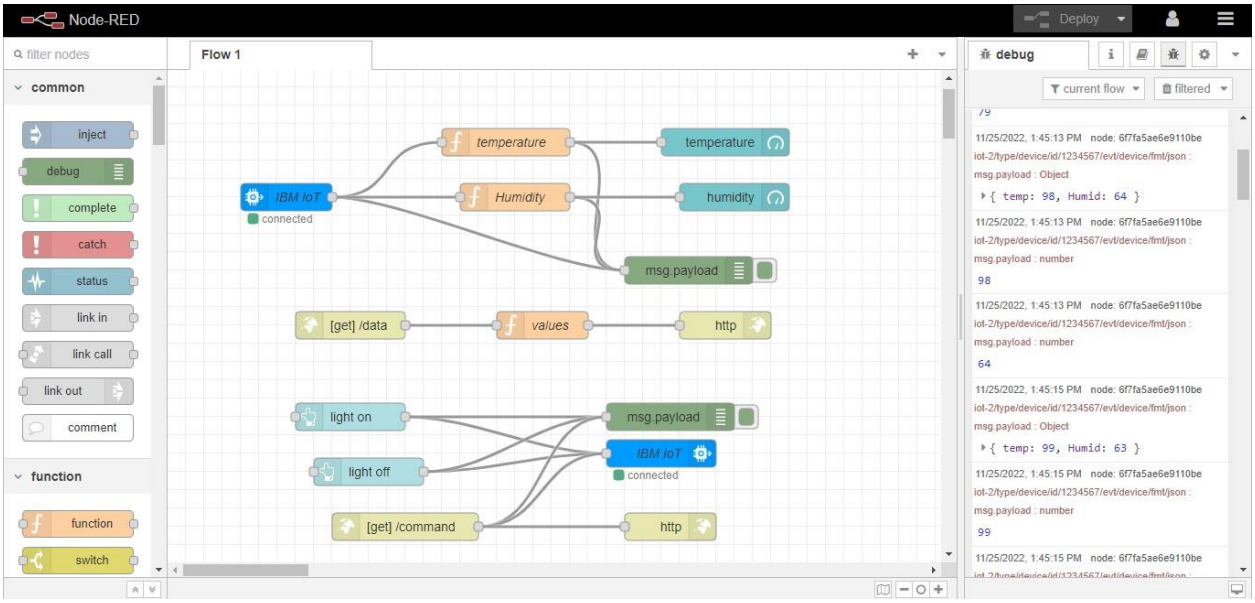

RESULTS

a.Performance Metrics

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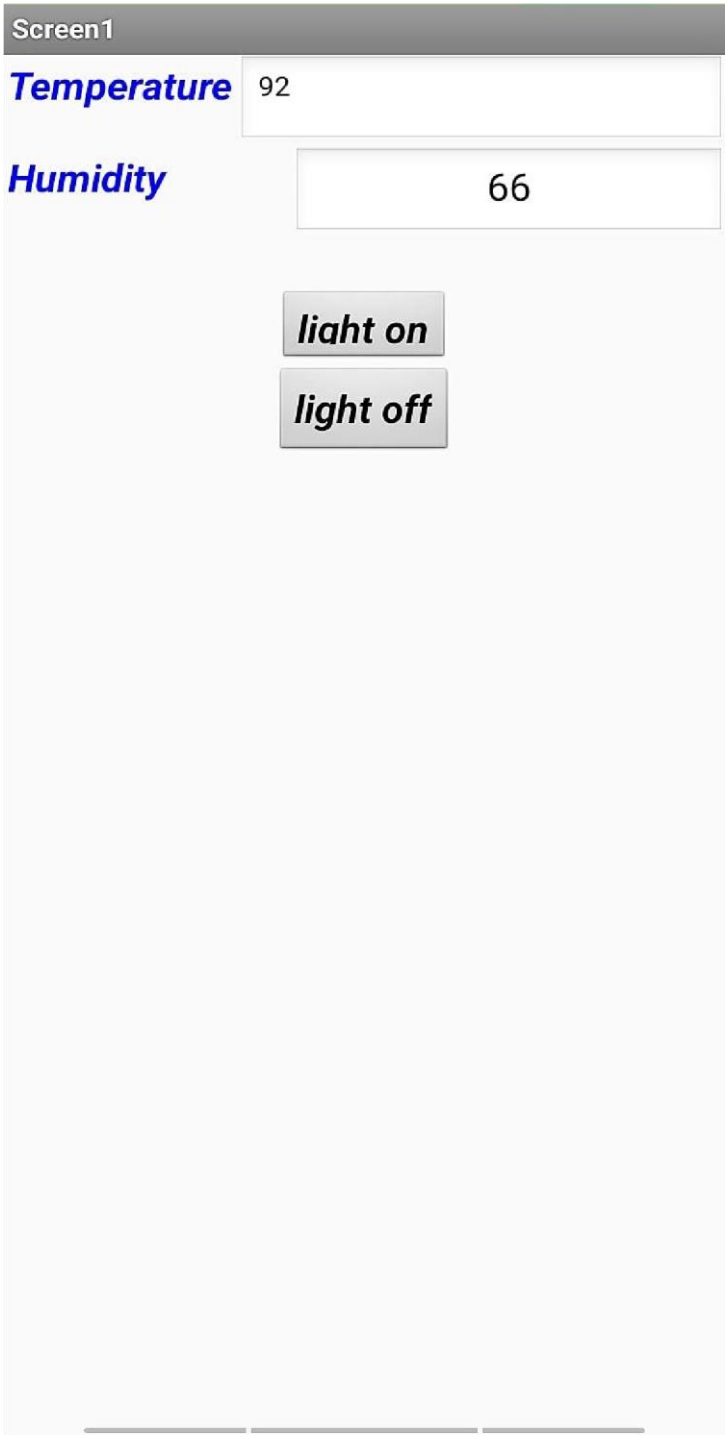

10.ADVANTAGES and DISADVANTAGES ADVANTAGES:

● Quickly Finding Any Issue In Production Line.

● Keeping Records Of Raw Materials & Accuracy.

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● Predict what problem might occur.

● Decrease the deaths in Accidents.

● Ensuring saefty and comfort.

● No Need For Routine Survey

DISADVANTAGES

● Misuse of privacy and data.

● Expense.

● Communication channel disconnection occurs oftern.

● Complex uses.

12.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.

13. 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'

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accuracy and precision based on IoT increases, the share of manual errors in taking medical readings will decrease.

14. APPENDIX

a.Source Code

Code for connecting sensor and IBM Cloud:

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

#Provide your IBM Watson Device Credentials
organization = "0z9ma9" deviceType =
"device" deviceId = "1234567" authMethod =
"token" authToken = "1234567890"

# Initialize GPIO

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

   if status=="lighton":
      print ("led is on")
   elif status=="lightoff":
      print ("led is off")
else :
      print ("please send proper command")

   #print(cmd)
try:
   deviceOptions = {"org": organization, "type": deviceType, "id": deviceId,
   "auth-method": authMethod, "auth-token": authToken}
   deviceCli = ibmiotf.device.Client(deviceOptions)
   #.....................................
```

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```
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(90,100)
   Humid=random.randint(60,100)

   data = { 'temp' : temp, 'Humid': Humid }
   #print data
   def myOnPublishCallback():
      print ("Published Temperature = %s C" % temp, "Humidity = %s %%" %Humid, "to IBM Watson")

   success = deviceCli.publishEvent("device", "json", data, qos=0,on_publish=myOnPublishCallback)
if not success:
      print("Not connected to IoTF")
   time.sleep(3)
   deviceCli.commandCallback = myCommandCallback deviceCli.disconnect()
```

github link

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