

A PROJECT REPORT ON

Hazardous Area Monitoring for Industrial Plant powered by IoT

Domain : Internet of Thing

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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 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

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 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

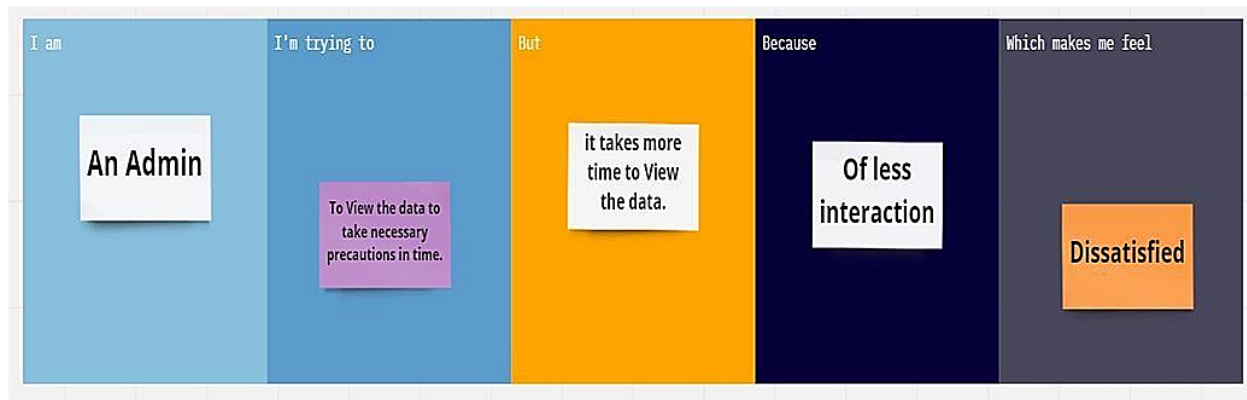
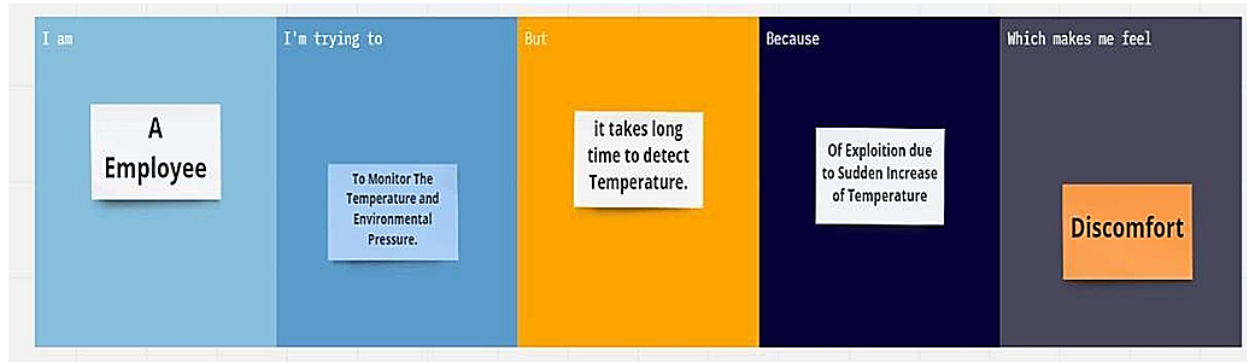
b. References

- 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 create experiencespeople 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

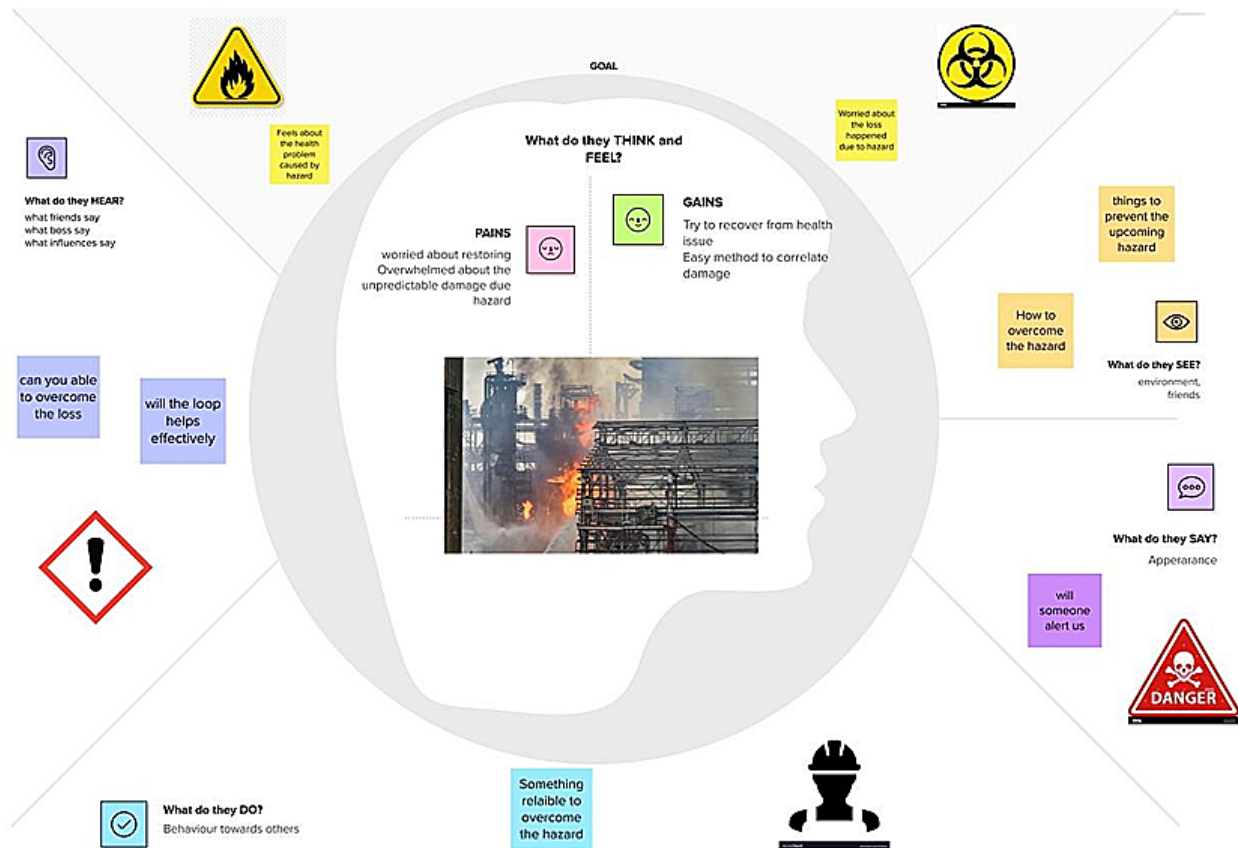
customers, which helps you better understand how they perceive your product or service



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 time 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

3.IDEATION & PROPOSEDSOLUTION

a. Empathy Map Canvas



b. Ideation & Brainstorming



Brainstorm & idea prioritization



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 tool

Use the Facilitation Superpowers to run a happy and productive session.

[Open article](#) →



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

Hazardous Area Monitoring
for Industrial Plant
Powered by IoT



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.

2

Brainstorm

Write down any ideas that came to mind that address your problem statement.

10 minutes

Kamalesh

Industrial accidents can be termed as old as industry itself and so are preventive measures

Explosion and Fire are two major constituents of these mishaps

The first step is to understand and define the problem occurred

These can be termed as accident or incident according to the occurred loss

Balasubramani

IoT aims to achieve higher operational and management efficiencies by machinery, equipment and all other factors located in industrial environment

To avoid hazardous occurrence in industrial plant, hazardous area monitoring helps us

In industrial plants, there are some areas which are to be monitored hence we can avoid dangerous activities

These areas should be monitored from time to time

Nitheesh

In our project we use sensors to detect fire occurrence in industrial plant

Monitoring of industrial plant is done by integrating the smart devices in areas to be monitored

Every device will be connected to temperature sensors and act as a beacon

These sensor broadcast the temperature data with their location to the beacon and the beacon is completely monitored

sivaranjani

The hazard monitoring system are used to minimize the risk of explosions

Sensors are accessed remotely and users can tolerate to generate alert in case of error

Sensors are key components to detect the problem in industrial plant as we are detecting the explosion we use Temperature sensor

It helps to detect the rise in temperature in industrial plant and we can see actual problem of the fire occurrence

3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you can break it up into smaller sub-groups.

20 minutes

Cloud Service

To create cloud service
To create cloud service
To create cloud service

Web Application

To create web app
To create web app
To create web app

Mobile Applications

To create mobile app
To create mobile app
To create mobile app

Project requirements

To create project requirements
To create project requirements
To create project requirements



Detectors

To create detector
To create detector
To create detector

Knowledge

To create knowledge
To create knowledge



Quick add-ons

- Share the mural**
Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.
- Export the mural**
Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

Keep moving forward

- Strategy blueprint**
Define the components of a new idea or strategy.
[Open the template](#)
- Customer experience journey map**
Understand customer needs, motivations, and obstacles for an experience.
[Open the template](#)
- Strengths, weaknesses, opportunities & threats**
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.
[Open the template](#)

[Share template feedback](#)

Activate Windows
Go to Settings to activate Windows

c. Proposed Solution

1. Problem Statement(Problem to be solved)

Difficulty in continuous manual monitoring of temperature ,workers safety and communicating to others in 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 device and 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 through beacon devices

4.Social Impact/ Customer Satisfaction

Due to safe environment, workers can work efficiently.

More focus on work without any fear. Industrial accidents can be avoided.

5.Business Model (Revenue Model)

Can be implemented in different hazardous areas.

Can make the wearables more advanced and customizable to one's need.

6.Scalability of the Solution

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

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

d. Problem Solution fit

Define CS, fit into CC	1. CUSTOMER SEGMENT(S) CS Employees who monitor hazardous area in industrial plants	6. CUSTOMER CONSTRAINTS CC Smart beacon coverage area Network access for beacon Beacon to watch connectivity	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	Explore AS, differentiate
	2. JOBS-TO-BE-DONE / PROBLEMS J&P To check and alert the humidity, Temperature, Infrared radiation and Air quality	9. PROBLEM ROOT CAUSE RC It is important to note the employees safety. Working in hazardous area in industries are highly risk. Therefore, this project helps employee to know about their environment.	7. BEHAVIOUR BE The employees have a wearable watch where they can see the required or specified details and act safely according to it	

Identify strong TR & EM	3. TRIGGERS TR Successful execution of our solution will make even other industry to implement this solution	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 beacon. From the cloud we will be accessing the reading and using that we will have a web page and a mobile application to display them. We will have <u>sms</u> service to alert abnormal readings	8. CHANNELS of BEHAVIOUR CH ONLINE All the <u>informations</u> will be stored in cloud, <u>so</u> the employees can see the cloud storage or mobile application for referring the details of surroundings. OFFLINE Employees used to wear a watch which captures the information of the surroundings.	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

a. Functional requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Data Gathering	The smart beacon devices must be able to detect and measure the temperature of a particular area in 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	<p>The wearable device should be slim and comfortable but not annoy or disturb the workers who are wearing them.</p> <p>They should also reliably display the temperature without large delays and notifications should be clear in cases of detected danger.</p>
NFR-2	Security	<p>The connection of the beacons to the cloud and wearable devices should be secure.</p> <p>The security of the database housing all the temperature data should also be bolstered.</p>
NFR-3	Reliability	<p>The wearable device should be able to function without any faults even at critical situation and dangerous temperature.</p> <p>If a fault is detected it should notify the user and the admin to be immediately about repaired and replaced.</p> <p>The beacons should also be maintained regularly to ensure reliability.</p>

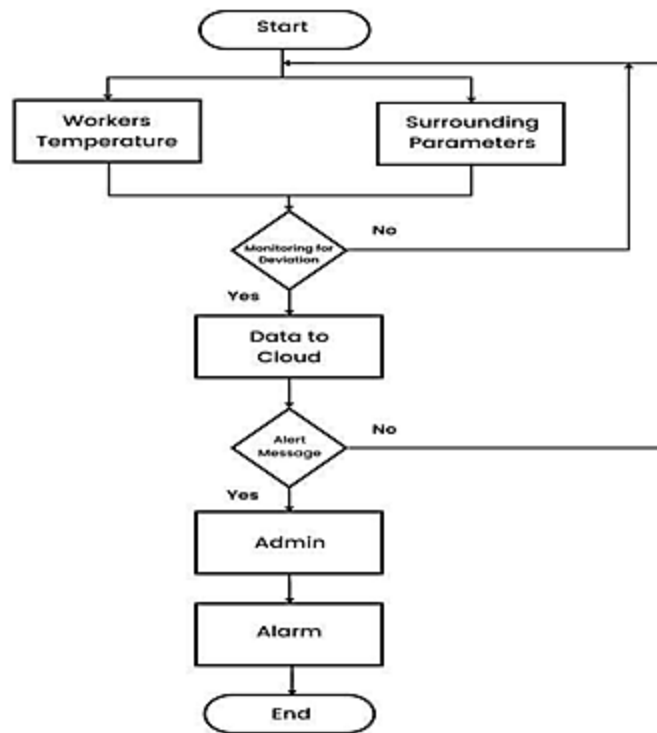
NFR-4	Performance	<p>The device should update temperature readings in real time and requires high end sensors and processors to do so.</p> <p>The time to send data to the cloud and other devices should also be made as small as possible.</p>
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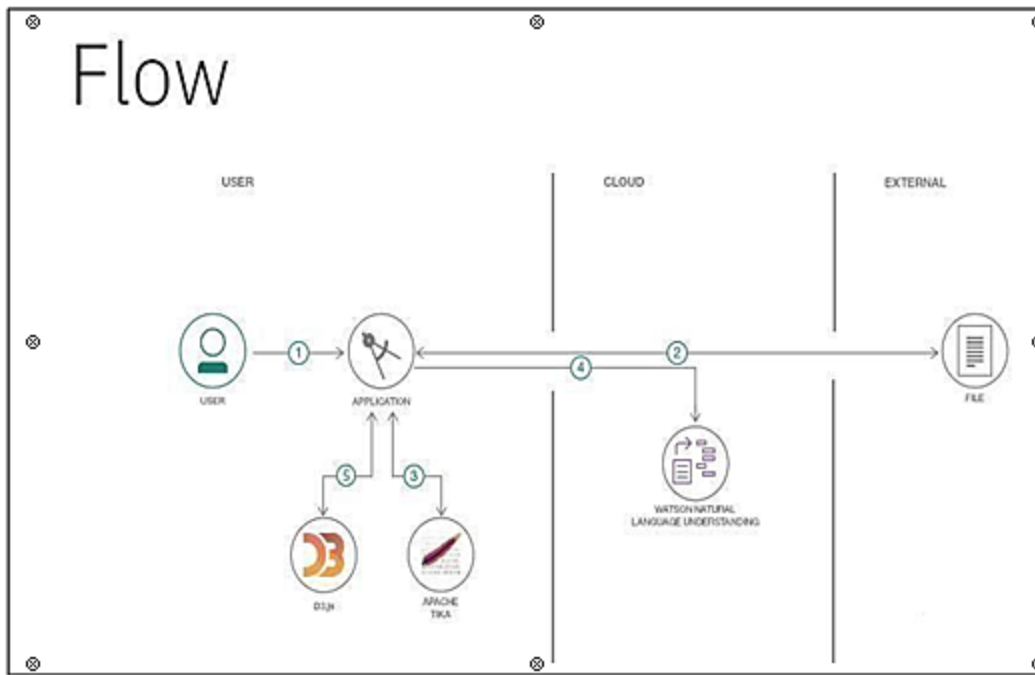
NFR-5	Availability	<p>The user should be able to check the temperature of the area no matter where or at what time they are in the plant.</p> <p>The dashboard should be constantly active so as to ensure safety precautions can be executed whenever danger is detected.</p>
NFR-6	Scalability	<p>If the area 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.</p> <p>It can also be replicated in different plants with different factors to be monitored giving it highly scalability.</p>

5. PROJECT DESIGN

a. Data Flow Diagrams

Data Flow Diagrams:



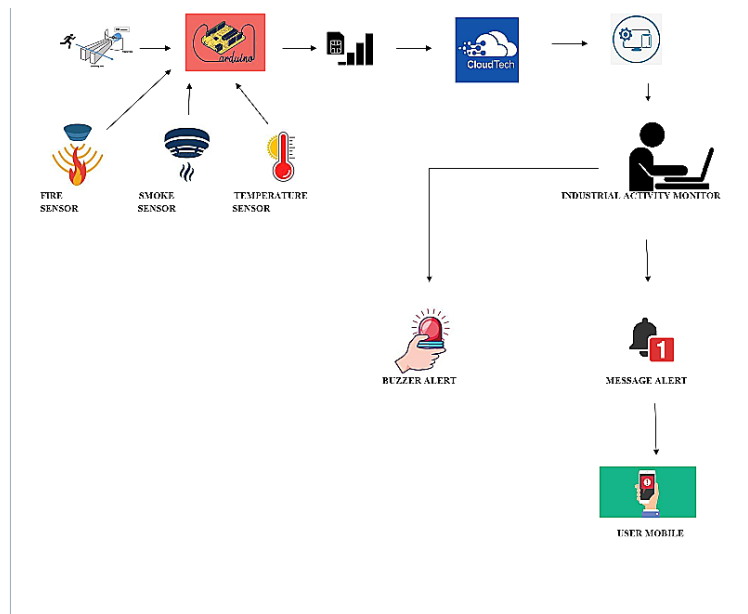


b. Solution & Technical Architecture

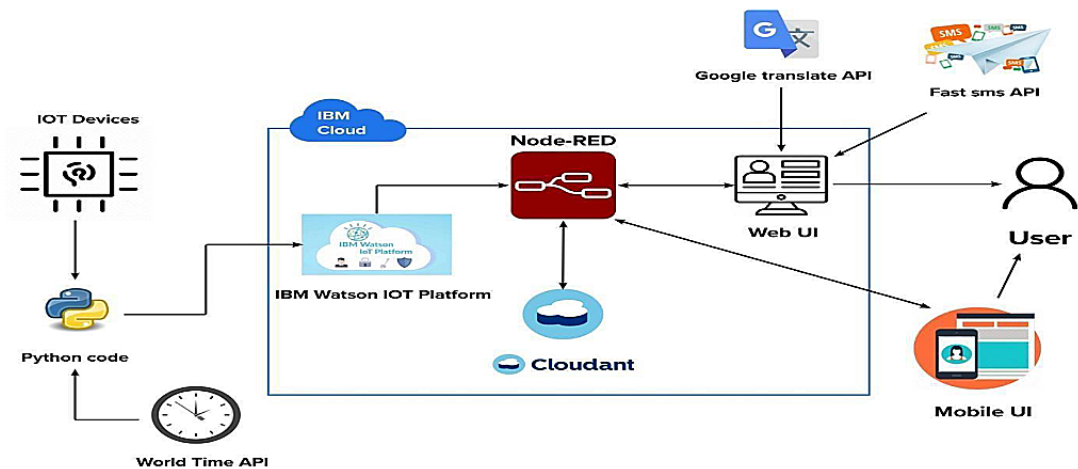
SOLUTION ARCHITECTURE :

Solution architecture bridges the gap between business problem and technology solution. It is a complex process with 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 actively records and analyzes the conditions to ensure safety of the workers and the environment around workers.
- When the conditions become critical beyond the safety limits, alert messages are sent to the industrial system and also a buzzer sound is activated.
- This provides specifications according to which the solution is defined and managed.
- Gives the best technology solution to solve the problem.



Technical Architecture



a.Sprint Planning & Estimation

Sprint	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 the credentials given by the industry	3	High	J.Nitheesh
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	V.S.Balasubramani
Sprint-2	IoT Dashboard Interfacing & Web UI	USN-3	As a user, I should be able to view the measured critical parameters in the plant using the employee dashboard and the website	1	Medium	T.Kamalesh

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	M.Sivaranjani
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	T.Kamalesh

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	6 Days	24 Oct 2022	29 Oct 2022		Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022		Oct 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022		Oct 2022
Sprint-4	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,

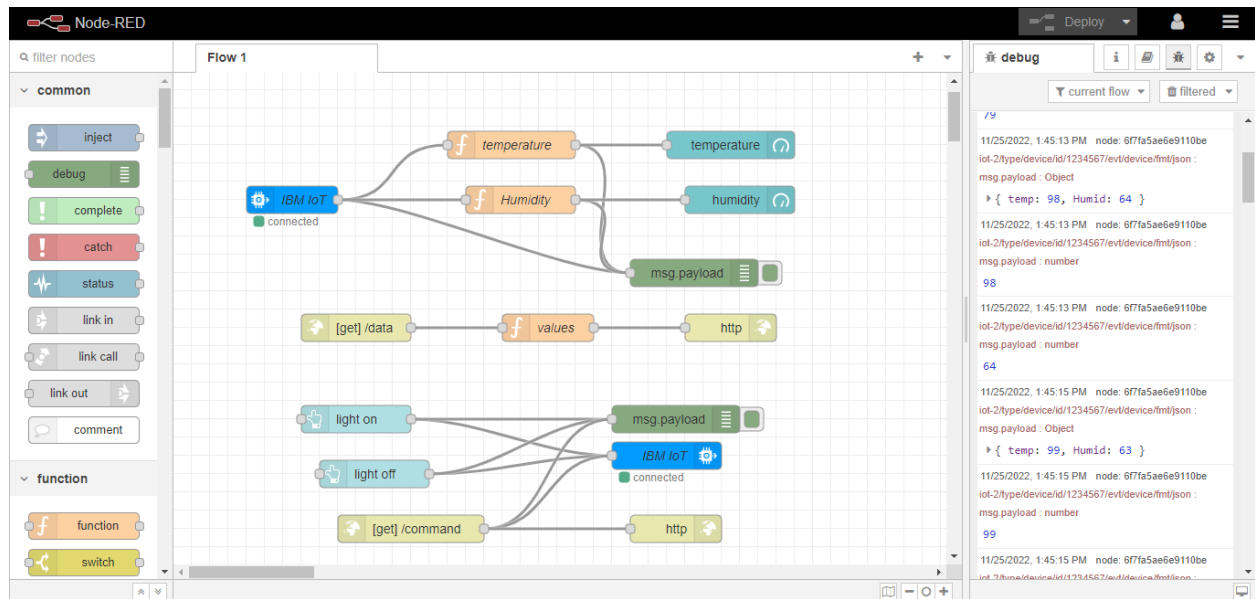
Python 3.6.5, MIT Invertor.

b.Feature 2:

The screenshot displays the IBM Watson IoT Platform interface. The top navigation bar includes the platform name, a user profile icon, and a user ID. The main content area shows a list of recent events for a device named 'ultrasonicsensor'. The events are listed in a table with columns for Event, Value, Format, and Last Received. The events show temperature and humidity data points. The bottom of the interface shows a pagination bar with '1 of 3 items' and a '1' button.

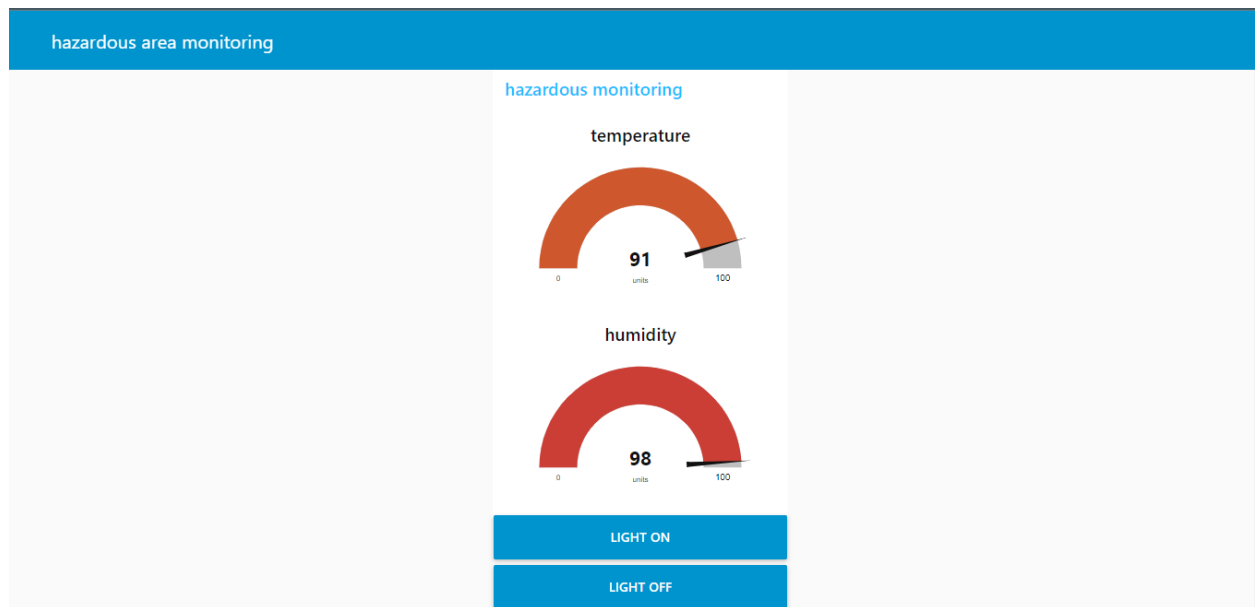
Event	Value	Format	Last Received
status	{"temperature":97,"humidity":45}	json	a few seconds ago
status	{"temperature":10,"humidity":72}	json	a few seconds ago
status	{"temperature":100,"humidity":48}	json	a few seconds ago
status	{"temperature":55,"humidity":66}	json	a few seconds ago
status	{"temperature":3,"humidity":3}	json	a few seconds ago

c.Database Schema

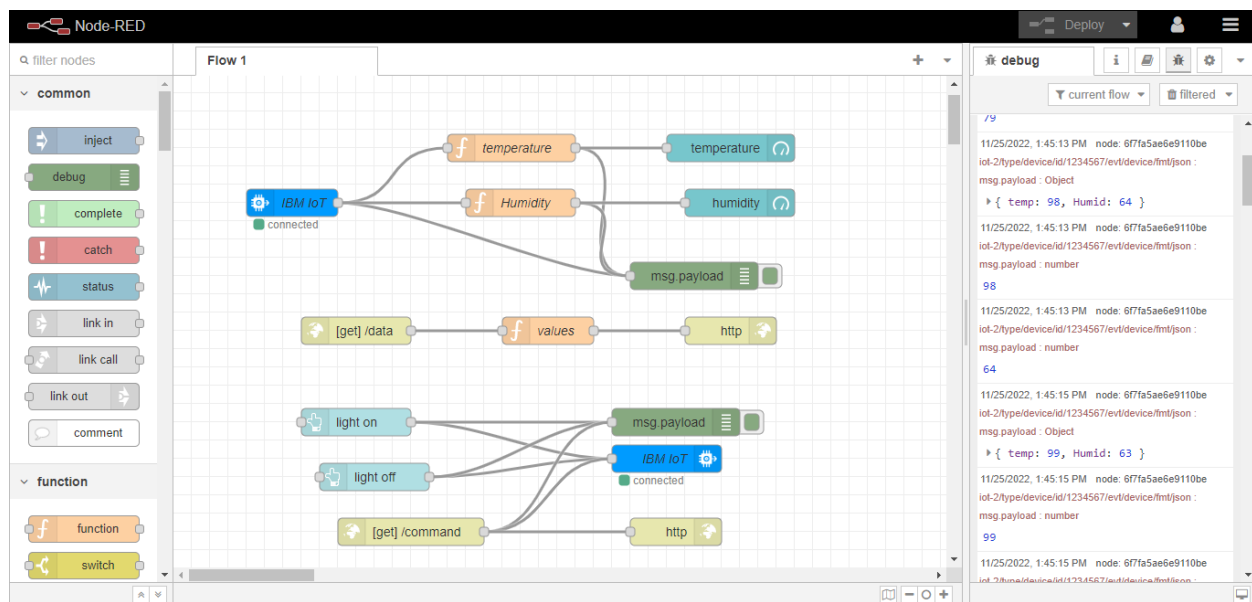


TESTING

a.Test Cases



b.User Acceptance Testing



RESULTS

a. Performance Metrics

Screen1

Temperature

92

Humidity

66

light on

light off

10.ADVANTAGES and 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.

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' 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)  
#.....
```

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:<https://github.com/IBM-EPBL/IBM-Project-45199-1660728783>

video link:<https://youtu.be/HJmmxNqL8Z0>

