IBM PROJECT REPORT

HAZARDOUS AREA MONITORING FOR INDUSTRIAL PLANTS POWERED BY

IoT

Domain: Internet of things.

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1. INTRODUCTION

In some industrial plants, there are some areas which are to be monitored from time to time. Sometimes the conditions may become critical which may lead to loss of property and also human loss. Industrial accidents are as old as the industry itself and so are preventive measures. The Standards for Explosive Areas or Atmospheres have also evolved diversely worldwide, based on the local needs of the industries for the overall safe operation of the plants. Explosions and fire are two of the major constituents of these mishaps. Depending upon the environment, these can be termed 'Accidents' or fade away as simply the 'incidents' or 'Near Misses' in the safety officers' statistics. The first step to logically is to start defining and understanding some of the terms used in the whole scope of toss prevention in accidents due to explosion and fire.

a. Project Overview

- Sending random Humidity and Temperature values will be sent to the IBM IoT platform.
- Sensors values can be viewed in the Web Application.
- Notifies the admin the random values cross the threshold value.

b. Purpose

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

2. LITERATURE SURVEY

a. Existing Solutions

Proof of Concept [1] Software: Information-Centric Networking (ICN), low power lossy networks (LLNs) every piece of information has been collected through the cloud. No hardware specification

Research in [2] Microcontroller: Arduino Mega, WIFI Module (ESP8266). Service: Blynk, IoT Sensors: Smoke sensor (MQ-2), Temperature and Humidity. All the components are connected with IoT by using the Blynk application. The sensors are used for detecting smoke and temperature.

According to [3] Microcontroller: is an MPS480 and RF module, RFID, and Zigbee Sensors: Temperature, smoke, and humidity sensors It can support thousands of nodes under a single network. The transmission rate of this technology is low.

Research in [4] Microcontroller: Arduino Module: GSM Sensors: Temperature, smoke and flammable gas sensors, air quality sensor All levels of air pollution by detecting. Message send through GSM • No instances of action

b. References

[1] Frey, M., Gundogan, C., Kietzmann, P., Lenders, M., Petersen, H., Schmidt, T. C., … Wahlisch, M. (2019). Security for the Industrial IoT: The Case for Information-Centric Networking. 2019 IEEE 5th World Forum on Internet of Things (WF-IoT). doi:10.1109/wfiot.2019.8767183.

[2] IOT BASED INDUSTRIAL MONITORING SYSTEM Hemlata Yadav*1, Naomi Oyiza*2, Sarfaraz Hassan*3, Dr Suman Lata*4, K. Jaya Chitra*5 Volume:04/Issue:04/April-2022 Impact Factor- 6.752.

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

[4] February 2021International Journal of Safety and Security Engineering 11(1):123-127 DOI:10.18280/ijsse.110114

c. Problem Statement Definition

To fulfil the modern-day human lifestyle and requirements many industrial plants play a major role. But with the exponential increase in growth of the industrial plants the safety and security of Workers and Engineers exponentially go down. This is due to a lack of Knowledge of hazards in the industrial plants among the employees. To overcome this bad situation industrial plants, need to develop some industrial safety regulations and maintain them. The industrial plants also need to be developed some infrastructure to monitor the hazards that happen in the industrial plants. And it helps the Engineers and plant managers to take the needful measures

to avoid a bad situation. In case of any malfunction in plants, it will also affect the environment and livelihood around the plants.

Problem statements:

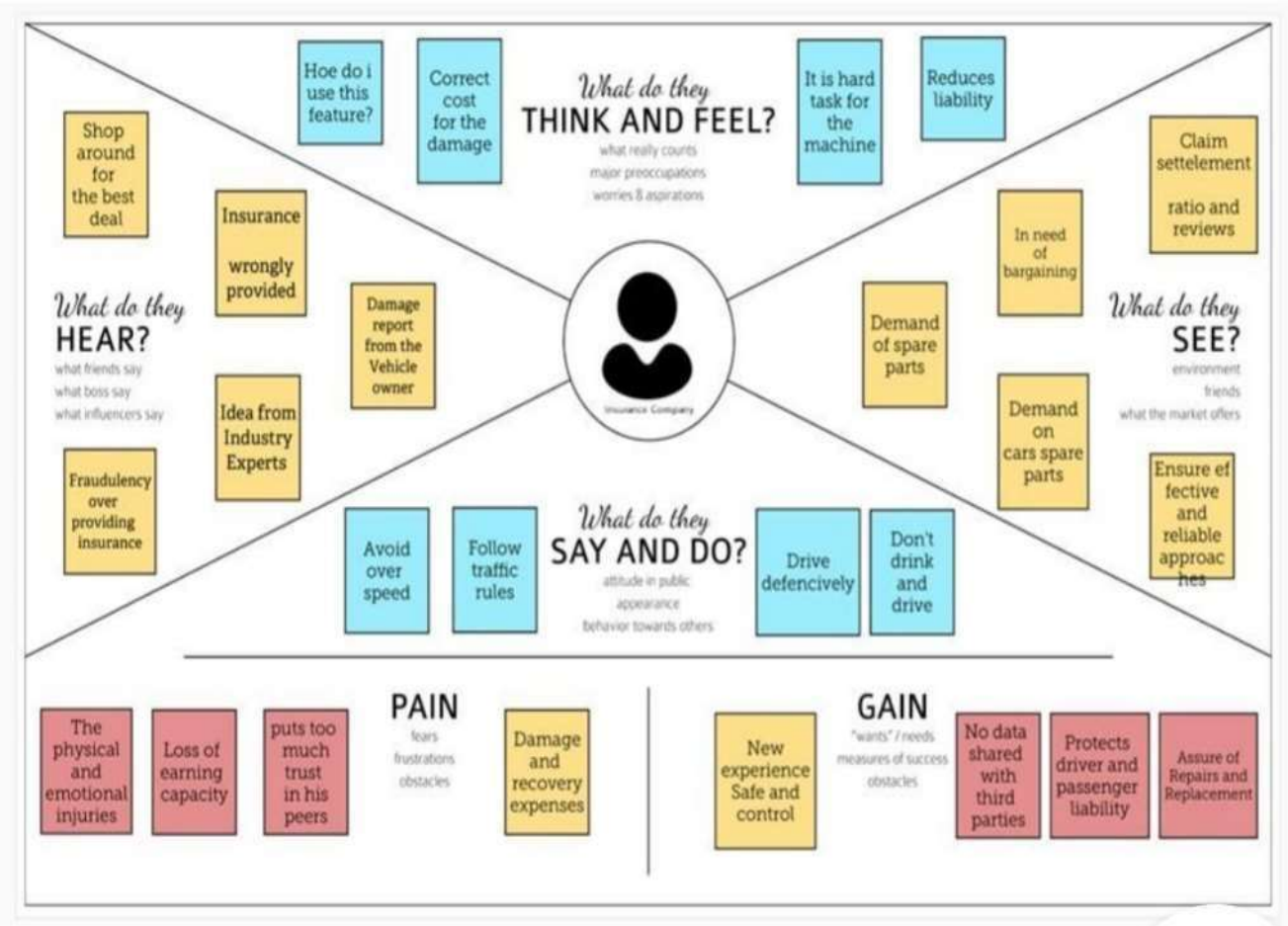
1. A Plant Manager needs to be informed of possible hazardous areas because they could pose a risk to the lives of the workers in the facility.

2. A technician needs to be informed whenever he is entering a hazardous area because it can lead to dangerous health complications to his/her or may cause disaster.

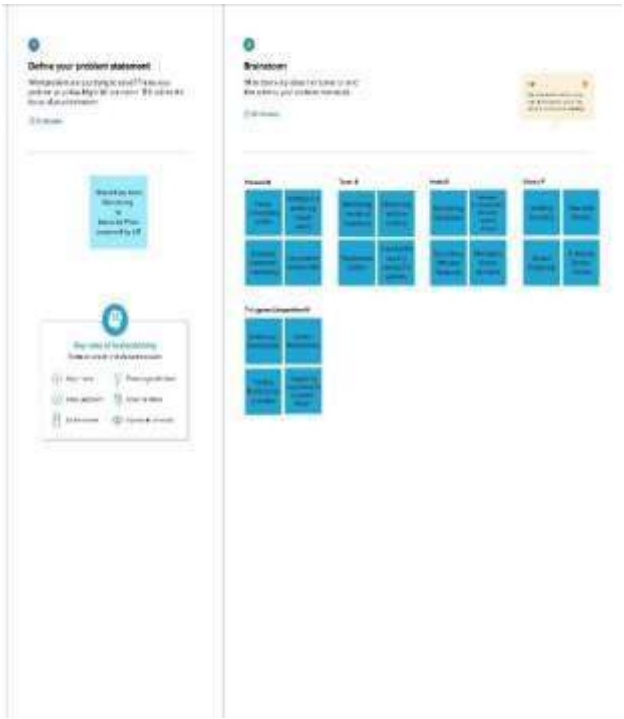
3. The Safety Inspector needs to easily examine whether the operations of the plant are hazardous or not. Because he needs to provide accurate reports to ensure safety.

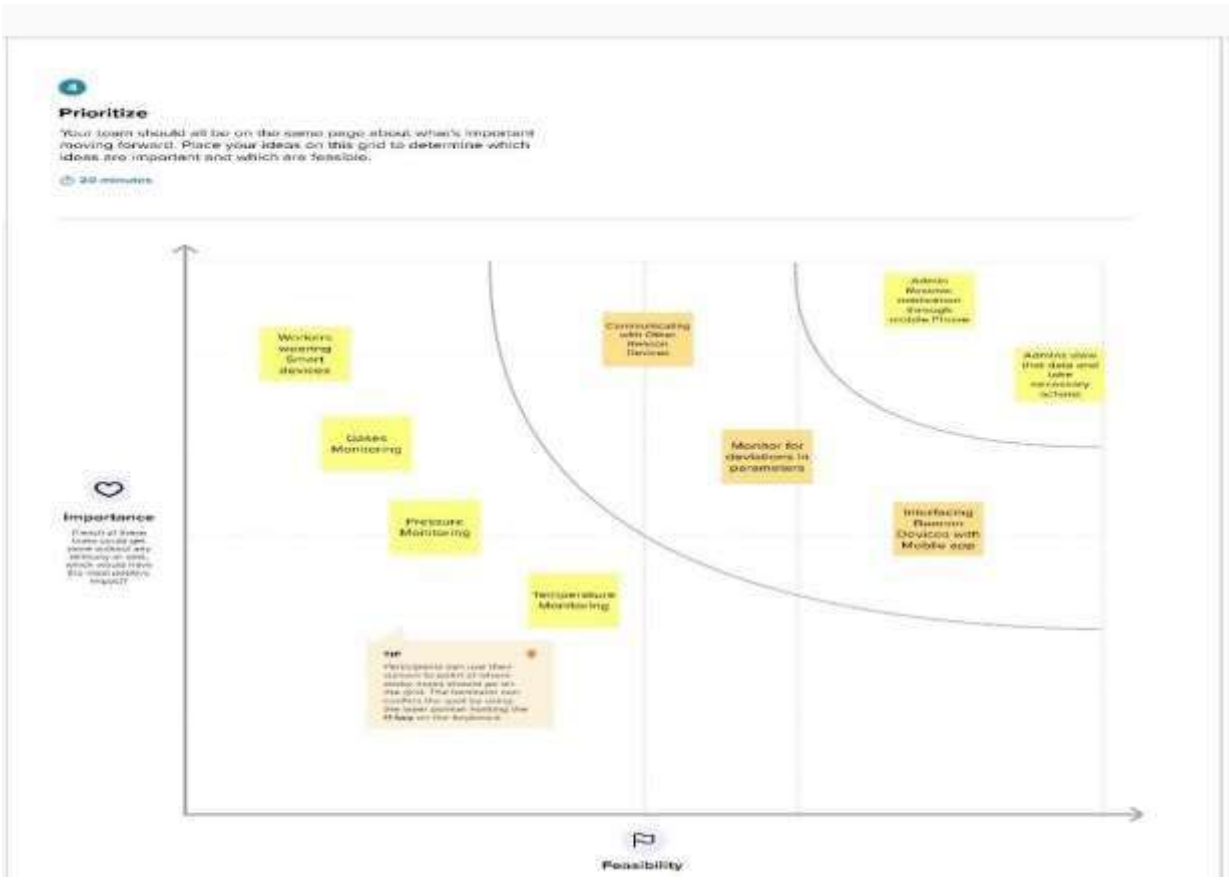
3. IDEATION & PROPOSED SOLUTION

a. Empathy Map Canvas



b. Ideation & Brainstorming





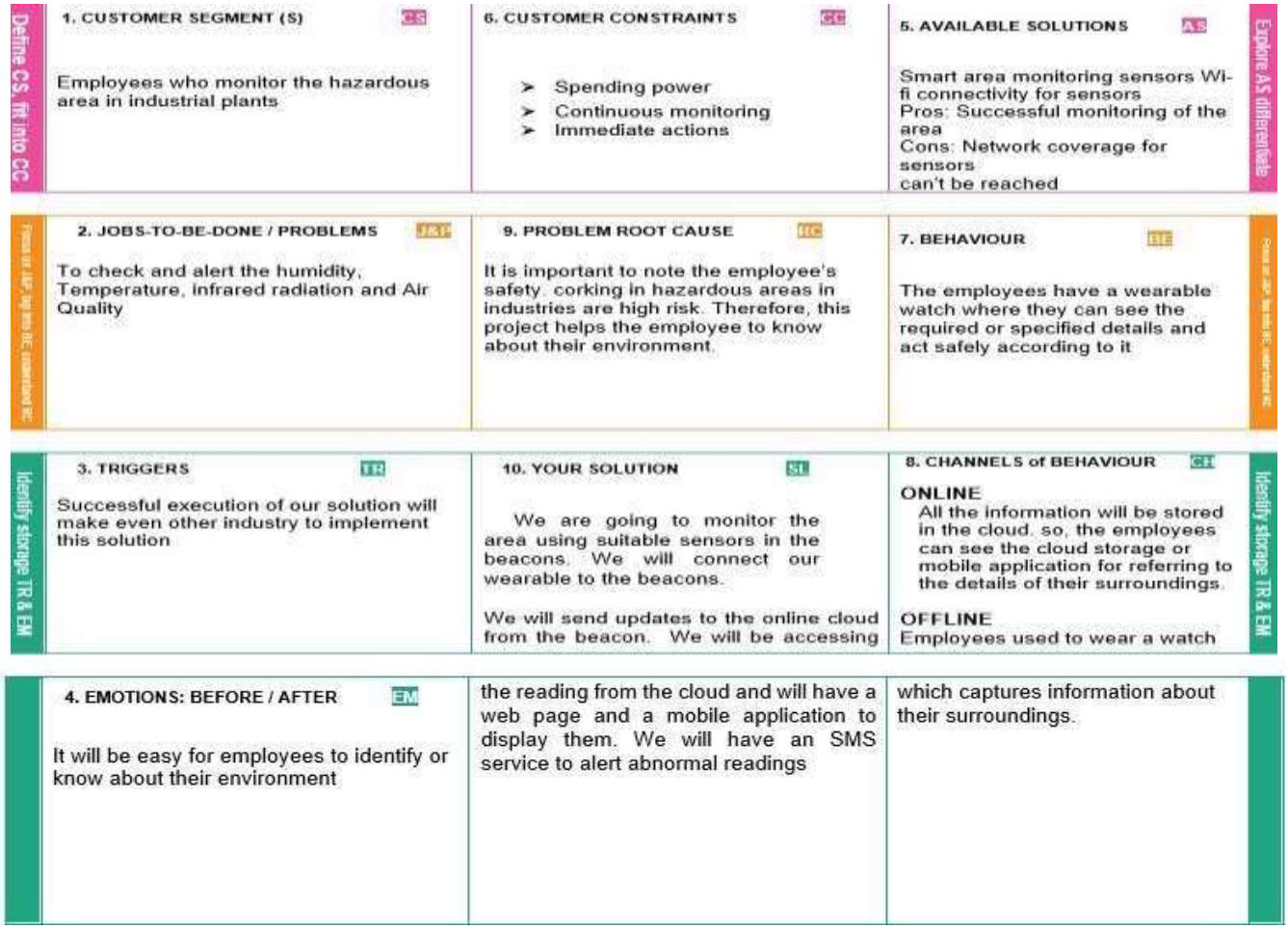
c. Proposed Solution

S. No	Parameter	Description
1.	Problem Statement (Problem to be solved)	Workers are the pillar of the company, while working in hazardous areas it is very difficult to avoid accidents, hence we need to ensure the safety of the workers.
2.	Idea / Solution description	Hazardous Area Monitoring Industrial Plant powered by IoT, we are developing a system which will automatically monitor the industrial applications and generate Alerts/Alarms or make intelligent decisions using the concept of IoT. Every device will be acting as a beacon and it is connected to temperature sensors. An alert message is also sent to the mobile whenever high temperature (or) toxic gases are detected within the area through SMS using API. Through this wearable gadget, the information is sent to the cloud database and through which the dashboard, the admins of that specific plant can see the information and take fundamental activities on the off chance that required.

3.	Novelty / Uniqueness	• Makes it easier to know the temperature (or) any hazardous gases present in the area without the worker having to constantly do manual checks. • Provides a different solution to ensure the safety of the workers. • Wearable devices display the current temperature present in the area all the time. • Alerts via SMS to mobiles of the workers when high temperature is detected. • Alerts on both the wearable device and mobile application occur simultaneously to prevent the worker from entering hazardous areas. •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 worker's safety.
4.	Social Impact / Customer Satisfaction	Due to a secure environment, labourers can work efficiently. More centre on work without any fear. 1) Real-time data is available 2) Reliable and consistent data 3) Automated detection 4)Excellent customer service 5)Ensures safety 6)Saves the lives of workers 7)Comfortable & User-friendly 8)Simple and reliable
5.	Business Model (Revenue Model)	We can introduce a product-based approach to earn good revenue. And cost-effective So, Wearable devices can be priced and sold by the industry to the workers.

6.	Scalability of the Solution	In some industrial plants, there are some areas which are to be monitored from time to time. To monitor the conditions, we can integrate the smart devices in the areas which are needed to be monitored. We use the IBM Watson cloud server to collect the live data and the current data. It ensures the
		safety of every worker working in harmful gases and high-temperature environment

d. Problem Solution fit



4. REQUIREMENT ANALYSIS

a. Functional requirements

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Cloud Registration	Registration through Gmail
FR-4	Cloud Confirmation	Confirmation via OTP and Email
FR-5	User Login	Login using credentials

FR-6	User testing	Only verify any alert messages
FR-7	User action	If there is any alert message, the admin alerts the workers
FR-8	Authentication	Through OTP verification Through Strong passwords
FR-9	Administration functions	Preventing and monitoring every second. If there is any deviation Admin sends a to workers.

b. Non-Functional requirements

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Cloud Registration	Registration through Gmail
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FR-7	User action	If there is any alert message, the alert the workers
FR-8	Authentication	Through OTP verification Through Strong passwords
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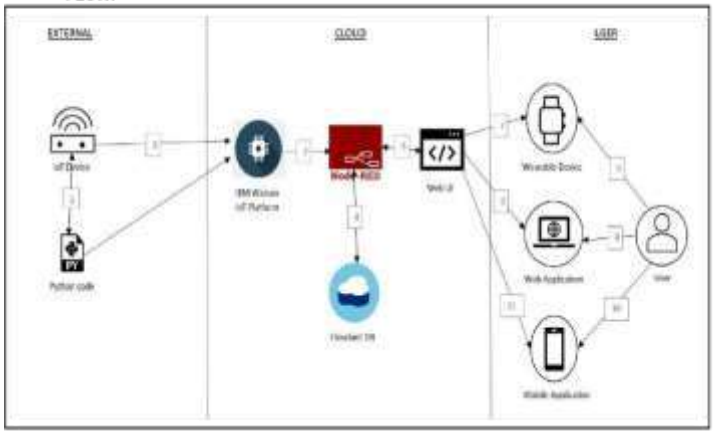
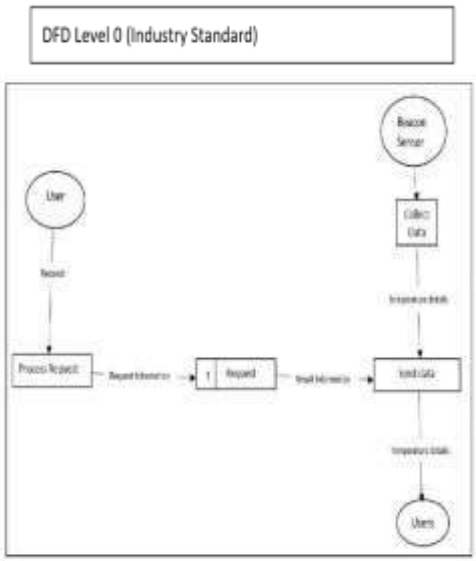
5. PROJECT DESIGN

a. Data Flow Diagrams

FLOW:

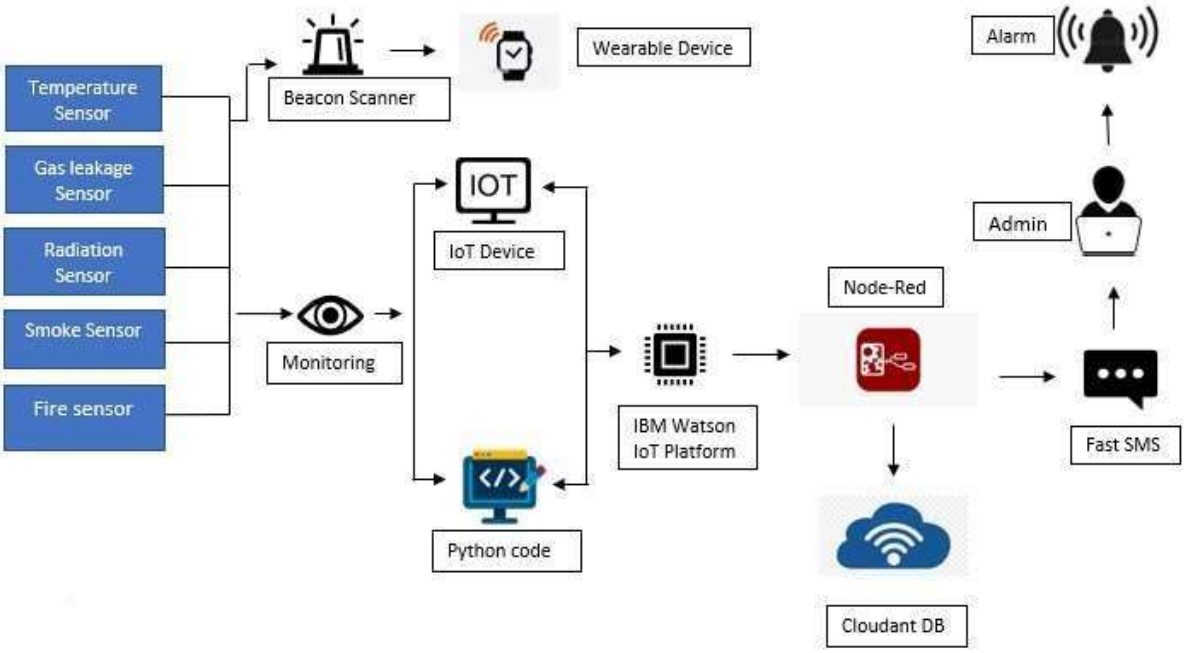


1. Necessary Python code for collecting temp. details from IoT device is written.
2. IoT device is connected with the IBM Watson IoT platform for gathering data.
3. Next step uses Node-Red services after IoT platform is all set.
4. Cloudant DB is used for storing and retrieving data.
5. Node-Red services are used to create Web application and UI designs.
6. (6,7,8,9,10,11) The user uses Smartwatch, Web and mobile app to receive various information and alerts.

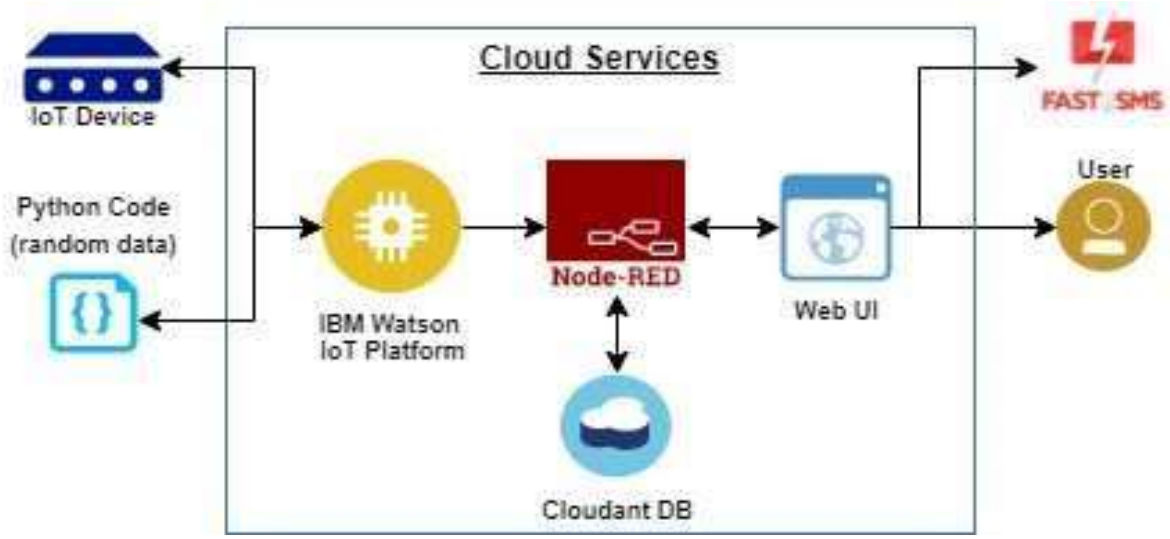


b. Solution & Technical Architecture

Solution Architecture:



Technical Architecture:



c. User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Technician	Installation	USN-1	The technician must install the smart beacons at points to ensure the entire area of the plant is covered.	A beacon can be found in every area of the plant.	High	Sprint-1
	Data Gathering	USN-2	The beacons obtain the temperature of their respective area using sensors.	The temperature of areas within the plant is obtained.	High	Sprint-1
	Data Sync	USN-3	The beacons send their data to the cloud in real time, which is sent to nearby wearable devices and the administrator's dashboard.	Data is sent to the cloud successfully and synced with other devices.	High	Sprint-1
Worker	Wearable device display	USN-4	The wearable devices should display the data sent by beacons within the area.	The user can see the temperature of the area on their device.	High	Sprint-1
	Wearable device adjustments	USN-5	The user can adjust the size of the wearable device to better suit them.	The user can make adjustments to the device to make working with it more comfortable.	Low	Sprint-2
	Wearable display customization	USN-6	The user can adjust the device display to suit their needs on the device itself.	The user can modify the display of the device to increase readability.	Medium	Sprint-2

	SMS Notifications	USN-7	The user is sent a notification to their phone from the wearable device through an API when the area they are in	The user is informed of potential danger via SMS as soon as it is	High	Sprint-1
			reaches dangerous temperatures.	detected by the beacons.		
Administrator	Admin Dashboard	USN-8	The beacons send the data through the cloud to a dashboard which is run by the administrator.	The data of all the beacons can be viewed by the administrator of the plant.	High	Sprint-1
	Dashboard Customization	USN-9	The dashboard can be customized by the admin to suit their requirements and priorities.	The admin can customize the UI for their dashboard.	Medium	Sprint-2

6. PROJECT PLANNING & SCHEDULING

a. Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Simulation Creation	USN-1	Connect sensors, Arduino and esp8266	2	High	Dinesh,Arunkumar

Sprint-1	Software	USN-2	Develop an application with MIT App inventor (Login page with firebase)	2	High	Dinesh, Sivakumar, Karthik
Sprint-2	Software and Hardware	USN-3	Connect the hardware with IBM Cloud and API Integration	2	Medium	Karthik,Dinesh,Manoj
Sprint-2	Software	USN-4	Application development for the project	2	High	Dinesh, Manoj, Karthik
Sprint-3	Software	USN-5	Establishing Node-Red	2	Medium	Dinesh, Arunkumar
			connection			Karthik,Manoj,Dinesh
Sprint-3	Software	USN-6	Connecting applications with NodeRed and further application development	2	High	Dinesh, Sivakumar, Karthik
Sprint-4	Testing	USN-7	Testing developed application and working model of hardware	2	High	Karthik,Dinesh,Manoj

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	16	6 Days	24 Oct 2022	29 Oct 2022		30 Oct 2022
Sprint-2	16	7 Days	31 Oct 2022	06 Nov 2022		07 Nov 2022
Sprint-3	16	6 Days	09 Nov 2022	13 Nov 2022		14 Nov 2022
Sprint-4	8	6 Days	15 Nov 2022	17 Nov 2022		17 Nov 2022 – 18 Nov 2022

7. CODING & SOLUTION

Language: Python.

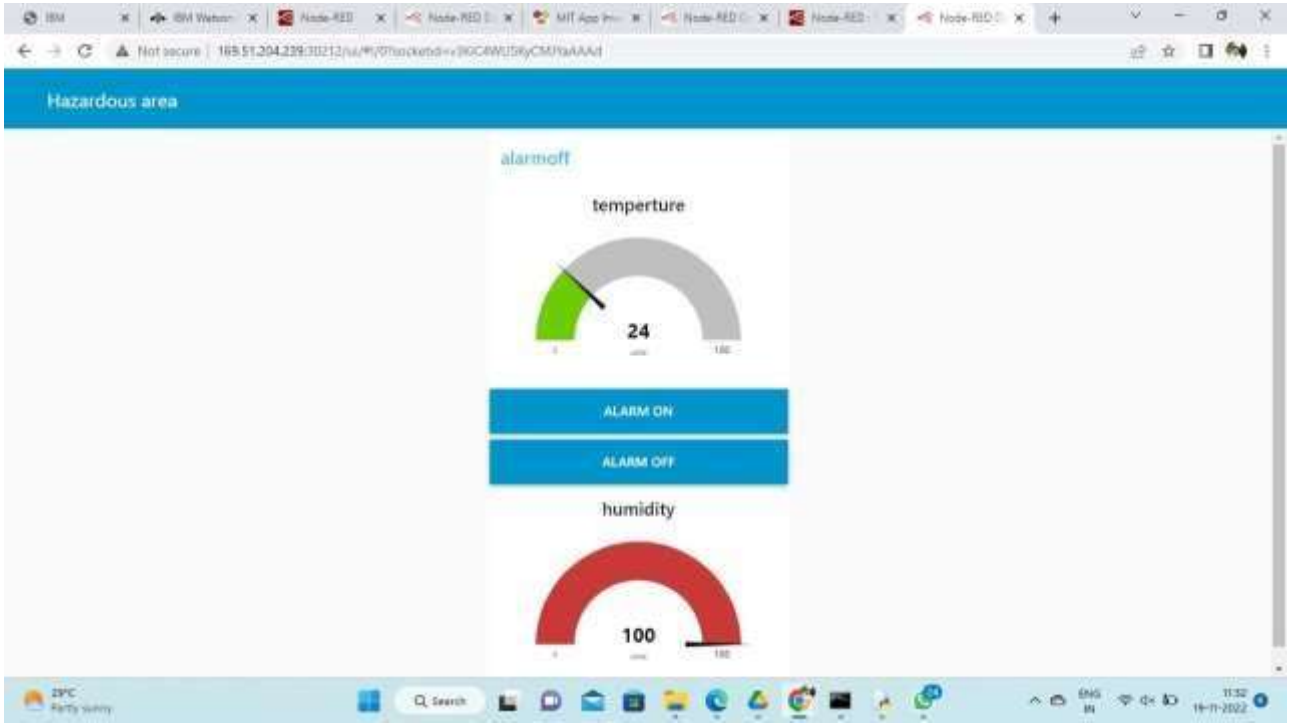
Tools/IDLE: Python 3.9.6, IBM Watson IoT platform, Node-RED, E-mail, Cloudant DB.

```
#Connecting the python to IBM Watson IoT platform

import wiotp.sdk.device import
time
import random

myconfig = {
        "identity":{
        "orgId":"ph99dh",
        "typeId":"NodeMCU ",
        "deviceId":"123456"
        },
        "auth":{
        "token":"gkfpv_xfl1FB1)*fvy”
        }
```

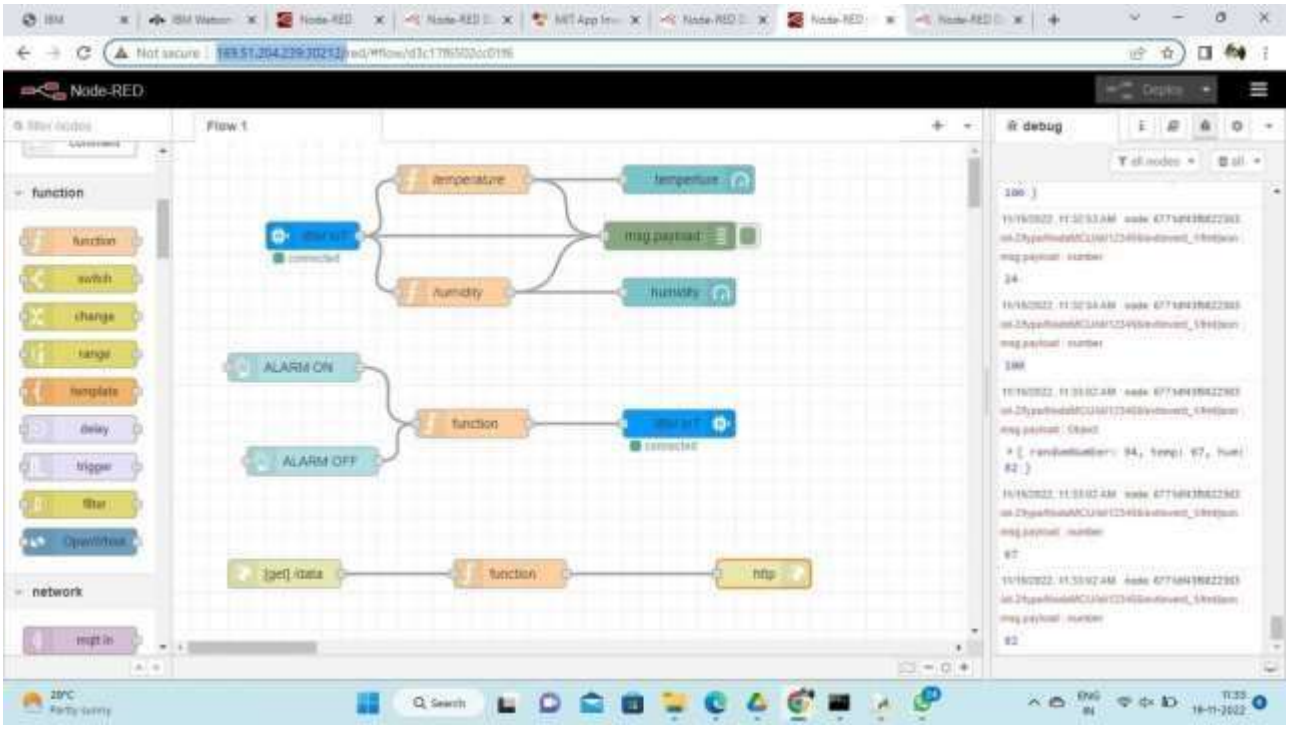
```
        }
        def myCommandCallback(cmd):    print("Message received from IBM IoT
platform: %s" % cmd.data['command'])   m=cmd.data['command']

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

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

8. TESTING

a. Test Cases



b. User Acceptance Testing



9. RESULTS

a. Performance Metrics

10. ADVANTAGES & DISADVANTAGES

ADVANTAGES

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

DISADVANTAGES

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

11. CONCLUSION

The Internet of Things offers a large scope for influencing the world of the future. The IoT system has several drawbacks, but these are outweighed by its benefits, such as saving consumers time and money. IoT applications are expected to soon be installed and utilized equally in household and commercial and business districts. Businesses are putting a lot of effort into combating IoT drawbacks and improving this cutting-edge technology for the benefit of humanity.

12. FUTURE SCOPE

Future IoT technologies will undoubtedly be successful, and IoT-enabled gadgets will probably be found everywhere, from businesses to homes. IoT has a bright and diverse future, and it won't be long until the aforementioned uses of the technology become a reality.

While real-time self-monitoring of a patient's health is made possible by wearable technology, the sensors and variations employed in the healthcare sector are substantially more advanced. The proportion of manual errors in taking medical readings will decrease as sensors' accuracy and precision based on IoT grow.

13. APPENDIX

a. Source code

```
import wiotp.sdk.device import
time
import random

myconfig = {
            "identity":{
            "orgId":"ph99dh",
            "typeId":"NodeMCU ",
            "deviceId":"123456"
            },
            "auth":{
            "token":"gkfpv_xfl1FB1)*fvy”
            }
            }
             def
myCommandCallback(cmd):
 print("Message received from IBM IoT platform: %s" % cmd.data['command'])
m=cmd.data['command']

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

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

b. **Video demonstration links**

Demo Link:

https://youtu.be/-b9NPIjsoag