



**GOVERNMENT COLLEGE OF ENGINEERING  
CHETTIKARAI, DHARMAPURI**



# **HAZARDOUS AREA MONITORING FOR INDUSTRIAL PLANT POWERED BY IOT**

**IBM NALAIYATHIRAN**

## **Document Title**

<b>TITLE</b>	Hazardous area monitoring for industrial plant powered by IoT
<b>DOMAIN NAME</b>	INTERNET OF THINGS
<b>TEAM ID</b>	PNT2022TMID41272
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# 1. INTRODUCTION

In the list of most threatening causes that led to global warming are fire hazards. Hazards can be resolved by the adaption of new and growing technologies which also help in better living. Applications in monitoring and control are performed by the wireless multisensory network are characterized by small, low power and cheap devices which are integrated with limited computation, sensing, and remote communication. It impacts enormously on fire emergency. Temperature sensors are installed in fire endangered areas which allow a person to manually provide temperature information on fire extinguishing website email or landline number. The process of accessing information from the website may be time-consuming and it may cause some amount of delay in the response to the fire extinguisher. IOT is a wireless technology. Use of IOT is in combination with fire fighting for hazard source monitoring, firefighting rescue, fire early warning, preventing and early disposal. It is effectively used for the enhancement of fire brigade firefighting and emergency rescue capabilities.

## 1.1 Project Overview

- 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.

## 1.2 Purpose

Fire monitoring is the goal of the project which is done with a wireless sensor network. There is an increase in productivity of automation and a decrease in data rate failure by using technologies in wireless sensor network Arduino and wireless communication is used in the project for industrial process monitoring. Wireless multisensory networks have met their applications in medical, military, industrial, agricultural and environmental monitoring; current voltage, temperature and water level are the traceable parameters. Harmful gases like carbon mono-oxide, methane, etc., can be detected by the Smoke sensors which may be harmful for the workers that can cause various lung diseases like asthma, pneumonia etc. Humidity is the amount of water vapours in the air, the sensor monitors the amount of humidity in the surroundings inside a plant and then alerts the workers regarding the changes in humidity which can lead to high pressure in the atmosphere and hence can cause hazards by radioactive chemicals present in power plants.

## 2. LITERATURE SURVEY

### 2.1 Existing Problem

- **Paper 1: IoT Based Intelligent Industry Monitoring System**

The Internet of Things (IoT) is a newly emerging field with a vision of connecting ‘things’, human and machines together making them an integral part of internet. The entire world is moving towards modernization and automation which may result in excessive pollution of environment. Determining the air quality is a prime need of the hour. This paper deals with the development of pollution monitoring system 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.

- **Paper 2: A Cloud-based architecture for the Internet of Things targeting industrial devices remote monitoring and control**

The process of acquiring, analysing and managing data obtained by sensors and actuators in industrial environments can benefit from modern Cloud-based platforms towards a complete implementation of the Industrie 4.0 concept. The analysis of huge data sets produced by these sensors (Big Data) could allow quick and accurate decision making. For example, productivity improvements can be achieved by analysing device performance and degradation for real-time feedback on configuration and optimization. This work proposes a Cloud-based architecture for Internet of Things (IoT) applications to improve the deployment of smart industrial systems based on remote monitoring and control. By using specific technologies available as a service, we demonstrate the proposed architecture on an automated electric induction motor use case. This approach includes layers for sensor network data gathering, data transformation between standard protocols, message queuing, real-time data analysis, reporting for further analysis, and real-time control. Particularly, by using the proposed architecture, we remotely monitored, controlled and processed data produced by sensors and actuators coupled to the motor. Preliminary results indicate this foundation can support predictive methods and management of automated system in the industrie 4.0 context.

- **Paper 3: Smart Sensor Network based Industrial Parameters Monitoring in IOT Environment using Virtual Instrumentation Server**

A remote monitoring and control are one of the most important criteria for maximizing the production in any industry. With the development of modern industry the requirement for industrial monitoring system is getting higher. This project explains the real time scenario of monitoring temperature and humidity in industries. National Instruments my RIO is used and results are observed on LabVIEW front panel and VI Server. The server VI program and client VI program is developed in block diagram for the two sensor data. This proposed system develops a sensor interface device essential for sensor data acquisition of industrial Wireless Sensor Networks (WSN) in Internet of Things (IOT) environment. By detecting the values of sensors like temperature, humidity present in the industrial area. The results are displayed on the web page. The data can be accessed with admin name and password. After logging into the web page the index of files is displayed. After restarting the my RIO kit and initiate the deploying process the file the excel sheet will appear on the VI Server. This VI server is tested for its working, using a

data acquisition web application using a standard web browser. The critical situation can be avoided and preventive measures are successfully implemented.

- **Paper 4: Beacon-Based Individualized Hazard Alarm System for Construction Sites: An Experimental Study on Sensor Deployment**

Researchers have proposed several forms of beacon sensor-based hazard alarm systems for increasing construction workers' awareness of site hazards, but research on how to deploy beacon sensors so that the system is adequate for achieving timely individualized hazard alarms is scarce. Against this background, this research investigates the impact of different beacon sensor locations in a construction site on how quickly a worker can receive the individualized hazard alarms. This research took an experimental study approach to address this objective. After a prototype of a beacon-based hazard alarm system was developed, the system was tested in a concrete structure building under construction. In the experiment, the locations where the experimenter received the first hazard alarm were recorded in repetitive trials while the beacon sensor was located in four different locations, such as (1) at the entrance of the room, (2) behind the front side wall, (3) on the internal wall facing the access point, and (4) on the internal wall not facing the access point and in a partially enclosed room in the concrete structure. The rate of successful alarm notification (i.e., the rate that the person received the hazard alarm before arriving at the target location) was 89%, 68%, 48%, and 19%, respectively, for the four locations of the beacon sensor. Meanwhile, the heat maps indicating where the hazard alarm notification was received show that the "behind the front side wall" setting yielded the most desired pattern of notification reception, wherein the person received the hazard alarm just before arriving at the room. These results show that the hazard alarm function of the system could be severely affected by the beacon sensor's location and implies that the locations of beacon sensors should be decided carefully based on the type of hazard involved and the workers targeted for receiving the alarms.

- **Paper 5 : A ThingSpeak IoT on Real Time Room Condition Monitoring System**

This paper presents the development of a ThingSpeak IoT on Real Time Room Condition Monitoring System with temperature and humidity measured for room condition. Many conditions like temperature and humidity monitoring systems have been designed previously but some lack systems are identified where it does not provide adaptively connections and alert to webpages on logging data collections. Thus, understanding the previous system model is important to compare the importance of new build parameters in designing the new system. An evaluation of the current model, hardware and software are important before a new architecture is developed. This research has developed a prototype system to monitor remotely a room temperature and humidity condition. The designed system assisted with an internet monitoring system for the room. Research methods consist of two parts involved hardware and software development. The hardware development covers the connections of temperature sensor and the software involved constructed coding using the C language program. The program then is compiled and uploaded into the Arduino MEGA 2560 to display the temperature of the room. An open-source Internet of Things called ThingSpeak is used as a platform to retrieve and display the collected data. Real-time monitoring can be accessed through smartphones and web applications. A room is analyzed in data gathering on time and daily basis conditions. This study has been considered successfully implemented and it is a significant study that performs on new IoT platforms and adaptively ready to monitor a room remotel

- **Paper 6: IoT based real time data monitoring for industry**

Our objective is to design an Industrial machine control and monitoring system using IOT. Surveillance is most important security systems in home, industrial, office and public places. In this security system is based on the embedded system along with Microcontroller and sensor networks. The human movement is detected using the PIR sensors. In this time, the system triggers an alarm detecting the presence of person in a specific interval of time and simultaneously sends the how many persons are intruder. When the security system is activated, the PIR Sensor is activated. This highly reactive approach has low computational requirement. Therefore, it is well suited for Industrial surveillance system. This surveillance security system implemented using Microcontroller and sensors. Industrial security systems have grown in popularity in recent years, a Industrial owners look for ways to protect their personal space and enhance their Industrial values. It is necessary for every Industrial owner to considering adding a industrial security and monitoring system, as burglaries, thefts and murders have become routine in big cities. This paper demonstrates a Industrial machine control system that allows the user to control it with a wireless device such as a Wi-Fi or Bluetooth or Internet enabled mobile phone. A desktop PC is used to run the server software. The system allows the user to control each of the lights and fans individually. It can automatically turn off the main motors and turn on a motors at a specified time

## 2.2 References

- **Paper 1:**  
BC Kavitha, R Vallikannu  
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- **Paper 2:**  
FAC-PapersOnLine 49-30 (2016) 108–113  
Ademir F. da Silva, Ricardo L. Ohta, Marcelo N. dos Santos, Alecio P. D. Binotto
- **Paper 3:**  
<https://doi.org/10.3991/ijoe.v13i11.7630> Nagarjuna Telagam!!",Nehru Kandasamy  
Institute of Aeronautical Engineering, Hyderabad, India [nagarjuna473@gmail.com](mailto:nagarjuna473@gmail.com)  
and  
Nagarjuna Telagam, Nehru Kandasamy, Menakadevi Nanjundan, TS Arulanandth  
Int. J. Online Eng. 13 (11), 111-119, 2017
- **Paper 4:**  
Kong, F.; Ahn, S.; Seo, J.;  
Kim, T.W.; Huang, Y. Beacon-Based  
Individualized Hazard Alarm System  
for Construction Sites: An  
Experimental Study on Sensor  
Deployment. Appl. Sci. 2021, 11,  
11654. <https://doi.org/10.3390/app112411654>
- **Paper 5:**  
Mohd Amirul Asyraf Razali, Murizah Kassim, Norakmar Arbain Sulaiman, Shuria  
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8494-4783
- **Paper 6:**  
Aravind R1, Yadikumarani2, Meghna K3, R Divyashree4, Harshitha Naregowda5

## 2.3 Problem Statement Definition

In industry, changes in the chemical reaction and environment affects the machines and causes some explosions. Due to this hazardous problem the industry will meet a million of losses and also loss the lives of the workers and nearby people

QUESTION	DESCRIPTION
Who does the problem affect?	Those who work in the industry, the management and the residential people.
What are the boundaries of the problem?	The boundaries are workflow, geographic area and environment pollution.
What is the issue?	Due to unawareness of the early defects of temperature raising, the problems were occurred. When the problem is fixed, there is no loss of machines and the lives of workers. When the problem is not solved, the industry should face the catastrophic losses.
When does the issue occur?	The issues occur when the machines are not maintained properly or due to environmental changes.
Where is the issue occurring?	The issue occurs in the industry, because we can't predict it earlier.
Why is it important that we fix the problem?	It is very important to safe the lives of the workers and residential people.

### 3. IDEATION & PROPOSED SOLUTION

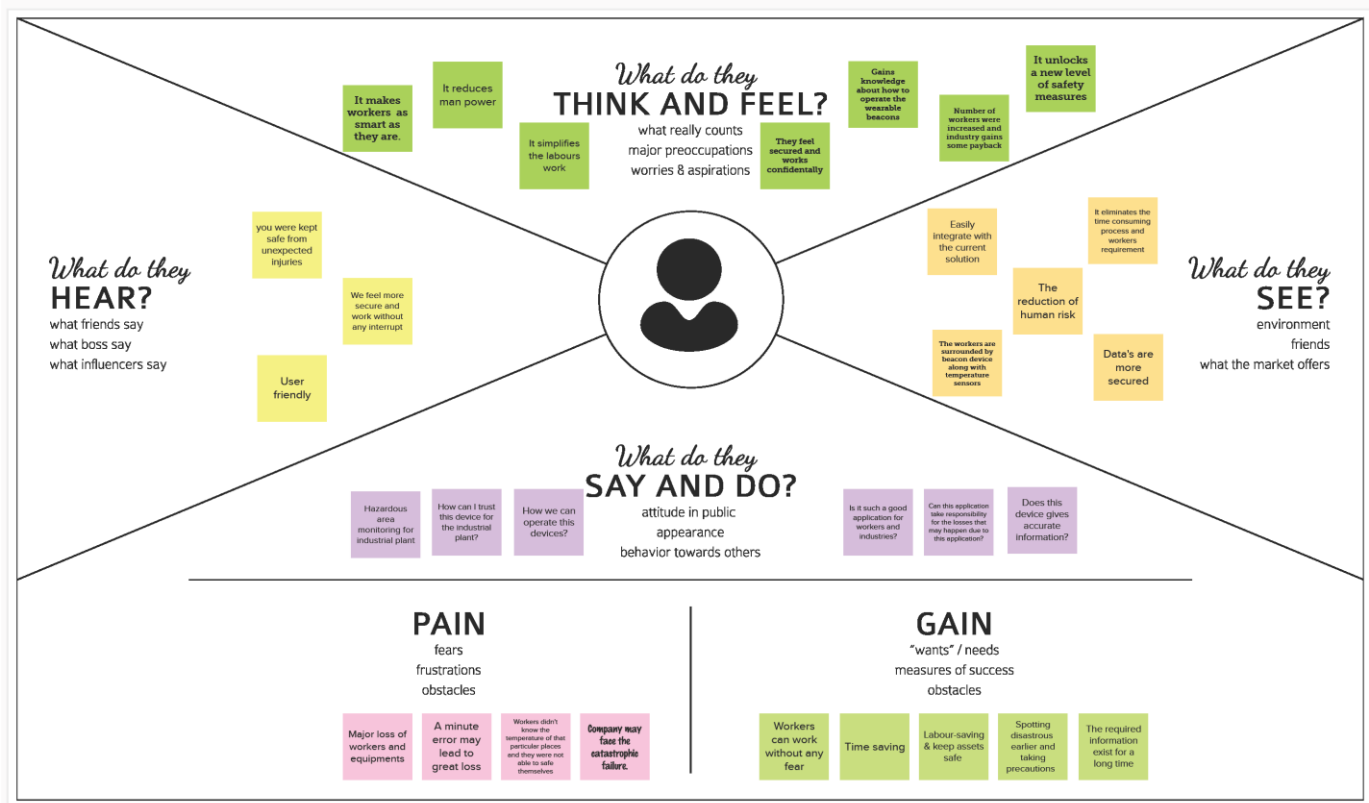
#### 3.1 Empathy Map Canvas

Edit this template  
Right-click to unlock

# Empathy Map Canvas

Gain insight and understanding on solving customer problems.

1  
Build empathy and keep your focus on the user by putting yourself in their shoes.



Share your feedback



## 3.2 Ideation & Brainstorming

[illegible]

**TIP**

Add customizable tags to sticky notes to make it easier to find, browse, organise, and categorize important ideas as themes within your mural.

**Importance**

If each of these tasks could get done without any difficulty or cost, which would have the most positive impact?

**TIP**

Participants can use their cursors to point at where sticky notes should go on the grid. The facilitator can confirm the spot by using the laser pointer holding the **H** key on the keyboard.

Sticky notes on the grid:

- Don't allow the person who are not well known about the machinery operations
- Place the cables when it starts working we can sense the temperature
- Place the temperature when it starts working we can sense the temperature
- Don't allow the person who are not well known about the machinery operations
- Avoid the high temperature area for industrial planning
- Avoid the high temperature area for industrial planning
- Place the thermometer to sense the temperature
- Place the maximum number of the indicators in the industry
- Don't allow the order content material next to the machines
- The workers must know about the safety measures
- Focus more, if the place was already affected by some hazardous
- The machine operators could monitor periodically
- Directly show the information to the fire engine service
- If the workers feel the mechanism of the industrial area, mark off as the hazardous
- Place the temperature cable when it starts working we can sense the temperature

### 3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	<p>Through this, we can monitor the temperature parameters of the hazardous areas in industrial plants.</p> <p>The area is integrated with smart beacon devices which will be broadcasting the temperature of that particular area.</p> <p>Every person working in those areas will be given smart wearable devices which will be acting as beacon scanners.</p> <p>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.</p> <p>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.</p>
2.	Idea / Solution description	<ul style="list-style-type: none"> <li>○ BLE is very similar to WI-FI in the sense that it allows device to communicate with each other.</li> <li>○ The handheld devices act as a free gateway to the internet for the BLE network ensuring ease of use and no additional costs.</li> <li>○ Bluetooth temperature sensor can carry additional sensors like humidity, shock, tamper etc.</li> </ul>
3.	Novelty / Uniqueness	<ul style="list-style-type: none"> <li>○ Temperature raise in electronic devices can be avoided by pre spraying the automatic foam.</li> <li>○ Temperature raise in some other places like boilers can be avoided by pre spraying the automatic sprinklers.</li> </ul>
4.	Social Impact / Customer Satisfaction	<ul style="list-style-type: none"> <li>○ Avoids large scale hazards in industries and saves the environment and people.</li> </ul>
5.	Business Model (Revenue Model)	<ul style="list-style-type: none"> <li>○ Sells BLE beacon with indoor positioning services or build indoor positioning service as service</li> </ul>
6.	Scalability of the Solution	<ul style="list-style-type: none"> <li>○ By using BLE device, we can sense more physical parameters of different sensors.</li> <li>○ Connect more number of beacons using BLE.</li> </ul>

## 3.4 Problem Solution fit

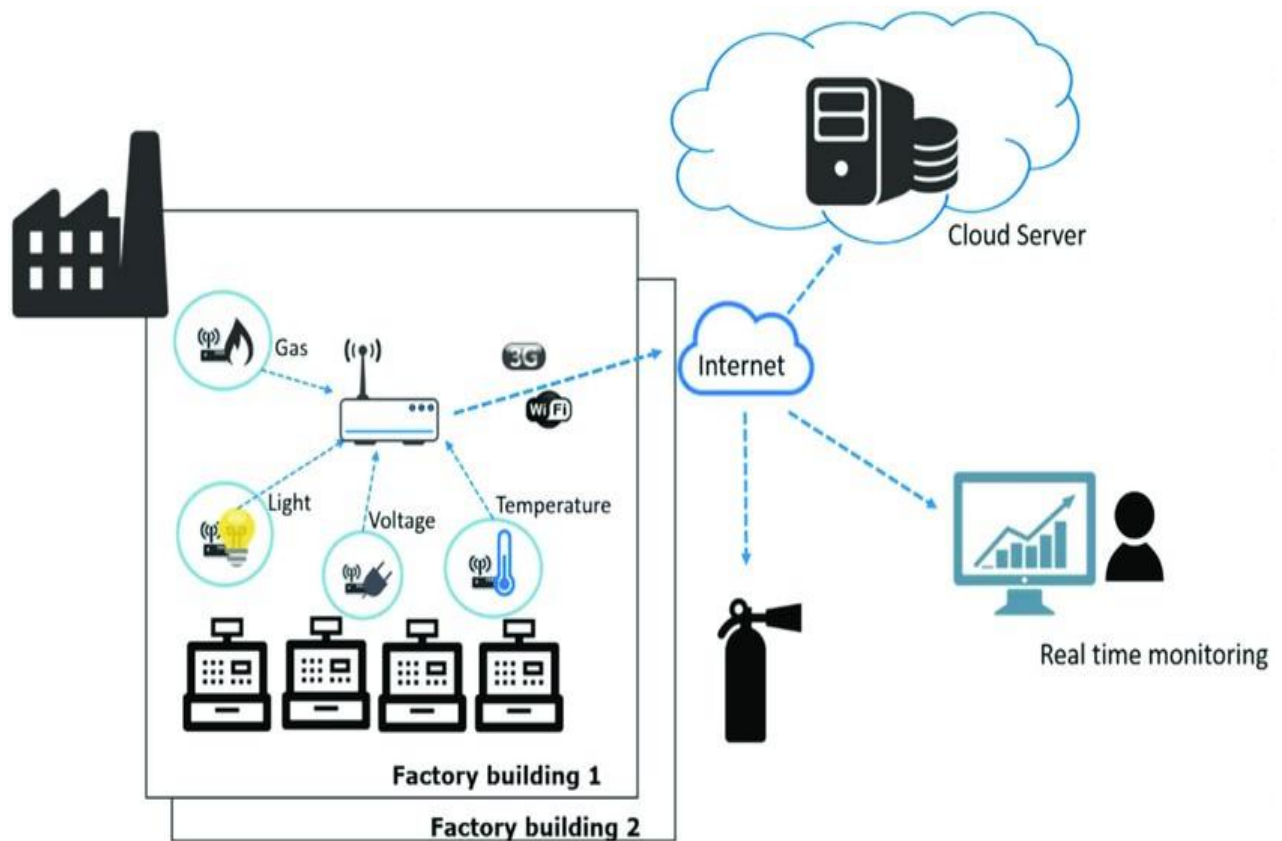
Project Title:		Project Design Phase-I - Solution Fit Template		Team ID: PNT2022TMIDxxxxxx	
<div> <div>Define CS, fit into CC</div> <div> <div>1. CUSTOMER SEGMENT(S)</div> <ul style="list-style-type: none"> <li>Industrial Workers and their family</li> <li>Administration</li> <li>Surroundings</li> </ul> </div> <div> <div>6. CUSTOMER CONSTRAINTS</div> <ul style="list-style-type: none"> <li>spending power</li> <li>budget</li> <li>Compact</li> <li>Network connection</li> </ul> </div> <div> <div>5. AVAILABLE SOLUTIONS</div> <ul style="list-style-type: none"> <li>pen and paper is an alternative to digital notetaking</li> </ul> </div> <div>Explore AS, differentiate</div> </div>					
<div> <div>focus on J&amp;P, tip into BE, understand RC</div> <div> <div>2. JOBS-TO-BE-DONE / PROBLEMS</div> <ul style="list-style-type: none"> <li>Continuously monitoring the Hazardous region</li> <li>Indicates a caution notification in the person's scanner and warns them and also sends an alert notification to the administration</li> </ul> </div> <div> <div>J&amp;P</div> <div>9. PROBLEM ROOT CAUSE</div> <ul style="list-style-type: none"> <li>Customers have to do it because of the change in regulations</li> <li>To avoid loss of Industrial assets</li> <li>To safeguard industrial workers</li> </ul> </div> <div> <div>RC</div> <div>7. BEHAVIOUR</div> <p>What does your customer do to address the problem and get the job done?</p> <ul style="list-style-type: none"> <li>find the right place to install the solution/find the place where problem occurs</li> <li>find the right installer</li> <li>monitoring the location</li> <li>calculate usage</li> <li>note caution period</li> <li>keep the place maintained regularly</li> <li>if it becomes hazardous the devices indicates before it happens and customer should prevent before it becomes harm</li> </ul> </div> <div> <div>BE</div> </div> </div>					
<div> <div>3. TRIGGERS</div> <ul style="list-style-type: none"> <li>Seeing their neighbour industries installing this solution</li> <li>Reading about a more efficient solution in the news.</li> </ul> </div> <div> <div>TR</div> </div> <div> <div>4. EMOTIONS: BEFORE / AFTER</div> <p>How do customers feel when they face a problem or a job and afterwards?</p> <ul style="list-style-type: none"> <li>Lost</li> <li>More insecurity with less confident</li> <li>Engage in conflicts</li> <li>Sleep deprivation</li> <li>Poor mental focus</li> <li>Lack of motivation</li> </ul> </div> <div> <div>EM</div> </div> <div> <div>10. YOUR SOLUTION</div> <ul style="list-style-type: none"> <li>By continuously monitoring the hazardous area using the device, we can avoid the disasters which affects the industry and workers</li> </ul> </div> <div> <div>SL</div> </div> <div> <div>8. CHANNELS of BEHAVIOUR</div> <p>ONLINE</p> <ul style="list-style-type: none"> <li>There should be internet connection for monitoring the hazardous region</li> </ul> <p>OFFLINE</p> <ul style="list-style-type: none"> <li>Sending message to users when the region is going to become hazardous</li> </ul> </div> <div> <div>CH</div> </div>					

## 4. REQUIREMENT ANALYSIS

### 4.1 Functional Requirements

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Communicate and exchange information to provide server for user	To monitor the temperature parameter of the Hazardous area in industrial plants.  Alert the person working in those areas and admins of that particular plant through SMS using API.
FR-2	Live asset monitoring	Set the reference Temperature  Detect the temperature and the particular location.  Warning when the temperature raise to set temperature.
FR-3	User requirement	Easily integrate with the current solution  It eliminates the time consuming process and workers requirement.  Improve efficiency.
FR-4	Mandatory	Keep safe from unexpected injuries.  The reduction of human risk.  Spotting disastrous earlier and taking precautions.  The required information exist for a long time.
FR-5	Testing  Reference Temperature(T1)  Crossed the Reference Temperature	The test case status is pass if  When the current temperatures equal to reference temperature(T1).  Once the temperature cross the warning SMS will be sent to the workers and admins of the plant.
FR-6	Architecture	(image)



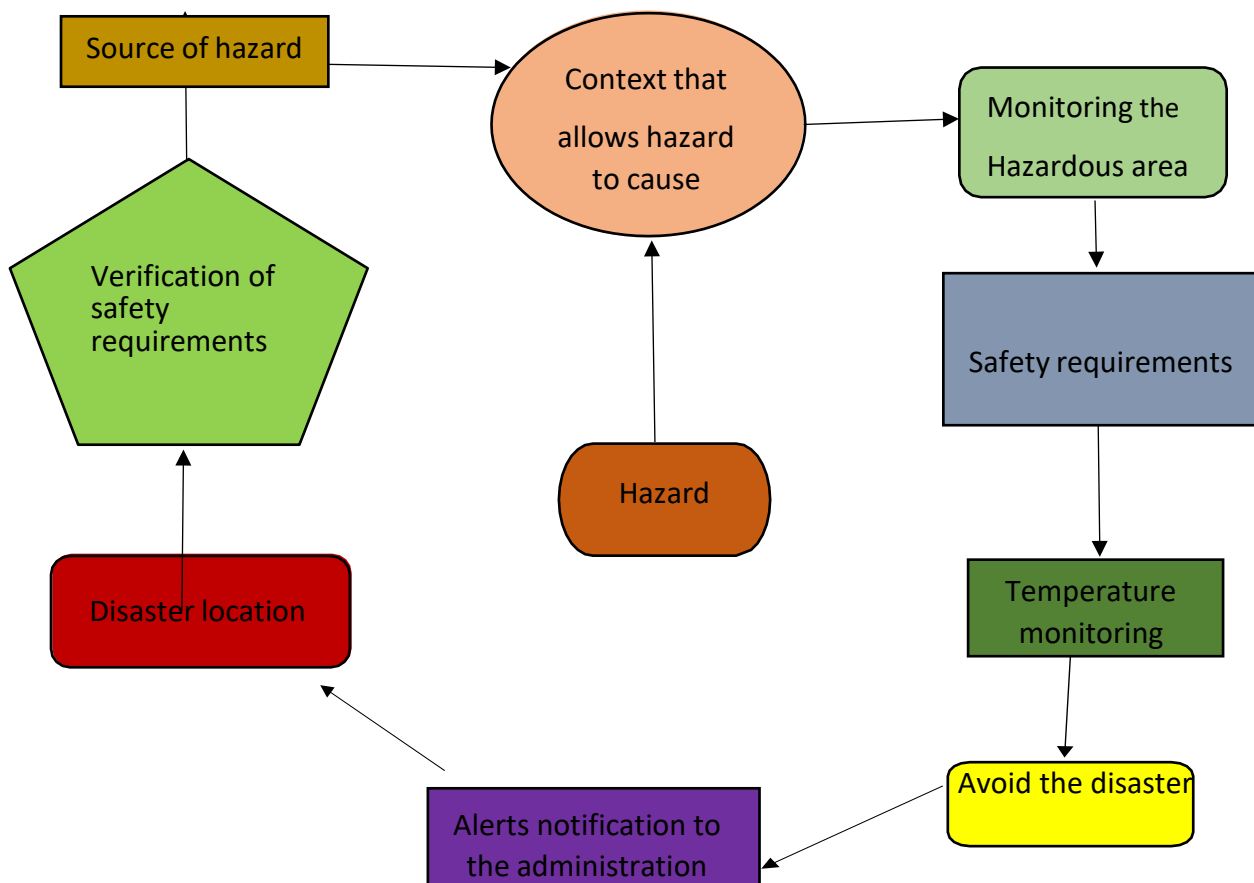
## 4.2 Non-functional Requirements:

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

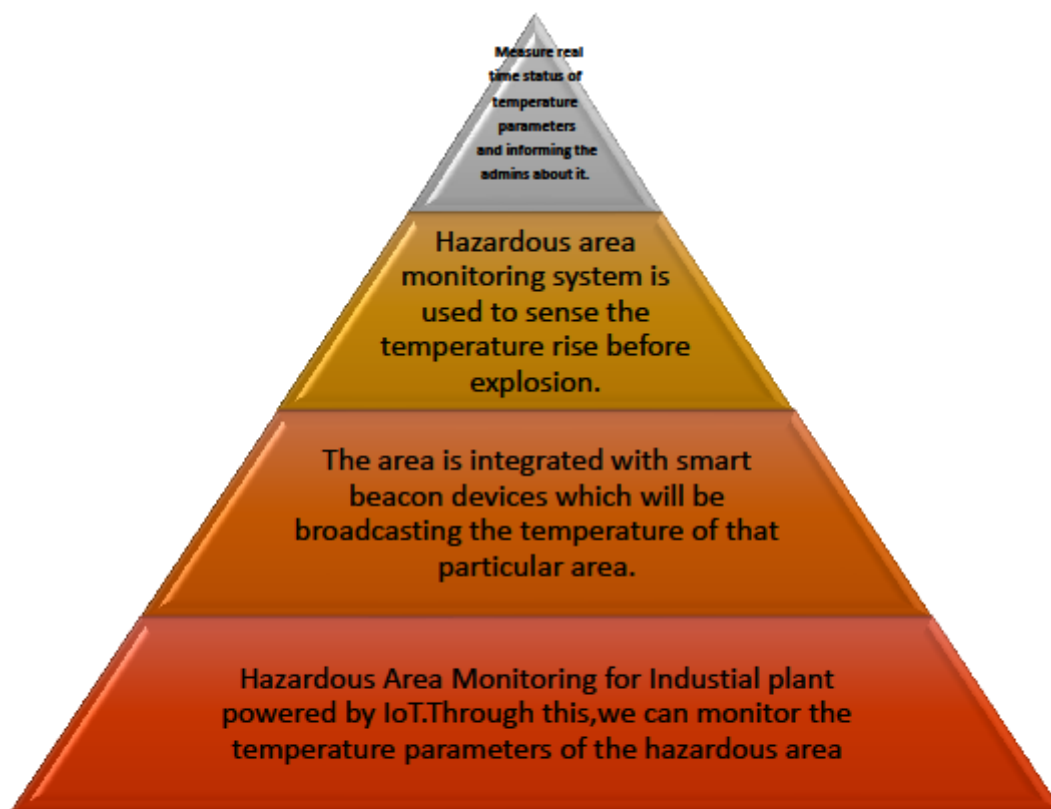
FR No.	Non-Functional Requirement	Description
NFR-1	<b>Usability</b>	High usability of user experience design for user, which is to solve the problem efficiently.
NFR-2	<b>Security</b>	The system can accessed by authorized person only.
NFR-3	<b>Reliability</b>	Monitoring the temperature parameter and providing clear solution for it, by accurate real time data collection.
NFR-4	<b>Performance</b>	The Performance should be very effective and efficient
NFR-5	<b>Availability</b>	The existing system affects the workers due to a minute error may lead to great loss and the company may face the catastrophic failure.
NFR-6	<b>Scalability</b>	Website traffic limit must be scalable enough to support users at a time.  The system should have upgradable feature.

## 5. PROJECT DESIGN

### 5.1 Data Flow Diagram



## 5.2 Solution & Technical Architecture



## 5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account/dashboard	High	Sprint-1
	Mail Confirmation	USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
	Facebook Access	USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
	Register	USN-4	As a user, I can register for the application through Gmail	I can register for the application	Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password	I can log into the required application	High	Sprint-1
Customer (Web user)	Same as Mobile user	Same as Mobile user	Same as Mobile user	Same as Mobile user	High	Sprint-1
Customer Care Executive	Farmer Welfare Department	USN-1	As a user, I managing a team of representatives offering customer support	I can communicate to them in proper manner	High	Sprint-1
	Agriculture Extension Department	USN-2	As a user, I provide technical aid to farmers on any agriculture issues	I can implementation of agriculture extension activities	High	Sprint-1
Administrator	Farm Administrator	USN-1	As a user, I provide administrative support for farmers	I informed about the financial and physical performance	High	Sprint-1
		USN-2	As a user, I live and work on the farm or an estate	I take responsibility	Medium	Sprint-1



## 6. PROJECT PLANNING AND SCHEDULING

### 6.1 Sprint Planning and Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email,password, and confirming my password.	2	High	Dheebiga
Sprint-1	confirmation	USN-2	As a user, I will receive confirmationemail once I have registered for the application	1	High	Biruntha
Sprint-2	confirmation via Facebook	USN-3	As a user, I can register for the application throughFacebook	2	Low	Divya
Sprint-1	confirmation via Email	USN-4	As a user, I can register for the application throughGmail	2	Medium	Pooj a shree
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	Biruntha

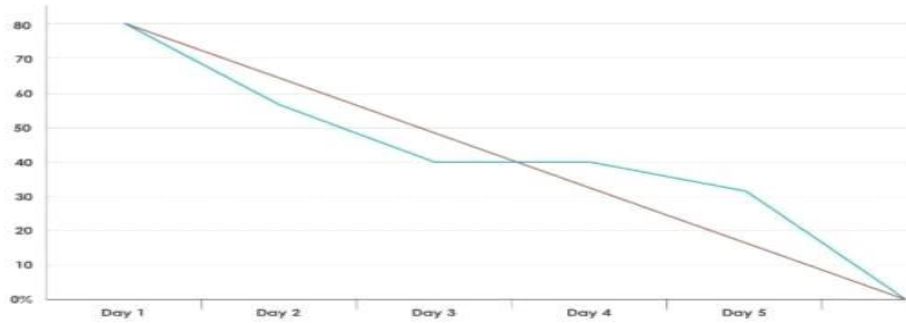
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint EndDate (Planned)	Story Points Completed (as on Planned EndDate)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	30	30 Oct 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	49	06 Oct 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	50	07 Oct 2022

### Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{\text{sprint duration}}{\text{velocity}} = \frac{20}{10} = 2$$

Burndown Chart:



## 6.2 Sprint Delivery Schedule

### Milestone List:-

S.No	Milestone	Mandatory/Optional	Completion Date
1.	Project Started	Mandatory	01/09/2022
2.	Complete gathering requirements	Mandatory	17/09/2022
3.	Complete Design	Mandatory	04/10/2022
4.	Complete Coding	Mandatory	20/10/2022
5.	Complete Testing	Mandatory	27/10/2022
6.	Complete implementation	Mandatory	07/11/2022
7.	Project End	Mandatory	12/11/2022

### Activity List :-

S.No.	Activity Title	Activity Description	Duration
1.	Understanding the project	Assign the team members after that create repository in the GitHub and then assign task to each member and guide them how to access the GitHub while submitting the assignments.	1 week
2.	Starting the project	Assign all the tasks based on sprints and work on it accordingly.	1 week
3.	Completing every tasks	Team Leader should ensure that whether every team member have completed the assigned tasks or not.	1 week
4.	Stand-Up Meetings	Team Leader must have a Stand-Up Meeting with the Team and Work on the Updates and Requirement Session.	1 week
5.	Deadline	Ensure that team members are completing every task within the deadline.	1 week
6.	Budget and Scope of the project	Analyze the overall budget which must be within certain limit. It should be favorable to every person.	1 week

## 7. CODING & SOLUTIONING

### 7.1 Feature 1

In this python code, first we specify the ibm Watson credentials to connect the python code to the ibm Watson and also give the conditions for control and monitor the motors or pumps in the industry.

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

#Provide your IBM Watson Device Credentials
organization = "6xryq0"
deviceType = "ESP32x"
deviceId = "19"
authMethod = "token"
authToken = "12345678"

# 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")

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()
```

### 7.2 Feature 2

Here we declare the parameters for two different zones and give the conditions for threshold values. If the values reached across the threshold values ,it will give the warning messages.

```
#####RANDOM LIBRARY#####
temperature02=random.randint(-20,100)
Humidity02=random.randint(0,100)
vibrate02=random.randint(0,100)
a1="Warning!!....Temperature is high in zone01"
a2="Warning!!....Temperature is high in zone02"
b1="Warning!!....vibration is high in zone01"
b2="Warning!!....vibration is high in zone01"
data = { 'temperature01' : temperature01, 'Humidity01': Humidity01, 'vibrate01': vibrate01, 'temperature02' : temperature02, 'Humidity02': Humidity02, 'vibrate02': vibrate02}

#print data
def myOnPublishCallback():
    print ("Published data for zone01 and zone02" "temperature01 = %s C" % temperature01, "Humidity01 = %s %%" % Humidity01, "vibrate01 = %s hz" % vibrate01,"temperature02 = %s C"
    success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0, on_publish=myOnPublishCallback)

    if not success:
        print("Not connected to IoT")
        time.sleep(1)

#condition for zone01
if temperature01>80:
    a1="Warning!!....Temperature is high in zone01"
    print("Warning!!....Temperature is high in zone01")
elif vibrate01>70:
    b1="Warning!!....vibration is high in zone01"
    print("Warning!!....vibration is high in zone01")
else :
    print("zone01 is in normal state")

#condition for zone02
if temperature02>80:
    a2="Warning!!....Temperature is high in zone02"
    print("Warning!!....Temperature is high in zone02")
elif vibrate02>70:
    b2="Warning!!....vibration is high in zone02"
    print("Warning!!....vibration is high in zone02")
else :
    print("zone02 is in normal state")
    time.sleep(5)

deviceCli.commandCallback = myCommandCallback

# Disconnect the device and application from the cloud
deviceCli.disconnect()
```

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## 8. TESTING

### 8.1 Test Cases

SL.NO	INPUT	OUTPUT	RESULT
01.	Temperature:55 Humidity:67 Vibration:12	Normal state	Passed
02.	Temperature:88 Humidity:54 Vibration:65	Temperature is high	Passed
03.	Temperature:54 Humidity:99 Vibration:77	Vibration is high	Passed
04.	Temperature:33 Humidity:23 Vibration:13	Normal state	Passed
05.	Temperature:99 Humidity:34 Vibration:78	Temperature is high Vibration is high	Passed
06.	Temperature:34 Humidity:56 Vibration:32	Normal state	Passed
07.	Temperature:65 Humidity:76 Vibration:79	Vibration is high	Passed
08.	Temperature:43 Humidity:76 Vibration:12	Normal state	Passed
09.	Temperature:89 Humidity:90 Vibration:100	Temperature is high Vibration is high	Passed
10.	Temperature:90 Humidity:23 Vibration:70	Temperature is high Vibration is high	Passed
11.	Temperature:62 Humidity:12 Vibration:89	Vibration is high	Passed
12.	Temperature:24 Humidity:55 Vibration:24	Normal state	Passed
13.	Temperature:65 Humidity:54 Vibration:89	Vibration is high	Passed

14.	Temperature:36 Humidity:79 Vibration:77	Vibration is high	Passed
15.	Temperature:56 Humidity:78 Vibration:99	Vibration is high	Passed
16.	Temperature:89 Humidity:99 Vibration:65	Temperature is high	Passed
17.	Temperature:66 Humidity:34 Vibration:54	Normal state	Passed
18.	Temperature:34 Humidity:74 Vibration:3	Normal state	Passed
19.	Temperature:43 Humidity:79 Vibration:88	Vibration is high	Passed
20.	Temperature:90 Humidity:56 Vibration:34	Temperature is high	Passed

## 8.2 User Acceptance Testing

### 1. Purpose of document:

The purpose of this document is to briefly explain the test coverage and open issues of the [ProductName] project at the time of the release to User Acceptance Testing (UAT).

### 2. Defect analysis:

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	5	0	1	6
Fixed	16	2	4	18	30
Not Reproduced	0	0	1	0	1
Skipped	0	0	2	1	2

Won't Fix	0	5	2	1	8
Totals	29	16	14	24	70

### 3. Test case analysis:

This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	51	0	0	51
Security	2	0	0	2
Outsource Shipping	3	0	0	3
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	2	0	0	2

## 9. RESULTS

### 9.1 Performance Metrics

#### Python output:

The screenshot shows a Python script on the left and its output in a terminal window on the right. The script is a simulation of an IoT device with two zones, each having temperature and vibration sensors. It includes logic for publishing data, checking for warnings, and handling disconnection. The terminal output shows the successful connection to the IoT device and a series of published data points for both zones, including temperature, humidity, and vibration frequency.

```

File Edit Format Run Options Window Help
>>> deviceCmd = command(command)
temperature02=random.randint(-20,100)
Humidity02=random.randint(0,100)
vibrate02=random.randint(0,100)
a1="Warning!!!!..Temperature is high in zone01"
a2="Warning!!!!..Temperature is high in zone02"
b1="Warning!!!!..vibration is high in zone01"
b2="Warning!!!!..vibration is high in zone02"
data = { 'temperature01': temperature01,
         'temperature02': temperature02,
         'humidity01': humidity01,
         'humidity02': humidity02,
         'vibrate01': vibrate01,
         'vibrate02': vibrate02 }

#Print data
def myonPublishCallback():
    print ("Published data for zone01 and zone02")
    success = deviceCli.publishEvent("IoTSensorData", data)
    if not success:
        print ("Not connected to IoT")
    time.sleep(1)

#condition for zone01
if temperature01>80:
    a1="Warning!!!!..Temperature is high in zone01"
    print("Warning!!!!..Temperature is high in zone01")
elif vibrate01>70:
    b1="Warning!!!!..vibration is high in zone01"
    print("Warning!!!!..vibration is high in zone01")
else:
    print("zone01 is in normal state")

#condition for zone02
if temperature02>80:
    a2="Warning!!!!..Temperature is high in zone02"
    print("Warning!!!!..Temperature is high in zone02")
elif vibrate02>70:
    b2="Warning!!!!..vibration is high in zone02"
    print("Warning!!!!..vibration is high in zone02")
else:
    print("zone02 is in normal state")
time.sleep(5)

deviceCli.commandCallback = myonPublishCallback

# Disconnect the device and application from the c
deviceCli.disconnect()

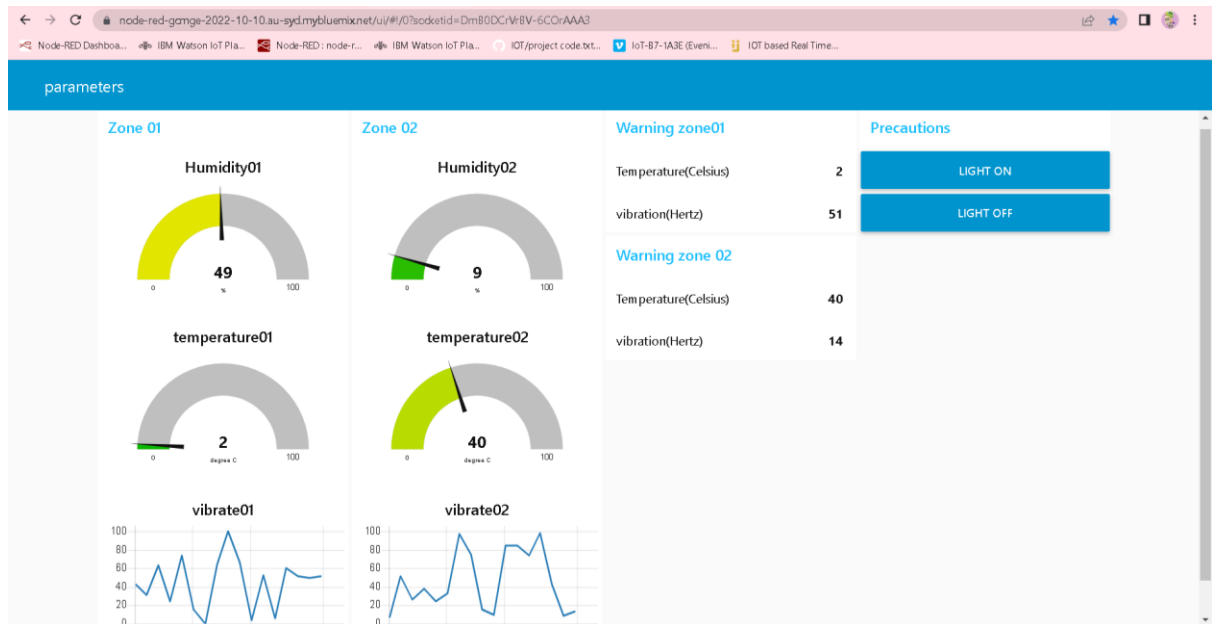
```

```

Python 3.7.4 Shell
Python 3.7.4 (tags/v3.7.4:ef9359112e, Jul 8 2019, 20:34:20) [MSC v.1916 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
RESTART: C:\Users\VIJESH R\AppData\Local\Programs\Python\Python37\lib\python.py
2022-11-17 19:12:33,680 ibmiotf.device.Client INFO Connected successfully: d:6eryq0:E8P32x:19
Published data for zone01 and zone02temperature01 = 47 C Humidity01 = 58 % vibrate01 = 43 hz temperature02 = -20 C Humidity02 = 42 % vibrate02 = 7 hz to IBM Watson
zone01 is in normal state
zone02 is in normal state
Published data for zone01 and zone02temperature01 = -17 C Humidity01 = 48 % vibrate01 = 31 hz temperature02 = 33 C Humidity02 = 24 % vibrate02 = 51 hz to IBM Watson
zone01 is in normal state
zone02 is in normal state
Published data for zone01 and zone02temperature01 = 67 C Humidity01 = 40 % vibrate01 = 63 hz temperature02 = 11 C Humidity02 = 19 % vibrate02 = 26 hz to IBM Watson
zone01 is in normal state
zone02 is in normal state
Published data for zone01 and zone02temperature01 = 57 C Humidity01 = 13 % vibrate01 = 24 hz temperature02 = 22 C Humidity02 = 6 % vibrate02 = 38 hz to IBM Watson
zone01 is in normal state
zone02 is in normal state
Published data for zone01 and zone02temperature01 = 13 C Humidity01 = 65 % vibrate01 = 74 hz temperature02 = 17 C Humidity02 = 62 % vibrate02 = 24 hz to IBM Watson
Warning!!!!..vibration is high in zone01
zone02 is in normal state
Published data for zone01 and zone02temperature01 = 29 C Humidity01 = 38 % vibrate01 = 16 hz temperature02 = 56 C Humidity02 = 24 % vibrate02 = 33 hz to IBM Watson
zone01 is in normal state
zone02 is in normal state
Published data for zone01 and zone02temperature01 = 40 C Humidity01 = 69 % vibrate01 = 0 hz temperature02 = 5 C Humidity02 = 32 % vibrate02 = 97 hz to IBM Watson
zone01 is in normal state
Warning!!!!..vibration is high in zone02
Published data for zone01 and zone02temperature01 = 43 C Humidity01 = 74 % vibrate01 = 64 hz temperature02 = 92 C Humidity02 = 50 % vibrate02 = 75 hz to IBM Watson

```

## Node-red Result:



## 10. ADVANTAGES & DISADVANTAGES

### 10.1 Advantages

This system helps in the following ways:

- To detect the exact direction of the fire source.
- The capability of sensing accurately with increased flexibility
- Reduce human effort.
- Reliable and economical.
- If any of the sensor output will be high, Voice module will produce the sound for intimating the condition to others.
- To detect fire in the disaster-prone area.
- Also extinguishes the fire on detection.
- Reduces the level of destruction.
- Simple and low cost technology.
- Measures flammability of gases.
- It has robust and simple construction.
- Automation of sensors leads to better monitoring of devices.



## **10.2 Disadvantages**

There are several disadvantages to hazardous area monitoring in industry plants powered by IoT. First, if the IoT system fails, the entire plant may be at risk. Second, IoT systems are often complex and may be difficult to manage and maintain. Third, the data collected by IoT systems may be inaccurate or incomplete, which could lead to incorrect decisions being made. Finally, the cost of implementing and maintaining an IoT system can be prohibitive for many companies.

## **11. CONCLUSION**

WSN is possible today due to technological advancement in various domains. Envisioned to be an essential part of our lives design constraints need to be satisfied for a realization of sensor networks. In this system, various sensors like fire, gas, LDR sense the fire and other parameters, the fire get extinguished with the help of water pump attached in the system. Similarly other actions will to be taken by the system. If the voltage and current go above the threshold value and leakage of gas are detected by gas sensors and the voice module plays an audio note which gives an alert message to the factory workers for the gas and fire detected. IOT and the Android app help us for remote monitoring.

## **12. FUTURE SCOPE**

There is a lot of potential for further development and expansion of hazardous area monitoring in industrial plants powered by IoT. Some possible areas for future development include:

- Developing more sophisticated and accurate sensors for detecting a wider range of hazardous conditions.
- Developing better algorithms for analyzing data from sensors and making predictions about potential hazards.
- Developing systems that can automatically shut down or isolate parts of a plant in the event of a hazard.
- Investigating ways to use IoT-powered systems for real-time monitoring of worker safety in hazardous areas.
- Developing systems that can provide workers with real-time information about potential hazards in their surroundings.
- Investigating ways to use IoT-powered systems to monitor environmental conditions in hazardous areas

## 13. APPENDIX

The appendix for hazardous area monitoring in industry plant powered by IoT point by point is as follows:

- Hazardous area monitoring helps to ensure the safety of plant personnel and equipment by detecting and monitoring potential hazards.
- IoT-enabled sensors can be used to monitor various parameters in a hazardous area, such as temperature, pressure, and gas concentration.
- Data collected by the sensors can be transmitted to a central control system in real-time, allowing for early detection and mitigation of potential hazards

Hazardous area monitoring can help to improve the overall safety of an industrial plant by reducing the risk of accidents and incidents

### Source code:

```
import time
```

```
import sys
```

```
import ibmiotf.application
```

```
import ibmiotf.device
```

```
import random
```

```
#Provide your IBM Watson Device Credentials
```

```
organization = "6xryq0"
```

```
deviceType = "ESP32x"
```

```
deviceId = "19"
```

```
authMethod = "token"
```

```
authToken = "12345678"
```

```
# 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")

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 zone01 and zone02

    temperature01=random.randint(-20,100)
    Humidity01=random.randint(0,100)
    vibrate01=random.randint(0,100)
    temperature02=random.randint(-20,100)
    Humidity02=random.randint(0,100)
    vibrate02=random.randint(0,100)
    a1="Warning!!!....Temperature is high in zone01"
    a2="Warning!!!....Temperature is high in zone02"
    b1="Warning!!!....vibration is high in zone01"

```

```

b2="Warning!!!....vibration is high in zone01"

data = { 'temperature01' : temperature01, 'Humidity01': Humidity01, 'vibrate01':
vibrate01, 'temperature02' : temperature02, 'Humidity02': Humidity02, 'vibrate02': vibrate02}

#print data

def myOnPublishCallback():

    print ("Published data for zone01 and zone02" "temperature01 = %s C" %
temperature01, "Humidity01 = %s %" % Humidity01, "vibrate01 = %s hz" %
vibrate01,"temperature02 = %s C" % temperature02, "Humidity02 = %s %" %
Humidity02, "vibrate02 = %s hz" % vibrate02, "to IBM Watson")

    success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)

if not success:

    print("Not connected to IoT")

    time.sleep(1)

#condtion for zone01
if temperature01>80:

    a1="Warning!!!....Temperature is high in zone01"

    print("Warning!!!....Temperature is high in zone01")
elif vibrate01>70:

    b1="Warning!!!....vibration is high in zone01"

    print("Warning!!!....vibration is high in zone01")
else :

    print("zone01 is in normal state")

#condition for zone02
if temperature02>80:

    a2="Warning!!!....Temperature is high in zone02"

```

```
print("Warning!!!....Temperature is high in zone02")
elif vibrate02>70:
    b2="Warning!!!....vibration is high in zone02"
    print("Warning!!!....vibration is high in zone02")
else :
    print("zone02 is in normal state")
time.sleep(5)
```

```
deviceCli.commandCallback = myCommandCallback
```

```
# Disconnect the device and application from the cloud
```

```
deviceCli.disconnect()
```

**GitHub link:**

<https://github.com/IBM-EPBL/IBM-Project-40286-1660627134>

**Project demo link:**

<https://youtu.be/T-Q5ZPk7IEE>