PROJECT REPORT

Team ID	**PNT2022TMID52413**
Project Name	**Hazardous Area Monitoring For Industrial Plant Powered By IoT**

TEAM MEMBERS:

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1. INTRODUCTION

1.1 Project Overview:

Internet of Things (IoT) represents a general concept for the ability of network devices to sense and collect data from the world around us, and then share that data across the internet where it can be processed and utilized for various practical purposes in different aspects of life. The reach of IoT based systems in industrial areas is still limited, but it has huge potential. In this project, we create an IoT based systems hazardous monitoring system specifically suited to requirements of mining, refining and manufacturing industries.

The system actively records, processor and analyzes the temperature of surroundings, which is a prime safety parameter in areas where molten metal is processed, manufactured in done or welds are made. Also, it keeps track of high levels of dangerous gases present in the environment (LPG/Natural Gas). If a parameter is violated, the systems send an immediate notification to a set of present lists of users on their smartphones, and continues logging and monitoring data for further analysis to suggest improvement 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.

1.2 Purpose:

We amalgamate technology along with the hazardous area monitioring inorder to effectively create a safe environment. Based on IoT technology and data to create a more efficient industry monitoring. This project helps the industries in monitoring the rise and fall of ttemperature and humidity. The alert system will be triggered when the tempwerature exceeds normal bounds,.

In case of emergencies, the admins will be notified in the same instant the workers are alerted, In the web applications , admins can view the sensor parameters. Thus , hazardous area monitoring provides us with themost optimal way of monitoring the industry in an efficidnt manner using iot technology.

2 . LITERATURE SURVEY:

2.1 Existing Problem :

Every day synthetic, toxic chemicals are released into the environment. It affects our water, land and air. These pollutants may cause serious health effects such as birth defects, development disorders, respiratory problems, cancer and in some cases can lead to death. Apart from this, it can also have adverse effect on wildlife and environment. The main polluting industries in India where hazardous gases evolve are waste water treatment plant, tanneries, coal mining industries, textile dye processing, and pesticide pollution. Consider few industries and their problem. Each year millions of people are affected by the toxic chemicals, primarily iron, limestone, pyrite and zinc that are released into the air by the dozens of lead smelting sites around the world. Lead smelting uses furnaces and other chemical agents to remove impurity from lead ores. Lead Smelting puts approximately 2.5 million people at risk at 70 polluted lead smelting sites worldwide, according to Blacksmith Institute.

2.2 References:

PAPER 1

TITLE: IoT-Based Data Logger for Weather Monitoring Using Arduino-Based Wireless Sensor network with Remote Graphical Application and Alerts.

AUTHOR NAME: Jamal Mabrouki ,Mourade Azrour,Driss Dhiba,Yousef Farhaoui, and Souad El hajjaji

DESCRIPTION:

In recent years, monitoring systems play significant roles in our life. So, in this paper, we propose an automatic weather monitoring system that allows having dynamic and real- time climate data of a given area. The proposed system is based on the internet of things technology and embedded system. The system also includes electronic devices, sensors, and wireless technology. The main objective of this system is sensing the climate parameters, such as temperature, humidity, and existence of some gases, based on the sensors. The captured values can then be sent to remote applications or databases. Afterwards, the stored data can be visualized in graphics and tables form.

PAPER 2

TITLE: Micraspis: A Computer-Aided Proposal Toward Programming and Architecting Smart IoT Wearables

AUTHOR NAME: LONGPHUOCTÔN, LAMSON LÊ, (Member, IEEE), AND MINH-SONNGUYEN

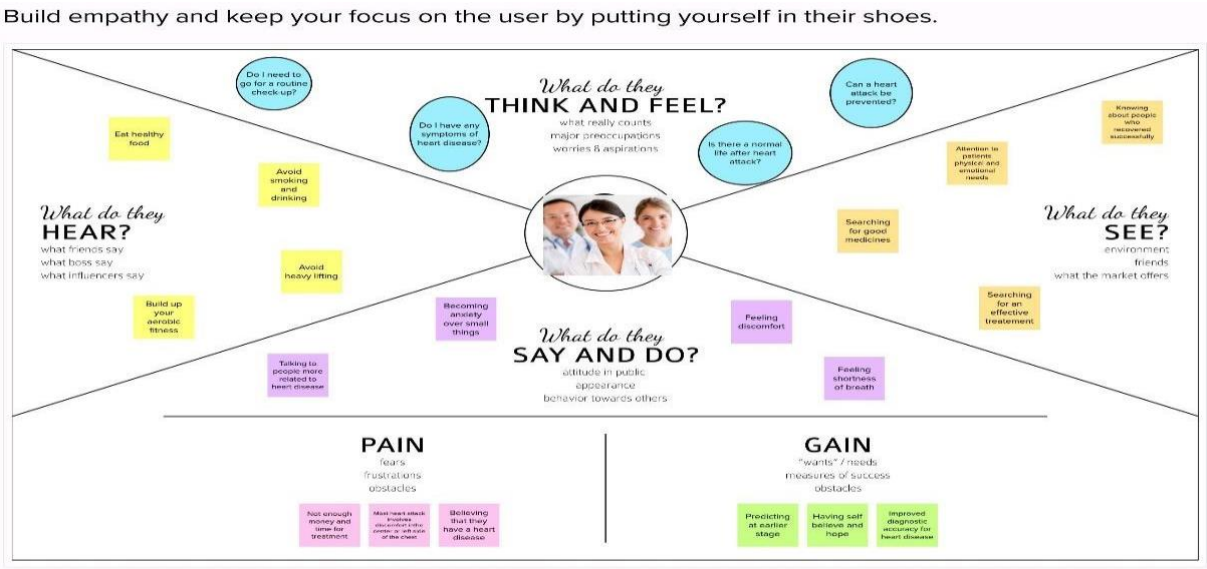
DESCRIPTION:

A wearable is a lightweight body-wore device that relies on data-driven communications to keep people connectedpurposefully, for instance, for fire-fighting, fast-food clients, and medicaltreatment. With the rise of wearable computing in the era of IoT driven smart applications, programmers now expect the time to market for these devices to be shortened. While support for

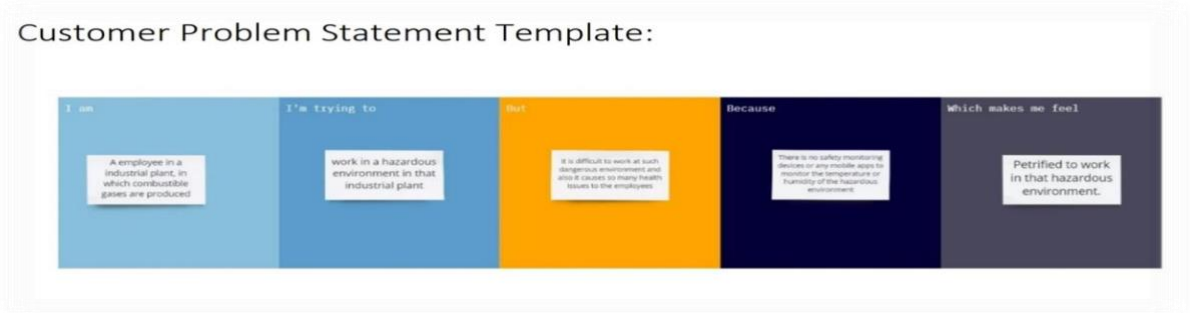
IoT programming in general has gathered traction, tool proposals that automate the development of smart solutions based on the Internet of Wearable Things, though of paramount importance, still stay on the sidelines. We propose a code generation tool called Micraspis that allows a wearable to be described both functionally and architecturally – as if they are two sides of the same coin. The tool has an underlying model-to-code transformation mechanism to generate source code that is executable on a specific IoT programming platform such as Arduino. Our experiments demonstrate that programming code generated by Micraspis amounts to at least 60% of the source code needed to fulfil the business logic of ordinary wearable devices. We conducted an interview to meticulously collect programmers' assessment on how Micraspis assists them in programming and architecting smart IoT wearables. A total of 161 programmers responded to a Likert scale questionnaire, with which at least 65% of them either agree or strongly agree. Overall, the results show that Micraspis has promising applicability in supporting IoWT-enabled smart solutions.

3 . IDEATION AND PROPOSED SOLUTION:

3.1 Empathy Map Canvas:



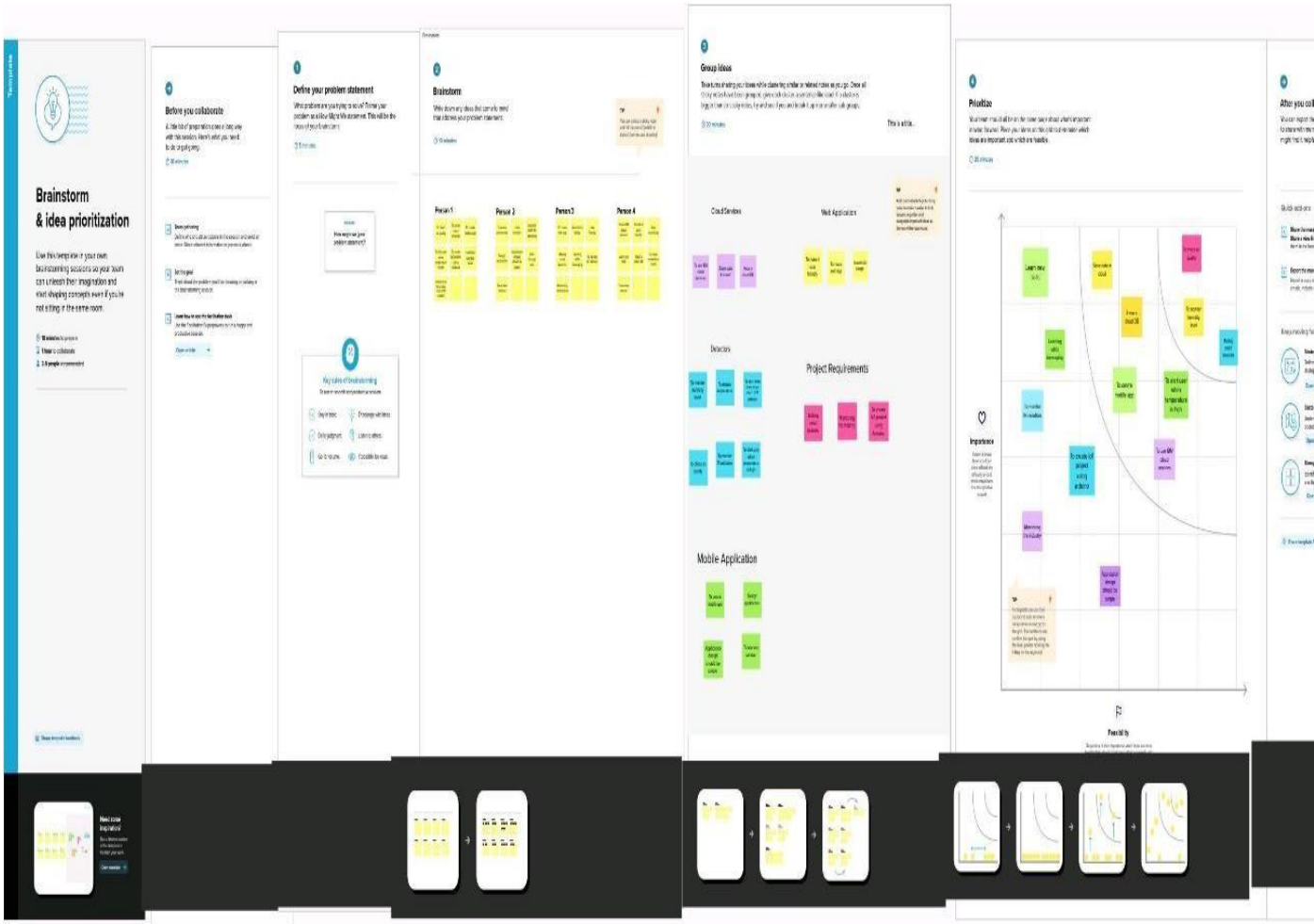
3.2 Ideation & Brainstorming



PROBLEM STATEMENT	I AM (CUSTOMER)	I'm TRYING TO	BUT	BECAUSE	WHICH MAKES ME FEEL

PS-1	A employee which working at a industrial plant, in which combustible gases is produced.	Working in the hazardous environment in that industrial plant.	It is difficult to work at such dangerous environment and also it causes so many health issues to the employees.	There is no safety monitoring devices or any mobile apps to monitor the temperature or humanity of the hazardous environment.	Petrified to work in that environment.

Brainstorming:

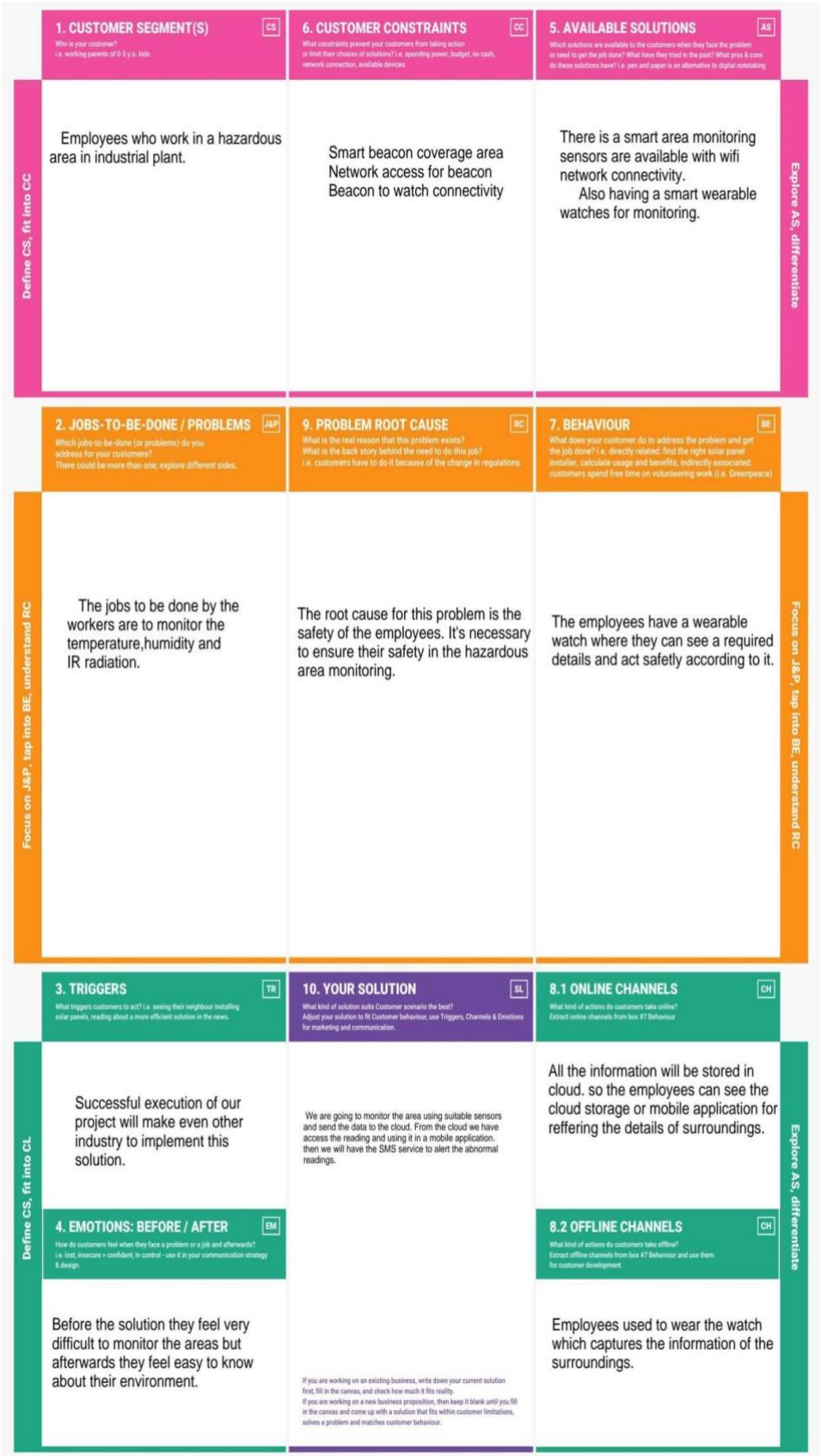


3.3 Proposed Solution:

S. No.	PARAMETERES	DESCRIPTION
1.	Problem Statement (Problem to solved)	Hazardous Area Monitoring for Industrial Plant powered by lot.
2.	Idea / Solution description	Hazardous Area Monitoring for industrial Plant powered by lot is a project report that focuses on the necessity of the monitoring of hazardous areas in industrial plants. Industrial plants are the ones that contain both hazardous and nonhazardous areas. The monitoring of the hazardous areas in industrial plants are important from time to time. If the damage that occurs in hazardous areas can result in the loss of property or lives. So, monitoring of such areas can help in easy monitoring of the hazardous areas. There can be smart devices integrated at the hazardous areas that can help in detecting any fishy things that can occur in the particular area.
3.	Novelty / Uniqueness	A hazardous area is any area with an atmosphere containing, or potentially containing gases, vapour or dust which are flammable or explosive. These areas are rigorously analysed with condition monitoring when installing equipment to minimize the risk to individuals and assets it is crucial that equipment operating in these conditions are effectively monitored to pre-empt any issues before they occur. Unlike most industries, these issues not only result in downtime, but present a significant safety risk.

4.	Social Impact / Customer Satisfaction	1)To prevent pollution 2) Real time plant monitoring 3) Reduced risks of disasters 4) Automated detection 5) Excellent customer experience.
5.	Business Model (Revenue Model)	Raspberry – Pi 3 Temperature Sensor - DS18820 Gas Sensor – MQ 5/9 Breadboard Raspbian OS (Running on R pi - 3) Simple push API Thing speak Cloud Platform.
6.	Scalability of the Solution	This system can be deployed in many industrial areas like mining, underground factories, metal refineries, automatic welding factories and even heavy parts production lines it will help to provide a safe and efficient working environment in which arose, while also opening new paths to improve the safety parameters of these places.

3.4 Problem Solution Fit:


1. CUSTOMER SEGMENT(S)
CS
Who is your customer?
i.e. working parents of 0-5 y.o. kids
Employees who work in a hazardous area in industrial plant.
6. CUSTOMER CONSTRAINTS
CC
What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices.
Smart beacon coverage area
Network access for beacon
Beacon to watch connectivity
5. AVAILABLE SOLUTIONS
AS
Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros & cons do these solutions have? i.e. pen and paper is an alternative to digital notetaking
There is a smart area monitoring sensors are available with wifi network connectivity.
Also having a smart wearable watches for monitoring.
Define CS, fit into CC
Explore AS, differentiate
2. JOBS-TO-BE-DONE / PROBLEMS
J&P
Which jobs-to-be-done (or problems) do you address for your customers?
There could be more than one; explore different sides.
The jobs to be done by the workers are to monitor the temperature,humidity and IR radiation.
9. PROBLEM ROOT CAUSE
RC
What is the real reason that this problem exists?
What is the back story behind the need to do this job?
i.e. customers have to do it because of the change in regulations.
The root cause for this problem is the safety of the employees. It's necessary to ensure their safety in the hazardous area monitoring.
7. BEHAVIOUR
BE
What does your customer do to address the problem and get the job done? i.e. directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace)
The employees have a wearable watch where they can see a required details and act safely according to it.
Focus on J&P, tap into BE, understand RC
Focus on J&P, tap into BE, understand RC
3. TRIGGERS
TR
What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news.
Successful execution of our project will make even other industry to implement this solution.
4. EMOTIONS: BEFORE / AFTER
EM
How do customers feel when they face a problem or a job and afterwards?
i.e. lost, insecure > confident, in control - use it in your communication strategy & design.
Before the solution they feel very difficult to monitor the areas but afterwards they feel easy to know about their environment.
10. YOUR SOLUTION
SL
What kind of solution suits Customer scenario the best?
Adjust your solution to fit Customer behaviour, use Triggers, Channels & Emotions for marketing and communication.
We are going to monitor the area using suitable sensors and send the data to the cloud. From the cloud we have access the reading and using it in a mobile application. then we will have the SMS service to alert the abnormal readings.
If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality.
If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.
8.1 ONLINE CHANNELS
CH
What kind of actions do customers take online?
Extract online channels from box #7 Behaviour
All the information will be stored in cloud. so the employees can see the cloud storage or mobile application for reffering the details of surroundings.
8.2 OFFLINE CHANNELS
CH
What kind of actions do customers take offline?
Extract offline channels from box #7 Behaviour and use them for customer development
Employees used to wear the watch which captures the information of the surroundings.
Define CS, fit into CL
Explore AS, differentiate

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	Data Gathering	The smart beacon must be able to detect and 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 an area near it.
FR-3	Beacon Data Syncing	The smart beacon must be able to share its stored data with both the wearable device and admin dashboard through the cloud.
FR-4	Wearable Device Display	The wearable device must be able to display the temperature of the area where there worker is currently present.
FR-5	SMS Notification	If the temperature of the area is found to reach dangerous levels, the worker should be informed via SMS to their phone instructing them to leave the area.
FR-6	Admin Dashboard	If the temperature of the area is found to reach dangerous levels the admin is informed via the dashboard and must take the necessary precautions.

4.2 Non-functional Requirements:

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

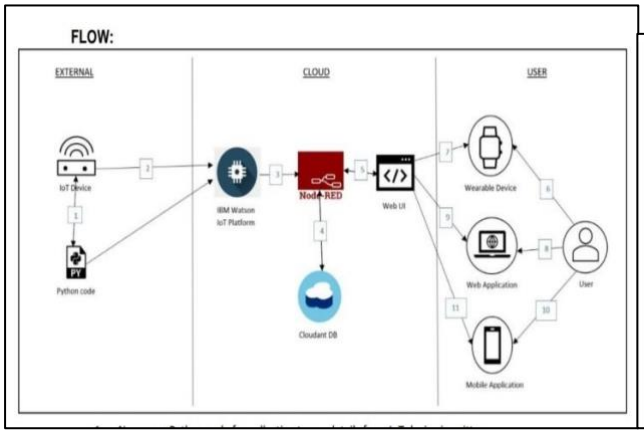
FR NO.	Non-Functional Requirement	Description
NFR-1	Usability	The wearable device should be slim and not annoy or disturb the workers who are wearing them. They should also reliably display the temperature without large delays and notifications should be clear in cases of detected danger.
NFR-2	Security	The connection of the beacons to the cloud and wearable devices should be secure. The security of the database housing all the temperature data should also be bolstered.
NFR-3	Reliability	The wearable device should be able to function without any faults even at dangerous temperatures. If a fault is detected it should notify the user and the admin to be immediately repaired and replaced. The beacons should also be regularly maintained to ensure reliability.
NFR-4	Performance	The device should update temperature readings in real time and requires high end sensors and processors to do so. The time to send data to the cloud and other devices should also be made as small as possible.

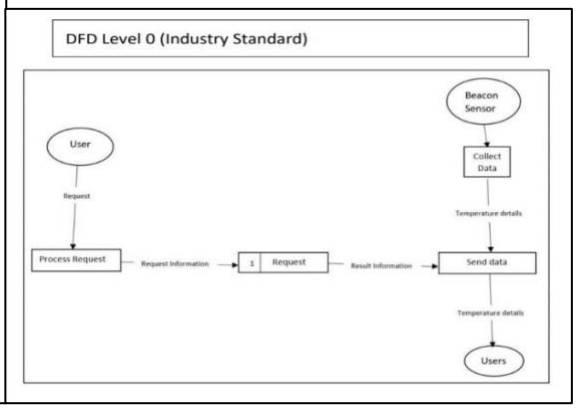
NFR-5	Availability	The user should be able to check the temperature of the area no matter where or at what time they are in the plant. The dashboard should be constantly active so as to ensure safety precautions can be executed whenever danger is detected.
NFR-6	Scalability	If the area that needs to 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 plants with different factors to be monitored giving it highly scalability.

5. PROJECT DESIGN:

5.1 Data Flow Diagrams:

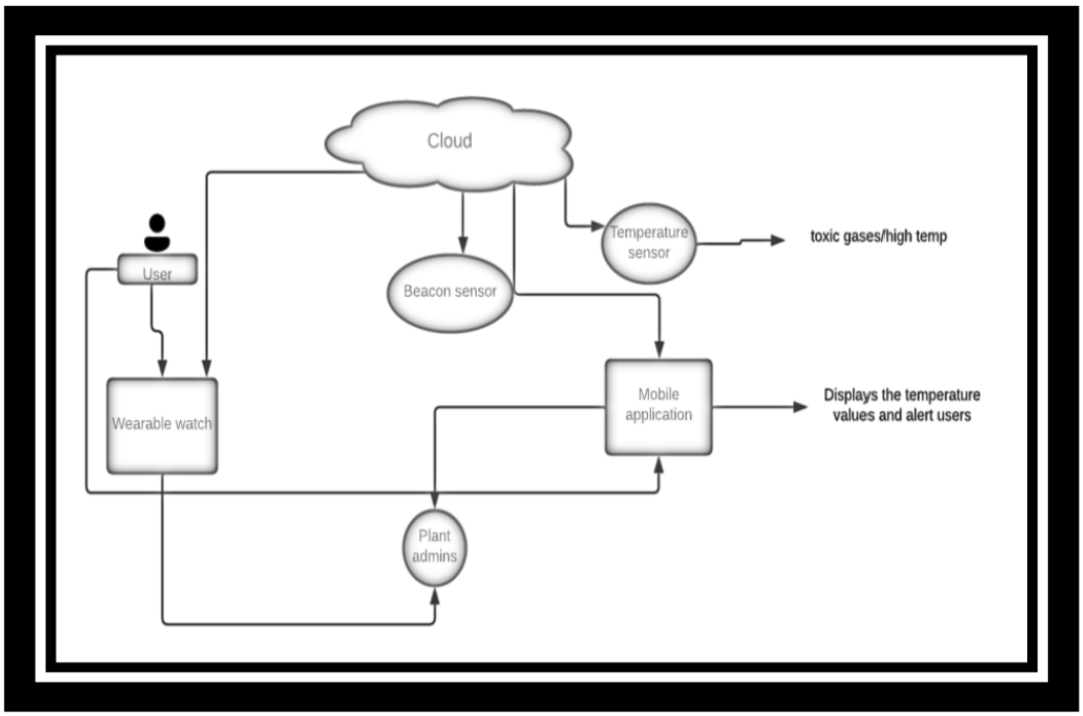
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.





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.

5.2 SOULUTION ARCHITECTURE:



- Gather data from sensor.
- Update the gathered data to Cloud.
- Display data in Web UI for visualization.
- Display data in mobile device to authorized individuals.
- Notify authorities in case of any anomalies in the environment data.

Integrity and data confidentiality are the 2 key security features to be taken care of. Tampering the data may lead to serious accidents. User can easily keep an eye on their industry though they stay at home. This system is similar to a surveillance system where we keep track of the conditions of the industry to keep the industry and the workers safe.

5.3 User Stories:

Use the below template to list all the user stories for the product.

User Type	Functional Requirement	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	A beacon can be found in every area of the plant.	High	Sprint-1

			the plant is covered.			
	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 the real time which is in turn sent to nearby wearable devices and the administrators 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 Notification	USN-7	The user is sent a notification to their phone from the wearable device through an API when the area they are in reaches dangerous temperatures.	The user is informed of potential danger via SMS as soon as it is detected by the beacons.	High	Sprint-1

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 personal requirements and priorities.	The admin can customize the UI for their dashboard.	Medium	Sprint-2

6 . PROJECT PLANNING & SCHEDULING:

6.1 Sprint Delivery Schedule:

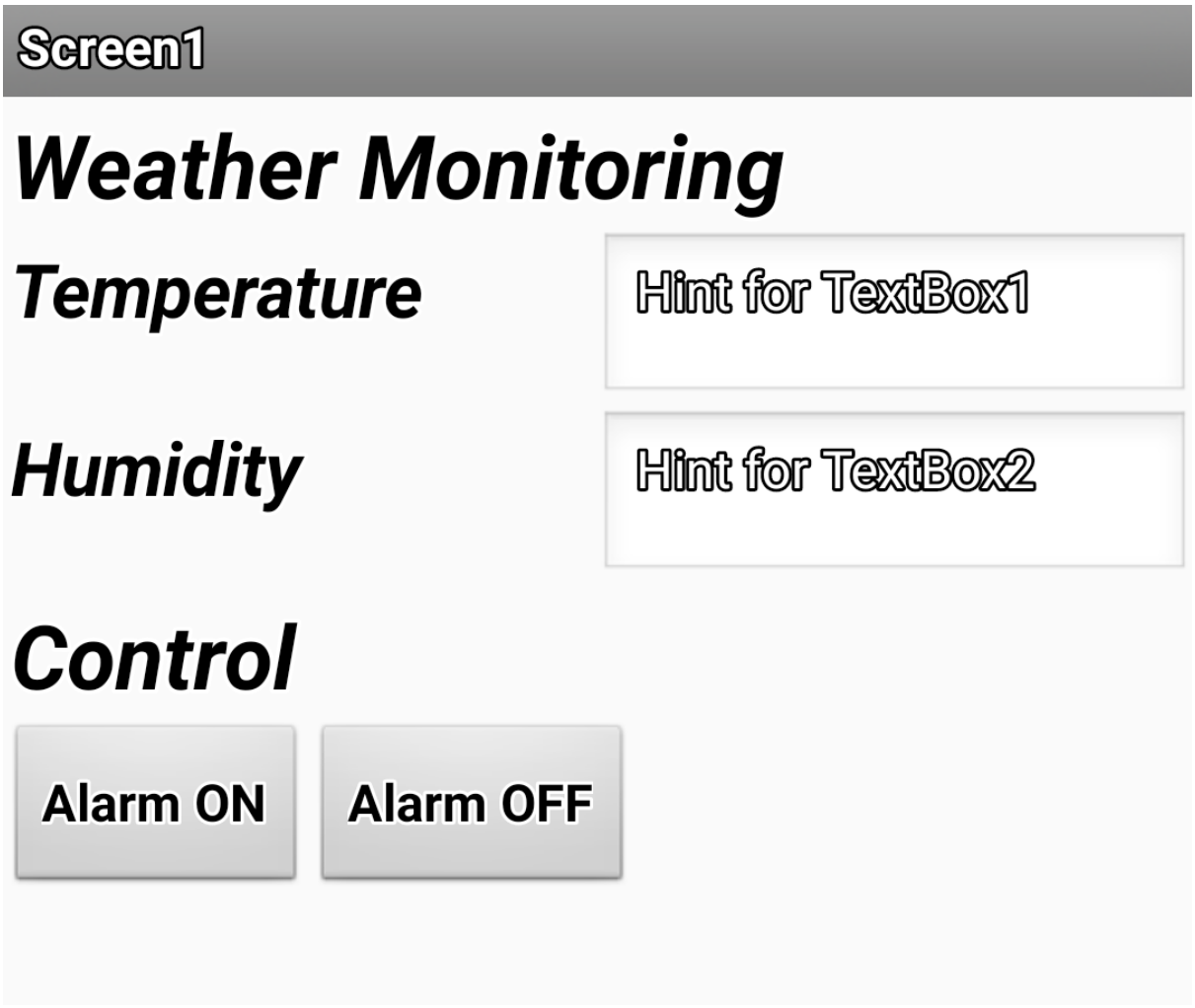
Use the below template to create the spirit planning, estimation and delivery schedule.

Sprint	Functional Requirement	User Story Number	User Story / Task	Story Points	Priority
Sprint-1	Installation of Beacons	USN-1	First the Admin will be installing smart beacons at necessary places.	15	High
Sprint-1	Providing Wearables	USN-1	The admin will be providing everyone at the industry a wearable device.	5	Medium
Sprint-2	Cloud Setup	USN-2	The smart Beacons will connect with the cloud services. Where we can get the realtime data from the wearable.	20	High

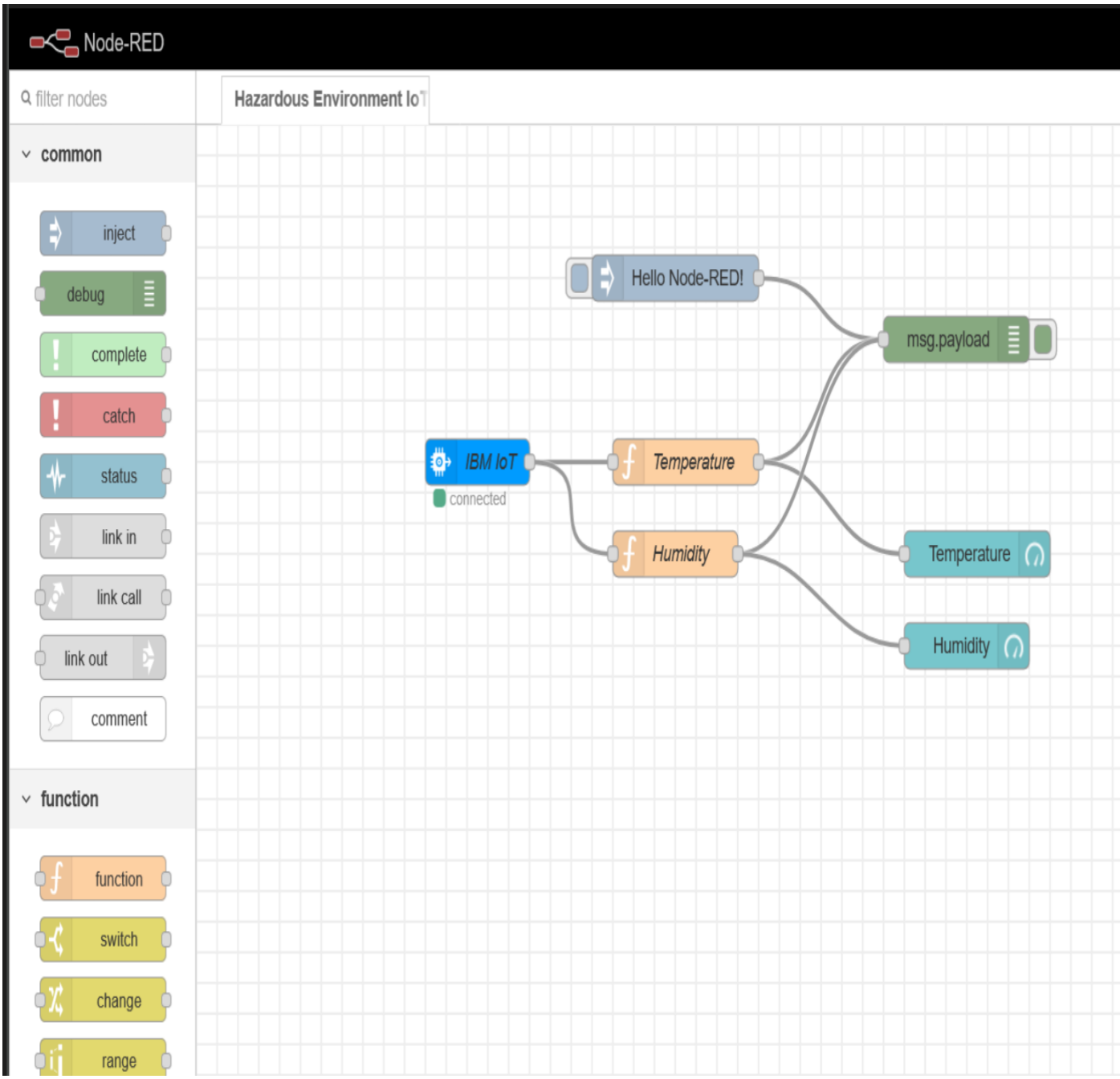
Sprint-3	Online Monitoring via Web	USN-3	Websites will be created and connected with the cloud services.	20	High
Sprint-4	Monitoring via Mobile	USN-4	Mobile Application will be created and fast SMS will be used to alert abnormality to the user.	20	High

7. CODING & SOLUTIONING (Explain the feature added in the project along with the cod

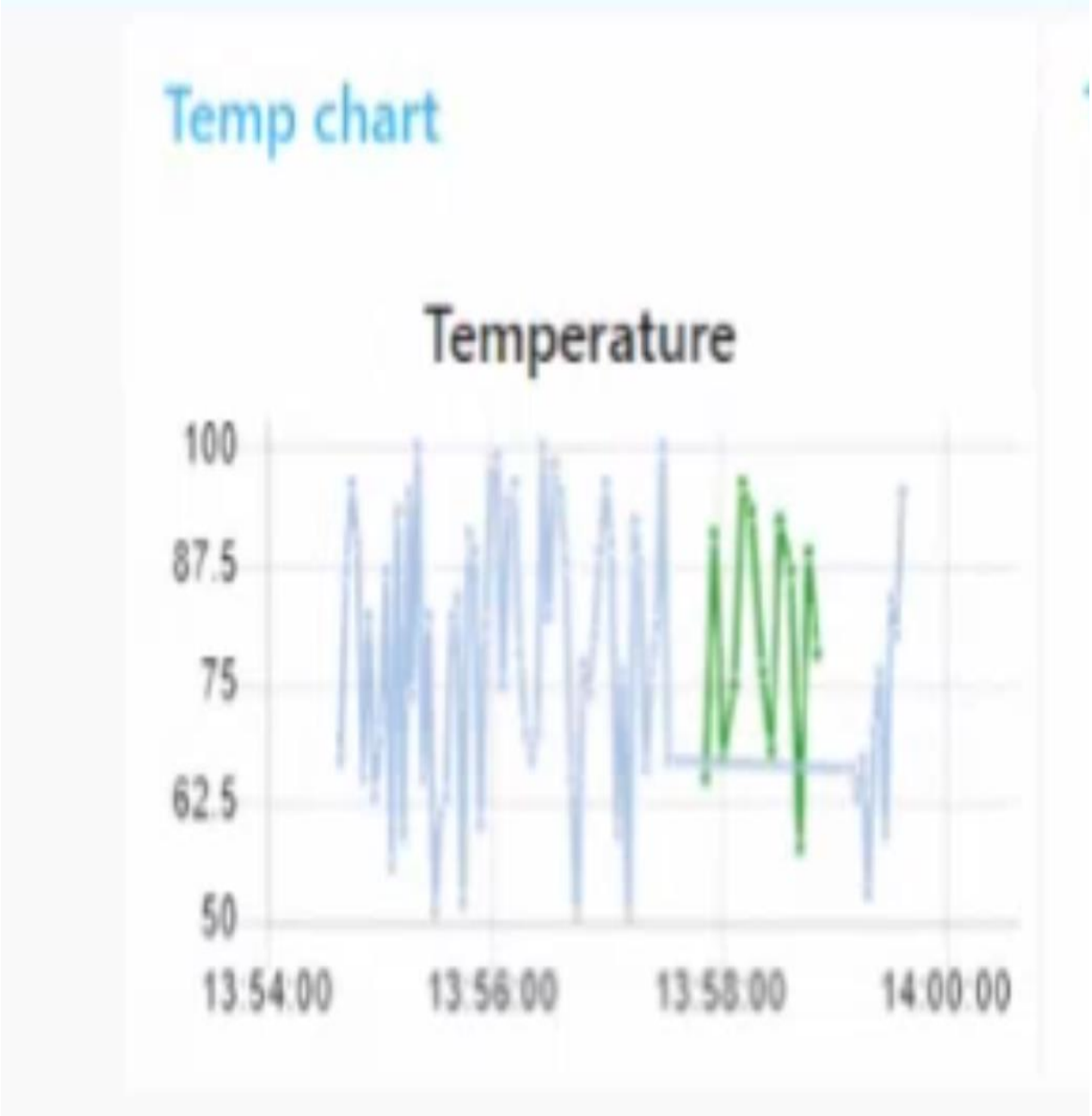
7.1 Feature 1 (Live Update on Collected Data)

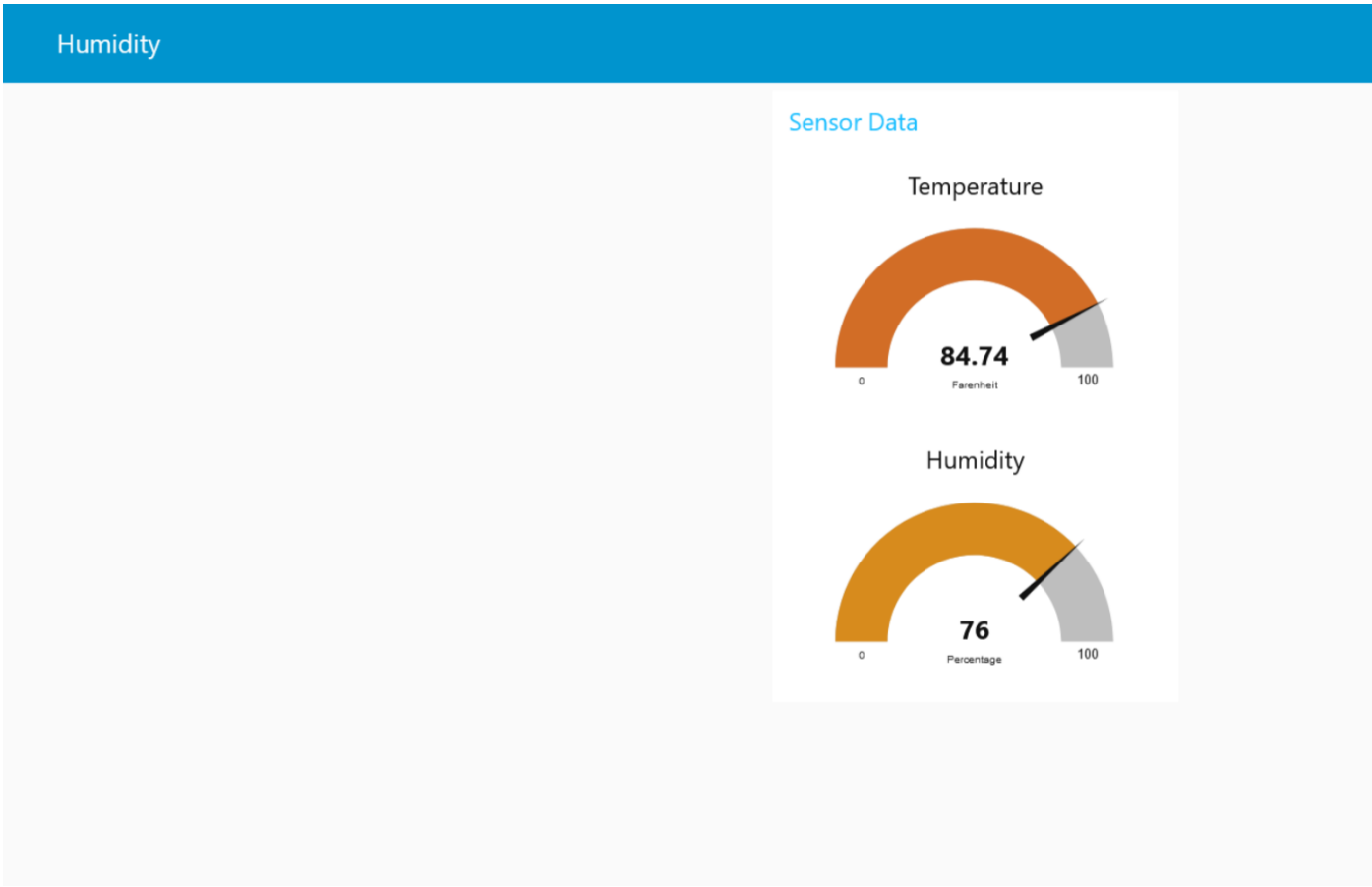

Screen1
Weather Monitoring
Temperature
Hint for TextBox1
Humidity
Hint for TextBox2
Control
Alarm ON
Alarm OFF

7.2 Feature 2 (Node red flow)



8 . RESULTS


Temp chart
Temperature
100
87.5
75
62.5
50
13:54:00
13:56:00
13:58:00
14:00:00



9. ADVANTAGES & DISADVANTAGES :

ADVANTAGE:

- IoT technology provides the most economic and budgeted solutions for the users.
- IoT is a fostering innovation.
- IoT powered level will be an improved supply chain.
- IoT provides a smart level monitoring end-to-end solutions.
- It ensures the industrial productivity and improved strategies through advanced analytics.
- The risk prevention must be teach to the staffs.
- IoT is a real-time supervision.

DISADVANTAGE:

Some disadvantage of using IoT in industry are as follows,

- Security and Privacy.

- Technical Complexity.
- Connectivity and Power Dependence.
- Integration.
- Higher costs (time and money).

10. CONCLUTION:

Currently, IoT is present and gaining more traction in a lot of fields, and one of the most important field is industrial applications. There are a huge number of ways in which industries can make use of IoT to improve working conditions, efficiency, cutting costs and improving the overall growth of the sector. However, hazard monitoring and mitigation is often overlooked in industrial areas.

Therefore, this project specifically aims to make use of IoT to actively monitor and analyze various factors in a typical heavy industrial zone like temperature and levels of gases in the environment. If, the above parameters exceed the recommended safe values. The system can track the same issue alerts. Also the data generated in real time can provide important information about how smoothly the work is going on in different zones.

This system can be deployed in many industrial areas like mining, underground factories, metal refineries, automatic welding factories and even heavy parts production lines. It will help to provides a safe and efficient working environment in such areas, while also opening new paths to improve the safety parameters of these places.

11. FUTURE SCOPE:

There are the top applications of IIoT that aid the future Scope of Industrial Monitoring:

1) Firstly, providing service engineers and manage remote access to industrial machines.

2) Secondly, allowing web-based virtual network connection to manage and observe HMI functions on the IOT platform.

3) In addition, it offers predictive analytics for maintaining machines and identifying potential problems.

4) Most importantly, it controls, monitors, and manages data from multiple systems in various locations. Simultaneously storing the collected data at a central cloud application. Hence, real-time machine data and analysis are easily accessible using industrial communication networks.

12. APPENDIX

Source Code

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


#Provide your IBM Watson Device Credentials
organization = "iagqzu"
deviceType = "Deepak"
deviceId = "123"
authMethod = "token"
authToken = "12345678"

# Initialize GPIO


def myCommandCallback(cmd):
   print("Command received: %s" % cmd.data['command'])
   status=cmd.data['command']
   if status=="AlarmOn":
      print ("Alarm is on")
   else :
      print ("Alarm is off")

   #print(cmd)




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

except Exception as e:
        print("Caught exception connecting device: %s" % str(e))
        sys.exit()

# Connect and send a datapoint "hello" with value "world" into the cloud as an event of type
"greeting" 10 times
deviceCli.connect()

while True:
     #Get Sensor Data from DHT11

     temp=random.randint(0,100)
```

```
        Humid=random.randint(0,100)

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

        success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
        if not success:
            print("Not connected to IoTF")
        time.sleep(10)

        deviceCli.commandCallback = myCommandCallback

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