A PROJECT REPORT ON

HAZARDOUS AREA MONITORING FOR INDUSTRIAL PLANT POWERED BY IoT

Domain: Internet of things.

Team ID: PNT2022TMID37599

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1. **INTRODUCTION**

a. Project Overview

Wounds, characteristic impact, and materials mischief, these types of accidents may be a direct result of the mechanical method, some essentialness related issues or transport works out. They are generally associated with either enormous inventory of ignitable, flimsy or very open gases or of standard risky manufactured substances in method organization or smaller measure of uncommonly hurtful. The causes arise out of unsafe situational and climatic conditions and assortments.

Reaction of smooth extreme hurting greater exposure. These smart industries will be additionally evolved and modified as differentiated and existing ones and able to monitor just as controlling of different industrial application. IoT is used for transmission and gathering of information. These systems are used to screen mechanical application by realizing industry standard shows using IoT.

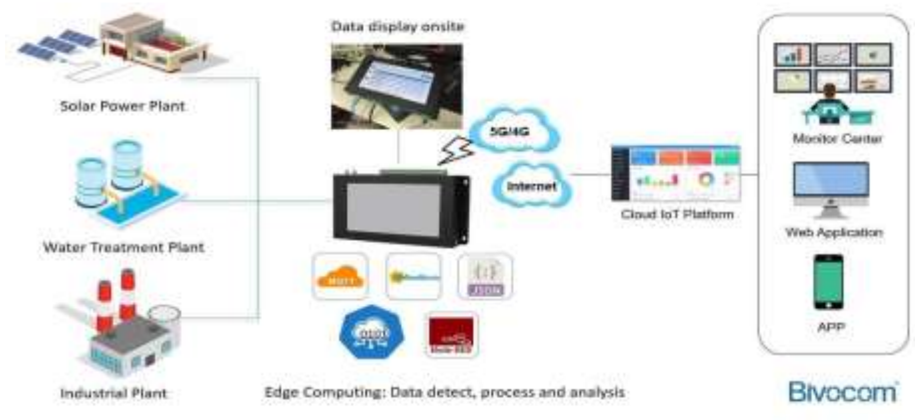


Fig: IoT based monitoring system environment

b. Purpose

Through this we can monitor the temperature and humidity parameters of the hazardous area in industrial plants.. 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 Application programming interface (API) then the admin will take the necessary precautions if required.

2. LITERATURE SURVEY

a. Existing Solutions

Research in [1] Ship detection and tracking is a basic task in any vessel traffic monitored area, whether marine or inland. It has a major impact on navigational safety and thus different systems and technologies are used to determine the best possible methods of detecting and identifying sailing units.Video monitoring is present in almost all of them, but it is usually operated manually and is used as a backup system. The method and the results of experiments on three sets of data using cameras with different characteristics, settings, and scene locations are presented.

According to [2] An IoT-based model for real-time condition monitoring of electrical machines, which addresses the challenges of data storage and scalability. This IoT-based vibration analytic model uses an IoT2040 Gateway with custom Linux OS image built for acquisition and streaming of vibration signals. The Python target application acquires dc motors shaft vibration using vibration sensors and communicates the data as events to cloud through serial device driver interface... The uniformity of threshold values obtained from IoT-based model in comparison with that of analysis carried out on the machines locally using myRIO for data acquisition ensures the integrity of the proposed statistical classification algorithm and reliability of the IoT model for condition monitoring with assured scalability.

Android user via C2DM Service [3] Water management is paramount in countries with water scarcity. This also affects agriculture, as a large amount of water is dedicated to that use. Typical commercial sensors for agriculture irrigation systems are very expensive, making it impossible for smaller farmers to implement this type of system. However, manufacturers are currently offering low-cost sensors that can be connected to nodes to implement affordable systems for irrigation management and agriculture monitoring.

Authors in [4] The state of the art technology in wind power plant control and automation. This wind power plant starts with a historical background about supervisory control and automation evolution in the last decades. An overview of SCADA at the wind power plant is presented, and operational concerns are addressed and examined. Notes on future trends will be provided.

Finally, recommendations are provided regarding SCADA systems and their application in the wind power plant environment. One of the most significant aspects of SCADA is its ability to evolve with the ever-changing face of Information Technology (IT) systems.

Research in [5] In our day to-day life there are many industries working with various hazardous chemical gases and the workers are often exposed to these gases To avoid these situations we need to develop an Automatic Toxic Gases Detection and Alerting System.

The existing detection systems are available to seme only a particular gas and they use GSM technology to indicate the critical situations. In these the dangerous, toxic and flammable gases such as Hydrogen Sulphide gas, Carbon Monoxide gas, Ammonia gas, and Methane gas are sensed using individual gas sensors and an Arduino UNO controller.

The values are constantly uploaded to the internet by using Ethernet module with an Arduino controller. The Internet of Things (IoTs) provides a proper access to values by an authorized persons and governmental organization.

References

SURVEY-1

Tittle is Vessel Detection and Tracking Method Based on Video Surveillance. and AUTHOR is N. Wawrzyniak, T. Hyla and A. Popik & YEAR OF PUBLISHED in 2019

SURVEY-2

Tittle is IoT-Based Vibration Analytics of Electrical Machines. And AUTHOR is Ganga. D, Ramachandran. V&YEAR OF PUBLISHED in2018

SURVEY-3

Tittle is IoT-Based Smart Irrigation Systems An Overview on the sensors and IOT systems for irrigation in precious agriculture. And AUTHOR is Laura Garcia, Lorena parraYEAR OF PUBLISHED in 2020

SURVEY-4

Tittle is Wind Power Plants Control System based on SCADA system. And AUTHOR K. Sayad, A.G.Abo-khalli A.M. Eltamaly.&YEAR OF PUBLISHED in 2017

SURVEY-5

Tittle is Monitoring of Hazardous Gases in Process Industries Through Internet.AUTHOR is P. Ragavi, Dr. K. R. Valluvan. YEAR OF PUBLISHED in 2016

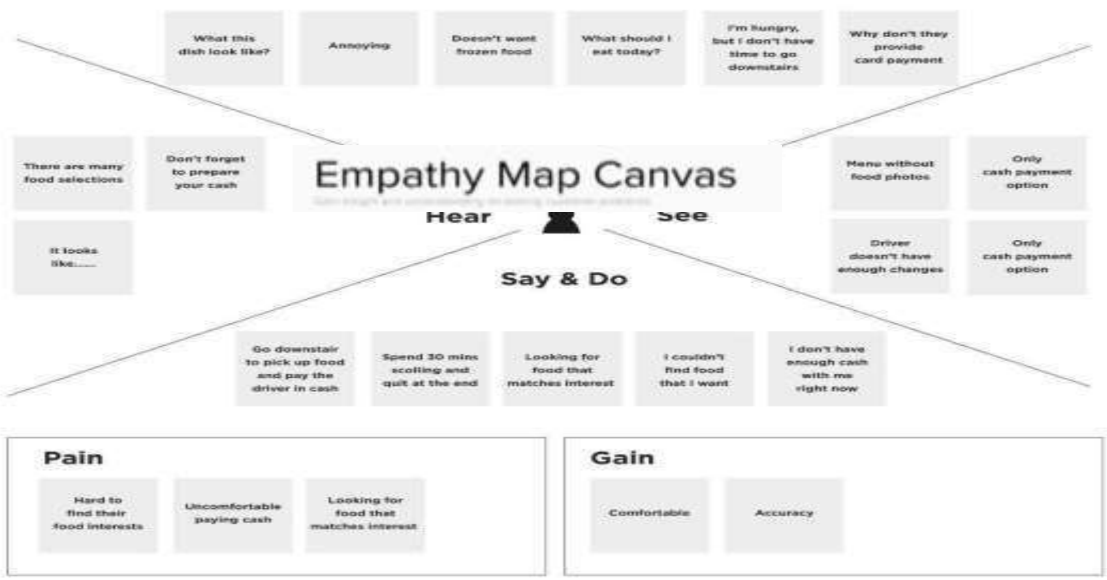
c. Problem Statement Definition

- Now-a-days, industries require advanced technology to monitor and control the parameters in hazardous areas (i.e., pressure, temperature, gas, electrostatic, vibration etc...) at anytime and anywhere. The sensing devices aroused to sense those parameters.

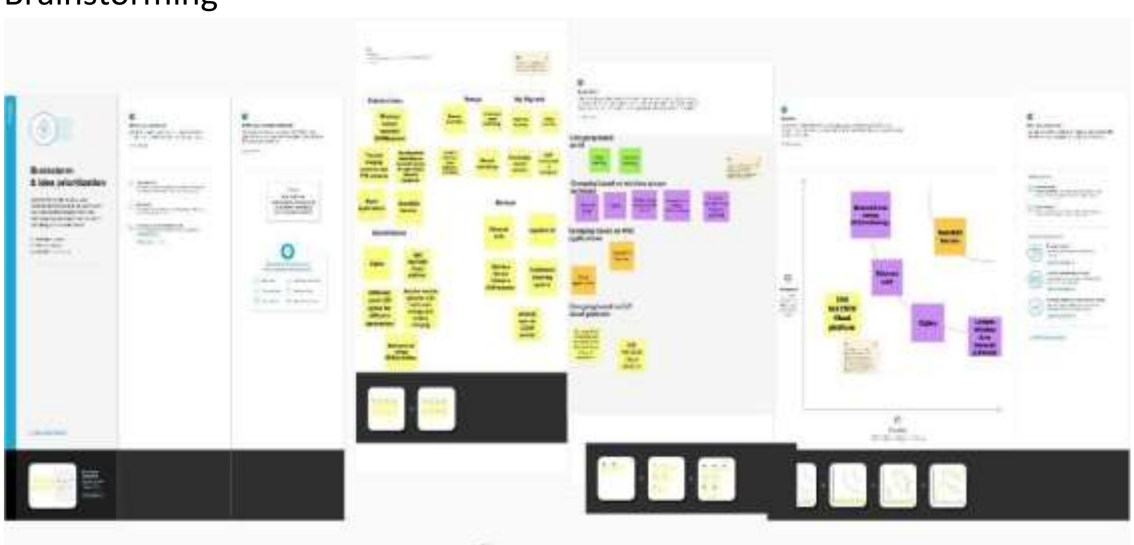
- In case the parameters are not monitored and controlled properly at the time of emergency, it leads to harmful situation. So, the method of monitoring the parameters in hazardous area through a single computer and a concept of automatic control will reduce the high manpower requirement, downtime, risk and cost.

3. IDEATION & PROPOSED SOLUTION

a. Empathy Map Canvas



b. Ideation & Brainstorming



c. Proposed Solution

(a) Problem statement:

Hazardous area monitoring for industrial plants powered by IoT.

(b) Idea /solution description:

- Beacon scanners for temperature indication.
- Receive Alerts to the mobile through email.

(c) Novelty/ Uniqueness:

Bluetooth low energy module in IoT.

(d) Social impact / customers satisfaction:

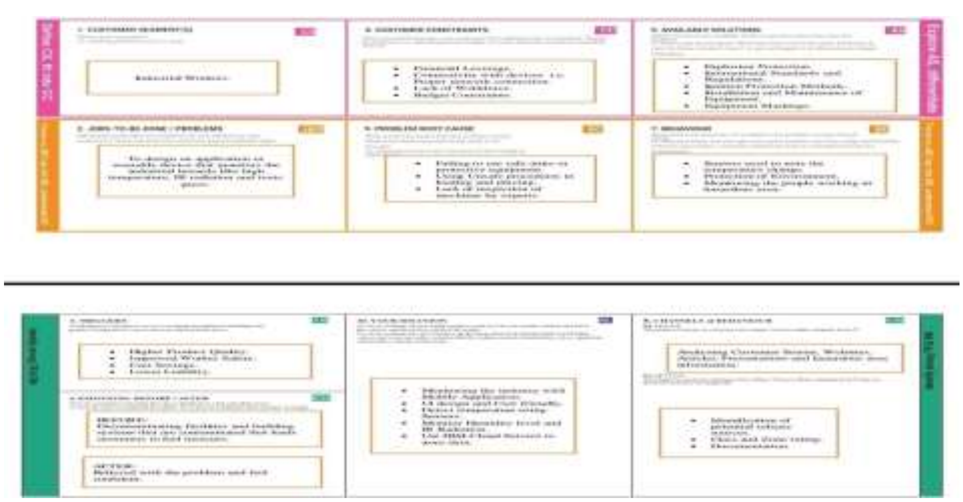
- Continuous monitoring of Industrial Hazardous area.
- Reliable communication between workers and Fixed base stations.

(e) Business model (Financial Benefit):

- Low power consumption
- Cost effective
- Easy portable
- Handy

(f) Scalability of solution: Scalable

d. Problem Solution fit



4. REQUIREMENT ANALYSIS (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 the 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.

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-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

a. Data Flow Diagrams

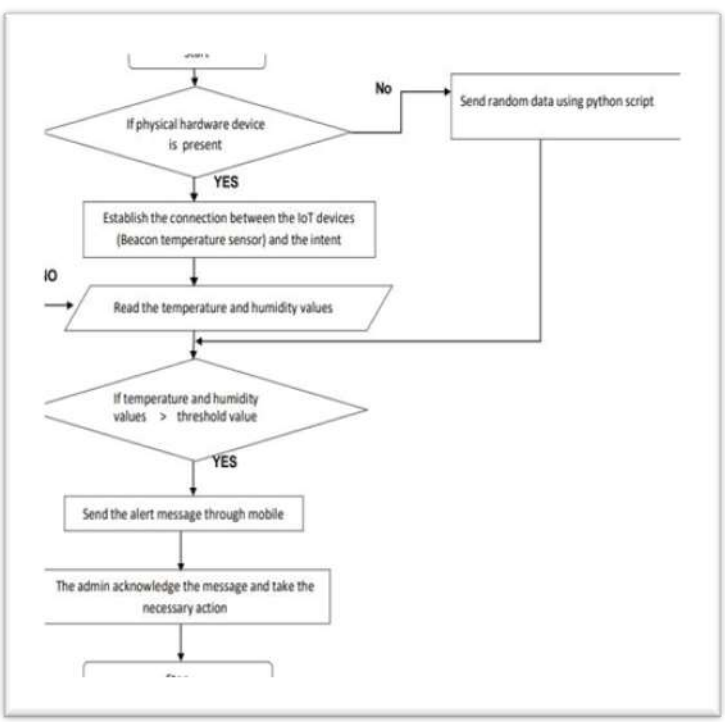
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically.

1.To monitor the condition in industrial plants using different sensors.

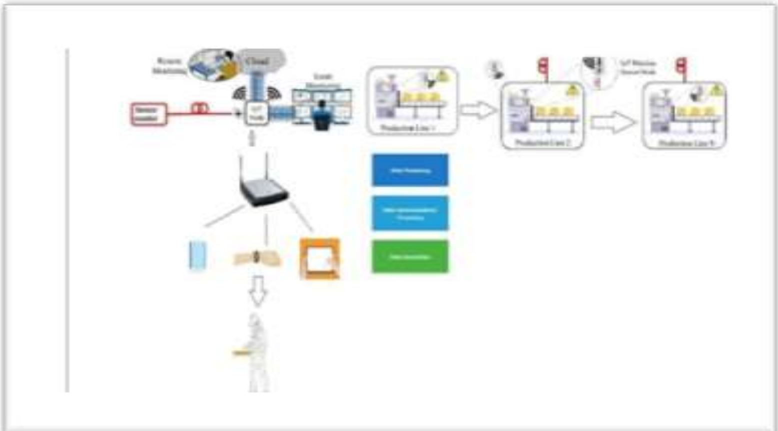
2.Send the information using GPRS modem and store it in cloud.

3.This entire system helps to monitor the condition to prevent human loss.

DFD for hazardous area monitoring of industrial power plant powered by IoT:



b.Solution & Technical Architecture Technical Architecture



Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- To monitor the condition, we can integrate the smart device in the area which are needed to be monitored every device will be acting as a beacon and it is connected to temperature sensors**.**
- In this project, we create an IoT-based hazards monitoring system specifically suited to the requirements of mining, refining, and manufacturing industries
- The system actively records, processes and analyzes the temperature of the surroundings, which is a prime safety parameter in areas where molten metal is processed, manufacturing is done or welds are made. if a parameter is violated, the system sends an immediate notification to a set of a preset list of users on their smartphone and continues logging and monitoring data for further analysis to suggest improvements in the safety regulation of the industry.
- broadcast the temperature data along with the location of that particular area through beacons. The persons who generally monitor these places will be given a wrist band and cell phones by alerting the Whenever the person enters the desired area

c. User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (admins of the industrial power plants)	Installation	USN-1	As a user, I can install IoT devices such as beacon temperature sensor.	I can view the temperature of the hazardous area	High	Sprint-1
		USN-2	As a user, I can send the python script (random data) to the IoT platform.		High	Sprint-1
		USN-3	As a user, I can receive SMS using API.	I can receive the alerts through mobile.	High	Sprint-2
		USN-4	As a user, I can download the web application.		Medium	Sprint-1
	Login	USN-5	As a user, I can login to the application by email and password.		High	Sprint-1
	Dashboard					
	Database	USN-6	As a user, I can store all the data in the IBM cloud database.			
Customer (Workers in the hazardous area)						

6. PROJECT PLANNING & SCHEDULING

a. Sprint Planning & Estimation

Product Backlog, Sprint Schedule, and Estimation

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Application	USN-1	As a user, I can use the web applications or app	2	High	All
Sprint-1	Authentication	USN-2	As a user, I will create an account in the application and verify the account	2	High	All
Sprint-2	PURCHASING	USN-3	As a user , i have to buy the cloudant database	2	High	All
Sprint-3	INSTALLATION	USN-4	As a user, i have to install the hardware IoT devices and python software	2	High	all
Spring-3		USN-5	As a user, I can receive the alert message through mobile	1	High	All
Sprint-4		USN-6	As a user , I can take the necessary actions to avoid the accident	2	High	All
Sprint-4	Workers	USN-7	As a user, I can view the temperature and humidity values	1	Low	All

Project Tracker, Velocity & Burndown Chart: (4 Marks)

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	4 Days	01 NOV 2022	04 NOV 2022	20	01 Oct 2022
Sprint-2	20	4 Days	05 NOV 2022	08 NOV 2022	20	09 Oct 2022
Sprint-3	20	4 Days	09 NOV 2022	12 NOV 2022	20	13 October 2022
Sprint-4	20	4 Days	13 NOV 2022	16 NOV 2022	20	18 October

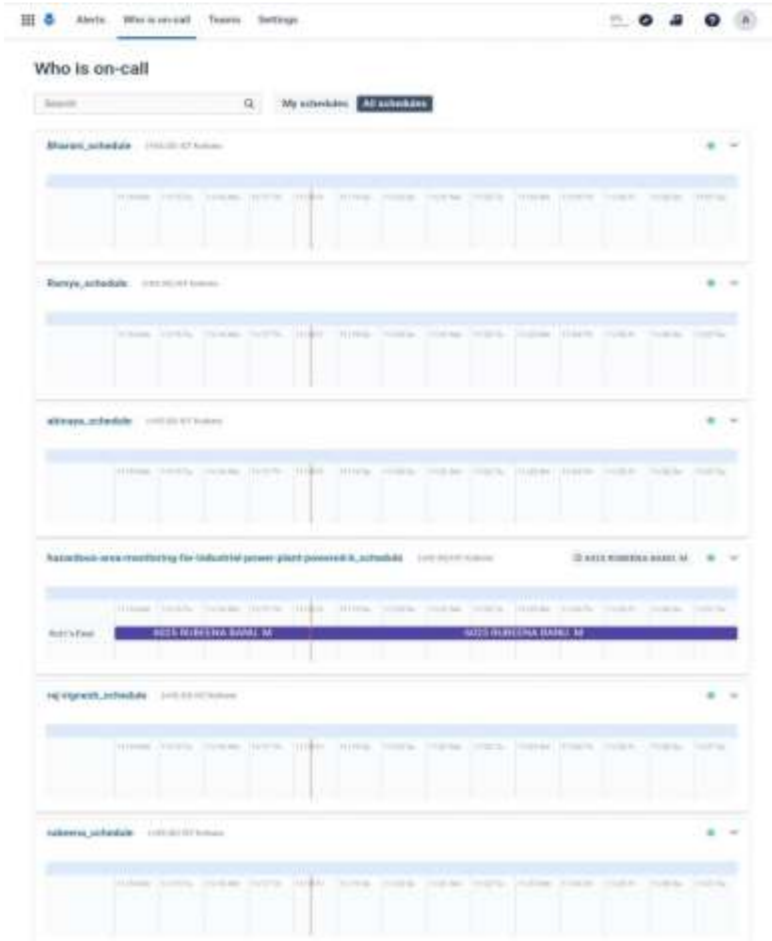
Burn down Chart:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress .

b. Sprint Delivery Schedule

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	4 Days	01 NOV 2022	04 NOV 2022	20	01 NOV 2022
Sprint-2	20	4 Days	05 NOV 2022	08 NOV 2022		
Sprint-3	20	4 Days	09 NOV 2022	12 NOV 2022		
Sprint-4	20	4 Days	13 NOV 2022	16 NOV 2022		

c. Reports from JIRA



7. CODING & SOLUTION

Language: Python.

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

#connecting the python to IBM watson IoT platform

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

```
#provide your IBM Watson Device Credentials
organization = "qpmeb8"
deviceType="jamallamudijyothsna384"
deviceid="123456789"
authMethod="use-token-auth"
authToken="jyothsna@1234"

# Initialize GPIOg

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

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



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

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

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

while True:
      # Get Sensor Data from DHT11

      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(1)




deviceCli.commandCallback = myCommandCallback

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

8. TESTING

a. Test Cases

b.**User Acceptance Testing**

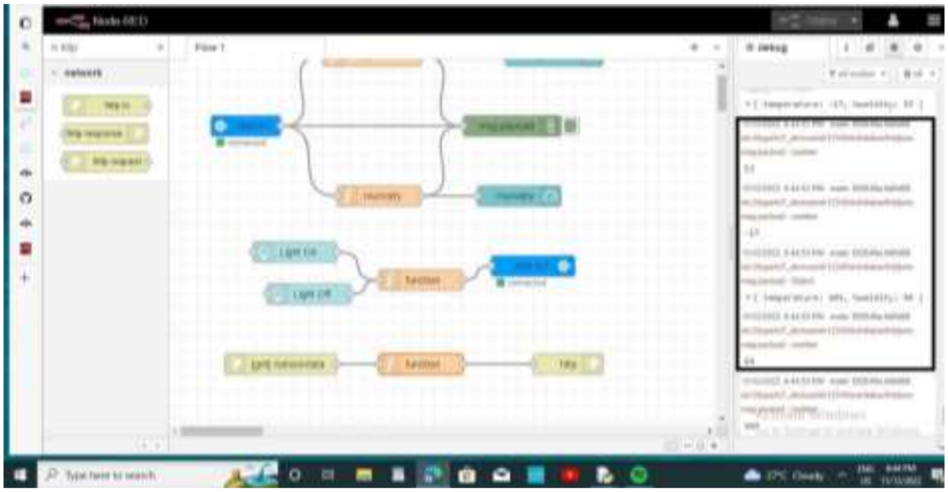


Fig. Screenshot of node-RED connections

9. RESULTS

a. Performance Metrics

Screenshot of mobile application

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 has a broad perspective in shaping tomorrow's world. Even though the IoT system has some demerits, its merits like saving consumer's time and money outstand its cons. It is predicted that soon IoT applications will be installed and used equally in both domestic and industrial areas. Companies are working hard to shoot back IoT disadvantages and making this futuristic technology more beneficial for the betterment of humanity.

12. FUTURE SCOPE

IoT is bound to be an effective technology in the future, and IoT enabled devices are likely to be all-pervasive, from industry to households. The future scope of IoT is bright and varied, and it is only a matter of time before the above applications of the technology are realized.

While wearable technology allows patients to self-monitor their health in real-time, the sensors and variants used in the healthcare industry are significantly more sophisticated. As sensors' accuracy and precision based on IoT increases, the share of manual errors in taking medical readings will decrease.

13. APPENDIX

a. Source code

```
#connecting the python to IBM watson IoT

platform import wiotp.sdk.device import

time import random

myconfig = {
```

```
    "identity":{
      "orgId":"zvvqaf",
      "typeId":"IoT_devices",
      "deviceId":"12345"
      },
    "auth":{
      "token":"qagOTm?(qV+deBQ*j*"
      }

    }
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:

- Video demonstration link for web application and alert message
  https://youtu.be/ErPbu38N2gY

Git hub link:

https://github.com/IBM-EPBL/IBM-Project-54459-1662023692