# A PROJECT REPORT ON

# **SELVAM COLLEGE OF TECHNOLOGY**

# Hazardous Area Monitoring for Industrial Plant powered by IoT

**Domain** : Internet of Things

Team ID: PNT2022TMID41908

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#### 1. INTRODUCTION

#### a. Project Overview

- ✓ The Industrial Internet of things or IoT has gained recognition due to the advancement it has made in communication technology. Industrial IoT is an application of IoT that enables control of industries over the Internet using smart devices and sensors. The two main entity which ensures effectiveness in any field is monitoring and control.
- ✓ It is the Gain knowledge of Watson IoT Platform.
- ✓ Connecting IoT devices to the Watson IoT platform and exchanging the sensor data.
- ✓ Gain knowledge on Cloudant DB.Creating a Web Application through which the user interacts with the device.

#### b. Purpose

Through this, we can monitor the temperature parameters of the hazardous areas in industrial plants. The area is integrated with smart beacon devices which will be broadcasting the temperature of that particular area. Every person working in those areas will be given smart wearable devices which will be acting as beacon scanners. Whenever the person goes near the beacon scanners, he can view the temperature on his wearable device and if the temperature is high, he will receive the alerts to the mobile through SMS using API. Through this wearabledevice, the data is sent to the cloud and through the dashboard, the admins of that particular plant can view the data and take necessary precautions if required.

#### 2. LITERATURE SURVEY

#### a. Existing problem

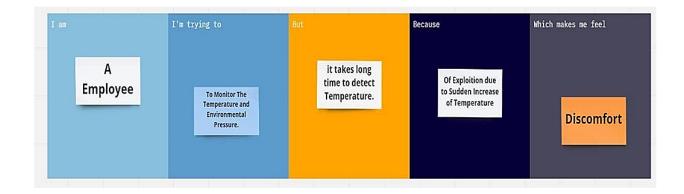
The main objectives of the proposed work are To provide low cost effective environmental radiological monitoring system. To develop an early warningsystem in NuclearPower plants and submarines. Whenever the nuclear radiationis released to the open environment, due to presence of radioactive elementspresent in the radiation, environmental parameters such as temperature, pressure, sound, smoke and carbon monoxide levels various rapidly. Due to breakdownof radioactive elementstemperature increases rapidly and humidity decreases. By these variations we can detect the presence of nuclear radiation. All these variations of atmospheric parameters are sensed by the incorporated sensor module and it's displayed by things speak web server. So radiation leakage in nuclear power plant can be detected. By the tremendous variation of atmospheric parameters, all the operators can be easily came to know about the radiation leakages. The Architecture of sensor module, abstract architecture of sensor nodes used in wireless Sensor network

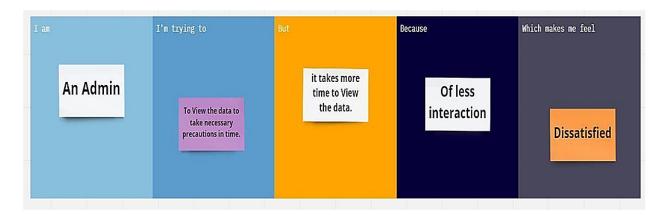
#### **b.** References

- 1) Ashwini S R , Dr. Shivashankar
- 2) Karthik R
- 3)Harish B R
- 4)Karan D Bafna

## c. Problem Statement Definition

Create a problem statement to understand your customer's point of view .The Customer Problem Statement template helps you focus on what matters to createexperiencespeople will love. A well-articulated customer problem statement allows you and your team to find theideal solution for the challenges your customers face. Throughout the process, you'llalso be able to empathize with your customers, which helps you better understandhowtheyperceive your productor service



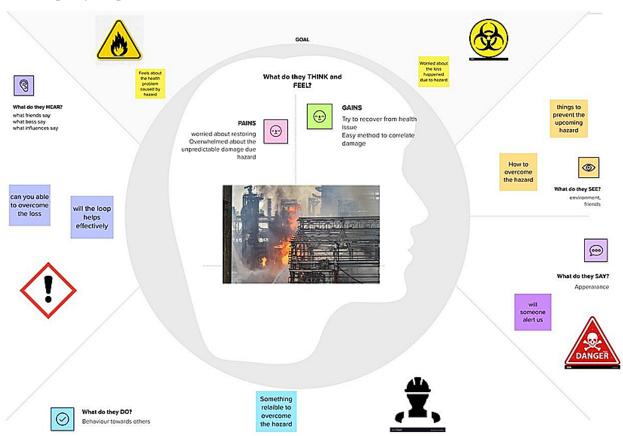


Problem	I am	I'm trying	But	Because	Which
Statement (PS)	(Customer)	to			makes me feel
PS-1	A Employee	To Monitor the temperat ure and environm ent pressure	It takes long to detect Temperature	Of exploitation to sudden increase of Temperature	Discomfort

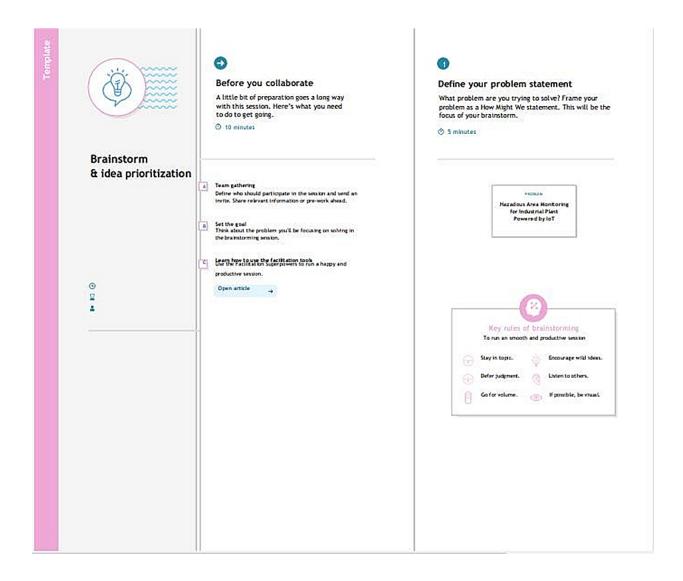
PS-2	An Admin	To view	It takes	Of less	Dissatisfied
		the data to	more time to	interaction	
		take	view the data		
		necessary			
		precaution			
		in time			

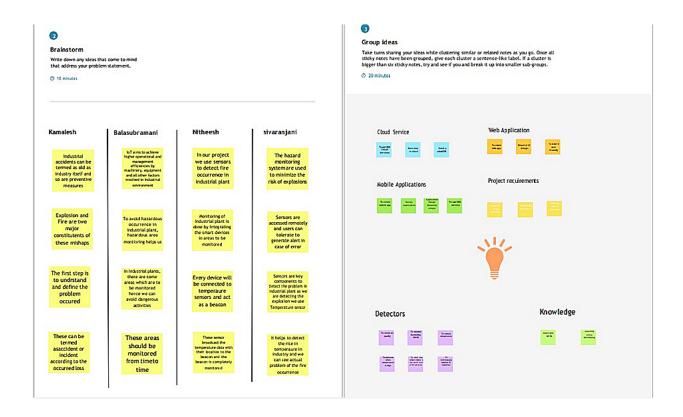
# **3.IDEATION & PROPOSEDSOLUTION**

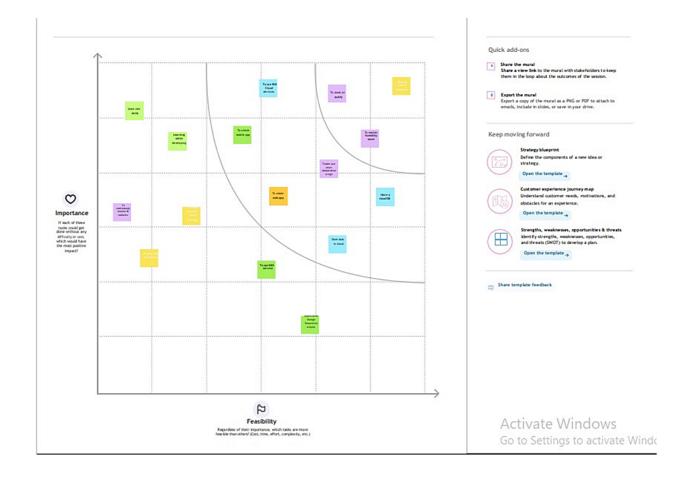
# a. Empathy Map Canvas



# b. Ideation & Brainstorming







#### c. Proposed Solution

#### 1. Problem Statement(Problem to be solved)

Difficulty in continuous manual monitoring of temperature ,workerssafety and communicating to othersin hazardous areas

#### 2.Idea / Solution description

The hazardous area is integrated with smart temperature beacon devices which will be sensing and broadcasting the temperature of that specific area. Every person working in those areas will be given smart wearable devices which will be acting as beacon scanners. Whenever the person goes near the beacons, he can view the temperature on his wearable deviceand if the temperature is high, he will receive the alerts to the mobile through SMS using API.

By this wearable device, the data is sent to the cloud database and through which the dashboard, the admins of that particular plant can view the data and take necessary actions if required.

#### 3. Novelty / Uniqueness

Smart wearable devices are used.

Advanced monitoring throughbeacon devices

# 4. Social Impact/ Customer Satisfaction

Due to safe environment, workers can work efficiently.

More focus on work withoutany fear. Industrial accidents can be avoided.

#### **5.Business Model (Revenue Model)**

Can be implemented in different hazardousareas.

Can make the wearables more advanced and

customizable to ones need.

## 6.Scalability of the Solution

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

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

#### d. Problem Solution fit

Define	1. CUSTOMER SEGMENT(S)	6. CUSTOMER CONSTRAINTS CC	5. AVAILABLE SOLUTIONS  Smart area monitoring sensors
CS, fit into CC	Employees who monitor hazardous area in industrial plants	Smart beacon coverage area Network access for beacon Beacon to watch connectivity	Wifi connectivity for sensors  Pros: Successful monitoring of area Cons: Network coverage for sensors can't be reached
Focus on J&P, tap into BE, understand RC	To check and alert the humidity, Temperature, Infrared radiation and Air quality	9. PROBLEM ROOT CAUSE  It is important to note the employees safty. Working in hazardous area in industries are highly risk. Therefore, this project helps employee to know about their environment.	The employees have a wearable watch where they can see the required or specified details and act saftly according to it

	3. TRIGGERS	10. YOUR SOLUTION SI	8. CHANNELS of BEHAVIOUR	
Identify strong TR & EM	Successful execution of our solution will make even other industry to implement this solution	We are going to monitor the area using suitable sensors in the beacons. We will connect our wearable to the beacons. We will send updates to online cloud from the beacon. From the cloud we will be accessing the reading and using that we will have a web page and a mobile application to display them. We will have sms service to alert abnormal readings	ONLINE  All the informations will be stored in cloud, so the employees can see the cloud storage or mobile application for referring the details of surroundings.  OFFLINE  Employees used to wear a watch which captures the information of the surroundings.	Identify strong TR & EM
	4. EMOTIONS: BEFORE / AFTER			
	It will be easy for employees to identify or to know about their environment			

# **4.** REQUIREMENT ANALYSIS

# a. Functional requirement

FR	Functional Requirement	Sub Requirement (Story / Sub-Task)
No.	(Epic)	
FR-1	Data Gathering	The smart beacon devices must be able to detect and
		measure the temperature of a particular areain real.
FR-2	Location Detection	The smart beacon must be able to detect when a
		wearable device has entered into an particular area.
FR-3	Beacon Data Syncing	The smart beacon must be able to share its stored data
		or information for both the wearable deviceand admin
		dashboard
		through the cloud.
FR-4	Wearable Device Display	The wearable device must viewable to display the
		temperature of the area where the workeris currently
		present.
FR-5	SMS Notification	If the temperature of the area is found to reach
		dangerous levels, the worker should be alertedvia
		SMS to their phoneinstructing them to leave the area.
FR-6	Admin Dashboard	If the temperature of the area is found to reach
		dangerous levels the adminis informed via the
		dashboard and must take the necessary precautions.

# **b.** Non-Functional requirements

FR	Non-Functional Requirement	Description
No.		
NFR-1	Usability	The wearable device shouldbe slim andcomfort mode but not annoy or disturbthe workers who are wearingthem.  They should also reliably display the temperature
		without large delays and notifications shouldbe clear in cases of detected danger.
NFR-2	Security	The connection of the beacons to the cloudand wearable devices should be secure.
		The security of the database housingall the temperature data should also be bolstered.

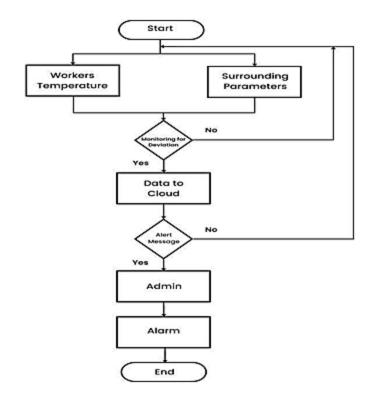
NFR-3	Reliability	The wearable device shouldbe able to function
		without any faults even at critical situation and
		dangerous temperature.
		If a faultis detected it should notifythe user and the
		admin to be immediately about repaired and
		replaced.
		The beacons should also be maintained regularly to
		ensure reliability.
		renability.
NFR-4	Performance	The device should update temperature readings in
		real timeand requires high endsensors and
		processors to do so.
		The time to send data to the cloud and otherdevices
		should alsobe made as small aspossible.

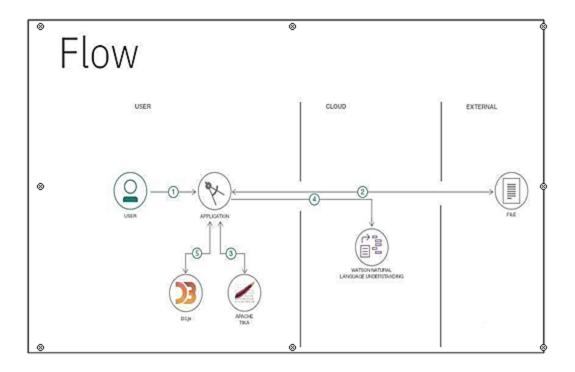
NFR-5	Availability	The user should be able to check the temperature
		of the area no matter where or at whattime they
		arein the plant.
		The dashboard shouldbe constantly activeso as to
		ensure safety precautions canbe
		executed whenever danger is detected.
NFR-6	Scalability	If the area that needs 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 plantswith
		different factors to be monitored
		giving it highly scalability.

# **5. PROJECT DESIGN**

# a. Data Flow Diagrams

# Data Flow Diagrams:



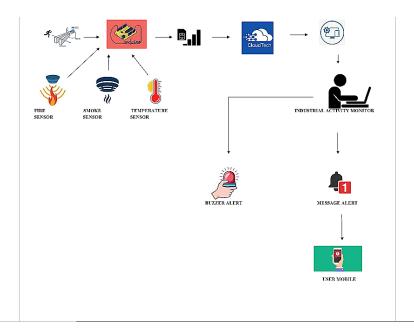


#### **b. Solution & Technical Architecture**

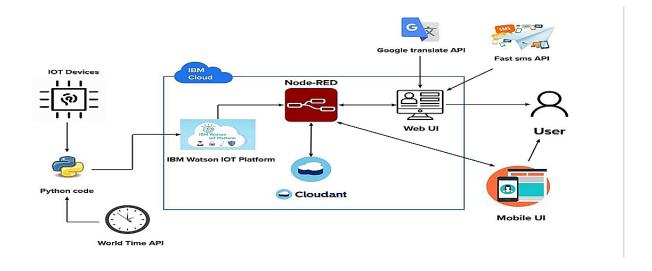
#### **SOLUTION ARCHITECTURE:**

Solution architecture bridgesthe gap between business problemand technology solution. It is a complex processwith many sub processes. Its goal are :

- Monitor the real time industrial conditions using various sensors.
- Pass the information using General packet radio service modem and store those information in the cloud which can be viewed by the industrial system.
- This system actively records and analyzethe conditions to ensure safety of the workers and the environment around workers.
- When the conditions becomes critical beyondthe safety limits, alert message are sent to industrial system and also buzzer sound is activated.
- This provides specifications according to which solution is defined and managed.
- Gives the best technology solution to solve the problem.



# **Technical Architecture**



# a.Sprint Planning & Estimation

Sprint	Functional	User Story	User Story/	Story	Priority	Team Member
	Requirement (Epic)	Number	Task	Points		
Sprint-	Registration	USN-1	As a user,I	3	High	J.Nitheesh
1			can register			
			for the			
			application			
			by entering			
			thecredentials			
			given by the			
			industry			

Sprint-	Monitoring	USN-2	As a user,I	3	High	V.S.Balasubrama
2	(Temperature, gas,		need to know			ni
	humidity, etc.)		the critical			
			parameters			
			around me			
			inside the			
			plant to			
			safeguard			
			myself			
Sprint-	IoT Dashboard	USN-3	As a user, I	1	Medium	T.Kamalesh
2	Interfacing & Web UI		should be able			
			to view the			
			measured			
			critical			
			parameters in the plantusing			
			the employee			
			dashboard			
			and			
			thewebsite			
Sprint-	Cloud Setup (Cloud	USN-4	The smart	1	Medium	M.Sivaranjani
3	Services)		sensors			
			should			
			connect with			
			IBM			
			cloud services			
			for real-time			
			data			
			monitoring of			
			critical			
			parameters			
			inside the			
			plant			

Sprint-	Mobile application	USN-5	As a user, I	2	High	T.Kamalesh
4	and wearable		should be able			
	devicesetup		to access the			
			data log			
			throughthe			
			mobile			
			application			
			and the			
			wearable			
			device and			
			receive timely			
			alerts			

# 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-	20	6 Days	24 Oct 2022	29 Oct 2022		Oct 2022
Sprint-	20	6 Days	31 Oct 2022	05 Nov 2022		Oct 2022
Sprint-	20	6 Days	07 Nov 2022	12 Nov 2022		Oct 2022
Sprint-	20	6 Days	14 Nov 2022	19 Nov 2022		Oct 2022

# 7. CODING & SOLUTIONING:

# a.Feature 1:

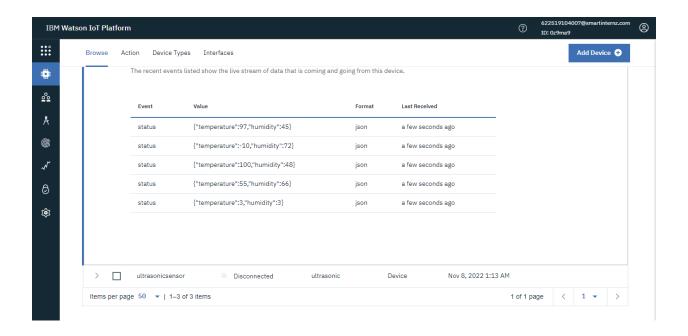
Hazardous Area Monitoring for Industrial Plant powered by IoT

**Languages** :C++, Python

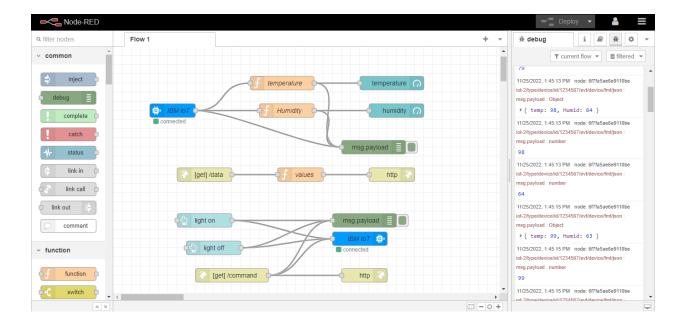
Tools/IDE: WOKWi, IBM Watson, Node-RED, IBM Cloudant DB,

Python 3.6.5, MIT Invertor.

# b.Feature 2:

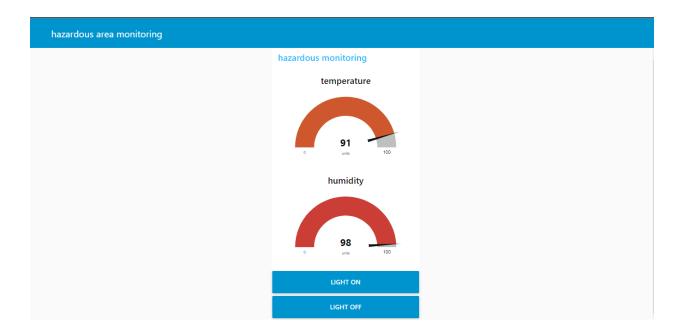


# c.Database Schema

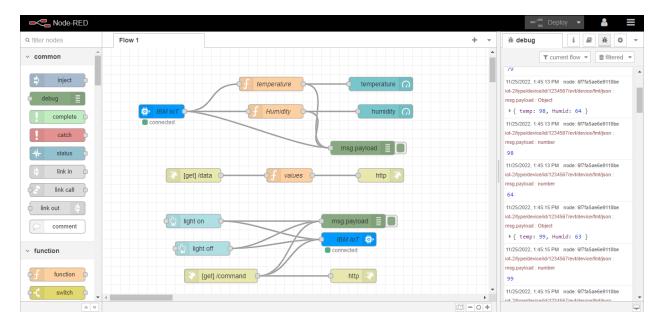


# **TESTING**

## a. Test Cases



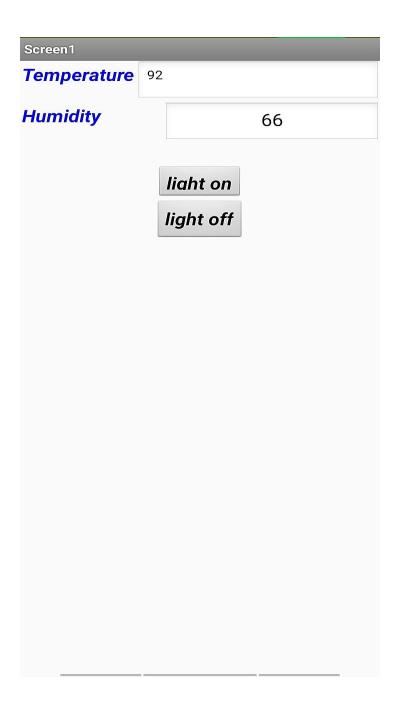
# **b.User Acceptance Testing**



# **RESULTS**

#### a.Performance Metrics

PARAMETER	PERFORMANCE	DESCRIPTION
ADMIN TESTING	95%-100%	THE TESTING DONE
		BEFORE IT IS
		DEPLOYED AS AN
		APP
CUSTOMER	75-85%	THE CUSTOMER NEED
SATISFACTION		TO BE SATISFIED WITH
		THE MOBILE
		APPLICATION
USER INTERFACE	65-85%	THE APP CAN USED BY
		ANYONE.(EASE
		OFACCESS)
SEVER RESPONSE	50-75%	url - response
DATA	60-80%	VALID DATA FROM
VALIDATION	(15-30	THE APP
WITHNO. OF	TESTCASE)	
TESTCASE		
ERROR	3-5%	REAL-TIME DELAY
		MAY OCCUR



#### 10.ADVANTAGES and DISADVANTAGES

#### **ADVANTAGES:**

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

#### **DISADVANTAGES**

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

#### **12.CONCLUSION:**

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

## 13. FUTURE SCOPE:

IoT is bound to be an effective technology in the future, and IoT enabled devices are likely to be all-pervasive, from industry to households. The future scope of IoT is bright and varied, and it is only a matter of time before the above applications of the technology are realized. While wearable technology allows patients to self monitor their health in real-time, the sensors and variants used in the healthcare industry are significantly more sophisticated. As sensors' accuracy and precision based on IoT increases, the share of manual errors in taking medical readings will decrease.

#### 14. APPENDIX

#### a.Source Code

```
Code for connecting sensor and IBM Cloud:
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random
#Provide your IBM Watson Device Credentials
organization = "0z9ma9"
deviceType = "device"
deviceId = "1234567"
authMethod = "token"
authToken = "1234567890"
# Initialize GPIO
def myCommandCallback(cmd):
  print("Command received: %s" % cmd.data['command'])
  status=cmd.data['command']
  if status=="lighton":
    print ("led is on")
  elif status=="lightoff":
    print ("led is off")
  else:
    print ("please send proper command")
  #print(cmd)
try:
  deviceOptions = {"org": organization, "type": deviceType, "id": deviceId,
```

```
"auth-method": authMethod, "auth-token": authToken}
  deviceCli = ibmiotf.device.Client(deviceOptions)
  #.....
except Exception as e:
  print("Caught exception connecting device: %s" % str(e))
  sys.exit()
# Connect and send a datapoint "hello" with value "world" into the cloud as an event of type "greeting" 10
times
deviceCli.connect()
while True:
  #Get Sensor Data from DHT11
  temp=random.randint(90,100)
  Humid=random.randint(60,100)
  data = { 'temp' : temp, 'Humid': Humid }
  #print data
  def myOnPublishCallback():
    print ("Published Temperature = %s C" % temp, "Humidity = %s %%" %Humid, "to IBM Watson")
  success = deviceCli.publishEvent("device", "json", data, qos=0,on_publish=myOnPublishCallback)
  if not success:
    print("Not connected to IoTF")
  time.sleep(3)
  deviceCli.commandCallback = myCommandCallback
deviceCli.disconnect()
```

Github link: https://github.com/IBM-EPBL/IBM-Project-45199-1660728783

Video link: <a href="https://youtu.be/HJmmxNqL8Z0">https://youtu.be/HJmmxNqL8Z0</a>