Professional Readiness for Innovation, Employability, and Entrepreneurship

**PROJECT REPORT**

|  |  |
| --- | --- |
| **Title** | Hazardous Area Monitoring for Industrial Plant powered by IoT |
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***Table of Contents***

*[1. INTRODUCTION 4](#_Toc120027957)*

[*1.1 Project Overview 4*](#_Toc120027958)

[*1.2 Purpose 4*](#_Toc120027959)

[*2. LITERATURE SURVEY 4*](#_Toc120027960)

[*2.1 Existing Problem 4*](#_Toc120027961)

[*2.2 References 5*](#_Toc120027962)

[*3. IDEATION & PROPOSED SOLUTION 6*](#_Toc120027963)

[*3.1 Empathy map 6*](#_Toc120027964)

[*3.2 Brainstorming Session 6*](#_Toc120027965)

[*3.3 Proposed Solution 7*](#_Toc120027966)

[*3.4 Proposed Solution fit 9*](#_Toc120027967)

[*4. REQUIREMENT ANALYSIS 9*](#_Toc120027968)

[*4.1 Functional Requirements 9*](#_Toc120027969)

[*4.2 Non-Functional Requirements 10*](#_Toc120027970)

[*5. PROJECT DESIGN 11*](#_Toc120027971)

[*5.1 Dataflow Diagrams 11*](#_Toc120027972)

[*5.1.1 DFD Level 0 11*](#_Toc120027973)

[*5.1.2. DFD Level 1 11*](#_Toc120027974)

[*5.1.3 DFD Level 2 12*](#_Toc120027975)

[*5.2 Solution and Technical Architecture 13*](#_Toc120027976)

[*5.3 User Stories 13*](#_Toc120027977)

[*5.4 Customer Journey 14*](#_Toc120027978)

[*6. PROJECT PLANNING & SCHEDULING 14*](#_Toc120027979)

[*6.1 Sprint planning and Estimation 14*](#_Toc120027980)

[*6.2 Sprint Delivery Schedule 16*](#_Toc120027981)

[*6.3 Reports from JIRA 17*](#_Toc120027982)

[*6.4 Burnout Chart 17*](#_Toc120027983)

[*7. CODING & SOLUTIONING 17*](#_Toc120027984)

[*7.1 Python Script 17*](#_Toc120027985)

[*7.2 Web application 19*](#_Toc120027986)

[*7.2.1 Node-RED data flow 19*](#_Toc120027987)

[*7.2.2 Web application data visualization 20*](#_Toc120027988)

[*7.3 Mobile application 21*](#_Toc120027989)

[*7.3.1 Screen 1 21*](#_Toc120027990)

[*7.3.2 Screen 2 21*](#_Toc120027991)

[*7.3.3 Screen 3 22*](#_Toc120027992)

[*8. TESTING 23*](#_Toc120027993)

[*8.1 Test Cases 23*](#_Toc120027994)

[*8.2 User Acceptance Testing (UAT) 23*](#_Toc120027995)

[*9. RESULTS 24*](#_Toc120027996)

[*10. ADVANTAGES & DISADVANTAGES 25*](#_Toc120027997)

[*11. CONCLUSION 26*](#_Toc120027998)

[*12. FUTURE SCOPE 27*](#_Toc120027999)

[*13. APPENDIX 27*](#_Toc120028000)

### INTRODUCTION

### Project Overview

Any heat escaping the machinery, burners, furnaces, etc. are ultimate sources of temperature increase. This happens either accidentally or out of negligence. This may not affect individuals directly, but can in-turn trigger another event of catastrophic nature, thus ensuring precautionary measures is essential. These temperature increases can be monitored regularly using various detectors containing sensors to detect any abnormal changes and trends in heat production and temperature increase, thereby allowing the concerned officials to act on it before anything happens to those working in that environment. This system solely aims on monitoring the temperature of the industry, thereby ensuring the safety of the workers and the industry.

### 1.2 **Purpose**

* This project helps the industries in monitoring the rise and fall of temperatures.
* The alert system will be triggered when the temperature exceeds normal bounds.
* In case of emergencies, the admins will be notified in the same instant the workers are alerted.
* In the web application, admins can view the sensor parameters.

### LITERATURE SURVEY

### 2.1 Existing Problem

Most of the industries have large machineries that produce heat due to friction. Many industries operate solely on the idea of heat production. They include smelting plants, recycling hubs, waste treatment facilities and even nuclear power generators. So, when these industries produce temperature that they can’t control, the result is catastrophic. This system solely aims on monitoring the temperature of the industry, thereby ensuring the safety of the workers and the industry.

### 2.2 References

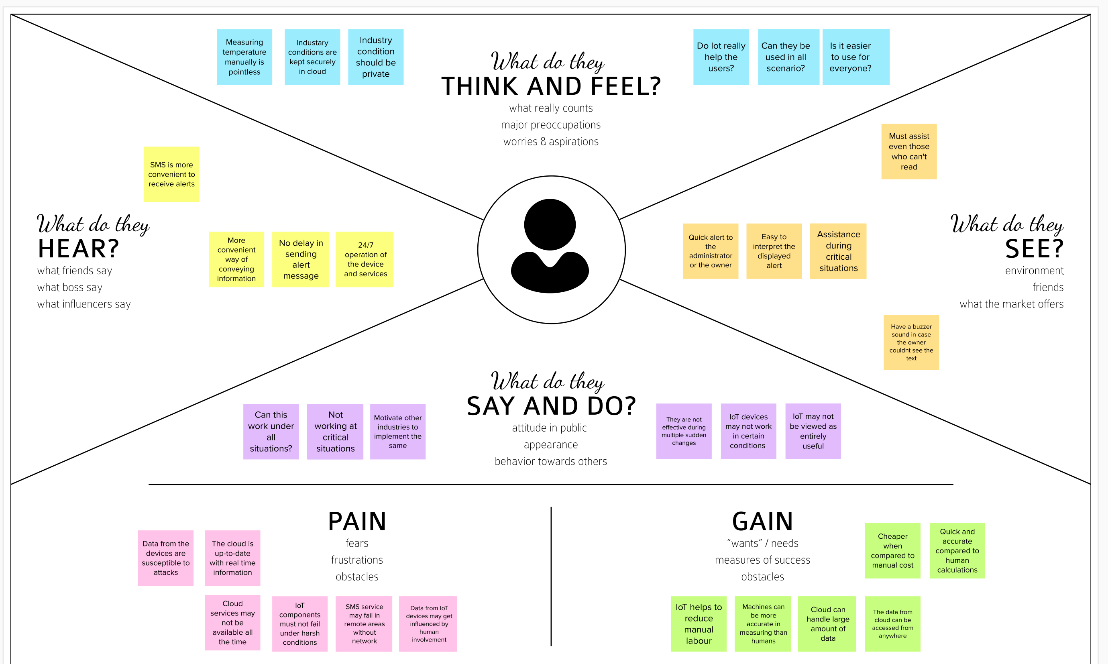
2.2.1 Kang, H., Sung, S., Hong, J., Jung, S., Hong, T., Park, H. S., & Lee, D.-E. (2020). Development of a real-time automated monitoring system for managing the hazardous environmental pollutants at the construction site. Journal of Hazardous Materials, 123483. doi:10.1016/j.jhazmat.2020.123483. This paper presents a way to monitor the noise and dust in industries using vibrations and sensors to measure vibrations, dust and noise.

2.2.2 Sureshkumar A (2015). A Study On Computer Based Monitoring SystemFor Hazardous Area Safety Measurement Using Virtual Instrumentation. International Conference on Inter Disciplinary Research in Engineering and Technology [ICIDRET], ICIDRET.2015.030. The basic idea of this paper is to provide a way to virtualize all the sensor automations instead of manually reading the data from sensors, to get the desired results from the environment

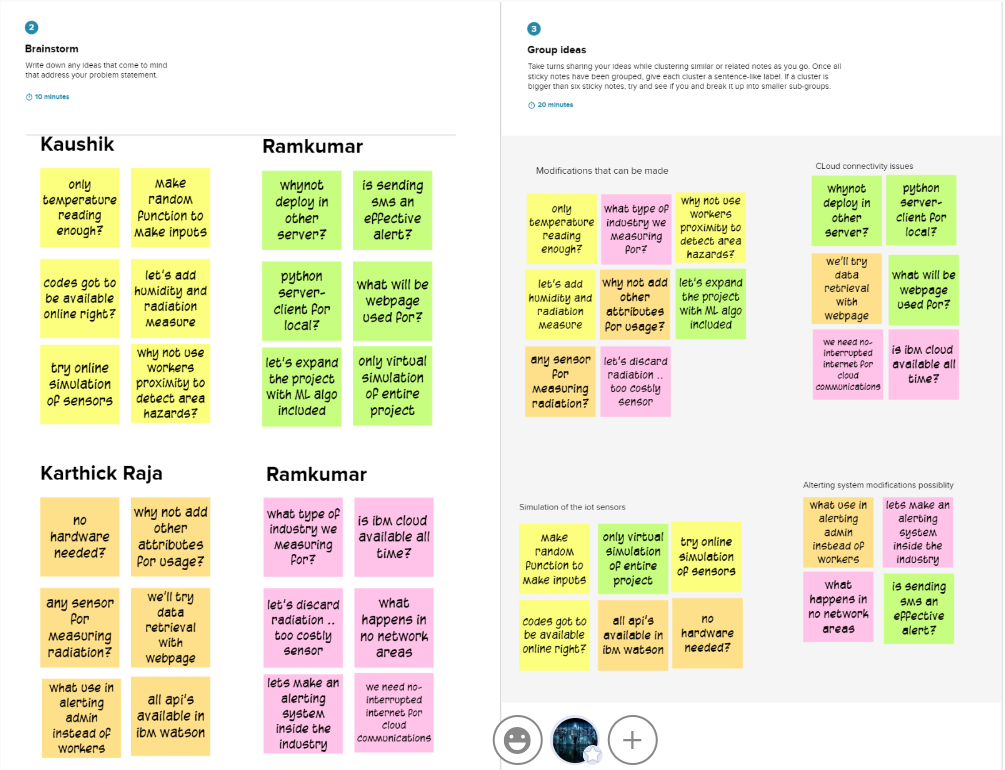
2.2.3 Somnath, Paul., T.V. Sarath., (2018). End to End IoT Based Hazard Monitoring System. International Conference on Inventive Research in Computing Applications (ICIRCA) 10.1109/ICIRCA.2018.8597430. This paper uses various IoT devices and messaging protocols to monitor parameters like temperature, humidity, presence or absence of objects.

### IDEATION & PROPOSED SOLUTION

### 3.1 Empathy map



### 3.2 Brainstorming Session





### 3.3 Proposed Solution

|  |  |  |
| --- | --- | --- |
| **S.No.** | **Parameter** | **Description** |
|  | Problem Statement (Problem to be solved) | * Hazardous Area Monitoring for Industrial Plant Powered by IoT |
|  | Idea / Solution description | * Using a variety of sensor, the environmental parameters such as temperature, humidity can be monitored * If the conditions exceeds safety limits, message is sent to users sms. |
|  | Novelty / Uniqueness | * Device being developed can monitor a wide range temperature and accurate humidity measurements. * Apart from notifying the user, an alert can be made in the hazardous area. * Reduces unwanted manpower. |
|  | Social Impact / Customer Satisfaction | * As the device is small, it is easy to install them in various locations based on necessity. |
|  | Business Model (Revenue Model) | * Device can be obtained by paying for the IBM clou/Watson subscription. * It can be yearly or monthly. * Based on the term of subscription 5 – 8% discount shall be made available. |
|  | Scalability of the Solution | * In future additional attributes like radiation can be included for safety measurements to expand industrial coverage. |

### Proposed Solution fit



### 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 | User Registration | Registration through Form  Online Payment for the service |
| FR-2 | User Access | Access the details using web browser  Access the details using mobile application |
| FR-3 | User alert | Gets alert as an SMS message  Gets alert alarm in the working area. |

### 4.2 **Non-Functional Requirements**

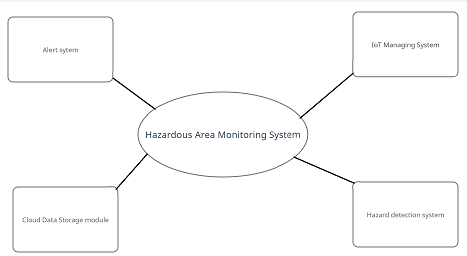
Following are the non-functional requirements of the proposed solution.

|  |  |  |
| --- | --- | --- |
| **FR No.** | **Non-Functional Requirement** | **Description** |
| NFR-1 | Usability | The device must be usable by the customer anywhere |
| NFR-2 | Security | Data from the sensors are stored securely and away from other data |
| NFR-3 | Reliability | Data can be retrieved anytime and no data is discarded without customer knowledge |
| NFR-4 | Performance | No performance delay in case of large number of data or more parameters |
| NFR-5 | Availability | The device doesn’t fail even under harsh conditions.  Device continues to send parameters, even after an alert situation. |
| NFR-6 | Scalability | Device must be capable of measuring conditions even in a larger industry |

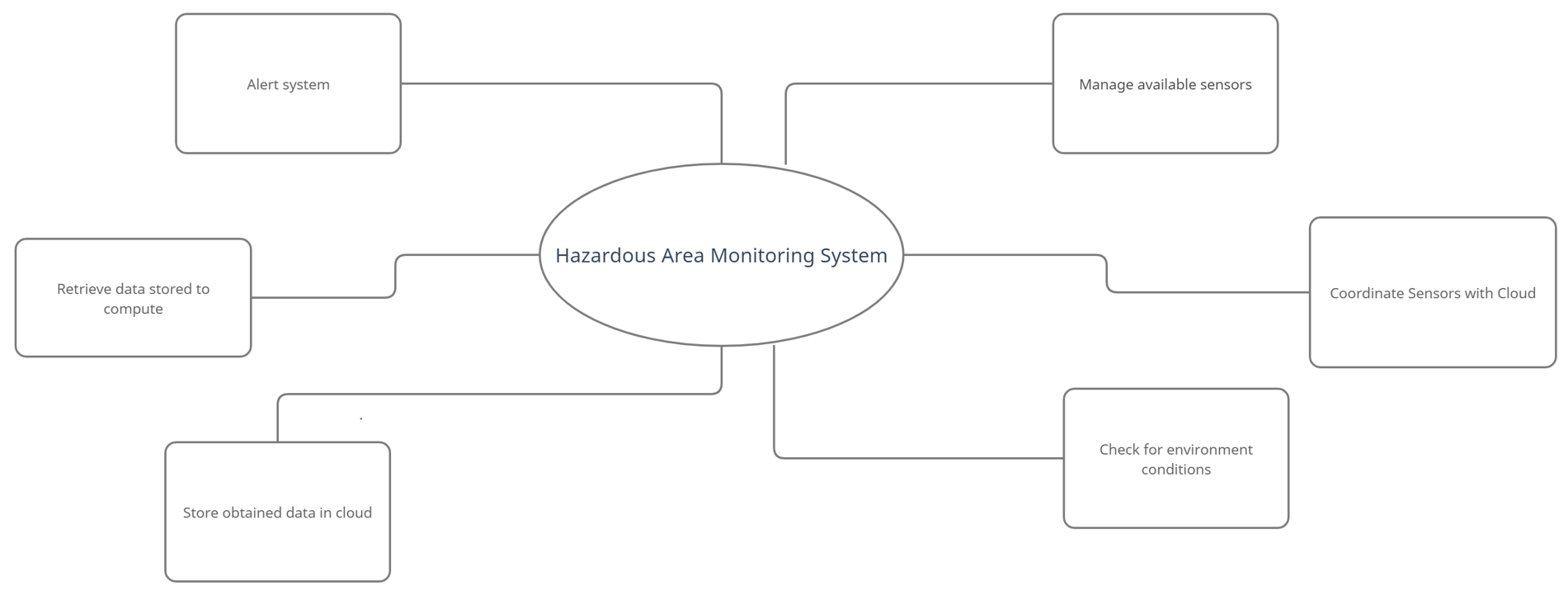
### PROJECT DESIGN

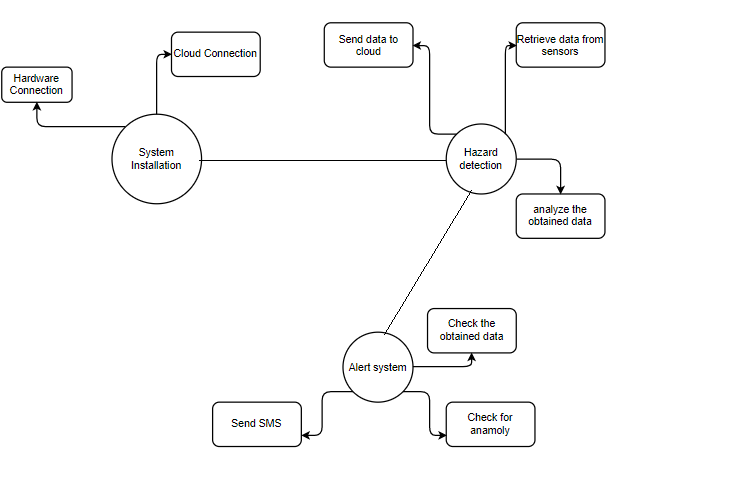
### 5.1 Dataflow Diagrams

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.

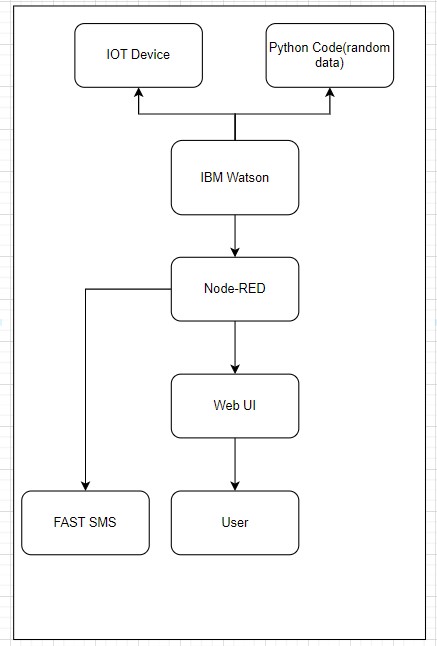
5.1.1 DFD Level 0 

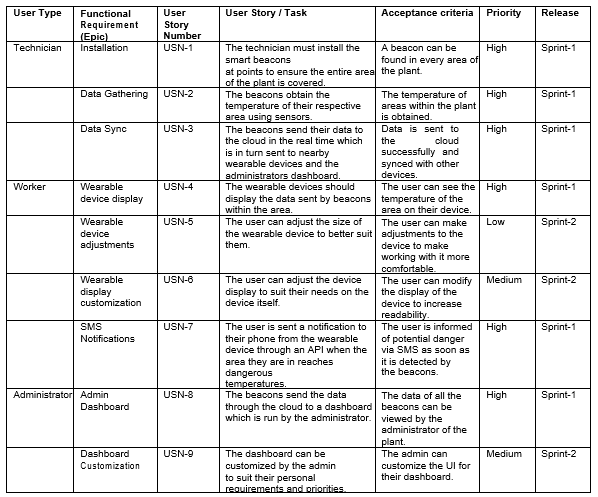
5.1.2. DFD Level 1



* + 1. DFD Level 2

5.2 Solution and Technical Architecture



5.3 User Stories

### Customer Journey



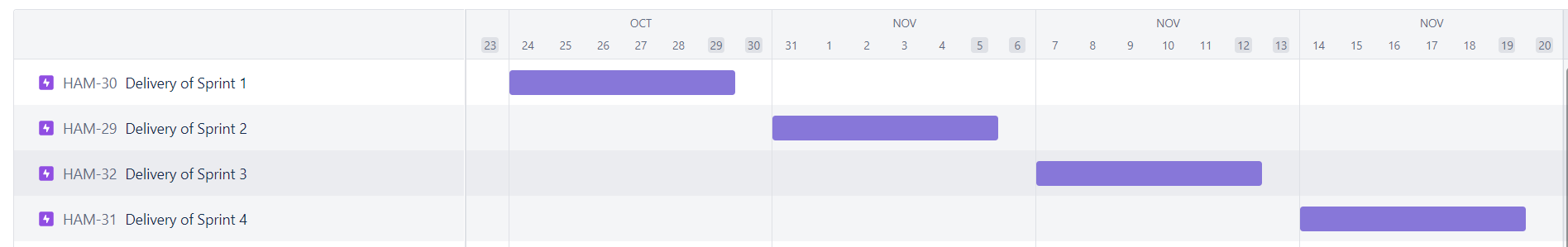
### 6. PROJECT PLANNING & SCHEDULING

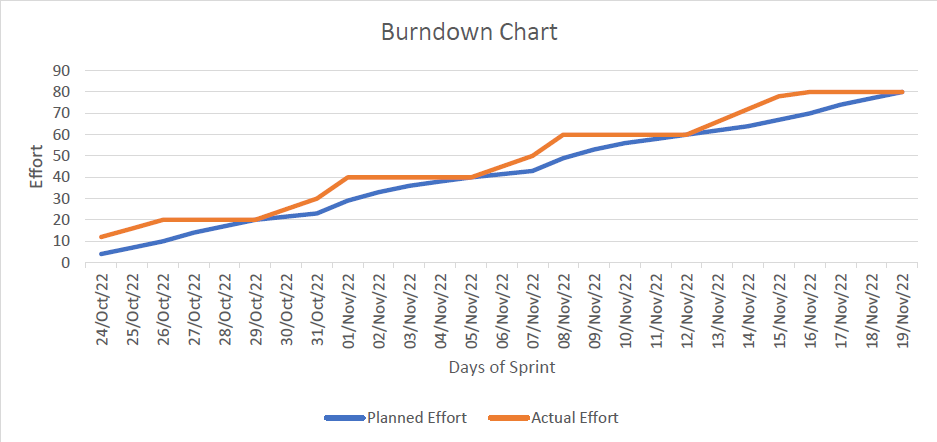
### 6.1 Sprint planning and Estimation

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sprint** | **Functional**  **Requirement (Epic)** | **User Story**  **Number** | **User Story / Task** | **Story Points** | **Priority** | **Team Members** |
| Sprint-1 | Objective | USN-1 | The sensor must detect the humidity | 7 | High | Kaushik Balaji,  Ram kumar |
| Sprint-1 | Features | USN-2 | The values must be displayed | 2 | Low | Kaushik Balaji, Karthick Raja |
| Sprint-1 | Features | USN-3 | Based on threshold, alert has to be sent | 5 | High | Ram kumar, Karthick Raja |
| Sprint-1 | Features | USN-4 | Based on threshold, Buzzer and other alerting system must be turned ON | 5 | High | Ram kumar, Karthick Raja |
| Sprint-2 | Focus | USN-6 | Alert SMS must be sent to the registered phone number | 2 | Low | Ram kumar , Kaushik Balaji |
| Sprint-2 | Features | USN-8 | Whether the malfunction is rectified or emergency measures needed | 5 | Medium | Ram kumar |
| Sprint-3 | Data Transfer | USN-9 | API key must be retrieved to transfer the data to IBM Cloud | 2 | Low | Karthick Raja, Ram Kumar |
| Sprint-3 | Data Transfer | USN-10 | Data of sensor must be sent to IBM Cloud | 5 | Medium | Ram kumar,Karthick Raja |
| Sprint-3 | Data Transfer | USN-11 | IBM Cloud should send data to Node Red | 2 | Medium | Ram kumar, Kaushik Balaji |
| Sprint-3 | Data Transfer | USN-12 | Data obtained in Node Red must be forwarded to MIT App | 3 | Medium | Ram kumar, Karthick Raja |
| Sprint-3 | Data Transfer | USN-13 | Data must be displayed in the application developed using MIT. | 8 | High | Ram kumar,Kaushik Balaji |
| Sprint-4 | Registration | USN-14 | User must register an account using Email and Mobile Number in the website | 2 | High | Ram kumar,Kaushik Balaji |
| Sprint-4 | Registration | USN-15 | Confirmation mail must be received to the registered Mail-ID | 2 | Medium | Kaushik Balaji,Ram kumar |
| Sprint-4 | Login | USN-16 | User can login into web application through email and password. | 3 | High | Karthick Raja, Ram kumar |
| Sprint-4 | Dashboard | USN-17 | User can access the dashboard and make use of available resources. | 2 | Medium | Ram Kumar |
| Sprint-4 | Focus | USN-18 | User must receive an SMS once an abnormal condition is detected | 5 | High | Kaushik Balaji |
| Sprint-4 | Allocation | USN-19 | Admin must receive information about the situation and can alert the concerned authorities | 3 | High | Kaushik Balaji, Ram kumar |
| Sprint-4 | Allocation | USN-20 | Admin must allot particular person to look after the atmospheric changes. | 3 | High | Ram kumar, Karthick Raja |

### 6.2 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 | 6 Days | 24 Oct 2022 | 29 Oct 2022 |  | 29 Oct 2022 |
| Sprint-2 | 20 | 6 Days | 31 Oct 2022 | 05 Nov 2022 |  | 05 Nov 2022 |
| Sprint-3 | 20 | 6 Days | 07 Nov 2022 | 12 Nov 2022 |  | 12 Nov 2022 |
| Sprint-4 | 20 | 6 Days | 14 Nov 2022 | 19 Nov 2022 |  | * 1. ov 2022 |

6.3 Reports from JIRA

6.4 Burnout Chart

### 7. CODING & SOLUTIONING

### 7.1 Python Script

import time

import sys

import ibmiotf.application

import ibmiotf.device

import random

# Provide your IBM Watson Device Credentials

organization = "c1n0yk"

deviceType = "Hazard"

deviceId = "2"

authMethod = "token"

authToken = "123456789"

# Initialize GPIO

def myCommandCallback(cmd):

print(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 ibmiotf.ConnectionException as e:

print("Caught exception connecting device: %s" % str(e))

sys.exit()

deviceCli.connect()

while True:

# Get Sensor Data from DHT11

temp = random.randint(50, 100)

mydata = {'temp': temp}

def on\_publish():

print("Published Temperature = %s C" % temp, "to IBM Watson")

success = deviceCli.publishEvent("Temp sensor", "json", mydata, qos=0, on\_publish=on\_publish)

if not success:

print("Not connected to IoTF")

deviceCli.commandCallback = myCommandCallback

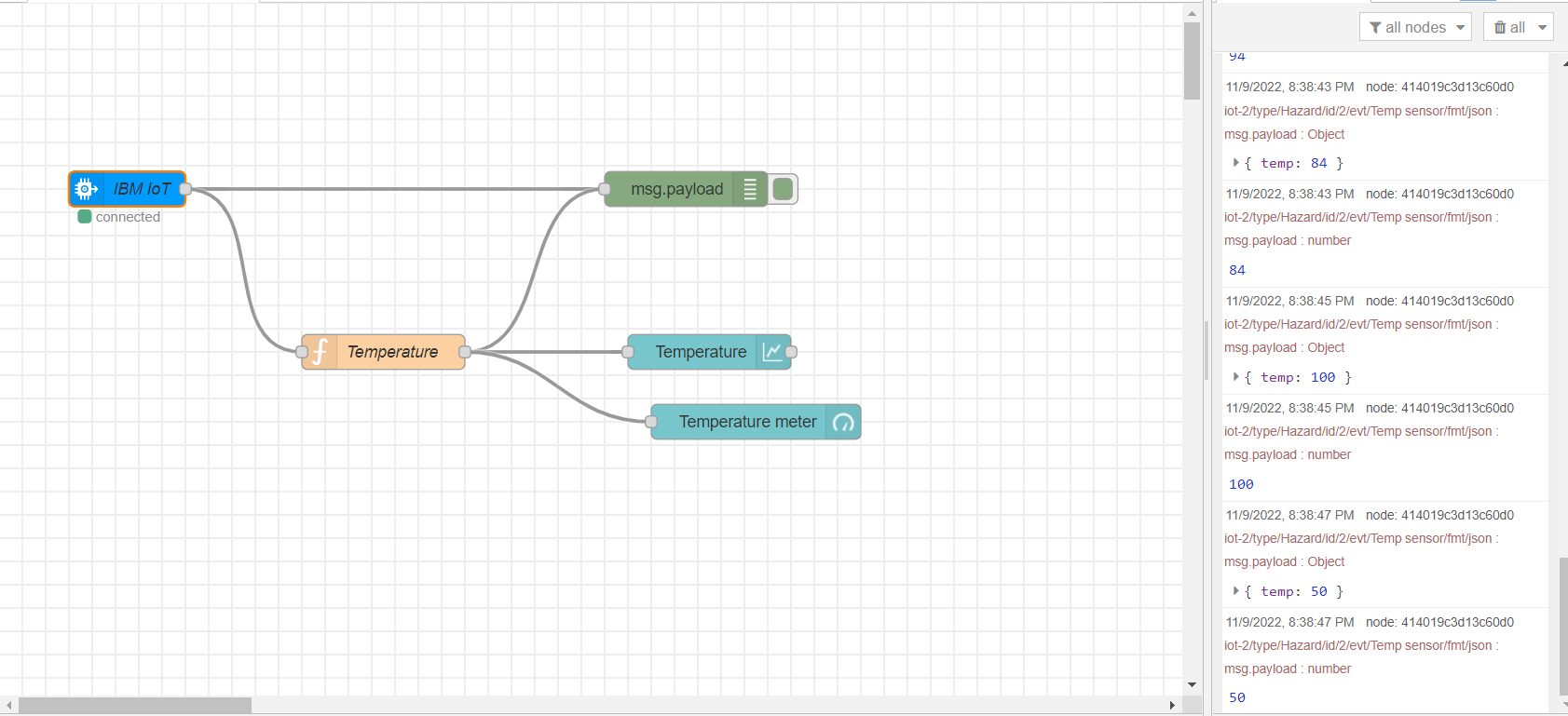
time.sleep(5)

# Disconnect the device and application from the cloud

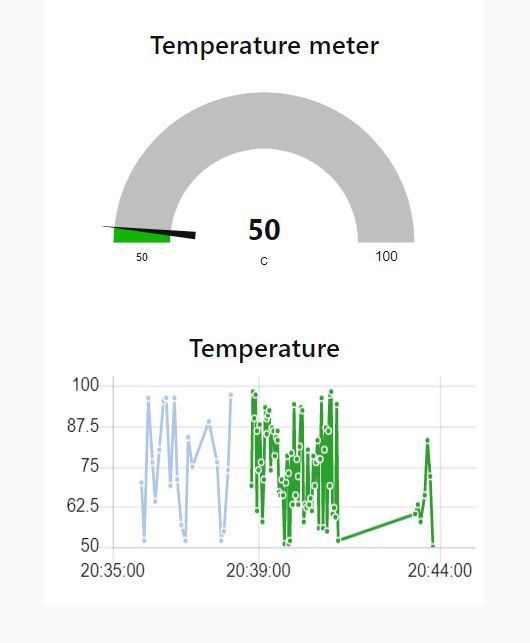
deviceCli.disconnect()

### 7.2 Web application

### 7.2.1 Node-RED data flow

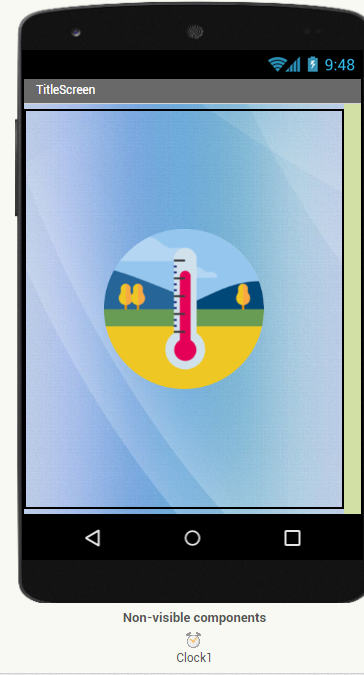
****

### Web application data visualization

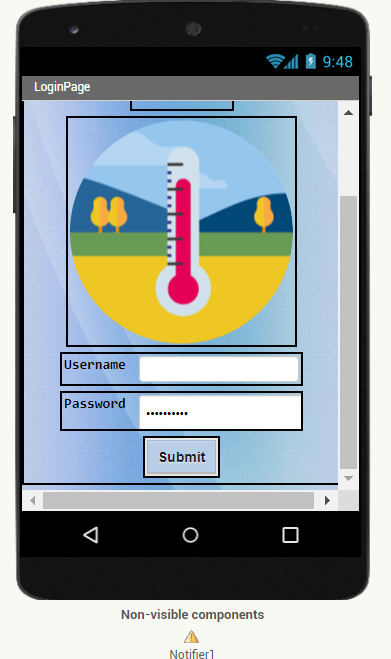


### 7.3 Mobile application

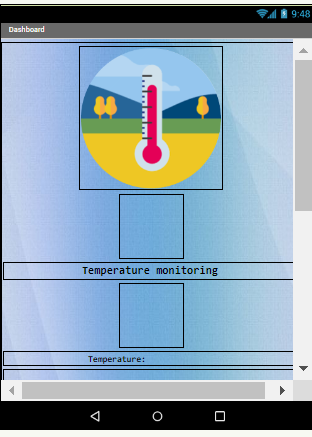
### 7.3.1 Screen 1



### 7.3.2 Screen 2

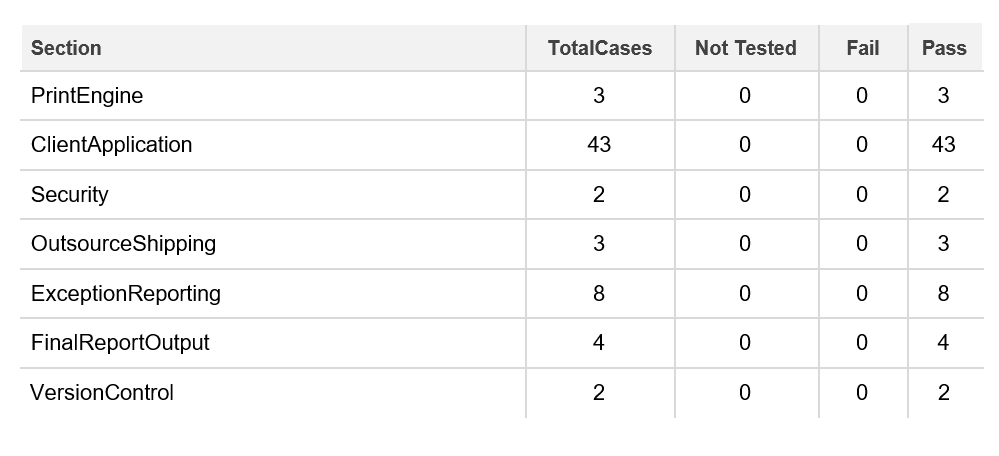


### 7.3.3 Screen 3

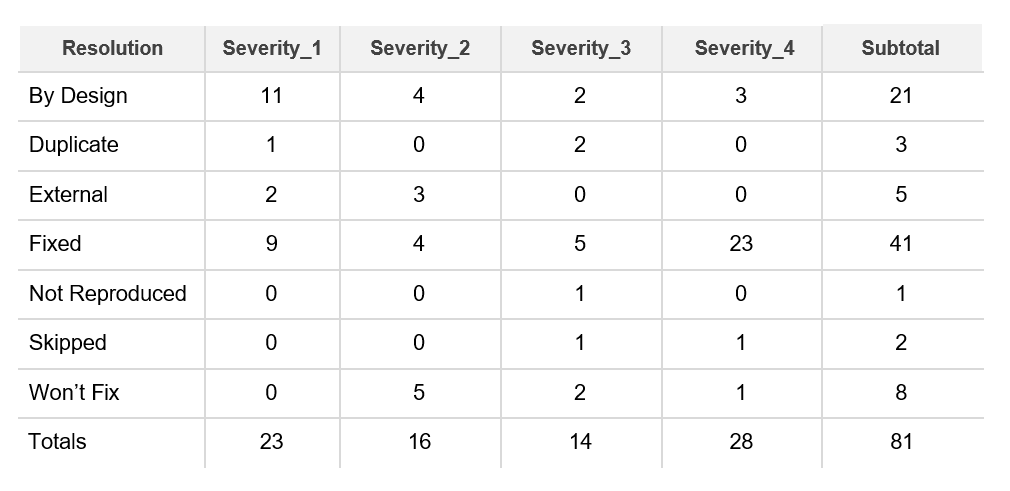


### 8. TESTING

### 8.1 Test Cases



### User Acceptance Testing (UAT)



### 9. RESULTS

9.1 **Performance Metrics**

The conclusion from this project's performance that the project system's detection of hazardous condition is remarkable. Useful for both domestic and professional needs. We can use this technology to save lives in risky situations. The hazard monitoring system indicates an alert when the area’s temperature crosses a safety limit. Power usage and transmission range estimates are made. The sensor was constructed using straightforward techniques and an Arduino UNO Micro controller.

### 10. ADVANTAGES & DISADVANTAGES

### Advantages

* Fast-pace communication:

In the case an automated system for monitoring the temperature changes in the environment, this is very accurate. We get the required data from the sensors, and send it to the central system for data storage and computation. As the central system does the most computation, the device has more than average performance, when equipped with a good internet connection.

* Round-the-clock support:

Because the data gathering is done by sensors, a little power supply is enough to keep the device running and provide protection to the area round the clock.

* Convenient mode of communication:

The main mode communication between the central device is a mobile application, made to show the constant changes in the data from the required area. As a mobile application is used, it is easier to see the conditions whenever needed. Also, as the alert system is based on SMS service, no internet connection is required to view the new data.

### Disadvantages

* Lack of intelligence:

As the device is purely based on alerting the user based on predefined safety limit, the system cannot learn about any upcoming changes in the safety limit. Lack of an intelligent system will reduce its effectiveness in the long run.

* Unsuitable for some customers:

In case the customer is someone who believes that human labor is better than machines, it becomes a hassle to convince these customers otherwise. Any small technical errors can create a large misunderstanding between the device and these customer, thus can heavily influence the coverage of the device to such customers.

* Requires technical expertise:

Although the device is designed to be user friendly, it is difficult to maintain the device without technical knowledge. The users need to have a basic knowledge of the components of the device, so that they need not wait for the professionals to arrive in case of technical glitches.

### 11. CONCLUSION

It is always better to have preventive measure, rather than taking actions after a disaster. Having a system to monitor the changes in the surroundings should help the owners of the industry to keep their industries safe and also keep their workers safe. Though the initial cost of installation of the device is higher, it is always better to spend on precaution, than spending on fixing any harmful situation.

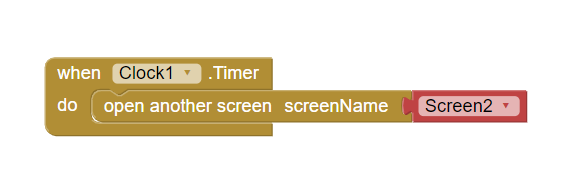
### 12. FUTURE SCOPE

As the device uses only temperature as its measuring quantity, our device is limited to industries that are in harm’s way due to temperature increase. In future we can make the device include parameters like smoke, dust, vibrations, and even radiations. Industries that use atomic radiations have been increasing and our device can help these industries stay on the safer side by helping them monitor the conditions regularly.

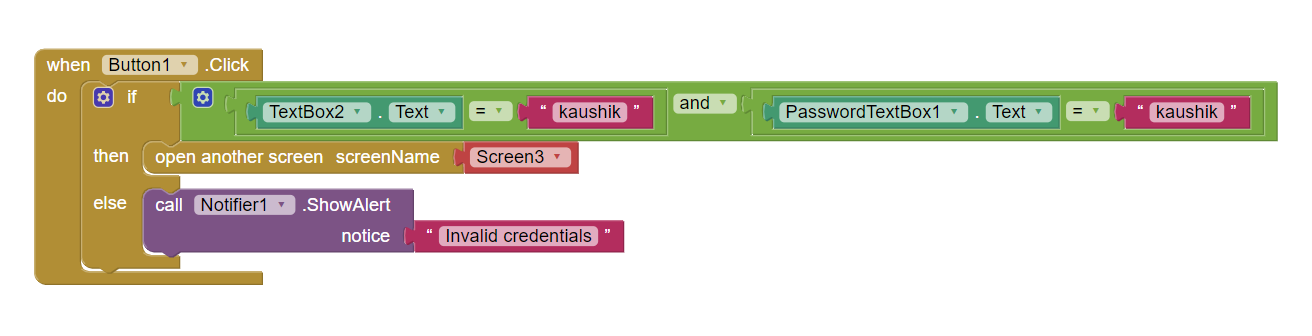
### 13. APPENDIX

**Source Code**

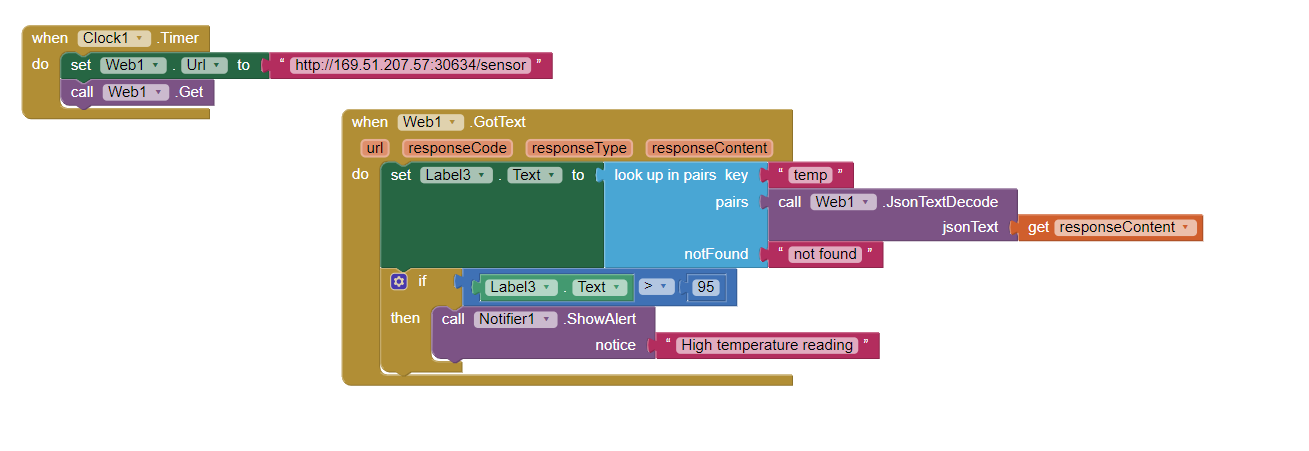
**Mit application Screen 1 Code block**



**Mit application Screen 2 Code block**



**Mit application Screen 3 code block**



**Code for event generation in IBM Watson**

{

"temp": random(50, 100)

}

**Node-RED Temperature (function) node**

msg.payload = msg.payload.temp

global.set("t", msg.payload)

return msg;

**Node-RED value (function) node**

msg.payload = {"temp" : global.get("t")}

return msg;

**Project links**

[**Project demo video link**](https://drive.google.com/file/d/1ujBcpz9-jNWgylBw8bzItJ_IoP8U4VnJ/view?usp=sharing)

[**Project Google drive link**](https://drive.google.com/drive/folders/1n4NwlESICkvKZc_PUnmBv6YC5akNrcal?usp=share_link)

[**Project github link**](https://github.com/IBM-EPBL/IBM-Project-2386-1658470723)