

**REAL – TIME RIVER WATER QUALITY MONITORING AND  
CONTROL SYSTEM  
NALAIYATHIRAN PROJECT BASED LEARNING ON  
PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY  
AND ENTREPRENEURSHIP**

**A PROJECT REPORT**

**Submitted by**

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**BACHELOR OF ENGINEERING**

**IN**

**ELECTRONICS AND COMMUNICATION ENGINEERING**



**UNIVERSITY COLLEGE OF ENGINEERING, RAMANATHAPURAM**

**ANNA UNIVERSITY::CHENNAI 600 025**

**NOVEMBER 2022**

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**NOVEMBER 2022**

## **BONAFIDE CERTIFICATE**

Certified that this project report titled “**Real-Time River Water Quality Monitoring and Control System by NALAIYATHIRAN PROJECT BASED LEARNING Program**”, is the bonafide work of **RAMESH M(913019106009), KARTHIK KISHORE M (913019106005), ROOPAN KUMAR R(913019106010),SANJAY M (913019106012), AJITHKANNAN P(913019106003)** who carried out the work under faculty mentor and industry mentor supervision, for the partial fulfillment of the requirements for the award of the degree of **BACHELOR OF ENGINEERING IN ELECTRONICS AND COMMUNICATION ENGINEERING.**

Certified further that to the best of my knowledge and belief, the work reported here in does not form part of any other thesis or dissertation on the basis of which a degree or an award was conferred on a nearlier occasion.

## **DECLARATION**

I, hereby declare that the Project work entitled “**Real-Time River Water Quality Monitoring and Control System by NALAIYATHIRAN PROJECT BASED LEARNING PROGRAM**” submitted to the IBM November 2022 in partial fulfillment for the award of the degree of **BACHELOR OF ENGINEERING IN ELECTRONICS AND COMMUNICATION ENGINEERING**, is the report of the original project work done by us under the guidance of Mr. (Faculty Mentor), Department of **ELECTRONICS AND COMMUNICATION ENGINEERING**, University College of Engineering, Ramanathapuram.

**NAME**

RAMESH M  
(Team Leader)

**I certify that the declaration made by the above candidate is true.**

**SIGNATURE FACULTY MENTOR**

**Department of Electronics and  
Communication Engineering  
University College of Engineering**

Ramanathapuram-623 513

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# **1. INTRODUCTION**



## 1.1 PROJECT OVERVIEW:

These days drinking water is the most valuable and significant for every single individual and potable water usage faces new difficulties in constant operation. Monitoring various aspects of the River Water Quality leads to a clear understanding of the aspects that should be considered for a healthy life and to avoid unsanitary water using Internet of Things (IOT) should allow for the integration of real time monitoring and controlling of water quality. The suggested system utilizes Internet of Things (IOT) through using sensors such as (PH, temperature and turbidity). Using a web application to immediately alert the people to check the status of water. The **IOT based Real-time river water quality monitoring and control system** being proposed via this report with micro controller mixed with different sensors and a Wi-Fi module producing live data is sent to cloud so that people or authorities can get the data easily. Using IBM Cloud services to store and using various types of codes to execute the system process. Real-time river water quality monitoring and control system is used to monitor and control the quality of water pH level, Temperature to get the proper quality of good water.

## 1.2 PURPOSE:

The main aim of our project is to monitor and control the quality of water in river water quality monitoring is used to alert us to current ongoing and emerging problems; To determine compliance with drinking water standards and to protect other beneficial uses of water and also helpful for people to drink good water.

## **2. LITERATURE SURVEY**

## **2.1 EXISTING PROBLEM:**

1. Mixing of water like drainage, chemical wastage.
2. Death of animals in river water.
3. When people throw plastics and in the river, it causes river water pollution.
4. Oilspilled, fertilizers, human wastes are the existing problems in the river water.

## **2.2 REFERENCES:**

1. **TITLE:** IOT Based real time river water quality monitoring system

**AUTHOR DETAILS** : Mohammad salahuddinchowdury, Talha bin emran, Subhasish, Abhjitpathak, Karalandersson, Mohd.manjuralam, Nurulabsar, Mohammadshahadathossain

**YEAR** 2019

2. **TITLE:** Smart water quality monitoring system with cost effective using IOT

**AUTHOR DETAILS** : Sathishpasika, Saitejagandha

**YEAR** 2020

3. **TITLE** : Smart water quality monitoring system for Real time applications

**AUTHOR DETAILS** : Tha.Sugapriya, S.Rakshya, K.Ramyadevi, M.Ramya,

**YEAR**            2018

**4. TITLE**            : Real time monitoring of water quality

**AUTHOR DETAILS:** Mohanabarathy.R, Sindhuparvathi.M, Priyanka.K,

**YEAR**            2019

**5. TITLE**            : Real time water quality monitoring system

**AUTHOR DETAILS:** Yashwanthgowda K.N, Vaishali.c, sumalatha S.T and spoorth G.B

**YEAR**            2020

**6. TITLE**            : Smart water quality and monitoring of motor in bore well by IOT

**AUTHOR**            : Nandhinimurugaiyan, Elakkiyasakthivel, Madhumithalavakumar,

**YEAR**            2020

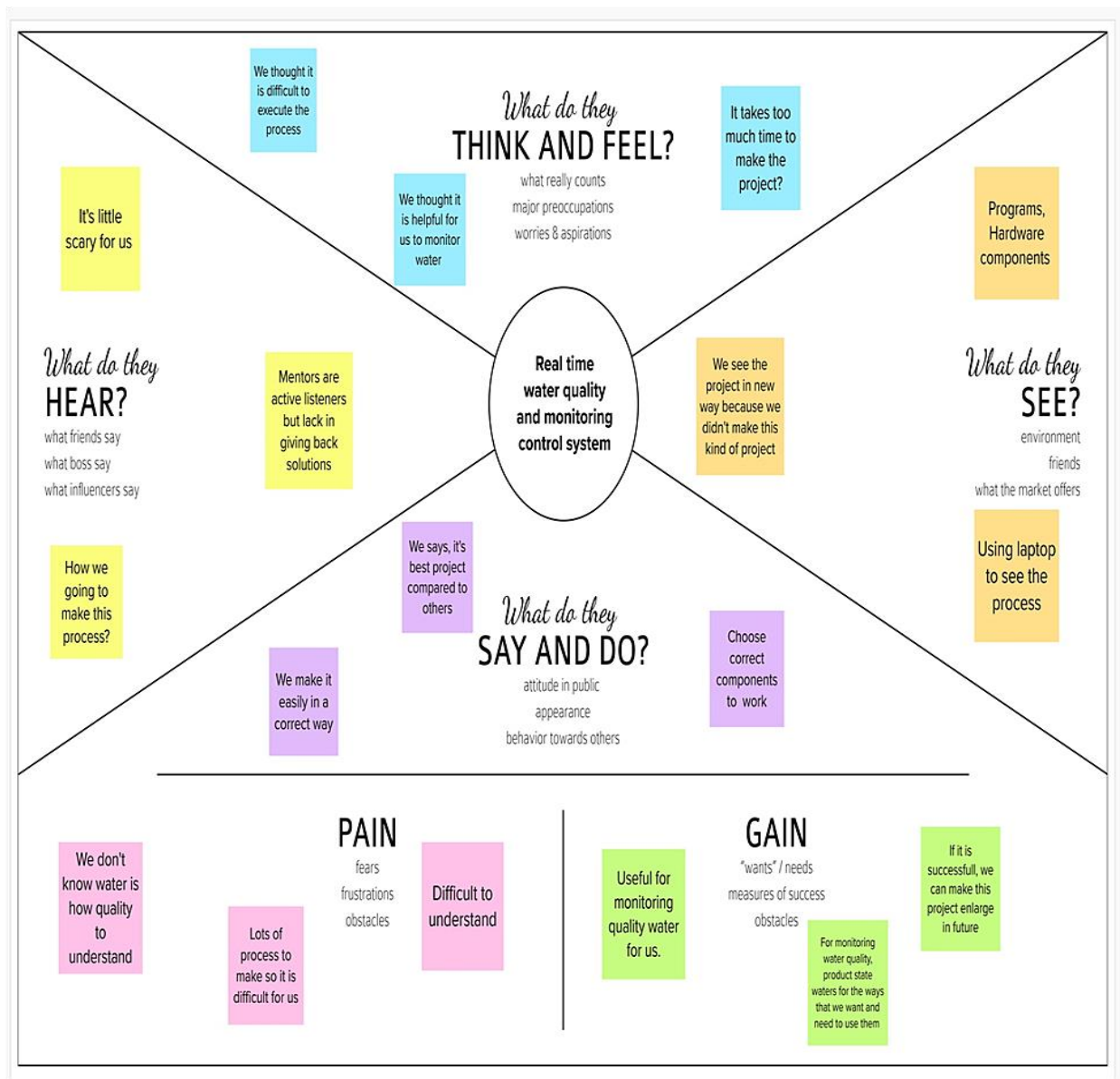
## **2.3 PROBLEM STATEMENT DEFINITION:**

### **REAL-TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM**


01.	<b>I AM</b>	Manufacturer
02.	<b>I'm trying to</b>	Detect the water quality monitoring and control system in river
03.	<b>But</b>	Using different types of sensor is a major problem in this system
04..	<b>Because</b>	If any one of the sensor are damaged or not working doesn't detect the system properly.
05.	<b>Which makes me feel</b>	This leads people to drink and use unsanitary water

### **3. IDEATION & PROPOSED SOLUTION**

### 3.1 EMPATHY MAP CANVAS:



## 3.2 IDEATION & BRAINSTORMING:



### Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

- 10 minutes to prepare
- 1 hour to collaborate
- 2-8 people recommended

#### Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes

---

- A** Team gathering  
Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.
- B** Set the goal  
Think about the problem you'll be focusing on solving in the brainstorming session.
- C** Learn how to use the facilitation tools  
Use the Facilitation Superpowers to run a happy and productive session.

[Open article](#) →

#### 1 Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

---

PROBLEM

The major problem of the real time projects are timing. Because of late detection it poses quality problems.

#### Key rules of brainstorming

To run a smooth and productive session

Stay in topic.	Encourage wild ideas.
Defer judgment.	Listen to others.
Go for volume.	If possible, be visual.

2

## Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

### TIP

You can select a sticky note and hit the pencil (switch to sketch) icon to start drawing!

### RAMESH

It ~~helps~~ help  
with the  
conclusion against  
leakages. It  
as well as to stop  
leakage in the

This project can  
be used as  
efficient water  
management  
system in local  
area

The system can  
be used to  
monitor the  
water level in the  
pipe or tank

By using remote  
monitoring  
technology it  
provide remote  
value control

### KARTHIK KISHORE

Monitoring system  
and control  
system. It can  
be used to  
monitor the  
water level in  
the pipe or tank

If there is any  
abnormal  
condition are  
found in water,  
buzzer will get  
alarm sound

By using the  
system, it can  
monitor the water  
level in the pipe  
or tank. It can  
be used to monitor  
the water level in  
the pipe or tank

The system can monitor  
the water level in the  
pipe or tank. It can  
be used to monitor  
the water level in  
the pipe or tank

### ROOBAN KUMAR

Water level  
monitoring  
system. It can  
be used to  
monitor the  
water level in  
the pipe or tank

It can be used to  
monitor the water  
level in the pipe  
or tank. It can  
be used to monitor  
the water level in  
the pipe or tank

It can be used to  
monitor the water  
level in the pipe  
or tank. It can  
be used to monitor  
the water level in  
the pipe or tank

The water level is  
monitored by using  
the system. It can  
be used to monitor  
the water level in  
the pipe or tank

### SANJAY

It can be used to  
monitor the water  
level in the pipe  
or tank. It can  
be used to monitor  
the water level in  
the pipe or tank

It can be used to  
monitor the water  
level in the pipe  
or tank. It can  
be used to monitor  
the water level in  
the pipe or tank

It can be used to  
monitor the water  
level in the pipe  
or tank. It can  
be used to monitor  
the water level in  
the pipe or tank

It can be used to  
monitor the water  
level in the pipe  
or tank. It can  
be used to monitor  
the water level in  
the pipe or tank

### AJITH KANNAN

The project can be  
used to monitor the  
water level in the  
pipe or tank. It can  
be used to monitor  
the water level in  
the pipe or tank

The project can be  
used to monitor the  
water level in the  
pipe or tank. It can  
be used to monitor  
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It can be used to  
monitor the water  
level in the pipe  
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It can be used to  
monitor the water  
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the water level in  
the pipe or tank



---

3

## Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you can break it up into smaller sub-groups.

 20 minutes

The water quality is sensed by using sensors and the quality of water is intimated to the user by SMS

By using remote monitoring technology it provide remote value control

### TIP



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



## Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes



## After you collaborate

You can export the mural as an image or PDF to share with members of your company who might find it helpful.

### Quick add-ons

- Share the mural**  
Share a view link to the mural with stakeholders to keep them in the loop about the outcome of the session.
- Export the mural**  
Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

### Keep moving forward

- Strategy blueprint**  
Define the components of a new idea or strategy.  
Open the template →
- Customer experience journey map**  
Understand customer needs, motivations, and expectations for an experience.  
Open the template →
- SWOT: strengths, weaknesses, opportunities & threats**  
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.  
Open the template →

Share template feedback

### 3.3 PROPOSED SOLUTION:

Project team shall fill the following information in proposed solution template.

S.No.	Parameter	Description
01.	Problem Statement (Problem to be solved)	The major problem of the real time projects are timing. Because of late detection of water quality problems .
02.	Idea / Solution description	To setting up internet connection in rural areas for quick detection of water quality through mobile application or SMS alert.
03.	Novelty / Uniqueness	Timely detection of water quality can keep the water in good condition.
04.	Social Impact / Customer Satisfaction	People can drink clean water and use it effectively.
05.	Business Model (Revenue Model)	It benefits for mergers to sell in medium cost to buffers and also helpful in the society.
06	Scalability of the Solution	Need more type of sensors and others components high cost is required.

### 3.4 PROBLEM SOLUTION FIT:

<b>1. CUSTOMER SEGMENT (S):</b>  People and Industrial companies are our customers. We take this ideas to customers.	<b>6. CUSTOMER CONSTRAINTS:</b>  The customer constraints are network connection, No cash and available devices to built the system	<b>5. AVAILABLE SOLUTOINS</b>  The solution of water quality monitoring and quality systems using robot to detect the problem and using sensors to identify the problem to the user by SMS.
<b>2. JOBS – TO – BE DONE / PROBLEM:</b>  Timing and Internet issues are the major problem in the system. Because me detect the water quality problems late.	<b>9. PROBLEM ROOT CAUSE:</b>  Timing and Internet connection is the real reason that problem exists.	<b>7. BEHAVIOUR</b>  Our customer address the problem, Sometimes they drink and use unsanitary water. This leads to health Problems.
<b>3. TRIGGERS:</b>  Water problem triggers the customers to act in various ways.	<b>10. YOUR SOLUTION:</b>  Using different types of sensors like PH sensor, turbidity sensor, temperature sensor to monitoring the water and display the conditions in	<b>8. CHANNELS OF BEHAVIOUR:</b>  <b>8.1 ONLINE:</b> They can't interact with the physical components. They complaint the problem through online easily.
<b>4. EMOTIONS: BEFORE/AFTER:</b>  The emotions are frustrated, anger, fear and neglected	LCD sensor	<b>8.2 OFFLINE:</b> They take the decision immediately in offline and solved it quickly.

## **4. REQUIREMENT ANALYSIS**

#### 4.1 FUNCTIONAL REQUIREMENT:

Following are the functional requirements of the proposed solution.

FR NO:	Functional requirements	Sub Requirement (Story / Sub - task)
FR – 1	User identification	The user has to identify whether the water conditions are good or bad then take the sample water to identify the water quality.
FR – 2	User detection	The user has to detect the quality of the river water using different types of sensors and measure the PH value.

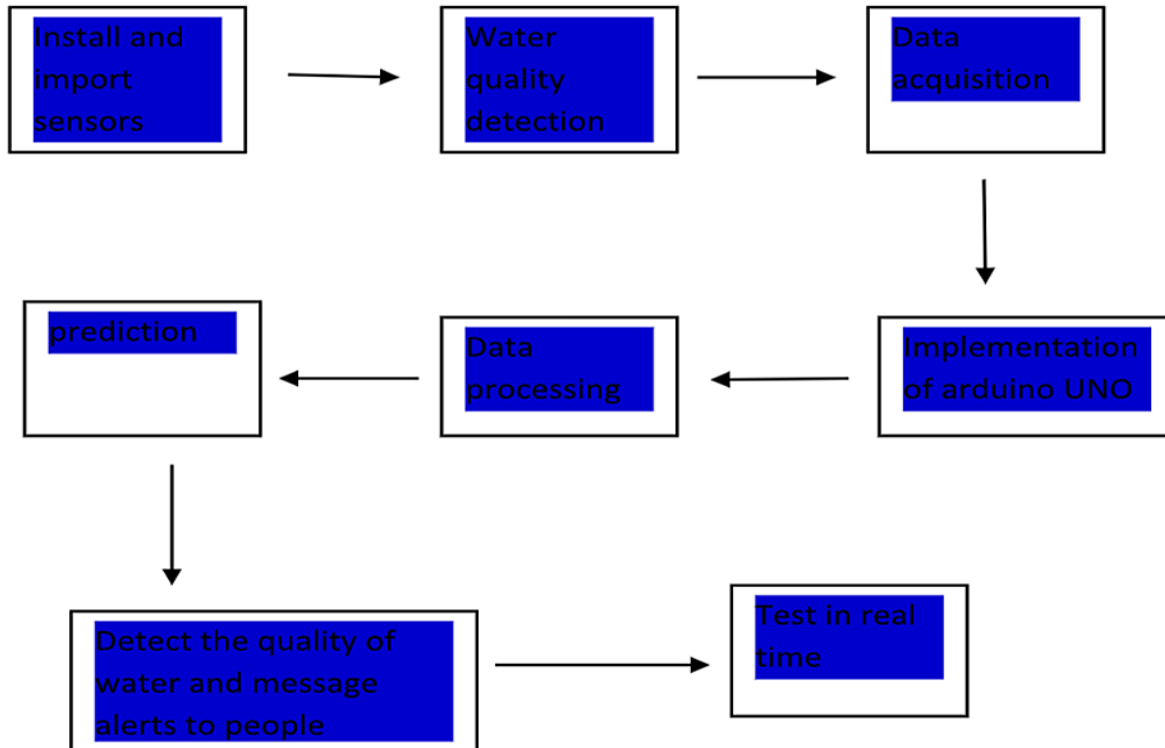
#### 4.2 Non - Functional Requirements:

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

FR NO	Non – Functional Requirement	Description
NFR – 1	Usability	The sensors are used to monitor the quality of water for people and to drink the water in good condition.
NFR – 2	Security	Using a web application to immediately alert the user not to drink the water keeps them safe from health problems.
NFR – 3	Reliability	The system is more reliable. It is simple to detect the quality of various types of water and is helpful for people to drink good water.

## **5. PROJECTDESIGN**

## 5.1 DATA FLOW DIAGRAM:



### Flow:

- We start collecting data from cloud services and collect a bunch of data from sensors.
- Save data in the form of numpy arrays.
- We then implement arduino UNO without.
- The number of sensor for the models determined by us, if we increase the number of sensors, the accuracy increases.
- But it requires much more time for implementing more sensors.
- Once detection is done, we can use this model for real time water quality detection and simultaneously used to detect PH value of water and temperature of the water.



## **5.2 Solution & Technical Architecture:**

### **1. Customer Segment:**

People and Industrial Companies are our customers. We take these ideas from industrial companies to people. They need this system to detect the water quality and monitoring.

### **2. Jobs to be done / problems:**

Timing is the major problem in this system. Because of late detection cause severe water problems. They didn't use the water after detect the water problems late.

### **3. Triggers:**

Water problems triggers the customers to act in various ways like, they complaint about water problems to government and protest take place.

### **4. Emotions:**

The emotions are very frustrated, anger, fear and neglected. It makes the people so depressed

### **5. Available Solutions:**

The solution of water quality monitoring and control systems using SMS to detect the problem quick in manner. Using different types of sensors to detect the water quality problems.

## **6. Customer constraints:**

The customer constraints are network connections to make the system difficult and to build this system we need sensor to handle good.

## **7. Behavior:**

Our customer addresses the problem, sometime the drink and use unsanitary water. This leads to health problems and it affects their children in future.

## **8. Channels of Behavior:**

### **Online:**

They can't interact with the physical components and complaint the problems through online easily.

### **Offline:**

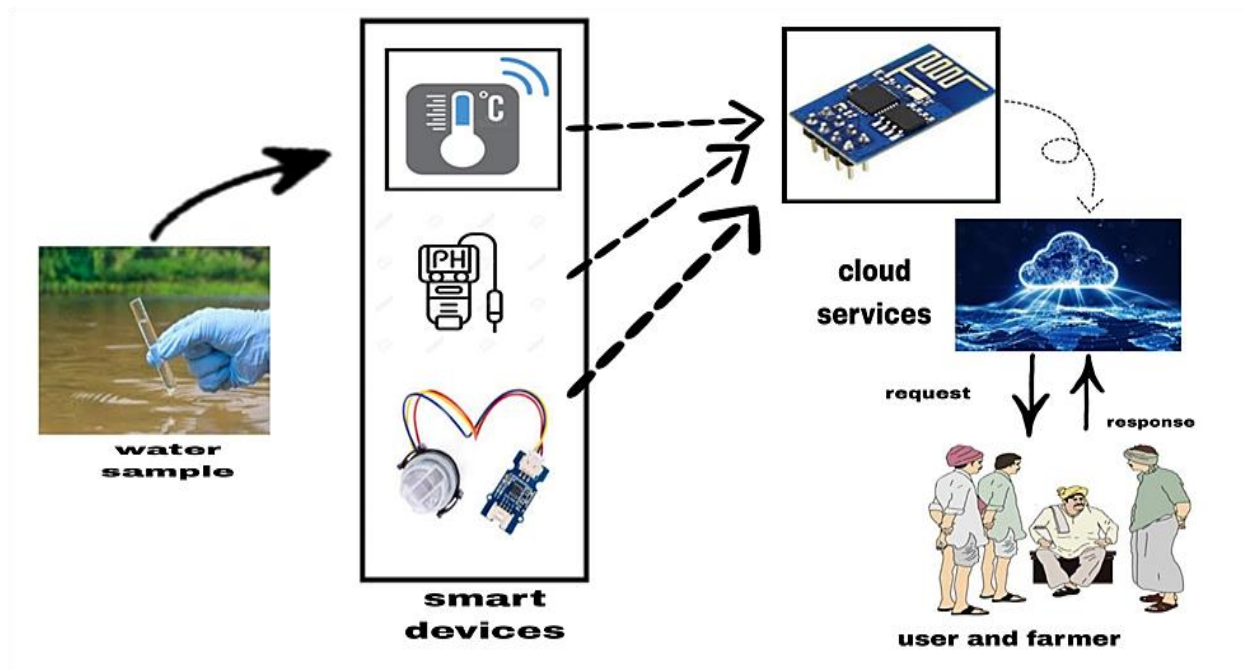
They take the decision immediately offline and solved it quickly. After detecting the problem, they find their way to executing the system.

## **9. Problem root cause:**

Timing is the real reason that this problem exists.

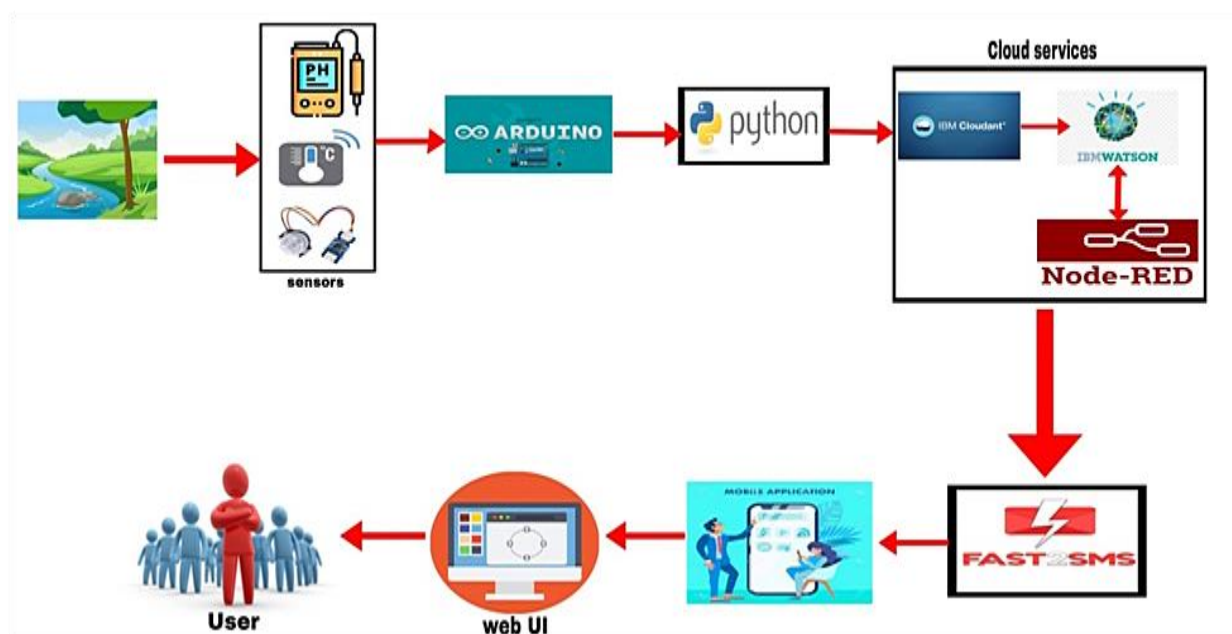
## **10. Your solution:**

Using different types of sensors like PH sensor, turbidity sensor to monitoring the water and display the conditions in LCD. Additionally, SMS alerts for water conditions are good or bad.



### Technical architecture:

The Deliverable shall include the architectural diagram as below and the information as per the table 1 & table 2.



**Table-1: Components & Technologies:**

<b>s.no</b>	<b>Component</b>	<b>Description</b>	<b>Technology</b>
01.	User interface	Web UI, Mobile App.	HTML, CSS, Python Script.
02.	Application Logic-1	Available water resource to detect and to search location.	Python Script.
03.	Application Logic-2	Statistical random values and graphical analysis.	IBM Watson STT service.
04.	Application Logic-3	Alert message to the user.	IBM Watson Assistant.
05.	Database	Random values of PH level turbidity and temperature in river water.	MySQL, NoSQL.
06.	Cloud Database	Database service on cloud by the administrator.	IBM Cloudant.
07.	File Storage	Storing the random values to compare with threshold value.	IBM Block storage.
08.	External API -1	Effective data generation.	IBM Watson API.
09.	External API -2	Google sign-in.	Google API.
10.	Machine Learning Model	To recognize file pattern (here graphical mode of statistical data is generated).	Object recognition model (IBM Watson and node-RED).
11.	Infrastructure (Server/Cloud)	Software library workspace.	Cloud foundry (IBM Cloudant), adding.

**Table-2: Application Characteristics:**

S.no	Characteristics	Description	Technology
01.	Open-source frameworks	The open-source tools we utilised to create our project.	Node-RED, IBM Cloudant, IBM Watson IoT Platform.
02.	Security implementations	Use of a login page with a user's unique user name and password on a web interface optimized for mobile devices and computers with adjustable screen sizes.	Password protection in MIT app.
03.	Scalable architecture	Optimised for mobile devices and computers with adjustable screen sizes.	Node-RED (Web UI).
04.	Availability	Accessible to user's through both a web UI and a mobile app.	Node-RED ( Web UI), MIT app (Mobile app).
05.	Performance	Give precise results and a prompt warning in the event of water contamination.	Node-RED ( Web UI) , MIT app (Mobile app).

**User stories:**

<b>User type</b>	<b>Functional requirement</b>	<b>User story number</b>	<b>User story/task</b>	<b>Acceptance criteria</b>	<b>Priority</b>	<b>Release</b>
Developer	System building	USN-1	Collect data set	I can collect data set	High	Sprint-1
		USN-2	Collecting data from sensor	I can collect from sensor	High	Sprint-2
		USN-3	Implementing arduino UNO from data collection	I can implement arduino UNO from data collection	High	Sprint-3
		USN-4	Message alert to people	I can receive message	High	Sprint-4

		USN-5	People identify the problem and resolve it by using mobile application	I can identify the problem and I try to resolve it	Medium	Sprint-5
Customer	Adoption	USN-1	Adopting new technology for boosting production	I can adopt new technology	Low	Sprint-1
	Detection	USN-2	Detect the quality of river water and PH value	I can detect the quality of water monitoring	High	Sprint-2

## **6 PROJECT PLANNING & SCHEDULING**

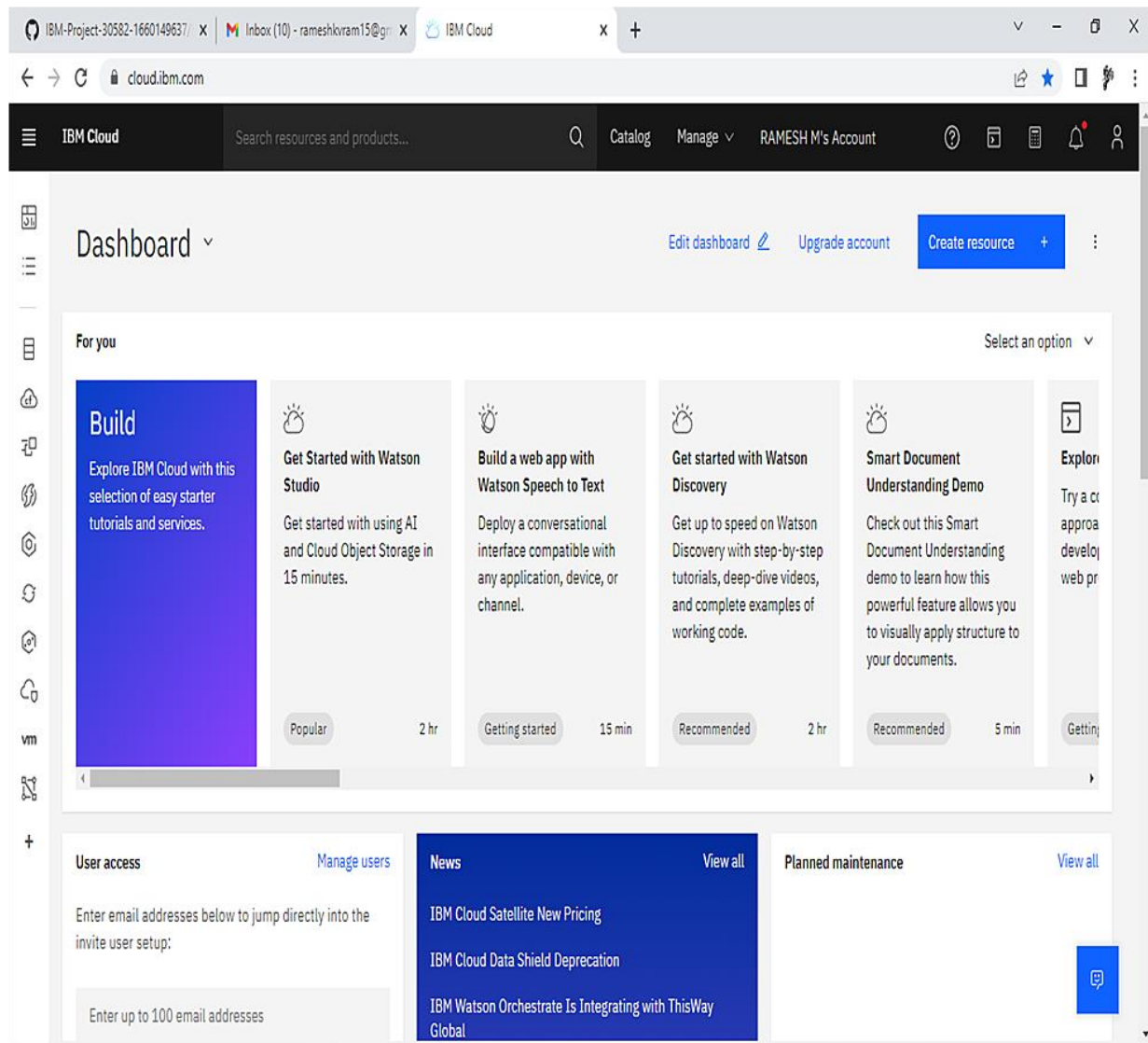


## 6.1 Sprint Planning and Estimation

### Sprint 1

#### USN-1

As a user, I will register in ICTA academy and create IBM cloud account.



## USN-2

As a user, I will access IBM cloud and launch the IBM Watson IOT platform

The screenshot shows the IBM Cloud 'Resource list' page. The browser address bar indicates the URL is `cloud.ibm.com/resources`. The page header includes the IBM Cloud logo, a search bar, and navigation links for 'Catalog', 'Manage', and the user's account 'RAMESH M's Account'. A user profile dropdown menu is open on the right, showing options like 'Profile', 'Log in to CLI and API', 'Privacy', 'Change theme', and 'Log out'. The main content area displays a table of resources with columns for Name, Group, Location, Product, and Status. The 'Internet of Things Platform-mq' resource is highlighted, showing it is located in 'London' and is 'Active'. A sidebar on the left provides a navigation menu with categories like Analytics, Blockchain, Databases, Developer tools, Logging and monitoring, Migration, Integration, Internet of Things, Security, Mobile, and Other.

Name	Group	Location	Product	Status
Q Filter by name or IP address... Filter by group or org... Filter... Q Filter... Q Filter...				
Analytics (0)				
Blockchain (0)				
Databases (2)				
Developer tools (6)				
Logging and monitoring (0)				
Migration (0)				
Integration (0)				
Internet of Things (1)				
Internet of Things Platform-mq	Default	London	Internet of Things Platform	Active
Security (0)				
Mobile (0)				
Other (0)				

### USN-3

As a user, I can create a device in the IOT IBM Watson platform for simulation

The screenshot shows the IBM Watson IoT Platform interface. The top navigation bar includes tabs for 'IBM-Project-30582-1660149', 'Inbox (10) - rameshkvr15', 'Service Details - IBM Cloud', 'IBM Watson IoT Platform', and 'Product overview of Maximo'. The URL bar shows 'bb0w3d.internetofthings.ibmcloud.com/dashboard/devices/browse/add'. The main header displays 'IBM Watson IoT Platform' and the user's email '913019106009@smartinternz.com' with the ID 'ID: bb0w3d'.

The left sidebar contains icons for various functions: a grid of dots, a gear, a group of people, a wrench, a network diagram, a line graph, a lock, and a settings gear.

The main content area has tabs for 'Browse', 'Action', 'Device Types', and 'Interfaces'. Below these is a search bar labeled 'Search by Device ID' and a 'Device Simulator' toggle switch. A table lists devices with columns for 'Device ID', 'Status', 'Device Type', 'Class ID', and 'Date Added'.

Device ID	Status	Device Type	Class ID	Date Added
1234	Disconnected	ESP32	Device	18 Nov 2022 11:40
1234	Disconnected	Sensor_River_UP	Device	14 Nov 2022 20:05
12345678	Disconnected	River_IOT	Device	17 Nov 2022 19:54

The third device, '12345678', is selected, and its details are shown in a modal window. The modal has tabs for 'Identity', 'Device Information', 'Recent Events', 'State', and 'Logs'. The 'Identity' tab is active, showing the following details:

Device ID	12345678
Device Type	River_IOT
Date Added	17 Nov 2022 19:54
Added By	913019106009@smartinternz.com
Connection Status	Disconnected

## USN-4

As a user, I can simulate the device created

The screenshot displays the IBM Watson IoT Platform dashboard. The top navigation bar includes the platform name and a user profile. The main content area shows a list of devices with columns for ID, status, type, and date. A modal window is open for the device with ID 1234, showing its details under the 'Identity' tab.

ID	Status	Type	Date
1234	Disconnected	ESP32	18 Nov 2022 11:40
1234	Connected	Sensor_River_UP	14 Nov 2022 20:05
12345678	Disconnected	River_IOT	17 Nov 2022 19:54

Identity	Device Information	Recent Events	State	Logs
Device ID	1234			
Device Type	Sensor_River_UP			
Date Added	14 Nov 2022 20:05			
Added By	913019106009@smartinternz.com			
Connection Status	Connected Connection Time: 18 Nov 2022 15:37 Client Address: 106.195.43.114 SecureToken			

## USN-5

As a user, I can get the values of temperature, PH and Turbidity, I can create a line chart with my output data

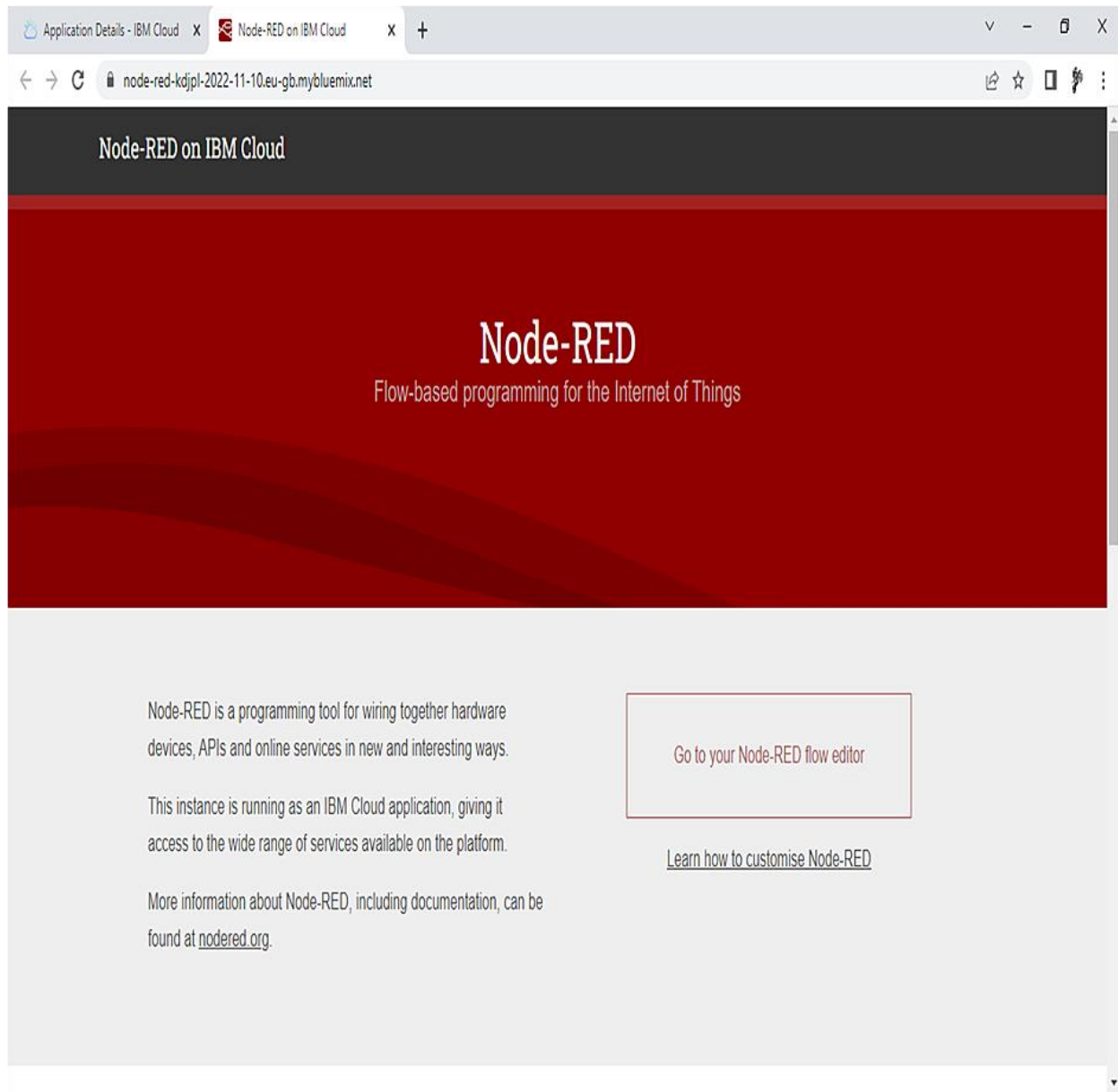
The screenshot displays the IBM Watson IoT Platform dashboard. The top navigation bar includes tabs for 'Browse', 'Action', 'Device Types', and 'Interfaces'. A search bar labeled 'Search by Device ID' is present. The main content area shows a list of devices. One device, ID 1234, is highlighted as 'Connected' with the type 'Sensor\_River\_UP'. Below this, a 'Recent Events' tab is selected, showing a stream of data events. The events table lists the status, value (JSON payload), format, and last received time.

Event	Value	Format	Last Received
status	{"Turbidity":90,"PHvalue":2,"temperature":75}	json	a few seconds ago
status	{"Turbidity":10,"PHvalue":12,"temperature":12}	json	a few seconds ago

## Sprint 2

### USN-6

As a user, I can create NODE RED by app deployment



## USN-7

As a user, I can get the API key through IBM Watson platform

The screenshot shows a web browser window with multiple tabs. The active tab is 'IBM Watson IoT Platform'. The address bar shows the URL: `bb0w3d.internetofthings.ibmcloud.com/dashboard/apps/browse/add`. The page header displays the user's email `913019106009@smartinternz.com` and ID `bb0w3d`. The main content area is titled 'The API key has been added.' and includes a warning: 'Authentication tokens are non-recoverable. If you misplace this token, you will need to re-register the API key to generate a new authentication token.'

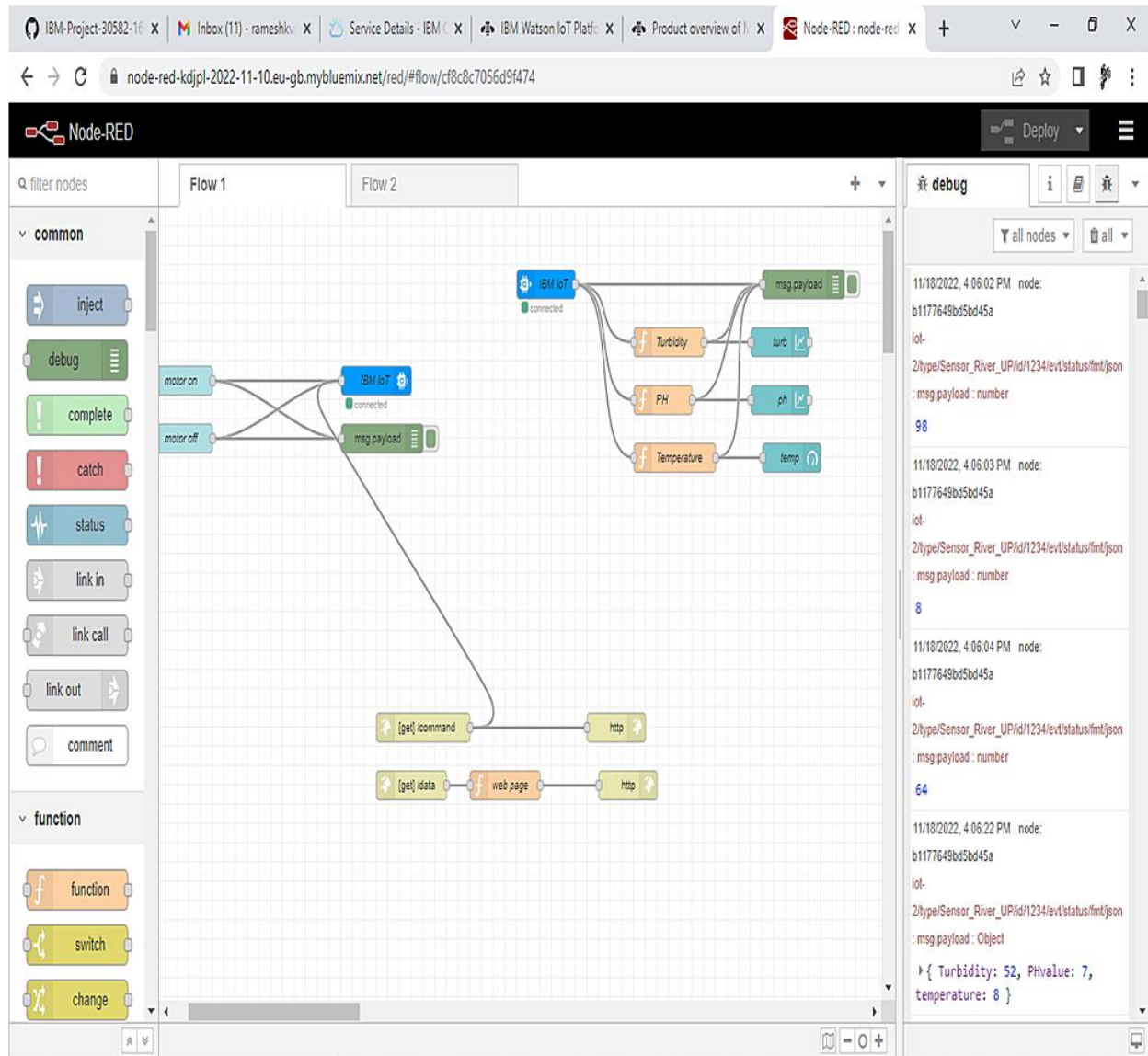
Generated Details		API Key Information	
API Key	a-bb0w3d-njqiv0rzme	Description	-
Authentication Token	H*YNU\$JEDfQHML9DGC	Role	Visualization Application
		Expires	18 Dec 2022

Make a note of the generated authentication token.  
Lost authentication tokens cannot be recovered. If you lose the token, you must reregister the API to generate a new token.

At the bottom of the modal are three buttons: 'View API Key', 'Add Another', and 'Close'. Below the modal is a 'Browse API Keys' section with a search bar labeled 'Type the app description to search for'.

## USN-8

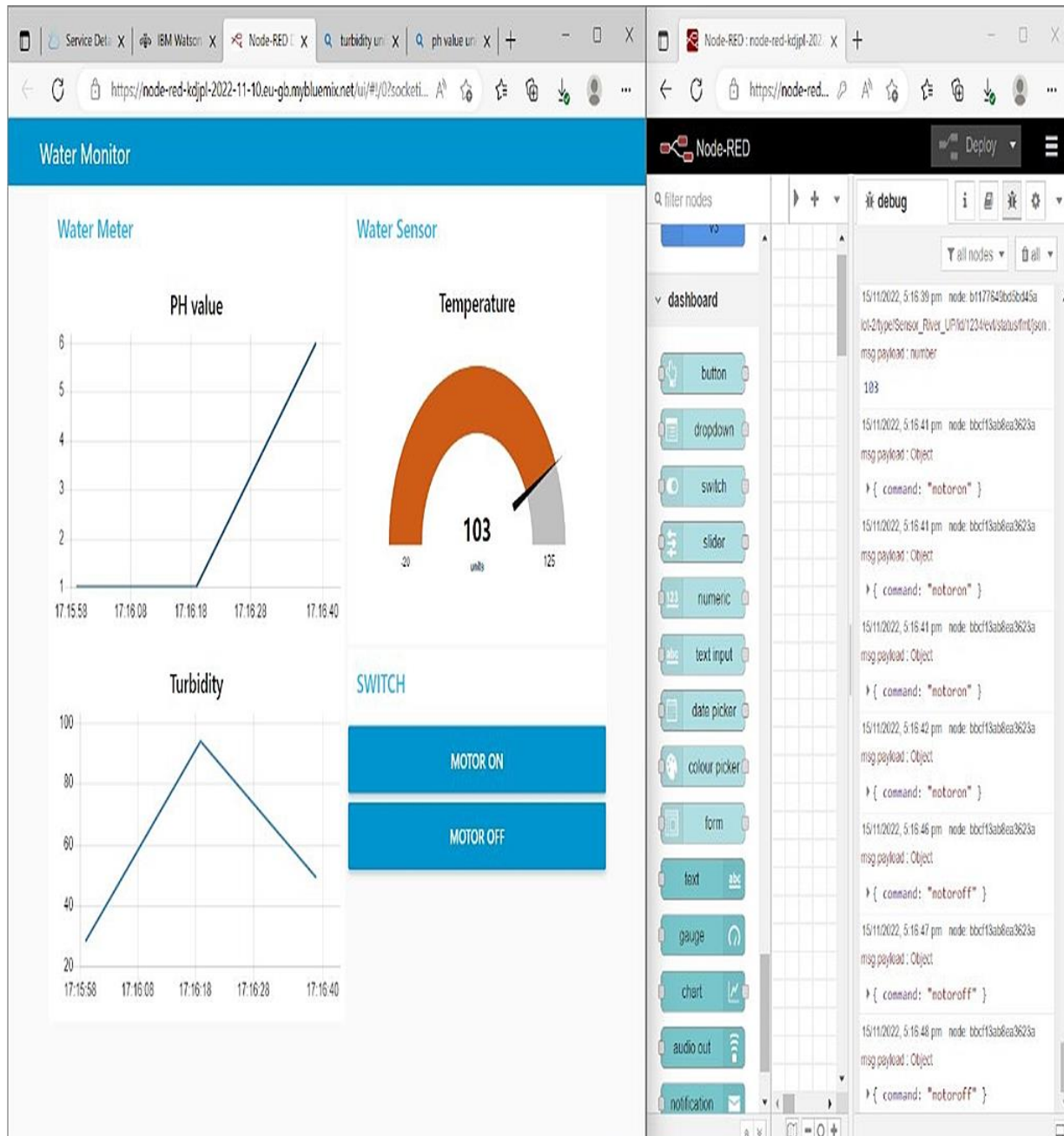
As a user, I can design the flow in NODE RED





## USN-9

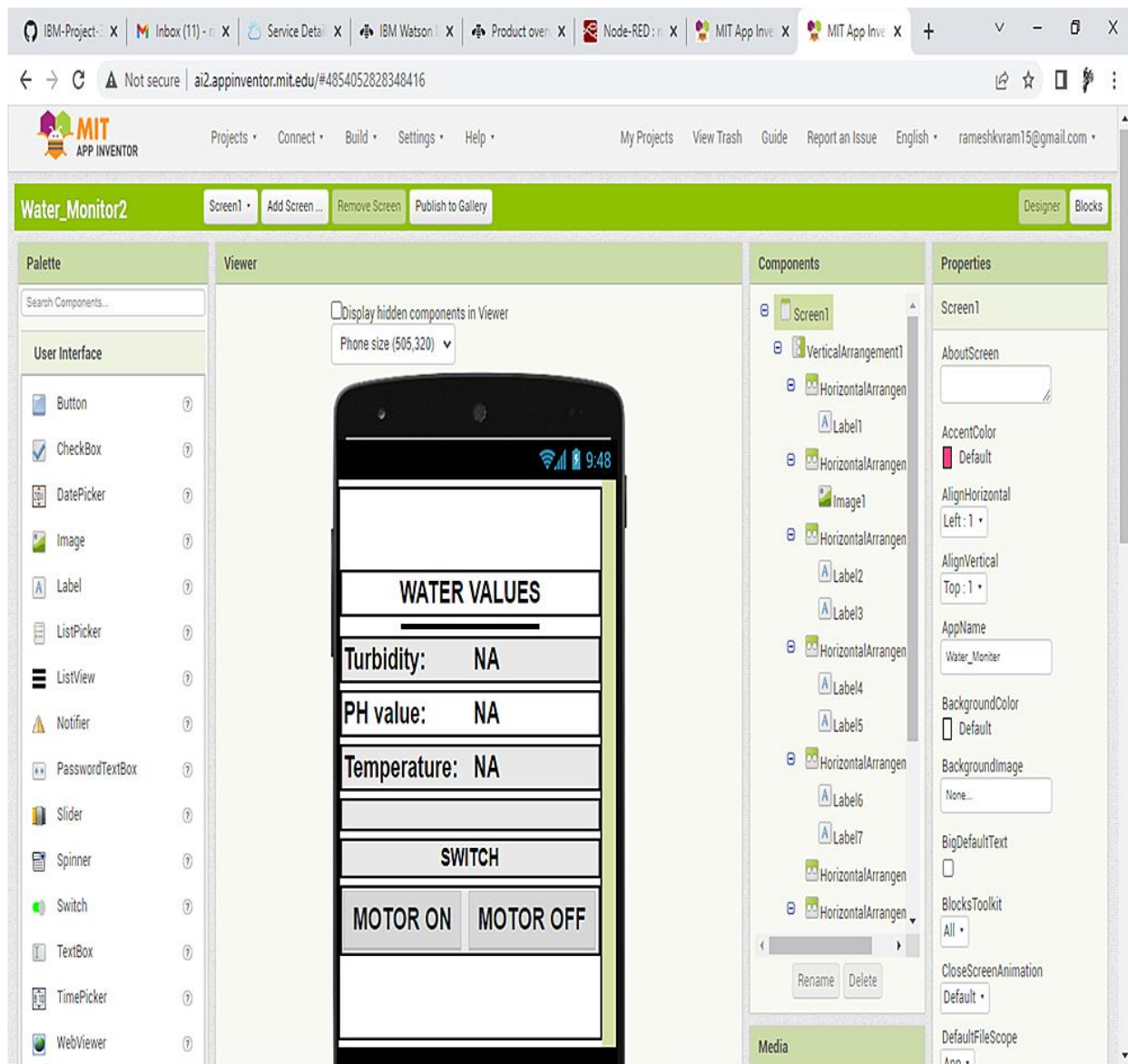
As a user, I can check for the gauge output



## Sprint 3

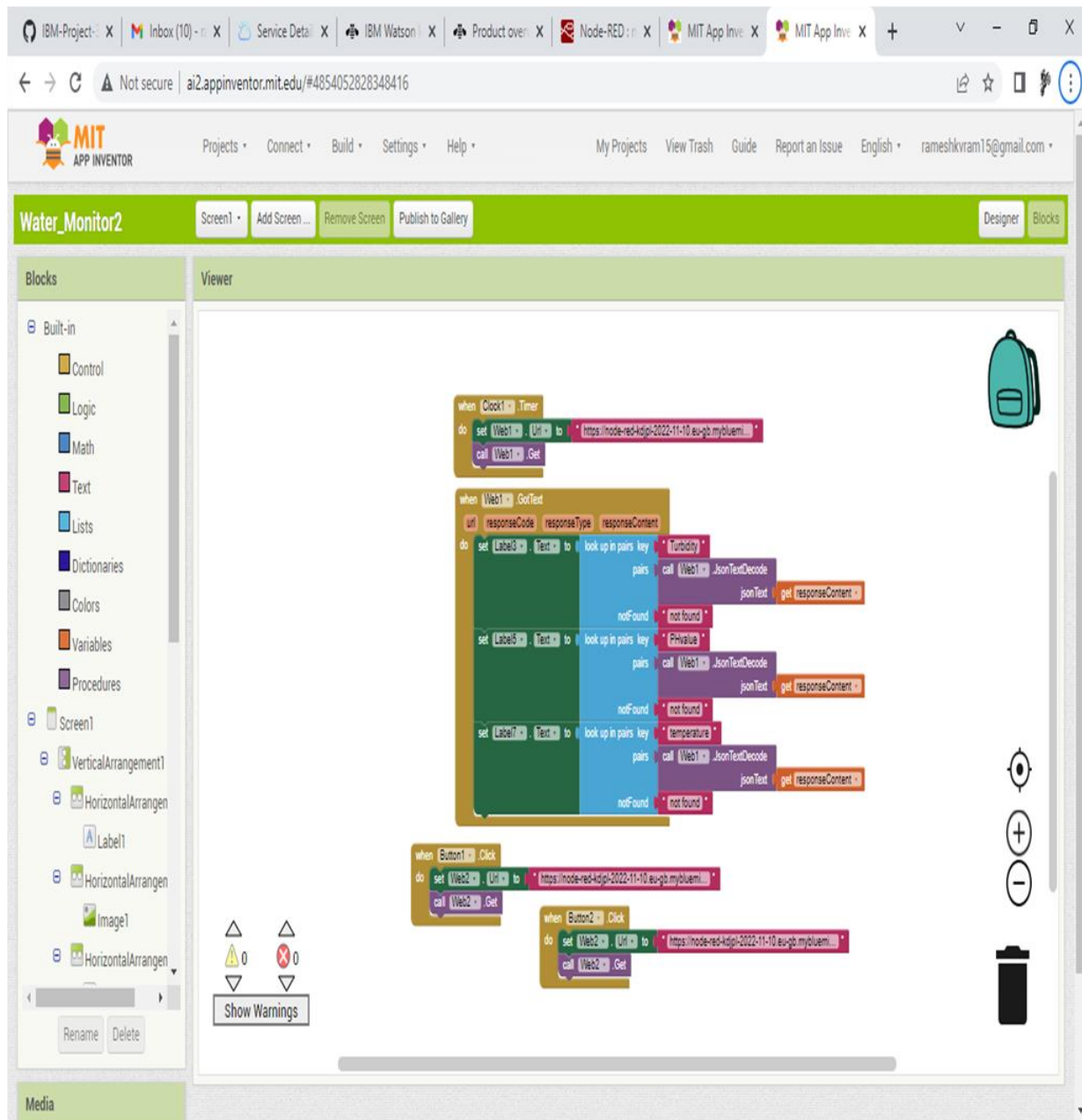
### USN-10

As a user, I can design the front end in MIT app inventor



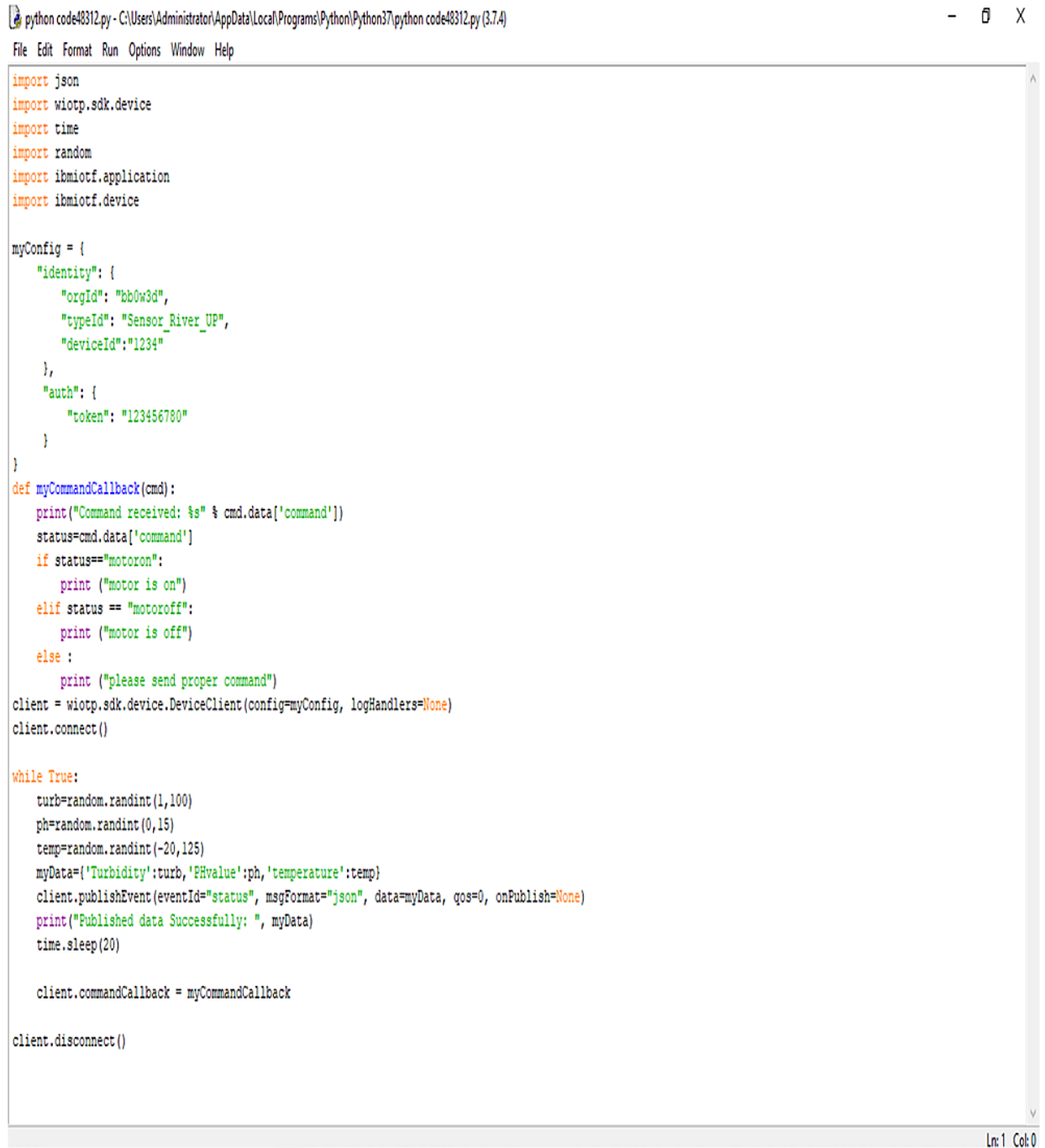
## USN-11

As a user, I can design the back end (blocks) in MIT app inventor



## USN-12

As a user, I can develop the python script



The screenshot shows a Python IDE window titled "python code48312.py - C:\Users\Administrator\AppData\Local\Programs\Python\Python37\python code48312.py (3.7.4)". The menu bar includes File, Edit, Format, Run, Options, Window, and Help. The code is as follows:

```
import json
import wiotp.sdk.device
import time
import random
import ibmiotf.application
import ibmiotf.device

myConfig = {
    "identity": {
        "orgId": "bb0w3d",
        "typeId": "Sensor_River_UP",
        "deviceId": "1234"
    },
    "auth": {
        "token": "123456780"
    }
}

def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="motoron":
        print ("motor is on")
    elif status == "motoroff":
        print ("motor is off")
    else :
        print ("please send proper command")

client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
client.connect()

while True:
    turb=random.randint(1,100)
    ph=random.randint(0,15)
    temp=random.randint(-20,125)
    myData={'Turbidity':turb,'PHvalue':ph,'temperature':temp}
    client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0, onPublish=None)
    print("Published data Successfully: ", myData)
    time.sleep(20)

    client.commandCallback = myCommandCallback

client.disconnect()
```

The status bar at the bottom right indicates "Ln:1 Col:0".



## USN-13

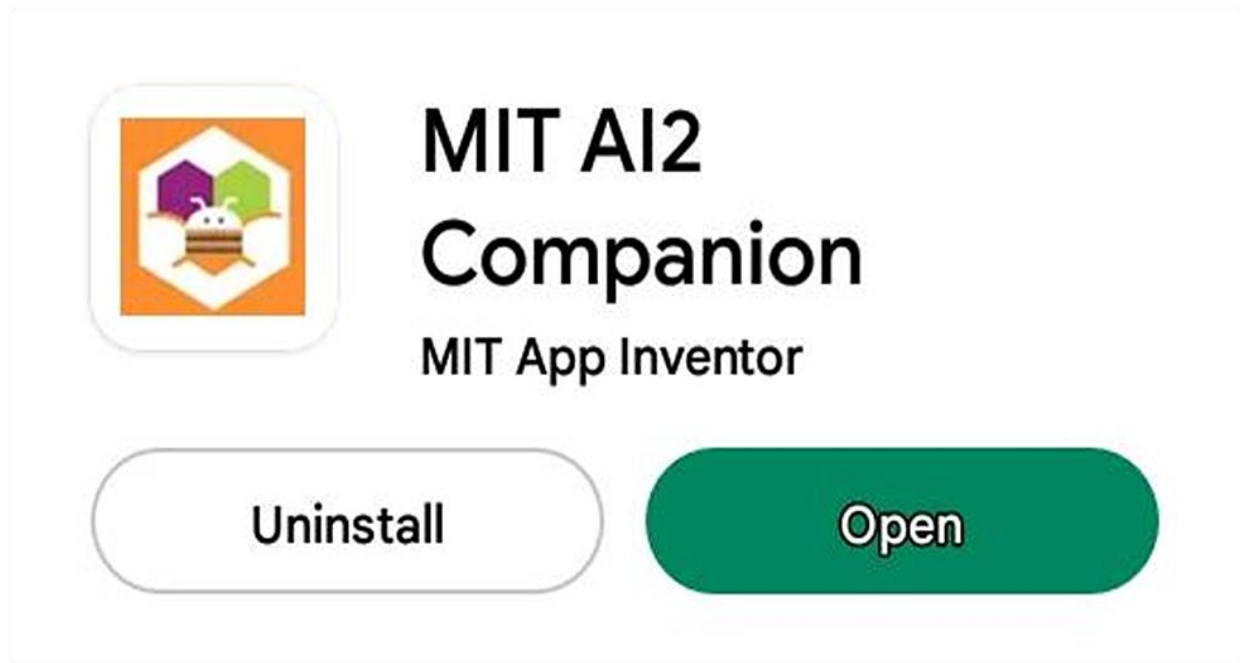
As a user, I can get the output of the program with the parameters



```
Python 3.7.4 Shell
File Edit Shell Debug Options Window Help
Published data Successfully: {'Turbidity': 13, 'PHvalue': 2, 'temperature': 111}
Published data Successfully: {'Turbidity': 52, 'PHvalue': 14, 'temperature': 57}
Published data Successfully: {'Turbidity': 46, 'PHvalue': 0, 'temperature': -8}
Published data Successfully: {'Turbidity': 41, 'PHvalue': 2, 'temperature': 121}
Published data Successfully: {'Turbidity': 81, 'PHvalue': 6, 'temperature': 97}
Published data Successfully: {'Turbidity': 32, 'PHvalue': 1, 'temperature': 2}
Published data Successfully: {'Turbidity': 60, 'PHvalue': 11, 'temperature': 43}
Published data Successfully: {'Turbidity': 97, 'PHvalue': 4, 'temperature': 55}
Published data Successfully: {'Turbidity': 71, 'PHvalue': 1, 'temperature': 116}
Published data Successfully: {'Turbidity': 42, 'PHvalue': 13, 'temperature': 71}
Published data Successfully: {'Turbidity': 61, 'PHvalue': 12, 'temperature': 59}
Published data Successfully: {'Turbidity': 81, 'PHvalue': 6, 'temperature': -15}
Published data Successfully: {'Turbidity': 52, 'PHvalue': 5, 'temperature': 69}
Published data Successfully: {'Turbidity': 29, 'PHvalue': 4, 'temperature': 12}
Published data Successfully: {'Turbidity': 26, 'PHvalue': 6, 'temperature': 14}
Published data Successfully: {'Turbidity': 88, 'PHvalue': 15, 'temperature': 23}
Published data Successfully: {'Turbidity': 22, 'PHvalue': 15, 'temperature': 27}
Published data Successfully: {'Turbidity': 50, 'PHvalue': 15, 'temperature': 9}
Published data Successfully: {'Turbidity': 9, 'PHvalue': 6, 'temperature': -8}
Published data Successfully: {'Turbidity': 54, 'PHvalue': 9, 'temperature': 96}
Published data Successfully: {'Turbidity': 56, 'PHvalue': 6, 'temperature': 71}
Published data Successfully: {'Turbidity': 64, 'PHvalue': 4, 'temperature': 52}
Published data Successfully: {'Turbidity': 94, 'PHvalue': 0, 'temperature': 101}
Published data Successfully: {'Turbidity': 89, 'PHvalue': 14, 'temperature': 49}
Published data Successfully: {'Turbidity': 72, 'PHvalue': 14, 'temperature': 110}
Published data Successfully: {'Turbidity': 21, 'PHvalue': 14, 'temperature': 12}
Published data Successfully: {'Turbidity': 36, 'PHvalue': 8, 'temperature': 70}
Published data Successfully: {'Turbidity': 93, 'PHvalue': 5, 'temperature': 92}
Published data Successfully: {'Turbidity': 93, 'PHvalue': 1, 'temperature': 52}
Published data Successfully: {'Turbidity': 91, 'PHvalue': 13, 'temperature': 3}
Published data Successfully: {'Turbidity': 4, 'PHvalue': 10, 'temperature': -20}
Published data Successfully: {'Turbidity': 88, 'PHvalue': 4, 'temperature': 84}
Published data Successfully: {'Turbidity': 27, 'PHvalue': 9, 'temperature': 110}
Published data Successfully: {'Turbidity': 54, 'PHvalue': 10, 'temperature': 35}
Published data Successfully: {'Turbidity': 83, 'PHvalue': 11, 'temperature': 125}
Published data Successfully: {'Turbidity': 85, 'PHvalue': 0, 'temperature': 11}
Published data Successfully: {'Turbidity': 47, 'PHvalue': 5, 'temperature': 110}
Published data Successfully: {'Turbidity': 48, 'PHvalue': 9, 'temperature': 95}
Published data Successfully: {'Turbidity': 1, 'PHvalue': 13, 'temperature': 19}
Published data Successfully: {'Turbidity': 100, 'PHvalue': 13, 'temperature': 13}
Published data Successfully: {'Turbidity': 78, 'PHvalue': 8, 'temperature': 122}
Published data Successfully: {'Turbidity': 38, 'PHvalue': 11, 'temperature': 65}
Published data Successfully: {'Turbidity': 15, 'PHvalue': 8, 'temperature': 62}
Ln: 17 Col: 0
```

## USN-14

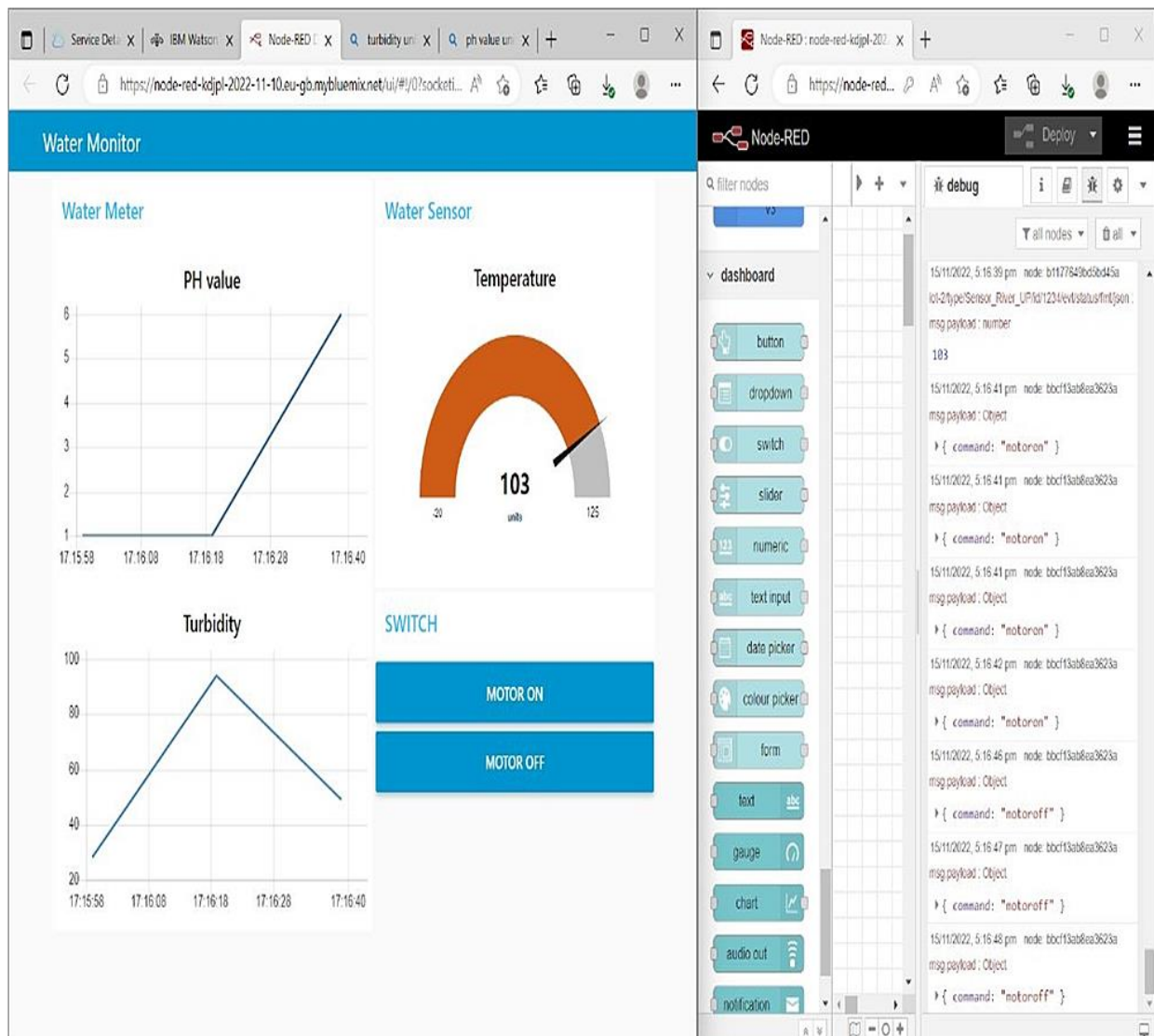
As a user, I can download MIT AI2 companion app in my mobile



## Sprint 4

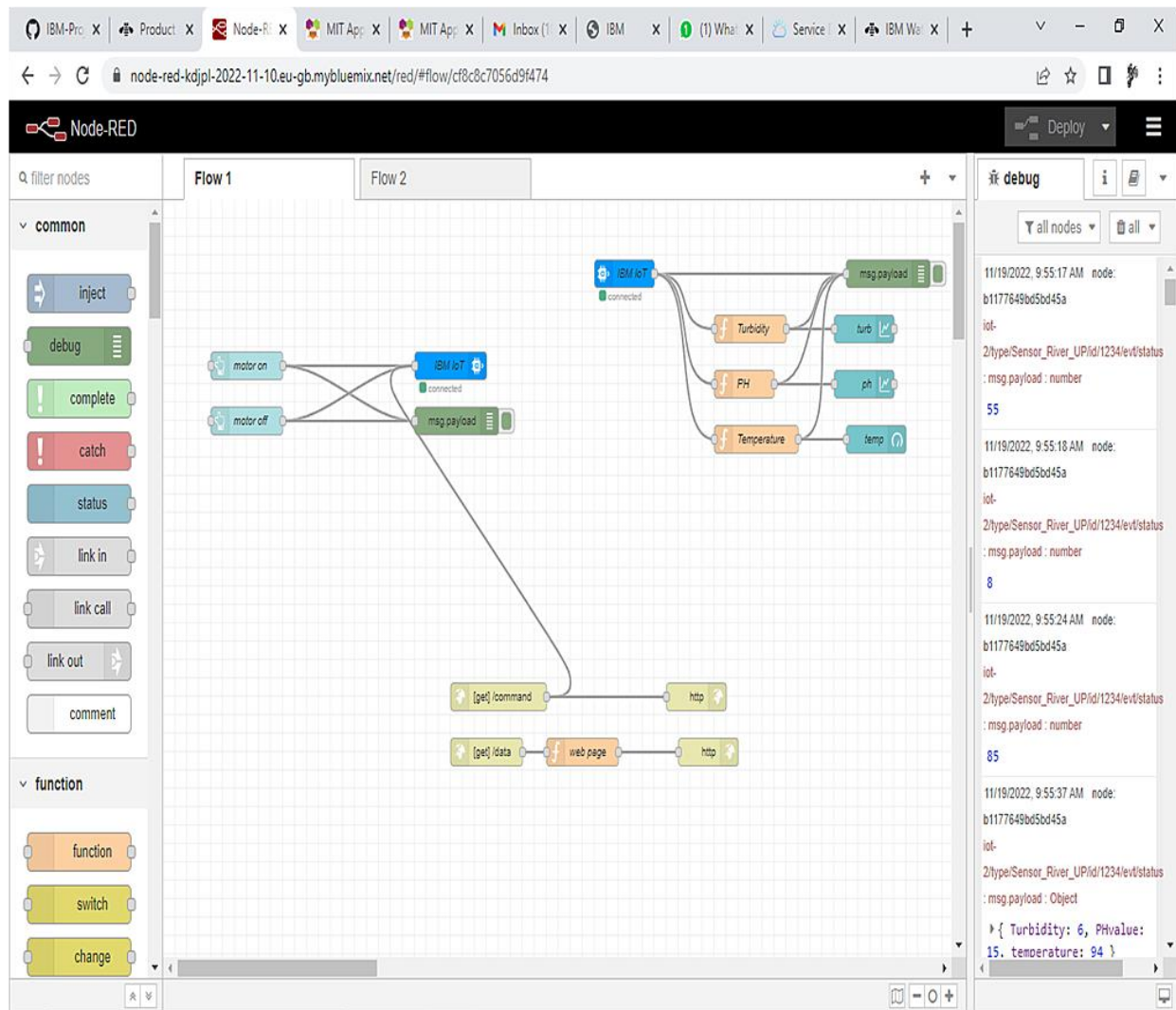
### USN-15

As a user, I can create a Web UL



## USN-16

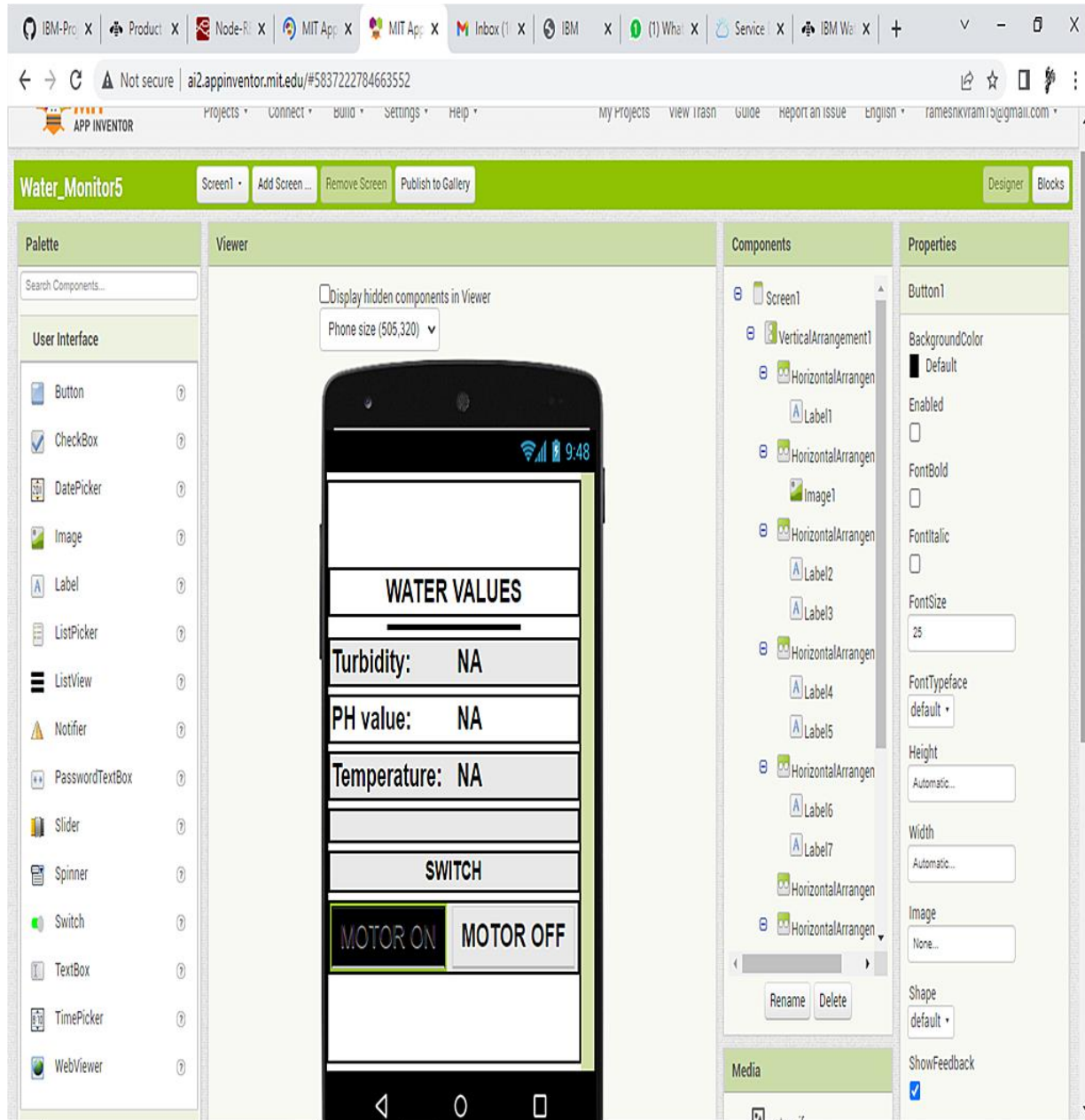
As a user, I can check whether I can get the values of the parameters





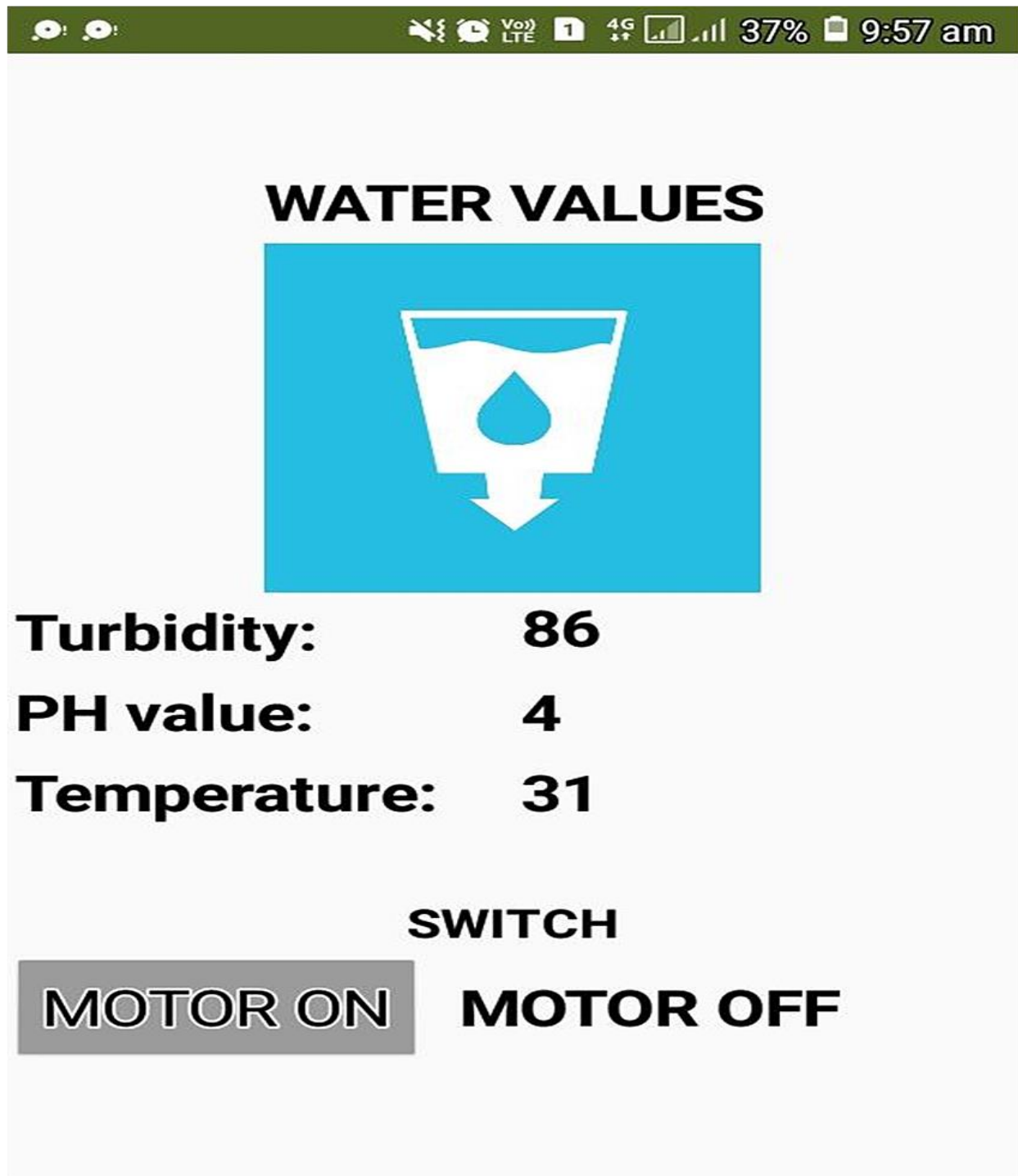
## USN-17

As a user, I can connect the Web UI with the mobile application through QR code.



## USN-18

As a user, I can get values of the parameters in my mobile application



## 6.2 Sprint Delivery schedule

Product Backlog, SprintSchedule, and Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story /Task	Story Points	Priority	Team Members
Sprint-1		US-1	Creating IBM Cloud and using its services.	4	High	Ramesh M Karthik kishore M Roopan kumar R Sanjay M Ajithkannan P
Sprint-1		US-2	Configure the IBM cloudservice and creatingIoT platform.	3	High	Ramesh M Karthik kishore M Roopan kumar R Sanjay M Ajithkannan P
Sprint-1		US-3	IBM Watson IoT platform acts as the mediator toconnect the web application to IoT devices, hence Launching IBM Watson IoT platform.	3	Low	Ramesh M Karthik kishore M Roopan kumar R Sanjay M Ajithkannan P
Sprint-1		US-4	In order to connect the IoT device to the IBM Cloud, createa device in theIBM Watson IoTPlatform and get the devicecredentials.	3	Medium	Ramesh M Karthik kishore M Roopan kumar R Sanjay M Ajithkannan P

Sprint-2		US-1	Configure the connection security and create API keys that are used in the NODE-RED service for accessing the IBM IoT Platform.		High	Ramesh M Karthik kishore M Roopan kumar R Sanjay M Ajithkannan P
Sprint-2		US-2	Create a Node-RED service.		High	Ramesh M Karthik kishore M Roopan kumar R Sanjay M Ajithkannan P
Sprint-3		US-1	Develop a python script to publish random sensor data such as temperature, turbidity and pH to the IBM IoT Platform.	4	High	Ramesh M Karthik kishore M Roopan kumar R Sanjay M Ajithkannan P
Sprint-3		US-2	After developing python code, commands are received just print the statements which represent the control of the devices.	3	Medium	Ramesh M Karthik kishore M Roopan kumar R Sanjay M Ajithkannan P
Sprint-3		US-3	Publish data to the IBM Cloud.	4	High	Ramesh M Karthik kishore M Roopan kumar R Sanjay M Ajithkannan P
Sprint-4		US-1	Create Web UI in Node-RED.		High	Ramesh M Karthik kishore M Roopan kumar R Sanjay M Ajithkannan P
Sprint-4		US-2	Configure the Node-RED flow to receive data from the IBM IoT Platform and also use Cloudant DB nodes to store the received sensor data in Cloudant DB.		High	Ramesh M Karthik kishore M Roopan kumar R Sanjay M Ajithkannan P

<b>Sprint</b>	<b>Total Story Points</b>	<b>Duration</b>	<b>Sprint Start Date</b>	<b>Sprint End Date (Planned)</b>	<b>Story Points Completed (as on Planned End Date)</b>	<b>Sprint ReleaseDate (Actual)</b>
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	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

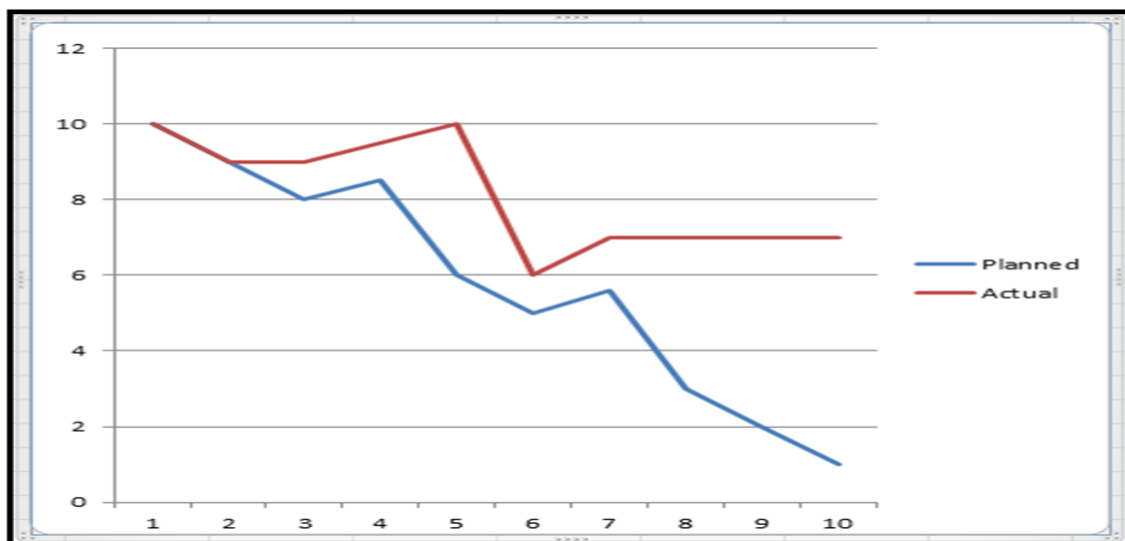
### Velocity:

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

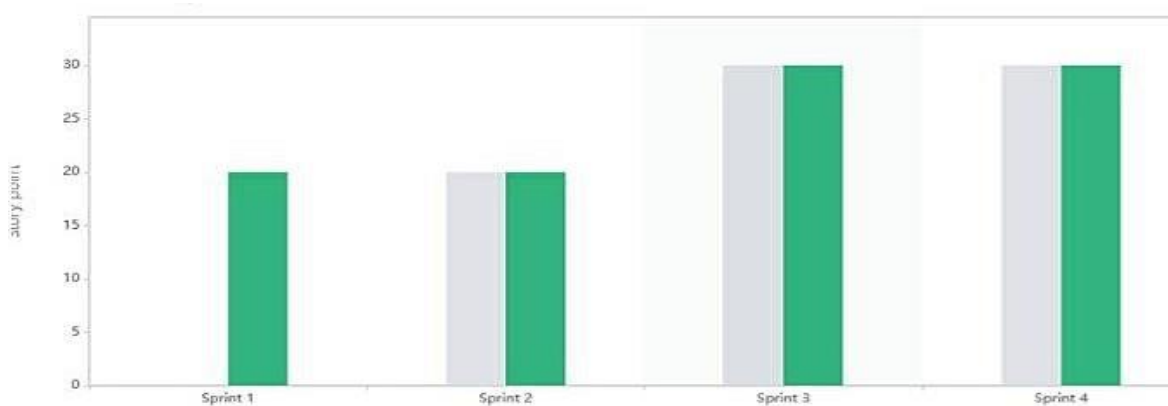
$$AV = \frac{\text{sprint duration}}{\text{velocity}} = \frac{20}{10} = 2$$

### Burndown 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 over time.



### 6.3 Reports from JIRA



## **7. CODING AND SOLUTIONING**

## 7.1 Feature 1

### **PH, Temperature:**

**pH sensor:** The pH of a solution is the measure of the acidity or alkalinity of that solution. The pH scale is a logarithmic scale whose range is from 0-14 with a neutral point being 7. Values above 7 indicate a basic or alkaline solution and values below 7 would indicate an acidic solution. It operates on 5v power supply and it is easy to interface with arduino. The normal range of pH is 6 to 8.5.

water temperature: Indicates how water is hot or cold. The range of DS18B20 temperature sensor is digital type which gives accurate reading.

## 7.2 Feature 2

### **Turbidity:**

**Turbidity sensor:** Turbidity is a measure of the cloudiness of water. Turbidity has indicated the degree at which the water loses its transparency. It is considered as a good measure of the quality of water. Turbidity blocks out the light needed by submerged aquatic vegetation. It also can raise surface water temperature above normal because suspended particles near the surface facilitate the absorption of heat from sunlight. The measurement of turbidity is a key test of water quality. Turbidity, as identified with a turbidity meter or sensor, is the measurement of water clarity.

## 7.3 Feature 3

To display the sensor values of PH, temperature and turbidity in front of the river. It shows the current status of the river to people and they didn't do anything.



## **8. TESTING**

## 8.1 Test Cases

A test case is a document which has a set of test data, preconditions, expected results and postconditions, developed for a particular test scenario in order to verify compliance against a specific requirement.

## 8.2 User Acceptance Testing

Defect analysis

resultion	Severity1	Severity2	Severity3	Severity4	Severity5
By Design	10	4	3	3	20
Duplicate	3	0	4	0	7
External	2	0	0	2	4
Fixed	7	3	5	7	22
Not Reproduced	0	0	2	0	2
Skipped	0	0	3	1	4
Won't Fix	0	7	3	1	11
total	22	14	20	14	70

## Test case analysis

section	total	cases	Not tested	Fail pass
Designing the circuit	3	0	1	2
Create a program suitable for the circuit and also compile and execute the program	4	0	0	4

Connect the output values to the cloud services by using NODE RED	3	0	1	2
Make the data's store in IBM watson	4	0	1	3
Connects the cloud data with the authorities communication device	4	0	2	2
Find report output	3	0	0	3

## **9. RESULTS**

## 9.1 Performance Metrics

NFT - Risk Assessment									
S.No	Project Name	Scope/feature	Functional Changes	Hardware Changes	Software Changes	Impact of Downtime	Load/Volume Changes	Risk Score	Justification
1	Real Time River Water Quality monitoring and control system	New	Low	Low	Low	Downtime does not affect the performance much.The errors can be resolved within a short duration of time.	>5 to 10%	ORANGE	As the sensors senses the parameters continuously ,there will not be any delay.As the sensors are well protected ,there is a low probability of physical damage.

NFT - Detailed Test Plan				
S.No	Project Overview	NFT Test approach	assumptions/Dependencies/Risk	Approvals/SignOff
1	Real Time River Water Quality monitoring and control system	LOAD TEST    ENDURANCE TEST	The project is capable of dealing with large amount of data (i.e) load. Congestion can be controlled and the system can operate efficiently.	Approved

End Of Test Report								
S.No	Project Overview	NFT Test approach	NFR - Met	Test Outcome	GO/NO-GO decision	Recommendations	Identified Defects (Detected/Closed/Open)	Approvals/SignOff
1	Real Time River Water Quality monitoring and control system	LOAD TEST ENDURANCE TEST	YES	The parameter values of Temperature, pH & Turbidity can be obtained continuously and the alert messages whenever the water is not fit to use is sent to the authorities without any delay.	GO	The rechargeable sensors can be used during the manufacturing of this system.	Closed	Approved

## **10. ADVANTAGES :**

- a. The system is very cheap as the hardware and software dose not cost much.
- b. User friendly and efficient.
- c. It is helpful for people to drink good water.

## **DISADVANTAGES**

- a. Drawback is high cost for smart sensors.
- b. It is working under internet, if it losses the net connection, it cannot be generate value for IBM service

## **11. CONCLUTION**

- a. This Real time river water quality monitoring and control system monitors PH turbidity & temperature of water.
- b. The system can monitor river water quality automatically and it is low in cost and does not require people on duty.
- c. So the river water quality using IOT testing is likely to be more economical, connenient and fast. The system has good flexibility.

## 12. FUTURE SCOPE

The future scope of this project is monitoring environmental condition, drinking water quality, treatment and disinfection of waste water ect... this system could be implemented in various industrial processes. The system can be modified into different needs of the user and it is beneficial for user to view the conditions of water in mobile apps or sms. The standardization of the data format for the process will also provide improved device consistency and execution time.

## 13. APPENDIX

### SOURCE CODE:

```
import json
import wiotp.sdk.device
import time
import random
import ibmiotf.application
import ibmiotf.device

myConfig = {
    "identity": {
        "orgId": "bb0w3d",
        "typeId": "Sensor_River_UP",
        "deviceId": "1234"
    },
    "auth": {
        "token": "123456780"
    }
}

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

```

if status=="motoron":
    print ("motor is on")
elif status == "motoroff":
    print ("motor is off")
else :
    print ("please send proper command")
client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
client.connect()

while True:
    turb=random.randint(1,100)
    ph=random.randint(0,15)
    temp=random.randint(-20,125)
    myData={'Turbidity':turb,'PHvalue':ph,'temperature':temp}
    client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0,
onPublish=None)
    print("Published data Successfully: ", myData)
    time.sleep(20)

    client.commandCallback = myCommandCallback

client.disconnect()

```

**GITHUB:** <https://github.com/IBM-EPBL/IBM-Project-18702-1659688705>

**PROJECT DEMO:** <https://www.youtube.com/embed/AUqEUMIfT3E>