Real-Time River Water Quality Monitoring and Control System

Final Project Report

Team ID	**PNT2022TMID43379**
Team Leader	**Manobharathi D**
Team Members	**Ashwath R** **Mahesh Krishnan Y** **Sivanandhan B**

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1. INTRODUCTION

a. Project Overview

Project is real-time river water quality monitoring and control system is about we do have so many low laying pits and the big pits are called canals and flow of water is called rivers .now a days most of the rivers are filled with dirty water and in some places we can not able to draw the water and we can not make use of the ground water because in our country or in the worlds there are place where any body can not able to make use of the ground water .there are people who only depend on the stream of water that flowing there near by simply rivers .such that river water plays an crucial role in so many lifes.not only human beings but also other animals and living things that are living inside the water ,so there is in need of using the good and efficient water .normally the purity of water is depend up on or the drinking water is safe is determined not only on impurities present in the water but also one thing is ph lever the ph level of the water should be 7 that is neutral state so we are using this project to control the river water ph level with the help of IOT. Current water quality monitoring system is a manual system with a monotonous process and is very time-consuming. This paper proposes a sensor-based water quality monitoring system. The main components of Wireless Sensor Network (WSN) include a microcontroller for processing the system, communication system for inter and intra node communication and several sensors. Real-time data access can be done by using remote monitoring and Internet of Things (IoT) technology. Data collected at the apart site can be displayed in a visual format on a server PC with the help of Spark streaming analysis through Spark MLlib, Deep learning neural network models, Belief Rule Based (BRB) system and is also compared with standard values. If the acquired value is above the threshold value automated warning SMS alert will be sent to the agent. The uniqueness of our proposed paper is to obtain the water monitoring system with high frequency, high mobility, and low powered. Therefore, our proposed system will immensely help Bangladeshi populations to become conscious against contaminated water as well as to stop polluting the water.

b. Purpose

In this project, we depict the design of Wireless Sensor Network (WSN) [4-7] that assists to monitor the quality of water with the support of information sensed by the sensors dipped in water. Using different sensors, this system can collect various parameters from water, such as pH, dissolved oxygen, turbidity, conductivity, temperature, and so on. The rapid development of WSN technology provides a novel approach to real-time data acquisition, transmission, and processing. The clients can get ongoing water quality information from far away. Now a day's Internet of things (IoT) is an innovative technological phenomenon. It is shaping today's world and is used in different fields for collecting, monitoring and analysis of data from remote locations. IoT integrated network if everywhere starting from smart cities, smart power grids, and smart supply chain to smart wearable [7- 12]. Though IoT is still under applied in the field of environment it has huge potential. It can be applied to detect forest fire and early earthquake, reduce air population, monitor snow level, prevent landslide, and avalanche etc. Moreover, it can be implemented in the field of water quality monitoring and controlling system [4, 13]. Water

quality monitoring has gained more interest among researchers in this twenty-first century. Numerous works are either done or ongoing in this topic focusing on various aspects of it. The key theme of all the projects was to develop an efficient, cost-effective, real-time water quality monitoring system which will integrate wireless sensor network and internet of things [14]. In this research, we monitor the physical and chemical parameters of water bodies inside Chittagong city by using an IoT based sensor network.

LITERATURE SURVEY

a. Existing problem

Nowadays water is the is the most valuable for all the human beings drinking water utilities faces challenges in real time operation. These challenges occurred because of growing population, limited water resources, ageing infrastructure etc. Hence there is a need of better methodologies for monitoring the water quality. To reduce the water related diseases and prevent water population World health Organization (WHO) has also stated This crisis as "the largest mass poisoning of a population in history". The main goal of this paper to build a Sensor-based Water Quality Monitoring System.

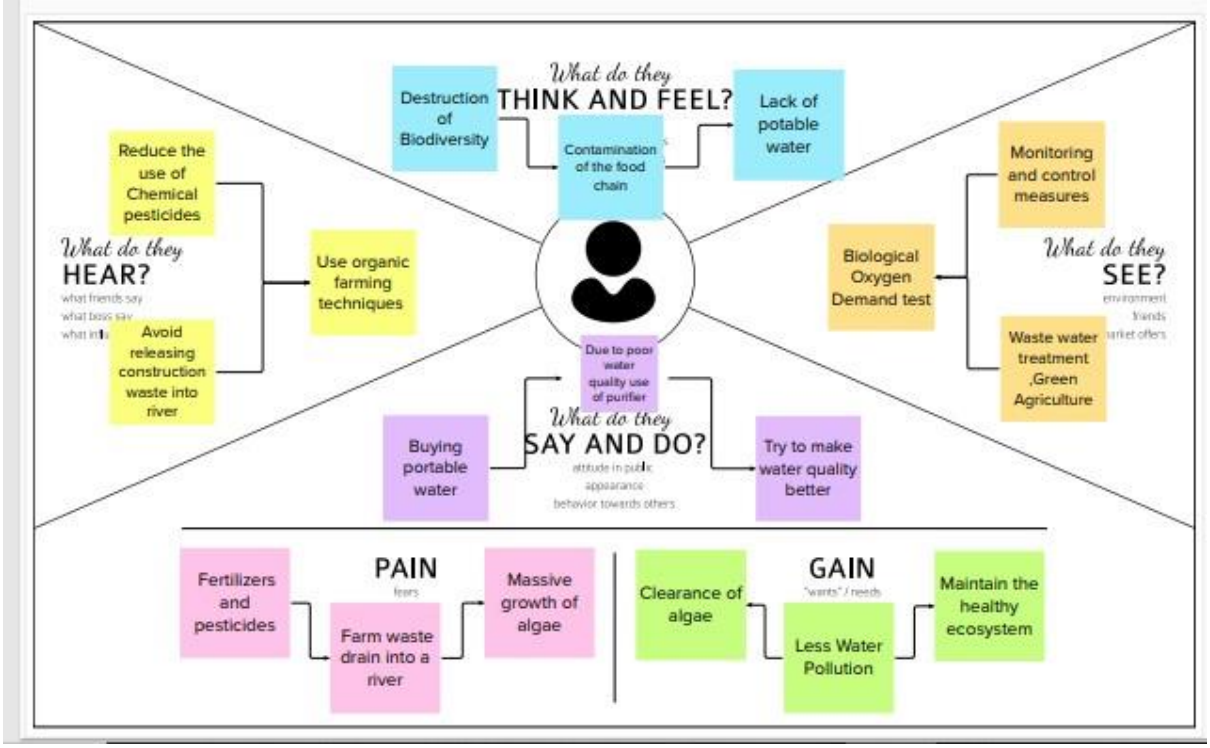
b. References

1. Real-Time River Water Quality Monitoring System- International Journal of Engineering Research & Technology (IJERT)
2. Real-Time Water Quality Monitoring System -International Research Journal of Engineering and Technology (IRJET)

c. Problem Statement Definition

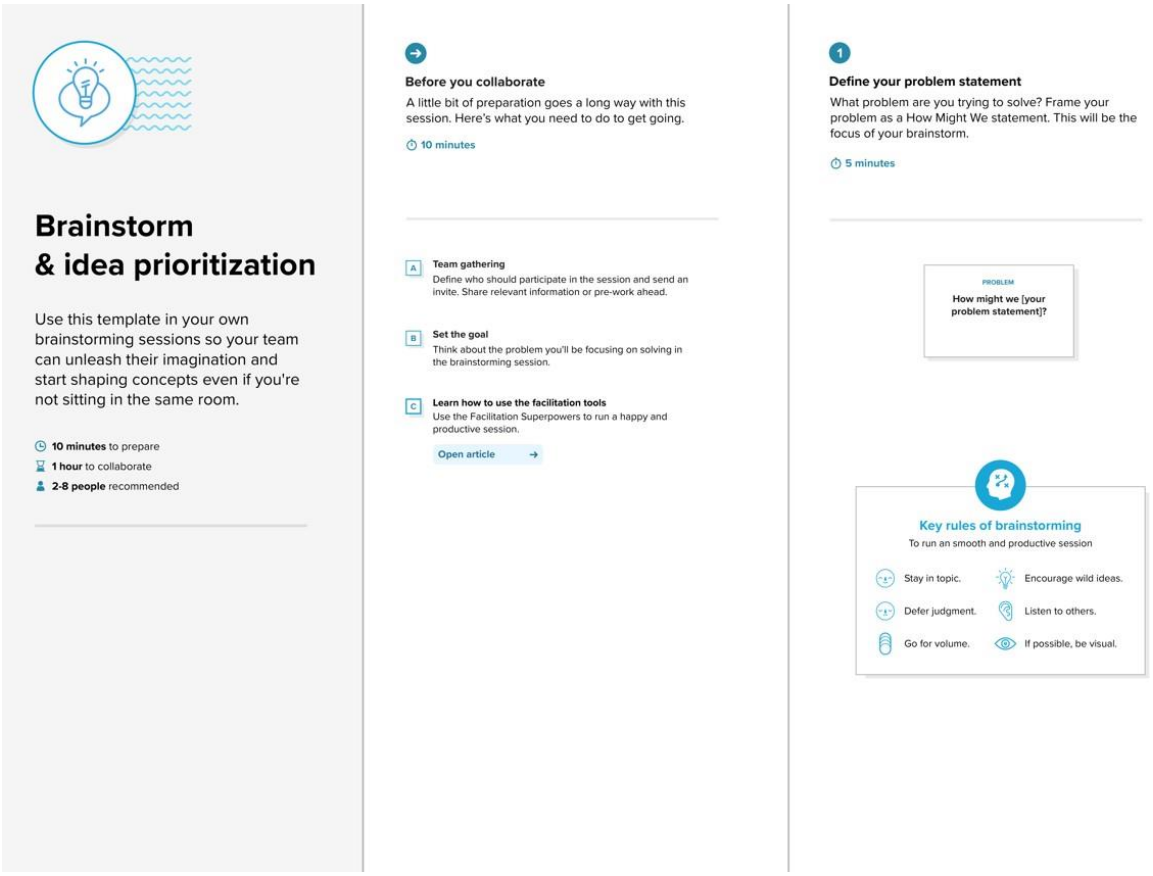
Water is the primary need of all living beings and living without water is impossible. With the advancement of technology and industrialization, environmental pollutions have become a major concern. Water pollution is one of the most serious types of this environmental pollution. Our lives depend on the quality of water that we consume in different ways, from juices which are produced by the industries. Any imbalance in the quality of water would severely affect the humans' health and at the same time it would affect the ecological balance among all species. Water quality refers to the chemical, biological, radiological, and biological parameters of the water.

3.1 Empathy Map Canvas

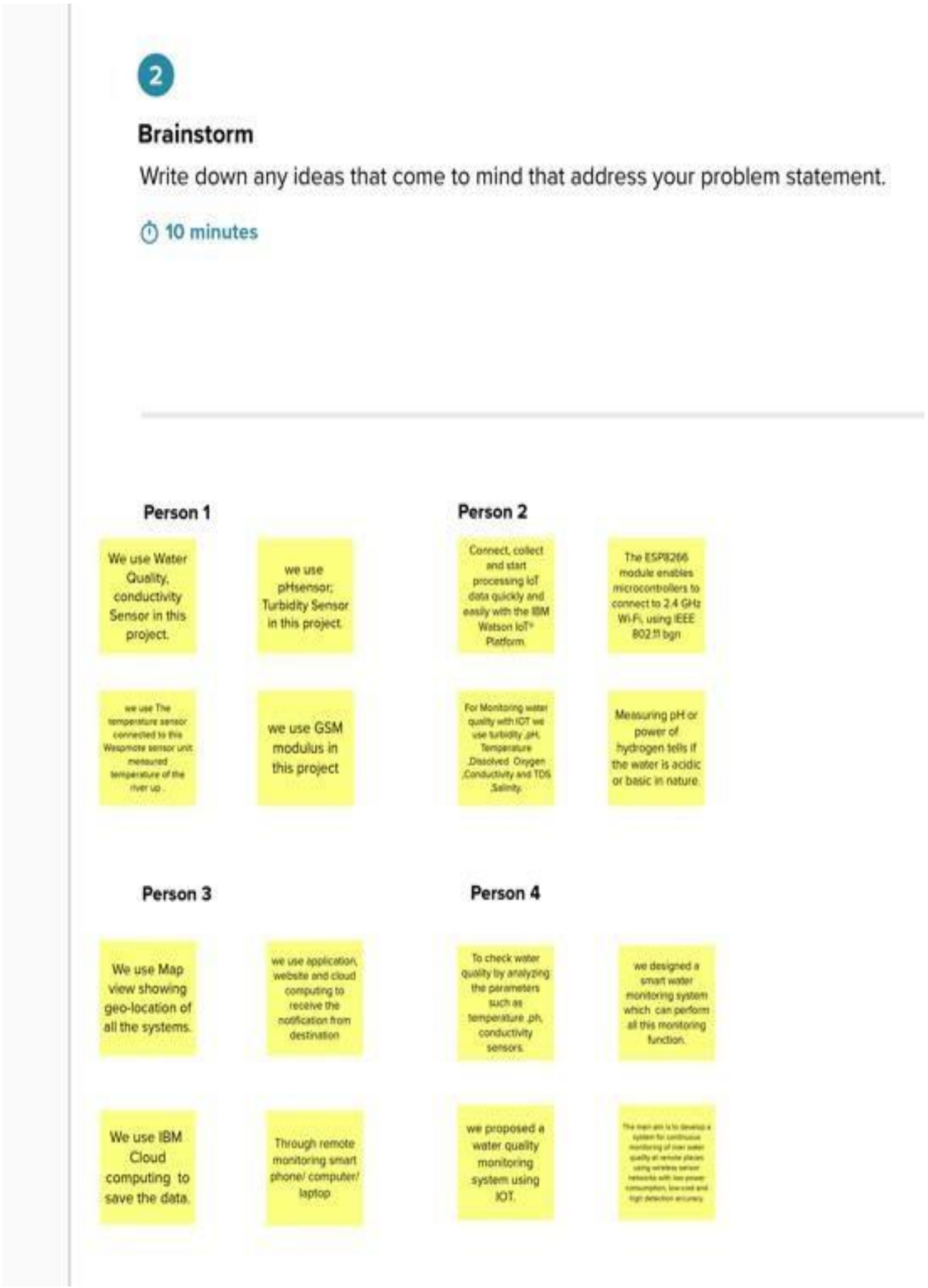


3.2 Ideation & Brainstorming

Step-1: Team Gathering, Collaboration and Select the Problem Statement



Step-2: Brainstorm, Idea Listing and Grouping



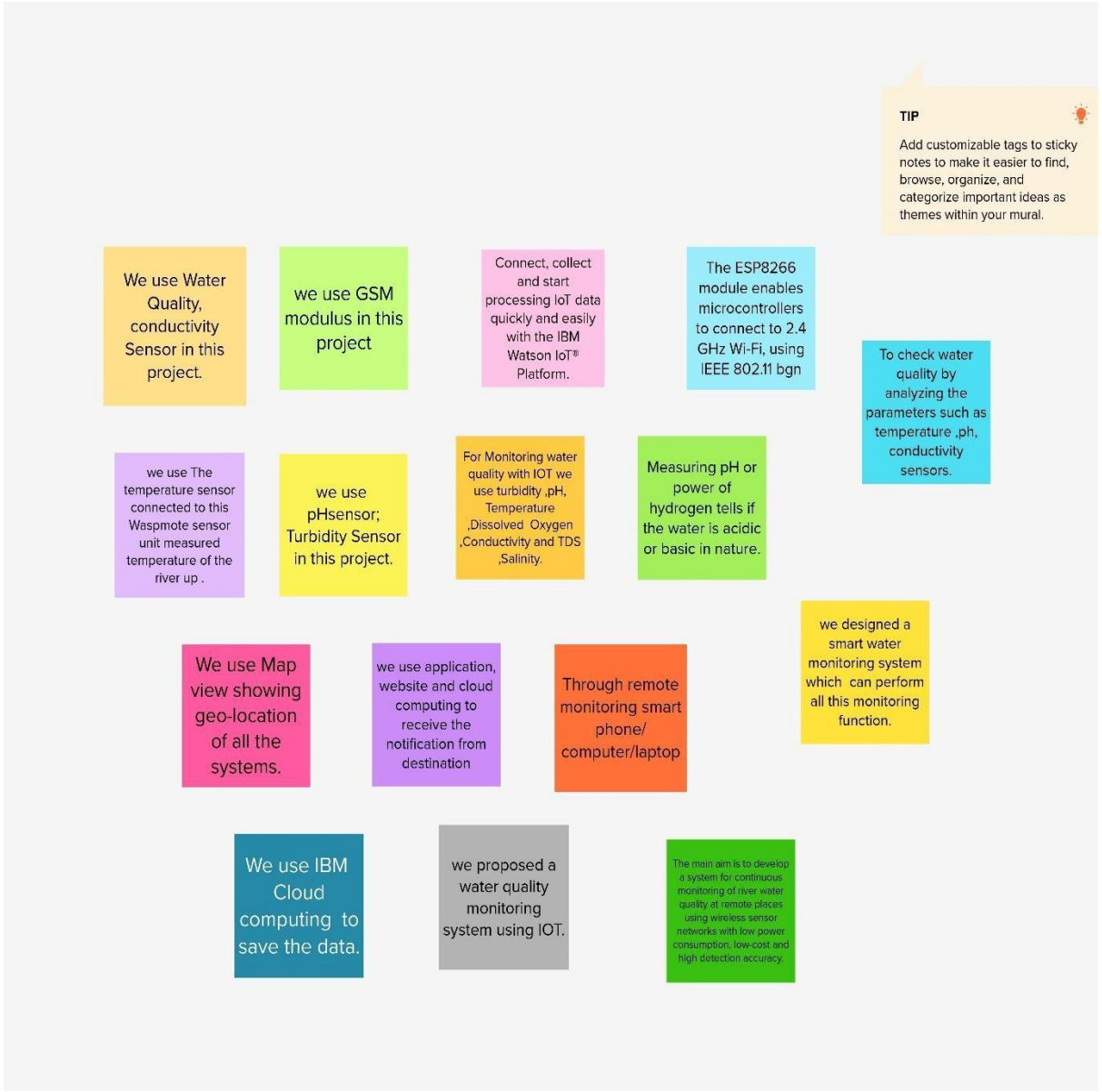
Step-3: Idea Prioritization

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 and break it up into smaller sub-groups.

20 minutes

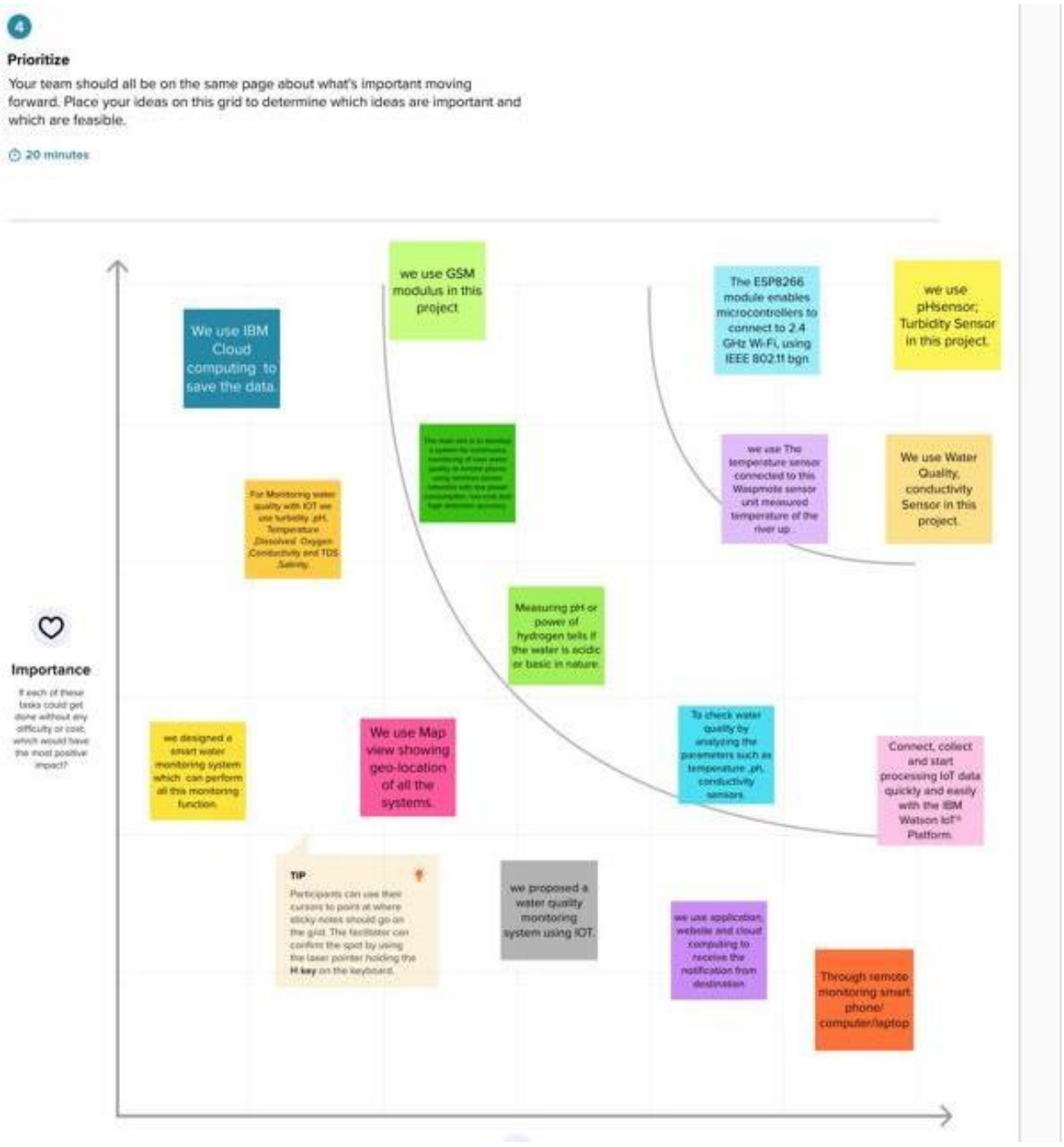


4

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



3.3 Proposed Solution

S. No.	Parameter	Description
1.	**Problem Statement (Problem to be solved)**	IOT Based Real Time River Water Quality Monitoring and Control System
2.	**Idea / Solution description**	1. To monitor the quality of water using sensors like Temperature, Potentiometer(pH), Turbidity, Salinity and so on. 2. Collecting those data and storing it in cloud and perform analyse to check if the water is contaminated or not for drinking. 3. If the water is contaminated an alert is made to the user/ local authority through SMS or can be viewed through web application anytime.
3.	**Novelty / Uniqueness**	1. Based on the collected data prediction is made whether the water can be used for cultivation of specific crops and suitable for the aquatic animals.
4.	**Social Impact / Customer Satisfactio**n	Algal growth, fertilizers, pesticides cause river pollution which can impact all living beings. Better monitoring and control measures can impact health and vegetation massively.
5.	**Business Model (Revenue Model)**	Service based product is developed to serve the local people to know the quality of water before consuming it or using it for any purpose. This prevents health issues or at most loss of living being.
6.	**Scalability of the Solution**	Developing the product as both web and mobile application it is portable, and data can be accessed from anywhere anytime. provide a real-time monitoring and a feasible solution for remote or distant places where water quality laboratory is not present.

3.4 Problem Solution fit

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

Normal people and industrialist are our customer because all the have the basic knowledge in water quality and also they need a pure water. We are targeting the people who are have the basic knowledge and who need to know the quality of water. As well as who are having water based industries.

6. CUSTOMER CONSTRAINTS CC

Network availability and available device are the biggest issue face by the customers and they need to spend a time to get daily update, it may high budget for some people. The resources in terms of financialas well as manpower are inadequate.

5. AVAILABLE SOLUTIONS

- The temperature of water can be monitored.
- The PH level of water is monitored and identified.
- Amount of oxygen dissolved in water.
- Any kind of chemical substances should be presence in water.

Explore AS, differentiate

Focus on J&P, tap into BE, understand RC

2. JOBS-TO-BE-DONE / PROBLEM J&P

All the people and industrialist are suffers to know the quality of water and also monitor the PH, Humidity, presence of chemical substances, amount of dissolved oxygen. They are only need the quality of water because impure water should because the various diseases.

9. PROBLEM ROOT CAUSE RC

The reason for available of this project to monitor the quality of water as well as the various substances are presence in water. We took this project to break the myth of utilizing the technology and also reduce the manpower

7. BEHAVIOUR BE

Directly related: Find better network availability, calculate the quality and quantity of water and also monitor simultaneously the quality and quantity of water.

Indirectly related: We should make the awareness to all other industries as well as people

Focus on J&P, tap into BE,

Identify strong TR & EM

3. TRIGGERS TR

- By installing this project, we can trigger people by seeing their neighbor make the utilization of technology more useful and reading about a more efficient solution in the news.
- In case of without using mobile app, one should always be there to maintain the parameters and the maintenance cost should be paid.

10. YOUR SOLUTION SL

- We provide a good source tothe public and we work based on public review.
- The PH level of water is identified.
- Turbidity of water is identified.
- Conductivity of water is identified and also monitor the presence of chemical substances in water

8. CHANNELS OF BEHAVIOUR CH

ONLINE:

- People and industrialist may provide review and rating for the system.
- The software used should be properly studied by everyone to operate it.
- The software and hardware connections should be given properly.

Find strong TR & EM

- But, in case of using mobile app the maintenance cost can be avoided and we can be able to monitor the parameters.

4.EMOTIONS: BEFORE / AFTER EM

BEFORE:

- Before implementing this project people feel it difficult to enjoy boating fishing and provision of safe drinking.
- They also face major problems in the development of industrial, hydroelectric and agricultural water requirements.

AFTER:

- After implementing this project people can be able to face all these above-mentioned problems easily

- Temperature of water is always monitored.
- Amount of oxygen dissolved in the water.
- TDS are used to describe the salinity level of water.
- Monthly report of maintaining the water will be displayed.

OFFLINE:

- Public and industrialist supply funds to develop thesystem and make the system to take a next move.
- The hardware setup should be installed properly.
- All the kind of hardware should be water resistant.

4. REQUIREMENT ANALYSIS

4.1 Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	**User Registration**	Registration through registered credentials register confirmation e-mails
FR-2	**User Confirmation**	Confirmation via Email Confirmation via OTP/SMS
FR-3	**Log in to the System**	Enter the OTP Check the Credentials Check the Access/Server
FR-4	**Manage the Modules**	Manage the system Admins of user Manage and Monitor Details of System User Manage the User Roles Manage the User Accessibility and User Permission Manage User Details Privacy
FR-5	**Check Process Details**	Temperature Details PH Details Turbidity Details dissolved oxygen level in water presence of chemical substances in water
FR-6	**Log out**	Save the existing measurements Exit

4.2 Non-functional Requirements:

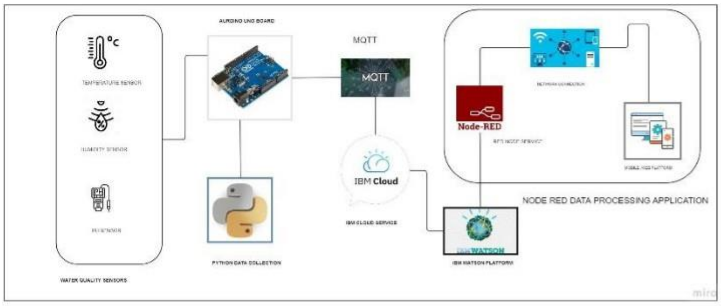
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Make Easier to Use, More Efficiency to Use, Reduction of Errors While Using this Techniques
NFR-2	**Security**	end by end encypted protocol in Data Authentication, Sensitive data proctected personally identifiable information(PII) other information details of users and networks
NFR-3	**Reliability**	Provideees the objective evidence necessary to make decisions on managing water quality today and in future also. This techniques make good communication between the user and the networks and it also achieves a better trade-off between costs and reliability
NFR-4	**Performance**	Implementing Monitoring River Water, by using sensing sensor to monitor the river water parameters making more useful for various environmental Usage.
NFR-5	**Availability**	PH Monitoring,Conductivity Analysis,CDOM(Dissolved Organic Matter),Measure of Carbonate and bicarbonate levels in water,this techniques made possible by linking information in water
NFR-6	**Scalability**	Automatic Water Sampler, PH testing, Recording the water temparature,chlorophyll flurorescence analysis measuring the dissolved oxygen levels.

5.1 Data Flow Diagrams

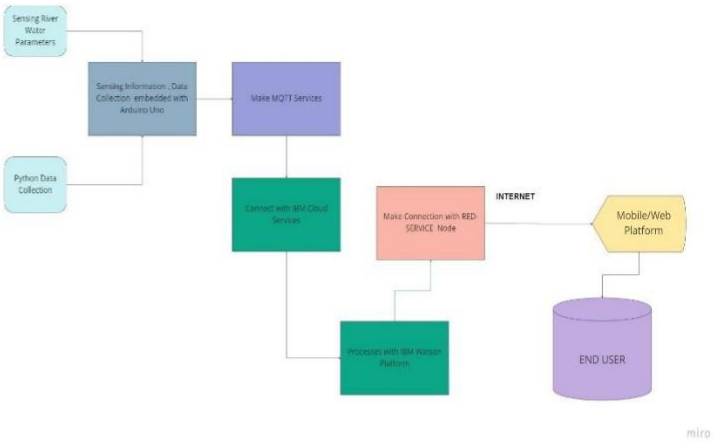
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

DATA FLOW:



1. Sensing the water Parameter with sensors and Collecting Water parameter Data using Python.
2. Made Several Embedded Connection with Ardiuno Uno Board and also have some MQTT Service Connection.
3. Make IBM Cloud Connectivity and Also with IBM Watson Service.
4. Made Connection with RED-Service Node
5. Finally End Users can monitor the information through Mobile/Web Platform

DATA FLOW DIAGRAM:



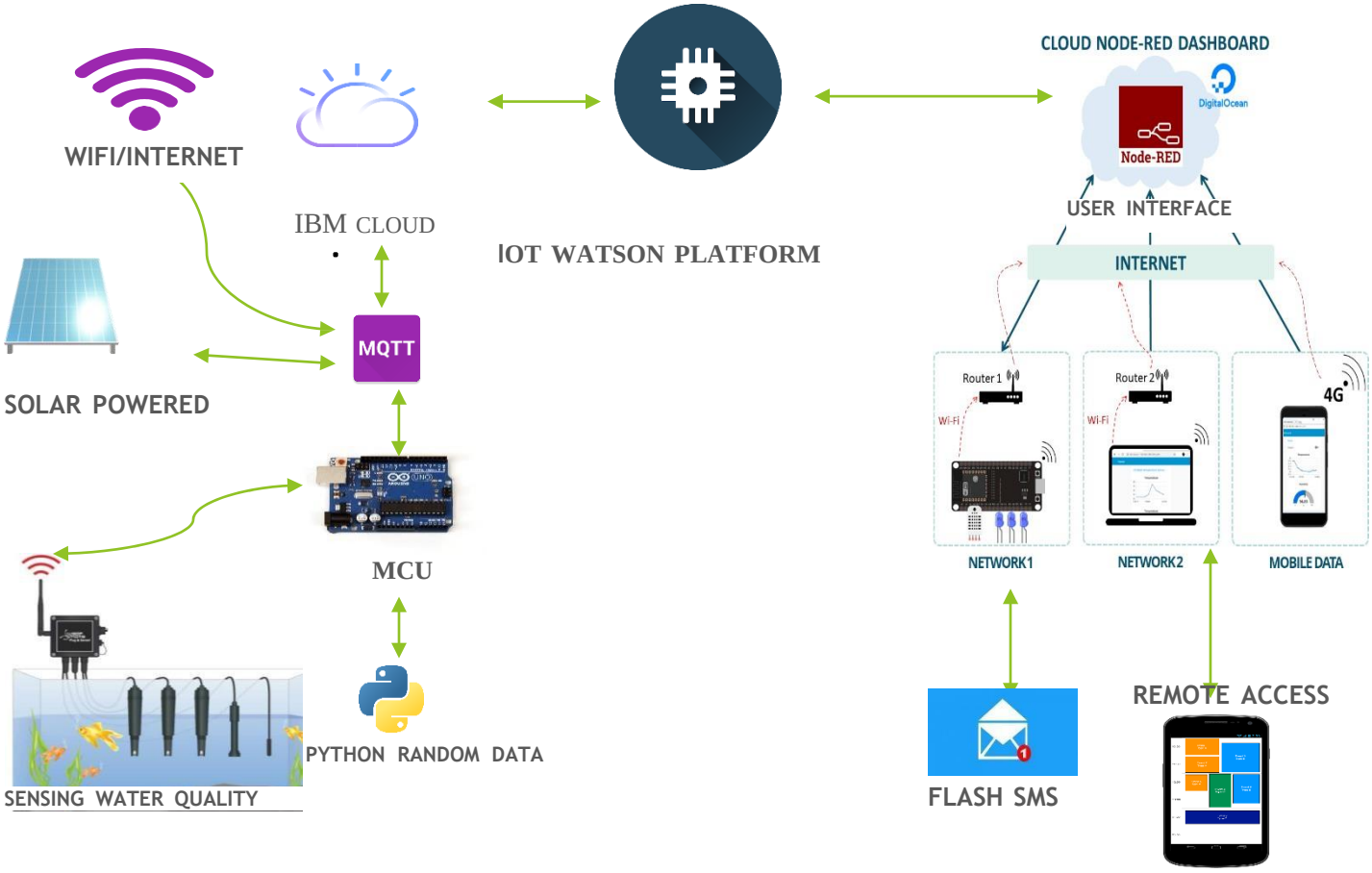
5.3 User Stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user/remote user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
	Notification	USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
	Signup through third parties	USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail	I can register and access the dashboard with Google credentials	Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password	I can register and access the dashboard through the application cred	High	Sprint-1
	Dashboard					
Customer (Web user)		USN-6	As I am a customer I need a proper support and service	Each and every process was under firewall /security protocol	High	Each sprint
Customer Care Executive		USN-7	24/7 service can provided by company			Sprint 3
Administrator		USB-8	Who will have the entire access of this project	All the access was with encrypted	High	Each sprint

5.2 Solution & 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:

- Find the best tech solution to solve existing business problems.
- Describe the structure, characteristics, behaviour, and other aspects of the software to project stakeholders.
- Define features, development phases, and solution requirements.
- Provide specifications according to which the solution is defined, managed, and delivered.



6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Mobile UI	USN-1	As a user, I can study the river water quality byregistering into Mobile app	10	High	Mano Bharathi D Ashwath R
Sprint-1	Alerting Authority	USN-2	As a user, I can alert the authority by sendingmail or SMS using Mobile App	5	Low	Ashwath R Sivanandhan B
Sprint-2	Node-Red WebUI design	USN-3	As a user, I can see the water parameters inweb application dashboard	20	Medium	Manobharathi D Ashwath R
Sprint-3	Python code	USN-4	Sending Sensor data values to IBM Watsoncloud using python code.	20	High	Ashwath R Sivanandhan B
Sprint-4	Monitoring	USN-5	For Real-Time water quality monitoring, messages are immediately send to concernedauthorities when parameters cross threshold.	20	High	Sivanandhan B Mahesh Krishnan Y

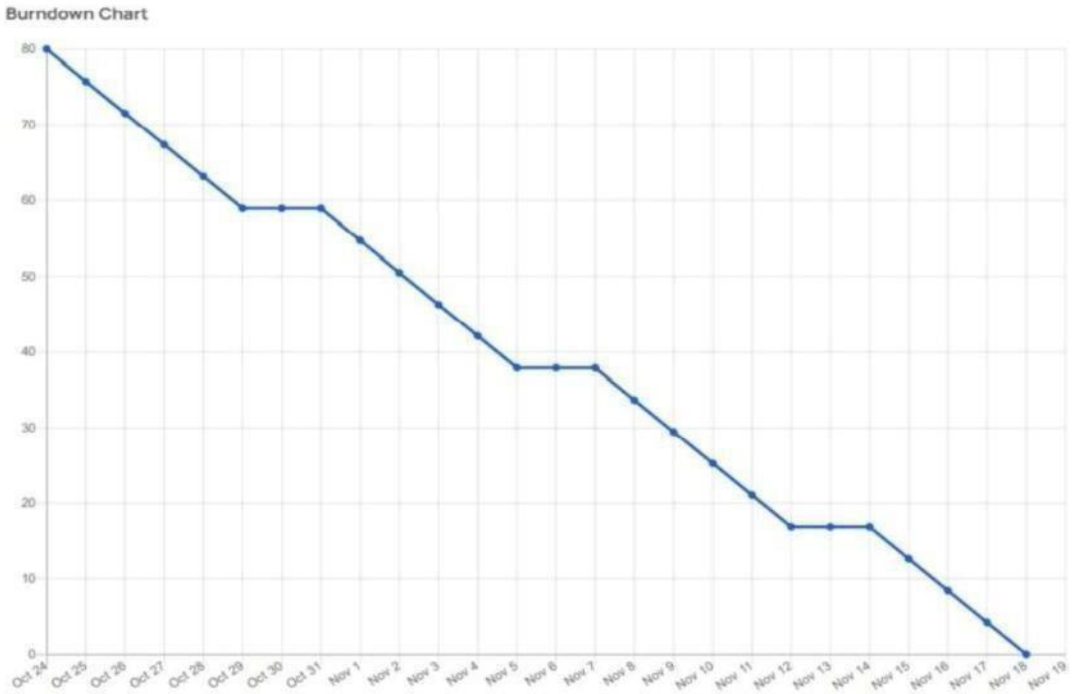
6.2 Sprint Delivery Schedule

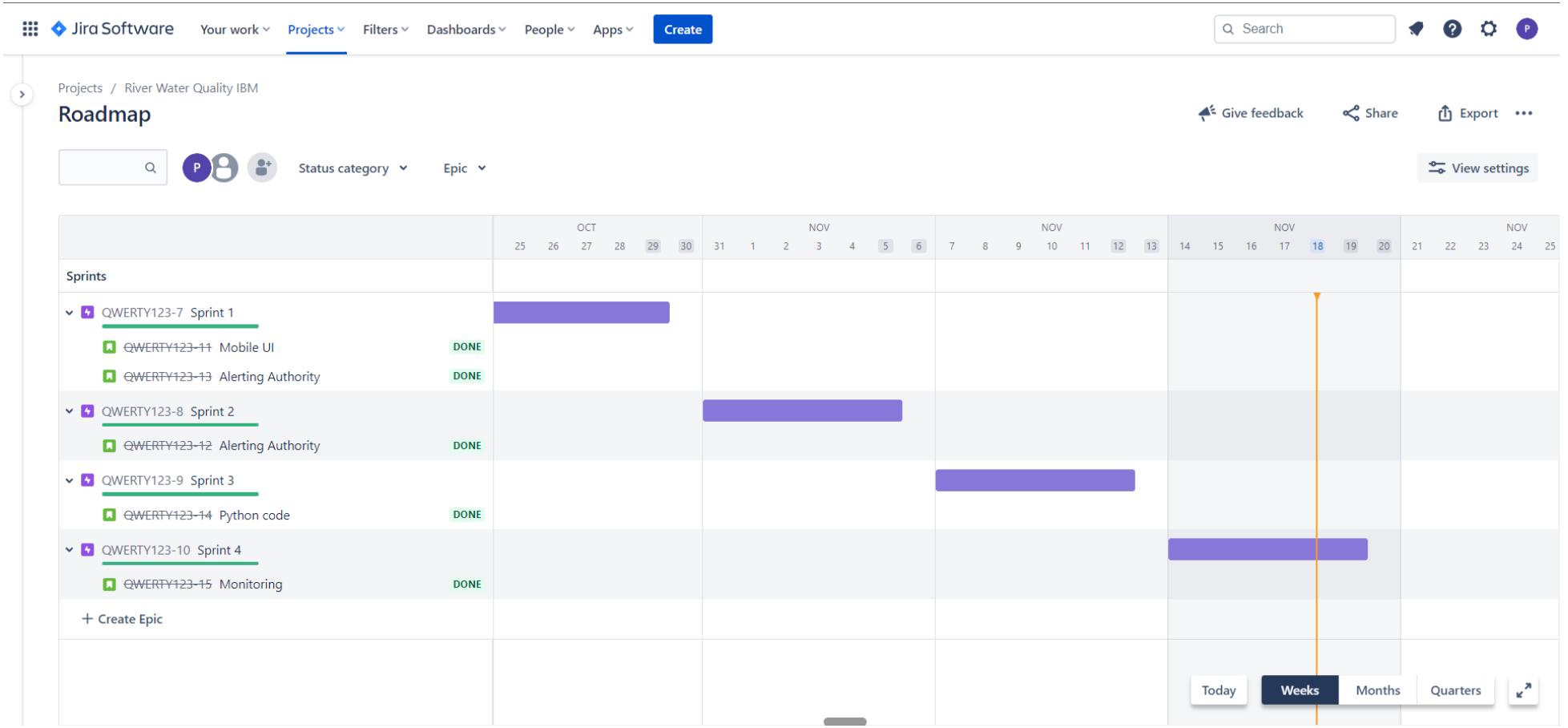
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

Velocity:

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

6.3 Reports from JIRA

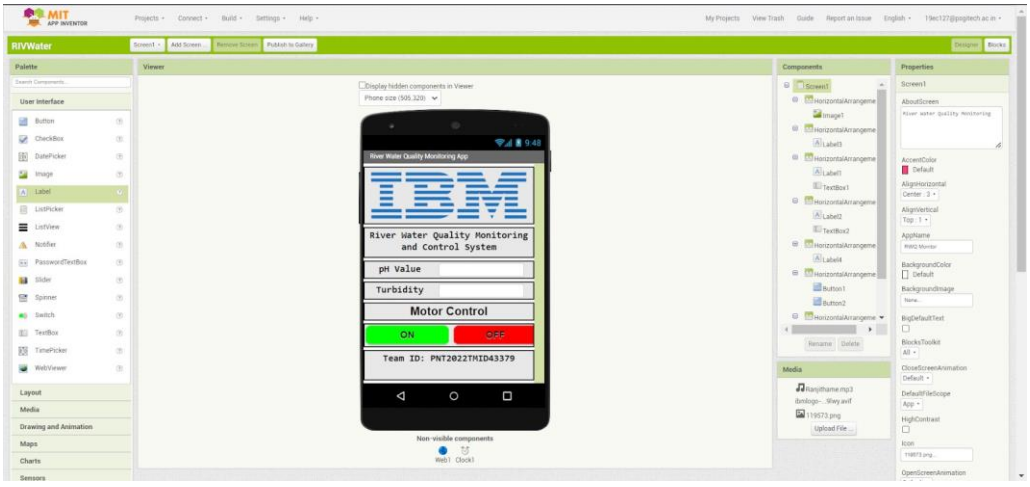



Jira Software
Your work
Projects
Filters
Dashboards
People
Apps
Create
Search
Projects / River Water Quality IBM
Roadmap
Give feedback
Share
Export
Status category
Epic
View settings
OCT
NOV
NOV
NOV
NOV
25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Sprints
QWERTY123-7 Sprint 1
~~QWERTY123-11~~ Mobile UI DONE
~~QWERTY123-13~~ Alerting Authority DONE
QWERTY123-8 Sprint 2
~~QWERTY123-12~~ Alerting Authority DONE
QWERTY123-9 Sprint 3
~~QWERTY123-14~~ Python code DONE
QWERTY123-10 Sprint 4
~~QWERTY123-15~~ Monitoring DONE
Create Epic
Today
Weeks
Months
Quarters

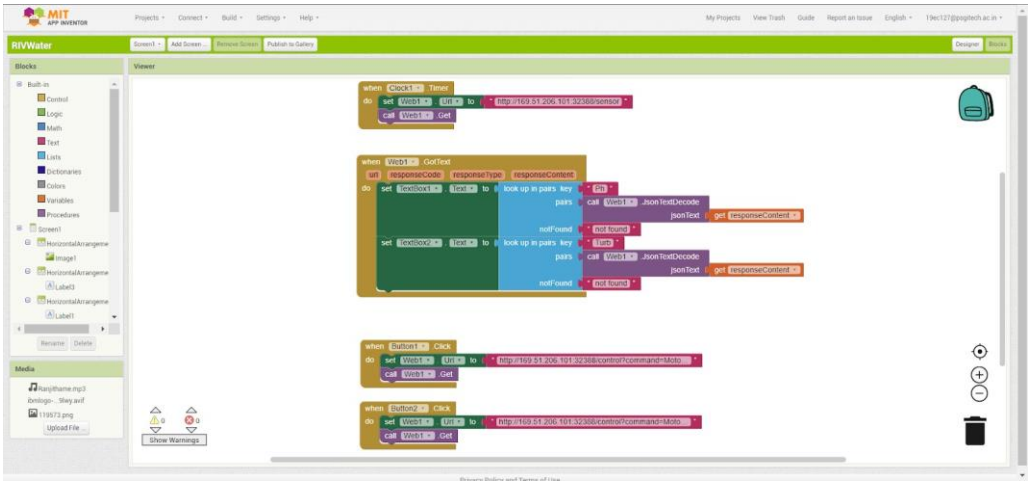
7. CODING & SOLUTIONING (Explain the features added in the project along with code)

Design a Mobile App to Monitor the Water Quality

Front End

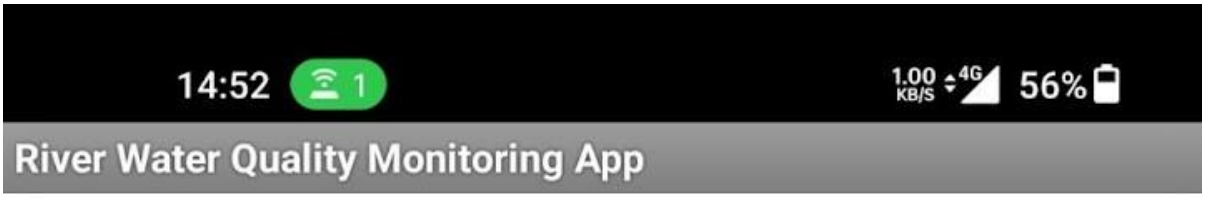


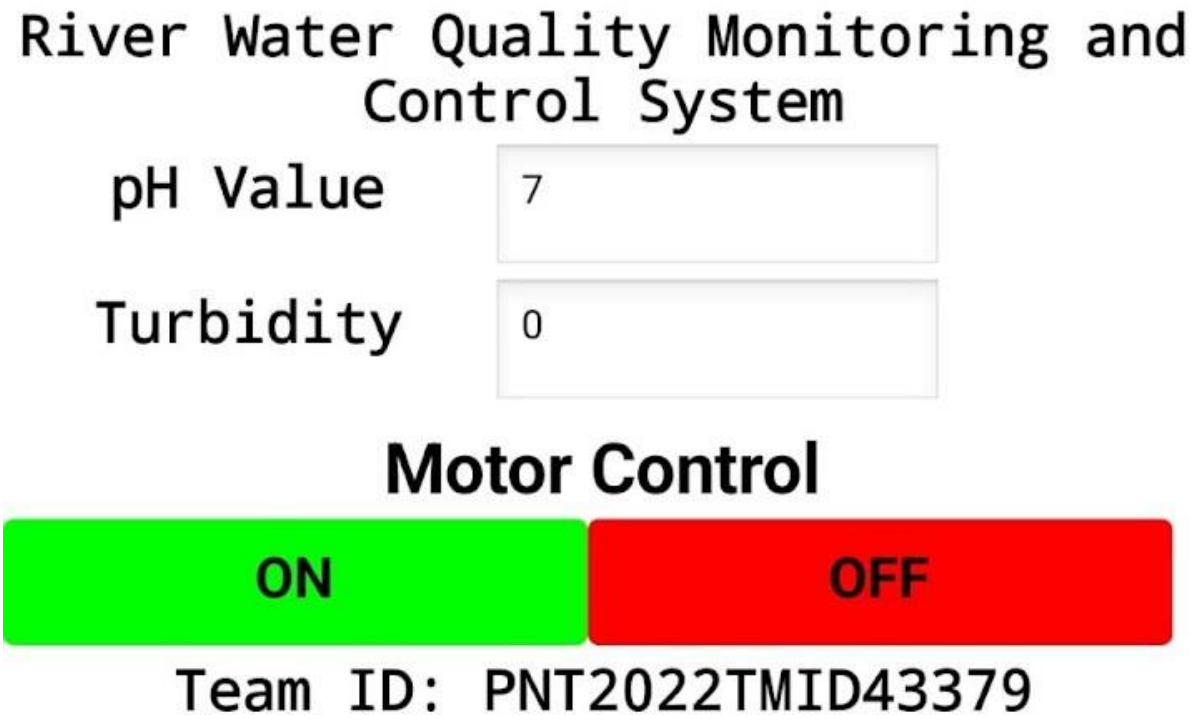
Back End



Testing the App:

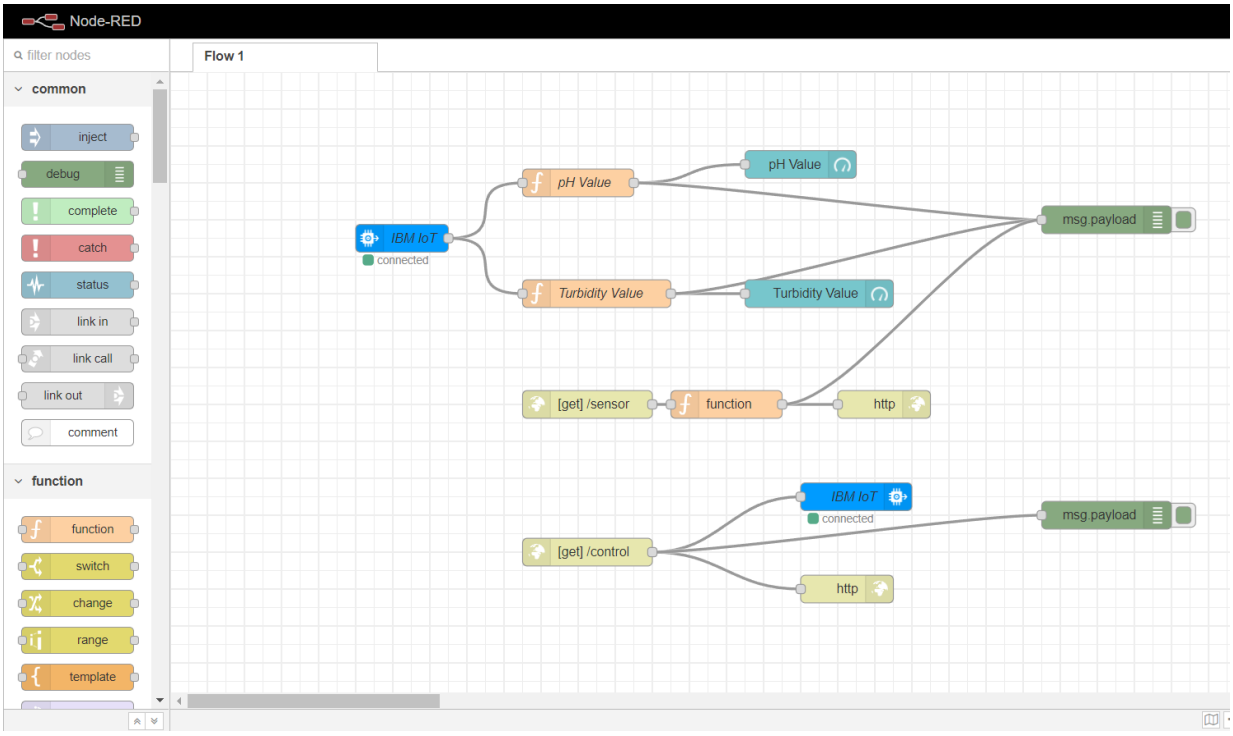
Receiving value from Cloud:



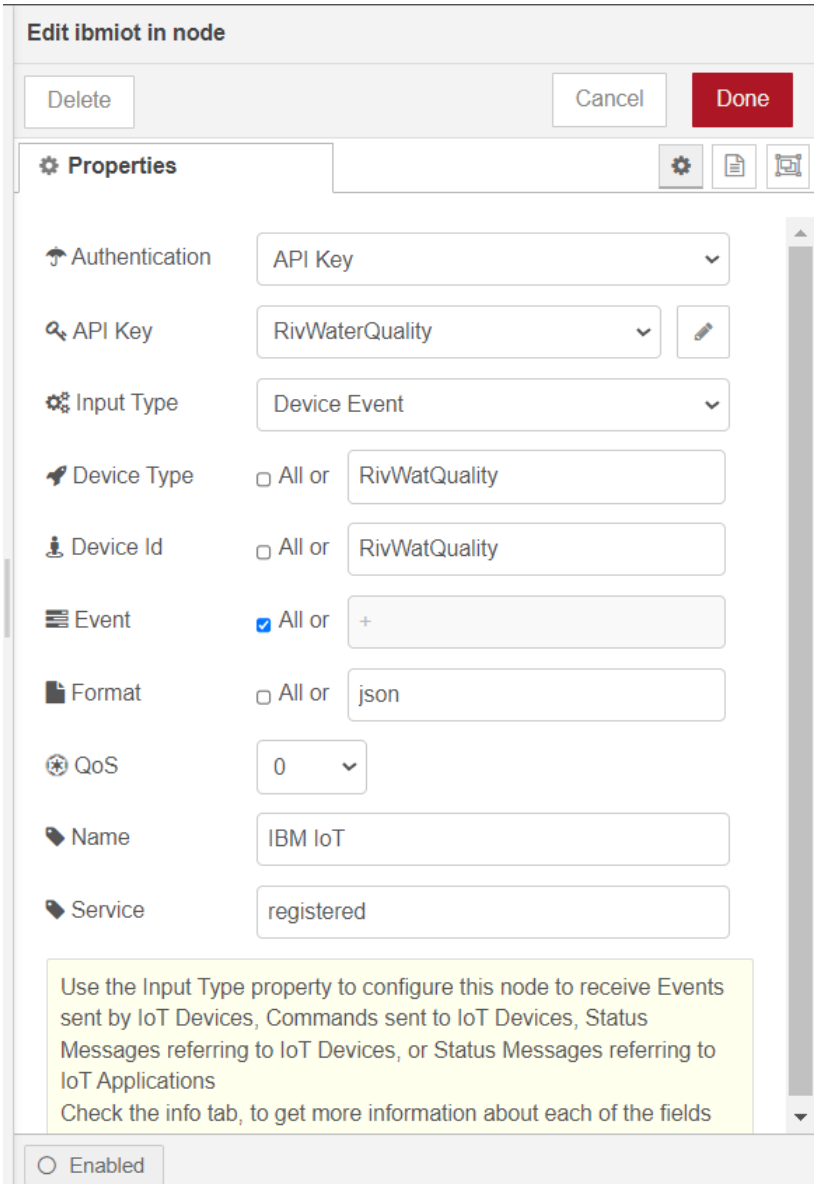


Mobile APK: [Download]

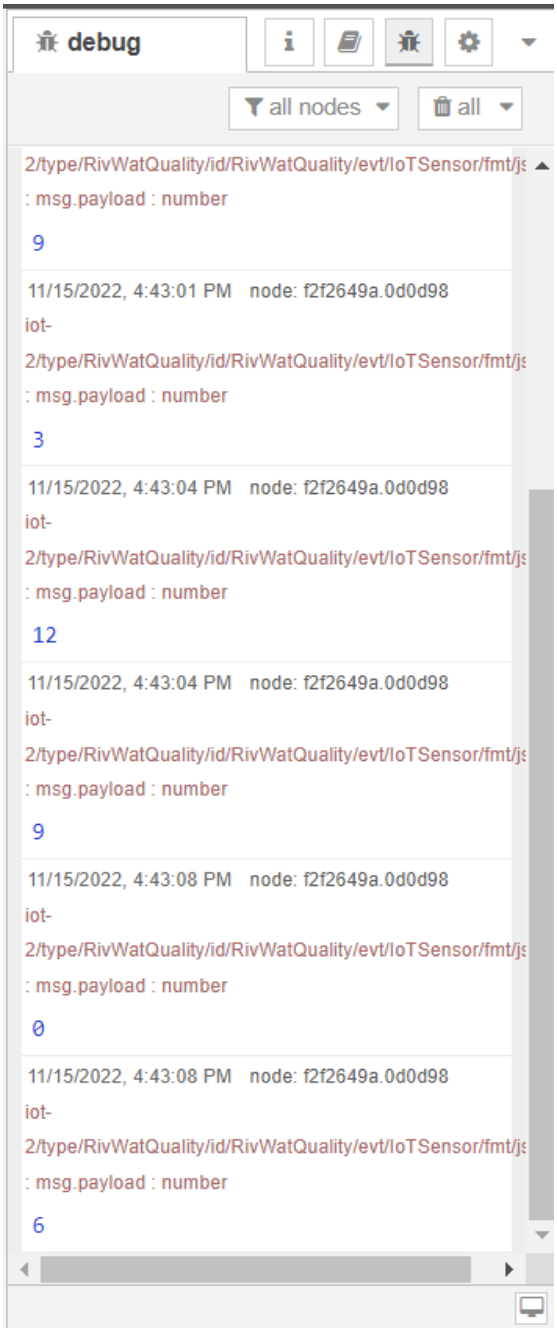
Design a Web Application to Monitor the Water Quality using NODE-RED



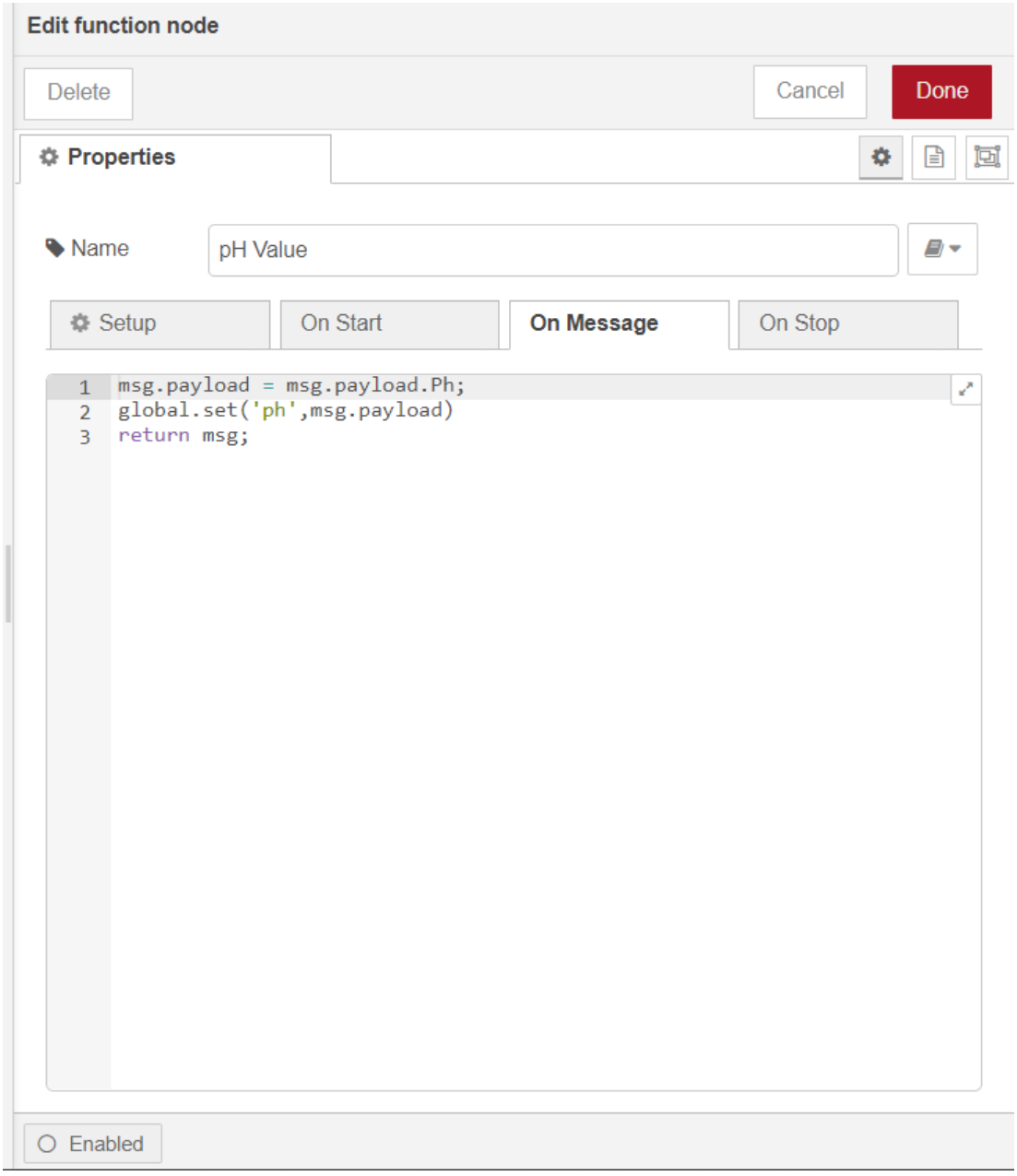
IBM IOT Input Module:



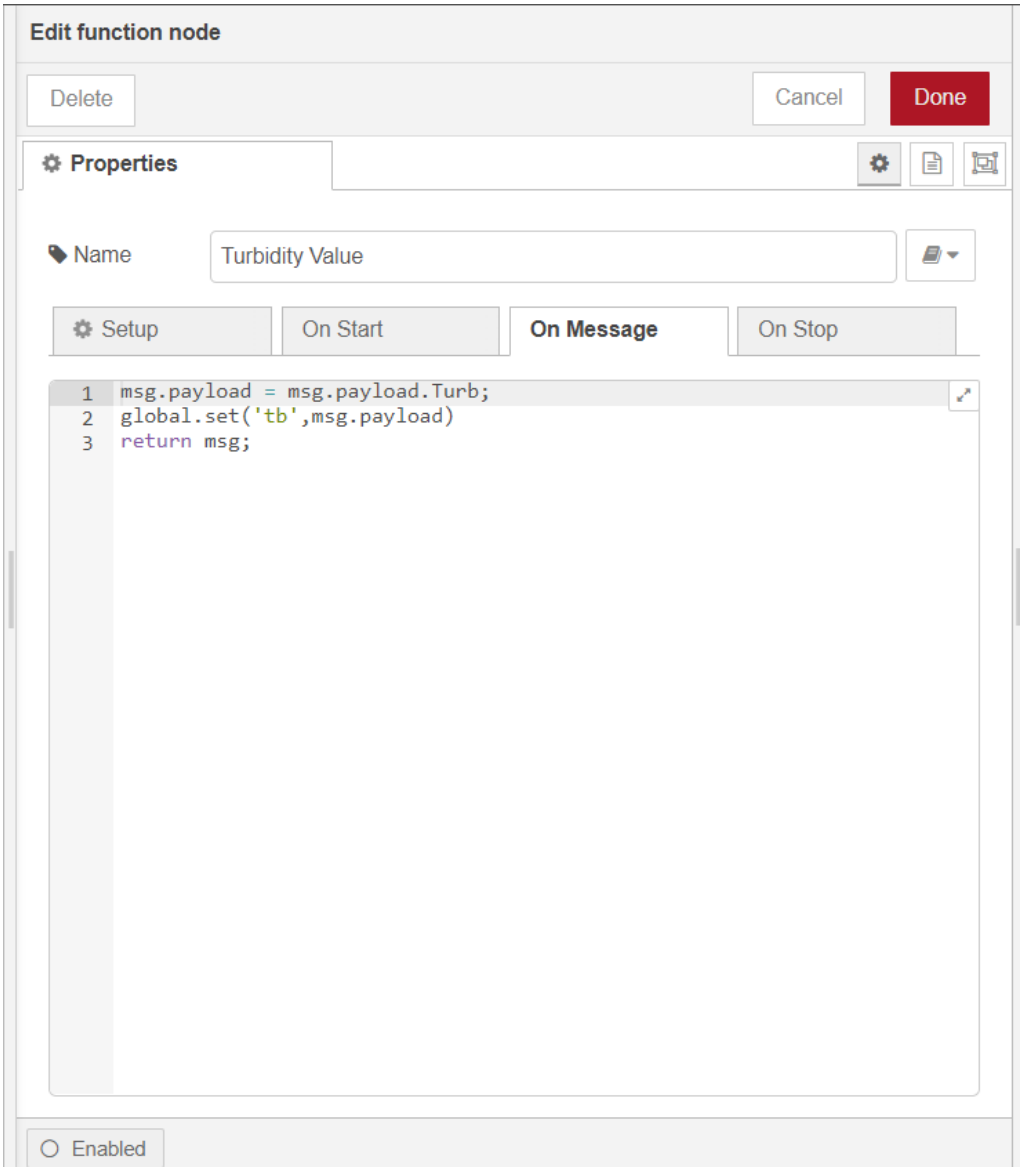
Debug Node Output:



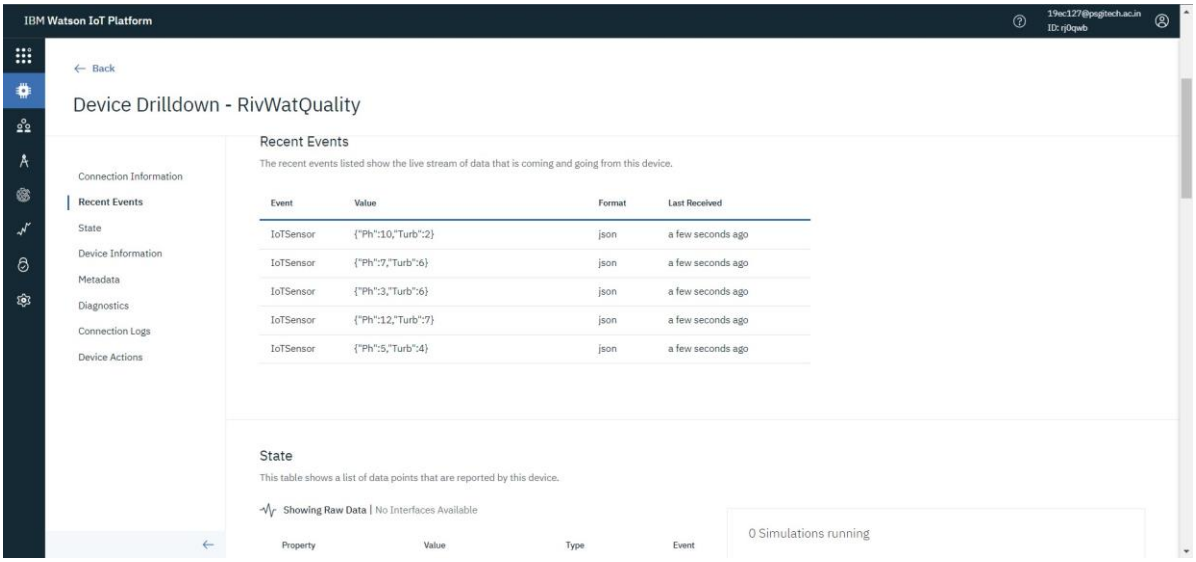
pH Function Node Script:



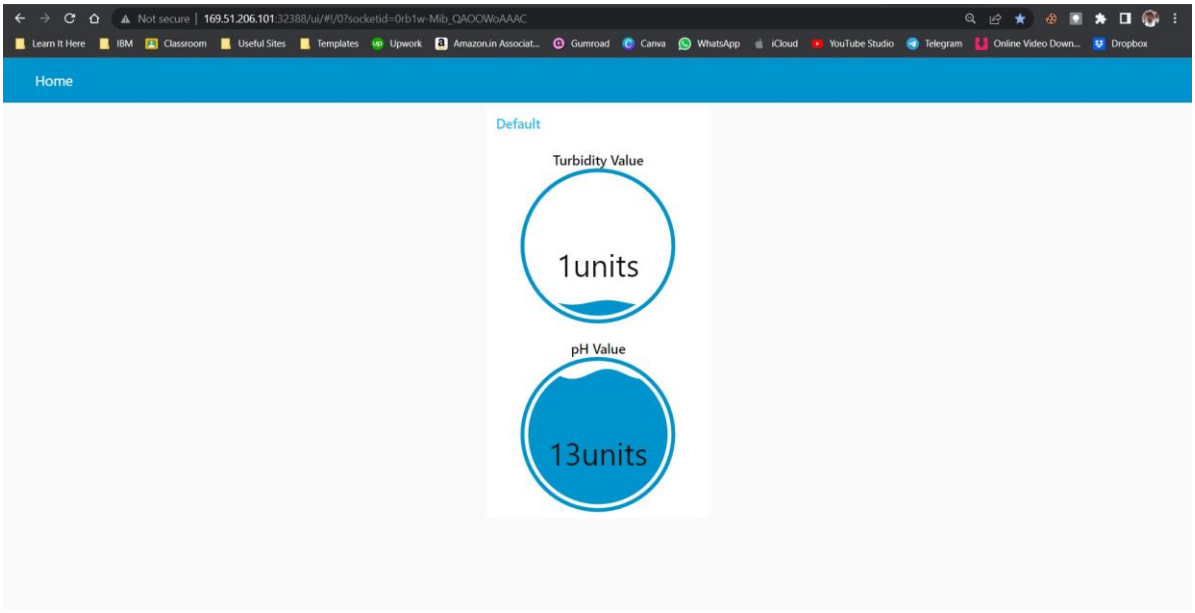
Turbidity Node Script:



IBM Watson IOT Platform:



Web Application:



Web UI Link: http://169.51.206.101:32388/ui/#!/0?socketid=0rb1w-Mib_QAOOWoAAAC

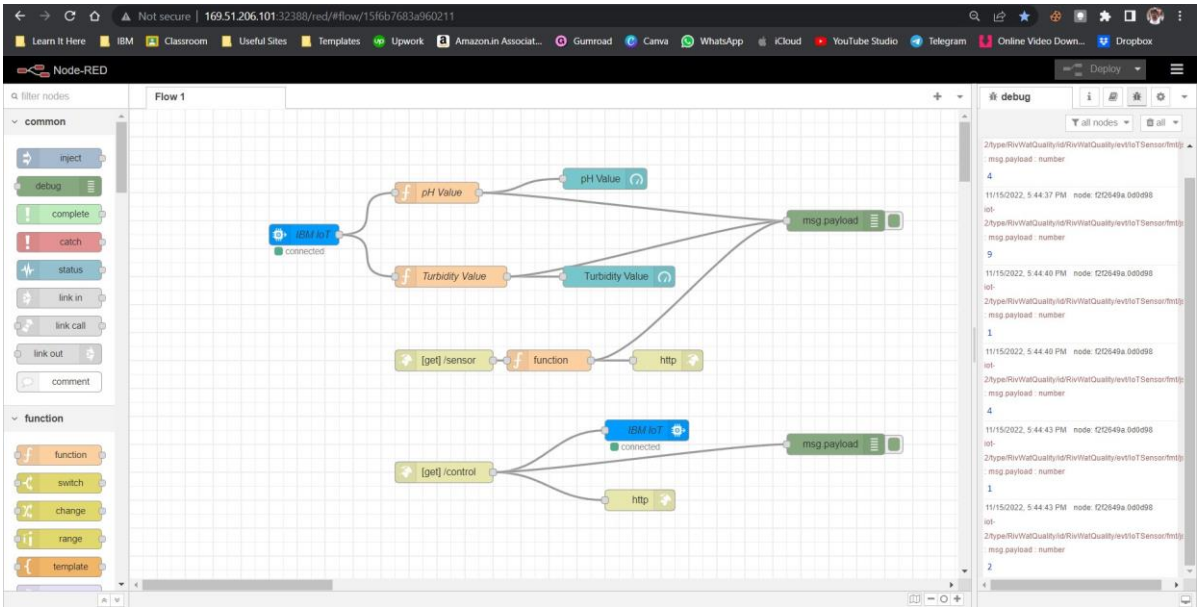
Python Code:

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

#ibm watson device credentials

organization="rj0qwb"
deviceType="RivWatQuality"
deviceid="RivWatQuality"
authMethod="token"
authToken="UFT_PB+dHA3k)0_pA7"

def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status =="MotorON":
        print("Motor Turned ON")
    else :
        print ("Motor Turned OFF")


#generate random values for pH and turbity


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

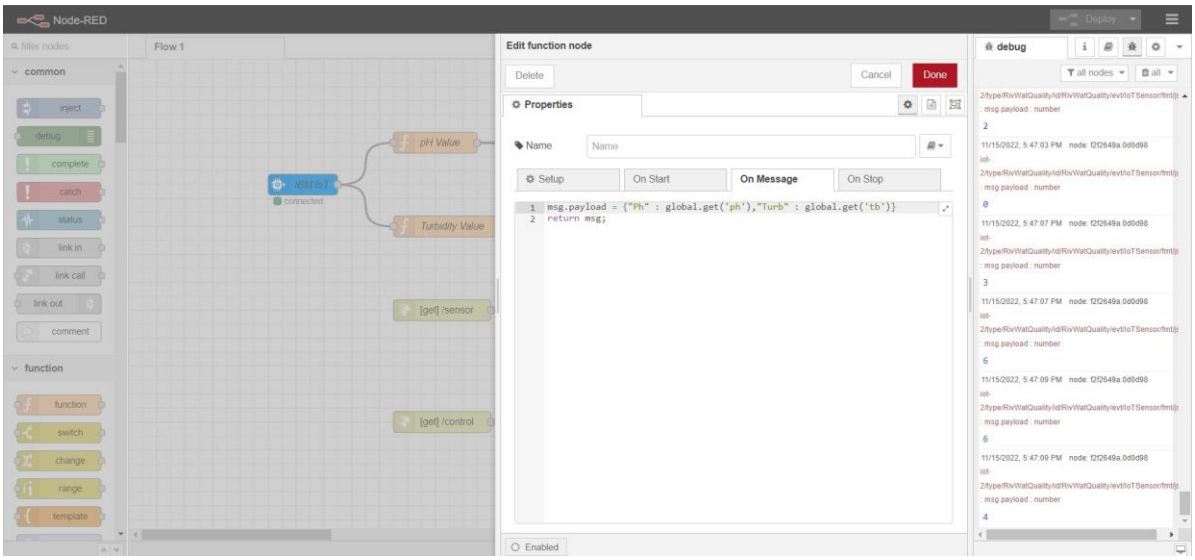
```
        deviceOptions={"org": organization,"type": deviceType,"id":
deviceid,"auth-method":authMethod, "auth-token":authToken}
        deviceCli = ibmiotf.device.Client(deviceOptions)

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


#connect and sending data of pH Values and Turbidity

deviceCli.connect()

while True:
    time.sleep(2)
    Ph=random.randint(0,14)
    Turb=random.randint(0,10)

    data={'Ph':Ph,'Turb':Turb}
    print(data)

    def myOnPublishCallBack():
        print("pH Value of Water %s " %Ph)
        print("Turb Value of Water %s " %Turb)


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 from the cloud

deviceCli.connect()
```

2. Executing the Python Code to send values to IBM Watson Platform by MQTT Protocol

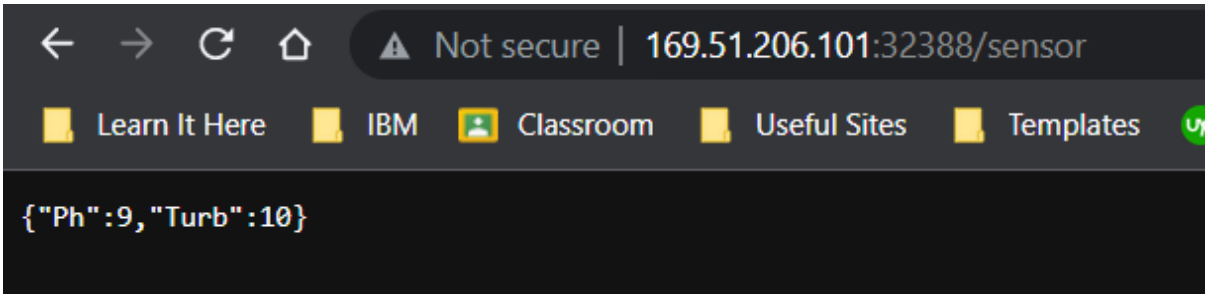
3. Sending obtained Values to Web UI Dashboard and Mobile App



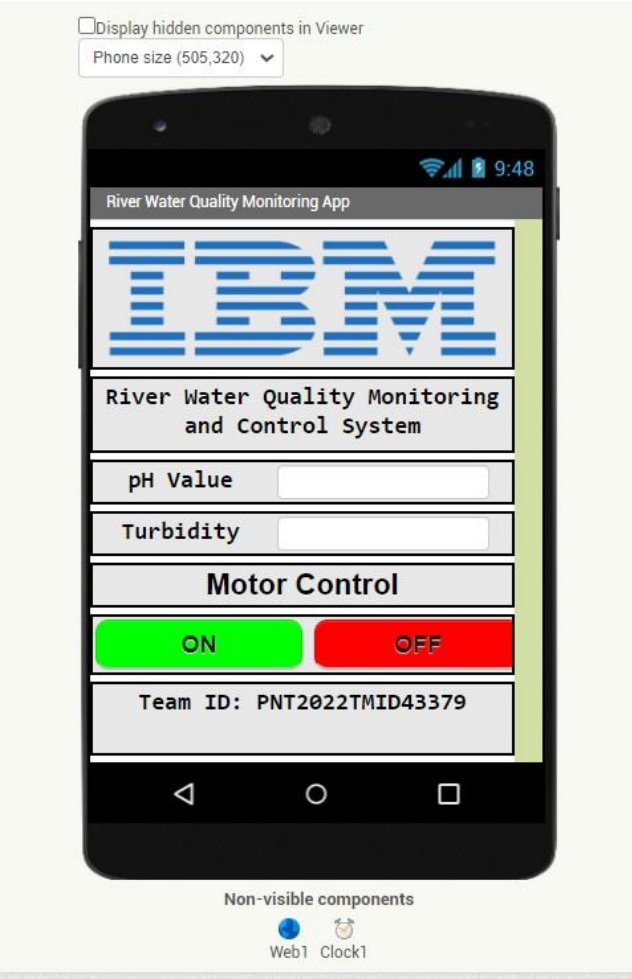
4. Payload Defined to send values to Mobile App



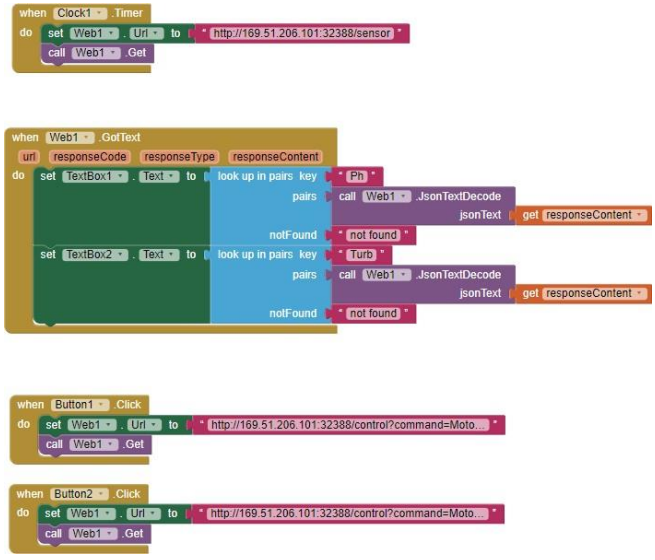
5. JSON Object Obtained using URL



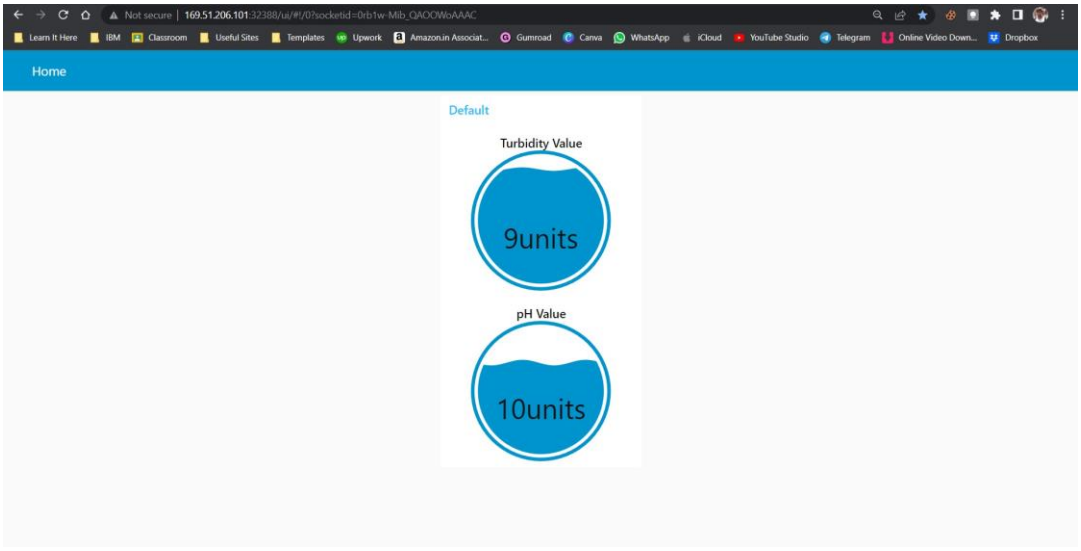
6. Mobile App to Receive data from Node Red



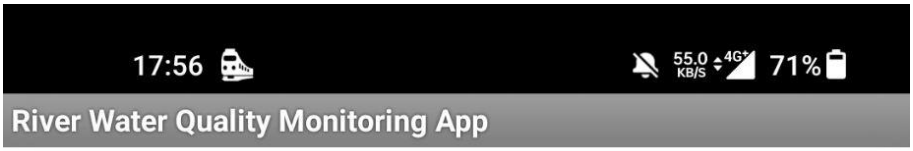
6. Configuring Mobile App Backend to receive data from Node Red

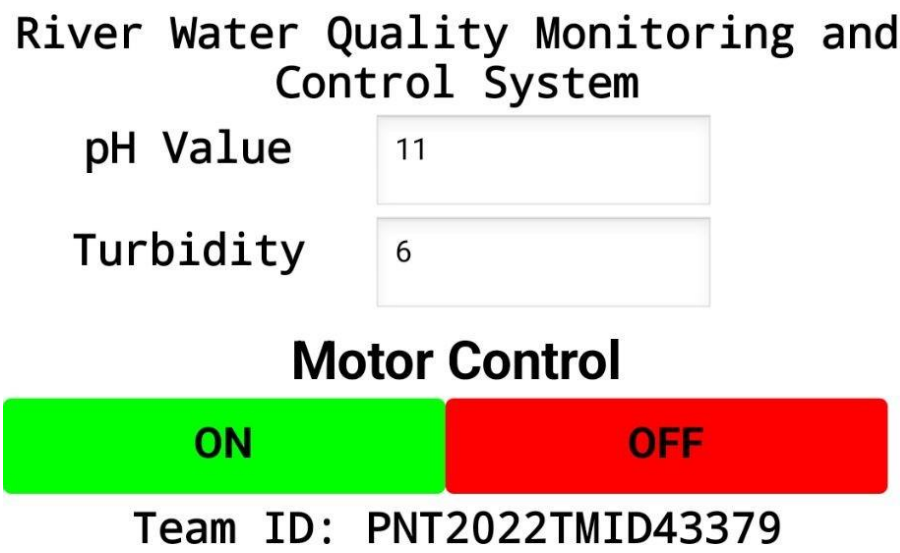


7. Web UI Dashboard



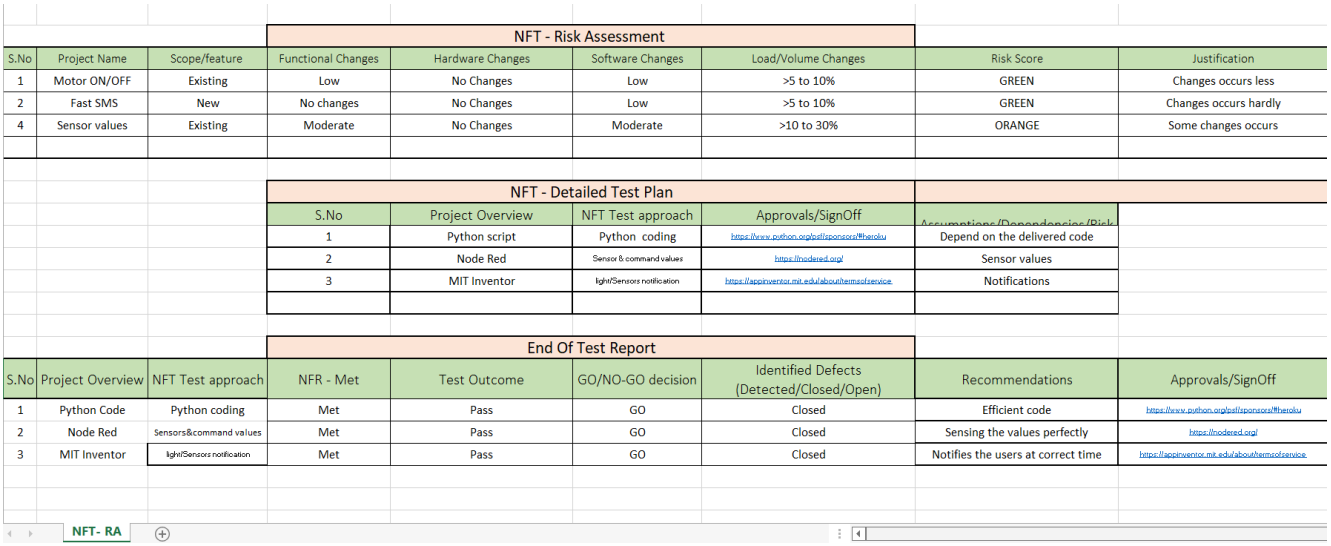
8. Monitoring the Values in Mobile App sent from Node-Red:





8. TESTING

8.1 Test Cases



NFT - Risk Assessment

S.No	Project Name	Scope/feature	Functional Changes	Hardware Changes	Software Changes	Load/Volume Changes	Risk Score	Justification
1	Motor ON/OFF	Existing	Low	No Changes	Low	>5 to 10%	GREEN	Changes occurs less
2	Fast SMS	New	No changes	No Changes	Low	>5 to 10%	GREEN	Changes occurs hardly
4	Sensor values	Existing	Moderate	No Changes	Moderate	>10 to 30%	ORANGE	Some changes occurs

NFT - Detailed Test Plan

S.No	Project Overview	NFT Test approach	Approvals/SignOff	Assumptions/Dependencies/Risk
1	Python script	Python coding	https://www.python.org/psf/sponsors/#heroku	Depend on the delivered code
2	Node Red	Sensor & command values	https://nodered.org/	Sensor values
3	MIT Inventor	light/Sensors notification	https://appinventor.mit.edu/about/termsofservice	Notifications

End Of Test Report

S.No	Project Overview	NFT Test approach	NFR - Met	Test Outcome	GO/NO-GO decision	Identified Defects (Detected/Closed/Open)	Recommendations	Approvals/SignOff
1	Python Code	Python coding	Met	Pass	GO	Closed	Efficient code	https://www.python.org/psf/sponsors/#heroku
2	Node Red	Sensors&command values	Met	Pass	GO	Closed	Sensing the values perfectly	https://nodered.org/
3	MIT Inventor	light/Sensors notification	Met	Pass	GO	Closed	Notifies the users at correct time	https://appinventor.mit.edu/about/termsofservice

NFT- RA

8.2 User Acceptance Testing

1. Purpose of Document

   The purpose of this document is to briefly explain the test coverage and open issues of the [ProductName] project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis

   This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	9	3	1	4	17
Duplicate	0	0	2	0	2
External	3	3	1	0	7
Fixed	12	6	4	19	41
Not Reproduced	0	0	1	1	2
Skipped	0	2	2	1	5
Won't Fix	0	2	3	2	7
Totals	24	16	14	27	81

3. Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	60	0	0	60
Security	5	0	1	4
Outsource Shipping	3	0	0	3
Exception Reporting	12	0	2	10
Final Report Output	5	0	0	5
Version Control	2	0	0	2

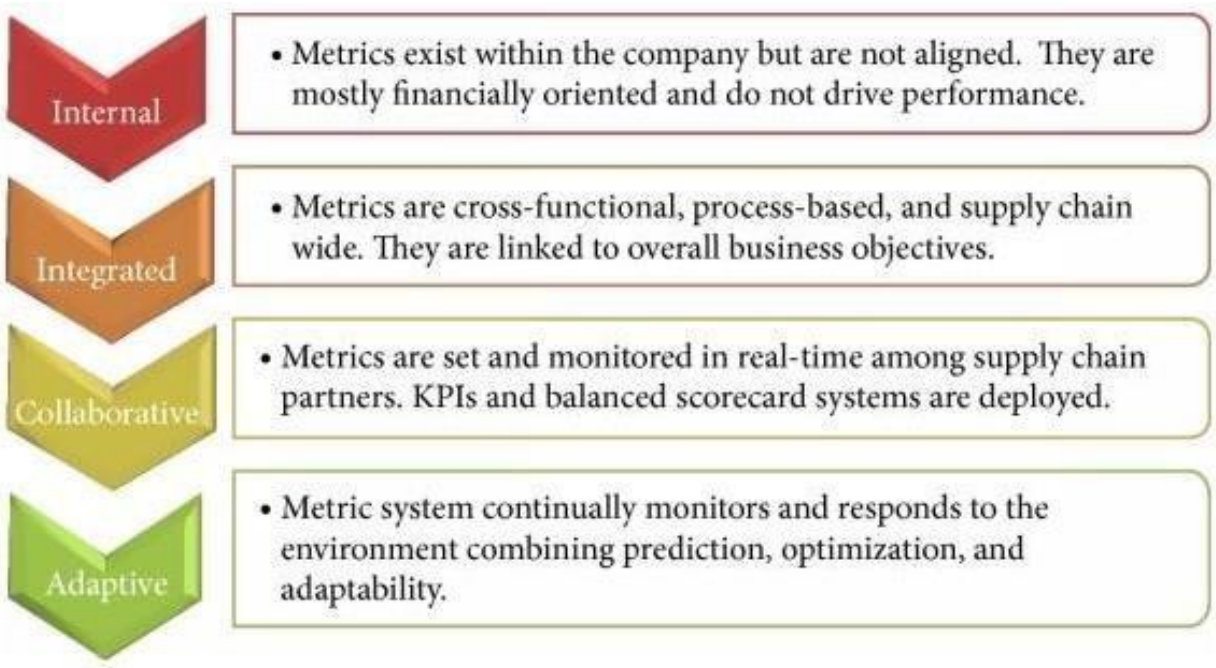
Performance Metrics:

COLLECTION OF PERFORMANCE MEASUREMENTS

Managing application performance requires the continuous collection of data about all relevant parts of the system starting from the end user all the way through the system. This collected data is the basis for getting a holistic end-to-end and up-to-date view of the application state including the end-user experience. In this chapter, we will discuss what data to collect, and from where and how to collect the data in order to achieve this view Most application systems are implemented in a way that, in addition to the application logic executed at the provider's site (referred to as the back-end), parts of the application are executed at client's site. The client site usually constitutes a system tier accessing the back-end

EXTRACTION OF PERFORMANCE-RELEVANT SYSTEM INFORMATION

summary statistics (e.g., counts, percentile, etc.) over time, execution traces provide a detailed representation of the application-internal control flow that results from individual system requests.



EXTRACTION OF PERFORMANCE-RELEVANT SYSTEM INFORMATION

collection of performance measurements from the relevant locations of the application system. This chapter focuses on the representation of higher the application system. While time series represent summary statistics (e.g., counts, percentile, etc.) over time, execution traces provide a detailed representation of the application-internal control flow that results from individual system requests.

From this data, architectural information, including logical and physical deployments and interactions (topology), can be extracted. For all cases, we will highlight examples and use cases in the context of APM level performance-relevant information about the system and their end-users that can be extracted from this data and that is used for APM visualization and reasoning, as detailed in the next chapters. Notably, we will focus on three commonly used representations, namely time series, execution traces, and augmented information about the architecture.

When depicting the number of users accessing a system, time series usually show a periodic pattern, e.g., based on the weekdays and the hours of the day. Other interesting patterns are spikes, for instance, indicating peaks in workload or hiccups.

EXECUTION TRACES

A data structure commonly used in APM for this purpose is an execution trace. Informally, an execution trace is a representation of the execution flow of a request through the system–ideally starting from the end user..

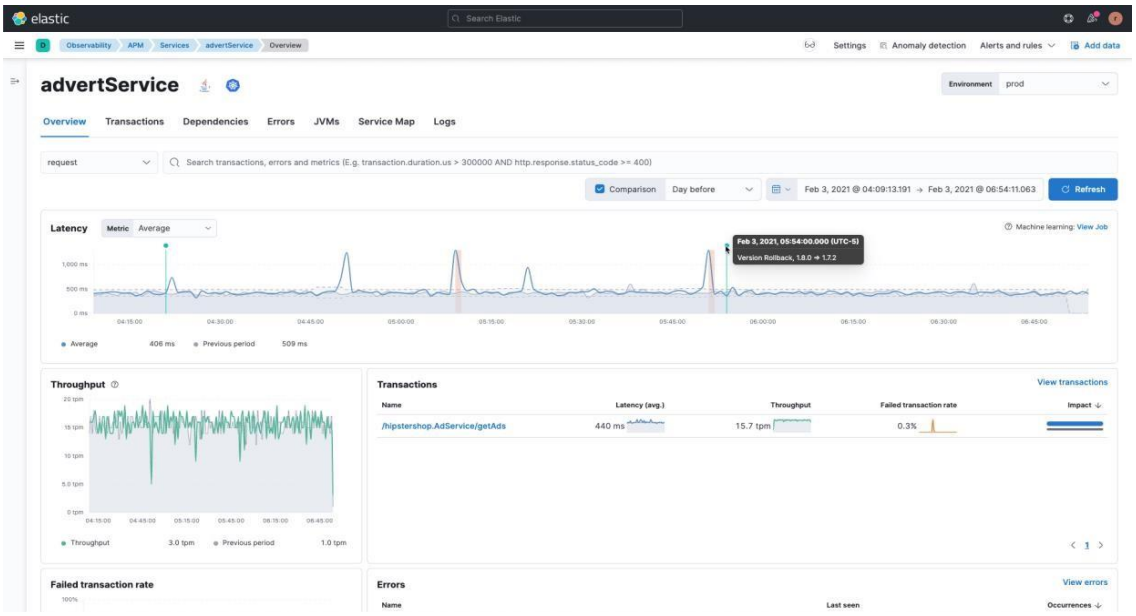
The execution trace starts with an operation called do Filter that is commonly found as an entry point in web-based applications. It can be observed that the execution of the do Filter operation includes a sequence of additional nested operation executions, until the list operation performs a sequence of calls to a database.

In addition to the execution flow, capturing components (e.g., Java classes or microservices) and operations, and locations (e.g., application server, IP address), execution traces usually include further measurements. One type of performance measurement commonly found in execution traces is the response time (or duration) of each operation execution.

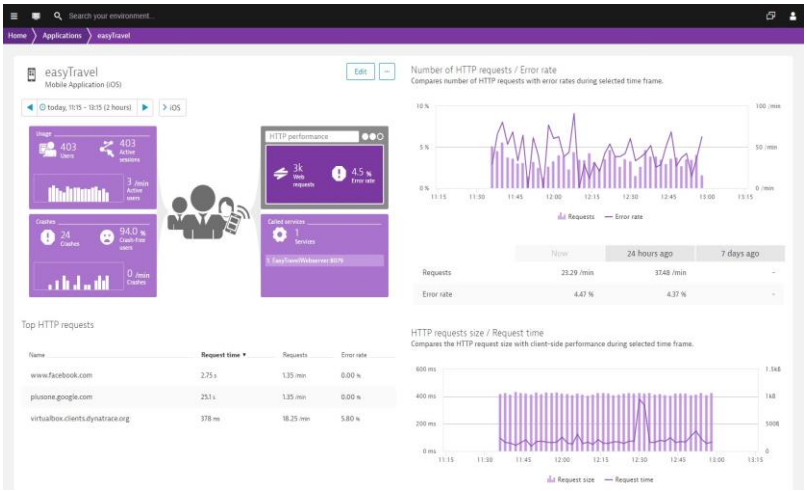
In the example, the response time for each operation execution is included in the second column. Moreover, execution traces may include information such as the parameters of the operation executions.

ARCHITECTURAL INFORMATION

Time series and execution traces allow to analyze the chronological order of performance measurements and of individual requests respectively. This information is commonly used to derive and represent performance-relevant architectural information of a system. The architecture of a system includes structural and dynamic information. Examples for structural information are the existence and deployment of software and hardware components.



The dynamic information includes interactions (e.g., number of calls, average response times) between components and associated information about the runtime behavior, e.g., a health state or time series. In Chapter 4 we include example of performance-augmented architectural information. This representation is useful to have an overall state of the system and it provides a basis for a detailed manual or automated.



Benefits or Advantages of IoT based Water Quality Monitoring System

Following are the benefits or advantages of IoT based Water Quality Monitoring System are as follows.

➤The boat is mobile in nature and hence large number of samples are easily collected from different locations in less time.

➤It is very easy to maintain the IoT based water quality monitoring system as all the electronic boards are available in the boat itself.

➤The system is very cheap as the hardware and software does not cost much.

➤Machine learning techniques have made it very easy to plot the data collected in various formats for proper analysis.

➤Cloud storage platforms such as IBM CLOUD,azure helps in storing the sensor data immediately and wirelessly to the robust servers.

Disadvantages of IoT based Water Quality Monitoring System

Following are the disadvantages of IoT based Water Quality Monitoring System are as follows.

➤the system cannot provide real time monitoring of water parameters

➤For trouble shooting the system technicians is required and this process might take some time

Water pollution is one of the biggest threats to all living beings. Polluted water causes various diseases in humans, plants, animals, which, in turn, negatively impact the life cycle of the ecosystem. If the contamination is detected early on, suitable measures can be taken to preserve water quality or even upgrade it.

Therefore, Smart Water Quality Monitoring using IoT is paramount to supply pure water in real-time. Thanks to innovation in sensors, wireless modules, and communication devices, the activity is easy.

Source Code: [Real-Time River Water Quality Monitoring and Control System]

GitHub Link: ***Project Documents***