IBM - NALAIYA THIRAN

PROJECT DOCUMENTATION
on
REAL-TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM

Submitted by

VIMALKARTHIK J	**AC19UCS137**
VINAYAGA MOORTHY R	**AC19UCS138**
VISHAL K	**AC19UCS139**
CHARAN ROHITH D	**AC19UCS146**

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ADHIYAMAAN COLLEGE OF ENGINEERING

DR. M.G.R NAGAR, HOSUR-635130

REPO ID: IBM-Project-12889-1659498368

TEAM ID: PNT2022TMID08054

FACULTY MEMBER: V Kalaivani

INDUSTRIAL MEMBER: Bharadwaj

TABLE OF CONTENTS

CHAPTER 1
INTRODUCTION

1.1 Overview

Water is the primary need of all living beings and living without water is impossible.With the advancement of technology and industrialization, environmental pollution has become a major concern.Water pollution is one of the most serious types of this environmental pollution. Pollution will degrade the quality and purity of water.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.

1.2 Purpose

This project aims to obtain a water monitoring system with high frequency, high mobility, and low power. Therefore, our system will immensely help populations to become conscious against contaminated water as well as to stop polluting the water.

CHAPTER 2

LITERATURE SURVEY

2.1 Existing problem

- Existing system has mechanisms which are semi-automated or manually controlled devices which are handled by a person responsible for monitoring the water quality.
- There is a need to have human intervention in taking various reading parameters.

2.2 References

Water quality monitoring system:
https://www.ripublication.com/awmc17/awmcv10n5_24.pdf

IOT Based Water Quality Monitoring System:
https://ijsrcseit.com/CSEIT1831361

Water Quality Monitoring System Implemented With IoT:
http://www.warse.org/IJETER/static/pdf/file/ijeter29972021.pdf

IoT Based Real-time River Water Quality Monitoring System:
https://www.sciencedirect.com/science/article/pii/S1877050919309391

2.3 Problem Statement Definition

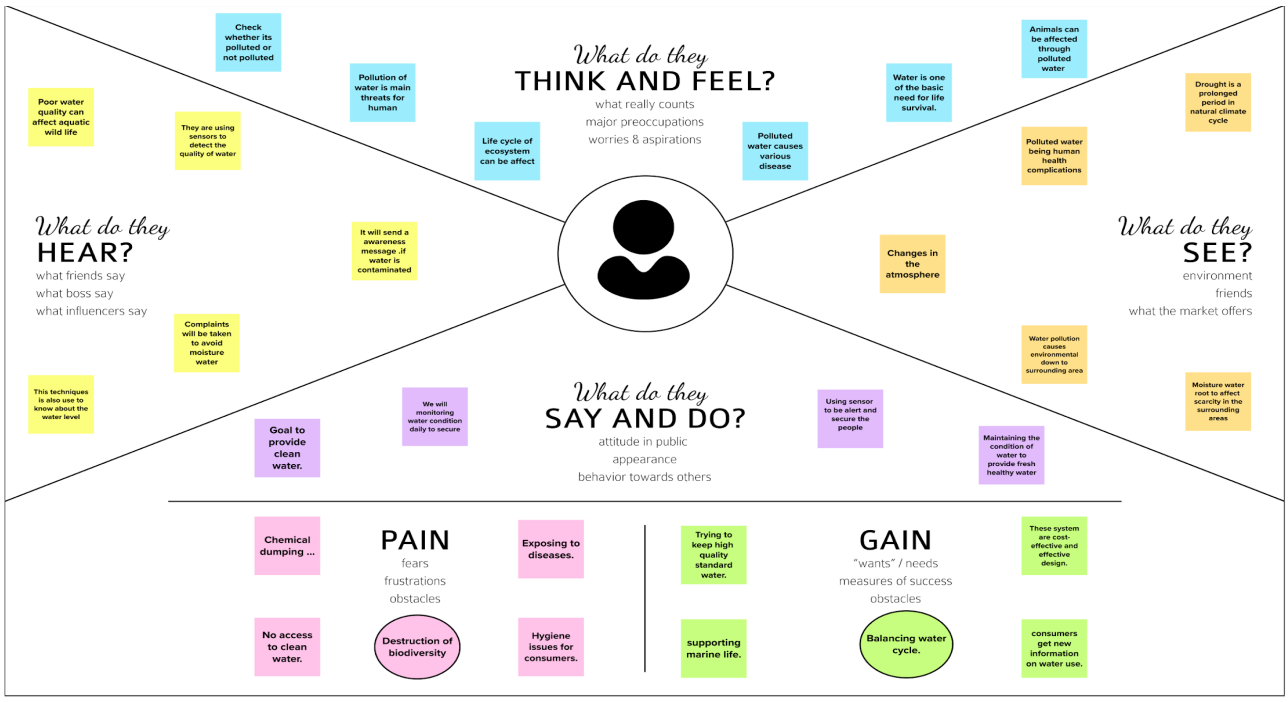
Achieving and maintaining suitable water quality is one of the important parameters to ensure health and well-being of the human as well as ecosystems. Among the various aquatic ecosystems, riverine ecosystems are more prone to pollution and therefore need to be monitored frequently and on regular time intervals. In this context, a real-time water quality monitoring system offers an excellent opportunity to keep track of the water quality on a continuous basis; which not only helps to identify the affected location and pollution source, but also creates alerts enabling the authorities to take immediate action. One such real-time water quality monitoring system was installed in the River Ganga (India), considering the fragility and significance of the Gangetic ecosystem. In this paper, we have presented the details of the real-time water quality monitoring system installed in River Ganga and results obtained through it for various parameters. The results have also been compared with the standard values. Additionally, based on this preliminary investigation, limitations and recommendations have also been presented to further enhance the utility of the system.

CHAPTER 3
IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviors and attitudes. It is a useful tool to help teams better understand their users.

Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.

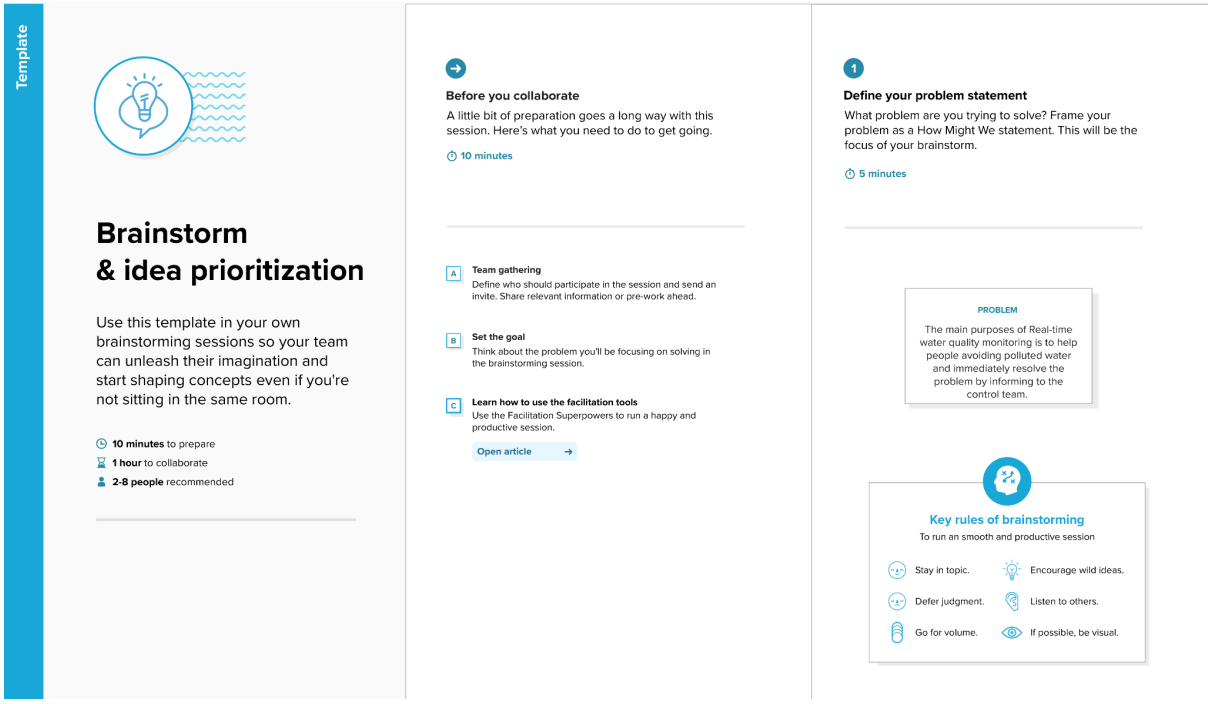


3.2 Ideation & Brainstorming

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions. 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.

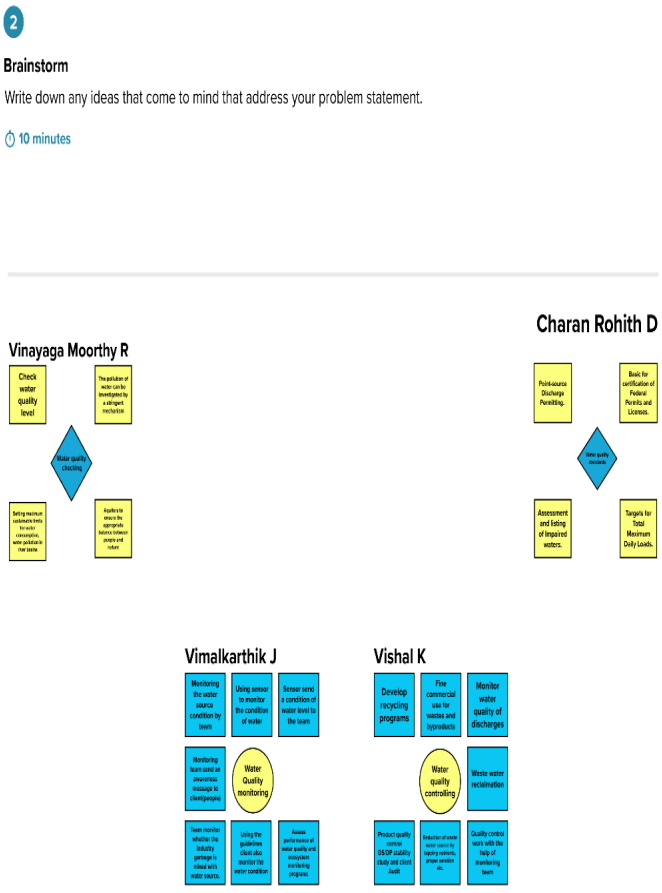
Step-1: Team Gathering, Collaboration and Select the Problem Statement

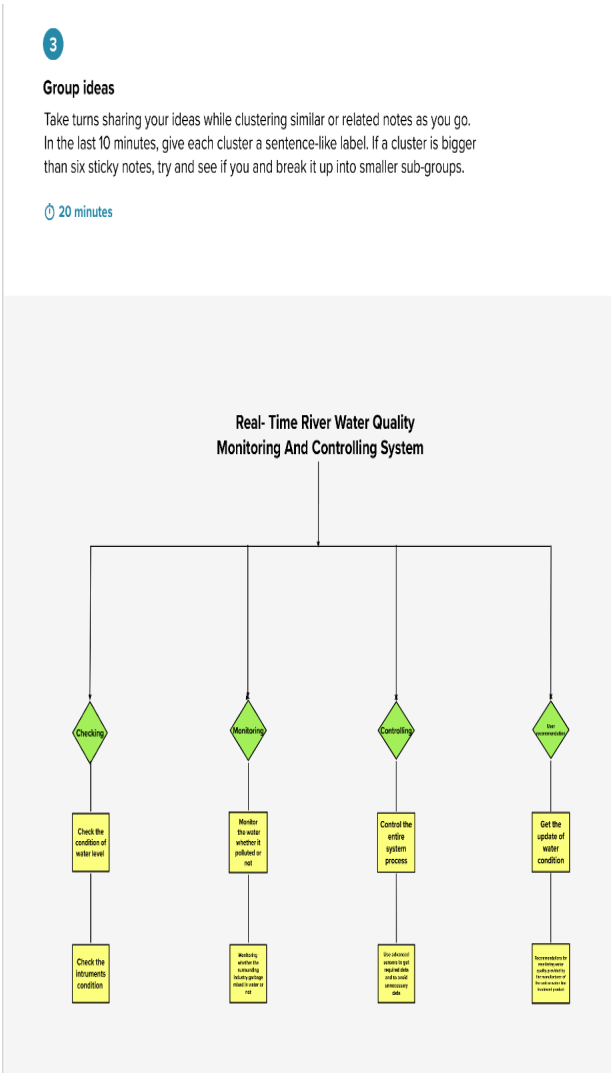
In this step team members gather and provide their ideas and collaborate those ideas and select their problem statement.The ideas should be relevant to their problem statement.



Step-2: Brainstorm, Idea Listing and Grouping

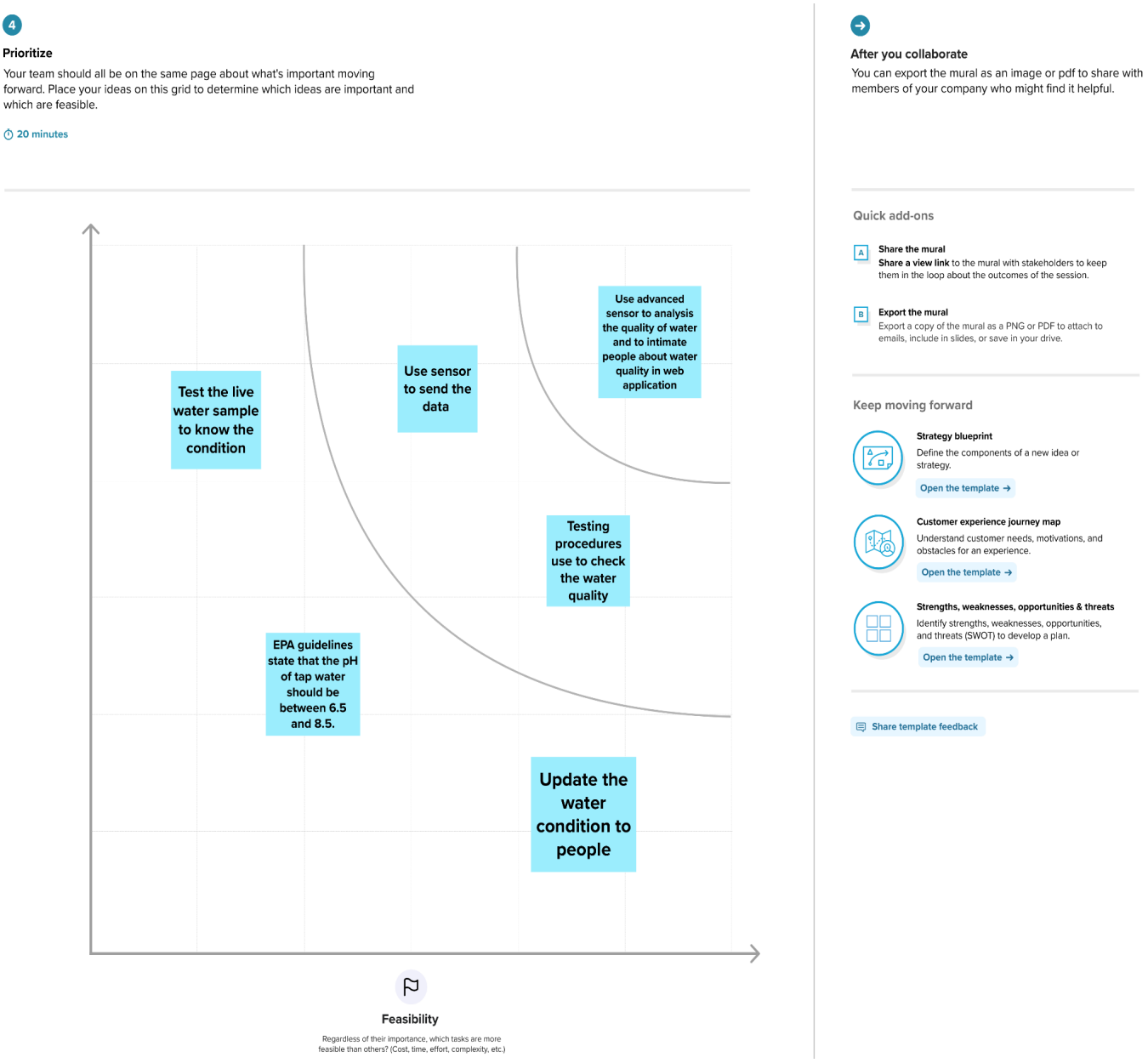
In this step they put their ideas and views which are prioritized based on their importance and the ideas are grouped.These ideas are categorized according to their relevant classifications.





Step-3: Idea Prioritization

As mentioned, idea prioritization is just a part of the idea management process. Having a structured idea management process and a systematic way of gathering, evaluating and prioritizing new ideas takes time. To make it work, the entire idea management process should be integrated into everyday ways of working.



3.3 Proposed Solution:

- **Problem Statement:**

To monitor the real time river water quality with the help of a control system.

- **Idea / Solution description:**

By using an Arduino with a water based sensor it detects the water quality and alerts the authority to announce whether the water is good or bad for localities.

- **Novelty / Uniqueness:**

We use the web application to present the water condition and announce the awareness message.

- **Social Impact / Customer Satisfaction:**

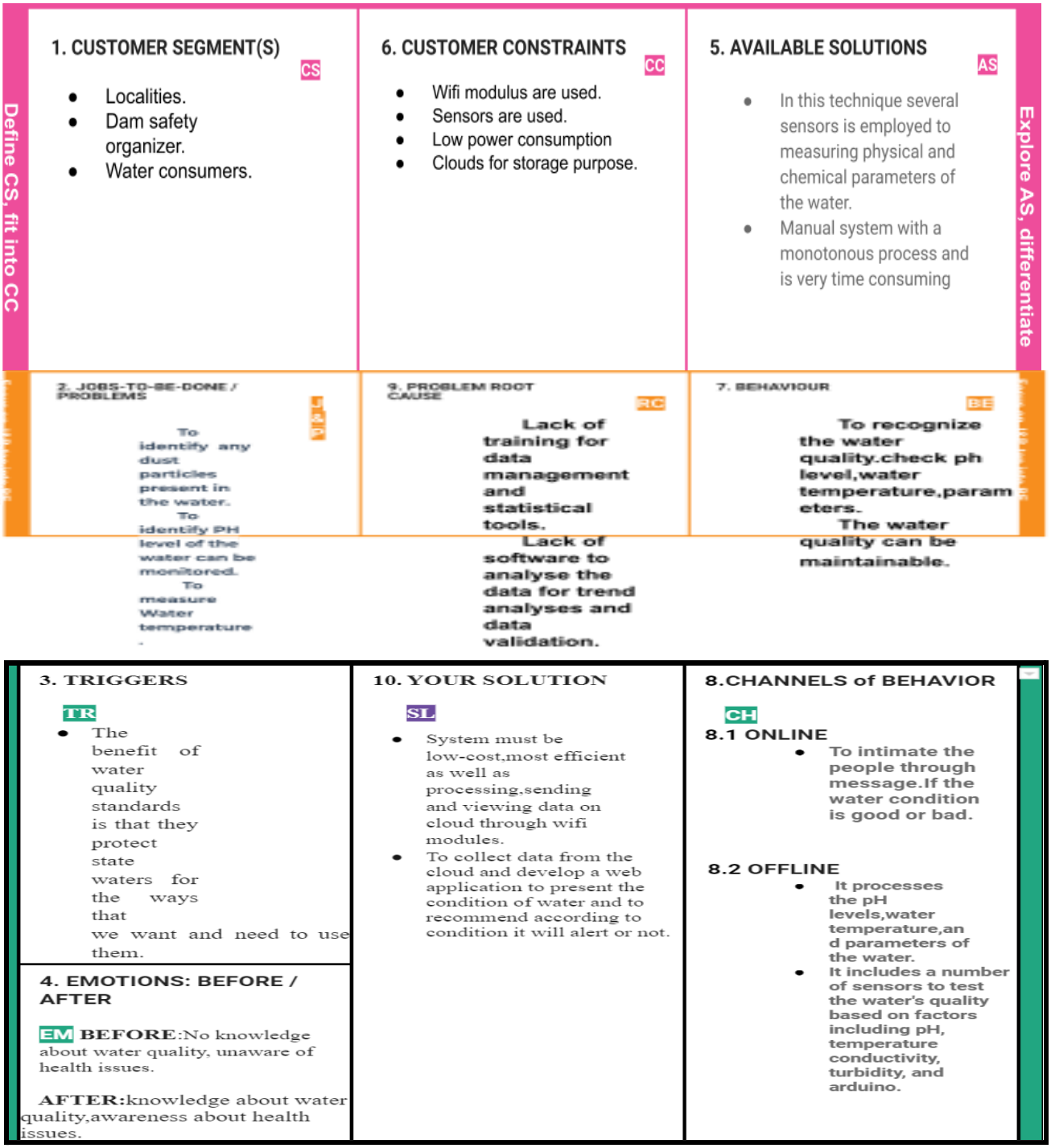
Save water and river resources from the polluted water and impure water.

- **Business Model (Revenue Model):**
  - ➔ By without using: The water resource will be spoiled without maintenance.
  - ➔ By using: Get the healthy water and good environment

- **Scalability of the Solution:**

It is well organized to provide pure water for the people and used for farming.

3.4 Problem Solution fit:



CHAPTER 4
REQUIREMENT ANALYSIS

4.1 Functional requirement

Following are the functional requirements of the proposed solution

FR-1

Functional Requirement (Epic) - User Requirement

Sub Requirement (Story / Sub-Task) - Monitoring water quality, water flow and temperature to control water pollution and algal bloom.

FR-2

Functional Requirement (Epic) - User Registration

Sub Requirement (Story / Sub-Task) - Manual Sign-Up using a website or Gmail.

FR-3

Functional Requirement (Epic) - User Confirmation

Sub Requirement (Story / Sub-Task) - OTP authentication through phone messages, email, notices, paper and confirmation.

FR-4

Functional Requirement (Epic) - Product Implementation

Sub Requirement (Story / Sub-Task) - Installing the product to monitor water quality for checking the confirmation by using websites.

FR-5

Functional Requirement (Epic) - Payment option

Sub Requirement (Story / Sub-Task) - Bank transfer,Debit cards,UPI Method.

FR-6

Functional Requirement (Epic) - Product Feedback

Sub Requirement (Story / Sub-Task) - Through the websites, phone conversation, and Gmail.

4.2 Non-Functional requirements

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

NFR-1

Non-Functional Requirement - Usability

Description - This application is used to describe the product and easy to access the product by the guidelines.

NFR-2

Non-Functional Requirement - Security

Description - This application security ensures the website by building a firewall and two step verification. Only can access by authorization person by given user id and password or otp verification.

NFR-3

Non-Functional Requirement - Reliability

Description - To maintain the product conditions and update the version of the product is up-to-date. System update and software update are possible to increase various features and durability.

NFR-4

Non-Functional Requirement - Performance

Description - This application collects the data of river water to provide accurate value. Using this method, we can alert the locality right on time. This application is user friendly and can be accessed by both end-users and management.

NFR-5

Non-Functional Requirement - Availability

Description - Depending on the requirement of the user, all required functions will be offered. when the user requests a feature or makes a message, all features made available in places where users like to know about it.

NFR-6

Non-Functional Requirement - Scalability

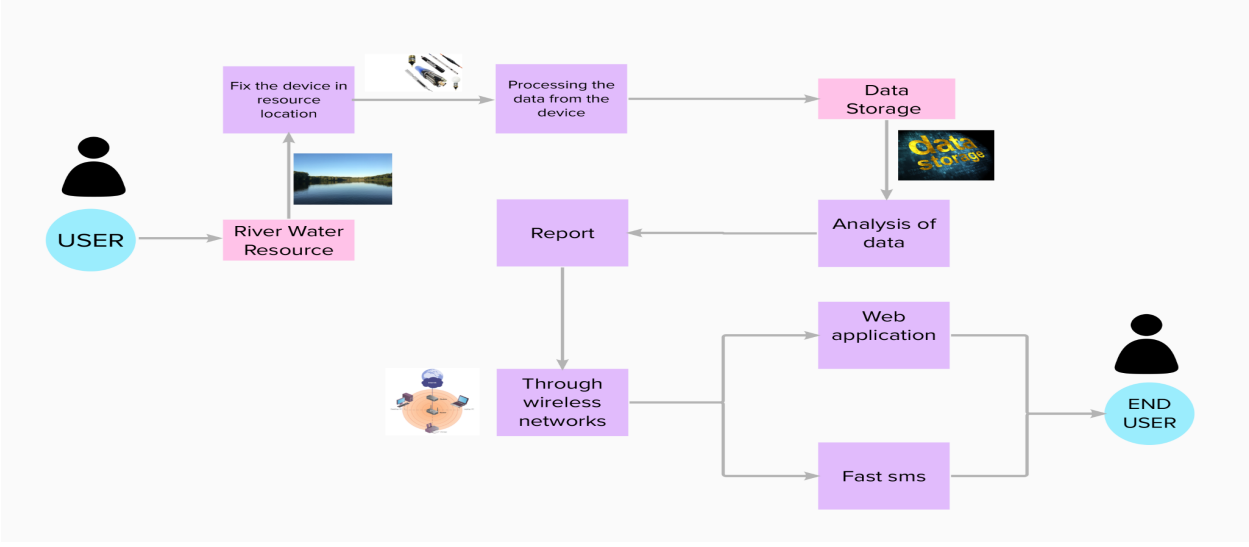
Description - Regardless of size, the product must fill the entire river's space.The product is based on monitoring water quality, flow, humidity, and temperature as well as controlling algal blooms.

CHAPTER 5
PROJECT DESIGN

5.1 Data Flow Diagrams

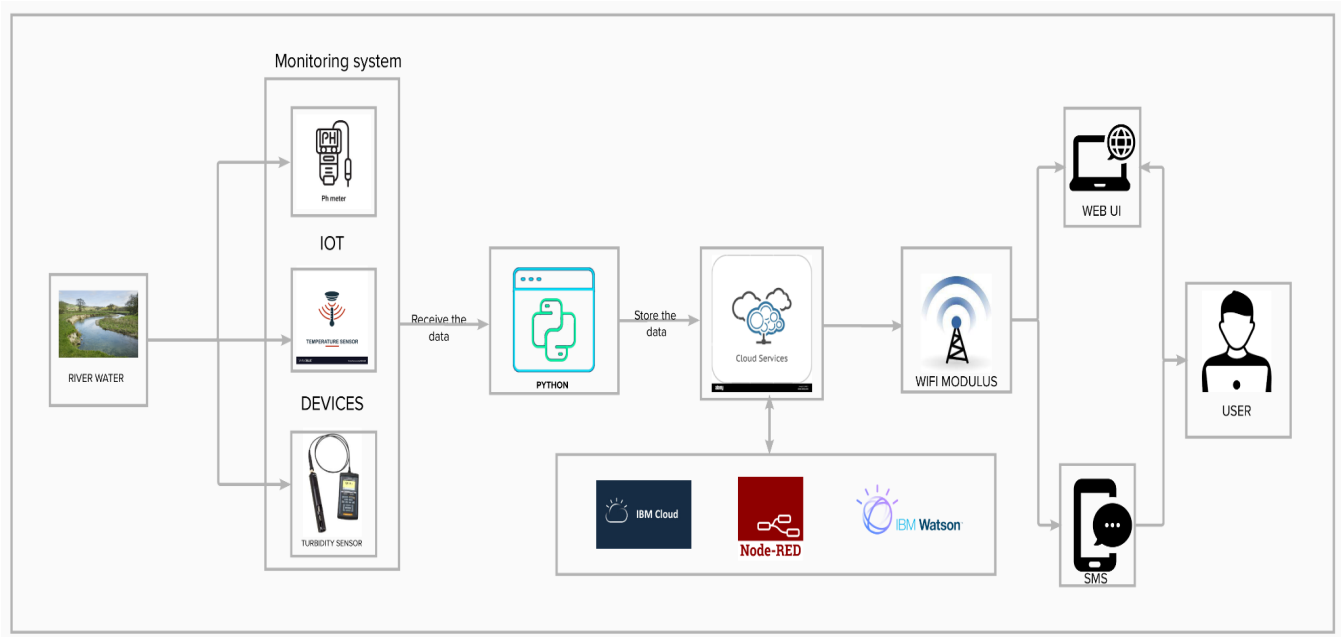
A data flow diagram shows the way information flows through a process or system. It includes data inputs and outputs, data stores, and the various sub processes the data moves through. DFDs are built using standardized symbols and notation to describe various entities and their relationships.

A data flow diagram (DFD) maps out the flow of information for any process or system. It uses defined symbols like rectangles, circles and arrows, plus short text labels, to show data inputs, outputs, storage points and the routes between each destination. Data flowcharts can range from simple, even hand-drawn process overviews, to in-depth, multi-level DFDs that dig progressively deeper into how the data is handled. They can be used to analyze an existing system or model a new one. Like all the best diagrams and charts, a DFD can often visually "say" things that would be hard to explain in words, and they work for both technical and nontechnical audiences, from developer to CEO. That's why DFDs remain so popular after all these years.

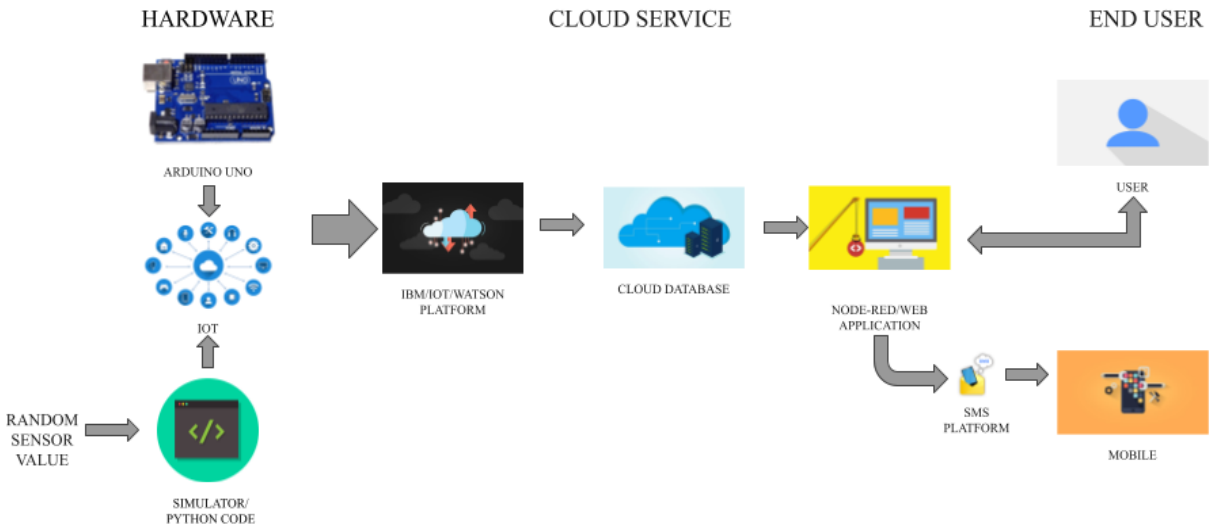


5.2 Solution & Technical Architecture

Technical architecture:



Solution architecture:



5.3 User Stories

Sprint-1

USN-1 :

User Story / Task : The device wants to maintain clean river water for a good environment.

Priority : High

USN-2 :

User Story / Task : To maintain the river water always to be clean

Priority : High

USN-3 :

User Story / Task : A farmer who raises crops for planting and yielding

Priority : High

USN-4 :

User Story / Task : 12% of water is needed for manufacturing business like paint and coating.

Priority : High

Sprint-2

USN-5 :

User Story / Task : Government forms NSS camps in each school and college for monthly once to clean the river water.

Priority : Medium

Sprint-3

USN-6 :

User Story / Task : As a user, I can register for the application by entering my email, password, and confirming my password. To get details about river water.

Priority : High

Sprint-4

USN-7 :

User Story / Task : As a user, we can receive a message from the administration about conditions of river water.

Priority : High

CHAPTER 6

PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

Sprint-1

USN-1 :

User Story / Task : As a user, I can register for the application by entering my email, password, and confirming my password

Priority : High

Story Points : 2

Team Members : Vinayaga Moorthy R, Vimalkarthik J

USN-2 :

User Story / Task : As a user, I can register for the application through Facebook

Priority : Low

Story Points : 2

Team Members : Vishal K, Charan Rohith D

USN-3 :

User Story / Task : As a user,I can register through the gmail or email

Priority : Low

Story Points : 2

Team Members : Vinayaga Moorthy R, Vishal K

Sprint-2

USN-4 :

User Story / Task : As a user, I will receive confirmation email once I have registered for the application

Priority : High
Story Points : 2
Team Members : Charan Rohith D, Vimalkarthik J

USN-5 :

User Story / Task : As a user, I can log into the application by entering email & password

Priority : High
Story Points : 2
Team Members : Vishal K, Vimalkarthik J

Sprint-3

USN-6 :

User Story / Task : As a user,I can view the sensor readings
Priority : High
Story Points : 2
Team Members : Vinayaga Moorthy R, Charan Rohith D

USN-7 :

User Story / Task : As a user, I can register for the application by entering my email, password, and confirming my password

Priority : Medium
Story Points : 2
Team Members : Vinayaga Moorthy R, Vimalkarthik J

Sprint-4

USN-8 :

User Story / Task : As a user,I get the notification about the water quality conditions.

Priority : High
Story Points : 2
Team Members : Charan Rohith D, Vishal K

USN-9 :

User Story / Task : As a user, I can get the messages about the water quality conditions.

Priority : High

Story Points : 2

Team Members : Vinayaga Moorthy R, Vimalkarthik J

6.2 Sprint Delivery Schedule

Sprint-1

- **Total Story Points -** 6
- **Duration -** 6 Days
- **Sprint Start Date -** 24 Oct 2022
- **Sprint End Date (Planned) -** 29 Oct 2022
- **Story Points Completed (as on Planned End Date) -** 6
- **Sprint Release Date (Actual) -** 29 Oct 2022

Sprint-2

- **Total Story Points -** 4
- **Duration -** 6 Days
- **Sprint Start Date -** 31 Oct 2022
- **Sprint End Date (Planned) -** 05 Nov 2022
- **Story Points Completed (as on Planned End Date) -** 4
- **Sprint Release Date (Actual) -** 31 Oct 2022

Sprint-3

- **Total Story Points -** 6
- **Duration -** 6 Days
- **Sprint Start Date -** 07 Nov 2022
- **Sprint End Date (Planned) -** 12 Nov 2022
- **Story Points Completed (as on Planned End Date) -** 6
- **Sprint Release Date (Actual) -** 07 Nov 2022

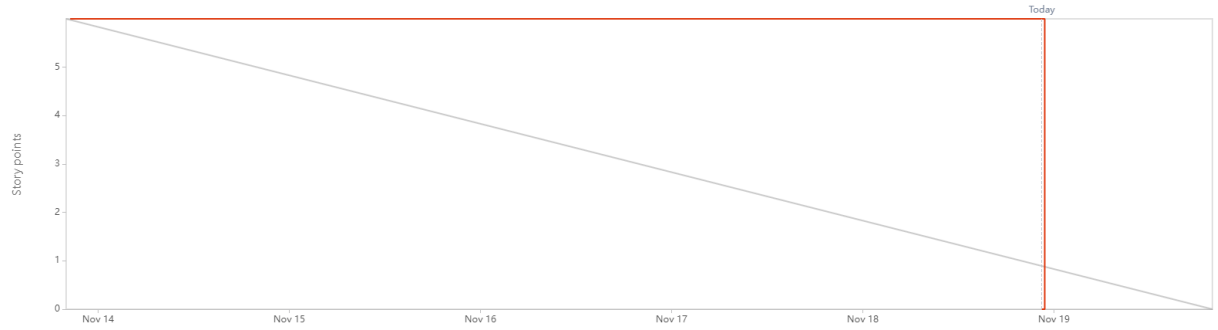
Sprint-4

- **Total Story Points -** 6
- **Duration -** 6 Days
- **Sprint Start Date -** 14 Nov 2022
- **Sprint End Date (Planned) -** 19 Nov 2022
- **Story Points Completed (as on Planned End Date) -** 6
- **Sprint Release Date (Actual) -** 14 Nov 2022

6.3 Reports from JIRA

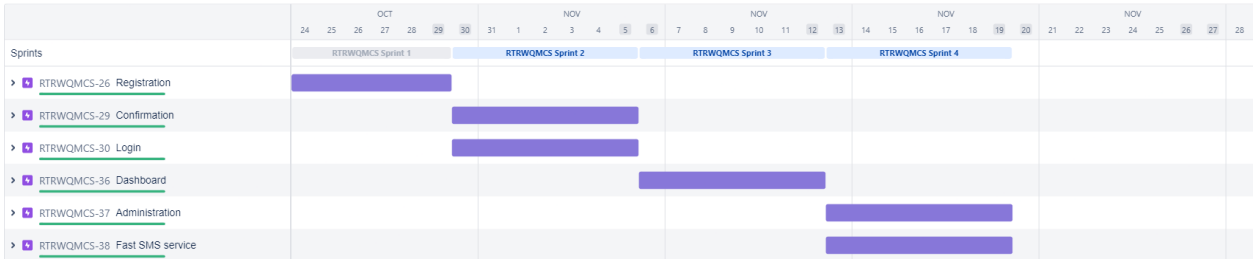
Burndown chart report :

A burndown chart is a graphical representation of work left to do versus time and completed work.It is often used in agile software development methodologies such as scrum,jira.However burndown charts can applied to any project containing measurable time.



Roadmap report :

It provides the details about the project completion status ,the work yet to be completed in four ways like days,months,weeks,quarters.



CHAPTER 7

CODING & SOLUTIONING

7.1 Feature 1

Details Acquisition feature

Here the user can get their details regarding their water quality and they can get into a conclusion with the help of data.

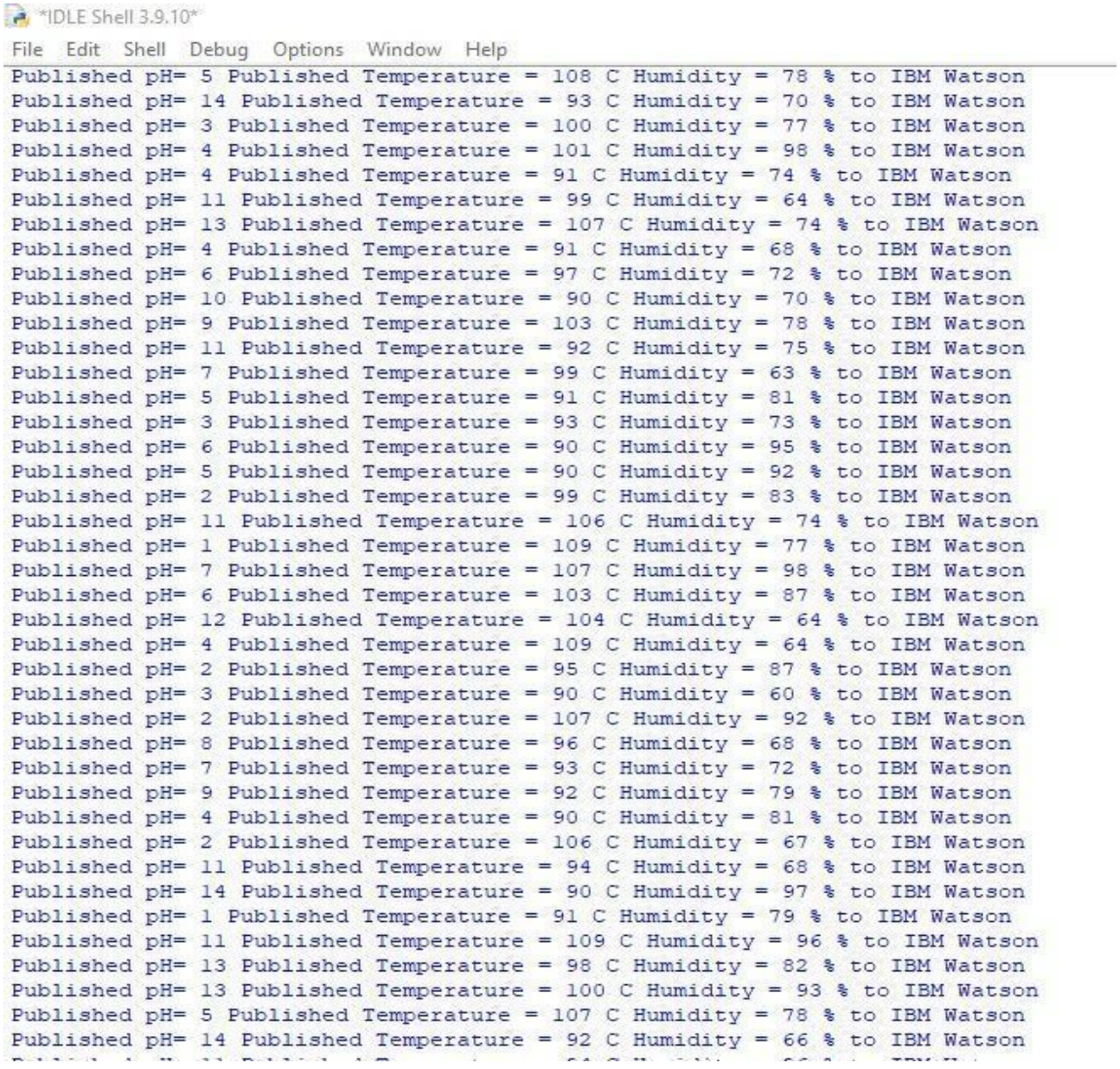
CODE

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random
from twilio.rest import Client
#Provide your IBM Watson Device Credentials
organization = "uyyqeq"
deviceType = "12345"
deviceId = "12345"
authMethod = "token"
authToken = "12345678"
# Initialize GPIO
def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
```

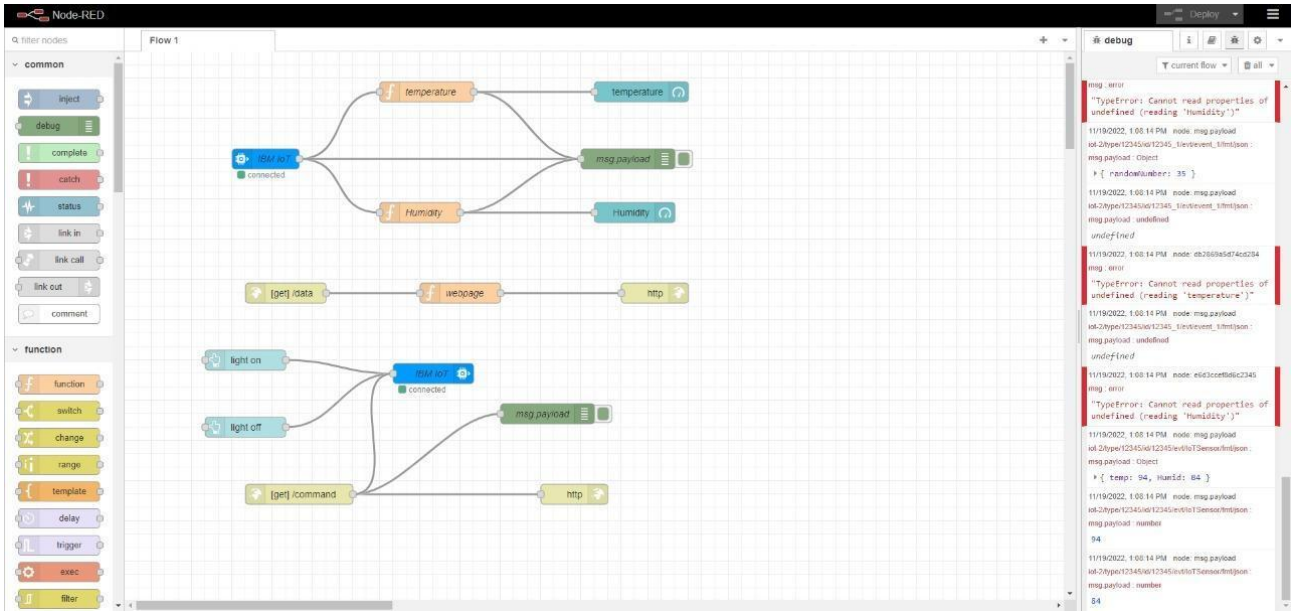
```
    if status=="lighton":
        print ("led is on")
    elif status == "lightoff":
        print ("led is off")
    else :
        print ("please send proper command")

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

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

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

while True:
        #Get Sensor Data from DHT11
        pH = random.randint(1, 14)
        temp=random.randint(90,110)
        Humid=random.randint(60,100)
```

```
        data = {'pH': pH, 'temp' : temp, 'Humid': Humid }
        def SMS():
            message = Client.messages.create(
            body="ALERT!! THE WATER QUALITY IS DEGRADED",
            from_=keys.twilio_number,
            to = keys.target_number)
            print(message.body)
            if temperature>70 or pH<6 or Humidity>500:
                SMS()
        #print data
        def myOnPublishCallback():
              print ("Published pH= %s" % pH,"Published Temperature = %s C" % temp,
"Humidity = %s %%" % Humid, "to IBM Watson")

                    success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
        if not success:
            print("Not connected to IoTF")
        time.sleep(10)

        deviceCli.commandCallback = myCommandCallback

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

FEATURE SCREENSHOT:



7.2 Feature 2



OUTPUT:

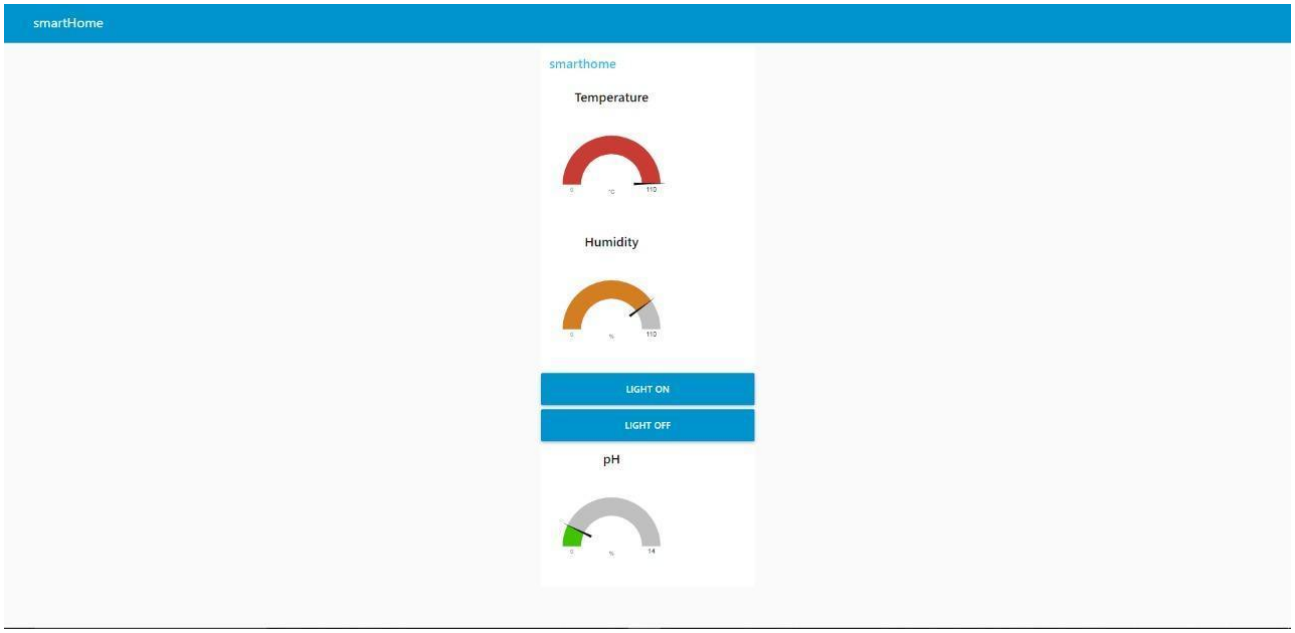
CHAPTER 8

TESTING

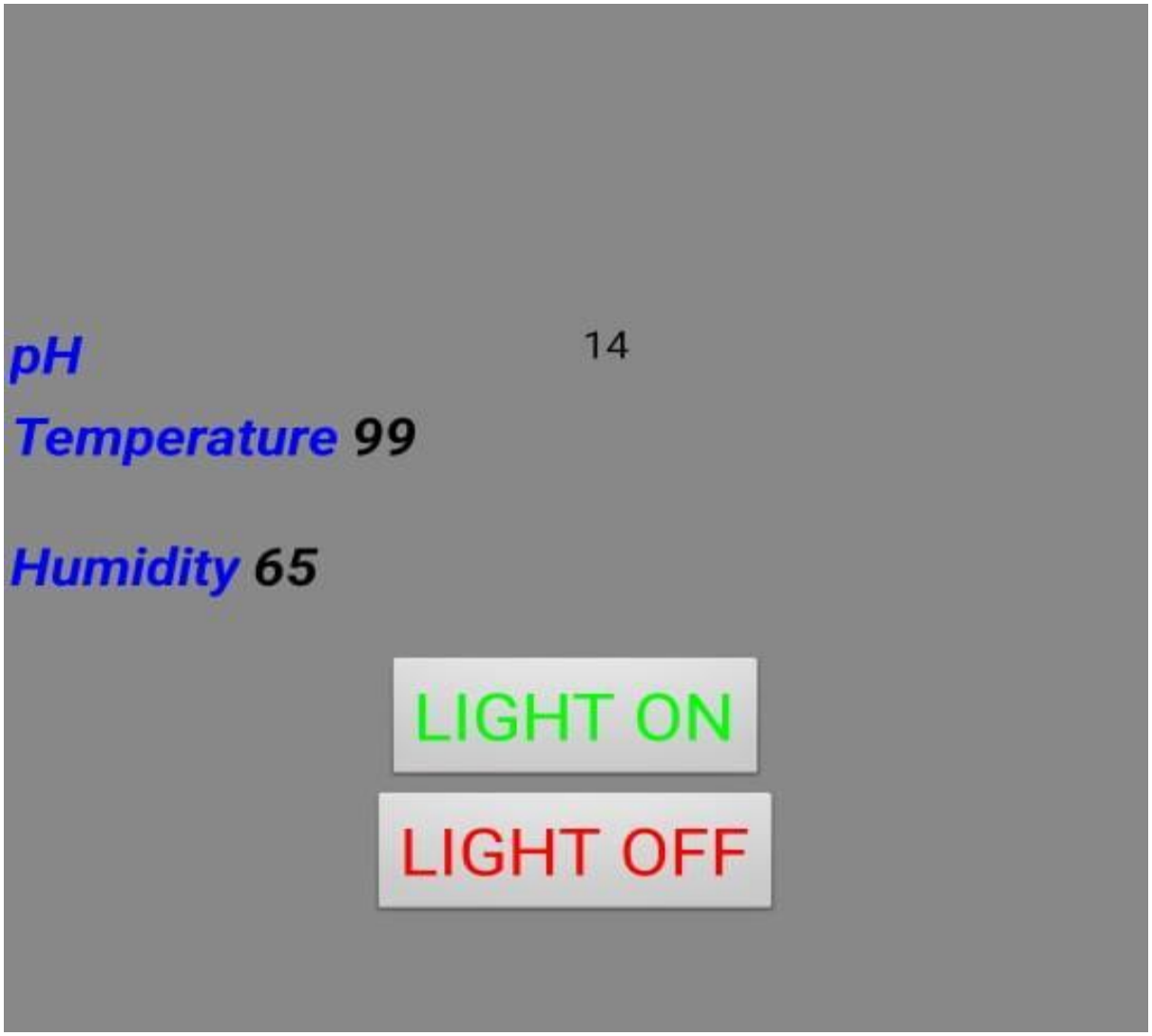
8.1 Test Cases

- We want to check the water condition whether drinkable or not based on data received.
- If the water conditions are normal and drinkable water nothing needs to be done.
- If the water conditions are not normal, water is polluted or spoiled and needs to be changed and alert the people.

8.2 User Acceptance Testing



(i) DASHBOARD



(ii) APP

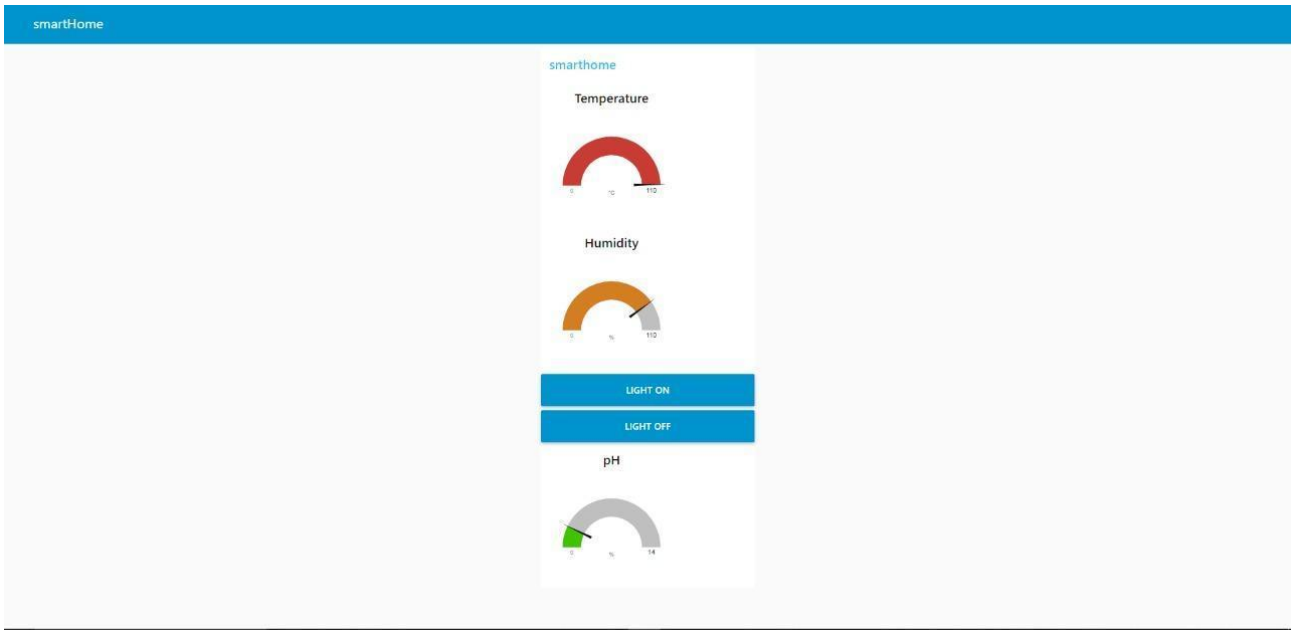
CHAPTER 9
RESULTS

9.1 Performance Metrics

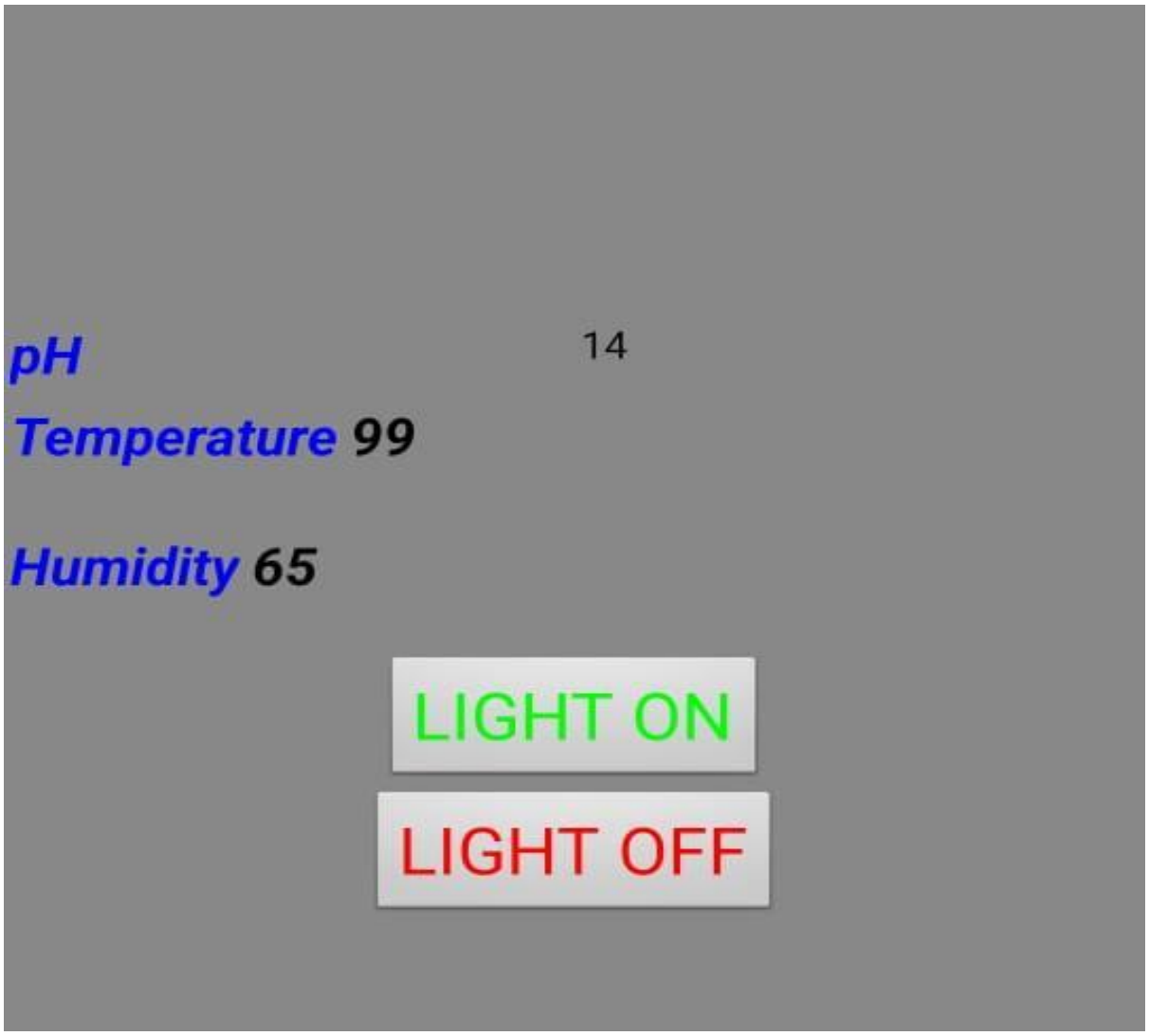
With this user interface users can easily predict the water quality based on their sensor's value and the process of alerting system and web application. Users are also able to know their water quality.

Some sample images of the output are provided below:

Sensors value of water quality in gauge:



Sensors value of water quality:



CHAPTER 10
ADVANTAGES & DISADVANTAGES

ADVANTAGES

- No need for manual collection
- Ease of use
- Cheap and quick process

DISADVANTAGES

- Collect samples manually.
- Complicated methodology.
- Time consuming.
- Low measurement precision.
- High cost.
- Lack of real-time monitoring

CHAPTER 11
CONCLUSION

Monitoring of Turbidity, PH & Temperature of Water makes use of water detection sensors with unique advantages. It is low in cost and does not require people on duty. To implement this, we need to deploy the sensor devices in the environment for collecting the data and analysis. By deploying sensor devices in the environment, we can bring the environment into real life.

This work presents a review of the recent works carried out by the researchers in order to make water quality monitoring systems smart, low powered and highly efficient such that monitoring will be continuous and alerts/notifications will be sent to the concerned authorities for further processing.

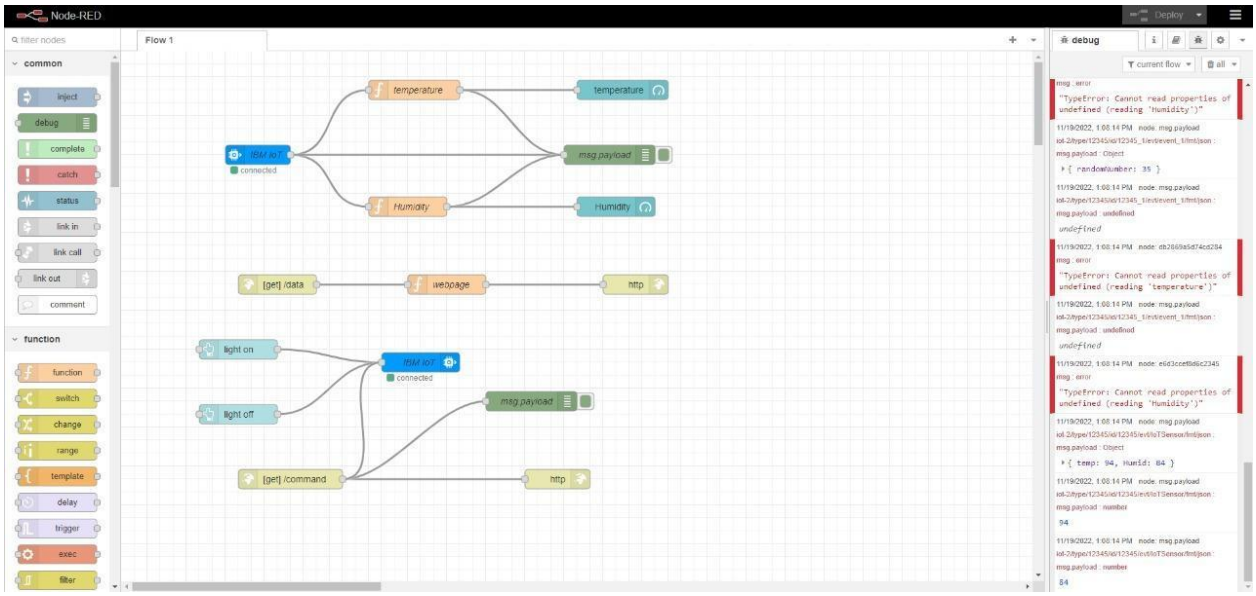
CHAPTER 12
FUTURE SCOPE

- In the future we will use more IOT concepts in this project.
- Detecting the more parameters for the most secure purpose.
- Increase the parameters by addition of multiple sensors.
- By interfacing the relay we control the supply of water.

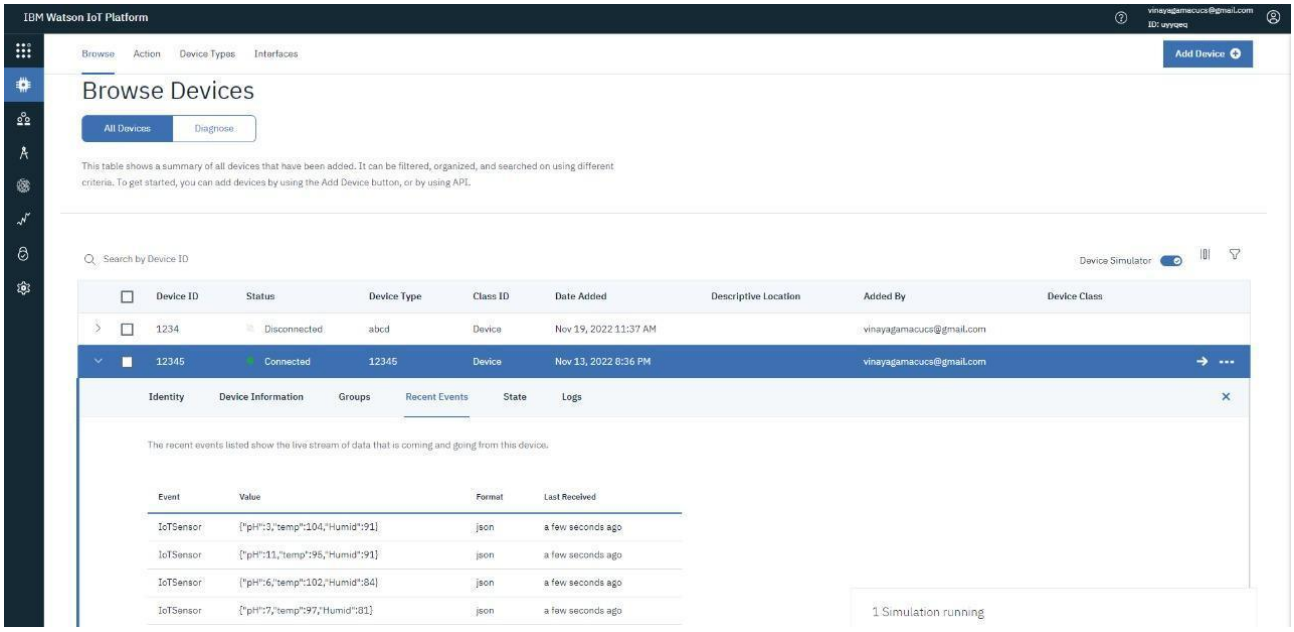
CHAPTER 13

APPENDIX

NODE-RED CONFIGURATION:



IBM IOT WATSON PLATFORM:



SOURCE CODE:

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random
from twilio.rest import Client
#Provide your IBM Watson Device Credentials
organization = "uyyqeq"
deviceType = "12345"
deviceId = "12345"
authMethod = "token"
authToken = "12345678"
# Initialize GPIO
def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="lighton":
        print ("led is on")
    elif status == "lightoff":
        print ("led is off")
    else :
        print ("please send proper command")
```

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

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

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

while True:
       #Get Sensor Data from DHT11
       pH = random.randint(1, 14)
       temp=random.randint(90,110)
       Humid=random.randint(60,100)

       data = {'pH': pH, 'temp' : temp, 'Humid': Humid }
       def SMS():
          message = Client.messages.create(
          body="ALERT!! THE WATER QUALITY IS DEGRADED",
          from_=keys.twilio_number,
          to = keys.target_number)
          print(message.body)
```

```
        if temperature>70 or pH<6 or Humidity>500:
            SMS()
    #print data
    def myOnPublishCallback():
        print ("Published pH= %s" % pH,"Published Temperature = %s C" % temp,
"Humidity = %s %%" % Humid, "to IBM Watson")

            success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
    if not success:
        print("Not connected to IoTF")
    time.sleep(10)

    deviceCli.commandCallback = myCommandCallback

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

GITHUB:

https://github.com/IBM-EPBL/IBM-Project-12889-1659498368

DEMO LINK:

https://drive.google.com/file/d/1thUZNpT1F6hU293UiOum5W2sn1ZpSBNx/view?usp=share_link