

PROJECT REPORT

Real-Time River Water Quality Monitoring And Control System

TEAM ID:PNT2022TMID33019

1.INTRODUCTION

1.1.PROJECT OVERVIEW

The environment around consists of five key elements e.g., soil, water, climate, natural vegetation, and landforms. Among these water is the utmost crucial element for human life. It is also vital for the persistence of other living habitats. Whether it is used for drinking, domestic use, and food production or recreational purposes, safe and readily available water is the need for public health . So it is highly imperative for us to maintain water quality balance. Otherwise, it would severely damage the health of the humans and at the same time affect the ecological balance among other species. Water pollution is a foremost global problem which needs ongoing evaluation and adaptation of water resource directorial principle at the levels of international down to individual wells. It has been studied that water pollution is the leading cause of mortalities and diseases worldwide. The records show that more than 14,000 people die daily worldwide due to water pollution. In many developing countries, dirty or contaminated water is being used for drinking without any proper prior treatment. One of the reasons for this happening is the ignorance of public and administration and the lack of water quality monitoring system which makes serious health issues

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 is everywhere starting from smart cities, smart power grids, and smart supply chain to smart wearable. 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 pollution, monitor snow level, prevent landslide, and avalanche etc. Moreover, it can be implemented in the field of water quality monitoring and controlling system. 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. In this research, we monitor the physical and chemical parameters of water bodies inside Chittagong city by using an IoT based sensor network.

1.2.PURPOSE

The main aim is to develop a system for continuous monitoring of river water quality at remote places using wireless sensor networks with low power consumption, low-cost and high detection accuracy. pH, conductivity, turbidity level, etc. are the limits that are analyzed to improve the water quality. Following are the aims of idea implementation (a) To measure water parameters such as pH, dissolved oxygen, turbidity, conductivity, etc. using available sensors at a remote place. (b) To assemble data from various sensor nodes and send it to the base station by the wireless channel. (c) To simulate and evaluate quality parameters for quality control. (d) To send SMS to an authorized person routinely when water quality detected does not match the preset standards, so that, necessary actions can be taken

2.LITERATURE SURVEY

2.1.EXISTING PROBLEM

It is important to monitor and maintain the PH level and turbidity of the river water. Since, the current water monitoring system is a manual system with a monotonous process and is very time consuming.

2.2.REFERENCE

1. IoT Based Real-time River Water Quality Monitoring System
Authors: Mohammad Salah Uddin Chowdury, Talha Bin Emran, Subhasish Ghosh, Abhijit Pathak, Mohd. Manjur Alam, Nurul Absar, Karl Andersson, Mohammad Shahadat Hossain.
2. Real Time Monitoring Of Water Quality Using IoT
Authors: Somnath Swain, Mayank Raj, Aman Kaushal
3. Internet of things enabled real time water quality monitoring system
Authors: S. Geetha, S. Gouthami
4. IOT Based Real-Time River Water Quality Monitoring System
Authors: Bhoomika R, Netra Jalagar, Pooja F B, Sangeetha Sontera, Shanthveeresh M S
5. The development of water quality monitoring system using internet of things
Authors: Sharifah Nurulhuda Tuan Mohd Yasin, Mohd Fauzi Mohd Yunus, Nur Bahiyah Abdul

Wahab.

6.IoT-Based Smart Water Quality Monitoring

Author:Kamal R

7.IoT Based Smart Water Quality Monitoring

Authors:Farmanullah Jan,Nasro Min-Allah,Dilek Dü,steğör

8.Review of Water Quality Monitoring using Internet of Things (IoT)

Authors:Mr. A.P. Roger Rozario AP (Sr. Gr.),R. Vijay Radha Surya,V. Sowmethran

9.IoT based smart water quality monitoring system

Author:N. Geetha

10.IoT BASED WATER QUALITY MONITORING SYSTEM

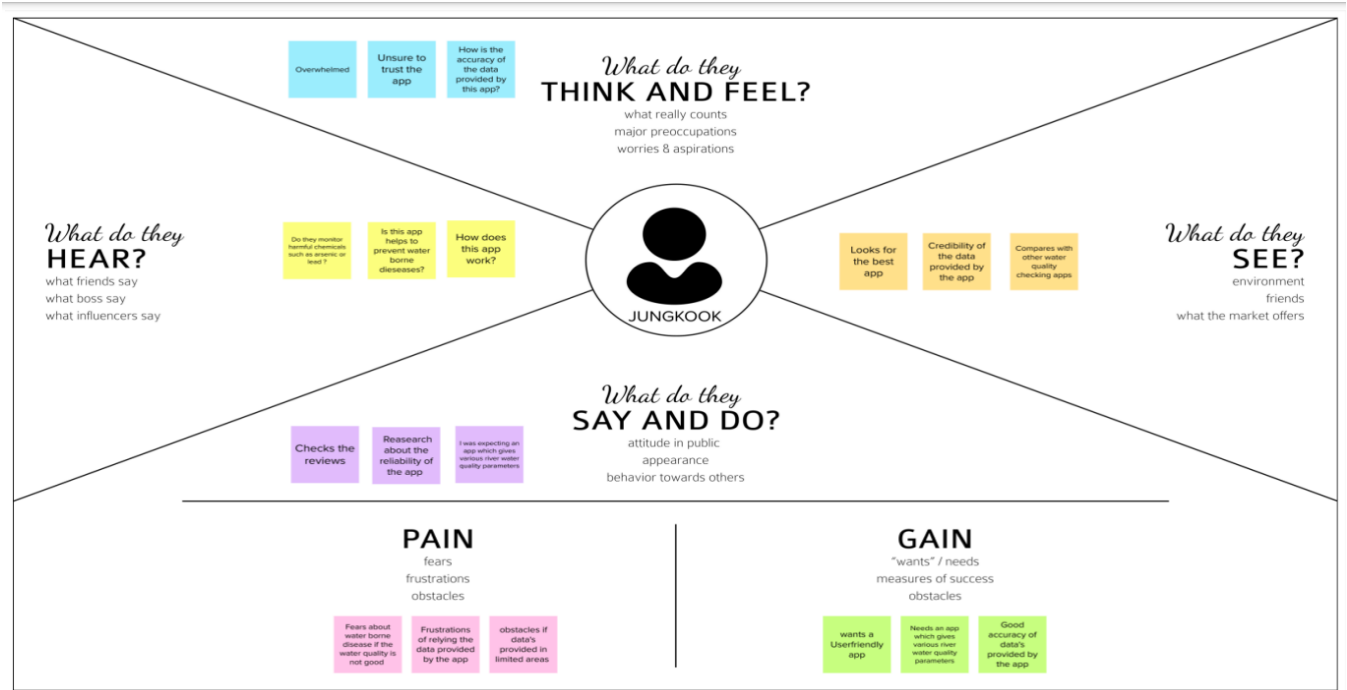
Authors:JAYTI BHATT,JIGNESH PATOLIYA

2.3.PROBLEM STATEMENT DEFINITION

Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	A Local Resident	Be a Responsible Citizen	I don't know what to do or where to start	<i>I'm unable to adapt to the new technology</i>	<i>Frustrated</i>
PS-1	A College Student	Create Awareness about water pollution	I don't have enough resources or technology	of insufficient data and resources of water bodies even around my own vicinity	hopeless

3.IDEATION & PROPOSED SOLUTION

3.1.EMPATHY MAP CANVAS



Reference: <https://www.mural.co/templates/empathy-map-canvas>

3.2.IDEATION & BRAINSTORMING



3.3.PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	It is important to monitor and maintain the PH level and turbidity of the river water.Since, the current water monitoring system is a manual system with a monotonous process and is very time consuming.
2.	Idea / Solution description	The continuous monitoring of river water quality at remote places using wireless sensor networks with low power consumption,low-cost and high detection accuracy of PH,turbidity level etc..are the limits that are analyzed to improve the water quality.
3.	Novelty / Uniqueness	The main aim is to develop an application which includes the measurement of total dissolved salt(TDS) and temperature of the water samples using sensors.The smartphone-based application also opens up the possibility to share the data and warnings using different options such as SMS,Whatsapp and E-mail.
4.	Social Impact / Customer Satisfaction	Monitoring water quality is an important part of helping us to determine whether or not we are making progress in cleaning up our waterways.it reveals the health and composition of rivers at a snapshot in

		time,as well as over weeks,months,and years.it is used to determine the quality of water so we know how much the water is polluted and how much PH levels it contains and a lot. so it helps us to get good and quality river water.
5.	Business Model (Revenue Model)	<ul style="list-style-type: none"> ● observation of the infrastructure of the water distribution network and any potential leaks ● detection of changes in quality of the water in the distribution supply network ● instant messaging services to customers and citizens when problems arise ● monitoring the functioning of the water storage structures ● management of water balance in a mine production area ● detection of contamination in the water ● automated collection of information to be reported to the environmental authorities
6.	Scalability of the Solution	This application promotes simplicity over complexity which helps the customers to use this application in an effective manner.

3.4.PROBLEM SOLUTION FIT

Define CS, fit into CC	<div>1. CUSTOMER SEGMENT(S) <small>Who is your customer? i.e. working parents of 0-5 y.o. kids</small></div> <div>The customer here is “Local Residents”</div>	<div>6. CUSTOMER CONSTRAINTS <small>vices.</small></div> <div><ul style="list-style-type: none">Unable to adapt to the new technology.Insufficient data and resources of water bodies even around my own vicinity.Unsure to trust the app.</div>	<div>5. AVAILABLE SOLUTIONS</div> <div>STREAM- Smart water quality monitoring and management system .</div> <div>pros: STREAM versions such as Inline, submerged, Floating.</div> <div>Cons: Easily affected by external factors .</div>	Explore AS, differentiate
	<div>2. JOBS-TO-BE-DONE / PROBLEMS <small>J&P</small></div> <div><ul style="list-style-type: none">detection of changes in quality of the water in the distribution supply network .instant messaging services to customers and citizens when problems arise.detection of contamination in the water.automated collection of information to be reported to the environmental authorities.</div>	<div>9. PROBLEM ROOT CAUSE <small>What is the real reason that this problem exists? What is the back story behind the need to do this job? i.e. customers have to do it because of the change in regulations.</small></div> <div><ul style="list-style-type: none">Pollution and waste from man-made resources.Lack of monitoring systems.If large amounts of fertilizers or waste drain into a river the concentration of nitrate and phosphate in the water increases considerably.Global warming & natural disasters.</div>	<div>7. BEHAVIOUR <small>What does your customer do to address the problem and get the job done? i.e. directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace)</small></div> <div><ul style="list-style-type: none">Downloading the water quality monitoring apps.To create awareness about the water pollution.Finding the source of the water pollutant.Constantly monitoring the quality of the water.</div>	
Focus on J&P, tap into BE, understand RC	<div>3. TRIGGERS <small>TR</small></div> <div><ul style="list-style-type: none">Water pollution, Algae bloom, Heavy metalsToxins, Water borne diseases</div>	<div>10. YOUR SOLUTION <small>SL</small></div> <div>The continuous monitoring of river water quality at remote places using wireless sensor networks with low power consumption, low-cost and high detection accuracy of PH, turbidity level etc. , are the limits that are analysed to improve the water quality.</div>	<div>8. CHANNELS of BEHAVIOUR <small>CH</small></div> <div><ul style="list-style-type: none">Downloading River Quality Monitoring appCreating Awareness in Social Media</div>	Extract online & offline CH of BE
	<div>4. EMOTIONS: BEFORE / AFTER <small>EM</small></div> <div><ul style="list-style-type: none">Frustration, Overwhelmed, AnxiousExcited, Happy, Satisfaction</div>		<div>8.2 OFFLINE</div> <div>Creating awareness in society by conducting welfare programme in school, colleges, public conferences etc.,</div>	

4.REQUIREMENT ANALYSIS

4.1.FUNCTIONAL REQUIREMENT

FR No	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIn
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User Interface	Description about how to use the application in the right manner .
FR-4	Monitoring Strategy	Monitoring the parameters like temperature, dissolved oxygen ,PH , ORP etc in water .
FR-5	Data Analysis	Analysis with predefined data to know the quality .
FR-6	Evaluation of Water Quality	At last , it evaluate and display the water quality percentage after analyzing .

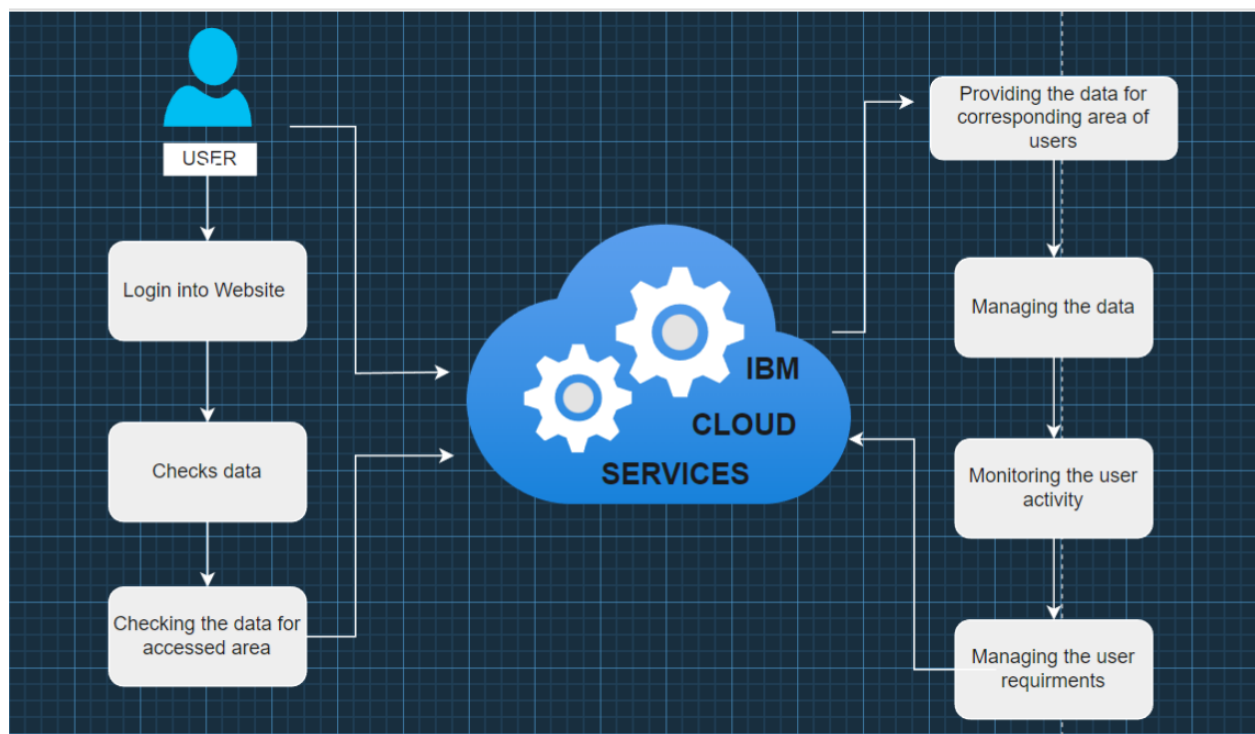
4.2.NON-FUNCTIONAL REQUIREMENT

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The error rate of users monitoring the quality mustn't exceed 10 percentage .
NFR-2	Security	Standard and encryption method is used for high security to keep the collection of data about the water quality .
NFR-3	Reliability	The application must perform without failure in 95 percentage of use cases.

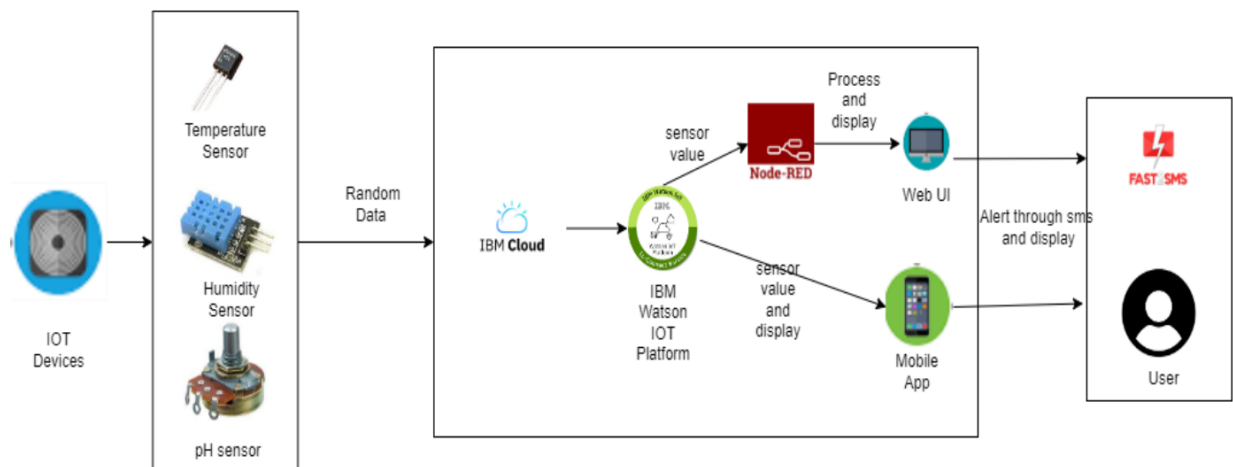
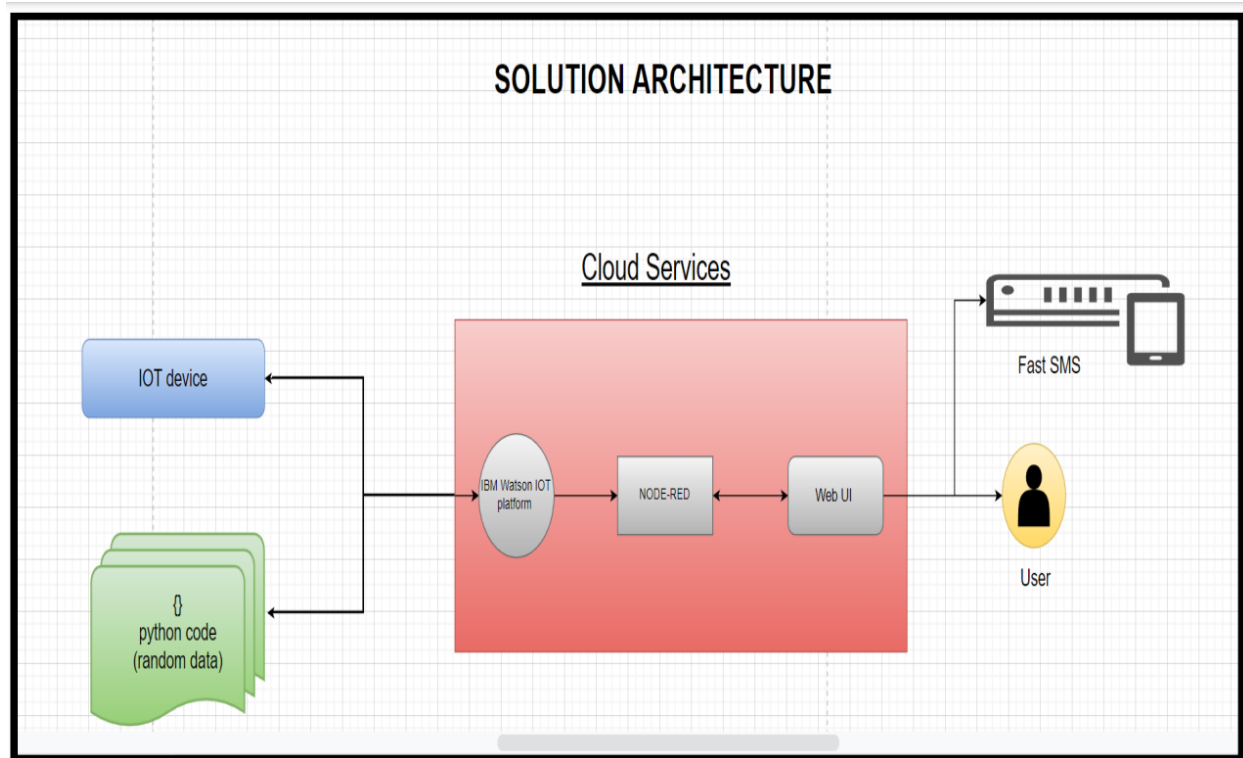
NFR-4	Performance	The application supporting 5000 + users per hour must provide 5 seconds or less responses time in desktop or Android .
NFR-5	Availability	The user interface must be available to users 99.98 percentage of day time.
NFR-6	Scalability	The application must be scalable enough to support 10,00,000 users at the same time while maintaining performance.

5.PROJECT DESIGN

5.1.DATA FLOW DIAGRAMS



5.2.SOLUTION & TECHNICAL ARCHITECTURE



5.3.USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Local Resident user)	Registration	USN-1	As a Local resident, I can register for the application by entering my email, password, and confirming my password.	I can access my account	High	Sprint-1
		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
	Login	USN-3	As a user, I can access my account of the web application through my login credentials.	I can access the dashboard with my individual Login id/ password	Low	Sprint-2
	Dashboard	USN-4	As a user, I want to know about my waterbodies locations instantly.	I can access the dashboard	Medium	Sprint-1
	Dashboard	USN-5	As a user, I can check and view the details of the river that I want to know	I can get the information of the river that is needed.	High	Sprint-1
Customer (Web user)	Web application	USN-6	As a user, I can know the parameters like pH	I can tend to know the ranges of	High	Sprint-2

			value, Temperature, Salinity, Harmful toxins etc.,	required parameters.		
Customer (Web user)	Web application	USN-7	As a user, I am able to know about the amount of potassium and Calcium present in the waterbodies.	I can get the ranges of the chemical compounds present in the required river water.	Medium	Sprint-2
Customer Care Executive	Web application	USN-8	As a user, I can protect myself and the resident people from the water born diseases by checking the quality of the waterbodies through this application	I can know the quality of the water and protect myself.	High	Sprint-1
Administrator	Report	USN-9	As an Administrator, I can collect the data's of quality measures of river water.	I can easily check if the water is harmful or not	Medium	Sprint-2
Authorities	Report	USN-10	As a Local Authority, I was notified by the web application if any hazardous things were present.	I can alert the users and report to my higher officials.	High	Sprint-1

6.PROJECT PLANING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1		USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	4
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	4
Sprint-2		USN-3	As a user, I can register for the application through Facebook	2	Low	4
Sprint-1		USN-4	As a user, I can register for the application through Gmail	2	Medium	4
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	4
Sprint-3	Dashboa	USN-6	As a user, I	3	High	4

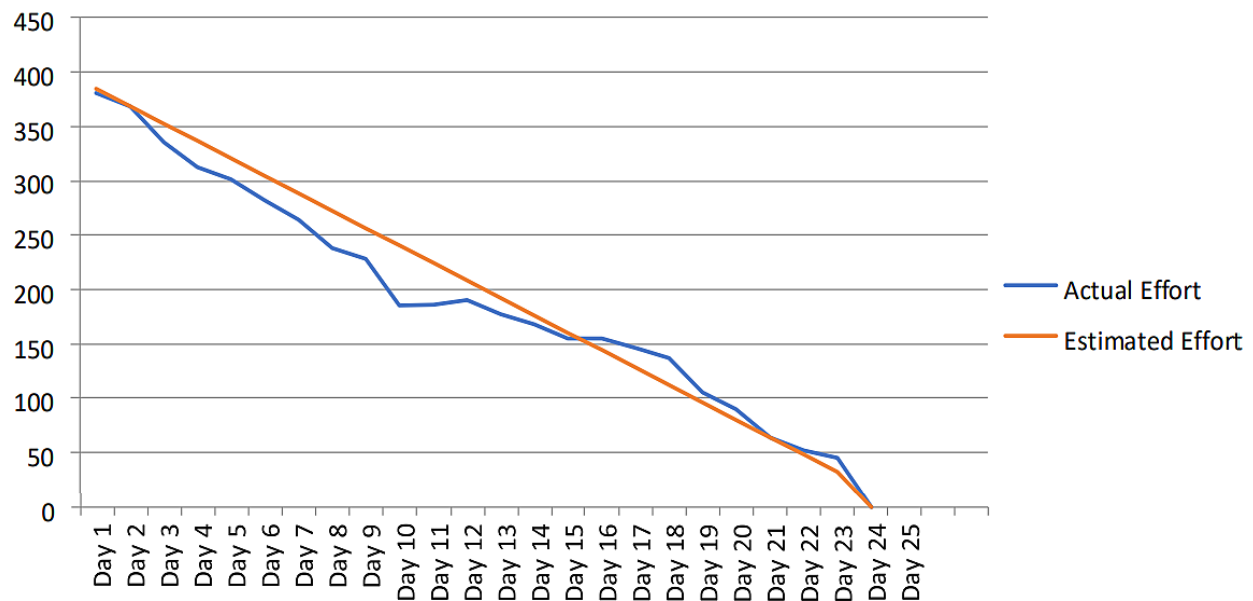
	rd		want to know about my waterbody's locations instantly.			
Sprint-3		USN-7	As a user, I can check and view the details of the river that I want to know	3	High	4
Sprint-2		USN-8	As a user, I can know the parameters like pH value, Temperature, Salinity, Harmful toxins, etc..	2	Medium	4
Sprint-3		USN-9	As a user, I can protect myself and the resident people from the water borne diseases by checking the quality of the waterbodies through this application	4	High	4
Sprint-4	Dashboa rd	USN-10	As a Local Authority, I was notified by the web application if	4	High	4

			any hazardous things were present.			
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6.2 SPRINT DELIVERY SCHEDULE

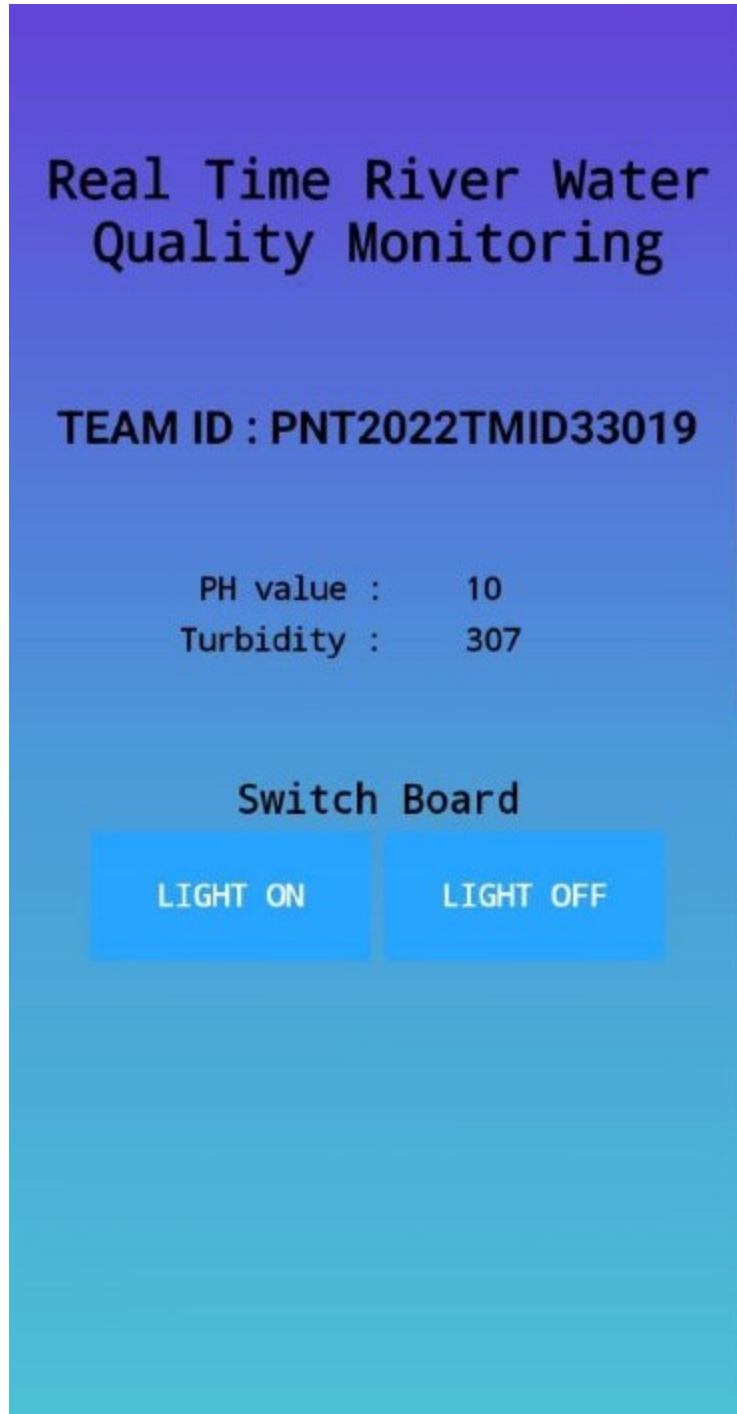
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)
Sprint-1	6	6 Days	24 Oct 2022	24 Oct 2022
Sprint-2	4	6 Days	31 Oct 2022	05 Nov 2022
Sprint-3	9	6 Days	07 Nov 2022	12 Nov 2022
Sprint-4	4	6 Days	14 Nov 2022	19 Nov 2022

6.3 REPORTS FROM JIRA



7.CODING & SOLUTIONING

7.1 FEATURE 1



7.2 FEATURE 2



8.TESTING

8.1 TEST CASES

Test Case ID	Feature Type	Component	Test Scenario	Pre-Requisite
TC-001	UI	Logo page	Verify whether the user is able to enter into our logo page .	MIT App Inventor, App Script
TC-002	Functional	Login Page	Verify whether the user is able to login with their Email and password.	MIT App Inventor, App Script
TC-003	Functional	Login Page	Verify whether the user is able to login with incorrect login credentials.	MIT App Inventor, App Script
TC-004	Functional	Login Page	Verify whether all the buttons displayed is navigated to the corresponding page.	MIT App Inventor, App Script

Steps to Execute	Test Data	Expected Result	Actual Result	Status
1.Click on the Nadhi application 2. Verify with functional elements <ul style="list-style-type: none">Logo	https://ibb.co/zQKPn4p	This page must show the logo of Application	Working as expected	Pass
1.Verify with UI elements <ul style="list-style-type: none">Email boxpassword box	https://ibb.co/fMvclN0K	App must show the below UI elements: <ul style="list-style-type: none">Email id box,Password box	Working as expected	Pass
1.Now Enter the valid Email and password.	Email: nadhi@gmail.com Password:nadhi	User should be navigated to the Home page.	Working as expected	Pass
1.If User Enter the invalid Email and password.	Email: nadhi@gmail.com Password:1234	User should not be navigated to the Home page	Working as expected	Pass
1.After login , User is Navigated to Home Page. 2.Click the buttons displayed in the Home Page	https://ibb.co/QnQCvzj	User should be navigated to the Home Page And Able to Access the buttons clicked.	Working as expected	Pass

Comments	TC for Automation (Y/N)	BUG ID	Executed By
Result is Verified	NO	-	
Result is Verified	NO	-	
Result is Verified	NO	-	
Result is Verified	NO	-	
Result is Verified	NO	-	

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 [Real Time River Water Quality Monitoring And Control System] 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	5	3	1	0	9
Duplicate	2	1	0	0	3
External	2	2	0	2	6

Fixed	3	2	1	0	6
Not Reproduced	0	0	1	0	1
Skipped	3	2	1	0	6
Won't Fix	2	0	1	0	3
Totals	17	10	5	2	34

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	5	0	0	5
Client Application	8	0	0	8
Security	1	0	0	1
Outsource Shipping	3	0	0	3
Exception Reporting	2	0	0	2
Final Report Output	1	0	0	1
Version Control	2	0	0	2

9. RESULTS

9.1 PERFORMANCE METRICS

[illegible]

10. ADVANTAGES & DISADVANTAGES

10.1 ADVANTAGES

Monitoring water quality is an important part of helping us to determine whether or not we are making progress in cleaning up our waterways. it reveals the health and composition of rivers at a snapshot in time, as well as over weeks, months, and years. it is used to determine the quality of water so we know how much the water is polluted and how much PH levels it contains and a lot. so it helps us to get good and quality river water.

10.2 DISADVANTAGES

- The system is less effective as sensors are installed very deep inside the water and their positions are fixed.
- The sensors are very expensive. Moreover their maintenance cost is also very high.

11. CONCLUSION

Monitoring of Turbidity, PH & Temperature of Water makes use of water detection sensor with unique advantage and existing GSM network. The system can monitor water quality automatically, and it is low in cost and does not require people on duty. So

the water quality testing is likely to be more economical, convenient and fast. The system has good flexibility. Only by replacing the corresponding sensors and changing the relevant software programs, this system can be used to monitor other water quality parameters. The operation is simple. The system can be expanded to monitor hydrologic, air pollution, industrial and agricultural production and so on. It has widespread application and extension value. By keeping the embedded devices in the environment for monitoring enables self protection (i.e., smart environment) to the environment. To implement this 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 i.e. it can interact with other objects through the network. Then the collected data and analysis results will be available to the end user through the Wi-Fi.

12. FUTURE SCOPE

We can use more sensors to detect more parameters for the water quality analysis purposes. The supply of water can be controlled by interfacing relay for easy detection. This system can be used to monitor other water quality parameters. The operation is user-friendly. The system can be expanded to monitor hydrologic, air pollution, industrial and agricultural production and so on. It has widespread application and extension value.

Applications:

- This system can be used for both commercial and domestic purposes.
- Different water supply agencies.
- In health department for identification and cause of water diseases.

13. APPENDIX

SOURCE CODE :

Python Code:

```
#IBM Watson IOT Platform
```

```
#pip install wiotp-sdk
```

```
import wiotp.sdk.device
```

```
import time
```

```
import random
```

```
myConfig = {
```

```
    "identity": {
```

```
        "orgId": "hj5fmy",
```

```

    "typeId": "NodeMCU",
    "deviceId": "12345"
  },
  "auth": {
    "token": "12345678"
  }
}

```

```

def myCommandCallback(cmd):
    print("Message received from IBM IoT Platform: %s" % cmd.data['command'])
    m=cmd.data['command']

```

```

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

```

```

while True:
    temp=random.randint(-20,125)
    hum=random.randint(0,100)
    myData={'temperature':temp, 'humidity':hum}
    client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0,
onPublish=None)
    print("Published data Successfully: %s", myData)
    client.commandCallback = myCommandCallback
    time.sleep(2)
client.disconnect()

```

Wokwi-Code :

```

#include <WiFi.h> //library for wifi

```

```

#include <PubSubClient.h> //library for MQTT
#include "DHT.h" // Library for dht11
#define DHTPIN 15 // what pin we're connected to
#define DHTTYPE DHT22 // define type of sensor DHT 11
#define LED 2

DHT dht (DHTPIN, DHTTYPE); // creating the instance by passing pin and
typr of dht connected

void callback(char* subscribetopic, byte* payload, unsigned int payloadLength);

//-----credentials of IBM Accounts-----

#define ORG "aacpzm" //IBM ORGANITION ID
#define DEVICE_TYPE "rasperry" //Device type mentioned in ibm watson IOT Platform
#define DEVICE_ID "ras123" //Device ID mentioned in ibm watson IOT Platform
#define TOKEN "12345678" //Token
String data3;
float h, t;

//----- Customise the above values -----
char server[] = ORG ".messaging.internetofthings.ibmcloud.com"; // Server Name
char publishTopic[] = "iot-2/evt/Data/fmt/json"; // topic name and type
of event perform and format in which data to be send
char subscribetopic[] = "iot-2/cmd/command/fmt/String"; // cmd
REPRESENT command type AND COMMAND IS TEST OF FORMAT STRING
char authMethod[] = "use-token-auth"; // authentication method
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID; //client id

//-----
WiFiClient wifiClient; // creating the instance for wificlient
PubSubClient client(server, 1883, callback ,wifiClient); //calling the
predefined client id by passing parameter like server id,portand
wificredential

void setup() // configureing the ESP32
{
  Serial.begin(115200);
  dht.begin();
  pinMode(LED,OUTPUT);
  delay(10);

```



```
Serial.println();  
wificonnect();  
mqttconnect();  
}
```

```
void loop()// Recursive Function  
{
```

```
    h = dht.readHumidity();  
    t = dht.readTemperature();  
    Serial.print("temperature:");  
    Serial.println(t);  
    Serial.print("humidity:");  
    Serial.println(h);
```

```
    PublishData(t, h);  
    delay(1000);  
    if (!client.loop()) {  
        mqttconnect();  
    }  
}
```

```
/*.....retrieving to  
Cloud.....*/
```

```
void PublishData(float temperature, float humidity) {  
    mqttconnect();//function call for connecting to ibm  
    /*  
        creating the String in in form JSon to update the data to ibm cloud  
    */  
    String payload = "{\"temperature\":";  
    payload += temperature;  
    payload += "," "\"humidity\":";  
    payload += humidity;  
    payload += "}";
```

```
    Serial.print("Sending payload: ");  
    Serial.println(payload);
```

```
    if (client.publish(publishTopic, (char*) payload.c_str())) {  
        Serial.println("Publish ok");// if it sucessfully upload data on
```

the cloud then it will print publish ok in Serial monitor or else it will print publish failed

```
    } else {  
        Serial.println("Publish failed");  
    }  
  
}
```

```
void mqttconnect() {  
    if (!client.connected()) {  
        Serial.print("Reconnecting client to ");  
        Serial.println(server);  
        while (!client.connect(clientId, authMethod, token)) {  
            Serial.print(".");  
            delay(500);  
        }  
    }
```

```
        initManagedDevice();  
        Serial.println();  
    }  
}
```

void wificonnect() //function defination for wificonnect

```
{  
    Serial.println();  
    Serial.print("Connecting to ");
```

WiFi.begin("Wokwi-GUEST", "", 6);//passing the wifi credentials to establish the connection

```
    while (WiFi.status() != WL_CONNECTED) {  
        delay(500);  
        Serial.print(".");  
    }  
    Serial.println("");  
    Serial.println("WiFi connected");  
    Serial.println("IP address: ");  
    Serial.println(WiFi.localIP());  
}
```

```
void initManagedDevice() {  
    if (client.subscribe(subscribetopic)) {  
        Serial.println((subscribetopic));  
        Serial.println("subscribe to cmd OK");  
    } else {  
        Serial.println("subscribe to cmd FAILED");  
    }
```

```

    }
}

void callback(char* subscribetopic, byte* payload, unsigned int payloadLength)
{

    Serial.print("callback invoked for topic: ");
    Serial.println(subscribetopic);
    for (int i = 0; i < payloadLength; i++) {
        //Serial.print((char)payload[i]);
        data3 += (char)payload[i];
    }
    Serial.println("data: "+ data3);
    if(data3=="lighton")
    {
        Serial.println(data3);
        digitalWrite(LED,HIGH);
    }
    else
    {
        Serial.println(data3);
        digitalWrite(LED,LOW);
    }
    data3="";
}

```

GITHUB LINK & PROJECT DEMO LINK :

GITHUB LINK :

<https://github.com/IBM-EPBL/IBM-Project-40886-1660637020>

PROJECT DEMO LINK :

YouTube Video link : <https://youtu.be/pluABWyTVlo>

Project simulation in Wokwi

<https://wokwi.com/projects/348596639893553747>

