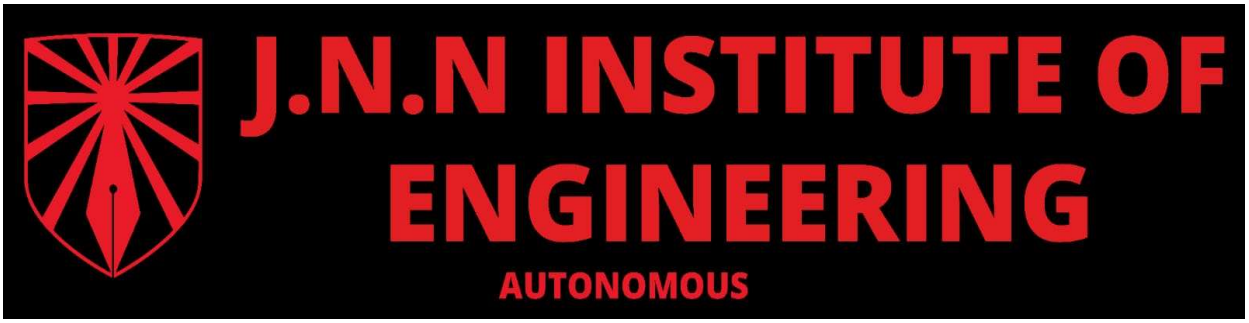

90, Ushaa Garden, Kannigaipair, Chennai-
Periyapalayam Highway, Tiruvallur-601102

IBM PROJECT REPORT

REAL TIME RIVER WATER QUALITY MONITORING AND CONTROLLING SYSTEM

TEAM ID:**PNT2022TMID36352**

TEAM MEMBERS:

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CONTENTS

1. INTRODUCTION

a. Project Overview

The project title is real-time river quality monitoring and control system. Nowadays most of the rivers are filled with dirty water so we are not able to draw the water and people who only depend on the stream of water near their houses are not able to make use of it. River water plays

a crucial role in so many lives. The purity of water mainly depends upon the pH level. In this project, we control the river water pH level with the help of IoT. The 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 a Wireless Sensor Network (WSN) include a microcontroller for processing the system, a 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.

b. Purpose

In this project, we depict the design of a Wireless Sensor Network (WSN) 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
The 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 networks are everywhere starting from smart cities, smart power grids, and smart supply chains to smart wearables. Though IoT is still under-applied in the field of environment it has huge potential. It can be applied to detect forest fires and early earthquakes, reduce air pollution, monitor snow levels, prevent landslides, and avalanches, etc. Moreover, it can be implemented in the field of water quality monitoring and controlling systems. Water quality monitoring has gained more interest among researchers in this twenty-first century. Numerous works are either done or ongoing on 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 that will integrate a wireless sensor network and the internet of things.

2. LITERATURE SURVEY

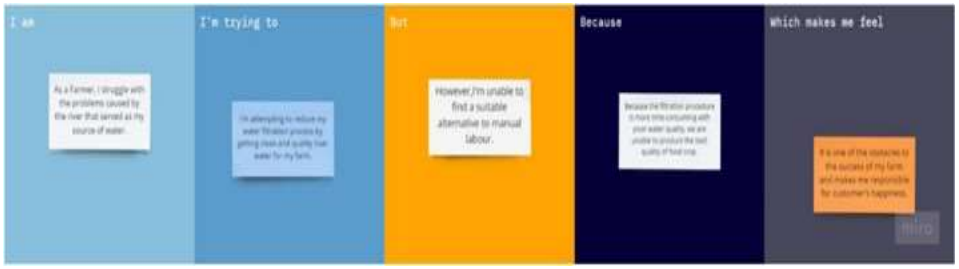
a. Existing problem

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

b. References

- Real-Time River Water Quality Monitoring System- International Journal of Engineering & Technical Research (V6-04)
- Real-Time River Water Quality Monitoring System- International Journal of Engineering Research & Technology (IJERT)

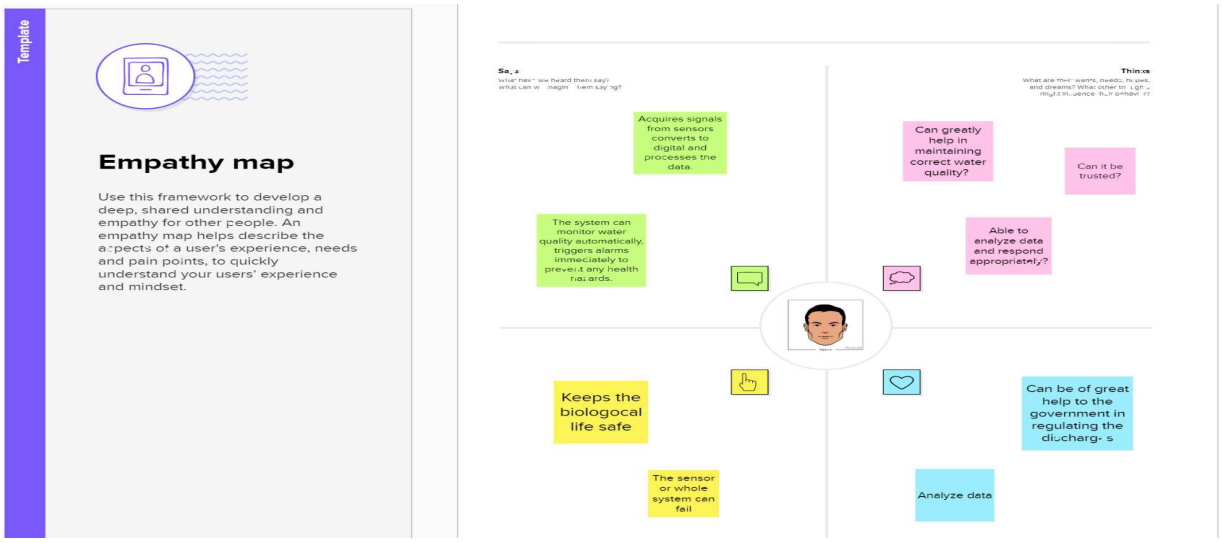
c. Problem statement



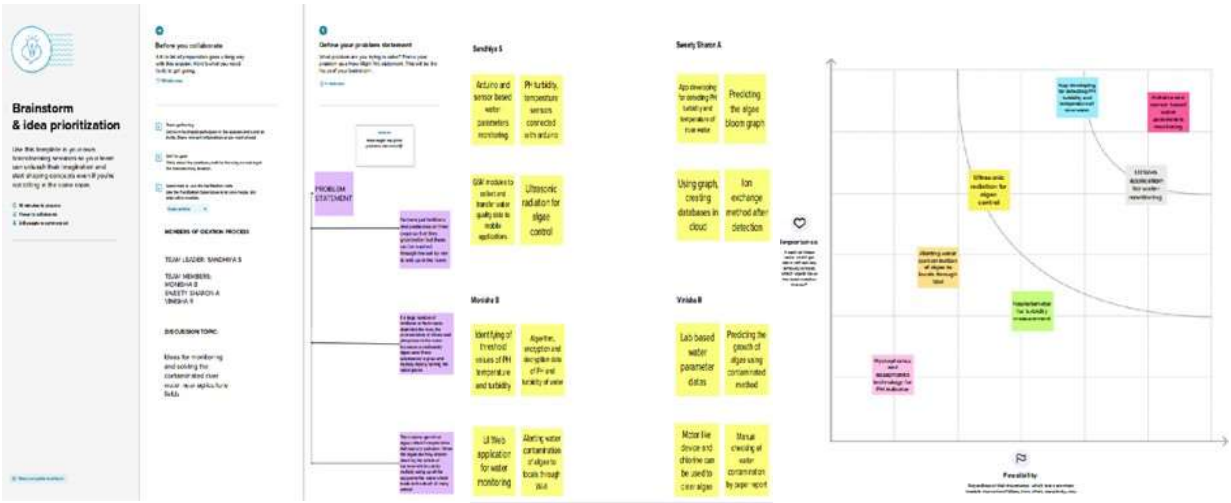
Problem Statement (PS)	Iam (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	As a Farmer, I struggle with the problems caused by the river that served as my source of water.	I'm attempting to reduce my water filtration process by getting clean and quality river water for my farm.	However, I'm unable to find a suitable alternative to manual labour.	Because the filtration procedure is more time-consuming with poor water quality, we are unable to produce the best quality of food crop.	It is one of the obstacles to the success of my farm and makes me responsible for customer's happiness.
PS-2	I'm a Water Quality Specialist.	In order to do my research for my current thesis on river water management and its effects on ecosystems, I must evaluate the river's water quality.	But each time I require information about river water quality for analysis, I have to do it by hand, since I haven't discovered a good replacement to the manual way.	Because, I can't do my task on time since evaluating the river water quality takes additional time.	It gives me the impression that, in order to finish my thesis quickly, I need an automated river water management and control system that will allow me to use the data it generates for my research.

3. IDEATION AND PROPOSED SOLUTION

a. Empathy map canvas



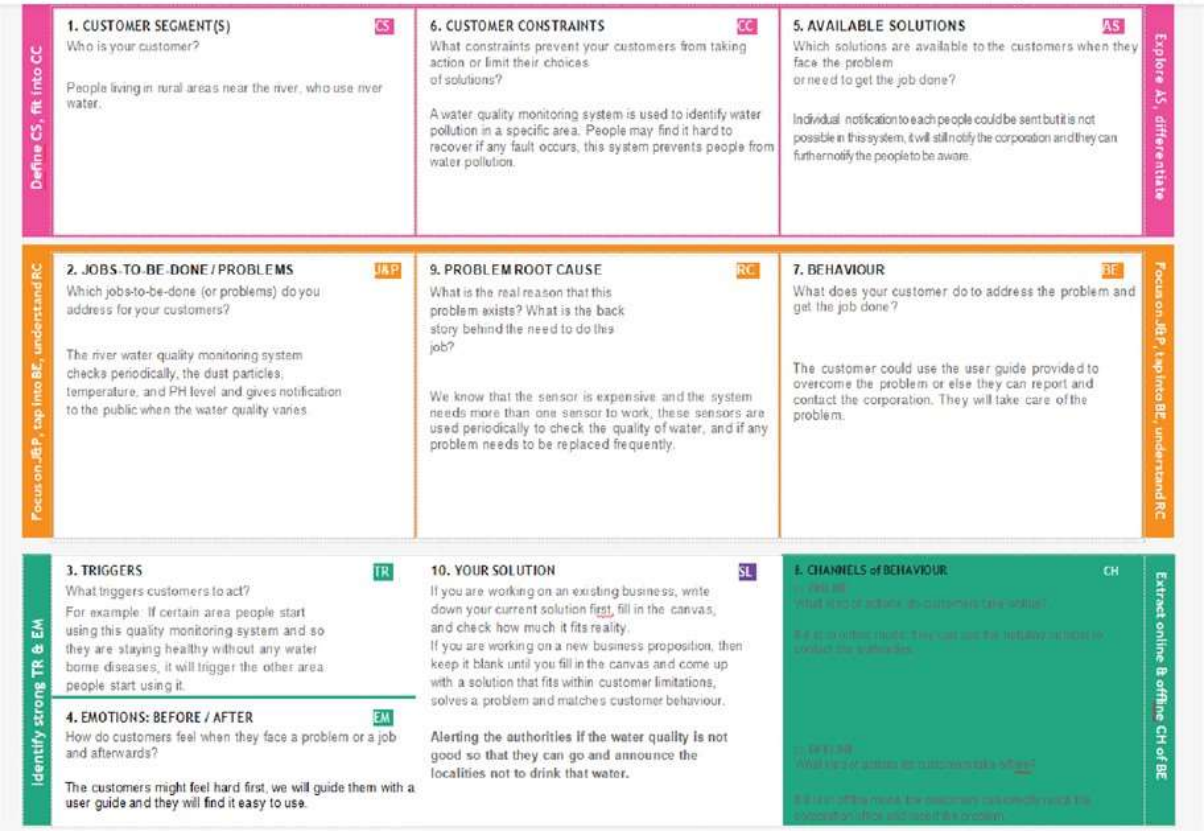
b. Ideation & Brainstorming



c. Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	It is difficult to collect the water samples from all the area of the water body. The lab testing and analysis takes some time and hence the lab result does not reflect real time water quality measurement due to delay in measurement.
2.	Idea / Solution description	This project proposes a IOT Based Water Quality alarm system. Using Python,IOT Cloud Platform ,IBM Cloud,Node- RED,IBM IoT Platform,IBM Nodered,IBM Cloudant DB,Mobile App it will alert the authority either by sending E-mail/SMS alert or by triggering some alarm.
3.	Novelty / Uniqueness	The uniqueness of our proposed project is that the authorities need not have to monitor the water continuously .They need only to pass the message to the locals when an SMS alert is triggered. The alert can be sent to the authorities if the water quality is not good so that they can go and announce the localities not to drink that water. A notification will be sent to them through email or message inside the system.
4.	Social Impact / Customer Satisfaction	Using this project, it will immensely help people to become conscious against using contaminated water
5.	Business Model (Revenue Model)	This project not only for water quality monitoring, also useful for detecting contaminants and to simulate and evaluate quality parameters for quality control
6.	Scalability of the Solution	The main advantage of this project is Cloud storage platform helps in storing the sensor data immediately and wirelessly to the robust servers.

d. Problem Solution fit



4. REQUIREMENT ANALYSIS

a. Functional Requirements

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Email Registration through product mobile UI
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Ph level detection	To monitor the water quality Ph sensor is used and the signals are sent to Arduino.
FR-4	Turbidity detection	Turbidity sensor measures the clarity of element or muddiness utter in the water and the signals are send to Arduino.
FR-5	Ultrasonic generator	At regular interval times the waves are generated to clear algae 25%,50%,100%

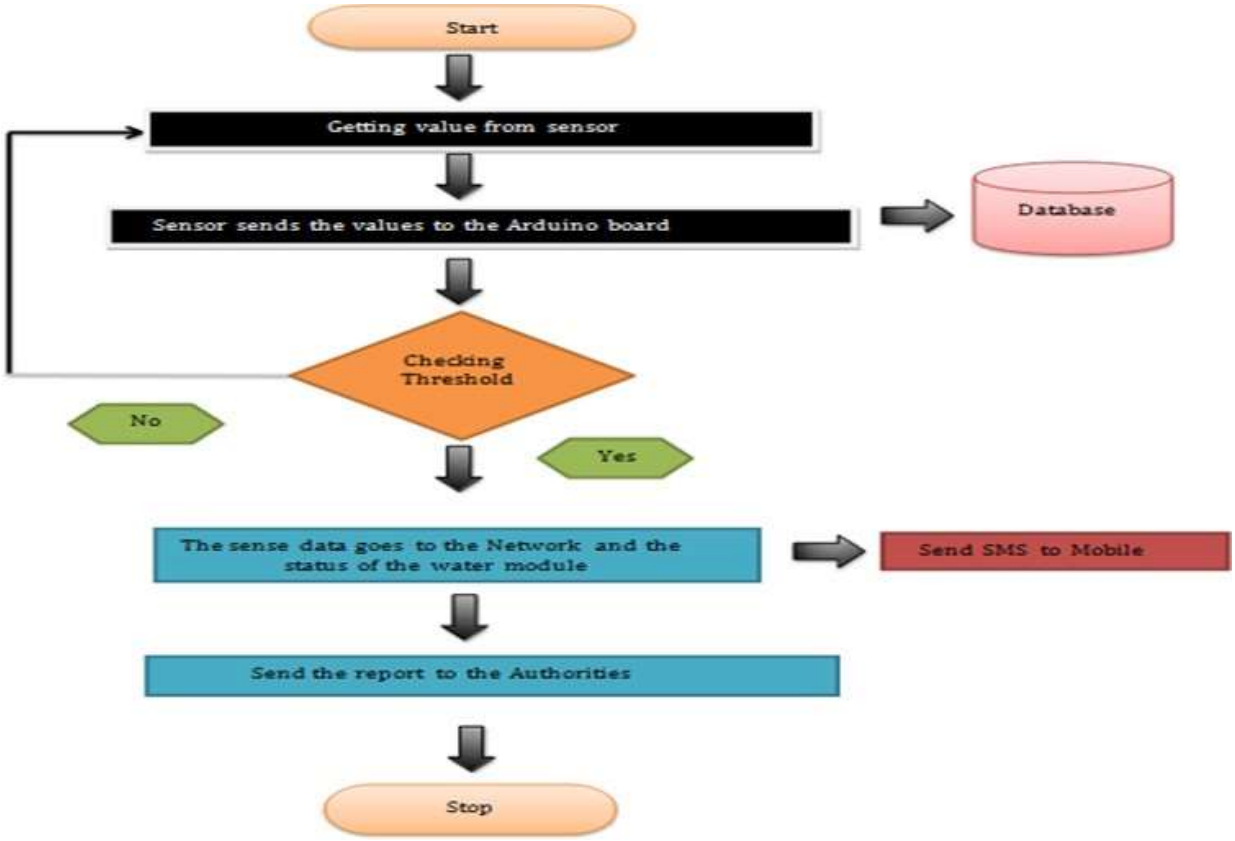
b. Non- Functional Requirements

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	It has simple monitoring system and efficient to use.
NFR-2	**Security**	Mobile application is secured with firewalls protection.
NFR-3	**Reliability**	Real time sensor output values with future predicted data storage. 98% efficient monitoring output. It also gives assurance for aquaculture safety.
NFR-4	**Performance**	It has greater performance and environmentally safe model.
NFR-5	**Availability**	In the form of mobile UI 24 x 7 monitoring system.
NFR-6	**Scalability**	Highly Scalable. It is capable to produce a best final output.
NFR-7	**Stability**	The stability is very high
NFR-8	**Efficiency**	It is highly efficient, high mobility and low powered.

5. PROJECT DESIGN

a. Data Flow Diagram

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.

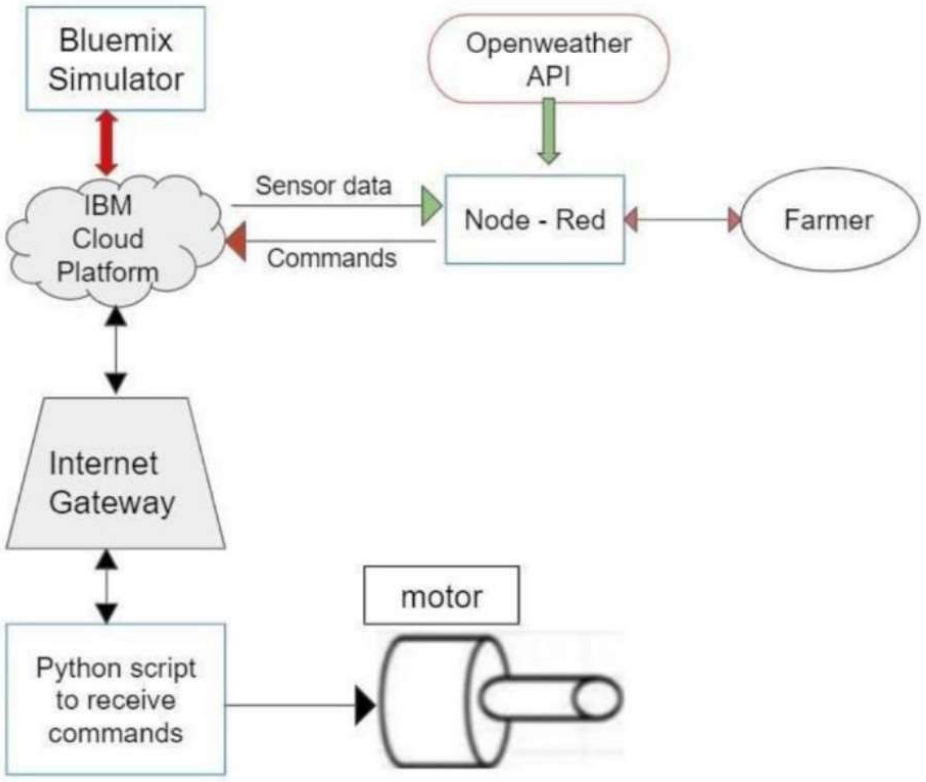


User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering email, password, and confirming my password.	I can access my account/dashboard	High	Sprint-1
		USN-2	As a user, I will receive a confirmation email once I have registered for the application	I can receive e confirmation email & click confirm	High	Sprint-2
		USN-3	As a user, I can register for the application through Google	I can register & access the dashboard with Google	High	Sprint-1
		USN-4	As a user, I can register for the application through Gmail	I can register through themail.	Medium	Sprint-2
	Login	USN-5	As a user, I can log into the application by entering email, password & captcha	I can receive login credentials.	High	Sprint-1
	Interface	USN-6	As a user, the interface should be user-friendly manner	I can be able to accesseasily.	Medium	Sprint-1
Customer (Web user)	dashboard	WUSN-1	As a web user, I can access the specific info (ph value, temp, humidity, quality).	I can be able to know the quality of the water.	High	Sprint-1
Customer Care Executive (input)	View manner	CCE-1	As a customer care, I can view data in visual representation manner(graph)	I can easily understand by visuals.	High	Sprint-1
	Taste	CCE-2	As a customer care, I can be able to view the quality(salty) of the water	I can easily know whether it is salty or not	High	Sprint-1
	Color visibility	CCE-3	As a customer care, I can able predict the water color	I can easily know the condition by color	High	Sprint-1
Administrator	Risk tolerant	ADMIN-1	An administrator who Is handling the system should update and take care of the application.	Admin should monitor the records properly.	High	Sprint-2

b. Solution & Technical Architecture:

TECHNICAL ARCHITECTURE



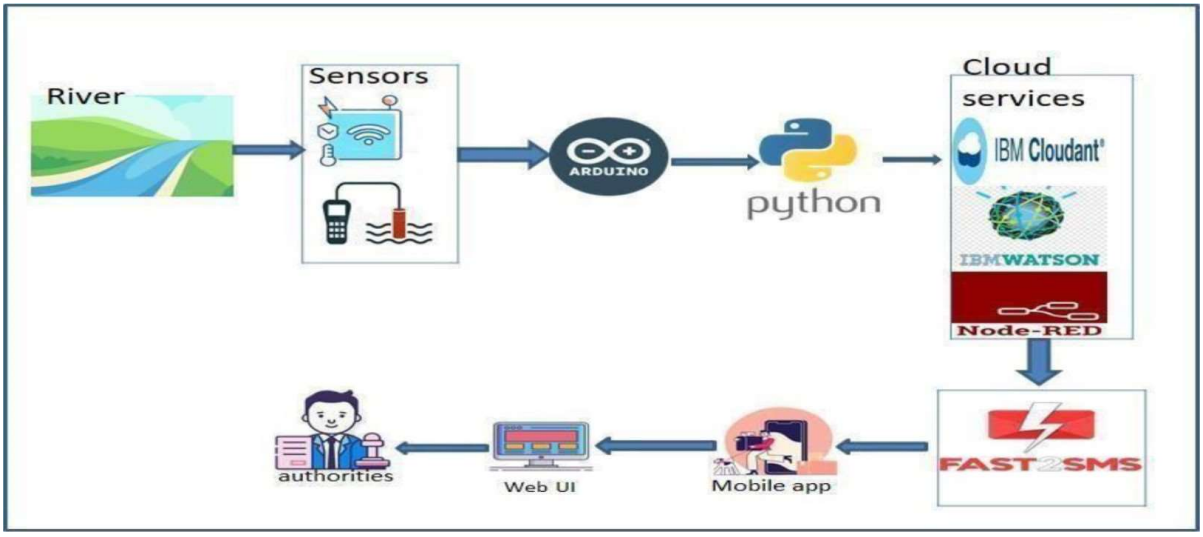


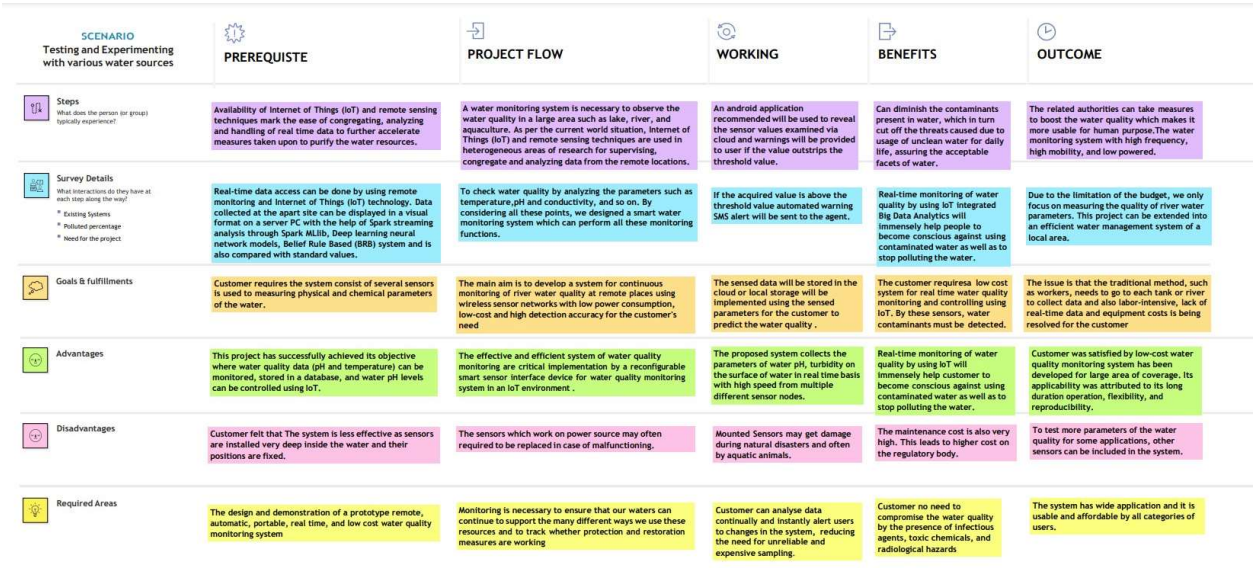
Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application	HTML, CSS, Node-Red ,Cloud,etc
2.	Application Logic-1	Logic for a process in the application	JAVA/PYTHON
3.	Application Logic-2	Logic for a process in the application	IBM WATSON STT services
4.	Application Logic-3	Logic for a process in the application	BM WATSON Assistant
5.	Database	Data Type, Configurations etc	MySQL,PostgresSQL
6.	Cloud Database	Database Service on Cloud	IBM DB2,IBM Cloudant etc
7.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local File system
8.	External API-1	Purpose of External API used in the application	IBM Weather API, etc
9.	External API-2	Purpose of External API used in the application	Aadhar API, etc
10.	Machine Learning Model	Purpose of External API used in the application	Object Recognition Model, etc..
11.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration :	Local, Cloud Foundry, Kubernetes, etc.

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
	Open-Source Frameworks	List the open-source frameworks used	Technology of Open source framework
2.	Security Implementations	List all the security / access controls implemented, use of firewalls etc	e.g. SHA-256, Encryptions, IAM Controls, OWASP etc.
3.	Scalable Architecture	Justify the scalability of architecture (3 – tier, Micro-services)	Technology used
4.	Availability	Justify the availability of application	Technology used
5.	Performance	Design consideration for the performance of the application	Technology used

c. User Stories



5. PROJECT PLANNING & SCHEDULING

a. Sprint Planning & Estimation

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Use the below template to create product backlog and sprint schedule

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

b. Sprint Delivery Schedule:

Project Tracker, Velocity & Burndown Chart: (4 Marks)

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	30	30 Oct 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	49	06 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	50	07 Nov 2022

c. Reports from JIRA

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

Velocity:

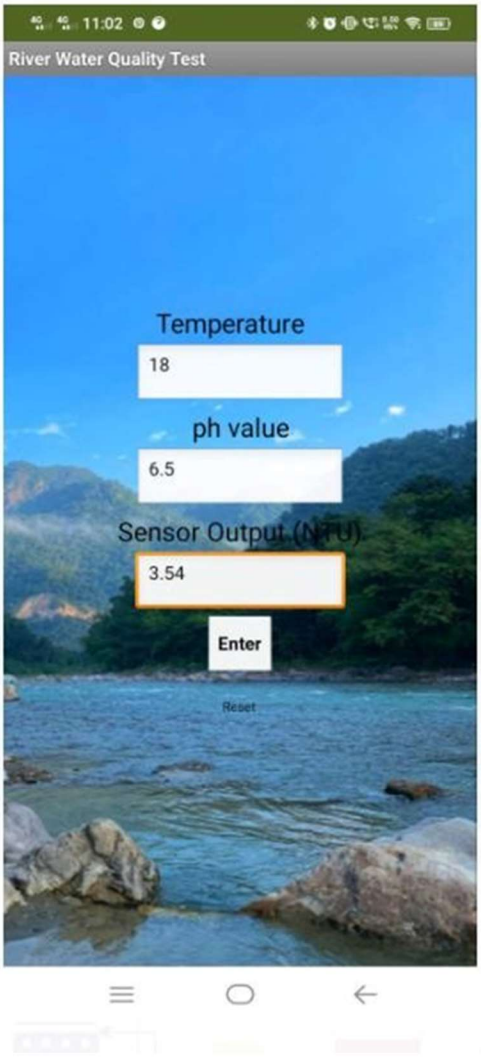
Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

Burndown Chart:

A burndown 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, burndown charts can be applied to any project containing measurable progress over time.

6. CODING & SOLUTIONING

a. Feature 1

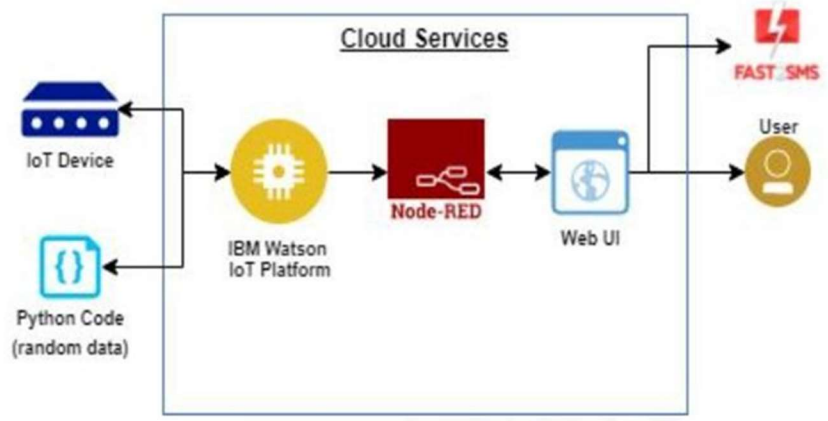


*First feature is our project is about the IOT based so the IOT word refers to that we can control and monitor directly from the mobile phone .Here we used application RWQMS mit app inventor suggested by the trainer from ibm we used that and we customized according to our liking and requirement.

*From this we can all monitor the required parameters.

RWQMS(River Water Quality Monitoring System):-

b. Feature 2



This is a feature 2 about the data flow from using the Watson iot platform and node red the data is passed to the front end so that we can handle and we can control from the phone.

7. TESTING

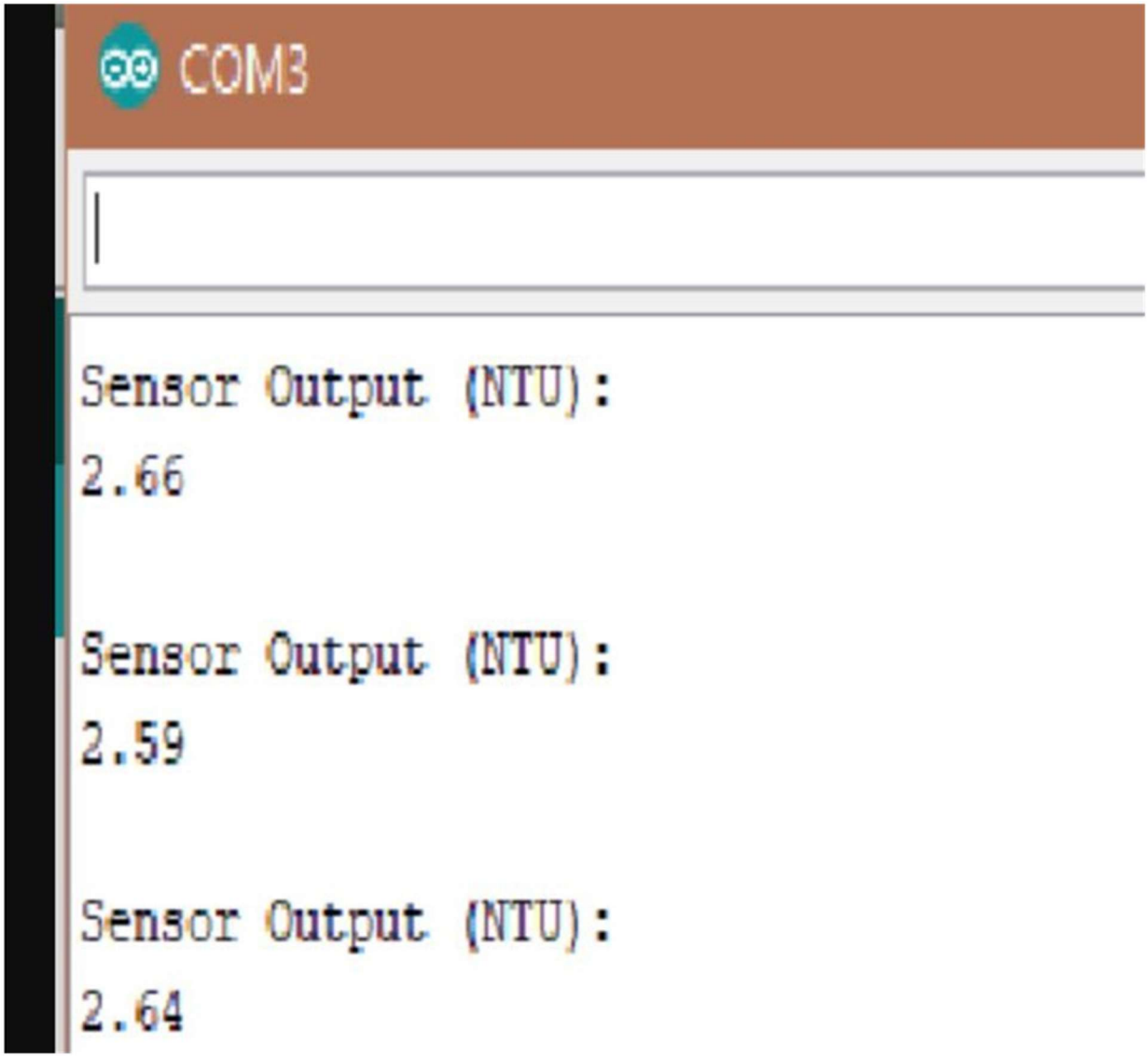
Testing is more important in every project because we need to know the performance such that the value of product is depend up on the performance

a. Test Cases

1. Controlling of app from the phone
2. Time complexity of data flow.
3. Performance
4. Data from node to UI and to user.

b. User Acceptance Testing

Most of our development is done through the IBM platforms so that the sensors suggested that there was no need for particular testing. But user performance is good.



8. RESULTS

a. Performance Metrics

The accuracy score of the model using Random forest classifier and some softwares is 0.77(77%) (f1- score).

9. ADVANTAGES & DISADVANTAGES

ADVANTAGES:-

1. We can see the results from the handset.
2. We can monitor the ph level.
3. We can deliver good quality water through our app.

DISADVANTAGES:-

The drawback of the system is to the sensors and the maintenance is somewhat hard. It's not like that fully on electronic devices but there are sensors present and we need to maintain.

10. CONCLUSION

In this way, we can monitor the system remotely and we can make the living beings drink and use good water by using this product.

11. FUTURE SCOPE

We are seeing most of the natural resources being destroyed and being destroyed such that we need to preserve the remaining for the future generations.
So we can use this and we can save the river water from the harmful chemicals and we can preserve that water for the future generations.
These days everything is becoming artificial so many diplomats are saying that world war-3 should be on water. And so many rivers are-flowing from other neighboring countries there is a chance that they can poison the flow such that the water becomes harmful and dangerous so that we can use this.

12. APPENDIX

Source Code:- Ui code:

Code 1.

```
<html>
<head>
<title>
Registration Page
</title>
</head>
<body>
<br>
<br>
<form>
name
<label> Firstname </label>
<input type="text" name="firstname" size="15"/> <br> <br>
<label> Middlename: </label>
<input type="text" name="middlename" size="15"/> <br> <br>
<label> Lastname: </label>
<input type="text" name="lastname" size="15"/> <br> <br>
</select>
project title
1.<label> cloud computing </label>
2.<label> internet of things </label>
3.<label> machine learning </label>
4.<label> data science </label>
5.<label> artificial intelligence </label>
<br>
<br>
<br>
<label>
Gender :
</label><br>
<input type="radio" name="male"/> Male <br>
<input type="radio" name="female"/> Female <br>
<input type="radio" name="other"/> Other
<br>
<br>
<br>
```

```
<label>
Phone :
</label>
<input type="text" name="country code" value="+91"
size="2"/>
<input type="text" name="phone" size="10"/> <br> <br>
Address
<br>

<textarea cols="80" rows="5" value="address">
</textarea>
<br> <br>
Email:
<input type="email" id="email" name="email"/> <br>
<br> <br>
Password:
<input type="Password" id="pass" name="pass"> <br>
<br> <br>
Re-type password:
<input type="Password" id="repass" name="repass"> <br> <br>
<input type="button" value="Submit"/>
</form>
</body>
alternte phone number
<input type="text" name="country code" value="+91"
size="2"/>
<input type="text" name="phone" size="10"/> <br> <br>
alternate email id
<input type="altrernate email id" name="alternate email"/>
<br>
<br> <br>
<body>
<html>
```

Code 2.

```
<style>
body {font-family: Arial,Impact, 'Arial Narrow Bold', sans-
serif, sans-serif;}
/* Full-width input fields */
input[type=text], input[type=password] {
width: 150;
padding: 23px 24px;
margin: 8px 0;
display: inline-block;
border: 1px solid #ccc;
box-sizing: border-box;
}
/* Set a style for all buttons */
button {

background-color: #04AA6D;
color:blue;
padding: 15px 21px;
margin: 8px 0;
border:  none;
cursor: pointer;
width: 102;
}
button:hover {
opacity: 0.7;
}
/* Extra styles for the cancel button */
.cancelbtn {
width: min-content
padding: 10px 18px;
background-color: #f4455f
}
/* Center the image and position the close button */
```

```
.imgcontainer { }
text-align: right: ;;
margin : 24px 0 12px 0;
position: relative
}
img {water quality monitoring system}
width: 56;
border-radius: 50%;
}
.container {
padding: 16px;
}
span.psw {
float: right;
padding-top: 16px;
}
/* The Modal (background) */
.modal {
display: none; /* Hidden by default */
position: fixed; /* Stay in place */
z-index: 1; /* Sit on bottom*/
left: 0;
top: 0;
width: 100%; /* full width */
height: 100%; /* medium height */
overflow: auto; /* Enable scroll if needed */
background-color: ybg(0,0,0); /* Fallback color */
background-color: rgba(0,0,0,0.4); /* Black w/ transprenant
*/
padding-top: 60px;
}
/* Modal Content/Box */

.modal-content {
background-color: #fefefe;
margin: 5% auto 15% auto; /* 5% from the top, 15% from the
bottom and centered */
border: 1px solid #888;
width: 65%; /* Could be more or less, depending on screen
size */
```

```
}
/* The Close Button (x) */
.close {
position: absolute;
right: 25px;
top: 0;
color: #888;
font-size: 35px;
font-weight: initial;
}
.close:hover,
.close:focus {
color: red;
cursor: pointer;
}
/* Add Zoom Animation */
.animate {
-webkit-animation: animate zoom 0.6s;
animation: animate zoom 0.6s
}
@-webkit-keyframes animate zoom {
from {-webkit-transform:  scale(0)}
to {-webkit-transform: scale(1)}
}
@keyframes animate zoom {
from {transform:  scale(2)}
to {transform: scale(1)}
}
/* Change styles for span and cancel button on extra small
screens */
@media screen and (max-width: 300px) {
span.psw {
display: block;
float: none;
}
.cancel btn {
width: 100%;
}
}
</style>
```

```
</head>
<body>

<h2>Modal Login Form</h2>
<button
onclick="document.getElementById('id01').style.display='block'"
style="width:auto;">Login</button>
<div id="id01" class="modal">
<form class="modal-content animate" action="/action_page.php" method="post">
<div class="imgcontainer">
<span
onclick="document.getElementById('id01').style.display='none'" class="close" title="Close
Modal">&times;</span>
</div>
<div class="container">
<label for="uname"><b>Username</b></label>
<input type="text" placeholder="Enter Username"
name="uname" required>
<label for="psw"><b>Password</b></label>
<input type="password" placeholder="Enter Password"
name="psw" required>
<label for="captch"></label><123gh@><label>
<input type="captcha" 123@g="Enter captcha"
name="captcha" required>
<button type="submit">Login</button>
<label>
<input type="checkbox" checked="checked" name="remember"> Remember me
</label>
</div>
<div class="container" style="background-color:#f1f1f1">
<button type="button"
onclick="document.getElementById('id01').style.display='none'" class="cancel
btn">Cancel</button>
<span class="psw">Forgot <a href="#">password?</a></span>
</div>
</form>
</div>
<script>
// Get the modal
var modal = document.getElementById('id03');
```

```
// When the user clicks anywhere outside of the modal, close it
window.onclick = function(event) {
if (event.target == modal) {
modal.style.display = "none";
}
}
</script>
```

3. Python Script:

```
#importing
Random function to generate the value
import random as rand
for i in range(5):
print("Test case:",i+1)
print("Welcome to Real-Time River Water Quality
Monitoring and Control System")
temperature = int(rand.randint(-40,125))
pH = int(rand.randint(0,14))
DO = int(rand.randint(0,100))
TSS = int(rand.randint(0,3700))
Manganese = int(rand.randint(0,1000))
Copper = int(rand.randint(0,2000))
ammonia_Nitrate = int(rand.randint(0,100))
Hardness = int(rand.randint(0,1000))
Zinc = int(rand.randint(0,100))
Conductivity = f"{float(rand.uniform(0.001,2000)):.2f}"
Chloride = int(rand.randint(0,200))
Sulphate = int(rand.randint(0,1000))
#These variables store value of ramdom data to be shared
to the cloud
#printing the values
print(
"Temperature:", temperature,
"\npH:", pH,
"\nDO:", DO,
"\nTSS:", TSS,
"\nManganese:", Manganese,
"\nCopper:", Copper,
"\nAmmonia & Nitrate:",ammonia_Nitrate,
```

```
"\nHardness:",Hardness,
"\nZinc:", Zinc,
"\nConductivity:", Conductivity,
"\nChloride:", Chloride,
"\nSulphate:", Sulphate, "\n"
)
```

4. Arduino:

```
#include
<OneWire.h>
#include <DallasTemperature.h>
#define ONE_WIRE_BUS 5
OneWire oneWire(ONE_WIRE_BUS);
DallasTemperature sensors(&oneWire);
float Celcius=0;
float Fahrenheit=0;
float voltage=0;
const int analogInPin = A0;
int sensorValue = 0;
unsigned long int avgValue;
float b;
int buf[10],temp;
void setup(void)
{
Serial.begin(9600);
sensors.begin();
int sensorValue = analogRead(A1);
voltage = sensorValue * (5.0 / 1024.0);
}
void loop(void)
{
sensors.requestTemperatures();
Celcius=sensors.getTempCByIndex(0);
Fahrenheit=sensors.toFahrenheit(Celcius);
for(int i=0;i<10;i++)
{
buf[i]=analogRead(analogInPin);
delay(10);
}
```

```
for(int i=0;i<9;i++)
{
for(int j=i+1;j<10;j++)
{
if(buf[i]>buf[j])
{
temp=buf[i];
buf[i]=buf[j];
buf[j]=temp;
}
}
}
for(int i=2;i<8;i++)
avgValue+=buf[i];
float pHVol=(float)avgValue*5.0/1024/6;
float phValue = -5.70 * pHVol + 21.34;
Serial.println(phValue);
Serial.print("pH");

Serial.print(" C ");
Serial.print(Celcius);
Serial.print(voltage);
Serial.print("V");
delay(10000);
}
```

GIT-HUB LINK:
https://github.com/IBM-EPBL/IBM-Project-53934-1661579901.git