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COLLEGE OF ENGINEERING AND TECHNOLOGY
(Approved by AICTE, Affiliated to Anna University & Accredited by NAAC)
Kinathukadavu, Coimbatore - 642 109.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

NALAIYA THIRAN
BATCH NO: B5-5M1E

PROJECT TITLE

REAL-TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM

TEAM ID: PNT2022TMID43481

TEAM MEMBERS

1.	VAISHNAVI R	720319106025
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TABLE OF CONTENTS

1. INTRODUCTION

1.1 PROJECT OVERVIEW

River Water quality monitoring System Water is one of the major compounds that profoundly influence ecosystem. But, nowadays it is been exploited heavily due to rapid industrialization, human waste and random use of pesticides and chemical fertilizers in agriculture, which leads to water contamination. Thus, a water monitoring system is necessary to observe the water quality in a large area such as lake, river, and aquaculture. As per the current world situation, Internet of Things (IoT) and remote sensing techniques are used in heterogeneous areas of research for supervising, congregate and analyzing data from the remote locations. In this paper, the suggested system is a minimal price real-time water quality monitoring system in IoT environment. This system comprise of numerous sensors for assessing the physical and chemical parameter. The factors of water that can be assessed using these sensors are pH, turbidity, conductivity, dissolved oxygen. Using this system the real time quality of water bodies can be determined and the data uploaded over the Internet are analyzed.

1.2 PURPOSE

Data collected over a period of time will show trends, for example identifying increasing concentrations of nitrogen pollution in a river or an inland waterway. The total data will then help to identify key water quality parameters. Collecting, interpreting and using data is essential for the development of a sound and effective water quality strategy. The absence of real-time data will however hamper the development of strategies and limit the impact on pollution control. Using digital systems and programs for data collection and management is a solution to this challenge.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

Due to population growth, urbanization, and climatic change, competition for water resources is expected to increase, with a particular impact on agriculture, river water. Water will be suitableness to potable water monitoring compound spillage identification done rivers, remote estimation for swimming pools. It holds self-sufficient hubs that unite with the cloud to ongoing water control .The River water needed to be treated before it is used in agriculture fields, hence the parameters affecting the quality of river-water need to be analysed and to be used for water treatment purpose.

2.2 REFERENCES

1) IoT Based Real-time River Water Quality Monitoring System
Mohammad Salah Uddin Chowdury, Talha BinEmran,
Science Direct – 2018

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.

2) Review of Water Quality Monitoring using Internet of Things (IoT)
Mr. A. P. Roger Rozario, R. Surya
IEEE, 2019

The quality of the water must be monitored in real-time to ensure its safety and supply. Monitoring water in traditional ways takes longer, which can take up to from 24 to 96 hours to identify contaminants in water supplies, which are more time taking. This project aims at developing a water quality monitoring system using sensors and IoT (Internet of Things). The water quality parameters like temperature, pH, and turbidity are measures using sensors and the water quality index is determined. The measured values from the sensors will be processed using a microcontroller, and alert message will be sent to the user via an android application developed using MIT app inventor in case of any abnormalities.

3) A Development and Implementation of Water Quality Assessment Monitoring (WQAM) System using the Internet of Things (IoT) in Water Environment
Muhammad Farhan Johan, S. Abdullah, A. Zanal Saurabh S. Soman, Hamidreza Zareipour , Om Malik
JEVA , 23 November 2021

This paper presents the development and implementation of Water Quality Assessment and Monitoring (WQAM) system. The system development used Wi-Fi enabled microcontroller to connect with the IoT environment and store the data in the IoT cloud server. The microcontroller used is Arduino UNO that interacts with three types of sensor probes which are pH, turbidity and temperature probe. All the data measurements is transferred using a Wi-Fi module which is ESP8266. The IoT cloud used to utilize the data frame is Thing Speak. This system was implemented on Bandar Pereda Lake and Deraa River in Pulao Pinang with two systems implemented at each location. The sensors were placed on the water surface for more accurate measurements. This system continuously measures the readings of pH, turbidity dan temperature on the lake/river for every 1 hour. Twenty readings were taken for every 1 hour within the first 20 minutes with 1 minute interval and the readings were stored in the IoT cloud server.

4) IoT-based System for Real-time Water Pollution Monitoring of Rivers
Mohammad Ariful Islam Khan; Mohammad Akidul Hoque; Sabbir Ahmed
IEEE September 2021

The research proposes a system to remotely monitor the water quality of a river so that the authorities can gather better insights about the condition of that particular river and predict the critical future phenomena. Consequently, they will be able to take auspicious steps in order to protect the rivers and save the environment. The proposed framework can observe

the real-time value of pH, conductivity, turbidity, temperature and flow of the water by utilizing various sensors. Furthermore, through our device, effective predictions about imminent floods can be made. Thus, authorities can commence early warning for floods and ensure prompt evacuation. Thus, our technique can significantly minimize the casualties caused by this disaster. In this context, real-time feeds are obtained through Internet of Things (IoT). For wireless data transmission Message Queuing Telemetry Transport (MQTT) is used.

5) Design and Implementation of Real Time Approach for The Monitoring of Water Quality Parameters

Siti Aishah Binti Makhtar; Norhafizah Binti Burham; Anees Bt Abdul Aziz

IEEE - June 2022

Access to safe drinking water is essential to nurturing human life on earth. Polluted air and unsanitary water can cause health problems. Unhygienic water can cause stomach and health-related problems.

A specific range of water quality parameters, mainly temperature, pH, total dissolved solids (TDS) and turbidity, can degrade the growth of these bacteria. This presented paperwork is to develop a smart water quality monitoring system using four sensors and an IoT platform to help determine water quality. It is to analyse the parameters of water samples such as tap water, co way water, river water, pond water, and lake water whether these water samples are in the threshold range for drinking or not. The device is initially used to measure pH, turbidity, total dissolved solids (TDS) and temperature, and then sent the information to the microcontroller Arduino Uno.

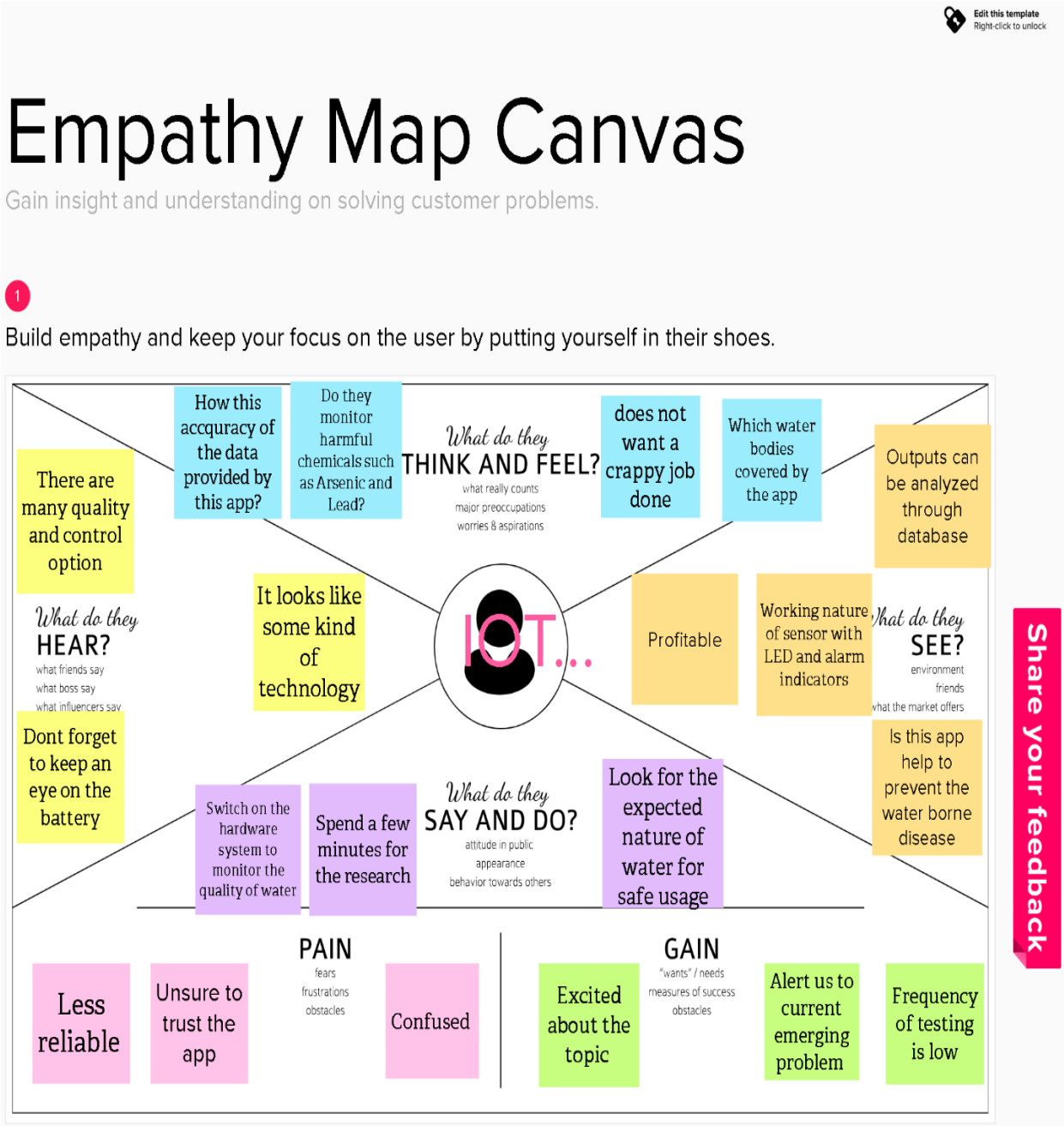
2.3 PROBLEM STATEMENT DEFINITION

The reduce the river water pollution and to monitor the parameters of river water and control measures can impact vegetation, health. The Real time analysis of Indicators of River water (Ph, salinity, nutrients, etc..,)

Problem Statement (PS)	**I am (Customer)**	**I'm trying to**	**But**	**Because**	**Which makes me feel**
PS-1	A Farmer	use river water for irrigation	I don't know the quality and levelof the water	I don't know how to measure the quality of the water	Frustrated
PS-2	An Industrialist	use river water for drinks manufacturing	I don't know the pH level of river water	we can't use water with acidic nature for cool drinks manufacturing	Indecisive

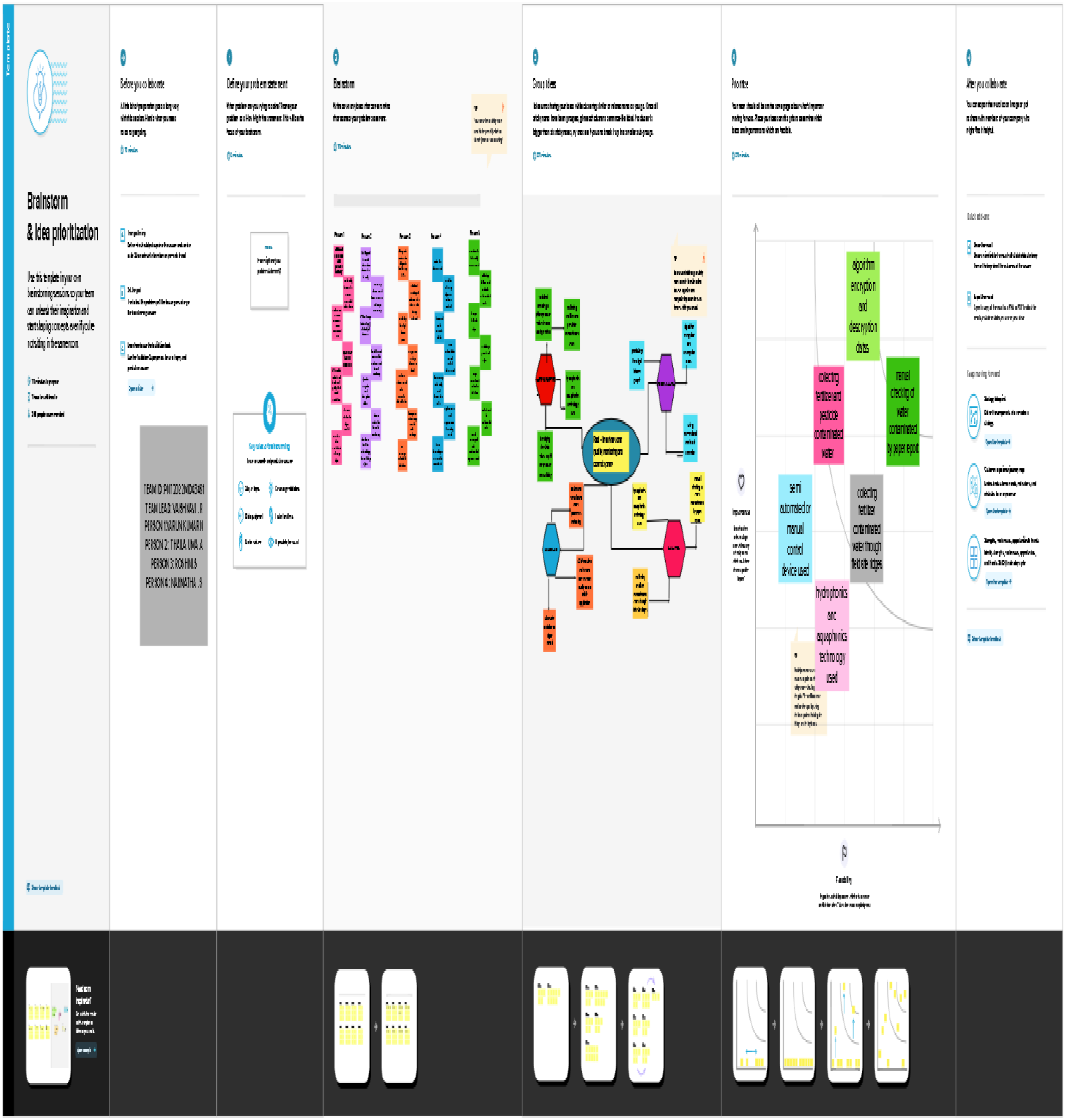
3. IDEATION AND PROPOSED SOLUTION

3.1 EMPATHYMAP CANVAS



3.2 IDEATION AND BRAINSTROMING

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.



Brainstorm
& Idea prioritization
Before you collaborate
Define your problem statement
Brainstorm
Group ideas
Prioritize
After you collaborate
TEAM ID: PNT2022TMID03491
TEAM LEAD: VAISHNAVI . R
PERSON 1: VARUN KUMAR.N
PERSON 2 : THAILA UMA .A
PERSON 3: ROSHINI.S
PERSON 4 : NARMATHA . S
algorithm encryption and description dates
collecting fertilizer and pesticide contaminated water
manual checking of water contaminated by paper report
semi automated or manual control device used
collecting fertilizer contaminated water through fieldside ridges
hydrophonics and aquaphonics technology used
Importance
Feasibility

3.3 PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Massive growth of algae called eutrophication leads to pollution (monitoring and controlling the quality of river water)
2.	Idea / Solution description	Detecting the dust particles, PH level of water, Dissolved oxygen and temperature to be monitored and altering the authorities if water quality is not good.
3.	Novelty / Uniqueness	River water quality can be monitored by web application. Quality parameter will track continuously with standard measurements.
4.	Social Impact / Customer Satisfaction	Localities will not get suffered by poor quality of water by alerting them when the water quality is not good.
5.	Business Model (Revenue Model)	Water quality monitoring system by Aeron systems for industrial water treatment plant, river bodies, aqua forming, digital loggers.
6.	Scalability of the Solution	Measuring of real time values and continuous monitoring helps in maintaining the quality of water.

3.4 PROBLEM SOLUTION FIT

Project Title: Real Time river water quality monitoring and control systems

Project Design Phase-I - Solution Fit Template

Team ID: PNT2022TMIDxxxxxx

PNT2022TMID43481

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

Who is your customer?
i.e. working parents of 0-5 y.o. kids

Framers and locals who depend on the river water for drinking purpose.
Authorities who maintain river water quality

6. CUSTOMER CONSTRAINTS CC

What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices.

budget and spending power

5. AVAILABLE SOLUTIONS AS

Which solutions are available to the customers when they face the problem
or need to get the job done? What have they tried in the past? What pros & cons do these solutions have? i.e. pen and paper is an alternative to digital notetaking

laboratory method which is a time consuming process

Explore AS, differentiate

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

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

Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides.

Ph values to be monitored
Turbidity values to be monitored
Water quality should be continuously detected
Controlling of algal bloom

9. PROBLEM ROOT CAUSE RC

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.

Chemical fertilizers that used in agriculture field
run off and settle in river water during rainy seasons
This will create algal bloom and spoil the river water

7. BEHAVIOUR BE

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)

Avoid using high amount of chemical fertilizers
continuous monitoring of river water

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

Identify strong TR & EM

3. TRIGGERS TR

What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news.

By knowing about working efficiency a and environment friendly application

4. EMOTIONS: BEFORE / AFTER EM

How do customers feel when they face a problem or a job and afterwards?
i.e. lost, insecure > confident, in control - use it in your communication strategy & design.

before:
unsafe water for drinking purpose (afraid of it)
after:
safe drinking water (satisfaction and safe)

10. YOUR SOLUTION SL

If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality.
If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.

Ph and turbidity values of water continuously monitored and these values compared so that algae production controlled
If there any where algae is formed it is eliminated used ultrasonic frequency generator

8. CHANNELS of BEHAVIOUR CH

8.1 ONLINE
What kind of actions do customers take online? Extract online channels from #7

8.2 OFFLINE
What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.

Online:
monitor water quality
Offline:
less usage of chemical fertilizers

Identify strong TR & EM

4. REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through product mobile UI
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Ph level detection	Ph sensor is used to monitor the water quality and the signals are send to Arduino.
FR-4	Turbidity detection	Turbidity sensor TS-300B measures the turbidity (counter of suspended matter) in the wash water and the signals are send to Arduino.
FR-5	Ultrasonic generator	Waves generated at regular interval times to clear algae 25% ,50%, 100%

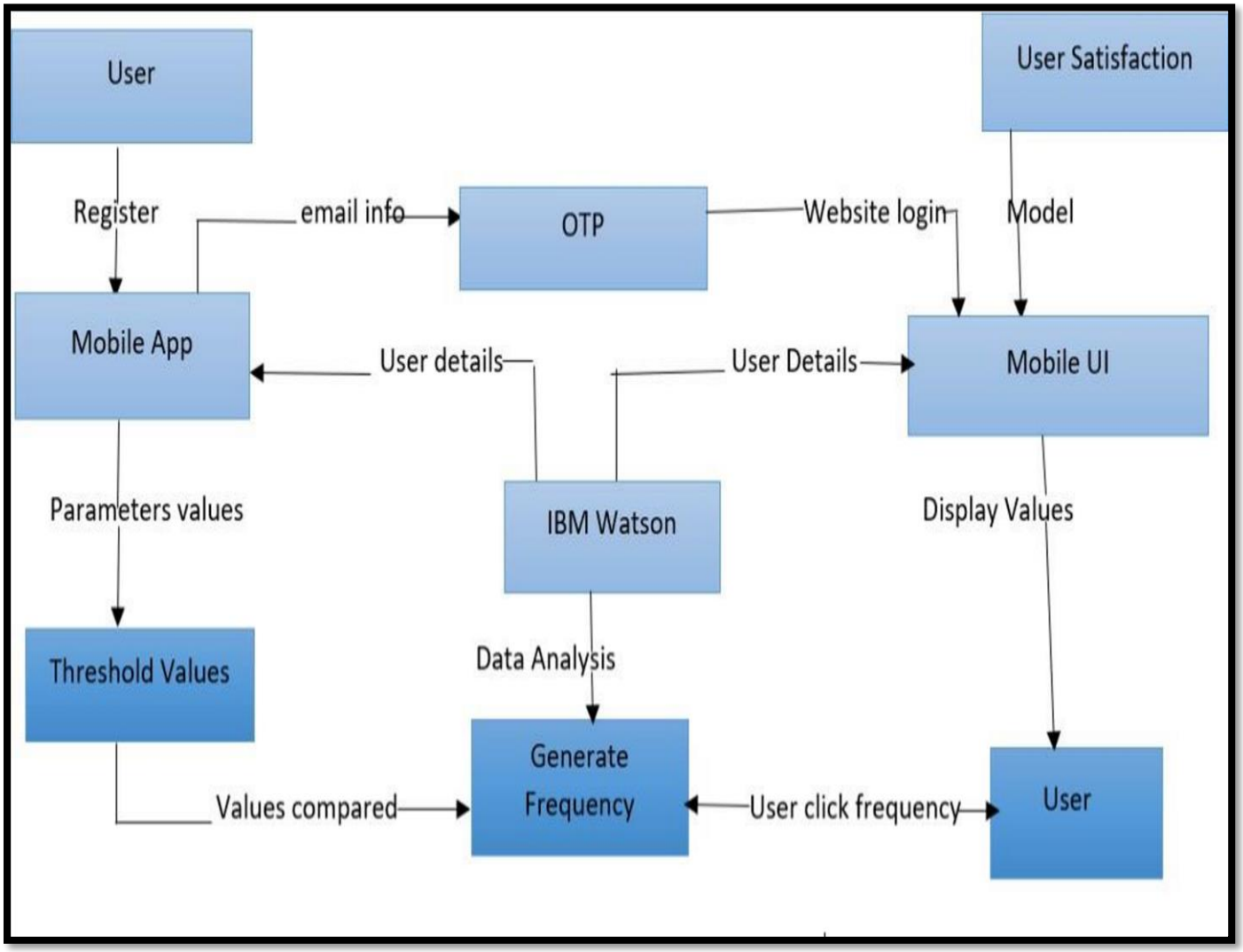
4.2 NON-FUNCTIONAL REQUIREMENTS

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Efficient to use and has simple monitoring system.
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. Assurance for aquaculture safety
NFR-4	**Performance**	Greater performance and environmentally safe model.
NFR-5	**Availability**	In form of mobile UI 24 x 7 monitoring system.
NFR-6	**Scalability**	Highly Scalable. It is capable to produce a best final output.

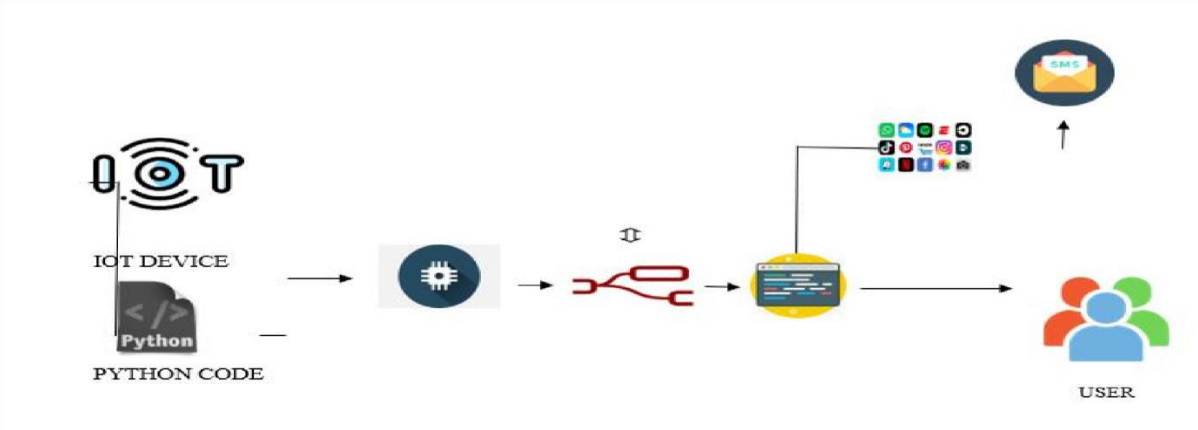
NFR-7	**Stability**	It is highly stable.
NFR-8	**Efficiency**	It is highly efficient and it has simple monitoring system.

5. PROJECT DESIGN

5.1 DATA FLOW DIAGRAM



5.2 SOLUTION AND TECHNICAL ARCHITECTURE



5.3 USER STORIES

User Story Number	User Story/Task	Story Points	Priority	Team Members
USN-1	As a user, I can register for the Application by entering my email, password, and confirming My password.	2	High	Vaishnavi R Varunkumar Thaila uma Roshini Narmatha
USN-3	As a user, I can register for the application through Facebook	2	Low	
USN-4	As a user, I can register for the application Through Gmail	2	Medium	
USN-2	As a user, I will receive confirmation email Once I have registered for the application	1	High	
USN-5	As a user, I can login to the application by Entering email & password	1	High	
	Get access to IBM cloud services.	2	High	

6. PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING AND ESTIMATION

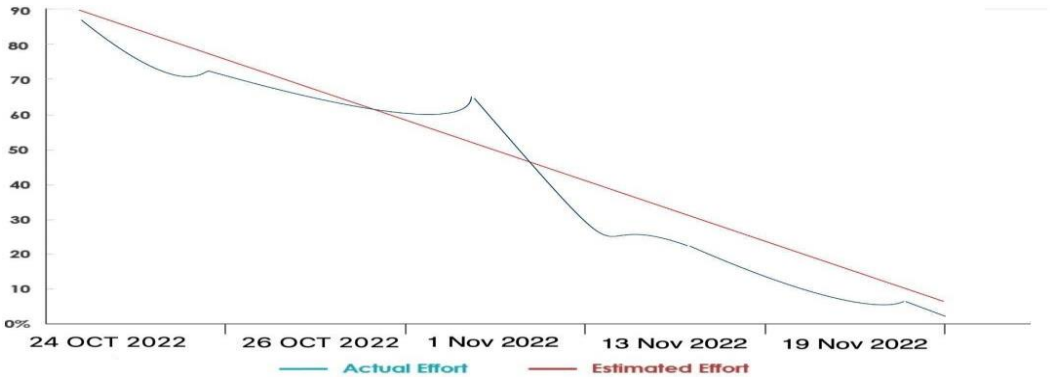
S.NO	ACTIVITY TITLE	ACTIVITY DESCRIPTION	DURATION
1	Understanding the project requirement	Assign the team members and create repository in the Github, Assign the task to each members and teach how to use and open and class the Github and IBM career education .	1 WEEK
2	Starting of project	Advice students to attend classes of IBM portal create and develop an rough diagram based on project description and gather of information on IOT and IBM project and team leader assign task to each member of the project .	1 WEEK
3	Attend class	Team members and team lead must watch and learn from classes provided by IBM and NALAYATHIRAN and must gain access of MIT license for their project.	4 WEEK
4	Budget and scope of project	Budget and analyze the use of IOT in the project and discuss with team for budget prediction to predict the favourability for the customer to buy	1 WEEK

6.2 SPRINT DELIVERY SCHEDULE

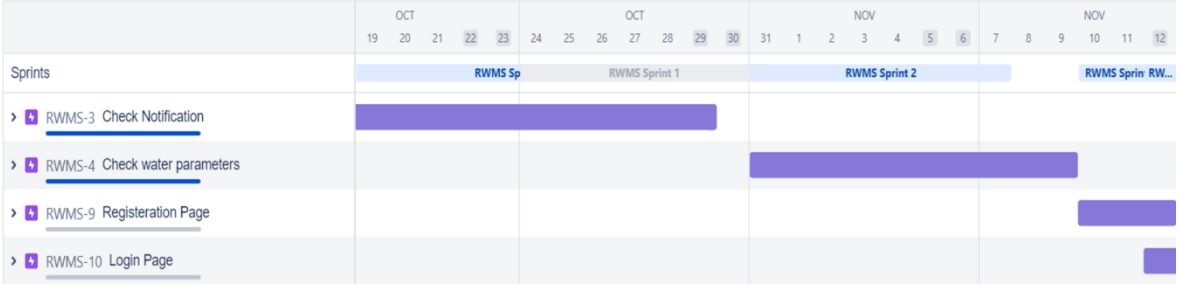
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date(Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date(Actual)
Sprint-1	20	2Days	24 Oct 2022	26 Oct 2022	20	29 Oct 2022
Sprint-2	20	4Days	26 Oct 2022	30 Oct 2022	40	
Sprint-3	20	12Days	1 Nov 2022	12 Nov 2022	60	
Sprint-4	20	6Days	13 Nov 2022	19 Nov 2022	80	19 Nov 2022

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

Burn down Chart:

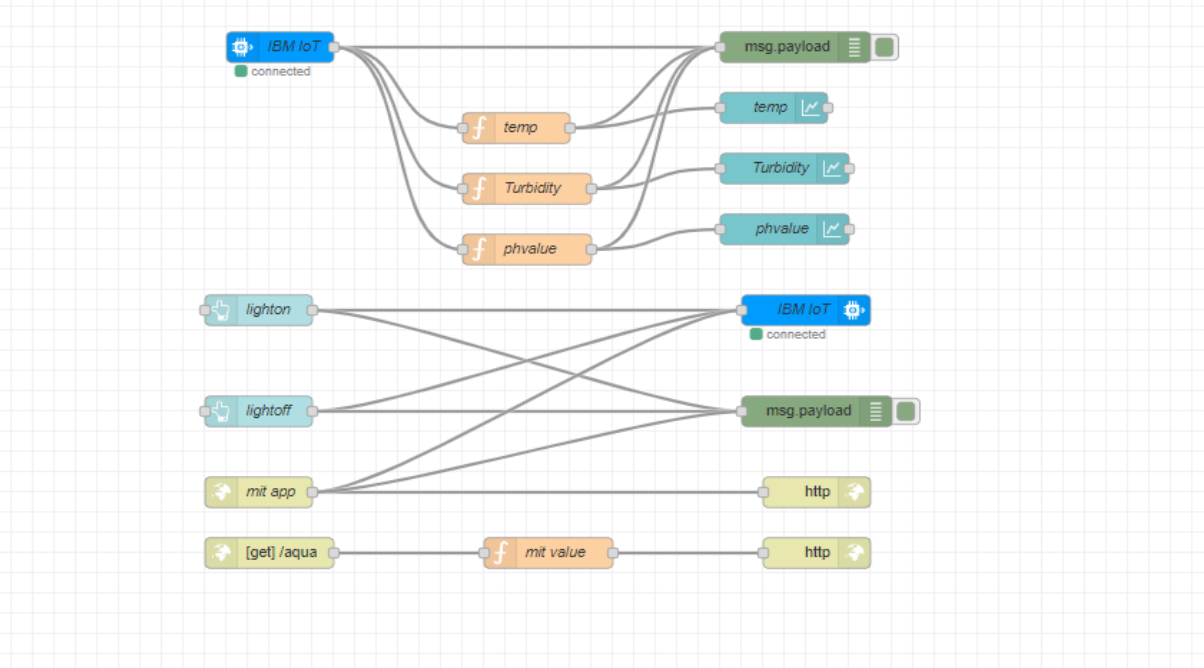


6.3 REPORTS FROM JIRA

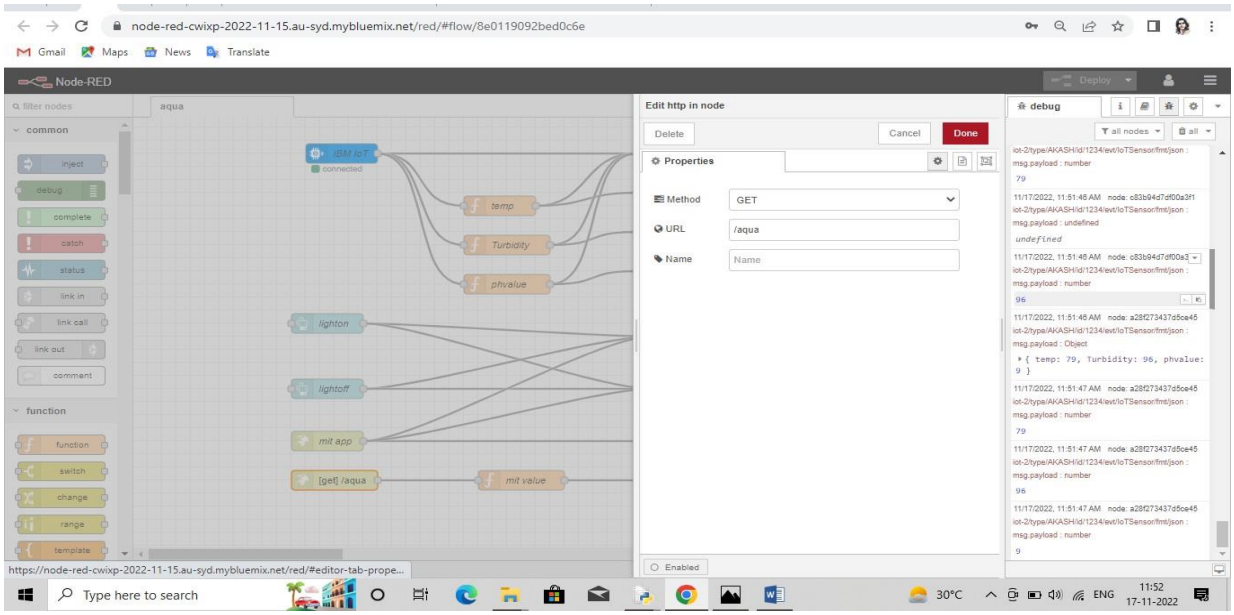


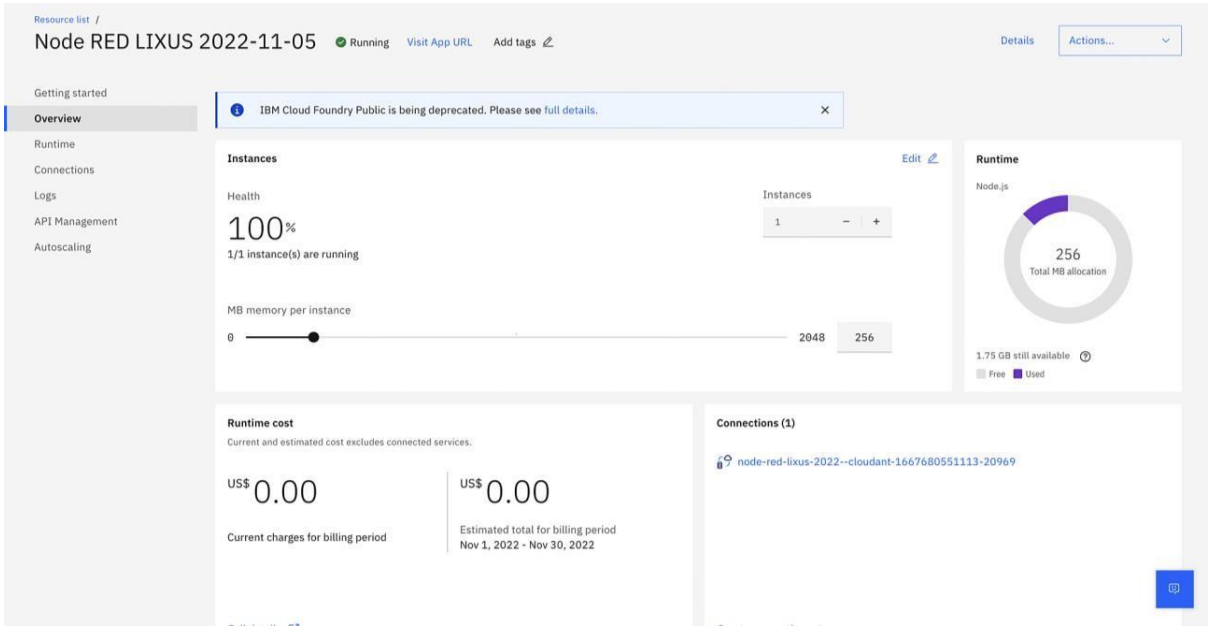
7. CODING AND SOLUTIONING

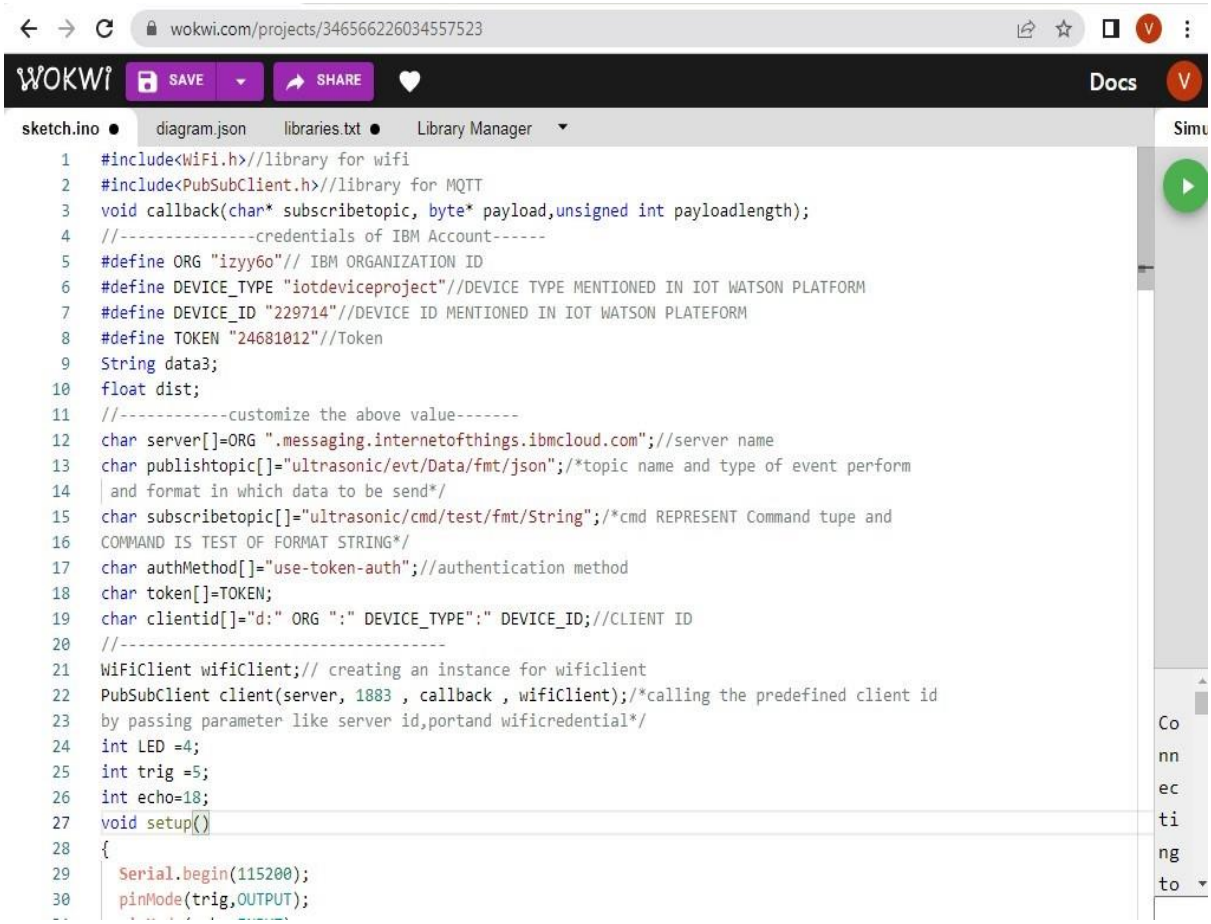
NODE RED SERVICE ASSOCIATED WITH CLOUD



OUTPUT




Resource list /
Node RED LIXUS 2022-11-05
Running
Visit App URL
Add tags
Details
Actions...
Getting started
Overview
Runtime
Connections
Logs
API Management
Autoscaling
IBM Cloud Foundry Public is being deprecated. Please see full details.
Instances
Edit
Health
100%
1/1 instance(s) are running
Instances
1
MB memory per instance
0
2048
256
Runtime
Node.js
256
Total MB allocation
1.75 GB still available
Free
Used
Runtime cost
Current and estimated cost excludes connected services.
US$ 0.00
Current charges for billing period
US$ 0.00
Estimated total for billing period
Nov 1, 2022 - Nov 30, 2022
Connections (1)
node-red-lixus-2022--cloudant-1667680551113-20969


wokwi.com/projects/346566226034557523
WOKWI
SAVE
SHARE
Docs
sketch.ino
diagram.json
libraries.txt
Library Manager
#include<WiFi.h>//library for wifi
#include<PubSubClient.h>//library for MQTT
void callback(char* subscribetopic, byte* payload,unsigned int payloadlength);
//---------------credentials of IBM Account------
#define ORG "izyy6o"// IBM ORGANIZATION ID
#define DEVICE_TYPE "iotdeviceproject"//DEVICE TYPE MENTIONED IN IOT WATSON PLATFORM
#define DEVICE_ID "229714"//DEVICE ID MENTIONED IN IOT WATSON PLATEFORM
#define TOKEN "24681012"//Token
String data3;
float dist;
//------------customize the above value-------
char server[]=ORG ".messaging.internetofthings.ibmcloud.com";//server name
char publishtopic[]="ultrasonic/evt/Data/fmt/json";/*topic name and type of event perform
and format in which data to be send*/
char subscribetopic[]="ultrasonic/cmd/test/fmt/String";/*cmd REPRESENT Command tupe 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 an instance for wificlient
PubSubClient client(server, 1883 , callback , wifiClient);/*calling the predefined client id
by passing parameter like server id,portand wificredential*/
int LED =4;
int trig =5;
int echo=18;
void setup()
{
Serial.begin(115200);
pinMode(trig,OUTPUT);

8. TESTING

8.1 TESTCASE ANALYSIS

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	15	0	0	15
Client Application	45	0	0	45
Security	1	0	0	1
Outsource Shipping	2	0	0	2
Exception Reporting	10	0	0	10
Final Report Output	4	0	0	4
Version Control	3	0	0	3

8.2 USER ACCEPTANCE TESTING

Login:

- Verify user is able to see login page
- Verify user is able to login to application or not?
- Verify login page elements

Signup:

- Whether the user can signup or not
- The username and password entered are saved in database or not.

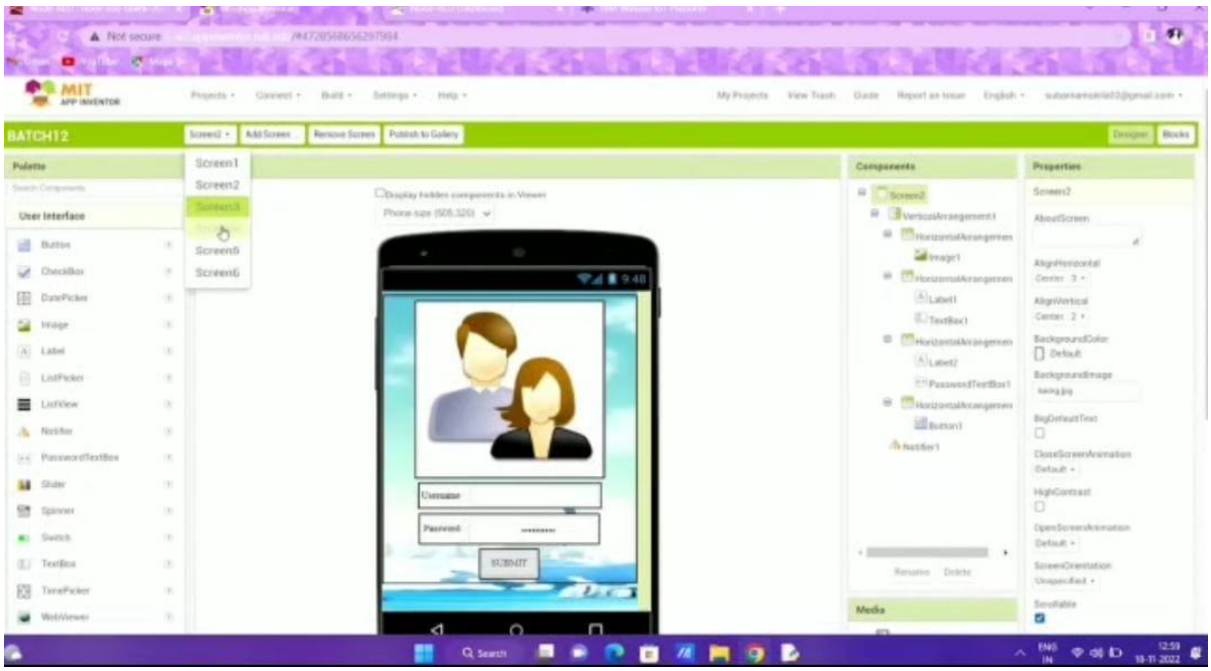
View the water quality measures:

- Whether the user is able to see the pH, temperature and turbidity values.
- Whether these values are periodically updated.

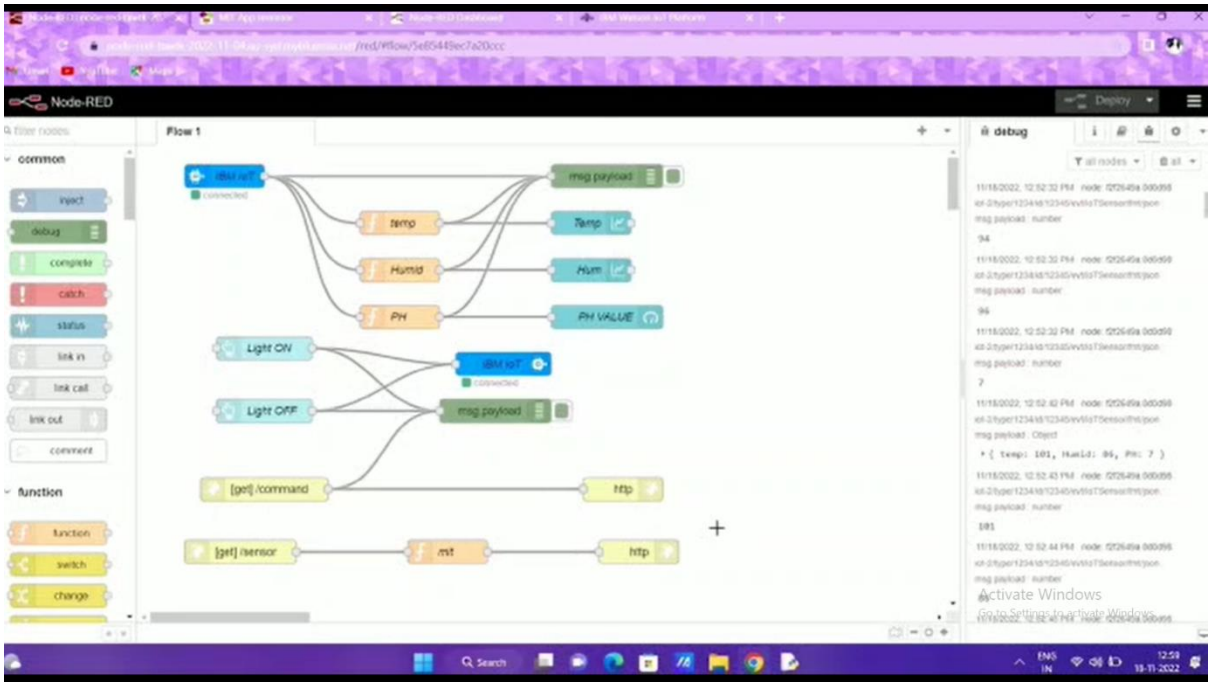
SMS:

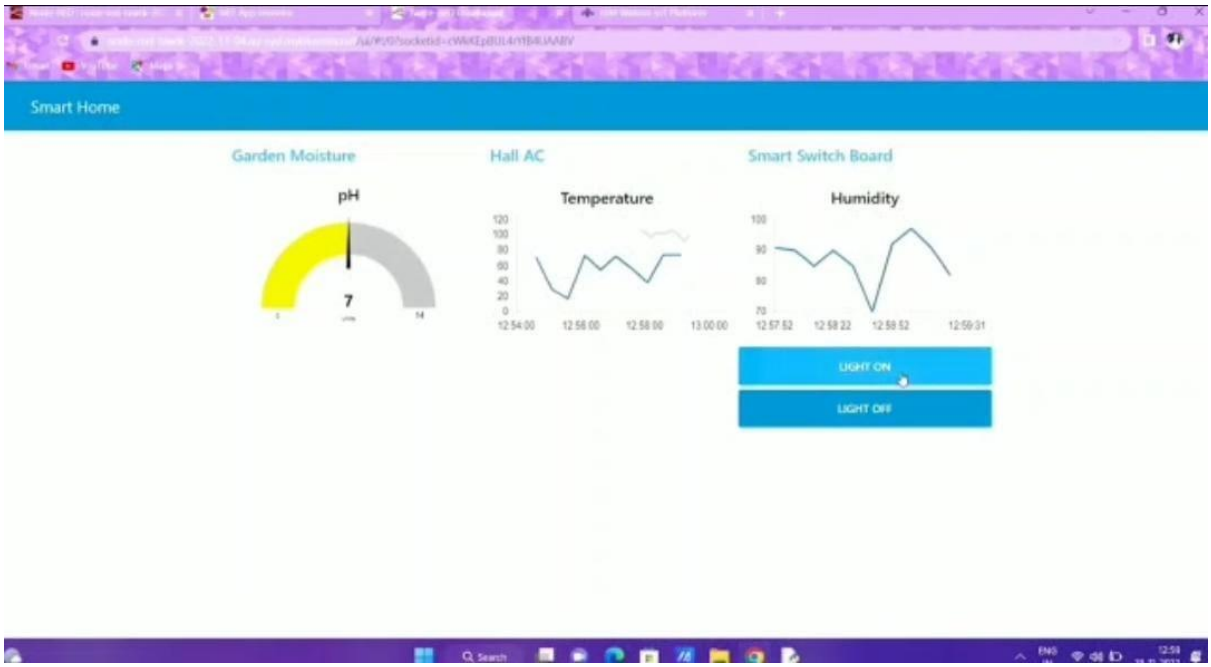
- Whether the user receives sms if water quality goes below a certain level

9. RESULTS



9.1 PERFORMANCE METRICS





10. ADVANTAGES & DISADVANTAGES

ADVANTAGES

- The prototype developed for water quality maintenance is very beneficial for safeguarding public health and also adds to the clean environment.
- The automation of this water monitoring, cleaning and control process removes the need of manual labor and thus saves time and money.
- The automation of the system makes the control and monitoring process more efficient and effective. Real time monitoring on mobile phone which is possible through the interface of plc with Arduino and Bluetooth module allows remote controlling of the system.

DISADVANTAGES

- It is difficult to collect the water samples from all the area of the water body.
- The cost of analysis is very high.
- The lab testing and analysis takes some time and hence the lab results does not reflect real time water quality measurement due to delay in measurement.
- The process is time consuming due to slow process of manual data collection from different locations of the water body.

11. CONCLUSION

Thus our project is used to Monitoring of humidity, 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

In future, we have planned to implement this project in large scale which will be helpful and used by all people. We can also implement as a revenue model. This system could also be implemented in various industrial processes. The system can be modified according to the needs of the user and can be implemented along with lab view to monitor data on computers.

13. APPENDIX

SOURCE CODE:

```
#include <OneWire.h>

#include <DallasTemperature.h>

#define ONE_WIRE_BUS 5

OneWireoneWire(ONE_WIRE_BUS);

DallasTemperature sensors(&oneWire);

float Celcius=0;

float Fahrenheit=0;

float voltage=0;
```

```
constintanalogInPin = A0;
intsensorValue = 0;
unsigned long intavgValue;
float b;
intbuf[10],temp;
void setup(void)
{

Serial.begin(9600);
sensors.begin();
intsensorValue = analogRead(A1);
 voltage = sensorValue * (5.0 / 1024.0);
}
void loop(void)
{
sensors.requestTemperatures();
Celcius=sensors.getTempCByIndex(0);
 Fahrenheit=sensors.toFahrenheit(Celcius);
for(inti=0;i<10;i++)
{
buf[i]=analogRead(analogInPin);
delay(10);
}
for(inti=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(inti=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);
}
```

DEMOLINK:

Project Demo Link:

https://drive.google.com/file/d/1u4m8h11ArcA9BfGBK3UzrT0CcUWS3sQk/view?usp=drivesdk

GitHub Link:

https://github.com/IBM-EPBL/IBM-Project-35406-1660284500