REAL TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM

Category: INTERNET OF THINGS

A PROJECT REPORT

Submitted by

NAME	ROLL.NO
Dhuvagares K S	718019L209
Kavi Arasan K	718019L221
Mohamed Ashfaque A	718019L224
Sri Charan M	718020L434

FROM

PSG COLLEGE OF TECHNOLOGY, COIMBATORE 641004

In fulfillment of project in IBM-NALAYATHIRAN 2022

TEAM ID: PNT2022TMID12856

PROJECT GUIDES

Industry Mentor: Bharadwaj

Faculty Mentor: Dr. G.Srivatsun

INDEX

1. INTRODUCTION

1.1 Project Overview:

River Water quality monitoring System

For all people, river water that is utilised for drinking is a very valuable resource. Multiple sensors make up the system, which is used to measure the physical and chemical characteristics of water. It is possible to measure the water's characteristics, including its temperature, pH, and dissolved oxygen. Anyone in the world can use this technology to find pollution in a body of water. The current technique for monitoring water quality is manual, has a tedious process, and takes a long time. This research suggests a sensor-based system for tracking water quality. A microcontroller for system processing, a communication system for inter and intra node communication, and a number of sensors are the core elements of a wireless sensor network (WSN). Remote monitoring and Internet of Things (IoT) technology can be used to access real-time data. Data gathered at the IBM cloud server are verified before being used to launch actions.

1.2 Purpose:

Chemical, physical, biological, and radiological aspects of water are referred to as its quality. It measures how well the water is functioning in relation to the needs of one or more biological species and/or any human needs or goals. Monitoring the state of a water body as well as sampling and analysing the water in a lake, stream, ocean, or river falls within the definition of water quality. Real-time monitoring and analysis of water are used in smart water quality monitoring to spot changes in parameters based on their physical, chemical, and biological properties. Monitoring water quality is crucial for both businesses and the general population in our oceans, rivers, on the surface, and ports. It enables us to evaluate how they are altering, examine patterns, and inform plans and strategies that enhance the quality of water and guarantee that water is used for its intended purpose. Water quality is determined by a number of factors. These consist of pH scale, water temperature, dissolved oxygen, turbidity, bio indicators, and nitrates. Monitoring the quality of the water makes it easier to pinpoint particular contaminants, a particular chemical, and the source of the contamination. Agricultural practises (such as the use of pesticides and fertilizer), oil pollution, river and marine

dumping, port, shipping, and industrial activity are a few of the many sources of water pollution. Other sources include sewage wastewater and agricultural practices.

Monitoring water quality and a water quality assessment regularly provides a source of dataidentify immediate issues – and their source.

- Identifying trends, short and long-term, in water quality.

- 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 thenhelp to identify key water quality parameters

- Environmental planning methods: water pollution prevention and management.

- 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.

- Monitoring water quality is a problem and a concern that affects both land and sea. The European Green Deal publishes many directives to establish standards of water quality and lays forth objectives for restoring biological variety and lowering water pollution within the European Union. Additionally, distinct legislative frameworks in each nation state, such as France, mandate effective water quality monitoring. The Environmental Protection Agency (EPA) in the US enforces laws to combat water contamination in every state. Countries all around the world are becoming more aware of the significance of efficient water quality monitoring metrics and techniques.

2 . LITERATURE SURVEY

2.1 Existing Problem:

Competition for water resources is anticipated to increase as a result of population expansion, urbanisation, and climate change, with an impact on agriculture and river water in particular. Water will be suitable for swimming pools, monitoring compound spillage identification in rivers, and potable water use. It contains independent hubs that collaborate with the cloud to maintain water control. The parameters impacting the quality of river water need to be analysed and used for water treatment because river water needs to be treated before it can be used in agricultural fields.

2.2 References:

1. K.S. Adu-Manu, C. Tapparello, W. Heinzelman, F.A. Katsriku, J.-D. Abdulai Water quality monitoring using wireless sensor networks: Current trends and future research directions ACM Transactions on Sensor Networks (TOSN) (2017).

2. S. Thombre, R.U. Islam, K. Andersson, M.S. Hossain IP based Wireless Sensor Networks : performance Analysis using Simulations and Experiments.Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications, 7(2016).

3. M.Chitra, D. Sadhihskumar, R. Aravindh, M. Murali, R. Vaittilingame IoT based Water Flood Detection and Early Warning System.The collected information (data) from the water level sensor and temperature and humidity sensor passed to Thingview Android application in order to find the flow graph level of the water level in the river and temperature, humidity values and sends SMS to the registered contact mobile numbers (2020).

4. Dr.Geetha IoT based real time water quality monitoring system using smart sensor WQM is a cost effective and efficient system designed to monitor drinking water quality with the help of IOT(2020).

2.3 Problem Statement:

Vegetation and health may be impacted by control efforts to reduce river water pollution and monitor its properties. The Real-time study of River Water Indicators (Ph,temperature ,humility etc..,)

3.IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas:

An empathy map is a straightforward, simple-to-understand picture that summarises information about a user's actions and views. It is a helpful tool that enables teams to comprehend their users more fully. It's important to comprehend both the actual issue and the individual who is experiencing it in order to develop a workable solution. Participants learn to think about issues from the user's perspective, as well as his or her objectives and obstacles, through the process of constructing the map..

3.2 Ideation & Brainstorming:

During a brainstorming session, everyone on a team is encouraged to engage in the process of original thought that results in problem solving. Volume over quality is prioritised, unconventional ideas are welcomed and developed upon, and everyone is urged to participate in order to produce a wealth of original solutions. Utilize this template during your own brainstorming meetings to enable your team to let their creativity run wild and begin developing notions even if they are not physically there.


Brainstorm
& Idea prioritization


2
Brainstorm
Write down any ideas that come to mind
that address your problem statement.
10 minutes


3
Prioritize
Importance

3.3 Proposed Problem:

Customer Problem Statement Template:

3.4 Proposed Solution:

Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	As a farmer I use the water from the river for irrigation.	I am trying to make sure that the water is free from contamination and does not affect my crops.	But I am unable to filter the contaminated water due to lack of knowledge and resources.	It is because of the over contamination in the river and due to the difficulty of figuring out the ideal solution to filter the water.	Worried and frustrated as it damages my crops.
PS-2	I'm a Fisherman	I fish in the river and sell the fishes I catch for a living. I couldn't find any fishes in the river most of them are dead and the breeding has drastically reduced.	But each time I require information about river water quality for analysis. Lack of knowledge on the	Because, I can't do my task on time since evaluating the river water quality takes additional time.	To fish, I require an automated river water management and control system.

3.5Proposed Solution:

Proposed Solution Template:

S.No	Parameter	Description
1.	Problem Statement(Problem to be solved)	Water is used for drinking, domestic use, and food production or recreational purposes. So it is highly imperative for us to maintain water quality balance. Otherwise, it would severely damage the health of the humans and affect the ecological balance. 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 and other issue is growth of algae called eutrophication This happens due to the lack of water quality monitoring system.
2.	Idea/Solution description	Detecting the dust particles,PH level of water, temperature to be monitored and altering the authorities if water quality is not good.
3.	Novelty/Uniqueness	IoT devices use various types of sensors to collect data about turbidity, temperature, pH, conductivity, etc. of river water continuously. Also, IoT devices have capability to stream the array of collected data wirelessly to the cloud.
4.	Social impact/customer satisfaction	In many developing countries, dirty or contaminated water is being used for drinking without any proper prior treatment. Water pollution is a foremost global problem which needs ongoing evaluation and adaptation of water resource directorial principle.
5.	Business Model (Revenue Model)	It is cost effective and affordable for all stages of people. it is used in industrial water treatment plant, river bodies, aqua forming and river water monitoring system.
6.	Scalability of the solution	Measuring of real time values and continuous monitoring helps in maintaining the quality of water

4 REQUIREMENT ANALYSI

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 LinkedIN
FR 2	User Confirmation	Confirmation via Email Confirmation via OTP
FR 3	Ph level detection	To observe the water quality, Phsensor is used and the signals are conveyed to the Arduino
FR 4	Turbidity detection	Turbidity sensor measures thepurity of element or marshy utter in the water and the signals are delivered to Arduino
FR 5	Humidity	Humidity sensors work by detecting changes that alter electrical currents or temperature in the air.

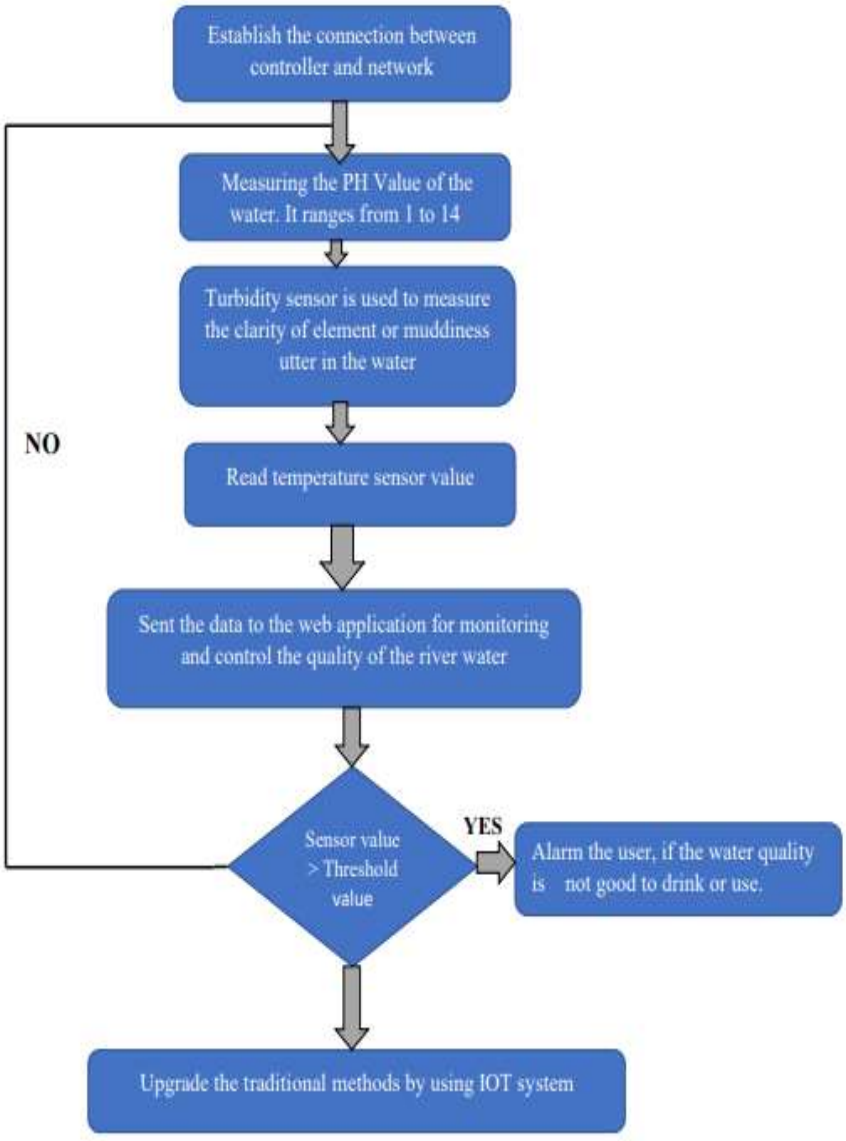
4.2 Non-functional Requirements:

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Monitors the flow and quality of ground water, and investigates surface-and ground-water interactions.
NFR-2	Security	The data and information are secured in the application by using the application firewall.
NFR-3	Reliability	The Real time sensor output values with future predicted data storage with output efficiency of 98%. It also gives certainty for aquaculture safety
NFR-4	Performance	The performance of system has higher efficiency and environmental friendly.
NFR-5	Availability	It is available in the form of mobile UI 24 x 7 monitoring system.
NFR-6	Scalability	The system has high scalability. Able to be changed in size or scale to give the best output.
NFR-7	Stability	The ability of the system to bring itself back to its stable configuration. The stability is high.
NFR-8	Efficiency	The monitoring system is highly efficient,high mobility with consumption of power.

5 PROJECT DESIGN

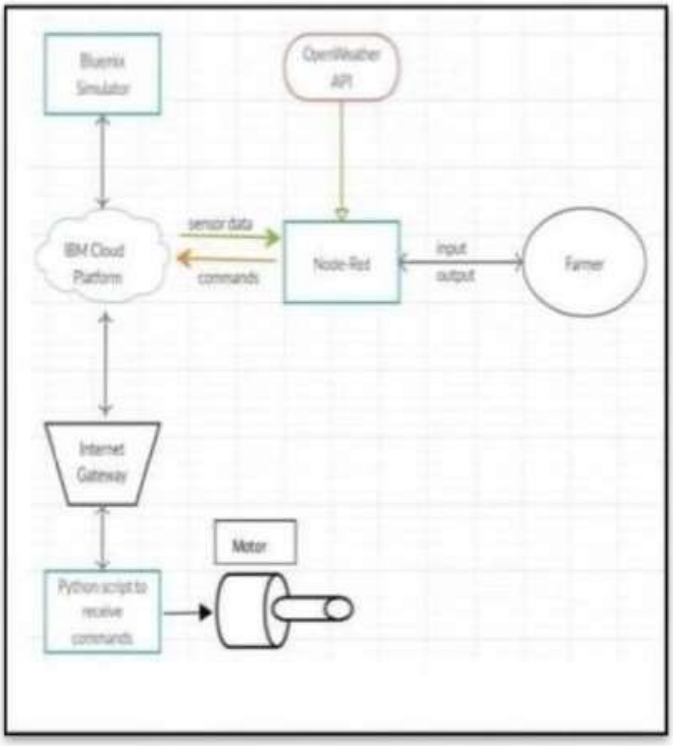
5.1 Data Flow Diagrams:

Summary This code pattern explains how to build an IOT based river water monitoring and controlling system with some predefined values.



5.2 SOLUTION AND TECHNICAL ARCHITECTURE

TECHNICAL ARCHITECTURE



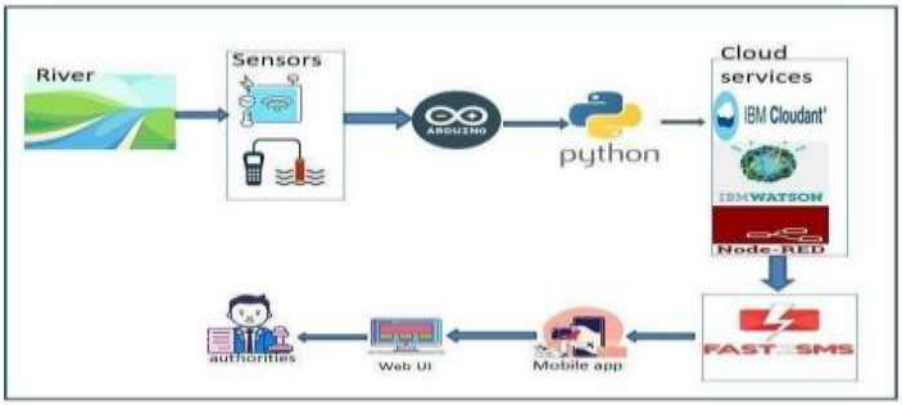


Table-1 : Components & Technologies:

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 Filesystem
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 Opensource 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

6.PROJECT PLANNING AND SCHEDULING

6.2 SPRINT DELIVERY SCHEDULE

Sprint	Functional Requirement (Epic)	User Story Number	User Story/Task	Story Points	Priority	Team Members
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	Kavi Arasan
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	Mohamed Ashfaque A
Sprint-2		USN-3	As a user, I can register for the application through Facebook	2	Low	Sri Charan M

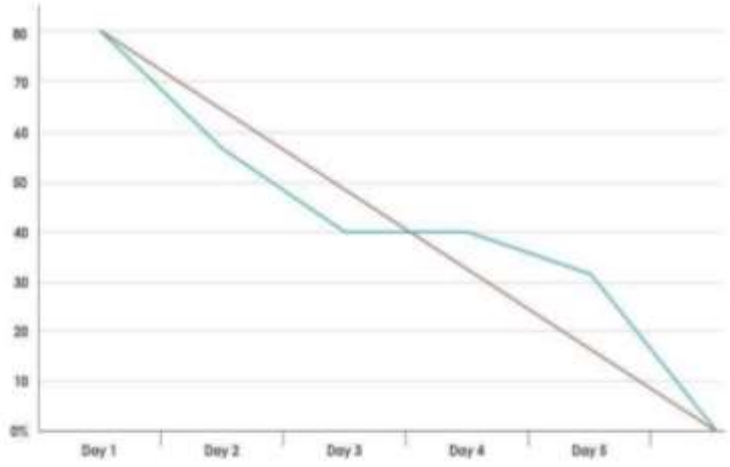
Sprint-1		USN-4	As a user, I can register for the application through Gmail	2	Medium	Dhuvaragesh
Sprint-1	Login	USN-5	As a user, I can log into the application by Entering email & password	1	High	Sri Charan M

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

Velocity

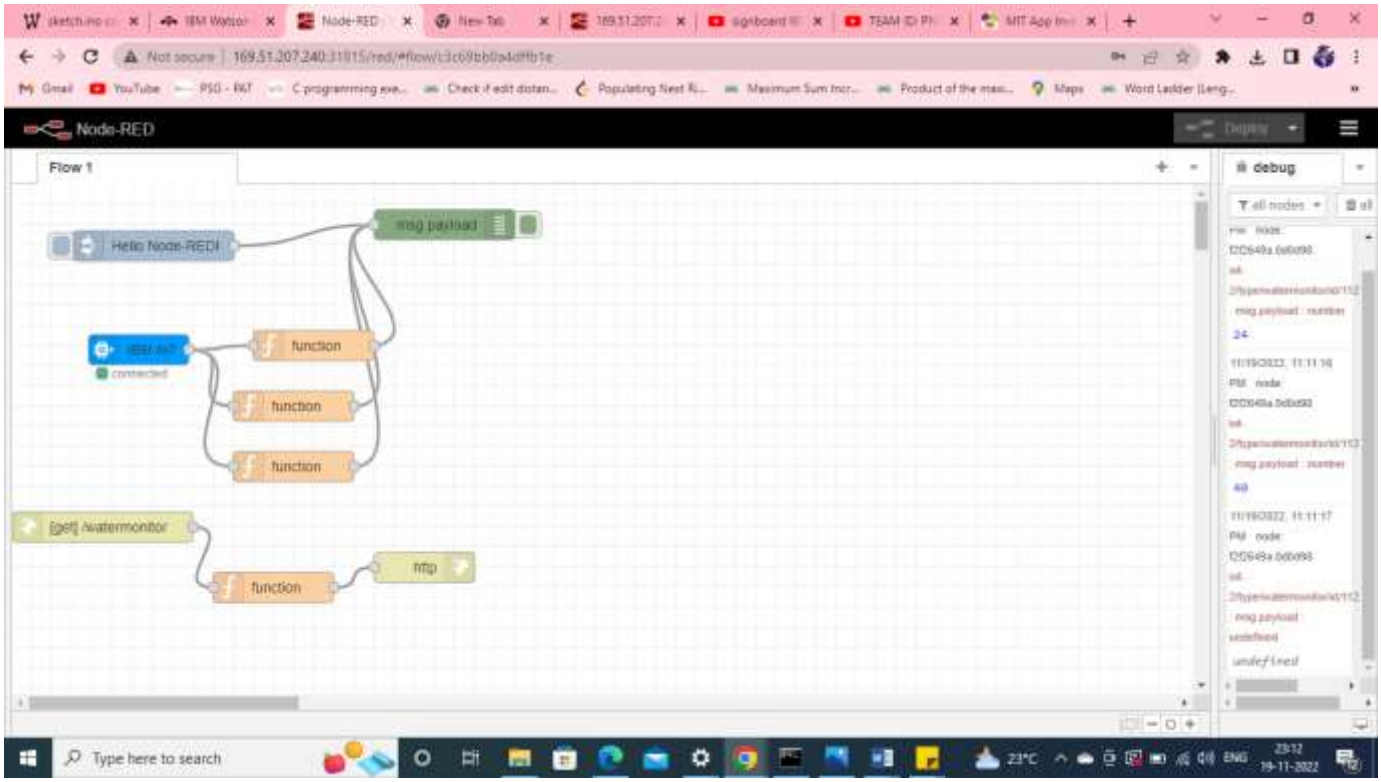
$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

Burndown Chart:



7. CODING AND SOLUTIONING

7.1 NODE RED SERVICE ASSOCIATED WITH IBM CLOUD:



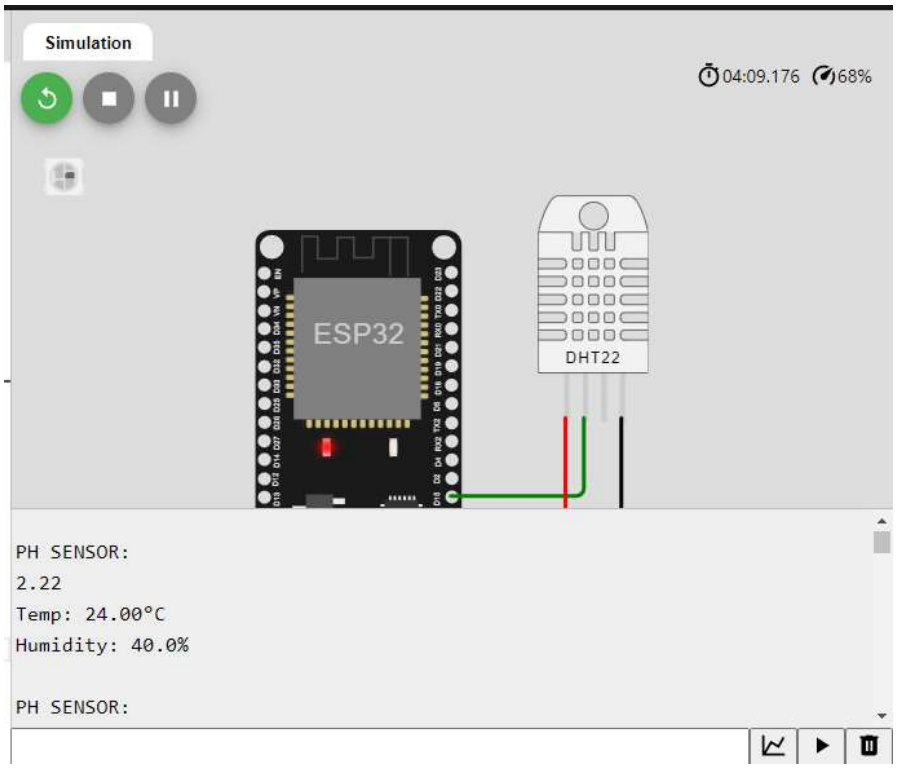
NODE-RED TO CREATE UI

PROJECT CODE OUTOUT:

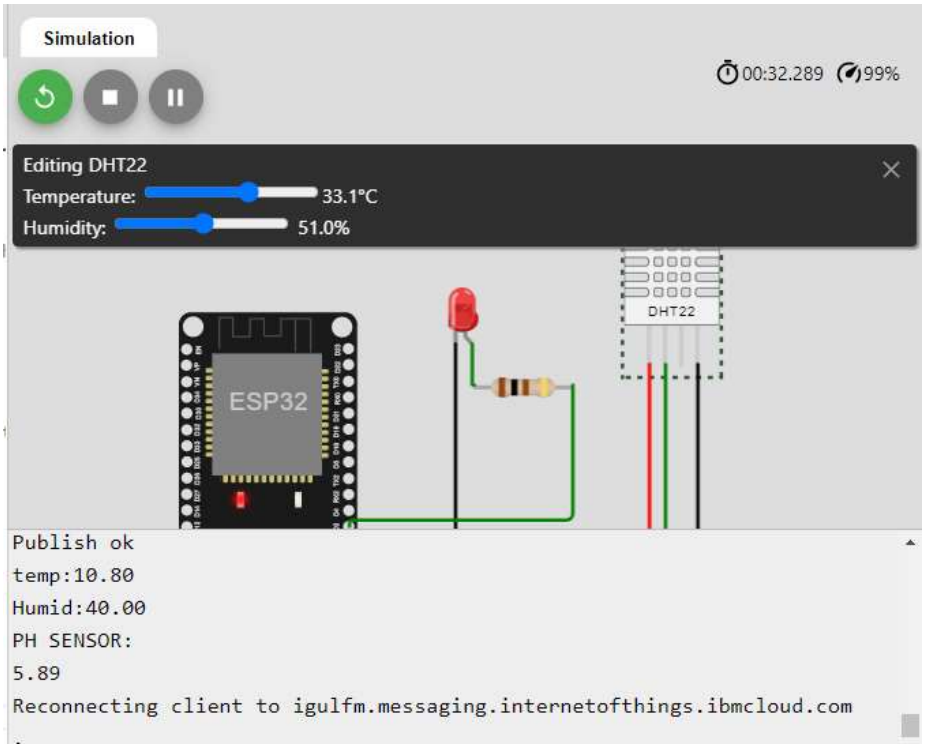
```
/**
   ESP32 + DHT22 Example for Wokwi

   https://wokwi.com/arduino/projects/322410731508073042
*/

#include "DHTesp.h"

const int DHT_PIN = 15;
const int potPin=A0;

float ph;
float volt;
float Value=0;
DHTesp dhtSensor;
//const int  = A1;


void setup() {
  Serial.begin(115200);
  dhtSensor.setup(DHT_PIN, DHTesp::DHT22);
   Serial.begin(115200);
  pinMode(potPin,INPUT);
  delay(1000);
  Serial.begin(9600); //Baud rate: 9600

}

void loop() {
  TempAndHumidity  data = dhtSensor.getTempAndHumidity();
  Serial.println("Temp: " + String(data.temperature, 2) + "°C");
  Serial.println("Humidity: " + String(data.humidity, 1) + "%");
  //Serial.println("---");
  //delay(1000);
  Value= analogRead(potPin);
  //Serial.print("Value");
  //Serial.print(Value);
  float voltage=Value*(3.3/4095.0);
  ph=(3.3*voltage);
  Serial.println("\nPH SENSOR: ");
  Serial.println(ph);
  delay(500);
}
```

8.TEST CASE

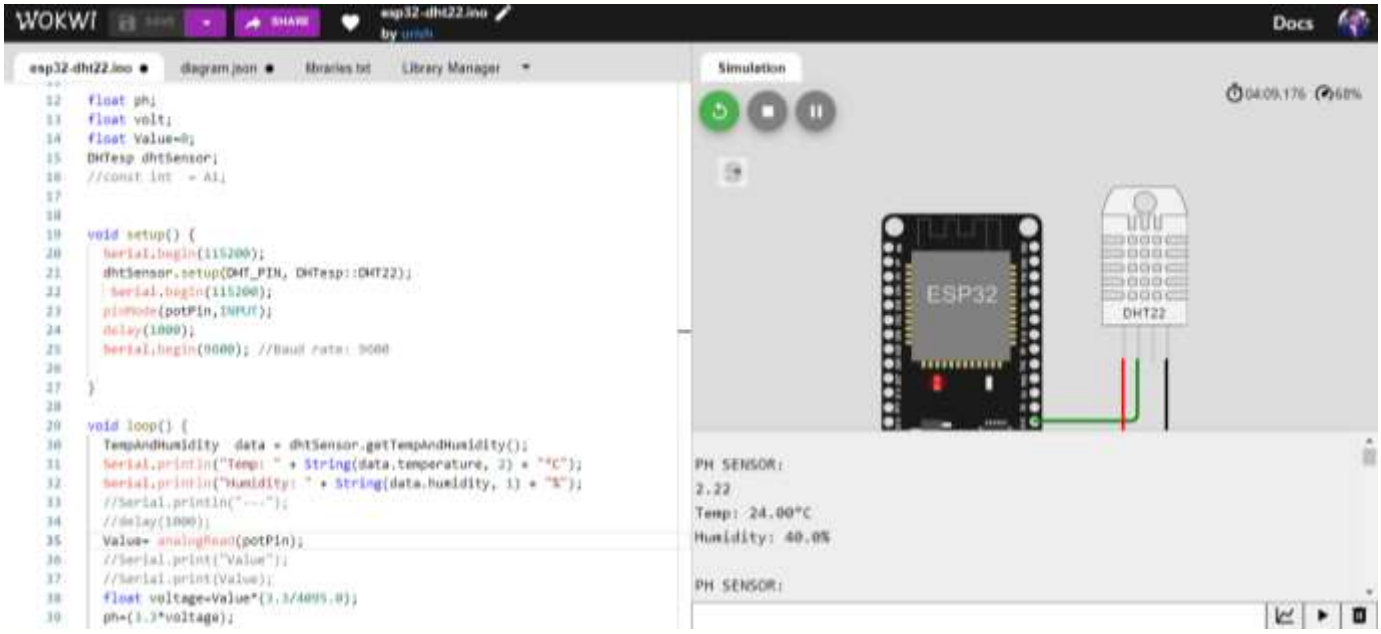
8.1 TEST CASE



8.2 USER ACCEPTANCE TEST

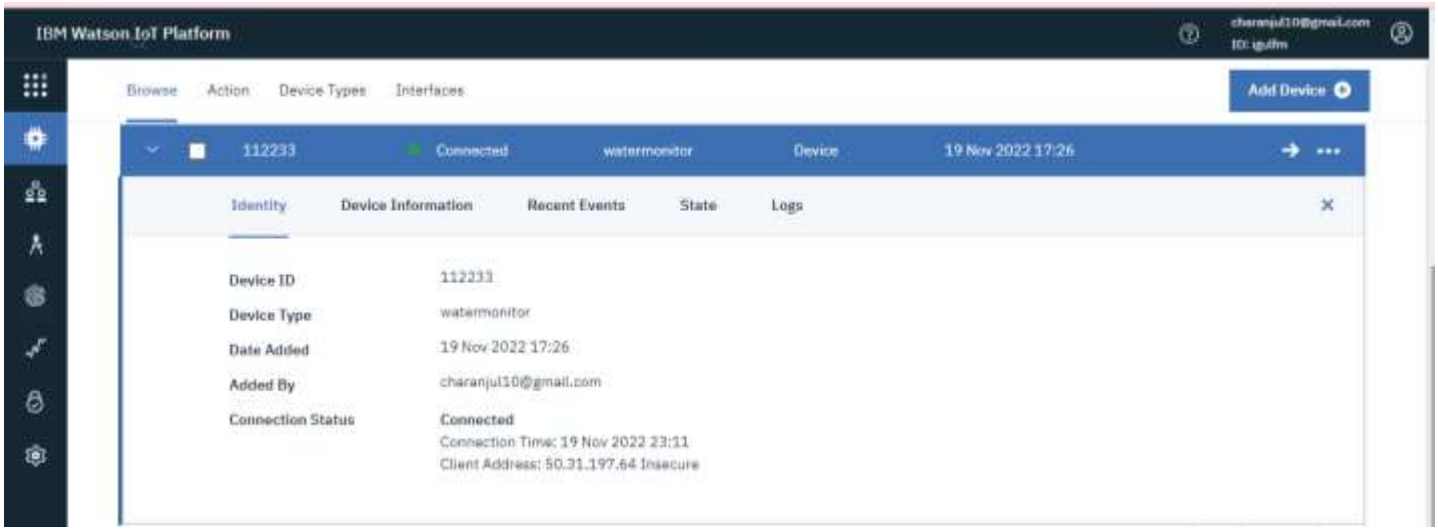


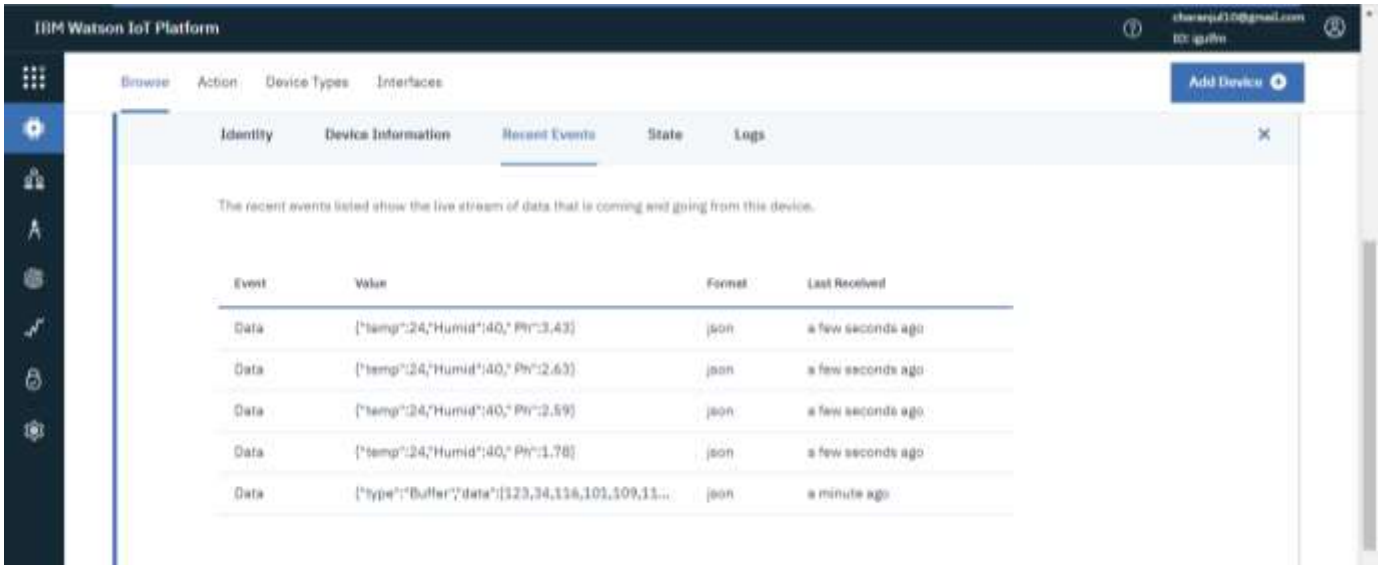
9. RESULTS




```
float ph;
float volt;
float Value=0;
DHTesp dhtSensor;
//const int  = A1;


void setup() {
  Serial.begin(115200);
  dhtSensor.setup(DHT_PIN, DHTesp::DHT22);
  Serial.begin(115200);
  pinMode(potPin,INPUT);
  delay(1000);
  Serial.begin(9600); //Baud rate: 9600

}

void loop() {
  TempAndHumidity  data = dhtSensor.getTempAndHumidity();
  Serial.println("Temp: " + String(data.temperature, 2) + "°C");
  Serial.println("Humidity: " + String(data.humidity, 1) + "%");
  //Serial.println("---");
  //delay(1000);
  Value= analogRead(potPin);
  //Serial.print("Value");
  //Serial.print(Value);
  float voltage=Value*(3.3/4095.0);
  ph=(3.3*voltage);
```

WOKWI TO IBM WATSON PLATFORM:





Real Time Water Monitoring System

Team ID: PNT2022TMID12856

Team Members

Dhuvagares k S - 718019L209

Kavi Arasan K - 718019L221

Mohamed Ashfaque - 718019L224

Sri Charan M - 718020L434

Login

MOBLIE APP TO RECEIVE DATA FROM CLOUDE

10 ADVANTAGES AND DISASVANTAGES

ADVANTAGES:

● The prototype developed for water quality maintenance is very beneficial for safeguardingpublic 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 systemDISADVANTAGES:

● 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.

● The method is prone to human errors of various forms.

11 CONCLUSION

This presents a detailed survey on the tools and techniques employed in existing smart water quality monitoring systems. Also, a low cost, less complex water quality monitoring system is proposed. The implementation enables sensor to provide online data to consumers. The proposed setup can be improved by incorporating algorithms for anomaly detection in water quality. So, this proposed system will surely helpful to the society for safe supply of water. Real-time monitoring of water quality by using IoT integrated Big Data Analytics will immensely help people to become conscious against using contaminated water as well as to stop polluting the water.The research is conducted focusing on monitoring river water quality in real-time. Therefore, IoT integrated big data analytics is appeared to be a better solution as reliability, scalability, speed, and persistence can be provided. During the project development phase an intense comparative analysis of real-time analytics technologies such as Spark streaming analysis through Spark ML lib, Deep learning neural network models, and Belief Rule Based (BRB) system will be conducted. This research would recommend conducting systematic experimentation of the proposed technologies in diverse qualities of river water in Bangladesh. Due to the limitation of the budget, only focus on measuring the quality of river water parameters. This project can be extended into an efficient water management system of a local area. Moreover, other parameters which wasn’t the scope of this project such as total dissolved solid, chemical oxygen demand and dissolved oxygen can also be quantified. So the additional budget is required for further improvement of the overall system.

12FUTURE SCOPE

Conductivity, dissolved oxygen parameter like implement in the river monitoring system. Application used in this project to add on subscriber option, to check their home water quality in day to life. 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.

13 APPENDIX

13.2 GIT-HUB LINK:

https://github.com/IBM-EPBL/IBM-Project-37748-1660320774

DEMO VIDEO LINK

https://drive.google.com/file/d/1Vqph-5Ak7Gg771mWFy4BJ9nRnB2Z2Kss/view?usp=sharing

.