SYED AMMAL ENGINEERING COLLEGE

Landai, Ramanathapuram-623502.

Tamil Nadu, India.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IBM – NALAIYA THIRAN

REAL TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM

TEAM ID: PNT2022TMID48248

TEAM MEMBERS:

1. P.Kamali-TEAM LEADER.
2. S.Pavithra-TEAM MEMBER.
3. S.Maha Lakshmi-TEAM MEMBER.
4. R.Ranjani Priya-TEAM MEMBER.

2

INDEX

4

1. INTRODUCTION :

1.1 PROJECT OVERVIEW

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 monitoringSystem number of contaminated water resources is Increasing day by day. Real-time water quality monitoring System which will integrate wireless sensor network and internet Of things.

Now a day's Internet of things (IoT) is an Innovative technological phenomenon. It is shaping today's World and it is used in different fields for collecting, monitoring and analysis of data from remote locations.

1.2 PURPOSE

Design and Implementation of Real Time Approach for The Monitoring of Water Quality Parameters . IoT integrated Network if everywhere starting from smart cities, smart power Grids, and smart supply chain to smart. It provides a novel Approach to real-time data acquisition, transmission and Processing. The clients can get ongoing water quality information from far away.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

- We are trying to take an initiative of consuming problem. So,that Achieve due to find proper method than manual practices.
- To helping for that owners to pay the charges based on the actual consumption of water flow of water can be measured.

5

2.2 REFERENCES

S. No	TITLE OF THE LITERATURE	TECHNOLOGIES USED	PROS	CONS
1	IoT Based IoT Based Real-time River Water Quality Monitoring System	A sensor-based water qualitymonitoring 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.	This 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	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)	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 implement -ation of Water Quality assessment monitoring (WQAM)	The development and implantation of Water assessment and monitoring (WQAM) system. The system development used Wi-fi enabled microcontroller to connect With the IOT environment and store the	The Microcontroller used is Arduino UNO that interacts with three types of sensor probes which are PH,turbidity and temperture probe. All the data measurements is transferred using a Wi-Fi	This system Was implemented on Bandar Pereda Lake and Dera River in pulao pingang with two system implemted

6

	System using the Internet Of Things(IOT) in Water environment.	Data in the IOT cloud server .	Module which is ESP8266. The IOT cloud used to utilize the data frame is thing speak.	at each location. The sensors were placed on the water surface for more accurate measurements.
4	IoT-based System for Real-time Water Pollution Monitoring of Rivers	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.	Thus, authorities can commence early warning for floods and ensure prompt evacuation. Thus, our technique can significantly minimize the casualties caused by this disaster.
5	Design and Implementation of Real Time Approach for The Monitoring of Water Quality Parameters	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 this bacteria.	To develop a smart water quality monitoring system using four sensors and an IoT platform to help determine water quality.
6	An IoT Based Smart Water Quality Monitoring System using Cloud	that results in polluting, most of the rivers, lakes and surface water in India. An IoT Based Smart Water Quality Monitoring System using Cloud and Deep Learning is proposed to monitor the quality of the water in water-bodies.	In conventional systems, the monitoring process involves the manual collection of sample water from various regions, followed by laboratory testing and analysis.	The quality of water should be monitored continuously, to ensure the safe supply of water from any water bodies and water resources.
7	Real-time water quality monitoring through Internet of Things and ANOVAbased analysis: a case study on river Krishna	Because the stochastic and intermittent property of wind speed, the prediction problem is very difficult to solve.	The prediction method using BP neural network, wavelet BP neural network.	The simulation results shows that the method used in this paper can give a better prediction, but there is still more other algorithm need to be studied to enhance the

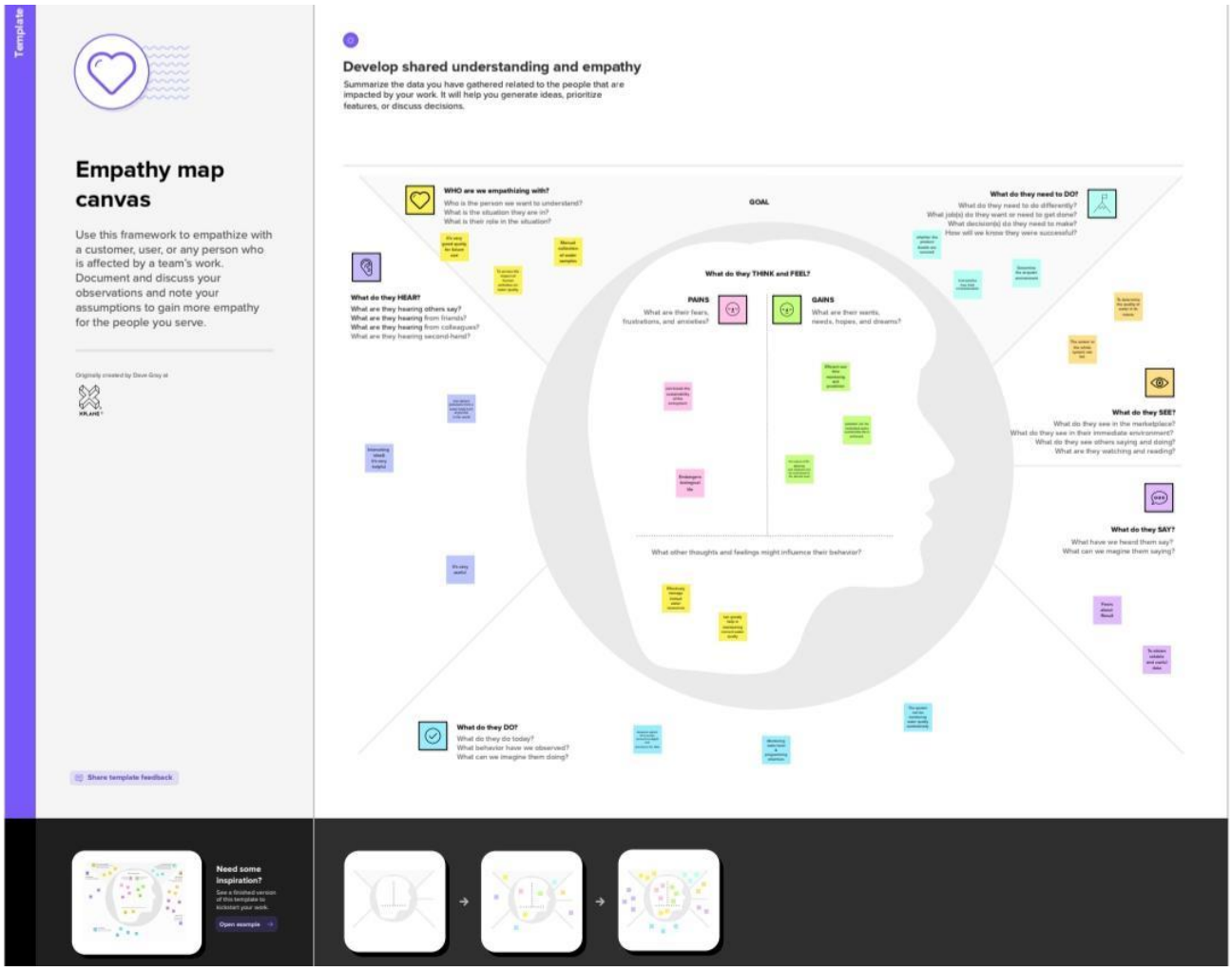
				the prediction precision. used to measure pH, turbidity, total dissolved solids (TDS) and temperature.
8	Forecasting of Wind Turbine Output Power Using Machine learning	In this paper, an attempt has been made to develop a statistical model based on Internet of Things (IoT) for water quality analysis of river Krishna using different water quality parameters such as pH, conductivity, dissolved oxygen, temperature, biochemical oxygen demand, total dissolved solids and conductivity.	These parameters are very important to assess the water quality of the river. The water quality data were collected from six stations of river Krishna in the state of Karnataka.	In our study, we have considered only stretch of river Krishna flowing in state of Karnataka, i.e., length of about 483 km. In recent years, the mineral-rich river basin is subjected to rapid industrialization, thus polluting the river basin.

2.3 PROBLEM STATEMENT DEFINITION

Water can be polluted any time. So the water we reserved in the water tank at our roof top or basement in our society or apartment may not be safe. Still in India most of the people use simple water purifier that is not enough to get surety of pure water. Sometimes the water has dangerous particles or chemical mixed and general purpose water purifier cannot purify that. And it's impossible to check the quality of water manually in every time. So an automatic real-time monitoring system is required to monitor the health of the water reserved in our water tank of the society or apartment. So it can warn us automatically if there is any problem with the reserved water. And we can check the quality of the water anytime and from anywhere. By keeping this mind we designed this system especially for residential areas.

3. IDEATION & PROPOSED SOLUTION:

3.1 EMPATHY MAP CANVAS



9

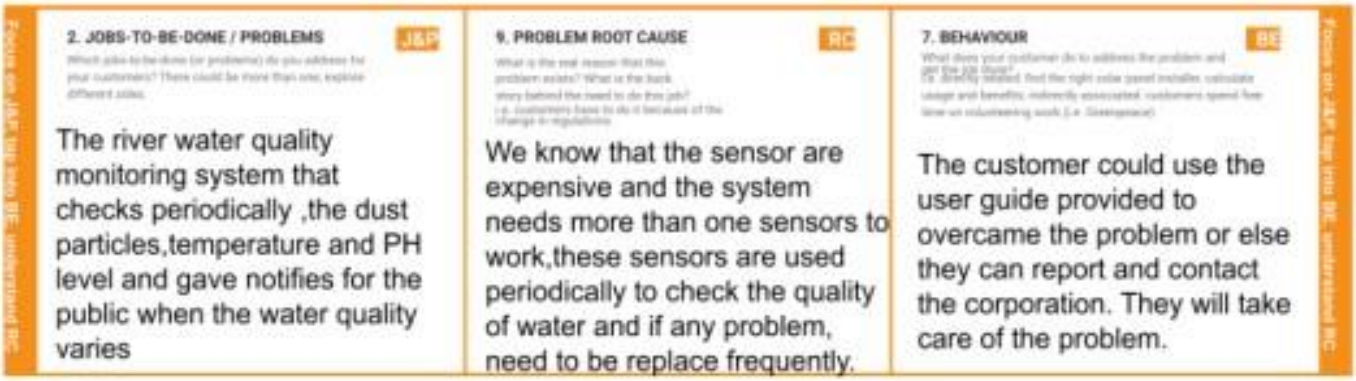
3.2 IDEATION & BRAINSTORM

https://github.com/IBM-EPBL/IBM-Project-19690-1659704165/blob/main/Project%20design%20and%20planning/Ideation%20phase/Brainstorm.pdf

3.3 PROPOSED SOLUTION

Our goal is to develop a system for real time quality assessment for water health at residential places using Raspberry Pi. pH, Turbidity and Temperature sensors are used to gather the parameters necessary to monitor water health in real time. Following are the objectives of the proposed system.

3.4 PROBLEM SOLUTION FIT



10

11

4. REQUIREMENT ANALYSIS :

4.1 FUNCTIONAL REQUIREMENT

Following are the functional requirements of the proposed solution.

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%

12

4.2 NON-FUNCTIONAL REQUIREMENTS

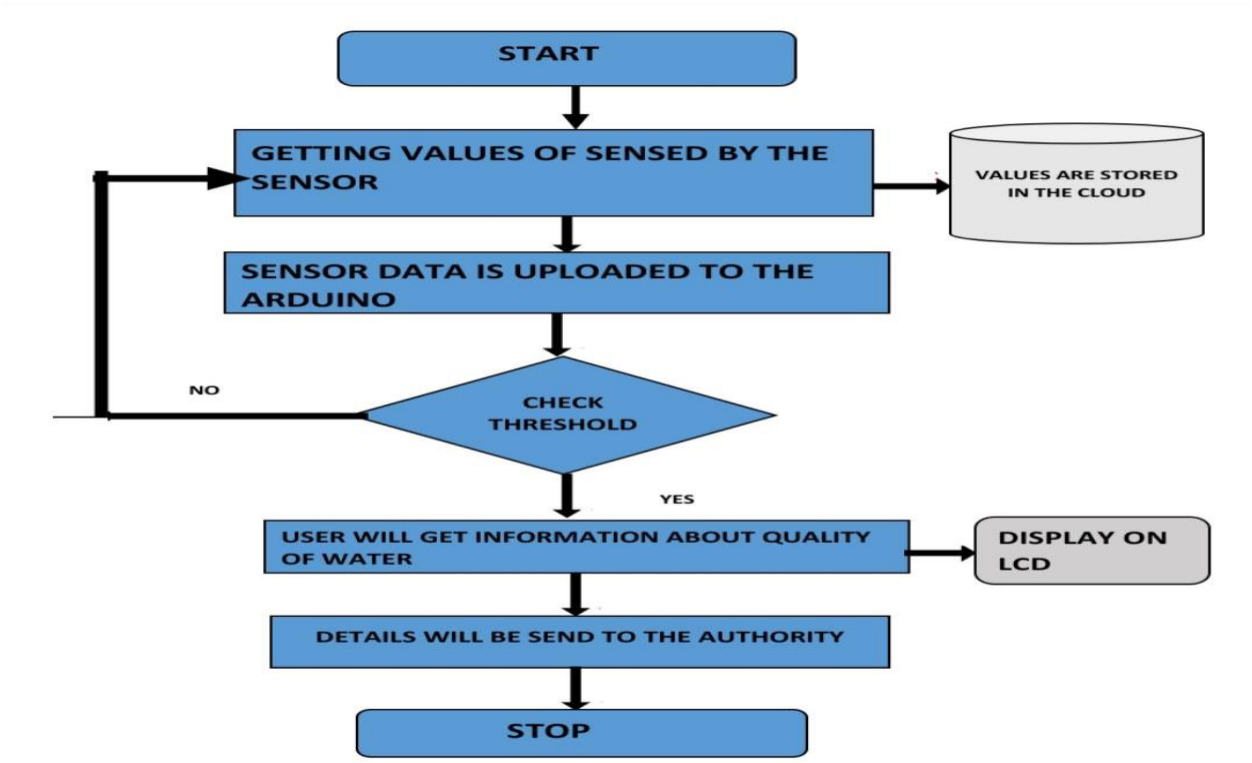
Following are the non-functional requirements of the proposed solution.

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 environmental safe model
NFR-5	Availability	In form of mobile UI 24 x 7 monitoring system

13

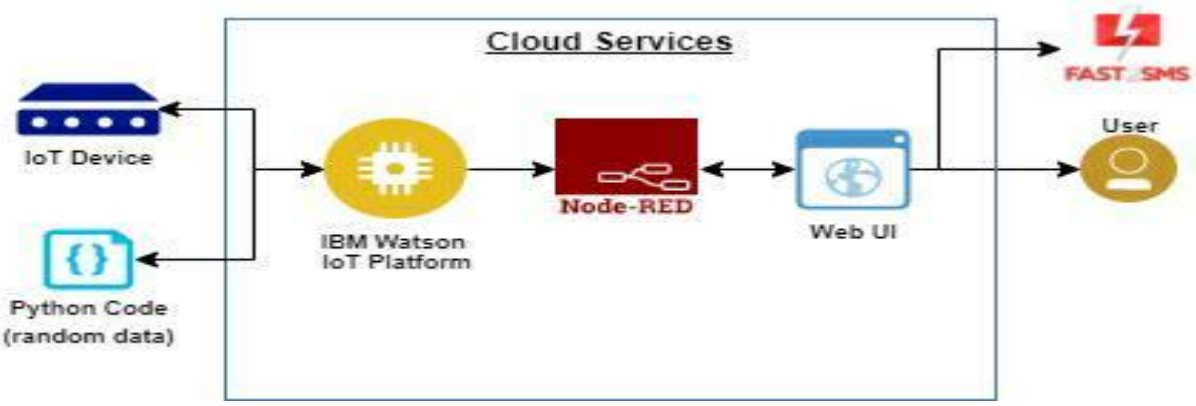
5. PROJECT DESIGN :

5.1 DATA FLOW DIAGRAMS



5.2 SOLUTION & TECHNICAL ARCHITECTURE

To measure various chemical and physical properties of water like pH, temperature and particle density of water using sensors. Send the data collected to a Raspberry Pi, show the data in display and send it to a cloud based Database using Wired/Wireless Channel. Trigger alarm when any discrepancies are found in the water quality. Data visualization and analysis using cloud based visualization tools.



5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story/Task	Acceptance Criterical	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 the mail.	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 able to access easily.	Medium	Sprint-1
Customer (Web user)	dashboard	USN-7	As a user, I can access the specific info(ph value, temp, humidity, quality).	I can able to know the quality of the water.	High	Sprint-1
Customer (input)	View manner	USN-8	As a user, I can view data in visual representation manner(graph)	I can easily understand by visuals.	High	Sprint-1
Administrator	Risk tolerant	USN-9	An administrator who Is handling the system should update and take care of the application.	Admin should monitor the records properly.	Medium	Sprint-2

15

6. PROJECT PLANNING & SCHEDULING :

6.1 SPRINT PLANNING & ESTIMATION

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	Pavithra
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	Kamali
Sprint-2		USN-3	As a user, I can register for the application through Facebook	2	Low	Maha Lakshmi
Sprint-1		USN-4	As a user, I can register for the application through Gmail	2	Medium	Ranjani Priya

16

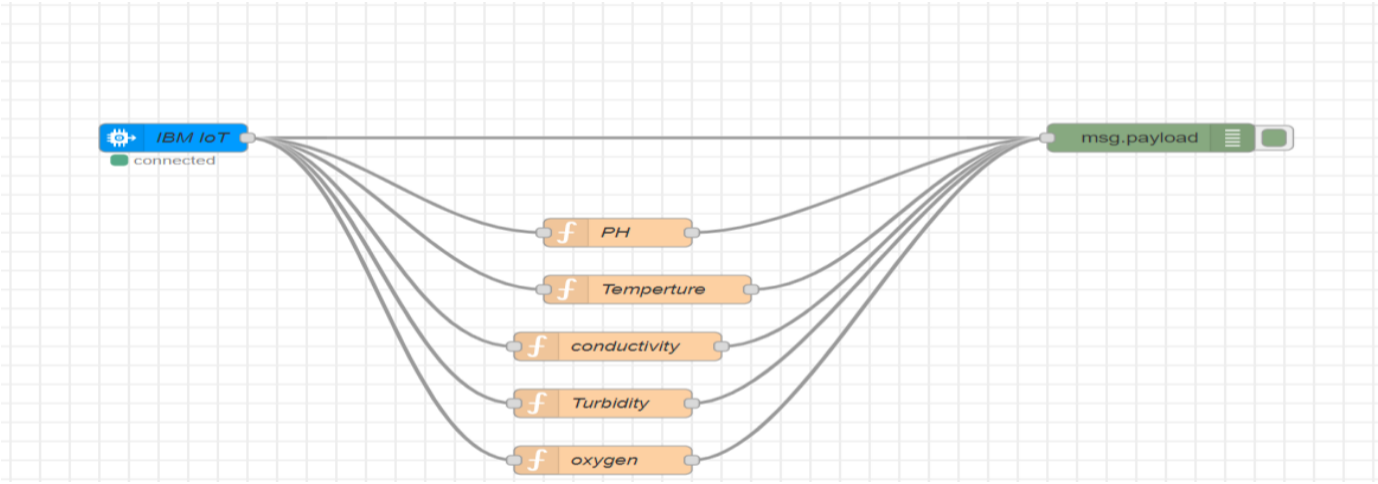
6.2 SPRINT DELIVERY SCHEDULE

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date(Planned)	Story Points Completed (ason Planned End Date)	Sprint ReleaseDate (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 Nov 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

17

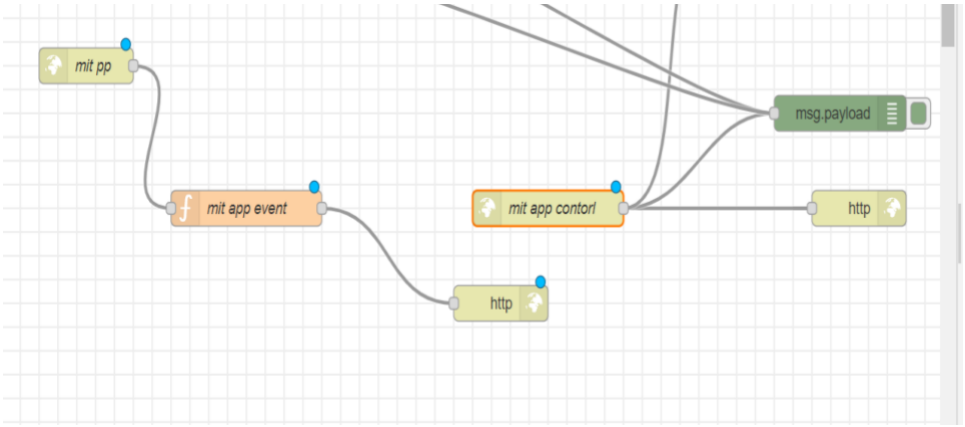
7. CODING & SOLUTION :

7.1 FEATURE 1 :WEB APPLICATION OF NODE-RED



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).

7.2 FEATURE 2- APPLICATION OF NODE-RED DASHBOARD



The estimation of water parameters like turbidity, pH, dissolved oxygen, etc. is done with the help of meters. So the disadvantages of this existing system are that; there is no continuous and remote monitoring, human resource is required, less reliable, no monitoring at the source of waters i.e. no on field monitoring and the frequency of testing is very low. Due to these disadvantages of the existing system it is required to develop a system that will allow real time and continuous monitoring of water quality.

18

8. TESTING :

8.1 TEST CASES :

- TEST CASE 1 :

  Quality level - Usual water Limit.

- TEST CASE 2 :

  Level of monitoring - Reduced PH & Temperture Limit.

- TEST CASE 3 :

  Rainy Weather - Further Reduced Speed Limit.

- TEST CASE 4 :

  Control &monitor - Increased levels.

8.2 USER ACCEPTANCE TESTING

Users may easliy 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.

19

20

9. RESULTS:

9.1 PERFORMANCE METRICS

The quality parameters are labeled datasets including desired outputs of specific combination Of inputs. The neural network will produce output to classify water quality as dangerous, be careful, and good.

- Smart pH measurements are predominantly conducted with pH sensitive glass electrodes, which have, in general, proven satisfactory in measurements of pH . Measurements involving cells with liquid junctions are subject to further uncertainties due to the dependence of liquid junction potentials upon medium concentration and composition and due to pressure changes in the system.
- Better management of the design and development of a low-cost system for real-time monitoring of water quality using the Internet of Things (IoT) is essential. Monitoring water quality in water bodies using Internet of Things (IoT) helps in combating environmental issues and improving the health and living standards of all living things.
- Smart the reduction of transparency of a liquid caused by the presence of undissolved suspended matter. Turbidity is not, a direct measure of suspended particles in water, but a measure of the scattering effect such particles have on light. Turbidity sensors measure the amount of light that is scattered by the suspended solids in water
- Applications that can benefit from this feature include HVAC environmental controls, temperature monitoring systems inside buildings, equipment, or machinery, and process monitoring and control systems.
- Rapid 8 fields for storing data of any type - These can be used to store the data from a sensor or from an embedded device

The general public, local governments, and the entire globe may profit from several other advantages in addition to the improved management, safety, and efficiency already mentioned. Which are:

- Security aspects
- Scalability solution
- Supply Chain Stability

IoT-based system further provides real-time alerts of water-related issues like logging , diseases, etc. It allows sufficient space for managers to make informed decisions and take necessary actions. Therefore, to never miss any alert, the solution consists of multiple alarm systems, including SMS alerts , platform alerts, etc. These alerts are presented as real-time notifications on the users' smart devices that immediately prompt the appropriate authorities to make effective decisions regarding the river/reservoir levels.

21

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 this bacteria. This presented paper work 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, 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.

Water Quality Metrics:

The table below displays the metrics used by our system to measure water quality .

	Safe water	**unsafe water**
pH	6.5 - 8.5	<6.49 & > 8.5
Turbidity	< 5	>5
Action	Turn On Green Led	Turn On Red Led and Buzzer

22

10.ADVANTAGES:

The estimation of water parameters like turbidity, pH, dissolved oxygen, etc. is done with the help of meters. So the disadvantages of this existing system are that; there is no continuous and remote monitoring, human resource is required, less reliable, no monitoring at the source of waters i.e. no on field monitoring and the frequency of testing is very low. Due to these disadvantages of the existing system it is required to develop a system that will allow real time and continuous monitoring of water quality. Thus various advanced technologies for monitoring water quality have been proposed in the recent years. In the structure of the wireless sensor networking in which a number of sensor nodes are located in a lake is proposed.

11. CONCLUSION :

To design a good quality model, we reviewed out different existing system developed by researchers. Different authors have proposed distinguished models to check water quality by analyzing the parameters such as temperature, pH and conductivity, and so on. By considering all these points, we designed a smart water monitoring system which can perform all these monitoring functions. The advantages of using neural network based analytics are like Artificial Neural Networks (ANNs) are good in learning and modeling non-linear relationships, and high . Though neural networks are prone to over fitting, the neural network model used in water quality monitoring system is not complex enough to cause over fitting problem. Also, there are many countermeasures to avoid over fitting. Also, computation overload is not going to delay the response of system as there are only a few water quality parameters.

12. FUTURE SCOPE :

Water is a finite resource that is necessary for agriculture, industry and the survival of all living things on the planet, including humans. Many people are unaware of the need of drinking adequate amounts of water on a daily basis. Many unregulated methods waste more water . Poor water allocation, inefficient consumption, lack of competent and integrated water management are all factors that contribute to this problem. Therefore, efficient use and water monitoring are potential constraint for home or office water management system .

23

24

13. APPENDIX :

13.1 SOURCE CODE

```
#include <WiFi.h>//library for wifi
#include <PubSubClient.h>//library for MQtt
#include "DHT.h"// Library for dht11
#define DHTPIN 4     // what pin we're connected to
#define DHTTYPE DHT11   // define type of sensor DHT 11
#define LED 5
DHT dht (DHTPIN, DHTTYPE);// creating the instance by passing pin and typr of dht connected

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

#define ORG "avu8gg"//IBM ORGANITION ID
#define DEVICE_TYPE "nodered"//Device type mentioned in ibm watson IOT Platform
#define DEVICE_ID "12"//Device ID mentioned in ibm watson IOT Platform
#define TOKEN " use-token-auth "     //Token
String data3;
float h, t;
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/test/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()
{
```


25

```
  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();
  }
}



void PublishData(float temp, float humid) {
  mqttconnect();//function call for connecting to ibm

  String payload = "{\"temperature\":";
  payload += temp;
  payload += "," "\"humidity\":";
  payload += humid;
  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);
```


26

```
    }

     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);
```


27

```
  }

  else
  {
Serial.println(data3);
digitalWrite(LED,LOW);

  }
data3="";


}
```

13.2 GITHUB & PROJECT DEMO LINK

https://github.com/IBM-EPBL/IBM-Project-19690-1659704165

https://github.com/IBM-EPBL/IBM-Project-19690-1659704165/tree/main/Final%20deliverables

28

29