

Real time river water quality monitoring and control system

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REAL-TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM

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TEAM ID	PNT2022TMID36752
PROJECT NAME	REAL-TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM
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TEAM MEMBER 1	HARI.N
TEAM MEMBER 2	JAYACHANDRAN.R
TEAM MEMBER 3	JOHN YABAZ.S
TEAM MEMBER 4	SURESH.S

1. INTRODUCTION

1.1 PROJECT OVERVIEW

Water is the primary need of all living beings and living without water is impossible. With the advancement of technology and industrialization, environmental pollutions have become a major concern. Water pollution is one of the most serious types of this environmental pollution. Our lives depend on the quality of water that we consume in different ways, from juices which are produced by the industries. Any imbalance in the quality of water would severely affect the humans' health and at the same time it would affect the ecological balance among all species. Water quality refers to the chemical, biological, radiological, and biological parameters of the water.

1.2 PURPOSE

The major goal is to create a system that uses wireless sensor networks to continuously monitor river water quality at remote locations with low power consumption, low cost and high detection accuracy. pH, conductivity, turbidity level other parameters are measured in order to enhance water quality.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

This Project focuses on Detection on water pollution and water management using smart sensors iot to ensure the safe supply of drinking water the quality should be monitored in real time for that purpose new approach IOT (Internet of Things) based water quality monitoring has been proposed. This system consists some sensors. Which measure the water quality parameter such as pH, turbidity, conductivity, dissolved oxygen, temperature.

2.2 REFERENCES

1. Real-Time River Water Quality Monitoring System- International Journal of Engineering Research & Technology (IJERT)
2. Real-Time Water Quality Monitoring System -International Research Journal of Engineering and Technology (IRJET)

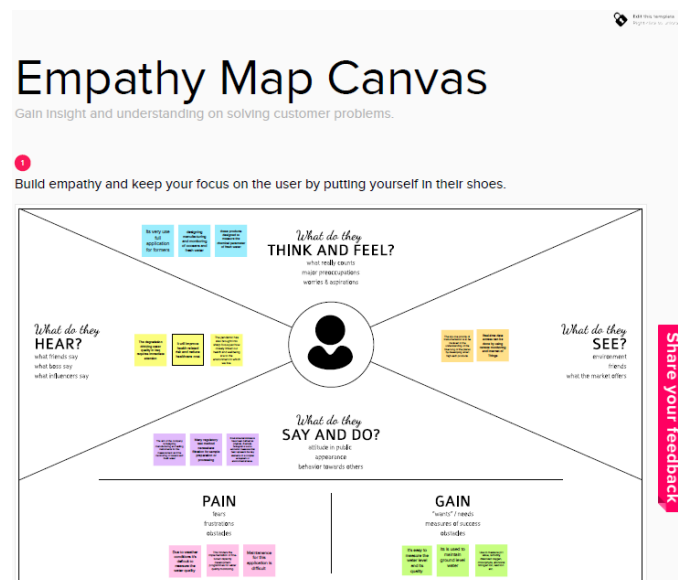
2.3 PROBLEM STATEMENT DEFINITION

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

3. IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

An Empathy map is a collaborative tool teams can use to gain a deeper insight into their customers. Much like a user persona, an empathy map can represent a group of users, such as a customer segment. Our empathy map canvas is shown as Real-Time river water monitoring and control system.



3.2 IDEATION & BRAINSTORMING

Ideation refers to the whole creative process of coming up with and communicating new ideas. It can take many different forms, from coming up with a totally new idea to combining multiple existing ideas to create a new process or organizational system. Ideation is similar to a practice known as brainstorming.

Ideation phase:

The main aim is to develop a system for continuous monitoring of river water quality at remote places using wireless sensor networks with low power consumption, low-cost and high detection accuracy. pH, conductivity, turbidity level, etc. are the limits that are analyzed to improve the water quality. Following are the aims of idea implementation

- To measure water parameters such as pH, dissolved oxygen, turbidity, conductivity, etc. using available sensors at a remote place.
- To assemble data from various sensor nodes and send it to the base station by the wireless channel.
- To simulate and evaluate quality parameters for quality control.
- To send SMS to an authorized person routinely when water quality detected does not match the preset standards, so that, necessary actions can be taken.

Control surface:

An Arduino mega is utilized as a core person. The Arduino victimized here is mega 2560 because multiple analog sign sensors probe requisite to be continuous with the Arduino inhabit. It has a set of registers that use as a solon use RAM. Specific intend to know registers for on-chip component resources are also mapped into the assemblage grapheme. The addressability of store varies depending on instrumentation series and all PIC devices someone several banking mechanisms to utilise addressing to additional faculty.

Subsequent series of devices have move instructions which can covert move had to be achieved via the register. Thus the mechanism functions with the exploit of coding intrinsically in the Arduino UNO R3 skate.

pH sensor:

The pH of thing is a useful constant to display because graduate and low pH levels can hump large effects on the author. The pH of a statement can grasp from 1 to 14. A pH sensor is an instrumentation that measures the

3.3 PROPOSED SOLUTION

Proposed Solution means the technical solution to be provide by the implementation agency in response to the requirements and the objectives of the project. he following information may be useful to you in completing this portion of your team's work. Skim this section, then refer back to it as necessary.

Project Design Phase-I Proposed Solution

Proposed Solution Template:

Project team shall fill the following information in proposed solution template.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	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.
2.	Idea / Solution description	The need for effective and efficient monitoring, evaluation and control of water quality in residential area has become more demanding in this era of urbanization, pollution and population growth. Ensuring safe water supply of drinking water is big challenge for modern civilization.
3.	Novelty / Uniqueness	The uniqueness of our proposed paper is to obtain the water monitoring system with high power.
4.	Social Impact / Customer Satisfaction	Water quality is one of the most critical indication of environmental pollution and it affects all of us. Water contamination can be accidental or intentional and the consequences are drastic unless the appropriate measures are adopted on the spot.
5.	Business Model (Revenue Model)	REAL TIME WATER QUALITY MONITORING AND ALERT SYSTEMS, APPLICATIONS AND SUSTAINABLE MONITORING USING OPEX BUSINESS MODEL, Water India 2011, Water Purification, Recycling & Supply February 10-12 2011, New Delhi, India Tritech Tritech Group Limited (Delhi) IS the Ltd.
6.	Scalability of the Solution	Nowadays, water quality monitoring requires real time data in which measurement must be performed in situ/online from a remote location. River monitoring, marine, aquaculture, agriculture, and mining are among the areas where online water quality monitoring have been widely implemented.

3.4 PROBLEM SOLUTION FIT

Problem solving is the act of defining a problem; determining the cause of the problem; identifying, prioritizing, and selecting alternatives for a solution; and implementing a solution. In order to effectively manage and run a successful organization, leadership must guide their employees and develop problem-solving techniques. Finding a suitable solution for issues can be accomplished by following the basic four-step problem-solving process and methodology outlined below.

**Solution Fit – Real-Time
River Water Quality
Monitoring and Control
System**

CUSTOMER SEGMENT(S) Customer reduce the water related diseases and prevent water pollution. World Health Organization (WHO) based Water Quality Monitoring System.	CUSTOMER CONSTRAINTS Customer wants water quality refers to the chemical, biological, radiological, and biological parameters of the water.	EMOTIONS: BEFORE / AFTER Water samples are analyzed at laboratories after its performed by human.	AVAILABLE SOLUTIONS Central Water Commission (CWC) monitors water quality, by collecting samples from representative locations within the processing and distribution system.	BEHAVIOR The system functions automatically and independently according to the code uploaded to the microcontroller.
JOBS-TO-BE-DONE In this project done by Arduino board. Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software.	PROBLEM ROOT CAUSE This project proposes a novel technique for the design of a water quality sensor node which can be used for monitoring the pH of water.	YOUR SOLUTION This system consists of some sensors. Which monitor the water quality parameters such as pH, turbidity, conductivity, dissolved oxygen, temperature.	ADVANTAGES In this system, low cost components i.e. microcontroller, LCD screen and other components are used to achieve the objectives of the proposed design with acceptable accuracy.	PROBLEMS The problem is, this system is, water is not monitoring seamlessly, and it always needs a human intervention.

4. REQUIREMENT ANALYSIS

Requirement analysis also called as requirement engineering is the process of determining user expectation for a new or modified product. These features are called requirements and must be qualified, relevant, and detailed. It is classified into two major types. They are;

4.1 FUNCTIONAL REQUIREMENT

4.2 NON-FUNCTIONAL REQUIREMENT

**Project Design Phase-II
Solution Requirements (Functional & Non-functional)**

Date	26 October 2022
Team ID	PNT2022TMD36752
Project Name	IOT Based Real Time River Water Monitoring and Control Systems

Functional Requirements:

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 sent 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 sent to Arduino.

FR-5	Ultrasonic generator	Waves generated at regular interval times to clear algae 25%, 50%, 100%
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Non-functional Requirements:

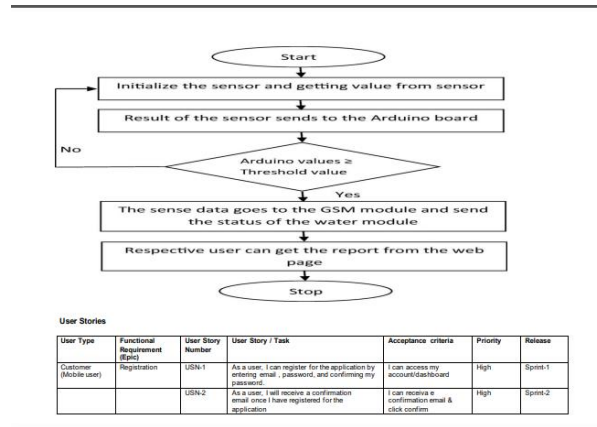
Following are the non-functional requirements of the proposed solution.

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 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.

5. PROJECT DESIGN

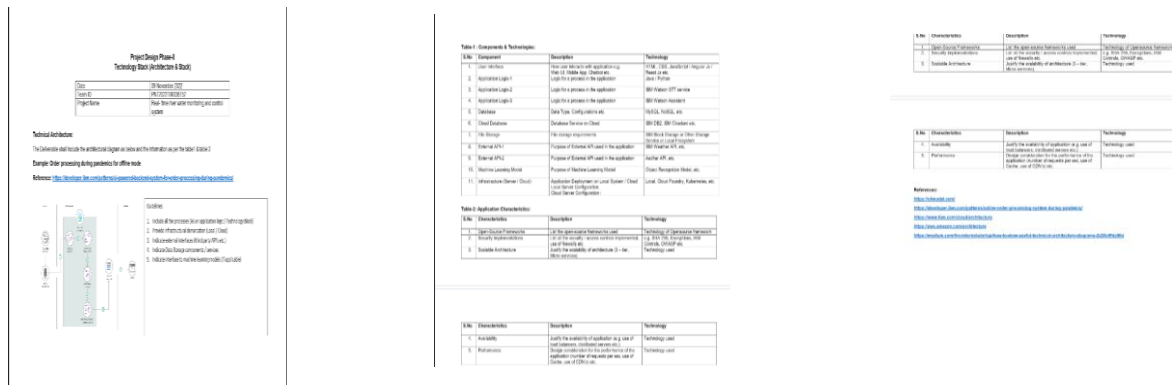
5.1 DATA FLOW DIAGRAM

Data flow diagram is a way of representing a flow of data through a processor or a system. DFD also provide information about the input and output of each entity and the process itself. A data flow diagram as no control flow they are no decision rules and no loops.



		USN3	As a user, I can register for the application through google	I can register & access the dashboard with google	High	Sprint-1	
		USN4	As a user, I can register for the application through Gmail	I can register through h mail.	Medium	Sprint-2	
		Login	USN5	As a user, I can log into the application by entering email, password & captcha	I can receive login credentials.	High	Sprint-1
		Interface	USN6	As a user, the interface should be user-friendly	I can able to access easily.	Medium	Sprint-1
Customer (Web user)	dashboard	USN7	As a user, I can access the specific info such value, temp, humidity, quality.	I can able to know the quality of the water.	High	Sprint-1	
Customer (prod)	View manner	USN8	As a user, I can view data in visual representation (mange/graph)	I can easily understand by visuals.	High	Sprint-1	
	Taste	USN9	As a user, I can able to view the quality(safety) of the water	I can easily know whether it is safety or not.	High	Sprint-1	
	Colour visibility	USN10	As a user, I can able predict the water colour	I can easily know the condition by colour	High	Sprint-1	
Administrator	Risk tolerant	USN11	An administrator who is handling the system should update and take care of the application.	Admin should monitor the records properly.	Medium	Sprint-2	

5.2 SOLUTION & TECHNICAL ARCHITECTURE



A Solution architecture is an architectural description of a specific solution. SAs combine guidance from different enterprise architectural viewpoints (business, information and technical) as well as from the enterprise solution architecture (ESA).

5.3 USER STORIES

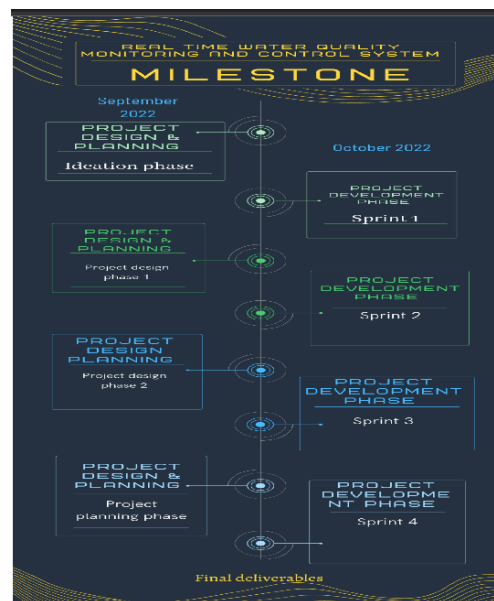
Nowadays water is the most valuable for all the human beings drinking water utilities faces challenges in real-time operation. Hence there is a need of better methodologies for monitoring the water quality. In real time river water, having some unwanted contents. In this Sprint will monitoring this water quality. It monitors the river water by 24/7 hours to control unwanted contents. The industry has quality pipes to transfer the water and proper maintenance service

once in a month. The industry must take care of what are the necessary process to controlling river water. The programmer designs the model to monitoring and control river water quality.

6. PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

Sprint planning is an event in scrum that kicks of the sprint. The purpose of sprint planning is to define what we can deliver in the sprint and how that work will be achieved. Sprint planning is done in collaboration with the whole scrum team.



6.2 SPRINT DELIVERY SCHEDULE

The deliverables of the sprint are not as predictable as they are for the other project. Sprint participation have produced sketches and drawing, writing, photograph, comic, strip, video and fully coded working prototypes

Project Planning Phase

Project Planning Template (Product Backlog, Sprint Planning, Stories, Story points)

Date	10 November 2022
Team ID	PNT202210010702
Project Name	Project - Real-Time River Water Quality Monitoring and Control System
Maximum Marks	8 Marks

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

Use the below template to create product backlog and sprint schedule.

Sprint	Functional Requirement (FR)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Monitoring the river water quality	USW-1	Nowadays water is the is the most valuable for all the human beings drinking water utilities faces challenges in real-time operation. Hence there is a need of better methodologies for monitoring the water quality.	2	High	<ul style="list-style-type: none"> • Dhanankumar.B • Hari.N • Jayachandran.R • John Yohas.S • Suresh.S
Sprint-2	Avoid unwanted content in river water	USW-2	In real time river water, having some unwanted contents. In this Sprint will monitoring this water quality	1	High	<ul style="list-style-type: none"> • Dhanankumar.B • Hari.N • Jayachandran.R • John Yohas.S • Suresh.S

Sprint-3	Controlling the water	USW-3	It monitors the river water by 24*7 sensors to control unwanted contents. The industry has quality pipes to transfer the water and proper maintenance service once in a month. The industry must take care of what are the necessary process to controlling river water.	2	Low	<ul style="list-style-type: none"> Dhanankumar.B Hari.N Jayachandran.R John Yohas.S Suresh.S
Sprint-4	The model is based on by sample dataset	USW-4	The programmer designs the model to monitoring and control river water quality	2	Medium	<ul style="list-style-type: none"> Dhanankumar.B Hari.N Jayachandran.R John Yohas.S Suresh.S

7. CODING & SOLUTIONING (Explain the features added in the project along with code)

7.1 Feature 1

```

#include <WiFi.h>//library for wifi
#include <PubSubClient.h>//library for MQTT
#include "DHT.h"// Library for dht11
#define DHTPIN 15 // what pin we're connected to
#define DHTTYPE DHT22 // define type of sensor DHT 11
#define LED 2
DHT dht (DHTPIN, DHTTYPE);// creating the instance by passing pin and typr of dht
connected

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

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

#define ORG "910vsj"//IBM ORGANITION ID
#define DEVICE_TYPE "dem0123"//Device type mentioned in ibm watson IOT Platform
#define DEVICE_ID "demo1234"//Device ID mentioned in ibm watson IOT Platform
#define TOKEN "demo1234" //Token
String data3;
float t;

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

//-----
WiFiClient wifiClient; // creating the instance for wificlient
PubSubClient client(server, 1883, callback ,wifiClient); //calling the predefined client id by
passing parameter like server id,portand wificredential
void setup()// configureing the ESP32
{
  Serial.begin(115200);
  dht.begin();
  pinMode(LED,OUTPUT);
  delay(10);
  Serial.println();

```



```

wificonnect();
mqttconnect();
}

void loop()// Recursive Function
{

    t = dht.readTemperature();
    Serial.print("temperature:");
    Serial.println(t);

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

/.....retrieving to Cloud...../

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

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

    if (client.publish(publishTopic, (char*) payload.c_str())) {
        Serial.println("Publish ok");// if it sucessfully upload data on the cloud then it will print
        publish ok in Serial monitor or else it will print publish failed
    } else {
        Serial.println("Publish failed");
    }
}

```

```

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

    initManagedDevice();
    Serial.println();
  }
}
void wificonnect() //function defination for wificonnect
{
  Serial.println();
  Serial.print("Connecting to ");

  WiFi.begin("Wokwi-GUEST", "", 6); //passing the wifi credentials to establish the connection
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
}

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

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

```

```

Serial.print("callback invoked for topic: ");
Serial.println(subscribetopic);
for (int i = 0; i < payloadLength; i++) {
  //Serial.print((char)payload[i]);
  data3 += (char)payload[i];
}

Serial.println("data: " + data3);
if(data3=="lighton")
{
Serial.println(data3);
digitalWrite(LED,HIGH);

}

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

}
data3="";

}

```

7.2 Feature 2

```

import ibmiotf.application
import ibmiotf.device
import time
import random
import sys
from twilio.rest
import Client
import keys
Client = Client(keys.account_sid, keys.auth_token)
organization = "c9pmw1"
deviceType = "IoT_Device"
deviceId = "1234"
authMethod = "use-token-auth"
authToken = "12345678"
pH = random.randint(1, 14)
turbidity = random.randint(1, 1000)
temperature = random.randint(0, 100)
def myCommandCallback(cmd):

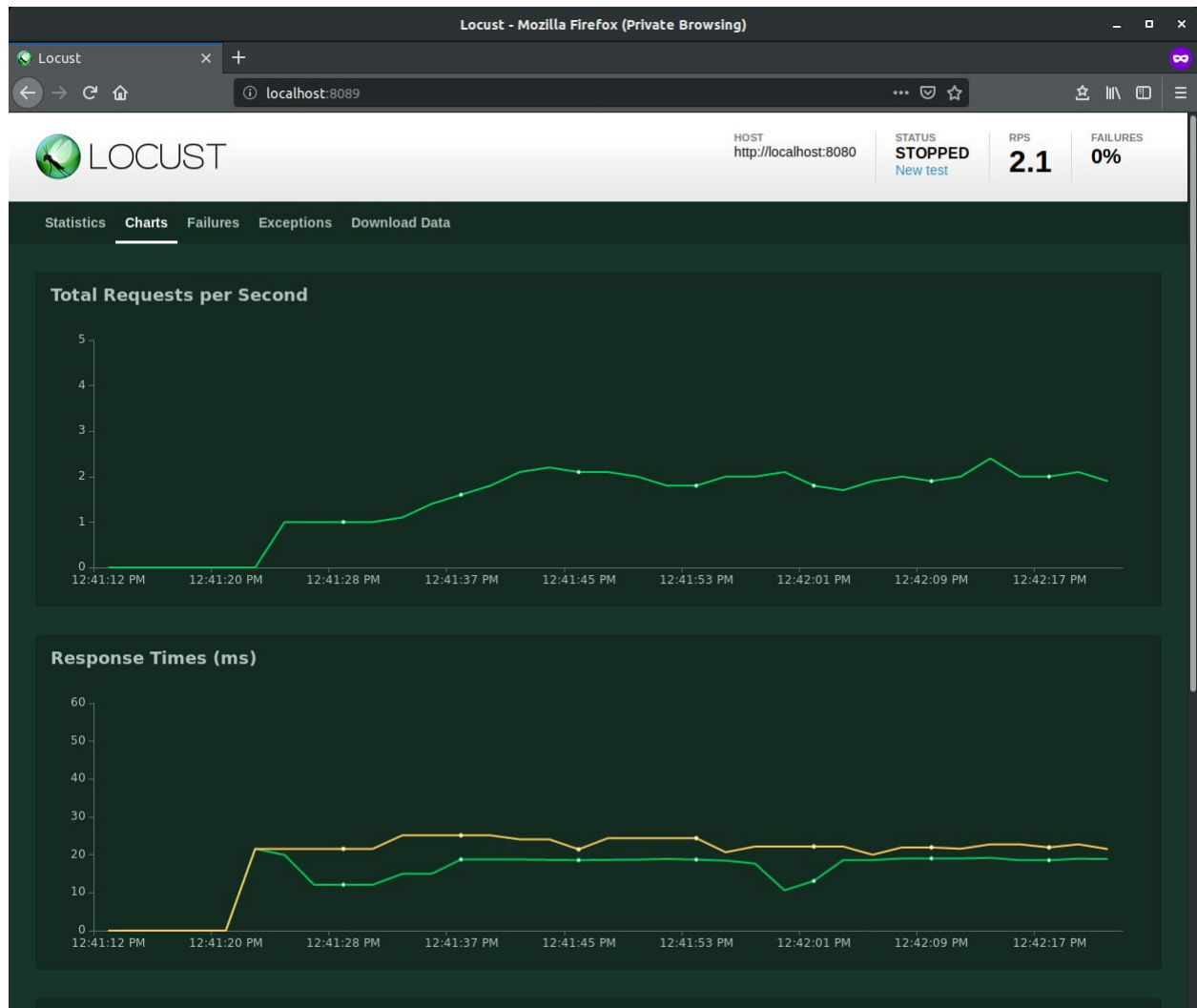
```

```

print("Command Received: %s" % cmd.data['command'])
print(cmd)
try:
    deviceOptions = {"org": organization, "type": deviceType, "id":
deviceId, "auth-method": authMethod, "auth-token": authToken}
    deviceCli = ibmiotf.device.Client(deviceOptions)
except Exception as e:
    print("caught exception connecting device: %s" % str(e))
    sys.exit()
deviceCli.connect()
while True:
    pH = random.randint(1, 14)
    turbidity = random.randint(1, 1000)
    temperature = random.randint(0, 100)
    data = {'pH': pH, 'turbid': turbidity, 'temp': temperature}
    def SMS():
        message = Client.messages.create(
            body="ALERT!! THE WATER QUALITY IS DEGRADED",
            from_=keys.twilio_number, to = keys.target_number)
    print(message.body)
    if temperature>70 or pH<6 or turbidity>500:
        SMS()
    def myOnPublishCallback():
        print("Published pH= %s" % pH, "Turbidity:%s" % turbidity,
            "Temperature:%s" % temperature)
    success = deviceCli.publishEvent("demo", "json", data, qos=0,
        on_publish=myOnPublishCallback)
    if not success: print("Not Connected to ibmiot")
    time.sleep(5)
    deviceCli.commandCallback = myCommandCallback
    deviceCli.disconnect()

```

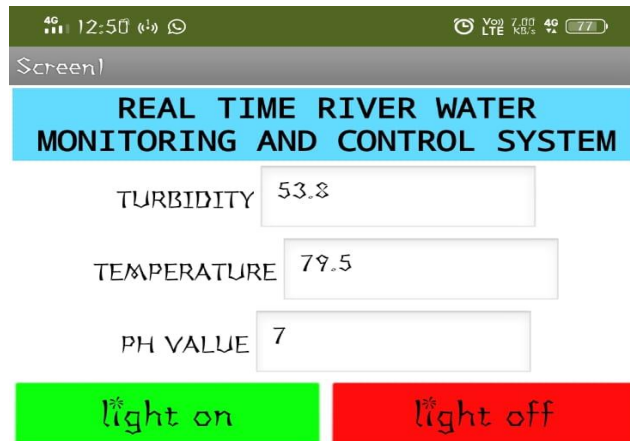
Testing results:



9. RESULTS

9.1 Performance Metrics

The result for the MIT app is created and the out is executed. The value for Temperature, humidity is verified using the sensors in the simulation process in the WOKWI work space. But the ph value and turbidity are entered manually with the permission of the mentor, because the ph sensor does not available in the NODE-RED website. Two buttons are added, one for switch on the led and another one for switch off the led.



The screenshot shows a mobile application interface with a status bar at the top displaying '4G', '12:50', and battery level '77%'. Below the status bar is a grey header with the text 'Screen1'. The main content area has a blue header with the text 'REAL TIME RIVER WATER MONITORING AND CONTROL SYSTEM'. Below the header, there are three input fields: 'TURBIDITY' with the value '53.8', 'TEMPERATURE' with the value '79.5', and 'PH VALUE' with the value '7'. At the bottom, there are two buttons: a green button labeled 'light on' and a red button labeled 'light off'.

Parameter	Value
TURBIDITY	53.8
TEMPERATURE	79.5
PH VALUE	7

light on light off

10. ADVANTAGES & DISADVANTAGES

- Real-Time River Water Monitoring and Controlling system project needed in rapidly changing system and it provides better understanding of interaction between constituents. It also providing better understanding of transport processes. These are the advantages of this project.
- In this project also have some disadvantages points following as, this equipment cost is greater and its operation and maintenance cost also greater. River water monitoring vulnerable to damage and loss. These are the main disadvantages of the project.

11. CONCLUSION

In this work, the design and demonstration of a prototype remote, automatic, portable, real time, and low-cost water quality monitoring system is described. In this system, low-cost components i.e., microcontroller, LCD screen and other components are used to achieve the objectives of the proposed design with acceptable accuracy. Compared to the previous related works, the cost of the system prototype is considerably low. To ensure the portability of the device, a self-made, small size Arduino microcontroller is used. The developed system was tested under different conditions, with solution of water with different impurities, and in different periods of time. The results of the test for all times have been successful. We conclude that all the objectives of the proposed system have been achieved. To test more parameters of the water quality for some applications, other sensors can be included in the system. The system has wide application and it is usable and affordable by all categories of users.

12. FUTURE SCOPE

In future real-time river water monitoring and control system have become extremely useful in domestic applications, agriculture, aquaculture, and municipal waste recycling. In addition, these systems monitoring water quality in rivers and other water bodies. The IoT networks are incredibly safe, and the communication speed is also high. The technology comfortably resolves all the issues that the previous techniques had. Finally, field technicians resorted to river water quality monitoring, which allowed them to monitor the water quality in real-time from anywhere across the globe using a combination of digital computing devices, internet services, communication media, and portable sensors. If you have read this far, you will agree on how vital IoT-based system are for ensuring that the water quality across domains and facilities remains pure. This is highly beneficial for the environment, to safeguard flora and fauna and aquatic lives, and simplify human survival.

13. APPENDIX

Source Code

GitHub & Project Demo Link

<https://github.com/IBM-EPBL/IBM-Project-31205-1660197571>