REAL-TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM

A PROJECT REPORT

Submitted by

Team – PNT2022TMID51098

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CHAPTER 1

INTRODUCTION

The limited water supplies brought on by global warming, the expanding population, the advancements in industry, etc. make monitoring water quality difficult nowadays. Therefore, it is necessary to create the finest approaches for real-time monitoring of the water quality indicators. Pollution from both point and non-point sources generally has an impact on water quality. As a result of industrialization, globalization, urbanization, agriculture, etc., hazardous materials of many categories have been combined with drinking water. In essence, poor water quality causes disease transmission and death. Waterborne illnesses cause up to 5 million deaths worldwide. The limited water supplies brought on by global warming, the expanding population, the advancements in industry, etc. make monitoring water quality difficult nowadays. The primary goal of water quality monitoring is to gather data at predetermined places and regular intervals that can be utilized to identify current trends. Pollution needs to be reduced, and monitoring water quality is the final step in making sure that pollution management in water is effective. Our proposed system is made up of a number of sensors that accurately calculate the standard values of water in real-time while requiring less labor overall.

The concentration of hydrogen ions is usually measured by water quality metrics like pH. It indicates whether the water is alkaline or acidic at the moment. A pH of 7 indicates that the water is pure; a pH of less than 7 indicates that the water is acidic, and a pH of more than 7 indicates that the water is alkaline. The pH values vary from 0 to 14. The pH level should be between 6.5 and 8.5 for drinking purposes. The second beneficial characteristic Turbidity is a measurement of the abundance of invisible suspended particles in water. The risk of diarrhea increases with increasing turbidity, cholera. Contrarily, if turbidity is low, the water is pure. Water temperature is determined via a temperature sensor. Manually collecting water samples from various sites is one of the classic methods of monitoring water quality. If the values generated by the sensors are exceeded, an alert is sent to the system user, who will then take the appropriate action. As we get the solutions of the water samples, we can measure the various quality attributes of the water and compare them with the given threshold values or standard values.

1.1 PROJECT OVERVIEW

Water is one of the main elements that significantly affect ecosystems. However, due to increasing industrialization, human waste, and the careless use of pesticides and chemical fertilizers in agriculture, which poison the water, it is now heavily exploited. In order to monitor the water quality across a large area, such as a lake, river, or aquaculture, a water monitoring system is necessary. According to the state of the world today, Internet of Things (IoT) and remote sensing techniques are utilized in a variety of study fields to monitor, collect, and analyze data from distant locations. In this research, a real-time, low-cost water quality monitoring system in an IoT environment is suggested. Several sensors make up this system, which evaluates physical and chemical parameters. These sensors can be used to measure pH, turbidity, conductivity, and dissolved oxygen in water. This method allows for the analysis of data provided online and the real-time assessment of water body quality.

1.2 PURPOSE

Water is necessary for all life, and without good watersheds, many necessary and optional human activities would be impossible. The same actions have a wide range of potential effects on watersheds. Watersheds frequently cross national, state, and local boundaries, thus even though two neighbors who live far from one another may not adhere to the same legal and cultural norms, they may still be considered members of the same watershed. By this standard, maintaining a watershed's or its lakes, streams, and rivers' health is your obligation as much as it is that of the local, state, or federal regulatory body. For the same reason, rather than being determined by governmental boundaries, water quality laws are increasingly centered on the watershed level. Streams and rivers serve as a crucial resource for human activities as well as a habitat for a variety of non-human creatures and plants. They provide an above-ground look at the hydrology and health of a watershed. Over 3.5 million miles of streams and rivers traverse various topographies in the United States alone.

The U.S. Environmental Protection Agency has discovered that, in spite of this extensive reliance on waterways, more than half of the country's streams and rivers are in poor biological condition. If your project could have an influence on a stream or river, it is essential to set up an effective monitoring system to ensure that the hydrology and water quality of the waterway are not adversely affected, and so that any impact can be remedied if it is discovered. The development of a reliable, affordable system for tracking the water quality in real time, using a wireless sensor network and the internet of things, was the overarching goal of all the initiatives.

Monitoring water quality is a problem and a concern that affects both land and sea. The European Green Deal outlines objectives for preserving biological variety and minimizing water pollution inside the European Union. It also publishes a number of directives to guarantee standards of water quality. Additionally, distinct legal frameworks for each nation state, such as France, mandate the efficient monitoring of water quality. The Environmental Protection Agency (EPA) of the United States carries out measures to manage water contamination in each state. Countries all around the world are becoming more aware of the significance of efficient monitoring techniques and metrics for water quality.

CHAPTER 2

LITERATURE SURVEY

2.1 EXISTING PROBLEMS

Competition for water resources is predicted to increase as a result of population expansion, urbanization, and climate change, with an impact on agriculture and river water in particular. Water quality will be ideal for potable water monitoring, spillage identification through rivers, and remote assessment for swimming pools. It contains autonomous hubs that connect to the cloud to maintain water control. Before being utilized in agricultural areas, river water must be treated, thus it is necessary to analyses and employ for water treatment the factors that affect the river's water quality.

2.2 REFERENCES

[1] An IOT Based Smart Water Quality Monitoring System using Cloud

IEEE – April 2020

Ajith Jerom B.; R. Manimegalai; R. Manimegalai

Other sources of pollution include agricultural runoff and unregulated small scale industry that results in polluting, most of the rivers, lakes and surface water in India. In this paper, 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. This process is ineffective, as this process is arduous and time-consuming and it does not provide real-time results. The quality of water should be monitored continuously, to ensure the safe supply of water from any water bodies and water resources. Hence, 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.

[2] IOT-based System for Real-time Water Pollution Monitoring of Rivers

IEEE - September 2021

Mohammad Ariful Islam Khan; Mohammad Akidul Hoque; Sabbir Ahmed

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.

[3] **Design and Implementation of Real Time Approach for The Monitoring of Water Quality Parameters**

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 analyses 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.

[4] A Development and Implementation of Water Quality Assessment Monitoring (WQAM) System using the Internet of Things (IoT) in Water Environment

JEVA - 23 November 2021

Muhammad Farhan Johan, S. Abdullah, A. Zanal Saurabh S. Soman, Hamidreza Zareipour, Om Malik

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.

2.3 PROBLEM STATEMENT DEFINITION

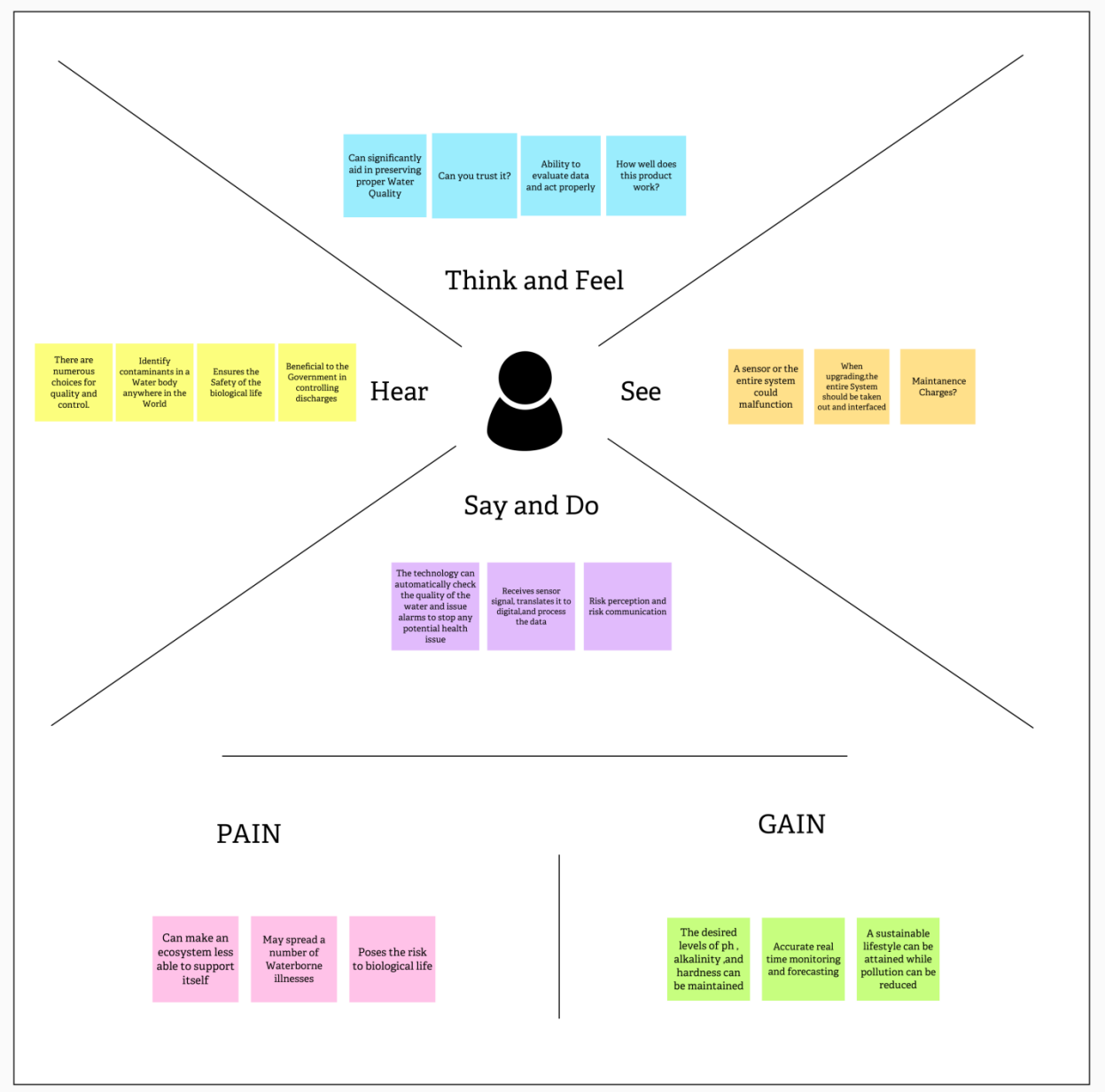
All living things need water to survive, and it is not possible to live without it. Environmental pollution has grown to be a big issue as a result of technological development and industrialization. One of the most significant types of this environmental contamination is water pollution. The quality of water that we drink - whether directly or through commercially made juices - is essential to our survival. Any disparity in water quality would have a negative impact on human health as well as the ecological balance among all animals. The parameters of the water's chemical, biological, radiological, and biological composition are referred to as its quality.

CHAPTER 3

IDEATION & PROPOSED SOLUTION

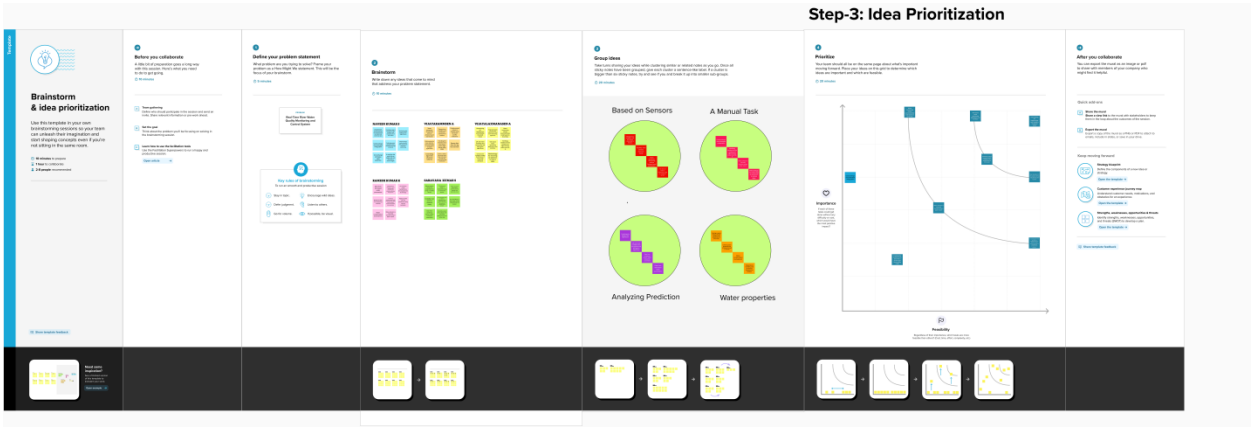
3.1 EMPATHY MAP CANVAS

An empathy map is a straightforward, simple-to-understand picture that summarizes 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 situations from the user's perspective, including goals and problems, through the exercise of constructing the map.



3.2 IDEATION & BRAINSTROMING

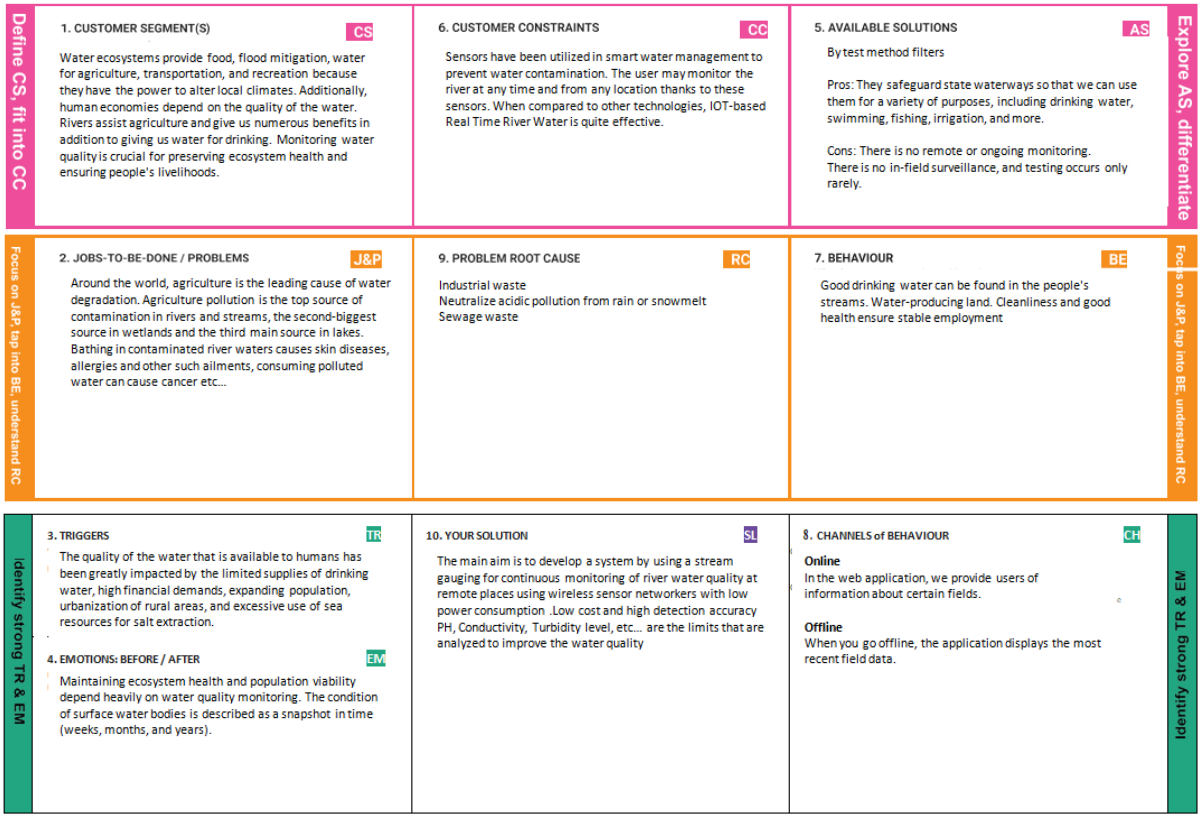
Each member of a team is encouraged to participate in the creative problem-solving process by participating in a free-flowing, open environment during a brainstorming session. A focus on quantity over quality, the acceptance and development of unconventional ideas, and the encouragement of all participants to work together in order to produce a wealth of original solutions are all priorities.



3.3 PROPOSED SOLUTION

S.No.	Parameter	Description
1	Problem Statement (Problem to be solved)	• In order to manage the algal bloom and keep an eye on water quality indicators like ph, turbidity and dissolved solvents using available sensors.
2	Idea / Solution description	• Utilizing Sensors and Arduino to monitor water parameters and ultrasonic frequency to control those parameters. • To collect data from numerous sensor nodes and wirelessly transmit it to the base station. • To send a SMS to the authorized person.
3	Novelty / Uniqueness	• The sensor will transmit an alert message to the neighboring control room if the water is contaminated. • When an employee isn't present, alert message is delivered to his mobile phone.
4	Social Impact / Customer Satisfaction	• Poor drinking water quality is the root cause of more than 50 different diseases, accounting for 80% of illnesses and 50% of child fatalities. • People come to know about the quality of water.
5	Business Model (Revenue Model)	• We can sell our project to the public sector through advertising. • Through social media, we can spread advertising.
6	Scalability of the Solution	• Operating this Model is a pretty simple process. • Both farming and drinking can be done with it.

3.4 PROBLEM SOLUTION FIT



CHAPTER 4

REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Registration of users to track the river water quality	Fill out a form to register with your Gmail or mobile phone.
FR-2	User Confirmation	Gmail confirmation or an OTP
FR-3	User Sign-Up	Type a strong password to log in. Numbers and special characters are required in the password. Ideally, a password would have more than 8 characters.
FR-4	Details About the Water	View current water strategy details in website show in percentage to understand easy as well as faster and notification from regular interval of time to monitor the water from the website or login.
FR-5	Sign out	For security reasons, you should log out after seeing the information. However, since the site won't send you any notifications after you log out, so receive send an SMS to let you know about any changes.

4.2 NON-FUNCTIONAL REQUIREMENTS

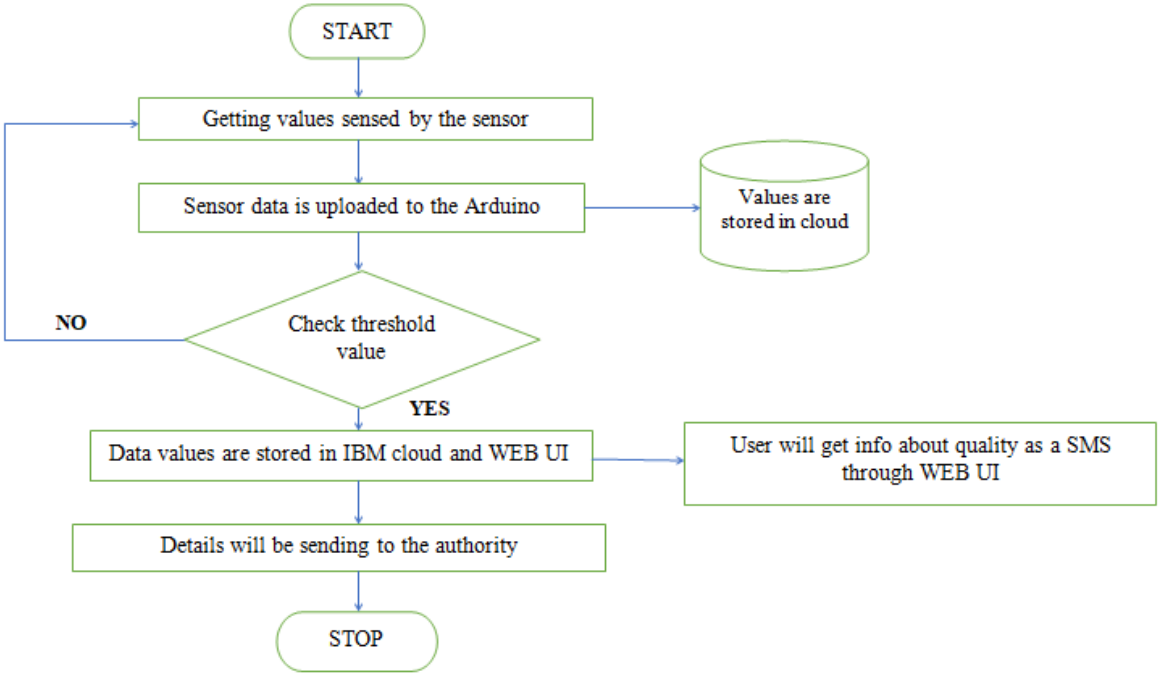
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	User interface screen loads cannot take more than two seconds. User friendly monitoring.
NFR-2	Security	Password protection for the user account. Only after email verification is account creation completed If your password is forgotten, you can reset it by selecting the Forgot Password option, and a confirmation email will be sent to your registered email address.
NFR-3	Reliability	Users can successfully access their accounts 99.99% of the time. If issue found solve within 1 hour
NFR-4	Performance	The whole monitoring data should be accessible after logging in, with time and statistics charts for easier understanding.
NFR-5	Availability	It is accessible online at all times, from any location, using only internet-based methods.
NFR-6	Scalability	The system can support more users concurrently without experiencing delays. Operating system is easy to use.

CHAPTER 5

PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS

A data flow diagram (DFD) is a common visual representation of how information moves through a system. A clean and understandable DFD can graphically represent the appropriate quantity of the system need. It displays how information enters and exits the system, what modifies the data, and where information is kept.



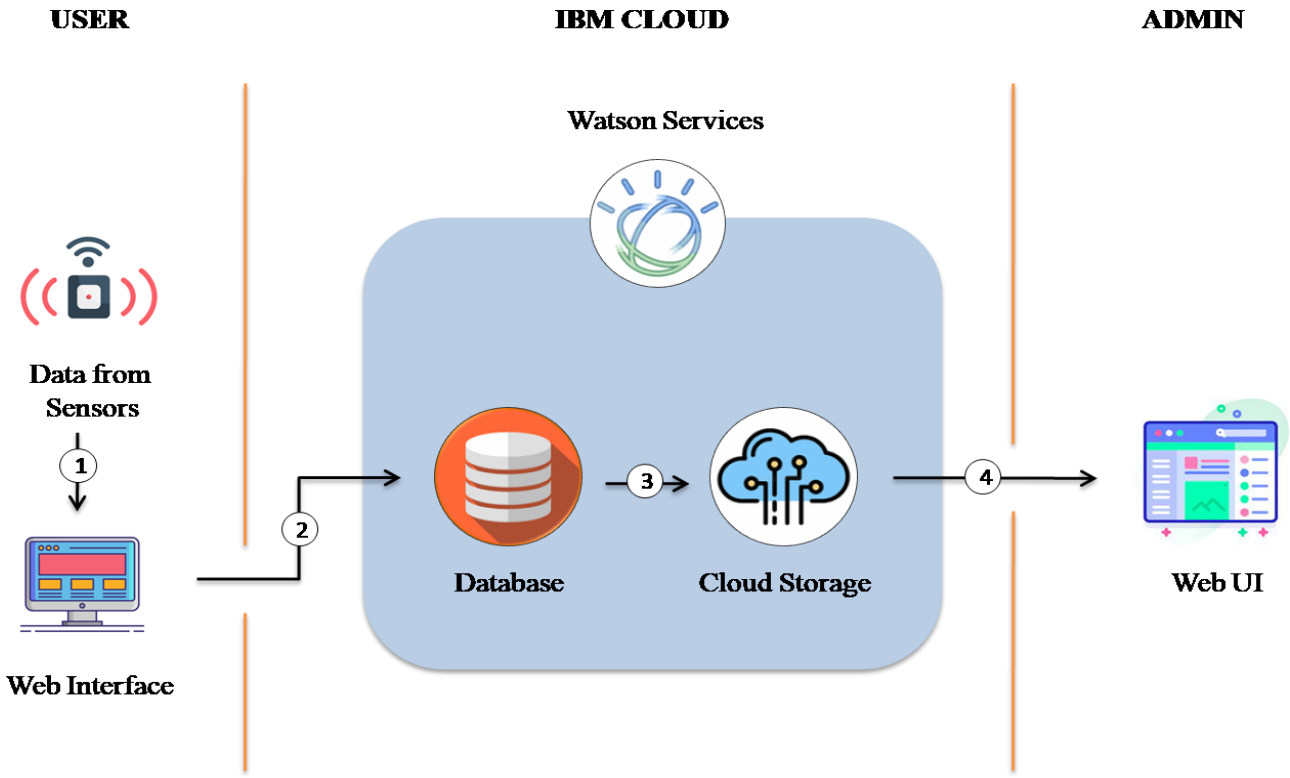
5.2 SOLUTION AND TECHNICAL ARCHITECTURE

An IOT-based river water monitoring and controlling system with some predefined values can be built using the instructions in this code pattern.

Flow:

- Feed the information obtained from the sensor unit situated along the riverside.
- The user will see the gathered information on the web page.
- The acquired data is then transferred to the database, where it is validated and kept track of along with the predetermined data.
- The acquired data will be saved in the IBM cloud storage if any data exceeds the predetermined data, at which point the control signal will be sent to the administrator.
- Later, the administrator will have UI control over the data.

Technical Architecture:



Components & Technologies:

S.No.	Component	Description	Technology
1.	User Interface	User interacts with application through Web UI and Mobile App	HTML, CSS, JavaScript
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 service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Database	Data Type, Configurations	MySQL,/NoSQL
6.	Cloud Database	Database Service on Cloud	IBM Cloudant
7.	File Storage	File storage requirements	IBM Block Storage/ Local File system
8.	External API-1	Purpose of External API used in the application	IBM Weather API
9.	External API-2	Purpose of External API used in the application	Aadhar API
10.	Machine Learning Model	Purpose of Machine Learning Model	Object Recognition Model
11.	Infrastructure (Server / Cloud)	Application Deployment on Local System / CloudLocal Server Configuration: Cloud Server Configuration :	Local, Cloud Foundry, Kubernetes

Application Characteristics:

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

5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application byentering my email address, password, and password confirmation.	Can gain access to my account/ Dashboard.	High	Sprint-1
		USN-2	Once I have registered for the application, Iwill receive a confirmation email.	I can receive an email confirmation and click/confirm.	High	Sprint-2
		USN-3	As a user, I can sign up for the app using Google.	I can use Google to register and access the dashboard.	High	Sprint-1
		USN-4	As a user, I can sign up for the applicationusing Gmail.	I can sign up through themail.	Medium	Sprint-2
	Login	USN-5	I can access the application as a user by entering my email address, password, and captcha.	I can obtain login information.	High	Sprint-1
	Interface	USN-6	As a user, the interface should be easy touse.	I can easily gain access.	Medium	Sprint-1
Customer (Webuser)	Dashboard	USN-7	As a user, I have access to specific information (pH value, temperature, humidity,and quality).	I can determine thewater's quality.	High	Sprint-1
Customer	View manner	USN-8	As a user, I can view data in a graphical format (graph).	Visuals help me understand better.	High	Sprint-1
	Taste	USN-9	As a user, I can see the water's quality (saltiness).	I can easily tell if it's salty or not.	High	Sprint-1

	Color visibility	USN-10	As a user, I can predict the colour of thewater.	I can quickly determine the condition based on the color.	High	Sprint-1
Administrator	Risk tolerant	USN-11	The application should be updated and maintained by the system administrator.	The records should be properly monitored by the administra tor.	Medium	Sprint-2

CHAPTER 6

PROJECT DESIGN & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

S.NO	MILESTONE	DESCRIPTION	STATUS
1	Prerequisites	Prerequisites are all the requirements at the requirement level necessary for carrying out thevarious project phases.	Completed
2	Create & Configure IBM cloud services	Higher levels of compliance, security, and management are made possible by IBM Cloud's solutions, which also feature tried-and-true architecture patterns and strategies for quick delivery of mission-critical workloads.	Completed
3	Ideation phase	Ideation is the process through which you come up with ideas and solutions using exercises like sketching, prototyping, brain-storming, writing in the head, coming up with the worst-casescenario, and a variety of other ideation approaches.	Completed
4	Project design phases	Project design is the initial stage of a project where the main characteristics, organization, success factors, and primary deliverables are planned out. The objective is to create one or more designs that can be applied to realize the intended project objectives.	Completed
5	Project planning phase	The project manager collaborates with the team to develop the technical design, task list, resource plan, communications plan, budget, and initial schedule for the project during the planning phase. The project manager also establishes the roles and responsibilities of the	Completed

		project team andits stakeholders.	
6	Develop the python script	A Python script is a collection of instructions found in a file and designed to be executed similarly to a programme. It is intended thatthe file will be executed from the command line or from a Python interactive shell to carry out a specific task. Of course, the file imports several modules and includes methods.	Completed
7	Develop web application	Instead of running locally and natively on the device's operating system (OS), web applications (or web apps) are application programmers that operate ina web browser.	Completed
8	Project development phase	Project development is the process of organizing and distributing resources to fully develop a project or product from concept to go-live.	Completed

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 enteringmy email, password, and confirming my password.	2	High	Naveenkumar, Vijayarammsen Vijayalaxmanasen Ramesh Kumar Saravanakumar
Sprint-1	User Confirmation	USN-2	As a user, I will receive confirmation email once I haveregistered for the application	1	Medium	Naveenkumar, Vijayarammsen Vijayalaxmanasen Ramesh Kumar Saravanakumar

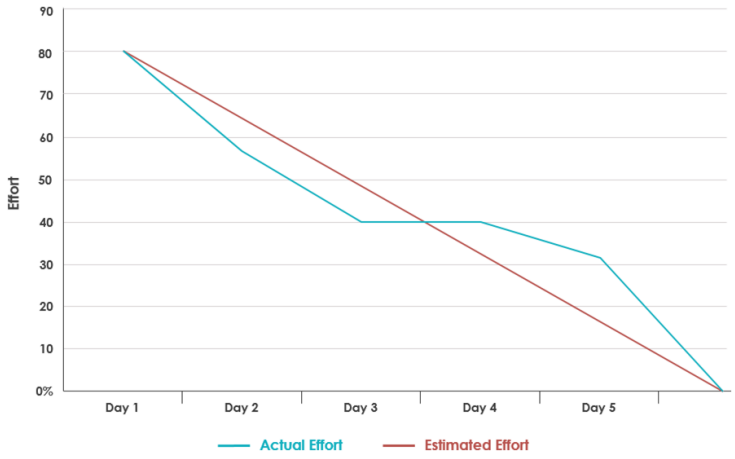
Sprint-1	Login	USN-3	As a user, I can log into the application by enteringemail & password	2	High	Naveenkumar, Vijayarammsen Vijayalaxmanasen Ramesh Kumar Saravanakumar
Sprint-2	Interface Sensor	USN-1	A sensor interface is a bridge between a device and anyattached sensor. The interface takes data collected by the sensor and outputs it to the attached device.	2	High	Naveenkumar, Vijayarammsen Vijayalaxmanasen Ramesh Kumar Saravanakumar
Sprint-3	Codi ng(A ccessi ng datas ets)	USN-1	Coding is a set of instructions used to manipulate information so that a certain input results in a particularoutput.	2	High	Naveenkumar, Vijayarammsen Vijayalaxmanasen Ramesh Kumar Saravanakumar
Sprint-4	Web Application	USN-1	As a user, I will show the current information of theRiver Water.	1	Medium	Naveenkumar, Vijayarammsen Vijayalaxmanasen Ramesh Kumar Saravanakumar

Velocity

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

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

Burndown Chart

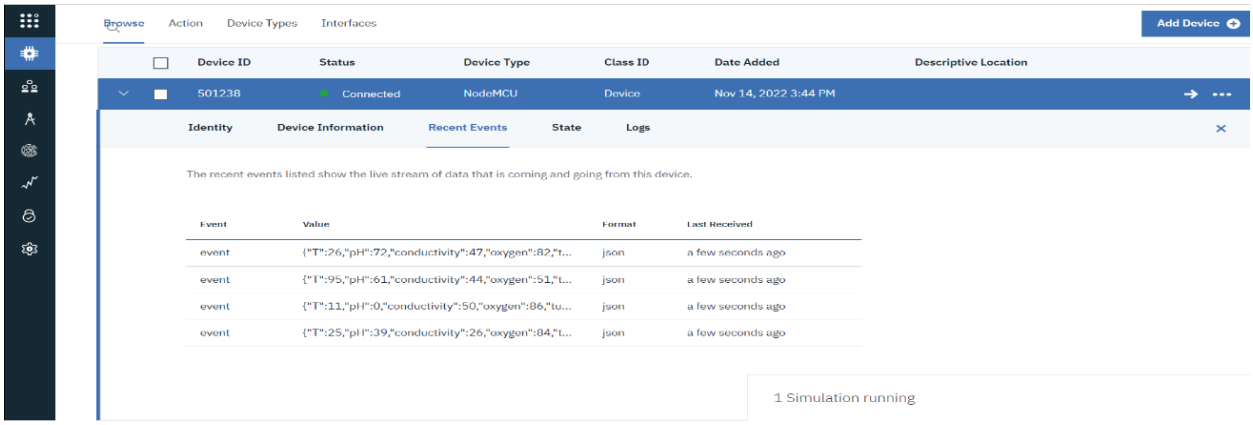


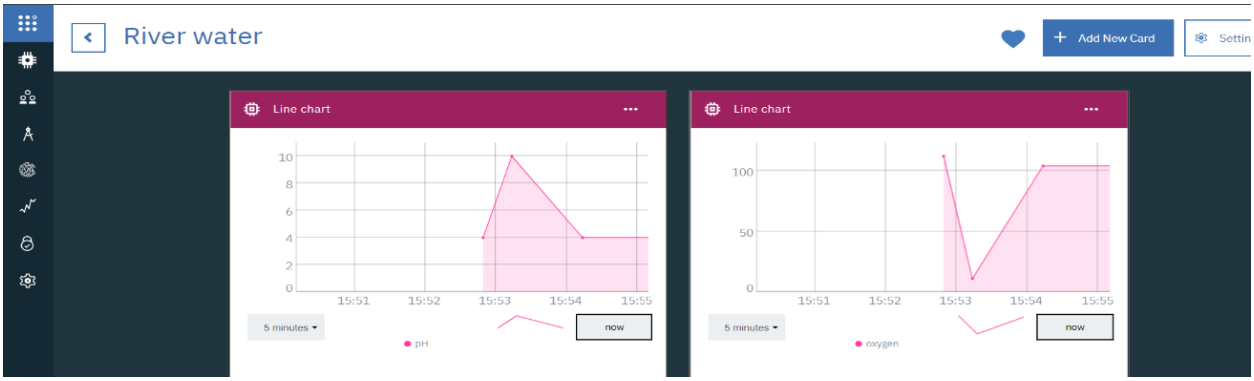
CHAPTER 7

CODING & SOLUTIONING

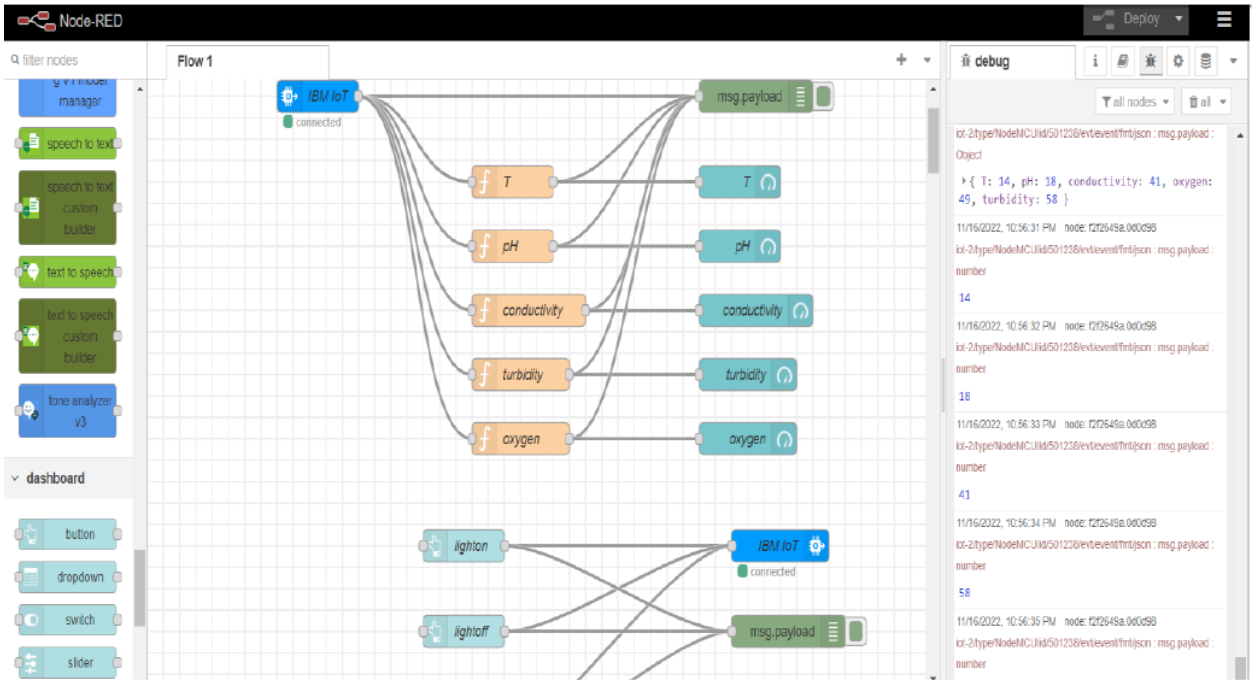
7.1 FEATURE 1

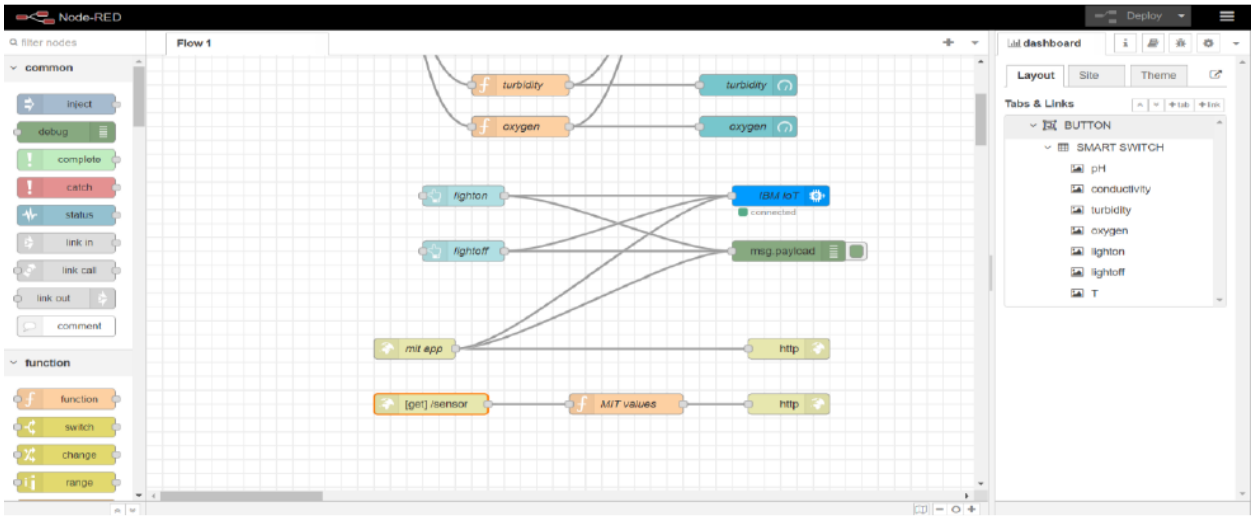
IBM Watson



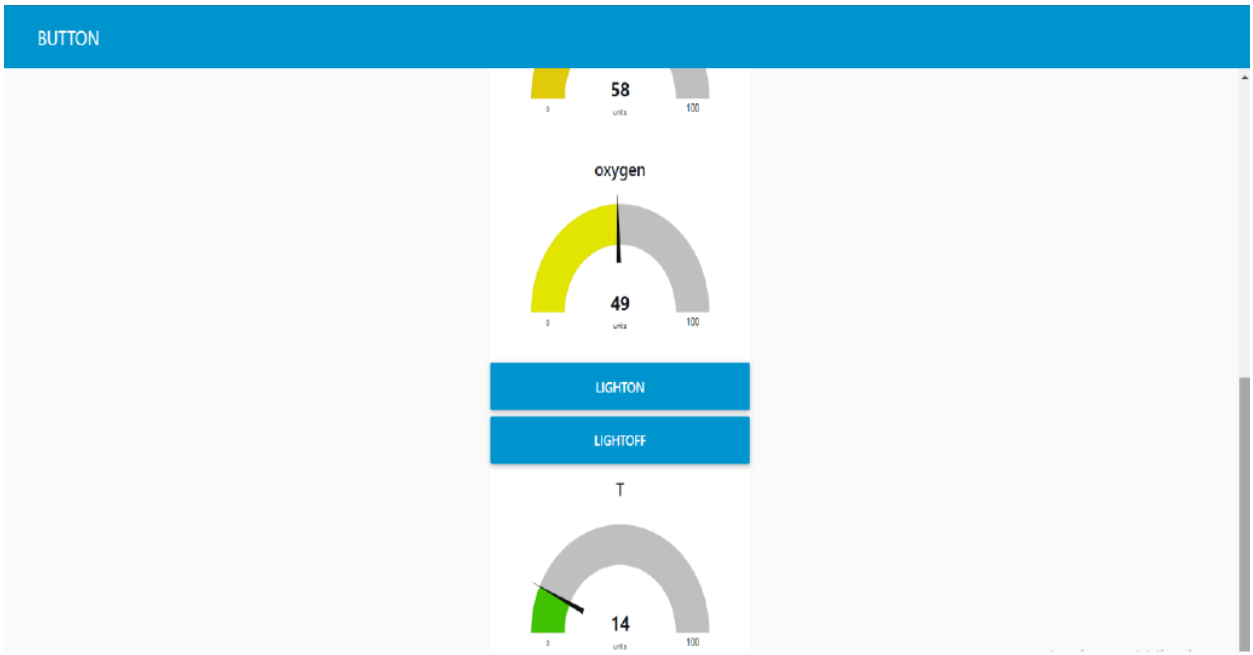


Node Red Service associated with IBM Cloud



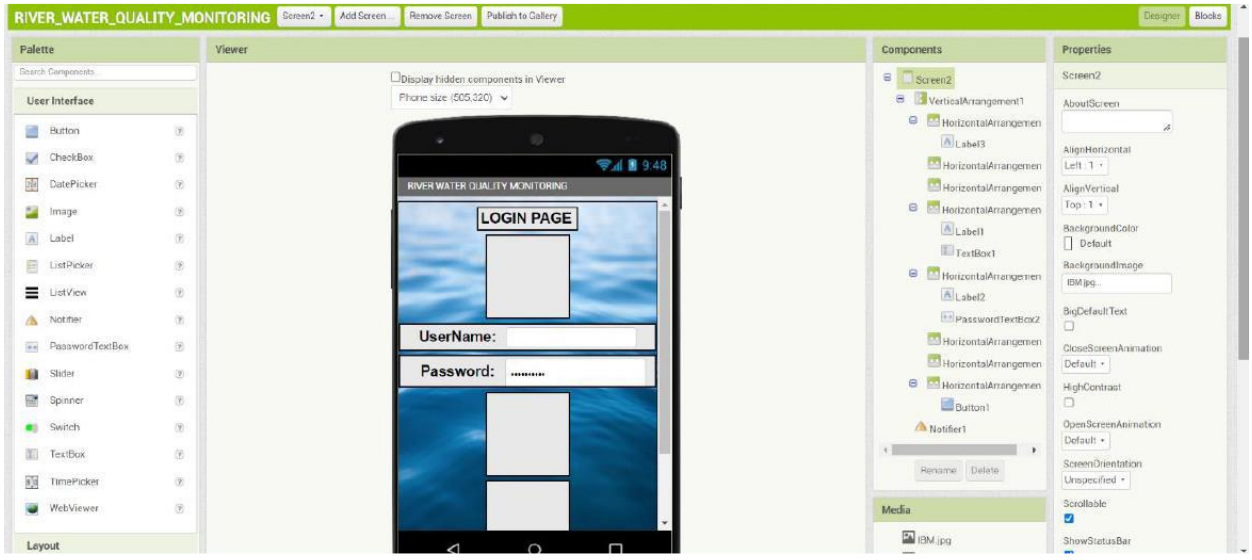


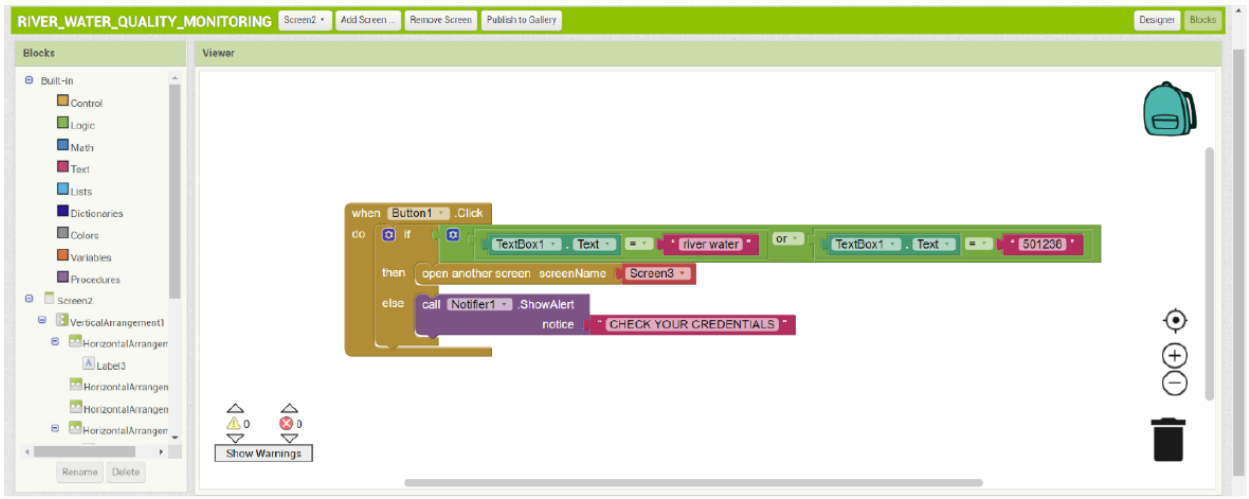
Node Red Dashboard

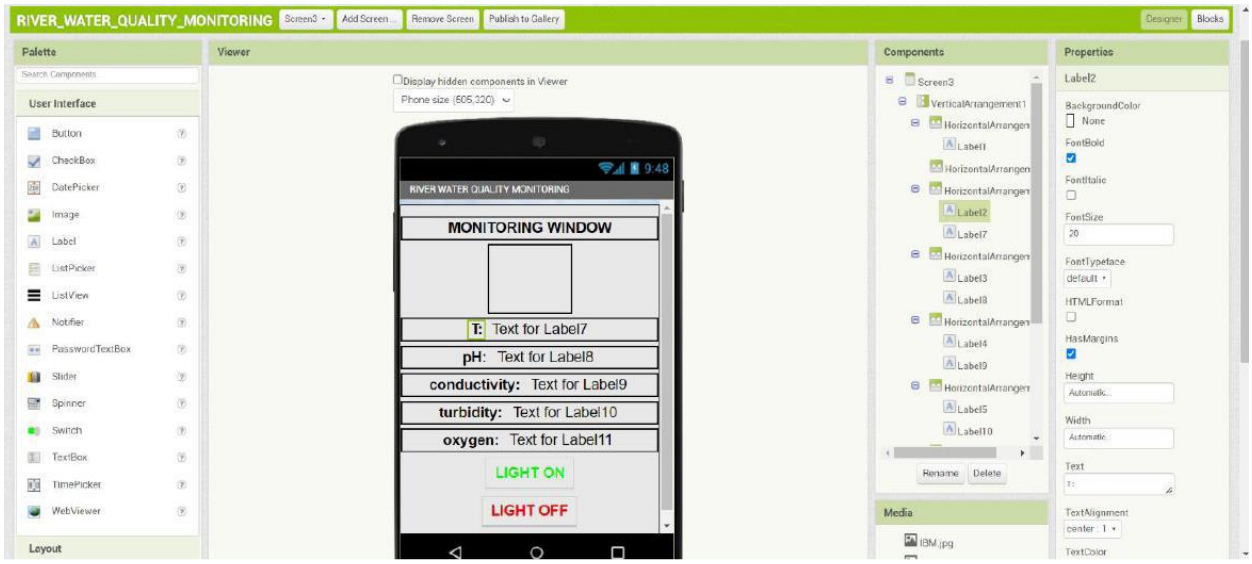


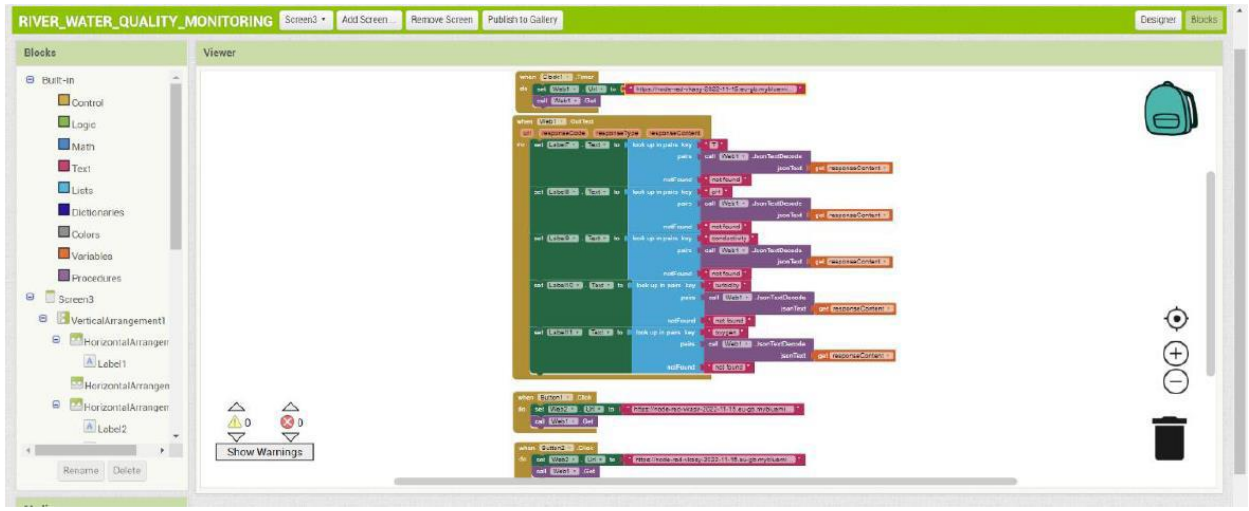
7.2 FEATURE 2

MIT APP Inventor




RIVER_WATER_QUALITY_MONITORING
Screen2
Add Screen ...
Remove Screen
Publish to Gallery
Designer
Blocks
Viewer
when Button1 .Click
do if TextBox1 . Text = river water or TextBox1 . Text = 501236
then open another screen screenName Screen3
else call Notifier1 .ShowAlert
notice CHECK YOUR CREDENTIALS
Show Warnings


RIVER_WATER_QUALITY_MONITORING
Screen3
Add Screen ...
Remove Screen
Publish to Gallery
Designer
Blocks
Palette
Viewer
Components
Properties
Display hidden components in Viewer
Phone size (505,320)
RIVER WATER QUALITY MONITORING
MONITORING WINDOW
T: Text for Label7
pH: Text for Label8
conductivity: Text for Label9
turbidity: Text for Label10
oxygen: Text for Label11
LIGHT ON
LIGHT OFF
Media
IBM.jpg


RIVER_WATER_QUALITY_MONITORING
Screen3
Add Screen ...
Remove Screen
Publish to Gallery
Designer
Blocks
Viewer
Show Warnings

CHAPTER 8

TESTING

8.1 TEST CASES

This report shows the number of test cases that have passed, failed, and untested.

Section	Total Cases	Not tested	Fail	Pass
Print Engine	15	0	0	15
Cloud 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

Purpose of the document

This document's goal is to provide a concise explanation of the test coverage and open issues for the REAL TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEMS project at the time of the release to User Acceptance Testing (UAT).

Result Analysis

This report lists the number of bugs that have been fixed or closed at each severity level, along with how they were fixed.

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Sub Total
By Design	9	5	4	3	21
Duplicate	2	0	2	0	4
External	3	4	1	2	10
Fixed	10	1	5	17	33
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	2	3
Won't Fix	0	3	3	1	7
Totals	24	13	17	25	79

CHAPTER 9

RESULTS

9.1 PERFORMANCE METRICS

			NFT - Risk Assessment						
S.No	Project Name	Scope/feature	Functional Changes	Hardware Changes	Software Changes	Impact of Downtime	Load/Voluem Changes	Risk Score	Justification
1	REAL-TIME RIVER WATER QUALITY & MONITORING SYSTEM	New	Low	No Changes	Moderate	3 days	>5 to 10%	ORANGE	As we have seen the chnages

Performance Table

Parameter	Performance	Description
Admin testing	95%-100%	The testing done before it is deployed as an app
Customer satisfaction	75-85%	The customer need to be satisfied with the mobile application
User interface	65-85%	The app can used by anyone.(ease of access)
Sever response	50-75%	Url - response
Data validation with no. Of test case	60-80% (15-30 Testcase)	Valid data from the app
Error	3-5%	Real-time delay may occur

CHAPTER 10

ADVANTAGES & DISADVANTAGES

ADVANTAGES

- The prototype created for maintaining water quality is excellent for preserving public health and also contributes to a clean environment.
- This water monitoring, cleaning, and control procedure is automated, which eliminates the need for manual work and saves time and money.
- The system's automation improves the effectiveness and efficiency of the control and monitoring processes. Remote control of the system is possible thanks to real-time mobile monitoring made possible by the Bluetooth module and Arduino interface on the PLC.
- Automation will speed up the process of checking the parameters.
- It is economically accessible to the average person.
- Offers protection against infections brought on by water.
- Measurement accuracy
- The user receives an SMS notice.

DISADVANTAGES

- The cost of analysis is very high
- It is challenging to collect water samples from every area of the water body.
- It takes time for lab testing and analysis.
- As a result, the results do not reflect real-time water quality measurements.
- The method is time-consuming and subject to a variety of human errors because manual data collection is done slowly from various locations around the water body.

CHAPTER 11

CONCULSION

This article provides a thorough analysis of the methods and technologies used by current smart water quality monitoring systems. A low-cost, simpler approach for monitoring water quality is also suggested. The implementation makes it possible for sensors to give customers online data. Algorithms for water quality anomaly detection can be added to the suggested setup to improve it. Therefore, the suggested system will undoubtedly benefit society's access to a reliable water supply. People will be greatly assisted in becoming aware of the dangers of using contaminated water and in stopping water pollution by real-time monitoring of water quality utilizing IoT integrated big data analytics.

Real-time river water quality monitoring is the main focus of the research. Because IoT integrated big data analytics can offer dependability, scalability, speed, and permanence, it appears to be a better solution. Real-time analytics tools including Spark streaming analysis through Spark ML lib, Deep learning neural network models, and the Belief Rule Based (BRB) system will all be thoroughly compared during the project development period.

This study suggests systematic testing of the suggested technologies in Bangladeshi rivers with various water quality characteristics. We only measure the characteristics that affect the quality of river water due to budgetary constraints. This project could be expanded into a productive local water management system. Additionally, other characteristics that were outside the purview of this experiment can also be quantified, including total dissolved solids, chemical oxygen demand, and dissolved oxygen. Therefore, greater funding is needed to continue to enhance the system as a whole.

CHAPTER 12

FUTURE SCOPE

Our usage of water detecting sensors provides a special benefit. Compared to a manual technique, it takes less time to check for contaminated levels and notifies the affected rate of water pollution instantly. Rural residents who live close to the river will be delighted with our suggestion. Monitoring water pollution in a certain location will be helpful. Consequently, this mechanism shields users from water pollution. It will be used to check the PH level, temperature, and water quality for agricultural purposes. This project will have a positive social impact on farmers as well.

This project can be scaled up to include more diverse types of sensors. The relay can be interfaced to allow us to regulate the water supply. We can use it as a revenue model as well. Additionally, this technology might be used in a number of industrial procedures. To monitor data on computers, the system can be adjusted to suit the needs of the user.

CHAPTER 13

APPENDIX

SOURCE CODE

Python Code to Publish Data

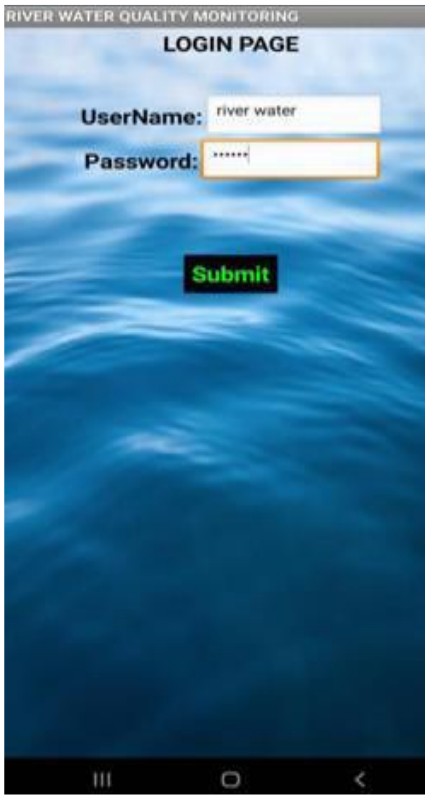
```
import random
import time
import sys
import ibmiotf.application
import ibmiotf.device


# Provide your IBM Watson Device Credentials
organization = "nqat1y" # repalce it with organization ID
deviceType = "NodeMCU" # replace it with device type
deviceId = "501238" # repalce with device id
authMethod = "token"
authToken = "10571213" # repalce with token
def myCommandCallback(cmd):
print("Command received: %s" % cmd.data['command'])
status=cmd.data['command']
if status == 'lighton':
print("LIGHT ON")
elif status == 'lightoff':
print("LIGHT OFF")
else:
print ("please send proper command")
try:
deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method": authMethod,
"auth-token": authToken}
```

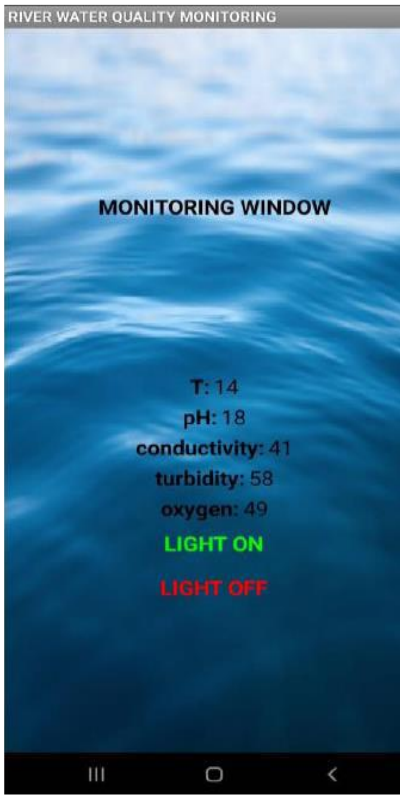
```
deviceCli = ibmiotf.device.Client(deviceOptions)


# ..............................................
except Exception as e:
print("Caught exception connecting device: %s" % str(e))
sys.exit()
deviceCli.connect()
while True:
pH = random.randint(0,100)
conductivity = random.randint(0,100)
T = random.randint(0,100)
oxygen = random.randint(0,100)
turbidity = random.randint(0,100)

# Send Temperature & Humidity to IBM Watson
data = {'T': T,'pH':pH,'conductivity':conductivity,'oxygen':oxygen,"turbidity":turbidity}

# print data
def myOnPublishCallback():
print("Published data",data, "to IBM Watson")
success = deviceCli.publishEvent("event", "json", data, 0, myOnPublishCallback)
if not success:
print("Not connected to IoTF")
time.sleep(5)
deviceCli.commandCallback = myCommandCallback

# Disconnect the device and application from the cloud
```

Output

```
Published data {'T': 23, 'pH': 85, 'conductivity': 37, 'oxygen': 41, 'turbidity'
: 2} to IBM Watson
Published data {'T': 39, 'pH': 87, 'conductivity': 1, 'oxygen': 32, 'turbidity':
 84} to IBM Watson
Published data {'T': 90, 'pH': 89, 'conductivity': 29, 'oxygen': 65, 'turbidity'
: 93} to IBM Watson
Published data {'T': 91, 'pH': 15, 'conductivity': 0, 'oxygen': 27, 'turbidity':
 60} to IBM Watson
Published data {'T': 52, 'pH': 65, 'conductivity': 59, 'oxygen': 78, 'turbidity'
: 23} to IBM Watson
Published data {'T': 96, 'pH': 96, 'conductivity': 20, 'oxygen': 47, 'turbidity'
: 90} to IBM Watson
Published data {'T': 87, 'pH': 73, 'conductivity': 92, 'oxygen': 41, 'turbidity'
: 85} to IBM Watson
Published data {'T': 90, 'pH': 21, 'conductivity': 81, 'oxygen': 83, 'turbidity'
: 61} to IBM Watson
```

Output in Mobile App





GITHUB LINK

https://github.com/IBM-EPBL/IBM-Project-41463-1660642315