PROJECT REPORT

REAL-TIME RIVER QUALITY MONITORING AND CONTROL SYSTEM

TEAM ID: PNT2022TMID19640

TEAM MEMBERS:

1. SUBALAKSHMI M

2.RAGAVI K

3.SWETHA G

4.RAM PRAKASH NCM

1.INTRODUCTION

1.1 PROJECT OVERVIEW

The conventional method of testing water quality is to gather samples of water manually and send them to the lab to test and analyze. This method is time consuming, wastage of manpower, and not economical. The water quality measuring system that we have implemented checks the quality of water in real time through various sensors (one for each parameter: pH, conductivity, temperature) to measure the quality of water. The ZigBee module in the system

transfers data collected by the sensors to the microcontroller wirelessly, and a GSM module transfers wirelessly the data further from the microcontroller to the smart phone/PC.

1.2 PURPOSE

Water is one of the most essential natural resources that has been gifted to mankind. But the rapid development of the society and numerous human activities speeded up the contamination and deteriorated the water resources. For above water quality monitoring is necessary to identify any changes in water quality parameters from time-to-time to make sure its safety in real time.

The Central Pollution Control Board (CPCB) has established a series of monitoring stations on water bodies across the country which monitor the water quality on either monthly or yearly basis. This is done to ensure that the water quality is being maintained or restored at desired level.

It is important that it is monitored on regular basis. Water quality monitoring helps in evaluating the nature and extent of pollution control required, and effectiveness of pollution control measures. CPCB has plans to establish a water quality monitoring network across the Ganga river basin. All the stations will operate in real time and central stations can access data from any of the above stations using GPRS/GSM or 3G cellular services.State pollution boards and CPCB zonal offices can also access data from central station.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

Child Safety Monitoring System Based on IOT

The available water resources are getting depleted and water quality is deteriorating due to the rapid increase in population and the need to meet demands of human beings for agriculture, industrial, and personal use. The quality of groundwater is also affected by pesticides and insecticides. The rivers in India are getting polluted due to industrial waste and discharge of untreated sewage. In order to eliminate problems associated with manual water quality monitoring, CPCB has planned to go hi-tech and plans to establish 'Real Time Water Quality Monitoring (WQM) Network' across Ganga Basin.

Kamal Alameh, presented web based WSN for monitoring water pollution using ZigBee and WiMAX networks. The system measured various WQP. It collected, processed, measured data from sensors, and directed through ZigBee gateway to the web server by means of WiMAX network to monitor quality of water from large distances.

INTERNET OF THINGS

Internet of Things (IoT) is defined as the network of physical objects/things - devices, vehicles, buildings embedded with sensor, micro-controller, and network connectivity that enables these objects to collect and exchange data. The IoT can be described as a huge web of embedded objects designed with built-in wireless technologies such that they can be monitored, controlled and linked within the existing Internet infrastructure. Each device has a unique identification and must be able to capture real-time data autonomously. Basic building blocks of IoT consist of sensors, processors, gateways, and applications. It is estimated that by 2020, 50 billion 'things' will be connected to the Internet .

2.2 REFERENCES

1. R.M. Bhardwaj, "Overview of Ganga River Pollution", Report: Central

Pollution Control Board, Delhi, 2011

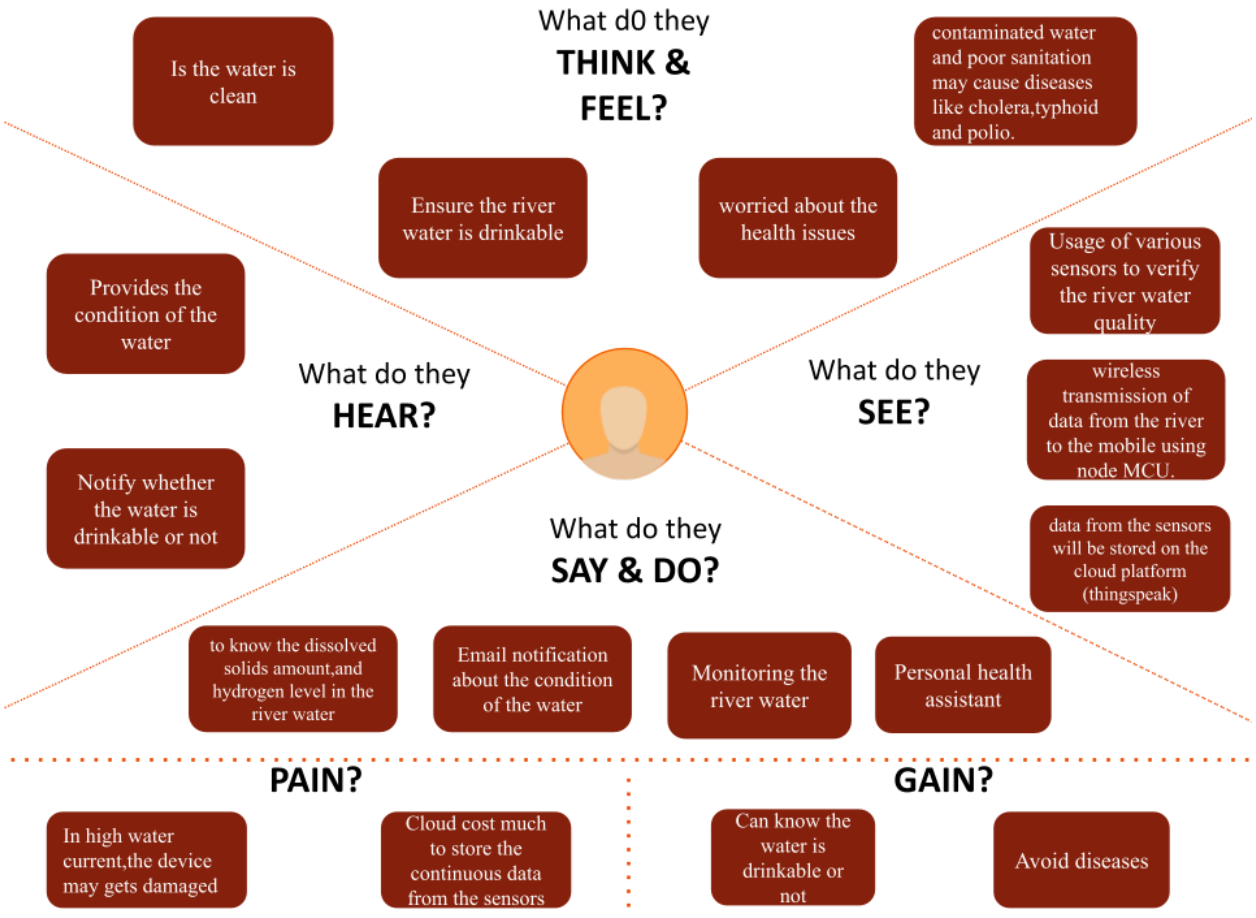
2. Nivit Yadav, “CPCB Real time Water Quality Monitoring", Report: Center for Science and Environment, 2012

3.Liang Hu, Feng Wang, Jin Zhou and Kuo Zhao “A Survey from the Perspective of Evolutionary Process in the Internet of Things”, International Journal of Distributed Sensor Networks, Article ID 462752, 2015

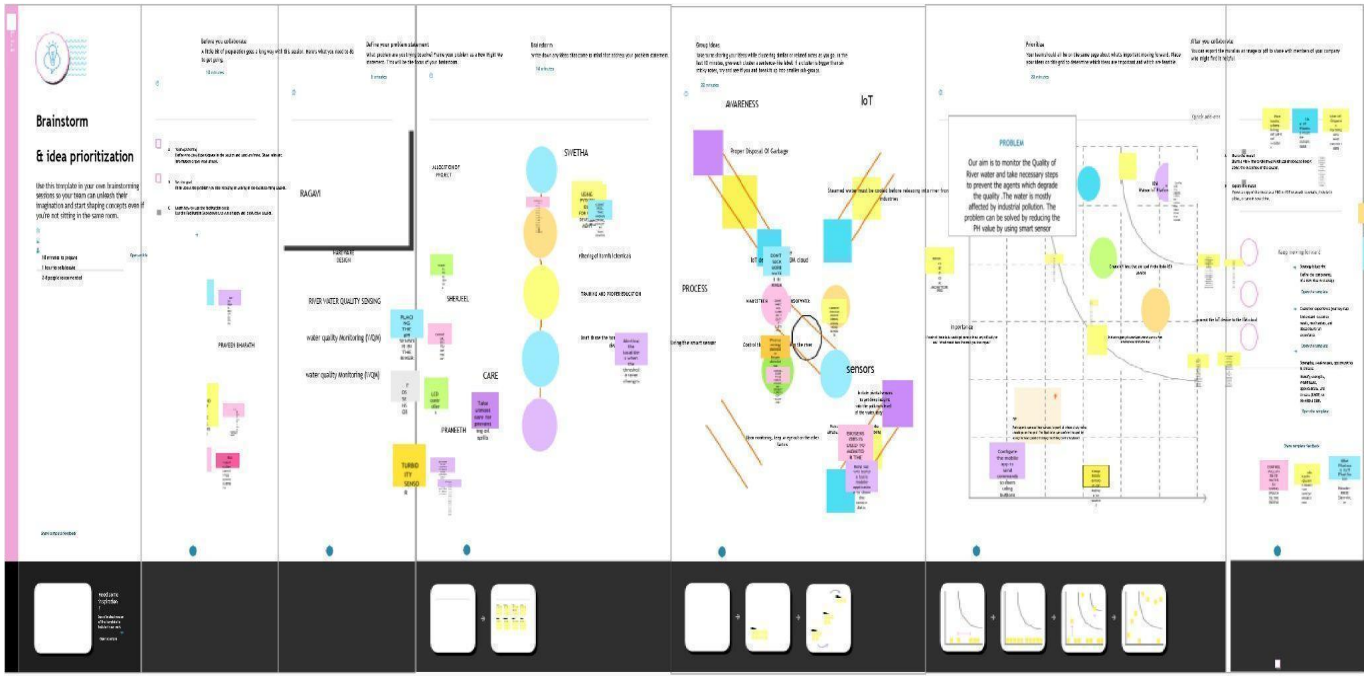
2.3 PROBLEM STATEMENT DEFINITION

1. IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS



3.2 IDEATION & BRAINSTORMING



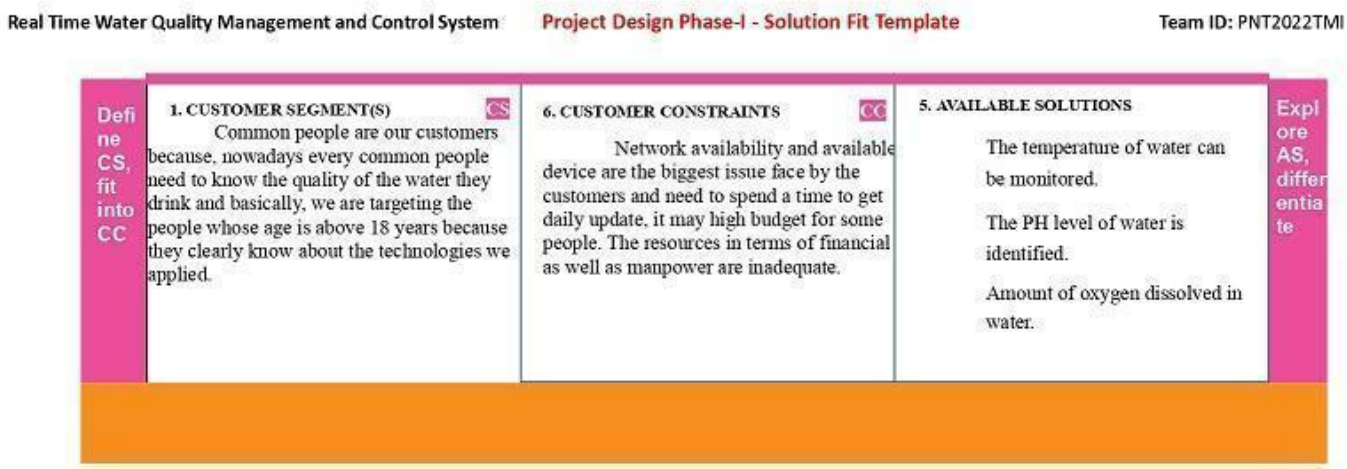
3.3 PROPOSED SOLUTION

- 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.
- 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.

3.4 PROBLEM SOLUTION FIT



F

ocus on J&P, tap into BE, understan d RC

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

In society people had to know the Quality of water, in conventional method it is impossible to inform people, and this leads to many problems like disease. Here we apply new technologies and trends to aware people. This project helps more graduate to work with it.

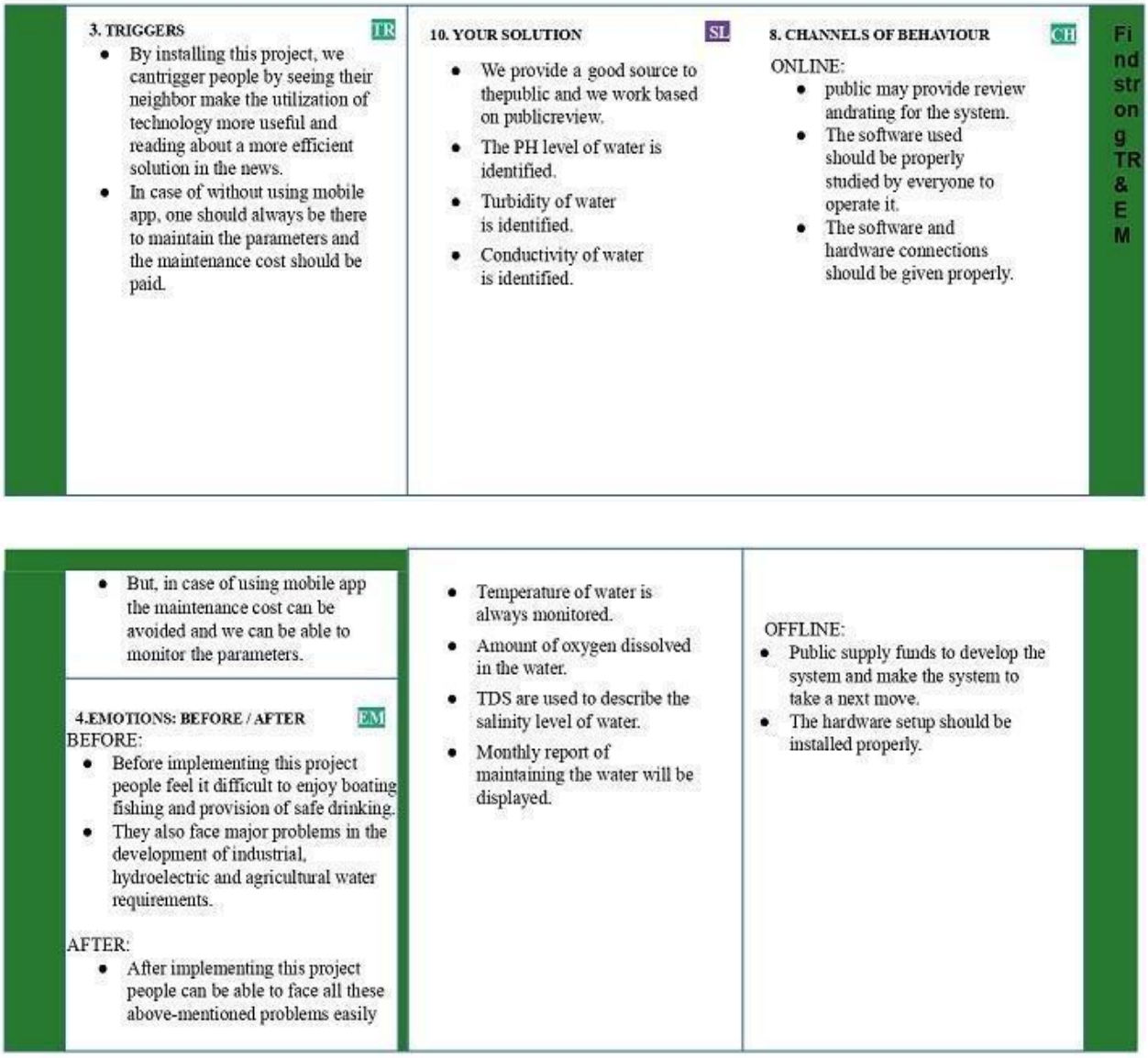
9. PROBLEM ROOT CAUSE RC

The reason for the arrival of this project is to keep and monitor the water used for multiple purpose especially for drinking purpose. We took this project to make the biggest change in society and breakthe myth of utilization of technologies.

7. BEHAVIOUR BE

Directly related: find better network availability, calculate the quality and quantity of water.
Indirectly related: customers spend free time on making awareness of the system to others.

Focus on J&P, tap into BE,



4. REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

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

Date	11 November 2022
Team ID	PNT2022TMID19640
Project Name	Real Time River Water Quality Monitoring And Control System
Maximum Marks	4 Marks

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 Email or Gmail. Registration through Phone number.
FR-2	User Confirmation	Confirmation via Gmail. Confirmation via Code.
FR-3	User access	Accepting all the terms and conditions. Confirmation of re- captcha.
FR-4	User mode	Online
FR-5	User alert	Alert Message to the registered Phone number if the measuredvalue crosses the threshold value.

4.2 NON-FUNCTIONAL REQUIREMENTS

Non-functional Requirements:

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

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Easy to use. Effective, Efficient, Engaging, Error tolerant. Easy to learn.
NFR-2	**Security**	Accepting Terms and Conditions. Confirmation via Email and OTP. Confirmation via re- captcha. Strong cryptography skills. Software security architects also have experience with malware, intrusion detection andprevention and firewalls.
NFR-3	**Reliability**	Great user interface. Software operating without failure while in aspecified environment over a set duration of time.
NFR-4	**Performance**	Fast loading of the result time and high performance.
NFR-5	**Availability**	Easy installation.

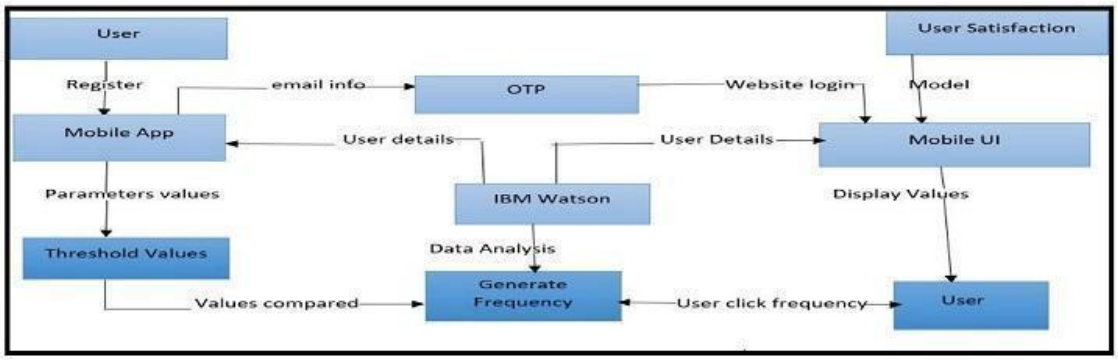
5. PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS

Project Design Phase-II
Data Flow Diagram & User Stories

Date	18 november 2022
Team ID	PNT2022TMID19640
Project Name	Real-Time River Water Quality Monitoring and Control System
Maximum Marks	4 Marks

Data Flow Diagrams:



User Stories

Use the below template to list all the user stories for the product.

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 Mobile UI by entering my user details.	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will receive OTP from email once I have registered for the Mobile App	I can receive OTP & Enter confirm	High	Sprint-1
		USN-3	As a user, I can see the parameters in the mobile app UI	I can Analysis all the details	Medium	Sprint-2
		USN-4	As a user, I can click the frequency to control the water quality		Medium	Sprint-1
	Login	USN-5	As a user, I can monitor the water quality		High	Sprint-1
	Dashboard					
Customer Care Executive	Via calling	USN	On calling company's customer care center	Accepted by faster response	High	Sprint 4
Administrator	Registration	USN	By personalized setting of products	Accepted	High	Sprint-5

5.2 . SOLUTION & TECHNICAL ARCHITECTURE

Project Design
Phase-I Solution
Architecture

Date	19 September 2022
Team ID	PNT2022TMID19640
Project Name	Real-Time River Water Quality Monitoring and Control System
Maximum Marks	4 Marks

Solution Architecture:

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- Find the best tech solution to solve existing business problems.
- Describe the structure, characteristics, behaviour, and other aspects of the software to project stakeholders.
- Define features, development phases, and solution requirements.
- Provide specifications according to which the solution is defined, managed, and delivered.

Example - Solution Architecture Diagram:

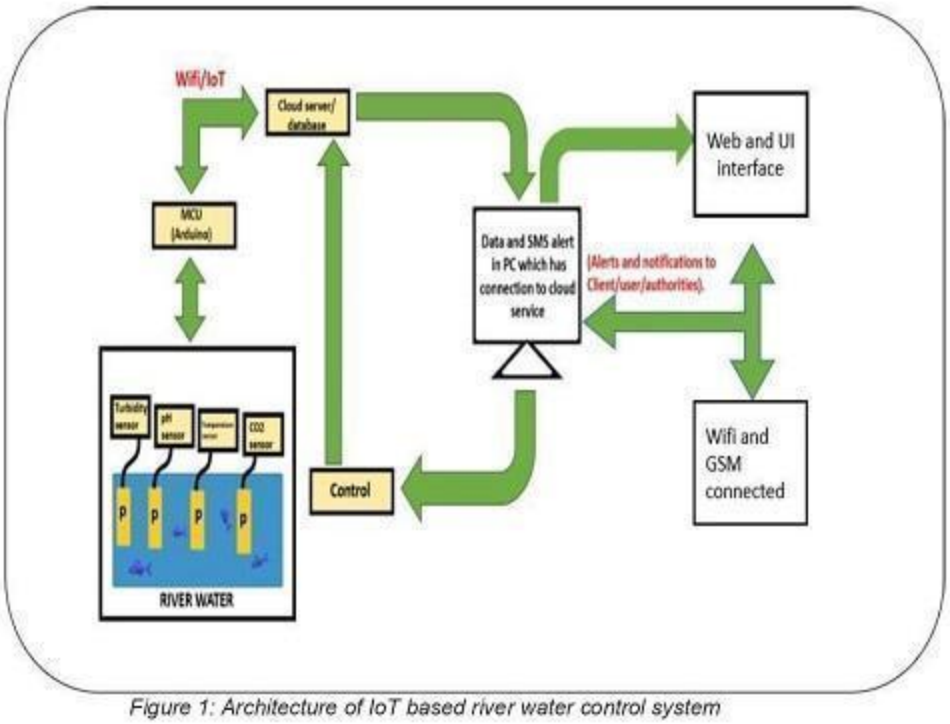


Figure 1: Architecture of IoT based river water control system

5.3 . USER STORIES

Use the below template to list all the user stories for the product.

User Type	Functional Requirement Story t (Eg	User Numbe r	User Story / Task	Acceptance criteria		y Release
Customer (Mobile user)	Regis		As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account /dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Google	I can register & access the dashboard with Google Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through G mail	I can access through Gmail		n Sprint-1
Customer (Web user)	Login	USN-5	As a user, I can log into the application by entering email & password	Login Details are High received to	High	Sprint-1
	Interface	USN-6	As a user, I can log into the application by entering email & password.	Easy Access application	High	Sprint-1
			7 As a web User, I can get rmation (data)(Temp etc..)	I can easily Understand how to use it.		Sprint-1
Customer Care Executive	View Perspectiv e	CCE	As a Customer care, I can view the data in graph plots	Easy Understanding of Graphs	High	Sprin
Administrator	Risk factor	1	MIN- As a Admin, Update done at each step and take care of any errors	Heavy Monitoring High is Required.		Sprint-2

6. PROJECT PLANNING & SCHEDULING

6.1. SPRINT DELIVERY

Project Planning Phase

Sprint Delivery Plan

Date	22 October 2022
Team ID	PNT2022TMID08171
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 (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	Reshma S
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	Sandhya S
Sprint-2		USN-3	As a user, I can register for the application through Facebook	2	Low	Yogeswari M
Sprint-1		USN-4	As a user, I can register for the application through Gmail	2	Medium	Sneha T
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	Sandhya S

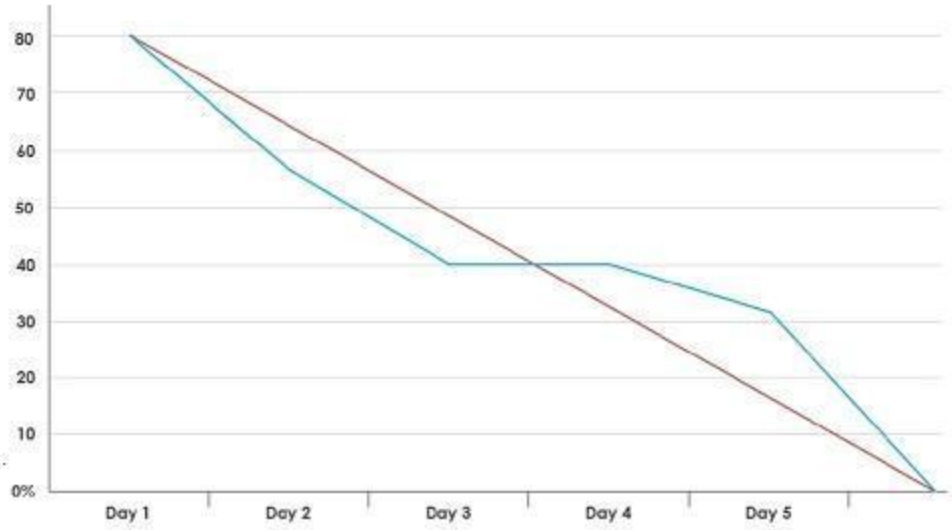
Project Tracker, Velocity & Burndown Chart: (4 Marks)

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	40	06 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	50	07 Nov 2022

Velocity:

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

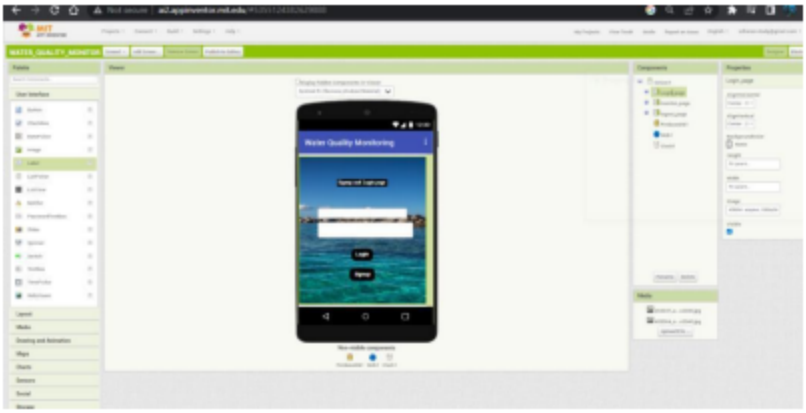
Burndown Chart:



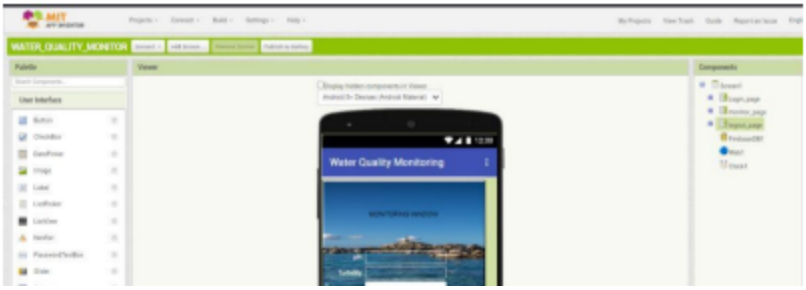
6.2. SPRINT PLANNING & ESTIMATION

Creating app with MIT app inventor:

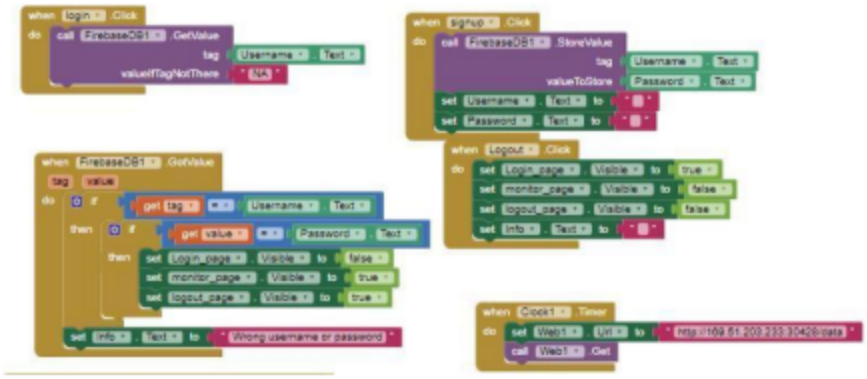
Login /sign page:



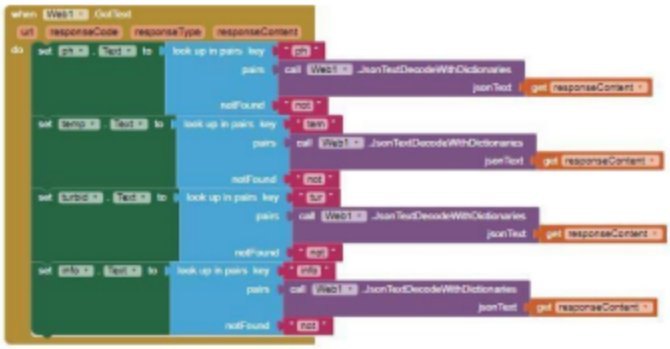
Monitoring page:



Block components inside MIT app inverter

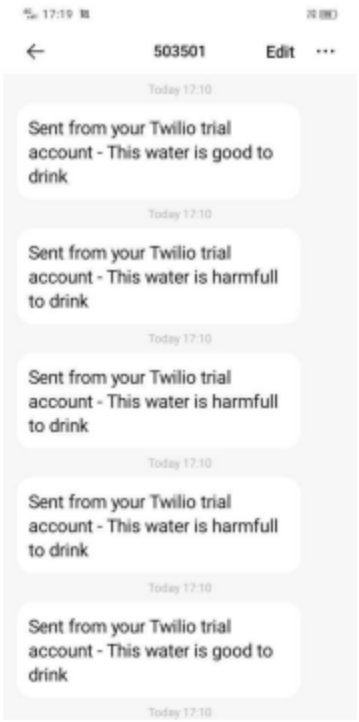


Linking App with Node-Red :



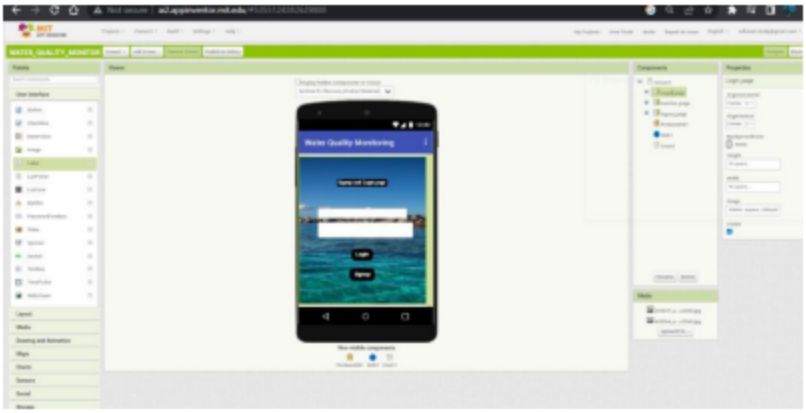
Program for sending Alert message:

```
From twilio.rest import Client

Account_sid = 'AC18b4d7a136b9a07a181a837c23ad1358'

Auth_token ='adc9782f6520041c84ac4930daad0625 '

Client = Client(account_sid, auth_token)

Message = client.messages.create(from_='+14632588702',body ='Alert:This water
is harmfull',to ='+91 95856 17613')

Print(message.sid)
```

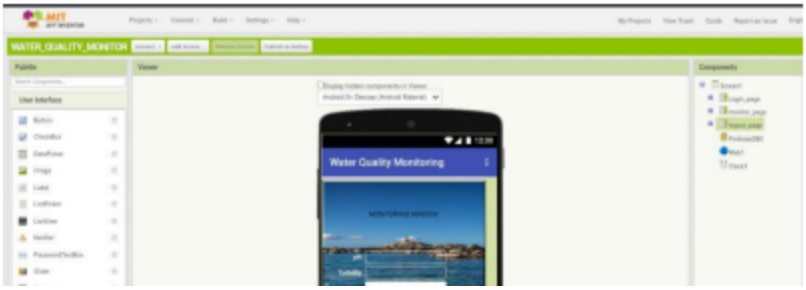


Creating app with MIT app inventor:

Login /sign page:

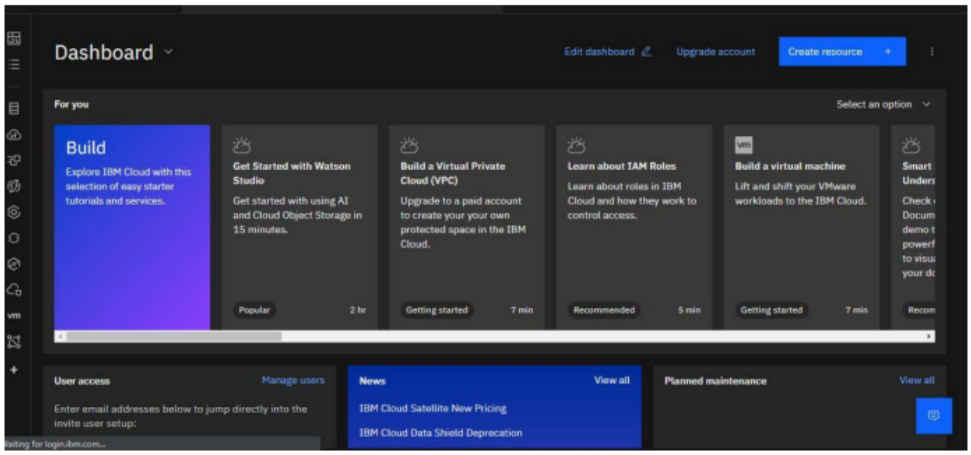


Monitoring page:



7. CODING & SOLUTION

7.1. NODE RED SERVICE ASSOCIATED WITH IBM CLOUD:



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
Client Application	45	0	0	45
Security	1	0	0	1
Outsource Shipping	2	0	0	2
Exception Reporting	10	0	0	10
Final Report Output	4	0	0	4
Version Control	3	0	0	3

8.2. USER ACCEPTANCE TESTING

1.Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the REAL TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEMS 28 project at the time of the release to User Acceptance Testing (UAT).

9. RESULTS

9.1. PERFORMANCE METRICS

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

10. ADVANTAGES

●The prototype developed for water quality maintenance is very

beneficial for safeguarding public health and also adds to the clean environment.

● The automation of this water monitoring, cleaning and control process removes the need of manual labor and thus saves time and money.

● The automation of the system makes the control and monitoring process more efficient and effective. Real time monitoring on mobile phones which is possible through the interface of plc with Arduino and Bluetooth module allows remote controlling of the system.

DISADVANTAGES:

● It is difficult to collect the water samples from all the area of the water body.

● The cost of analysis is very high.

● The lab testing and analysis takes some time and hence the lab results does not reflect real time water quality measurement due to delay in measurement.

● The process is time consuming due to slow process of manual data collection from different locations of the water body. ● The method is prone to human errors of various forms.

11. CONCLUSION

Thus our project is used to 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.

FUTURE SCOPE

We use water detection sensor has unique advantage.It consumes less time to monitor than a manual method for checking polluted levels,and notifies immediately to reduce affected rate of pollution in water.People who are living in rural areas near to the river will be very satisfied with our idea.It will be useful to monitor water pollution in specific area.So this system prevent people from water pollution.It will be used for farming purpose to check quality water,temperature and PH level.Our Impact of this project is also create a social satisfaction for farmers to.The scalability of this project gives the addition of more different type of sensors.By interfacing the relay we can control the supply of water. We can also implement

it as a revenue model.This system could also be implemented in various industrial processes. The system can be modified according to the needs of the user and can be implemented along with a lab view to monitor data on computers.

13.APPENDIX

13.1 SOURCE CODE:

PYTHON CODE TO PUBLISH DATA

```
import ibmiotf.application
import ibmiotf.device
import time
import random
import sys
organization = "wbp1fk"
deviceType = "ESP32"
deviceId = "sensor_data_1"
authMethod =
"token"authToken =
"prototype_1"

pH = random.randint(1, 14)
turbidity
```

```
= random.randint(1, 1000)
temperature = random.randint(0,
100) info=""
def myCommandCallback(cmd):
print("Command Received: %s" %
cmd.data['command']) print(cmd)
try:
deviceOptions={"org":organization,"type":devi
ceType,
"id":deviceId,"auth-method":authMethod,"auth-t
oken":authToken} deviceCli =
ibmiotf.device.Client(deviceOptions) except
Exception as e:
```

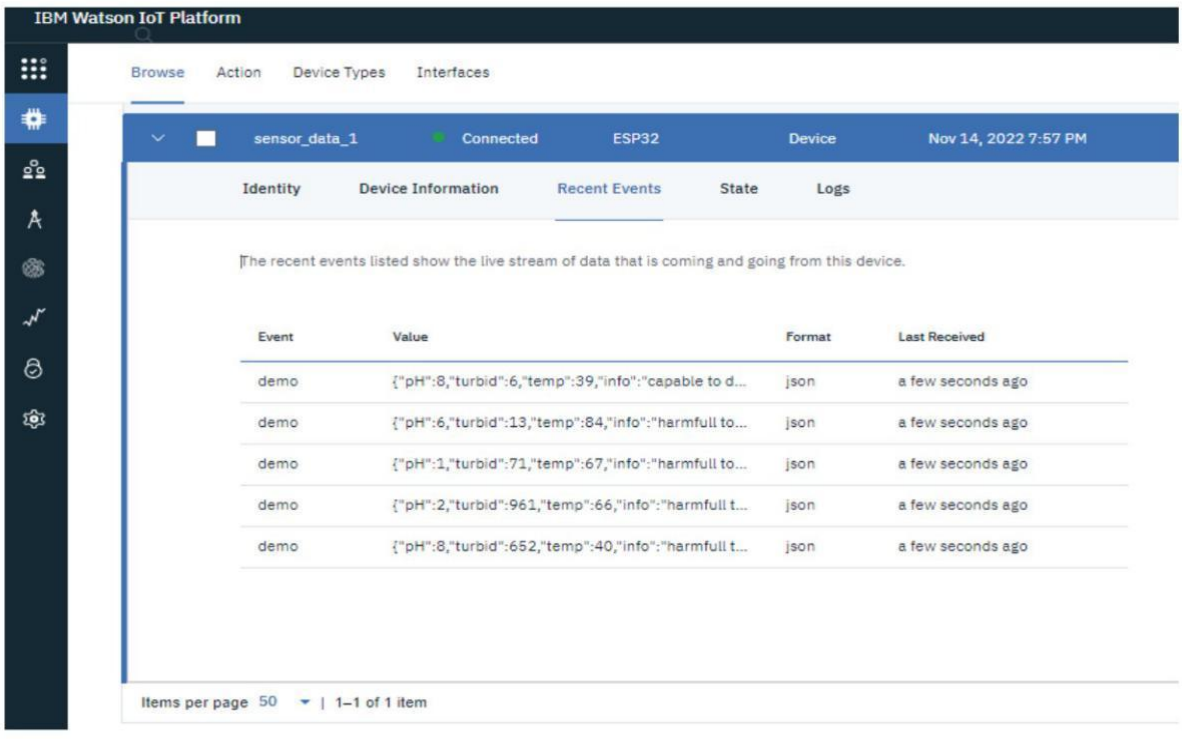


```
print("caught exception connecting device: %s" % str(e))
sys.exit()
deviceCli.connect()
while True:
pH = random.randint(1, 14)
turbidity = random.randint(1, 1000)
temperature = random.randint(0, 100)
if temperature>70 or pH<6 or pH>8 or turbidity>500:
print("high")
print("high")
```

```
info="harmfull to drink"
else:
info="capable to drinking"
data = {'pH': pH, 'turbid': turbidity,'temp': temperature,'info':info}
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()
```

OUTPUT

```
high2022-11-14 20:03:53,055   ibmiotf.device.Client      INFO    Connected succe
ssfully: d:wbp1fk:ESP32:sensor_data_1

Published pH= 9 Turbidity:595 Temperature:24
high
Published pH= 10 Turbidity:259 Temperature:98
Published pH= 14 Turbidity:163 Temperature:59
high
Published pH= 1 Turbidity:109 Temperature:56
high
Published pH= 8 Turbidity:527 Temperature:7
high
Published pH= 11 Turbidity:874 Temperature:62
Published pH= 9 Turbidity:76 Temperature:40
high
Published pH= 12 Turbidity:478 Temperature:91
high
Published pH= 7 Turbidity:887 Temperature:54
Published pH= 13 Turbidity:18 Temperature:64
Published pH= 13 Turbidity:219 Temperature:47
high
Published pH= 10 Turbidity:764 Temperature:36
high
Published pH= 11 Turbidity:545 Temperature:88
```



13.2 GIT-HUB LINK:

IBM-EPBL/IBM-Project-4520-1658733854: Real-Time River Water Quality Monitoring and Control System (github.com)

PROJECT DEMO LINK:

https://youtu.be/PZqefcxTthg