REAL-TIME RIVER QUALITY MONITORING AND CONTROL SYSTEM

TEAM ID: PNT2022TMID10977

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INTRODUCTION

1.1 Project Overview:

River Water quality monitoring System Water is one of the major compounds that profoundly influence ecosystem. But, nowadays it is been exploited heavily due to rapid industrialization, human waste and random use of pesticides and chemical fertilizers in agriculture, which leads to water contamination. Thus, a water monitoring system is necessary to observe the water quality in a large area such as lake, river, and aquaculture. As per the current world situation, Internet of Things (IoT) and remote sensing techniques are used in heterogeneous areas of research for supervising, congregate and analyzing data from the remote locations. In this paper, the suggested system is a minimal price real time water quality monitoring system in IoT environment. This system comprise of numerous sensors for assessing the physical and chemical parameter. The factors of water that can be assessed using these sensors are pH, turbidity, conductivity, dissolved oxygen. Using this system the real time quality of water bodies can be determined and the data uploaded over the Internet are analyzed.

1.2 Purpose:

Water quality refers to chemical, physical biological and radio logical characteristics of water. It is a measure of the condition of water relative to the necessities of one or more bio-tic species and or to any human need or purposes .Water quality monitoring is defined as a sampling and analysis of the water in lake, stream, ocean and river and conditions of the water body. Smart water quality monitoring is a process of real-time monitoring and the analysis of water to identify changes in parameters based on the physical, chemical and biological characteristics.Monitoring water quality is clearly important: in our seas, our rivers, on the surface and in our ports, for both companies and the public. It enables us to assess how they are changing, analyze trends and to inform plans and strategies that improve water quality and ensures that water meets its designated use.There are several indicators determining water quality. These include dissolved oxygen, turbidity, bio indicators, nitrates, pH scale and water temperature.Monitoring water quality helps to identify specific pollutants, a certain chemical, and the source of the pollution.There are many sources of water pollution: wastewater from sewage seeping into the water supply; agricultural practices (e.g., the use of pesticides and fertilizer); oil pollution, river and marine dumping, port, shipping and industrial activity. Monitoring water quality and a water quality assessment regularly provides a source of data identify immediate issues – and their source.

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

- Data collected over a period of time will show trends, for example identifying increasing concentrations of nitrogen pollution in a river or an inland waterway. The total data will then help to identify key water quality parameters.
- Environmental planning methods: water pollution prevention and management.
- Collecting, interpreting and using data is essential for the development of a sound and effective water quality strategy. The absence of real-time data will however hamper the development of strategies and limit the impact on pollution control. Using digital systems and programs for data collection and management is a solution to this challenge.
- Monitoring water quality is a global issue and concern: on land and at sea. Within the European Union, the European Green Deal sets out goals for restoring biological biodiversity and reducing water pollution, as well as publishing various directives to ensure standards of water quality. Individual nation states, for example France, have also clear regulatory frameworks requiring the effective monitoring of water quality. In the United States, the Environmental Protection Agency (EPA) enforces regulations to address water pollution in each state. Across the world, countries increasingly understand the importance of effective water quality monitoring parameters and methods.

2. LITERATURE SURVEY

2.1 Existing Problem:

Due to population growth, urbanization ,and climatic change ,competition for water resources is expected to increase, with a particular impact on agriculture, river water. Water will be suitableness to potable water monitoring compound spillage identification done rivers, remote estimation for swimming pools. It holds self-sufficient hubs that unite with the cloud to ongoing water control .The River water needed to be treated before it is used in agriculture feilds,hence the parameters affecting the quality of river-water need to be analysed and to be used for water treatement purpose.

2.2 References:

1. River Water Quality Robot Embedded with Real-Time Monitoring System: Design and Implementation **[Author:** M. A. A. M. Shahrani, S. N. S. Al-Humairi, N. S. M. Puad and M. A. Zulkipli**]**

2. River Water Quality Monitoring and Simulation Based on WebGIS — Anhui Yinghe River as an Example **[Author:** N. Maojing**]**

3. Development and Application of Mobile Water Level Monitoring Based on Multi-sensor Integration. **[Author:** : H. Zhang, W. Tao and M. Cao**]**

4. A demonstration of wireless sensing for long term monitoring of water quality. **[Author:** F. Regan et al**]**

5. Design of IoT-Based River Water Monitoring Robot Data Transmission Model Using Low Power Wide Area Network (LPWAN) Communication Technology **[Author:** R. D. Lestari, A. Rusdinar, M. A. Murti, G. Tawaqal and D. Lee**]**

6. Real Time Wireless Monitoring and Control of Water Systems Using Zigbee 802.15.4 **[Author:** S. Maqbool and N. Chandra **]**

7. Development of a Real-Time Water Quality Buoy for the Fraser River Estuary **[Author :** A. Ethier and J. Bedard**]**

8. Toward a Smart Real Time Monitoring System for Drinking Water Based on Machine Learning **[Author:** D. Jalal and T. Ezzedine**]**

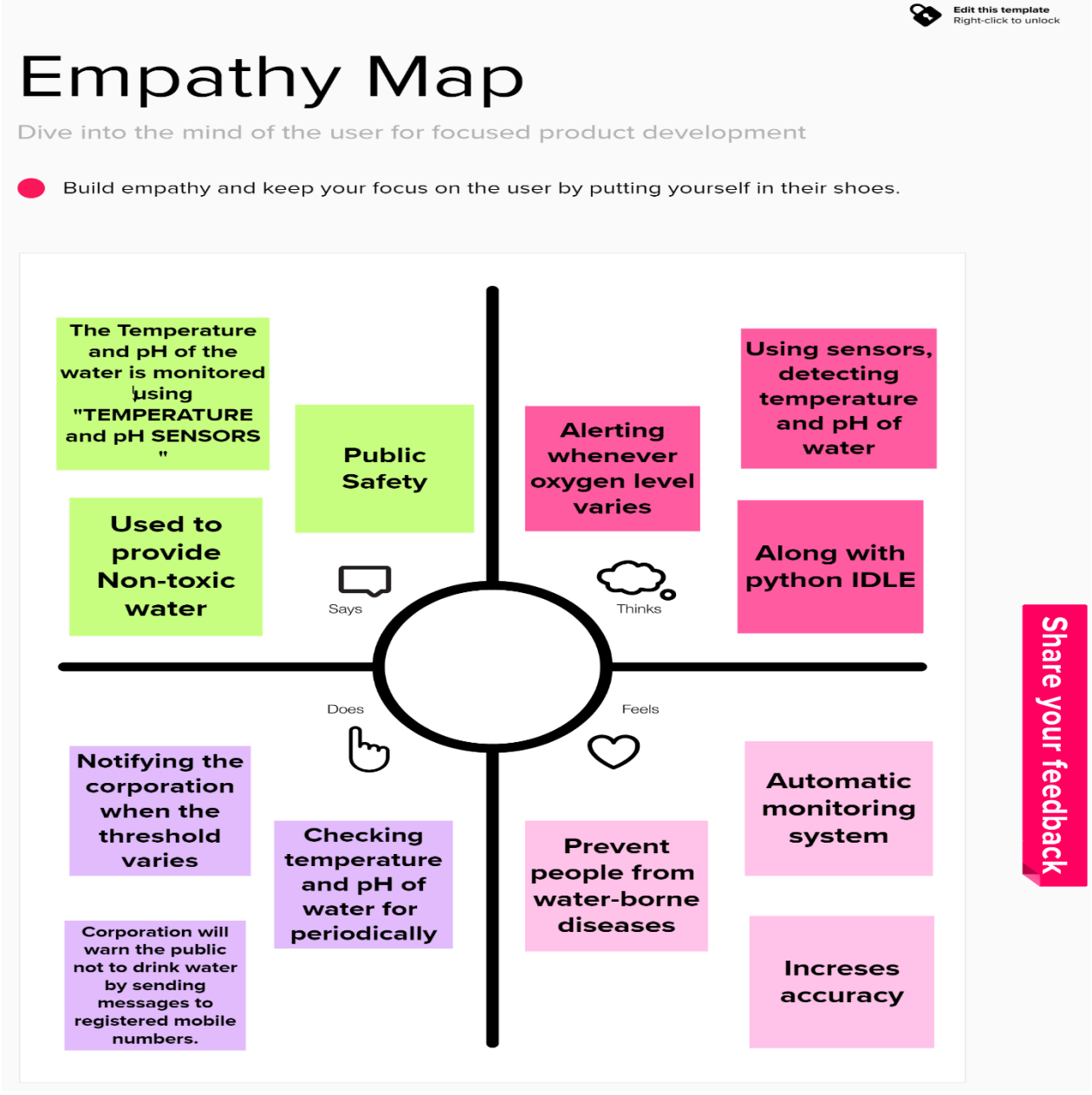
2.3 Problem Statement:

The reduce the river water pollution and to monitor the parameters of river water and control measures can impact vegetation,health. The Real time analysis of Indicators of River water(Ph,salinity,nutrients,etc..,)

IDEATION & PROPOSED SOLUTION

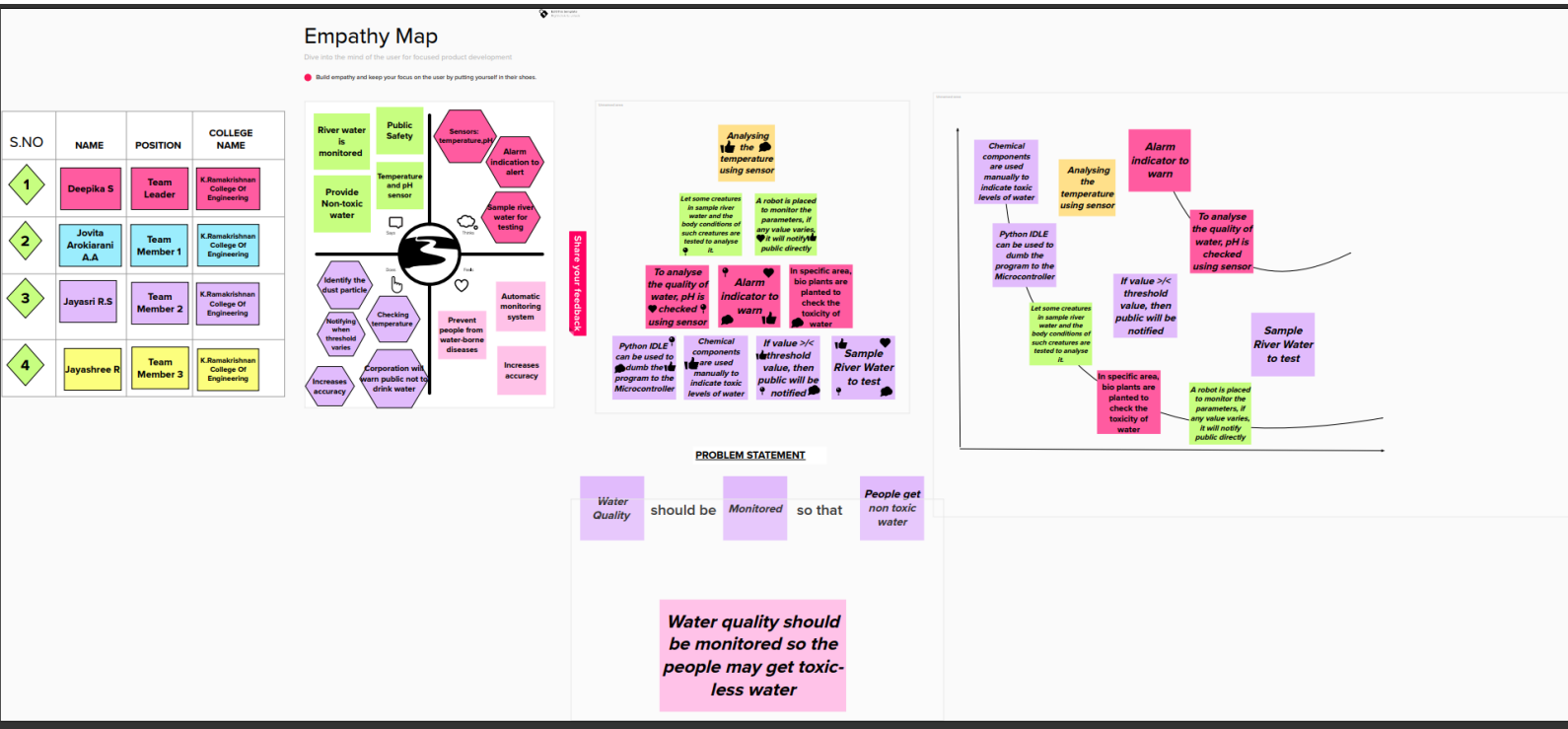
3.1 Empathy Map Canvas:

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes. It is a useful tool to helps teams better understand their users.Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.



3.2 Ideation & Brainstorming:

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions.



3.3 Proposed Solution:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	"Real Time River Water Quality Monitoring and Control System" is an attempt to develop a general sensor and data model for monitoring water quality. The parameters for determining the quality of water are the pH level, turbidity and temperature.
2.	Idea / Solution description	Real-time system was proposed to measure river water quality. With this system, real-time data can be collected from the active site and analysed at a remote server.
3.	Novelty / Uniqueness	The uniqueness of our proposed project is to obtain the water monitoring system with high frequency, high mobility, and low powered.
4.	Social Impact / Customer Satisfaction	It socially help water system managers identify threats to surface water earlier, make more fully informed decisions affecting the systems and the public they serve, and comply with ever-changing regulatory water quality monitoring requirements at federal, state and local levels.
5.	Business Model (Revenue Model)	It helps businesses, as river water is a primary source to drive the economic engines of irrigation and hydropower.
6.	Scalability of the Solution	It has a good scalability because it prevents from infection and provides a healthy life.

3.4 PROBLEM SOLUTION:

Problem-Solution fit canvas 2.0

IOT Based Real time River water quality monitoring and control system

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

Who is your customer?

According to our problem statement, people living in rural areas and so, who uses river water.

6. CUSTOMER CONSTRAINTS CC

What constraints prevent your customers from taking action or limit their choices of solutions?

Only one system is used for specific area and so people may find it hard to recover if any fault occurs, as we used sensors to detect temperature and pH.

5. AVAILABLE SOLUTIONS AS

Which solutions are available to the customers when they face the problem need to get the job done? What have they tried inthe past? What pros & cons do these solutions have?

Eventhough the individual notifications to each people could not be sent, the system will still notify the corporation and they can further notify the people.

Explore AS, differentiate

Focus on J&P, tap into

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

Which jobs to be done (or problems) do you addressfor your customers?

The river water quality monitoring system checks the temperature and pH of the water periodically and notifies the public when the quality of the water varies.

9. PROBLEM ROOT CAUSE RC

What is the real reason that this problem exists? What is the back story behind the need to do this job?

As we know sensors are bit costly and our system needs more than one sensors to work. The sensors are used periodically to check the quality of the water and might need to be replaced frequently.

7. BEHAVIOUR BE

What does your customer do to address the problem andget the job done?

The customer could use the user guide provided to overcome the problem or else they can report and contact the corporation. They will take care of the problem.

Focus on J&P, tap Int C

Identify strong TR & EM

3. TRIGGERS TR

What triggers customers to act? i.e. seeing their neighbour installing

For Example : If certain area people start using this quality monitoring system and so they are staying healthy without any water borne diseases, it will trigger the other area people start using it.

4. EMOTIONS: BEFORE / AFTER EM

How do customers feel when they face a problem or ajob and afterwards?

The customers might feel hard first, we will guide them with a user guide and they will find it easy to use.

10. YOUR SOLUTION SL

If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality.
If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.

Our Solution is to check the quality of the river water periodically using two sensors. The parameters like temperature and pH of the river water is monitored and alerts when any changes in the parameters occus.

8. CHANNELS of BEHAVIOUR CH

8.1 ONLINE

What kind of actions do customers take online?

If it is in online mode, they can use the helpline number to contact the authorities.

8.2 OFFLINE

What kind of actions do customers take offline?

If it is in offline mode, the customers can directly reach the corporation office and report the problem.

Extract online & offline CH of BE

AMALTAMA

4 REQUIREMENT ANALYSIS

4.1 Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Requirement	River Water Protection using pH and Humidity
FR-2	User Registration	Registration through Form Registration through Email Registration through Linkedin
FR-3	User Confirmation	Confirmation Via Email Confirmation Via OTP Confirmation Via SMS
FR-4	Payment Options	Credit,Debit and ATM Card Cash on delivery UPI/QR Code
FR-5	Product Delivery and Installation	Free Installation
FR-6	Product Feedback	Through GoogleForm Through WebPage

4.2 Non-functional Requirements:

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

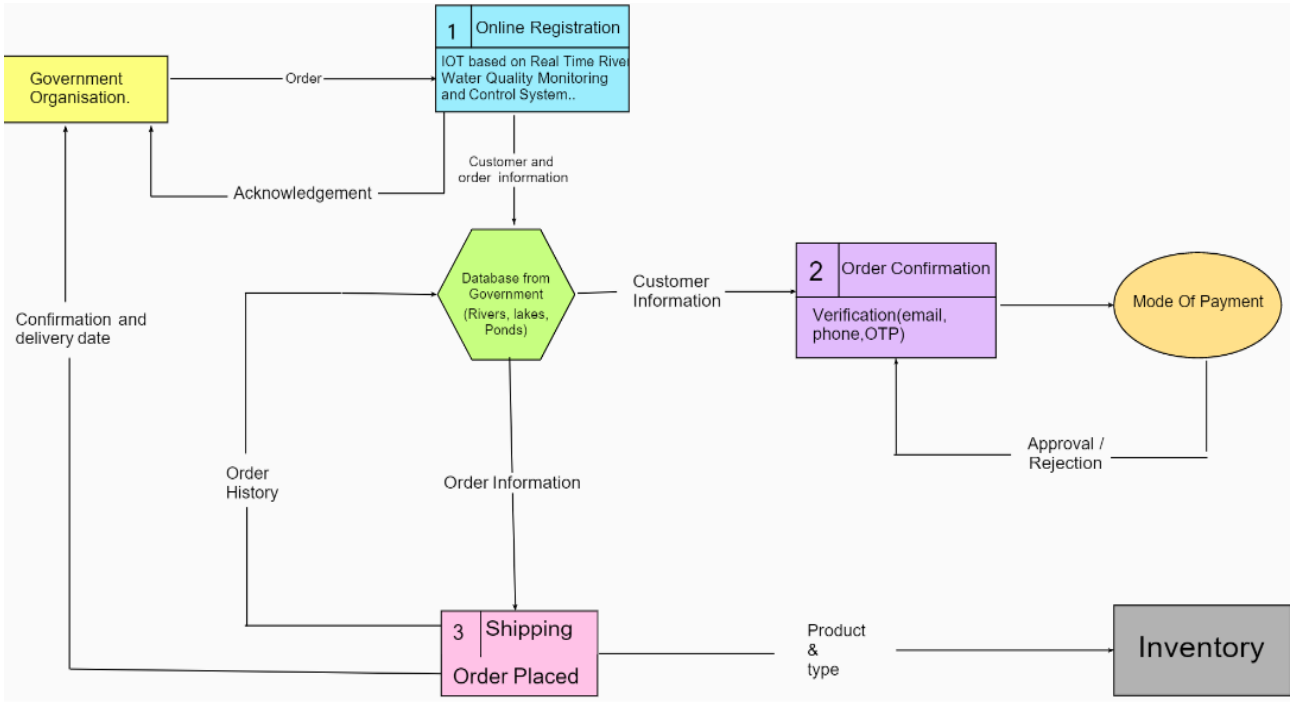
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Monitoring provides the objective evidence necessary to make sound decisions on managing water quality today and in the future
NFR-2	**Security**	It is secured for the customer as the quality of water is detected frequently.
NFR-3	**Reliability**	The customer could use the userguide provided to overcome the problem or else they can contact the corporation.
NFR-4	**Performance**	Used to detect the quality of water in frequent intervals.
NFR-5	**Availability**	When it fails to alert every individual we have sent a notification to the corporation which alerts the entire region.

NFR-6	**Scalability**	It has a good scalability because it prevent the people from diseases.

5 PROJECT DESIGN

5.1 Data Flow Diagrams:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.



5.2 SOLUTION AND TECHNICAL ARCHITECTURE

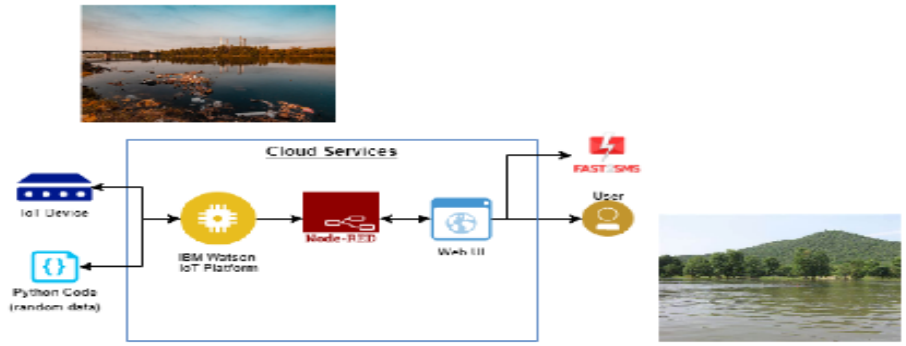
Summary

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

Flow

- Feed the data received from the Sensor unit which are placed in the river sides.
- The collected data will be displayed in the Web page to the user.
- Then the collected data is sent to the data base, where the collected data and the predefined data are checked and monitored.
- If any data exceed the predefined data then the control signal will send to the Admin.
- The collected data will be stored in the IBM cloud storage.
  Later the data will be controlled by the admin via UI.

SOLUTION ARTCHITECTURE DIAGRAM :



IOT BASED REAL TIME RIVER WATER
QUALITY MONITORING AND CONTROL SYSTEM.

5.3 CUSTOMER JOURNEY MAP

Customer Journey Map

PHASES	Motivation	Parameters Checking	Alerts the authorit -ies	Notification sent to public	Feedback
Actions	Monitors the temperature and pH of river water	Detects the level of the temperature and pH	Notifies the authorities with the detected levels.	Also notifies the public through SMS to registered number.	Given as rating to the authority.
Touchpoints	The customers feel excited	After installation,the corporation don't need to monitor.	The public no need to be concerned about toxic water	After this, public will be given healthy water to drink.	Best and can be trustful.
Customer Feeling					
Emotions	Motivated to be healthy with non-toxic water.	Corporation feels it will take longer duration.	Satisfied because of healthy culture.	Feel relieved to drink non-toxic water.	User Friendly.
Overall Experiences	Excellent	Average	Good	Good	Very good

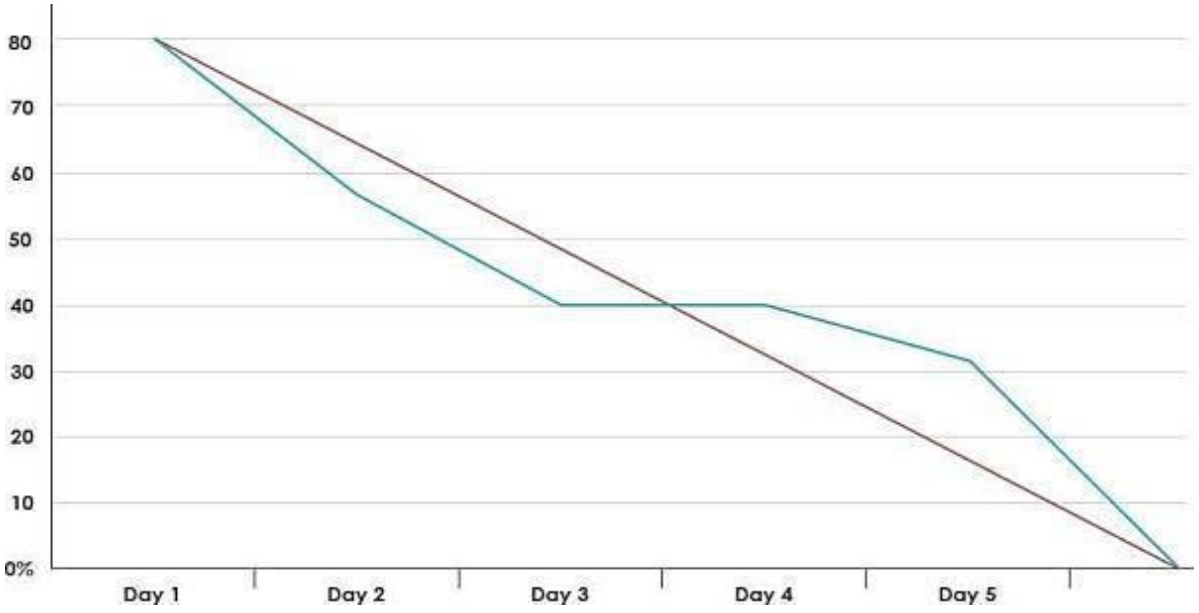
6.PROJECT PLANNING PHASE

TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	A literature review is a comprehensive summary of previous researches on the topic. The literature review surveys scholarly articles, books, and other sources relevant to a particular area of research.	03 SEPTEMBER 2022
Empathy Map	An empathy map is a collaborative tool teams can use to gain a deeper insightinto their customers. It helps us to understand the customer's pain, gain and difficulties from their point of view.	10 SEPTEMBER 2022
Ideation	Brainstorming is a group problem-solving method that helped us to gather and organize various ideas and thoughts from teammembers.	17 SEPTEMBER 2022
Proposed Solution	It helped us analyze and examine our solution more in the grounds of uniqueness, social impact, business model, scalability etc.	26 SEPTEMBER 2022
Problem Solution Fit	It helped us understand and analyze all the thoughts of our customer, their choice of options, problems, root cause,behaviour and emotions.	28 SEPTEMBER 2022

Velocity:

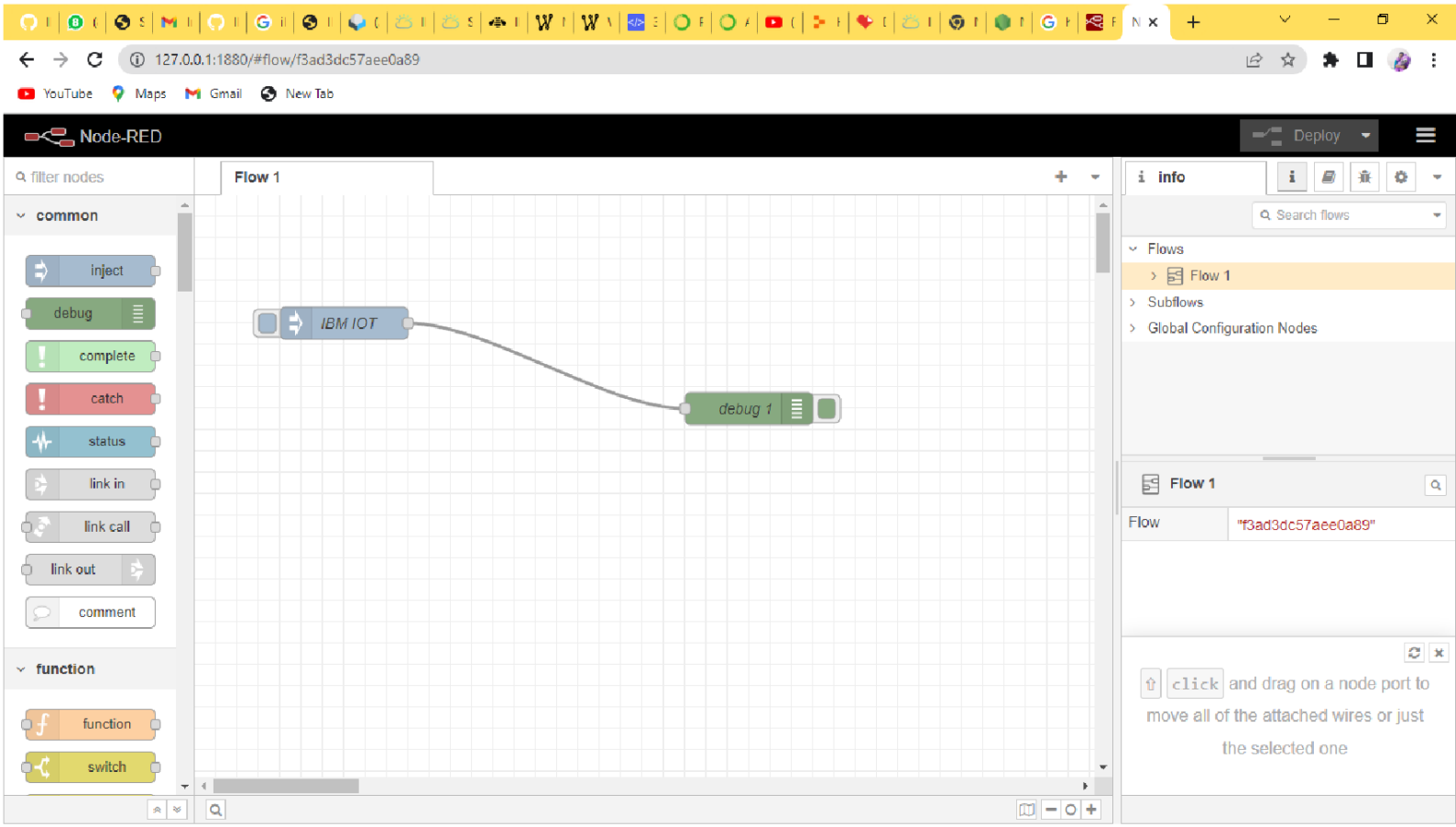
$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

Burndown Chart:



9. CODING AND SOLUTIONING

7.1 NODE RED SERVICE ASSOCIATED WITH IBM CLOUD:



08.TESTING

8.1Test Case Analysis

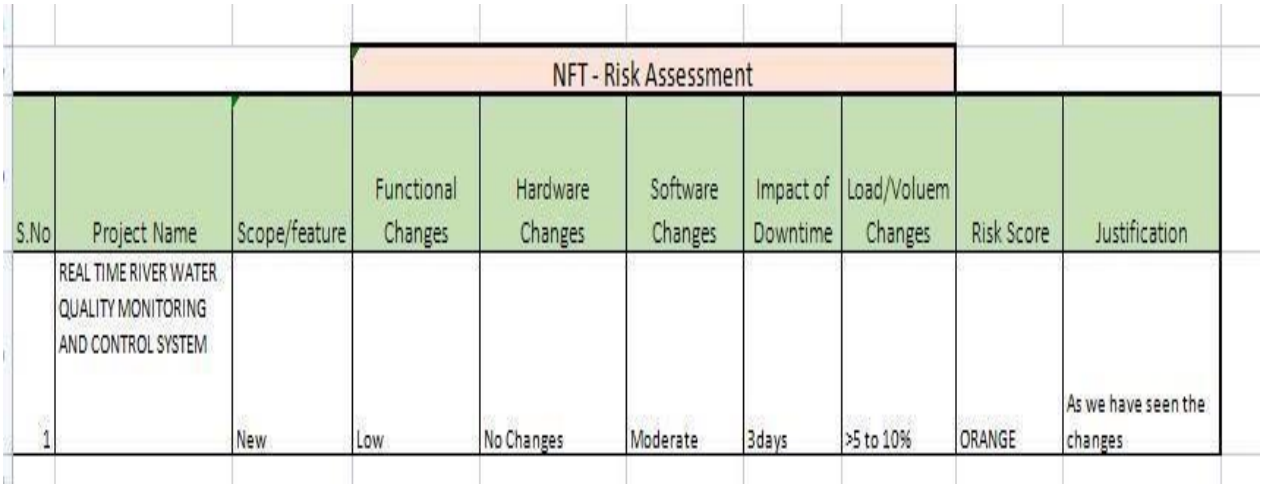
This report shows the number of test cases that have passed, failed, and untested

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

Test case id	Feature	Component	Test Scenario	Steps to Execute	Test Data	Actual Result	Status
Login page	Functional	Home page	Verify user is able to see the Given app	1. Download the given APK File 2. Click on download button 3. Verify login popup displayed or not"	APK File	Working as expected	Pass
Login page	Functional	Home page	Verify user is able to see the Login/Signup popup when user open the Aqua Meter	1. Download the given APK File 2.Click on download button 3.Verify login popup displayed or not"	APK File	Working as expected	Pass
Login page	Functional	Home page	Verify the UI elements in Login/Signup popup	1. Download the given APK File 2.Click on download button 3.Verify login popup with below UI elements: A .Username text box A .password text box B .Submit button	APK File	Working as Expected	Pass
Login Page	Functional	Home page	Verify user is able to log into application with Valid credentials	"1 Download the given APK File 2. Click on download button 3. Enter Valid “Given “ username in Username text box 4. Enter valid password in password text box 5. Click on Submit button"	Username: Username Password: Password	Working as Expected	Pass
Login Page	Functional	Home page	Verify user is able to see the output	1. output displayed	APKFile	Working as Expected	Pass

9. RESULT

9.1 PERFROMANCE 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 AND CONTROL SYSTEM	New	Low	No Changes	Moderate	3days	>5 to 10%	ORANGE	As we have seen the changes

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

10. ADVANTAGES AND DISADVANTAGES

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 phone 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 softwareprograms, 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 too.The scalabilty 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 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 lab view to monitor data on computers.

13. APPENDIX

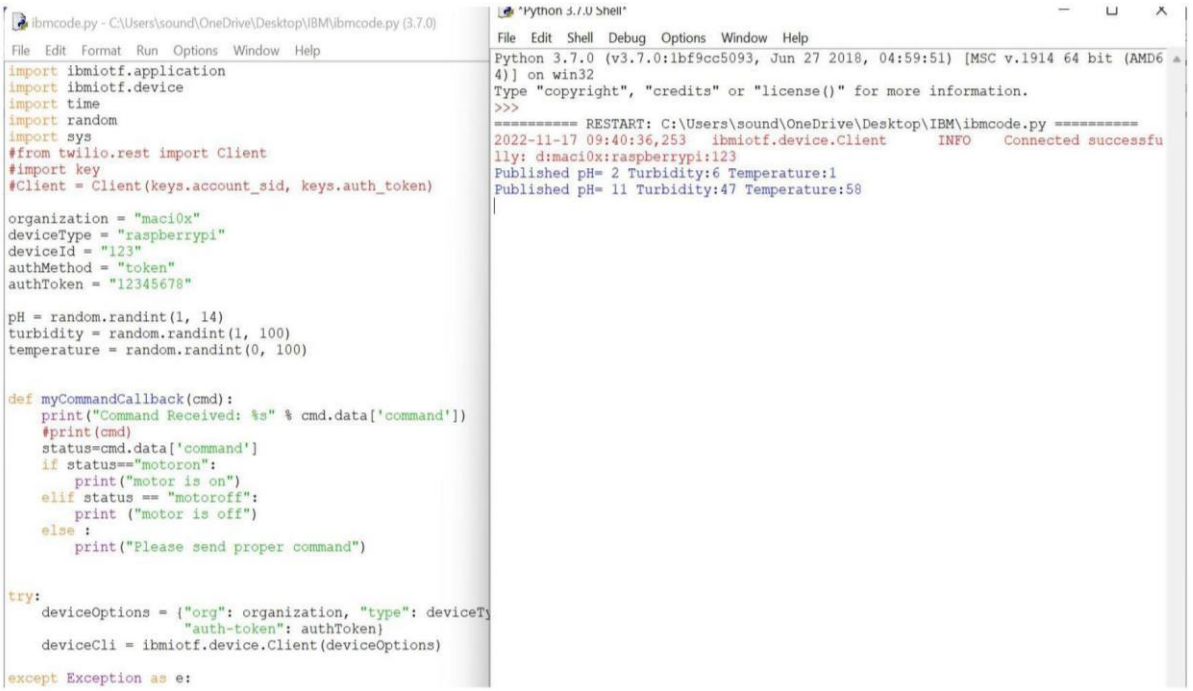
13.1 SOURCE CODE:

PYTHON CODE TO PUBLISH DATA

```
import ibmiotf.applicationimport
ibmiotf.device import time
import randomimport sys
#from twilio.rest import Client#import key
#Client = Client(keys.account_sid, keys.auth_token)

organization = "maci0x" deviceType =
"raspberrypi"deviceId = "123" authMethod =
"token" authToken = "12345678"

pH = random.randint(1, 14) turbidity =
random.randint(1, 100)
temperature = random.randint(0, 100)


def myCommandCallback(cmd):
    print("Command Received: %s" % cmd.data['command'])#print(cmd)
    status=cmd.data['command']if
    status=="motoron":
        print("motor is on") elif status ==
```

```
        "motoroff":
            print ("motor is 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(1, 14) turbidity =
    random.randint(1, 100)
    temperature = random.randint(0, 100)

    data = {'pH': pH, 'turbid': turbidity, 'temp': temperature}


    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



ibmcode.py - C:\Users\sound\OneDrive\Desktop\IBM\ibmcode.py (3.7.0)

File Edit Format Run Options Window Help

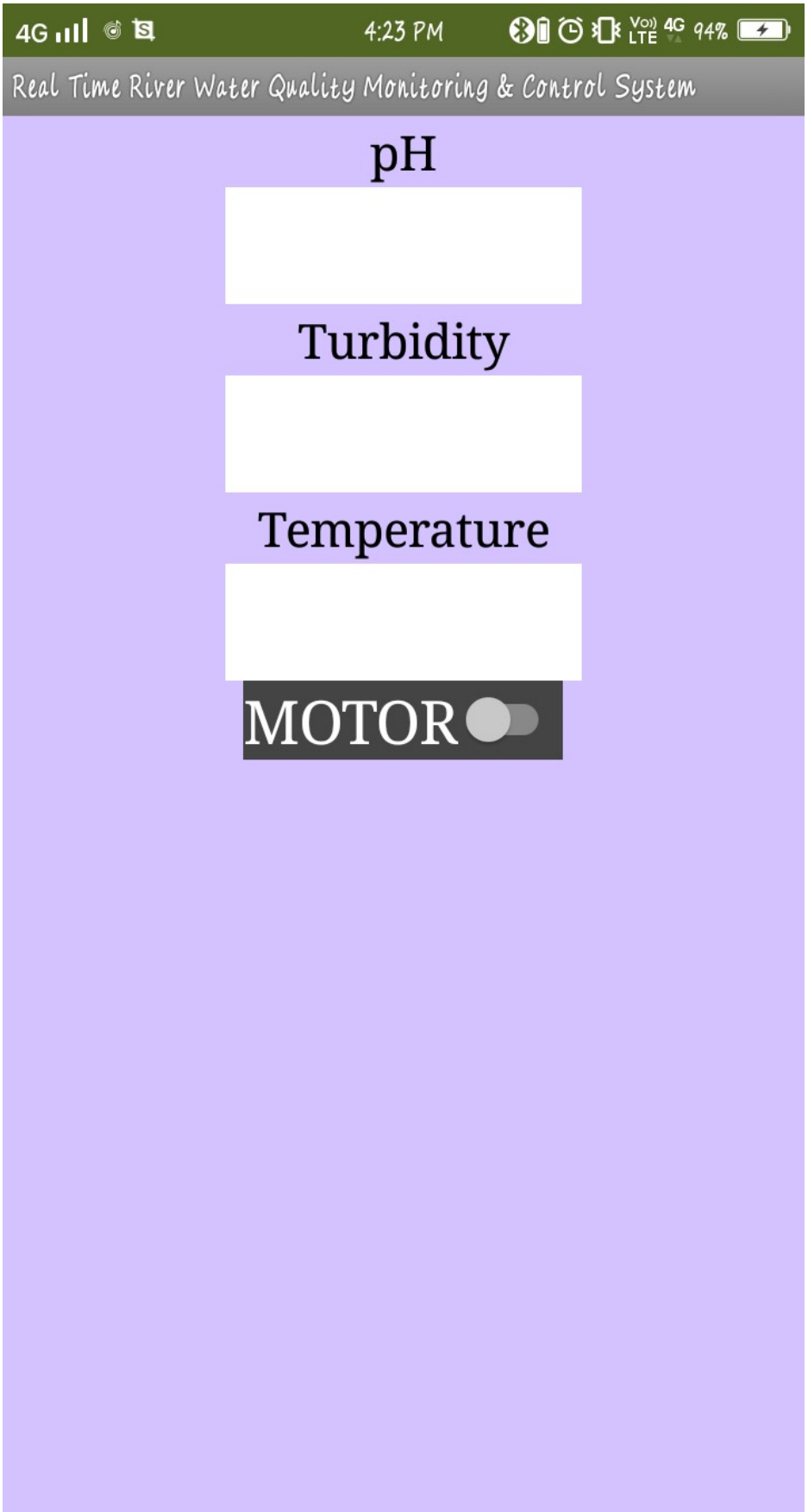
```
import ibmiotf.application
import ibmiotf.device
import time
import random
import sys
#from twilio.rest import Client
#import key
#Client = Client(keys.account_sid, keys.auth_token)

organization = "maci0x"
deviceType = "raspberrypi"
deviceId = "123"
authMethod = "token"
authToken = "12345678"

pH = random.randint(1, 14)
turbidity = random.randint(1, 100)
temperature = random.randint(0, 100)


def myCommandCallback(cmd):
    print("Command Received: %s" % cmd.data['command'])
    #print(cmd)
    status=cmd.data['command']
    if status=="motoron":
        print("motor is on")
    elif status == "motoroff":
        print ("motor is off")
    else :
        print("Please send proper command")


try:
    deviceOptions = {"org": organization, "type": deviceTy
                     "auth-token": authToken}
    deviceCli = ibmiotf.device.Client(deviceOptions)

except Exception as e:
```

Python 3.7.0 Shell

File Edit Shell Debug Options Window Help

```
Python 3.7.0 (v3.7.0:1bf9cc5093, Jun 27 2018, 04:59:51) [MSC v.1914 64 bit (AMD6
4)] on win32
Type "copyright", "credits" or "license()" for more information.
>>>
========== RESTART: C:\Users\sound\OneDrive\Desktop\IBM\ibmcode.py ==========
2022-11-17 09:40:36,253   ibmiotf.device.Client      INFO    Connected successfu
lly: d:maci0x:raspberrypi:123
Published pH= 2 Turbidity:6 Temperature:1
Published pH= 11 Turbidity:47 Temperature:58
```

MOBILE APP:


4G
4:23 PM
94%
Real Time River Water Quality Monitoring & Control System
pH
Turbidity
Temperature
MOTOR

13.2 GIT-HUB LINK:

https://github.com/IBM-EPBL/IBM-Project-6161-1658824099