PROJECT REPORT

REAL-TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM

TEAM ID: PNT2022TMID07524

TEAM MEMBERS

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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. **Smart water quality Monitoing System [Author:** Mr. Kumar K**]**

2. **Real Time Water Quality Monitoring and Management [Author:** Deepika gupta**]**

3.The Monitoring of Water Quality in IOT Environment [Author: Anuadha T**]**

4.IOT Based Real time River Water Quality Monitoring System [Author: Elsevier B.V**]**

5.Smart Portable Water Monitoring [Author: Okoli Chinedu David**]**

6. Intelligent System for Monitoring and Detecting Water Quality [Author: Jamal Mabrouki**]**

2.3 Problem Statement:

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

- The chemicals and other industrial effluents from the industries along the river side pollute the river water.Though advanced techniques to treat the chemicals are being adopted some are still violating the environment safety standards.
- High population density around the river banks and the reckless dumping of non-biodegradable waste, especially plastics, is further adding to water pollution.
- All these degrades the water quality making it unfit for consumption and also disturbing the life in water.

Project Title: Real Time River water Quality Monitoring and Control System

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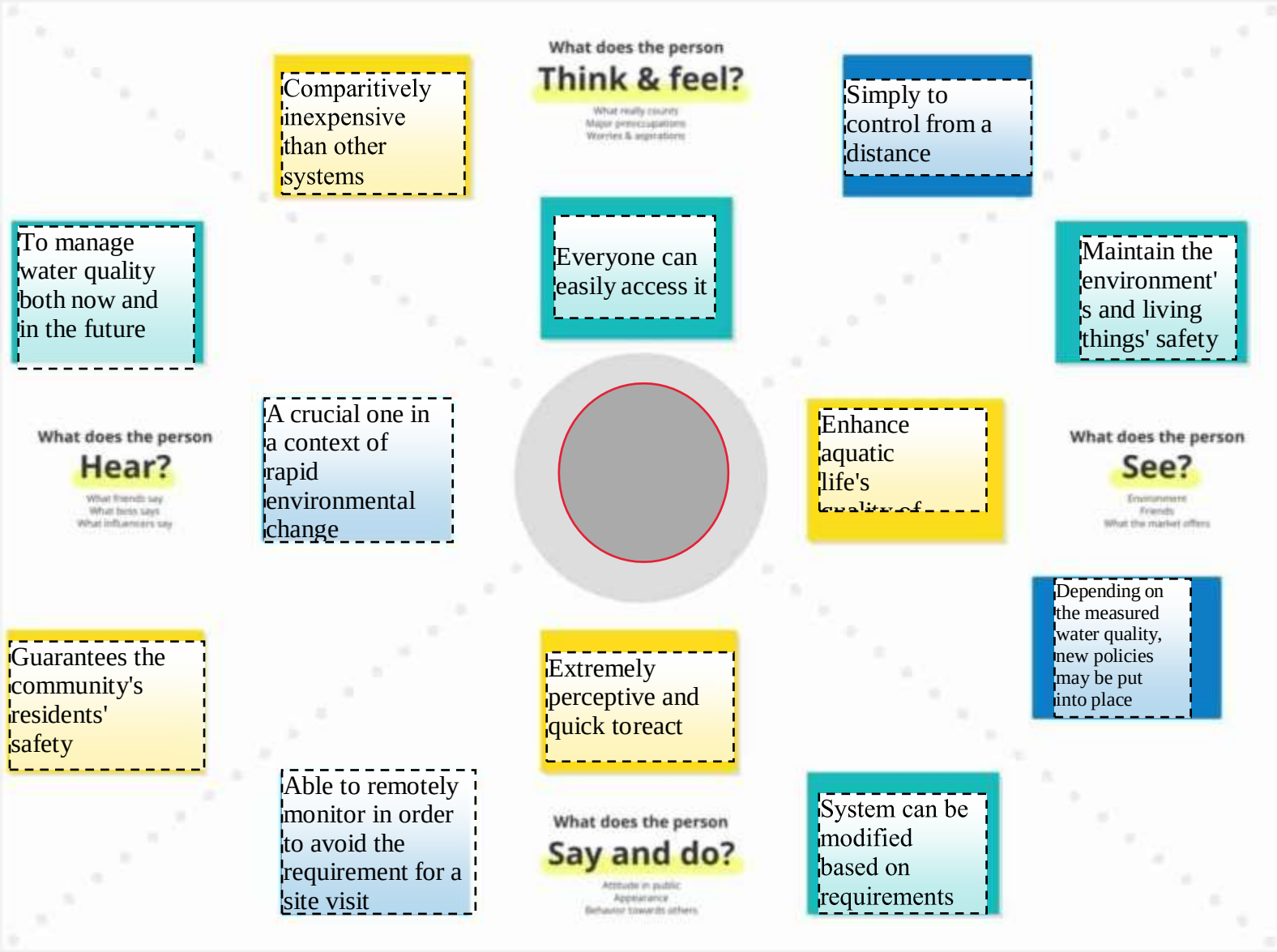
CUSTOMER EMPATHY MAP

Identify your customer and create a great product, service or design
Learn more at https://conceptboard.com/blog/create-a-...



Pain

Fears
Frustrations
Obstacles

Since the system is computer-based ,occasionally problemsmay be brought on by software or server problems. If the sensors are damaged in any way, they must be repaired or replaced. Periodic site monitoring is needed to verify that

Gain

Wants/Needs
Measures of Success
Obstacles

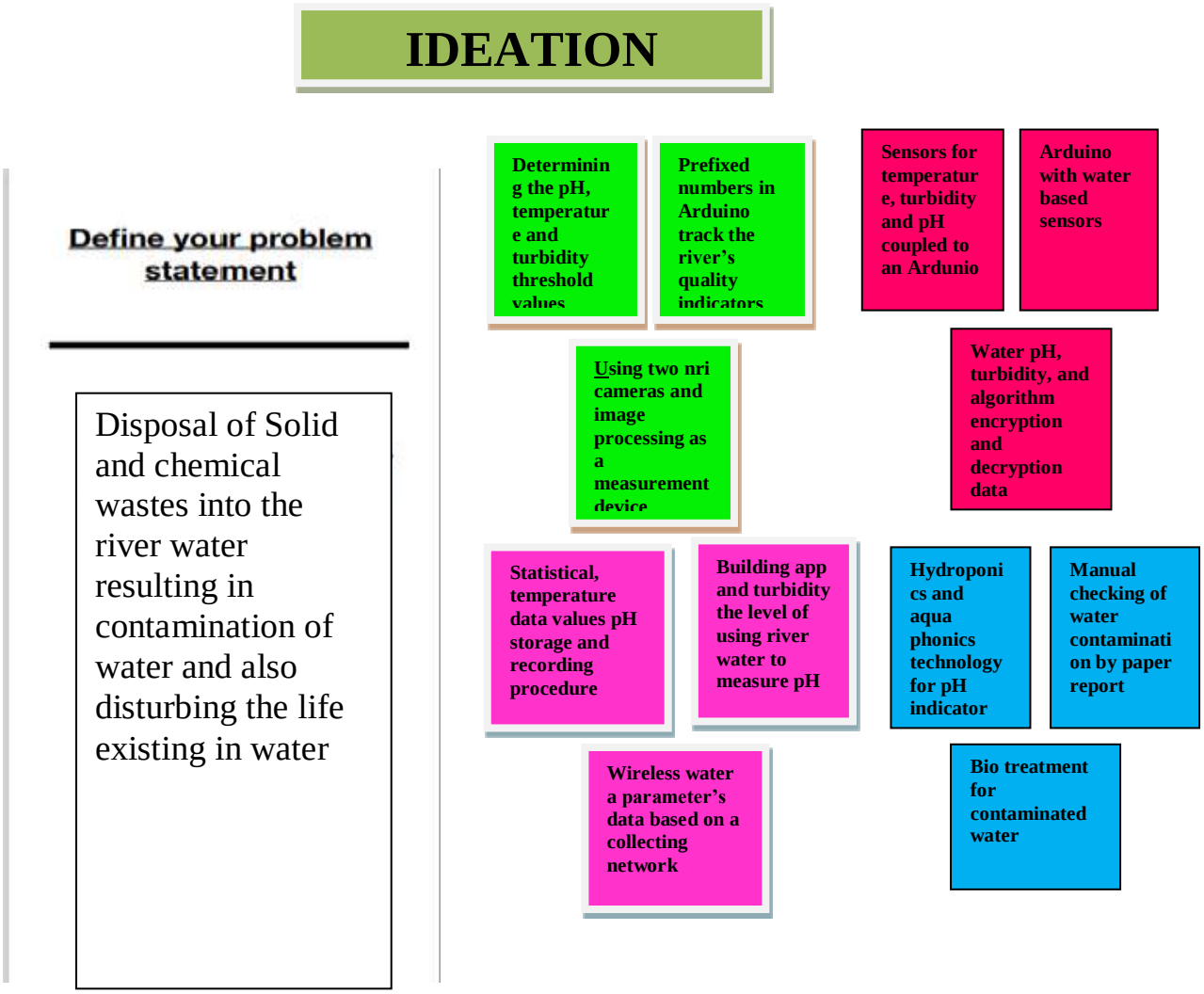
It can lower the chance of contractinginfections originating in water and it also determines how well the water is. Remote water quality testing allows authorities to

Source: XPLANE.com

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.

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.



3.3 Proposed Solution:

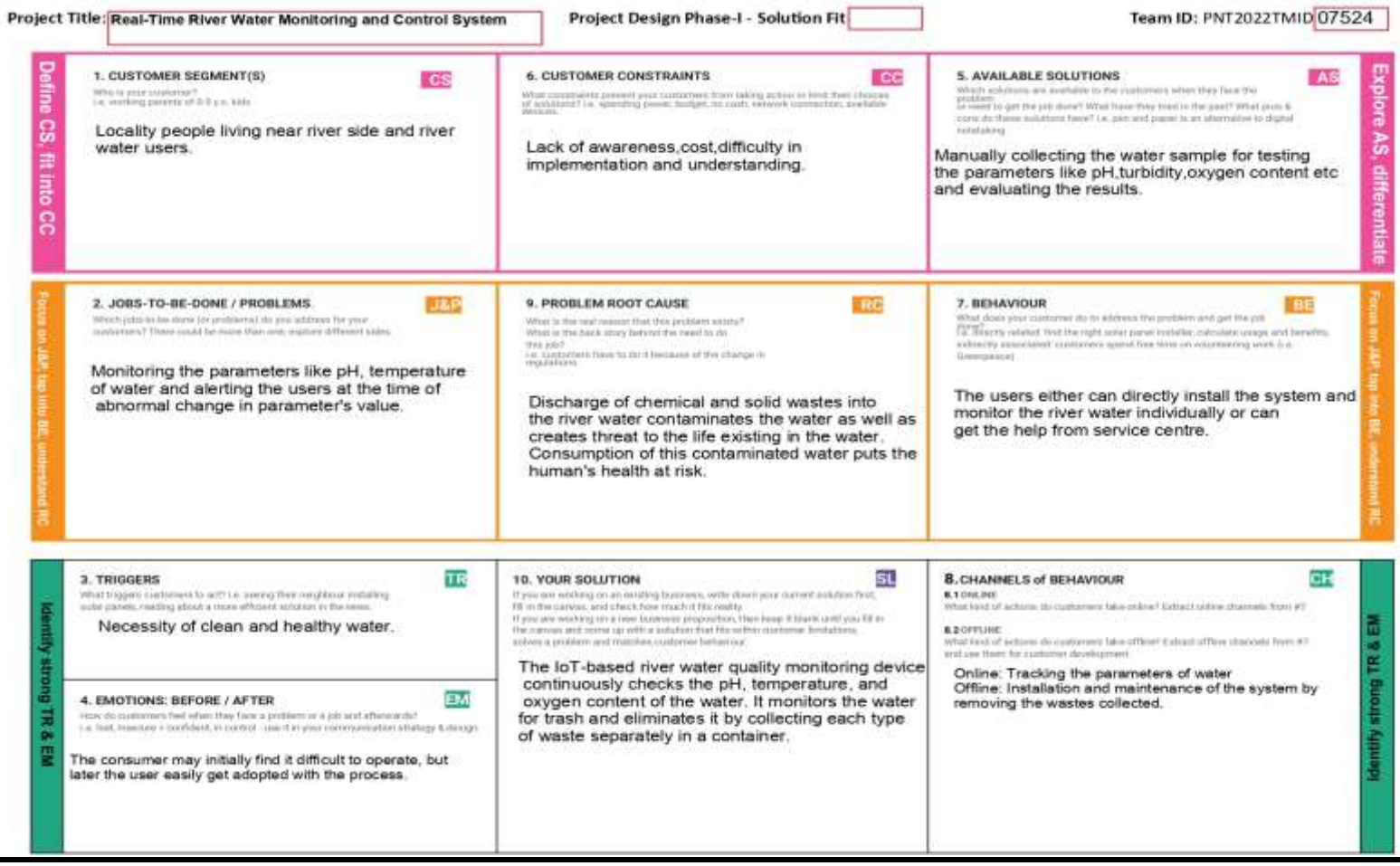
S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Pollution of water is one of the main threats in recent times as drinking water is getting contaminated and polluted. The polluted water can cause various diseases to humans and animals, which in turn affects the life cycle of the ecosystem. If water pollution is detected in an early stage, suitable measures can be taken and critical situations can be avoided. To make certain the supply of pure water, the quality of the water should be examined in real-time. Smart solutions for monitoring of water pollution are getting more and more significant these days with innovation in sensors, communication, and Internet of Things (IoT) technology. In this paper, a detailed review of the latest works that were implemented in the arena of smart water pollution monitoring systems is presented. The paper proposes a cost effective and efficient IoT based smart water quality monitoring system which monitors the quality parameters uninterruptedly. The developed model is tested with three water samples and the parameters are transmitted to the cloud server for further action.
2.	Idea / Solution description	An assembled Arduino microcontroller is used as the core controller of the system. Once the code is uploaded to the microcontroller, no PC system, keyboard command, monitor is required to operate the system.The system functions automatically and independently according to the code uploaded to the microcontroller. In this system, three sensors are used to measure the essential water parameters. As it was studied from the previous researches, the most essential water parameters needed to be monitored by the average users are water pH level,

		water turbidity (cloudiness) and water temperature which is a measurement of the amount of the water in a container.Therefore, four essential water parameters which are temperature, pH level and turbidity can be measured by this proposed system. Sensors circuits are connected to the microcontroller and the probes of the turbidity, pH, and temperature sensors placed inside the water.A water proof temperature sensor is used to avoid any damage or electrical shock to the system and the user. An ultrasonic sensor is used to measure the level of the water in thecontainer. The ultrasonic sensor is connected in the system such that it will be placed on the top of the water container.The ultrasonic sensor sends electromagnetic waves to the water surface and receives the wave back after touched the water surface. From the time taken to send and receive the wave by the ultrasonic sensor and the velocity of the electromagnetic waves, the distance which shows the water level in the container is calculated by the microcontroller.All sensors read the water quality parameters and send the data to the microcontroller in the form of electrical signals.The microcontroller is programmed such that is will analyze the result and compare it with the standard ranges which are predetermined in the code. If any water parameter crossed the standard limit, the alarm system will turn on.In case of any abnormality in a water parameter detected by the microcontroller, the buzzer will buzz to indicate that the water is not proper for use. To show the sensor readings (The water parameters) on the device itself, an LCD (Liquid Crystal Display) screen is used. The LCD screen is connected to the microcontroller, and through the wired connection, it receives the sensor readings from the microcontroller and displays them accordingly.

3.	Novelty / Uniqueness	• To measure various chemical and physical properties of water like pH, temperature and particle density of water using sensors. • Send the data collected to a Raspberry Pi, show the data in display and send it to a cloud based Database using Wired/Wireless Channel. • Trigger alarm when any discrepancies are found in the water quality. • Data visualization and analysis using cloud based visualization tools.
4.	Social Impact / Customer Satisfaction	The main objectives of this research were to assess the level of customer satisfaction on urban water supply services of Southern Region, Ethiopia, and identify major determinants. Quantitative data were collected from 8,413 customers in seventeen towns, using a questionnaire based on the SERVQUAL model. Qualitative data were collected from customers via focus group discussion, and interviews were used with utility employees and officials. The results showed 47% of customers were satisfied with the water supply enterprise services, while 43% were dissatisfied for various reasons. The customer satisfaction score was below the acceptable level for all service quality dimensions, and understanding of customers, communication, and responsiveness were far below the benchmark. The correlation analysis revealed the existence of a monotonic, positive relationship between customers' total satisfaction and service quality dimensions. The proportional odds model indicated that total customer satisfaction was highly dependent on the nine service quality dimensions used in this research.
5.	Business Model (Revenue Model)	• We can sell this technology to the industries and also to the small scale and large scale industries to develop their industrial security and wellness.

		• We can also provide it as a service based to earn money out of it. • For example we may offer our services to the company as a contract for a period of time to make revenue.
6.	Scalability of the Solution	The scalability on this model is high as there are involves more demand on safety and security of workers and the companies too.so, the danger the losses caused are get reduced by this system. And we need lesser man power to work with this kind of activities

3.4 PROBLEM SOLUTION:



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 Registration	Registration through Form Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	pH level detection	Using the pH sensor the pH level of water is monitored and signals is sent to Arduino
FR-4	Temperature detection	Signals from the temperature sensor is set to Arduino for temperature detection
FR-5	Turbidity detection	Measure the cloudiness of water using turbidity sensor and signals are sent to Arduino

4.2 Non-functional Requirements:

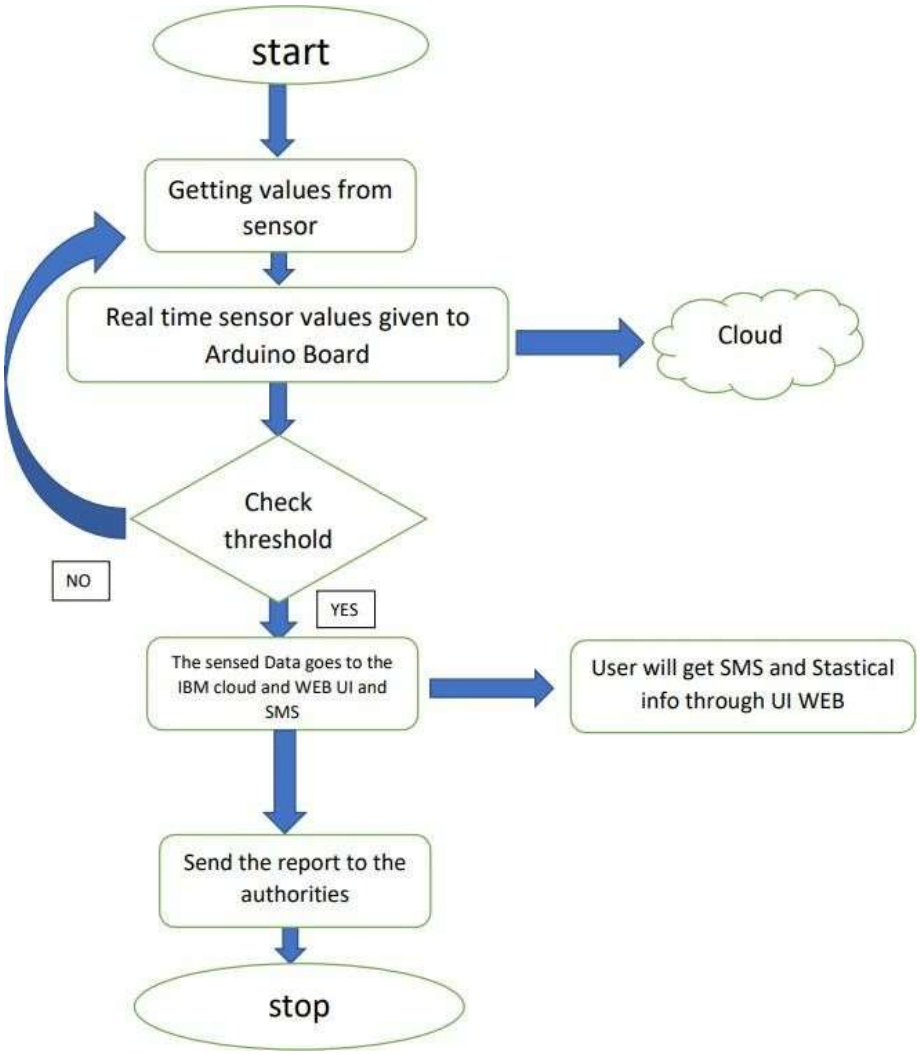
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	System is used to monitor the water parameters and alert the user according to the collected data
NFR-2	**Security**	Mobile application is secured from external threats by using credentials so that respective user alone can access.
NFR-3	**Reliability**	The sensed values are stored and compared with standard values and provides efficient output to users. No damage to the environment is caused.
NFR-4	**Performance**	The response of the system is fast as it immediately alerts the user about the water condition and eco-friendly model
NFR-5	**Availability**	The information of monitoring system is made available 24x7 through mobile application
NFR-6	**Scalability**	The system is capable in producing optimised output
NRF-7	**Efficiency**	It is a low powered and highly efficient system

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.

Components & Technologies:

S.No	Component	Description	Technology
1.	Received data from sensors	The information gathered from the sensor units installed along rivers	ESP32 wifi module
2.	Web interface	The gathered information was presented visually	HTML,CSS, javascript
3.	database	Datatype	MySQL
4.	Cloud database	Cloud database service	IBM cloud
5.	Data storage	Storage needs for files	IBM Block storage

Application Characteristics:

S. No	Characteristics	Description	Technology
1.	PH level monitoring	By putting sensors in rivers, it is possible to check the pH level of the water there.	PH-sensor
2.	Temperature monitoring	You can check the temperature of river water	Temperature sensor
3.	Pollution monitoring	It is possible to check the purity and clarity of river water	Conductive sensor

5.3 User Stories

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

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 byentering my email, password, and confirming my password.	2	High	Aparna J
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	Diviya T
Sprint-2		USN-3	As a user, I can register for the application through Facebook	2	Low	Nishanthini S
Sprint-1		USN-4	As a user, I can register for the application through Gmail	2	Medium	Diviya T
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	Abinaya S

6. PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING & SCHEDULING:

TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by referring the, technical papers,research publications etc.	10 OCTOBER 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements	10 OCTOBER 2022
Ideation	List the by organizing the brainstorming session and prioritize the top 3 ideas basedon the feasibility & importance.	15 OCTOBER 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	16 OCTOBER 2022
Problem Solution Fit	Prepare problem - solution fit document.	16 OCTOBER 2022
Solution Architecture	Prepare solution architecture document.	16 OCTOBER 2022

6.1SPRINT DELIVERY SCHEDULE

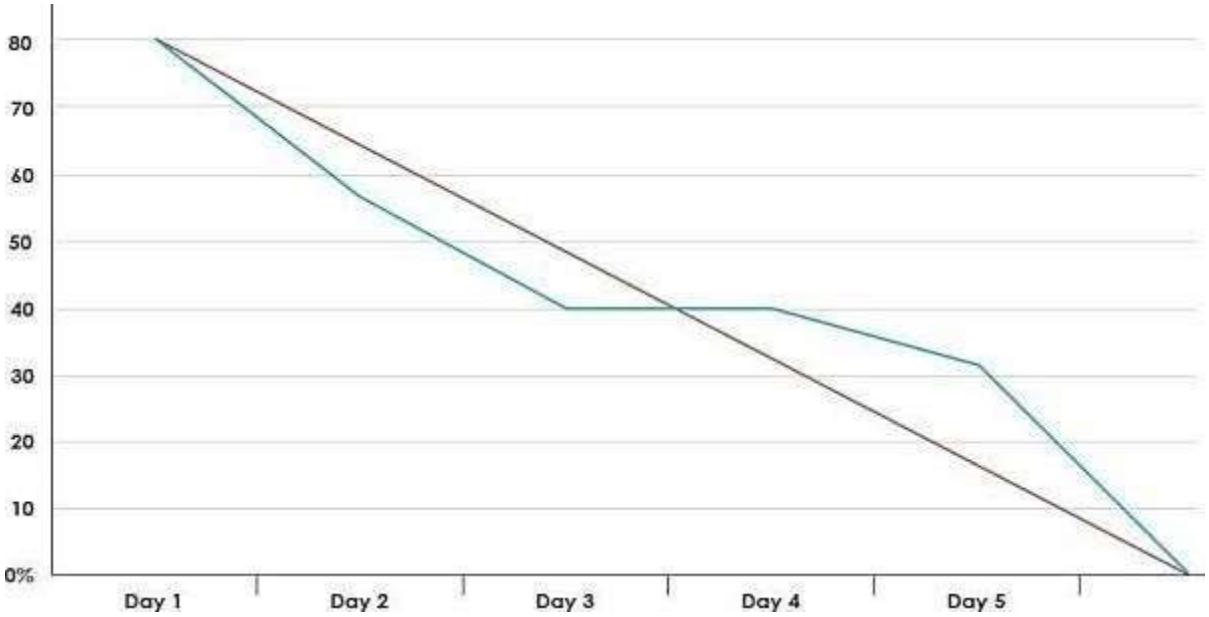
Product Backlog, Sprint Schedule, and Estimation

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	49	06 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	50	07 Nov 2022

Velocity:

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

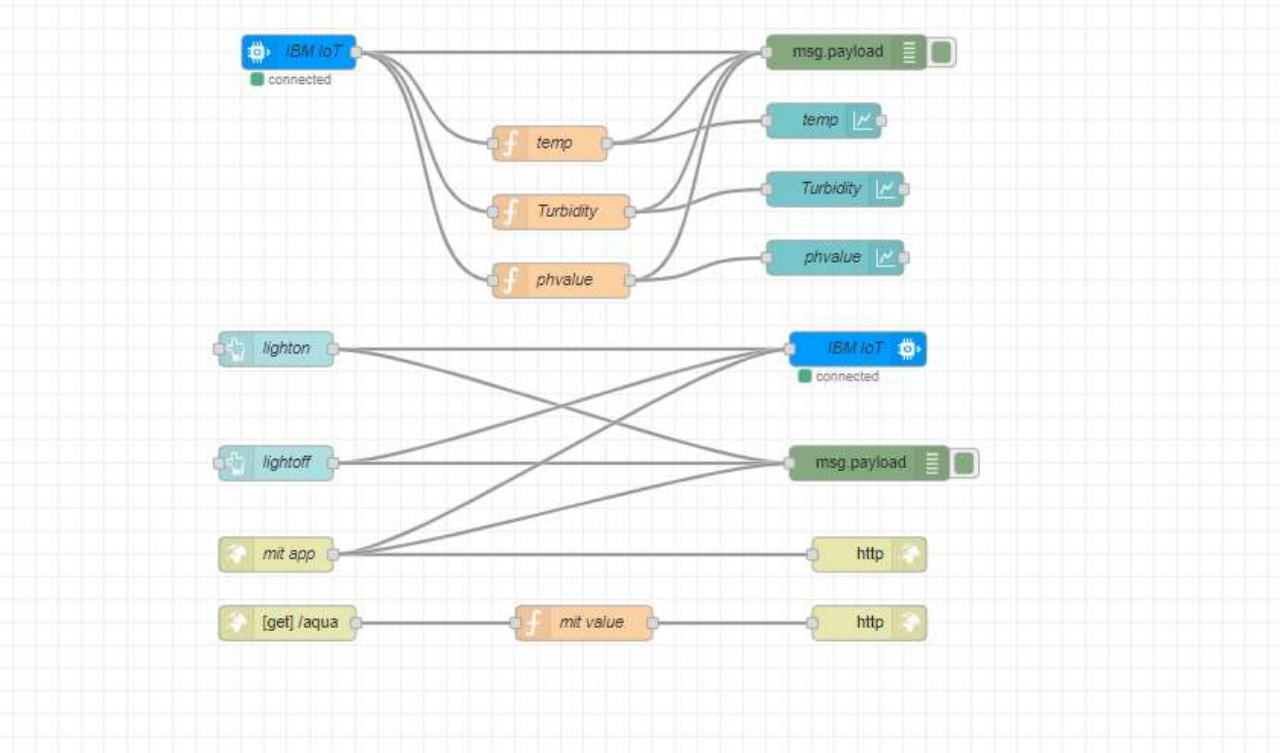
Burndown Chart:



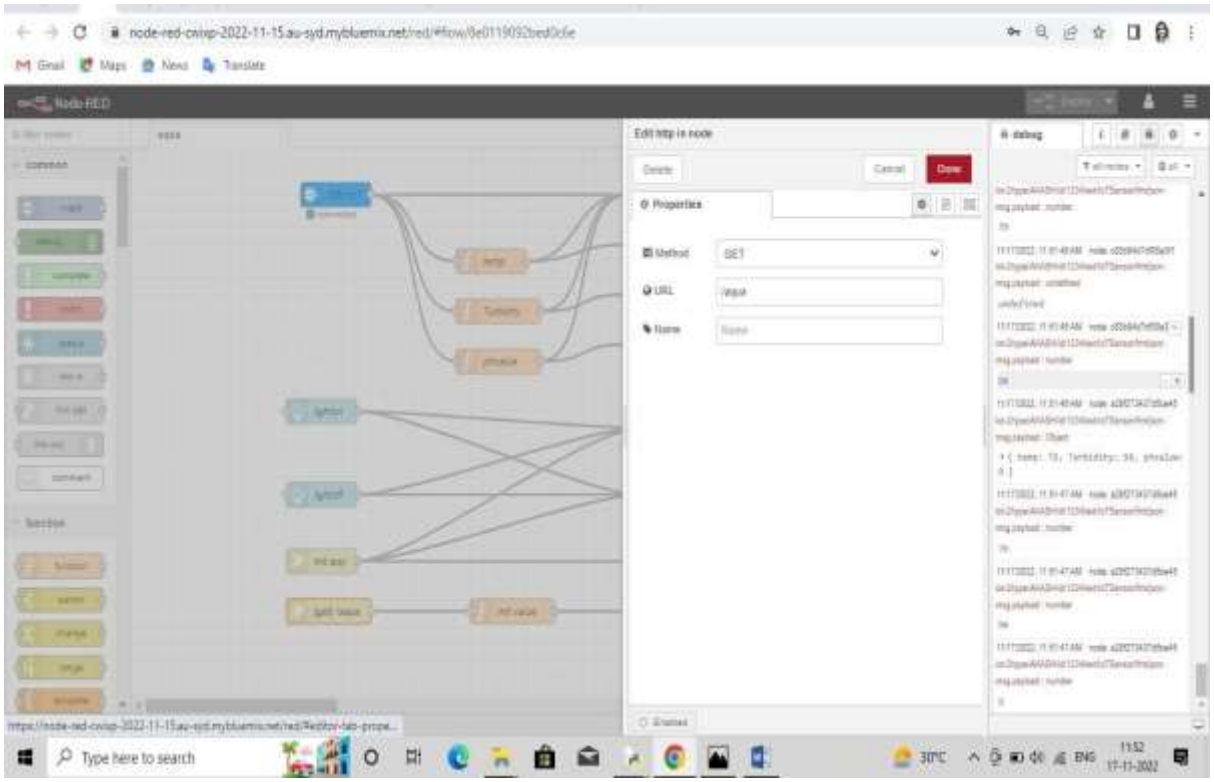
6.2REPORT FROM JIRA

7.CODING AND SOLUTIONING

7.1NODE RED SERVICE ASSOCIATED WITH IBM CLOUD:



Node red Outputs:



8.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

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 project at the time of the release to User Acceptance Testing (UAT).

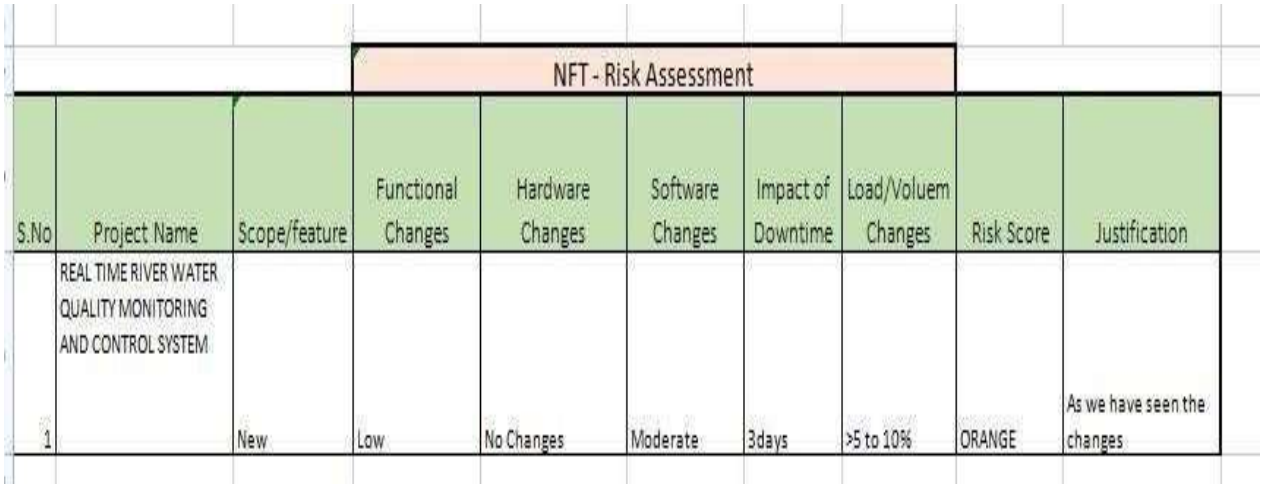
2. Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

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

9.1PERFROMANCE 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 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.

12.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

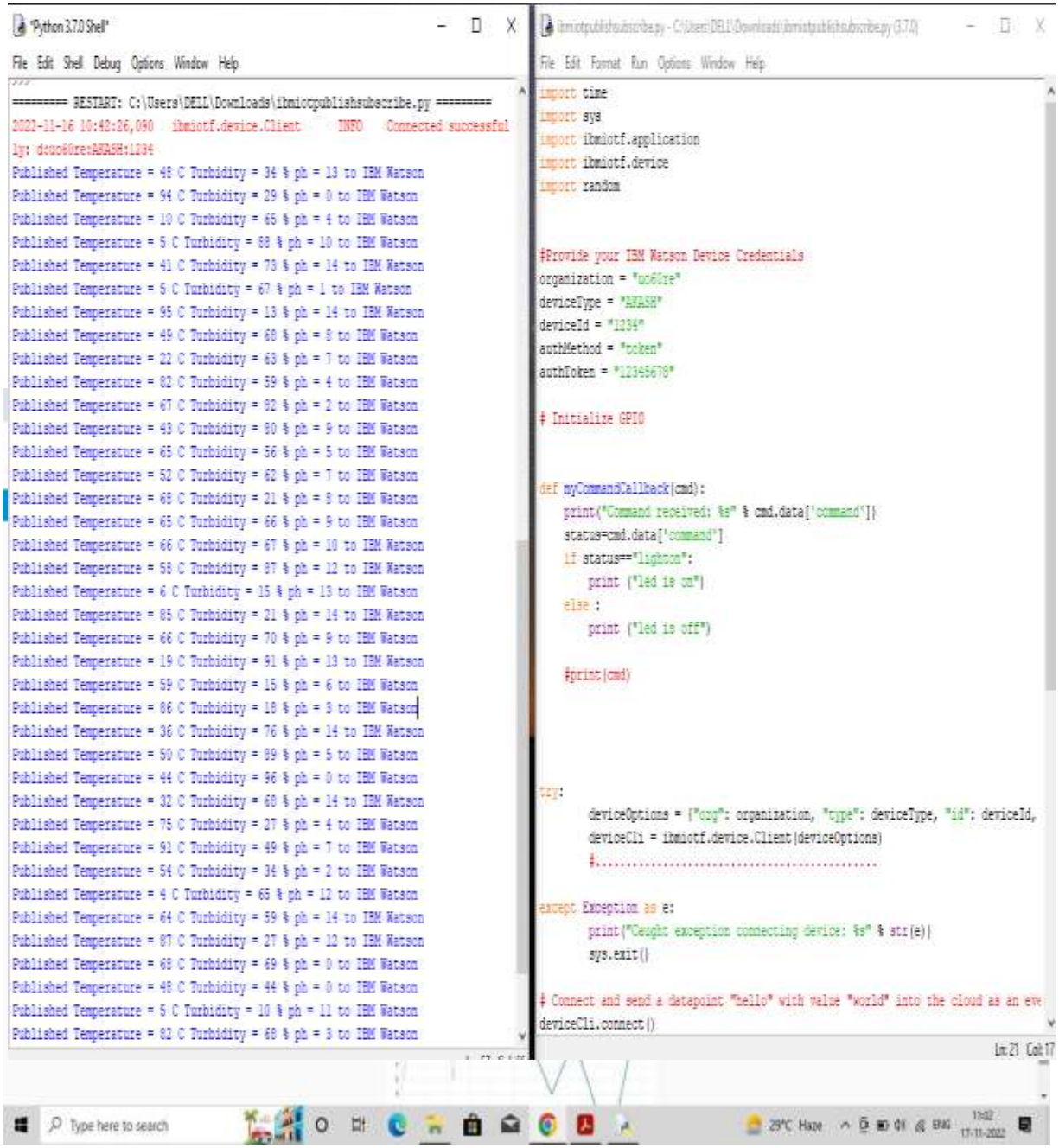
```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random


#Provide your IBM Watson Device
Credentials
organization = "wupmpr"
```

```
    deviceType
    ="Iotsensors"
    deviceId = "00822"
    authMethod = "use-
    token-auth"
    authToken= "02032001"

    # Initialize GPIO


    def myCommandCallback(cmd):
        print("Command received: %s" %
cmd.data['command'])
        status=cmd.data['command']
        if status=="lighton":
            print ("led is on")
        else:
            print ("led is off")
        #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()
```

```
    # Connect and send a datapoint
"hello" with value "world" into the cloud
as an event of type "greeting" 10 times
    deviceCli.connect()

    while True:
        #Get Sensor Data from DHT11

        temp=random.randint(60,100)

Turbidity=random.randint(0,100)
        phvalue=random.randint(2,14)

        data = { 'temp' : temp,
'Turbidity': Turbidity,'phvalue': phvalue}
        #print data
        def myOnPublishCallback():
            print ("Published temp = %s
'C" % temp, "Turbidity = %s %%" %
Turbidity,"phvalue = %s %%" % phvalue,
"to IBM Watson")

        success =
deviceCli.publishEvent("IoTSensor",
"json", data, qos=0,
on_publish=myOnPublishCallback)
        if not success:
            print("Not connected to
IoTF")
        time.sleep(10)

        deviceCli.commandCallback =
myCommandCallback
```

```
# Disconnect the device and
application from the cloud
deviceCli.disconnect()
```

OUTPUT



MOBILE APP:

GIT-HUB LINK:

https://github.com/IBM-EPBL/IBM-Project-53120-1661314424