REAL-TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEMS

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PROJECT REPORT

INTRODUCTION:

1.1 Project Overview

When detection of water quality is conventionally performed, water samples will be obtained and sent for laboratory examinations which costs for time, financial aid and human resources. Such techniques do not provide data in real-time. The proposed water quality monitoring system is consisting of a microcontroller and basic sensors, which is compact and very useful for pH, turbidity, water level detection, temperature and humidity of the atmosphere, continuous and real-time data sending via wireless technology to the monitoring station. This projected the water quality observation interface sensors with quality observation with IOT setting. WQM selects parameters of water like temperature, pH level, water level and CO2 by multiple different device nodes. This methodology sends the information to the web server. The data updated at intervals within the server may be retrieved or accessed from anyplace within the world. If the sensors do not work or get into abnormal conditions, then a buzzer will go ON. So for this project we are going to effectively analyze the two components involved in a real time quality monitoring system. For the hardware part we are going to take sensors to analyze the river water and a ping it to a controller used to control the sensor nodes. For the software part we are going to use Node RED in IOT Watson platform. So after we develop the software code we are going to load in the hardware component and a bigger data storage is needed for all those temperature, turbidity, and pH values of river water. An IOT Watson platform inter-connected to Node RED acts as a directive to Web UI forming the cloud services and storage. Python language which is Simple in nature, Highly Compatible and Object-Oriented it performs easy compilation and Increases Speed and Productivity employing Lots of Libraries and Built-in Data Structures for which it greatly accounts for our data storage issue. In our project we use WSN technology to perform a low and consistent energy management for wireless connection of sensor nodes. Thus creating a much efficient product that we present to people which is beneficial and both Safe and Affordable.

1.2 Purpose

Our culture being centered around the prominence of water being manifested in many forms. Our project is yet another step in conservation and preservation of the water bodies.

Due to rapid urbanization and increase in population, water resources are exploited. Not only depleting in the attempt of acquisition also contaminating while doing so. One of the ways of the quality being degraded is "Eutrophication".

Where a water body develops a surplus amount of nutrients and phosphorus from pollutants allowing for te rapid growth of algae and plankton. It takes minimum of a year to regain the old nature of the lake

Though the eutrophication caused by enteromopha prolifera does not affect humans or animals directly, due to oxygen meant for aquatic life forms being consumed, the ecosystem is disturbed

2. LITERATURE SURVEY

2.1 Existing problem

In "Smart Water Quality Monitoring System" by Mr. Kumar K explains that 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.

Jayti Bhatt,Jignesh Patoliya entitled "Real Time Water Quality Monitoring System". This paper describes to ensure the safe supply of drinking water the quality should be monitored in real time for that purpose new approach IOT (Internet of Things) based water quality monitoring has been proposed. In this paper, we present the design of IOT based water quality monitoring system that monitor the quality of water in real time. This system consists some sensors which measure the water quality parameter such as pH, turbidity, conductivity, dissolved oxygen, temperature and total dissolved solids (TDS). The measured values from the sensors are processed by microcontroller and this processed values are transmitted remotely to the core controller that is raspberry pi using Zigbee protocol. Finally, sensors data can view on internet browser application using cloud computing.

Nikhil Kedia entitled "Water Quality Monitoring for Rural Areas-A Sensor Cloud Based Economical Project." Published in 2015 1st International Conference on Next Generation Computing Technologies (NGCT-2015) Dehradun, India. This paper highlights the entire water quality monitoring methods, sensors, embedded design, and information dissipation procedure, role of government, network operator and villagers in ensuring proper information dissipation. It also explores the Sensor Cloud domain. While automatically improving the

water quality is not feasible at this point, efficient use of technology and economic practices can help improve water quality and awareness among people.

2.2 References

1. "Smart Water Quality Monitoring System" authored by Mr. Kumar K International Journal of Innovations in Engineering and Science, Vol. 3, No.3, 2018.
2. Jayti Bhatt, Jignesh Patoliya, "IoT Based Water Quality Monitoring System" IRFIC, 21 feb, 2016.
3. Nikhil Kedia, "Water Quality Monitoring for Rural Areas- A Sensor Cloud Based Economical Project" in 1st International Conference on Next Generation Computing Technologies (NGCT-2015) Dehradun, India, 4-5 September 2015. 978-1-4673-6809-4/15©2015 IEEE.
4. B. Anuradha, R. Chaitra, D. Pooja "IoT based low cost system for monitoring of water quality in real time" Int. Res. J. Eng. Technol. (IRJET) Volume : 05 (Issue : 05) (2018) May-2018.
5. Michal lom, ondrej priby & miroslav svitek, "Internet 4.0 as a part of smart cities" 978-1-5090-1116-2/16 ©2016 IEEE.

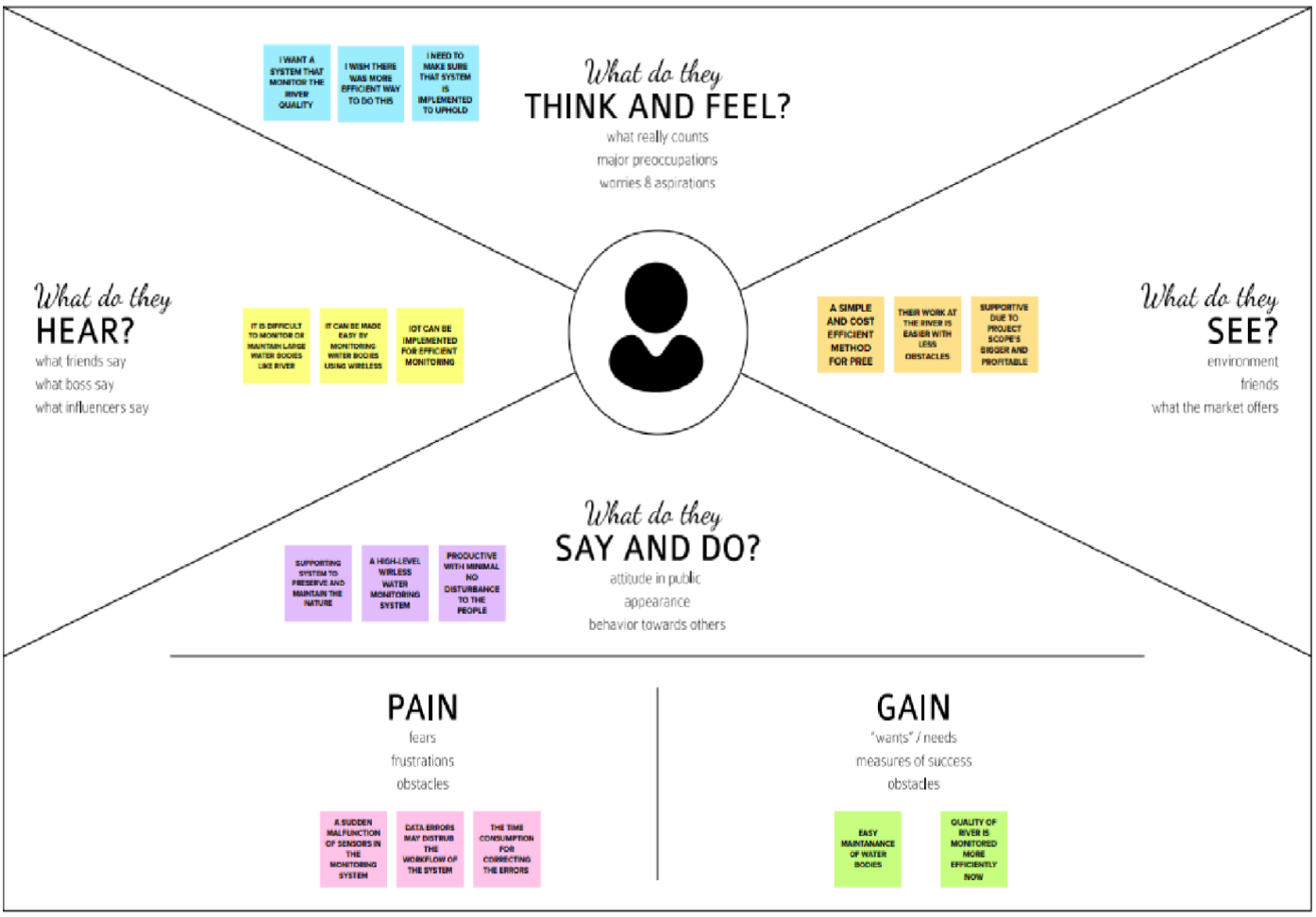
2.3 Problem Statement Definition

Generally in accordance with the referred papers published regarding the issue is centered with a concern of ignorance to the extent of human intervention directly or indirectly leading to greater fluctuations in the characteristics of the water bodies affecting the livelihood of people who are dependent.

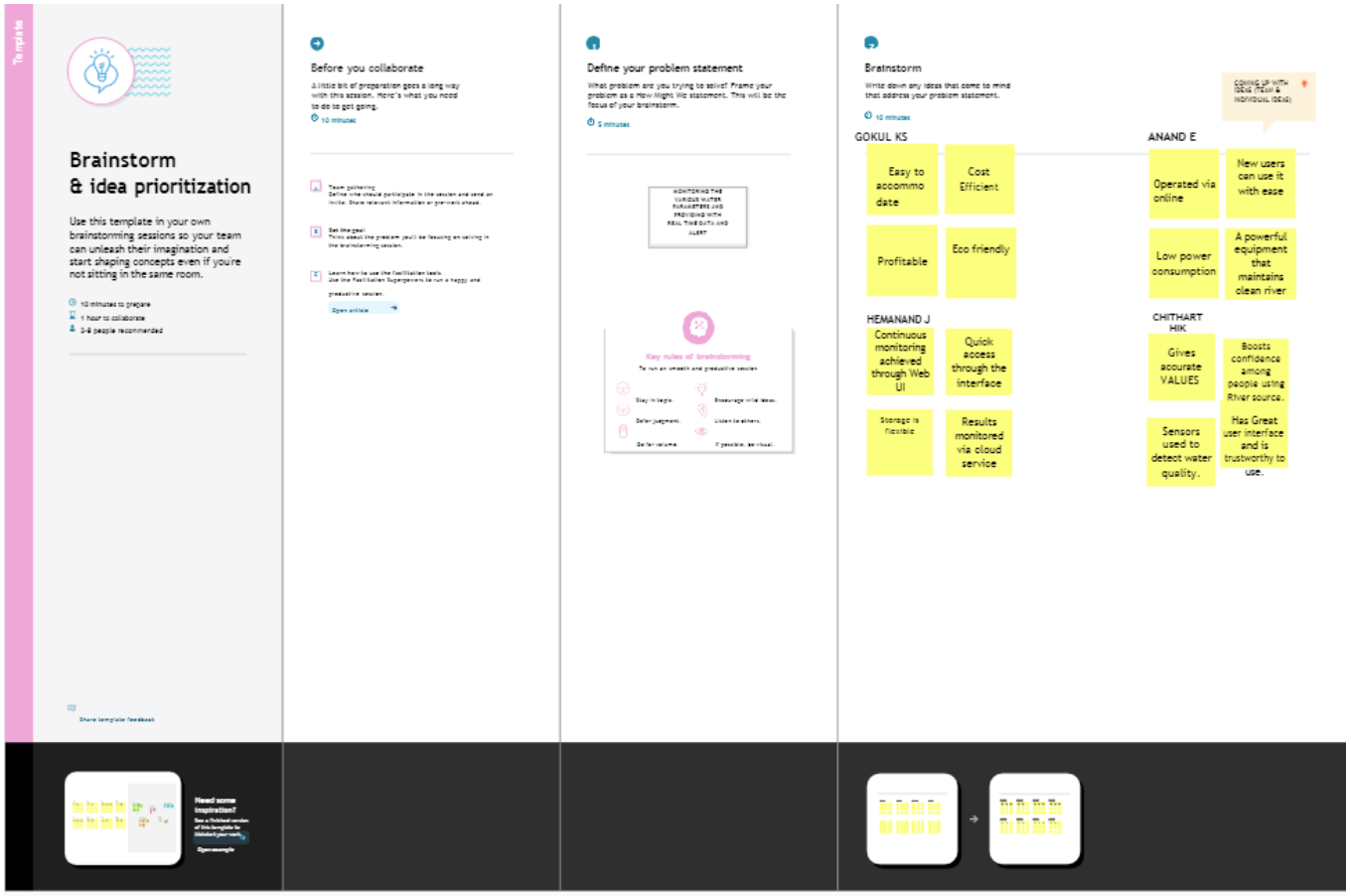
IDEATION & PROPOSED SOLUTION

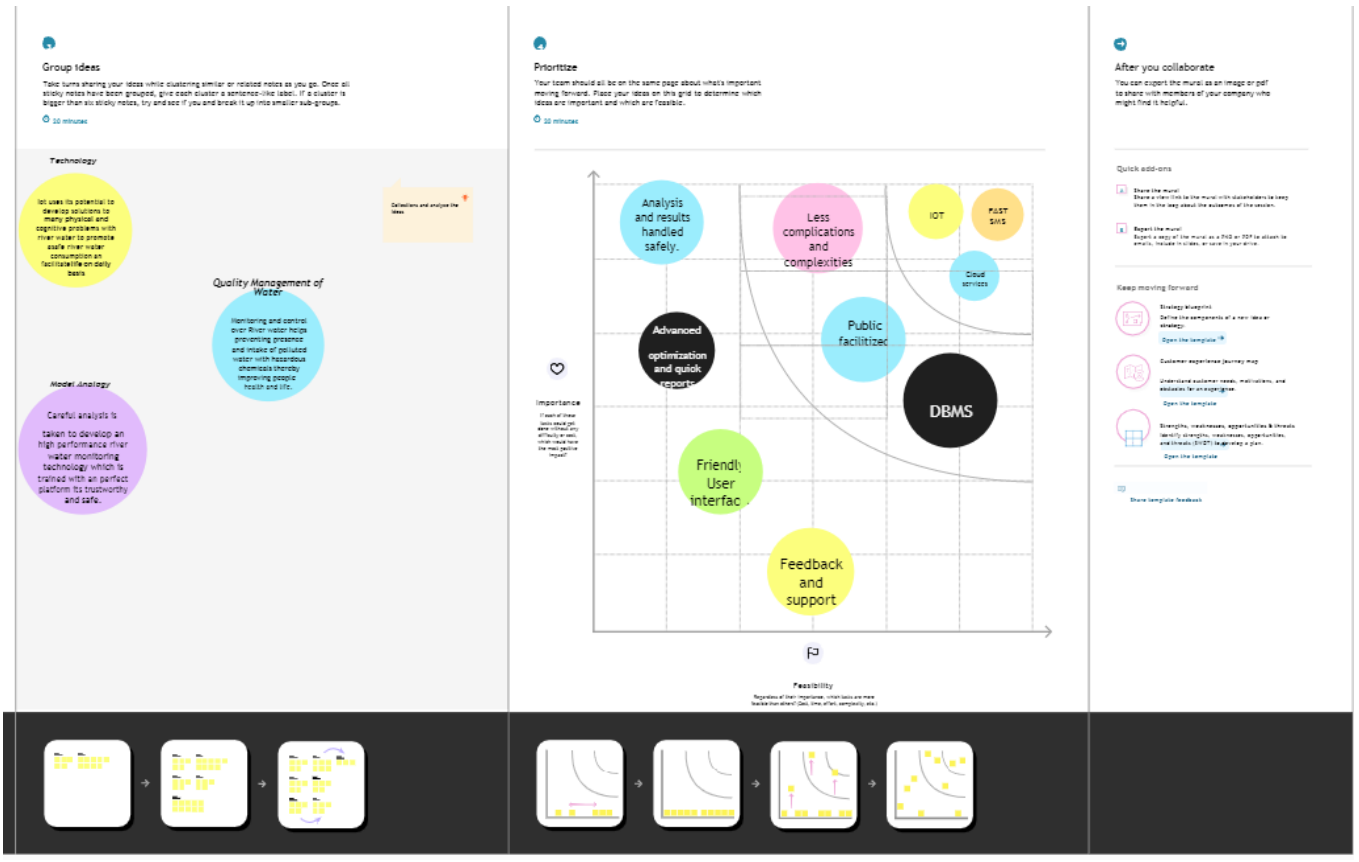
3.1 Empathy Map Canvas

As an attempt to provide the approach of the project towards the Target customer, an Empathy map for the project is provided and discussed. Empathy map-which is collaborative tool used **to gain a deeper insight into their customers**. Much like a user persona, an empathy map can represent a group of users, such as a customer segment.



3.2 Ideation & Brainstorming





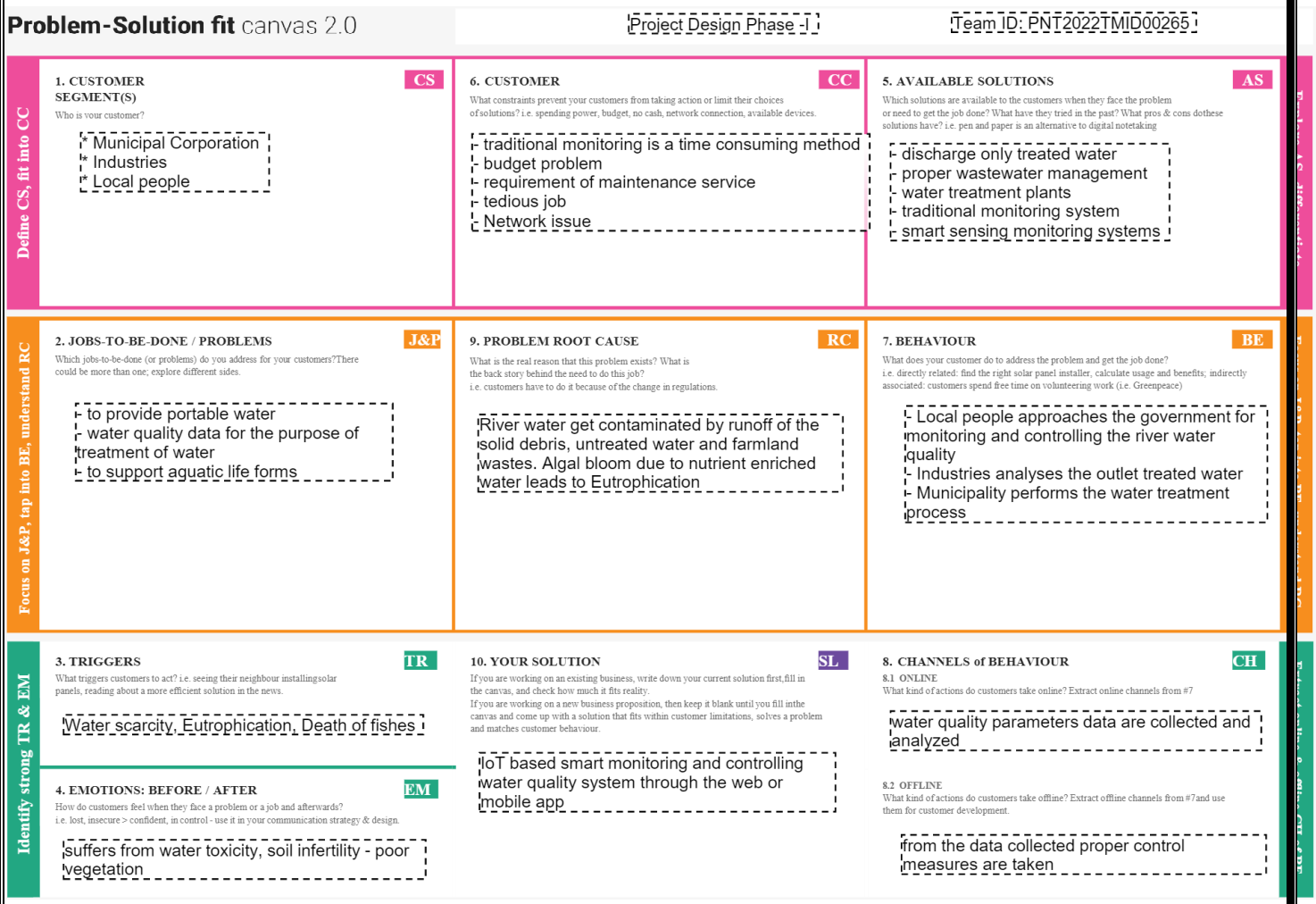
3.3 Proposed Solution

River water quality can be monitored by the web application. It can be able to know if there are any dust particles in the river water. The PH level of the river water can be monitored. Water temperature can be monitored. Alerting the authorities if the water quality is not good so that they can go and announce the localities not to drink that river water.

Exhibited in the form of Water monitoring and control model.

This system uses different sensors for monitoring the water quality by determining pH, turbidity, conductivity and temperature. The Arduino controller used will access the sensor data. With the use of IoT, the collected data is analyzed and the pollution of water can be investigated by a stringent mechanism.

3.4 Problem Solution fit



4. REQUIREMENT ANALYSIS

4.1 Functional requirement

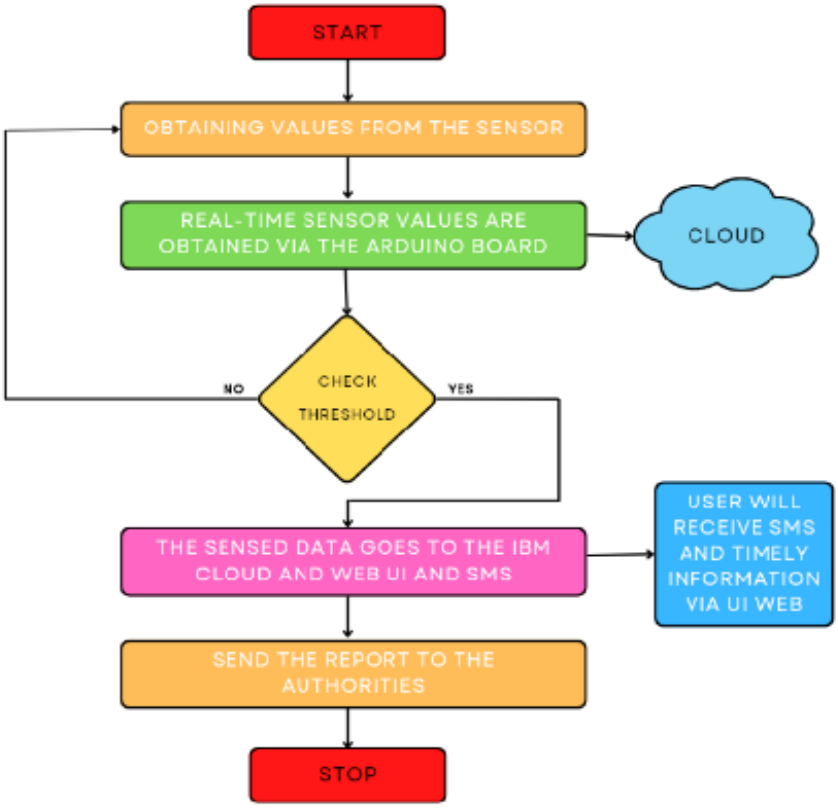
Functional requirements of the model will include the need of a cloud platform to serve as an integration point in the operation, periodic maintenance to ensure the seamless working of the model, proper power backup.Components needed to an atleast to physically represent the model to an extent which require the use of different sensors for monitoring the water quality by determining pH, turbidity, conductivity and temperature. The Arduino controller used will access the sensor data. With the use of IoT, the collected data is analyzed and the pollution of water can be investigated by a stringent mechanism.

4.2 Non-Functional requirements

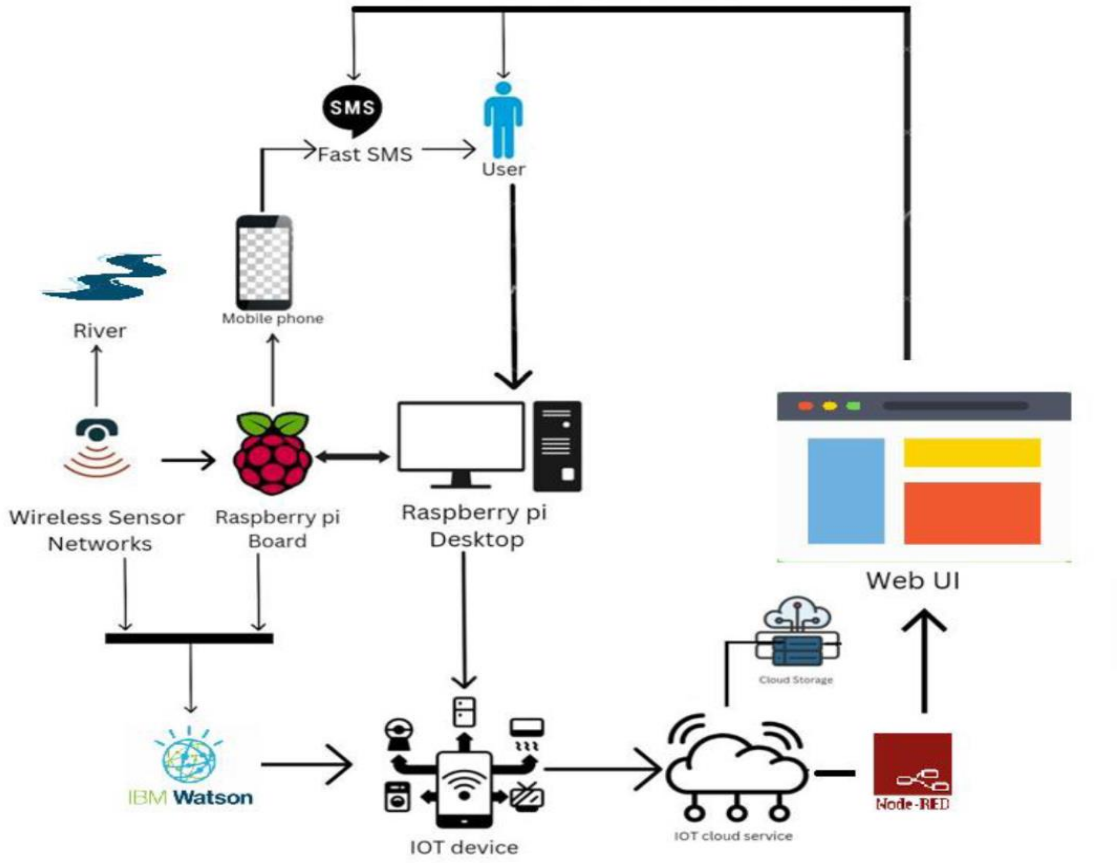
With the option provided to choose to opt the model for the water body monitoring, prior knowledge behind the working mechanism of the model should be known by the user. Utilizing the human resource to properly to scheduling the usage of the model.

5. PROJECT DESIGN PROJECT DESIGN

5.1 Data Flow Diagram



5.2 Technical Architecture



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 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 Facebook	I can register & access the dashboard with Google	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail	can register through the mail	Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password	I can receive login credentials	High	Sprint-1
Customer (Web user)	Dashboard	USN-6	As a user, I can access the specific info(ph value, turbidity).	I can able to know the quality of the water	High	Sprint-1
Customer Care Executive		USN-7	24/7 Service can be provided by company	I can clear my doubts.	Medium	Sprint-2
Administrator	Risk tolerant	USN-8	An administrator who Is handling the system should update and take care of the application	Admin should monitor the records properly	Medium	Sprint-2

6. PROJECT PLANNING & SCHEDULING

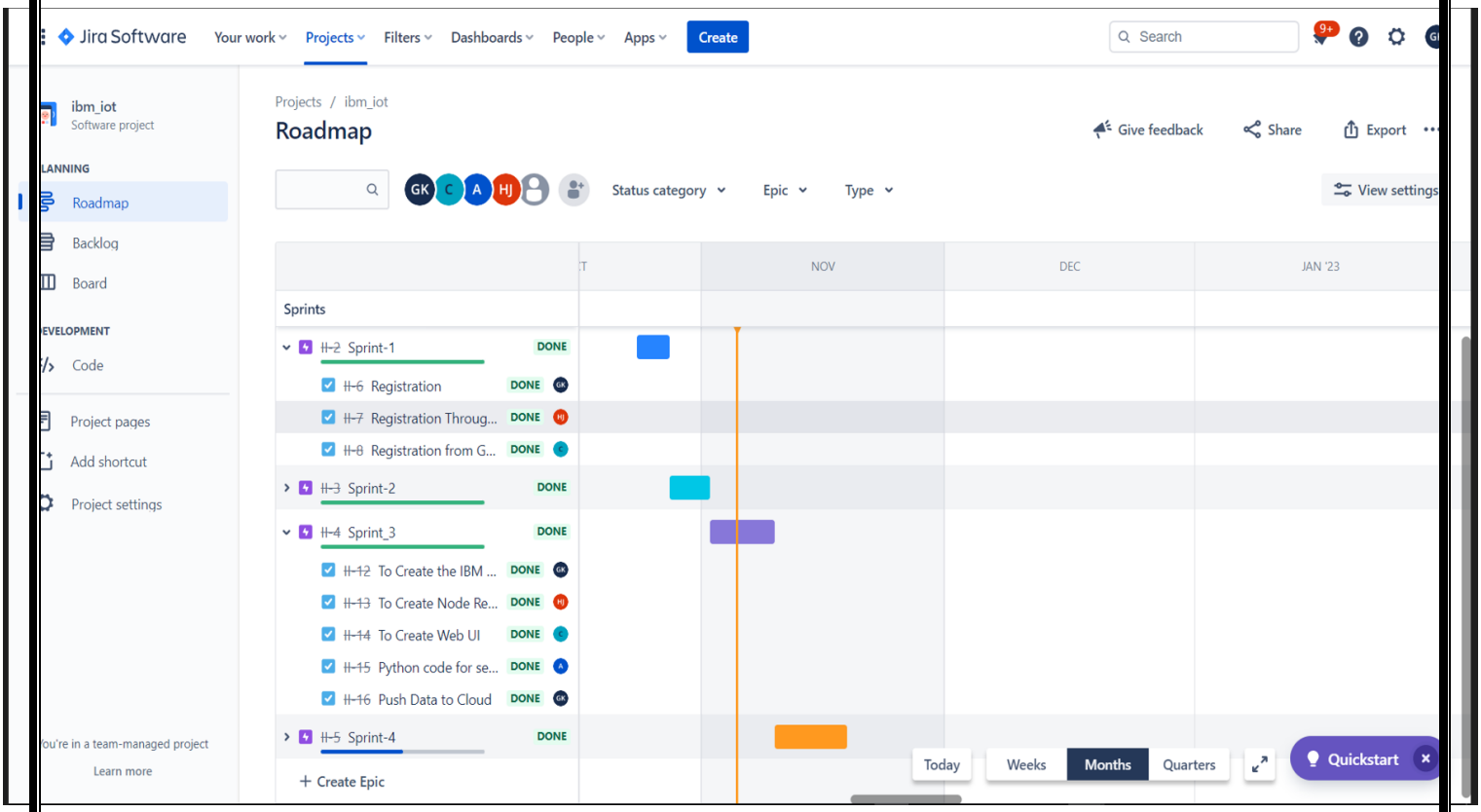
6.1 Sprint Planning & Estimation

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	4 Days	24 Oct 2022	27 Oct 2022	20	29 Oct 2022
Sprint-2	20	5 Days	28 Oct 2022	01 Nov 2022	20	04 Nov 2022
Sprint-3	20	8 Days	02 Nov 2022	09 Nov 2022	20	11 Nov 2022
Sprint-4	20	9 Days	10 Nov 2022	18 Nov 2022	20	19 Nov 2022

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 entering my email, password, and confirming My password.	2	High	Gokul Anand
	Registration via Facebook	USN-3	As a user, I can register for the application through Facebook	2	Low	Hemanand
	Registration via Mail ID	USN-4	As a user, I can register for the application through Gmail	2	Medium	Chitharthik
Sprint-2	Confirmation	USN-2	As a user, I will receive confirmation email onceI have registered for the application	1	High	Anand
	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	Hemanand
	IBM Cloud service Access		Get access to IBM cloud services.	2	High	Chitharthik
Sprint-3	Create the IBM Watson IoT and device Settings	USN-6	To create the IBM Watson IoT Platform and integrate the microcontroller with it, to send the sensed data on Cloud	2	High	Gokul
	Create a node red service	USN-7	To create a node red service to integrate the IBM Watson along with the Web UI	2	medium	Hemanad
	Create a Web UI	USN-8	To create a Web UI, to access the data from the cloud And display all parameters.	2	Medium	Chitharthik
	To develop a Python code	USN-9	Create a python code to sense the physical quantity And store data.	2	Medium	Anand
	Publish Data to cloud.	USN-10	Publish Data that is sensed by the microcontroller to the Cloud	3	High	Gokul
Sprint-4	Fast-SMS Service	USN-11	Use Fast SMS to send alert messages once the parameters like pH, Turbidity and temperature goes beyond the threshold	3	High	Gokul Anand
	Testing	USN-12	Testing of project and final deliverables	3	Medium	Hemanand Chitharthik

6.3 Reports from JIRA



7. CODING & SOLUTIONING

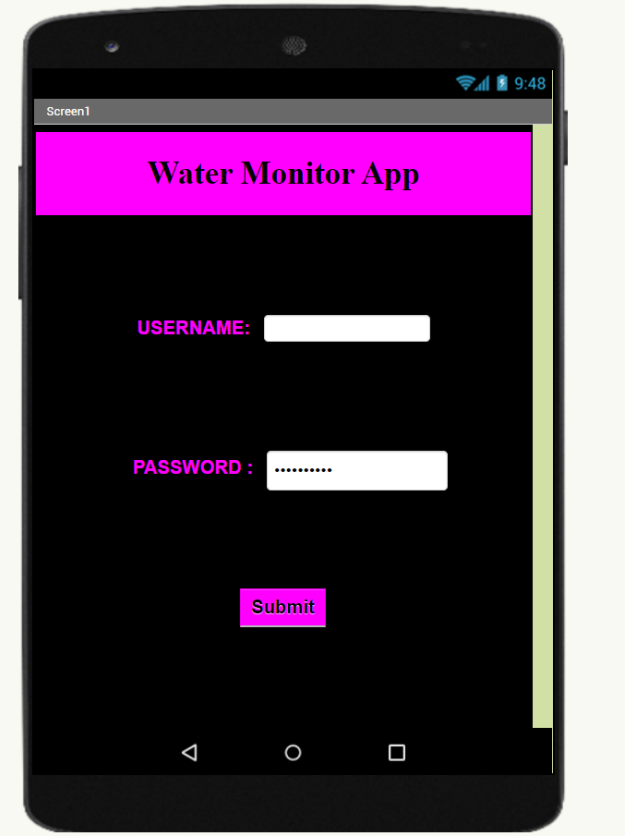
7.1 Python Code:

```
import random
import time
import sys
import ibmIoTf.application
import ibmIoTf.device
from twilio.rest import Client


#IBM Watson Device Credentials

organization = "uwujz1"  # repalce it with organization ID    uwujz1
deviceType = "ibm_IoT"  # replace it with device type
deviceId = "Python_IoT"  # repalce with device id
authMethod = "token"
authToken = "1234asdf"  # repalce with token
```

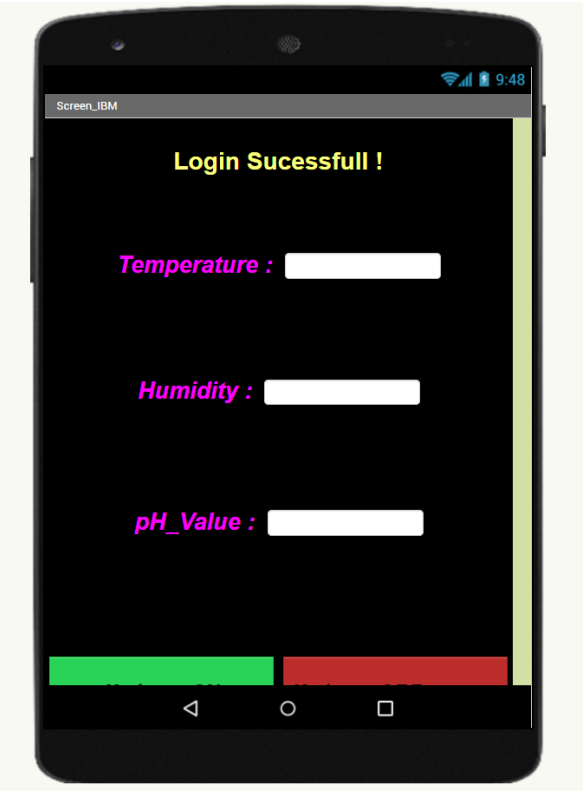
```
def myCommandCallback(cmd):
    print("Command received: %s" %cmd.data['command'])

    status = cmd.data['command']
    if status == "Motor ON":
        print("MOTOR ON")
    else:
        print("MOTOR OFF")

#connecting with IoT device
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()

#twilio sms service
account_sid ='AC7d3677f934bbdf90eb5aef3459939e4a'
auth_token = 'c83c527d7037201cbfa631e6ea99dbc1'
client = Client(account_sid, auth_token)

message = client.messages .create(
                        body="High Temperature - ALERT !",
                        from_='+13465455379',
                        to='+919943562883'
                    )


while True:
    temp = random.randint(90,100)
    humidity = random.randint(0,100)
    pH=random.randint(0,100)
    # Send Temperature & Humidity to IBM Watson
    data =  {'temperature':temp, 'humidity':humidity,'pH':pH}   #output


    def myOnPublishCallback():

        print("Data publish ",data, "to IBM Watson\n")
```

```
    if(temp>95):
        print("Temp alert -sms sent successful")
        print(message.sid)


    success = deviceCli.publishEvent("event", "json", data, 0,
myOnPublishCallback)
    if not success:
        print("Not connected to IoTF")
    time.sleep(2)

    deviceCli.commandCallback = myCommandCallback
deviceCli.disconnect()
```

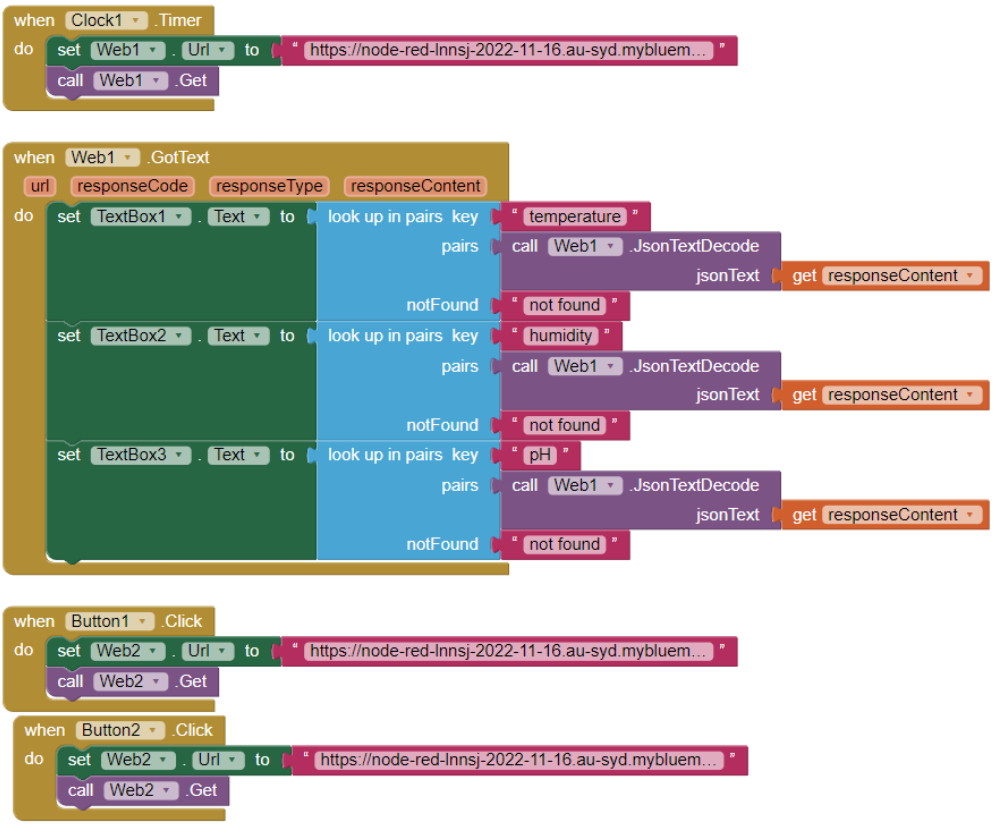
7.2.1 Feature 2 –Login security:



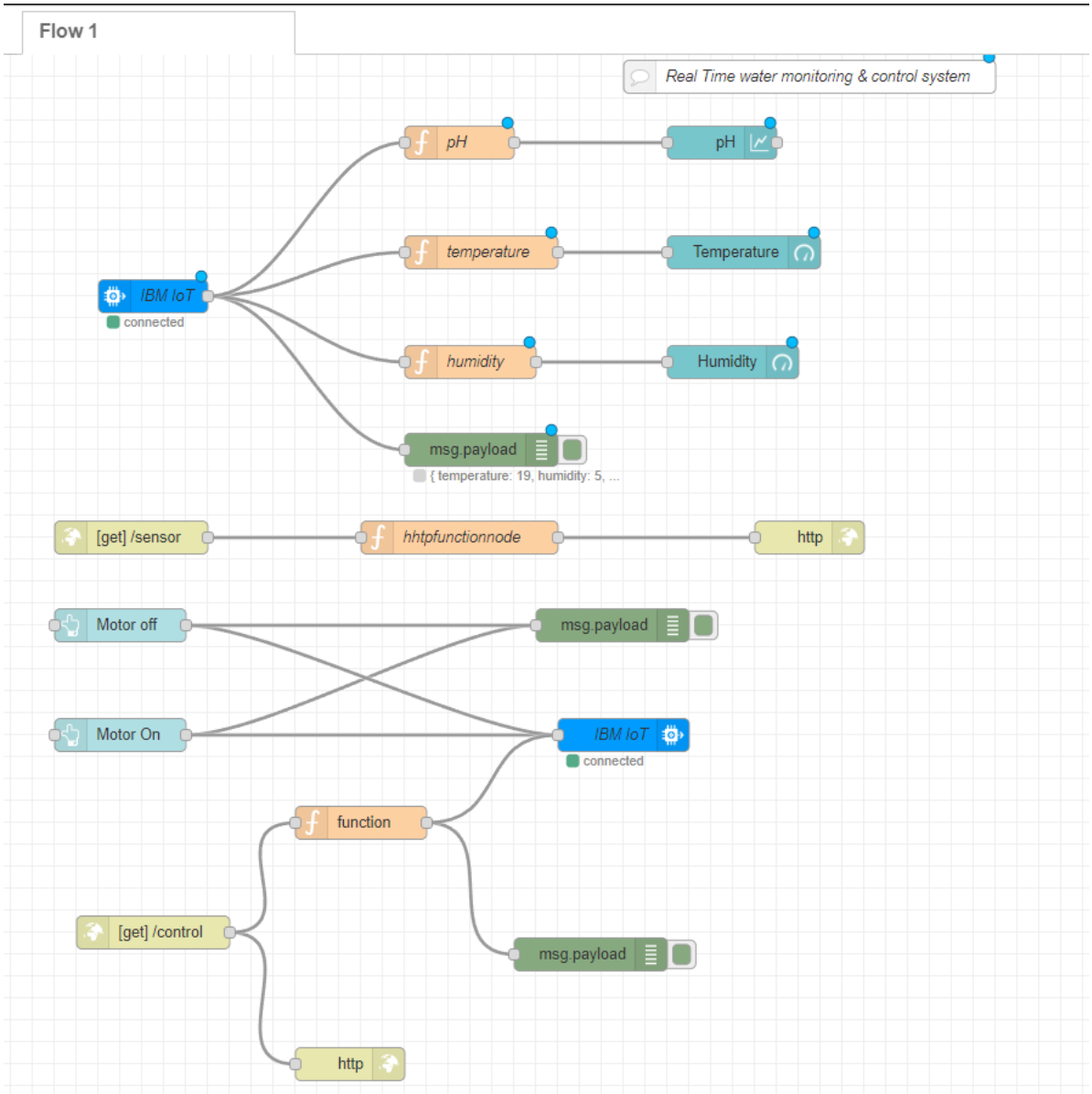
7.2.2 Home Page :



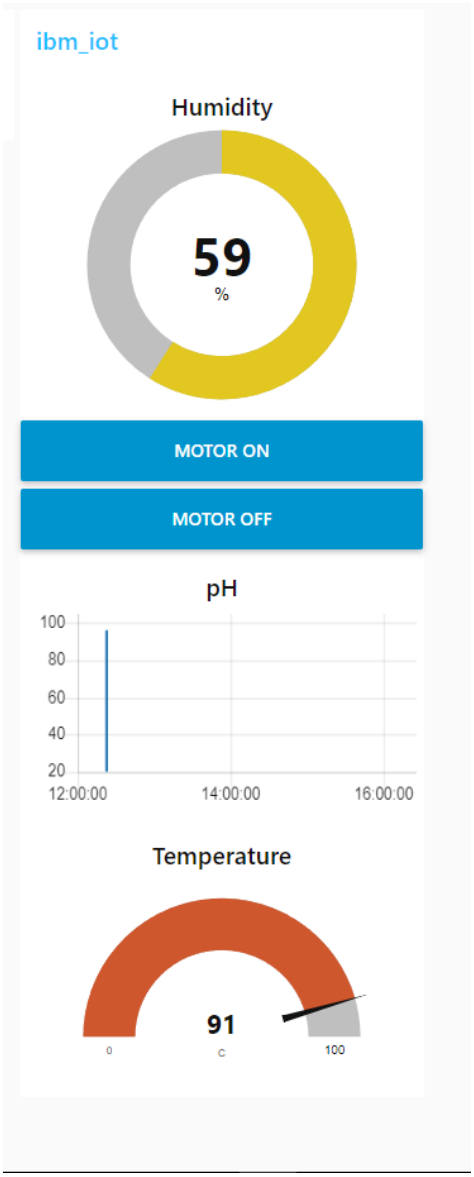
7.2.3 Blocks:



7.3 Node-Red Flows:



7.3.1 Web UI:


ibm_iot
Humidity
59
%
MOTOR ON
MOTOR OFF
pH
100
80
60
40
20
12:00:00
14:00:00
16:00:00
Temperature
91
C
0
100

8. SMS Alert

9. ADVANTAGES & DISADVANTAGES

Like every system is use, which constitutes utilization of it and be fundamentally segregated or used based on knowing its edge over similar entities and its disadvantages. Similarly for the water monitoring model, acknowledging the same ultimately renders the users to know when and when not to rely on the system.

9.1 Pros:

- Offers Flexibility over conventional water preservation methods.
- Scalable based on the use case
- Reliable with almost least human intervention

9.2 Cons:

- Though, understanding the working of system comes with benefit since every member in team uses the model requires knowledge, making it redundant for many.
- Establishing a new method takes time to implement.
- Relaying of misinterpreted data in any phase makes it useless.

10. CONCLUSION

The IoT aided water monitoring system will improve the standards of preserving the target water bodies with much ease over the conventional methods which rely much on human resource or manual human intervention.

Compared with typical means of measurement once acclimating to the adopted model comes with knowledge behind to assist the operation and patience to see greater yields and

once familiarized with the working, the improvement and efficiency in performance will be greater than the latter.

12. FUTURE SCOPE

With the growing demand and need to preserve water bodies, the model can further be developed to fully be automated, with only maintenance a real concern also making it more affordable to people of all backgrounds with less to no complex knowledge needed beforehand to work with the model.

13. APPENDIX

Source Code GitHub : github.com/IBM-EPBL/IBM-Project-12947-1659501329

Project Demo Link : IBM_IoT - Google Drive