REAL-TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM

PROJECT REPORT

1.INTRODUCTION

1.1 Project overview

Only 3 percent of Earth's water is fresh. The world's fresh water comes from many different sources. The river is a natural stream of flowing water with a significant volume of freshwater. Rivers carry water and nutrients to areas all around the earth. They play a very important part in the water cycle, acting as drainage channels for surface water. Rivers provide habitat for the vast marine life that has various fishes and sea animals. People depend on rivers for their way of life and their livelihoods. From fishing to agriculture, the way we manage our waterways has a direct impact on people's lives. River valleys and plains provide fertile soil. Farmers in dry region irrigate their cropland using water carried by irrigation ditches from nearby rivers. But water is the most depreciated thing we have right now. We do not realise its importance until it will be in scarcity. From the urban viewpoint the issues might not be majorly visible, but the need for rivers is the base to a healthy community and livelihood. As much as how much to clean up rivers is emphasized, importance should be given firstly to not dump wastes into the river. Hence monitoring water quality is very important for maintaining ecosystem health and the livelihood of the population. helps us infer about the factors that to ensure it is not contaminated. By having a real time river water quality monitoring system using sensors one can read the temperature, turbidity, pH, hardness which have to be in the levels 20-40 degree C, 0.1-5 NTU, 6.5-8.5 and 75-150 mg/L respectively for uncontaminated clean water. So, by monitoring those levels we can keep a check on it not crossing certain thresholds for which alerts are sent and action can be taken. Therefore, best practices and efforts are needed to monitor and improve water quality.

1.2 Purpose

The very need and motivation to do this project is the very fact that the water table is in the depreciating state. As time goes, we will have to conserve every drop of water like we are saving up gold as of now. With the vast industrial and medicinal wastes dumped into the river, cleaning up is what many environment concerned organizations and socialists are already doing. But it is only making the slightest change, for the amount of waste dumped into the rivers is magnifying compared to what we can clean and again use it to make it dirty. So rather than treating after gone, prevention is better than cure. The main objective is to reduce the dying marine life due to water poisoning, where the habitat becomes unsuitable to breath and have life there. Moreover, not everybody could afford a water purifier and that revolves around the whole point that this is very essential in less privileged areas as those are the regions where natures water resource is abundant but also exploited. Women have to walk several miles to get two jugs of water for a single day for their family and that water also being contaminated leads to many water borne diseases and worse death. Hence a real time river water quality monitoring system which could monitor, alert to oversee the usability of the water is the

solution. As the motive and implementation of this project is only for the betterment of both humans and animals, it is very much needed.

2.LITERATURE SURVEY:

2.1 Existing problem :

- Our aim is to monitor the Quality of River water and take necessary steps to prevent the agents which degrade the quality
- Every time there is an industry dump in the river or a mixture of toxins identified through sensors, the product comes into action
- With the monitoring system in action, our persona has the freedom to make the choice of consuming water for their day-to-day activities
- When the river water is monitored continuously, the residents of the ecosystem can live without fear of contracting any water borne diseases due to their familiarity with the nature of the water they consume

2.2 References:

- Mohammad Salah Uddin Chowdury, Talha Bin Emran, Subhasish Ghosh Abhijit Pathak, Mohammed Manjur Alam, Nurul Absar, Karl Andersson, Mohammad Shahadat Hossain “IoT Based Real-Time Water Quality Monitoring System”, Procedia Computer Science, Volume 155, 2019, Pages 161-168, ISSN 1877-0509, https://doi.org/10.1016/j.pro cs.2019.08.025
- S. Chopade, H. P. Gupta, R. Mishra, P. Kumari and T. Dutta, "An Energy-Efficient River Water Pollution Monitoring System in Internet of Things," in IEEE Transactions on Green Communications and Networking, vol. 5, no. 2, pp. 693-702, June 2021, doi: 10.1109/TGCN.2021.30624 70.
- E. A. Kadir, A. Siswanto, S. L. Rosa, A. Syukur, H. Irie and M. Othman "Smart Sensor Node of WSNs for River Water Pollution Monitoring System," 2019 International Conference on Advanced Communication Technologies and Networking (CommNet), 2019, pp. 1-5, doi: 10.1109/COMMNET.2019. 8742371.
- Q. Ye, X. Yang, C. Chen and J. Wang, "River Water Quality Parameters Prediction Method Based on LSTMRNN Model," 2019 Chinese Control And Decision Conference (CCDC), 2019, pp. 3024-3028, doi: 10.1109/CCDC.2019.88328 85
- R. D. Lestari, A. Rusdinar, M. A. Murti, G. Tawaqal and D. Lee, "Design of IoT-Based River Water Monitoring Robot Data Transmission Model Using Low Power Wide Area Network (LPWAN) Communication Technology," 2019 IEEE International Conference on Internet of Things and Intelligence System (IoTaIS), 2019, pp. 201-205, doi: 10.1109/IoTaIS47347.2019. 8980377
- Yasuo Nihei, Akira Kimizu,” A new monitoring system for river discharge with horizontal acoustic Doppler current profiler measurements and river flow simulation” Water Resources Research, Volume 44, Issue 4.

2.3 Problem Statement Definition:

- Wireless Sensor Networks (WSNs)inclusive of microcontrollers for processing the system and for communication between the nodes present inside the system. Visualization of the data was carried out using SparkMLib. Finally, an SMS was sent to the target regarding quality of the river according to certain metrics.
- Compressed deep neural network to monitor any pollution present within the river water. Following this, the authors have made use of a knowledge distillation technique to train the model. Conclusively, the paper develops on this approach as it goes by throughout the work, as agame-theory approach to establish reduced energy consumption for monitoring through longer ranges.
- This paper utilised Wireless Sensor Networks(WSN) and have exploited the advantage of its interoperability and communication to multiple sensors. With this, they have also monitored the water level and flow rate for the purpose of generating flood alerts.
- Horizontal acoustic doppler current profiler (H-ADCP) measurements and river flow simulation to achieve constant and continuous river monitoring at a lower cost

3.IDEATION & PROPOSED SOLUTION:

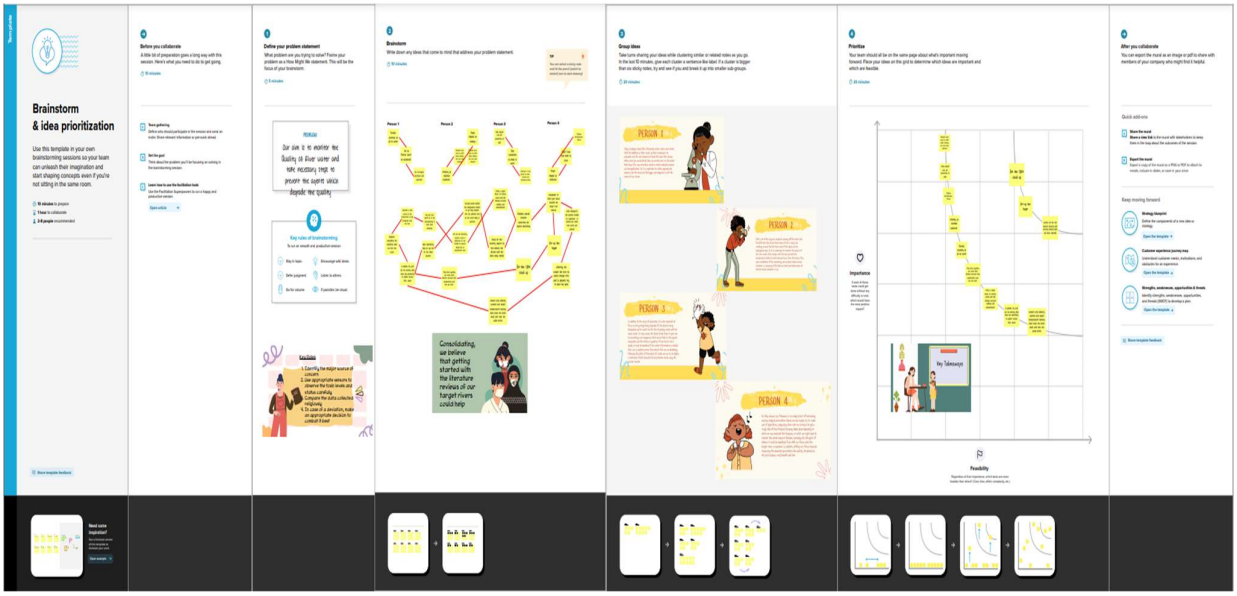
3.1 Empathy Map Canvas:

- This Empathy Map Mainly focus on what do they think and feel / What do the hear / What do they say and do / What do they See / Gain / Pain.

- They think and fear that the system might cost more than that they can afford and worry that the water purity standards are degrading
- They hear news and reports that water in their area is highly polluted and is causing harm to marine life.
- The persona see's their environment that is surrounded by factories, industries and various sources of river water contamination.

- Identify the major pollutant which causes degradation of water quality

3.2 Ideation & Brainstorming:



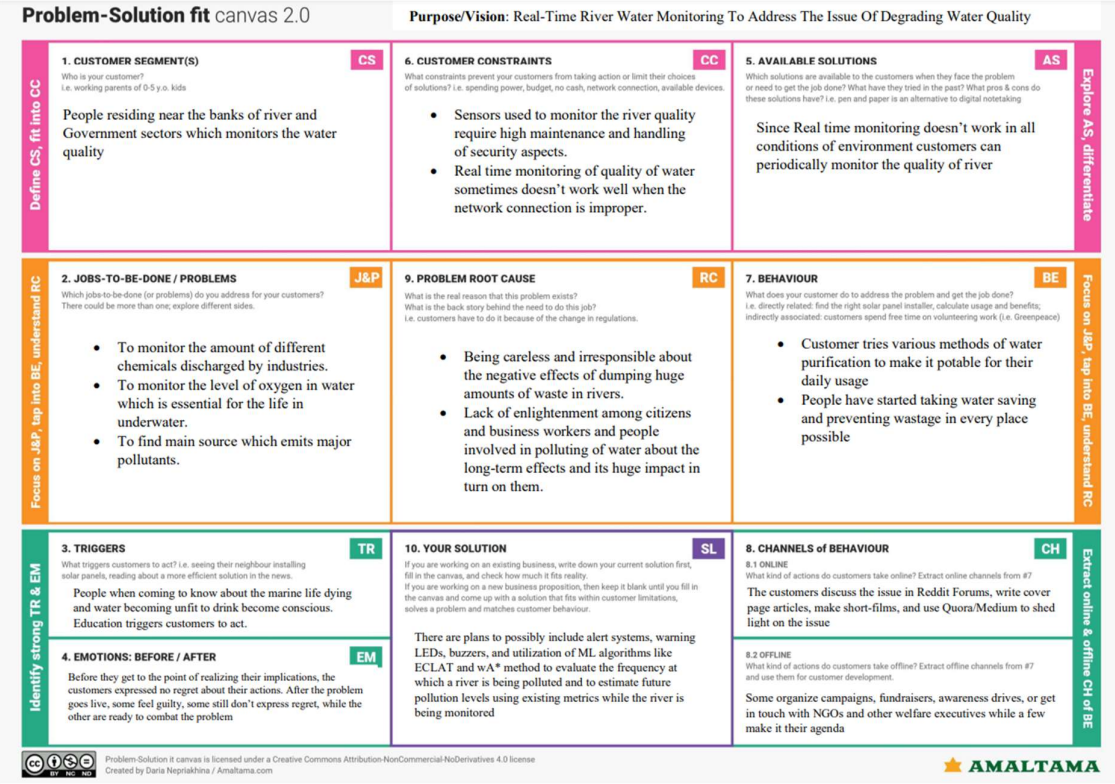
- Our aim is to monitor the Quality of River water and take necessary steps to prevent the agents which degrade the quality
- First step: Periodic checking of pH of water
- Second step: Filtering of harmful chemicals
- Third Step: Take utmost care for preventing oil spills
- Forth step: Perform Denitrification Process
- Final step: Consult with industry mentors and exhibit reinforcement learning: learn from the errors made and tune the model better

3.3 Proposed Solution:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Our aim is to monitor the Quality of River water

2.	Idea / Solution description	Take necessary steps to prevent the agents which degrade the quality by continuously monitoring the quality and composition of water
3.	Novelty / Uniqueness	• The very idea of real time river monitoring and not purification of contaminated water is the unique aspect. • As prevention is better than cure the proposed model will monitor any deviations from accepted levels of pollutants and see that it doesn't cross a threshold.
4.	Social Impact / Customer Satisfaction	• It benefits people (us) and raises the sanitary conditions and standard of living • Marine life benefits as monitoring river water ensures a clean and toxin free environment for marine beings • Aids in social biodiversity and thereby food chain
5.	Business Model (Revenue Model)	• Overall financial revenue of the nation would be made in check. Around 5.55 billion dollars is used by people to buy bottled purified water. • Around 67,221 crores is used for drinking water and sanitation department in the budget plan of India. This finance could be drastically reduced with the implementation of a real time river water monitoring and control system.
6.	Scalability of the Solution	□ The proposed solution could be employed in desired location thereby facilitating the people living on that region. □ The deployed model could be scaled to an extent to implement creative ideas

3.4 Problem Solution fit:



- From this Problem-solution fit diagram, plans to possibly include alert systems, warning LEDs, buzzers, and utilization of ML algorithms like ECLAT and wA* method to evaluate the frequency at which a river is being polluted and to estimate future pollution levels using existing metrics while the river is being monitored.

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
FR-2	User Confirmation	Confirmation via Email

FR-3	App Login	Username and password have to be known

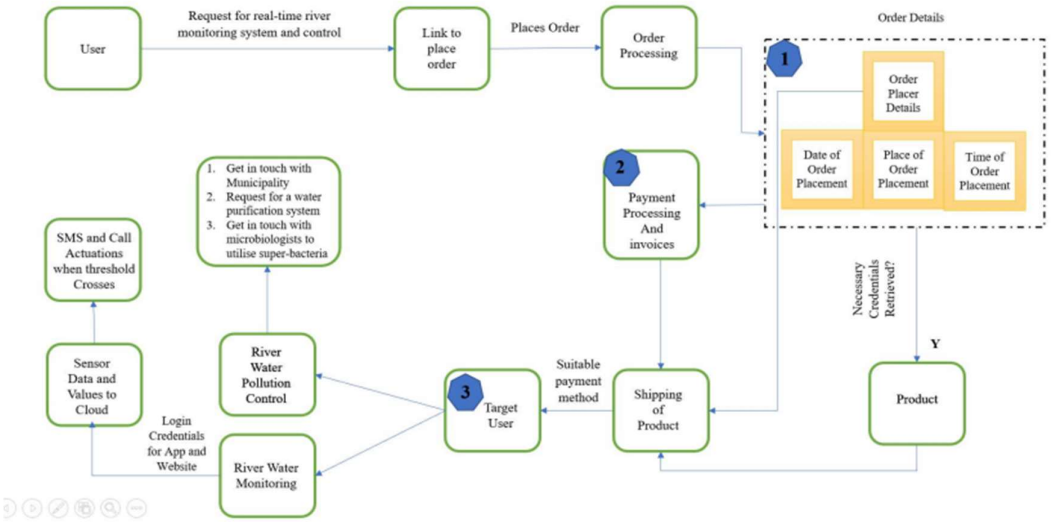
4.2 Non-Functional requirements:

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

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The app created is user friendly and a customer can easily access the data regarding chemical constituents etc.
NFR-2	Security	The application cannot be used by any other user who hasn't registered.
NFR-3	Reliability	The real time of water quality monitoring is less reliable but it is more reliable for prior 5-10 minutes simulation results.
NFR-4	Performance	The performance is better since a virtual based software(cloud) is used and hence faster to integrate the data.
NFR-5	Availability	All open-source frameworks such as MIT App Inventor are used.
NFR-6	Scalability	The Application is more scalable since all data are integrated into cloud.

5.PROJECT DESIGN:

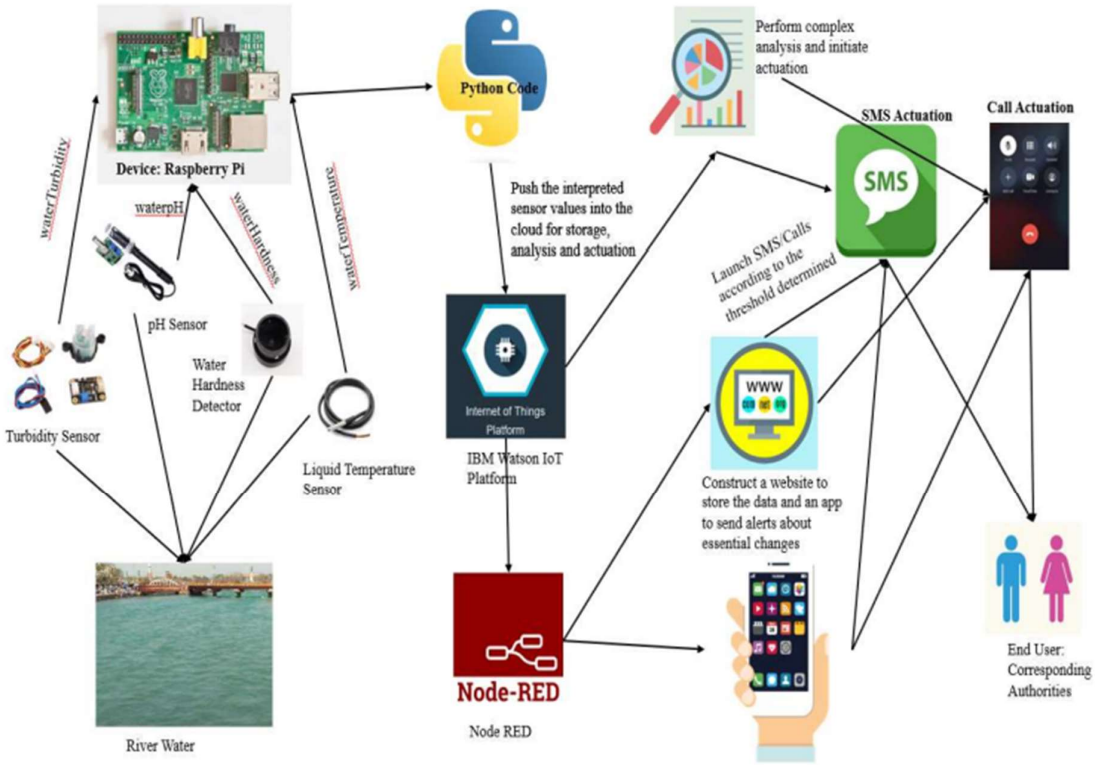
5.1 Data Flow Diagrams:



- From this dataflow, This device can used for who are all facing problem with River water pollution control and River water Monitoring .
- They can buy it by placing order
- This device can have a capable of send a SMS or call alert actuations when threshold crosses.

5.2 Solution & Technical Architecture:

Solution Architecture Diagram



- To utilise wireless sensor networks to establish effective communication and better security with the sensor devices that we have planned to use.
- The sensor devices that have a proposition of being used include turbidity sensor, liquid temperature sensor, pH sensor, and hardness sensor which help in evaluation of the essential factors when it comes to river quality monitoring: the alkalinity levels which play a pivotal role in allowing safe and secure water for daily use, the hardness levels which have an extended impact on plant and animal life, and the temperature levels which stay an indicator of the global warming

- There is a proposition to include actuation alerts that include SMS and call alerts to the respective authorities responsible in handling the river water quality to ensure the safe quality of livelihood among people consuming the water.

Technical Architecture:

Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g. Web UI, Mobile App, Chatbot etc.	HTML
2.	Application Logic-1	Logic for a process in the application	Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Database	Data Type, Configurations etc.	Python
6.	Cloud Database	Database Service on Cloud	IBM Cloudant
7.	File Storage	File storage requirements	IBM Block Storage
8.	External API-1	Purpose of External API used in the application	IBM Weather API
9.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud	Cloud Foundry

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks used	Node Red , MIT app inventor, Wowki
2.	Security Implementations	List all the security / access controls implemented, use of firewalls etc.	App-Login Credential
3.	Scalable Architecture	Justify the scalability of architecture (3 – tier, Micro-services)	IBM Weather API, IBM Cloudant . IBM Watson STT service,etc..
4.	Availability	Justify the availability of application (e.g. use of load balancers, distributed servers etc.)	Node Red , MIT app inventor, Wowki

5.	Performance	Design consideration for the performance of the application (number of requests per sec, use of Cache, use of CDN's) etc.	Number of requests per second is 2.

5.3 User Stories:

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 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 Instagram/Reddit	I can register & access the dashboard with Instagram/Reddit Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail	I can receive further news and can access the dashboard using Gmail	Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password	I can receive security and verification alerts as I log into the application	High	Sprint-1
	Dashboard	USN-6	As a user, I can log in to the application and access the details	I can access my dashboard and the necessary requirements	Medium	Sprint

			mentioned in the dashboard including my last login details			
Customer (Web user)	Registration	USN-7	As a user, I can register for the website by entering my email, password and confirming my password	I can access my account	High	Sprint-1
		USN-8	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
User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
		USN-9	As a user, I can register for the application through Instagram/Reddit	I can register & access the dashboard with Instagram/Reddit Login	Low	Sprint-2
		USN-10	As a user, I can register for the application through Gmail	I can receive further news and can access the dashboard using Gmail	Medium	Sprint-1
	Login	USN-11	As a user, I can login to the website by entering my email/social media account	I can log into the website and receive security alerts	High	Sprint-1
	Dashboard	USN-12	As a user, I can login to the website and access my dashboard	I can access my dashboard	Medium	Sprint-1
Customer Care Executive	Data read and log	USN-13	As a user, I can report any issues with irrelevant data being logged into the app	I can get quick replies on reporting my issues	High	Sprint-3

		USN-14	As a user, I can report any issues with unwanted data log into the website	I get 24x7 touch on letting them be known of the issues	High	Sprint-3
	Logging into the app/account hacking	USN-15	As a user, I can report any issues with logging in or account hacking to the executive	Immediate resolution of the problem on reporting the same	High	Sprint-3
Administrator	Data visualization	USN-16	As a user, I can report any missing information/faulty data visualizations	Service taken care of and proper data visualizations	Medium	Sprint-4
	Reporting issues in modification of data	USN-15	As a user, I can report any issues in modification of data like discontinuity to the admin as data gets logged into the app	Privileges allowed and access to deletion and modification of data	Medium	Sprint-4

6.PROJECT PLANNING & SCHEDULING:

6.1 Sprint Planning & Estimation:

Sprint 1:

Creation Of Device in IBM Watson IoT Platform with device id: 123, device name: raspberrypi. Creation of Node-Red Service (i.e) App deployment by creating organization, space in Cloud foundry and developing toolchain(pipeline).

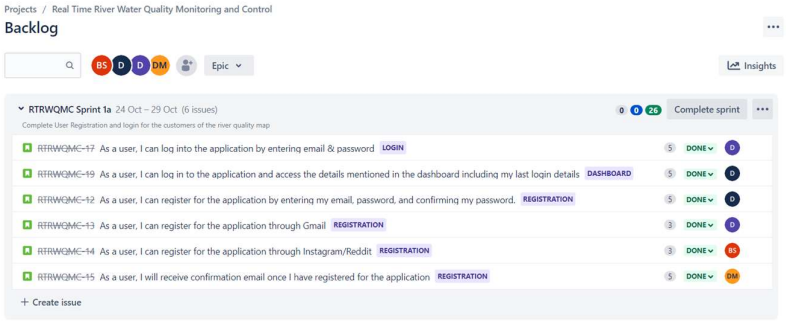
Sprint 2:

- Develop the Python script and Publish the data to the IBM cloud (Watson IoT Platform). Python 3.7.0 version have to be installed and ibmiot library is needed to be imported including the other required libraries. The IBM Watson device credentials should be given – organization type, authentication token, etc.
- This is done to integrate Python code and the device in IBM Watson Cloud platform. Output of the code is shown which has the continuous real timed sensed parameter values sending to IBM Cloud
- Publishing data to Cloud

Sprint 3:

Develop The Web Application Using Node Red Service:

- Create Node Red flow to get data from Device



- Code to get sensor values
- Use Dashboard Nodes For creating UI (Web App)

Create an HTTP to communicate with Mobile App:

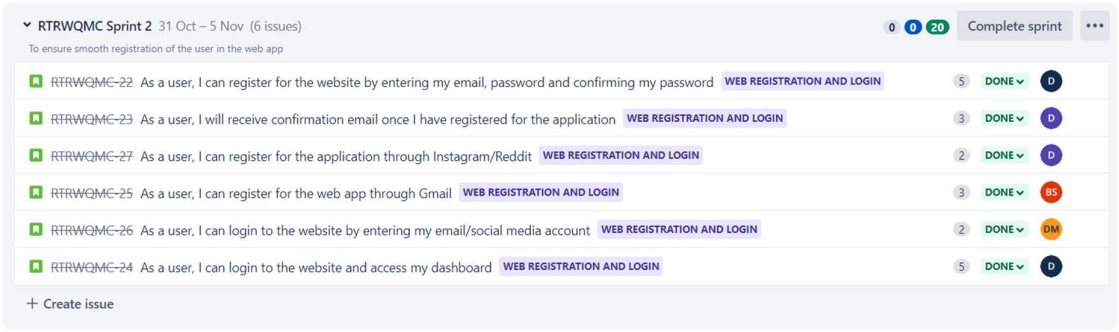
- Node Red flow for Sending data to MIT App
- Node Red flow for Control Unit and an HTTP link to receive the inputs simulated by user from MIT app

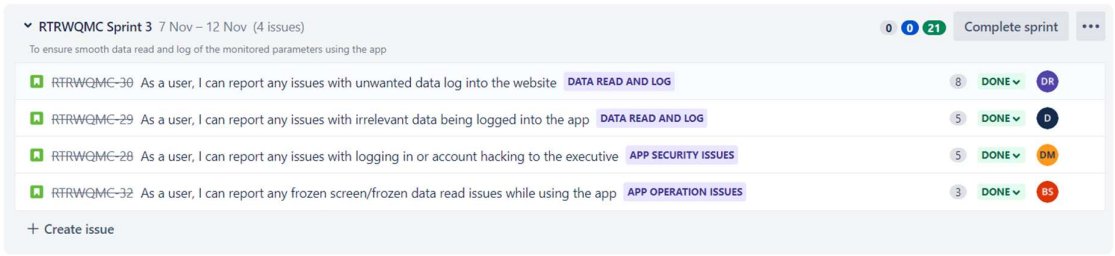
Sprint 4:

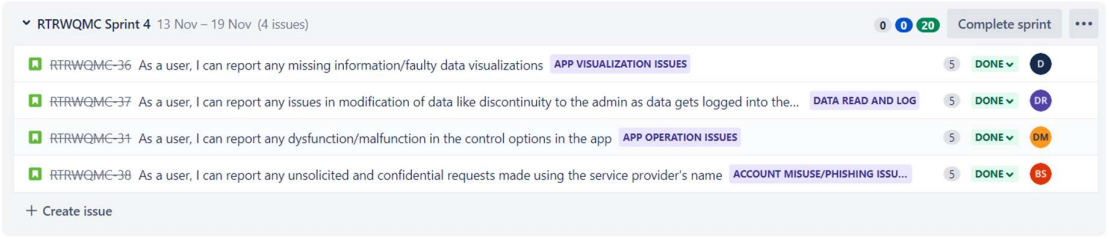
Building Mobile App:

- Design UI for Log-in Credentials of User
- Configure The Application For verifying the Log-in credentials
- Design UI to display the Water Turbidity, Hardness, pH and Temperature
- Configure The Application to receive the data from cloud
- Configure the mobile app for controlling motor using buttons

6.2 SPRINT DELIVERY SCHEDULE

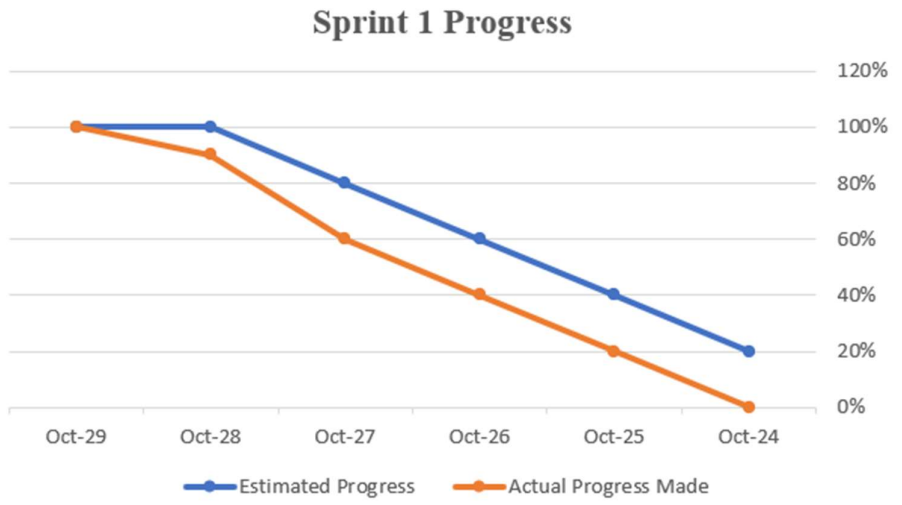


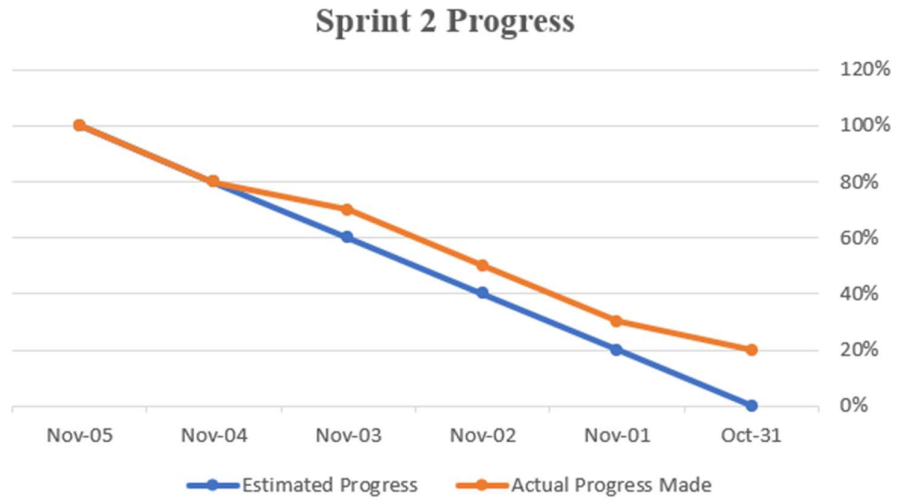


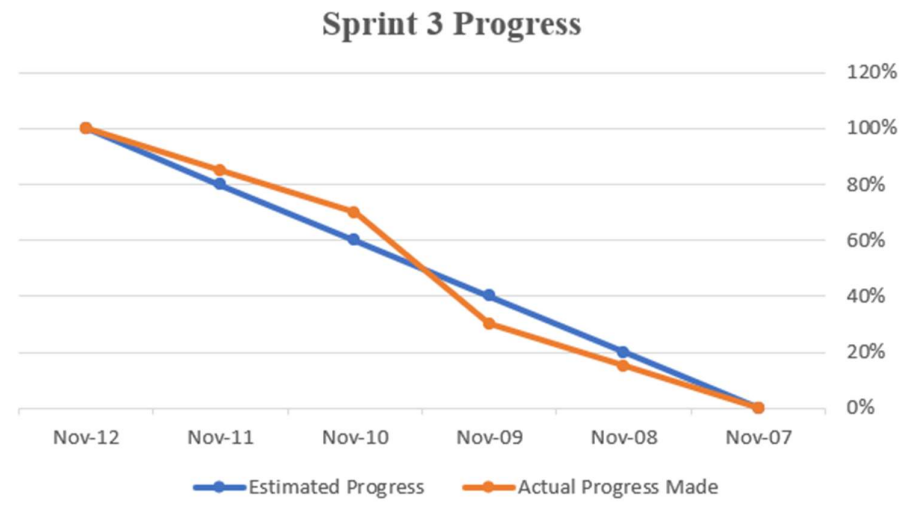


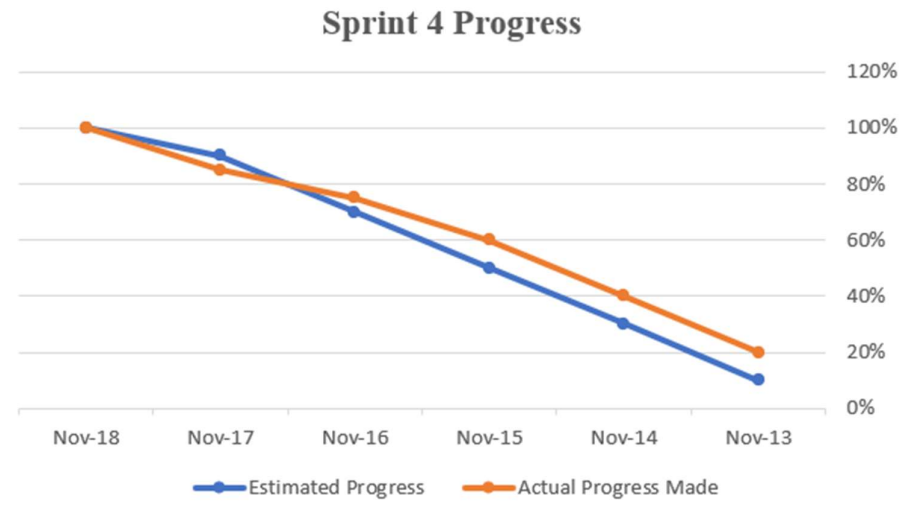
6.3 REPORTS FROM JIRA

a. Burndown Charts

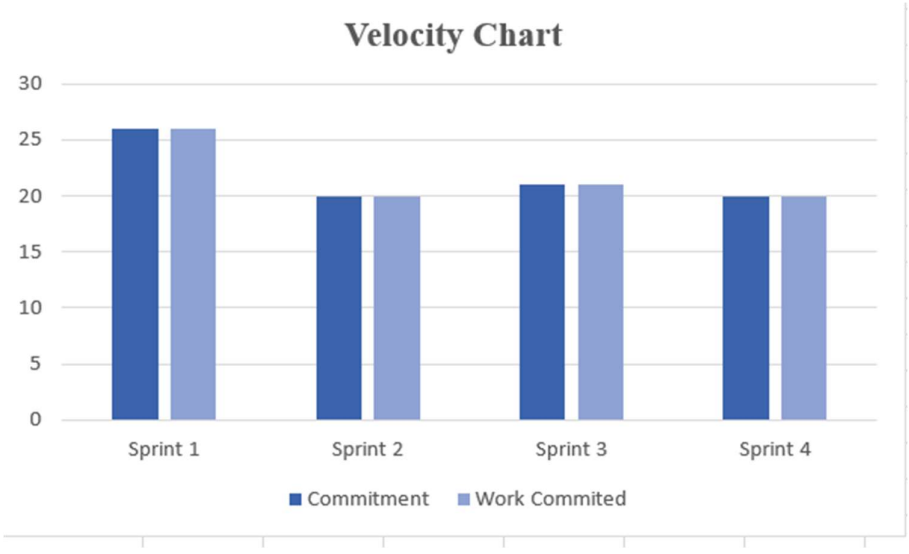




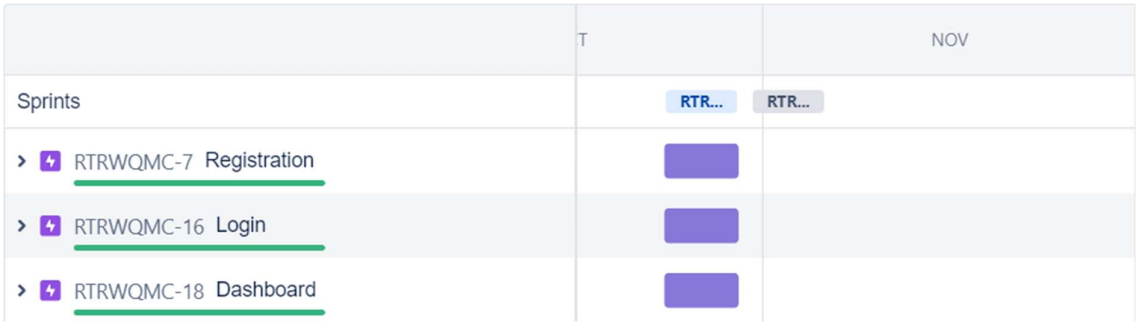


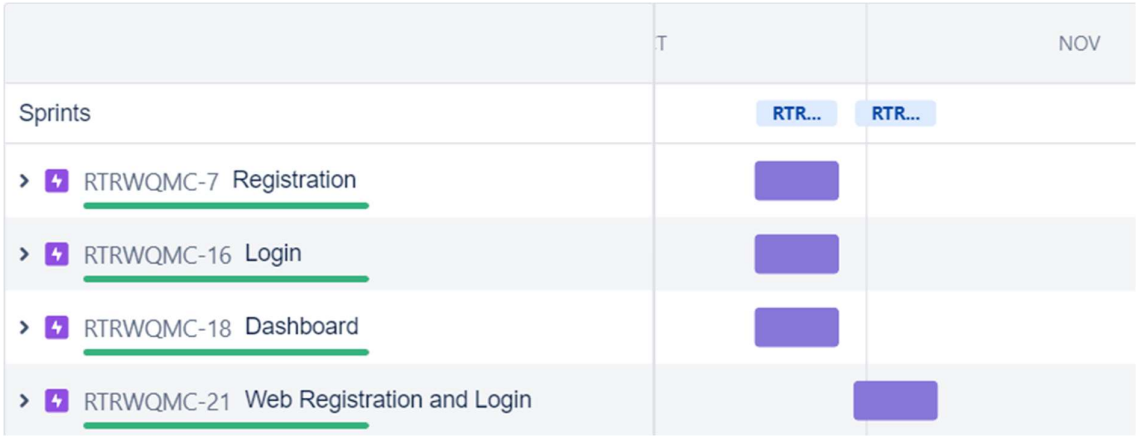


b. Velocity Track Burndown



c. Roadmap progress from Jira across sprints





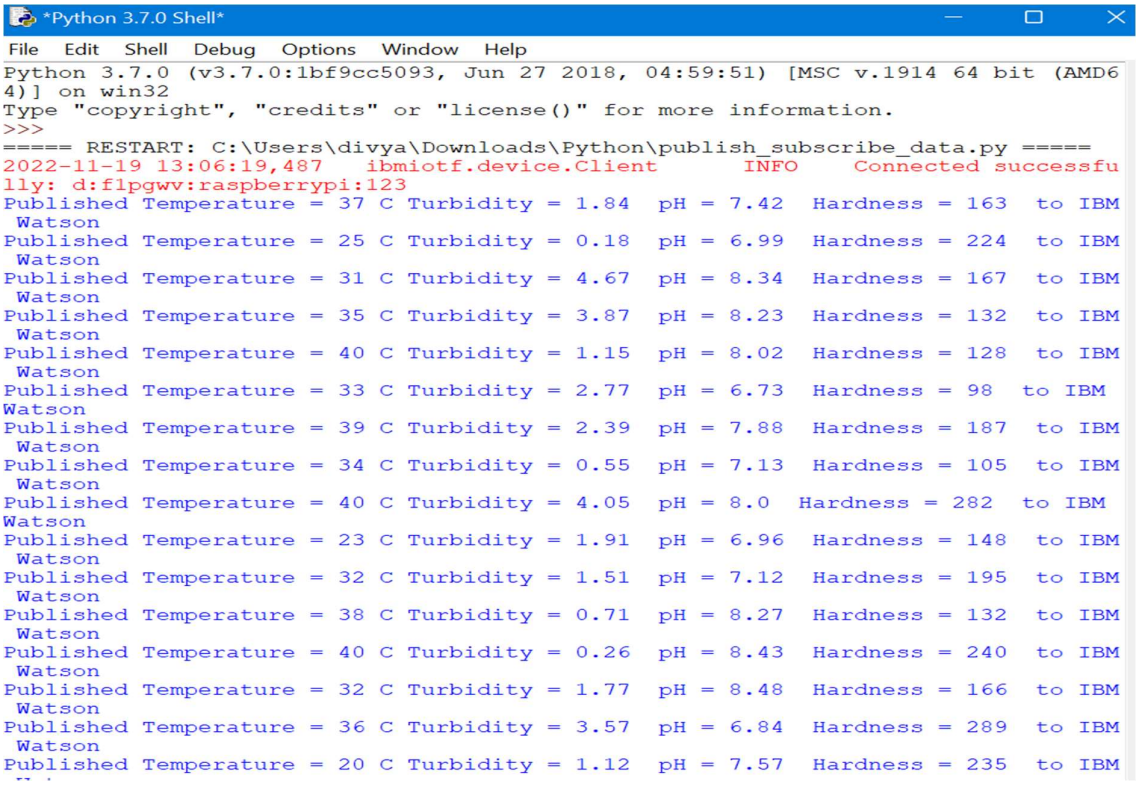
7. CODING AND SOLUTIONING

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


#Provide your IBM Watson Device Credentials
organization = "f1pgwv"
deviceType = "raspberrypi"
deviceId = "123"
authMethod = "token"
authToken = "12345678"

# Initialize GPIO


def myCommandCallback(cmd):
   print("Command received: %s" % cmd.data['command'])
   status=cmd.data['command']
   if status=="on":
      print ("control is on")
   else :
      print ("control 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(20,40)
        Turbidity=random.randint(1,5)
        pH=random.randint(2,10)
        Hardness=random.randint(75,300)

        data = { 'temp' : temp, 'Turbidity': Turbidity ,'pH': pH, 'Hardness': Hardness}
        #print data
        def myOnPublishCallback():
            print ("Published Temperature = %s C" % temp, "Turbidity = %s " % Turbidity,"pH =
%s " % pH,"Hardness = %s " % Hardness, "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:

Published data to IBM Watson Cloud.



8. TESTING

8.1 TEST CASES

Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Comments	TC for Automation(Y/N)	BUG ID	Executed By
LoginPage_TC_OO1	Functional	Home Page	Verify user is able to see the Login/Signup popup when user clicked on My account button	None	For SignUp: Enter User Name and Password and Enter Login Button	Sensed Parameters	Login/Signup popup should display	Working as expected	Pass	None	N	-	Dhivya S
LoginPage_TC_OO2	Functional	Home page	Verify user is able to log into application with Valid credentials	None	1.Click the app 2.Click on My Account dropdown button 3.Enter Valid username/email in Email test box 4.Enter valid password in password text box 5.Click on login button	Username: xyz@gmail.com Password: abc	User should navigate to user account homepage	Working as expected	Pass	None	N	-	Dhanalakshmi M
LoginPage_TC_OO3	Functional	Login page	Verify user is able to log into application with InValid credentials	None	1.Click the app 2.Click on My Account dropdown button 3.Enter Valid username/email in Email test box 4.Enter valid password in password text box 5.Click on login button	Username: xyz@gmail.com password: AbC	Application should show 'Incorrect email or password ' validation message.	Working as expected	Pass	None	N	-	Daphnie Ritika R
LoginPage_TC_OO4	Functional	Login page	Verify user is able to log into application with InValid credentials	None	1.Click the app 2.Click on My Account dropdown button 3.Enter Valid username/email in Email test box 4.Enter valid password in password text box 5.Click on login button	Username: s2c@gmail.com password: abc	Application should show 'Incorrect email or password ' validation message.	Working as expected	Pass	None	N	-	Balambal S
LoginPage_TC_OO5	Functional	Login page	Verify user is able to log into application with InValid credentials	None	1.Click the app 2.Click on My Account dropdown button 3.Enter Valid username/email in Email test box 4.Enter valid password in password text box 5.Click on login button	Username: xyz password: abc	Application should show 'Incorrect email or password ' validation message.	Working as expected	Pass	None	N	-	Balambal S

8.2 USER ACCEPTANCE TESTING

Defect Analysis

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	5	2	0	0	7
Duplicate	3	0	1	0	4
External	2	5	0	1	8
Fixed	7	2	1	2	12
Not Reproduced	0	0	1	0	1
Skipped	0	0	2	1	3
Won't Fix	0	0	0	1	1
Totals	17	9	5	5	36

Test case analysis

Security	10	0	0	10
Outsource Shipping	3	0	0	3
Exception Reporting	9	2	0	7
Final Report Output	10	0	0	10
Version Control	5	0	0	5

9.RESULTS

9.1 PERFORMANCE METRICS

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Project Development Phase

Performance Testing Template

Team ID	PNT2022TMID32888
Project Name	Project - Real-Time Rivers Water Quality Monitoring and Control

NFT - Risk Assessment

S.No	Project Name	Scope/feature	Functional Change	Hardware Changes	Software Changes	Impact of Downtime	Load/Volume Changes	Risk Score	Justification
1	RTRWQMaC	New	Low	No Changes	Moderate	<5 to 10%	>5 to 10%	GREEN	Through user use, risk issues were minimur
2	RTRWQMaC	New	Low	No Changes	Moderate	<4 to 6%	<3 to 4%	GREEN	Through user use, risk issues were minimur
3	RTRWQMaC	New	Moderate	No Changes	Moderate	<3 to 4%	<3 to 6%	GREEN	Through user use, risk issues were minimur
4	RTRWQMaC	New	Low	No Changes	Moderate	<4 to 6%	<3 to 4%	GREEN	Through user use, risk issues were minimur
5	RTRWQMaC	New	Low	No Changes	Moderate	<3 to 4%	>2 to 6%	GREEN	Through user use, risk issues were minimur

NFT - Detailed Test Plan

S.No	Project Overview	NFT Test approach	mptions/Dependencies/	Approvals/SignOff
1	RTRWQMaC	User Testing	NoAssumptions/User-Per	No scope change request will be made unless necessary

End Of Test Report

S.No	Project Overview	NFT Test approach	NFR - Met	Test Outcome	GO/NO-GO decisio	Recommendations	(Detected/Closed/Open)	Approvals/SignOff
1	RTRWQMaC	Performance	Yes	Good Performance; No frozer	GO	May try to evaluate the item	Open	No scope change request necessary
2	RTRWQMaC	Usability	Yes	Easy Usability across all ages	Go	-	Detected	No scope change request necessary

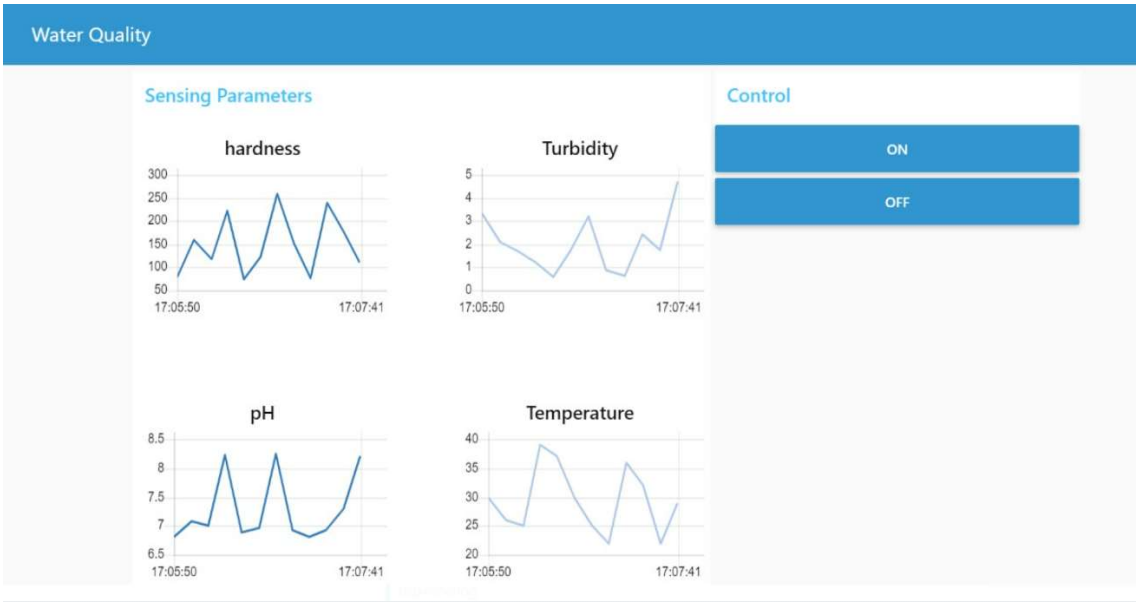
Performance Test: **Speed**: Moderately Fast; **Stability:** The app is stable for the runtime

Scalability Test: **Response Time:** Moderately Fast; **Throughput:** For the monitoring duration, throug

Usability Test: App is useful, easily accessible, easy to use for all ages, and is desirable

The real-time sensed parameters of turbidity, pH, temperature and hardness are monitored and have been sent to the IBM Watson Cloud and hence the continuous database values are stored. This is integrated with Node-RED service. and are displayed in the MIT App inventor as the final output.

These are the visualized results of the real time-sensed parameters and Control buttons.



This is the final output in the user interface application.

10. ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- Ensures the inherent need for clean water by continuously monitoring rivers about their respective pH, turbidity, temperature and hardness levels.
- Is a motivation to lesser dumping to industrial, medical and untreated waste into the river water and when on implementation certain rules on dumping will be implemented by the government which will be a step toward a cleaner Earth.
- Ensures prevention of water borne diseases that affect mankind due to poor hygiene and consumption and usage of contaminated water,
- Will be a major factor to ensure the life cycle and food cycle as clean water means less land and marine animals that die while ensure a proper functioning of the ecosystem,
- Marine life would benefit for the good with a cleaner living habitat, the number of organisms getting poisoned and fishes dying will reduce. This will in turn ensure human health as consuming poisoned fish will lead to health issues.
- Most of the business need clean water as a raw material for manufacture of their products, mainly food industries, Sea food business and other 'ocean as a resource' industries get affected with business when the water quality is not usable. So businesses and corporations also benefit from a river monitoring system.
- Could influence individuals and organizations on the bigger picture to be precautionous of the ill effects and hence take other environmental measures they can to ensure clean water.

DISADVANTAGES:

- The monitoring and solution control system does not do purification of water which might be what many people could be thinking to benefit them as an individual
- There needs to be internet connection at al time to get the continuous values of the parameters read as this is an IOT implementation. This may not be facilitated in some remote areas.

11. CONCLUSION :

The proposed solution uses Python code and MIT App is used for the front-end use interface and the sensed parameters are sent to the IBM Watson cloud using Node Red as the flow diagram virtual gateway to integrate all of these platforms together. Hence the real time

sensed parameters are displayed and visualized in real time. This solution will help benefit the various sectors including humans daily water needs, marine life survival, business and the surplus needs for clean water are given a viable solution with the proposed monitoring system. This will lead to reduction of sewage and other wastes mindlessly dumped into the river and hence ensure a hygienic environment with uncontaminated water.

12. FUTURE SCOPE

- Future scope can be extended to predict and the respective levels of the sensed parameters of pH, hardness, turbidity and temperature. Other parameters for sensing can be introduced and purification can be performed by the use of AI(Artificial Intelligence) and Machine learning algorithms which could be helpful to get an idea on the trend and rate of wastes dumped and type of wastes dumped and its prediction.
- Also using WSNs(Wireless sensor networks) inclusive of microcontrollers for communication between the nodes present inside the IOT system can be done. This can find the range within which the devices will be able to communicate with each other. This is a further scope that can be explored.

13. APPENDIX

SOURCE CODE

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

#Provide your IBM Watson Device Credentials
organization = "bxobbs"
deviceType = "b5ibm"
deviceId = "b5device"
authMethod = "token"
authToken = "b55m1eibm"
```

```
# 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(0,100)
      Humid=random.randint(0,100)
```

```
        data = { 'temp' : temp, 'Humid': Humid }
        #print data
        def myOnPublishCallback():
            print ("Published Temperature = %s C" % temp, "Humidity = %s %%" % Humid, "to
IBM Watson")

        success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
        if not success:
            print("Not connected to IoTF")
        time.sleep(1)

        deviceCli.commandCallback = myCommandCallback

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

ibmiotpublishsubscribe.py

Displaying ibmiotpublishsubscribe.py

GITHUB LINK

https://github.com/IBM-EPBL/IBM-Project-20454-1659719705

PROJECT DEMO LINK

project-demo-hfsrfzru_ngtEh8LP.mpg