PROJECT BASED EXPERIENTIAL LEARNING PROGRAM (NALAIYA THIRAN)

Real-Time River Water Quality Monitoring and Control System

A PROJECT REPORT

Submitted by

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Perundurai, Erode

NOVEMBER 2022

1. INTRODUCTION

1.1 Project Overview

The need for effective and efficient monitoring, evaluation and control of water quality in residential area has become more demanding in this era of urbanization, pollution and population growth. Ensuring safe water supply of drinking water is big challenge for modern civilization. Traditional methods that rely on collecting water samples, testing and analyses in water laboratories are not only costly but also lack capability for real-time data capture, analyses and fast dissemination of information to relevant stakeholders for making timely and informed decisions. In this paper, a real time water quality monitoring system prototype developed for water quality monitoring in Residential home is presented. The development was preceded by evaluation of prevailing environment including availability of cellular network coverage at the site of operation. It detects water temperature, dissolved oxygen, pH, and electrical conductivity in real-time and disseminates the information in graphical and tabular formats to relevant stakeholders through a web-based portal and mobile phone platforms. The experimental results show that the system has great prospect and can be used to operate in real world environment for optimum control and protection of water resources by providing key actors with relevant and timely information to facilitate quick action taking.

1.2 Purpose

Monitoring data is used to determine whether or not pollution regulations are being complied with. From oil spills and radiation leaks to floods and mass erosion, water quality monitoring data is a must when developing emergency strategies. To protect, restore, and enhance environmental quality towards good public health, environmental integrity, and economic viability. Monitoring is essential to ensure that the intended project objective can be achieved within the given time frame following the activities as planned to be carried out by project personnel. Quality control consists of evaluating 2 main processes during data collection. One is instrumentation control, which monitors the instrument used to collect data. The other is population quality control, which monitors the sample to make sure it is representative of the targetpopulation.

2.LITERATURE SURVEY

Ahmed Abbas Fadel , Mohamed Ibrahim Shujaa, Department of Computer Engineering Techniques, Middle Technical University (MTU), Iraq proposed a Water treatment monitoring systems are presently divided into manual and dynamic systems. Due to, the constant changes in water, either due to seasonal changes in water chemistry or due to the operative conditions of the industrial environment, the dynamic systems have to be utilized by the water manufacturers. However, water is very beneficial for life and human health, therefore to reduce the endangerment of pollution, by improving and increasing the plant operation in addition to production. This paper suggests a new technique for water factory manufacturers by adopting wireless sensor nodes. The monitor node connected with a microcontroller device using Esp32 as transmitter and receiver nodes. The node sends its statues over the wireless network utilizing a defined internet protocol (IP). The proposed system shows its effectiveness in water monitoring systems through synchronous water monitoring and simple configuration compared to traditional systems

Kartik Maheshwari , Adrija Chakraborty proposed a Monitoring the quality of water and its proper management is crucial for any industrial and economic application. The global shortage of water demands a sustainable solution to optimize its usage. The Internet of Things provides a robust and cost-effective solution for real-time monitoring of various parameters of water. The paper aims to implement an intelligent water quality monitoring system with the aid of IoT. The proposed system was successfully implemented to determine the turbidity, TDS, flow rate and the level of water for a given sample. The data obtained from the sensors are uploaded to the ThingSpeak dashboard for online monitoring purpose. Besides, an SMS alert is sent to the user whenever the turbidity and TDS values have crossed the threshold limit defined for good quality water

Varsha Lakshmikantha, Anjitha Hiriyannagowda, Akshay Manjunath, Aruna Patted, Jagadeesh Basavaiah , Audre Arlene Anthony a Department of Electronics and Communication Engineering, Vidyavardhaka College of Engineering, Mysuru, India proposed a 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

Spoorthi L , Nikhitha Kashyap , Rajatha , Priyanka M , Prof. Bhargavi K Department of Electronics and Communication Engineering, Vidyavardhaka College of Engineering, Mysuru, India proposed a Wireless communication developments are creating new sensor capabilities. The current developments in the field of sensor networks are critical for environmental applications. Internet of Things (IoT) allows connections among various devices with the ability to exchange and gather data. IoT also extends its capability to environmental issues in addition to automation industry by using industry 4.0. As water is one of the basic needs of human survival, it is required to incorporate some mechanism to monitor water quality time to time. Around 40% of deaths are caused due to contaminated water in the world. Hence, there is a necessity to ensure supply of purified drinking water for the people both in cities and villages. Water Quality Monitoring (WQM) is a cost-effective and efficient system designed to monitor drinking water quality which makes use of Internet of Things (IoT) technology

Vennam Madhavireddy, B. Koteswarrao 1PG Student, Department of Electronics and Communication Engineering, Marri Laxman Reddy Institute of Technology and Management, Hyderabad, India. Department of Electronics and Communication Engineering, Marri Laxman Reddy Institute of Technology and Management, Hyderabad, India.The economical and effective system of water quality observation is the most robust implementation of impure water. Drinking water could be precious for all people as water utilities face more challenges. These challenges arise due to the high population, fewer water resources, etc. So, different methods are used to monitor in the real-time water quality. To make sure that safe distribution of water is done, it must be observed in real time for a new method in the "Internet of Things (IoT)" based water quality has been projected.

Real time water quality observation is examined by data acquisition, method, and transmission with an increase in the wireless device network method in the IoT. Microcontroller and the processed values remotely to the core controller ARM with a WI-FI protocol are used to interface the measured values from the sensors. 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 be ON.

A.N.Prasad, K. A. Mamun, F. R. Islam, H. Haqva School of Engineering and Physics University of the South Pacific Laucala, Fiji Islands — Nowadays Internet of Things (IoT) and Remote Sensing (RS) techniques are used in different area of research for monitoring, collecting and analysis data from remote locations. Due to the vast increase in global industrial output, rural to urban drift and the over-utilization of land and sea resources, the quality of water available to people has deteriorated greatly. The high use of fertilizers in farms and also other chemicals in sectors such as mining and construction have contributed immensely to the overall reduction of water quality globally. Water is an essential need for human survival and therefore there must be mechanisms put in place to vigorously test the quality of water that made available for drinking in town and city articulated supplies and as well as the rivers, creeks and shoreline that surround our towns and cities. The availability of good quality water is paramount in preventing outbreaks of water-borne diseases as well as improving the quality of life. Fiji Islands are located in the vast Pacific Ocean which requires a frequent data collecting network for the water quality monitoring and IoT and RS can improve the existing measurement. This paper presents a smart water quality monitoring system for Fiji, using IoT and remote sensing technology.

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S. Nalini Durga1 , M. Ramakrishna, G. Dayanandam Research Scholar, School of Sciences, Sri Padmavathi Mahila Visvavidyalayam, Tirupathi. India Water is the most precious and valuable resource. With the increase in population, availability of clean water has become a problem. Today, water-supply department as well as common man is facing problems in real-time operations like water distribution and conservation efficiency. Therefore it is important to find a solution to address water wastage through efficient water monitoring and control system. In this paper, the problem is solved through autonomous water tank filling system using IoT where in embedded sensors are used to monitor the tank status along with some other key attributes like power supply, incoming water supply in real-time. Our intention of this research work was to establish a flexible, economical, easy configurable and most importantly, a portable system which can solve our water wastage problem along with saving the electrical energy. This enhances the efficiency of water distribution and reduces wastage.

Sefali Surabhi Rout1 , Hitesh Mohapatra2 , Rudra Kalyan Nayak3 , Ramamani Tripathy4 , Dhiraj Bhise 5 , S.P.Patil6 , Amiya Kumar Rath7 1,2,7 Department of CS&E, Veer Surendra Sai University of Technology, Burla, Sambalpur- 768018, OD, India 2,3Department of Computer Science and Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram-522502, Guntur, AP, India Conservation of water in urban areas is an ongoing challenge in which technology like IoT and WSN is playing a very crucial role. Studies show that 54% of India is facing absolute water scarcity or high economic water stress. To address this challenge the forecasting and monitoring of water consumption along with effective management and distribution are important. This paper implements the seasonal threshold constraint on water distribution which conserves a significant amount of water loss over uniform supply around the year by considering end-user behavior changes according to the season. The results have been confirmed through simulation of the proposed algorithm Weather-based Smart Water Monitoring (WSWM). This extensive study only suggests a possible alternative approach to design the water distribution system to conserve water. However, more work is required for achieving an optimized approach for sustainable urban water management

Smart Meter for Water Utilization using IoT D.Anandhavalli1, K.S. Sangeetha2, V. Priya Dharshini3, B. Lukshana Fathima proposed Smart water meter is a device that measures the amount of water consumed by householders who have the device fitted within their premises. Water conservation is a big issue in many apartments. A common meter is fitted and cumulative consumption amount is shared among households where they are being charged more than what is to be paid. There are several idea to overcome this issue. In this paper we have proposed a solution to this issue in which a device is used to calculate the flow rate and quantity of water consumed by the householders and send it to the cloud to monitor the consumption of water.

cili Yanga , Shuang-Hua Yangb , Ewa Magierac , Wojciech Froelichc , Tomasz Jachc , Chrysi LaspidouAs proposed the water resource is becoming scarce, conservation of water has a high priority around the globe, study on water management and conservation becomes an important research problem. People are increasingly becoming more individual households, which tend to be less efficient, requiring more resources per capita than larger households. In order to address these challenges, this paper presents the achievements of monitoring domestic water consumption at the appliance level and intervening people’s water usage behavior which have been made in ISS-EWATUS, an European Commission funded FP7 project. The water amount consumed by every household appliance is wirelessly recorded with the exact consumption time and stored in a central database. People’s water consumption behavior is likely affected by the real-time water consumption awareness, instant practical advices regarding water-saving activities and classification of water consumption behavior for individuals, all of which are provided by a decision support system deployed as a mobile application in a tablet or any other mobile devices. Only the enhanced water consumption awareness is presented in this paper due to the space limitation. The integrated monitoring and decision support system has been deployed and in use in Sosnowiec in Poland and Skiathos in Greece since March 2015. The domestic water consumption monitoring system at appliance level and the local DSS for affecting people’s water consumption behavior are innovative and have little seen before according to the knowledge of the authors.

1.3 Existing problem

Rivers and streams drain water that falls in upland areas. Moving water dilutes and decomposes pollutants more rapidly than standing water, but many rivers and streams are significantly polluted all around the world. Water pollution has very negative effects on public health. A lot of diseases result from drinking or being in contact with contaminated water, such as diarrhea, cholera, typhoid, dysentery or skin infections. In zones where there is no available drinking water, the main risk is dehydration obviously.

References

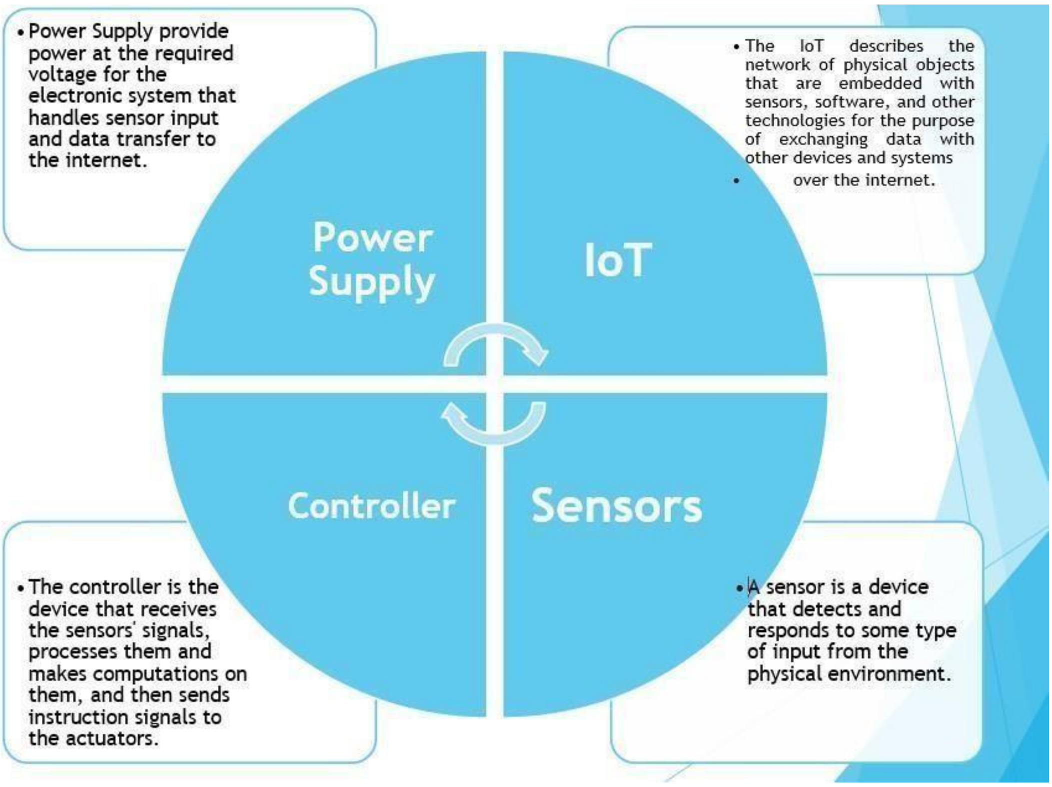
1. Sridharan, S. (2014) Water Quality Monitoring System Using Wireless Sensor Network. International Journal of Electronic Communications Engineering Advanced Research,3,399-402
2. Losilla, F., Garcia-Sanchez, A.-J., Garcia-Sanchez, F., Garcia-Haro, J. and Haas, Z.J. (2011) A Comprehensive Approach to WSN-Based ITS Application. Sensors, 10, 10220-10265. http://dx.doi.org/10.3390/s111110220
3. Mo Deqing, Zhao Ying, Chen Shangsong, “Automatic Measurement and Reporting System of Water Quality Based on GSM,” 2012 International Conference on Intelligent System Design and Engineering Application.
4. Nikhil Kedia, Water Quality Monitoring for Rural Areas- A Sensor Cloud Based Economical Project, in 1st International Conference on Next Generation Computing Technologies (NGCT2015) Dehradun, India, 4-5 September 2015. 978- 1-4673-6809-4/15/$31.00 ©2015 IEEE

Problem Statement Definition

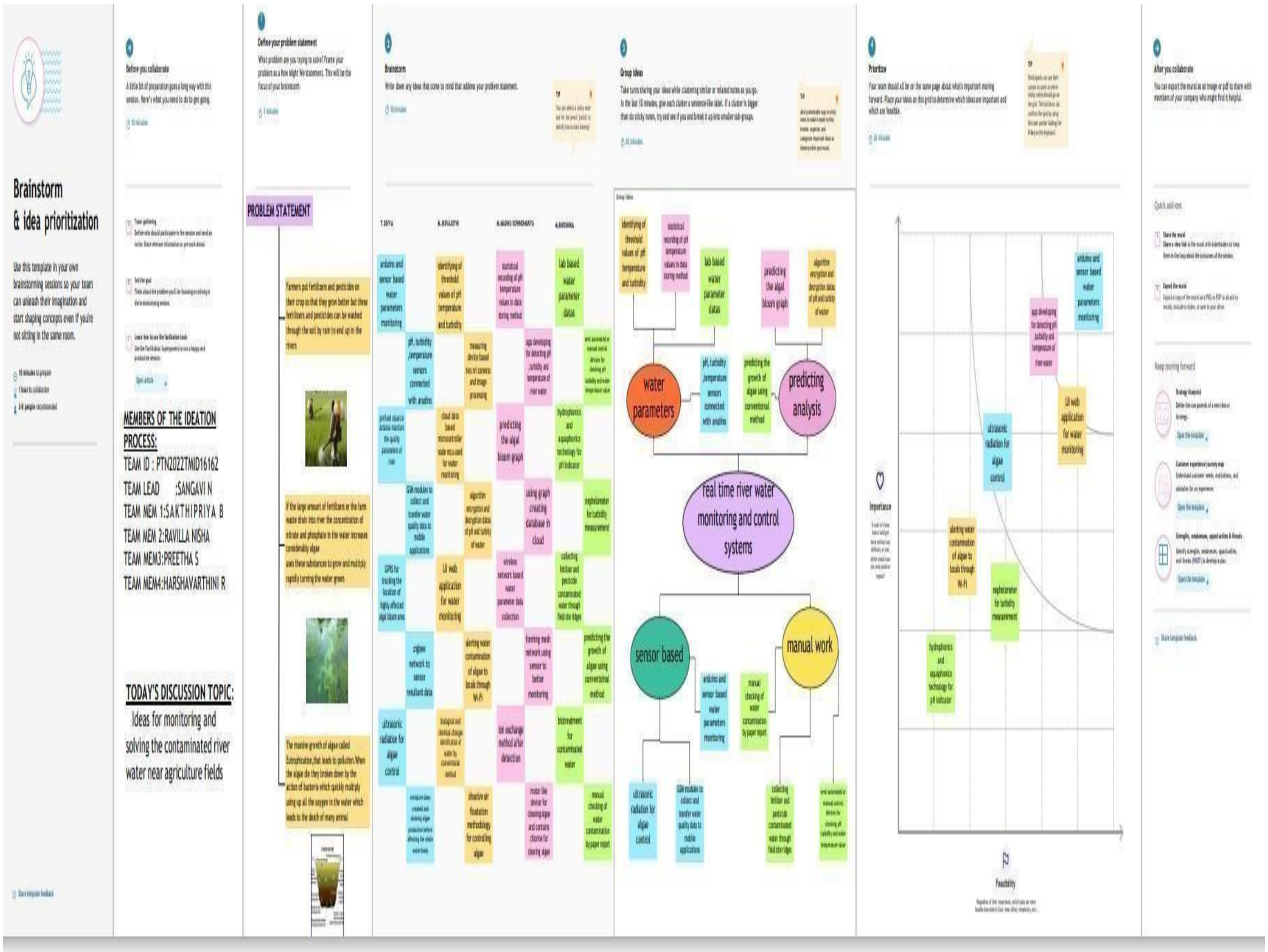
Due to the fast growing urbanization supply of safe drinking water is a challenge for the every city authority. Water can be polluted any time. So the water we reserved in the water tank at our roof top or basement in our society or apartment may not be safe. Still in India most of the people use simple water purifier that is not enough to get surety of pure water. Sometimes the water has dangerous particles or chemical mixed and general purpose water purifier cannot purify that. And it's impossible to check the quality of water manually in every time. So an automatic real-time monitoring system is required to monitor the health of the water reserved in our water tank of the society or apartment. So it can warn us automatically if there is any problem with the reserved water. And we can check the quality of the water anytime and from anywhere. By keeping this mind we designed this system especially for residential areas.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming



3.3 Proposed Solution

The main aim is to develop a system for continuous monitoring of river water quality at remote places using wireless sensor networks with low power consumption, low-cost and high detection accuracy. pH, conductivity, turbidity level, etc. are the limits that are analysed to improve the water quality.

Following are the aims of idea implementation

(a) To measure water parameters such as pH, dissolved oxygen, turbidity, conductivity, etc. using available sensors at a remote place.

(b) To assemble data from various sensor nodes and send it to the base station by the wireless channel.

(c) To simulate and evaluate quality parameters for quality control.

(d) To intimate to an authorized person routinely when water quality detected does not match the pre-set standards, so that, necessary actions can be taken.

In the proposed architecture, each water reservoir will be attached with a sensor node equipped with a set of sensor probes capable of measuring the parameters like pH, turbidity etc. According to the specifications of the sensor probes and the processor board of the sensor the signal conditioning circuit will be designed to generate the sensor output to the processor board through Analog to Digital Converter. The processor board processes the data according to the quality specifications and transmits to the central server through the transceiver. The measured data in each of the reservoir shall be sent to the central server through the respective transceivers either directly or indirectly through other sensor or repeater nodes.

3.4 Problem Solution fit

1. CUSTOMERSEGMENT(S)

*Farmers (agricultural use)

*Village people, who are living near to river.

2.CUSTOMER CONSTRAINTS

1. Salination
2. Pollution
3. Algae &sewage

3. AVAILABLESOLUTIONS

1. Turning Sewage Water Int Drinkable Water (**On** putting the purifier in any water container)

2. providing improved control, which reduces waste and defects.

4. JOBS-TO-BE-DONE / PROBLEMS

- Use Less Plastic
- Do Not Dispose of Oils in the Sink
- Handle Toxic Chemicals Properly
- Plant trees in catchment areas of rivers and also on banks.

5. PROBLEM ROOT CAUSE

- domestic sewage
- early rainwater and urban sewage
- industrial waste water

6. BEHAVIOUR

1. Sensors are fixed in river to continuously monitor the water.

2. After collecting data, the controller transmits to base station (monitoring area)

7.solutions

- Using Ph sensor,Turbidity sensor & temperature sensor for continue monitoring.
- Using purifier or by solar RO model controlling done

8.Triggers

1. To make use of river water efficiently and also pollution free.

2. To make use of river water for agriculture.

Overview of project

1. With use of effective sensor collecting data and transmitting is done with help of Iot and Controller

2. Analysing data and controlling of river quality is done.

4. REQUIREMENT ANALYSIS

4.1 Functional requirement

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Arduino(control system)	Sensors are interfaced to Arduino and it collects measurements data periodically from sensors.
FR-2	WSN Sensor	Multiple sensor nodes installed for the detection of pH, temperature, dust particles, turbidity.
FR-3	Software Design Requirements	WSN requires IoT platform which requires Neural Network Model to classify water quality as Good Or Bad. IoT integrated big data analytics to store data in cloud and analyze it constantly.
FR-4	LCD/PC/Mobile display	Displays the resulting sensed pH, temperature, turbidity. If ,acquired value > Threshold value, then comment=BAD. If, acquired value < Threshold value, then comment=GOOD.

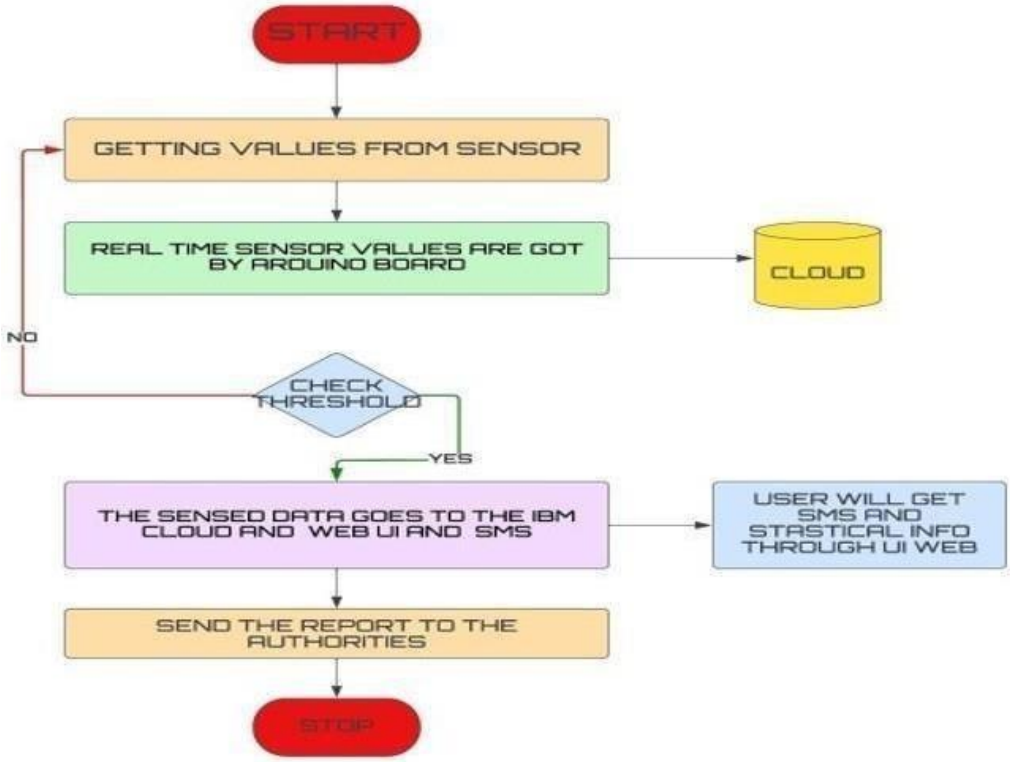
Non-functional Requirements:

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

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	It is important to monitor water quality to ensure that, it is safe for humans to drink it as well as for wild life and marine life and to understand environmental impacts and to not harm sea life.
NFR-2	**Security**	The IoT networks are incredibly safe and communication speed is also high. The technology comfortably resolves all the issues.
NFR-3	**Reliability**	The water quality and monitoring system is reliable and it's output can be assured. Since standardized hardware components and software designs are used.
NFR-4	**Performance**	Real-time quality of water is executed and alertring the authorities if water quality is not good.
NFR-5	**Availability**	The monitoring system is made available for use at any time with accuracy.
NFR-6	**Scalability**	The system with high frequency, high mobility and low powered and cost-effective.

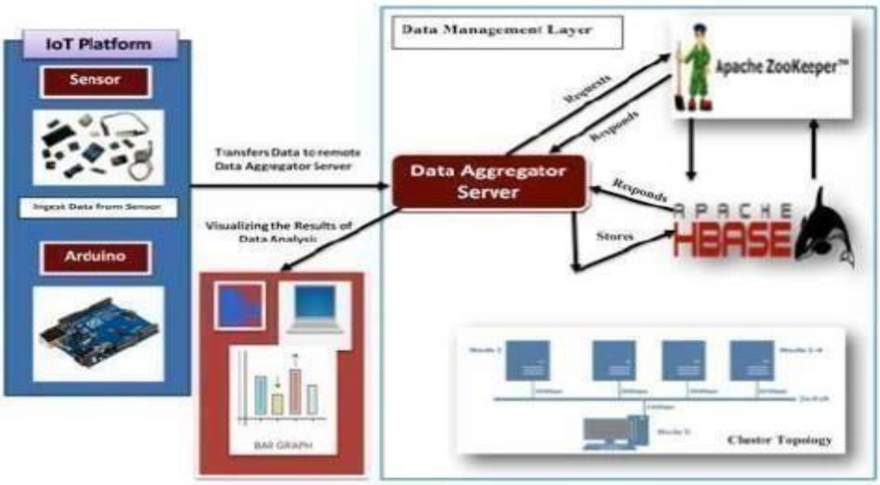
5. PROJECT DESIGN

5.1 Data Flow Diagrams



5.2 Solution & Technical Architecture

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



- **Arduino MegaBoard.**

Arduino is an open-source electronics prototyping platform based on flexible, easy-to- use hardware and software. Its intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. Or more simply, you load on some code and it can read sensors, perform actions based on inputs from buttons, control motors, and accept shields to further expand its capabilities. Really, you can do almost anything.

All Arduino boards have one thing in common: they are programmed through the Arduino IDE. This is the software that allows you to write and upload code. Beyond that, there can be a lot of differences. The number of inputs and outputs (how many sensors, LEDs, and buttons you can use on a single board), speed, operating voltage, and form factor are just a few of the variables. Some boards are designed to be embedded and have no programming interface (hardware) which you would need to buy separately. Some can run directly from a 3.7V battery, others need at least 5V.

Check the chart on the next page to find the right Arduino for your project.

Fig 2 :Ardino mega board

- **liquid-crystal display (LCD):**

It is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome.[1] LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and seven- segment displays, as in a digital clock.

- **The Temperature and PH sensor.**

To measure the temperature of a water tank and log it via the Arduino. The idea is to maintain the temperature of the water at 25-30C at all times. I've noticed that most applications have used a sensor such as DS18S20 or TMP35/TMP36/TMP37. but since my application requires to measure the temperature in water, I think a more suitable sensor should have a waterproof probe (or external probe).

The usual way is to contain the water inside a tank / container which can transmit heat – usually metal. To the outside of this is then bonded the temperature sensor – be that a simple bi- metallic strip thermostat, or a more complex temperature sensing transducer. Of course, this requires a metal tank, and that will radiate heat, which will be wasteful. Ideally you would want some form of waterproof probe. You haven't mentioned the amount of water you're dealing with – how big is the tank? How deep especially.There are thermocouples available in a rigid probe form – quite how waterproof these are I'm not sure, but these are never very long, so you won't be able to get it more than 6 inches or so into the water before you risk complete submersion.

- **The Turbidity Sensor**

Turbidity is an indicator often used to find the amount of suspended sediment in water. By cumbersome mechanical

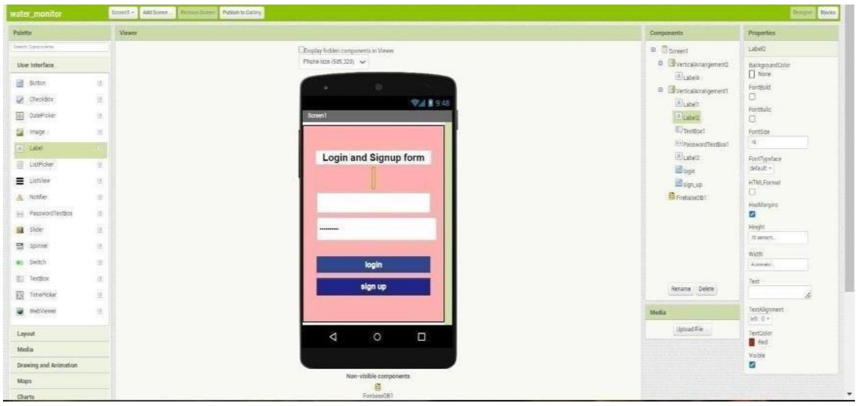
sampling, it is possible to measure the concentration of suspended solids (in mg/l) in water, but turbidity is increasingly used instead, as it is easy to use and cheaper too. It is an ecologically important parameter as the various effects of suspended solids in aquatic ecosystems are due to their light scattering properties rather than their absolute mass.

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 email, password, and confirming my password.	I can access my account/dashboard	High	Sprint-1
		USN-2	As a user, I will receive a confirmation email once I have registered for the application	I can receive e confirmation email & click confirm	High	Sprint-2
		USN-3	As a user, I can register for the application through Google	I can register & access the dashboard with Google	High	Sprint-1
		USN-4	As a user, I can register for the application through Gmail	I can register through the mail.	Medium	Sprint-2
	Login	USN-5	As a user, I can log into the application by entering email, password & captcha	I can receive login credentials.	High	Sprint-1
	Interface	USN-6	As a user, the interface should be user-friendly manner	I can able to access easily.	Medium	Sprint-1
Customer (Web user)	dashboard	WUSN-1	As a web user, I can access the specific info (ph value, temp, humidity, quality).	I can able to know the quality of the water.	High	Sprint-1
Customer Care Executive (input)	View manner	CCE-1	As a customer care, I can view data in visual representation manner(graph)	I can easily understand by visuals.	High	Sprint-1
	Taste	CCE-2	As a customer care, I can able to view the quality(salty) of the water	I can easily know whether it is salty or not	High	Sprint-1
	Color visibility	CCE-3	As a customer care, I can able predict the water color	I can easily know the condition by color	High	Sprint-1
Administrator	Risk tolerant	ADMIN-1	An administrator who Is handling the system should update and take care of the application.	Admin should monitor the records properly.	High	Sprint-2

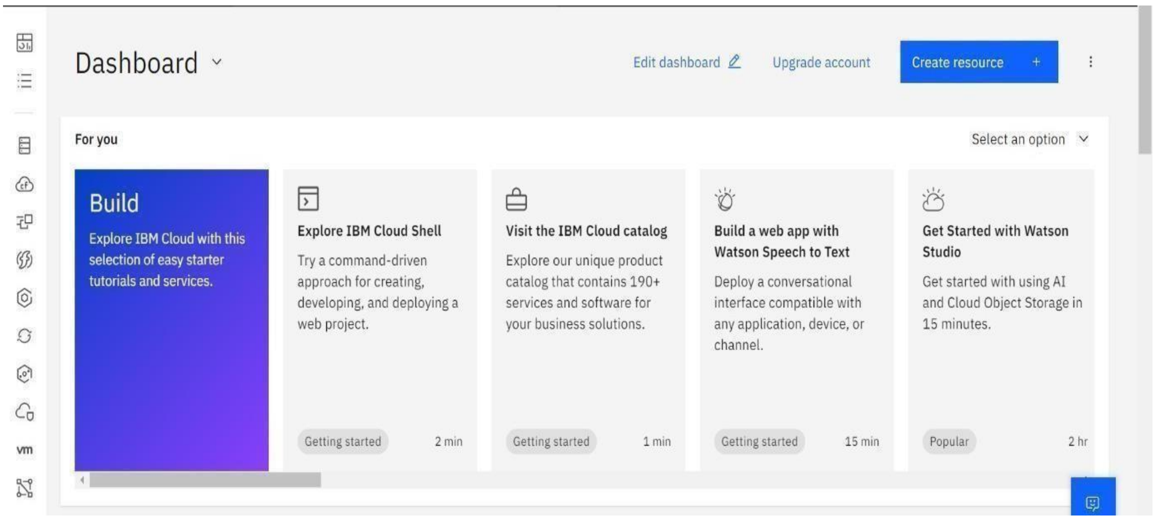
6. PROJECT PLANNING & SCHEDULING

SPRINT 1 : LOGIN PAGE:

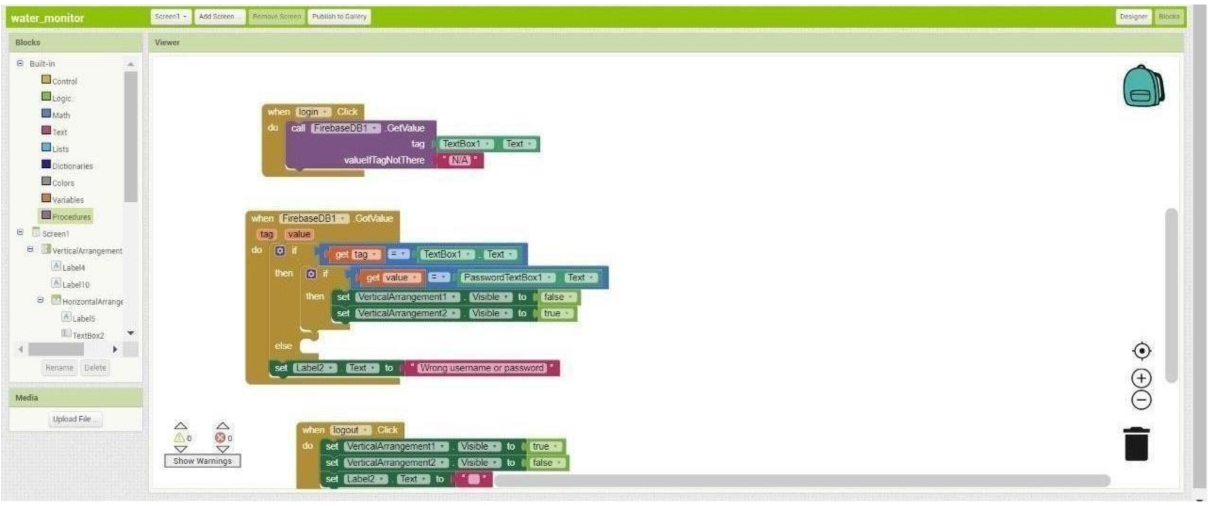


MONITORING WINDOW:

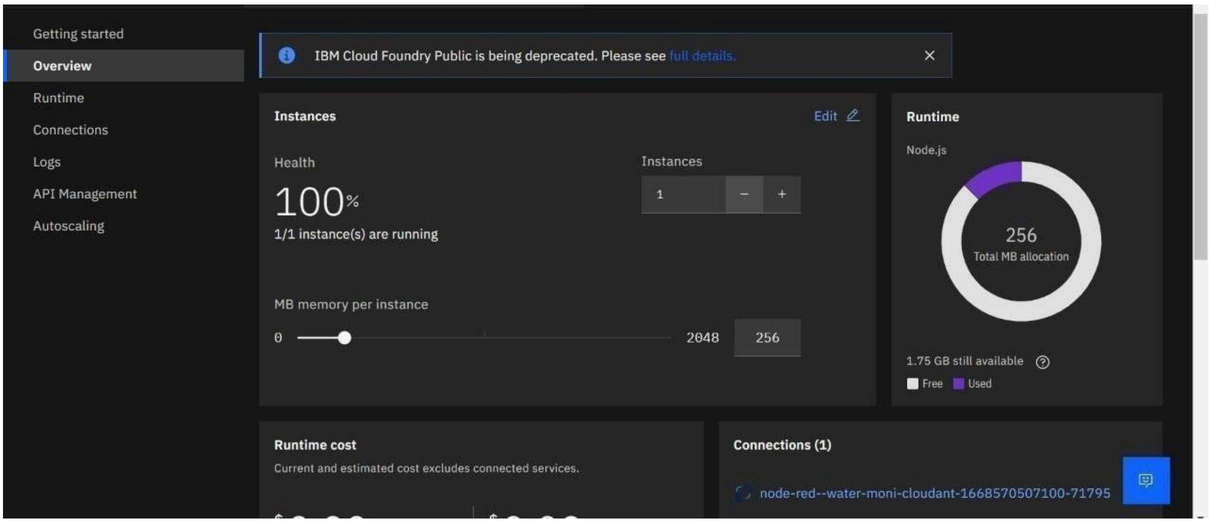
IBM CLOUD ACCOUNT- DASHBOARD:



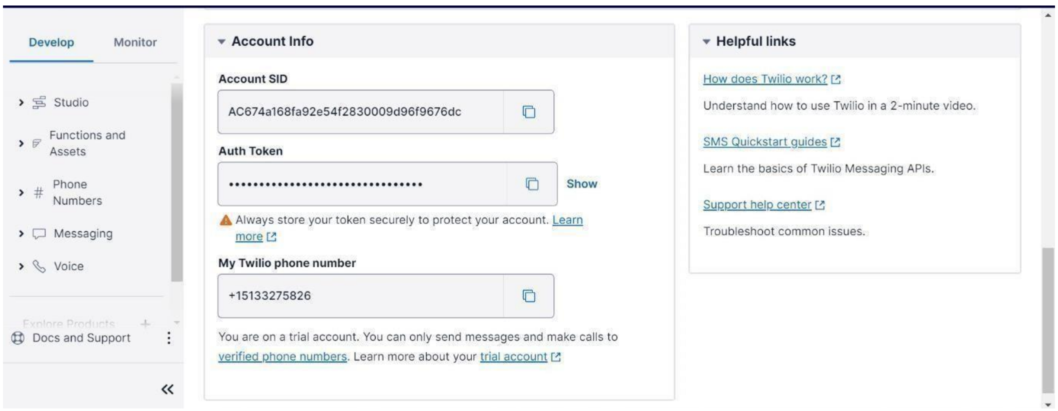
SECURE LOGIN: : Real Time Database Connection



NODE RED FLOW



Twilio account creation:



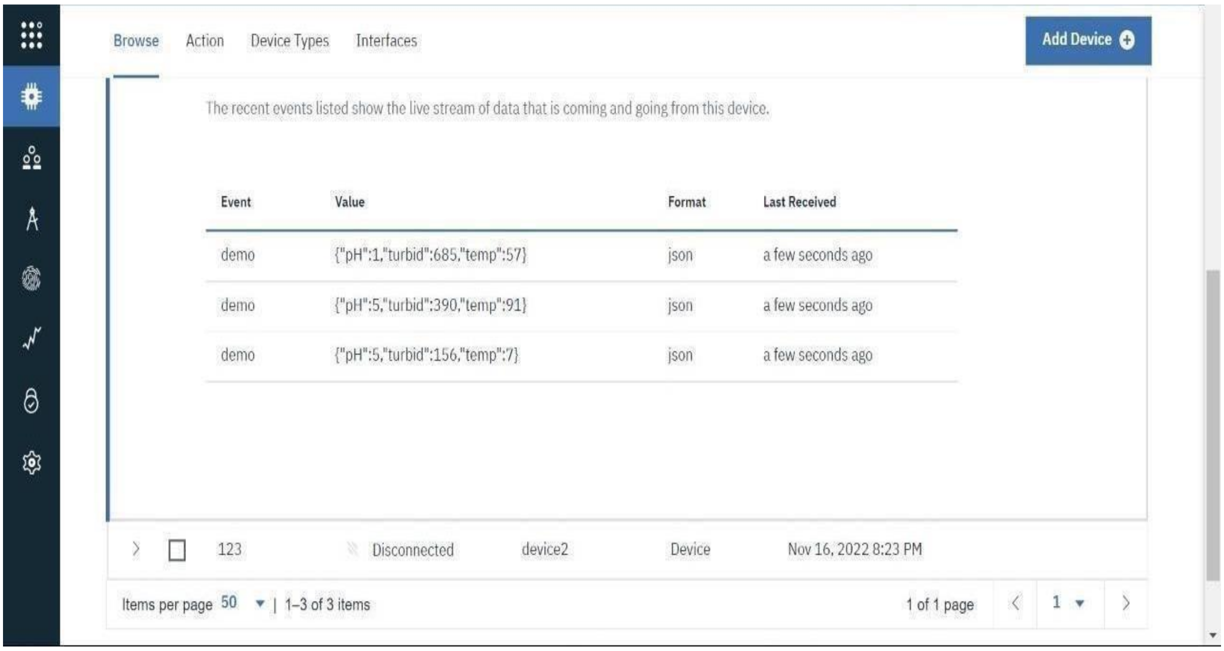
SPRINT 2 PYTHON

CODE:

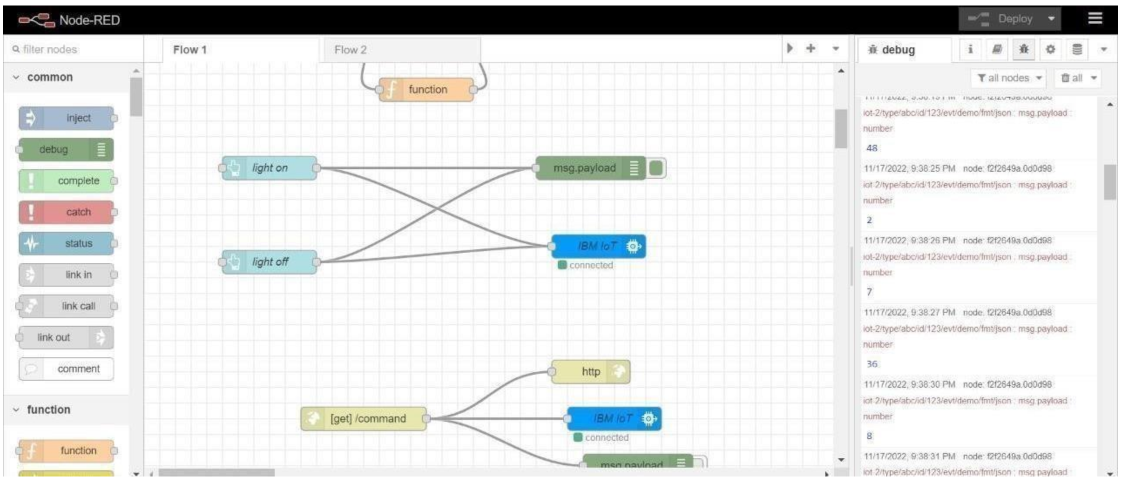
```
import ibmiotf.device
import ibmiotf.application
import time import random
import sys from twilio.rest
import Client
import keys
Client = Client(keys.account_sid, keys.auth_token)  organization
= "15rapi"
deviceType = "abc" deviceId = "123" authMethod = "token"
authToken = "12345678" pH = random.randint(1, 14)
turbidity = random.randint(1, 1000) temperature =
random.randint(0, 100) def myCommandCallback(cmd):
print("Command Received: %s" % cmd.data['command'])
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()
deviceCli.connect() while True:
pH = random.randint(1, 14)  turbidity
= random.randint(1, 1000)
temperature = random.randint(0, 100)
data = {'pH': pH, 'turbid': turbidity, 'temp': temperature} def
SMS(): message = Client.messages.create(
body="ALERT!! THE WATER QUALITY IS
DEGRADED",
from_=keys.twilio_number, to = keys.target_number) print(message.body)
if temperature>70 or pH<6 or turbidity>500:  SMS()
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()
```

#Twilio Account Credentials account_sid ='AC674a168fa92e54f2830009d96f9676dc' auth_token ='a0127bca9a184493c92a4f6e5db2c91b' twilio_number ='+15133275826' target_number ='+919345523274'

Data publish in IBM Watson Cloud



SPRINT 3 NODE RED ARCHITECTURE



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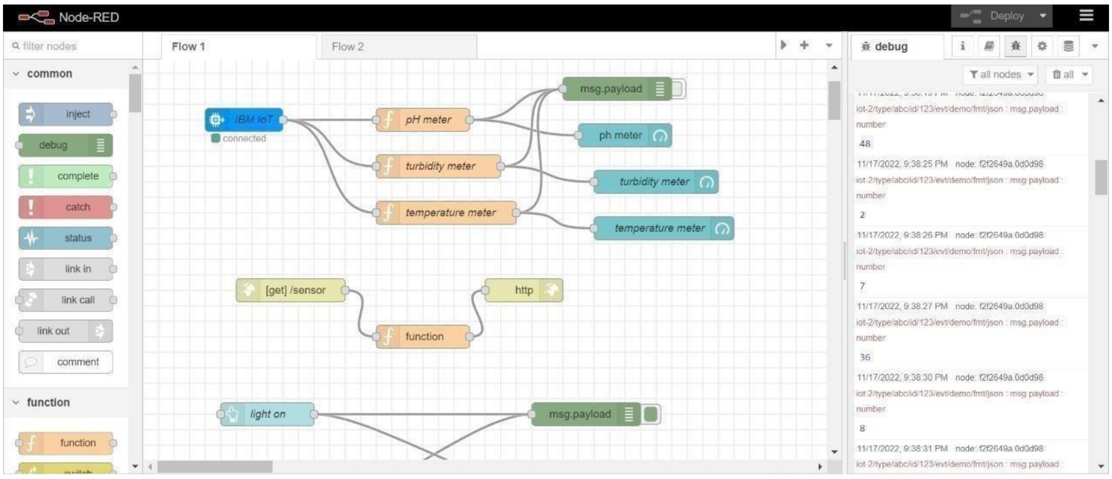
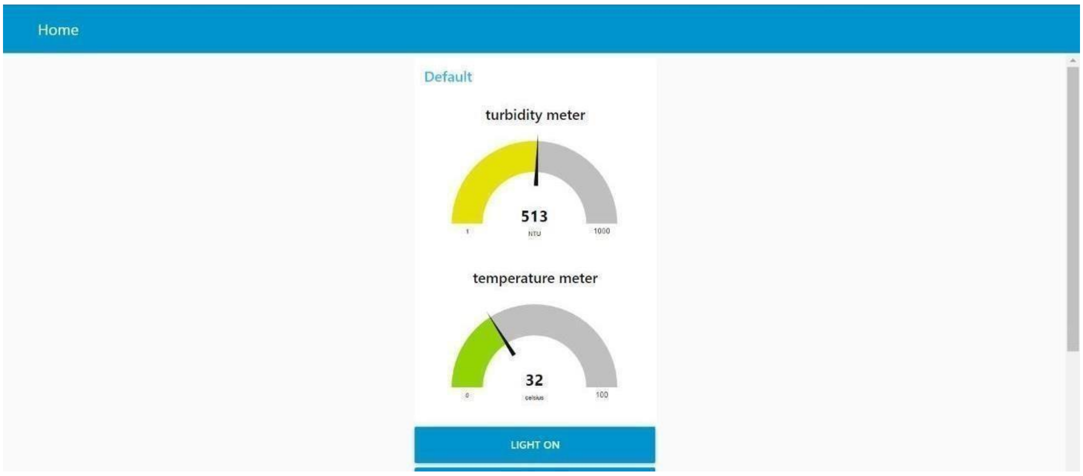
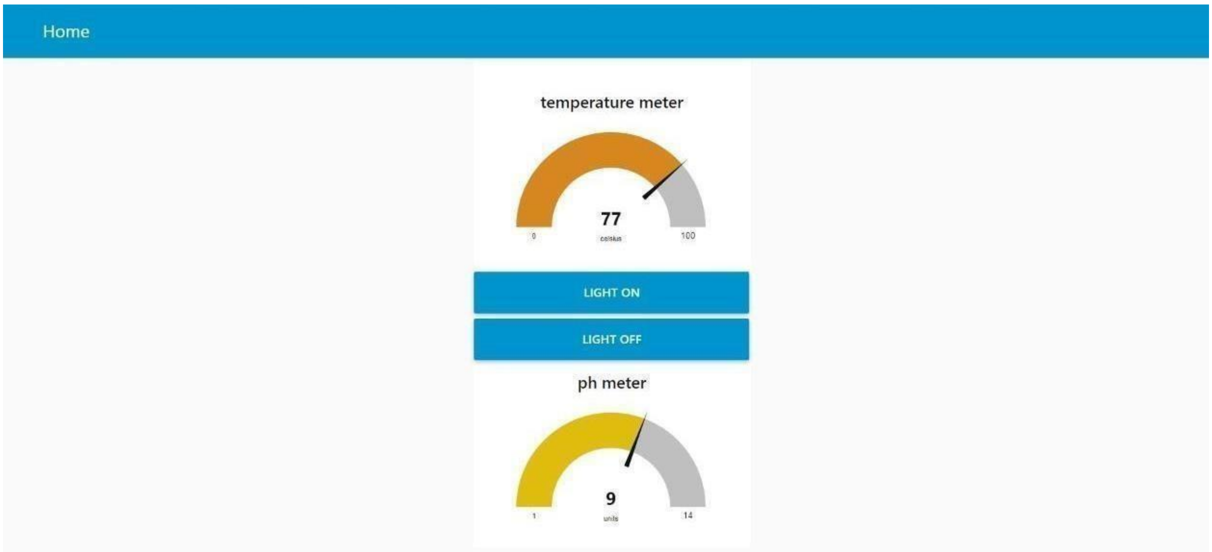


WEB UI FOR USER TO INTERACT WITH THE

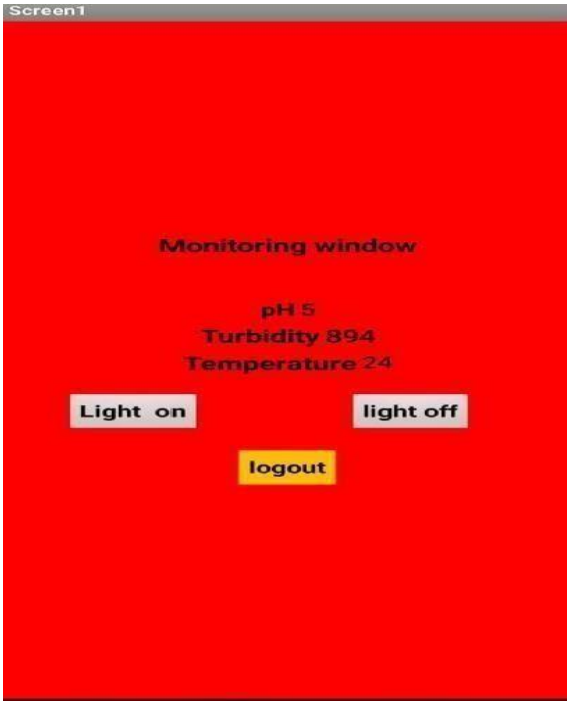




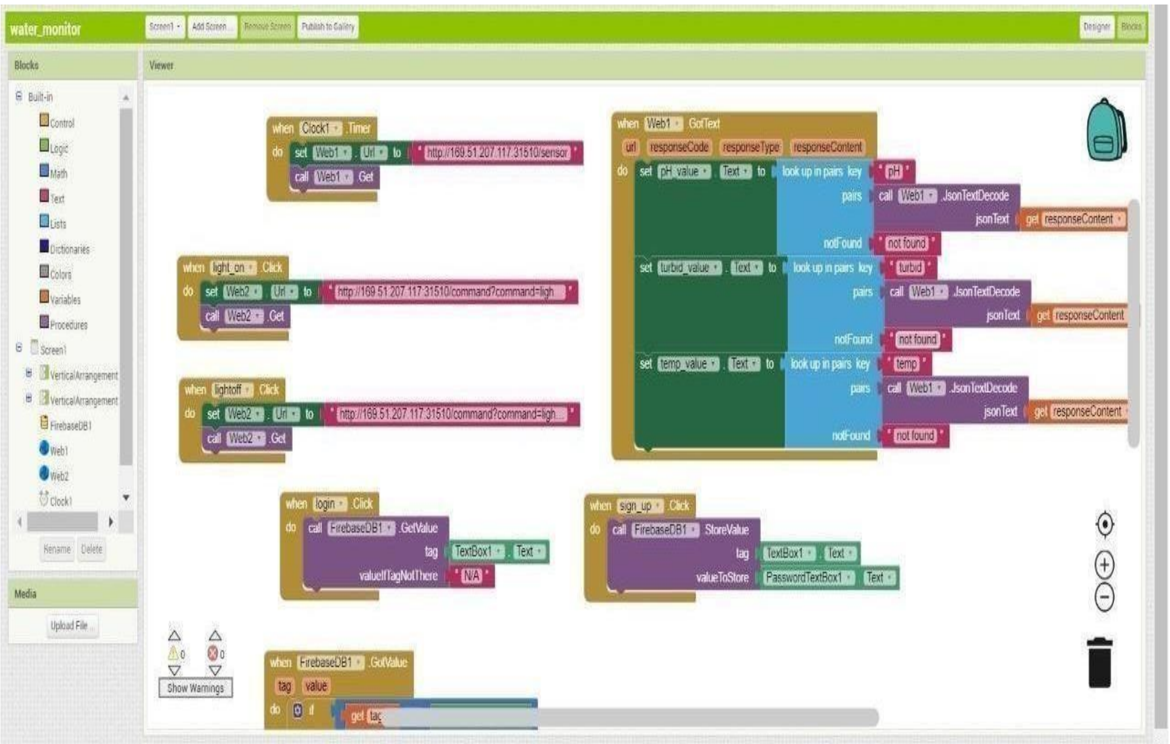
SPRINT 4

Alert message sent to user:

RECEIVE DATA FROM CLOUD AND DISPLAY IN MOBILE APP:



MIT APP COMPONENTS BLOCK : LOGIC SECTION:



6.1 Sprint Planning & Estimation

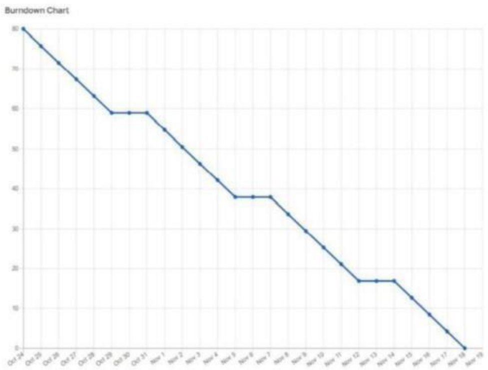
TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	Gather/collect the relevant information on project use case, refer the existing solutions, technical papers, research publications etc.	03 October 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements	3 October 2022
Ideation	List the by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	13 October 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	13 October 2022
Problem Solution Fit	Prepare problem - solution fit document.	13 October 2022
Solution Architecture	Prepare solution architecture document.	13 October 2022
Customer Journey Map	Prepare the customer journey maps to understand the user interactions & experiences with the application (entry to exit).	19 October 2022
Functional Requirement	Prepare the functional requirement document.	19 October 2022
Data Flow Diagrams	Draw the data flow diagrams and submit for review.	19 October 2022
Technology Architecture	Prepare the technology architecture diagram.	19 October 2022
Prepare Milestone & Activity List	Prepare the milestones & activity list of the project.	15 November 2022
Project Development - Delivery of Sprint-1, 2, 3 & 4	Develop & submit the developed code by testing it.	IN PROGRESS..

•

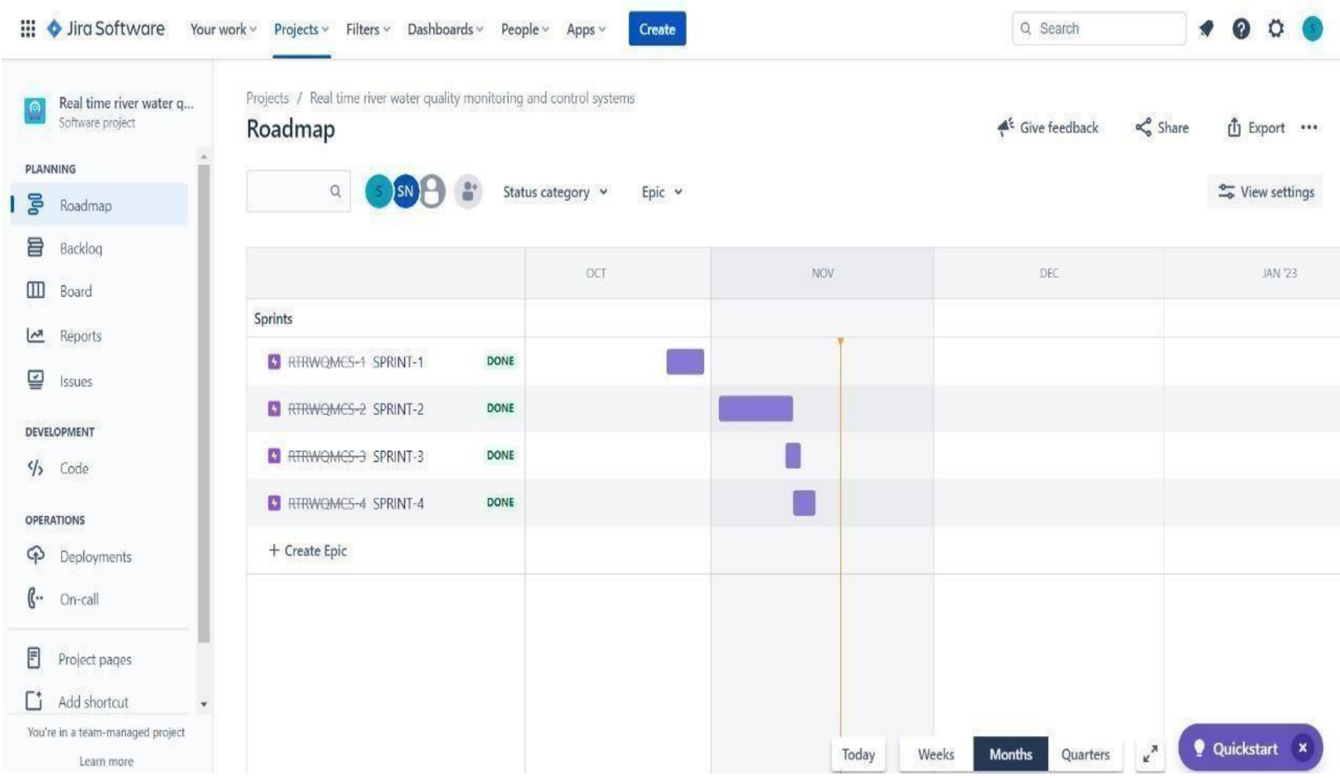
6.2 Sprint Delivery Schedule & Estimation

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	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

Burndown Chart:



6.3 Reports from JIRA



7. CODING & SOLUTION

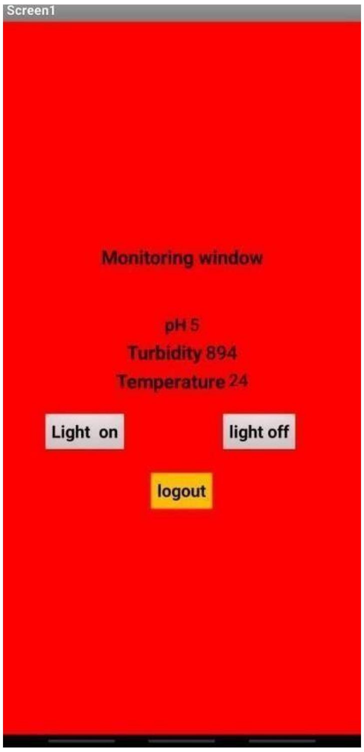
```
import ibmiotf.device
import ibmiotf.application
import time
import random
import sys
from twilio.rest import Client
import keys
Client = Client(keys.account_sid, keys.auth_token)

organization = "15rapi"
deviceType = "abc"
deviceId = "123"
authMethod = "token"
authToken = "12345678"

# Initialize GPIO
def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="light on":
        print ("led is on")
    elif status == "light off":
        print ("led is off")
    else :
        print ("please send proper command")

pH = random.randint(1, 14)
turbidity = random.randint(1, 1000)
temperature = random.randint(0, 100)


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

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

Ln: 30 Col

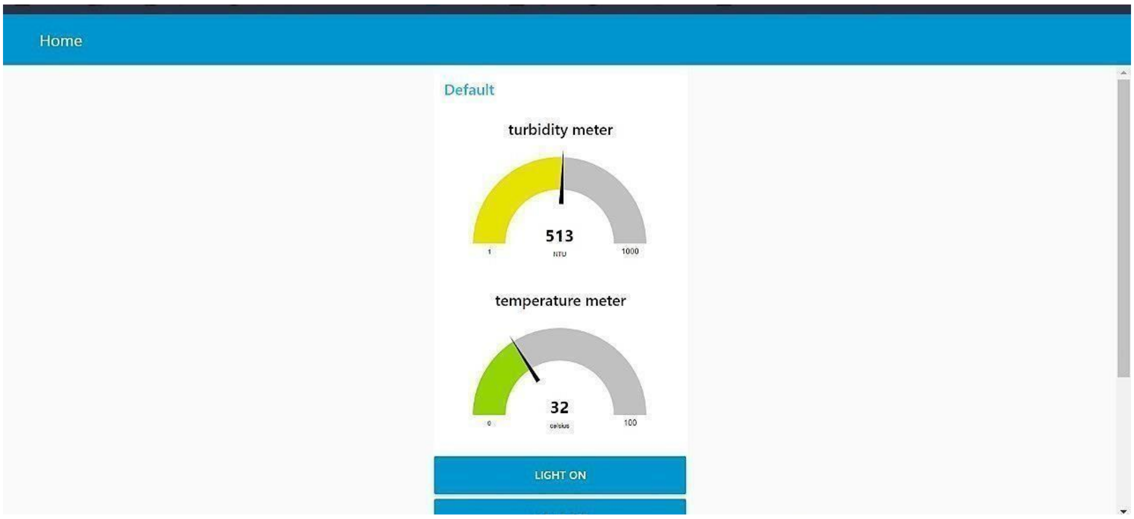
```
2022-11-17 22:35:05,761   ibmiotf.device.Client      INFO    Connected succe
ssfully: d:15rapi:abc:123
Published pH= 12 Turbidity:404 Temperature:3
Sent from your Twilio trial account - ALERT!! THE WATER QUALITY IS DEGRADED
Published pH= 6 Turbidity:546 Temperature:34
Sent from your Twilio trial account - ALERT!! THE WATER QUALITY IS DEGRADED
Published pH= 5 Turbidity:619 Temperature:42
Sent from your Twilio trial account - ALERT!! THE WATER QUALITY IS DEGRADED
Published pH= 5 Turbidity:272 Temperature:53
Sent from your Twilio trial account - ALERT!! THE WATER QUALITY IS DEGRADED
Published pH= 12 Turbidity:23 Temperature:79
Sent from your Twilio trial account - ALERT!! THE WATER QUALITY IS DEGRADED
Published pH= 10 Turbidity:970 Temperature:90
Sent from your Twilio trial account - ALERT!! THE WATER QUALITY IS DEGRADED
Published pH= 4 Turbidity:112 Temperature:52
Sent from your Twilio trial account - ALERT!! THE WATER QUALITY IS DEGRADED
Published pH= 5 Turbidity:410 Temperature:96
Sent from your Twilio trial account - ALERT!! THE WATER QUALITY IS DEGRADED
Published pH= 1 Turbidity:773 Temperature:98
Sent from your Twilio trial account - ALERT!! THE WATER QUALITY IS DEGRADED
Published pH= 6 Turbidity:605 Temperature:89
Sent from your Twilio trial account - ALERT!! THE WATER QUALITY IS DEGRADED
Published pH= 6 Turbidity:710 Temperature:53
```

Ln: 5 Col: 0

LOGIN &MONITORING:



WEB UI



8. TESTING & RESULTS

- ### 8.1. Test Cases

Test case ID	Test case	Input	Output	Status
1	When the values of the parameters are above the threshold value	Temperature=3,pH=3,Turbidity=404	ALERT!!THE WATER QUALITY IS DEGRADED	Pass
2	When the values of the parameters are within the range	Temperature=45, pH=7,Turbidity=350	(no alert message is sent)	Pass

8.2 User Acceptance Testing

Defect Analysis **Resolution**	**Severity 1**	**Severity 2**	**Severity 3**	**Severity 4**	**Subtotal**
By Design	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	24	14	13	26	77

9. Test Case Analysis

Test Case Analysis **Section**	**Total Cases**	**Not Tested**	**Fail**	**Pass**
Client Application	51	0	0	51
Security	2	0	0	2
Exception Reporting	9	0	0	9
Final ReportOutput	4	0	0	4
Version Control	2	0	0	2

9. ADVANTAGE

Benefits or Advantages of IoT based Water Quality Monitoring System

Following are the benefits or advantages of IoT based Water Quality Monitoring System are as follows.

➤The boat is mobile in nature and hence large number of samples are easily collected from different locations in less time.

➤It is very easy to maintain the IoT based water quality monitoring system as all the electronic boards are available in the boat itself.

➤The system is very cheap as the hardware and software does not cost much.

➤Machine learning techniques have made it very easy to plot the data collected in various formats for proper analysis.

➤Cloud storage platforms such as adafruit, azure helps in storing the sensor data immediately and wirelessly to the robust servers.

- Based on a study of existing water quality monitoring system and scenario of water we can say that proposed system is more suitable to monitor water quality parameters in real time.

- The River Water Management and Alert System built
- on this architecture enable access, control and management of river water pollution.
- The water quality parameters such as pH, Temperature, Turbidity can be monitored

DISADVANTAGES

- There are no specific management plans or sanctions on water extractions in many areas, such as pumping groundwater or rivers. These have caused less water to be

soluble and even led to the mining of that resource in some respects. This hampers the water levels and increases the risk of contaminated water.

- This paper focuses only on the pH, turbidigity, temperature of river water here the other parameters such as conductivity is not considered.

- The disadvantage of this system is, water is not monitoring seamlessly, and it always needs a human intervention.

CONCLUSION

An IoT system was developed to monitor river water in real time. The IoT system was used to collect the data from identified stations for different water quality parameters such as pH, turbidity, temperature and conductivity to generate a data set that was used to monitor the quality of water. The collected data set can also be used in future to make the system intelligent by applying machine learning techniques.

Real-time monitoring of water quality by using IoT integrated will immensely help people to become conscious against using contaminated water as well as to stop polluting the water. The research is conducted focusing on monitoring river water quality in real-time. Therefore, IoT integrated big data analytics is appeared to be a better solution as reliability, scalability, speed, and persistence can be provided

11..FUTURE SCOPE

In this proposed system we only focus on measuring the quality of river water parameters. This project can be extended into an efficient water management system of a local area. Moreover, other parameters which wasn’t the scope of this project such as total dissolved solid, chemical oxygen demand and dissolved oxygen can also be quantified.

12. APPENDIX

Source Code

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

Client = Client(keys.account_sid, keys.auth_token)
organization = "15rapi" deviceType = "abc"
deviceId = "123" authMethod = "token"
authToken = "12345678"

pH = random.randint(1, 14) turbidity =
random.randint(1, 1000)  temperature
= random.randint(0, 100)

def myCommandCallback(cmd):
print("Command Received: %s" % cmd.data['command'])
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()
deviceCli.connect() while True:
```

```
pH = random.randint(1, 14)  turbidity
= random.randint(1, 1000)
temperature = random.randint(0, 100)

data = {'pH': pH, 'turbid': turbidity, 'temp': temperature} def
SMS():

message = Client.messages.create(
body="ALERT!! THE WATER QUALITY IS
DEGRADED",
from_=keys.twilio_number,
to = keys.target_number)

print(message.body) if temperature>70 or
pH<6 or turbidity>500: SMS() 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()
```

GitHub Link:
https://github.com/IBM-EPBL/IBM-Project-22488-1659852848

Project Demo Link:
https://drive.google.com/file/d/1q334656k_WaOe8jgSFfbalS_d3cdF_jX/view?usp=sharing