REAL TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM

Category: INTERNET OF THINGS

A PROJECT REPORT
Submitted by

Renugha.S.S - 711119104047

Sabarivasan.P - 711119104050

Ragul Gandhi.M - 711119104046

Santhosh.R - 711119104053

JANSONS INSTITUTE OF TECHNOLOGY

Approved by AICTE and Affiliated to Anna University, Chennai.
Coimbatore, Tamilnadu - 641659

In fulfillment of project in IBM-NALAYATHIRAN 2022

Team Id: PNT2022TMID42599

PROJECT GUIDES

Industry Mentor: Bharadwaj

Faculty Mentor: Praveena.A

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CHAPTER 1
INTRODUCTION

1.1 Project Overview

Nowadays water i.e., drinking water gets polluted due to various factors. There are many means of drinking water. One among them is Groundwater. We people use borewells for consuming the ground water. But is it safe to drink as such from the ground or using any sort of filtration? It may contain harmful toxins and not fit for drinking as such, it may lead to many diseases. Before using the groundwater, monitoring the quality of the water is the better solution. Using IoT we get to know whether it is consumable or not. We can also alert the user through Alert Message through the Mobile Application when the water reaches the threshold point. This project is aimed to monitor the quality of the borewell water for the use of household and drinking. Aims to check the pH, salinity, chlorine level in the borewell water. The user can switch ON and OFF whenever he/she wants it. And the past month data collected from the sensors are stored and can viewed any time.

1.2 Purpose

Current water quality monitoring system is a manualsystem with a monotonous process and is very time-consuming. It is sensor-based water quality monitoring system. The main components of Wireless Sensor Network (WSN) include a microcontroller for processing the system, communication system for inter and intra node communication and several sensors. Real-time data access can be done by using remote monitoring and Internet of Things (IoT) technology. In this project, we have used IBM Watson IoT platform as our core platform for our project.

CHAPTER 2
LITERATURE SURVEY

2.1 EXISTING PROBLEM

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 from 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.

2.2 REFERENCES

TITLE : The Water Quality Online Monitoring System Based on Wireless Sensor Network

YEAR : 2020

AUTHORS : Qiuchan BAI,Jiahao Wu,Chunxia JIN,

DESCRIPTION : Due to the poor real-time performance of water quality monitoring, secondary pollution, high cost and other issues, this paper proposes to use wireless sensor network technology to design a water quality monitoring system. The system has strong real-time, online monitoring functions, and acquires multiple parameter data that affect water quality, timely and accurately monitor water quality information,

prevent water environmental pollution, reduce the impact of water pollution, and meet the requirements of efficient and intelligent water quality.\",

TITLE : Design of Water Quality Monitoring System

YEAR : 2020

AUTHORS : Chenwei Feng,Jiangnan Yuan,Yu Sun,Junming You,

DESCRIPTION : With the rapid development of social economy, excessive discharge of industrial sewage leads to water pollution, and it also affects the quality of domestic water. Therefore, it is necessary to monitor the water quality. A practical and convenient water quality monitoring system is designed in this paper, which is based on the MCU (Micro-programmed Control Unit) and Bluetooth technology. This design takes the Arduino development board based on ATMega328P chip as the core, and uses sensors to collect pH, turbidity, conductivity and water temperature. The measured data is sent to the smart phone via Bluetooth, and abnormal parameters are prompted. The test results show that the system can obtain the water quality parameters in time and accurately, and the overall operation of the system is stable, which is suitable for many occasions of water quality monitoring.

TITLE : Design of Monitoring System for Rural Drinking Water Source Based on WSN

YEAR : 2017

AUTHORS : Zexin Lin,Weixing Wang,Huili Yin,Sheng Jiang,Guohui Jiao,Jieping Yu,

DESCRIPTION : In order to solve the existing traditional rural drinking water monitoring in a lot of manpower, material resources, real-time, this paper introduces a WSN based on the rural drinking water source monitoring system design, the system consists of five parts: water quality monitoring, soil monitoring node node, node, routing node and

gateway server. Water quality monitoring node, soil monitoring nodes send the collected data to the gateway node through the wireless module sent directly, or through the routing gateway node to the gateway node, each node of the data collection, unified by the GPRS module to upload server. The system can periodically detect the water quality and the important indicators of the soil in the rural water sources, and combine the water pollution with the soil non-point source pollution to realize on-line monitoring and provide guidance for pollution control. Network test shows that the designed system can realize data acquisition and remote transmission, stability, range of dissolved oxygen system for 1.09%~1.86% acquisition error, pH error is in the range of 0.64%~1.68%, Cu concentration in the range of error is 1.98%~2.22%, Cu concentration in the range of error is 1.58%~ 2.01%.

TITLE : Water quality monitoring system based on Internet of Things

YEAR : 2020

AUTHORS : Chengcheng Zhang,Jian Wu,Jiancheng Liu,

DESCRIPTION : Aiming at the problems of the current water quality detection system, a new type of real-time online water quality monitoring system solution based on the Internet of Things is proposed. This solution integrates the design of STM32 singlechip microcomputer, sensors, WiFi wireless transmission and remote water quality management. The system uses sensors to monitor water quality turbidity, pH value, temperature and other parameters, and uploads the data to the management center through wireless communication. According to the analysis results, the water environment quality was measured, and water quality problems were pre-warned to prevent further spread of pollution, improve the scientificity and efficiency of water quality monitoring and management, and provide relevant departments with response

strategies and management measures. This system has good real-time performance and strong practicability, and can be promoted and used in the future to promote the development of water environment monitoring.

TITLE : Application of NB-IoT Technology in City Open Water Monitoring

YEAR : 2020

AUTHORS : He Sui,Guangming Zheng,Jingxian Zhou,Hui Li,Zhaojun Gu,

DESCRIPTION : Water quality monitoring is an important way to monitor the environment, control pollution and protect water resources, and its research has great practical significance for environmental protection. Aiming at the disadvantages of existing water quality monitoring methods such as high node power consumption and small coverage, this paper proposes an online water quality monitoring system scheme using NB-IOT protocol communication. The prototype system shows that the system can meet the water quality monitoring needs of Bolong Lake.

TITLE : The Unmanned Autonomous Cruise Ship for Water Quality Monitoring and Sampling

YEAR : 2017

AUTHORS : Jia Shuo,Zhang Yonghui,Ran Wen,Tong Kebin,

DESCRIPTION : Regular manual sampling and fixed node on-line detection are main methods of water quality monitoring in waters at present. Sampling nodes are subj ect to great restrictions. This paper presents an autonomous cruise unmanned ship for water quality monitoring and sampling, which can be achieved in the waters of any designated location for water quality sampling, achieves the real-time on-line monitoring of the whole water environment by means of the combination of dynamic nodes and

static monitoring nodes. This paper introduces the control unit system, the ground station control unit system and the water quality sampling and the monitoring unit system of the unmanned ship and carries out the actual test. The unmanned ship designed in this paper has successfully achieved autonomous cruise, designated water quality sampling and dynamic online real-time water quality monitoring, which provides a new means for water quality monitoring in waters.

TITLE : Automation system for monitoring the quality of water sources to maintain their sustainability using microcontroller

YEAR : 2022

AUTHORS : Ahmed Aziz Atiast,Khansaa Dheyaa Aljafaar,

DESCRIPTION : Pollution of the water environment is the greatest hazard these days, especially in the conditions that the plant is going through, including the decline of rain, and desertification. This paper presents a proposed system to maintain water quality so that it is suitable for human use and reduce water waste by an employee the Arduino microcontroller, and sensors to design an automation system of water pollution monitoring, the design of the system involves the development of the process of monitoring physiochemical parameters of the water environment affected by the dumping of industrial waste in rivers, The parameters such as pH, temperature, turbidity and dissolved oxygen are used to detect the number of impurities that comes out of the industry. The measured values collected using the PH sensor, temperature sensor, turbidity sensor, and Ultrasonic sensor are processed by the Arduino microcontroller, and an alert message will be sent through the GSM, When there is a deviation of water quality parameters from the pre-defined set of standard values, the proposed system aids in preventing harmful pollutants entering the water resources and also ensure the

availability of safe drinking water to everyone, reducing the causes of river pollution through continuous monitoring and informing users of the impact of water on pollutants for intervention and removal of these pollutants, and thus water resources have been preserved as essential sources for the continuation of human life.

REFERENCE BOOKS AND LINKS:

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- Chengcheng Zhang,Jian Wu,Jiancheng Liu,'Water quality monitoring system based on Internet of Things',2020 3rd International Conference on Electron Device and Mechanical Engineering (ICEDME)
- He Sui,Guangming Zheng,Jingxian Zhou,Hui Li,Zhaojun Gu,'Application of NB-IoT Technology in City Open Water Monitoring',2020 6th International Symposium on System and Software Reliability (ISSSR)
- Jia Shuo,Zhang Yonghui,Ran Wen,Tong Kebin,'The Unmanned Autonomous Cruise Ship for Water Quality Monitoring and Sampling',2017 International Conference on Computer Systems, Electronics and Control (ICCSEC)

- Ahmed Aziz Atiast,Khansaa Dheyaa Aljafaar,'Automation system for monitoring the quality of water sources to maintain their sustainability using microcontroller',2022 International Conference on Electrical, Computer and Energy Technologies (ICECET)
- Zhu-lin Hao,Yuan-yuan Zhang,Min-quan Feng,'Water quality assessment based on BP network and its application',2011 International Symposium on Water Resource and Environmental Protection
- Xiaoyi Wang,Jun Dai,Zaiwen Liu,Xiaoping Zhao,Suoqi Dong,Zhiyao Zhao,Miao Zhang,'The lake water bloom intelligent prediction method and water quality remote monitoring system',2010 Sixth International Conference on Natural Computation
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- Liming Zhang,Haowen Yan,'Implementation of a GIS-based water quality standards syntaxis and basin water quality prediction system',2012 International Symposium on Geomatics for Integrated Water Resource Management
- YanBing Wang,Fang Lv,'Design of water quality monitoring system based on NB-IoT technolog',2022 3rd International Conference on Computer Vision, Image and Deep Learning & International Conference on Computer Engineering and Applications (CVIDL & ICCEA)
- Shihu Shu,Suiqing Liu,Xuefeng Wang,Liang Yu,Shihu Shu,Dong Zhang,Mingqun Meng,'Determination and applications of water age in distribution system',2010 International Conference on Mechanic Automation and Control Engineering
- Jianwei Tao,Zili Zhang,Wenxian Yu,'Monitoring Taihu water quality by using high resolution satellite image',2011 19th International Conference on Geoinformatics
- Sheikameer Batcha. S,Pushpalatha. N,Kasthuri. M,Rokith. K,Subathra. D,Ragul. S,'Monitoring System For Water Quality Using Solar Powered IoT',2022 8th International Conference on Smart Structures and Systems (ICSSS)
- Chen Kai,Zhu Weiwei,Dou Lu,'Research on Mobile Water Quality Monitoring System Based on Underwater Bionic Robot Fish Platform',2020 IEEE International Conference on Advances in Electrical Engineering and Computer Applications(AEECA)
- Jamie Quinn,Tanjila Kabir,Maham Altaf,Liam Sawyer,Yi Wang,Mahbuboor Choudhury,Juneseok Lee,'H2O: Smart Drinking Water Quality Monitoring System',2022 IEEE International Conference on Imaging Systems and Techniques (IST)

- Manish Kumar Jha,Rajni Kumari Sah,M. S. Rashmitha,Rupam Sinha,B. Sujatha,K. V. Suma,'Smart Water Monitoring System for Real-Time Water Quality and Usage Monitoring',2018 International Conference on Inventive Research in Computing Applications (ICIRCA).

2.3 Problem Statement Definition

There are many means of drinking water. One among them is Groundwater. But is it safe to drink as such from the ground or using any sort of filtration? It may contain harmful toxins and not fit for drinking as such, it may lead to many diseases. Before using the groundwater, monitoring the quality of the water is the better solution. Using IoT we get to know whether it is consumable or not. We can also alert the user through Alert Message through the Mobile Application when the water reaches the threshold point. This project is aimed to monitor the quality of the borewell water for the use of household and drinking. Aims to check the pH, salinity, chlorine level in the borewell water.

Customer Problem Statement Template:

Reference link :

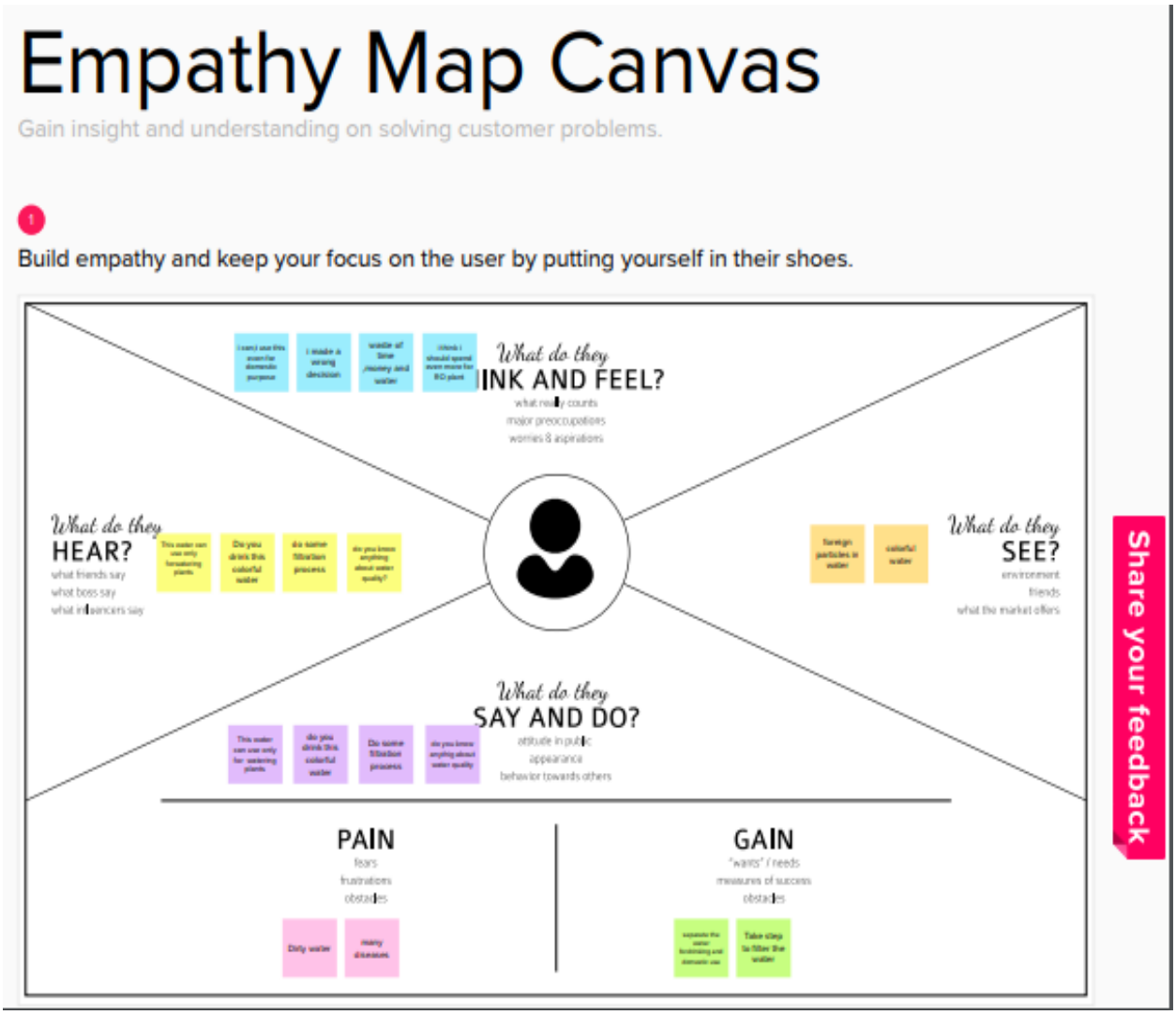
https://miro.com/app/board/uXjVPIVONoQ=/?moveToWidget=3458764537403559126&cot=10

Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	Land owner	get ground water	the groundwater is not pure and up to the quality	of the contaminated groundwater	sick
PS-2	Farmer	Water the crops. (Groundwater)	The water is not having proper nutrients	of the less or more nutrients	unhealthy

CHAPTER 3

IDEATION & PROPOSED SOLUTION

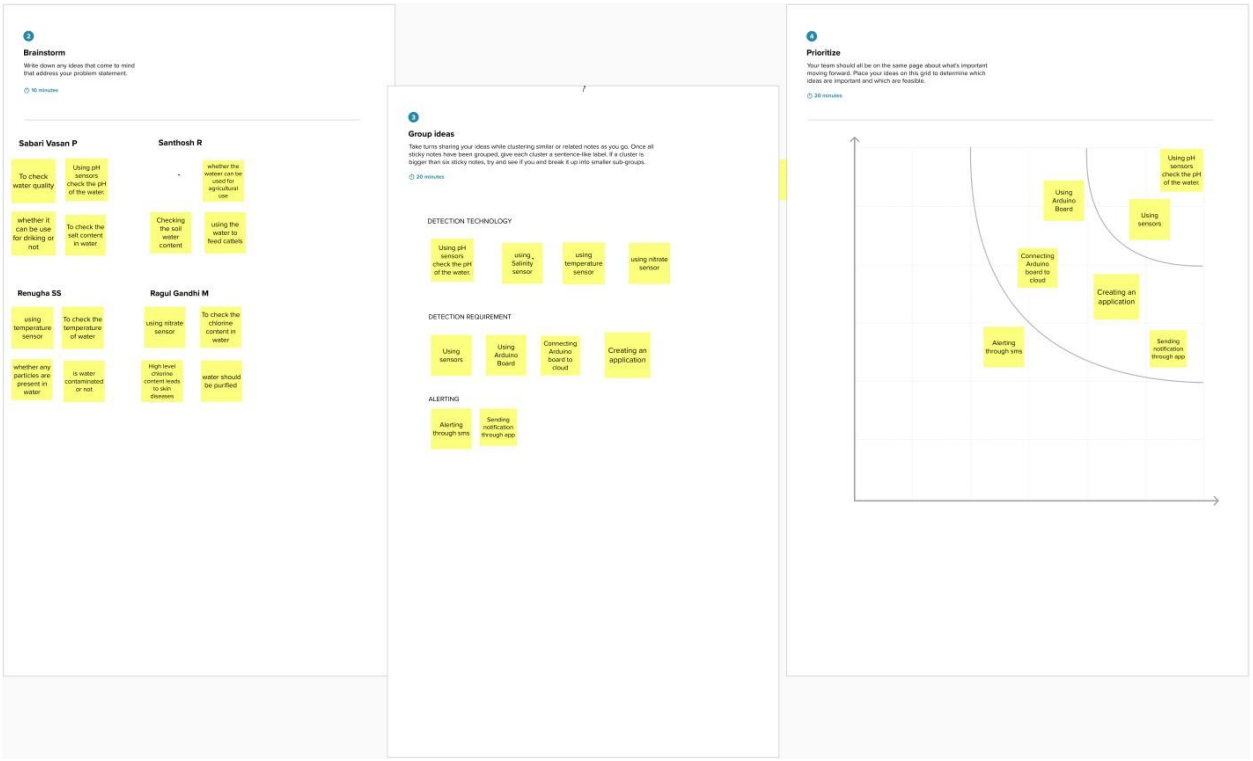
3.1 Empathy Map Canvas



Reference

Link:https://app.mural.co/t/jansonsinstituteoftechnology4907/m/jansonsinstituteoftechnology4907/1663995478539/c25f801a8830f64aca427b8cae022e6efc69596e?sender=u8ae0c1599014533bb2e95539

3.2 Ideation & Brainstorming



Reference Link:

https://app.mural.co/t/jansonsinstituteoftechnology4907/m/jansonsinstituteoftechnology4907/1667291493071/79a003d9d510bb8568c2a96dd381703ca09a8785?sender=u2c4a924bc47b96 ea2ce80112

3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	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. 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.. 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.

2.	Idea / Solution description	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.
3.	Novelty / Uniqueness	Monitoring of real time quality of Water from reserve tank of house and colony makes use of PH, turbidity and temperature sensor with Raspberry Pi and existing Cloud system for data analytics. The system can monitor water quality automatically, triggers alarms immediately to prevent any health hazards and it is low in cost and does not require people on duty. So, the system is likely to be more economical, convenient and fast. The system has good flexibility.

4.	Social Impact / Customer Satisfaction	Water purification is the process of removal of undesirable chemicals, biological contaminants, suspended solids and gases from water. Direct consumption of tap water or debased water causes cholera, dysentery, typhoid, diarrhea and polio. The presence of pollutants in the water causes diseases like arsenicosis due to arsenic and fluorides components in the water. In most parts of India, tap water is not potable hence there is a need for smart water quality monitoring and purification systems. This system will notify the user regarding the purity of the water on some explicit water parameters and helps user to drink polluted free water.

5.	Business Model (Revenue Model)	In our proposed method, an assembled Arduino microcontroller is used as the core controller of the system. Once the code is uploaded to the microcontroller, no PC system, keyboard command, monitor is required to operate the system. The system functions automatically and independently according to the code uploaded to the microcontroller. In this system, three sensors are used to measure the essential water parameters. Essential water parameters needed to be monitored by the average users are water pH level, water turbidity (cloudiness) and water temperature which is a measurement of the amount of the water in a container.
6.	Scalability of the Solution	Real-time monitoring of water quality by using IOT integrated Big Data Analytics 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.

3.4 Problem Solution fit

Define CS, fit into CC

1.CUSTOMER SEGMENT(S) CS

- Here the customers are the people in the need of ground water.
- Farmers who plant crops in the fields.

6. CUSTOMER CONSTRAINTS CC

- Costly equipment
- Timely alerts are not possible

5. AVAILABLE SOLUTIONS AS

- People get the quality of water either for domestic or commercial (factory/farming)
- User get to know the current water quality.

Explore AS, differentiate

Focus on J&P, tap into BE, understand RC

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

Remembrance of water quality measure by sensors.

- Message sent on regarding water quality to the closest persons.
- Alert the patient about the low water quality

9. PROBLEM ROOT CAUSE

- Purifiers cannot monitor the water all the time.
- Elder people(self-reliant) who needs care to be taken.
- Water might have more nutrients at high level this leads unhealthy crops.

7. BEHAVIOUR

- The customer can use 'help' option in the application to get the problem solved.
- The user can use user guide available in the 'about' section for reference.

Focus on J&P, tap into BE, understand RC

CHAPTER 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 Gmail Registration by phone number
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User Login (Web)	Login with registered mail id and password
FR-4	User Login (mobile app)	Login with registered mobile number and password
FR-5	User's water quality Information	In the app, enter your water quality details with date. Then set the time in the app.

4.2 NON FUNCTIONAL REQUIREMENTS

Following are the non functional requirements of the proposed solution.

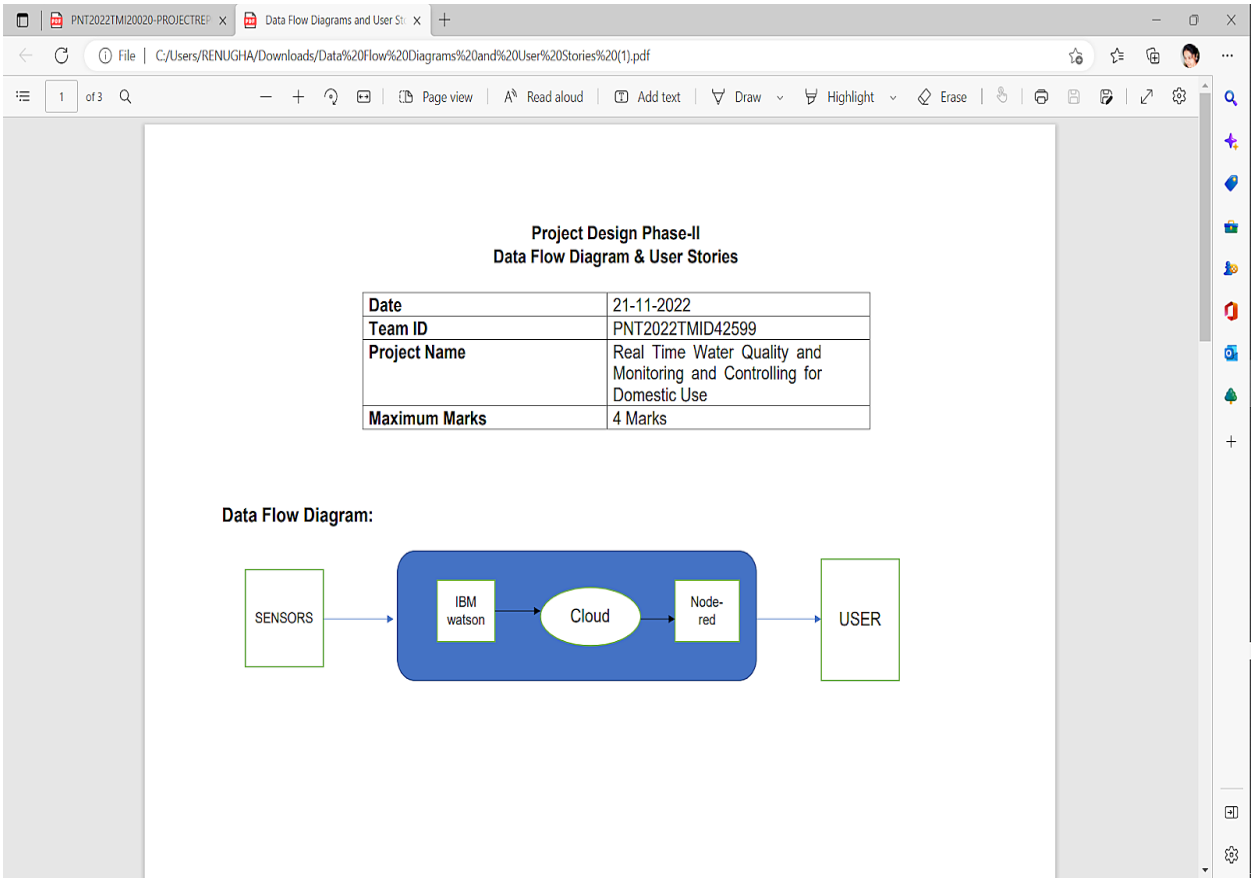
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The system should be user-friendly for the users. It is used to remaind the water quality level. It alerts the users through app.

NFR-2	**Security**	The login information should not be accessed by any other users than the respective. The data of the users should be kept confidential.
NFR-3	**Reliability**	Reminds on correct time The user data should be updated and examined after certain period of time
NFR-4	**Performance**	The water quality level will be delivered accurately to the given time. It works without any connection interruption
NFR-5	**Availability**	The system should be monitored 24X7 for the alert of water quality. It can be used by any registered users from any place.
NFR-6	**Scalability**	It is easily adaptable The device is compatible and portable The application can handle any number of registration.

CHAPTER 5

PROJECT DESIGN

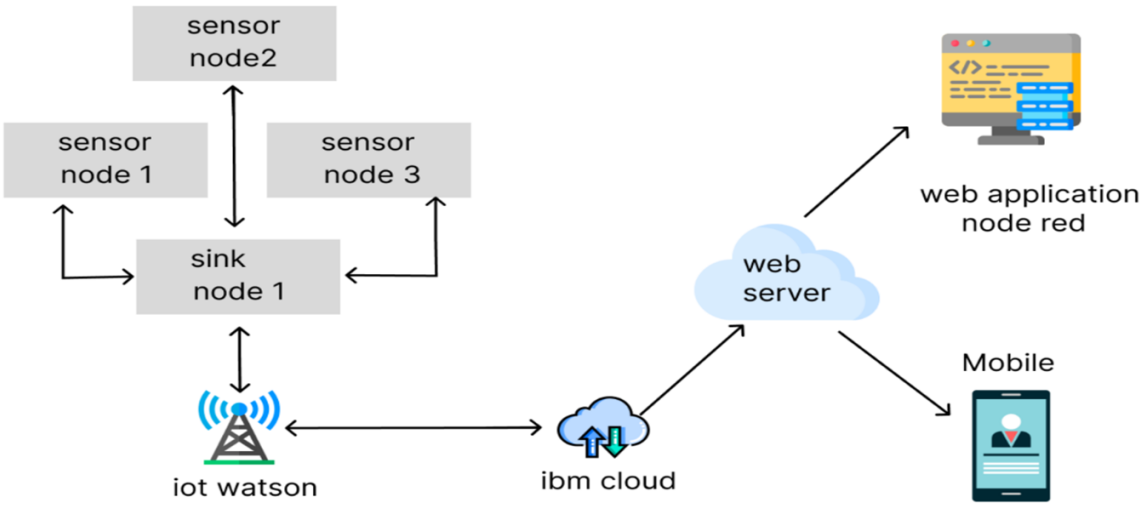
5.1 Data Flow Diagrams



Project Design Phase-II
Data Flow Diagram & User Stories

Date	21-11-2022
Team ID	PNT2022TMID42599
Project Name	Real Time Water Quality and Monitoring and Controlling for Domestic Use
Maximum Marks	4 Marks

Data Flow Diagram:



5.2 Solution and Technical Architecture:

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

Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	Web UI, Mobile App	Node – Red, Kubernetes, MIT mobile app inventor
2.	Application Logic-1	Generate random data	Python
3.	Application Logic-2	Generate random sensor data	IBM Watson IOT Platform
4.	Cloud Database	Cloud Database Database Service on Cloud IBM	IBM DB2, IBM Cloudant etc.

5.	External API-1	Send SMS to customer	Fast SMS API
6.	External API-2	Send data to web	IBM cloudant service API.
7.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration :	IBM Cloud platforms and services

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Node red for web app development	json
2.	Security Implementations	Use of a login page with a user's unique username and password on a web interface optimised for mobile devices	Authentication token, passwords for secure access
3.	Scalable Architecture	Optimised for mobile devices and computers with adjustable screen sizes	Node-Red Web UI
4.	Availability	Accessible to users through both a web UI and a mobile app	Node-Red Web U and MIT app inventor (Mob App)
5.	Performance	Give precise results and a prompt warning in the event of water contamination	Node – Red(Web UI), MIT App inventor (Mobile App

5.3 USER STORIES

User Type	Functional Requirement	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Senior citizen)	Ground water quality for domestic use	USN-1	As a user, I want to use good quality of water. And I need to know the quality of the water I'm consuming.	I want to take medicine on time.	Medium	Sprint-1,2
Customer (Mentally idled patient)	Ground water quality for drinking purpose	USN-2	As a user, I should maintain good health by consuming good quality of water in time. I need to monitor the quality of the water	My patient needs to take medicines at proper time.	High	Sprint-3

Customer (Disabled person)	Ground water nutrient check for farming	USN-3	As a user, I need to check my quality of water that is given to plants. Need to intimate me when the water exceeds the threshold. And also I need to check the previous readings of the sensors.	I need to take medicines at accurate time by notification.	High	Sprint-4

CHAPTER 6

PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-4 mob app	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	Renugha SS Sabarivasan P Santhosh R Ragul Gandhi M
Sprint-4		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	Renugha SS Sabarivasan P Santhosh R Ragul Gandhi M
Sprint-2		USN-3	As a user, I can register for the application through App and Web App	2	Low	Renugha SS Sabarivasan P Santhosh R Ragul Gandhi M

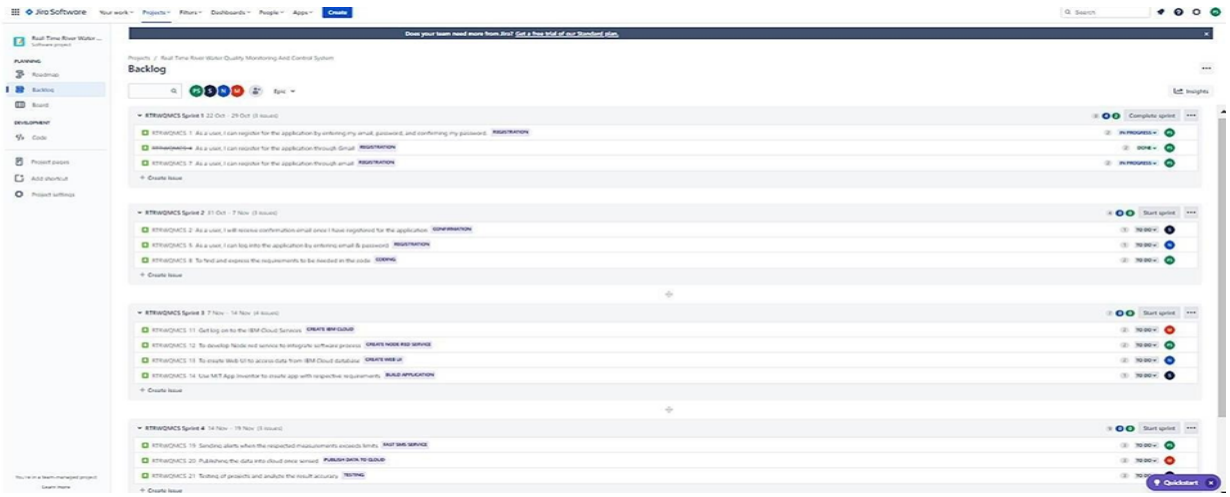
Sprint-4		USN-4	As a user, I can register for the application through Gmail	2	Medium	Renugha SS Sabarivasan P Santhosh R Ragul Gandhi M
Sprint-4	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	Renugha SS Sabarivasan P Santhosh R Ragul Gandhi M

6.2 SPRINT DELIVERY SCHEDULE

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 cloud and watson creation	20	1 Day	01 Nov 2022	02 Nov 2022	20	02 Nov 2022
Sprint-2 node red web ui creation	20	2 Days	03Nov 2022	05 Nov 2022	20	06 Nov 2022
Sprint-3 publish data to cloud	20	2 Days	08 Nov 2022	10 Nov 2022	20	15 Nov 2022
Sprint-4 mob app creation and integration of data	20	2 Days	15 Nov 2022	17 Nov 2022	20	20 Nov 2022

6.3 REPORTS FROM JIRA



CHAPTER 7

CODING & SOLUTIONING

7.1 FEATURE 1

IBM WATSON IoT PLATFORM

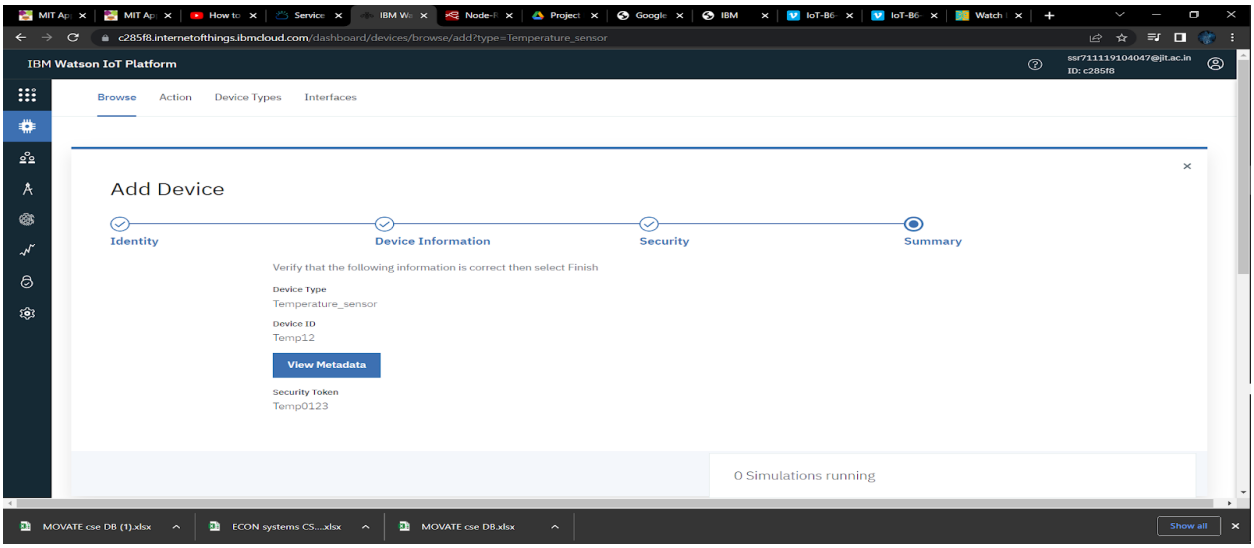
The very first process in this project section is to develop the IBM IoT Platform. This IoT platform is the core formula for all the connection process. As the only way of connecting several applications is the basic work of the cloud platform.The process of signing in to the cloud process is the large process which carries verfication segments too. After creating the Cloud Profile, lets move to device creation part.

Device Creation

Device Type : Temperature_sensor

Device Id : Temp12

With following details, we have created a device and the code for this device carries the requirements which satisfies the project specification. We used temperature, humidity and the pH value in the code. temperature - 0 to 100 humidity - 0 to 100 ph value - 0 to 14

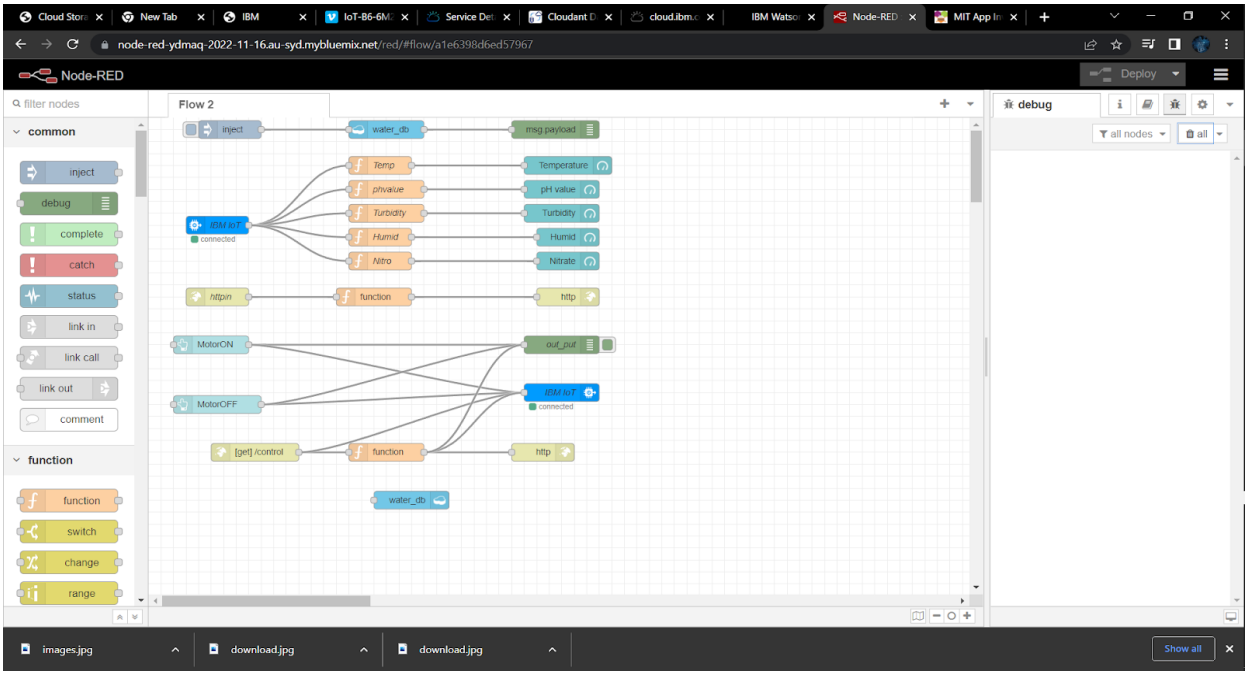


NODE-RED SERVICE

Here we can create the Web user interface and the Web Application by designing the circuit. Our Node-Red Circuit designs are as follows.

The first step is to install the IBM IoT block from the node-red service and we have set three functions namely, temp,turb, pH, humid, nitro. These 5 functions process temperature, humidity and the pH value, Turbidity and Nitrate contents as simulation. And the functions are connected to the msg.payload button.
After this, we set two buttons on the Switch board, Motor ON and Motor OFF.

Now for connecting to the web we use the "http" extension. And also, for connection to the Application we use MIT app application with get option function in Node-Red. The Node-Red website is copied and added "/control" to review the output.

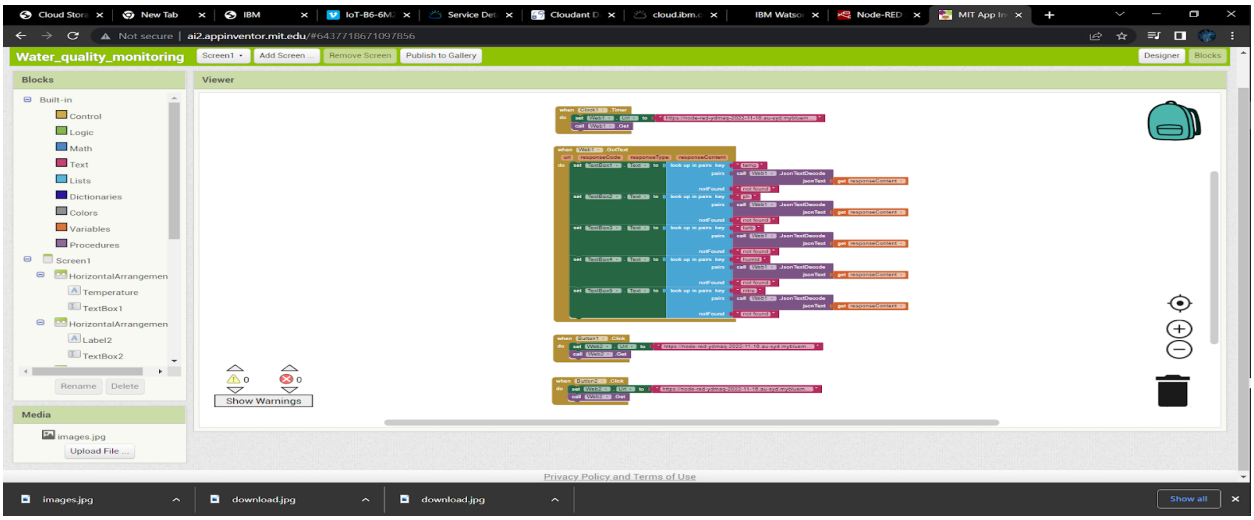


Node-Red Circuit Design

MIT APP INVENTOR

This phase is the most priority requirement of our project. Using an application

helps users to monitor in easy way. MIT App inventor helps to desgin our application. We have created a Screen for our App.



Code block for MIT app

7.2 FEATURE 2

Python code to publish the data

```
def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    control=cmd.data['command']
    if control=="MotorON":
        print("Motor is ON")
    if control=="MotorOFF":
```

```
        print("Motor is OFF")
while True:
    temp=random.randint(0,50)
    ph=random.randint(0,14)
    turb=random.randint(0,300)
    humid=random.randint(0,70)
    nitro=random.randint(0,10)
    data = {'temp': temp, 'ph' : ph, 'turb': turb, 'humid': humid, 'nitro': nitro }
    def myOnPublishCallback():
        print ("Temperature = %s" % temp, "PH Level = %s C" % ph, "Turbidity = %s C" %
turb,"Humidity = %s" % humid,"Nitrate = %s" % nitro
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
deviceCli.disconnect()
```

CHAPTER 8

TESTING

8.1 TEST CASES

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	9	0	0	9
Client Application	5	0	1	4
Security	2	0	0	2
Exception Reporting	3	0	0	3
Final Report Output	7	0	0	7

8.2 USER ACCEPTANCE TESTING

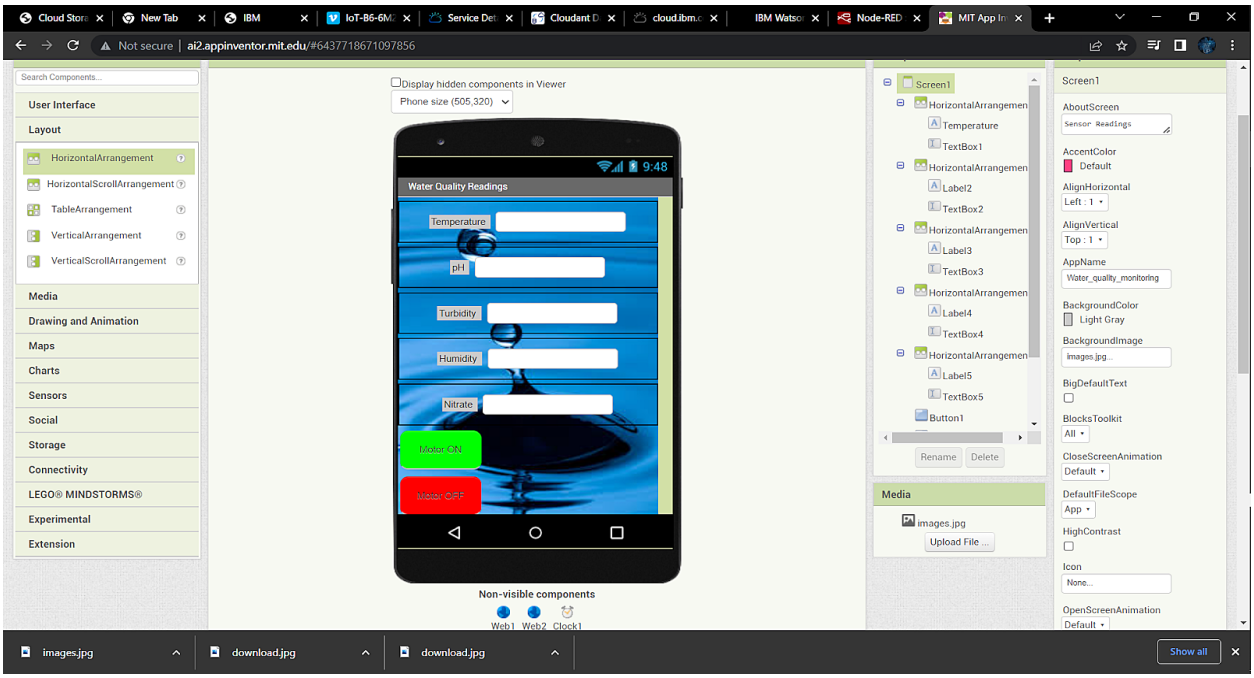
Resolution	Severity 1	Severity 2	Severity 3	Total
By Design	4	2	5	11
External	6	4	3	13
UI	2	5	2	9
Fixed	3	2	7	12
Totals	15	13	17	45

CHAPTER 9

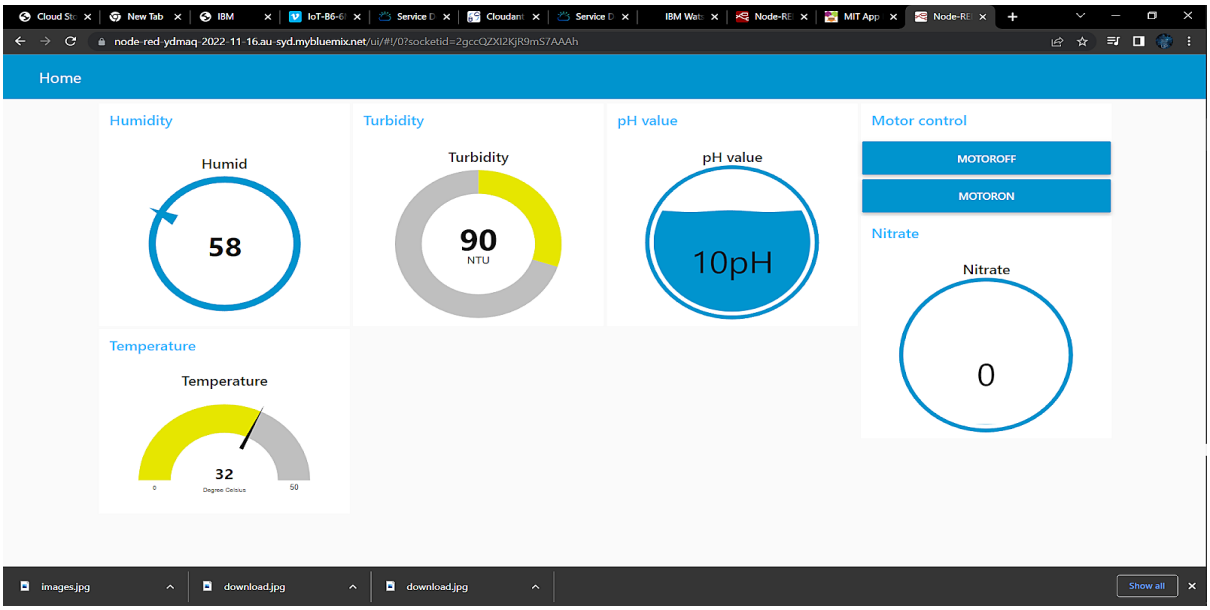
RESULTS

9.1 Performance Metrics

The performance and the working of the code is ver quick and the results appears in quick succession. Our code is linked with the most used IBM Watson IoT Platform which works with much perfection. This cloud platform is very secure to use and configure easily. Asthe code issimulated within seconds the result appears. We have done lot of works using this IoT platform which is very simple and good user friendly platform. Below we display our connected IoT platform which delivers the results as the code is run.



UI for the MIT mob app



Node-Red Page Web User Interface

CHAPTER 10
ADVANTAGES & DISADVANTAGES

ADVANTAGES

Water quality standards also protect iconic, locally grown products such as wild rice and walleye. Protecting human health — Some pollutants pose risks to human health. Water quality standards protect human health and avoid the costs related to medical care, productivity loss, and even loss of life. This helps us to understand how the levels of nutrients, dissolved oxygen, temperature, salinity and phytoplankton change over time and how best to manage these conditions. Water quality is critical to environmental and ecosystem health. By monitoring water quality, researchers, scientists, and regulators can understand the impact of human activities, seasonal fluctuations, and weather events. Water quality data helps inform sustainable decision making and comprehensive regulatory policy.

DISADVANTAGE

It is difficult to collect the water samples from all the area of the water body. The cost of analysis is very high. The lab testing and analysis takes some time and hence the lab results does not reflect real time water quality measurement due to delay in measurement. Relationship and capacity challenges in water quality monitoring are discussed based on a rational approach to decision-making. Such an approach considers the costs and benefits of individuals and organisations in decision-making with regard to water quality monitoring. Both benefits and costs can be material (i.e. increase or decrease of financial resources) and immaterial (e.g. loss or gain of time, reputation).

CHAPTER 11

CONCLUSION

The proposed system is created with the use of different sensors, nodemcu as controller and Cloud for storing the data from Controller and sending the command to raspberry PI for measuring water quality and water level. The generated data can be viewed using web interface all over the city. The advantage of the system is to provide the adequate water supply with good quality water to each house, industry, and others. The proposed model can be implemented as a part of the smart city.

CHAPTER 12

FUTURE SCOPE

Environmental water quality monitoring aims to provide the data required for safeguarding the environment against adverse biological effects from multiple chemical contamination arising from anthropogenic diffuse emissions and point sources. Current monitoring approaches tend to emphasize either targeted exposure or effect detection. Here, we argue that irrespective of the specific purpose, assessment of monitoring results would bene t substantially from obtaining and linking information on the occurrence of both chemicals and potentially adverse biological effects. As of now, water quality monitoring is just a wave of seeds. The development of this process must take advance at a quick rate. In the future, there will be a reduction in pollution as water quality monitoring grows.

CHAPTER 13

APPENDIX SOURCE CODE

CODE

Python to Publish data

```
import requests

import json

import ibmiotf.application

import ibmiotf.device

import time

import random

import sys



#Provide your IBM Watson Device Credentials

organization = "c285f8"

deviceType = "Temperature_sensor"

deviceId = "Temp12"

authMethod = "token"
```

```
authToken = "Temp0123"


# Initialize GPIO
def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    control=cmd.data['command']
    if control=="MotorON":
        print("Motor is ON")
    if control=="MotorOFF":
        print("Motor is OFF")

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

deviceCli.connect()

while True:

 #Get Sensor Data from DHT11

    temp=random.randint(0,50)

    ph=random.randint(0,14)

    turb=random.randint(0,300)

    humid=random.randint(0,70)

    nitro=random.randint(0,10)

    data = {'temp': temp, 'ph' : ph, 'turb': turb, 'humid': humid, 'nitro': nitro }

 #print data


    def myOnPublishCallback():

        print ("Temperature = %s" % temp, "PH Level = %s C" % ph, "Turbidity = %s C" %
turb,"Humidity = %s" % humid,"Nitrate = %s" % nitro )


    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()
```

13.2 Github and project link

Github: https://github.com/IBM-EPBL/IBM-Project-21549-1659783795

Demo link: https://www.youtube.com/embed/-FTdYF--dRE