REAL-TIME RIVER WATER QUALITY MONITORINGAND CONTROL SYSTEM

A PROJECT REPORT

Submitted by

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ABSTRACT

The environment consists of five key elements e.g., soil, water, climate, natural vegetation, and landforms. Among these water is the major need of human life. It is also vital for the persistence of other living habitats. Whether it is used for drinking, domestic use, and food production or recreational purposes, safe and readily available water is the need for public health. So it is highly imperative for us to maintain water quality balance. Otherwise, it would severely damage the health of the humans and at thesame time affect the ecological balance among other species. Internet of things (IoT) is an innovative technological phenomenon. It is shaping today's world and is used in different fields for collecting, monitoring and analysis of data from remote locations.

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CHAPTER 1

INTRODUCTION

1.1 PROJECT OVERVIEW

River Water Quality Monitoring is the major tasks for upcoming generation as Water Pollution rates are increasing day by day. People who are not researchers are most likely to intersect environmental science in the context of protecting or restoring a place or species about which they are concerned, or in the context of pollution—trying to understand the sources and effects of contaminants, or trying to prevent or remediate environmental contamination. The works in this entry address pollutants affecting river ecosystems, including the people who live within or use resources from those ecosystems. Pollution is commonly subdivided based on the primary medium affected by contamination, creating categories such as air pollution, soil pollution, freshwater pollution, groundwater pollution, or marine pollution. In reality, of course, all of these media are intimately connected. Atmospheric deposition of contaminants pollutes soil and water bodies. Contaminated groundwater seeps into rivers, and contaminated rivers recharge groundwater aquifers. Fluxes of water, sediment, solutes, and even organisms carrying contaminants within their tissues create vectors to disperse pollutants. This is one of the great challenges to understanding and mitigating pollution: the contaminant is seldom an inert substance that stays in one place.

Another great challenge is that there are many different types of contaminants, including human and animal wastes such as sewage or intestinal bacteria, excess nutrients, heavy metals, petroleum products, radioactive isotopes, and an enormous array of synthetic chemicals such as pesticides and personal care products. Each type of contaminant can disperse through environmental media, combining with other chemical compounds to form metabolites that may have different levels of toxicity for organisms or different dispersal mechanisms than the original contaminant. Yet another challenge in understanding and managing pollutants is that a substance that is harmful to one type of organism may not cause harm to another

environmental standards set by government agencies for maximum permissible levels of contaminants are based on very limited knowledge and are likely to be inadequate. Most of the standards are also based on acute effects that show up very quickly. Contaminant levels below permissible standards can cause chronic effects—subtle but pervasive changes that eventually degrade the health of individual organisms and populations. Some chronic effects result from bioaccumulation, as an organism accumulates contaminants within its tissues over the course of its life, and bio-magnification, as organisms pass on their accumulated doses to predators or scavengers.

1.2 PURPOSE

Current water quality monitoring system is a manual system 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. The project starts with the Python Script, while running the code the description connects with the Cloud platform and generates the output. Let us move on to the complete details of our project in upcoming sections.

CHAPTER 2

LITERATURE SURVEY

2.1 EXISTING PROBLEM

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. 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.

Water quality monitoring (WQM) system is widely being explored as it is needed to prevent the problem of water contamination worldwide. This paper presents the development and implementation of Water Quality Assessment and Monitoring (WQAM) system. The system development used Wi-Fi enabled microcontroller to connect with the IoT environment and store the data in the IoT cloud server. The microcontroller used is Arduino UNO that interacts with three types of sensor probes which are pH, turbidity and temperature probe. All the data measurements is transferred using a Wi-Fi module which is ESP8266. The IoT cloud used to utilize the data frame is Thing Speak. This system was implemented on Bandar Perda Lake and Derhaka River in Pulau Pinang with two systems implemented at each location. The sensors were placed on the water surface for more accurate measurements. This system continuously measures thereadings of pH, turbidity dan temperature on the lake/river for every 1 hour. Twenty readings were taken for every 1 hour within the first 20 minutes with 1 minute interval

and the readings were stored in the IoT cloud server. The readings are accessible via Thing Speak GUI. In conclusion, this system would benefit the authorities to take advantage of using the WQAM system with the aid of the IoT that is less time consuming, less cost and more reliable in real time.

Our 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 analyzed to improve the water quality. Following are the aims of idea implementation: a. To measure water parameters such as pH, dissolved oxygen, turbidity, conductivity, temperature etc. using available sensors at remote place. b. To collect data from various sensor nodes and send it to base station by wireless channel.

c. To simulate and analyze quality parameters for quality control. d. To send SMS to an authorized person automatically when water quality detected does not match the preset standards, so that, necessary actions can be taken.

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2.3 PROBLEM STATEMENT DEFINITION

A problem statement is important to a process improvement project because it helps clearly identify the goals of the project and outline the scope of a project. It also helps guide the activities and decisions of the people who are working on the project. The problem statement can help a business or organization gain support and buy-in fora process improvement project. A good problem statement can be created by identifyingand answering several questions related to the problem. This process involves identifying what the problem is, why it is a problem, when and where the problem was identified, who the problem impacts, how they are impacted by the problem and how much of an impact the problem has.

Creating a problem statement to understand customer's point of view. The below shown block diagram is a perfect example for our topic.

Fig1. Problem Statement

CHAPTER 3

IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

Empathy maps are an efficient tool used by designers to not only understand user behavior, but also visually communicate those findings to colleagues, uniting the team under one shared understanding of the user. Essentially, an empathy map is a square divided into four quadrants with the user or client in the middle. Each of the fourquadrants comprises a category that helps us delve into the mind of the user. The four empathy map quadrants look at what the user says, thinks, feels, and does.

With the user at the center and the categories in each of the four surrounding quadrants, an empathy map arranges all of your research about the user into an easy-to-read visual.

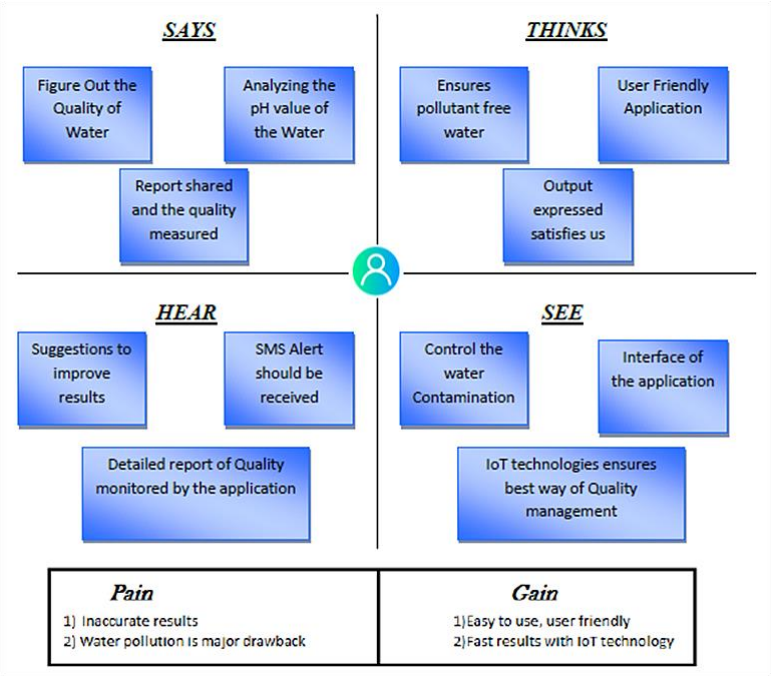

Fig2. Empathy Map

3.2 IDEATION & BRAINSTORMING

Brainstorming is a method design teams use to generate ideas to solve clearly defined design problems. Brainstorming is a method of generating ideas and sharing knowledge to solve a particular commercial or technical problem, in which participants are encouraged to think without interruption. Brainstorming is a group activity where each participant shares their ideas as soon as they come to mind. At the conclusion ofthe session, ideas are categorized and ranked for follow-on action.

When planning a brainstorming session it is important to define clearly the topicto be addressed. A topic which is too specific can constrict thinking, while an ill-definedtopic will not generate enough directly applicable ideas. The composition of the brainstorming group is important too. It should include people linked directly with the subject as well as those who can contribute novel and unexpected ideas. It can comprise staff from inside or outside the organization.

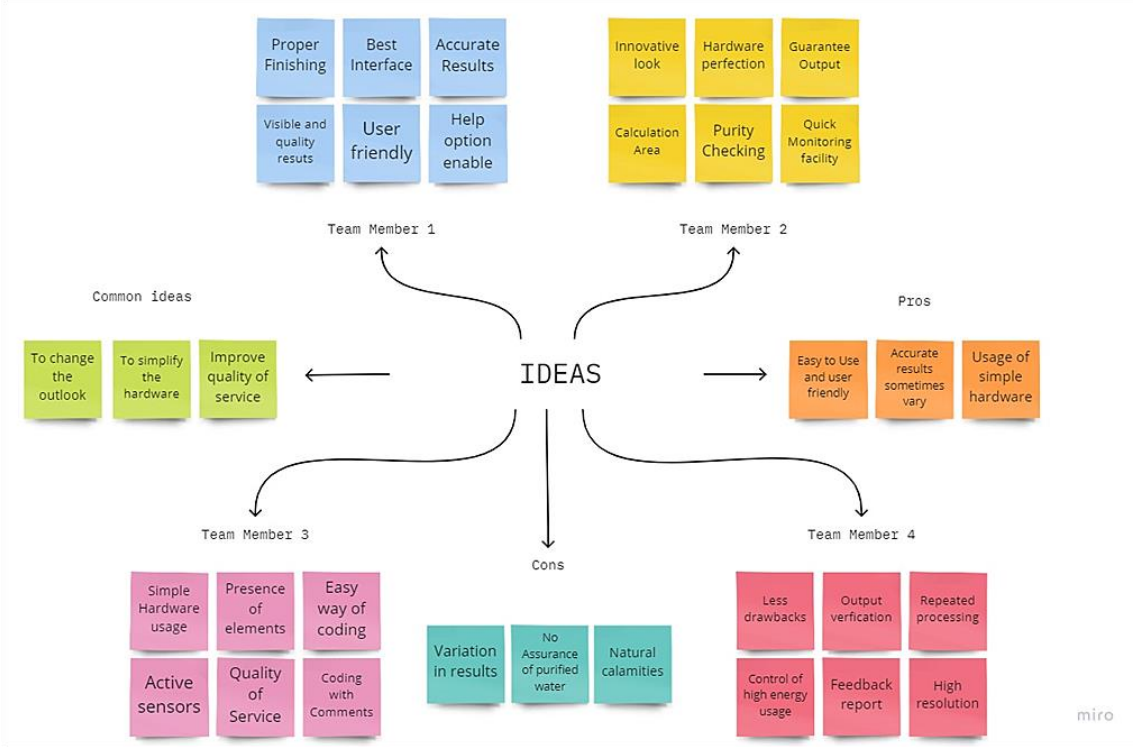

Fig3.Brainstorming

3.3 PROPOSED SOLUTION

Proposed Solution means the technical solution to be provided by the Implementation agency in response to the requirements and the objectives of theProject.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Customer segments and customer limitations
2.	Idea / Solution description	Develop a system for a real time quality assessment for water health at residential places using internet of things
3.	Novelty / Uniqueness	Analyzing the pH value of the water
4.	Social Impact / Customer Satisfaction	User friendly application
5.	Business Model (Revenue Model)	SMS Alert are received
6.	Scalability of the Solution	IOT technologies ensure best way of quality management

3.4 PROBLEM SOLUTION FIT

<table>
<tr><td rowspan="2">Block A</td><td>1. Customer segment(s)
Who is customer?
The water which is more hygienic to use which are bought by the persons.

*The main goal of Our Project is the customer Satisfaction.</td><td>6.Customer Constraints
The purity of the water can be the main question of the customer. The analyzed water quality should as much as perfect so that the customer can be satisfied.</td><td>5. Available Solution
The actual solution of this system is to find the perfect quality of the water by determining the temperature, humidity, pH value and waste water content in the water.</td></tr>
<tr><td>Block B</td><td>2.Jobs to be done /Problems
The job to be done is to find and determine the quality of the water.

*The Quality of the Water will be determined as Perfect as Possible</td><td>9.Problem Root Cause
The root cause is what which, if any dust particles such as algae mixes with river, water gets polluted badly.</td><td>7. Behaviour
The behaviour symbolises that the water scarcity occurs due to more water pollution.
Pure Water Contamination.</td></tr>
<tr><td>Block C</td><td>3. Triggers
While consuming the impure water causing various diseases, this can be stopped by controlling pollutants.

4. Emotions: Before / After
The customer satisfaction can be fulfilled in accordance to the outcome.</td><td>10. Our Solution
We provide a solution to overcome disaster is to stop water pollution and make environment clean. So that there will be no need of checking quality of water.</td><td>8.Channels of Behaviour
1.ONLINE
In online we can access the outcomes of the quality measured
2.OFFLINE
The status of the system can be verified in offline mode. The stability can be checked.</td></tr>
</table>

CHAPTER 4

REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration via Email Registration via Phone number
FR-2	User Confirmation	Confirmation via Email Confirmation via Mobile OTP
FR-3	Personal information	Follow the details displayed in the application
FR-4	Security	Password and Verification process

4.2 NON FUNCTIONAL REQUIREMENTS

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Used to find the quality of water, pH value and temperature
NFR-2	**Security**	It has high privacy security configuration
NFR-3	**Reliability**	The app displays the quality of water with random outputs
NFR-4	**Performance**	It gives accurate value with user friendly process
NFR-5	**Availability**	The app will be available in the play store or web
NFR-6	**Scalability**	We can increase the performance features of the app

CHAPTER 5

PROJECT DESIGN

5.1 DATA FLOW DIAGRAM

A data-flow graph is a collection of arcs and nodes in which the nodes are either places where variables are assigned or used, and the arcs show the relationshipbetween the places where a variable is assigned and where the assigned value is subsequently used.

Our Data Flow Diagram shows the entire process from the entry of the Application to the exit which is controlled by the User. Here, after the user login the app moves on to the profile section where the user can see the materials to be selected then the measurement what he need to acquire is to be chosen. Final output can be shown in the separate page.

The Data Flow Graph of our proposed solution is shown below:

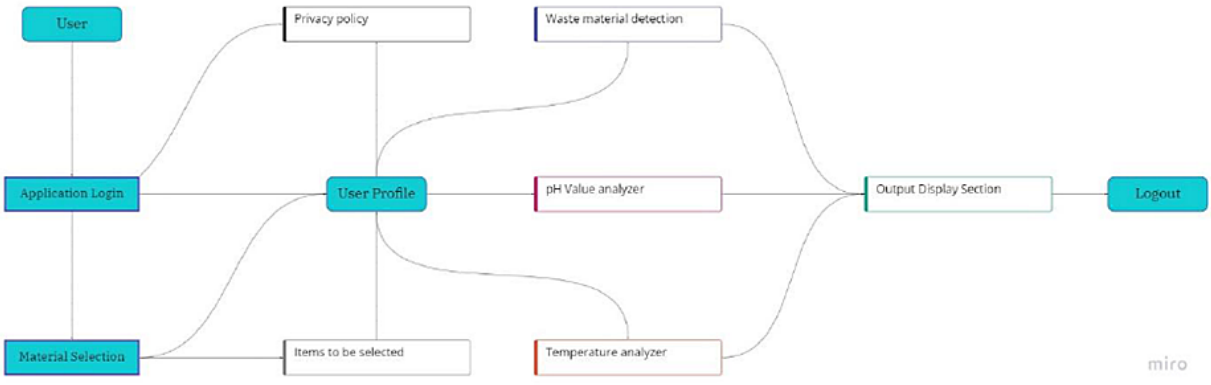

Fig4. Data Flow Graph

5.2 SOLUTION & TECHNICAL ARCHITECTURE

For Solution Architecture,

- The Quality of the Water will be determined by our IoT process.
- While consuming the impure water causing various diseases, this can bestopped by controlling pollutants.
- We provide proper solution to overcome this disaster.

Perfect measuring is done in our experiment.

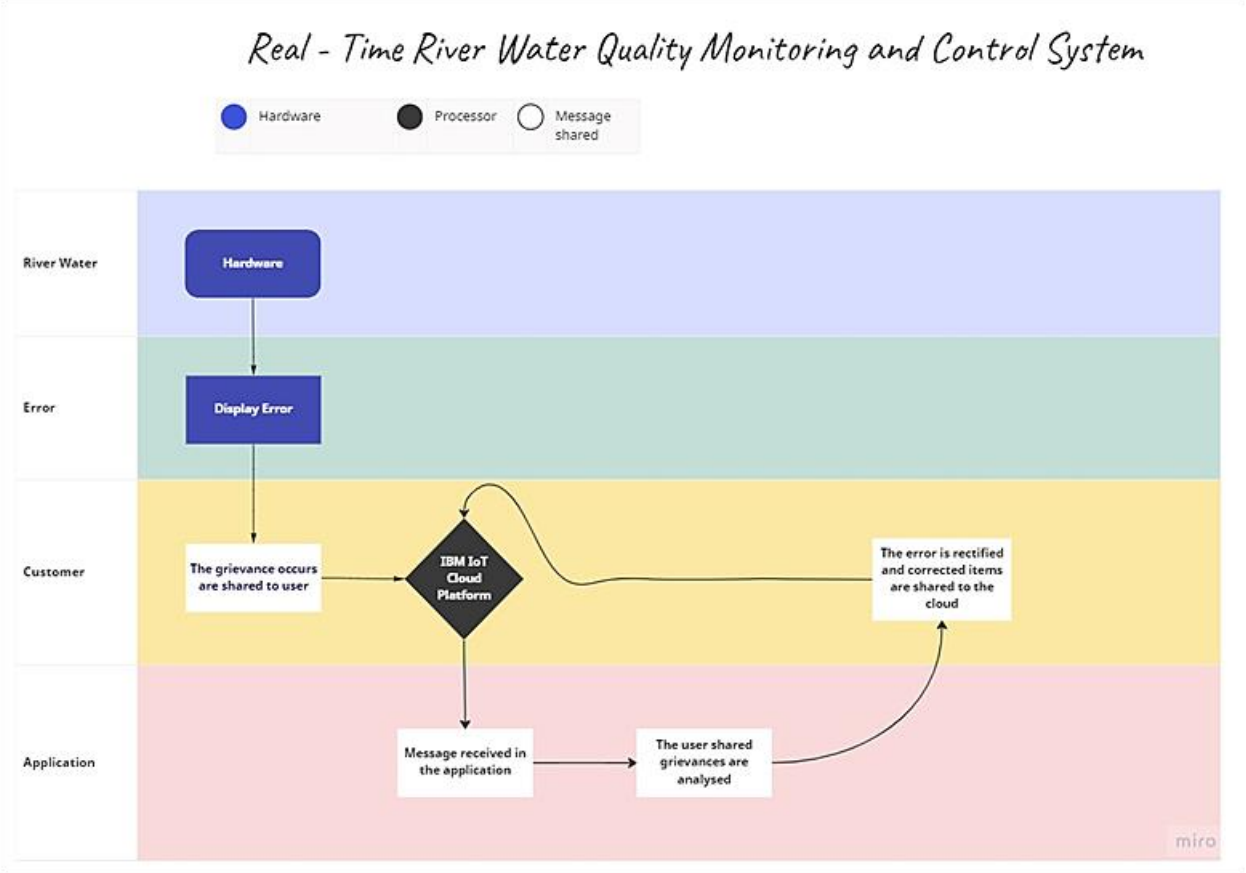

Fig5.Solution Architecture

For Technical Architecture,

Technical architecture—which is also often referred to as application architecture, IT architecture, business architecture, etc.—refers to creating a structured software solution that will meet the business needs and expectations while providing a strong technical plan for the growth of the software application through its lifetime. IT architecture is equally important to the business team and the information technology team.

Technical architecture includes the major components of the system, their relationships, and the contracts that define the interactions between the components. The goal of technical architects is to achieve all the business needs with an application that is optimized for both performance and security. IT architects plan for things they know are coming in the future and for things they don't yet envision or dream. Taking the time to design the architecture at the start will prevent major design changes, code refactoring, and expensive rework later in the project.

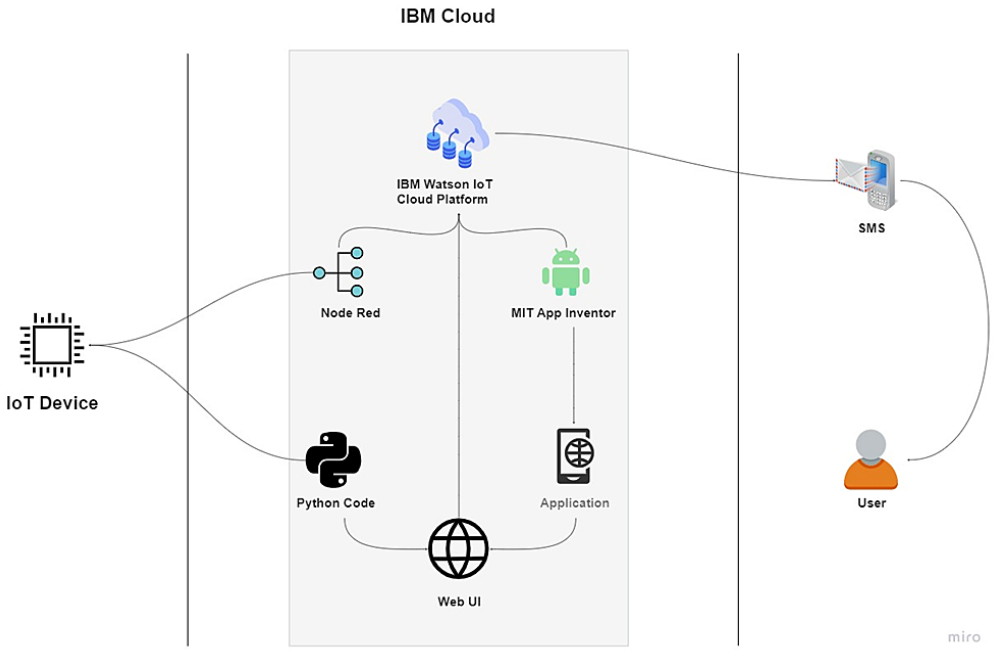

Fig6.Technical Architecture

5.3 USER STORIES

A user story is an informal, general explanation of a software feature written from the perspective of the end user. Its purpose is to articulate how a software feature will provide value to the customer. It's tempting to think that user stories are, simply put, software system requirements. But they're not.

A key component of agile software development is putting people first, and a user story puts end users at the center of the conversation. These stories use non- technical language to provide context for the development team and their efforts. After reading a user story, the team knows why they are building, what they're building, and what value it creates. User stories are one of the core components of an agile program. They help provide a user-focused framework for daily work — which drives collaboration, creativity, and a better product overall.

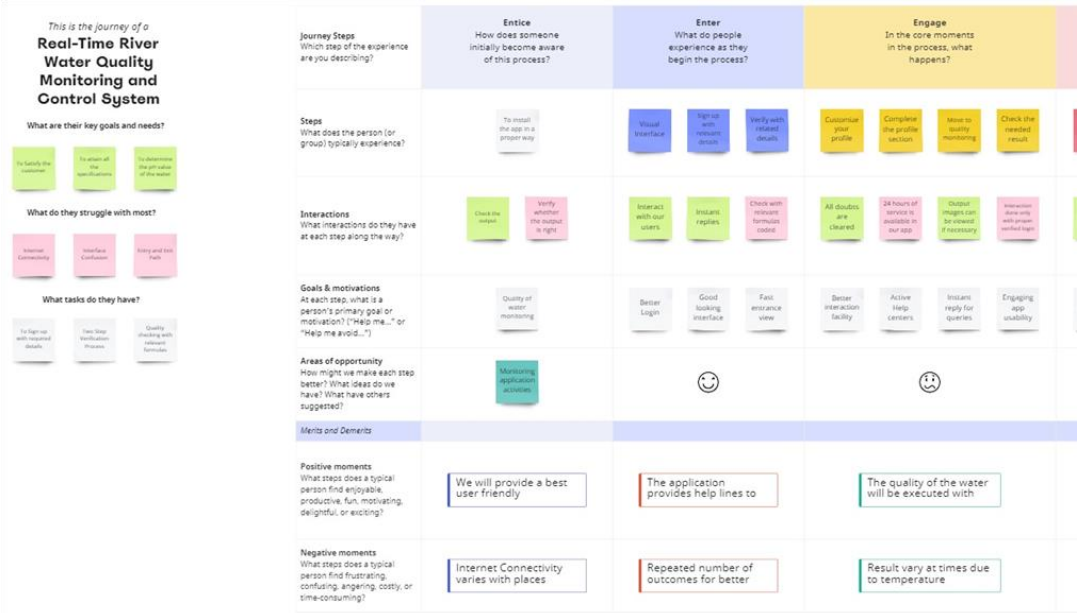

Fig7.Customer Journey

CHAPTER 6
PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	M.Priyadharshini E.Jananipriya M.Sudarvizhi B.Sangeetha
Sprint-1	Registration through Gmail	USN-2	As a user, I can register for the application through Gmail	2	Low	M.Priyadharshini E.Jananipriya M.Sudarvizhi B.Sangeetha
Sprint-1	Registration through other Mail	USN-3	As a user, I can register for the application through email	2	Medium	M.Priyadharshini E.Jananipriya M.Sudarvizhi B.Sangeetha
Sprint-2	Confirmation Mail	USN-4	As a user, I will receive confirmation email once I have registered for the application	1	High	M.Priyadharshini E.Jananipriya M.Sudarvizhi B.Sangeetha

Sprint-2	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	M.Priyadharshini E.Jananipriya M.Sudarvizhi B.Sangeetha
Sprint -2	Coding	USN-6	To find and express the requirements to be needed in the code	2	High	M.Priyadharshini E.Jananipriya M.Sudarvizhi B.Sangeetha
Sprint -3	Create IBM Watson	USN-7	Get log on to the IBM Cloud Services	2	High	M.Priyadharshini E.Jananipriya M.Sudarvizhi B.Sangeetha
Sprint-3	Create Node Red Service	USN-8	To develop Node red service to integrate software process	2	Medi um	M.Priyadharshini E.Jananipriya M.Sudarvizhi B.Sangeetha
Sprint -3	Create Web UI	USN-9	To create Web UI to access data from IBM Cloud database	2	Medi um	M.Priyadharshini E.Jananipriya M.Sudarvizhi B.Sangeetha
Sprint-3	Developing App	USN-10	Use MIT App Inventor to create app with respective requirements	1	Medi um	M.Priyadharshini E.Jananipriya M.Sudarvizhi B.Sangeetha

Sprint-4	Fast SMS Service	USN-11	Sending alerts when the respected measurements exceeds limits	3	High	M.Priyadharshini E.Jananipriya M.Sudarvizhi B.Sangeetha
Sprint-4	Publish data to the cloud	USN-12	Publishing the data into cloud once sensed	3	High	M.Priyadharshini E.Jananipriya M.Sudarvizhi B.Sangeetha
Sprint-4	Testing	USN-13	Testing of projects and analyze the result accuracy	3	Medium	M.Priyadharshini E.Jananipriya M.Sudarvizhi B.Sangeetha

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	20	6 Days	24 Oct 2022	29 Oct 2022	20	04 Nov 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	06 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	13 Nov2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

6.3 REPORTS FROM JIRA

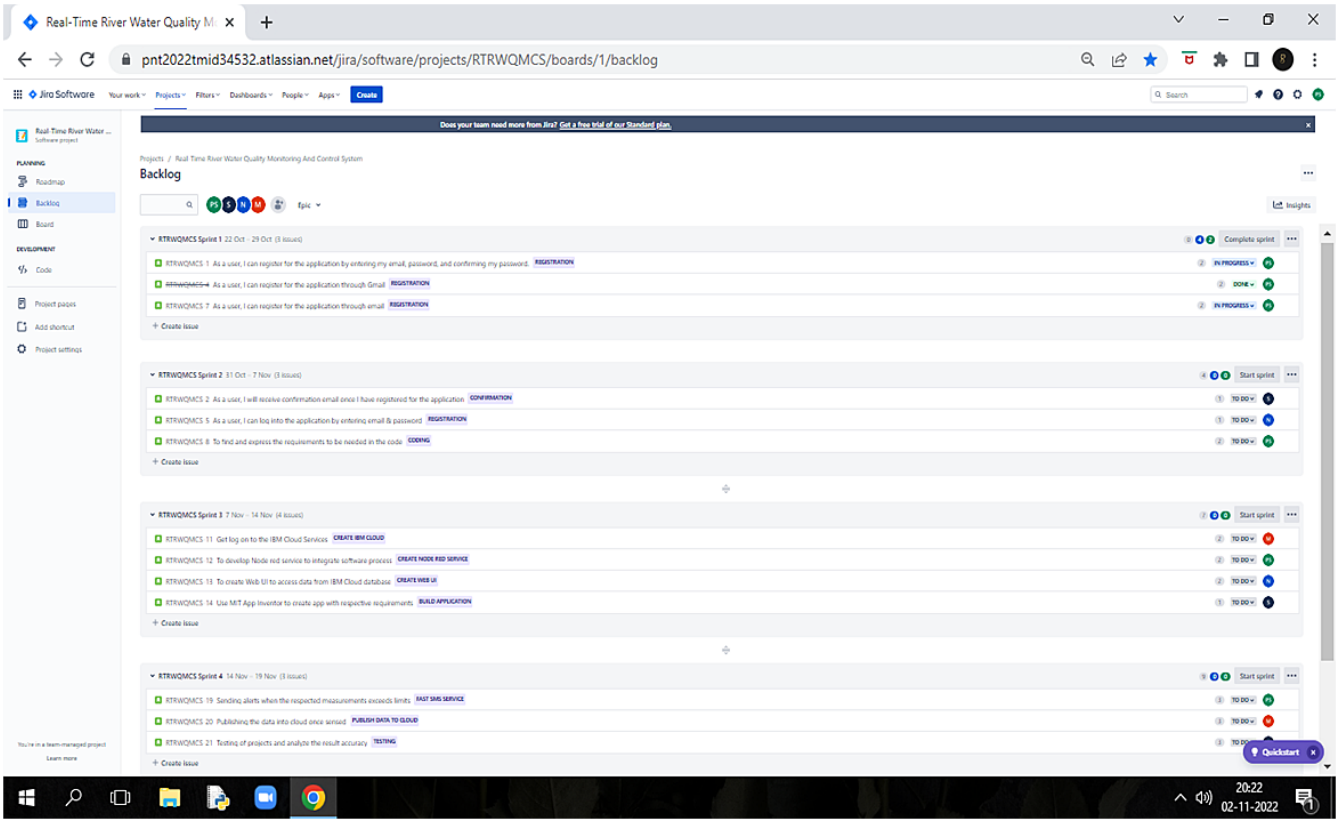

Fig8. Sprint Assigned Page

Fig9. First Road Map

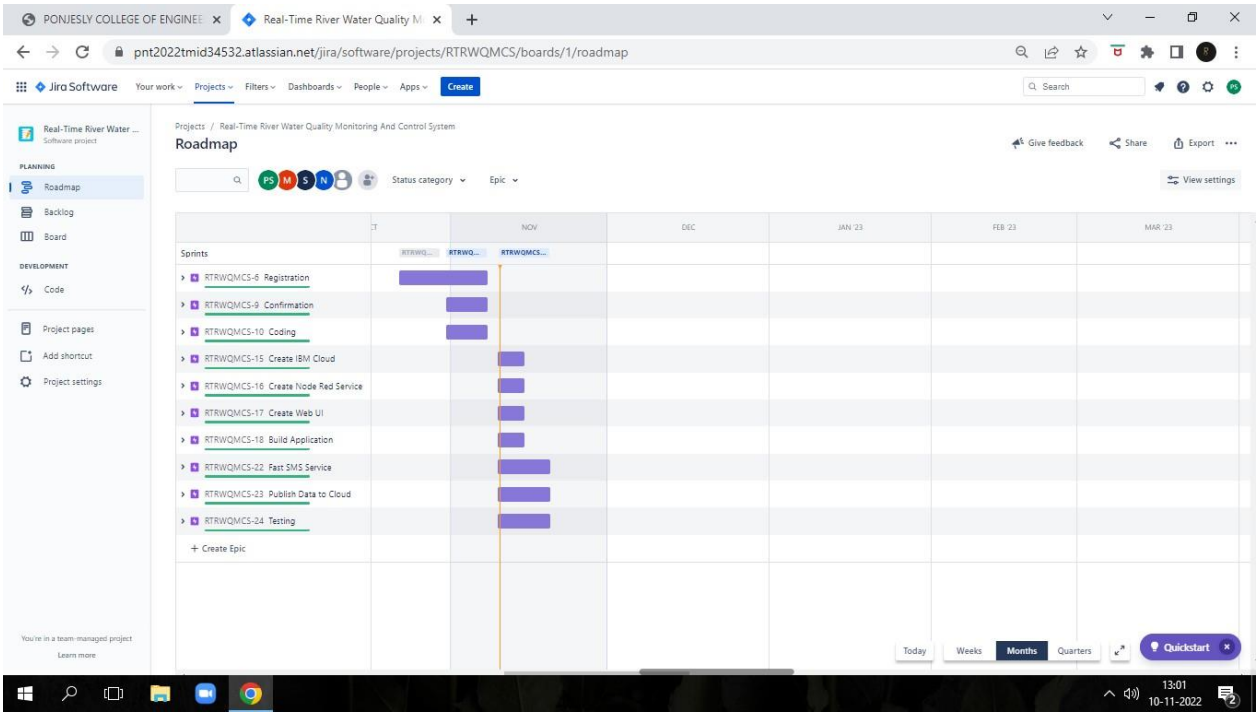

Fig10. Road Map After Tasks Done

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 verification segments too. After creating the Cloud Profile, let's move to device creation part.

Device Creation

Now the next step is to create a device, we have created a device with following details

Device Type: 1234

Device Id: 1234567

With following details, we have created a device and the code for this device carries the requirement which satisfies the project specification. We used temperature, humidity and the pH value in the code.

1. temperature - 0 to 100
2. humidity - 0 to 100
3. ph value - 0 to 14

While, the device is made to run the results are appeared in the Recent Eventstab near the Device part.

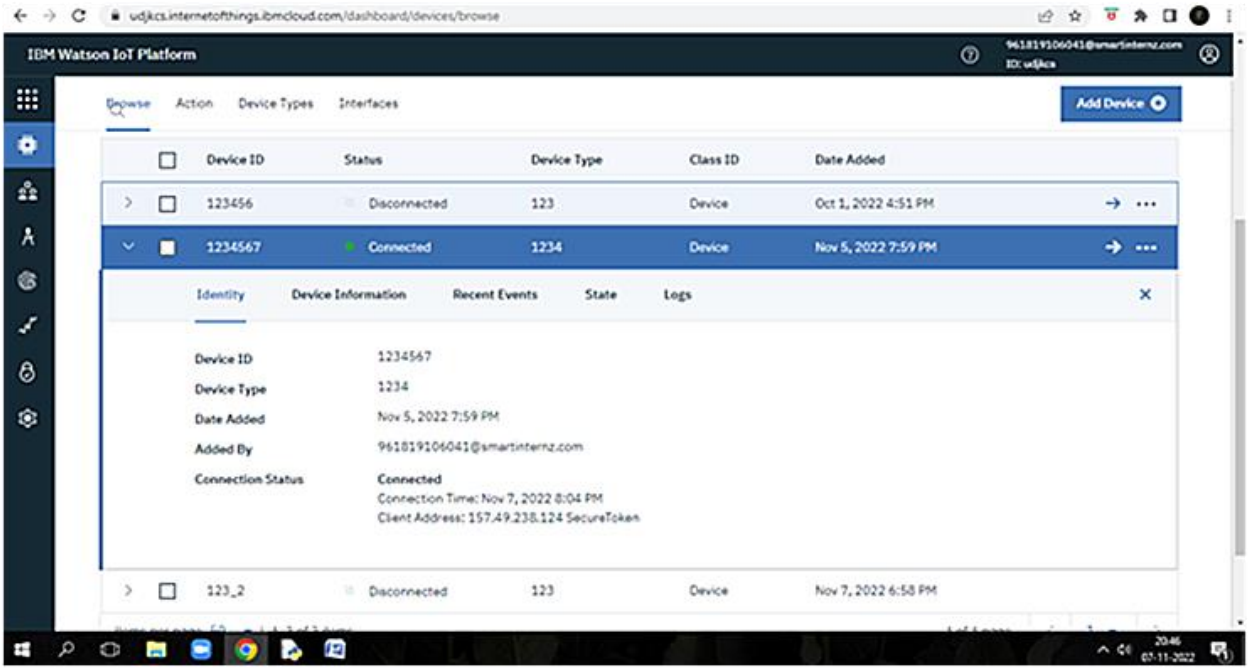

Fig11.Created Device

NODE-RED SERVICE

After registering to the IBM IoT Platform and created the device, now we move on to the Node-Red Service, in this here we can create the Web user interface and the Web Application by designing the circuit. Our Node-Red Circuit designing 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, hum, pH these three functions processes temperature, humidity and the pH value. And the three functions are connected to the msg.payload button. At separately the functions are designed in the wave of chart, where temperature and humidity are designed in the Line Chart and pH value as Gaugechart.

After this, we set two buttons of the Switch board, Light ON and Light OFF. This button works as if it pressed to light ON, the python code displays "led is on", if light OFF, it shows " led is off".

Now for connecting to web we use "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 "/sensor" to review the output.

For simulating the Node-Red Service, there appears "Deploy" button.

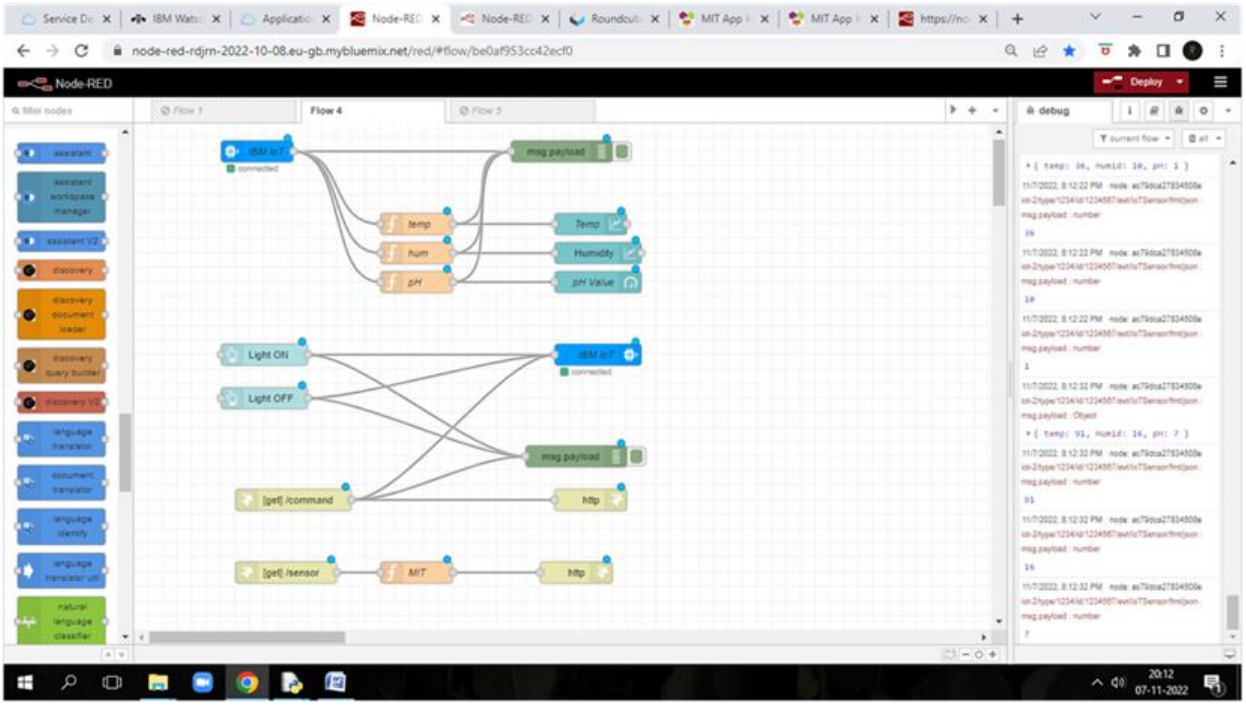

Fig12. Node-Red Circuit Design

USER INTERFACE

After the successful simulation of the Node-Red Service, User Interface is created. Our Web UI includes Temperature, Humidity, pH Value in accordance with Switch Board of Light ON and Light OFF. The Temperature and Humidity varies from 0 to 100. And the pH varies from 0 to 14.

Our Executed User Interface from the Node-Red is shown below.

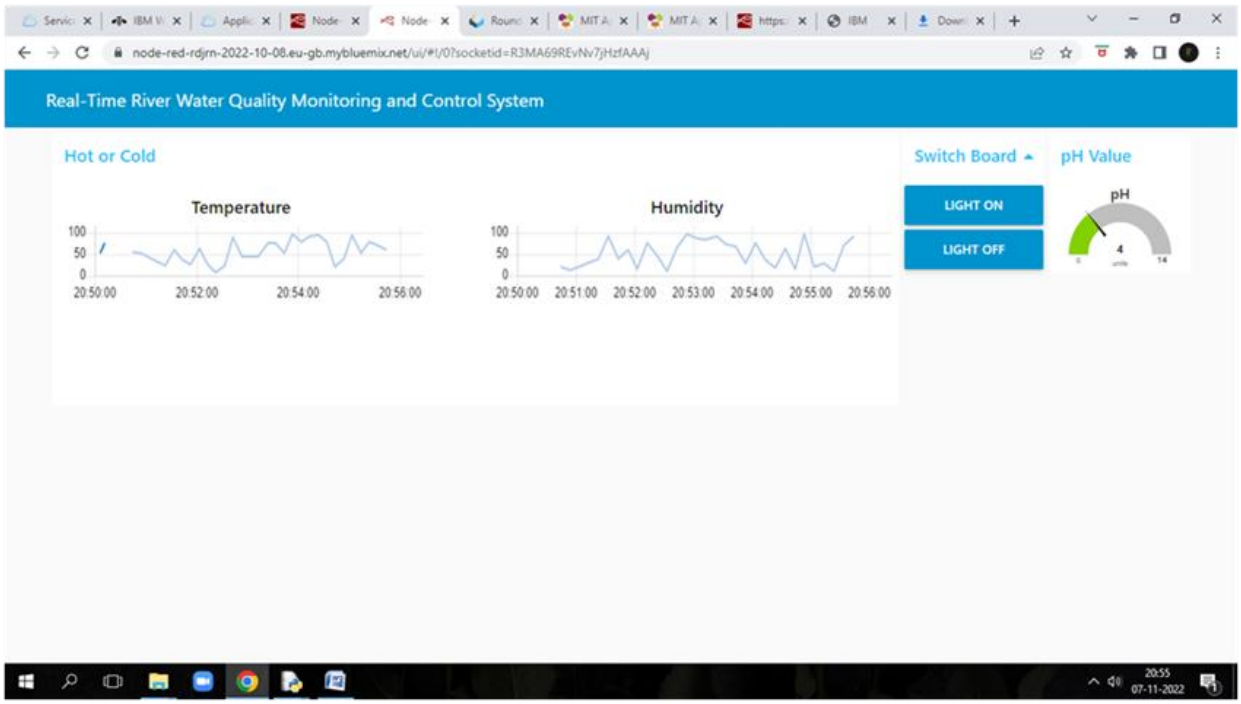

Fig13.Node-Red Page Web User Interface

MIT APP INVENTOR

This phase is the most priority requirement of our project. Using an application helpsusers to monitor in easy way. MIT App inventor helps to design our application. We have created 6 Screens for our App.

The First screen lets you get started with the application. The Second Screen is the login Page and following the registration page screen, we have kept the buttons sign in with Gmail and email. Through the respective screen the user can sign up with the application. Also we have place the notify condition, when the details goes wrong, it alerts "Check your Credentials". As the details are correct it moves on to the next screen. We have set the credentials as 1234 for both username and password.

Here we display the Login Page of our Application

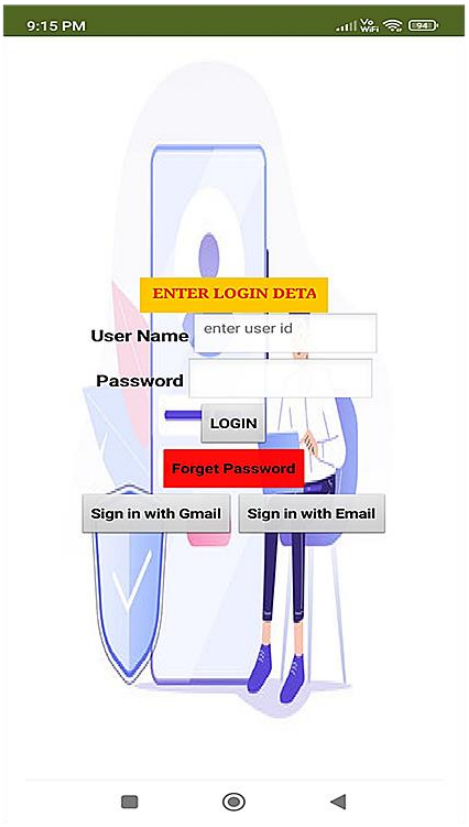

Fig14.Login Page

Following the Login Page, Selection of process is shown with three categories such as Temperature, Humidity and pH value and at last Logout button.

When the category is selected the page moves on to the Output Display Page where we can see all the three results as the python code is made simulated.

The last page contains Switch board of Light ON and Light OFF. As same as user interface, here also when we press these buttons the output of led on or off is displayed in the Python code

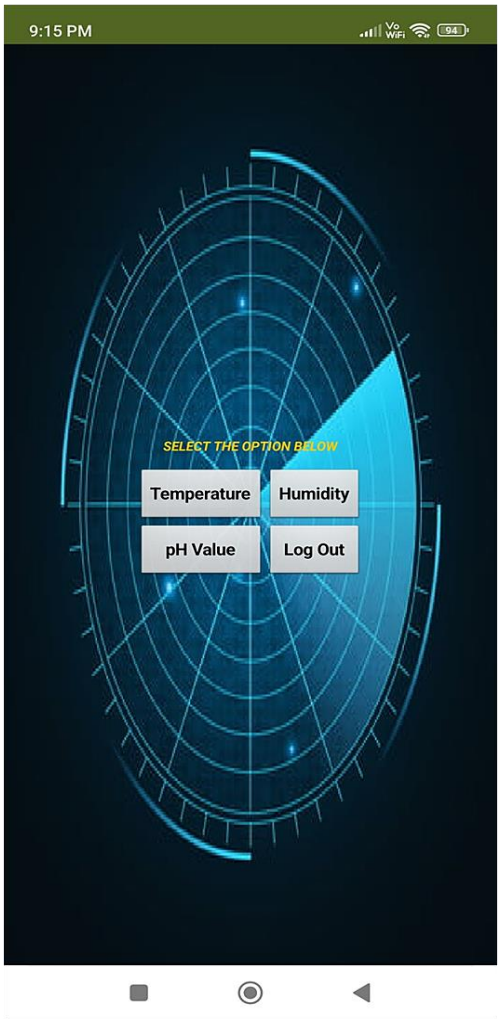

Fig15.Output Selection Page

7.2 FEATURE 2

PYTHON CODE

Our Python Code is very Simple and easy to understand. The programs carries our device details and the requirements of the project are kept defined. All conditions are made properly and the output is done successfully.

CODE

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


#Provide your IBM Watson Device Credentials
organization = "udjkcs"
deviceType = "1234"
deviceId = "1234567"
authMethod = "token"
authToken = "123456789"

# Initialize GPIO


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

# 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)
    pH=random.randint(0,14)

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

CHAPTER 8
TESTING

8.1 TEST CASES

As the code is made to run, the system waits to connect with IoT platform. On account of connection with the IBM Watson Platform, the code displays the output with relevant details. The output is shown in Cloud platform, the links to Node-Red also to the UI section. Finally when the Application is operated, the output is also displayed init.

In our python code, we used temperature, humidity and pH value with the following conditions

temp=random.randint(0,100)

Humid=random.randint(0,100)

pH=random.randint(0,14)

The output of our Code is shown below,

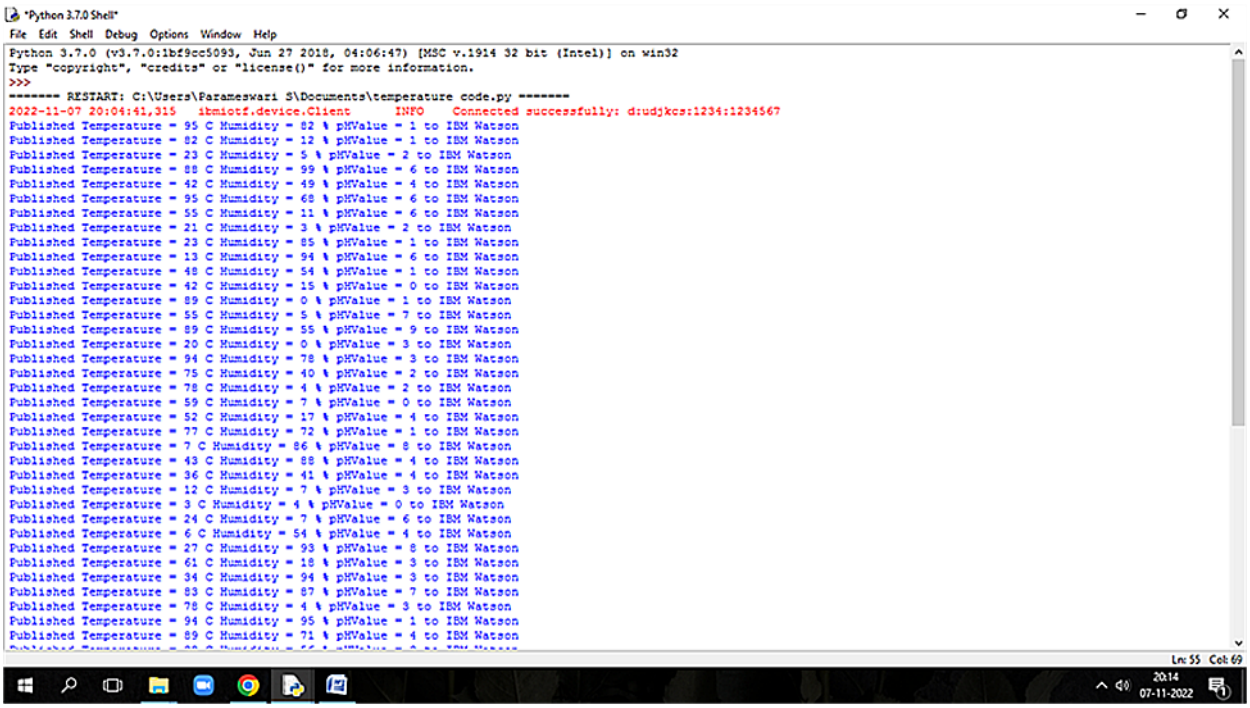

Fig16.Python Output

8.2 USER ACCEPTANCE TESTING

As the completion of the application development, the app should give as muchsupport to the user. The developer must make sure of the avoidance of the disability in working of application by the user. All the appearance of the app should able to be configurable to the user. The usage of the application must satisfy the user at 100%. All the specifications must be simple and easy to use.

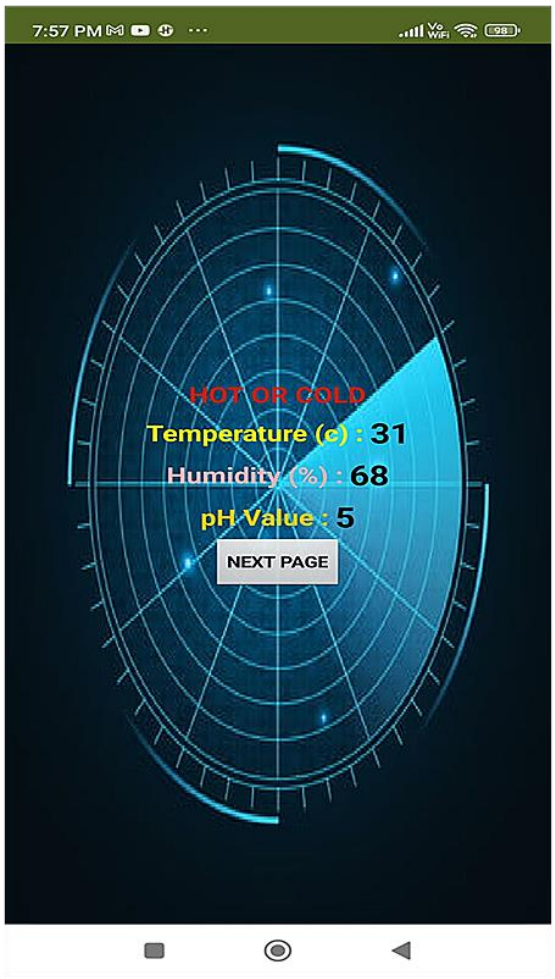

Fig17. Application Output

CHAPTER 9
RESULTS

9.1 PERFORMANCE METRICS

The performance and the working of the code is very 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. As the code is simulated 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.

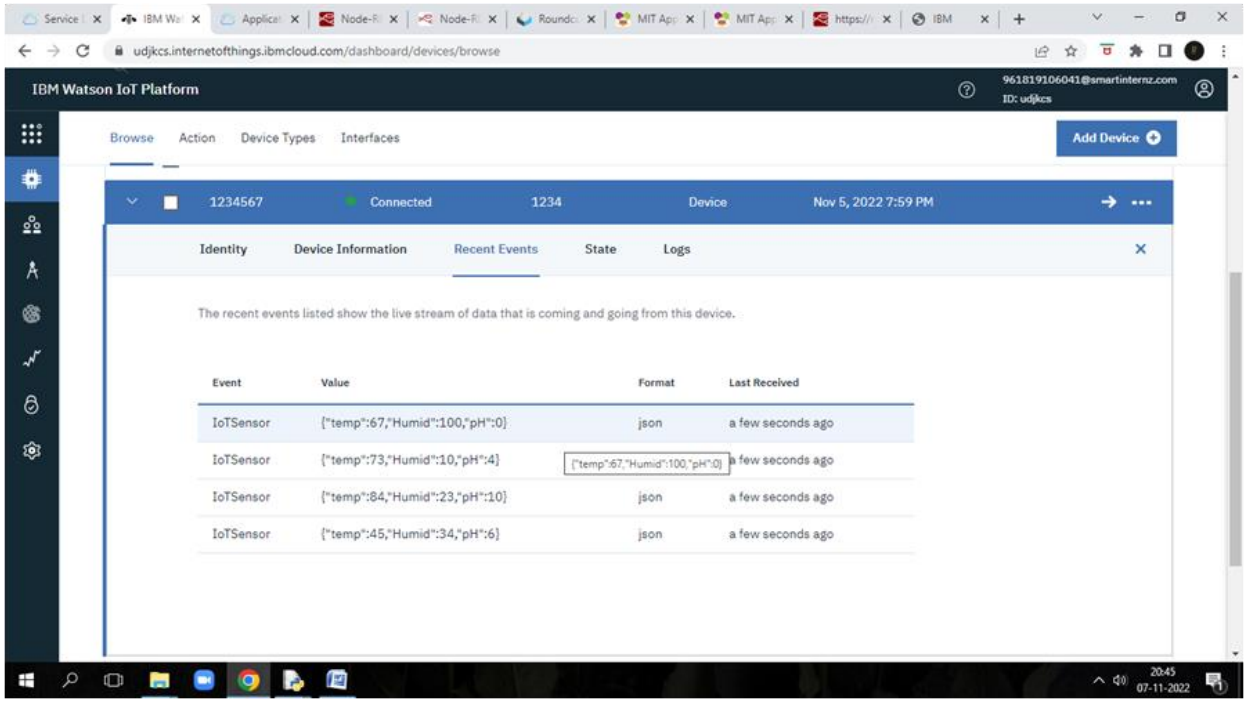

Fig18. IoT Platform Output

CHAPTER 10
ADVANTAGES & DISADVANTAGES

ADVANTAGES

Water quality standards also protect iconic, locally grown products such as wild rice andwalleye. 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.

DISADVANTAGES

It is difficult to collect the water samples from all the area of the water body. The cost of analysis is very high. The lab testing and analysis takes some time and hence the lab results does not reflect real time water quality measurement due to delay in measurement. 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 organizations 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

This way of monitoring the water quality made us very easy. Water monitoring is a crucial part of maintaining many environments including industrial buildings, commercial properties and healthcare establishments. Technology has advanced to the extent that there are now highly sophisticated, accurate and convenient water monitoring systems which offer a whole host of benefits. The major cause of water impurity by industrial wastes and also human acts. By analyzing the quality of water we can consume healthy state, but if we reduce the pollution causing acts we can gain more water ie. pure water even naturally. Stop polluting the river water and make environment clean and hygienic. Indicators are needed for monitoring the system from source to tap, including aesthetic changes, water quality indicators, suspicious activity, changes in water pressure and illness in the community. Action plans for management of both accidental and intentional pollution with biological and chemicals should include a base line understanding of the vulnerabilities and baseline quality. Triggers for action must be put in place: spill notification, rainfall, raw water turbidity, fecal indicators and public health indicators. The physical/chemical/biological and geological nature of the water system under study must be considered. Site assessment is an important component of the risk/management framework. Integration of inventory of risks to the watershed, along with climate prediction factors and the monitoring of the raw ambient water quality are critical. Monitoring recovery after contamination events is essential; this will require that baseline data sets are available. Climatic factors and meteorological data continue to show a pattern associated with water quality impacts (during floods but even droughts) and are often associated with treatment and management failures. Thusmeteorological data, weather forecasting and climate prediction scenarios should be integrated in the development of any assessment and management strategy.

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 benefit substantially from obtaining and linking information on the occurrence of both chemicals and potentially adverse biological effects. As of now thewater quality monitoring just a wave of seeds. The development of this processes must be take advances in quick rate. In future, there will be reduction in pollution as waterquality monitoring grows.

CHAPTER 13

APPENDIX

SOURCE CODE

As we successfully developed and programmed our python code, lets this be thefinal code of execution.

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


#Provide your IBM Watson Device Credentials
organization = "udjkcs"
deviceType = "1234"
deviceId = "1234567"
authMethod = "token"
authToken = "123456789"

# Initialize GPIO


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

# 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)
    pH=random.randint(0,14)

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

PROJECT DEMONSTARTION VIDEO UPLOADED HERE

GITHUB LINK : http://github.com/IBM-EPBL/IBM-Project-13258-1659515415

PROJECT DEMO LINK : http://youtu.be/qs7SUG6ZTvY