**PROJECT REPORT**

**REAL-TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM**

|  |  |
| --- | --- |
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# CHAPTER 1

# INTRODUCTION

* 1. **Project Overview**

The major goal is to create a system that uses wireless sensor networks to continuously monitor river water quality at remote locations with low power consume option, low cost and high detection accuracy. The main aim is to assure low cast efficient water quality monitoring and control over river. To operated battery is safer and low rate of electrical shocks. Project predict hardness, turbidity, humidity and make river water to safe drinking water with better consistency for house hold purpose. Real-time data access can be done by using remote monitoring and Internet of Things (IoT) technology. Data collected at the apart site can be displayed in a visual format on a server PC with the help of Spark streaming analysis through Spark MLlib, Deep learning neural network models, Belief Rule Based (BRB) system and is also compared with standard values. Also, it assures low cost efficient water quality monitoring and control over river water. Since its battery operated, it is much safer for the locality and people to use the river water that has low rate of electrical shocks as the battery is completely insulated and rechargeable so that the system is continuous.

By using this product people can predict, analyze the hardness of water and also the factors like temperature and turbidity of water for having a safe drinking and water with better consistency for house hold purposes. Since water is an essential compound in our daily basis intake of it in healthy manner is provided by our cost-efficient quality monitoring and control system which is market affordable and greatly lifesaving factor for people using river water. The environment around consists of five key elements e.g., soil, water, climate, natural vegetation, and landforms. Among this water is the utmost crucial element for 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.

**1.2 Purpose**

In an healthy manner controlling of turbidity, hardness, pH value of normal river water using IoT. The system collects various parameters from water, such as pH, dissolved oxygen, turbidity, conductivity, temperature and so on.

The remote sensing technology is the cornerstone of IoT based water quality monitoring. This implements the approach by using the pH sensor, turbidity sensor to obtain analog readings for water contaminates. The clients can get ongoing water quality information from far away. Now a day’ s 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. IoT integrated network if everywhere starting from smart cities, smart power grids, and smart supply chain to smart wearable.

Though IoT is still under applied in the field of environment it has huge potential. It can be applied to detect forest fire and early earthquake, reduce air population, monitor snow level, prevent landslide, and avalanche etc. Moreover, it can be implemented in the field of water quality monitoring and controlling system. Water quality monitoring has gained more interest among researchers in this twenty-first century. Numerous works are either done or ongoing in this topic focusing on various aspects of it. The key theme of all the projects was to develop an efficient, cost-effective, real-time water quality monitoring system which will integrate wireless sensor network and internet of things. In this research, we monitor the physical and chemical parameters of water bodies inside Chittagong city by using an IoT based sensor network.

**CHAPTER 2**

**LITERATURE SURVEY**

* 1. **Existing Problems**

Nowadays, water quality monitoring faces challenges because of global warming limited water resources, growing population, industrial improvements etc. So there is need to develop a best methodologies to monitor the water quality is generally affected due to both point and non-point sources of pollution. Generally poor water quality spreads diseases. There is need for effective monitoring, evaluation and control of water quality in different areas. Ensuring safe water supply of drinking water is big challenge for today’s generation. The excessive use of fertilizers in farms and also in other sectors such as mining and construction have contributed in overall reduction of water quality. To ensure the safe supply of the drinking water the quality needs to be monitor.

So we can give a design and development of a low cost system for real time monitoring of the water quality using IoT(Internet of Things) and machine learning. The system include of different sensors is used for measuring physical and chemical parameters of the water. Turbidity measures the large number of suspended particles in water that are invisible. If the turbidity is higher then there is higher risk of diarrhea, cholera [1]. On the other hand, if turbidity is lower then the water is clean. Temperature sensor measures whether water is hot or cold. The traditional methods of water quality monitoring involve the manual collection of water samples from different locations. As we will get the solutions of water samples then we can measure the different quality attributes of water and compare them with the given threshold values or standard values, if the values generated from the sensors are exceeded then alert is sent to the user of system and necessary actions will be taken by users.

* 1. **References**

[1] Kengnal P, Megeri MN, Giriyappanavar BS, Patil RR (2015) Multivariate analysis for the water quality assessment in rural and urban vicinity of Krishna River (India). Asian J Water Environ Pollut 12:73–80

[2] Kumar M, Singh Y, Al MKET (2010) Interpretation of water quality parameters for villages of Sanganer Tehsil by using multivariate statistical analysis. J Water Resour 2:860–863. H

[3] Loganathan K, Ahamed AJ (2017) Multivariate statistical techniques for the evaluation of groundwater quality of Amaravathi River Basin: South India. Appl Water Sci 7:4633–4649.

[4] Nagar EA (2007) Guidelines for Water Quality Monitoring Central Pollution Control Board Parivesh Bhawan Foreword. Water 1–35

**2.3 Problem Statement Definition**

Water is one of the major compounds that profoundly influence ecosystem. But, nowadays it is been exploited heavily due to rapid industrialization, human waste and random use of pesticides and chemical fertilizers in agriculture, which leads to waste contamination. Thus, a water monitoring system is necessary to observe the water quality in a large area such as lake, river, and aquaculture. As per the current world situation, Internet of Things (IoT) and remote sensing techniques are used in heterogeneous areas of research for supervising, congregate and analyzing data from the remote locations.

In this paper, the suggested system is a minimal price real time water quality monitoring system in IoT environment. This system comprises of numerous sensors for assessing the physical and chemical parameter. The factors of water that can be assessed using these sensors are pH, turbidity, conductivity, dissolved oxygen. Using this system, the real time quality of water bodies can be determined and the data uploaded over the Internet are analyzed.

India is facing a major issue of natural resource exiguity, especially in case of water due to population growth and economic development. Most of the water bodies are contaminated due to the superfluous pollutants, which are mostly human-made. Thus certify the cleanliness of water is a major challenge. Rapid industrialization and greater emphasis on agriculture growth with latest technology, usage of more fertilizers and pesticides caused large impurity in aquatic surroundings directing to debasement of water quality and depletion of aquatic life. Water bodies are contaminated due to point and non-point sources of pollution, which include sewage discharge, discharge from industries, run-off from agricultural fields, urban run-off and even due to floods, droughts and lack of education and awareness amid users.

The involvement of users in looking at the aspects like hygiene, environment sanitation, storage and disposal are exceptive elements to uphold the quality of water bodies. The tonicity of lakes, rivers and other water bodies and their biological diversification are directly linked with the health of nearly every element of the ecosystem. Due to the use of befouled water by ecosystem components, the waterborne diseases are spreading over surroundings causing death and slowing down socio-economic progress. About 5 million people have died because of waterborne diseases all over the world (Water Resource Information System of India, 2017). Fertilizers and pesticides used for agriculture purpose can be washed by rain through soil, which ends up in water bodies. Industrial effluents are also washed into water bodies.

These pollutants go into the food chain and gather till they reach noxious levels, ultimately killing birds, fish quality whereas for agriculture and industries the quality can be flexible. Industries use water from rivers to power machinery and for Increment in water temperature diminishes the broke down oxygen level in water which influences the biotic life. The large portion of the above variables makes water quality. checking more paramount in our biological system Water quality observing is the gathering of data from the suggested framework dispatched at the set areas at a standard interim of time, with a precise goal to give the constant information which will be utilized to characterize the ebb and flow conditions. The primary point of constant water quality observing framework incorporates the valuation of water quality parameters, for example, physical, substance properties, with a definite goal to recognize the varieties in water parameters and to give an early cautioning of the dangers.

The framework additionally gives a constant examination of the gathered information recommends reasonable medicinal measures to slacken the water pollution. The aim of this paper is to deliver survey of functions held in smart water quality monitoring system with respect to application, communication technology used, sensors used etc. and to portrayal minimal price periodic smart water quality monitoring system using Arduino microcontroller with Wi-Fi module to examine parameters like pH, turbidity, temperature, water level, conductivity. The system also takes account facility to inform the user and the concerned authorities on variation of parameters in water bodies.

**CHAPTER 3**

**IDEATION & PROPOSED SOLUTION**

**3.1 Empathy solution**

* The empathy map includes what do you think and what do you? they think about the human health affect, increase the chlorine concentration, affect the environment also.
* What do they and what do? present unwanted component and clean water.
* Pain of the problems are polluted water and shortage of water, disease.
* Gain of the empathy map is pure water and detect the temperature of the river water.
* 

Fig 3.1: Empathy map

**3.2 IDEATION & BRAINSTORMING**

The ideation phase detects the main purpose of the project to work in the germs and bacteria present in the water and affect the eco system

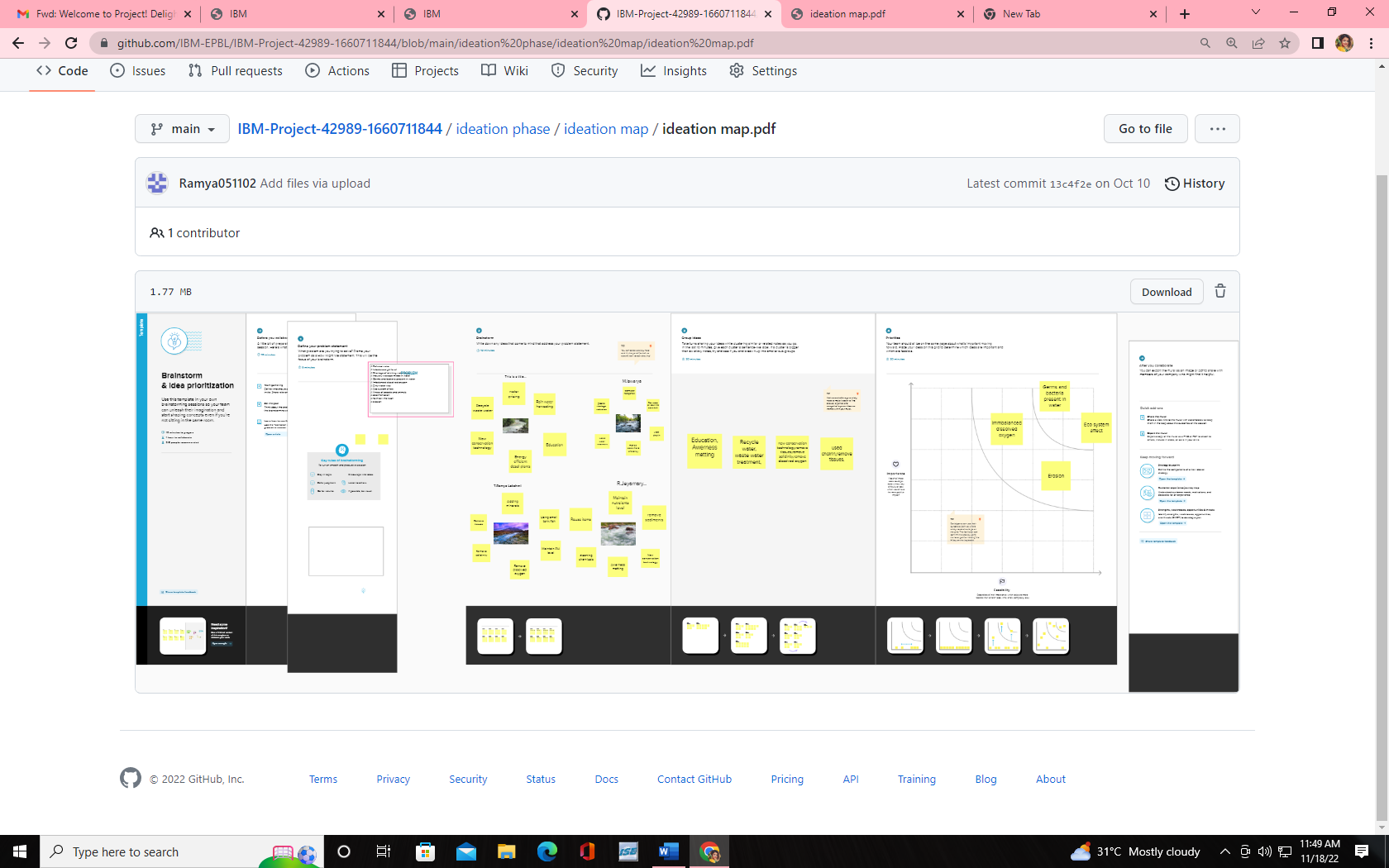
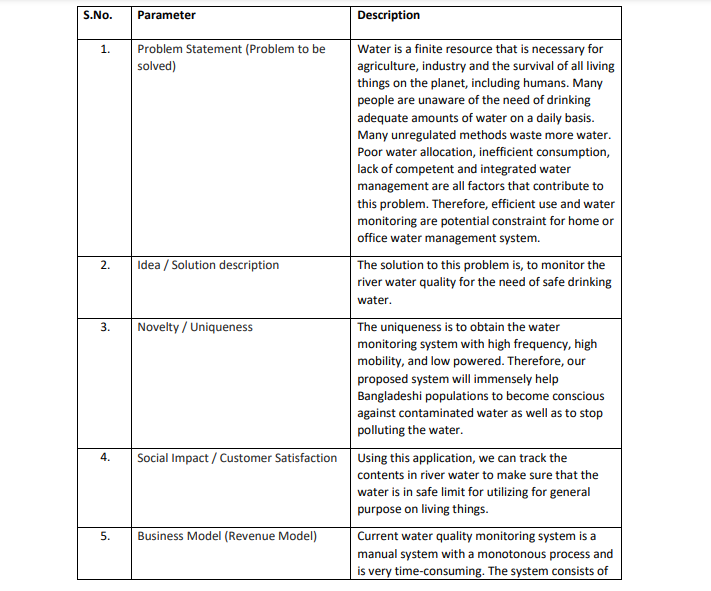
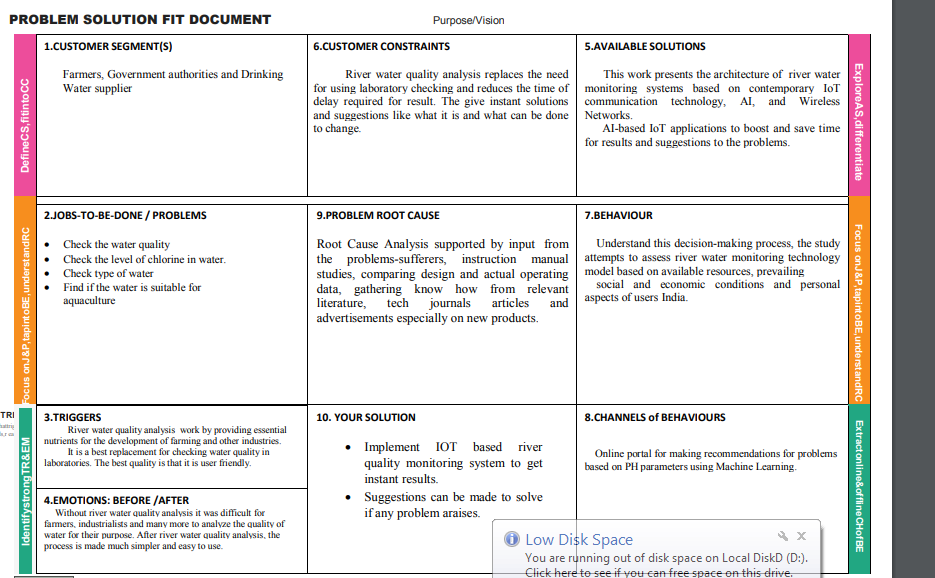
.

Fig 3.2: Ideation map

3.3 PROPOSED SOLUTION



**3.4 PROBLEM SOLUTION FIT**

**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 / SubTask)** |
| FR-1 | User Registration | Registration through Form  Registration through Email  Registration through product mobile **UI** |
| FR-2 | User Confirmation | Confirmation via Email Confirmation via OTP |
| FR-3 | Ph level detection | To monitor the water quality Ph sensor is used and the signals are sent to Arduino. |
| FR-4 | Turbidity detection | Turbidity sensor measures the clarity of element or  muddiness utter in the water and the  signals are send to Arduino. |
| FR-5 | Ultrasonic generator | At regular interval times the waves are generated to clear algae 25%,50%,100% |

**4.2 Non-functional Requirements:**

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

|  |  |  |
| --- | --- | --- |
| **FR No.** | **Non-Functional Requirement** | **Description** |
| NFR-1 | **Usability** | It has simple monitoring system and efficient to use |
| NFR-1 | **Security** | Mobile application is secured with firewalls protection. |
| NFR-1 | **Reliability** | Real time sensor output values with future predicted data storage. 98% efficient monitoring output. It also gives assurance for aquaculture safety. |
| NFR-1 | **Performance** | It has greater performance and environmentally safe model. |
| NFR-1 | **Availability** | In the form of mobile UI 24 x 7 monitoring system. |
| NFR-1 | **Scalability** | Highly Scalable. It is capable to produce a best final output. |
| NFR-1 | **Stability** | The stability is very high |
| NFR-1 | **Efficiency** | It is highly efficient, high mobility and low powered |

**CHAPTER 5**

**PROJECT DESIGN**

**5.1 Data flow diagram**

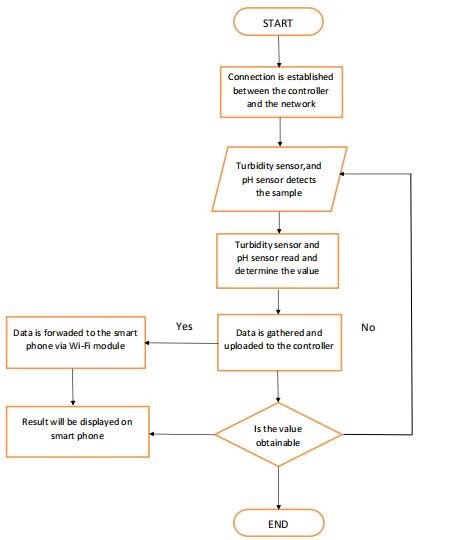


Fig 5.1: Data Flow Diagram

**5.2 SOLUTION &TECHNICAL ARCHITECTURE**

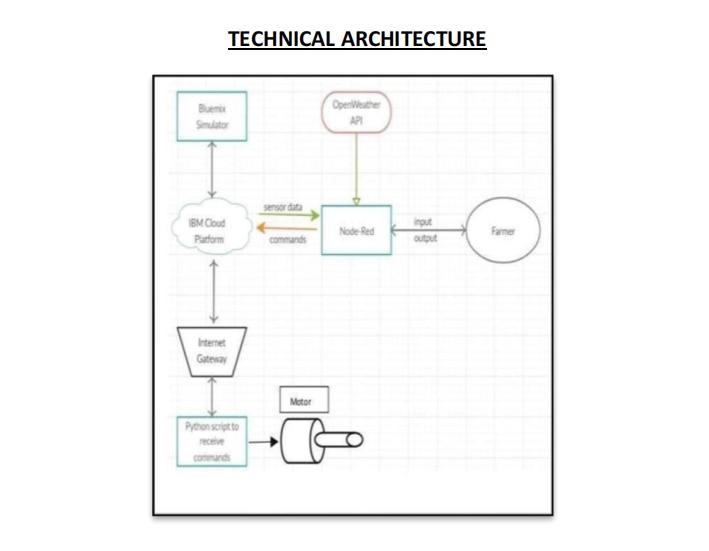


Fig 5.2 Solution &Technical Architecture

**5.3 USER STORIES**

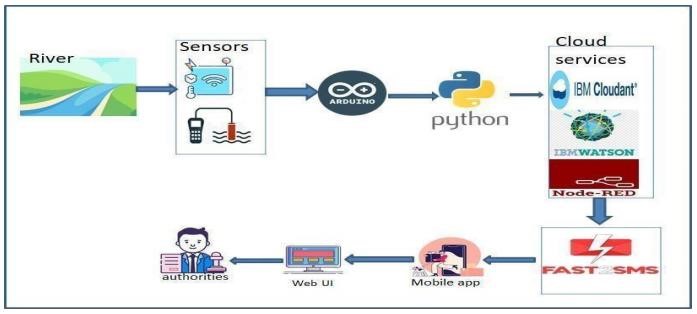


Fig 5.3 :User stories

**CHAPTER 6**

**PROJECT PLANNING & SCHEDULING**

Table

Description automatically generated**6.1 Sprint planning and 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 | Anushiya k |
| Sprint-1 |  | USN-2 | As a user, I will receive confirmation email once I have registered for the application | 1 | High | IswaryaM. |
| Sprint-2 |  | USN-3 | As a user, I can register for the application through Facebook | 2 | Low | Jeyamary R |
| Sprint-1 |  | USN-4 | As a user, I can register for the application through Gmail | 2 | Medium | Ramya Lakshmi T |
| Sprint-1 | Login | USN-5 | As a user, I can log into the application by Entering email & password | 1 | High | Anushiya k |

**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 | 31 Oct 2022 | 5 nov 2022 | 20 | 4Nov 2022 |
| Sprint-2 | 20 | 6 Days | 1 Oct 2022 | 6 Nov 2022 | 30 | 7 Nov 2022 |
| Sprint-3 | 20 | 6 Days | 07 Nov 2022 | 12 Nov 2022 | 49 | 13Nov 2022 |
| Sprint-4 | 20 | 6 Days | 14 Nov 2022 | 19 Nov 2022 | 50 | 18 Nov 2022 |

Text

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**6.3 Reports from JIRA**

Chart, line chart

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|  |  |  |  |
| --- | --- | --- | --- |
| 1 | Understanding the project requirement | The Aim is team members are assigned with tasks for each to be executed as a responsible team lead.Also create repository in the Github, Assign members and teach how to use and open the Github and IBM career education portals . | 1 WEEK |
| 2 | Starting of project | Advisory of team lead to his team members based on regularly attending training sessions for installing and use of prerequiste . Also necessarily attending the training sessions based on python code,development of android app in mobile app invtr.com and working along NodeRed is ensured by the team lead and acknowledged by team members simultaneously. | 1 WEEK |

|  |  |  |  |
| --- | --- | --- | --- |
| 3 | Attend class | Team members and team lead must watch and learn from  classes provided by IBM and  NALAYATHIRAN and  must gain access of MIT license for their project. | 4 WEEK |
| 4 | Budget and scope of project | Budgetary planning process taken up on whole as a team to detect the user compatible price to the buy the product based on budgetary on IOT and component level. | 1 WEEK |

## **CHAPTER 7**

## **TESTING**

Testing is more important in every project because we need to know the performance such that the value of product is depend up on the performance

### **7.1 Test Cases**

1.Controlling of app from the phone

2.Time complexity of data flow.

3.Peformance

4.Data from node to UI and to user.

### **7.2 User Acceptance Testing**

Most of our development is done through the IBM platforms so that the sensors suggested that no need of particular testing. But user performance is well and good.

Graphical user interface, text, application

Description automatically generated

**CHAPTER 8**

**RESULTS**

We are displaying the resulting sensed pH, temp, turbidity, and ORP values. It continuously senses the values of pH, temp, turbidity, and ORP and the resulting values are displayed to the LCD, PC or mobile in real-time. If the acquired value is above the threshold value comments will be displayed as ‘BAD’. If the acquired value is lower than the threshold value comments will be displayed as ‘GOOD’. A bar/line graph will also be shown for perfect understanding. The time series representation of sensor data with decision the resulting sensed pH, temp, turbidity, and ORP values. It continuously senses the values of pH, temp, turbidity, and ORP and the resulting values are displayed to the LCD, PC or mobile in real-time. If the acquired value is above the comments will be displayed as ‘GOOD’. A bar/line graph will also be shown for perfect understanding. Most of our development is done through the IBM platforms so that the sensors suggested that no need of particular testing. But user performance is well and good.

**CHAPTER 9**

**ADVANTAGE AND DISADVANTAGE**

**ADVANTAGE**

**1.**We can see the results from the hand set.

**2.**We can monitor the ph level.

**3.**We can deliver the good quality water through our app.

### **DISADVANTAGES**

The drawback of the system is to the sensors and the maintain is somewhat hard its not like that fully on electronic device but there are sensors are present and we need to maintain.

**CHAPTER 10**

**Conclusion**

In this way that we can monitor the system from remote and we can make the living beings to drink and use good water by using this product.

**CHAPTER 11**

**FUTURE SCOPE**

We are seeing most of the natural resources are destroyed and being destroyed such that we the remaining for the feature generations. So, we can use this and ewe can save the river water from the harmful chemicals and we can preserve that water for the feature generations. These days everything is becoming artificial so many diplomats are said that the worlwar-3 should be on water. And so many rivers re-flowing from other neighboring countries there is chance that they can poisonous the flow such that the water become harmful and dangerous so that we can use this.

**Chapter 12**

**APPENDIX**

<**html**>

<**head**>

<**meta** charset="UTF-8">

<**title**> Login </**title**>

<**link** rel="stylesheet" href="{{ url\_for('static', filename='style.css') }}">

</**head**>

<**body**></**br**></**br**></**br**></**br**></**br**>

<**div** align="center">

<**div** align="center" class="border">

<**div** class="header">

<**h1** class="word">Login</**h1**>

</**div**></**br**></**br**></**br**> <**h2** class="word">

<**form** action="{{ url\_for('login') }}"

method="post"> <**div** class="msg">{{ msg

}}</**div**><**input** id="username"name="username"

type="text" placeholder="Enter Your Username" class="textbox"/></**br**></**br**>

<**input** id="password" name="password" type="password"

placeholder="Enter Your Password" class="textbox"/></**br**></**br**></**br**>

<**input** type="submit" class="btn" value="Sign In"></**br**></**br**>

</**form**>

</**h2**>

<**p** class="bottom">Don't have an account? <**a** class="bottom"

href="{{url\_for('register')}}"> Sign Up here</**a**></**p**>

</**div**>

</**div**>

</**body**>

</**html**>

**Register.html**

<**html**>

<**head**>

<**meta** charset="UTF-8">

<**title**> Register </**title**>

<**link** rel="stylesheet" href="{{ url\_for('static', filename='style.css') }}">

</**head**>

<**body**></**br**></**br**></**br**></**br**></**br**>

<**div** align="center">

<**div** align="center" class="border">

<**div** class="header">

<**h1** class="word">Register</**h1**>

</**div**></**br**></**br**></**br**> <**h2** class="word">

<**form** action="{{ url\_for('register') }}"

method="post"> <**div** class="msg">{{ msg }}</**div**>

<**input** id="username" name="username"

type="text" placeholder="Enter Your Username" class="textbox"/></**br**></**br**>

<**input** id="password" name="password" type="password"

placeholder="Enter Your Password" class="textbox"/></**br**></**br**>

<**input** id="email" name="email" type="text"

placeholder="Enter Your Email ID" class="textbox"/></**br**></**br**>

<**input** type="submit" class="btn" value="Sign

Up"></**br**> </**form**>

</**h2**>

<**p** class="bottom">Already have an account? <**a**

class="bottom" href="{{url\_for('login')}}"> Sign In here</**a**></**p**> </**div**>

</**div**>

</**body**>

</**html**>

**Style.css**

.header{ **padding**: 5px 120px; **width**: 150px; **height**:

70px; **background-color**: #236B8E;

}

.border{ **padding**: 80px 50px; **width**: 400px; **height**:

450px;

**border**: 1px solid #236B8E; border-radius: 0px; **background-color**: #9AC0CD;

}

.btn {

**padding**: 10px 40px; **background-color**: #236B8E; **color**: #FFFFFF; **font-style**: oblique; **font-weight**: bold; border-radius: 10px;

}

.textbox{ **padding**: 10px 40px; **background-color**: #236B8E; text-**color**: #FFFFFF; border-radius: 10px;

}

::placeholder { **color**:

#FFFFFF; opacity: 1; **font-style**: oblique; **font-weight**: bold;

}

.word{ **color**: #FFFFFF; **font-style**: oblique; **font-weight**: bold;

}

.bottom{ **color**: #236B8E; **font-style**: oblique; **font-weight**: bold;

}

**Python code**

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

#Provide your IBM Watson Device Credentials organization = "uyyqeq" deviceType = "12345" deviceId = "12345" 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")

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(90,110) Humid=random.randint(60,100)

data = { 'temp' : temp, 'Humid': Humid }

#print data def myOnPublishCallback(): print ("Published Temperature = %s C" % temp, "Humidity = %s %%" % Humid, "to IBM Watson") success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0, on\_publish=myOnPublishCallback) if not success:

print("Not connected to IoTF")

time.sleep(10) deviceCli.commandCallback = myCommandCallback

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

**GitHub link**

**https://github.com/IBM-EPBL/IBM-Project-42989-1660711844**