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

**Category: INTERNET OF THINGS**

**A PROJECT REPORT**

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***In fulfillment of project in IBM-NALAIYATHIRAN 2022***

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**PROJECT GUIDES**

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**INTRODUCTION**

1.1 Project Overview

                          The environment around consists of five key elements e.g., soil, water, climate, natural   vegetation, and landforms. Among these 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. So it is highly imperative for us to maintain water quality balance. Otherwise, it would severely damage the health of the humans and at the same time affect the ecological balance among other species. Water pollution is a foremost global problem which needs ongoing evaluation and adaptation of water resource directorial principle at the levels of international down to individual wells. It has been studied that water pollution is the leading cause of mortalities and diseases worldwide. The records show that more than 14,000 people die daily worldwide due to water pollution. In many developing countries, dirty or contaminated water is being used for drinking without any proper prior treatment. One of the reasons for this happening is the ignorance of public and administration and the lack of water quality monitoring system which makes serious health iss.ues.

                    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.

1.2 Purpose:

          Water quality refers to chemical, physical biological and radio logical characteristics of water. It is a measure of the condition of water relative to the necessities of one or more bio-tic species and or to any human need or purposes .Water quality monitoring is defined as a sampling and analysis of the water in lake, stream, ocean and river and conditions of the water body. Smart water quality monitoring is a process of real-time monitoring and the analysis of water to identify changes in parameters based on the physical, chemical and biological characteristics.Monitoring water quality is clearly important: in our seas, our rivers, on the surface and in our ports, for both companies and the public. It enables us to assess how they are changing, analyze trends and to inform plans and strategies that improve water quality and ensures that water meets its designated use.There are several indicators determining water quality. These include dissolved oxygen, turbidity, bio indicators, nitrates, pH scale and water temperature.Monitoring water quality helps to identify specific pollutants, a certain chemical, and the source of the pollution.There are many sources of water pollution: wastewater from sewage seeping into the water supply; agricultural practices (e.g., the use of pesticides and fertilizer); oil pollution, river and marine dumping, port, shipping and industrial activity. Monitoring water quality and a water quality assessment regularly provides a source of data identify immediate issues – and their source.

● Identifying trends, short and long-term, in water quality.

● Data collected over a period of time will show trends, for example identifying increasing concentrations of nitrogen pollution in a river or an inland waterway. The total data will then help to identify key water quality parameters.

● Environmental planning methods: water pollution prevention and management.

● Collecting, interpreting and using data is essential for the development of a sound and effective water quality strategy. The absence of real-time data will however hamper the development of strategies and limit the impact on pollution control. Using digital systems and programs for data collection and management is a solution to this challenge.

● Monitoring water quality is a global issue and concern: on land and at sea. Within the European Union, the European Green Deal sets out goals for restoring biological biodiversity and reducing water pollution, as well as publishing various directives to ensure standards of water quality. Individual nation states, for example France, have also clear regulatory frameworks requiring the effective monitoring of water quality. In the United States, the Environmental Protection Agency (EPA) enforces regulations to address water pollution in each state. Across the world, countries increasingly understand the importance of effective water quality monitoring parameters and methods.

**Literature survey**

2.1 Existing problems:

         Due to population growth, urbanization ,and climatic change ,competition for water resources is expected to increase, with a particular impact on agriculture, river water. Water will be suitableness to potable water monitoring compound spillage identification done rivers, remote estimation for swimming pools. It holds self-sufficient hubs that unite with the cloud to ongoing water control .The River water needed to be treated before it is used in agriculture feilds,hence the parameters affecting the quality of river-water need to be analysed and to be used for water treatement purpose.

2.2 References

1. K.S. Adu-Manu, C. Tapparello, W. Heinzelman, F.A. Katsriku, J.-D. Abdulai

         Water quality monitoring using wireless sensor networks: Current trends and future research directions ACM Transactions on Sensor Networks (TOSN) (2017).

2. S. Thombre, R.U. Islam, K. Andersson, M.S. Hossain

         IP based Wireless Sensor Networks : performance Analysis using Simulations and Experiments.ournal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications, 7 (2016).

3. Rushikesh Kshirsagar, R.Mudhalwadkar, Saish Kalaskar

            Design and Development of IoT Based Water Quality Measurement System. The idea about low-cost IOT based portable approach for water quality measurements system. Because of its low-cost approach, everyone can afford to use it to determine quality of water(2019).

4. N. Vijayakumar, R. Ramya 72.3 Problem Statement

          The reduce the river water pollution and to monitor the parameters of river water and control measures can impact vegetation,health. The Real time analysis of Indicators of River water(Ph,salinity,nutrients,etc..,).

5. M.Chitra, D. Sadhihskumar, R. Aravindh, M. Murali, R. Vaittilingame

IoT based Water Flood Detection and Early Warning System.The collected information (data) from the water level sensor and temperature and humidity sensor passed to Thingview Android application in order to find the flow graph level of the water level in the river and temperature, humidity values and sends SMS to the registered contact mobile numbers (2020).

6. Dr.Geetha

        IoT based real time water quality monitoring system using smart sensor WQM is a cost effective and efficient system designed to monitor drinking water quality with the help of IOT(2020).

**2.3 Problem Statement:**

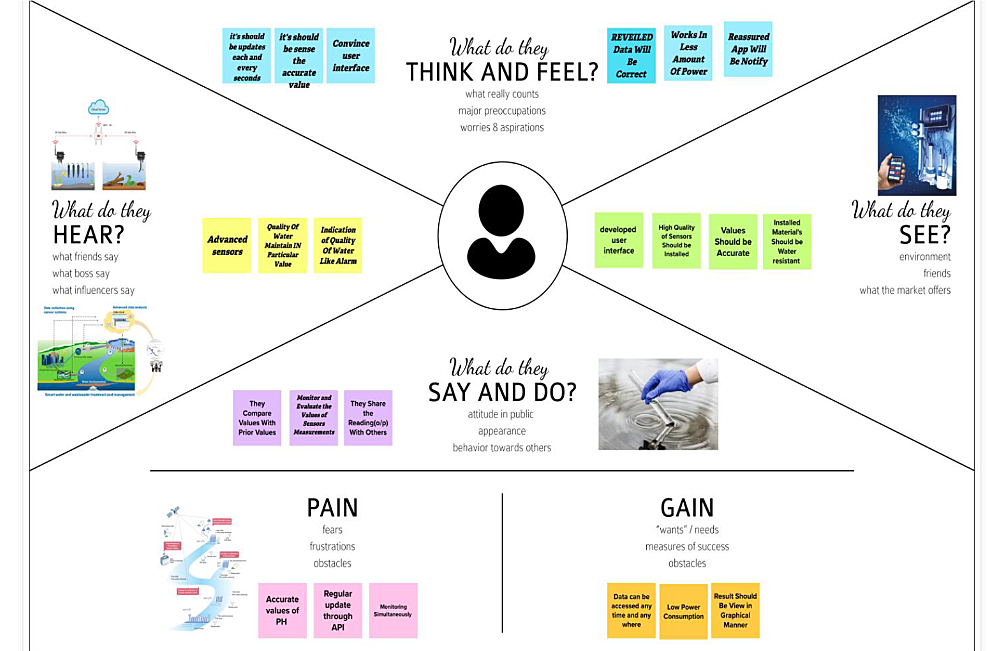
   The reduce the river water pollution and to monitor the parameters of river water and control measures can impact vegetation,health. The Real time analysis of Indicators of River water(Ph,salinity,nutrients,etc..,).

**IDEATION AND PROPOSED SOLUTIONS**

**3.1 .Empathy Map Canva:**

            An empathy map is a simple, easy-to-digest visual that captures knowledge about a user’s behaviours and attitudes. It is a useful tool to helps teams better understand their users.Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user’s perspective

along with his or her goals and challenges.



**3.2 Ideation & Brainstomin**

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

a) To measure water parameters such as pH, dissolved oxygen, turbidity, conductivity, etc.

b) using available sensors at a remote place.

c) To assemble data from various sensor nodes and send it to the base station by the

d) wireless channel.

e) To simulate and evaluate quality parameters for quality control.

f) To send SMS to an authorized person routinely when water quality detected does not g) match    the present standards, so that, necessary actions can be taken.

**Control surface:**

An Arduino mega is utilized as a core person. The Arduino victimized here is mega 2560 Because multiple analog sign sensors probe requisite to be conterminous with the Arduino inhabit. It has a set of registers that use as a solon use RAM. Specific intend to know registers for on-chip component resources are also mapped into the assemblage grapheme. The addressability of store varies depending on instrumentation series and all PIC devices someone several banking mechanisms to utilise addressing to additional faculty. Subsequent series of devices have move instructions which can covert move had to be achieved via the register. Thus the mechanism functions with the exploit of coding intrinsically in the Arduino UNO R3 skate.

**pH sensor:**

The pH of thing is a useful constant to display because graduate and low pH levels can hump large effects on the author. The pH of a statement can grasp from 1 to 14. A pH sensor is an instrumentation that measures the hydrogen-ion density in a bleach, indicating its tartness or alkalinity. It constitute varies from 0 to 14 pH. Uttermost pH values also process the solubility of elements and compounds making them cyanogenetic. Mathematically pH is referred as, pH = -log [H+].

**Turbidity sensor:**

Turbidity train sensor is victimised to measure the clarity of element or muddiness utter in the water. The mu  ddiness of the open cut food is ordinarily between 255 NTU. Irrigate is visibly at levels above 80 NTU. The standards for intemperance liquid is 130 NTU to 250 NTU. The turbidity device consists of soft sender and acquirer, the transmitter needs to transmit unsubtle bright, it is said to be turbid. The consequence of turbidity is a reduction in water clarity, aesthetically unpleasant, decreases the rate of photosynthesis, increases water temperature.

**Temperature sensor:**

Here DS18B20 is old as the temperature device. Usually, its present use to perceive the temperature of the life, if we site the device wrong the conductor electrode and placed into the H2O, it can discover the temperature of H2O also. The normal temperature of the people is (25 -30)° C.

**LCD display:**

LCD (Liquid Crystal Display) impede is a flat brace electronic exhibit power and finds in a Countywide orbit of applications. A 16x2 LCD demo is the really fundamental power and is rattling commonly victimised in varied devices and circuits. These modules are desirable over heptad segments and otherwise multi-segment LEDs

**Wi-Fi module:**

  Wi-Fi or Wi-Fi is a subject for wireless localized area scheme with devices. Devices that can use Wi-Fi study permit private computers, video-game consoles, smartphones, digital cameras, paper computers, digital frequency players and ultramodern printers. Wi-Fi matched devices can insert to the Cyberspace via a LAN web and wireless make a bushel. Much a reach quantity (or point) has a cap ableness of around 20 meters (66 feet) indoors and a greater compass outdoors. Wi-Fi subject may be utilised to render the Internet reach to devices that are within the capability of a wireless meshwork that is connected to the Internet.

**Software design:**

The proposed water quality monitoring system based on WSN can be divided into three parts: a) IoT platform b) Neural network models in Big Data Analytics and water quality management c) Real-time monitoring of water quality by using IoT integrated Big Data Analytics.

**IoT Platform :**

  The quality parameters are labelled datasets including desired outputs of specific combination of inputs. The neural network will produce output to classify water quality as dangerous, be careful, and good. The classification layer will run on top of Hadoop cluster. The advantages of using neural network based analytics are like Artificial Neural Networks (ANNs) are good in learning and modelling non-linear relationships, and high volatile data. Though neural networks are prone to over fitting, the neural network model used in water quality monitoring system is not complex enough to cause over fitting problem. Also, there are many countermeasures to avoid over fitting. Also, computation overload is not going to delay the response of system as there are only a few water quality parameters Neural network models in Big Data Analytics and water quality management: The use of artificial neural networks for the prediction of water quality parameters has already been investigated long before . Multilayer neural network model is depicted below having five inputs in 1, In 2, In 3, In 4, In 5 in input layer, a hidden layer with four neurons and three neurons in output layer. There are two bias input neurons connected to hidden layer neurons and output layer neurons. In the neural network model 5 inputs can be pH value, temperature, turbidity, ORP, and conductivity and 3 outputs will be dangerous, be careful, and good. Before training the neural network model few other parameters need to be set; as for example: Learning rate = 0.01, Learning algorithm = Back Propagation, Bias input =1, Connection weights = randomly assigned, Activation function = sigmoid function.

The output of sigmoid function neuron with inputs: Xj, weights: Wj and bias b is : F(X) = 1 / (1 + exp (− Σ jwjxj− b))

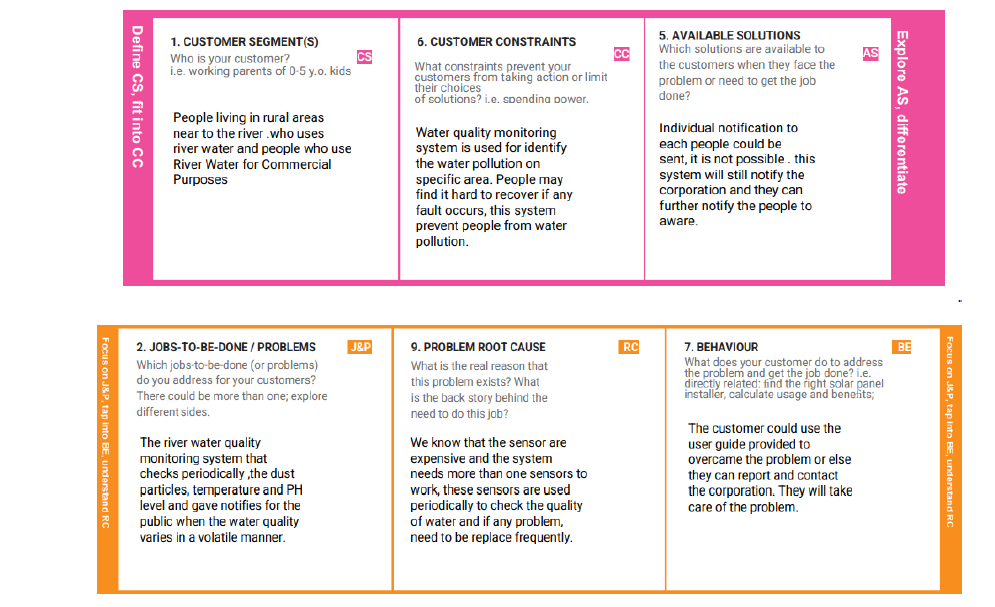
**Real-time monitoring of water quality by using IoT integrated Big Data Analytics:**

IoT devices use various types of sensors to collect data about turbidity, ORP, temperature, pH,conductivity, etc. of river water continuously. Also, IoT devices have capability to stream the array of collected data wirelessly to the remote Data Aggregator Server in the cloud. Moreover, the volume of semi structured data increases with time in such a velocity that only the Big Data Analytics applications can efficiently store and analyse the data constantly . The system should be reliable and scalable. So, data management layer will be deployed and operational on the Apache Hadoop cluster. Hadoop helps distributed storing and processing of big data across cluster of computers. Also, such operational environment is horizontally scalable i.e. nodes or computers can be added to a cluster later while volume and velocity of data streaming will be increasing. Hadoop cluster is fault tolerant as jobs are redirected automatically to the running nodes when nodes are failed. The data in Hadoop is highly available as multiple copies of data are stored in data nodes managed by name node, standby name node, journal nodes and failover controller. IoT applications need high speed

**3.3 Proposed solutions**

|  |  |  |
| --- | --- | --- |
| **S.NO.** | **Parameter** | **Description** |
| 1 | Problem Statement (Problem to be solved) | IOT Based Real Time River Water Quality Monitoring and Control System |
| 2. | Idea / Solution description | To monitor the quality of water using sensors like temperature, potentiometer(pH), turbidity, salinity and so on. 2.Collecting those data and storing it in cloud and perform analyse to check if the water is contaminated or not for drinking. 3.If the water is contaminated an alert is made to the user/ local authority through SMS or can be viewed through web application anytime. |
| 3. | Novelty / Uniqueness | Based on the collected data prediction is made whether the water can be used for cultivation of specific crops and suitable for the aquatic animals. |
| 4. | Social Impact / Customer Satisfaction | Algal growth, fertilizers, pesticides cause river pollution which can impact all living beings. Better monitoring and control measures ca |
| 5. | Scalability of the Solution | Developing the product as both web and mobile application it is portable, and data can be accessed from anywhere anytime. provide a real-time monitoring and a feasible solution for remote or distant places where water quality laboratory is not present. |
| 6. | Business Model (Revenue Model) | Service based product is developed to serve the local people to know the quality of water before consuming it or using it for any purpose. This prevents health issues or at most loss of living being |

**3.4 Problem Solution Fit**



**Requirement analysis**

**4.1 Functional requirement**

|  |  |  |
| --- | --- | --- |
| **FR No.** | **Functional Requirement**  **(Epic)** | **Sub Requirement (Story / Sub-Task)** |
| FR-1 | Users Authorization levels | Complete mapping are shown in a hierarchical manner in order to show only the specific Data |
| FR-2 | Historical Data | The datas collected are stored in the cloud from the starting stage till updation is completed |
| FR-3 | User Authentication | The credentials is accessible only to the authorized users to access the model. |
| FR-4 | Users rules and laws | There are some specific guidelines and procedures which has to befollowed by the  users |

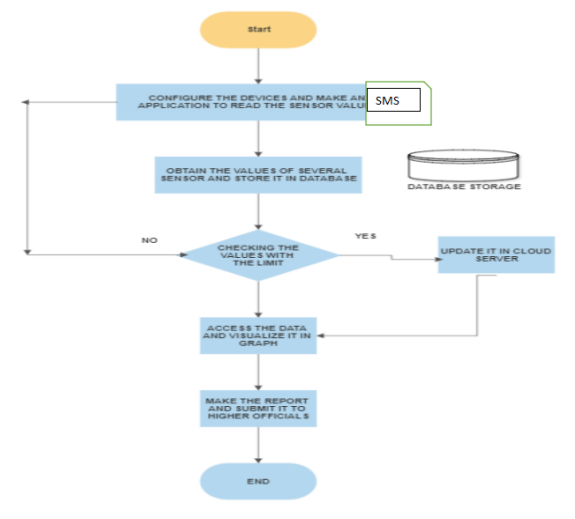
**4.2 Non Functional  requirements**

|  |  |  |
| --- | --- | --- |
| **NFR**  **No.** | **Non-Functional Requirement** | **Description** |
| NFR-1 | Usability | The Final data should be easily understandable. |
| NFR-2 | Security | The model are designed in a safe and  secured manner inorder to maintain the privacy |
| NFR-3 | Reliability | Even if there is any firmware issues (failures) thelast updated datas are stored in a  default manner |
| NFR-4 | Performance | High quality sensors are used to provide accurate datas. |
| NFR-5 | Availability | The model is designed in such a way that are  available ,usable,accesible and can be modified anytime |
| NFR-6 | Scalability | The system is scaled according to the size of The river(water bodies |

**PROJECT DESIGN**

**5.1 Data Flow Diagrams:**

          A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.



**5.2 SOLUTION AND TECHNICAL ARCHITECTURE**

**Summary**

      This code pattern explains how to build an IOT based river water monitoring and controlling system with some predefined values.

**Flow**

* Feed the data received from the Sensor unit which are placed in the river sides.

* The collected data will be displayed in the Web page to the user.

* Then the collected data is sent to the data base, where the collected data and the predefined data are checked and monitored.

* If any data exceed the predefined data then the control signal will send to the Admin.

* The collected data will be stored in the IBM cloud storage. Later the data will be controlled by the admin via Web UI.

**Components & Technologies:**

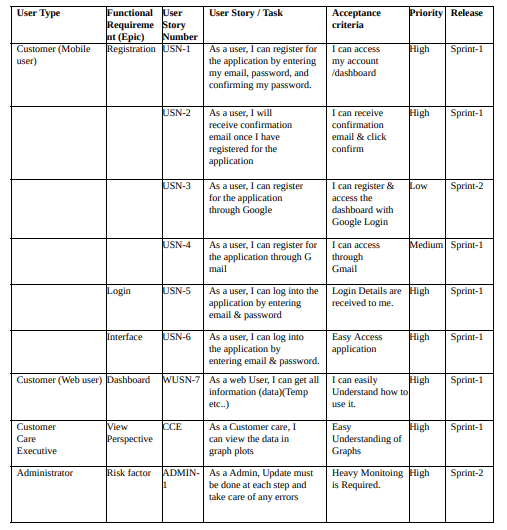
|  |  |  |  |
| --- | --- | --- | --- |
| **S.No** | **Component** | **Description** | **Technology** |
| 1 | Sensor Data | The data is collected form the various sensor placed in the river sides | ESP32Wifi module Raspberry Pie. |
| 2. | Database for Storage | The data/info need to be stored for accessing it in future | MySQL-Oracle |
| 3. | File Storage | File storage requirements | IBM Block Storage or Other Storage Service or Local Filesystem |
| 4. | Cloud Database | Database Service on Cloud | IBM cloud |
| 5. | Data Storage | File storage requirements | IBM cloud |

**Application Characteristics:**

|  |  |  |  |
| --- | --- | --- | --- |
| **S.NO** | **Characteristics** | **Description** | **Technology** |
| 1. | PH level Monitoring | The PH level of river water can be monitoredvia placing sensors in rivers. | PH-sensor |
| 2. | Air Quality Monitoring | Theclarityandpurity ofriver water can be monitored | Surface Mount Sensor |
| 3. | Temperature Monitoring | The temperature of river water can be monitored | Temperature sensor |
| 4. | Water Treatment | can be used as both a safety device in the water purification process as carbon dioxide, methane, and carbon monoxide are some of the key gases produced during the treatment process | NDIR gas sensors |
| 5. | Soil Condition Monitoring | Soil condition monitoring sensors allow farmers to collect data about rainfall, temperature, and other metrics over time to track trends and predict irrigation needs. | Acoustic sensor |

**5.3 User Stories**

Use the below template to list all the user stories for the product



**PROJECT PLANN**

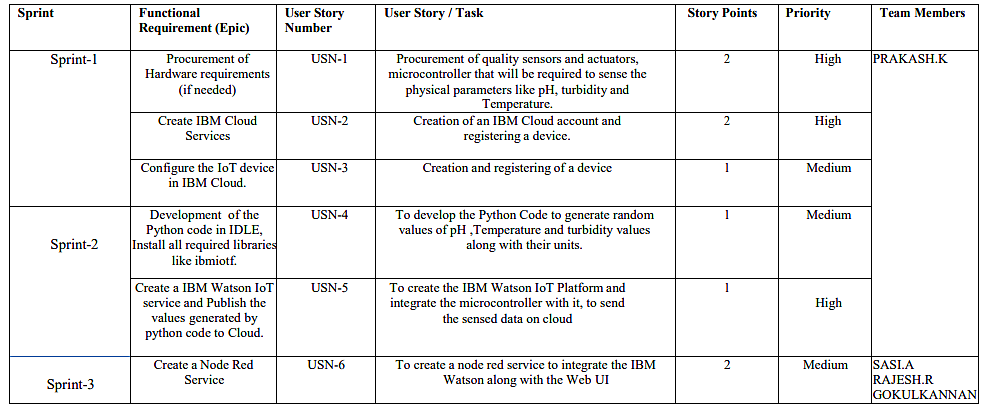
**PLANNING AND SCHEDULING**

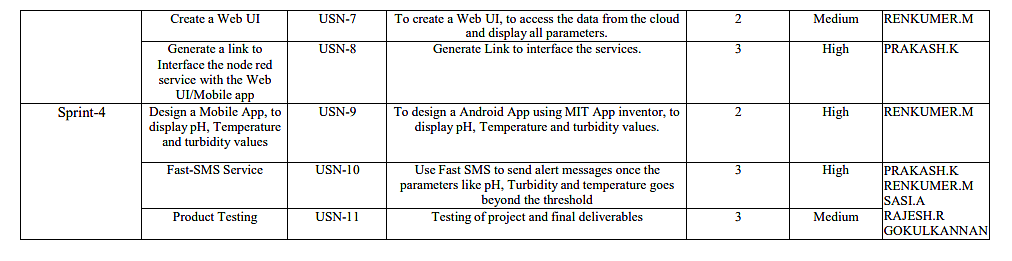
**6.1 SPRINT PLANNING & SCHEDULING:**

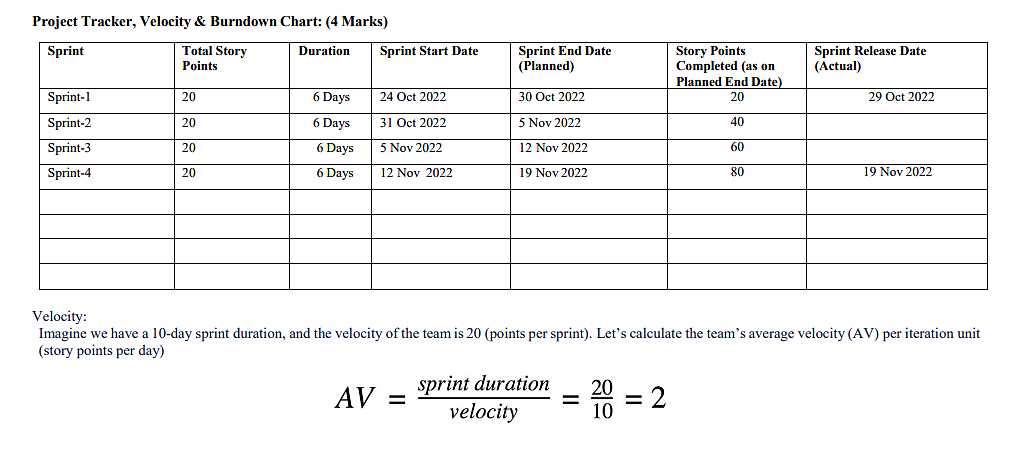
|  |  |  |
| --- | --- | --- |
| **TITLE** | **DESCRIPTION** | **DATE** |
| Literature Survey & Information Gathering | Literature survey on the selected project is done by gathering information about related details on technical papers and web browsing. | 06 OCTOBER 2022 |
| Empathy Map | Prepared Empathy Map Canvas to combine thoughts and pains, gains of the project with all team members . | 08 OCTOBER 2022 |
| Ideation | Brainstorming session is conducted with all team members to list out all the ideas and prioritise the top 3 ideas. | 09 OCTOBER 2022 |
| Proposed Solution | Prepared the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc. | 28 OCTOBER 2022 |
| Problem Solution Fit | Prepared problem - solution fit document. | 30 OCTOBER 2022 |

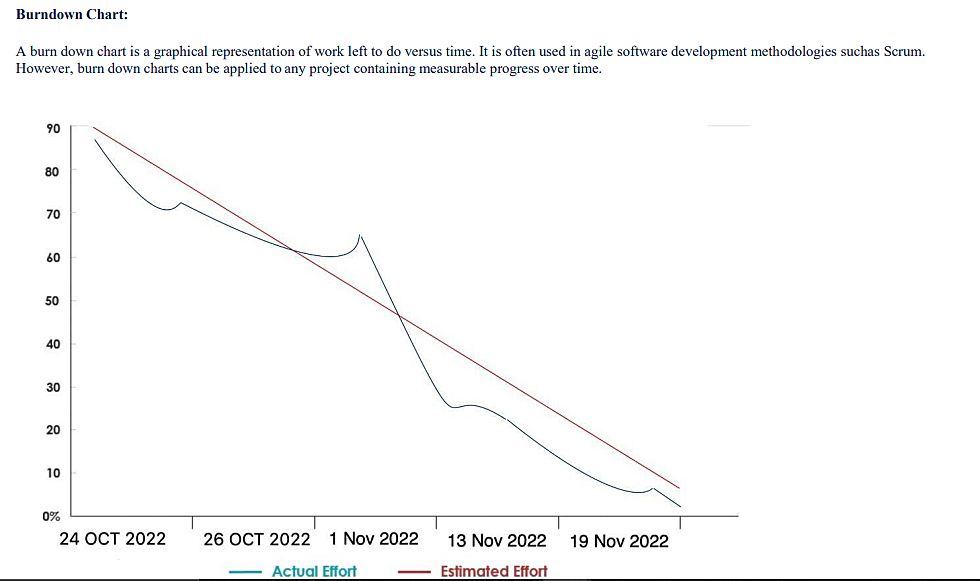
**6.2 SPRINT DELIVERY SCHEDULE**

Product Backlog, Sprint Schedule, and Estimation







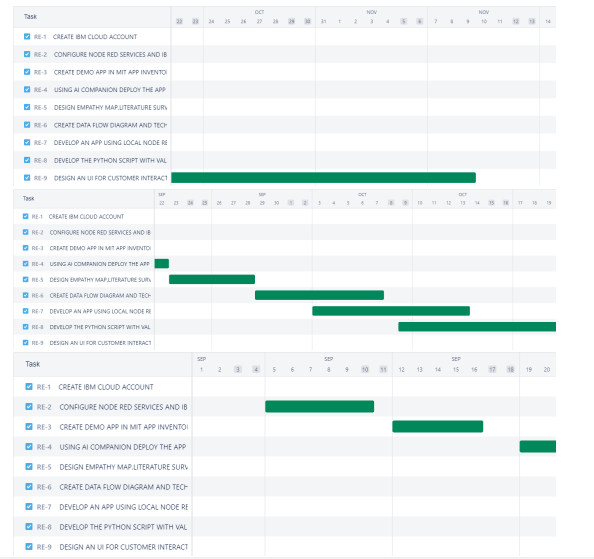


**6.3 REPORT FROM JIRA:**

**REFERENCE LINK (JIRA SOFTWARE):**

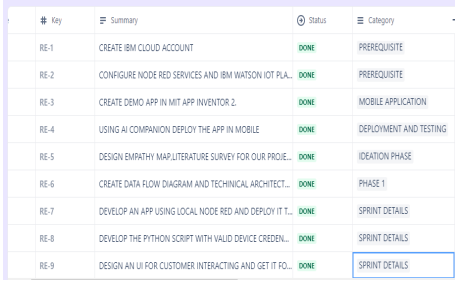
https://ibmprojectrealtimemonitoring.atlassian.net/jira/core/projects/RE/board

**TIMELINE CREATED USING JIRA SOFTWARE**

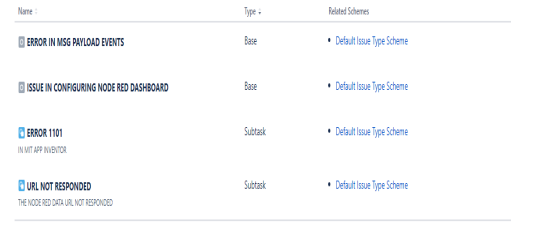


https://id.atlassian.com/login/select-account?application=jira&continue=https%3A%2F%2Fibmprojectrealtimemonitoring.atlassian.net%2Fjira%2Fcore%2Fprojects%2FRE%2Flist%3Ffilter%3DstatusCategory%2B%253D%2BDone%2BAND%2BstatusCategoryChangedDate%2B%253E%253D%2B-1w%26showDone%3Dtrue%26atlOrigin%3DeyJpIjoiMmVlZjFiNTA2ODIxNDg0MGFmOGZlMTA2Y2M0Y2VjN2IiLCJwIjoiaiJ9&login\_hint=not%3Aprakashkandasamy4%40gmail.com&redirectCount=1

**LISTS IN JIRA:**

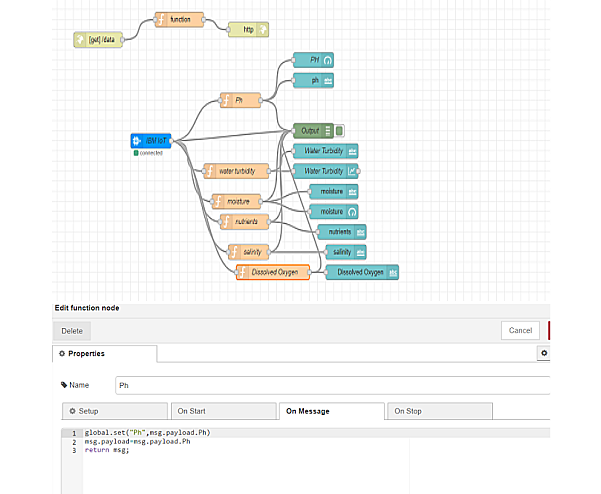


**ISSUES :**

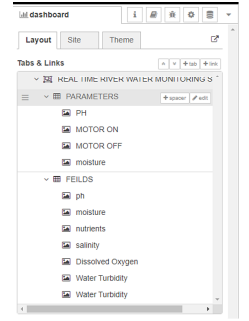


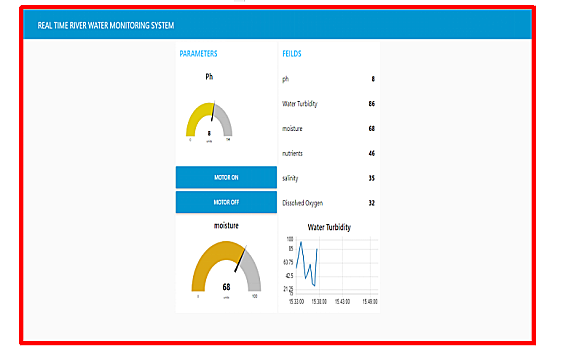
**CODING AND SOLUTIONING**

**7.1 NODE RED SERVICE ASSOCIATED WITH IBM CLOUD:**



**Node red Dashboard:**

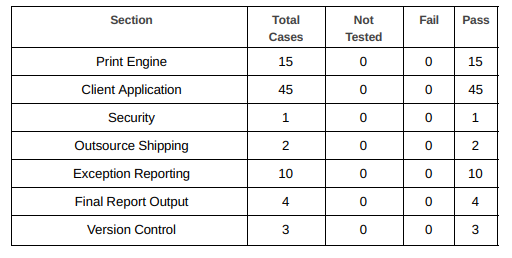




**TESTING**

**8.1 Test Case Analysis:**

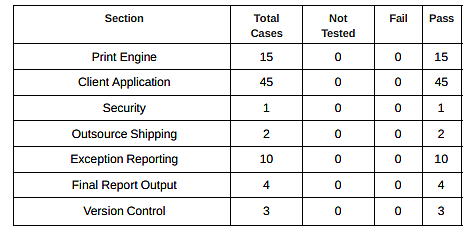
       This report shows the number of test cases that have passed, failed, and untested



**8.2 USER ACCEPTANCE TESTING:**

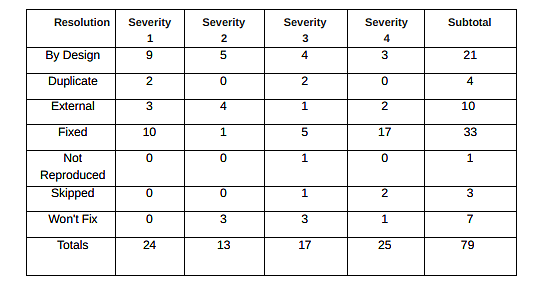
**1.Purpose of Document**

           The purpose of this document is to briefly explain the test coverage and open issues of the REAL TIME RIVER WATER QUALITY MONITORING AND CONTROL  SYSTEMS project at the time of the release to User Acceptance Testing (UAT).



**2.Defect Analysis**

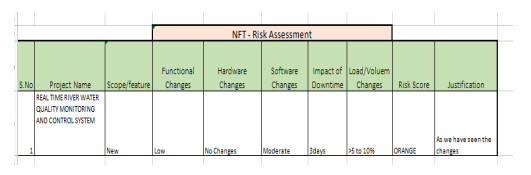
          This report shows the number of resolved or closed bugs at each severity level, and how they were resolved



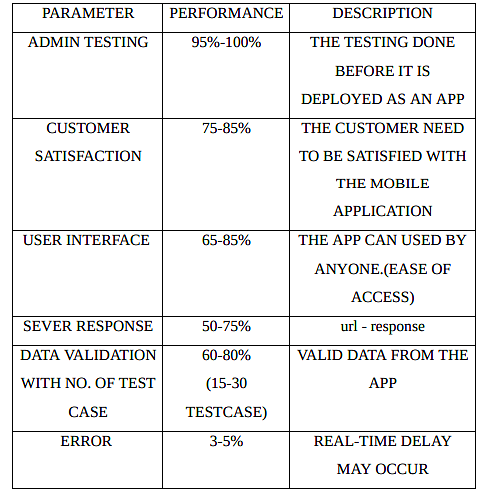
**RESULT**

**9.1 PERFROMANCE METRICS:**

                                 Managing application  performance requires the continuous collection of data about all relevant parts of the system starting from the end user all the way through the system. This collected data is the basis for getting a holistic end-to-end and up-to-date view of the application state including the end-user experience. In this chapter, we will discuss what data to collect, and from where and how to collect the data in order to achieve this view Most application systems are implemented in a way that, in addition to the application logic executed at the provider’s site (referred to as the back-end), parts of the application are executed at client’s site. The client site usually constitutes a system tier accessing the back-end



**PERFORMANCE TABLE**



**ADVANTAGES AND DISADVANTAGES**

**ADVANTAGES:**

* The prototype developed for water quality maintenance is very beneficial for safeguarding public health and also adds to the clean environment.

* The automation of this water monitoring, cleaning and control process removes the need of manual labor and thus saves time and money

* .The automation of the system makes the control and monitoring process more efficient and effective. Real time monitoring on mobile phone which is possible through the interface of plc with Arduino and Bluetooth module allows remote controlling of the system.

**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.
* The process is time consuming due to slow process of manual data collection from different locations of the water body.
* The method is prone to human errors of various forms.

**CONCLUSION**

Thus our project is used to Monitoring of Turbidity, PH & Temperature of Water makes use of water detection sensor with unique advantage and existing GSM network. The system can monitor water quality automatically, and it is low in cost and does not require people on duty. So the water quality testing is likely to be more economical, convenient and fast. The system has good flexibility. Only by replacing the corresponding sensors and changing the relevant software programs, this system can be used to monitor other water quality parameters.

The operation is simple. The system can be expanded to monitor hydrologic, air pollution, industrial and agricultural production and so on. It has widespread application and extension value.By keeping the embedded devices in the environment for monitoring enables self protection (i.e., smart environment) to the environment. To implement this need to deploy the sensor devices in the environment for collecting the data and analysis. By deploying sensor devices in the environment, we can bring the environment into real life i.e. it can interact with other objects through the network.

Then the collected data and analysis results will be available to the end user through the Wi-Fi.

**FUTURE SCOPE**

We use water detection sensor has unique advantage.It consumes less time to monitor than a manual method for checking polluted levels,and notifies immediately to reduce affected rate of pollution in water.People who are living in rural areas near to the river will be very satisfied with our idea.It will be useful to monitor water pollution in specific area.So this system prevent people from water pollution.

It will be used for farming purpose to check quality water,temperature and PH level.Our Impact of this project is also create a social satisfaction for farmers too.The scalabilty of this project gives the addition of more different type of sensors.By interfacing the relay we can control the supply of water. We can also implement as a revenue model.This system could also be implemented in various industrial processes. The system can be modified according to the needs of the user and can be implemented along with lab view to monitor data on computers.

**APPENDIX**

**13.1 SOURCE CODE:**

**PYTHON CODE TO PUBLISH DATA**

#program to publish data in ibm watson iot platform

import ibmiotf.application

import ibmiotf.device

import time import random

import sys

from twilio.rest import Client

import keys Client = Client(keys.account\_sid, keys.auth\_token)

organization = "m77pq1"

deviceType = "raspberrpi"

deviceId = "1431516"

authMethod = "usetoken-auth"

authToken = "Prakash151 6"

pH = random.randint(1, 14)

turbidity = random.randint(1, 1000)

temperature = random.randint(0, 100)

def myCommandCallback(cmd):

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

print(cmd)

try:

deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method":

authMethod,

                  "auth-token": authToken}

deviceCli = ibmiotf.device.Client(deviceOptions)

except Exception as e:

print("caught exception connecting device: %s" % str(e))

sys.exit()

deviceCli.connect()

while True:

pH = random.randint(1, 14)

turbidity = random.randint(1, 1000)

temperature = random.randint(0, 100)

data = {'pH': pH, 'turbid': turbidity, 'temp': temperature}

def SMS():

message = Client.messages.create(

body="ALERT!! THE WATER QUALITY IS DEGRADED",

from\_=keys.twilio\_number,

to = keys.target\_number)

print(message.body)

if temperature>70 or pH<6 or turbidity>500:

SMS() def myOnPublishCallback():

print("Published pH= %s" % pH, "Turbidity:%s" % turbidity, "Temperature:%s" % temperature) success = deviceCli.publishEvent("demo", "json", data, qos=0, on\_publish=myOnPublishCallback) if not success:

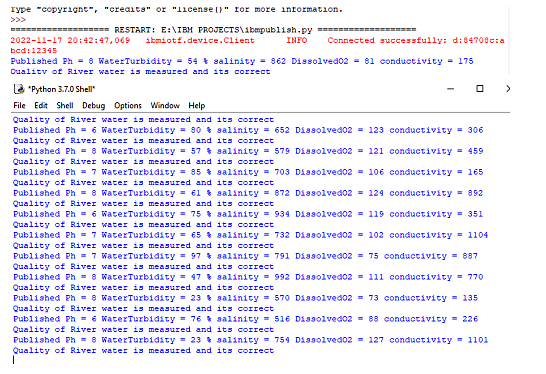
print("Not Connected to ibmiot")

time.sleep(5)

deviceCli.commandCallback = myCommandCallback

deviceCli.disconnect()

**OUTPUT:**



**HTML CODE:**

**<!DOCTYPE html>**

**<html lang="en">**

**<head>**

**<style>**

**h1 {text-align: center;}**

**p {text-align: center;}**

**div {text-align: center;}**

**body {**

**background-image: url("https://thumbs.dreamstime.com/b/clear-transparent-light-bluewater-pool-texture-background-150961732.jpg");**

**background-color: #cccccc;**

**}**

**</style>**

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

**<meta http-equiv="X-UA-Compatible" content="IE=edge">**

**<meta name="viewport" content="width=device-width, initial-scale=1.0">**

**<title>Login page in HTML</title>**

**</head>**

**<body>**

**<h1>Login Page</h1>**

**<form action="">**

**<!-- Headings for the form -->**

**<div class="headingsContainer">**

**<h3>Sign in</h3>**

**<p>Sign in with your username and password</p>**

**</div>**

**<!-- Main container for all inputs -->**

**<div class="mainContainer">**

**<!-- Username -->**

**<label for="username">Your username</label>**

**<input type="text" placeholder="Enter Username" name="username" required>**

**<br><br>**

**<!-- Password -->**

**<label for="pswrd">Your password</label>**

**<input type="password" placeholder="Enter Password" name="pswrd" required>**

**<!-- sub container for the checkbox and forgot password link -->**

**<div class="subcontainer">**

**<label>**

**<input type="checkbox" checked="checked" name="remember"> Remember me**

**</label>**

**<p class="forgotpsd"> <a href="#">Forgot Password?</a></p>**

**</div>**

**<button type="submit" onclick="window.location.href = 'https://node-red-qltdp-2022-**

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**11-07.eu-gb.mybluemix.net/ui';">Login</button>**

**<!-- Sign up link -->**

**<p class="register">Not a member?  <a href="#">Register here!</a></p>**

**</div>**

**</p>**

**</form>**

**</body></html>**

**13.2 GIT-HUB LINK:**

     https://github.com/IBM-EPBL/IBM-Project-6014-1658822130

**PROJECT DEMO LINK:**

  1. https://node-red-qltdp-2022-1107.eugb.mybluemix.net/ui/#!/0?socketid=WzX3XVVK\_oZjhjBAAAAl

2. https://possible-wheat-booth.glitch.me/