## REAL TIME RIVER WATER QUALITY MONITORING & CONTROL SYSTEM

**Team ID: PNT2022TMID17030**

## A PROJECT REPORT

Submitted by

1. Nafeeshussain

2. Nagaraj

3. Sridharbalan

4. Sakthivel

**Industry Mentor's Name Faculty Mentor's Name**

Bharadwaj M. Ravikumar

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**Abstract**

Pollution of water is one of the main threats in recent times as drinking water is getting contaminated and polluted. The polluted water can cause various diseases to humans and animals,which in turn affects the life cycle of the ecosystem. If water pollution is detected in an early stage, suitable measures can be taken and critical situations can be avoided. To make certain the supply of pure water, the quality of the water should be examined in real-time. Smart solutions for monitoring of water pollution are getting more and more significant these dayswith innovation in sensors, communication, and Internet of Things (IoT) technology. A detailed review of the latest works that were implemented in the arena of smart water pollutionmonitoring systems is presented. A cost effective and efficient IoT based smart water quality monitoring system which monitors the quality parameters uninterruptedly. The developed model is tested with watersamples and the parameters are transmitted to the cloud server for further action.

**1. Introduction**

The Internet of Things (IoT) describes the network of physical objects—“things”—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devicesand systems over the internet.

The Internet of Things (IoT) describes physical objects (or groups of such objects) with sensors, processing ability, software, and other technologies that connect and exchange data with other devicesand systems over the Internet or other communications networks.[ Internet of things has beenconsidered a misnomer because devicesdo not need to be connected to the publicinternet, they only need to be connected to a network and be individually addressable..

The field has evolved due to the convergence of multiple technologies, including ubiquitous computing, commodity sensors, increasingly powerful embedded systems, and machine learning.Traditional fields ofembedded systems, wireless sensor networks, control systems, automation (including home and building automation), independently and collectively enable the Internet of things. In the consumer market, IoT technology is most synonymous with products pertaining to the concept of the "smart home", including devices and appliances (such as lighting fixtures, thermostats, home security systems, cameras, and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as smartphones and smart speakers.IoT is also used in healthcare systems.

There are a number of concerns about the risks in the growth of IoT technologies and products, especially in the areas of privacy and security, and consequently, industry and governmental moves to address these concerns have begun, includingthe development of international and local standards, guidelines,and regulatory frameworks.

**1.1 Project overview**

Pollution of water is one of the main threats in recent times as drinking water is getting contaminated and polluted. The polluted water can cause various diseases to humans and animals,which in turn affects the life cycle of the ecosystem. If water pollution is detected in an early stage, suitable measures can be taken and critical situations can be avoided. To make certain the supply of pure water, the quality of the water should be examined in real-time. Smart solutions for monitoring of water pollution are getting more and more significant these dayswith innovation in sensors, communication, and Internet of Things (IoT) technology. A detailed review of the latest works that were implemented in the arena of smart water pollutionmonitoring systems is presented. A cost effective and efficient IoT based smart water quality monitoring system which monitors the quality parameters uninterruptedly. The developed model is tested with watersamples and the parameters are transmitted to the cloud server for further action.

**1.2 Purpose**

The sole purpose of the system requirement and specification is to give detailed information of what the cleanv: monitoring system will incorporate from the developer’s view before implementation of the system for use. Assessment and functionality will also be looked into to ensure it meets the envisioned purpose to help in waste management so as reduce pollution of the environment.

**2. Literature Survey**

**i.Farman Ullah Jan, Nasro Min-Allah and Dilek Dü¸stegör,IoT BasedSmartWater QualityMonitoring: Recent Techniques, Trends and Challenges for Domestic Applications**

Safe water is becoming a scarce resource, due to the combined effects of increased population, pollution, and climate changes. Water quality monitoring is thus paramount, especially for domestic water. Traditionally used laboratory-based testing approaches are manual, costly, time consuming, and lack real-time feedback. Recently developed systems utilizing wireless sensor network (WSN) technology have reportedweaknesses in energy management, data security,and communication coverage. Due to the recent advances in Internet-of-Things (IoT) that can be applied in the development of more efficient, secure, and cheaper systems with real-time capabilities, we present here a survey aimed at summarizing the current state of the art regarding IoT based smart water quality monitoring systems (IoT-WQMS) especially dedicated for domestic applications. In brief, this study probes into common water-quality monitoring (WQM) parameters, their safe-limits for drinking water, related smart sensors, criticalreview, and ratification of contemporary IoT-WQMS via a proposed empirical metric, analysis, and discussion and, finally,design recommendations for an efficientsystem. No doubt,this study will benefit the developing field of smart homes, offices,and cities.

## b.Yaroshenko, I.; Kirsanov, D etc all,IoTBased Smart Water Quality Monitoring: Recent Techniques,Trends and Challenges for Domestic Applications

Water is becoming a scarce resource,due to the combined effects of increased popu-lation, pollution, and climate changes. Water quality monitoring is thus paramount, especially for domestic water.

Recently developed systems utilizing wireless sensor network (WSN) technology have reported weaknesses in energy management, data security, and communication coverage.

**2.2 References**

**2.2.1 A River water Quality Monitoring Solution Geared towards Citizens.**

The economical and effective system of water quality observation is the most robust implementation of impure water. Drinking water could be precious for all people as water utilities face more challenges. These challenges arise due to the high population, fewer water resources, etc. So, different methods are used to monitor in the real-time water quality. To make sure that safe distribution of water is done, it must be observed in real time for a new method in the “Internet of Things(IoT)” based water quality has been projected.

Real-time water quality observation is examined by data acquisition, method, and transmission with an increase in the wireless device network method in the IoT. Microcontroller and the processed values remotely to the core controller ARM with a WI-FI protocol are used to interface the measured values from the sensors. The water quality observation interface sensors with quality observation with IOT setting. WQM selects parameters of water like temperature, pH level, water level and CO2 by multiple different device nodes. This methodology sends the information to the web server. The data updated at intervals within the server may be retrieved or accessed from anyplace within the world. If the sensors do not work or get into abnormal conditions, then a buzzer will be ON.

**2.3 Problem Statement**

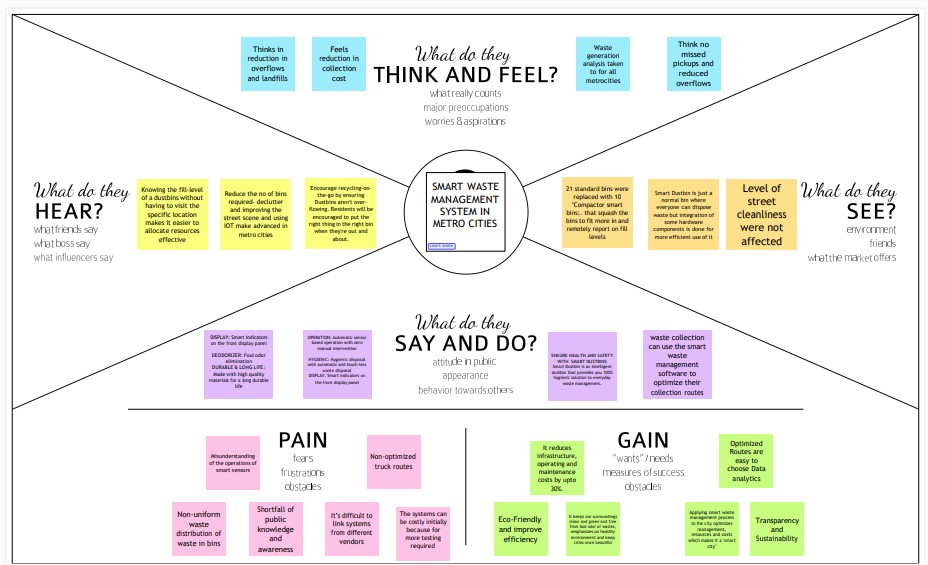
Pollution of water is one of the main threats in recent times as drinking water is getting contaminated and polluted. The polluted water can cause various diseases to humans and animals,which in turn affects the life cycle of the ecosystem. If water pollution is detected in an early stage, suitable measures can be taken and critical situations can be avoided. To make certain the supply of pure water, the quality of the water should be examined in real-time. Smart solutions for monitoring of water pollution are getting more and more significant these dayswith innovation in sensors, communication, and Internet of Things (IoT) technology. A detailed review of the latest works that were implemented in the arena of smart water pollutionmonitoring systems is presented. A cost effective and efficient IoT based smart water quality monitoring system which monitors the quality parameters uninterruptedly. The developed model is tested with watersamples and the parameters are transmitted to the cloud server for further action.

**3. Ideation and Proposed Solution**

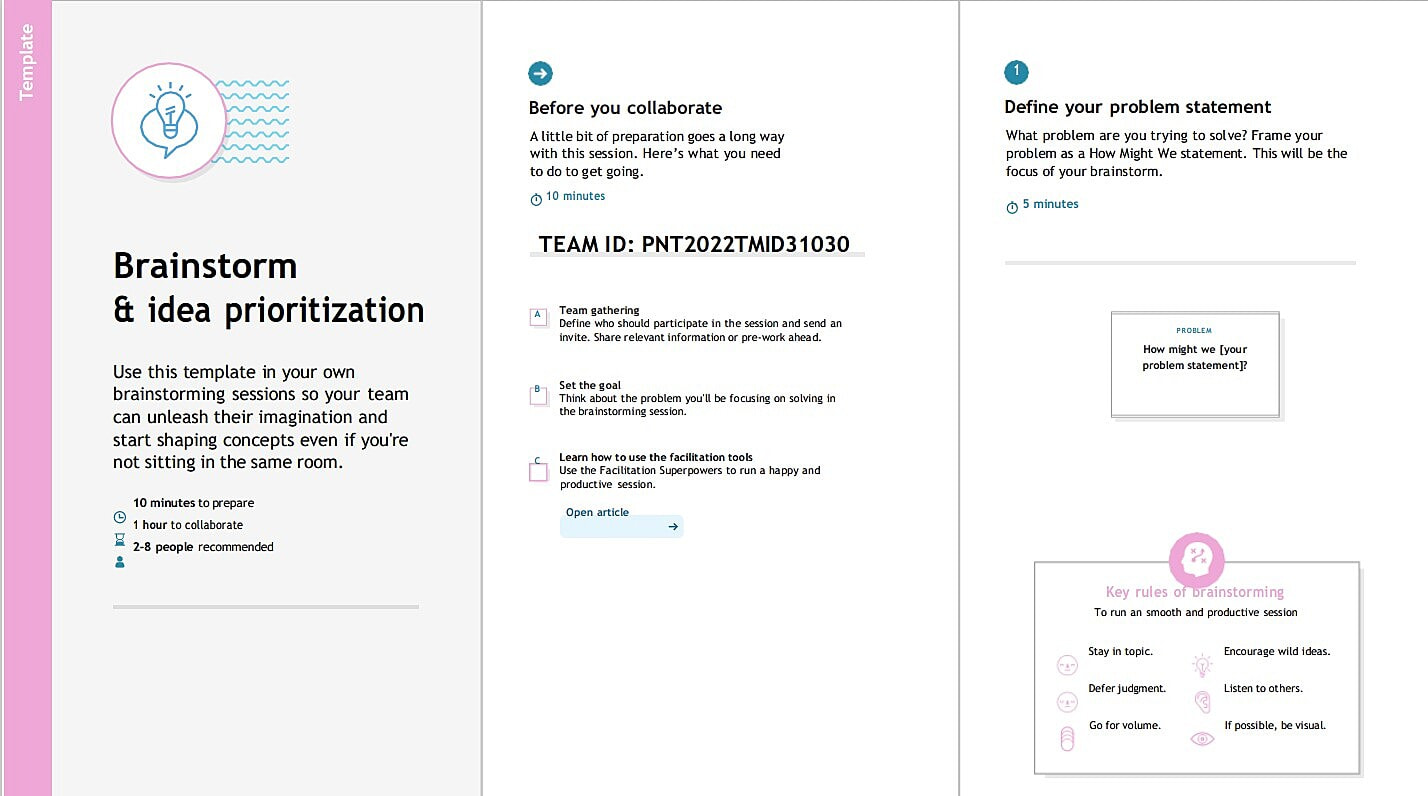
The contaminated water is detected in an early stage, suitable measures can be taken and critical situations can be avoided. To ensure the supply of clean water, water quality should be inspected. In real time, Smart solutions for monitoring water pollution are becoming more and more important these days with innovations in sensors, communication and the Internet of Things (IoT) technology. Review of recent work implemented in the arena of smart water pollution monitoring systems.

The complexity reduces and the performance increases by collecting the data of the water parameters like temperature,water level, co2, pH. The informationcollectedis updatedon the web server (cloud) that can be retrievedfrom anywhere in the world.

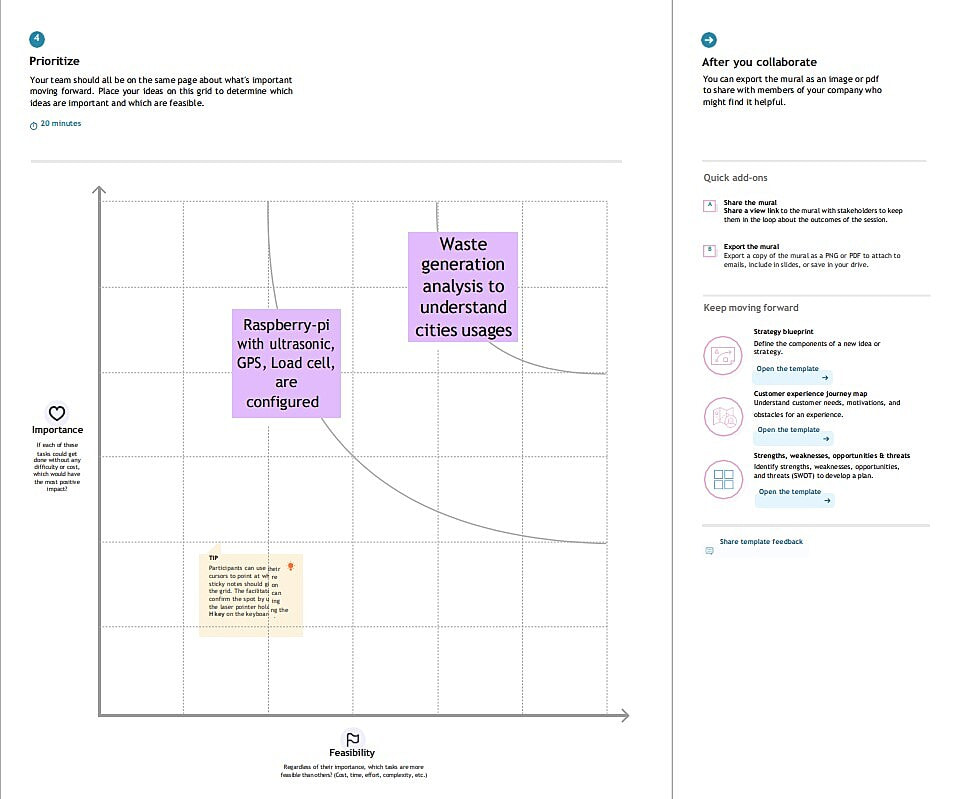
**3.1 Empathy Map Canvas**



**3.2 Ideation and Brainstorming**



**Ideation Phase 1**



**Ideation Phase 2**

**3.3 Proposed Solution**

The contaminated water is detected in an early stage, suitable measures can be taken and critical situations can be avoided. To ensure the supply of clean water, water quality should be inspected. In real time, Smart solutions for monitoring water pollution are becoming more and more important these days with innovations in sensors, communication and the Internet of Things (IoT) technology. Review of recent work implemented in the arena of smart water pollution monitoring systems.

**3.4 Problem Solution fit**



**Problem solution fit 1**

**4. Requirement Analysis**

The following are the functional and non functional rerquirements of river water quality monitoring system.

**4.1 HARDWARE REQUIREMENTS**

* + 1. Arduino Broad
    2. Node MCU
    3. Temperature sensor
    4. Turbidity sensor
    5. PH sensor
    6. Conductivity sensor
    7. Humidity sensor
    8. CO2 sensor
    9. LCD Display
    10. Mobile Phone /pc

## SOFTWARE REQUIREMENTS

* + 1. **Operating system** : Windows10
    2. **Software** : Arduino
    3. **Coding Language** : C

**HARDWARE DESCRIPTION**

## Arduino Board

Arduino is an open-source platform used for buildingelectronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board -- you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functionsof the micro-controller into a more accessible package.

**NodeMCU**

NodeMCU is an open-source platform, its hardware design is open for edit/modify/build. NodeMCU Dev Kit/board consist of ESP8266 wifi enabled chip. The ESP8266 is a low-cost i-fi chipdeveloped by Espressif Systems with TCP/IP protocol. For more information about ESP8266, you can refer to theESP8266 Wifi Module .

**4.2 Non Functional Requirements**

1. **Usability**

IOT device verifies that usability is a special and important perspective to analyze user requirements, which can further improve the design quality. In the design process with user experience as the core, the analysis of users’ product usability can indeed help designers better understand user's potential needs in waste management, behavior and experience.

**2. Performance**

The Smart Sensors use ultrasound technology to measure the fill levels (along with other data) in bins several timesa day. Using a variety of IoT networks( (NB-IoT,GPRS), the sensors send the data to sensors Smart Waste Management Software System, a powerful cloud-based platform, for data-driven daily operations, available also as a waste management app. Customers are hence provided data-driven decision making,and optimization of waste collection routes, frequencies, and vehicle loadsresulting in route reduction by at least 30%.

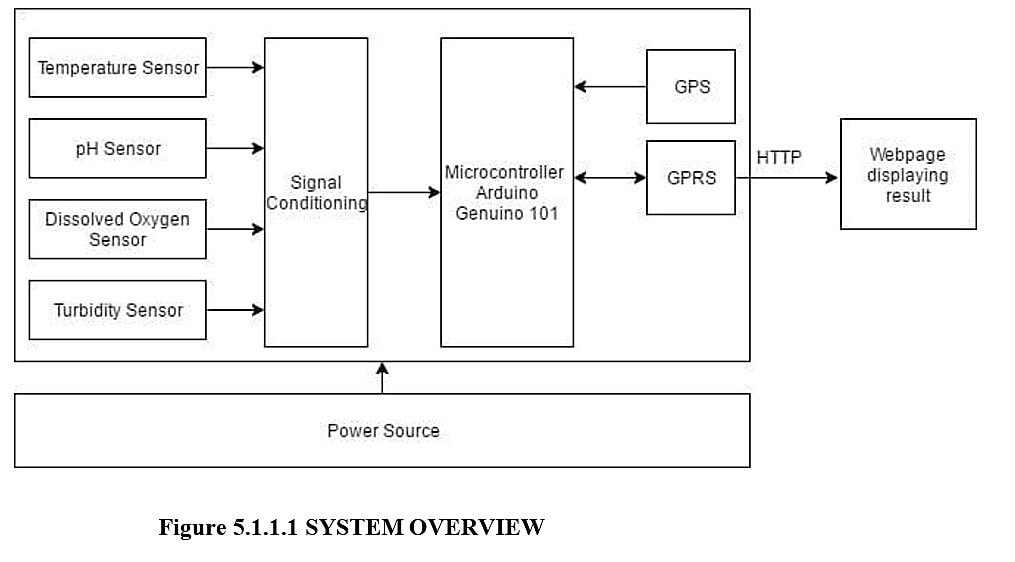
**5. Project Design**

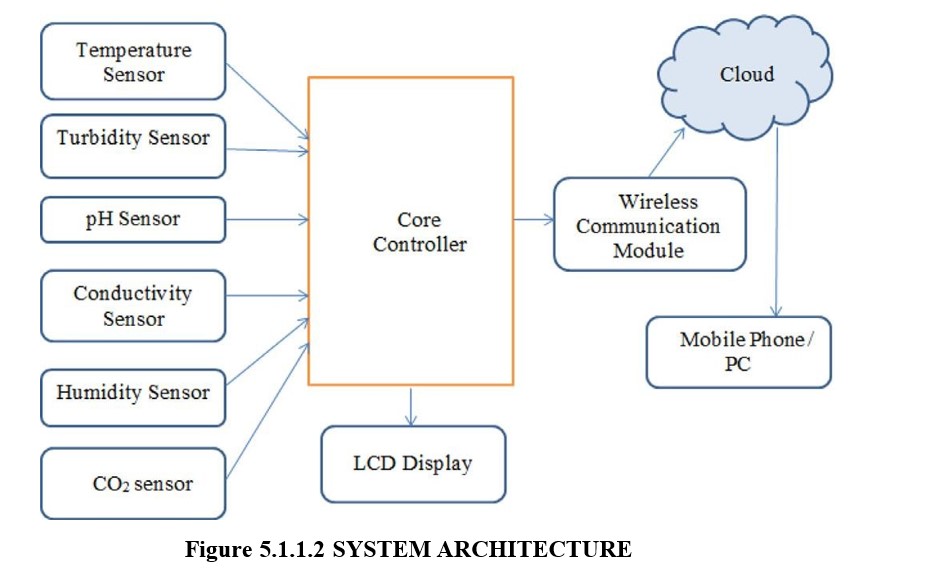
Changing from one approach to another has always proven to be difficult in most scenarios. For the waste management system it will be difficult for users to embrace it due to fears of high technicality needed to use the system.

**OVERVIEW OF THE PROJECT**

**IoT based smart water quality monitoring system**

In general a water quality monitoringsystemconsists of various sen- sors such a pH sensor, turbidity sensors, temperature sensors, conduc- tivity sensors, humidity sensors and many other sensors. Fig 5.1.1.2 shows the general block diagram of a smart water quality monitoring system. As shown in the figure, the core controller forms the heart of the system. All the sensors are connected to a core controller and this controller con- trols the operation, gets data from sensors, and compares it with that of the standard values and sends the values to the concerned end user or authorities through wireless modules. With the advances in IoT technology, the water quality monitoring system is becoming smarter with reduced power consumption and ease of operation. Fig 5.1.1.3 shows the operating flow chart of the smart water quality monitoring system. The core controller is integrated with various sensors such as pH sensor, conductivity sensor, temperature sensor, turbidity sensor and many sensors. The sensor leads are placed in the water to be tested. The sensor values will be processed by ADC and the core controller reads the value and it will beuploaded on the cloud.The values will be monitored con- tinuously by checking whether the sensor value is greater than thresh- old or not. If the sensor value is greater than threshold, then it will be 183 communicated to the concerned end user for further action. If sensor value is lesser than threshold,then the parameters are again checked for different water sources.





**5.2 Solution and Technical architecture**

**Table-1 : Components & Technologies:**

|  |  |  |  |
| --- | --- | --- | --- |
| **S.No** | **Component** | **Description** | **Technology** |
| **1.** | User Interface | Web Portal | HTML,CSS,NodeRed,  Javascript.o r on |
| **2.** | Application Logic-1 | To calculate the distance of dreck and show the real time level in web portal , information getting viaultra sonic sensorand  the alert message activate with python script to web portal. | Ultrasonic sensor/ Python. |
| **3.** | Application Logic-2 | To calculate the weight of the garbage and show the real time weight in web portal, this info getting via load cell and the alert message activate with python to  web portal. | Load cell/Python. |
| **4.** | Application Logic-3 | Getting location of the Garbage. | GSM / GPS. |
| **5.** | Cloud Database. | Database Service on Cloud | IBM DB2, IBM  Cloudant etc. |
| **6.** | File Storage | File storage requirements | Github,Local file system. |
| **7.** | External API- 1. | Firebase is a set of hosting services for any type of application. It offers NoSQL and real-time hosting of databases, authentication, and notifications, such as a real-time communication  communication server. | Firebase. |
| **8.** | Ultrasonic Sensor | To throw alert message when garbage is getting full. | Distance Recognition Model. |
| **9.** | Infrastructure (Server / Cloud) | Application Deployment on LocalSystem / Cloud  Local Server Configuration:localhost Cloud Server Configuration:  localhost,Firebase. | Localhost,Web portal. |

**5.3 User stories**

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **User Type** | **Functional Requirement (Epic)** | **User Story**  **Number** | **User Story /Task** | **Acceptance criteria** | **Priority** | **Release** |
| Admin | Login | USN-1 | As an administrator, I assigned user names and passwords to each  employee and managed them. | I can control my online account and dashboard. | Medium | Sprint-1 |
| Co-Admin | Login | USN-2 | As a Co-Admin, I'll control the waste level monitor. If a garbage filling alert occurs, I will notify the trash truckof the location and rubbish ID. | I can handle the waste collecti-on. | High | Sprint-1 |
| Truck Driver | Login | USN-3 | As a Truck Driver, I'll follow Co Admin'sinstruction toreach the filled  garbage. | I can take the shortest path to reach the waste  filled routespecified. | Medium | Sprint-2 |
| Local Garbage Collector | Login | USN-4 | As a Local Garbage Collector, I’II gather all the waste from the garbage, load it onto a  garbage truck, and deliver it to Landfills | I can collect the trash,pull it to the truck, and send it out. | Medium | Sprint-3 |
| Municipality  officer | Login | USN-5 | As a Municipality officer, I'll make sure everything is proceeding as planned  and without any problems. | All of these processes are under my control. | High | Sprint-4 |

**6. Project planning and scheduling**

**6.1 Sprint planning and estimation**

|  |  |  |
| --- | --- | --- |
| **TITLE** | **DESCRIPTION** | **DATE** |
| **Literature Survey & Information Gathering** | Literature survey on the selected project & gathering information by referring the, technical papers, research publications etc. | 28 SEPTEMBER 2022 |
| **Prepare Empathy Map** | Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements | 24 SEPTEMBER 2022 |
| **Ideation** | List the by organizing the brainstorming session andprioritize the top 3 ideas based on the feasibility & importance. | 25 SEPTEMBER 2022 |
| **Proposed Solution** | Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc. | 23 SEPTEMBER 2022 |
| **Problem Solution Fit** | Prepare problem - solution fit document. | 30 SEPTEMBER 2022 |
| **Solution Architecture** | Prepare solution architecture document. | 28 SEPTEMBER 2022 |

|  |  |  |
| --- | --- | --- |
| **Customer Journey** | Prepare the customer journey maps to understand the user interactions & experiences with the application (entry to exit). | 20 OCTOBER2022 |
| **Functional Requirement** | Prepare the functional requirement document. | 8 OCTOBER2022 |
| **Data FlowDiagrams** | Draw the data flow diagrams and submit for review. | 9 OCTOBER2022 |
| **Technology Architecture** | Prepare the technology architecture diagram. | 10 OCTOBER2022 |
| **Prepare Milestone & Activity List** | Prepare the milestones &activity list of the project. | 22 OCTOBER2022 |
| **Project Development - Delivery of Sprint-1, 2, 3 &4** | Develop & submit the developed codeby testing it. | 17 NOVEMBER 2022 |

**6.2 Sprint Delivery Schedule**

# 

# Product Backlog , Sprint Schedule and Estimation

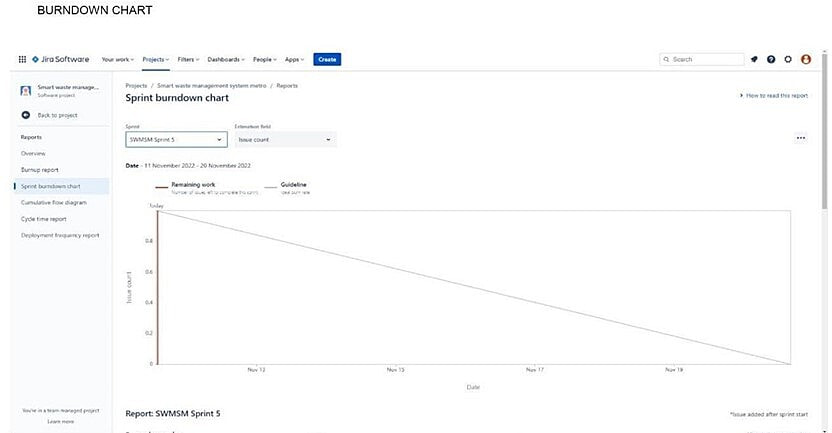
Use the below template to create product backlog and sprint schedule

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sprint** | **Functional Requirements (Epic)** | **User Story Number** | **User Story/ Task** | **Story**  **Points** | **Priority** | **Team Members** |
| Sprint-1 | Login | USN-1 | As a Administrator, I need to give user id and passcode for ever workers over there in municipality | 10 | High | Nafeezhussain |
| Sprint-1 | Login | USN-2 | As a Co-Admin, I’ll control the waste level by monitoring them via realtime web portal. Once the filling happens, I’ll notifytrash truck with  location of bin with bin ID | 10 | High | Nagaraj |
| Sprint-2 | Dashboard | USN-3 | As a Truck Driver, I’ll follow Co-Admin’s Instruction to reach thefilling bin in short roots  and savetime | 20 | Low | Sakthivel |
| Sprint-3 | Dashboard | USN-4 | As a Local Garbage Collector, I’II gather all the  waste from the garbage, load it onto a garbage truck, anddeliver it to Landfills | 20 | Medium | Sridharbalan |
| Sprint-4 | Dashboard | USN-5 | As a Municipality officer, I'll make sure everything is proceeding as planned and  without any problems | 20 | High | Nafeezhussain |

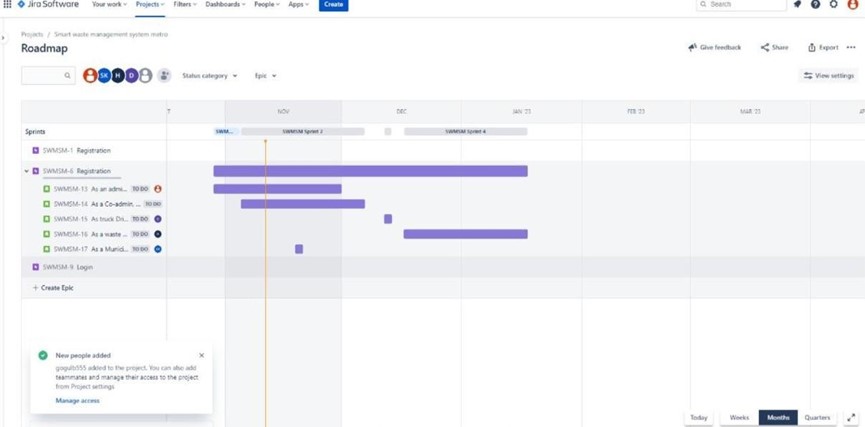
# Project Tracker, Velocity & Burndown Chart:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sprint** | **Total Story Points** | **Duration** | **Sprint Start Date** | **Sprint End Date (Planned)** | **Story Points**  **Completed (as on Planned End Date)** | **Sprint Release Date (Actual)** |
| Sprint-1 | 20 | 6 Days | 24 Oct 2022 | 29 Oct 2022 | 20 | 29 Oct 2022 |
| Sprint-2 | 20 | 6 Days | 31 Oct 2022 | 05 Nov2022 | 20 | 05 Nov2022 |
| Sprint-3 | 20 | 6 Days | 07 Nov  2022 | 12 Nov2022 | 20 | 12 Nov2022 |
| Sprint-4 | 20 | 6 Days | 14 Nov 2022 | 19 Nov2022 | 20 | 19 Nov2022 |

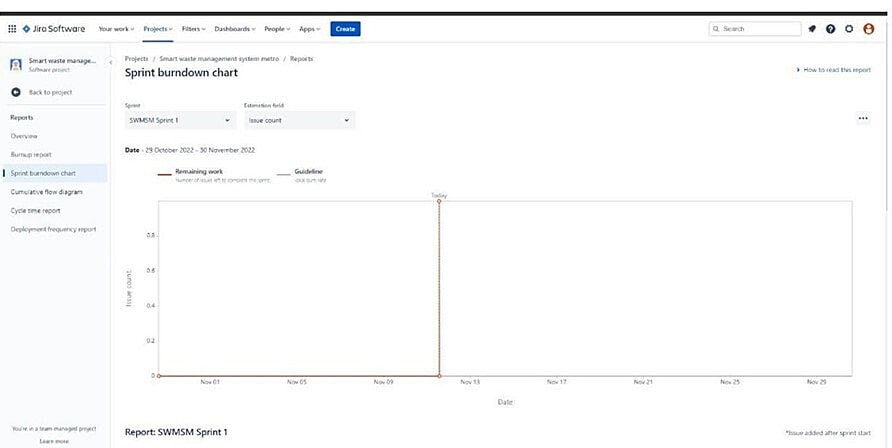
**6.3 Reports from JIRA**



**JIRA 1**

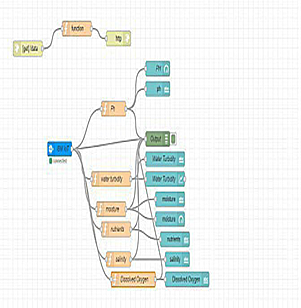


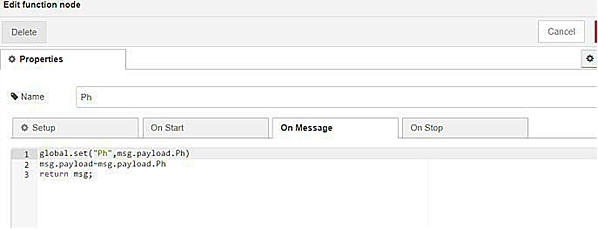
**JIRA 2**

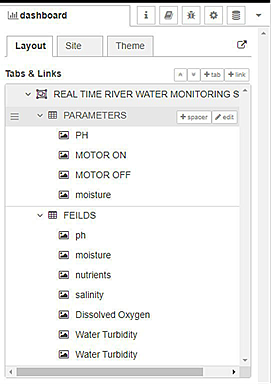


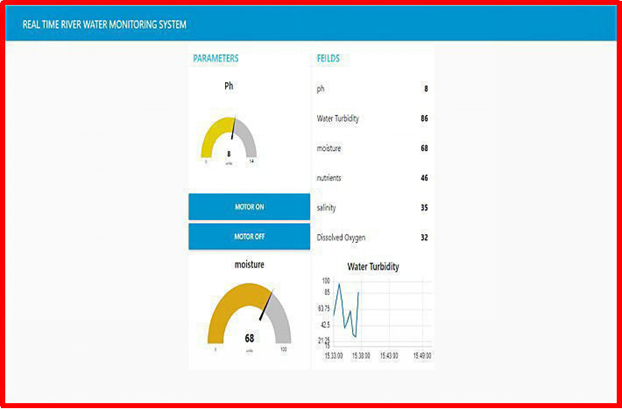
**JIRA 3**

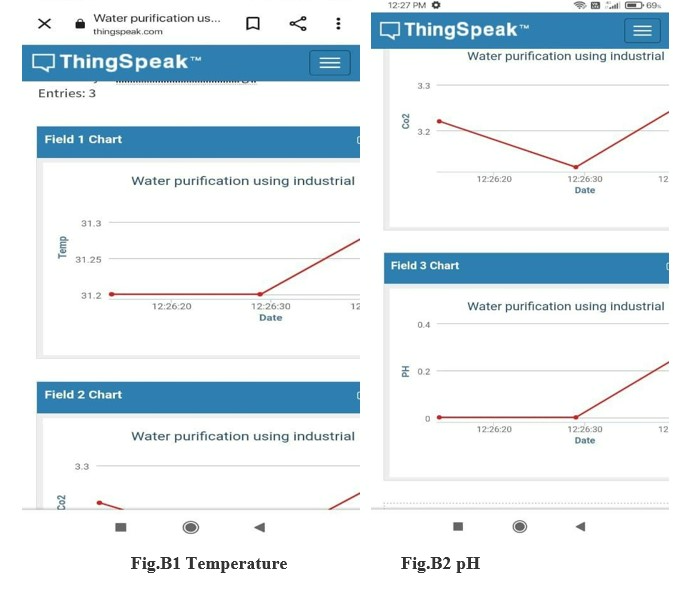
**7. Coding and Solutioning**

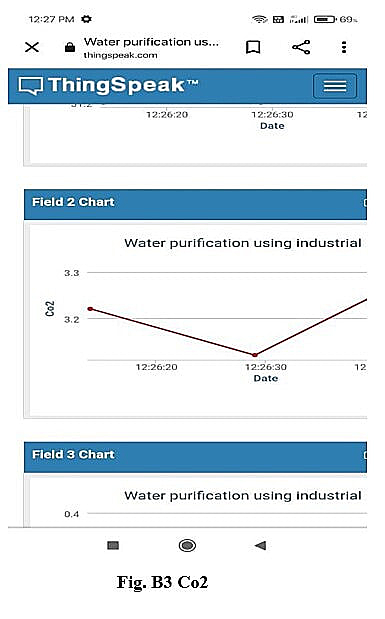












**8. Testing**

**8.1 Test Case Analysis**

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

and untested

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Section | Total Cases | Not Tested | Fail | Pass |
| Print Engine | 15 | 0 | 0 | 15 |
| Client Application | 45 | 0 | 0 | 45 |
| Security | 1 | 0 | 0 | 1 |
| Outsource Shipping | 2 | 0 | 0 | 2 |
| Exception Reporting | 10 | 0 | 0 | 10 |
| Final Report Output | 4 | 0 | 0 | 4 |
| Version Control | 3 | 0 | 0 | 3 |

**8.2 USER ACCEPTANCE TESTING**

1. Purpose of Document

The purpose of this documentis to briefly explain the test coverageand open issuesof the REAL TIME RIVER WATER QUALITYMONITORING AND CONTROLSYSTEMS

project at the time of the release to User Acceptance Testing (UAT).

1. Defect Analysis

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Resolution | Severity1 | Severity2 | Severity3 | Severity4 | Subtotal |
| By Design | 9 | 5 | 4 | 3 | 21 |
| Duplicate | 2 | 0 | 2 | 0 | 4 |
| External | 3 | 4 | 1 | 2 | 10 |
| Fixed | 10 | 1 | 5 | 17 | 33 |
| Not Reproduced | 0 | 0 | 1 | 0 | 1 |
| Skipped | 0 | 0 | 1 | 2 | 3 |
| Won't Fix | 0 | 3 | 3 | 1 | 7 |
| Totals | 24 | 13 | 17 | 25 | 79 |

**9.RESULT**

**9.1 PERFROMANCE METRICS**

PERFORMANCE TABLE

|  |  |  |
| --- | --- | --- |
| PARAMETER | PERFORMANCE | DESCRIPTION |
| ADMIN TESTING | 95%-100% | THE TESTING DONE  BEFORE IT IS DEPLOYED AS AN APP |
| CUSTOMER SATISFACTION | 75-85% | THE CUSTOMER NEED TO BE SATISFIED WITH THE MOBILE  APPLICATION |
| USER INTERFACE | 65-85% | THE APP CAN USED BY ANYONE.(EASE OF  ACCESS) |
| SEVER RESPONSE | 50-75% | url - response |
| DATA VALIDATION | 60-80% | VALID DATA FROM THE |
| WITH NO.OF TEST | (15-30 | APP |
| CASE | TESTCASE) |  |
| ERROR | 3-5% | REAL-TIME DELAY  MAY OCCUR |

**10. ADVANTAGES AND DISADVANTAGES**

**ADVANTAGES:**

The prototype developed for water quality maintenance is very beneficial for safeguarding publichealth and also adds to the cleanenvironment.

The automation of thiswater monitoring, cleaning and controlprocess removes the need of manuallabor 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 samplesfrom 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 reflectreal time water quality measurement due to delay in measurement.

The process is time consuming due to slow process of manual data collection from different locationsof the water body.

The method is prone to human errors of variousforms.

**11. CONCLUSION**

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

The operationis simple. The system can be expandedto monitor

hydrologic, air pollution, industrialand agricultural production and so on. It has widespread application and extension value.By keeping the embedded devicesin 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 objectsthrough the network.

Then the collected data and analysisresults will be available to the

end user throughthe Wi-Fi.

**12. 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 livingin rural areas near to the river will be very satisfied with our idea.It will be useful to monitor water pollution in specific area.Sothis system preventpeople from waterpollution.It will be used for farming purpose to check quality water,temperature and PH level.OurImpact of this project is also create a social satisfaction for farmers too.Thescalabilty of this project gives the addition of more differenttype of sensors.By interfacing the relay we can control the supply of water. We can also implement as a revenue model.This systemcould also be implemented in various industrial processes. The system can be modified accordingto the needs of the user and can be implemented along with lab view to monitor data on computers.

## 13. Appendix

## SOURCE CODE

## Arduino Code

#include <OneWire.h>

#include <DallasTemperature.h> #include <ArduinoJson.h> OneWire oneWire(2);

DallasTemperature temp\_sensor(&oneWire); float calibration\_value = 21.34;

int phval = 0;

unsigned long int avgval; int buffer\_arr[10], temp; void setup()

{

Serial.begin(9600); temp\_sensor.begin();

}

StaticJsonBuffer<1000> jsonBuffer; JsonObject& root = jsonBuffer.createObject(); void loop() {

for (int i = 0; i < 10; i++)

{

buffer\_arr[i] = analogRead(A0); delay(30);

}

for (int i = 0; i < 9; i++)

{

for (int j = i + 1; j < 10; j++)

{

if (buffer\_arr[i] > buffer\_arr[j])

{

temp = buffer\_arr[i]; buffer\_arr[i] = buffer\_arr[j]; buffer\_arr[j] = temp;

}

}

}

avgval = 0;

for (int i = 2; i < 8; i++) avgval += buffer\_arr[i];

float volt = (float)avgval \* 5.0 / 1024 / 6;

float ph\_act = -5.70 \* volt + calibration\_value; temp\_sensor.requestTemperatures();

int moisture\_analog=analogRead(A1);

int moist\_act=map(moisture\_analog,0,1023,100,0); root["a1"] = ph\_act;

root["a2"] = temp\_sensor.getTempCByIndex(0); root["a3"] = moist\_act;

root.printTo(Serial); Serial.println("");

}

## NodeMCU Code:

#include<ESP8266WiFi.h> #include<WiFiClient.h> #include<ESP8266WebServer.h> #include <ArduinoJson.h>

const char\* ssid = "admin";//Replace with your networkSSID

const char\* password = "12345678";//Replacewith your network password ESP8266WebServer server(80);

String page = "";

int data1, data2, data3; void setup()

{

Serial.begin(9600); WiFi.begin(ssid, password);

while (WiFi.status() != WL\_CONNECTED)

{

delay(500);Serial.print(".");

}

Serial.println(WiFi.localIP()); server.on("/", []()

{

page = "<html><head><title>IoT Design</title></head><style type=\"text/css\">";

page += "table{border-collapse: collapse;}th {background-color: green ;color:white;}table,td

{border: 4px solid black;font-size: x-large;";

page+="text-align:center;border-style:groove;border-color: rgb(255,0,0);}</style><body><center>";

page += "<h1>Smart Aquaculture Monitoring using IoT</h1><br><br><table style=\"width: 1200px;height: 450px;\"><tr>";

page=+"<th>Parameters</th><th>Value</th><th>Units</th></tr><tr><td>PH Value</td><td>"+String(data1)+"</td><td>N/A</td></tr>"; page+="<tr><td>Temperature</td><td>"+String(data2)+"</td><td>Centigrade</td></tr><tr><t d>Moisture</td><td>"+String(data3)+"</td><td>%</td>";

page += "<meta http-equiv=\"refresh\" content=\"3\">";

server.send(200, "text/html", page);

});

server.begin();

}

void loop()

{

StaticJsonBuffer<1000> jsonBuffer;

JsonObject& root = jsonBuffer.parseObject(Serial); if (root == JsonObject::invalid())

{

return;

Serial.println("invalid");

}

data1 = root["a1"];data2 = root["a2"];data3 = root["a3"]; Serial.println(data1); Serial.println(data2); Serial.println(data3); server.handleClient();

}

**Github link:**

[**https://github.com/IBM-EPBL/IBM-Project-6090-1658823434**](https://github.com/IBM-EPBL/IBM-Project-6090-1658823434)

**Demo link:**

[**https://youtu.be/cJBJmsTWSXw**](https://youtu.be/cJBJmsTWSXw)