Project Final Deliverable

Report Document

Date	19 November 2022
Team ID	PNT2022TMID48076
Project Name	Project – REAL TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM

REAL TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM

Team ID: PNT2022TMID48076

Batch: B2-2M4E

TEAM LEADER:

Name: S. SANGEETHA

Register Number: 912419104026

TEAM MEMBERS:

Name: S. DHANAM

Register Number: 912419104006

Name: C. KARTHIGA

Register Number: 912419104012

Name: S. SOLAINANDHINI

Register Number: 912419104031

Name: K.VINMATHI

Register Number: 912419104039

REAL TIME RIVER WATER MONITORING AND CONTROL SYSTEM

A IBM PROJECT REPORT

Submitted By

S.Sangeetha (912419104026)

C.Karthiga(912419104012)

S.Dhanam(912419104006)

S.Solainandhini(912419104031)

K.Vinmathi(912419104039)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SHANMUGANATHAN ENGINEERING COLLEGE ARASAMPATTI – 622507

ANNA UNIVERSITY :: CHENNAI 600 025

NOVEMBER 2022

CONTENTS

1 . INTRODUCTION

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 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 issues . In this paper , we depict the design of Wireless Sensor Network (WSN) that assists to monitor the quality of water with the support of information sensed by the sensors dipped in water.

Using different sensors , this system can collect various parameters from water, such as pH, dissolved oxygen, turbidity, conductivity, temperature, and so on. The rapid development of WSN technology provides a novel approach to real-time data acquisition , transmission , and processing . 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.

1.1PROJECT OVERVIEW:

To design a good quality model, we reviewed out different existing system developed by researchers. Different authors have proposed distinguished models to check water quality by analyzing the parameters such as temperature, pH and conductivity, and so on. By considering all these points, we designed a smart water monitoring system which can perform all these monitoring functions. Stephen Brosnan investigated a WSN to collect real time water quality parameters (WQP). Quio Tie-Zhn, developed online water quality monitoring system based on GPRS/GSM . The information was sent by means of GPRS network, which helped to check remotely the WQP.

Kamal Alameh presented web based WSN for monitoring water pollution using ZigBee and WiMAX networks. The system collected, processed measured data from sensors, and directed through ZigBee gateway to the web server by means of WiMAX network to monitor quality of water from large distances in real time. Dong He developed WQM system based on WSN [14]. The remote sensor was based on ZigBee network. WSN tested WQP and sent data to Internet using GPRS. With the help of Web, information was gathered at remote server. Vijayakumar et al., designed a low cost system design for real time water quality monitoring in IoT utilizes sensors to check many important physical and chemical parameters of water . The parameters such as turbidity, temperature, pH, dissolved oxygen conductivity of water can be measured.

In our project, we proposed a water quality monitoring system based on IoT. Current water quality monitoring system is a manual system with a monotonous process and is very time-consuming. This paper proposes a sensor-based water quality monitoring system. The

main components of Wireless Sensor Network include a micro controller for processing the system, communication system for inter and intranode communication and several sensors. Real-time data access can be done by using remote monitoring and Internet of Things (IOT) technology. The uniqueness of our proposed paper is to obtain the water monitoring system with high frequency, high mobility, and low powered. Therefore, our proposed system will immensely help populations to become conscious against contaminated water as well as to stop polluting the water.

1.3.PURPOSE:

The essential parameters of the water quality vary based on the application of water. For example, for aquariums, it is necessary to maintain the temperature, pH level, dissolved oxygen level, turbidity, and the level of the water in a certain normal range in order to ensure the safety of the fish inside the aquarium. For the industrial and household applications, however, some parameters of the water are more essential for monitored frequently than the others, depending on the usage of the water.

Water pollution is one of the most serious types of this environmental pollution. Our lives depend on the quality of water that we consume in different ways, from juices which are produced by the industries. Any imbalance in the quality of water would severely affect the humans' health and at the same time it would affect the ecological balance among all species. Water quality refers to the chemical, biological, radio logical, and biological parameters of the water.

River sampling networks must be described by the strategy for the selection of sampling sites; eg. major rivers in a country or frequent sampling downstream point sources. A general description of the total number of sampling sites, number of rivers, number of river systems and information on catchment areas (eg. catchment area size distribution) generally give a fair description of the sampling network. Many river sampling networks are composed of two or more sampling networks, eg. a few intensive sampling sites located in major rivers and numerous basic sampling sites located at less important tributaries and river reaches.

2. LITRATURE SURVEY

2.1 EXISTING PROBLEM:

Existing system has a mechanisms which are semi-automated or manually controlled devices which are to be handled by a person responsible for monitoring the water quality. There is need to have human intervention in taking various reading of the water parameters.The instruments or tools are used either by putting/inserting a water sensing part into water and seeing the result on small display device or by directly inserting a portable device in water and watching the output on the display.

Central Water Commission (CWC) monitors water quality, by collecting samples from representative locations within the processing and distribution system. These samples are analyzed at the well-equipped laboratories. At these laboratories, samples of raw water, filter water and treated water are taken for analysis, these analysis can be performed by human intervention which for specific period only. The disadvantage of this system is, water is not monitoring seamlessly, and it always needs a human intervention.

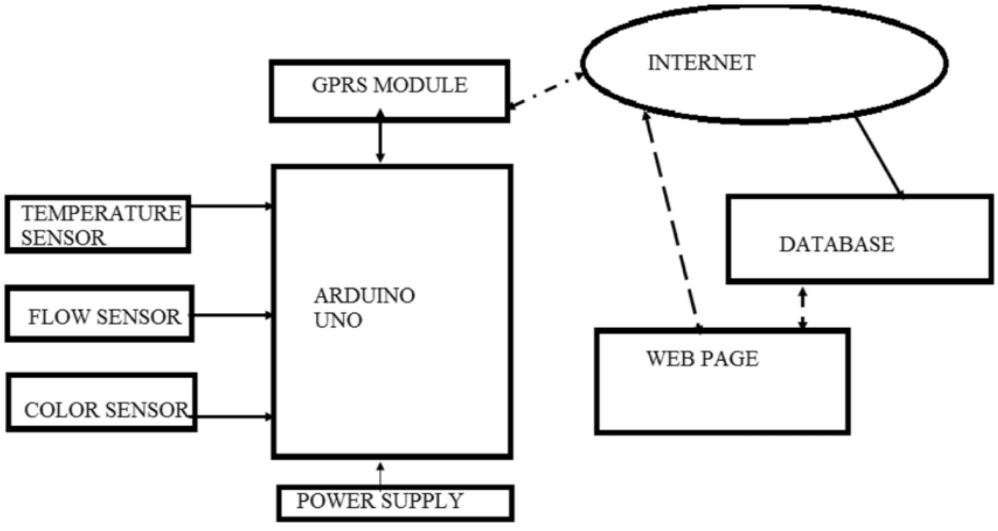


Figure 2.1 Existing Solution

2.2 REFERENCES:

i. K. S. Adu-Manu, C. Tapparello, W. Heinzelman, F. A. Katsriku, and J.-D. Abdulai, "Water quality monitoring using wireless sensor networks: Current trends and future research directions," ACM Transactions on Sensor Networks (TOSN), vol. 13, p. 4, 2017.

i. B. Chen, Y. Song, T. Jiang, Z. Chen, B. Huang, and B. Xu, "Real-time estimation of population exposure to PM2.5 using mobile- and station-based big data," Int J Environ Res Public Health, vol. 15, Mar 23 2018.

i. B. Paul, "Sensor based water quality monitoring system," BRAC University, 2018.

i. . Andersson and M. S. Hossain, "Smart Risk Assessment Systems using Belief-rule-based DSS and WSN Technologies", in 2014 4th International Conference on Wireless Communications, Vehicular Technology, Information Theory and Aerospace and Electronic Systems, VITAE 2014 : Co-located with Global Wireless Summit, Aalborg, Denmark 11-14 May 2014, 2014.

i. Thombre, R. U. Islam, K. Andersson, and M. S. Hossain, "IP based Wireless Sensor Networks : performance Analysis using Simulations and Experiments", Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications, vol. 7, no. 3, pp. 53–76, 2016.

i. Andersson and M. S. Hossain, "Heterogeneous Wireless Sensor Networks for Flood Prediction Decision Support Systems", in 2015 IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS) : 6th IEEE INFOCOM International Workshop on Mobility Management in the Networks of the Future World, 2015, pp. 133–137.

i. Thombre, R. U. Islam, K. Andersson, and M. S. Hossain, "Performance Analysis of an IP

based Protocol Stack for WSNs", in Proceedings of the 2016 IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS), 2016, pp. 691–696.

Z. Abedin, S. Paul, S. Akhter, K. N. E. A. Siddiquee, M. S. Hossain, and K. Andersson, "Selection of Energy Efficient Routing Protocol for Irrigation Enabled by Wireless Sensor Networks", in Proceedings of 2017 IEEE 42nd Conference on Local Computer Networks Workshops, 2017, pp. 75–81.

i. Ul Islam, K. Andersson, and M. S. Hossain, "Heterogeneous Wireless Sensor Networks Using CoAP and SMS to Predict Natural Disasters", in Proceedings of the 2017 IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS) : The 8th IEEE INFOCOM International Workshop on Mobility Management in the Networks of the Future World (MobiWorld'17), 2017, pp. 30–35.

i. K. N. E. A. Siddiquee, F. F. Khan, K. Andersson, and M. S. Hossain, "Optimal Dynamic Routing Protocols for Agro-Sensor Communication in MANETs", in Proceedings of the 14th Annual IEEE Consumer Communications & Networking Conference, Las Vegas, 8-11 January 2017.

i. E. Alam, M. S. Kaiser, M. S. Hossain, and K. Andersson, "An IoT-Belief Rule Base Smart System to Assess Autism", in Proceedings of the 4th International Conference on Electrical Engineering and Information & Communication Technology (iCEEiCT 2018), 2018, pp. 671–675.

W. Rundel, E. A. Graham, M. F. Allen, J. C. Fisher, and T. C. Harmon, "Environmental sensor networks in ecological research," New Phytologist, vol. 182, pp. 589-607, 2009.

i. Chilamkurti, S. Zeadally, A. Vasilakos, and V. Sharma, "Cross-layer support for energy efficient routing in wireless sensor networks," Journal of Sensors, vol. 2009, 2009.

i. R. Maier and G. C. Dandy, "The use of artificial neural networks for the prediction of water quality parameters," Water resources Research, vol. 32, pp. 1013-1022, 1996.

.Vijayakumar and R. Ramya, "The real time monitoring of water quality in IoT environment," in 2015 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS), 2015, pp. 1-

i. T. White, Hadoop: The definitive guide: " O'Reilly Media, Inc.", 2012.

i. A. K. Jain, J. Mao, and K. Mohiuddin, "Artificial neural networks: A tutorial," Computer, pp. 31-44, 1996.

i. H. R. Maier and G. C. Dandy, "The use of artificial neural networks for the prediction of water quality parameters," Water resources Research, vol. 32, pp. 1013-1022, 1996.

i. . S. Hossain, S. Rahaman, R. Mustafa, and K. Andersson, "A belief rule-based expert system to assess suspicion of acute coronary syndrome (ACS) under uncertainty", Soft Computing - A Fusion of Foundations, Methodologies and Applications, vol. 22, no. 22, pp. 7571–7586, 2018.

i. Mahmud, K. N. Rahman, and M. S. Hossain, "Evaluation of Job Offers Using Evidential Reasoning", Global Journal of Computer Science and Technology, Vol. 13, No. 6, 2013, pp. 41-50.

i. . Hossain, K. Andersson, and S. Naznin, "A Belief Rule Based Expert System to Diagnose Measles under Uncertainty", in Proceedings of the 2015 International Conference on Health Informatics and Medical Systems (HIMS'15), 2015, pp. 17–23.

i. .S. Hossain, PO., Zander, S. Kamal, and L. Chowdhury, "Belief Rule Based Expert Systems to Evaluate E-Government", Expert Systems, The Journal of Knowledge Engineering, Vol. 32, No.5, 2015, Jhon Wiley & Sons Ltd.

i. . S. Hossain, F. Ahmed, F. Tuj-Johora, and K. Andersson, "A Belief Rule Based Expert System to Assess Tuberculosis under Uncertainty", Journal of medical systems, vol. 41, no.

3, 2017.

i. . S. Hossain, S. Rahaman, A.-L. Kor, K. Andersson, and C. Pattison, "A Belief Rule Based Expert System for Datacenter PUE Prediction under Uncertainty", IEEE Transactions on Sustainable Computing, vol. 2, no. 2, pp. 140–153, 2017.

2.3 PROBLEM STATEMENT DEFINITION:

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 analyze the data constantly .

- Real water is highly polluted in present situation due to suspended materials.
- Farmers put fertilizers and pesticides on their crop so that they grow better but these fertilizers and pesticides can be washed through the soil by rain to end up in the rivers which causes concentration of nitrate and phosphate in the water increases considerably.
- The massive growth of algae called Eutrophication, which leads to pollution. When the algae die they broken down by theaction of bacteria which quickly multiply using up all the oxygen in the water which leads to the death of many animal.
- Some of the time the water has perilous particles or compound blendedand broadly useful water purifier can't refine that. Furthermore, checking the nature of water physically in each time is unthinkable.
- The ability to make real-time decisions during critical moments can be vital in preventing expensive repairs and breakdown. Water quality analysis is to measure the required parameters of water, followingstandard methods, to check whether they are in accordance with the standard. If the water quality is poor and it is below the permissible level it makes decision by comparing it with the previous reading date.

3. IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviour 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.

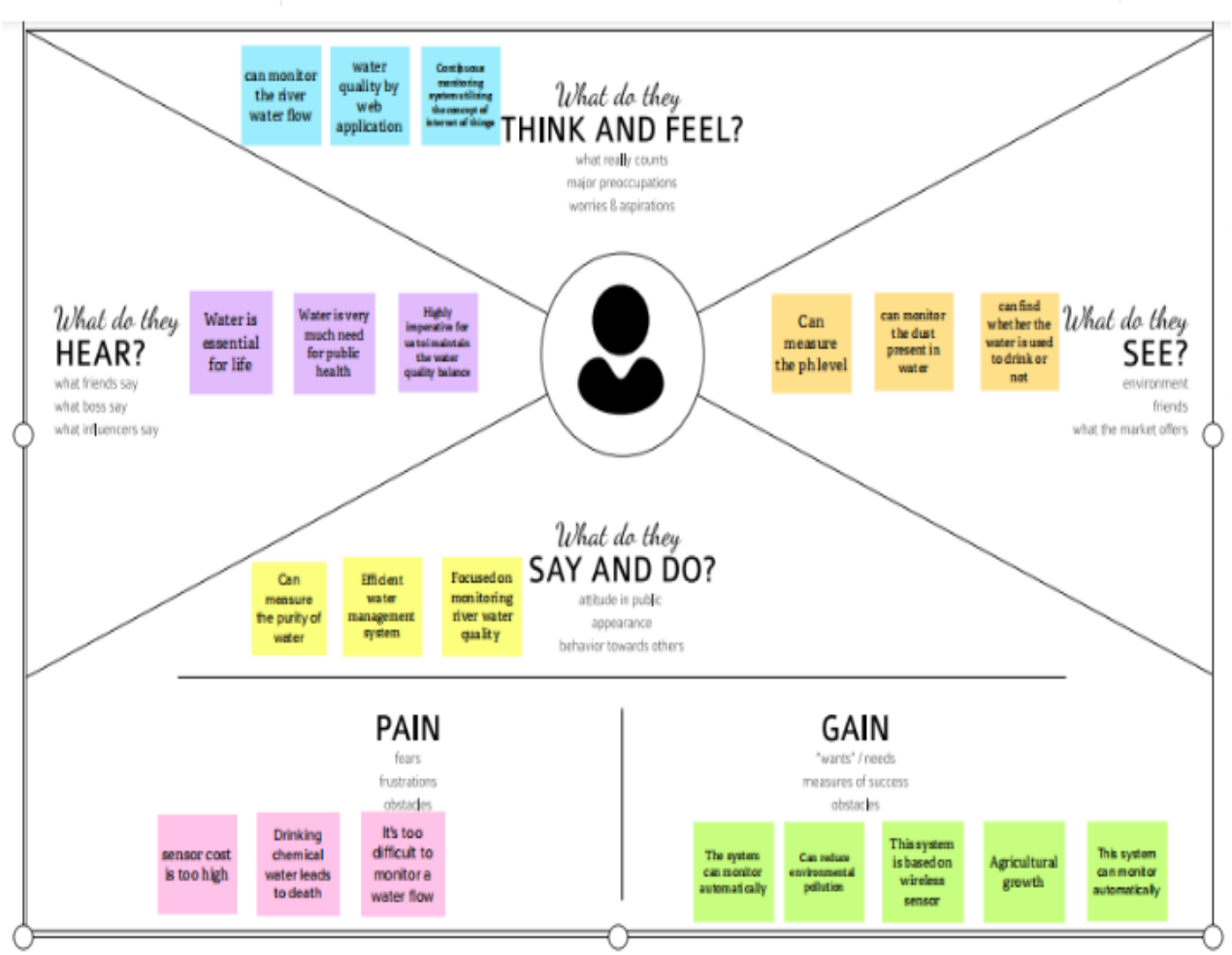


Figure 3.1 Empathy map

3.2 IDEATION AND BRAINSTROMING:

Ideation is the process where you generate ideas and solutions through

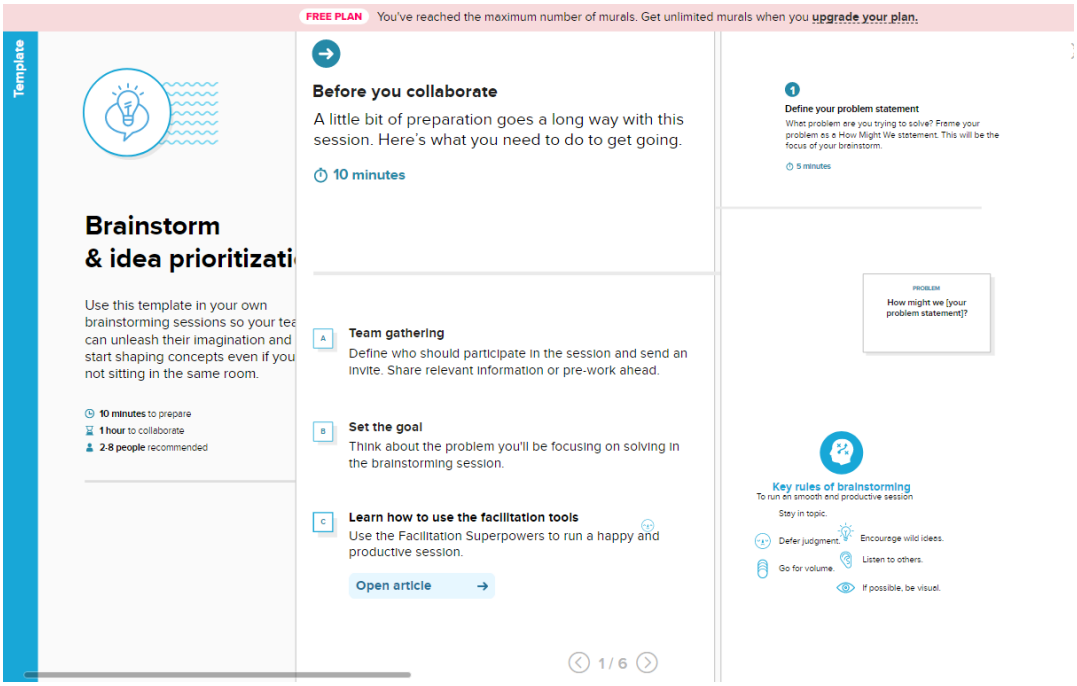
sessions such as Sketching, Prototyping, Brainstorming, Brainwriting, Worst Possible Idea, and a wealth of other ideation techniques. Ideation is also the third stage in the Design Thinking process. Although many people might have experienced a “brainstorming” session before, it is not easy to facilitate a truly fruitful ideation session.

In this article, we’ll teach you some processes and guidelines which will help you facilitate and prepare for productive, effective, innovative and fun ideation sessions.Ideation is often the most exciting stage in a Design Thinking project, because during Ideation, the aim is to generate a large quantity of ideas that the team can then filter and cut down into the best, most practical or most innovative ones in order to inspire new and better design solutions and products.

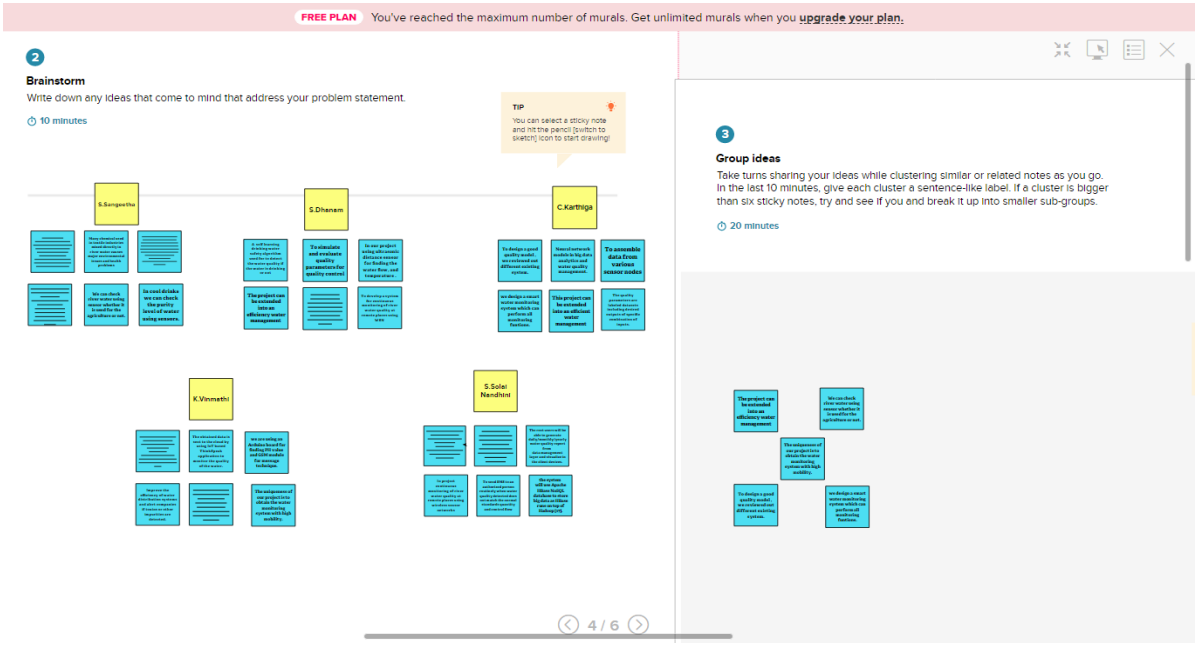
Brainstorm & Idea Prioritization Template:

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions. Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same.

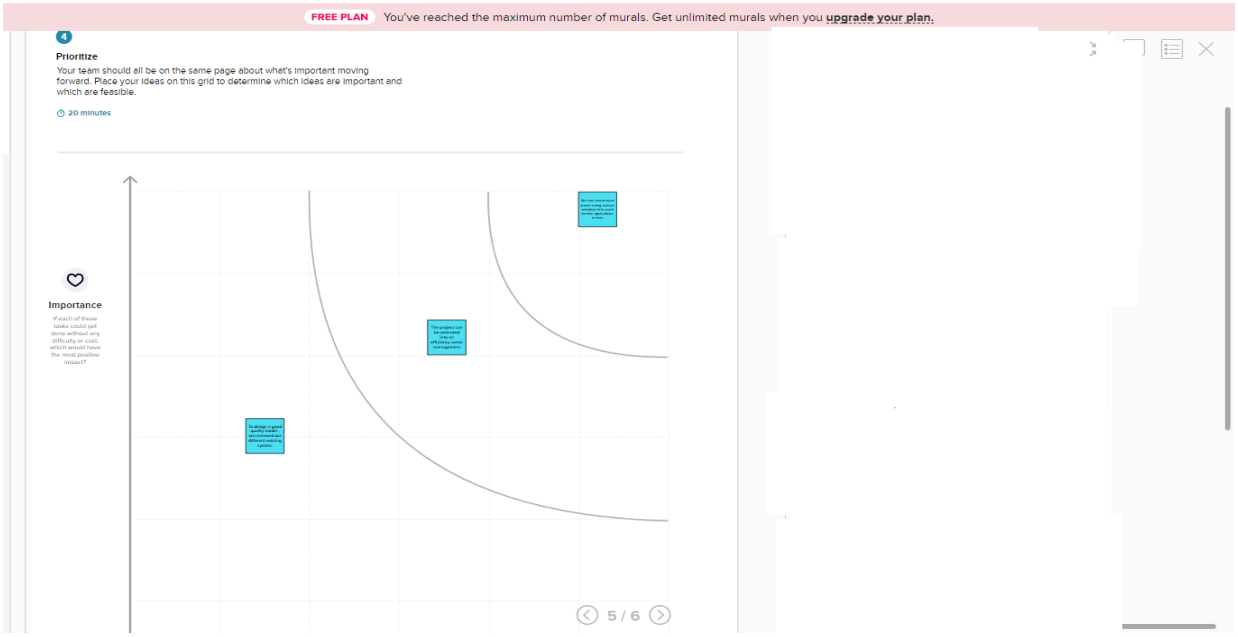
Step-1: Team Gathering, Collaboration and Select the Problem Statement



Step-2: Brainstorm, Idea Listing and Grouping



Step-3: Idea Prioritization



3.3 PROPOSED SOLUTION:

In our proposed method, an assembled Arduino micro controller is used as the core controller of the system. Once the code is uploaded to the micro controller, no PC system, keyboard command, monitor is required to operate the system. The system functions automatically and independently according to the code uploaded to the micro controller. In this system, three sensors are used to measure the essential water parameters.

As it was studied from the previous researches, the most essential water parameters needed to be monitored by the average users are water pH level, water turbidity (cloudiness) and water temperature which is a measurement of the

amount of the water in a container.Therefore, four essential water parameters which are temperature, pH level and turbidity can be measured by this proposed system. Sensors' circuits are connected to the micro controller and the probes of the turbidity, pH, and temperature sensors placed inside the water .A water proof temperature sensor is used to avoid any damage or electrical shock to the system and the user.

An ultrasonic sensor is used to measure the level of the water in the container. The ultrasonic sensor is connected in the system such that it will be placed on the top of the water container. The ultrasonic sensor sends electromagnetic waves to the water surface and receives the wave back after touched the water surface. From the time taken to send and receive the wave by the ultrasonic sensor and the velocity of the electromagnetic waves, the distance which shows the water level in the container is calculated by the micro controller.

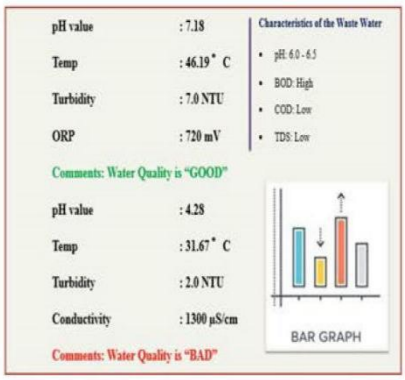
All sensors read the water quality parameters and send the data to the micro controller in the form of electrical signals.The micro controller is programmed such that is will analyze the result and compare it with the standard ranges which are predetermined in the code. If any water parameter crossed the standard limit, the alarm system will turn on.

In case of any abnormality in a water parameter detected by the micro controller, the buzzer will buzz to indicate that the water is not proper for use. To show the sensor readings (The water parameters) on the device itself, an LCD (Liquid Crystal Display) screen is used. The LCD screen is connected to the micro controller, and through the wired connection, it receives the sensor readings from the micro controller and displays them accordingly.

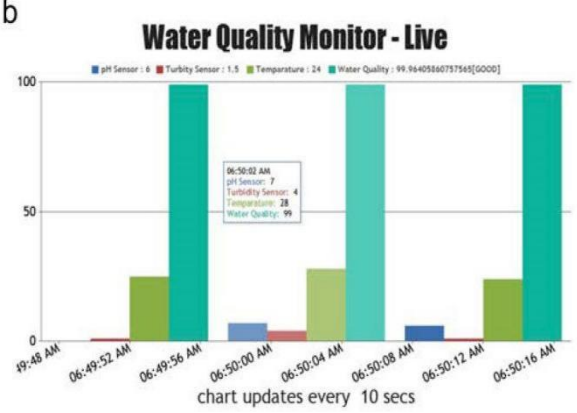
The main aim is to develop a system for continuous monitoring of river water quality at remote places using wireless sensor networks with low power consumption, low-cost and high detection accuracy. pH, conductivity, turbidity level, etc. are the limits that are analyzed to improve the water quality.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

parameters such as pH, dissolved oxygen, turbidity, conductivity, etc. using available sensors at a remote place. (b) To assemble data from various sensor nodes and send it to the base station by the wireless channel. (c) To simulate and evaluate quality parameters for quality control. (d) To send SMS to an authorized person routinely when water quality detected does not match the preset standards, so that, necessary actions can be taken.

a



b

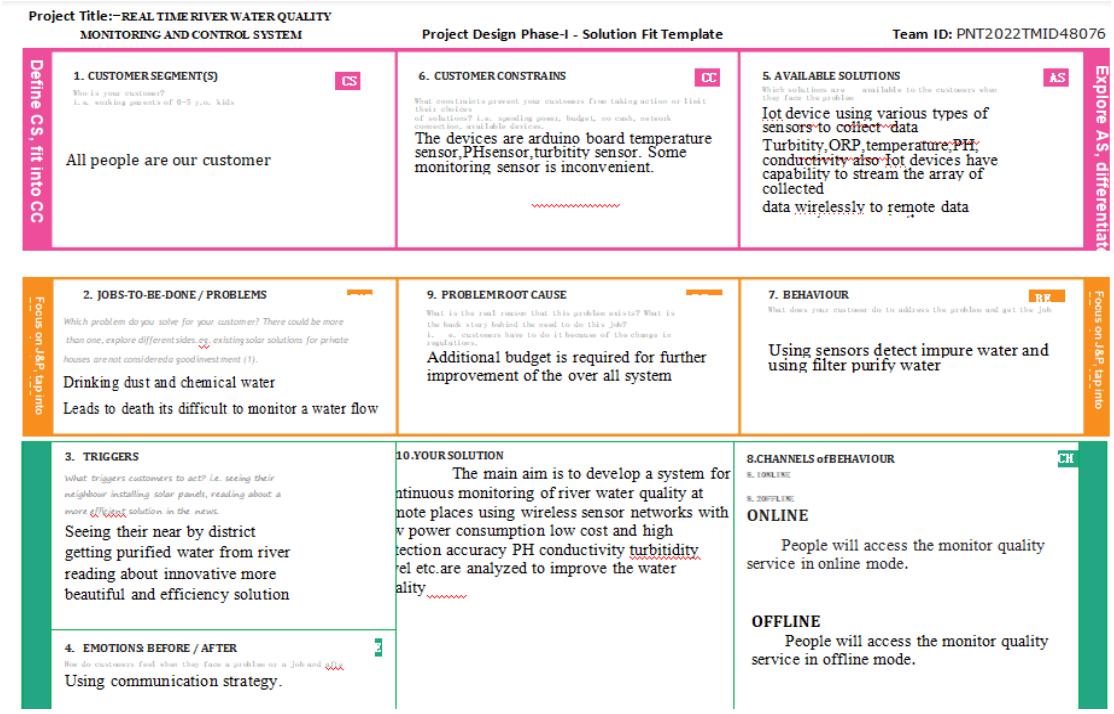


Full scheme of the system. In the proposed architecture, each water reservoir will be attached with a sensor node equipped with a set of sensor probes capable of measuring the parameters like pH, turbidity etc. According to the specifications of the sensor probes and the processor board of the sensor the signal conditioning circuit will be designed to generate the sensor output to the processor board through Analog to Digital Converter.

The processor board processes the data according to the quality specifications and transmits to the central server through the transceiver. The measured data in each of the reservoir shall be sent to the central server through the respective transceivers either directly or indirectly through other sensor or repeater nodes.

IOT Water Quality Monitor Station and Data Management Layer Architecture Integration. Turbidity, oxidation reduction potential (ORP), temperature, pH, conductivity, etc. of river water are gathered continuously through IOT devices. IOT devices have capability to stream the array of collected data wireless to the remote Data Aggregator Server in the cloud which are efficiently stored and analyzed through the Big Data Analytic applications. Thus, the Data Aggregator Server can retrieve the analysis result and transfer the result to the applications running on smart phones, tablets, laptops, and desktops in the cloud.

3.4 PROBLEM SOLUTION FIT:



4.REQUIREMENTS

4.1 FUNCTIONAL REQUIREMENTS:

Following are the functional requirements of the proposed solution

Functional requirements may involve calculations, technical details, data manipulation and processing, and other specific functionality that define what a system is supposed to accomplish

.Behavioral requirements describe all the cases where the system uses the functional requirements, these are captured in use cases. Functional requirements are supported by non-functional requirements (also known as "quality requirements"), which impose constraints on the design or implementation (such as performance requirements, security, or reliability).

.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	▪ Registration through Form ▪ Registration through Gmail ▪ Registration through Linked-IN
FR-2	User Confirmation	▪ Confirmation via Email ▪ Confirmation via OTP

4.2 NON FUNCTIONAL REQUIREMENTS:

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

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	▪ Monitoring provides the objective evidence necessary to make sound decisions on managing water quality today and in the future.
NFR-2	Security	▪ Applications can create z-node in zookeeper. Apache H-Base is managed by Apache Zoo-Keeper. ▪ The IOT application will help the users to visualize the water quality analysis results produced by data management layer over different time series continuously. This application runs on client devices such as Smart phones, laptops and desktops. ▪ The root users will be able to generate daily/monthly/yearly water quality report from data management layer and visualize in the client devices.

NFR-3	**Reliability**	▪ **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.**
NFR-4	**Performance**	▪ **To measure water parameters such as PH, dissolved oxygen, turbidity, conductivity, etc. us0ing available sensors at a remote place.** ▪ **To assemble data from various sensor nodes and send it to the base station by the wireless channel.** ▪ **To simulate and evaluate quality parameters for quality control.**

		▪ **To send SMS to an authorized person routinely when water quality detected does not match the pre-set standards, so that, necessary actions can be taken.**
NFR-5	**Availability**	▪ **Using different sensors, this system can collect various parameters from water, such as PH, dissolved oxygen, turbidity, conductivity, temperature, and so on.** ▪ **The rapid development of WSN technology provides a novel approach to real-time data acquisition, transmission, and processing.** ▪ **The clients can get ongoing water quality information from far away.**

NFR-6	**Scalability**	▪ **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 Monitor to improve the water quality.**

As defined in requirements engineering, functional requirements specify particular results of a system. This should be contrasted with non-functional requirements, which specify overall characteristics such as cost and reliability.

5. PROJECT DESIGN

5.1 Data Flow Diagrams:

Also known as DFD, Data flow diagrams are used to graphically represent the flow of data in a business information system. DFD describes the processes that are involved in a system to transfer data from the input to the file storage and reports generation. A Data flow diagrams can be divided into logical and physical. The logical data flow diagram describes flow of data through a system to perform certain functionality of a business. The physical data flow diagram describes the implementation of the logical data flow.

Example:

5.1.1 DFD-(Data Flow Diagrams):

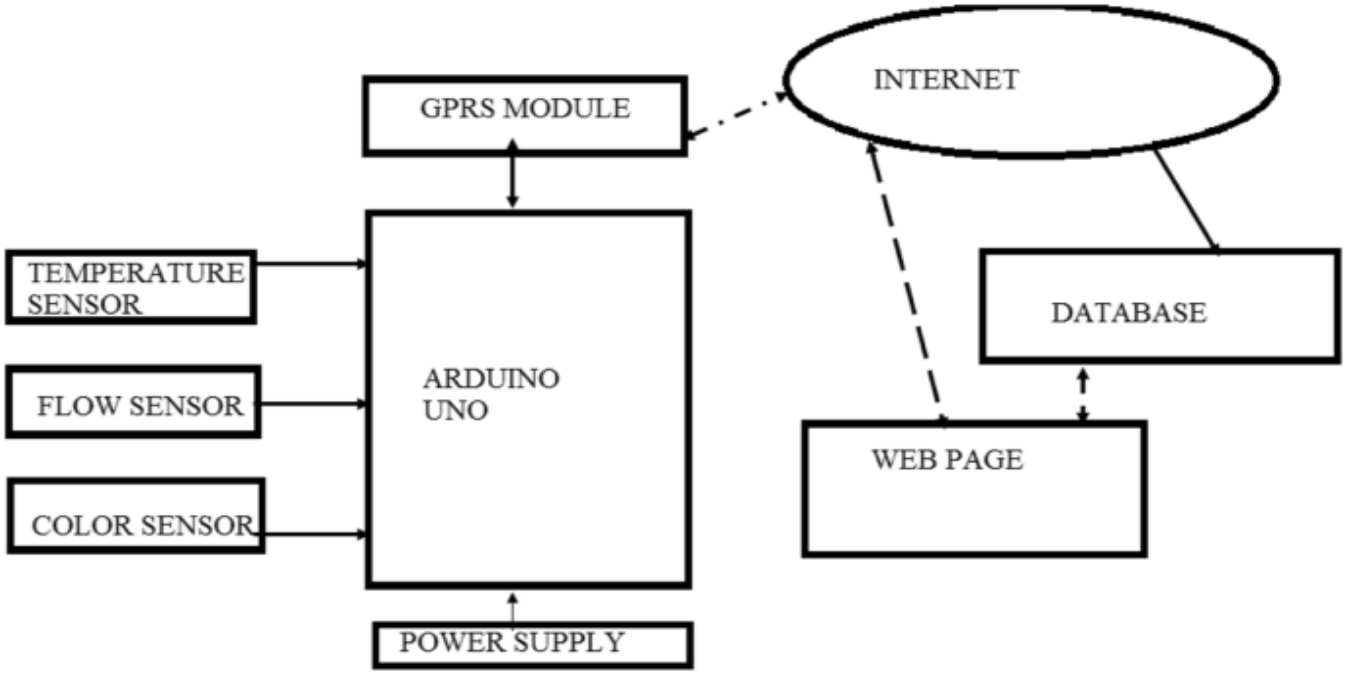


Fig:5.1.1.DFD-(data flow diagram)

5.1.2 Diagram for water Quality monitoring system:

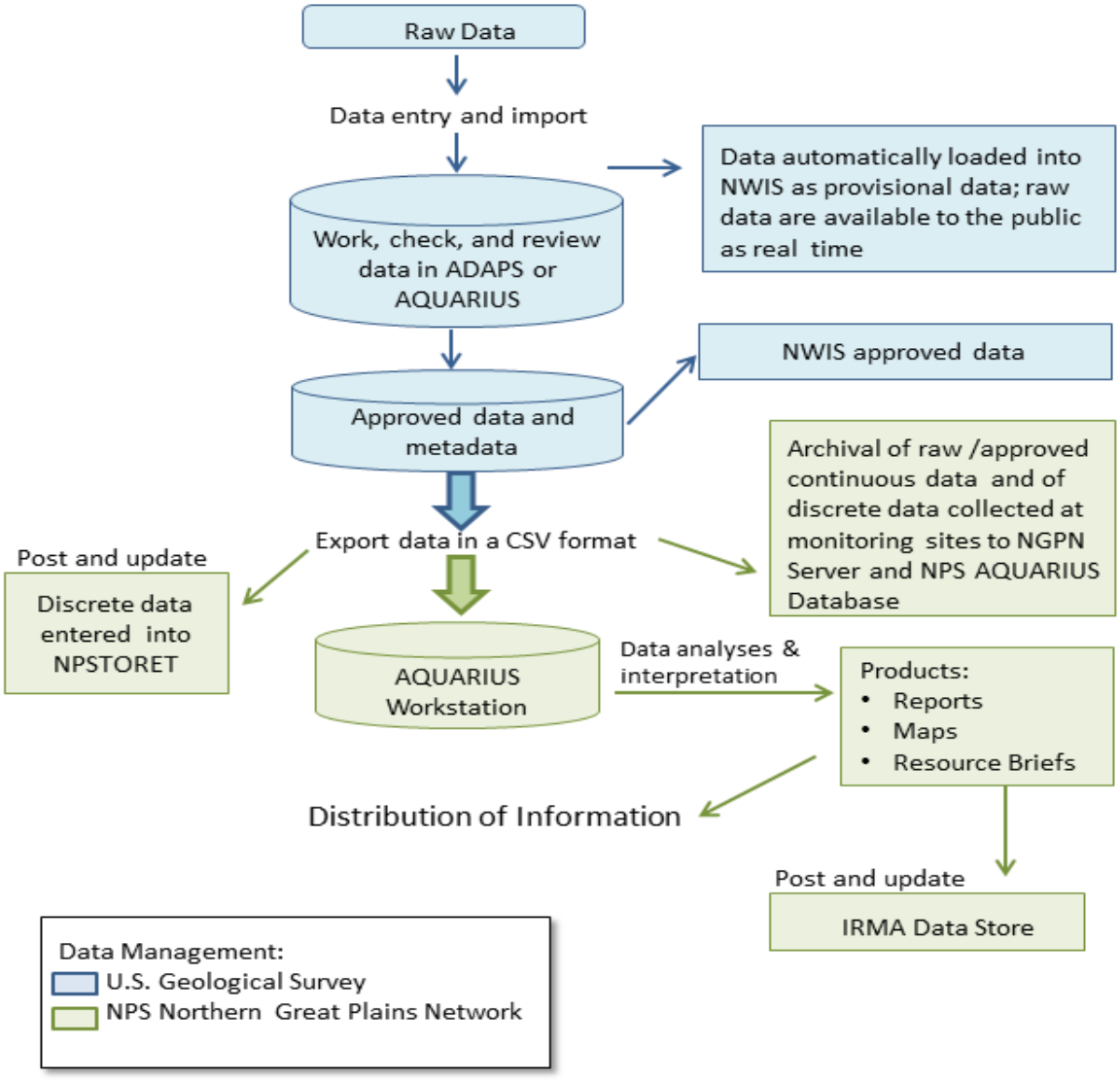


Fig:5.1.2 Diagram for water Quality monitoring system

5.1.3. DFD-(Level 0):

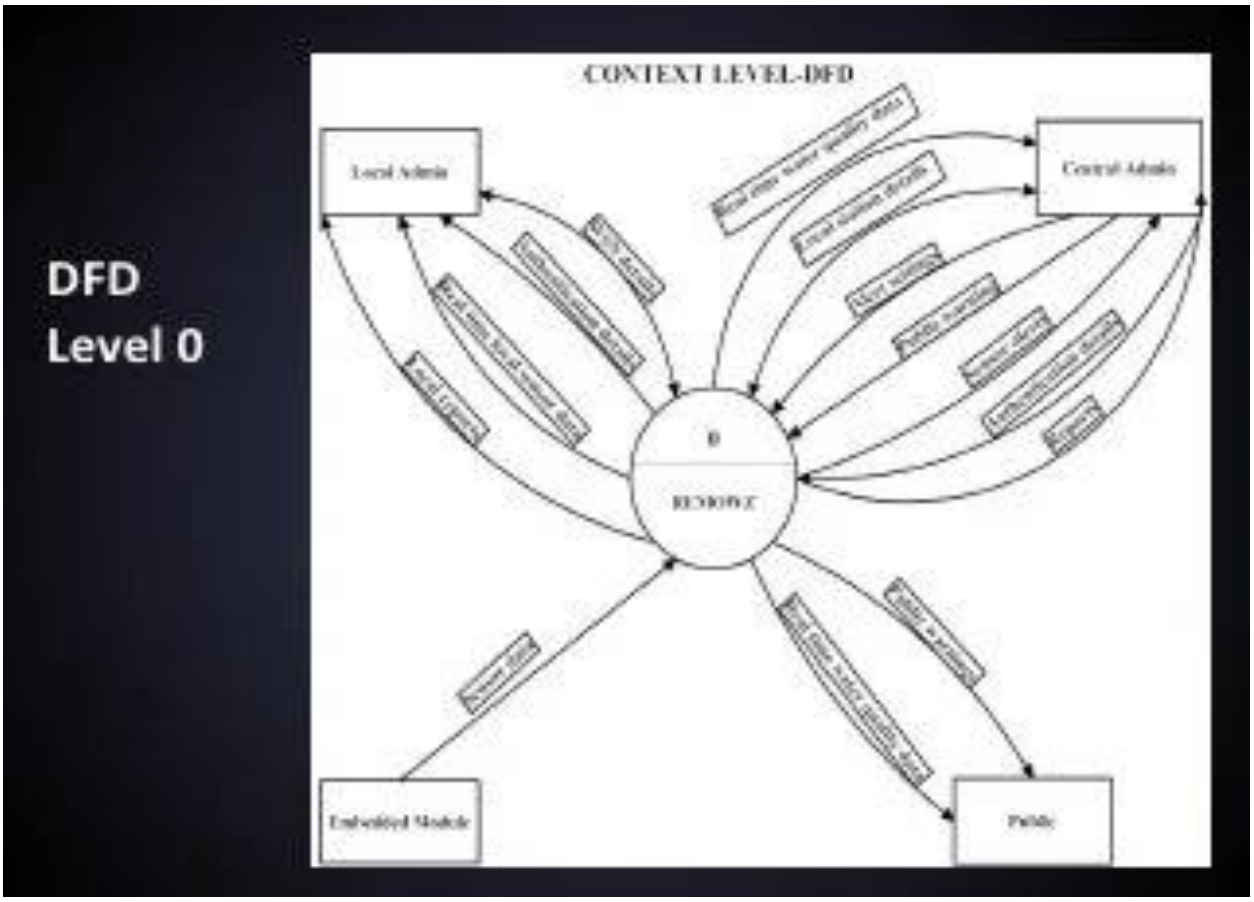


Fig: 5.1.3. DFD-(Level 0)

A data flow diagram (DFD) **maps out the flow of information for any process or system**. It uses defined symbols like rectangles, circles and arrows, plus short text labels, to show data inputs, outputs, storage points and the routes between each destination.

5.1.4.DFD-(level 1):

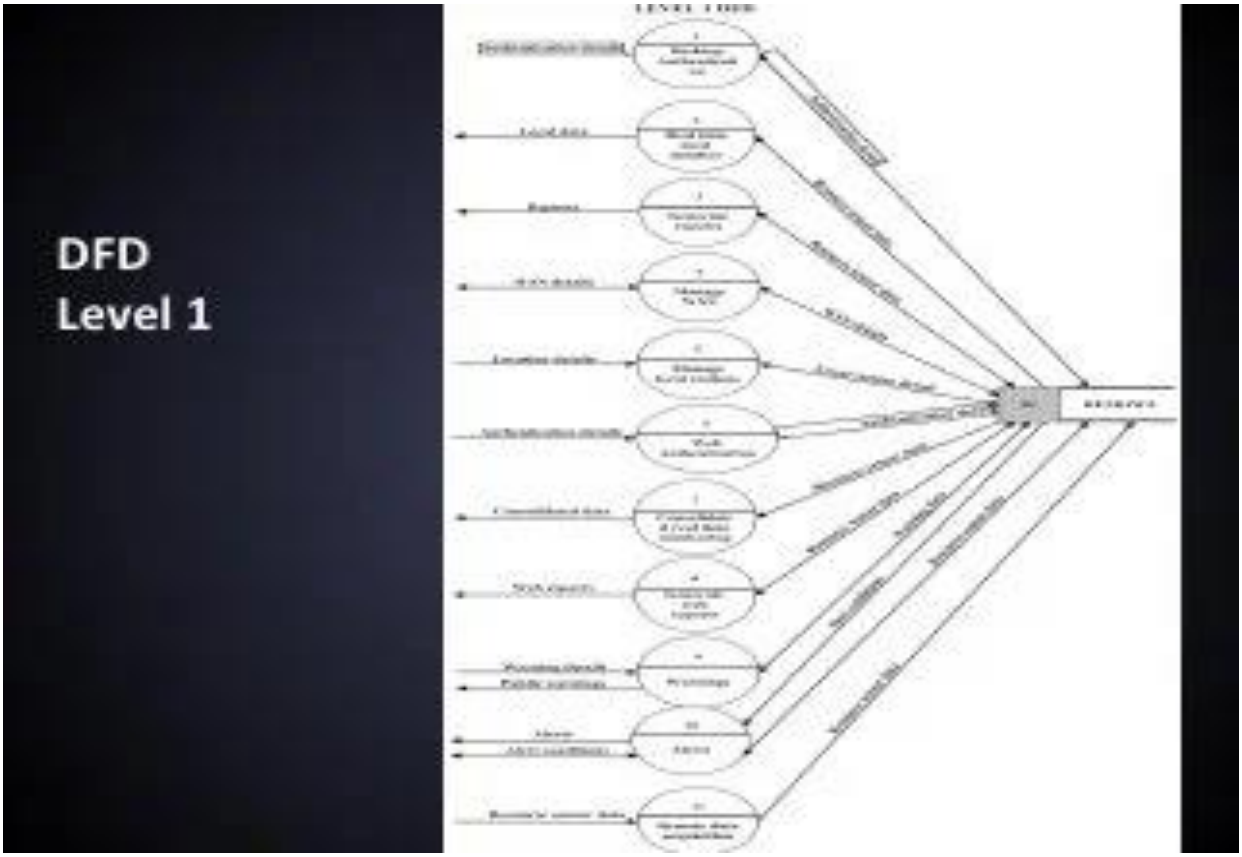


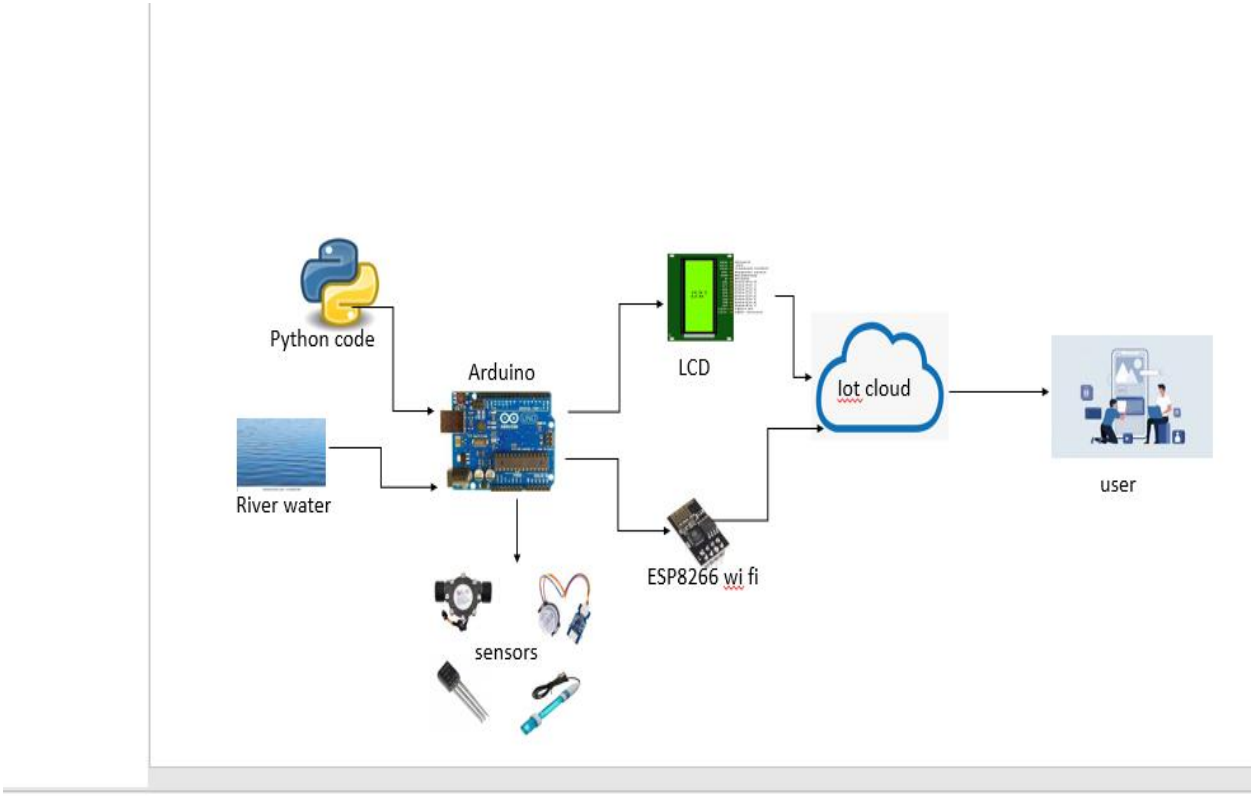
Fig:5.1.4.DFD-(level 1)

5.2 Solution & Technical Architecture:

5.2.1 Solution Architecture:

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

Example - Solution Architecture Diagram:



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
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2

		USN-4	**As a user, I can register for the application through G mail**	**–**	**Medium**	**Sprint-1**
	Login	**USN-5**	**As a user, I can log into the application by entering email & password**	**–**	**High**	**Sprint-1**
Customer (web user)	**notification**	**USN-6**	**As a user, when there is an abnormal situation with the water flow notification will be received on web application.**	**Alert message will be received if user is active in that web site**	**High**	**Sprint-1**

6. PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING AND ESTIMATION:

6.1.1 Product Backlog, Sprint Schedule, and Estimation:

create product backlog and sprint schedule.

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.	5	High	KARTHIGA.C

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint -1		USN-2	As a user, I will receive confirmation email once I have registered for the application	5	High	DHANAM.S
Sprint -2		USN-3	As a user, I can register for the application through Facebook	3	High	S.SOLAI NANDHINI
Sprint -3	Notification	UNS-6	When river water has dust particles it notify mobile app.	6	High	KARTHIGA.C

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint -4	Notification	USN-7	When river water is quality to use it notify to user	6	High	VINMATHI.K
Sprint -1		USN-4	As a user, I can register for the application through Gmail	2	Mediu m	K.VINMATHI
Sprint -1	Login	USN-5	As a user, I can log into the application by entering email & password	3	High	SANGEETHA.S

6.2 Sprint Delivery Schedule:

6.2.1sprint 1:

6.2.1.1 simulation:

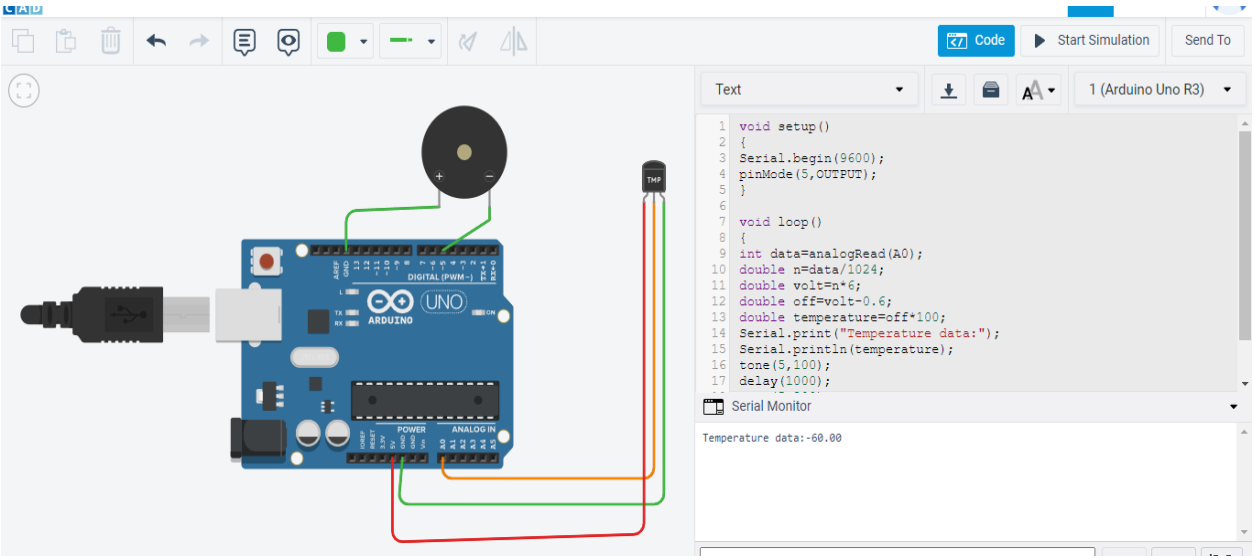


Fig:6.2.1.1 simulation:

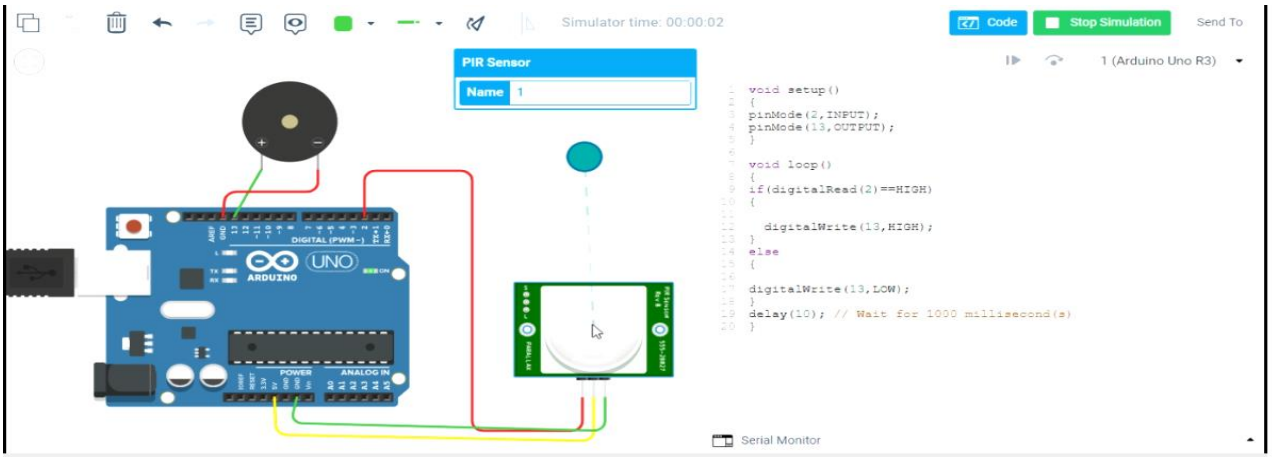


Fig:6.2.1.2 simulation:

6.3 Reports from JIRA:

6.3.1 Roadmap

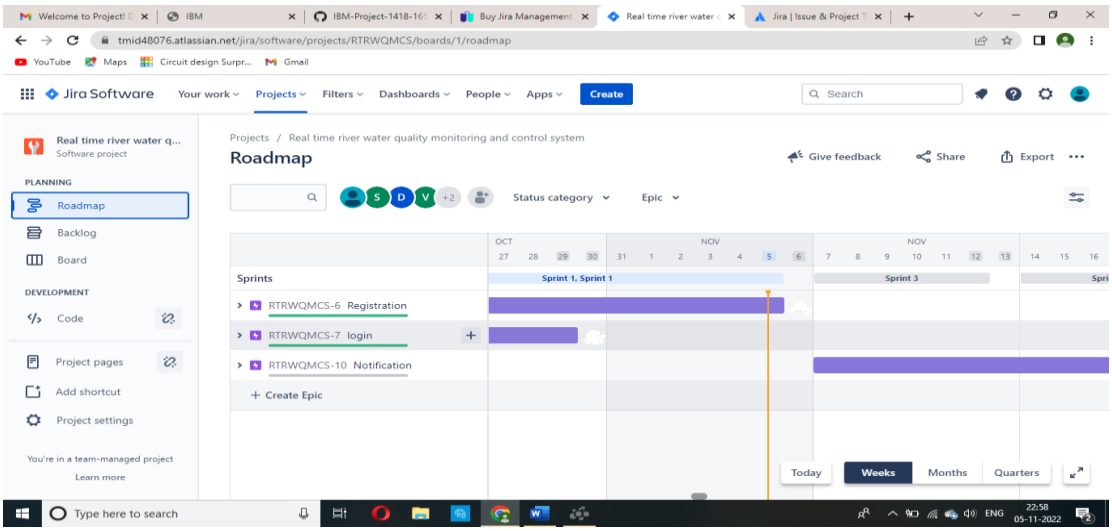


Fig:6.3.1 Roadmap

6.3.2 Sprint delivery chart using Jira software tools:

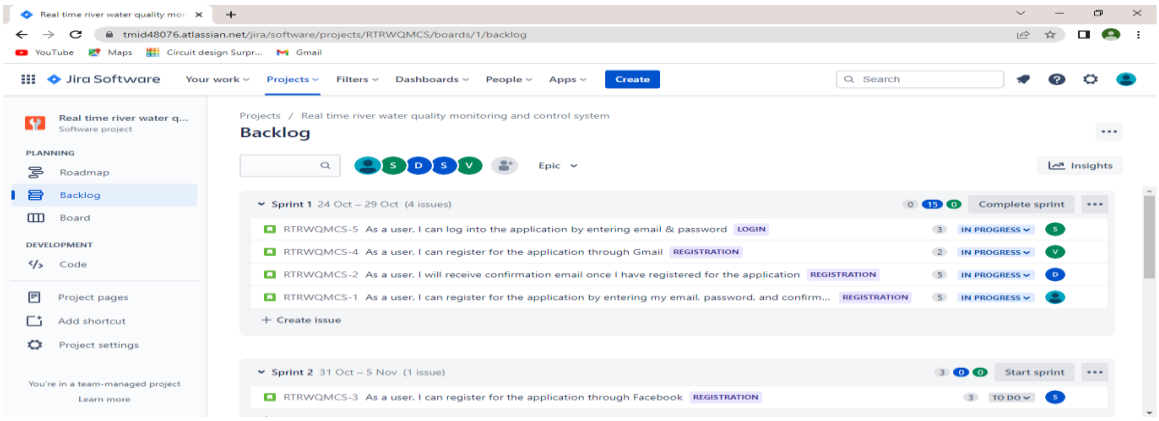
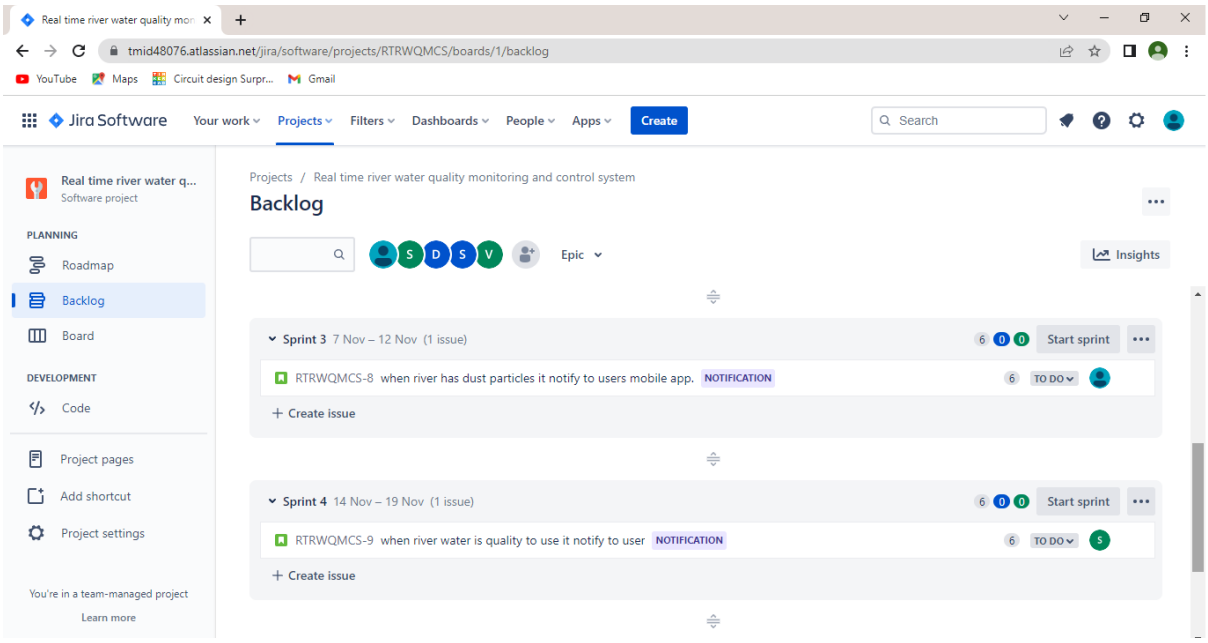
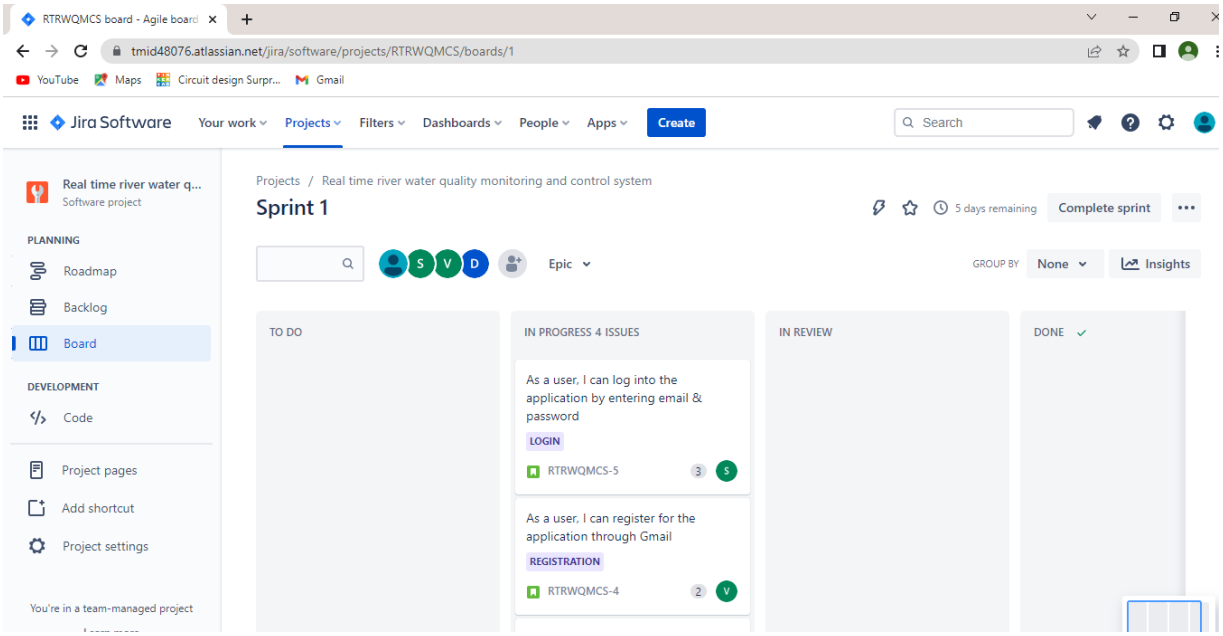


Fig::6.3.2 Sprint delivery chart using Jira software tools:





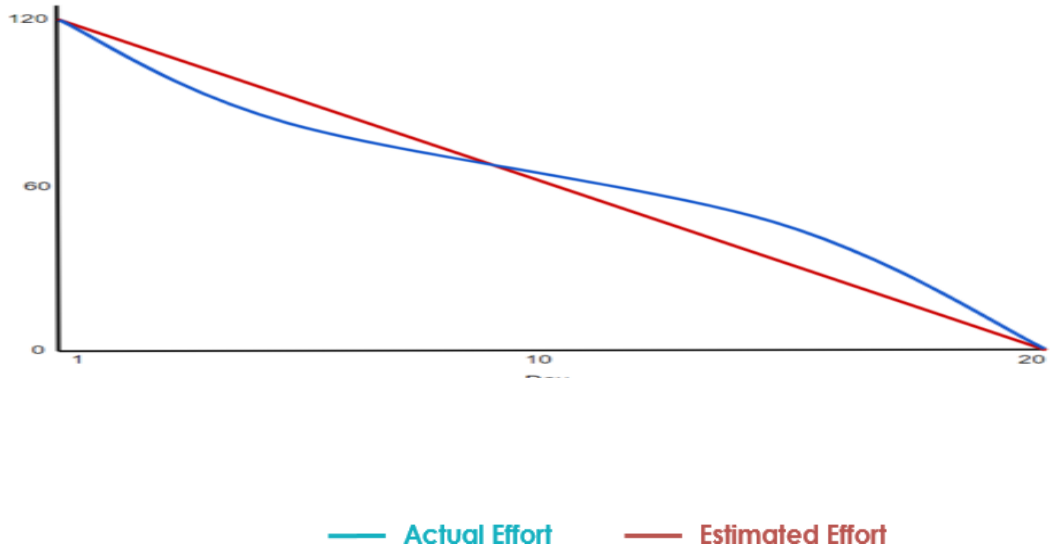
6.3.3 Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

6.3.4 Burndown Chart:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.



7.CODING

7..1 Coding for sprint 1:

```
<html>
<head>

<form action="action_page.php" method="post">
<form>
<div class="container">
<h1>Register Here</h1>
<p>Please fill in the details to create an account with us.</p>
<hr><div>
<label for="id"><b>device id</b></label>
<input type="text" placeholder="device id" name="id"></div>
<div>
<label for="email"><b>Enter Email</b></label>
<input type="text" placeholder="Enter Email" name="email"></div>
<div>
<label for="pwd"><b>Password</b></label>
<input type="password" placeholder="Enter Password" name="pwd"></div>
<div>
<label for="confirm"><b>Confirm Password</b></label>
<input type="password" placeholder="Confirm Password"
name="confirm"></div>
<hr>
<p>By creating an account you agree to our <a href="#">Terms &
Privacy</a>.</p>
<button type="submit" class="registerbtn"><strong>Register</strong></button>
</div>
<div class="container signin">
```

```
<p>Already have an account? <a href="#">Sign in</a>.</p>
</div>
</form><style></head>
body {
background-color: lightblue;

}
</style>
<style> div {

background-color: lightblue;
padding-top: 30px;
padding-right: 30px;
padding-bottom: 50px;
padding-left: 80px;
position:center;
align-content: center;
}
</style></html>
```

7.2 FEATURES:

7.2.1 Features of Arduino:

- Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software.
- It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments.

Or more simply, you load on some code and it can read sensors , perform actions based on inputs from buttons, control motor sand accept shields to further expand it capabilities. Really, you can do almost anything.

- All Arduino boards have one thing in common: they are programmed throu
- the Arduino IDE. This is the software that allows you to write and upload code.
- Beyond that, there can be a lot of differences. The number of inputs and o
- (how many sensors, LEDs, and buttons you can use on a single board),
- operating voltage, and form factor are just a few of the variables.
- Some boards are designed to be embedded and have no programming
- (hardware) which you would need to buy separately. Some can run directly fr
- a 3.7V battery, others need at least 5V.

7.2.2 Features of temperature and PH sensor:

- To measure the temperature of a water tank and log it via the Arduino. The idea is to maintain the temperature of the water at 25-30C at all times.
- I' ve noticed that most applications have used a sensor such as DS18S20 orTMP35/TMP36/TMP37.
- But since my application requires to measure the temperature in water, I think a more suitable sensor should have a waterproof probe (or external probe).
- The usual way is to contain the water inside a tank / container which can transmit heat - usually metal. To the outside of this is then bonded ttemperature sensor - be that a simple bi-metallic strip thermostat, or a more complex temperature sensing transducer.
- Of course, this requires a metal tank, and that will radiate heat, which will be wasteful. Ideally you would want some form of waterproof probe.

7.2.3 Features of the turbidity Sensor:

Turbidity is an indicator often used to find the amount of suspended sediment in water.

By cumbersome mechanical If there is any abnormal conditions are found in water buzzer will get alarm sound and lcd monitor will display water PH temperature, turbidity water level in tanks.

7.2.4 Features of the Conductivity Sensor:

- A conductivity sensor measures the ability of a solution to conduct an electrical current.
- It is the presence of ions in a solution that allow the solution to be conductive: the greater the concentration of ions, the greater the conductivity.
- Conductivity is the measurement of the solution or substance's ability to carry or conduct an electric current.
- Conductivity sensors are used to measure conductivity in aqueous solutions to determine the purity or impurity of a liquid.

7.2.5 Features of the Humidity Sensor:

- A humidity sensor (or hygrometer) senses, measures and reports both moisture and air temperature.
- The ratio of moisture in the air to the highest amount of moisture at a particular air temperature is called relative humidity.

- The humidity sensor is a device that senses, measures, and reports the relative humidity (RH) of air or determines the amount of water vapor present in gas mixture (air) or pure gas.
- Humidity sensing is related to a water adsorption and desorption process.

Coding for sprint 2:

LOGIN FOLDER:

app.py

```
from flask import Flask, render_template, request, redirect, url_for, session
from flask_mysqldb import MySQL
import MySQLdb.cursors
import re
app = Flask(__name__)
app.secret_key = 'your secret key'
app.config['MYSQL_HOST'] = 'localhost'
app.config['MYSQL_USER'] = 'root'
app.config['MYSQL_PASSWORD'] = 'your password'
app.config['MYSQL_DB'] = 'geeklogin'
mysql = MySQL(app)
@app.route('/')
@app.route('/login', methods =['GET', 'POST'])
def login():
    msg = ''
    if request.method == 'POST' and 'username' in request.form and 'password' in
request.form:
        username = request.form['username']
        password = request.form['password']
```

```
        cursor = mysql.connection.cursor(MySQLdb.cursors.DictCursor)
        cursor.execute('SELECT * FROM accounts WHERE username = % s AND
password = % s', (username, password, ))
        account = cursor.fetchone()
        if account:
            session['loggedin'] = True
            session['id'] = account['id']
            session['username'] = account['username']
            msg = 'Logged in successfully !'
            return render_template('index.html', msg = msg)
        else:
            msg = 'Incorrect username / password !'
    return render_template('login.html', msg = msg)
 @app.route('/logout')
def logout():
    session.pop('loggedin', None)
    session.pop('id', None)
    session.pop('username', None)
    return redirect(url_for('login'))
 @app.route('/register', methods =['GET', 'POST'])
def register():
    msg = ''
    if request.method == 'POST' and 'username' in request.form and 'password' in
request.form and 'email' in request.form :
        username = request.form['username']
        password = request.form['password']
email = request.form['email']
cursor = mysql.connection.cursor(MySQLdb.cursors.DictCursor)
```

```
cursor.execute('SELECT * FROM accounts WHERE username = % s', (username,
))
account = cursor.fetchone()
if account:
msg = 'Account already exists !'
elif not re.match(r'[^@]+@[^@]+\.[^@]+', email):
msg = 'Invalid email address !'
elif not re.match(r'[A-Za-z0-9]+', username):
msg = 'Username must contain only characters and numbers !'
elif not username or not password or not email:
msg = 'Please fill out the form !'
else:
cursor.execute('INSERT INTO accounts VALUES (NULL, % s, % s, % s)',
(username, password, email, ))
mysql.connection.commit()
msg = 'You have successfully registered !'
elif request.method == 'POST':
msg = 'Please fill out the form !'
return render_template('register.html', msg = msg)
```

index.html

```
<html>
<head>
<meta charset="UTF-8">
<title> Index </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">Index</h1>
</div></br></br></br>
<h1 class="bottom">
Hi {{session.username}}!!</br></br> Welcome to the index page...
</h1></br></br></br>
<a href="{{ url_for('logout') }}" class="btn">Logout</a>
</div>
</div>
</body>
</html>
```

Login.html

```
<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;
}
```

8.TESTING

8. Acceptance Testing

8.1.1UAT Execution & Report Submission

1.Purpose of Document

The User Acceptance Test represents the **final step** in the development of a web, mobile or software application.During UATs, the end users (in this case the testers) are required to test the software tool that has been developed, in order to validate whether it's able to **meet the use objectives** for which it was initially designed.

3.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	7	0	1	6
Client Application	51	0	1	50
Security	2	0	0	2
Outsource Shipping	3	0	0	3
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	2	0	1	1

8.2.USER ACCEPTANCE TESTING:

UAT is vital in getting software ready for production. At this point in the development process, testing has gone through a series of phases, and the team has the following tests:

- **Unit (or component) testing**: Testing of individual modules, units of code, or software.
- **Smoke tests**: Tests to determine the stability of units or modules and their endurance.
- **Integration tests**: Tests of modules or components integrated into groups to verify that they function and communicate as a whole.
- **Regression tests**: Tests to verify that data and functionality haven't lapsed after changes are implemented.
- **Security tests**: Tests to expose potential vulnerabilities.
- **Performance tests**: Testing the stability and responsiveness of the software as a whole.
- **API testing**: Testing the software's function within its API framework.

Each test above is crucial, and the results of each verify functionality, integration, and communication while exposing faults and vulnerabilities.But even if all these tests are successful, it's still possible that the software doesn't fully meet the client or business requirements and criteria outlined in its conception. It also may not be as user-friendly as intended.This is where UAT plays a vital role. It ensures the software meets the business requirements and operates correctly in real-world circumstances by evaluating different situations.

Criteria and best practices for user acceptance testing:

Due to the costliness of UAT and the complexity of combining manual and automated testing in this phase, it's important to prepare ahead and develop a plan. What are the criteria for running user acceptance tests, and what are considered best practices for successful results?

Complete other test phases: Before initiating UAT, it's best to finish unit testing, integration testing, and system testing. Most faults and vulnerabilities should be resolved and eliminated at this point. The software should be fully functioning prior to end-user acceptance.

Identify your target audience: The most well-designed software or application may fall flat if it doesn't resonate with its target audience, so it's crucial to identify and study your market base.

Develop a test plan: Outline the objectives and scope of the user acceptance test and create a timeline. Good preparation is key in minimizing any obstacles and reducing UAT cycles.

Create scripted test cases: Identify scenarios you want to test and document them so that testers can work with scripted test cases. Having this information will make their feedback more useful for the development team. Include goals such as timelines and expectations.

Select testers: Even if in-house analysts are used for running UAT, it's advisable to include users from the target audience. Both sets of results will have their respective value to the team, but the actual users will give you a picture of the real-world acceptance of the software and its UI.

Test the environment: After selecting testers and providing them with credentials and access, test the environment to make sure it functions as intended. Failure to do this might result in frustration and negative feedback if functionality is less than adequate even before testing begins.

- **Determine protocols for reports and resolutions**: Establish a standarforreporting errors, bugs, and other test feedback. Determine priorities and documentation protocol. Communicate to team members and testers how reports will be handled and how new test cycles will be initiated.

  UAT test approach is defined

  Business users Who would be performing this testing are identified
- **Clearly define acceptance criteria**: Clearly defined goals and criteria will determine the effectiveness of the UAT and have a direct impact on the quality and marketability of the end product.

8.2.1. UAT INITIATION:

Environments are sorted out.

Test data requirements are identified

Required support from all other teams are discussed and support teams are identified.

UAT Test Initiation

- UAT test approach is defined
- Business users who would be performing this testing are identified
- Environments are sorted out
- Test Data requirements are identified
- Required support from all other teams are discussed and support team: identified

UAT Test Design

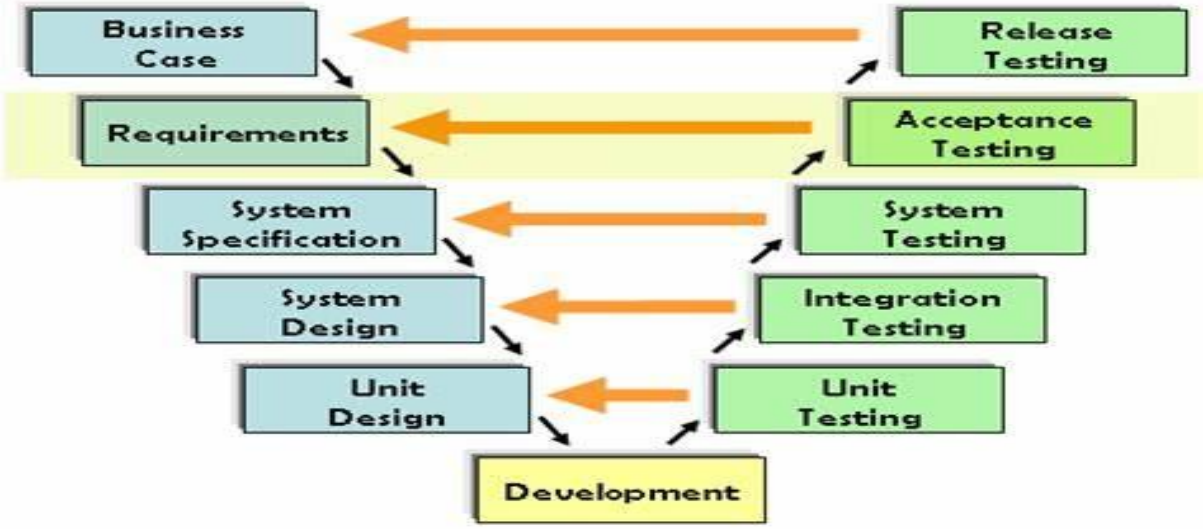
- Business Scenarios to be validated are identified and documented
- Relevant test Data is identified
- Scenarios are uploaded in the corresponding Management Tools
- Appropriate user accesses are requested and sorted out

UAT Test Execution

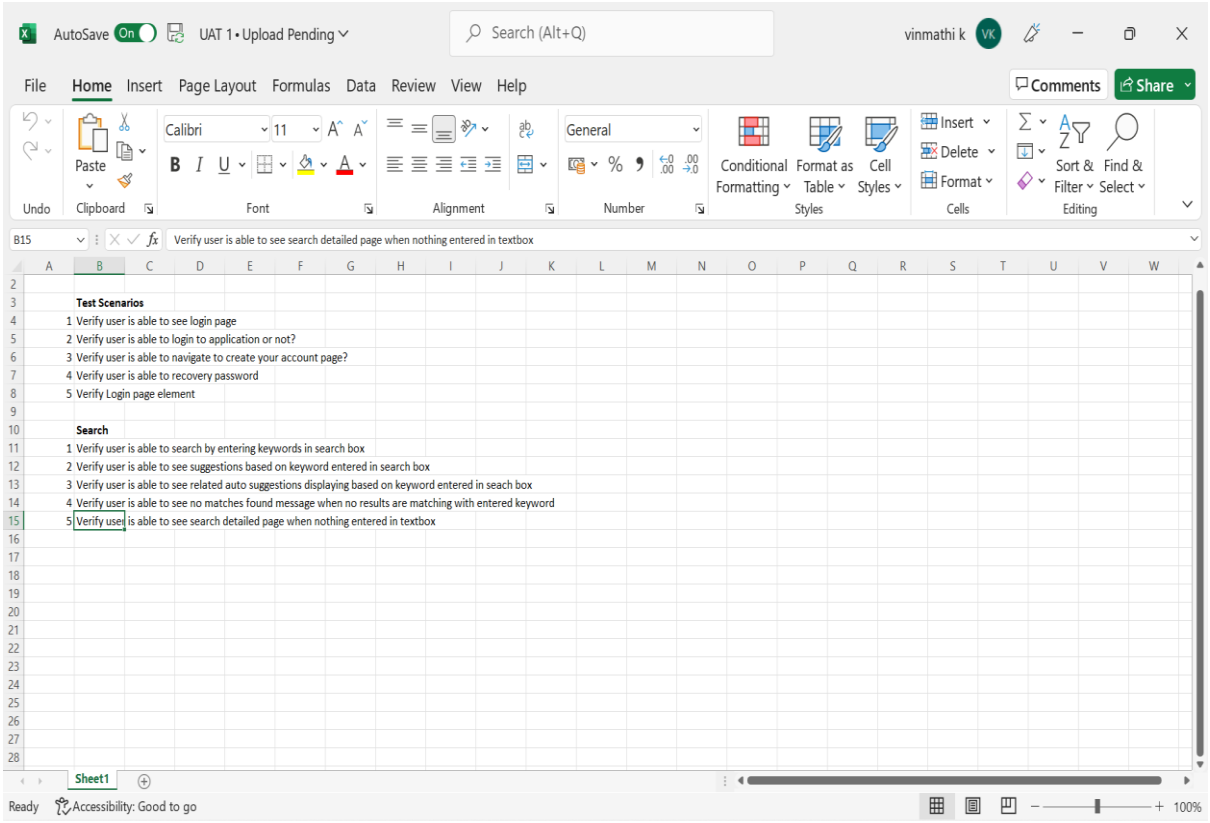
- Test Execution of the business scenarios are performed
- Appropriate defects are raised in the test management tool
- Defect Re-testing and Regression testing is performed

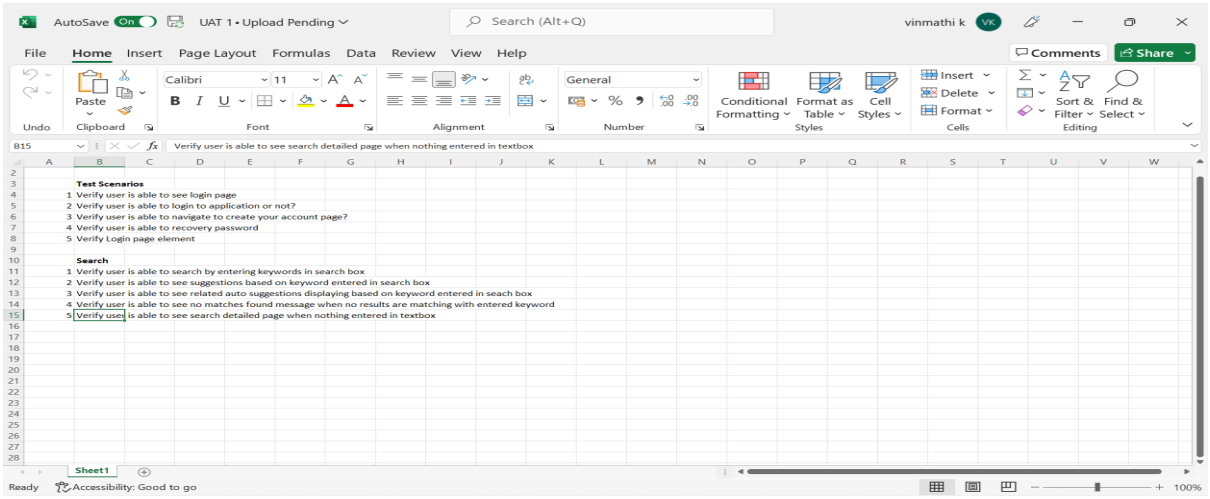
UAT Test Closure

- UAT closure report is produced
- Go/ No- Go decision is discussed and recommended

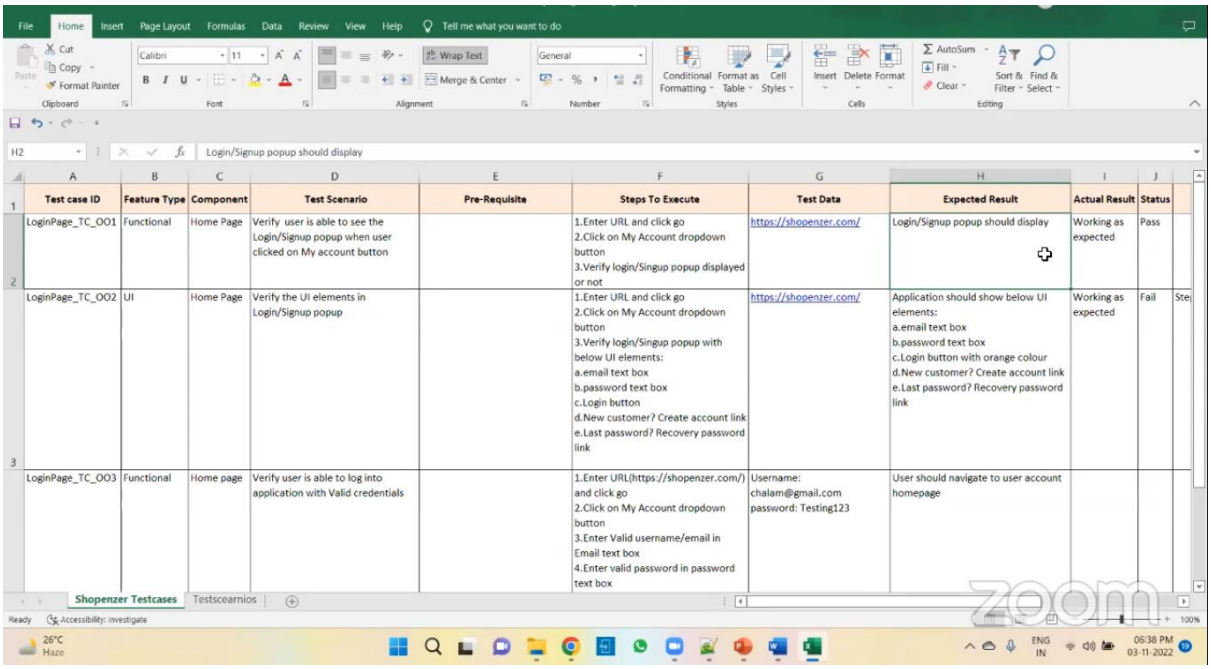


8.2.2 FLOW CHART OF UAT

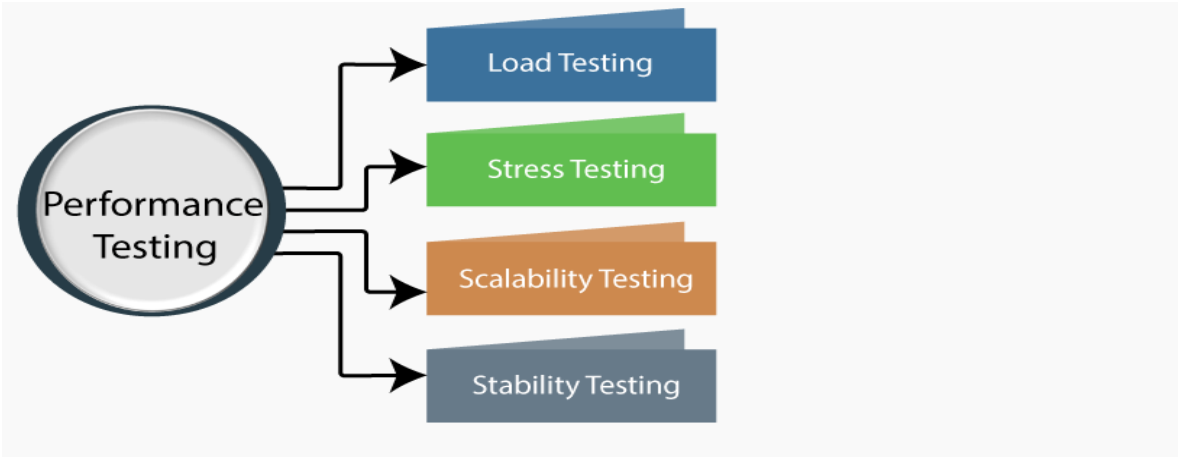




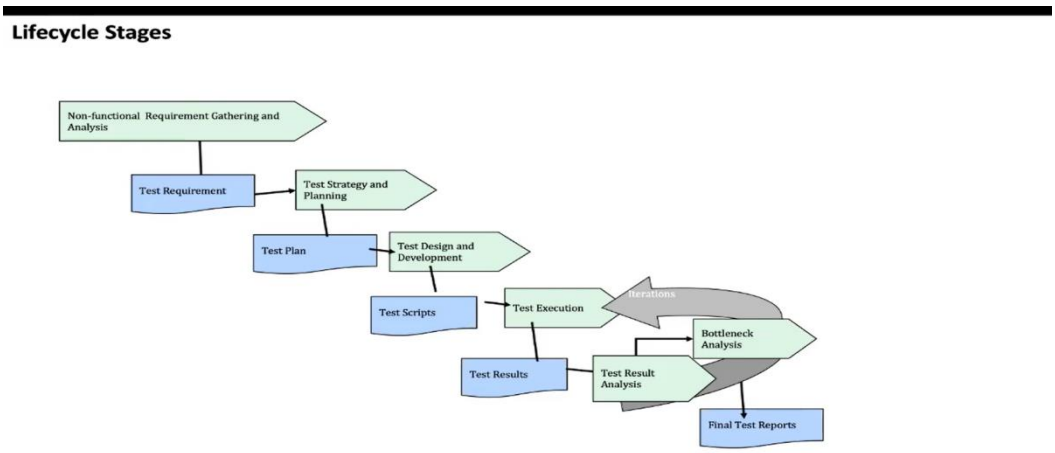
	Test Scenarios
1	Verify user is able to see login page
2	Verify user is able to login to application or not?
3	Verify user is able to navigate to create your account page?
4	Verify user is able to recovery password
5	Verify Login page element
	Search
1	Verify user is able to search by entering keywords in search box
2	Verify user is able to see suggestions based on keyword entered in search box
3	Verify user is able to see related auto suggestions displaying based on keyword entered in seach box
4	Verify user is able to see no matches found message when no results are matching with entered keyword
5	Verify user is able to see search detailed page when nothing entered in textbox



Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status
LoginPage_TC_001	Functional	Home Page	Verify user is able to see the Login/Signup popup when user clicked on My account button		1.Enter URL and click go 2.Click on My Account dropdown button 3.Verify login/Singup popup displayed or not	https://shopenzer.com/	Login/Signup popup should display	Working as expected	Pass
LoginPage_TC_002	UI	Home Page	Verify the UI elements in Login/Signup popup		1.Enter URL and click go 2.Click on My Account dropdown button 3.Verify login/Singup popup with below UI elements: a.email text box b.password text box c.Login button d.New customer? Create account link e.Last password? Recovery password link	https://shopenzer.com/	Application should show below UI elements: a.email text box b.password text box c.Login button with orange colour d.New customer? Create account link e.Last password? Recovery password link	Working as expected	Fail
LoginPage_TC_003	Functional	Home page	Verify user is able to log into application with Valid credentials		1.Enter URL(https://shopenzer.com/) and click go 2.Click on My Account dropdown button 3.Enter Valid username/email in Email text box 4.Enter valid password in password text box	Username: chalam@gmail.com password: Testing123	User should navigate to user account homepage		



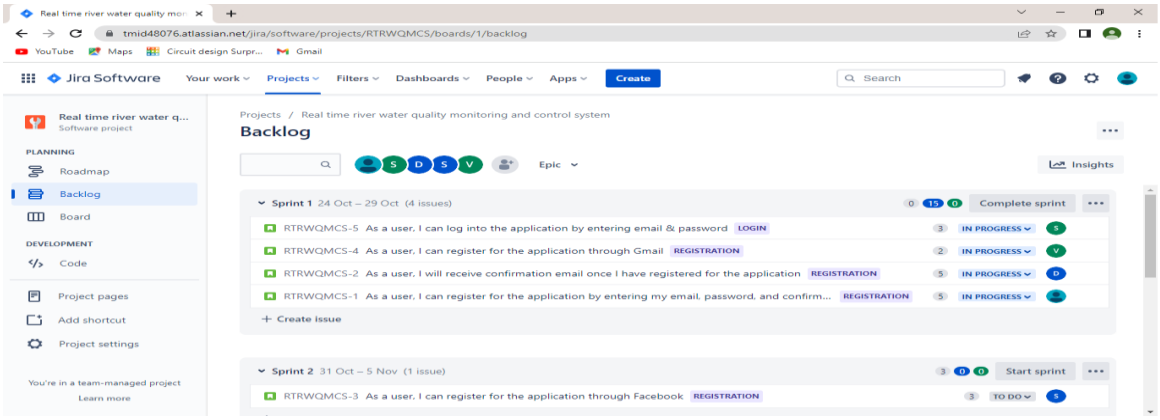
LIFE CYCLE STAGES:

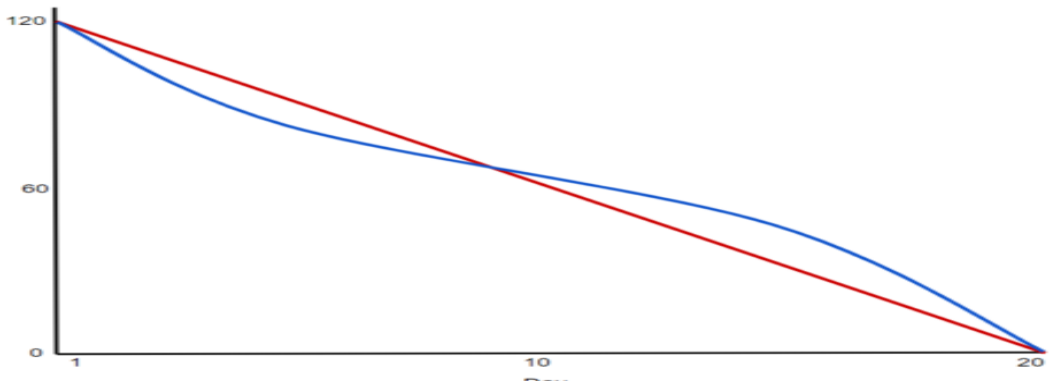


9. RESULTS

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 is shown in Figure

9.1.PERFORMANCE METRICS:





9.2.SCREEN SHOTS:

9.2.1 PYTHON EXECUTION:

Fig: 9.2.1. PYTHON EXECUTION

9.2.2 IBM WATSON:

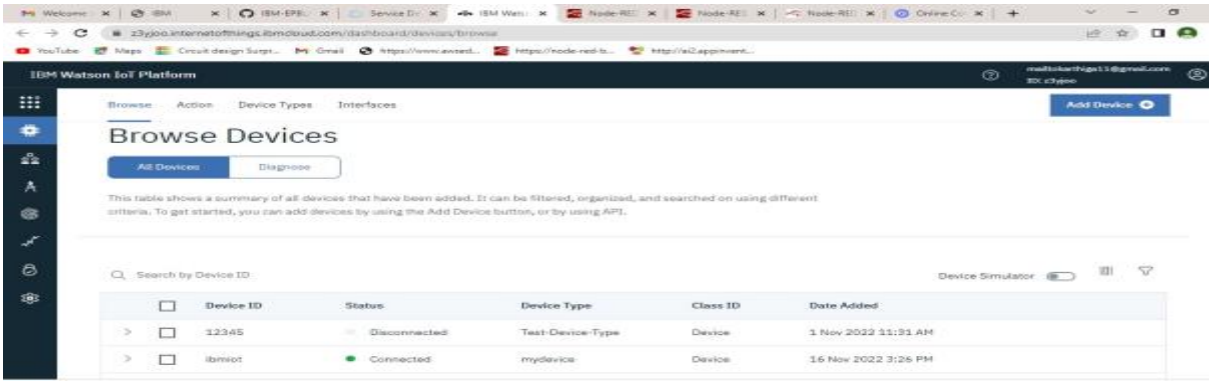


Fig: 9.2.2. IBM WATSON

9.2.3 IBM WATSON EXECUTION:

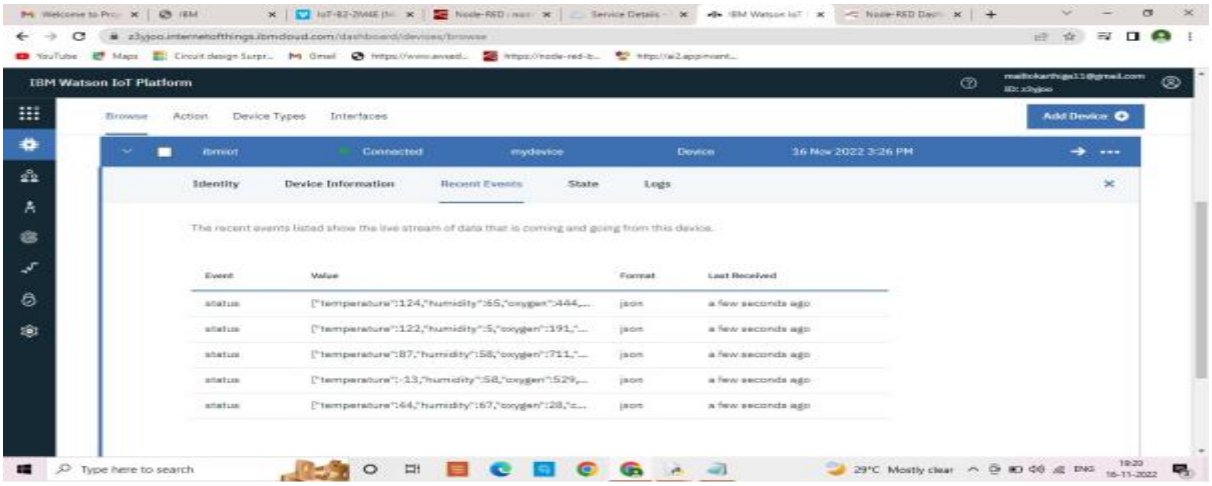


Fig: 9.2.3. IBM WATSON EXECUTION

9.2.4 NODE RED CONNECTION:

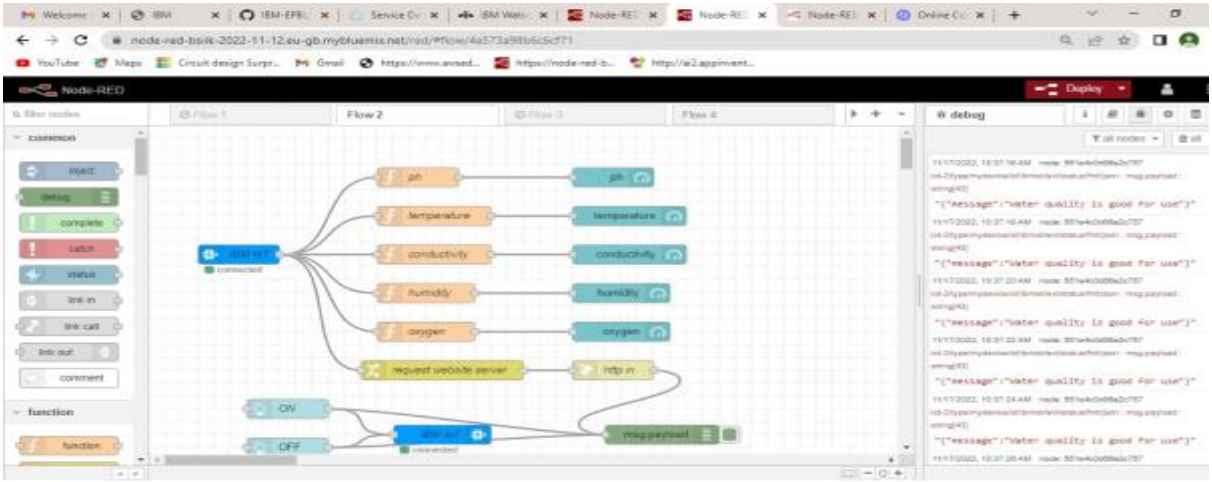


Fig: 9.2.4 NODE RED CONNECTION

9.2.5 NODE RED EXECUTION:

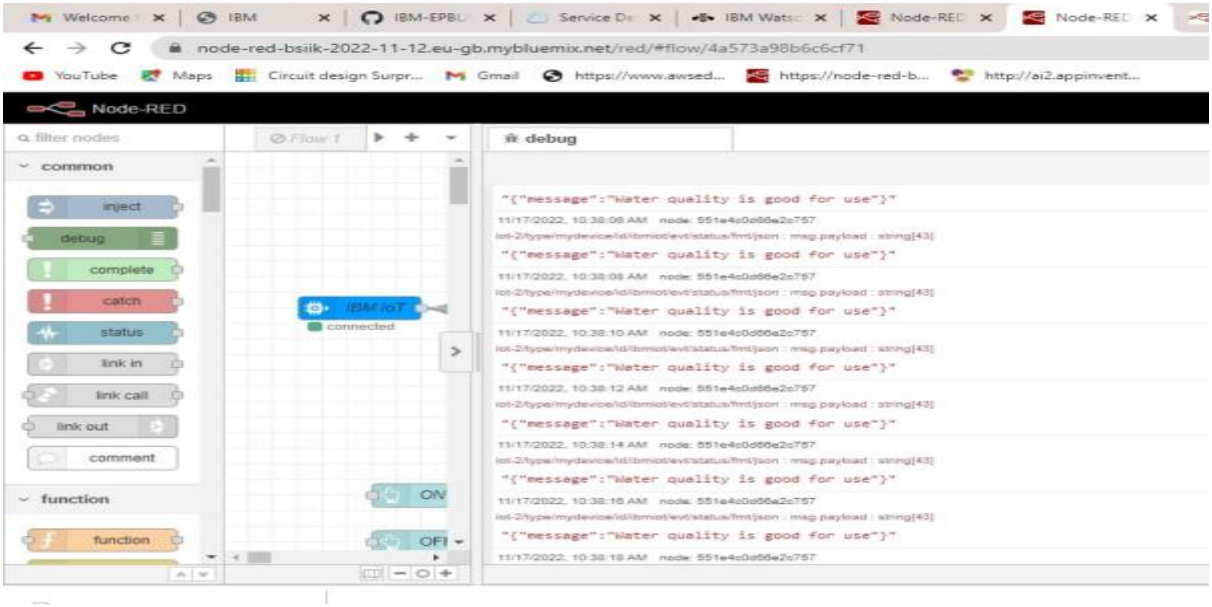


Fig: 9.1.5 NODE RED EXECUTION

9.2.6 WEB APPLICATION USING NODE-RED:

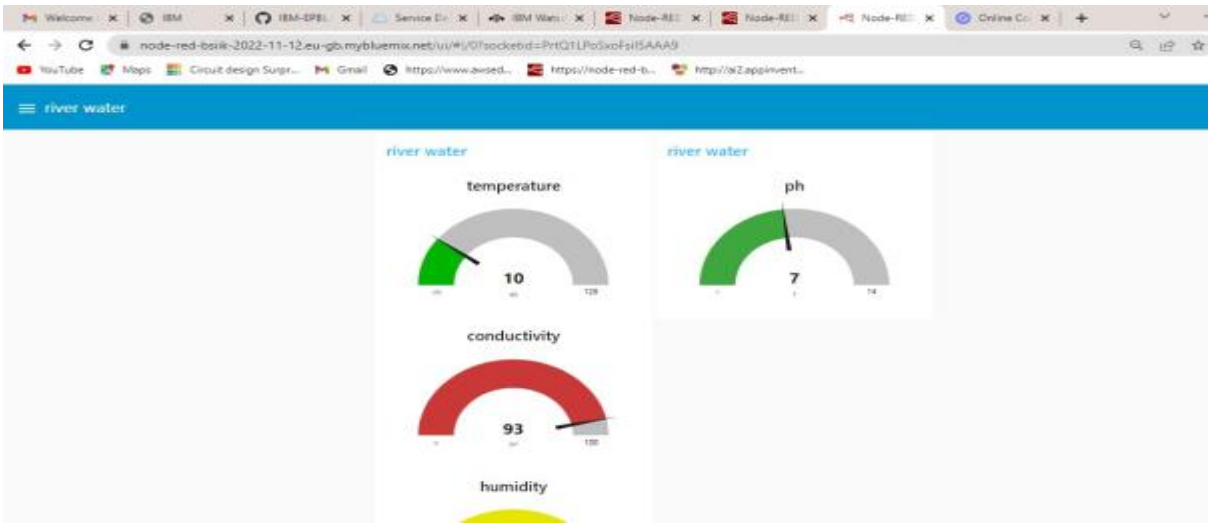


Fig: 9.2.6 WEB APPLICATION USING NODE-RED

9.2.7. MOBILE APP USING MIT APP INVENTOR:

Fig: 9.1.7 MOBILE APP USING MIT APP INVENTOR

9.1.7.2 MOBILE APP USING MIT APP INVENTOR:

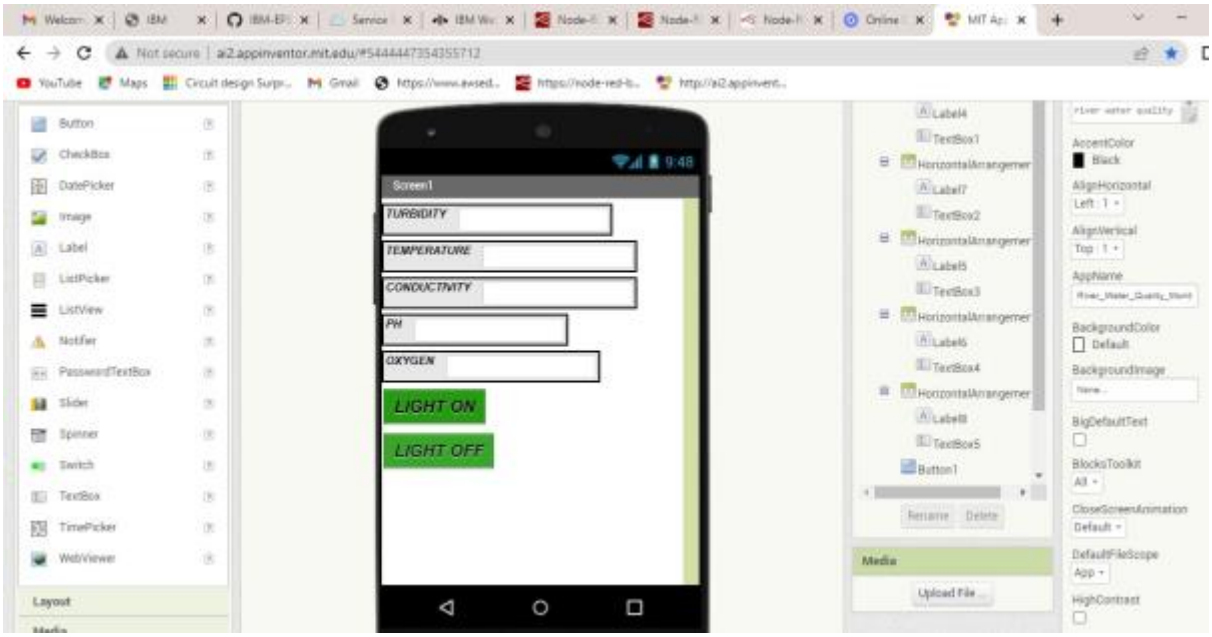


Fig: 9.2.7. MOBILE APP USING MIT APP INVENTOR

10. ADVANTAGES AND DISADVANTAGES

10.1 ADVANTAGES

- It can reduce the environment pollution.

- This system is based on wireless sensor.
- This system can monitor automatically.
- It can used for agricultural growth.

10.2 DISADVANTAGES

- Sensor cost is too high.
- Drinking chemical water leads to death.

11. CONCLUSION

The system was tested under different conditions and with different qualities of water. The output of the system was successful and in accordance with the research objectives. As mentioned, the sensor readings are obtained on an LCD screen on the device prototype itself. If there are any abnormal conditions are found in water buzzer will get alarm sound and LCD monitor will display water ph temperature, turbidity water level in tanks.

12. FUTURE SCOPE

In this work, the design and demonstration of a prototype remote, automatic, portable, real time, and low cost water quality monitoring system is described. In this system, low cost components i.e. microcontroller, LCD screen and other components are used to achieve the objectives of the proposed design with acceptable accuracy.

Compared to the previous related works, the cost of the system prototype is considerably low. To ensure the portability of the device, a self-made, small size Arduino microcontroller is used. The developed system was tested under different conditions, with solution of water with different impurities, and in different periods of time. The results of the test for all times have been successful. We conclude that all the objectives of the proposed system have

been achieved. To test more parameters of the water quality for some applications, other sensors can be included in the system. The system has wide application and it is usable and affordable by all categories of users.

13.APPENDIX

13.1DEMO LINK:

https://drive.google.com/file/d/1l5mJ85reR43sykuJNQoEFCNeqOYFteyC/view?usp=share_link

13.2GITGUB LINK:

https://github.com/IBM-EPBL/IBM-Project-1418-1658387135