

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

PROJECT REPORT - NALAIYATHIRAN

Submitted by

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Source Code

GitHub & Project Demo Link

ABBREVIATIONS

GSM	Global System for Mobile Communications
IoT	Internet of Things
WSN	Wireless Sensor Network
UAT	User Acceptance Testing
pH	potential of Hydrogen
NFR	Non Functional Requirement
DFD	Data Flow Diagram
DB	Data Base
TA	Technical Architecture

• INTRODUCTION

The need for effective and efficient monitoring, evaluation and control of water quality in residential area has become more demanding in this era of urbanization, pollution and population growth. Ensuring safe water supply of drinking water is big challenge for modern civilization. Traditional methods that rely on collecting water samples, testing and analyses in water laboratories are not only costly but also lack capability for real-time data capture, analyses and fast dissemination of information to relevant stakeholders for making timely and informed decisions. In the 21st century, there are lots of inventions, but at the same time there are pollutions, global warming and so on are being formed, because of this there is no safe drinking water for the world's pollution. Nowadays, maintaining pure supply of water to the people is getting more challenging day by day. In India mainly in big cities the municipality corporation use lots of chemical to purify the river water then supply that to the people. And we reserved that water without any test. And we also don't know the water is either safe for drinking or not. And now a day's water quality monitoring in real time faces challenges because of global warming limited water resources, growing population, etc. Hence there is need of developing better methodologies to monitor the water quality parameters in real time. The water parameters pH measures the concentration of hydrogen ions. It shows the water is acidic or alkaline. Pure water has 7 pH value, less than 7pH has acidic, more than 7pH has alkaline. The range of pH is 0-14pH. For drinking purpose it should be 6.5-8.5pH.

Turbidity measures the large number of suspended particles in water that is invisible. Higher the turbidity higher the risk of diarrhea, cholera. Lower the turbidity then the water is clean. Temperature sensor measures how the water is, hot or cold. Here in this paper we tried to find the problem and then make a solution for it. Water is a scarce but essential natural resource for humans, animals, and plants.

- Approximately 5-10 million deaths due to water-related diseases are reported annually . However, of the available water on earth, approximately 97%, is saline, implying that freshwater only comprises 3%.
- Furthermore, 68.75% of freshwater is stored in the form of glaciers and icecaps, whereas 30.1% is groundwater and 0.3% is surface water .
- As of 2013, only 2.6 billion people had access to improved water quality standard .

- The quality of water determines whether it is a source of life and good health or death and diseases. It is affected by increasing environmental degradation due to various sources of pollution, including sewage discharge, effluents from industries, and runoff from agricultural and urban setups.
- Floods, drought, and lack of awareness are also significant contributors to water pollution .
- Developing countries such as the Republic of Iraq suffer significantly from water pollution, as evidenced by the number of reported deaths and cases due to water-related diseases .

- **Project Overview**

The parameters monitored in the proposed system are described below.

- **Potential of Hydrogen (pH):** pH is a measure of the acidity or alkalinity of a solution, which is usually determined by the concentration of hydrogen ions (H^+). Drinking alkaline water poses no health risks but can cause discomfort such as alkaline taste in the mouth, which makes coffee taste bitter and results in lime scale that lowers the efficiency of electric water heaters.
- **Temperature:** Temperature regulates the metabolism of an aquatic system. Death of aquatic life occurs due to high temperatures as water cannot hold dissolved gases such as oxygen at such temperatures.
- **Turbidity:** Turbidity indicates the extent to which water loses its transparency due to the presence of suspended particles. The higher the concentration of particles, the higher the turbidity.

The system affords following features.

- High usability
- Remote monitoring of water stations
- Real-time operation
- Ability to send warning SMS
- Generating reports on water quality over different durations. The project has been developed with the use of **IBM IOT Watson** platform through which the random values are obtained.

The design flow is developed with the help of **Node –RED**. The web application is developed with **MIT app inventor**.

The data obtained are stored in the cloudant DB (Database).

- **Purpose**

Monitoring water quality is very important for maintaining ecosystem health and the livelihood of the population. It reflects the health of surface water bodies as a snapshot in time (weeks, months, and years). Therefore, best practices and efforts are needed to monitor and improve water quality. As water plays a very important role in the well being of all the organism. It is mandatory for the intake of quality water .Here the water quality monitoring system plays a vital role .Due to the rapid growth of industries and various technologies ,the environment is polluted worsely affected. The pollution is occurred in various forms such land,water,noise etc.The effects of pollution are hazardous.The real time river water quality system focuses on the regular monitoring of river water and the control of polluted water supply .The project therefore reduces the risk of increasing water borne diseases and improves the quality of life.

- **LITERATURE SURVEY**

A literature review is a comprehensive summary of previous research on a topic. The literature review surveys scholarly articles, books, and other sources relevant to a particular area of research. The review should enumerate, describe, summarize, objectively evaluate and clarify this previous research. It should give a theoretical base for the research and help you (the author) determine the nature of your research.

The literature review acknowledges the work of previous researchers, and in so doing, assures the reader that your work has been well conceived. It is assumed that by mentioning a previous work in the field of study, that the author has read and evaluated.

- **Existing problem**

Due to the fast growing urbanization supply of safe drinking water is a challenge for the every city authority. Water can be polluted any time. So the water we reserved in the water tank at our roof top or basement in our society or apartment may not be safe. Still in India most of the people use simple water purifier that is not enough to get surety of pure water. Sometimes the water has dangerous particles or chemical mixed and general purpose water purifier cannot purify that. And it's impossible to check the quality of water manually in every time. So an automatic real-time monitoring system is required to monitor the health of the water reserved in our water tank of the society or apartment. So it can warn us automatically if there is any problem with the reserved water. And we can check the quality of the water anytime and from anywhere.

- Water is a finite resource that is necessary for agriculture, industry and the survival of all living things on the planet, including humans.
- Many people are unaware of the need of drinking adequate amounts of water on a daily basis. Many unregulated methods waste more water.
- Poor water allocation, inefficient consumption, lack of competent and integrated water management are all factors that contribute to this problem.

- **References**

- **Vaishnavi V. Daigavane and Dr. M.A Gaikwad** entitled “Water Quality Monitoring System Based on IOT” Published in 2017 Advances in Wireless and Mobile Communications. ISSN 0973-6972 Volume 10, Number 5 (2017), pp. 1107-1116 © Research India Publications. This paper highlights Monitoring of Turbidity, PH & Temperature of Water makes use of water detection sensor with unique advantage and existing GSM network. The system can monitor water quality automatically, and it is low in cost and does not require people on duty. By keeping the embedded devices in the environment for monitoring enables self protection (i.e., smart environment) to the environment. To implement this need to deploy the sensor devices in the environment for collecting the data and analysis. By deploying sensor devices in the environment, we can bring the environment into real life i.e. it can interact with other objects through the network. Then the collected data and analysis results will be available to the end user through the Wi-Fi.

- **Jyotirmaya Ijaradar and Subhasish Chatterjee** entitled “Real- Time Water Quality Monitoring System” published in the year 2018 International Research Journal of Engineering and Technology (IRJET). This paper highlights Monitoring of real time quality of Water from reserve tank of house and colony makes use of PH, turbidity and temperature sensor with Raspberry Pi and existing Cloud system for data analytics. The system can monitor water quality automatically, triggers alarms immediately to prevent any health hazards and it is low in cost and does not require people on duty.

- **Mohammad Salah Uddin Chowdurya, Talha Bin Emranb , Subhasish Ghosha , Abhijit Pathaka , Mohd. Manjur Alama , Nurul Absara , Karl Anderssonc , Mohammad Shahadat Hossaind** entitled “IoT Based Real-time River Water Quality Monitoring System” published in the year 2019 at The 16th International Conference on

Mobile Systems and Pervasive Computing (MobiSPC) August 19-21, 2019, Halifax, Canada. This paper highlights Real-time monitoring of water quality by using IoT integrated Big Data Analytics will immensely help people to become conscious against using contaminated water as well as to stop polluting the water. The research is conducted focusing on monitoring river water quality in real-time. Therefore, IoT integrated big data analytics is appeared to be a better solution as reliability, scalability, speed, and persistence can be provided. During the project development phase an intense comparative analysis of real-time analytics technologies such as Spark streaming analysis through Spark MLlib, Deep learning neural network models, and Belief Rule Based (BRB) system will be conducted [20- 27].

- **ALI J. RAMADHAN** entitled “SMART WATER-QUALITY MONITORING SYSTEM BASED ON ENABLED REAL-TIME INTERNET OF THINGS” published in the year 2020 Journal of Engineering Science and Technology Vol. 15, No. 6 (2020) 3514 - 3527 © School of Engineering, Taylor’s University. The paper highlights smart electronic system to monitor the quality of water supplied to people in Najaf, Republic of Iraq. Characteristics of the proposed system include remote monitoring capabilities supported by WSN and IoT along with a more efficient system architecture compared to similar systems owing to its use of ten sensors to monitor water quality at five stations. The proposed system measures values of ten parameters pertaining to water quality and can issue timely warnings in the form of SMS and e-mails to responsible authorities to ensure appropriate action.

- **Bhoomika R , Netra Jalagar , Pooja F B , Sangeetha Sontera , & Shanthveeresh N S(Asst., Professor)** entitled “IOT Based Real-Time River Water Quality Monitoring System” published in the year 2021

.The paper highlights Water turbidity, PH, and temperature are monitored using a water detection sensor that has a unique advantage and is already connected to a GSM network. The technology can automatically monitor water quality, is low-cost, and does not require personnel to be on duty. As a result, water quality testing will most likely be more cost-effective, convenient, and quick. This system may be used to monitor different water quality metrics by simply replacing the matching sensors and modifying the required software packages

- **Nikhil Kedia**, Water Quality Monitoring for Rural Areas- A Sensor Cloud Based Economical Project, in 1st International Conference on Next Generation Computing Technologies (NGCT-2015) Dehradun, India, 4-5 September 2015. 978-1-4673-6809-4/15/\$31.00 ©2015 IEEE

- **Jayti Bhatt, Jignesh Patoliya**, Iot Based Water Quality Monitoring System, IRFIC, 21feb,2016.

- **Michal lom, ondrej priby & miroslav svitek**, Internet 4.0 as a part of smart cities, 978-1-5090-1116-2/16/\$31.00 ©2016 IEEE

- **Zhanwei Sun, Chi Harold Liu, Chatschik Bisdikia_, Joel W. Branch and Bo Yang**, 2012 9th Annual IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks

- **Problem Statement Definition**

Water is a finite resource that is necessary for agriculture, industry and the survival of all living things on the planet, including humans. Many people are unaware of the need of drinking adequate amounts of water on a daily basis. Many unregulated methods waste more water. Poor water allocation, inefficient consumption, lack of competent and integrated water management are all factors that contribute to this problem. Therefore, efficient use and water monitoring are potential constraint for home or office water management system. Due to the fast growing urbanization supply of safe drinking water is a challenge for the every city authority. Water can be polluted any time. So the water we reserved in the water tank at our roof top or basement in our society or apartment may not be safe. Still in India most of the people use simple water purifier that is not enough to get surety of pure water. Sometimes the water has dangerous particles or chemical mixed and general purpose water purifier cannot purify that. And it's impossible to check the quality of water manually in every time. So an automatic real-time monitoring system is required to monitor the health of the water reserved in our water tank of the society or apartment.

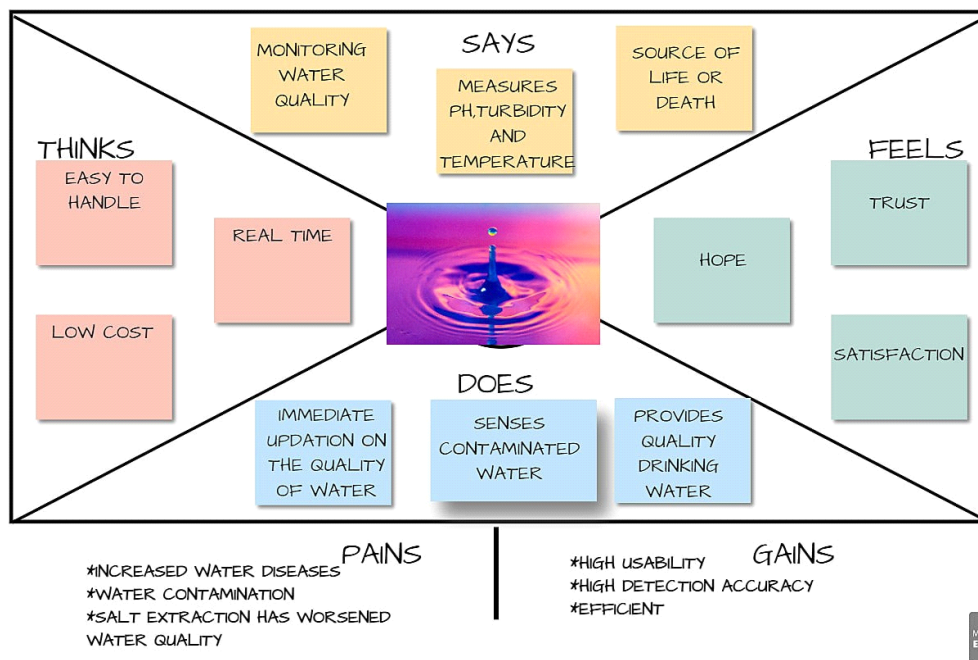
- **IDEATION & PROPOSED SOLUTION**

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 provided by the Implementation agency in response to the requirements and the objectives of the Project.

- **Empathy Map Canvas**

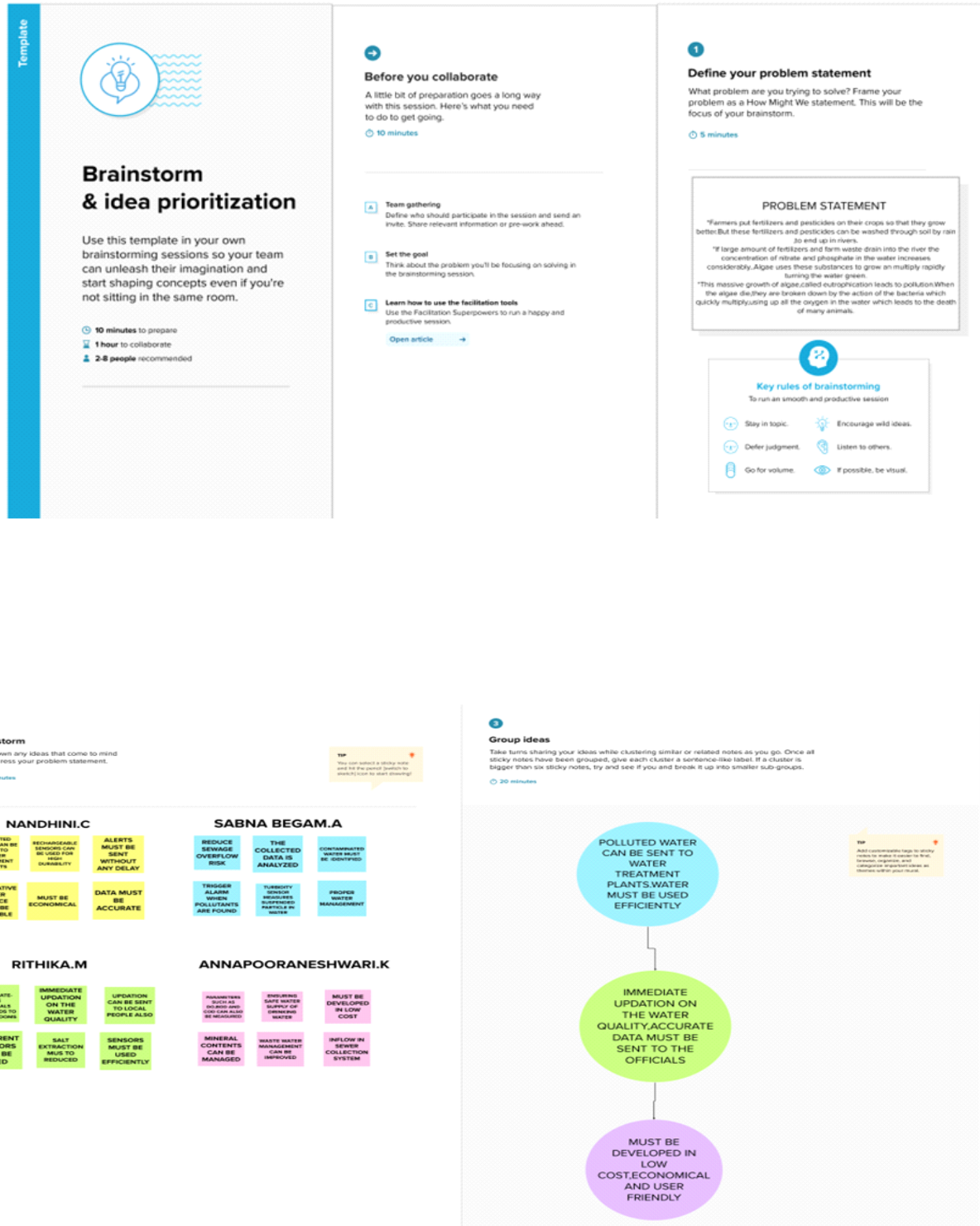
An empathy map helps to map what a design team knows about the potential audience. This tool helps to understand the reason behind some actions a user takes deeply. This tool helps build Empathy towards users and helps design teams shift focus from the product to the users who are going to use the product. The empathy map template which we have used has four sections namely Says, feels, Thinks, Does. It also includes the user pains and gains. The opinion of all our team members has been recorded in this template.

REAL-TIME RIVER WATER QUALITY MONITORING SYSTEM



- **Ideation & Brainstorming**

Brainstorming is a group problem-solving method that involves the spontaneous contribution of creative ideas and solutions. This technique requires intensive, freewheeling discussion in which every member of the group is encouraged to think aloud and suggest as many ideas as possible based on their diverse knowledge

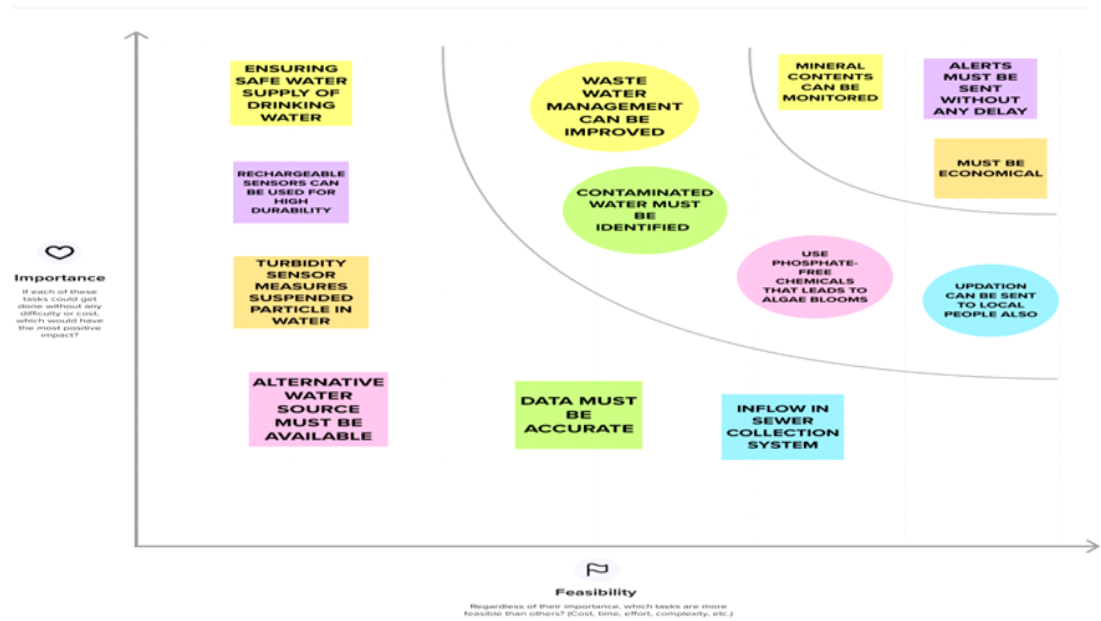


4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

⌚ 20 minutes



- The ideas that hit our mind by defining the problem statement was discussed within our team.
- The brainstorming session was held at our college by our faculty mentor.
- The ideas were entered in the template provided and prioritized.

- **Proposed Solution**

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

S:No	Parameter	Description
1.	Problem Statement (Problem to be solved)	The pollution of water Resource is a major threats to human life. Some chemical are present in water causes diseases to human and animals.
2.	Idea / Solution description	Polluted water can be sent to water treatment plant .Real time data access can be done by using remote monitoring and IOT technology.
3.	Novelty / Uniqueness	Measuring the Temperature and PH meter of water. This technology can automatically monitor the water quality. Water detection sensor has a unique advantage.
4.	Social Impact / Customer Satisfaction	River pollution can impact all living beings. Better monitoring and control measure can impact vegetation, health. The system can control water quality automatically and does not require People on duty.
5.	Business Model (Revenue Model)	This method is very adaptable. As a result water quality testing will be more cost effective, convenient and quick.
6.	Scalability of the Solution	It uses cloud storage for security purpose and backup the data any time .So it is user friendly and easy to handle . Add new sensor to monitor other parameters also.

- The problem statement has been analysed detailly and the proposed solution has been designed considering the various factors to make the project much efficient.

- **Problem Solution fit**

The Problem-Solution Fit Canvas is a template to help identify solutions with higher chances of solution adoption, reduce time spent on testing and get a better overview of the current situation.

Problem-Solution Fit canvas

Define CS, fit into CL	1. CUSTOMER SEGMENT(S) CS *Quality checkers *River Water monitoring authorities	6. CUSTOMER LIMITATIONS CL <small>EG. BUDGET, DEVICES</small> * Wide biosphere *Difficult to collect water samples.	5. AVAILABLE SOLUTIONS AS <small>PLUSES & MINUSES</small> *The samples are collected and tested in Laboratories. Plus: Accurate measurements are made. Minus: It is a time consuming process.
	2. PROBLEMS / PAINS + ITS FREQUENCY PR *Excess use of fertilizers leads to pollution which in turn leads to the death of animals. *It also causes many diseases in human Beings.	9. PROBLEM ROOT / CAUSE RC *Excessive use of fertilizers and pesticides. *Pollution of water. *Eutrophication	7. BEHAVIOR + ITS INTENSITY BE *The authorities are responsible for the supply of quality water directly.
Focus on PR, tap into BE, understand RC	3. TRIGGERS TO ACT TR *To build a stable society	10. YOUR SOLUTION S * The river water can be monitor with the help of sensors. * Immediate updation can be sent to the authorities .	8. CHANNELS of BEHAVIOR CH ONLINE *The SMS updations are sent through wireless technology . OFFLINE *The sensor senses the temperature,turbidity and PH.
	4.EMOTIONS EM BEFORE- DISTRUST AFTER-SURENESS		
Identify strong TR & EA			

Based on the devised problem statement ,the pains, emotions, customer limitations, root cause, behavior and the behaviour has been captured.

- **REQUIREMENT ANALYSIS**

Requirements analysis, also called requirements engineering, is the process of determining user expectations for a new or modified product. These features, called requirements, must be quantifiable, relevant and detailed. In software engineering, such requirements are often called functional specifications.

- **Functional requirements**

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. These are the requirements that the end user specifically demands as basic facilities that the system should offer. All these functionalities need to be necessarily incorporated into the system as a part of the contract.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story/ Sub-Task)
FR-1	River watersensing	The sensing parameters are PH, Turbidity, temperature.
FR-2	Data collection	The accurate value of PH, Temperature, Turbidity are collected.
FR-3	Monitor	The collected data can be monitored by using quality monitoring system such as (python code).
FR-4	Control	The system control the utilization of degraded water.
FR-5	Data storage	The data can be stored by using cloudservice such as (IBM Watson, Nodered, Web UI)
FR-6	Intimation to Authority	The stored data can be send to Authority by using (FAST SMS).

The functional requirements are proper functioning of the sensor nodes, data collection and proper intimation of the water quality levels.

- **Non-Functional requirements**

Non-Functional Requirements are the constraints or the requirements imposed on the system. They specify the quality attribute of the software. Non-Functional Requirements deal with issues like scalability, maintainability, performance, portability, security, reliability, and many more. Non-Functional Requirements address vital issues of quality for software systems.

- Users, clients, and developers are unsatisfied.
- Inconsistent software.
- Time and cost overrun to fix the software which was prepared without keeping NFRs in mind.

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	To monitor the riverwater quality.
NFR-2	Security	This system uses cloud storage for security purpose and backup the data any time.
NFR-3	Reliability	The sensor sense the physical data and provide accurate data to the authority.
NFR-4	Performance	This system works in low powered and highly efficient.
NFR-5	Availability	The system is available for 24/7 for the regular supply of quality water.
NFR-6	Scalability	This project is scalable because it covers a particular zone.

Types of Non-functional Requirements :

- Scalability
- Reliability
- Regulatory
- Maintainability

These can be classified as :

- **Performance constraints** – Reliability, security, response time, etc.
- **Operating constraints** – These include physical constraints (size, weight), personnel availability, skill level considerations, system accessibility for maintenance, etc.
- **Interface constraints** – These describe how the system is to interface with its environment, users, and other systems. For example, user interfaces and their qualities (e.g., user-friendliness).
- **Economic constraints** – Immediate and/or long-term costs.
- **Lifecycle requirements** – Quality of the design: These measured in terms such as maintainability, enhance ability, portability.

- **PROJECT DESIGN**

Project design is an early phase of the project lifecycle where ideas, processes, resources, and deliverables are planned out. A project design comes before a project plan as it's a broad overview whereas a project plan includes more detailed information.

- A project design is a method of organizing ideas, materials, and processes in order to achieve a specific goal. Project managers rely on smart design to avoid mistakes and offer parameters to keep key components of the project, such as the Project Timeline and budget, on track.
- Some people make the mistake of rushing through the basic stages of a project, such as a Project Design. Any seasoned project

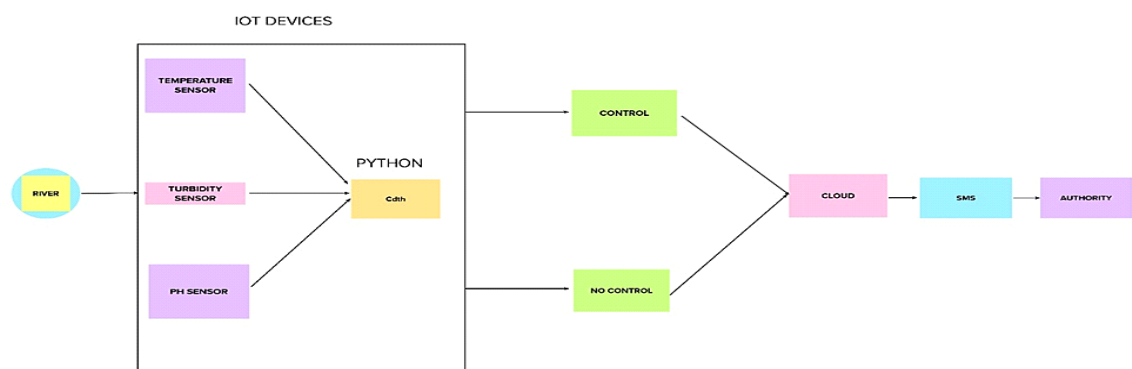
manager will tell you that the more effort you put into the front-end of a project, the better the backend results will be.

- One of the initial roles of the project manager is to design the project. Decisions regarding how to administer and govern the project are made at this point. A project plan is developed, focusing on the needs of the stakeholders, the organisation, and, of course, the project itself. This document will thereafter be used to oversee the project's remaining stages.

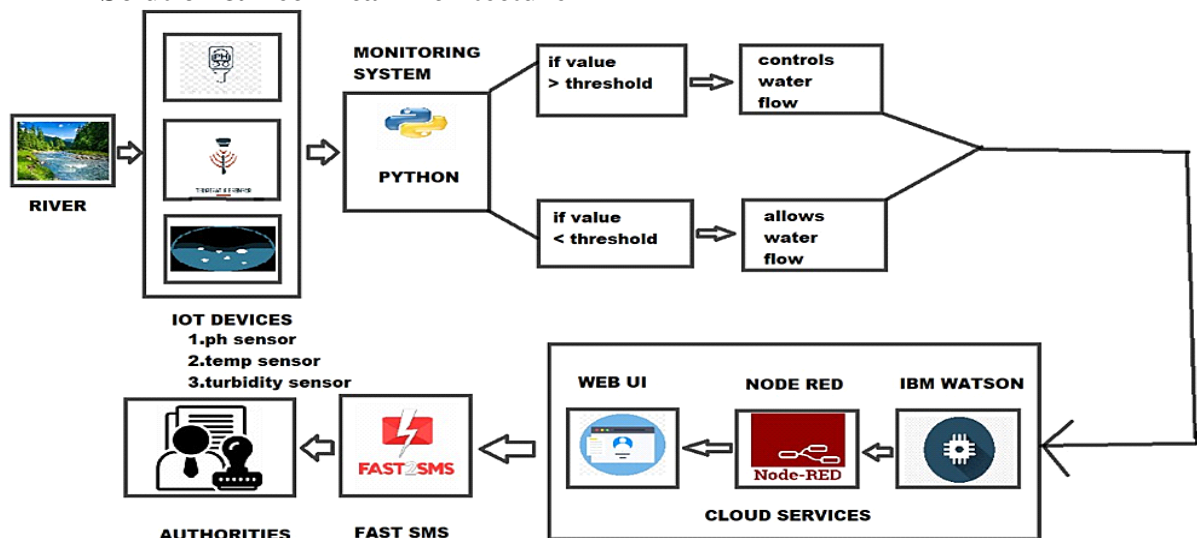
- **Data Flow Diagram**

DFD is the abbreviation for Data Flow Diagram. The flow of data of a system or a process is represented by DFD. It also gives insight into the inputs and outputs of each entity and the process itself. DFD does not have control flow and no loops or decision rules are present. Specific operations depending on the type of data can be explained by a flowchart. Data Flow Diagram can be represented in several ways. The DFD belongs to structured-analysis modeling tools. Data Flow diagrams are very popular because they help us to visualize the major steps and data involved in software-system processes.

Data flow describes the information transferring between different parts of the systems. The arrow symbol is the symbol of data flow. A relatable name should be given to the flow to determine the information which is being moved. Data flow also represents material along with information that is being moved. Material shifts are modeled in systems that are not merely informative. A given flow should only transfer a single type of information. The direction of flow is represented by the arrow which can also be bi-directional.



- **Solution & Technical Architecture**



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

Technical Architecture (TA) is a form of IT architecture that is used to design computer systems. It involves the development of a technical blueprint with regard to the arrangement, interaction, and interdependence of all elements so that system-relevant requirements are met. At its core, the term architecture describes the formation of a structure by strategically assembling single components. In this process of assembling, the architect has to adhere to certain rules or requirements like legal constraints, financial constraints, or scientific laws. New application is compatible with the existing technology at a company by specifying things like the communications network or hardware that it uses.

- **User Stories**

A user story is a well-formed, short and simple description of a software requirement from the perspective of an end-user, written in an informal and natural language. It is the main artifact used in the agile software development process to capture user requirements.

User Type	Functional Requirement(Epic)	User Story Number	User Story / Task	Acceptance criteria
Circuit designer	Designing the circuit	USN-1	As a user, I can design the circuit by using open source softwares.	I can get the exact design for my project.
		USN-2	As a user, I can design the	I can make several
			circuit by using free web app like	attempts to get the
			Tinkercad.	right
				design.

Programmer	Create a program suitable for the circuit	USN-3	As a user, I can create programs in the userfriendly language.	I can create a simple program for the circuit
		USN-4	As a user, I can compile and execute the programs.	I can get the program with accurate outputs.
Engineer	Connects the output	USN-	As a user, I can	I can make the data

	to the cloud	5	connect the output values to the cloud services by using NODE RED.	to receive in cloud.
	Store the output values	USN-6	As a user, I can make the data's store in IBM cloudant database.	I can retrieve the data anywhere, anytime.
	Connects the cloud data with the authorities communication device.	USN-7	As a user, I can produce connection to the authorities mobile phones so that they can receive the alerts.	I can make the authorities informed about the water's quality.
	Alerts has to be sent to the authorities	USN-8	As a user, I can make use of platforms such as Fast SMS to send the timely updates to the authorities.	I can make the authorities to get accurate values and alerts
Authorities	Checks the water quality alerts	USN-9	As a user, I check the quality values of the water that is sent to me.	I can make sure that the people in my zone get quality water.

User stories are either written by a product manager or a team member on behalf of the end-user, explaining the expected functionality from the system being developed. User stories are written to capture the most important elements of a requirement following a predefined template. The most commonly used user story template is called the connextra template where a user describes his role, his capabilities, and what benefits he expects to receive from the system using a single sentence.

Users should keep the following agile principles in mind when writing user stories.

- Working software is the primary measure of progress.
- The highest priority is to satisfy the customer through early and continuous delivery of valuable software

- **PROJECT PLANNING & SCHEDULING**

Project Planning and Scheduling', though separate, are two sides of the same coin in project management. Fundamentally, 'Project planning' is all about choosing and designing effective policies and methodologies to attain project objectives. While 'Project scheduling' is a procedure of assigning tasks to get them completed by allocating appropriate resources within an estimated budget and time-frame.

The basis of project planning is the entire project. Unlikely, project scheduling focuses only on the project-related tasks, the project start/end dates and project dependencies. Thus, a 'project plan' is a comprehensive document that contains the project aims, scope, costing, risks, and schedule. And a project schedule includes the estimated dates and sequential project tasks to be executed.

- **Sprint Planning & Estimation**

Sprint planning is an event in scrum that kicks off the sprint. The purpose of sprint planning is to define what can be delivered in the sprint and how that work will be achieved. Sprint planning is done in collaboration with the whole scrum team.

The sprint is a set period of time where all the work is done. However, before you can leap into action you have to set up the sprint. You need to decide on how long the time box is going to be, the sprint goal, and where you're going to start. The sprint planning session kicks off the sprint by setting the agenda and focus. If done correctly, it also creates an environment where the team is motivated, challenged, and can be successful.

The What – The product owner describes the objective (or goal) of the sprint and what backlog items contribute to that goal. The scrum team decides what can be done in the coming sprint and what they will do during the sprint to make that happen.

The How – The development team plans the work necessary to deliver the sprint goal. Ultimately, the resulting sprint plan is a negotiation between the development team and product owner based on value and effort.

The Who – You cannot do sprint planning without the product owner or the development team. The product owner defines the goal based on the value that they seek. The development team needs to understand how they can or cannot deliver that goal.

The Inputs – A great starting point for the sprint plan is the product backlog as it provides a list of 'stuff' that could potentially be part of the current sprint.

The Outputs – The most important outcome for the sprint planning meeting is that the team can describe the goal of the sprint and how it will start working toward that goal. This is made visible in the sprint backlog.

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint EndDate (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 Nov 2022	20	31 Oct 2022
Sprint-3	30	6 Days	07 Nov 2022	12 Nov 2022	30	07 Nov 2022
Sprint-4	30	6 Days	14 Nov 2022	19 Nov 2022	30	14 Nov 2022

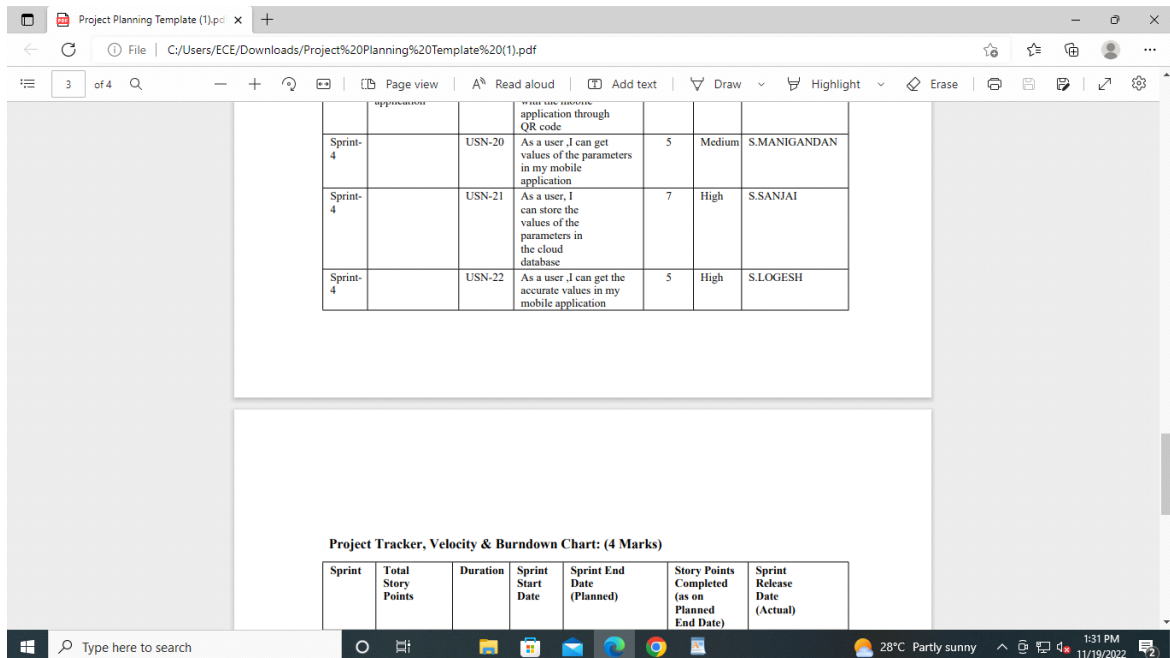
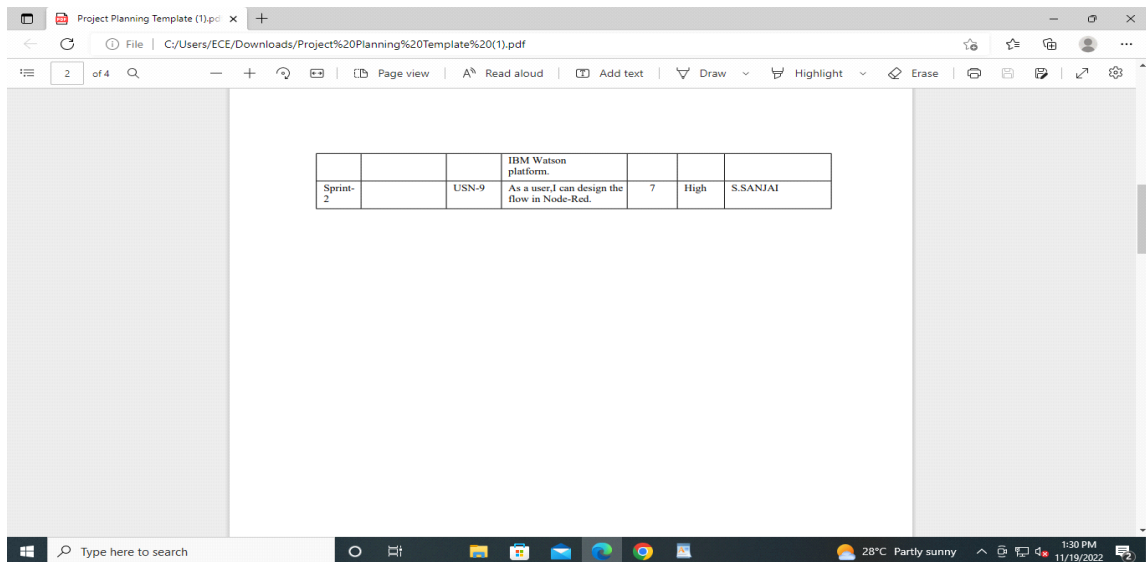
- **Sprint Delivery Schedule**

A sprint schedule is a document that outlines sprint planning from end to end. It's one of the first steps in the agile sprint planning process—and something that requires adequate research, planning, and communication.

Agile Product Delivery is a customer-centric approach to defining, building, and releasing a continuous flow of valuable products and services to customers and users.

Use the below template to create product backlog and sprint schedule

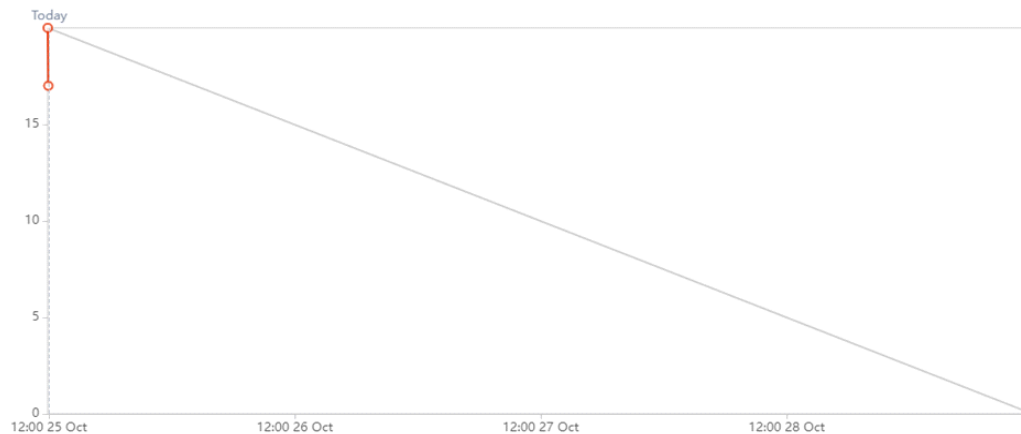
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Create and configure IBM cloud services (IBM Watson)	USN-1	As a user, I will register in ICTA Academy and create IBM cloud account.	3	High	S.LOGESH
Sprint-1		USN-2	As a user, I will access IBM cloud and launch the IBM Watson IOT platform	2	Medium	S.SANJAI
Sprint-1		USN-3	As a user, I can create a device in the IOT IBM Watson platform for simulation.	5	High	G.BHARATHI
Sprint-1		USN-4	As a user, I will get the device ID and device type of my device.	2	Medium	S.MANIGANDAN
Sprint-1		USN-5	As a user, I can simulate the device created.	3	High	S.SANJAI
Sprint-1		USN-6	As a user, I can get the values of temperature, PH and turbidity. I can create a line chart with my output data.	5	High	S.LOGESH
Sprint-2	Create and access Node- Red	USN-7	As a user, I can create Node- red by app deployment	4	Low	G.BHARATHI
Sprint-2		USN-8	As a user, I can get the api key through	4	Low	S.MANIGANDAN



- **Reports from JIRA**

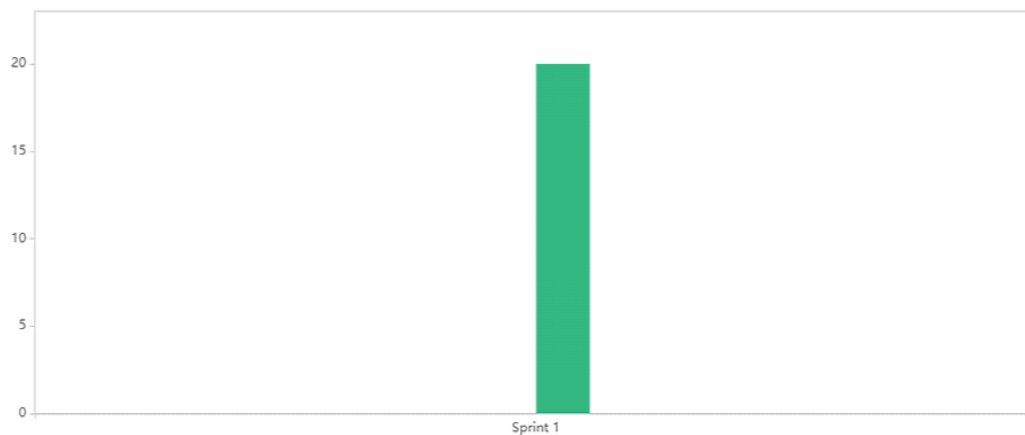
Jira is a software application used for issue tracking and project management. The tool, developed by the Australian software company Atlassian, has become widely used by agile development teams to track bugs, stories, epics, and other tasks.

Sprint burndown chart:

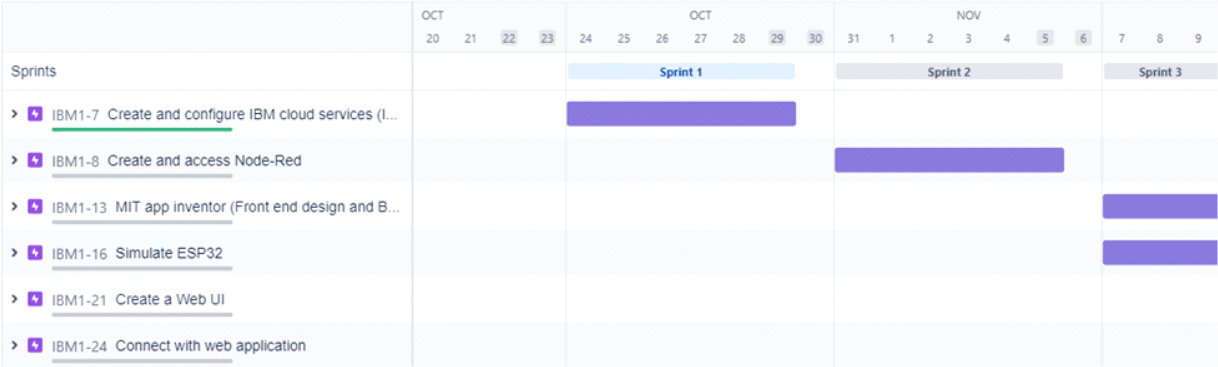


JIRA FILES FOR SPRINT-1:

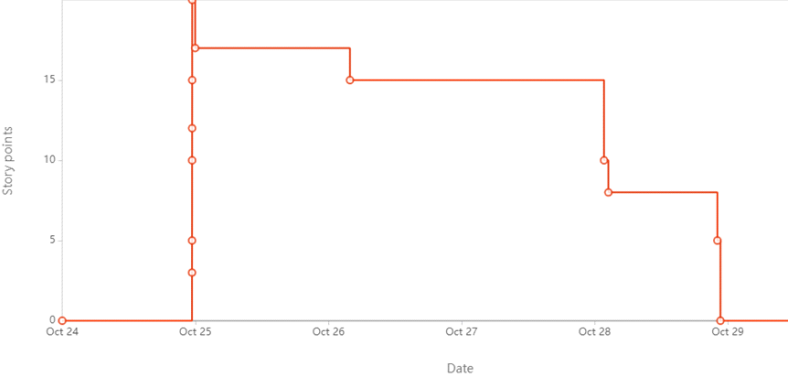
Velocity chart:



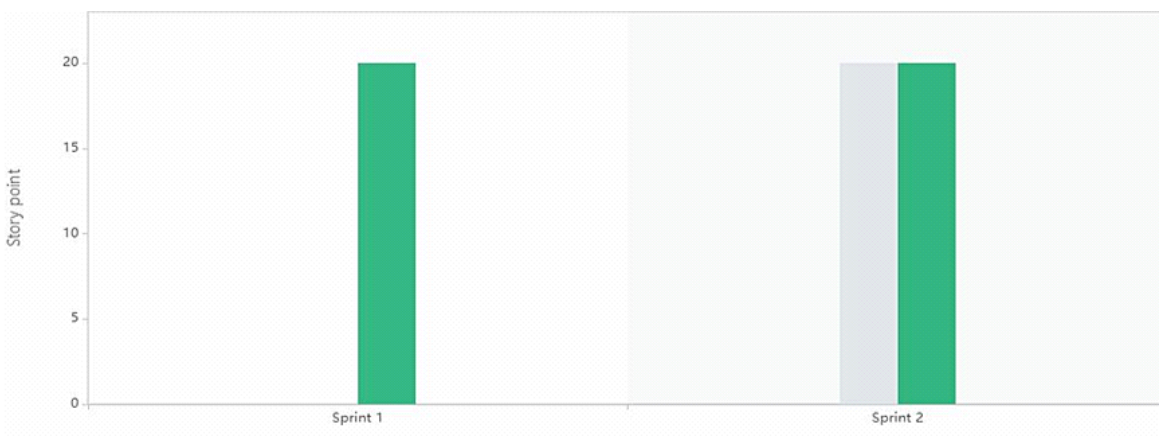
Road map:



Burndown chard:

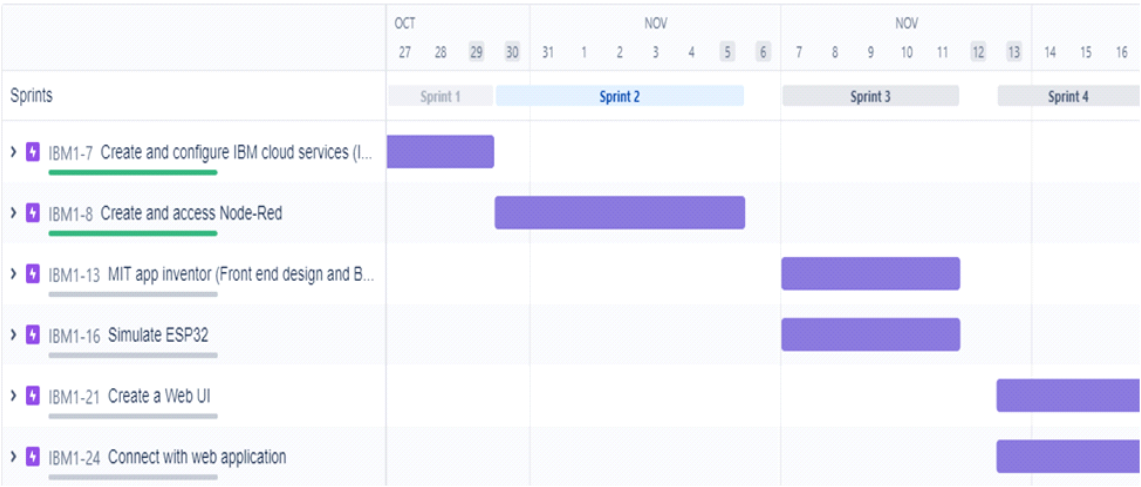


JIRA FILES FOR SPRINT-2:

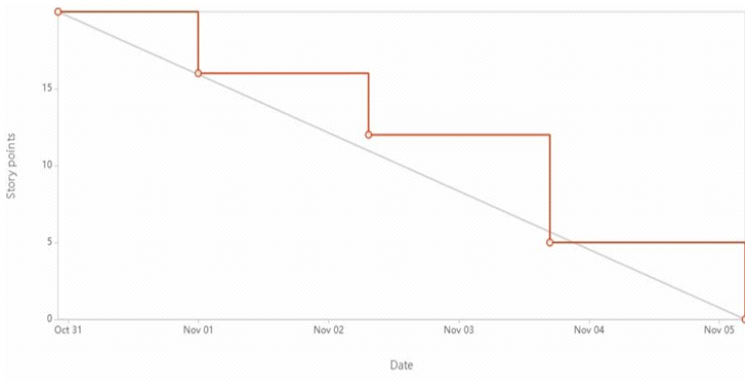


Velocity chart:

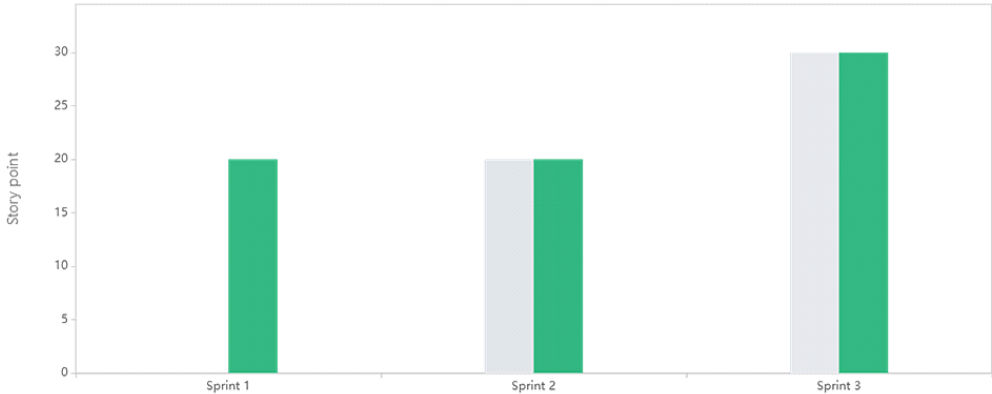
Road map:



Burndown chart:

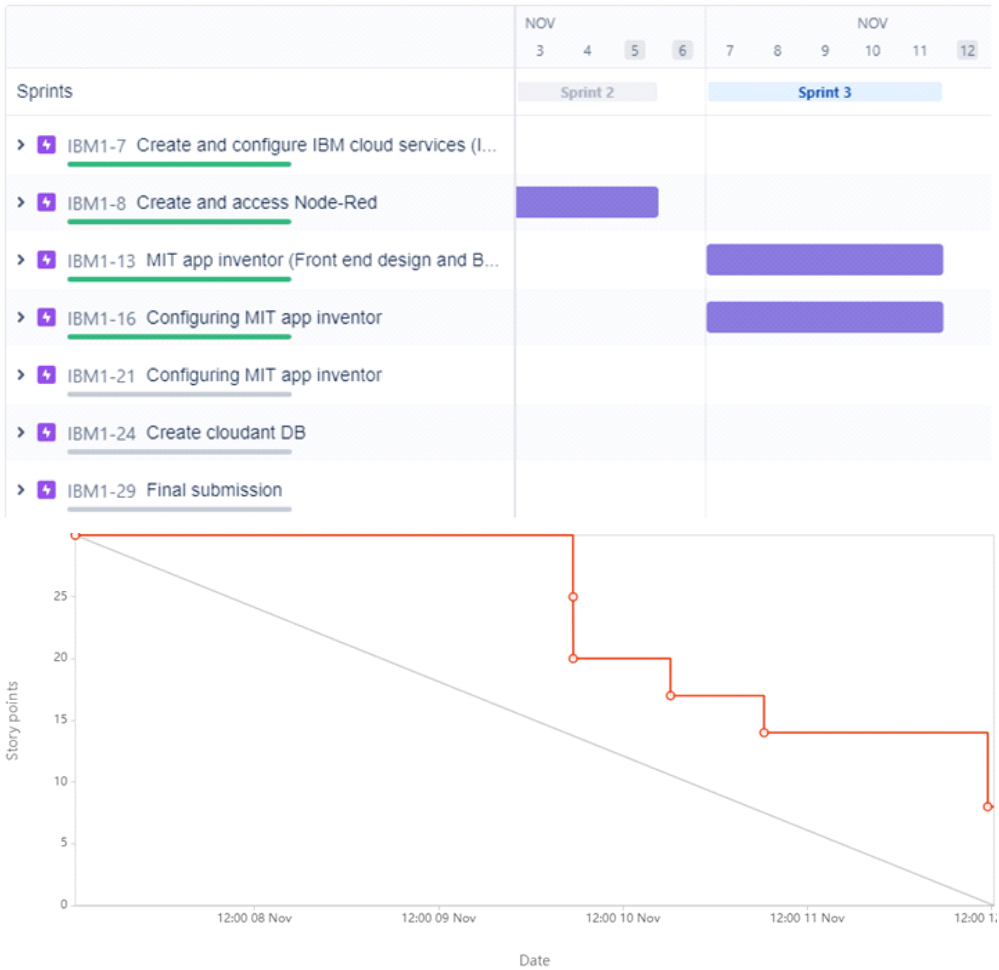


JIRA FILES FOR SPRINT-



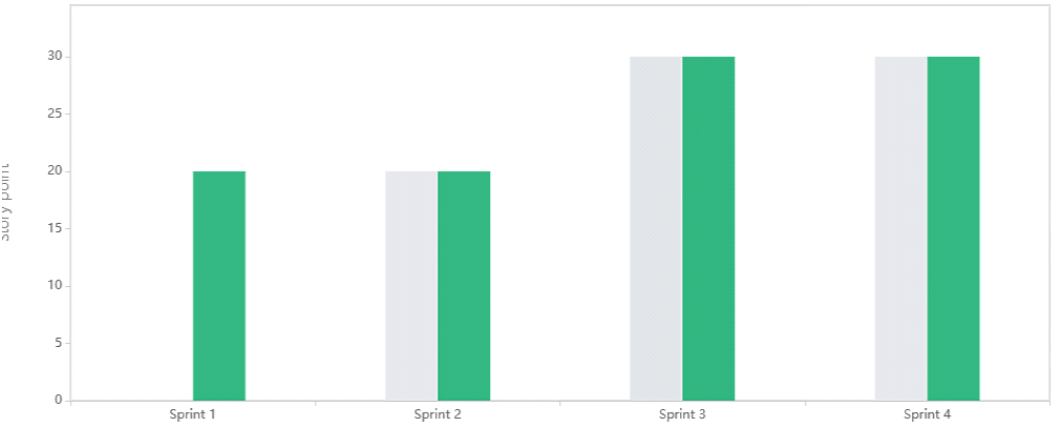
Velocity chart:

Road map:



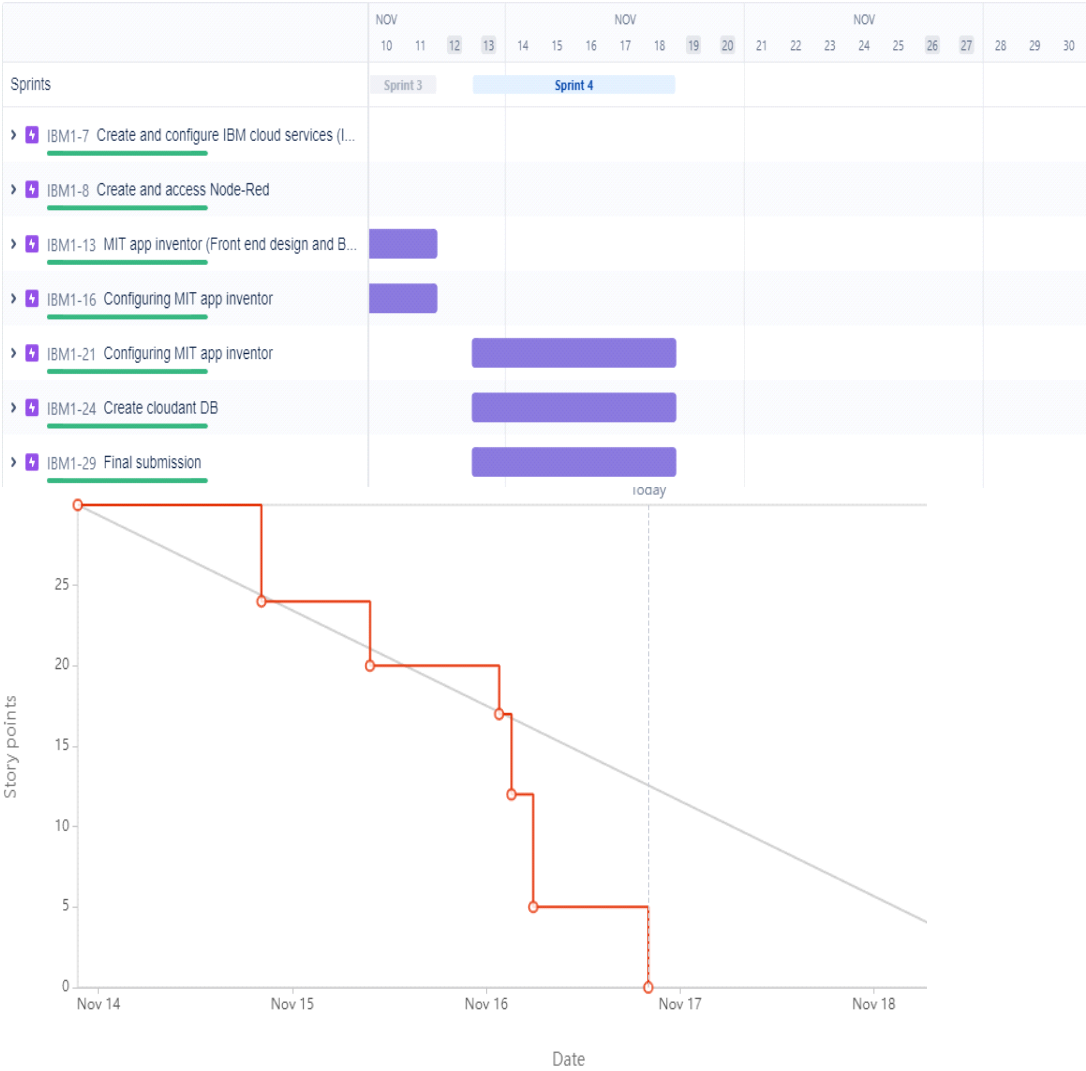
Burndown chart:

JIRA FILES FOR SPRINT-4:



Velocity chart:

Roadmap:



Burndown chart:

- **CODING & SOLUTIONING**

Coding is basically the computer language used to develop apps,

websites, and software. Without it, we'd have none of the most popular technology we've come to rely on such as Facebook, our smartphones, the browser we choose to view our favorite blogs, or even the blogs themselves an action or process of solving a problem.

PYTHON:

Python is a high-level, general-purpose programming language. Its design philosophy emphasizes code readability with the use of significant indentation. Python is dynamically-typed and garbage- collected. It supports multiple programming paradigms, including structured, object-oriented and functional programming



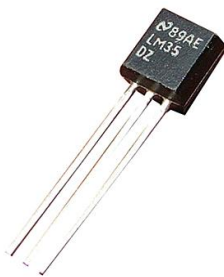
- **Feature 1**

- **PH, TEMPERATURE:**

- © **pH sensor:** The pH of a solution is the measure of the acidity or alkalinity of that solution. The pH scale is a logarithmic scale whose range is from 0-14 with a neutral point being 7. Values above 7 indicate a basic or alkaline solution and values below 7 would indicate an acidic solution. It operates on 5V power supply and it is easy to interface with arduino. The normal range of pH is 6 to 8.5.



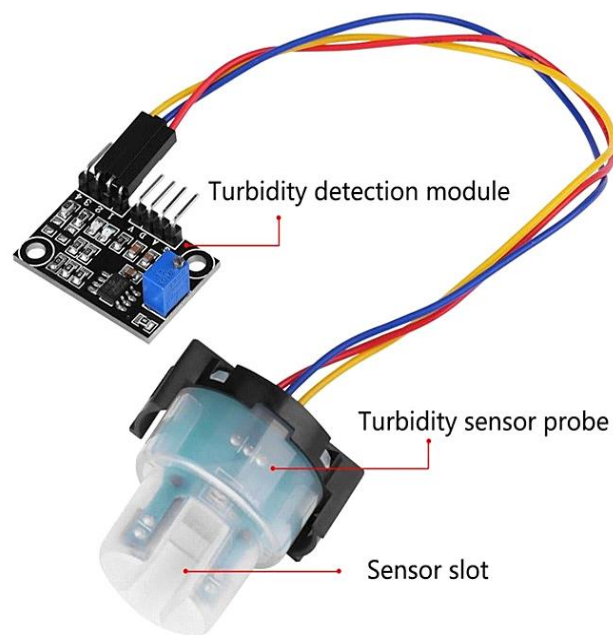
- © **Water Temperature:** indicates how water is hot or cold. The range of DS18B20 temperature sensor is -55 to +125 °C. This temperature sensor is digital type which gives accurate reading.



- **Feature 2**

- **TURBIDITY :**

Turbidity sensor: Turbidity is a measure of the cloudiness of water. Turbidity has indicated the degree at which the water loses its transparency. It is considered as a good measure of the quality of water. Turbidity blocks out the light needed by submerged aquatic vegetation. It also can raise surface water temperatures above normal because suspended particles near the surface facilitate the absorption of heat from sunlight. The measurement of turbidity is a key test of water quality. Turbidity, as identified with a turbidity meter or sensor, is the measurement of water clarity.



PYTHON CODE:

```
import time

import sys

import ibmiotf.application

import ibmiotf.device

import random


#Provide your IBM Watson Device Credentials

organization = "aozb7v"

deviceType = "123"

deviceId = "iot"

authMethod = "token"

authToken = "12345678"


# Initialize GPIO

def myCommandCallback(cmd):

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

    status=cmd.data['command']

    if status=="lighton":

        print ("led is on")

    elif status == "lightoff":

        print ("led is off")

    else :

        print ("please send proper command")

try:

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

method": authMethod, "auth-token": authToken}

    deviceCli = ibmiotf.device.Client(deviceOptions)

    #.....
```

```
except Exception as e:
```

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

```
    sys.exit()
```

```
# Connect and send a datapoint "hello" with value "world" into the cloud as an event of type "greeting" 10 times
```

```
deviceCli.connect()
```

```
while True:
```

```
    #Get Sensor Data from DHT11
```

```
    temp=random.randint(90,110)
```

```
    Humid=random.randint(60,100)
```

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

```
    #print data
```

```
    def myOnPublishCallback():
```

```
        print ("Published Temperature = %s C" % temp, "Humidity = %s %" % Humid, "to IBM Watson")
```

```
        success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0, on_publish=myOnPublishCallback)
```

```
        if not success:
```

```
            print("Not connected to IoT")
```

```
            time.sleep(10)
```

```
        deviceCli.commandCallback = myCommandCallback
```

```
# Disconnect the device and application from the cloud
```

```
deviceCli.disconnect()
```

- **Database Schema**

A database schema is the skeleton structure that represents the logical view of the entire database. It defines how the data is organized and how the relations among them are associated. It formulates all the constraints that are to be applied on the data.

A database schema defines its entities and the relationship among them. It contains a descriptive detail of the database, which can be depicted by means of schema diagrams. It's the database designers who design the schema to help programmers understand the database and make it useful.

IBM Cloud Refresh IBM Watson IoT Pla... Node-RED | node... MIT App Inventor One-time Password...

river

Document ID Options

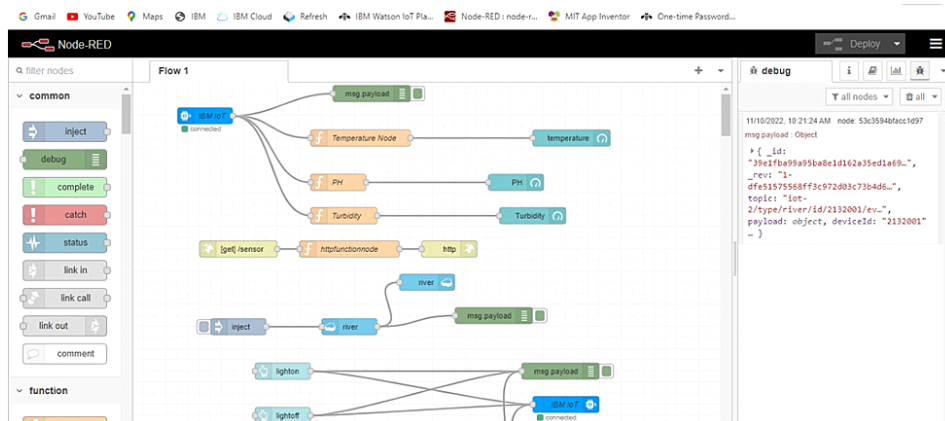
All Documents

Query
Permissions
Changes
Design Documents

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Create Document

Showing document 1 - 20. Documents per page: 20 < >



- **TESTING**

The process or method of finding error/s in a software application or program so that the application functions according to the end user's requirement is called testing.

Software testing is the process of verifying a system with the purpose of identifying any errors, gaps or missing requirement versus the actual requirement.

	Test Scenarios
1	Verify user is able to see login page
2	Verify user is able to get gauge values
3	Verify user is able to get the parameter values
4	Verify user is able to get the alert messages
5	Verify the project works in real time

- **Test Cases**

A test case is a document, which has a set of test data, preconditions, expected results and postconditions, developed for a particular test scenario in order to verify compliance against a specific requirement. Test Case acts as the starting point for the test execution, and after applying a set of input values, the application has a definitive outcome and leaves the system at some end point or also known as execution postcondition.

Test Case ID	Test Case Description	Test Data	Expected Results	Actual Results	Status
1	Verify user is able to see login page	Valid username and password	User is redirected to the dashboard	User is redirected to the dashboard	Pass
2	Verify user is able to get gauge values	Valid username and password	User is able to view gauge values	User is able to view gauge values	Pass
3	Verify user is able to get the parameter values	Valid username and password	User is able to view parameter values	User is able to view parameter values	Pass
4	Verify user is able to get the alert messages	Valid username and password	User is able to view alert messages	User is able to view alert messages	Pass
5	Verify the project works in real time	Valid username and password	Project works in real time	Project works in real time	Pass
6	Verify user is able to login with valid credentials	Valid username and password	User is redirected to the dashboard	User is redirected to the dashboard	Pass
7	Verify user is able to login with invalid credentials	Invalid username and password	User is redirected to the login page with an error message	User is redirected to the login page with an error message	Pass
8	Verify user is able to login with empty credentials	Empty username and password	User is redirected to the login page with an error message	User is redirected to the login page with an error message	Pass
9	Verify user is able to login with special characters	Special characters in username and password	User is redirected to the login page with an error message	User is redirected to the login page with an error message	Pass
10	Verify user is able to login with uppercase and lowercase letters	Uppercase and lowercase letters in username and password	User is redirected to the dashboard	User is redirected to the dashboard	Pass
11	Verify user is able to login with numbers and special characters	Numbers and special characters in username and password	User is redirected to the dashboard	User is redirected to the dashboard	Pass
12	Verify user is able to login with a long password	Long password	User is redirected to the dashboard	User is redirected to the dashboard	Pass
13	Verify user is able to login with a short password	Short password	User is redirected to the login page with an error message	User is redirected to the login page with an error message	Pass

IBM

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(1) WhatsApp

Google Sheets: Online Spr

Testcases Report Template - Google

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- **User Acceptance Testing**

User acceptance testing (UAT), also called application testing or end-user testing, is a phase of software development in which the software is tested in the real world by its intended audience.

User Acceptance Testing (UAT) or application testing, is the final stage of any software development or change request lifecycle before go-live. It is the final stage of any development process to determine that the software does what it was designed to do in real-world situations. Actual users test the software to determine if it does what it was designed to do in real-world situations, validating changes made and assessing adherence to their organization's business requirements.

Acceptance Testing UAT Execution & Report Submission					
Date	10 November 2022				
Team ID	PNT20221MID06701				
Project Name	Project - Real time river water quality monitoring and control system				
Maximum Marks	4 Marks				

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the [ProductName] project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis

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

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	8	5	2	3	18
Duplicate	2	0	3	0	5
External	1	0	0	1	2
Fixed	8	2	4	6	20
Not Reproduced	0	0	1	0	1
Skipped	0	0	2	1	3
Won't Fix	0	6	2	1	9
Totals	19	13	14	12	58

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
Designing the circuit	3	0	1	2
Create a program suitable for the circuit and also compile and execute the programs	4	0	0	4
connect the output values to the cloud services by using NODE RED.	3	0	1	2
Make the data's store in IBM cloudant database	5	0	1	4
Connects the cloud data with the authorities communication device.	3	0	1	2
Alerts has to be sent to the authorities	3	0	1	2
Final Report Output	2	0	0	2

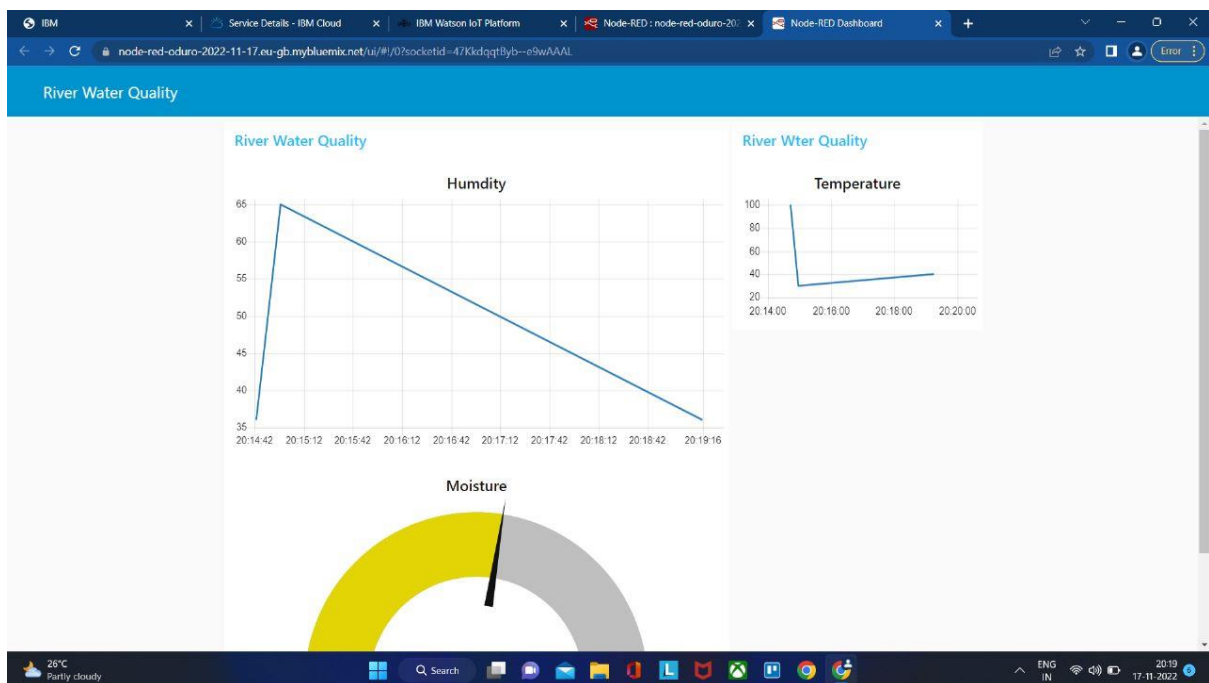
- **RESULTS**

Project results are the changes or effects that are expected to take place after implementing the project. The results are generally positive improvements to the lives of the beneficiaries.

- **Performance Metrics**

Performance metrics are defined as figures and data representative of an organization's actions, abilities, and overall quality. There are many different forms of performance metrics, including sales, profit, return on investment, customer happiness, customer reviews, personal reviews, overall quality, and reputation in a marketplace. Performance metrics can vary considerably when viewed through different industries.

Performance metrics are integral to an organization's success. It's important that organizations select their chief performance metrics and focus on these areas because these metrics help guide and gauge an organization's success.



- **ADVANTAGES & DISADVANTAGES**

ADVANTAGES:

- Immediate updation to authorities
- Large storage of data
- Accurate values of ph,temperature,turbidity
- Sensor based testing
- Less down time
- Task Management

A real time operating system typically takes less amount of time to shift from one task to another. Usually it takes 3 microseconds or less to shift tasks.

DISADVANTAGES:

- Differentiated data from the main station is given to environment and public department using internet.
- large quantities of data storage and retrieval may be less efficient
- Sensors has to be recharged periodically
- It does not has the capacity to purify water

- **CONCLUSION**

Monitoring of Turbidity, PH & Temperature of Water makes use of water detection sensor . The system can monitor water quality automatically, and it is low in cost and does not require people on duty. So the water quality testing is likely to be more economical, convenient and fast. The system has good flexibility. Only by replacing the corresponding sensors and changing the relevant software programs, this system can be used to monitor other water quality parameters. The operation is simple. The system can be expanded to monitor hydrologic, air pollution, industrial and agricultural production and so on. It has widespread application and extension value. By keeping the embedded devices in the environment for monitoring enables self protection (i.e., smart environment) to the environment. To implement this need to deploy the sensor devices in the environment for collecting the data and analysis. By deploying sensor devices in the environment, we can bring the environment into real life i.e. it can interact with other objects through the network. Then the collected data and analysis results will be available to the end user through the WiFi.

This project can be extended into an efficient water management system of a local area. Moreover, other parameters which wasn't the scope of this project such as total dissolved solid, chemical oxygen demand and dissolved oxygen can also be quantified. So the additional budget is required for further improvement of the overall system

- **FUTURE SCOPE**

- In future we use advanced IOT concept in this project
- Detecting the more parameters for most secure purpose
- Increase the parameters by addition of multiple sensors
- By interfacing relay we controls the supply of water
- Monitoring environmental conditions, drinking water quality, treatment and disinfection of waste water etc.
- The system could also be implemented in various industrial processes.
- The system can be modified according to the needs of the user and can be implemented along with lab view to monitor data on computers.

GitHub & Project Demo Link



Project Team ID : PNT2022TMID06701.

GitHub Link :

<https://github.com/IBM>

HYPERLINK

<https://github.com/IBM-EPBL/IBM-Project-29981-16601369617>

Project Demo Link :

<https://youtu.be/nuUCC1HFQSU>