

Project Report Format

1. INTRODUCTION

1.1 Project Overview

1.2 Purpose

2. LITERATURE SURVEY

2.1 Existing problem

2.2 References

2.3 Problem Statement Definition

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy map Canvas

3.2 Ideation & Brainstorming

3.3 Proposed Solution

3.4 Problem Solution fit

4. REQUIREMENT ANALYSIS

4.1 Function requirement

4.2 Non- Function requirement

5. PROJECT DESIGN

5.1 Data Flow Diagrams

5.2 Solution & Technical Architecture

5.3 User Stories

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

6.2 Sprint Delivery Schedule

6.3 Report from JIRA

7. CODING & SOLUTIONING

7.1 Feature 1

7.2 Feature 2

7.3 Database Schema(if Applicable)

8. TESTING

8.1 Test Cases

8.2 User Acceptance Testing

9. RESULTS

9.1 Performance Metrics

10. ADVANTAGES & DISADVANTAGES

11. CONCLUSION

12. FUTURE SCOPE

13. APPENDIX

Source Code

GitHub & Project Demo link

REAL- TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM

❖ INTRODUCTION

1.1 Project Overview

Real time river water quality monitoring and control system involves wireless communication system and central server for information

management. Energy constraint, memory, restriction, data accuracy, sensor localization and not at least the cost minimization where the most challenge in the project. On this basis the water resource management system development all data should be integrated and visualized by using GIS.

Water pollution is one of the biggest fears for green globalization. To ensure a safe supply of drinking water the quality needs to be monitored in a real-time water quality monitoring and control system using IOT. To monitor and regulation of water parameters with their range. Quantitative information on the physical, chemical and biological characteristics of water. The system consists of several sensors are used to measure the physical and chemical parameter of the water. By monitoring the quality of water the awareness about drinking water is spread among people.

Quantitative information on the physical, chemical and biological characteristics of water. The system consists of several sensors are used to measure the physical and chemical parameter of the water. By monitoring the quality of water the awareness about drinking water is spread among people. Hence there is need of developing better methodologies to monitor the water quality and controlling parameters in real time. The real time parameter pH, turbidity, humidity measures the concentration of hydrogen ions. It shows the water is acidic or alkaline. Pure water has 7pH value less than 7pH has acidic, more than 7pH alkaline. The range of pH is 0-14pH. For drinking purpose it should be 6.5-8.5pH. Turbidity measures the large number suspended particles in water 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 the problem and then make a solution for it. What is the primary need of all living beings and living without water is impossible.

Current industrial and automation monitoring and control systems makes use of PC based servers. Devices in these monitoring systems are connected to these servers and therefore there is necessity to keep this server ON all the time which increases power requirement and hence increases cost of the system. The solution to this problem is to use embedded based web server instead of using PC based server. This embedded web server implementation can be achieved with the help of Raspberry Pi board. This server allows remote monitoring of industrial environment and also web

access to the automation and monitoring system and provides remote controlling of industrial appliances as well.

Raspberry Pi (Raspbian OS), and Python are freely available for users to use and also to develop. Security will be critical for many applications and devices. These applications and devices are applied into specific domain of our everyday life like industry, education and in hospitals. Security is very much essential in all kind of application activities. This system is handled by particular user only, and hence the system is more secured. Internet of Things (IoT) is rapidly increasing technology. IoT is the network of physical objects or things embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data. In this paper, we are developing a system which will monitor the industrial applications and controlling action using IoT concept. IoT has given us an effective way to make powerful industrial systems and applications by using Raspberry pi.

1.2 PURPOSE

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 system consists of several sensors which is used to measure physical and chemical parameters of the water. The main components of Wireless Sensor Network (WSN) include a microcontroller for processing the system, communication system for inter and intra node communication and several sensors. Real-time data access can be done by using remote monitoring and Internet of Things (IoT) technology

Smart solutions for water quality monitoring are gaining importance with advancement in communication technology. This paper presents a detailed overview of recent works carried out in the field of smart water quality monitoring. Also, a power efficient, simpler solution for in-pipe water quality monitoring based on Internet of Things technology is presented. The model developed is used for testing water samples and the data uploaded over the Internet are analysed.

The system also provides an alert to a remote user, when there is a

deviation of water quality parameters from the pre-defined set of standard values.

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 Bangladeshi populations to become conscious against contaminated water as well as to stop polluting the water.

2.LITERATURE SURVEY

2.1 EXISTING PROBLEM

Rivers and streams drain water that falls in upland areas. Moving water dilutes and decomposes pollutants more rapidly than standing water, but many rivers and streams are significantly polluted all around the world.

Around the world, rivers, lakes, and wetlands have increasingly come under similar assault from **poorly planned dams, pollution, habitat loss, sand mining, climate change, and the introduction of invasive species.**

Pollution:

Chemical waste products from industrial processes are sometimes accidentally discharged into rivers. Examples of such pollutants include cyanide, zinc, lead, copper,

If large amounts of fertilizers or farm waste drain into a river the concentration of nitrate and phosphate in the water increases considerably. Algae use these substances to grow and multiply rapidly turning the water green. This massive growth of algae, called eutrophication, leads to pollution.

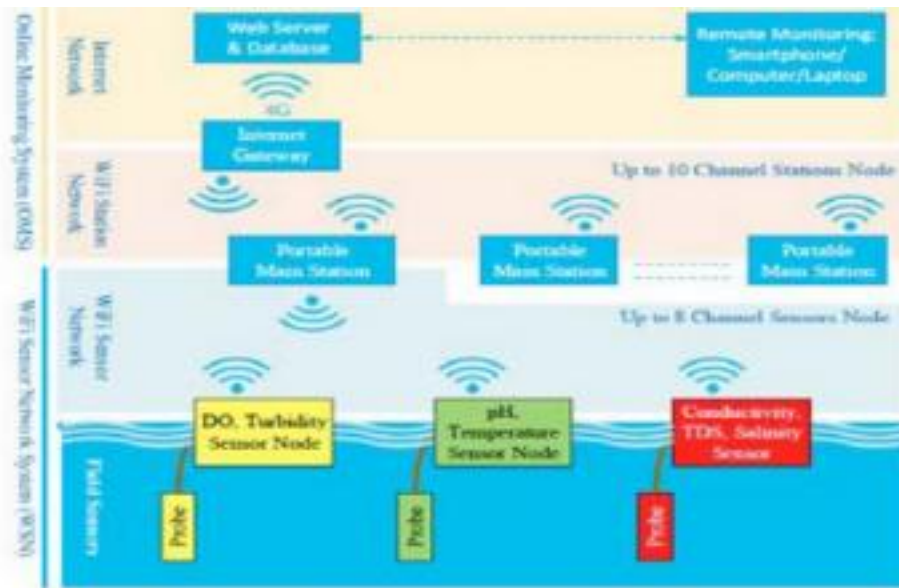
Proposed system:

pH, Turbidity and Temperature sensors are used to gather the parameters necessary to monitor water health in real time. Following are the objectives of the proposed system.

- To measure various chemical and physical properties of water like pH, temperature and particle density of water using sensors.
- Send the data collected to a Raspberry Pi, show the data in display and

send it to a cloud based Database using Wired/Wireless Channel.

- Trigger alarm when any discrepancies are found in the water quality.
- Data visualization and analysis using cloud based visualization tools.



Sensors for monitoring:

- ❖ pH sensor,
- ❖ Turbidity sensor,
- ❖ Temperature sensor and
- ❖ LCD display.

PH sensor (**potential of hydrogen**):

pH Sensors for Quality Water. A pH sensor helps to measure the acidity or alkalinity (An alkali is a chemical that can dissolve in water, combine with acids to form salts, and make acids less acidic). of the water with a value between 0-14. When the pH value dips below seven, the water starts to become more acidic. Any number above seven equates to more alkaline. pH of less than 7 indicate acidity, whereas a pH of greater than 7 indicates a base. pH is really a measure of the relative amount of free hydrogen and hydroxyl ions in the water.

Turbidity sensor:

Turbidity train sensor is victimised to measure the clarity of element or muddiness utter in the water. The muddiness of the open cut food is ordinarily between 255 NTU(**Nephelometric Turbidity unit**). Irrigate is visibly at levels above 80 NTU.

The standards for intemperance liquid is 130 NTU to 250 NTU. The turbidity device consists of soft sender and acquirer, the transmitter needs to transmit unsubtle bright, it is said to be turbid. The consequence of turbidity is a reduction in water clarity, aesthetically unpleasant, decreases the rate of photosynthesis, increases water temperature.

Temperature sensor:

A temperature sensor is a device that detects and measures hotness and coolness and converts it into an electrical signal.

Temperature sensors are devices used to measure temperature in solids, liquids or gases. They are used within industrial applications and have many more commercial uses. Most of the temperature sensors we supply monitor temperature by measuring the change in resistance of an electrical current.

Enter the code and upload it to your Arduino. Once the code is running, open the serial monitor and make sure your baud rate is set to 9600.

You will see the temperature displayed in both Fahrenheit and Celsius. The temperature may look incorrect to you. Here DS18B20 is old as the temperature device. Usually, its present use to perceive the temperature of the life, if we site the device wrong the conductor electrode and placed into the H₂O, it can discover the temperature of H₂O also. The normal temperature of the people is (25 -30)°C.

LCD display:

LCD (Liquid Crystal Display) impede is a flat brace electronic exhibit power and finds in a countywide orbit of applications. A 16x2 LCD demo

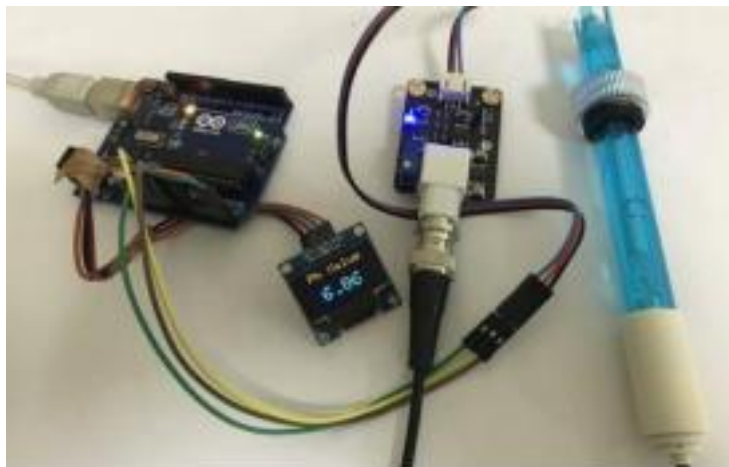
is the really fundamental power and is rattling commonly victimised in varied devices and circuits. These modules are desirable over heptad segments and otherwise multi-segment LEDs.

Software design :

The proposed water quality monitoring system based on WSN can be divided into three parts:

- IoT platform
- Neural network models in Big Data Analytics and water quality management
- Real-time monitoring of water quality by using IoT integrated Big Data Analytics

Hardware design:



2.2 References:

- ❖ [3] B. Paul, "Sensor based water quality monitoring system," BRAC University, 2018. © 2019 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>) Peer review under responsibility of the Conference Program Chairs

- ❖ Zhu Wang, Qi Wang and Xiaoqiang Hao, "The Design of the Remote Water Quality Monitoring System based on WSN", *Proceedings of the IEEE*, 2009
- ❖ B O'Flynn, Rafael Martinez-Catala, S. Harte, C.
- ❖ O'Mathuna, John Cleary, C. Slater, et al., "SmartCoast-A Wireless Sensor Network for Water Quality Monitoring", *32nd IEEE Conference on Local Computer Networks*, pp. 815-816, 2007.
- ❖
Regan Fiona, Lawlor Antoin, Brendan O Flynn, J. Torres2, R Martinez-Catala2, C. O' Mathuna, et al., "A demonstration of wireless sensing for long term monitoring of water quality", *4th IEEE International Workshop on Practical Issues In Building Sensor Network Applications*, pp. 819-825, October 20–23, 2009.
- ❖ Eduardo Garcia Breijo, Luis Gil Sanchez, Javier Ibanez Civera, Alvaro Tormos Ferrando and Gema Prats Boluda, "Thick-Film Multisensor for Determining Water Quality Parameters", *Proceedings of the IEEE*, 2002.
- ❖ Tuan Le Dinh, Wen Hu, Pavan Sikka, Peter Corke, Leslie Overs and Stephen Brosnan, "Design and Deployment of a Remote Robust Sensor Network: Experiences from an Outdoor Water Quality Monitoring Network", *32nd IEEE Conference on Local Computer Networks*, pp. 799-806, 2007.
- ❖ Frederick J. Kohlmann, "What is pH and how is it measured?-Technical Handbook", *Hach Company*, 2003.
- ❖ Marco Zennaro, Athanasios Floros, Gokhan Dogan and Antoine Bagula, "On the design of aWater QualityWireless Sensor Network (WQWSN): an Application toWater Quality Monitoring in Malawi", *International Conference on*

Parallel Processing Workshops, pp. 330-336, 2009.

- ❖ Xiuna Zhu and Daoliang Li, "CDMA-based Remote WirelessWater Quality Monitoring System for Intensive Fish Culture", *International Conference on Communications and Mobile Computing*, pp. 380-385
- ❖ Kotsilieris Theodore and George T. Karetsos, "A mobile agent enabled wireless sensor network for river water monitoring", *The Fourth International Conference on Wireless and Mobile Communications*, pp. 346-351, 2008.
- ❖ Waltenegus Dargie and Christian Poellabauer, *Fundamentals of Wireless Sensor Networks-Theory and Practice*, John Wiley & Sons Ltd, 2010.
- ❖ R. M. Bhardwaj, "Water Quality Monitoring in India - Achievements and Constraints" in International Work Session on Water Statistics, Vienna, Jun 2005.

2.3 PROBLEM STATEMENT DEFINATION

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



I am	Common people living a normal life on Earth	Common people living on Earth who consume water in their day to-day life for different purpose
I'm trying to	Monitor the quality of the water	Wants to monitor the water consumed everyday whether the water is contaminated or pure, pH, temperature, salinity in it
but	Do not know to monitor the quality of water	Time consuming process for manual testing
because	Lack of required knowledge	Common people lack knowledge of this type of testing, sensors etc.
Which makes me feel	Doubted and fearful of the consumed water	Decline of pure water, increasing viral diseases

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

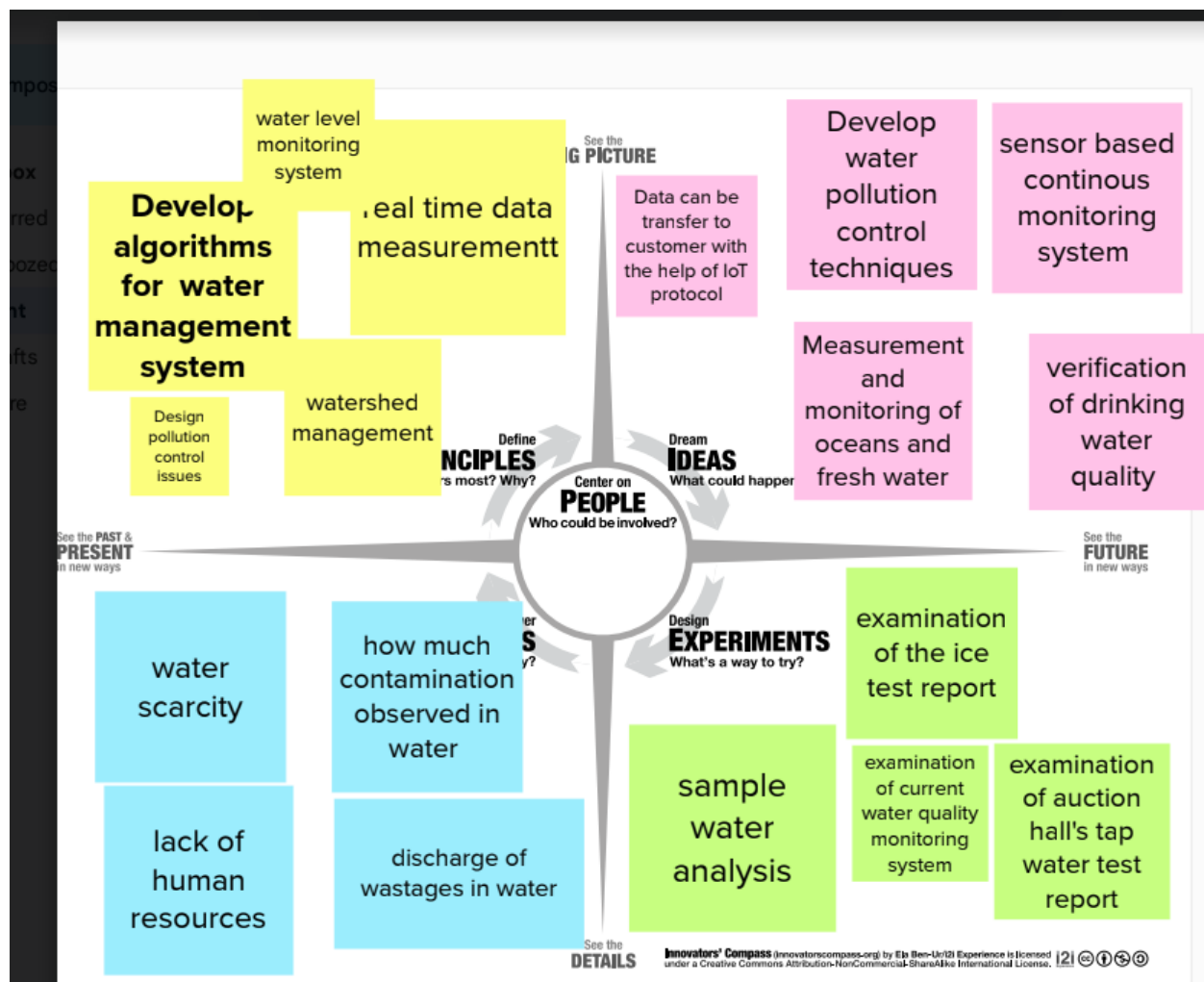
INTRODUCTION:

Nowadays, the tendency of the companies is not just producing software, but to take into consideration the people for whom we are designing, and what they need. But, without having in mind what our user is thinking and how they are behaving our design is pointless.

In simple terms, empathy is placing in other people's shoes and feel what they are feeling. If you are looking for an elaborated definition, Simon Baron-Cohen (in his book "Zero Degrees of Empathy: A New Theory of Human Cruelty") defined the

empathy as the “*ability to identify what someone else is thinking or feeling and to respond to their thought and feeling with an appropriate emotion*”. Empathy has a lot of benefits on both sides, but the most important one is **trust**.

EMPATHY MAP



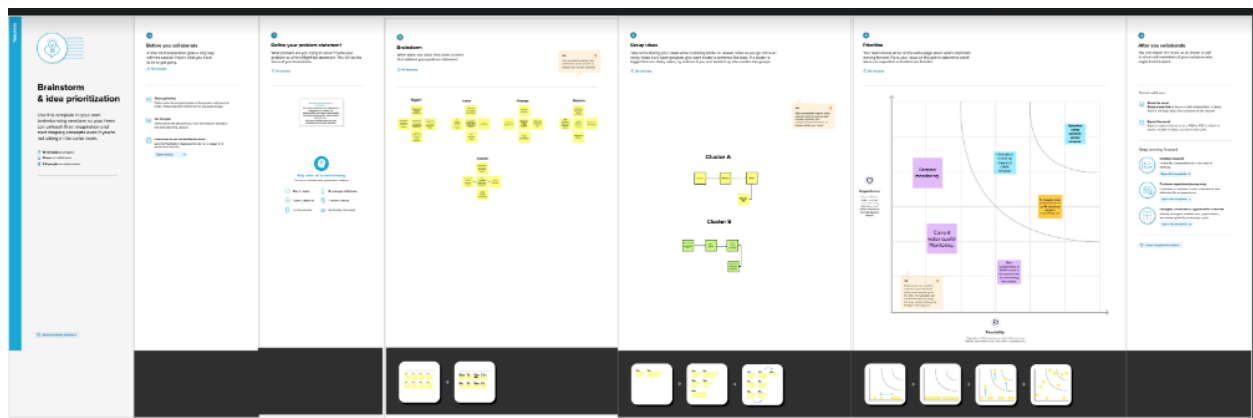
3.2 Ideation & Brainstorming

INTRODUCTION:

In a nutshell, brainstorming is one of the most creative ways of problem-solving in which we work on ideas. We can either come up with a new idea or build on an existing idea as well. Since there is no rule of thumb in brainstorming, it can be applied individually or in a group.

- Firstly, a goal is defined to understand what the main purpose of brainstorming is.
- Once we have an end-goal to achieve or a problem to solve, various challenges that come along are explored.
- Furthermore, different aspects of the problem or situation are explored and we list down ways to overcome the challenges.
- There is no structure in brainstorming, and no idea is considered wrong. All ideas are noted during the brainstorming sessions, and some can even be clubbed together.

Brainstorming



3.3 PROPOSED SOLUTION

INTRODUCTION:

- ❖ **Proposed solution should relate the current situation to a desired result and describe the benefits that will accrue when the desired result is achieved.** So, begin your proposed solution by briefly describing this desired result.
- ❖ In the introduction, you need to describe the problem and explain why it needs to be solved and then give your thesis solution. Remember:
- ❖ If it is an unknown problem, you will need to explain it in detail.
- ❖ If it is a familiar problem, then you need to paint a vivid picture.
- ❖ In both situations, you will need to convince the reader that it is an important problem.
- ❖ **Your proposed solution should relate the current situation to a desired result and describe the benefits that will accrue when the desired result is achieved.** So, begin your proposed solution by briefly describing this desired result.
- ❖ Proposed Solution means **the technical solution to be provided by the Implementation agency in response to the requirements and the objectives of the Project.**
- ❖ Sample 1Sample 2. Proposed Solution means the Proposed System with modifications that meet the Agency's requirements as set forth in this RFP.

Project team shall fill the following information in proposed solution template.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	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.
2.	Idea/ Solution description	The solution to this problem is, to monitor the river water quality for the need of safe drinking water.
3.	Novelty / Uniqueness	The uniqueness is to obtain the water monitoring system with high frequency, high mobility, and low powered. Therefore, our proposed system will immensely help Bangladeshi populations to become conscious against contaminated water as well as to stop polluting the water.

4.	Social Impact / Customer Satisfaction	Using this application, we can track the contents in river water to make sure that the water is in safe limit for utilizing for general purpose on living things.
5.	Business Model (Revenue Model)	Current water quality monitoring system is a manual system with a monotonous process and is very time-consuming. The system consists of

		several sensors which is used to measure physical and chemical parameters of the water.
6.	Scalability of the Solution	This system proposes a sensor based water quality monitoring system, consists of several factors which is used to measure physical and chemical factors of the water.

3.4 PROBLEM SOLUTION FIT

INTRODUCTION:

Fit simply means that **you have found a problem with your customer and that the solution you have realized for it actually solves the customer's problem.**

However, if companies skip the testing of the Problem-Solution Fit they came up with, they will risk landing in the situation where nobody wants their solution, which is rather sad given the amount of time and finance put in.

this occurs when you have evidence that customers care about certain jobs, pains, and gains. At this stage you've proved the existence of a problem and have designed a value proposition that addresses your customers' jobs, pains and gains.

1. CUSTOMER SEGMENT(S) CS <ul style="list-style-type: none"> ➤ Aqua ponics ➤ Dam safety organisation (SDSO) ➤ Wholesaler of mineral water 	5. CUSTOMER CONSTRAINTS CC <ul style="list-style-type: none"> ➤ Sensors are used ➤ Compact in size ➤ Consumes low power 	8. AVAILABLE SOLUTIONS AS <ul style="list-style-type: none"> ➤ The technology develops a means to supervise and track river water in real time so that quality and flow can be maintained to use less electricity and deliver at a lower cost ➤ The device will be small and simple to operate and cons is Device use without sufficient network connection
2. JOBS-TO-BE-DONE / PROBLEMS J&P <ul style="list-style-type: none"> ➤ To control the flow of water using IoT ➤ To identify the ph value and mineral content in the water ➤ To identify the presents of algal bloom in the tank or water bodies ➤ The quality , quantity and temperature of the water can be maintained 	6. PROBLEM ROOT CAUSE RC <ul style="list-style-type: none"> ➤ It involves improper upkeep of the water supply and inappropriate upkeep of the people. ➤ Lack of system administration and upkeep is the problem. ➤ It uses a lot of electricity. 	9. BEHAVIOUR BE <ul style="list-style-type: none"> ➤ To recognise the tank's algae growth, checks the PH level, mineral content, temperature, water flow direction, and water quantity. ➤ These are portable and are easily maintainable. ➤ It uses less data and power. Additionally, it might serve as a reference for the best safety steps to take.
3. TRIGGERS TR <ul style="list-style-type: none"> ➤ They are able to recognise the issue with the water without anyone's assistance. ➤ It uses little energy and is small in size. Customers will find it easy to use 	7. YOUR SOLUTION SL <ul style="list-style-type: none"> ➤ The system finds a way for supervising and monitoring the real time river water so that quality & flow can be maintained ➤ To consume less powerconsumption and to provide in cheaper cost ➤ The device will be in compact size and user friendly to use 	10. CHANNELS of BEHAVIOUR CH <p>ONLINE</p> <ul style="list-style-type: none"> ➤ The cloud storage can be used to regulate water flow. <p>OFFLINE</p> <ul style="list-style-type: none"> ➤ The proposed system includes a number of sensors to test and guarantee the water's quality based on factors including pH, temperature,
4. EMOTIONS: BEFORE / AFTER EM <ul style="list-style-type: none"> ➤ Before :Anxity,time consumption and unaware of things 		

4 REQUIREMENT ANALYSIS

4.1 Functional Requirements

INTRODUCTION:

- Functional requirements define what a product must do, what it features and function.**
- Functional requirements are the product features or functions that developers must implement to enable users to accomplish their tasks. So, it's important to make them clear both for the development team and the stakeholders. Generally, functional requirements describe system behavior under specific conditions.**

Following are the functional requirements of the proposed solution

S No	Functional Requirement	Sub Requirement (Sub-Task)
1	User Requirements	River water Protection Monitors PH, Salinity, Turbidity, Conductivity and dissolve solvents and to analyze the quality of river water
2	User Registration	the user registration of our project is registering the website and can login the webpage and it also register
3	User Confirmation	the user confirmation is after send the reach the confirmation message or mail after the fill the form
4	certification requirement	the certification requirement of our project is used to maintain the accuracy and quality
5	logout	Log out the user successfully

4.2 Non-functional Requirements

INTRODUCTION:

Nonfunctional Requirements (NFRs) define system attributes such as security, reliability, performance, maintainability, scalability, and usability. They serve as constraints or restrictions on the design of the system across the different backlogs.

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

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	usability is a measure of how well a specific user in a specific context can use a product/design to achieve a defined goal effectively, efficiently and
NFR-2	Security	Sign in to use Google's Security Checkup to strengthen your online security. Secure your data & devices. Add extra protections. Check recent security events.
NFR-3	Reliability	the reliability of this project are used to very efficient and it can move to next phase
NFR-4	Performance	The performance of this project is very good and excellent. it reduce time, cost and it give accurate solution
NFR-5	Availability	the availability of this project are very accurate and efficient performance
NFR-6	Scalability	the scalability of this project is little bit advanced because it is very high external requirements are used

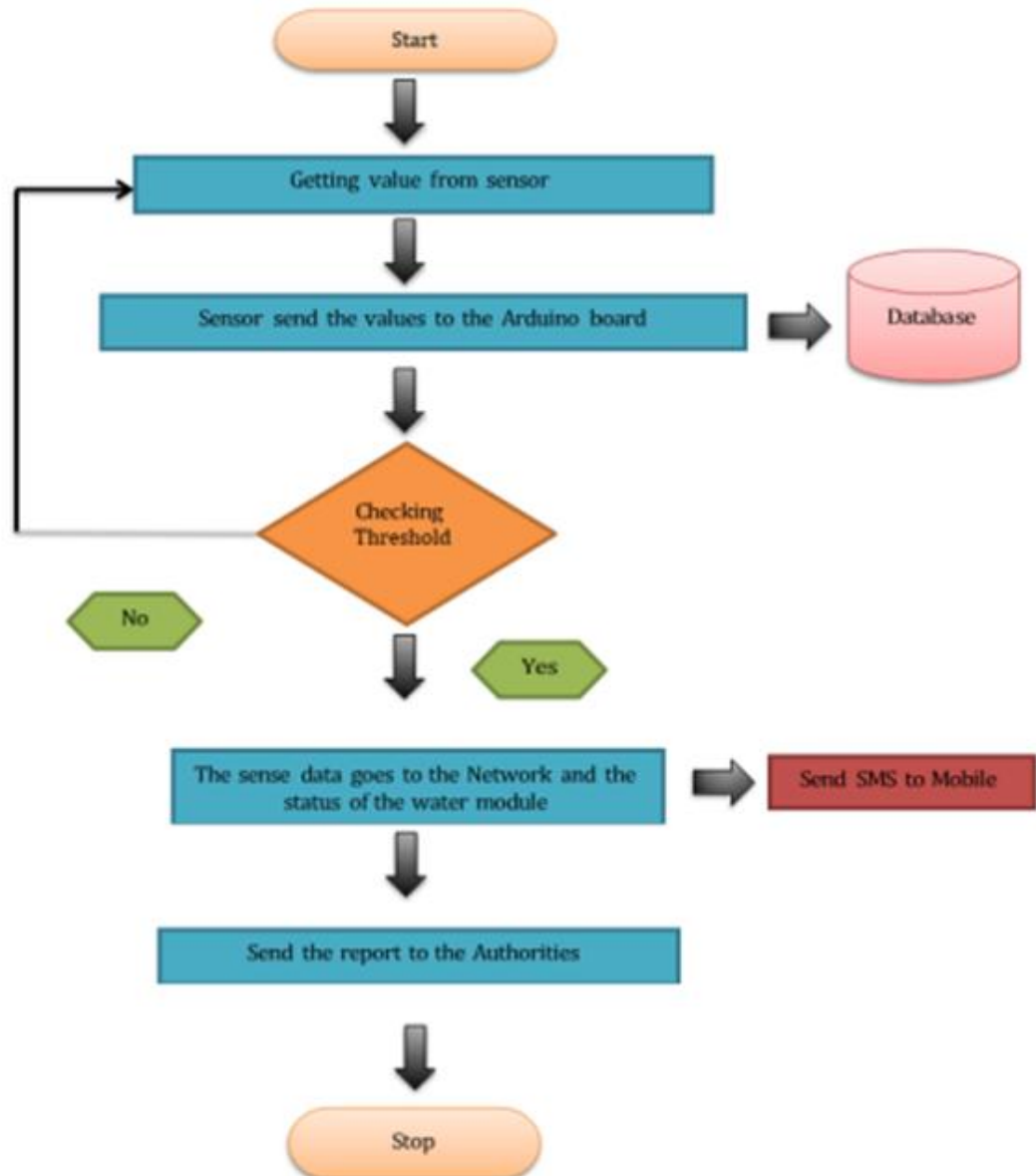
5 PROJECT DESIGN

5.1 Data Flow Diagram

INTRODUCTION:

- A data flow diagram (DFD) is **a graphical or visual representation using a standardized set of symbols and notations to describe a business's operations through data movement**.
- They are often elements of a formal methodology such as Structured Systems Analysis and Design Method
- A data flow diagram **shows the way information flows through a process or system**. It includes data inputs and outputs, data stores, and the various subprocesses the data moves through.
- DFDs are built using standardized symbols and notation to describe various entities and their relationships.
- 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
- key Takeaways from this Introduction. To design is **to plan how a product or a service will look and function**. A design process follows a linear process of exploration of a problem, solutions to this problem and then executing on the adequate solution.

- Project design is an early phase of a project where the project's key features, structure, criteria for success, and major deliverables are planned out. The aim is **to develop one or more designs that can be used to achieve the desired** .



5.2 Solution & Technical Architecture

INTRODUCTION:

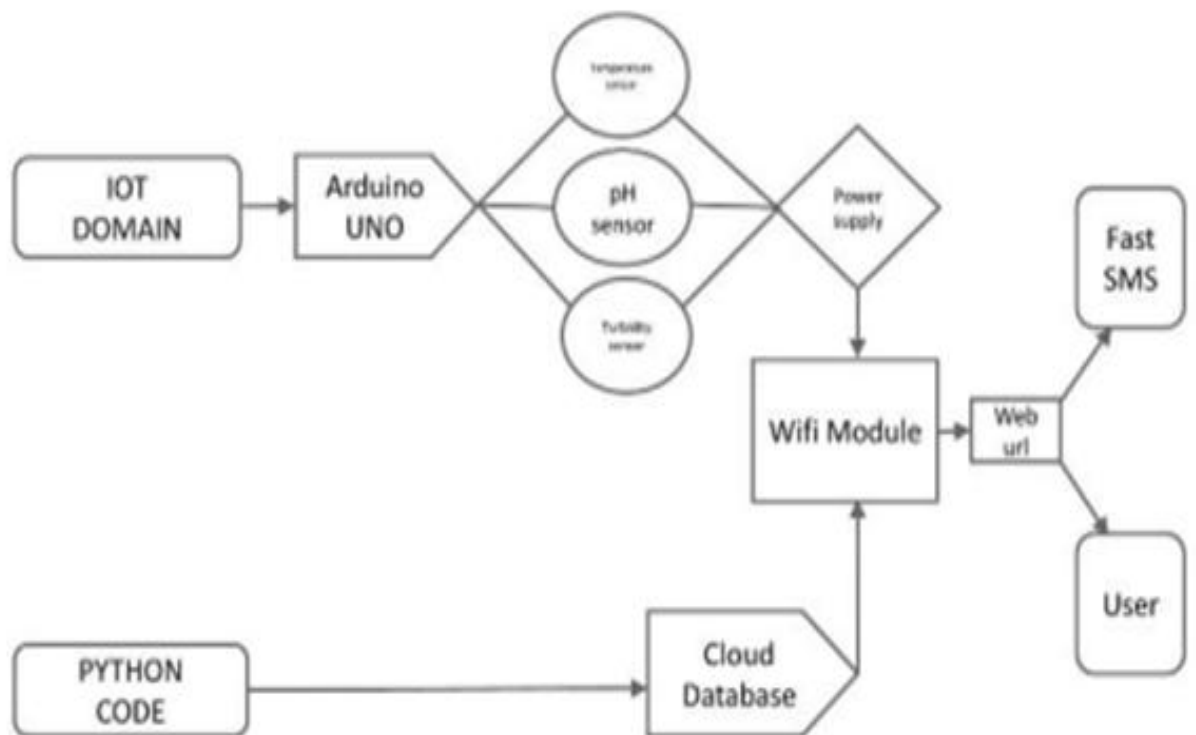
Solution Architecture :

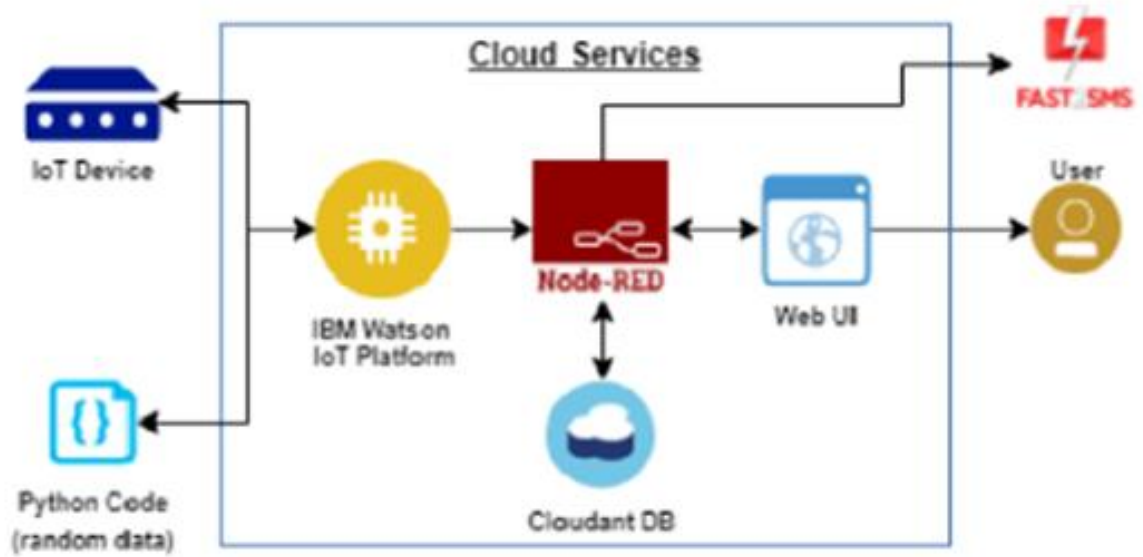
- ❖ **A solution architect is in charge of leading the practice and introducing the overall technical vision for a particular solution.**
- ❖ **A solutions architect creates the overall technical vision for a specific solution to a business problem.**
- ❖ **A solutions architect creates the overall technical vision for a specific solution to a business problem. They design, describe, and manage the solution**

Technical Architecture:

- ❖ **A Technical architect also referred to as an IT Systems Architect, is a systems logistics specialist who creates, maintains, and implements IT systems for a growing business or IT firm.**
- ❖ **You will need the right mix of IT knowledge and managerial skills to succeed in a technical architect career.**

Solution Architecture:





Technical Architecture:

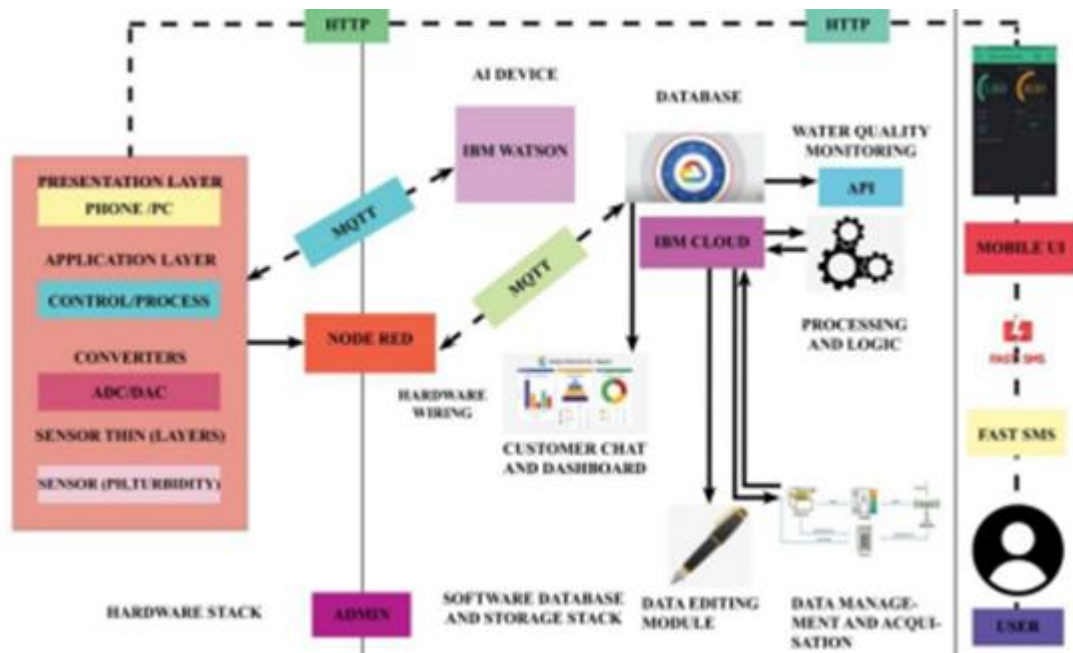


Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	Mobile UI	HTML, CSS, java script
2.	Application Logic-1(mobile application)	Scale meter is introduced to monitor the water parameters	Java
3.	Application Logic-2(AI Application)	For predicting future values of water quality range	IBM Watson Assistant
4.	Database	Data Type	NOSQL.
5.	Cloud Database	Database Service on Cloud	IBM Cloudant
6.	File Storage	File storage requirements: Container Platform Version 4.6	IBM Block Storage
7.	External API-1	The data is used to compare the values for sensor with threshold values	IBM water quality API
8.	External API-2	For the locals and authorities to know the water quality	mobile API,
9.	Machine Learning Model(node-red)	For interfacing hardware and software application(a virtual wiring tool)	Platform: Node.js
10.	Infrastructure (Server / Cloud)	Application Deployment on cloud Cloud Server Configuration : application-client bnd	IBM cloud

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Bootstrap	CSS
2.	Security Implementations	MQTT, CoAP, DTLS, 6LoWPAN	Encryptions, OWASP
3.	Scalable Architecture	The scalability of architecture (3 – tier)	IOT and mobile application
4.	Availability	Distributed servers	IBM cloud and Watson
5.	Performance	Use of cache better performance	Fast SMS application

5.3 User Stories

INTRODUCTION:

- ❖ The technique of expressing requirements as user stories is one of the most broadly applicable techniques introduced by the agile processes. User stories are an effective approach on all time-constrained projects, and are a great way to begin introducing a bit of agility to your projects.
- ❖ In this session, we look at how to identify and write good user stories. The presentation describes the six attributes that good stories should exhibit and presents 13 guidelines for writing better stories. We will explore how user "role modeling" can help when gathering a project's initial stories.
- ❖ Because requirements touch all job functions on a development project, this tutorial will be equally suited for analysts, customers, testers, programmers, managers or anyone involved in a software development project. By the end of this tutorial, you will leave knowing the six attributes of a good story, learn a good format for writing most user stories, learn practical techniques for gathering user stories, know how much work to do up-front and how much to do just-in-time.

User Stories

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 email, password, and confirming my password.	I can access my account/dashboard	High	Sprint-1
		USN-2	As a user, I will receive a confirmation email once I have registered for the application	I can receive e confirmation email & click confirm	High	Sprint-2
		USN-3	As a user, I can register for the application through Google	I can register & access the dashboard with Google	High	Sprint-1
		USN-4	As a user, I can register for the application through Gmail	I can register through the mail.	Medium	Sprint-2
	Login	USN-5	As a user, I can log into the application by entering email, password & captcha	I can receive login credentials.	High	Sprint-1
	Interface	USN-6	As a user, the interface should be user-friendly manner	I can able to access easily.	Medium	Sprint-1
Customer (Web user)	dashboard	WUSN-1	As a web user, I can access the specific info (ph value, temp, humidity, quality).	I can able to know the quality of the water.	High	Sprint-1
Customer Care Executive (input)	View manner	CCE-1	As a customer care, I can view data in visual representation manner(graph)	I can easily understand by visuals.	High	Sprint-1
	Taste	CCE-2	As a customer care , I can able to view the quality(salty) of the water	I can easily know whether it is salty or not	High	Sprint-1
	Color visibility	CCE-3	As a customer care , I can able predict the water color	I can easily know the condition by color	High	Sprint-1
Administrator	Risk tolerant	ADMIN-1	An administrator who is handling the system should update and take care of the application.	Admin should monitor the records properly.	High	Sprint-2

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

INTRODUCTION:

- ❖ 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.
- ❖ It's critical for each team member to be on the same page, which is why **planning must always include the full scrum team**. An effective sprint plan should motivate and provide the team with a clear picture of how this set of work helps to move the product forward.

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint1	Simulation creation	USN-1	Connect Sensors and Arduino with python code	2	High	Ragavi Manisha sasika
Sprint2	Software	USN-2	Creating device in the IBM Watson IoT platform, workflow for IoT scenarios using Node-Red	2	High	Priyanga Sasika Ananthi
Sprint3	MIT App Inventor	USN-3	Develop an application for the real time river water quality management project using MIT App Inventor	2	High	Manisha Ragavi

Sprint4	Dashboard	USN-4	Design the Modules and test the app	2	High	Ananthi priyanga
Sprint5	Web UI	USN-5	To make the user to interact with software.	2	High	Sasika Ragavi

6.2 Sprint Delivery Schedule

INTRODUCTION:

- ❖ In case you're unfamiliar, 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.

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint 1	20	6Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint 2	20	6Days	31 Oct 2022	05 Nov 2022		05 Oct 2022
Sprint 3	20	6Days	07 Nov 2022	12 Nov 2022		12 Oct 2022
Sprint 4	20	6Days	14 Nov 2022	19 Nov 2022		15 Oct 2022

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)

$$AV = \frac{\text{Sprint duration}}{20} = 10 = 2$$

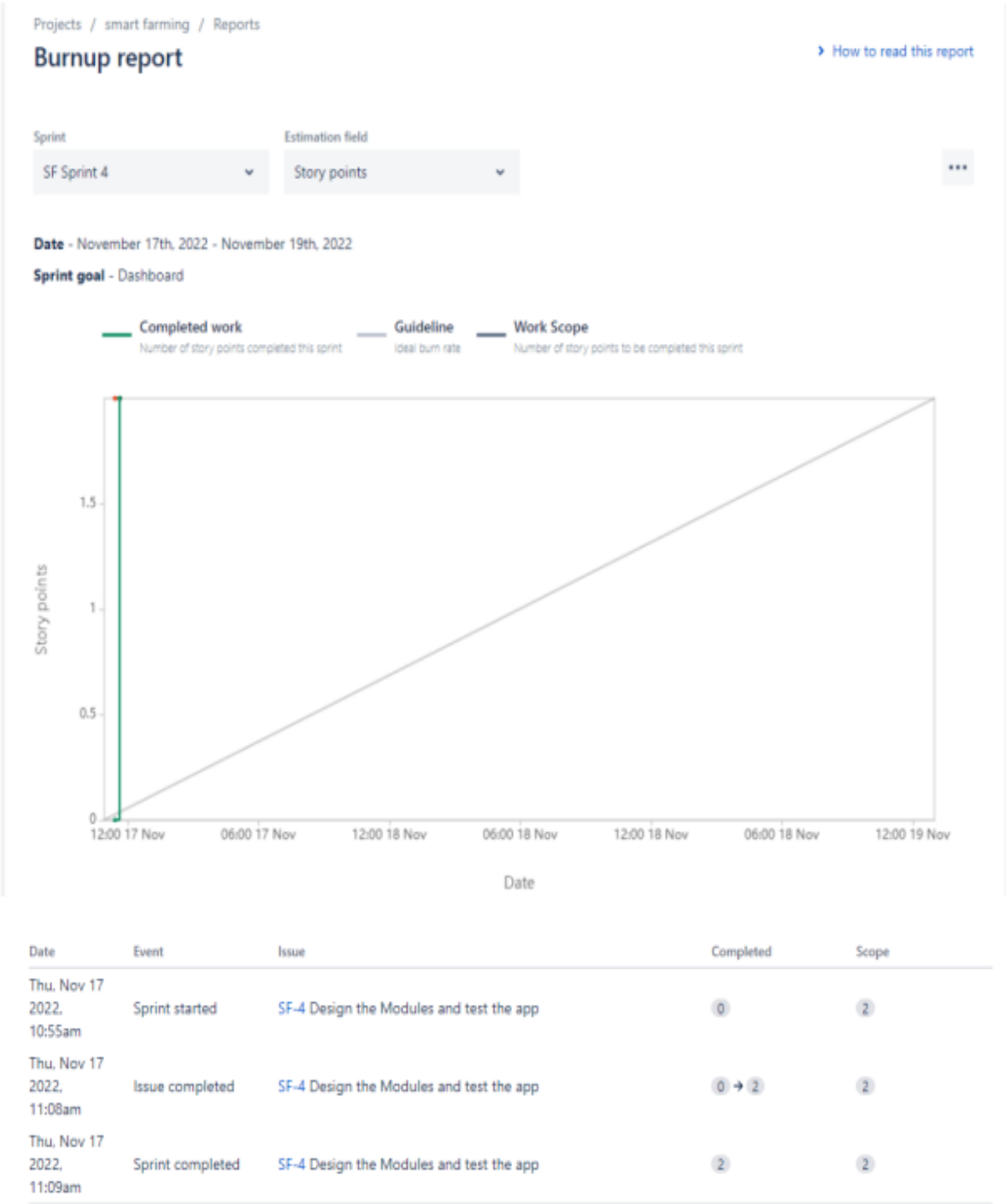
Velocity

6.3 Report from JIRA

INTRODUCTION:

- ❖ Create User Stories & Issues, Plan Sprints, & Distribute Tasks Across Your **Software** Team
- ❖ Explore Various "Per User" Pricing Options, So You'll Never Pay For More Than You Need.
- ❖ Flexible Kanban Boards. Integrates w/ Other Tools. For Teams of All Sizes. Open DevOps.
- ❖ Jira Software is **an agile project management tool that supports any agile methodology, be it scrum, kanban, or your own unique flavor**. From agile boards, backlogs, roadmaps, reports, to integrations and add-ons you can plan, track, and manage all your agile software development projects from a single tool.

BURNUP REPORT:



7. CODING & SOLUTIONING

7.1 Feature 1

ARDUINO

INTRODUCTION:

- ❖ Arduino is **an open-source electronics platform based on easy-to-use hardware and software**. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.
- ❖ The Arduino hardware and software was designed for artists, designers, hobbyists, hackers, newbies, and anyone interested in **creating interactive objects or environments**. Arduino can interact with buttons, LEDs, motors, speakers, GPS units, cameras, the internet, and even your smart-phone or your TV!



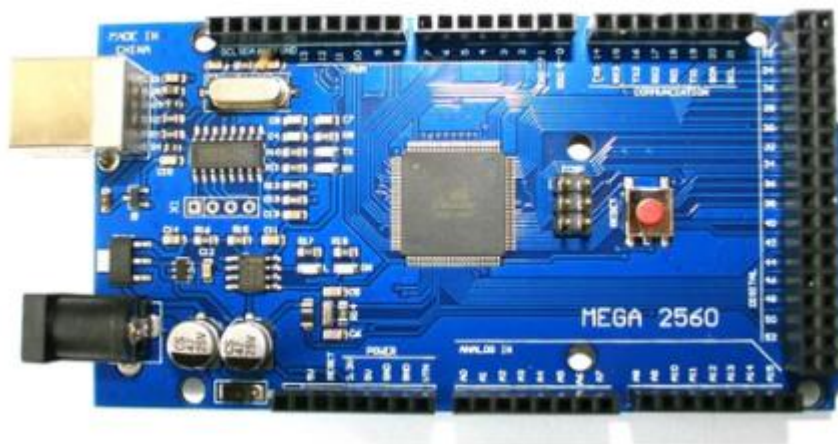
- ❖ Arduino is **an electronics prototyping system designed to simplify microcontroller projects**. The idea is to create these projects without having to know much about microcontrollers or programming, microcontrollers for dummies is one way of describing Arduino.
- ❖ Arduino UNO. Microcontroller. ATmega328P. USB connector. USB-B. Built-in LED Pin. Digital I/O Pins. Analog input pins. ...

- ❖ Arduino NANO. Microcontroller. ATmega328. USB connector. Mini-B USB. Built-in LED Pin. Digital I/O Pins. Analog input pins. ..
- ❖ Arduino Micro. Microcontroller. ATmega32u4. USB connector. Micro USB.

TYPES OF ARDUNIO:

Arduino Board	Processor	Analogue I/O
Arduino Uno	16Mhz ATmega328	6 input, 0 output
Arduino Due	84MHz AT91SAM3X8E	12 input, 2 output
Arduino Mega	16MHz ATmega2560	16 input, 0 output
Arduino Leonardo	16MHz ATmega32u4	12 input, 0 output

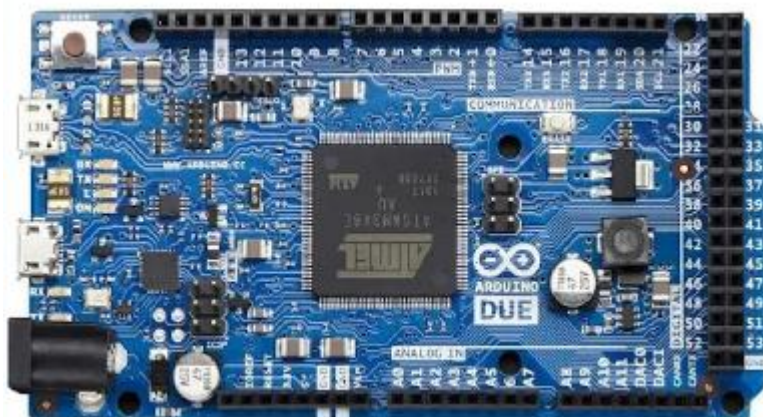
Arduino Mega



Arduino Uno



Arduino Due



Arduino Leonardo



7.2 Feature 2

1. PH SENSOR
2. Turbidity sensors
3. Temperature Sensor

PH SENSOR INTRODUCTION:

- ❖ A pH sensor **helps to measure the acidity or alkalinity of the water with a value between 0-14**
- .
- ❖ When the pH value dips below seven, the water starts to become more acidic. Any number above seven equates to more alkaline. Each type of pH sensor works differently to measure the quality of the water
- .

- ❖ People use sensors to **measure temperature, gauge distance, detect smoke, regulate pressure** and a myriad of other uses. Because analog signals are continuous, they can account for the slightest change in the physical variable (such as temperature or pressure).

Turbidity sensors INTRODUCTION:

- ❖ The gravity Arduino **Turbidity sensor** from DfRobot detects water quality by measuring the levels of turbidity. It uses light to detect suspended ...
- ❖ Turbidity sensors **measure the amount of light that is scattered by the suspended solids in water**. As the amount of total suspended solids (TSS) in water increases, the water's turbidity level (and cloudiness or haziness) increases.



Temperature Sensor INTRODUCTION:

- ❖ A temperature sensor is **an electronic device that measures the temperature of its environment and converts the input data into electronic data to record, monitor, or signal temperature changes**. There are many different types of temperature sensors.
- ❖ A temperature sensor is **a device that detects and measures hotness and coolness and converts it into an electrical signal**.

- ❖ A temperature sensor is a key component of any process heating application as it **provides temperature feedback about the process, which can be used to monitor or control the process.**

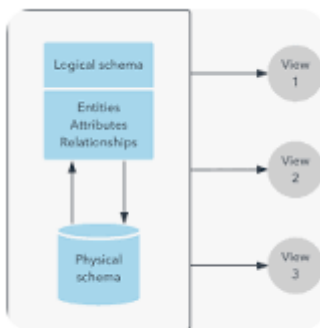
7.3 Database Schema(if Applicable)

INTRODUCTION:

- ❖ A **database schema** serves as a blueprint for the shape and format **of** data within a **database**. For relational **databases**, this includes describing categories
- ❖ A database schema **defines how data is organized within a relational database**; this is inclusive of logical constraints such as, table names, fields, data types, and the relationships between these entities
- ❖ Schema is of three types: **Logical Schema, Physical Schema and view Schema**. Logical Schema – It describes the database designed at logical level. Physical Schema – It describes the database designed at physical level
- ❖ A database schema is a plan or diagram that refers to the organization of the data stored in the database. There are two types of schema – logical and physical. The first represents how data is organized, and the second defines the structure of its physical storage.
- ❖ plural schemata 'skē-mə-tə also schemas. : **a diagrammatic presentation**. broadly : a structured framework or plan : outline. : a mental codification of experience that includes a particular organized

way of perceiving cognitively and responding to a complex situation or set of stimuli

- ❖ There are two main kinds of database schema: A logical database schema conveys the logical constraints that apply to the stored data. It may define integrity constraints, views, and tables. A physical database schema lays out how data is stored physically on a storage system in terms of files and indices.



8. TESTING

8.1 Test Cases

INTRODUCTION:

- ❖ A test case is a **singular set of actions or instructions for a tester to perform that validates a specific aspect of a product or application functionality.**
- ❖ If the test fails, the result might be a software defect that the organization can triage
- ❖ **Test Case** with **introduction**, software development life cycle, design, development,

testing, quality assurance, quality control,
methods, black box testing, ...

Count	Inputs	Output	Results
1	Latitude:17.4219272 Longitude:78.5488783	Parents Can view the child's location in the application	Normal condition
2	Latitude:17.5442272 Longitude:78.7687831	Parents Can view the child's location in the application	Normal condition
3	Latitude:30.4219272 Longitude:108.5488783	Parents Can view the child's location in the application and also alert message sent and stored in cloud	Critical condition
4	Latitude:17.0987654 Longitude:78.6542789	Parents Can view the child's location in the application	Normal condition

8.2 Acceptance Testing

INTRODUCTION:

- ❖ A QA team conducts acceptance tests **to ensure the software or app matches business requirements and end-user needs**. An acceptance test returns either a pass or fail result. A fail suggests that there is a flaw present, and the software should not go into production.

Types of acceptance testing include:

- Alpha & Beta Testing.
- Contract Acceptance Testing.
- Regulation Acceptance Testing.
- Operational Acceptance testing.

The 6 Steps of Testing to get to “Final Acceptance”

- Stage 1: Factory Acceptance Test.
- Stage 2: Customer Acceptance Test.
- Stage 3: Site Acceptance Test.
- Stage 4: Coverage Verification Test.
- Stage 5: Final System Acceptance Test.
- Stage 6: Burn In Period.

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	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	12	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	24	14	13	26	77

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	0	7
Client Application	51	0	0	51
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	0	2

□

9. RESULTS

9.1 Performance Metrics

INTRODUCTION:

- ❖ Performance measurement is **the process used to assess the efficiency and effectiveness of projects, programs and initiatives.**
- ❖ It is a systematic approach to collecting, analyzing and evaluating how “on track” a project/program is to achieve its desired outcomes, goals and objectives.
- ❖ **Performance measurement** is an assessment of how well an organization performs when providing goods and services to its customers.
- ❖ Performance measurement is **used to motivate managers to make decisions that benefit the corporation and themselves.** Therefore, the key to good performance measurement techniques is to set goals that are realistic and that incorporate decisions over which the manager has control



NFT - Risk Assessment								
Project Name	Scope/feature	Functional Change	Hardware Changes	Software Changes	Impact of Downtime	Load/Volumen Changes	Risk Score	Justification
Real time river water	chemical analysis of water, and all complex.	Low	No Changes	Moderate	No Changes	>5 to 10%	ORANGE	As we have seen the chnages
	Increased efficiency							allow water quality monitoring
	Easy to Use							at household levels as well.
	Automated Method.							
		NFT - Detailed Test Plan						
		S.No	Project Overview	NFT Test approach	Implications/Dependencies/	Approvals/SignOff		
		1	Real time river water quality	min-0.48 max-0.93	up to 32% in 2100 in the S	approve any dam ... River		
			monitoring and control system	Average-0.73	strategic risk hydroelectric p	Sign off-Cancer, Scorpio, and Pisces		
			End Of Test Report					
Project Overview	NFT Test approach	NFR - Met	Test Outcome	GO/NO-GO decision	Recommendations	Identified Defects (Detected/Closed/Open)	Approvals/SignOff	
Real time river water	Biodiversity-0.53,0.51	PH-6.0 to 8.5	PH value raw water-7.62	GO decision	No	cost of analysis is very high	approve any dam ... River	
	Hydrology-0.558,0.27	sodium-200	PH value filter water-7.18			Less reliability.	Sign off- Cancer, Scorpio, and Pisces	
	Water Quality-0.47,0	Iron-0.2 to 1.7	Efficiency-5.8			Frequency of testing is very low.		
	Geomorphology-0.41	nitrate-10	Remark-Safe					

ADVANTAGES

- ❖ To measure physical & chemical parameters of water.

- ❖ **Enhance environmental** Compared to the conventional water quality testing techniques, sensor based water quality testing has many advantages such as **accurate, high sensitivity, good selectivity, speed, fast response, low cost** etc
- ❖ It is a cost effective and efficient system designed to monitor drinking water quality.
- ❖ For instance, installing a real-time river monitoring solution will provide managers with accurate details and the **status of river water levels, enabling** them to **make quick and informed** decisions that result in **effective ROI**.
- ❖ Modern smart water monitoring systems **analyse data continually and instantly alert users to changes in the system, giving peace of mind and reducing the need for unreliable and expensive sampling.**
- ❖ To measure physical & chemical parameters of water.
- ❖ To protect , restore, and enhance environmental quality towards good public health.
- ❖ The system is very cheap as the hardware and software does not much.
- ❖ It accurate measurements on PH, total dissolved salts, electrical conductivity and the temperature of your water.
- ❖ The parameters such as Temperature, PH and dissolved oxygen of the water can be measured.

DISADVANTAGES

- ❖ There is no continuous and remote monitoring.
- ❖ Human resource is required.
- ❖ Less reliability.
- ❖ No monitoring at the source of water.
- ❖ Frequency of testing is very low.
- ❖ It is difficult to collect the water sample from all the area of water body.
- ❖ The cost of analysis is very high.
- ❖ The lab testing and analysis takes some time and hence the lab results does not reflect real time water quality measurement due to delay in measurement.
- ❖ Some cleaning system cost a lot of money.
- ❖ The process is time consuming due to slow process of manual data collection from different locations of the water body.

11 . CONCLUSION

- ❖ Real-time river water 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].
- ❖ This research would recommend conducting systematic experimentation of the proposed technologies in diverse qualities of river water in Bangladesh.
- ❖ Due to the limitation of the budget, we only focus on measuring the quality of river water parameters.
- ❖ 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.

- ❖ The IoT system was used to collect the data from identified stations for different water quality parameters such as pH, turbidity, DO, BOD, NO₃, temperature and conductivity to generate a data set that was used to monitor the quality of water.
- ❖ The collected data were successfully utilized to assess the water quality of river Krishna using one-Way ANOVA which analyze a particular parameter and predict the quality based on value obtained.
- ❖ Two-way ANOVA was used to do the analysis of two parameters as a single entity as well as a combination of two parameters. The results showed that one-Way ANOVA was best suited for training the IoT system.
- ❖ The observations showed that all the water quality parameters play a vital role in one or the other seasons. In summer season, the parameters conductivity and TDS were found to be more concentrated due to low water level in the river and the water quality was 30.39%. In rainy season, the water quality was 65.37% and the parameter affecting the water quality was DO.
- ❖ In winter seasons, DO was the parameter which affected the water quality and the water quality was 46.47%. The collected data set can also be used in future to make the system intelligent by applying machine learning techniques.

12 FUTURE SCOPE

- ❖ This system makes use of many sensors (**pH, conductivity, turbidity, temperature, oxidation-reduction potential**), **processing module microcontroller**, These sensors capture the data in the form of analog signals.

- ❖ The ADC converts these signals into the digital format. These digital signals are sent to the microcontroller via a Wi-Fi module.
- ❖ The microcontroller will furtherance the digital information, analyze it, and further communication is done by the Wi-fi module.
- ❖ The Wi-Fi module sends an Information with the water quality parameters onto the smart phone or PC of the concerned user, which also displayed on the LCD of the micro controller.
- ❖ In this water quality monitoring system, microcontroller accepts and processes the data collected from the sensors to the Web. page via Wi-Fi module.
- ❖ This is carried out with the help of coding. The code is written in Embedded-C and using the Arduino software to simulate the code.

13. APPENDIX

- ❖ Friedler and Juanico (1996) proposed guidelines for water allocation for rehabilitation of rivers in Israel. This appendix therefore focuses on Israel's rivers but the biophysical principles apply to all rivers in the study area, including the Jordan River.
- ❖ The river should have waters that sustain biodiversity, provide the ecosystem service of "open space," and also allow for economic development along the river course.

- ❖ With respect to water quantity, at less than 10 percent of natural base flow (excluding storm water) the river ceases to function as a river, whereas this 10 percent flow quantity can be tolerated, provided this low flow only occurs for short periods.

- ❖ To maintain the aquatic and riparian biodiversity, however, 30 percent of natural base flow is minimal sustained average.

- ❖ Flood flows are critical too. Floods remove deposits accumulated during the long summer that would otherwise obstruct the flow.

- ❖ Water quality standards are proposed for chlorination (carried out to meet health requirements, but which can be toxic to all fish), for organic load (high load causes dangerous anoxia), for ammonium (which can generate toxic ammonia) and for pH and salinity (which must be kept within ranges prevalent in the natural stream).

- ❖ A prerequisite for meeting these standards is that the velocity should not be lower than 0.2 m/sec (with water width and depth of at least 5 m and 0.5 m, respectively).

- ❖ It should be noted that compliance with human health regulations alone can still be destructive to the river's aquatic biodiversity.

- ❖ The recipe and timetable for the rehabilitation of the "dead" rivers of Israel is as follows: (1) a legal procedure of water allocation to the river should be completed, and the discharge of Suggested
Citation:"Appendix D: Guidelines for Rehabilitation of Rivers.

- ❖ " National Academy of Sciences. 1999. Water for the Future: The West Bank and Gaza Strip, Israel, and Jordan. Washington, DC: The National Academies Press. doi: 10.17226/6031.

- ❖ the allocated water should proceed; (2) point pollution sources along the river course should be removed, and at the same time nonpoint pollution sources should be identified and controlled; (3) measures for secondary treatment of sewage sources should be taken; and (4) tertiary treatment should be applied, and facilities for pooling wastewater to control the flow of the river should be constructed and operated.

- ❖ National Academies of Sciences, Engineering, and Medicine. 1999. Water for the Future: The West Bank and Gaza Strip, Israel, and Jordan. Washington, DC: The National Academies Press. <https://doi.org/10.17226/6031>.

- ❖ The 28 km of the Yarkon River meander through Israel's most densely populated area. The discharge of the source of Yarkon river, Ein Afek springs, was 220 to 200 million m³/yr of water prior to the transportation of most of it to irrigate the Negev in 1955.

- ❖ The river died out, and to rehabilitate it, 65 million m³/yr of water were allocated in 1992. The effect on the river was most dramatically expressed in the return of its fish fauna.

- ❖ But later this amount was reduced, from the pressures of other users, and the state of the river deteriorated.

- ❖ The master plan for rehabilitating the river (Rahamimov, 1996), commissioned by the Yarkon River Authority, which was established in 1988, paves the way for full rehabilitation of the river.

- ❖ The master plan follows the guidelines for river rehabilitation in Israel and is based on the premise that only 9 million m³/yr of freshwater could be allocated, with the rest replaced by treated wastewater, 12 million m³/yr of which is already allocated.
- ❖ The allocation to be released from the impounded Ein Afek springs, together with the allocation of treated wastewater, is to guarantee 10 percent of the original flow—2,500 m³/hr.
- ❖ The water will be sold to users along the river course, that is to authorities who will operate parts of the riparian areas as recreational areas.
- ❖ Finally, prior to reaching the last, saline section of the river, the water will be impounded for conventional use.
- ❖ Thus, except for the little water lost by evaporation, there will be no losses to the national water budget. Percolated water will recharge the aquifer, and the rest will be sold twice.
- ❖ This arrangement should fully compensate for the cost of impounding the water downstream rather than upstream near the source (i.e., will cover the cost of uplifting the water for users above the point of impoundment).
- ❖ Hundreds of tons of garbage have been removed from the river to restore its original depth, the river's banks have been cleaned up, reinforced, and raised, sewage treatment plants in some cities discharging wastewater to the river have been inaugurated, and mosquito larvae are controlled by introduced predatory fish (*Gambusia*) and by seasonal application of *Baillus thuringiensis israelensis* (BTI), a mosquito larvae—specific pathogen, inert to all other forms of life.

- ❖ The last approach is a demonstration of the potential use of local biodiversity—this
- ❖ Suggested Citation:"Appendix D: Guidelines for Rehabilitation of Rivers." National Academy of Sciences. 1999.
- ❖ Water for the Future: The West Bank and Gaza Strip, Israel, and Jordan. Washington, DC: The National Academies Press. doi: 10.17226/6031.×
- ❖ pathogen, discovered in an Israeli ephemeral pond, has become the major means of control of local mosquitoes, and also a source of income as an export product.
- ❖ Following the example of the Yarkon River, the 44 km of the Alexander river, inhabited by a relatively large and sole population of the Nile softshell turtle (*Trionyx triunguis*), is being rehabilitated as of 1995, and now receives 225,000 m³/hr from various sources.
- ❖ The Soreq river used to be a permanent coastal river, with winter floods added by stream from the Soreq mountains. This stream currently is a permanent flow of Jerusalem's 14 million m³/yr of sewage, 20 percent of which is lost by percolation prior to reaching the coastal plain.
- ❖ The remainder reaches treatment plants in the foothills and is used for irrigating cotton.
- ❖ A proposal has been made to create a continuous flow along the coastal part, with 15 million m³/yr of treated wastewater from local towns.
National Academies of Sciences, Engineering, and Medicine. 1999.
- ❖ Water for the Future: The West Bank and Gaza Strip, Israel, and Jordan. Washington, DC: The National Academies Press.
<https://doi.org/10.17226/6031>.

Source Code

```
#importing Random function to generate the value
import random as rand

for i in range(5):
    print("Test case:",i+1)
    print("Welcome to Real-Time River Water Quality Monitoring and
Control System")
    temperature = int(rand.randint(-40,125))
    pH = int(rand.randint(0,14))
    DO = int(rand.randint(0,100))
    TSS = int(rand.randint(0,3700))
    Manganese = int(rand.randint(0,1000))
    Copper = int(rand.randint(0,2000))
    ammonia_Nitrate = int(rand.randint(0,100))
    Hardness = int(rand.randint(0,1000))
    Zinc = int(rand.randint(0,100))
    Conductivity = f"{float(rand.uniform(0.001,2000)):.2f}"
    Chloride = int(rand.randint(0,200))
    Sulphate = int(rand.randint(0,1000))
    #These variables store value of random data to be shared to the cloud

    #printing the values
    print(
        "Temperature:", temperature,
        "\npH:", pH,
        "\nDO:", DO,
        "\nTSS:", TSS,
        "\nManganese:", Manganese,
        "\nCopper:", Copper,
        "\nAmmonia & Nitrate:", ammonia_Nitrate,
        "\nHardness:", Hardness,
        "\nZinc:", Zinc,
        "\nConductivity:", Conductivity,
        "\nChloride:", Chloride,
        "\nSulphate:", Sulphate, "\n"
```

OUTPUT :

```
* Test case: 1
Welcome to Real-Time River Water Quality Monitoring and Control System
Temperature: 80
pH: 6
DO: 5
TSS: 2881
Manganese: 499
Copper: 1057
Ammonia & Nitrate: 84
Hardness: 253
Zinc: 92
Conductivity: 434.60
Chloride: 162
Sulphate: 987
```

```
Test case: 2
Welcome to Real-Time River Water Quality Monitoring and Control System
Temperature: -3
pH: 13
DO: 38
TSS: 620
Manganese: 578
Copper:1250
Ammonia & Nitrate: 95
Hardness: 380
Zinc: 81
Conductivity: 812.55
Chloride: 0
Sulphate: 225
```

GitHub & Project Demo link

<https://drive.google.com/file/d/15iBfGDknm3f7dtWJnbHfyr15YO2LWiWu/view?usp=sharing>