REAL TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM

Category: **INTERNET OF THINGS**

A PROJECT REPORT

Submitted by

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SRI VENKATESWARA COLLEGE OF ENGINEERING

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PROJECT GUIDES

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INTRODUCTION

1.1 Project Overview:

River Water quality monitoring System

River water which is used as drinking water is a very precious commodity for all human beings.The system consists of several sensors which are used for measuring physical and chemical parameters of water. The parameters such as temperature, pH, and dissolved oxygen of the water can be measured. Using this system a person can detect pollutants from a water body from anywhere in the world.Current water quality monitoring system is a manual system with a monotonous process and is very time-consuming This paper proposes a sensorbased water quality monitoring system.

The main components of Wireless Sensor Network (WSN) include a micro-controller for processing the system, communication system for inter and intranode communication and several sensors Real-time data access can be done by using remote monitoring and Internet of Things (IoT) technology Data collected at the IBM cloud Server and verify them to trigger the actions to be performed.

1.2 Purpose:

Water quality refers to chemical, physical biological and radio logical characteristics of water. It is a measure of the condition of water relative to the necessities of one or more bio-tic species and or to any human need or purposes .Water quality monitoring is defined as a sampling and analysis of the water in lake, stream, ocean and river and conditions of the water body. Smart water quality monitoring is a process of real-time monitoring and the analysis of water to identify changes in parameters based on the physical, chemical and biological characteristics.Monitoring water quality is clearly important: in our seas, our rivers, on the surface and in our ports, for both companies and the public.

It enables us to assess how they are changing, analyze trends and to inform plans and strategies that improve water quality and ensures that water meets its designated use.There are several indicators determining water quality. These include dissolved oxygen, turbidity, bio indicators, nitrates, pH scale and water temperature.Monitoring water quality helps to identify specific pollutants, a certain chemical, and the source of the pollution.There are many sources of water pollution: wastewater from sewage seeping into the water supply; agricultural practices (e.g., the use of pesticides and fertilizer); oil pollution, river and marine dumping, port, shipping and industrial activity.

Monitoring water quality and a water quality assessment regularly provides a source of data identify immediate issues – and their source.

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

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

- Environmental planning methods: water pollution prevention and management.

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

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

LITERATURE SURVEY

2.1 Existing Problem:

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

2.2 References:

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

2. S. Thombre, R.U. Islam, K. Andersson, M.S. Hossain IP based Wireless Sensor Networks : performance Analysis using Simulations and Experiments.Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications, 7 (2016).

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

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

2.3 Problem Statement:

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

IDEATION & PROPOSED SOLUTION

3.1 Empathy Map :

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

3.2 Ideation & Brainstorming:

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

SAY AND DO?

DATA MANAGMENT

PROVIDE A MONITORING AND CONTROL

HEAR?

DOES IT TRANSFER THE DATA

QUALITY OF WATER

THINK AND FEEL?

WATER QUALITY MONITORING

LOCATION TRACKING

SEE?

DATA TRANSFER

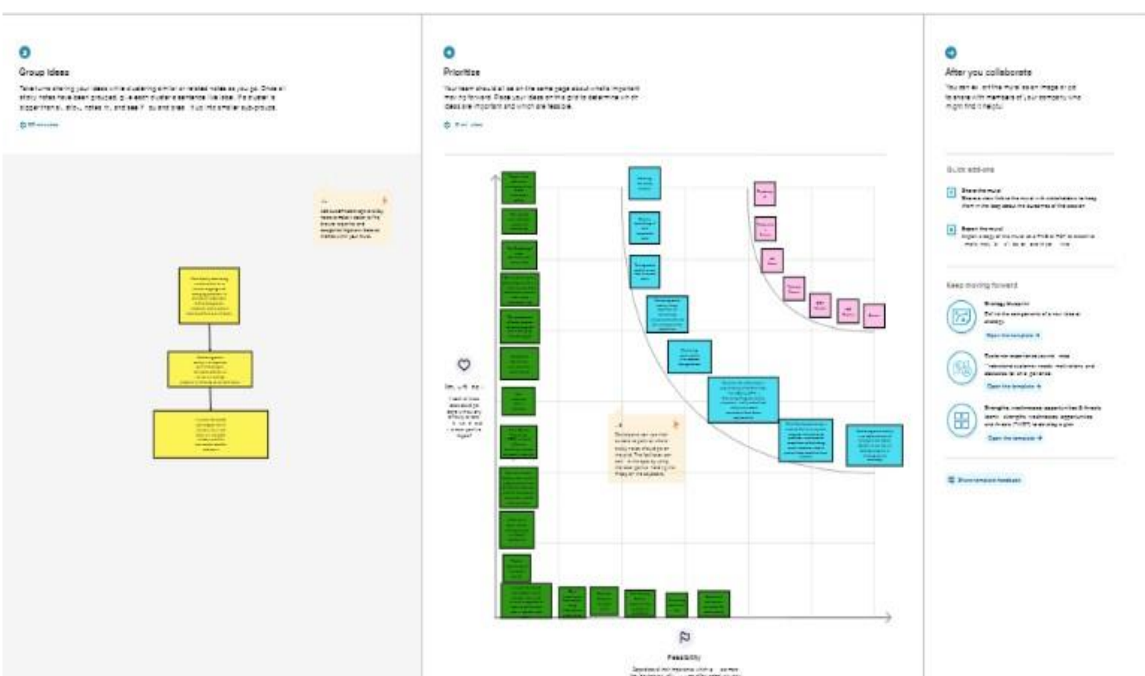
INFORMATION MANAGMENT

PAIN:

- NEED A PROPER INTERNET AND WATER FLOW
- SENSORS FAULTS

GAIN:

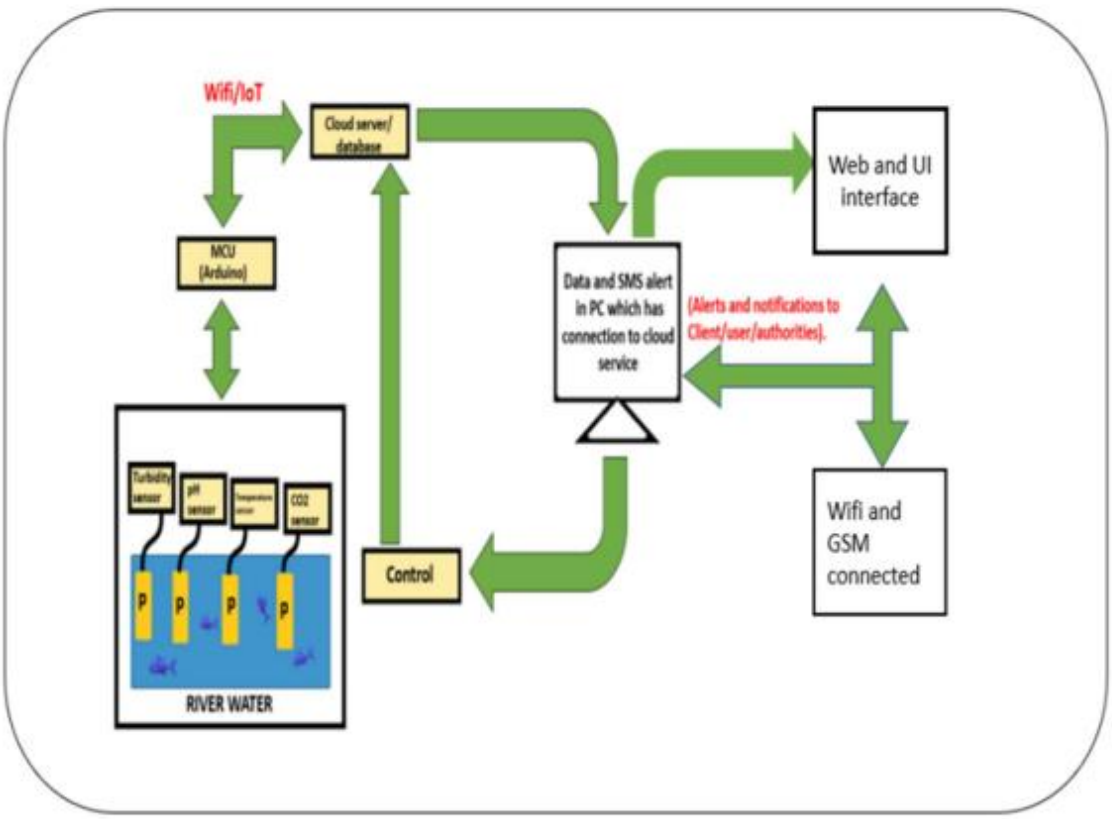
- QUALITY PURPOSE
- UPDATED INFORMATION



3.3 Proposed Solution:

S.No.	**Parameter**	**Description**
1.	Problem Statement (Problem to be solved)	Eutrophication, or the massive development of algae, causes pollution (monitoring and managing the quality of river water
2.	Idea / Solution description	Detecting dust particles, monitoring water PH, dissolved oxygen, and temperature, and changing authorities if water quality is poor
3.	Social Impact / Customer Satisfaction	Localities will not suffer as a result of poor water quality since they will be notified when the water quality is not good
4.	Business Model (Revenue Model)	Aeron systems provides water quality monitoring systems for industrial water treatment plants, river bodies, aqua forming, and digital recorders
5.	Scalability of the Solution	The assessment of realtime readings and continual monitoring helps in the preservation of water quality.
6.	Novelty / Uniqueness	A web application may be used to monitor the quality of river water. The quality parameter will be tracked in real time with standard measurements.

3.3 Proposed Solution:



4 REQUIREMENT ANALYSI

4.1 Functional Requirements:

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR 1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIN
FR 2	User Confirmation	Confirmation via Email Confirmation via OTP
FR 3	Ultrasonic generator	Periodically the waves are generated to destroy algae in the range of 25%,50%,100%
FR 4	Ph level detection	To observe the water quality, Ph sensor is used and the signals are conveyed to the Arduino
FR 5	Turbidity detection	Turbidity sensor measures the purity of element or marshy utter in the water and the signals are delivered to Arduino

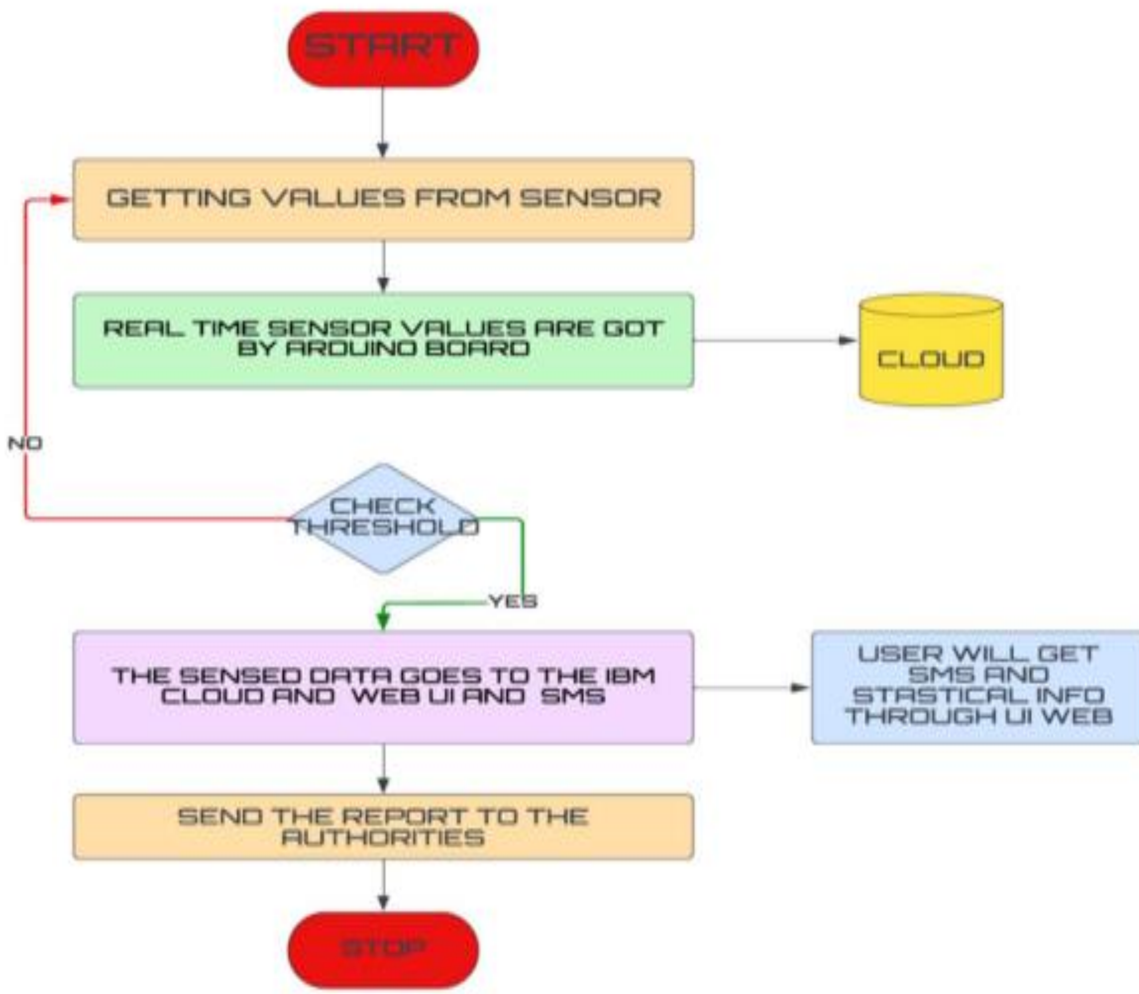
4.2 Non-functional Requirements:

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Monitors the flow and quality of ground water, and investigates surface- and ground-water interactions.
NFR-2	Security	The data and information are secured in the application by using the application firewall.
NFR-3	Reliability	The Real time sensor output values with future predicted data storage with output efficiency of 98%. It also gives certainty for aquaculture safety
NFR-4	Performance	The performance of system has higher efficiency and environmental friendly.
NFR-5	Availability	It is available in the form of mobile UI 24 x 7 monitoring system.
NFR-6	Scalability	The system has high scalability. Able to be changed in size or scale to give the best output.
NFR-7	Stability	The ability of the system to bring itself back to its stable configuration. The stability is high.
NFR-8	Efficiency	The monitoring system is highly efficient,high mobility with consumption of power.

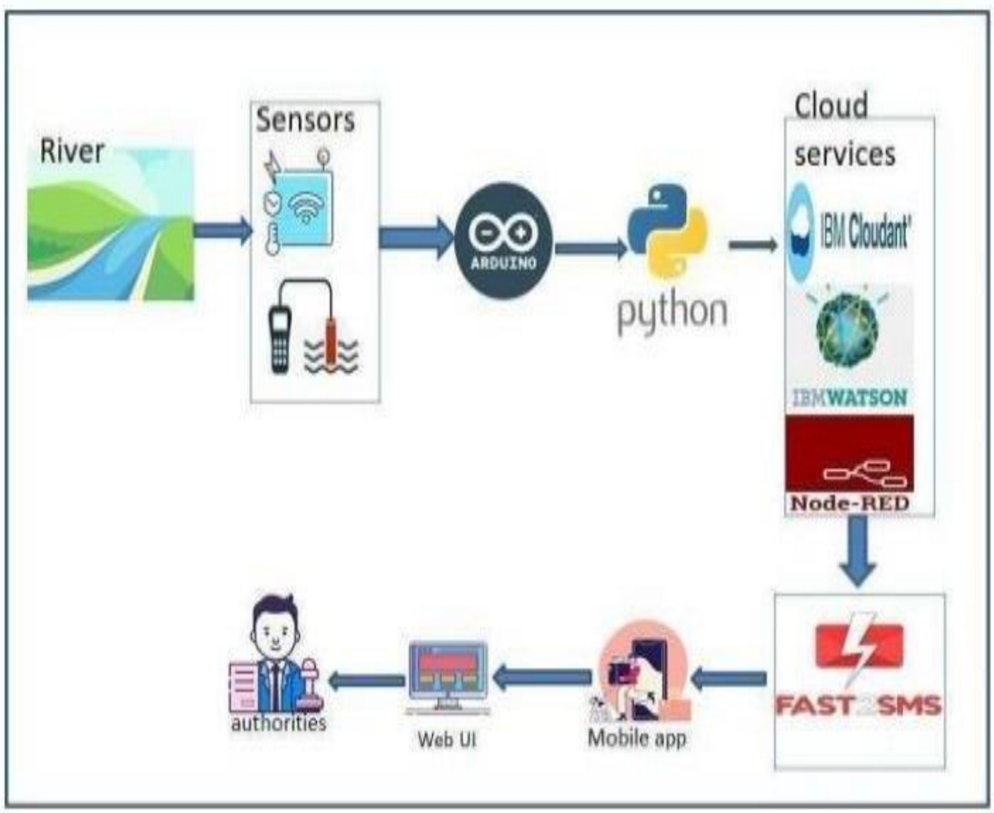
5. PROJECT DESIGN

5.1 Data Flow Diagrams:

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



5.2 SOLUTION AND TECHNICAL ARCHITECTURE



TECHNICAL ARCHITECTURE

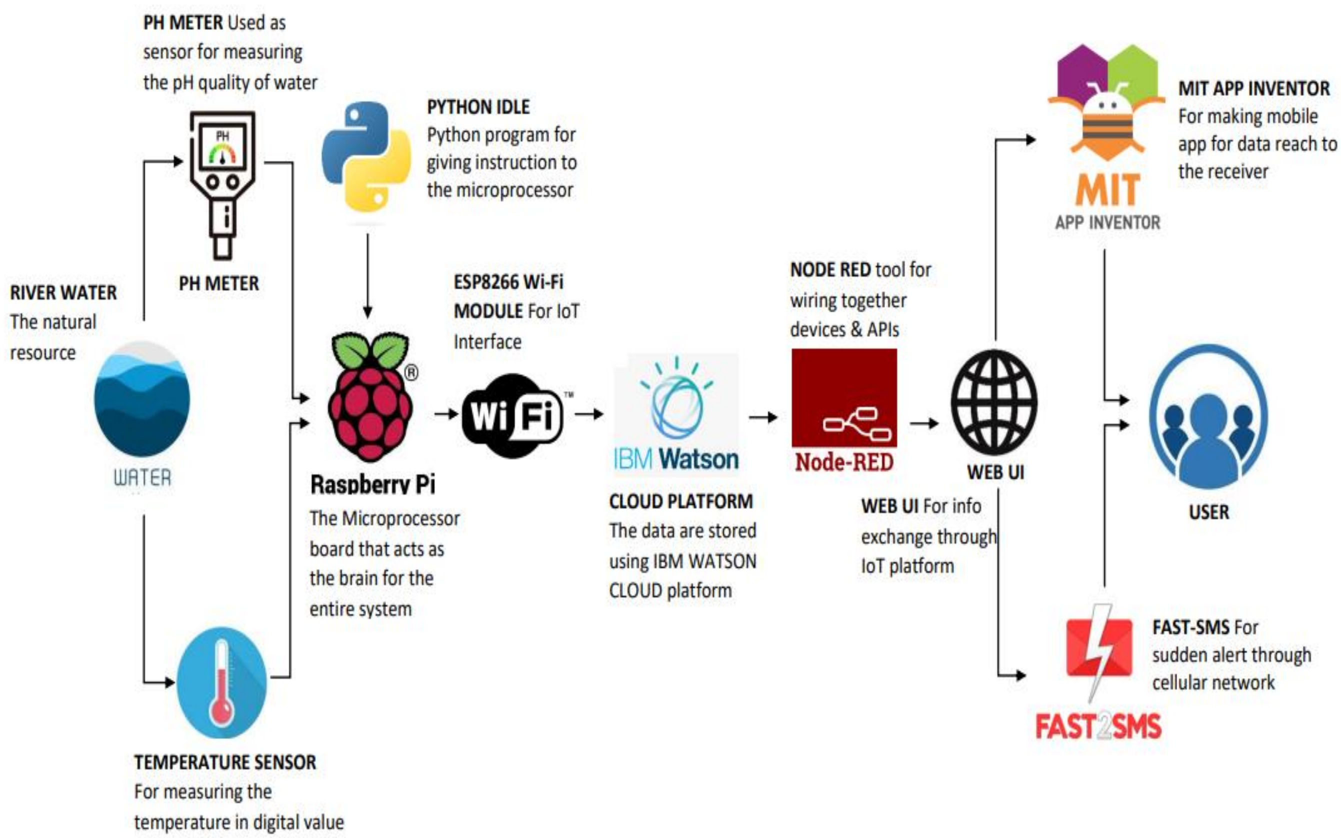


Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application	HTML, CSS, Node-Red ,Cloud,etc
2.	Application Logic-1	Logic for a process in the application	JAVA/PYTHON
3.	Application Logic-2	Logic for a process in the application	IBM WATSON STT services
4.	Application Logic-3	Logic for a process in the application	BM WATSON Assistant
5.	Database	Data Type, Configurations etc	MySQL,PostgresSQL
6.	Cloud Database	Database Service on Cloud	IBM DB2,IBM Cloudant etc
7.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
8.	External API-1	Purpose of External API used in the application	IBM Weather API, etc
9.	External API-2	Purpose of External API used in the application	Aadhar API, etc
10.	Machine Learning Model	Purpose of External API used in the application	Object Recognition Model, etc..
11.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration :	Local, Cloud Foundry, Kubernetes, etc.

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
	Open-Source Frameworks	List the open-source frameworks used	Technology of Opensource framework
2.	Security Implementations	List all the security / access controls implemented, use of firewalls etc	e.g. SHA-256, Encryptions, IAM Controls, OWASP etc.
3.	Scalable Architecture	Justify the scalability of architecture (3 – tier, Micro-services)	Technology used
4.	Availability	Justify the availability of application	Technology used
5.	Performance	Design consideration for the performance of the application	Technology used

6.PROJECT PLANNING AND SCHEDULING

6.2 SPRINT DELIVERY SCHEDULE

Sprint	Functional Requirement (Epic)	User Story Numb err	User Story / Task	Story Points	Priority
Sprint-1	Registration	USN-1	As a user, I canregister for the application by entering my email, password, and confirming My password.	2	HIGH
	Registration via Facebook	USN-3	As a user, I can register for the application through Facebook	2	LOW
	Registration via Mail ID	USN-4	As a user, I can register for the application through Gmail	2	MEDIUM
Sprint-2	Confirmation	USN-2	As a user, I will receive confirmation email once I have registered for the application	1	HIGH
	Login	USN-5	As a user, I can log into the application by entering email & password	1	HIGH
	IBM Cloud service Access		Get access to IBM cloud services.	2	HIGH
Sprint-3	Create the IBM Watson IoT and device Settings	USN-6	To create the IBM Watson IoT Platform and integrate the microcontroller with it, to send the sensed data on Cloud	2	HIGH
	Create a node red service	USN-7	To create a node red service to	2	MEDIUM

			integrate the IBM Watson along with the Web UI		
	Create a Web UI	USN-8	To create a Web UI, to access the data from the cloud and display all parameters.	2	MEDIUM
	To develop a Python code	USN-9	Create a python code to sense the physical quantity and store data	2	MEDIUM
Sprint-4	Publish Data to cloud.	USN-10	Publish Data that is sensed by the microcontroller to the Cloud	3	HIGH
	Fast-SMS Service	USN-11	Use Fast SMS to send alert messages once the parameters like pH, Turbidity and temperature goes beyond the threshold	3	HIGH
	Testing	USN-12	Testing of project and final deliverables	3	MEDIUM

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	4 Days	24 Oct 2022	27 Oct 2022	20	29 Oct 2022
Sprint-2	20	5 Days	28 Oct 2022	01 Nov 2022	20	04 Nov 2022
Sprint-3	20	8 Days	02 Nov 2022	09 Nov 2022	20	11 Nov 2022
Sprint-4	20	9 Days	10 Nov 2022	18 Nov 2022	20	19 Nov 2022

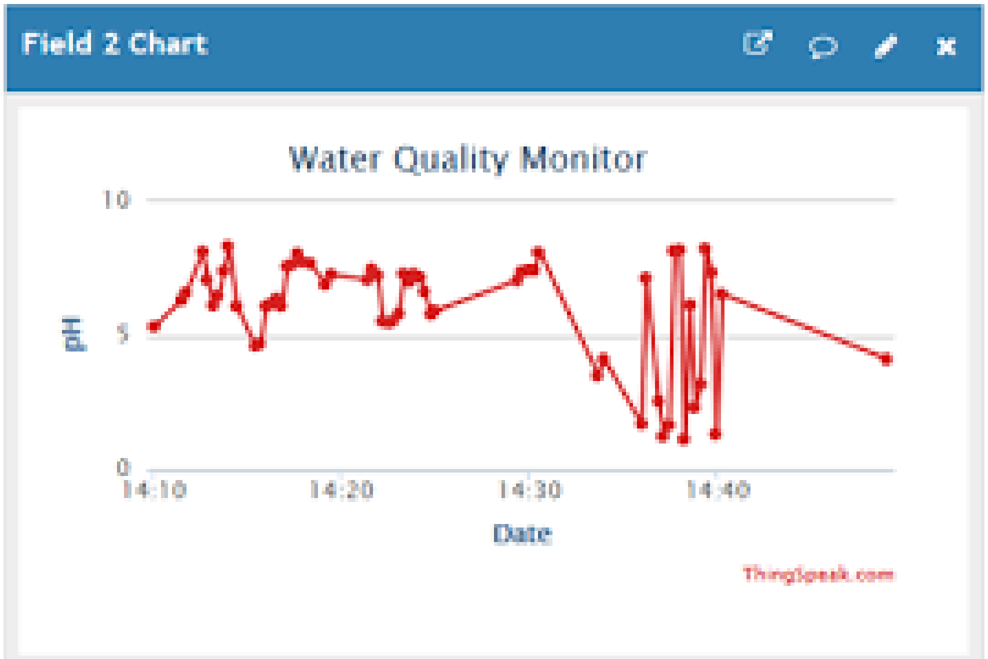
Velocity:

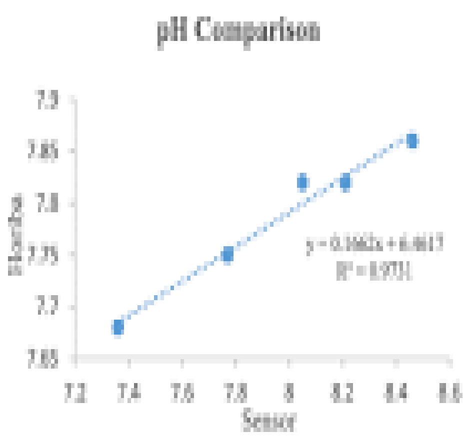
Imagine we have 10-day sprint duration, and the velocity of the team is 20 (points per sprint) Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

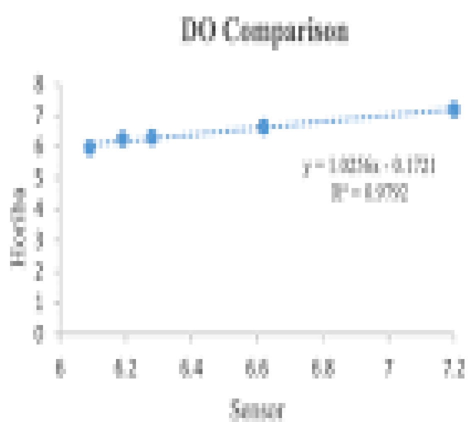
$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

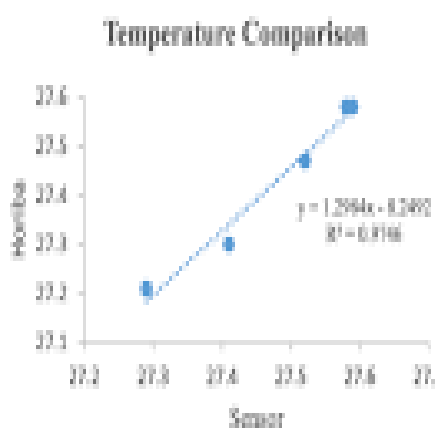
Burndown Chart:

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


Field 2 Chart
Water Quality Monitor
pH
Date
14:10
14:20
14:30
14:40
ThingSpeak.com

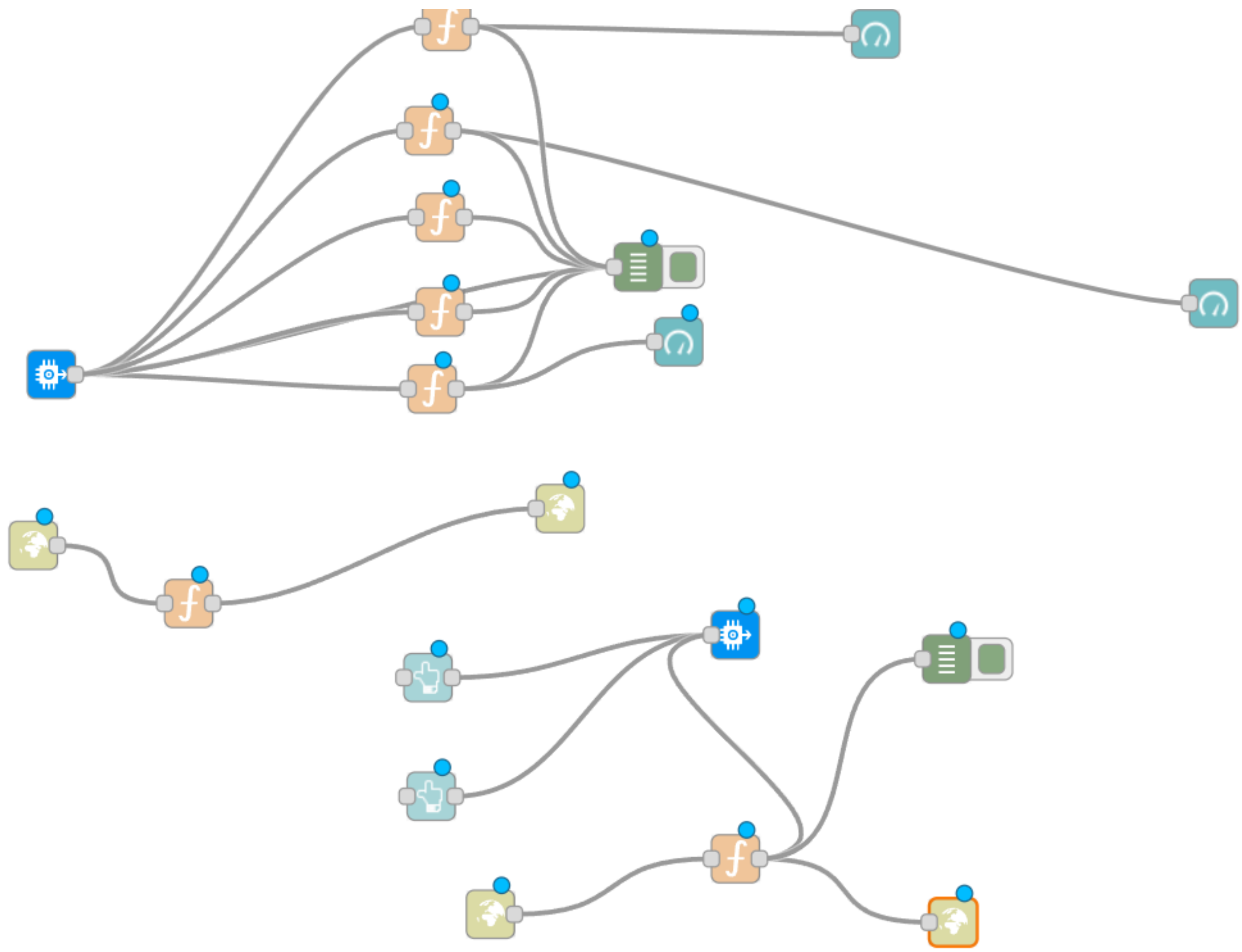

pH Comparison
Sensor


DO Comparison
Horiba
Sensor

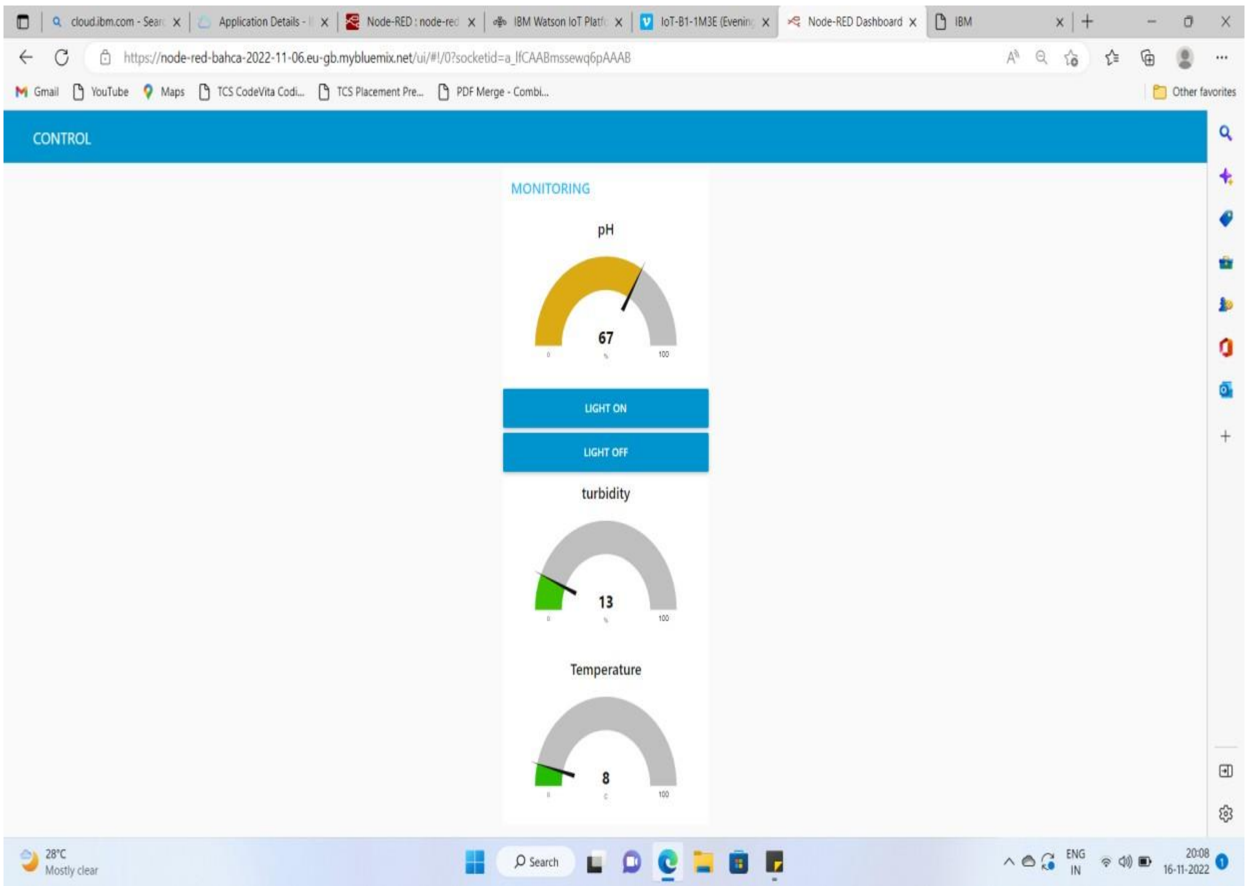

Temperature Comparison
Sensor

7.CODING AND SOLUTIONING

7.1 NODE RED SERVICE ASSOCIATED WITH IBM CLOUD:



NODE-RED TO CREATE UI



ADVANTAGES:

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

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

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

DISADVANTAGES:

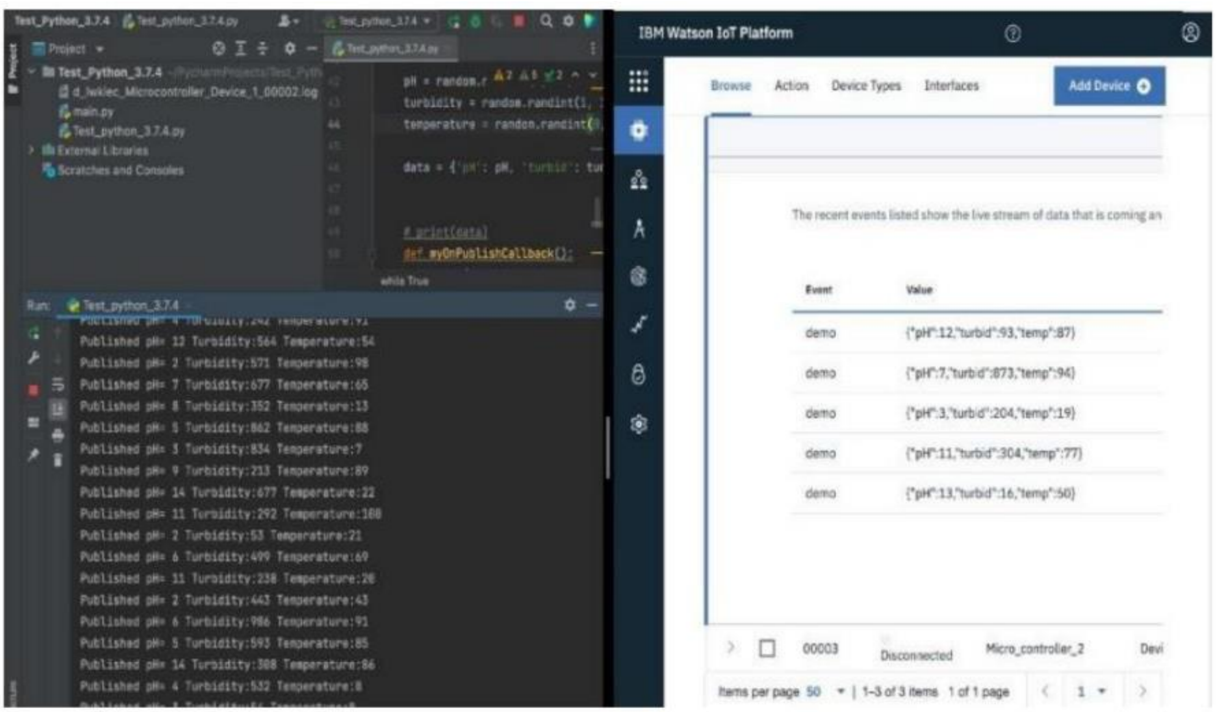
● It is difficult to collect the water samples from all the area of the water body. ● The cost of analysis is very high.

● The lab testing and analysis takes some time and hence the lab results does not reflect real time water quality measurement due to delay in measurement.

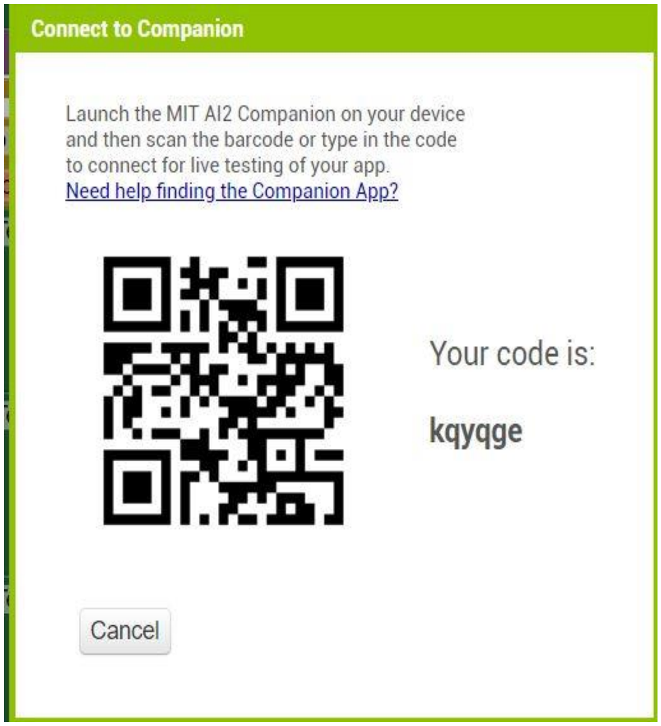
● The process is time consuming due to slow process of manual data collection from different locations of the water body.

● The method is prone to human errors of various forms.

PROJECT CODE OUTOUT:



MIT APP OUTPUT



13.2 GIT-HUB LINK:

https://github.com/IBM-EPBL/IBM-Project-11941-1659359473

DEMO VIDEO LINK