REAL-TIME RIVER WATER QUALITY MONITORING SYSTEM

A PROJECT REPORT

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REAL-TIME RIVER WATER QUALITY MONITORING SYSTEM

1. INTRODUCTION

1.1 PROJECT OVERVIEW

With the feminized of lots of innovation, development globalization, communication, etc. it is said that the life has become easier now has it was before. It is the 21st century and its messy or polluted water is now now being utilized for drinking and the purposes with no sort of separating or filtering in many developing nations. The lack of user-friendly river water quality monitoring system is creating these serious.

The environment around consists of five key elements e.g., soil, water, climate, natural vegetation, and landforms. Among these water is the utmost crucial element for human life. It is also vital for the persistence of other living habitats [1]. Whether it is used for drinking, domestic use, and food production or recreational purposes, safe and readily available water is the need for public health [2]. So it is highly imperative for us to maintain water quality balance. Otherwise, it would severely damage the health of the humans and at the same time affect the ecological balance among other species [3]. Water pollution is a foremost global problem which needs ongoing evaluation and adaptation of water resource directorial principle at the levels of international down to individual wells. It has been studied that water pollution is the leading cause of mortalities and diseases worldwide. The records show that more than 14,000 people die daily worldwide due to water pollution. In many developing countries, dirty or contaminated water is being used for drinking without any proper prior treatment. One of the reasons for this happening is the ignorance of public and administration and the lack of water quality monitoring system which makes serious health issues [3, 4]. In this paper, we depict the design of Wireless Sensor Network (WSN) [4-7] that assists to monitor the quality of water with the support of information sensed by the sensors dipped in water. Using different sensors, this system can collect various parameters from water, such as pH, dissolved oxygen, turbidity, conductivity, temperature, and so on. The rapid development of WSN technology provides a novel approach to real-time data acquisition, transmission, and processing. The clients can get ongoing water quality information from far away. Now a day's Internet of things (IoT) is an innovative technological phenomenon. It is shaping

today's world and is used in different fields for collecting, monitoring and analysis of data from remote locations. IoT integrated network if everywhere starting from smart cities, smart power grids, and smart supply chain to smart wearable [7- 12]. Though IoT is still under applied in the field of environment it has huge potential. It can be applied to detect forest fire and early earthquake, reduce air population, monitor snow level, prevent landslide, and avalanche etc. Moreover, it can be implemented in the field of water quality monitoring and controlling system [4, 13]. Water quality monitoring has gained more interest among researchers in this twenty-first century. Numerous works are either done or ongoing in this topic focusing on various aspects of it. The key theme of all the projects was to develop an efficient, cost-effective, real-time water quality monitoring system which will integrate wireless sensor network and internet of things [14]. In this research, we monitor the physical and chemical parameters of water bodies inside Chittagong city by using an IoT based sensor network.

1.2 PURPOSE

The main aim of this project is to detect the quality of river water and quantity of pollutants present in water and so that river water quality is monitored and effective measures can be taken accordingly . To develop a system for real time quality assessment for river water health at residential places using Raspberry Pi. Sensors are used to gather different parameters in River water to monitor water health in real time. IoT is appeared to be a better solution as reliability, scalability, speed, and persistence can be provided

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

LITERATURE PAPER TITLE 1 :

Real-time water quality monitoring through Internet of Things and ANOVA-based analysis:

a case study on river Krishna (3,December 2019)

AUTHOR : Prasad M .

Pujar Harish H

Raviraj . M

Uma kant . P

OBJECTIVE :

In this paper it has emphasized on the IOT based water quality monitoring system by the statistical analysis where one way and two way analysis of variance (ANOVA).

LITERATURE PAPER TITLE 2 :

Ultrasonic as a green chemistry for bacterial and algal control in drinking water treatment source (20 September 2020)

AUTHOR : Nourhan F.Ali

Zenat M.kamel

S.Z.Wahba

OBJECTIVE :

The treatment process is done using ultrasonic waves at a frequency of 20,40 and 60 KHz at different time intervals namely 15,30,45 and 60 minutes.

LITERATURE PAPER TITLE 3 :

Improved Cyanobacteria Removal from Harmful Algae Blooms by Two-Cycle, Low-Frequency, Low Density, and Short Duration Ultrasonic Radiation(29 August 2020)

AUTHOR : Haocai Huang

Gang Wu

Chaowu Sheng

Wu Jiannan

Danhua Li

Hangzhou Wang

OBJECTIVE :

This paper has a proposed cyanobacteria removal method based on two applications of low frequency, low density and short duration and ultra sonic radiation for calculating the effectiveness of ultrasonic radiation is done by algae removal rate/ultrasonic dosage .

LITERATURE PAPER TITLE 4 :

IOT based real time river water quality monitoring system(August 19,2019)

AUTHOR : Elsevier B.V

OBJECTIVE :

The main objective of this paper is to access data by the remote monitoring and IOT technology .If the acquired value is above the threshold value automated warning SMS alert will send to the agent .

LITERATURE PAPER TITLE 5 :

Design and Development of Real Time Water Quality Monitoring System (October 18,2019)

AUTHOR : Meghana M,

Kiran Kumar B

M DivyaKiran

OBJECTIVE :

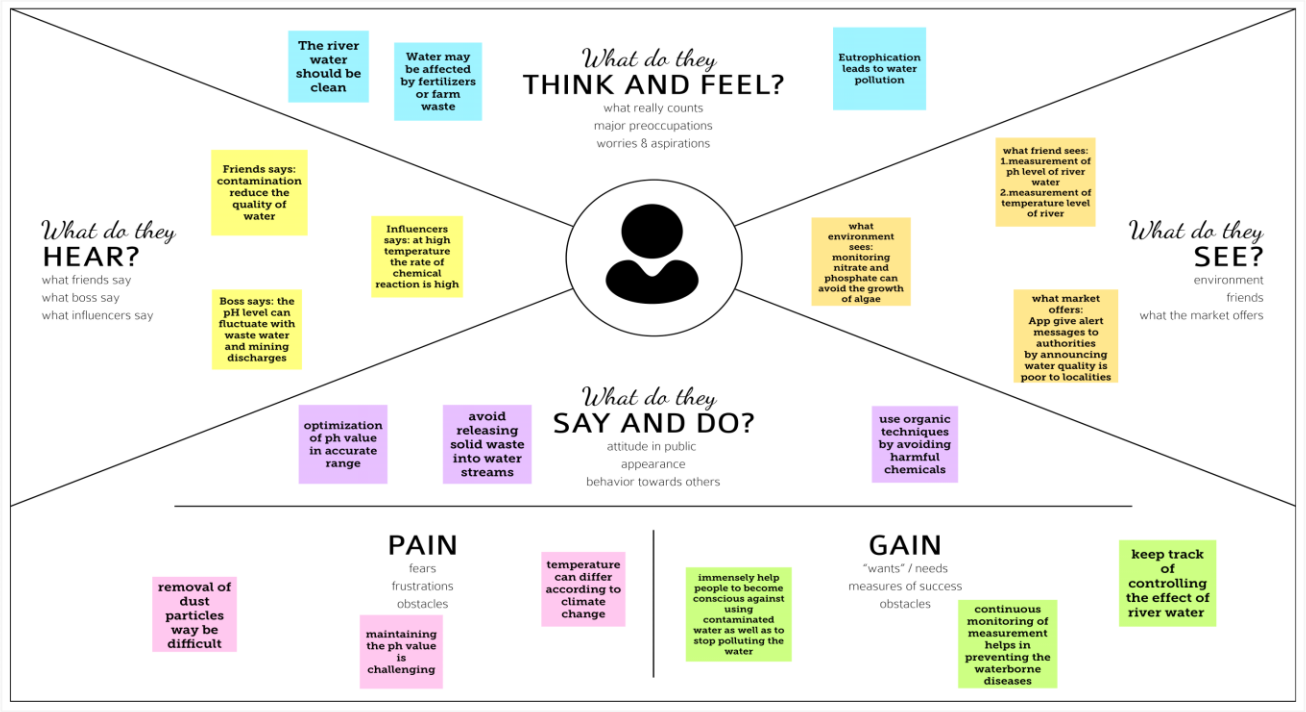
This paper presents a system that is developed to measure the parameters of water such as turbidity dissolved solvents PH and temperature .The sensors are interfaced with Arduino UNO and raspberry Pi for data processing and transmission .This data is transmitted through Wi-Fi to the remote place .

2.2 PROBLEM STATEMENT :

- Farmers put fertilizers and pesticides on their crop so that they grow better but these fertilizers and pesticides can be washed through the soil by rain to end up in the rivers.
- If the large amount of fertilizers or the farm waste drain into river the concentration of nitrate and phosphate in the water increases considerably algae uses these substances to grow and multiply rapidly turning the water green
- The massive growth of algae called Eutrophication, that leads to pollution .When the algae die they broken down by the action of bacteria which quickly multiply using up all the oxygen in the water which leads to the death of many animal .

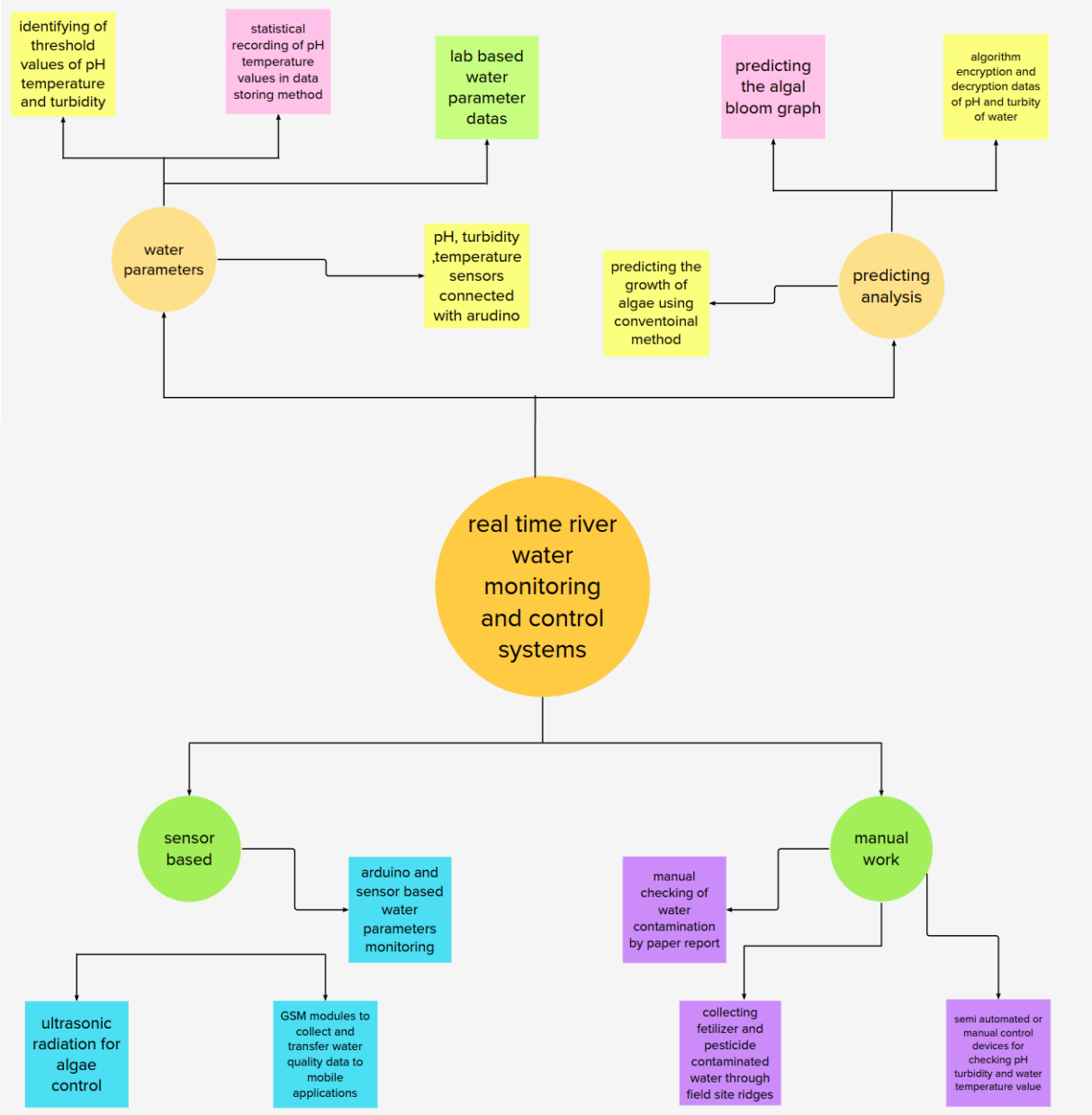
3. IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

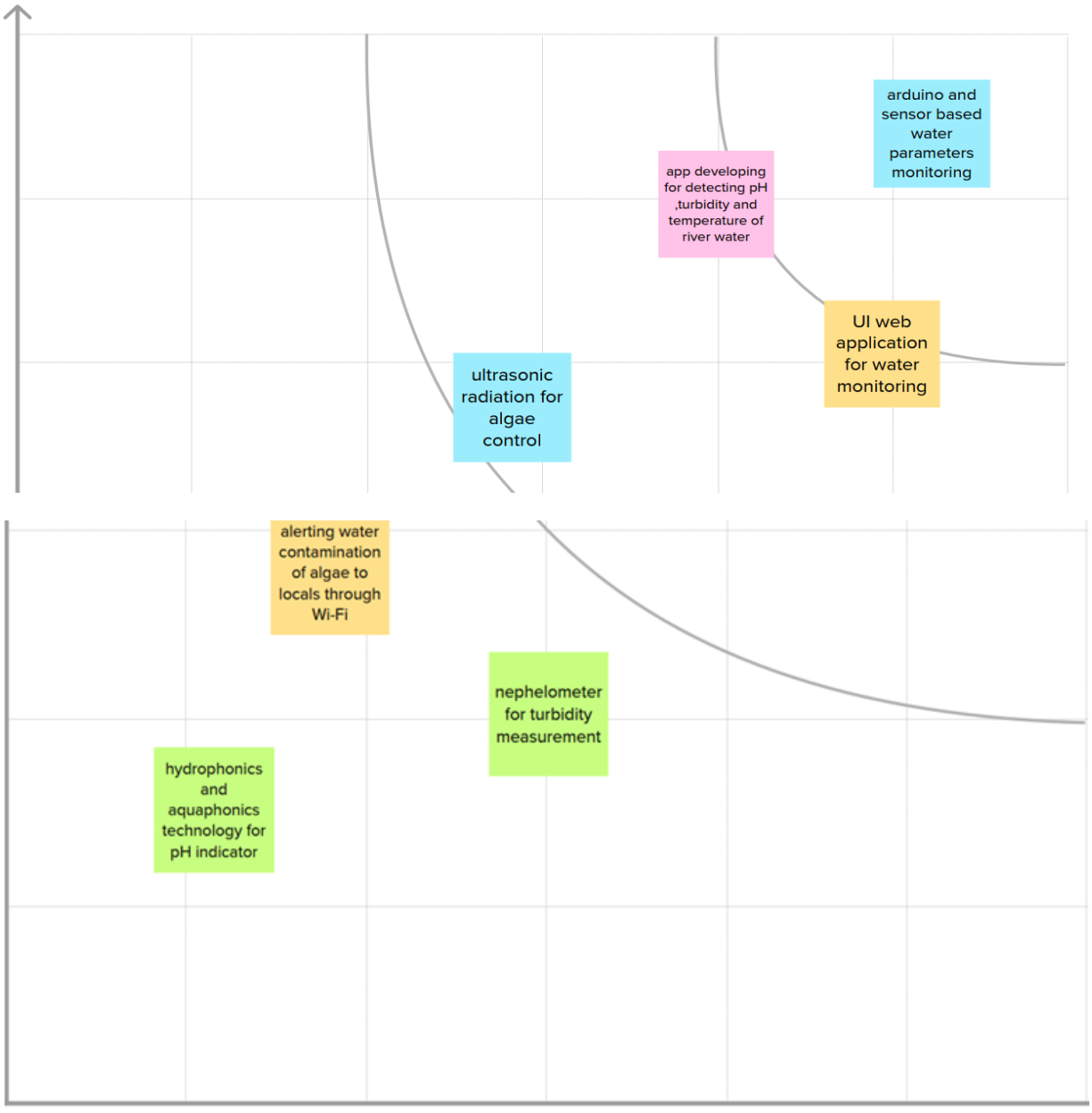


3.2 IDEATION & BRAINSTORMING

Group Ideas :



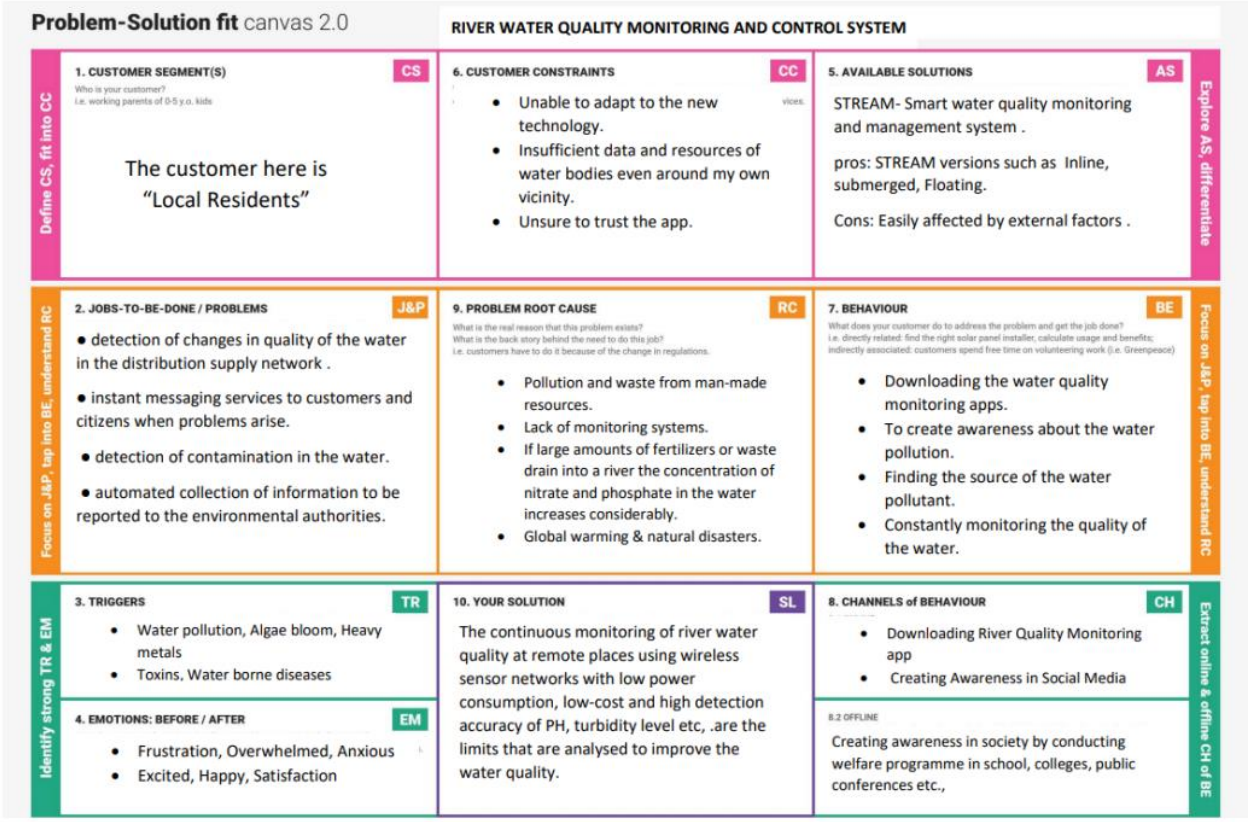
Prioritize :


arduino and sensor based water parameters monitoring
app developing for detecting pH ,turbidity and temperature of river water
UI web application for water monitoring
ultrasonic radiation for algae control
alerting water contamination of algae to locals through Wi-Fi
nephelometer for turbidity measurement
hydrophonics and aquaphonics technology for pH indicator

3.3 PROPOSED SOLUTION

S.No	PARAMETER	DESCRIPTION
1.	Problem statement (problem to be solved)	Monitoring and controlling the quality of the river water
2.	Idea/ Solution description	Detecting the dust particles , Measure the pH and temperature and altering the authorities that water is not good
3.	Novelty/ Uniqueness	The quality parameters will track continuously with standard measurements.
4.	Social Impact / Customer Satisfaction	Localities will not suffered by poor quality of water by alerting them when the water quality is not good.
5.	Business model (revenue model)	Aeronsystems.com
6.	Scalability of the solution	Measuring of real time values and continuous monitoring helps in maintaining the quality of water

3.4 PROBLEM- SOLUTION FIT



4. REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

Following are the functional requirements of the proposed solution.

FR No	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Assurance using a confirmed password
FR-2	View Water Detail	On the website, you can view current water information and traditional water eligibility.
FR-3	Logout	Logs out the user successfully

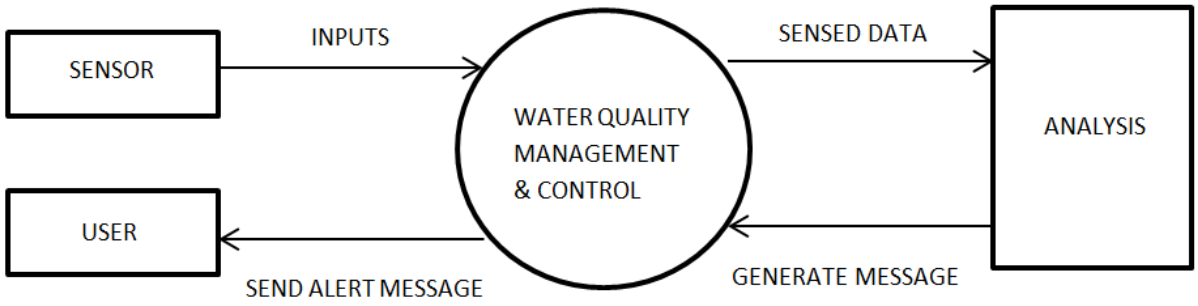
4.2 NON-FUNCTIONAL REQUIREMENTS :

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

NFR No.	Non-Functional Requirement	Description
NFR-1	Usability	The maximum load time for user interface screens is 2 seconds..
NFR-2	Security	password-protected user account Account creation is only carried out following email confirmation
NFR-3	Reliability	98% of the time, users may access their accounts without any issues Assurance for aquaculture safety
NFR-4	Performance	Set interface screen loads cannot take more than two seconds. Within 10 seconds, login information was validated
NFR-5	Availability	About 4 hours will be the maximum downtime.
NFR-6	Scalability	The system can manage approximately 1000 users at once

5. PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS



User Stories

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

USER TYPE	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
User(Mobile user)	Check Notification	USN-1	User can check the notification of the alert message	User can check the notification	High	Sprint-1
	Check water parameters	USN - 2	User can check the level of water parameters like temperature, humidity, PH level etc.	User can check the level of water parameters	High	Sprint - 1

5.2 SOLUTION & TECHNICAL ARCHITECTURE

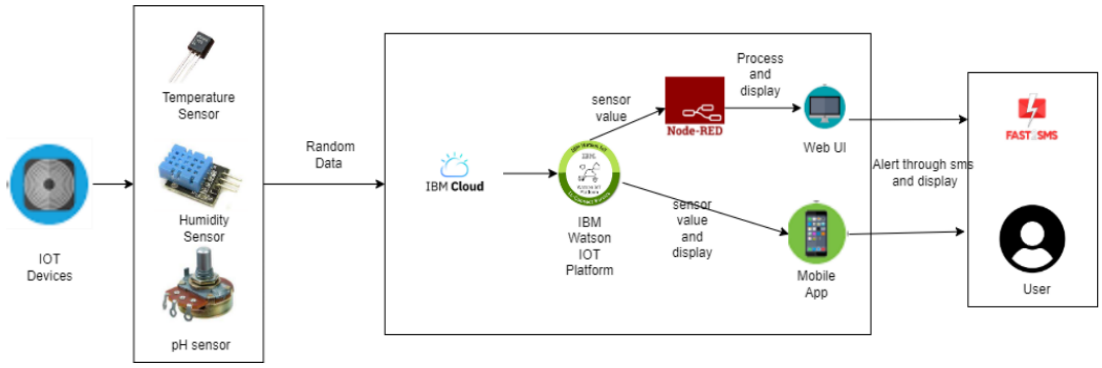


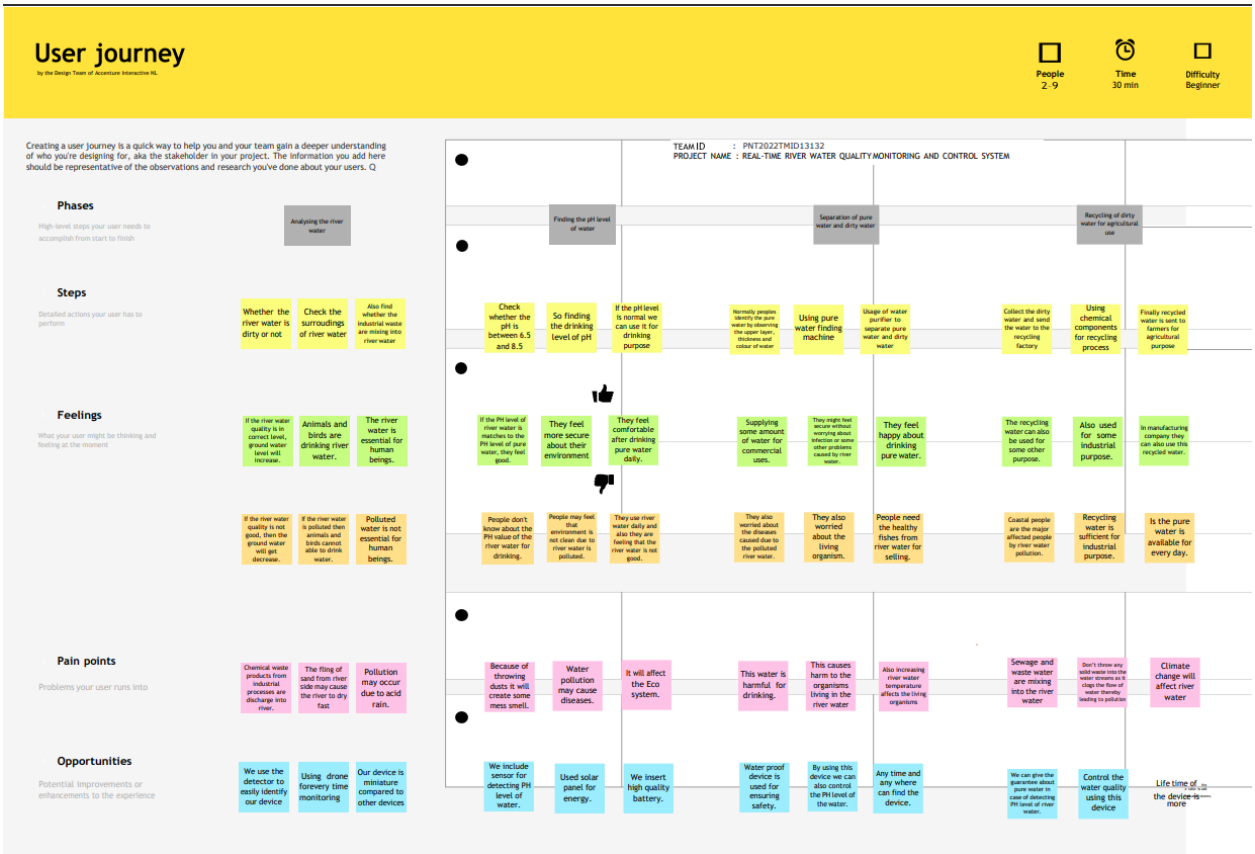
Table-1: Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	Web UI	Node – Red, Kubernetes, MIT mobile app inventor
2.	Application Logic-1	Generate random data	Python
3.	Application Logic-2	Generate random sensor data	IBM Watson IOT Platform
4.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant
5.	External API-1	Send SMS to customer	Fast SMS API
6.	Infrastructure (Server / Cloud)	Application Deployment on Cloud	Cloud Foundry, Kubernetes

Table-2: Application Characteristics:

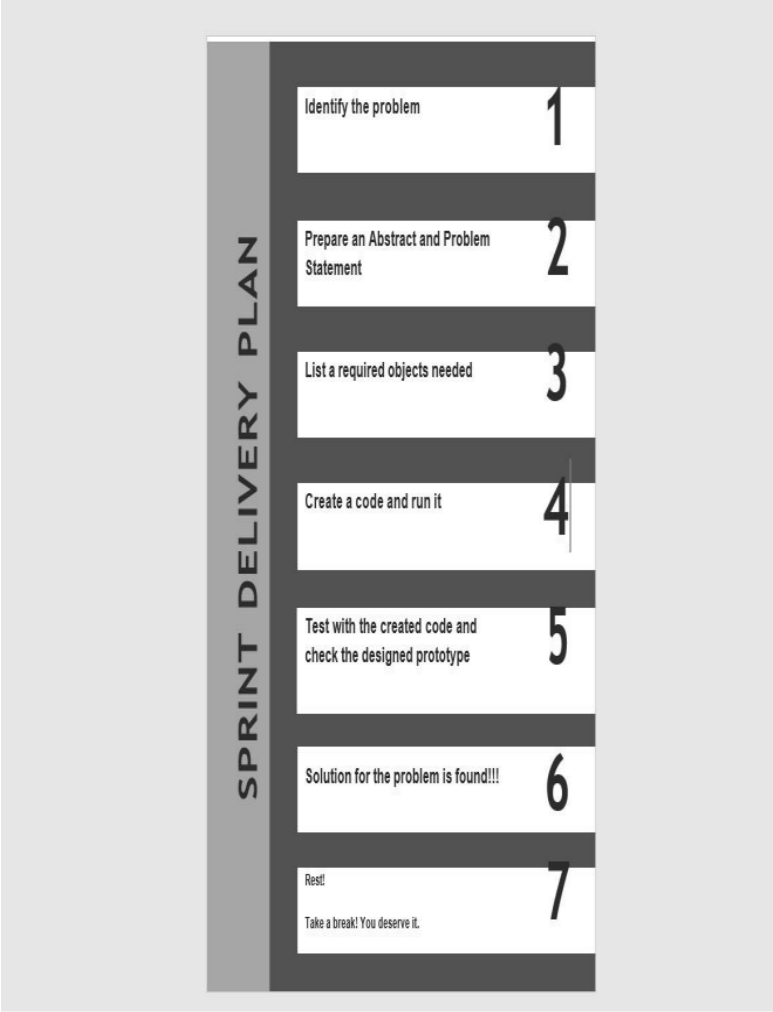
S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Open-source tools we utilised to create our project	Node – Red, IBM Cloudant, IBM Watson IOT Platform
2.	Security Implementations	Use of a login page with a user's unique username and password on a web interface optimised for mobile devices and computers with adjustable screen sizes	Password protection in MIT App
3.	Scalable Architecture	Optimised for mobile devices and computers with adjustable screen sizes	Node – Red (Web UI)
4.	Availability	Accessible to users through both a web UI and a mobile app	Node – Red(Web UI), MIT App(Mobile App)
5.	Performance	Give precise results and a prompt warning in the event of water contamination	Node – Red(Web UI), MIT App(Mobile App

5.3 USER STORIES



6. PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION



6.2 SPRINT DELIVERY SCHEDULE

To create product backlog and sprint schedule

Sprint	Functional Requirement (Epic	User Story Number	User Story / Task	Story Points	Priority	Team Member
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	DHATCHAYANI K NANCY S NIVETHA P SOWMYA B
Sprint-1	Registration	USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	DHATCHAYANI K NANCY S NIVETHA P SOWMYA B
Sprint-2	Registration	USN-3	As a user, I can register for the application through phone number	2	High	DHATCHAYANI K NANCY S NIVETHA P SOWMYA B
Sprint-2	User interface	USN-4	Professional responsible for user requirements & needs	2	High	DHATCHAYANI K NANCY S NIVETHA P SOWMYA B
Sprint-3	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	DHATCHAYANI K NANCY S NIVETHA P SOWMYA B

Sprint-3	Dashboard	USN-6	As a user, I must receive any updates or pop 1ups in my dashboard	2	High	DHATCHAYANI K NANCY S NIVETHA P SOWMYA B
Sprint-4	Details	USN-7	As a user, I should get notification about the progress and any updates via email or sms	1	High	DHATCHAYANI K NANCY S NIVETHA P SOWMYA B
Sprint-4	Privacy	USN-8	The developed application should be secure for the users	2	High	DHATCHAYANI K NANCY S NIVETHA P SOWMYA B

Project Tracker, Velocity & Burndown Chart

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint	20	2 Days	06 Nov 2022	08 Nov 2022	20	09 Nov 2022
Sprint	20	2 Days	09 Nov 2022	11 Nov 2022	20	12 Nov 2022
Sprint	20	2 Days	12 Nov 2022	14 Nov 2022	20	15 Nov 2022
Sprint	20	2 Days	15 Nov 2022	17 Nov 2022	20	18 Nov 2022

7. CODING & SOLUTIONING

7.1 FEATURE 1

- IOT device
- Wokwi software
- Iot Watson platform
- Node red
- Cloudant db
- Web UI

7.2 FEATURE 2

- Registration
- Login
- Verification
- Check the sensors
- Buzzer the alarm
- Fast SMS

8. TESTING

8.1 TEST CASES

S NO	TEST CASE	FEATURE	STEP TO EXECUTE	EXPECTED RESULT	ACTUAL RESULT	EXECUTED BY
1	FUNCTIONAL	LOGIN	LOGIN TO EXECUTE BY FILLING THE DETAILS	CORRECT LOGIN CREDENTIALS	WORKING AS EXPECTED	DHATCHAYANI
	FUNCTIONAL	REGISTRTION	REGISTRATION THROUGH FORMS	REGISTRATION FORM TO BE FILLED AND DISPLAYED	WORKING AS EXPECTED	NANCY
	FUNCTIONAL	WOKWI	TO DEVELOP THE IOT DEVICE AND CODE THE IOT DEVICE	SENSE THE DATA	WORKING AS EXPECTED	NANCY
	FUNCTIONAL	IBM WATSON	PUSH THE SENSED DATA FROM WOKWI	SENSED DATA IN IBM WATSON	WORKING AS EXPECTED	NIVETHA
	WORKING AS EXPECTED	NODE RED	TO CONNECT WITH THE IBM WATSON AND THEN COLLECT THE SENSED DATA AND DISPLAY IN NODE RED DASHBOARD	VISUAL REPRESENTATION OF SENSED DATA IN NODE RED DASHBOARD	WORKING AS EXPECTED	SOWMYA

9. RESULTS

The resulting sensed pH, temp, turbidity, and ORP values. It continuously senses the values of pH, temp, turbidity, and ORP and the resulting values are displayed to the LCD, PC or mobile in real-time. If the acquired value is above the threshold value comments will be displayed as ‘BAD’. If the acquired value is lower than the threshold value comments will be displayed as ‘GOOD’. A bar/line graph will also be shown for perfect understanding. The time series representation of sensor data with decision.

10.ADVANTAGES & DISADVANTAGES

ADVANTAGES:

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

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.

11.CONCLUSION

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]. 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.

12.FUTURE SCOPE

The future scope of this project is monitoring environmental conditions, drinking water quality, treatment and disinfection of waste water etc. This 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.

13.APPENDIX

SOURCE CODE

```
#include LiquidCrystal
1cd(5,6,8,9,10,11);
int red1ed = 2;
int green1ed = 3;
int buzzer = 4;
int sensor = A0;
int sensorThresh = 400;
void setup()
{
pinMode(red1ed, OUTPUT);
pinMode(green1ed,OUTPUT);
pinMode(buzzer,OUTPUT);
pinMode(sensor,INPUT);
serial.begin(9600);
1cd.begin(16,2);
}
```

```
Void loop()
{
int analogValue = analogRead(sensor);
Serial.print(analogvalue);
if(analogValue>sensorThresh)
{
digitalWrite(red1ed,HIGH);
digit1Weite(green1ed,LOW);
tone(buzzer,1000,10000);
1cd.clear();
1cd.setCursor(0,1);
1cd.print("MONITORING");
delay(1000);
1cd.clear();
1cd.setCursor(0,1);
1cd.print("EVACUATE");
delay(1000);
}
Else
  {
digitalWrite(greenlad,HIGH);
digitalWrite(red1ed,LOW);
noTone(buzzer);
1cd.clear();
1cd.setCursor(0,0);
1cd.print("SAFE");
```

```
delay(1000);
1cd.clear();
1cd.setCursor(0,1);
1cd.print("ALL CLEAR");
delay(1000);
}
}
```

Proposed system

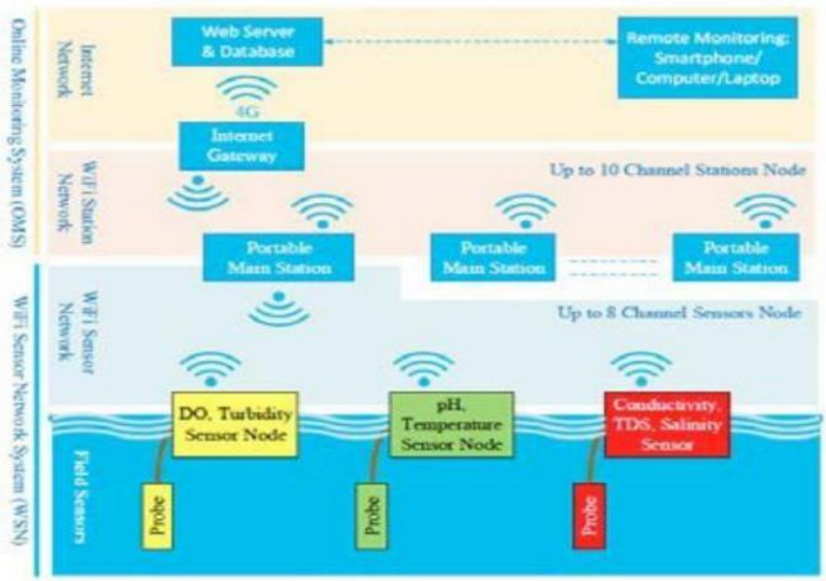
The main aim is to develop a system for continuous monitoring of river water quality at remote places using wireless sensor networks with low power consumption, low- cost and high detection accuracy. pH, conductivity, turbidity level, etc. are the limits that are analyzed to improve the water quality.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

(a) To measure water parameters such as pH, dissolved oxygen, turbidity, conductivity, etc. using available sensors at a remote place.

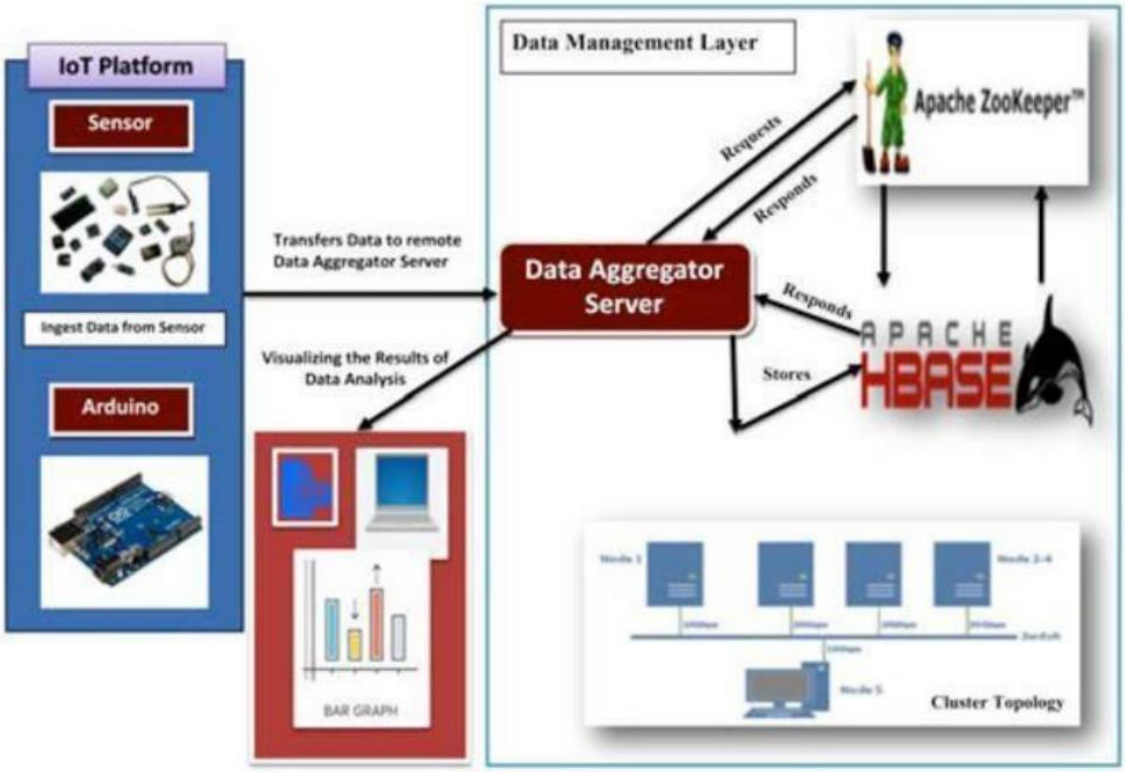
(b) To assemble data from various sensor nodes and sendit to the base station by the wireless channel.

(c) To simulate and evaluate quality parameters for quality control.

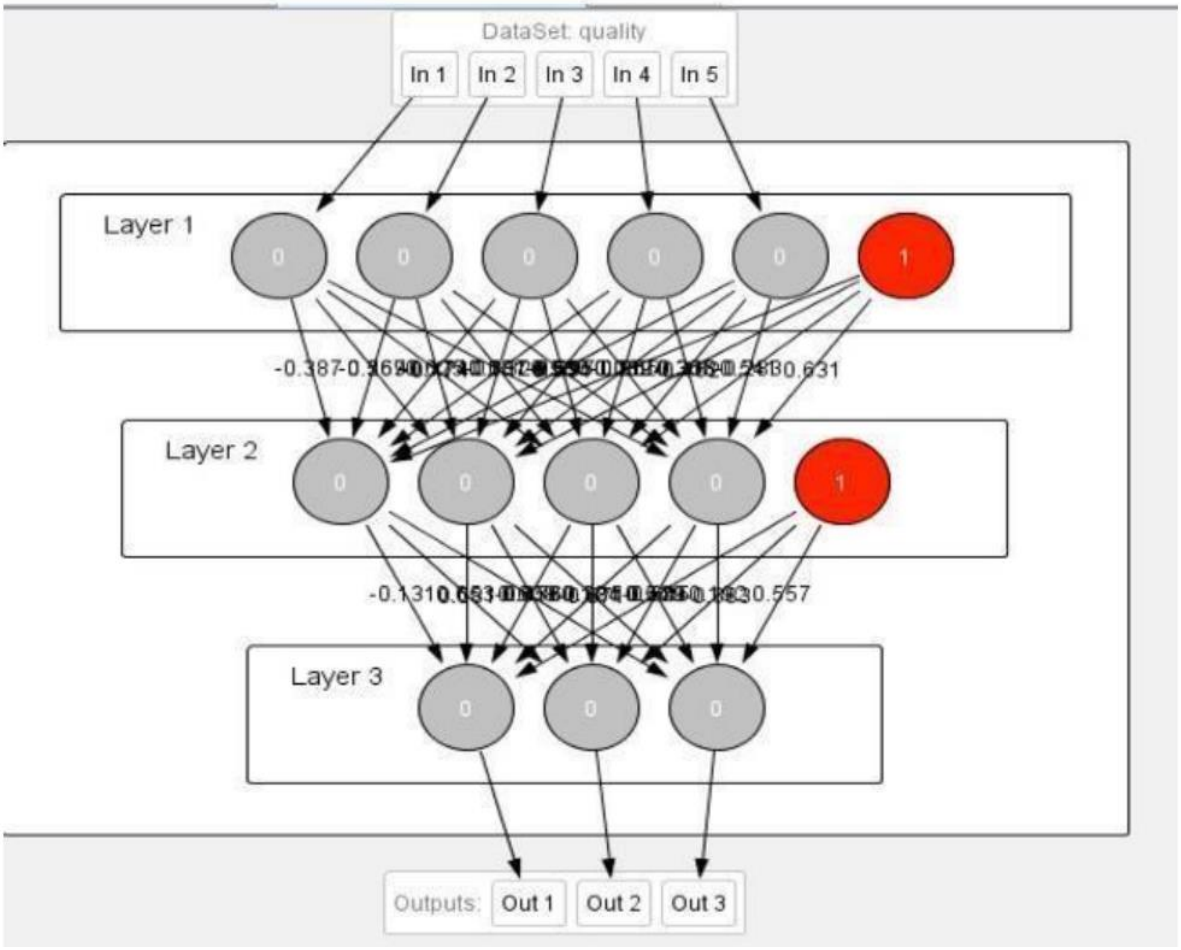
(d) To send SMS to an authorized person routinely when water quality detected does not match the preset standards, so that, necessary actions can be taken



Real time monitoring of water quality by using IoT integrated Big Data Analytics



$$F(X) = 1 / (1 + \exp^{(-\sum_j wjxj - b)})$$



Neural network models in Big Data Analytics and water quality management

CPCB Real time river water monitoring and control system:

In order to eliminate problems associated with manual water quality monitoring, Central Pollution Control Board (CPCB) has planned to go for hi-tech solution. CPCB is planning to install

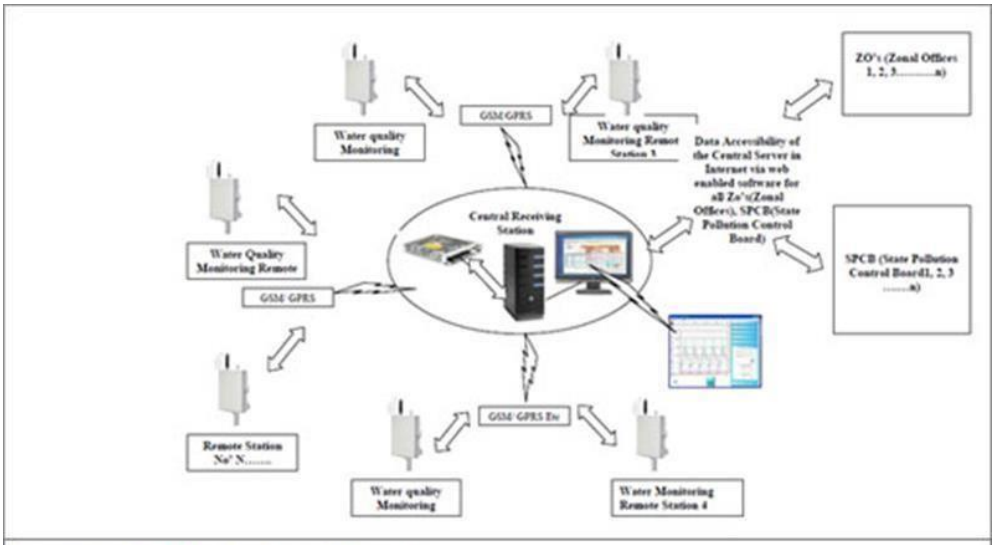
'Real Time Water Quality Monitoring Network' across Ganga Basin for testing ten parameters. The Ganga is the largest and the most important river of India, with its watershed covering 10 Indian states, namely Uttaranchal, Uttar Pradesh, Bihar, Jharkhand, West Bengal, Himachal Pradesh, Rajasthan, Haryana, Madhya Pradesh and Delhi.

Discharge of untreated sewage from urban centers is a major cause of water quality degradation in the river. The total wastewater generation from222 towns in Ganga basin is reportedly 8250 MLD, out of which 2538 MLD is directly discharged into the River, 4491 MLD is disposed into its tributaries and 1220 MLD is disposed on land or low lying areas. “River Yamuna is one of the most gross

polluted rivers in the country. There are number of inter-state issues and events of episcopal pollution. In case of Ganga, we have to address large number of petitions, RTIs, VIP references etc and the NGRBA is constituted for large scale investment towards STPs etc”, says Dr. R M Bharadwaj, Senior Scientist, Central Pollution Control Board The parameters that CPCB plans to monitor online are pH, turbidity, conductivity, temperature, Dissolved Oxygen, Dissolved Ammonia, Bio- chemical Oxygen Demand, Chemical Oxygen Demand, nitrates and chlorides. All the stations will be operational in real time mode and central station will be able to access data from any of these stations. The stations will also be tolerant to extreme environmental conditions in India such as high or low temperature, high humidity coastal conditions and high temperature desert conditions. Moreover, the stations will be such that it won’t require manual intervention for at-least 5 years, except for routine calibration and batteryreplacement

HOW SYSTEM WORKS:

Earlier, with manual sampling we used to get analysis report of one sample in a month. But with real time monitoring, we will get at least 50 and a maximum of 95 data every day. Regular and large number of data will enable us to take decision which can be implemented on time and is effective", adds Dr. Bharadwaj.



Source: Central Pollution Control Board

GITHUB LINK

https://github.com/IBM-EPBL/IBM-Project-14803-1659590114