REAL-TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM

A MAIN PROJECT REPORT
TEAM ID:PN2022TMID40723

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In partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

JAYALAKSHMI INSTITUTE OF TECHNOLOGY

THOPPUR, DHARMAPURI – 636 352

ANNA UNIVERSITY:: CHENNAI – 600 025

MAY 2022

ANNA UNIVERSITY:: CHENNAI – 600 025 MAY 2022

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INDEX:

Abstract:

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. Data collected at the apart site can be displayed in a visual format on a server PC with the help of Spark streaming analysis through Spark MLlib, Deep learning neural network models, Belief Rule Based (BRB) system and is also compared with standard values. If the acquired value is above the threshold value automated warning SMS alert will be sent to the agent. 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.

Introduction:

The environment around consists of five key elements e.g., soil, water, climate, natural vegetation, and landforms. Among these water is the utmost crucial element for human life. It is also vital for the persistence of other living habitats [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.

LITERATURE SURVEY

1. Water quality monitoring system based on Internet of Things

Author: Chengcheng Zhang, Jian Wu, Jiancheng Liu

Publication: IEEE 2020

Chengcheng et al presents a solution that integrates the design of STM32 single- chip microcomputer, sensors, WiFi wireless transmission and remote water quality management system. It monitors water quality turbidity, pH value, temperature and uploads the data to the management center through wireless communication.

2. **IoT Based Real-time River Water Quality Monitoring System**

Author: Mohammad Salah Uddin Chowdurya, Talha Bin Emran b, Subhasish Ghosha , Abhijit Pathak a, Mohd. Manjur Alama, Nurul Absar a, Karl Andersson c, Mohammad Shahadat Hossain d **Publication:** Science Direct 2019 Mohammad et al proposed a manual method for sensorbased water quality monitoring system with high frequency, high mobility, and low power. Here the data collected at the site can be displayed in a visual format on a server

PC with the help of Spark streaming analysis through Spark MLlib, Deep learning neural network models, Belief Rule Based (BRB) system and is also compared with standard value.

3. Efficient Cloud Based Real Time Water Quality Monitoring System Using Internet Of Things

Author: M.Usha Rani, Dr.R.Alageswaran, Sathish Kumar A **Publication:** JASC: Journal of Applied Science and Computations(2018) M.Usha Rani et al proposes water sampling system with required sensor. Whenever the water level in the lakes or ponds reaches the lower/upper level it is identified and notification is sent to the administrator. It can also predict overflow and water scarcity in future from the past results. The parameters like PH, calcium, sulphate and nitrate ions that is present in the water is also identified.

4. Water Quality Monitoring System Using IOT

Author: Dr. Nageswara Rao Moparthi, Ch. Mukesh, Dr. P. Vidya Sagar

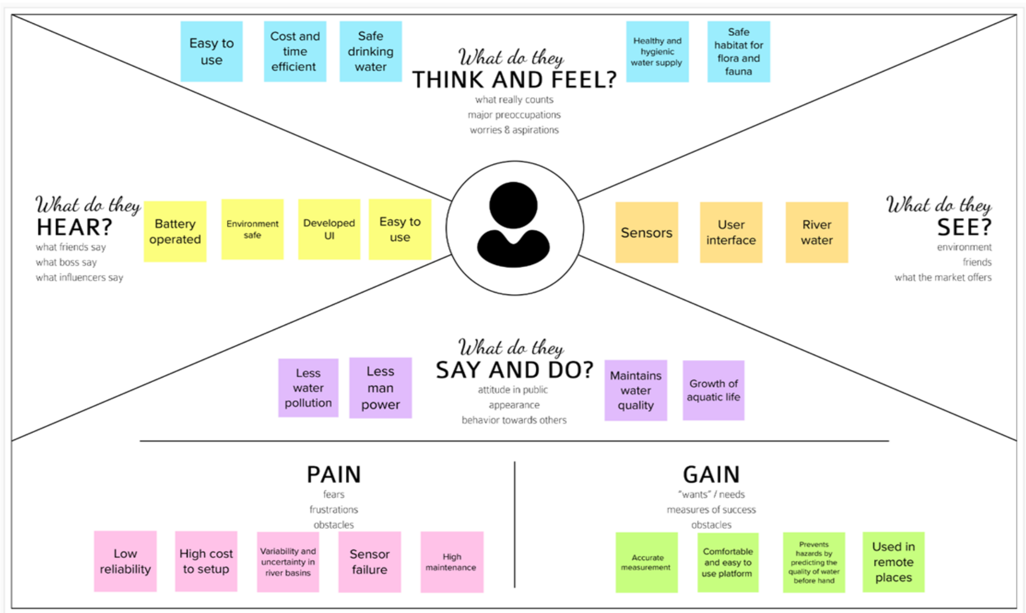
Publication: IEEE 2018 Dr. Nageswara Rao Moparthi et al implements Water Quality Monitoring System for municipal water tanks and drinking water reservoirs using an Arduino board and GSM module. This module can be easily implemented when a wireless oxygen sensor is used.

5. **Real-Time Water Quality Monitoring System**

Author: Jyotirmaya Ijaradar1, Subhasish- Chatterjee **Publication:**International Research Journal of Engineering and Technology (IRJET) (2018) Jyotirmaya et al proposed real-time water quality monitoring system for water health at residential places. It measure various chemical and physical properties of water like pH, temperature and particle density of water using sensors and send the data to cloud and trigger an alarm when discrepancies are found in water quality

IDEATION PHASE:

Empathy map conves



Ideation &Brinestroming:

Ideation phase:

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.

propsed solution:

S.No.	Parameter	Description

1.	Problem Statement (Problem to be solved)	Workers who are engaged with a busy industries packed with gas either harmful or harmless needs a way to monitor their gas pipelines continuously and detect early if there is any leakage of gas in their surroundings so that they can work efficiently on major crises rather than worrying about monitoring or leakage of gas, this will indeed reduce the manpower of that industry and create a peaceful environment.

2.	Idea / Solution description	Workers who are engaged with a busy industries packed with gas either harmful or harmless needs a way to monitor their gas pipelines continuously and detect early if there is any leakage of gas in their surroundings so that they can work efficiently on major crises rather than worrying about monitoring or leakage of gas, this will indeed reduce the manpower of that industry and create a peaceful environment.

3.	Novelty / Uniqueness	Even though there are many existing solutions for this problem they failed to satisfy the needs of customer. Some of the solutions are only detecting some particular gases where some others failed to alert the main department and other solutions are with some delays. Our solution not only notify the industry person but also notify the fire fighters so that can take control over the situation and our solution will alert the workers even there is a small leak of gases.

4.	Social Impact / Customer Satisfaction	Our solution will be very helpful for the workers and the society which is associated or located nearby the industries. Our solution will prevent great disasters like Bhopal Gas Tragedy so that so many lives can be saved. Through this project the workers mental pressure will be reduced so that they can concentrate on other works or by relaxing them.
5.	Business Model (Revenue Model)	The main target of our solution is Industries so we have planned to visit industries and explain them about the benefits of our products. So that they can aware of the importance of this solution and use it.
6.	Scalability of the Solution	Our solution can be integrated for further future use because the solution we have provided will be lay on the basic or initial stage of any upgraded version.

REQUIRMENT ANALYSIS:

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Login	Confirmation through verified password
FR-2	View Water Details	View current water details in website View traditional water eligibility in website
FR-3	Logout	Logs out the user successfully

Non-functional Requirements:

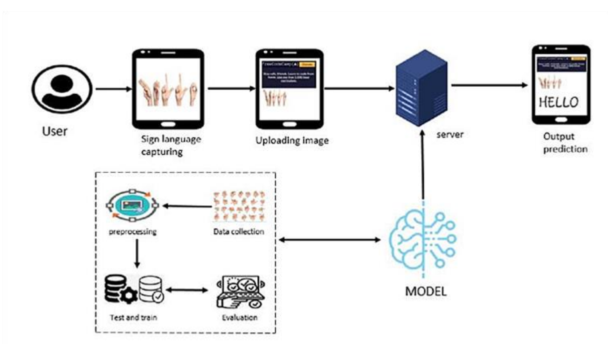
Following are the non-functional requirements of the proposed solution.

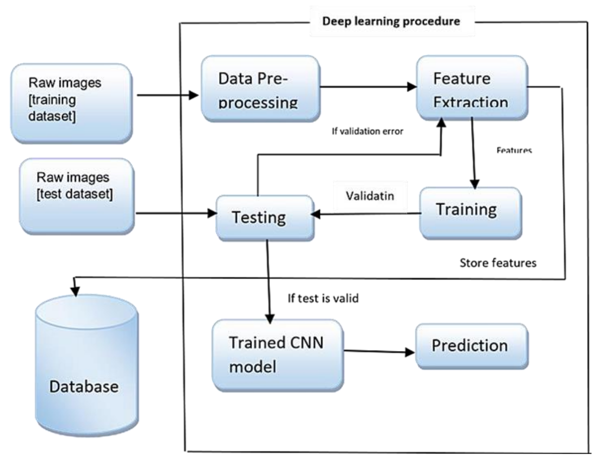
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Load time for user interface screens shall not be more than 2 seconds.
NFR-2	**Security**	User account is password protected Account creation done only after email verification

NFR-3	**Reliability**	Users can access their account 98% of the time without failure
NFR-4	**Performance**	Load time for user interface screens shall not be more than 2 seconds. Login info verified within 10 seconds.
NFR-5	**Availability**	Maximum down time will be about 4 hours
NFR-6	**Scalability**	System can handle about 1000 users at any given time

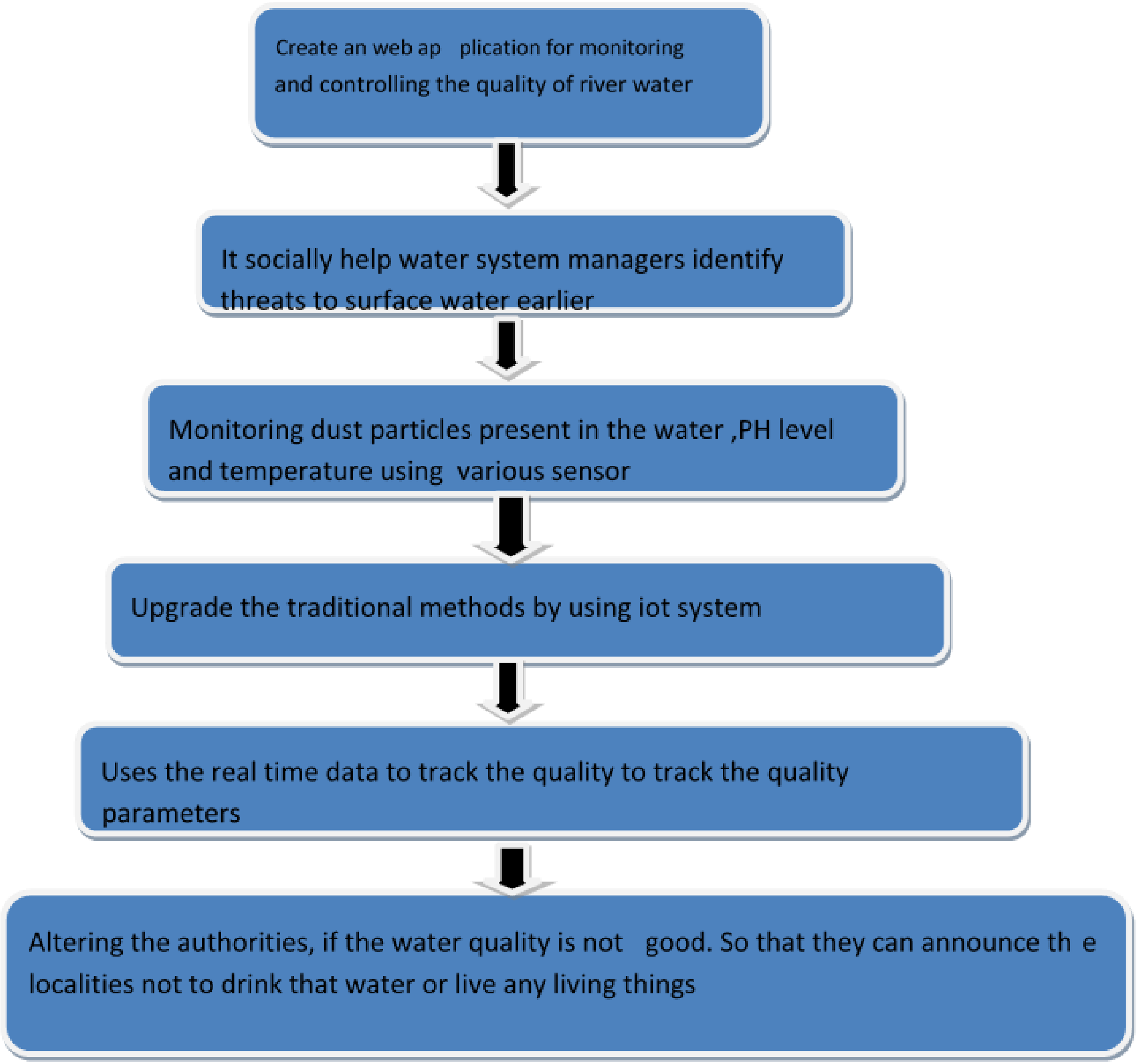
PROJECT DESIGN :

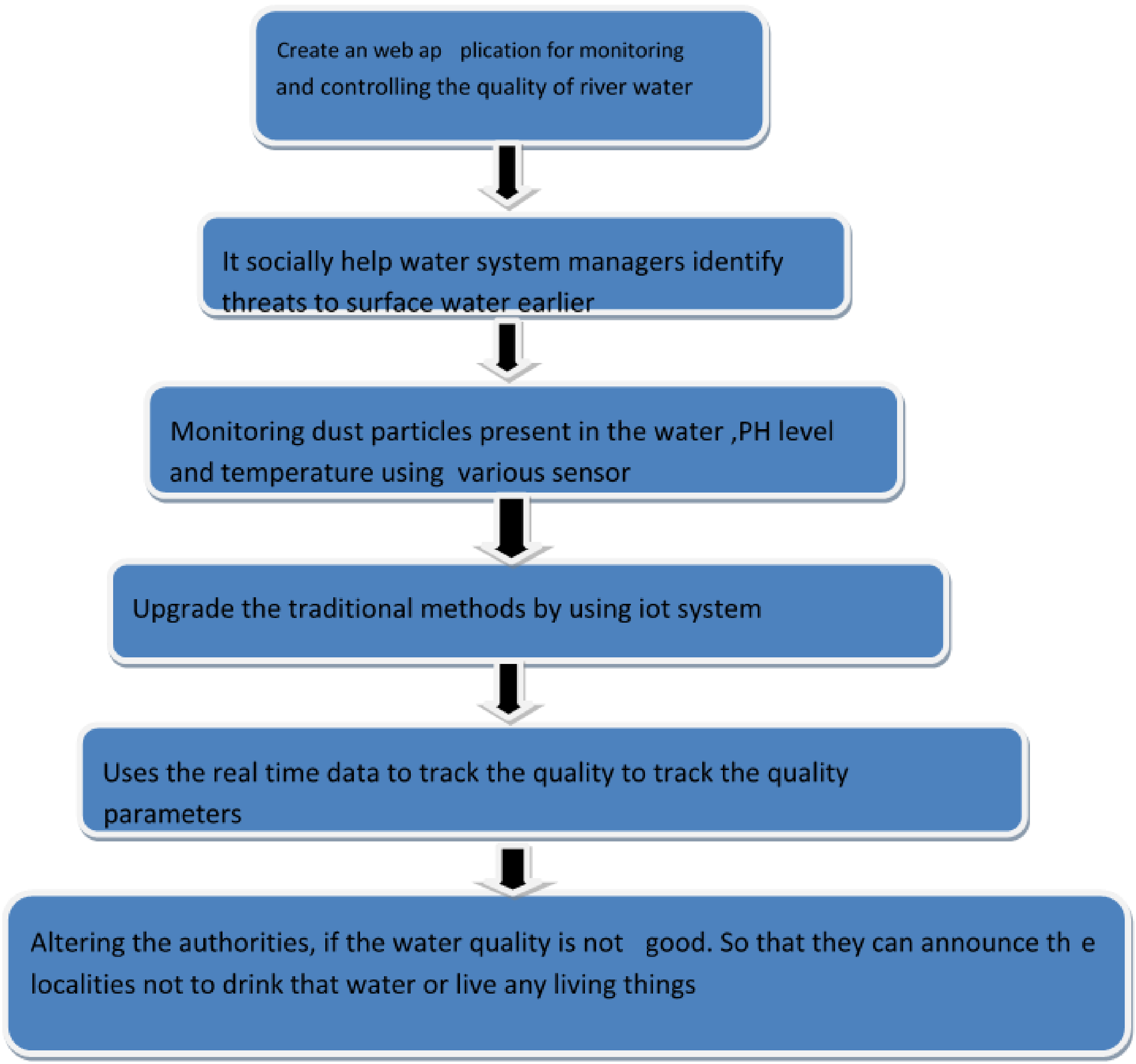
Data Flow Diagrams:





SOLUTION ATCHITECTURE


Create an web ap plication for monitoring and controlling the quality of river water
It socially help water system managers identify threats to surface water earlier
Monitoring dust particles present in the water ,PH level and temperature using various sensor
Upgrade the traditional methods by using iot system
Uses the real time data to track the quality to track the quality parameters
Altering the authorities, if the water quality is not good. So that they can announce th e localities not to drink that water or live any living things



PROJECT PLANNING &SCHEDULING:

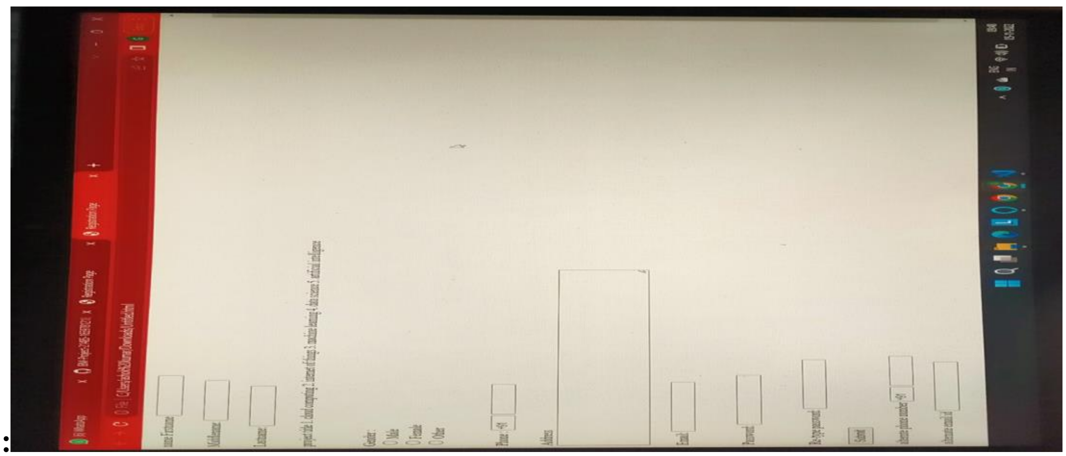
SPRINT PLANNING & ESTIMATION

CODE:

```
<html>
        <head>
        <title>
        Registration Page
        </title>
        </head>
        <body>
        <br>
        <br>
```

```
<form>
name
<label> Firstname </label>
<input type="text" name="firstname" size="15"/> <br> <br>
<label> Middlename: </label>
<input type="text" name="middlename" size="15"/> <br> <br>
<label> Lastname: </label>
<input type="text" name="lastname" size="15"/> <br> <br>
</select>
project title
1.<label> cloud computing </label>
2.<label> internet of things </label>
3.<label> machine learning </label>
4.<label> data science </label>
5.<label> artificial intelligence </label>
<br>
<br>
<br>
<label>
Gender :
</label><br>
<input type="radio" name="male"/> Male <br>
<input type="radio" name="female"/> Female <br>
<input type="radio" name="other"/> Other
<br>
<br>
<br>
<label>
Phone :
</label>
<input type="text" name="country code"  value="+91" size="2"/>
<input type="text" name="phone" size="10"/> <br> <br>
Address
<br>
<textarea cols="80" rows="5" value="address">
</textarea>
<br> <br>
Email:
<input type="email" id="email" name="email"/> <br>
<br> <br>
Password:
<input type="Password" id="pass" name="pass"> <br>
<br> <br>
```

```
Re-type password:
<input type="Password" id="repass" name="repass"> <br> <br>
<input type="button" value="Submit"/>
</form>
</body>
alternte phone number
<input type="text" name="country code" value="+91" size="2"/>
<input type="text" name="phone" size="10"/> <br> <br>
alternate email id
<input type="altrernate email id" name="alternate email"/> <br>
<br> <br>
<body>
<html>
```



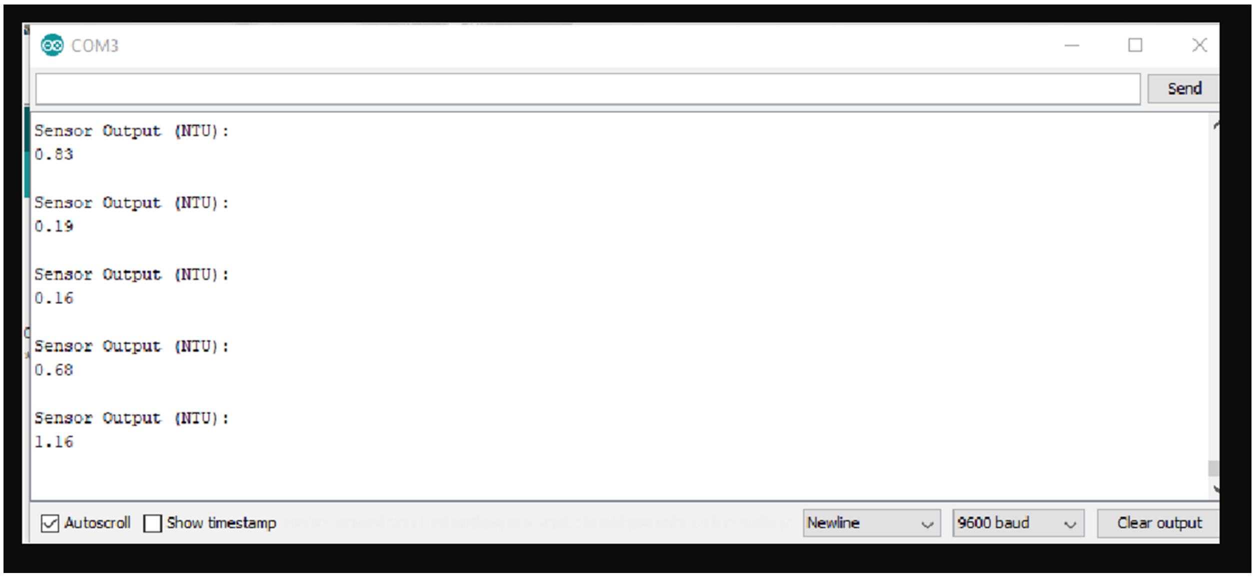
ESTIMATION:

SPRINT DELIVERY SCHEDULE:

```
#include
<OneWire.h>
#include <DallasTemperature.h>
#define ONE_WIRE_BUS 5
OneWire oneWire(ONE_WIRE_BUS);
DallasTemperature sensors(&oneWire);
float Celcius=0;
float Fahrenheit=0;
float voltage=0;
const int analogInPin = A0;
int sensorValue = 0;
unsigned long int avgValue;
float b;
int buf[10],temp;
```

```
void setup(void)
{

 Serial.begin(9600);
 sensors.begin();
 int sensorValue = analogRead(A1);
 voltage = sensorValue * (5.0 / 1024.0);
}
void loop(void)
{
 sensors.requestTemperatures();
 Celcius=sensors.getTempCByIndex(0);
 Fahrenheit=sensors.toFahrenheit(Celcius);
 for(int i=0;i<10;i++)
{
 buf[i]=analogRead(analogInPin);
 delay(10);
}
for(int i=0;i<9;i++)
{
 for(int j=i+1;j<10;j++)
  {
 if(buf[i]>buf[j])
  {
 temp=buf[i];
 buf[i]=buf[j];
 buf[j]=temp;
  }
   }
}
for(int i=2;i<8;i++)
avgValue+=buf[i];
float pHVol=(float)avgValue*5.0/1024/6;
float phValue = -5.70 * pHVol + 21.34;
Serial.println(phValue);
Serial.print("pH");



 Serial.print(" C ");
 Serial.print(Celcius);


 Serial.print(voltage);
```

```
Serial.print("V");
delay(10000);
}
```



CODING SOLUTIONING:

Feature 1:

The station cn monitor weather conditions,water leave in streams, rivers, tanks and mud or sludge pits,tha stability of building structures.

Feature 2:

Tha EMA compact monitaring station send tha values it mearing and caluatees throught one or two indepeation channal to warning contres or moblie phone.

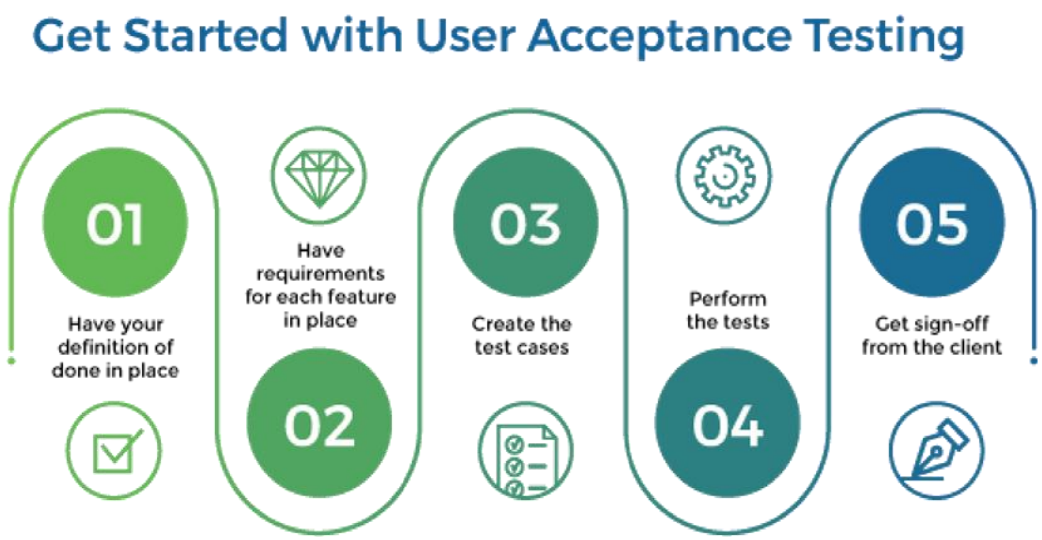
TESTING:

Test cases

In the context of this thesis it is important to note the use of subtle differences in the definition of automated testing. In literature we often find mentions of how automated test cases can require a lot of manual effort coding cases.

Acceptance Testing

User acceptance testing (UAT) is necessary when implementing changes to an IT landscape due to the ever increasing complexity of software which can cause bugs to slip through even under the most perfect development conditions. Commonly, acceptance testing is performed as the last step before the release of a software, after all other testing phases have exited. As implied by its name, user acceptance testing is typically performed by the end users in a real setting during the unit-, integration- and system testing phases.



Test planning, monitoring and control

This step entails planning and setting up the base for the execution of the tests. Setting goals and identifying the aim(s) of the test phase based on the requirements supplied.

Related works:

To design a good quality model, we reviewed out different existing system developed by researchers. Different authors have proposed distinguished models to check water quality by analyzing the parameters such as temperature, pH and conductivity, and so on. By considering all these points, we designed a smart water monitoring system which can perform all these monitoring functions. Stephen Brosnan investigated a WSN to collect real time water quality parameters (WQP). Quio Tie-Zhn, developed online water quality monitoring system based on GPRS/GSM [15]. The information was sent by means of GPRS network, which helped to check remotely the WQP. Kamal Alameh presented web based WSN for monitoring water pollution using ZigBee and WiMAX networks. The system collected, processed measured data from sensors, and directed through ZigBee gateway to the web server by means of WiMAX network to monitor quality of water from large distances in real time. Dong He developed WQM system based on WSN [14]. The remote sensor was based on ZigBee network. WSN tested WQP and sent data to Internet using GPRS. With the help of Web.

pH sensor:

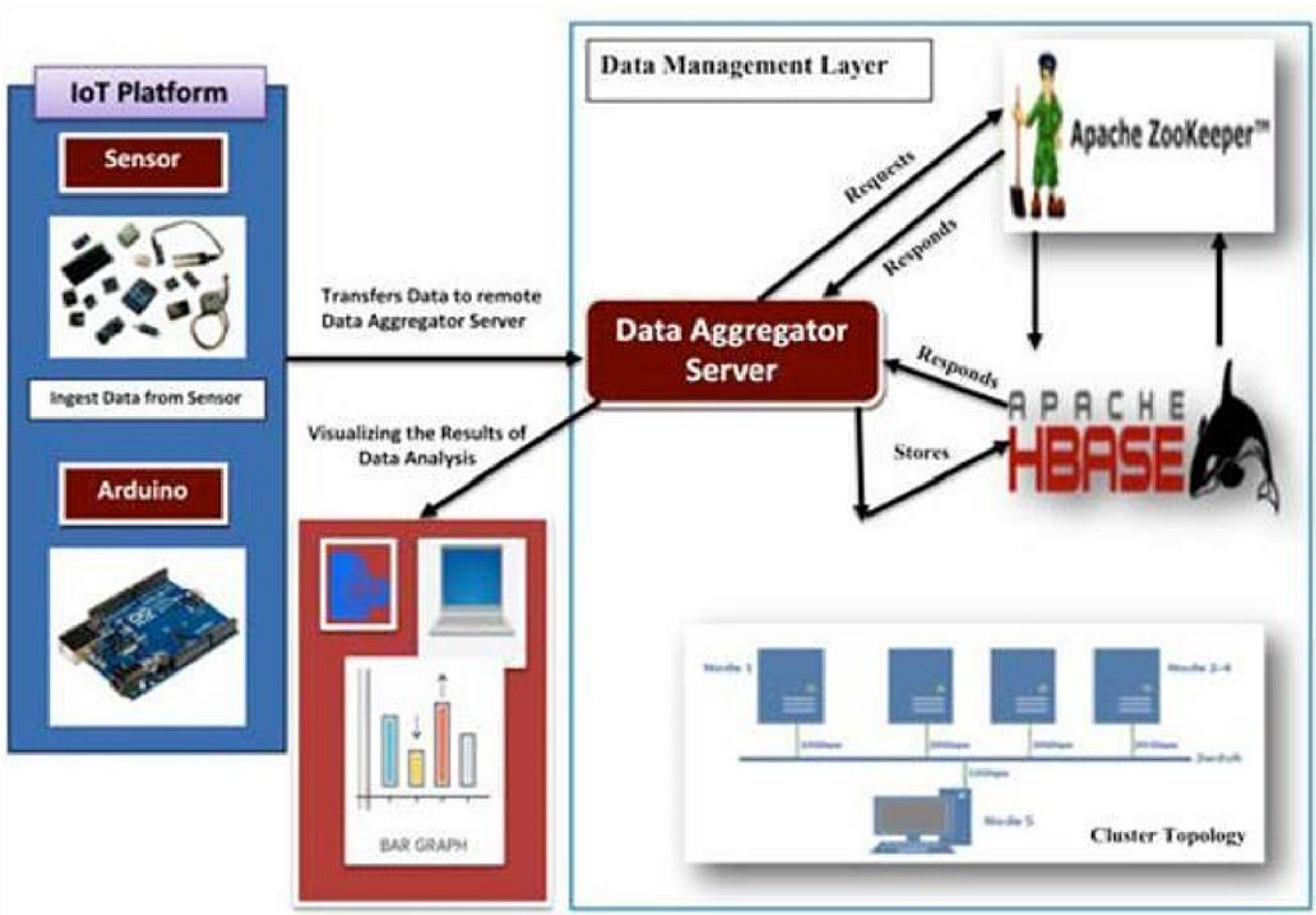
The pH of thing is a useful constant to display because graduate and low pH levels can hump large effects on the author. The pH of a statement can grasp from 1 to 14. A pH sensor is an instrumentation that measures the hydrogen-ion density in a bleach, indicating its tartness or alkalinity. Its constitute varies from 0 to 14 pH.

IoT Platform:

The quality parameters are labeled datasets including desired outputs of specific combination of inputs. The neural network will produce output to classify water quality as dangerous, be careful, and good. The classification layer will run on top of Hadoop cluster [17]. The advantages of using neural network based analytics are like Artificial Neural Networks (ANNs) are good in learning and modeling non-linear relationships, and high volatile data [18]. Though neural networks are prone to over fitting, the neural network model used in water quality monitoring system is not complex enough to cause over fitting problem. Also, there are many countermeasures to avoid over fitting. Also, computation overload is not going to delay the response of system as there are only a few water quality parameters.

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

IoT devices use various types of sensors to collect data about turbidity, ORP, temperature, pH, conductivity, etc. of river water continuously. Also, IoT devices have capability to stream the array of collected data wirelessly to the remote Data Aggregator Server in the cloud. Moreover, the volume of semi structured data increases with time in such a velocity that only the Big Data Analytics applications can efficiently store and analyze the data constantly [18]. The system should be reliable and scalable. So, data management layer will be deployed and operational on the Apache Hadoop cluster. Hadoop helps distributed storing and processing of big data across cluster of computers. Also, such operational environment is horizontally scalable i.e. nodes or computers can be added to a cluster later while volume and velocity of data streaming will be increasing. Hadoop cluster is fault tolerant as jobs are redirected automatically to the running nodes when nodes are failed. The data in Hadoop is highly available as multiple copies of data are stored in data nodes managed by name node, standby name node, journal nodes and failover controller. IoT applications need high speed of read/write of data and highly available data.



Result:

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

CODE:

```
# Import common libraries
import numpy as np import
pandas as pd

import matplotlib.pyplot as plt


# Import the PyGeohydro libaray tools import
pygeohydro as gh

from pygeohydro import NWIS, plot


# Use the national water info system (NWIS) nwis
= NWIS()

# Specify date range of interest dates =
("2020-01-01", "2020-12-31") # Filter
stations to have only those with proper
dates stations =
info_box[(info_box.begin_date <=
dates[0]) &
(info_box.end_date >= dates[1])].site_no.tolist()
```

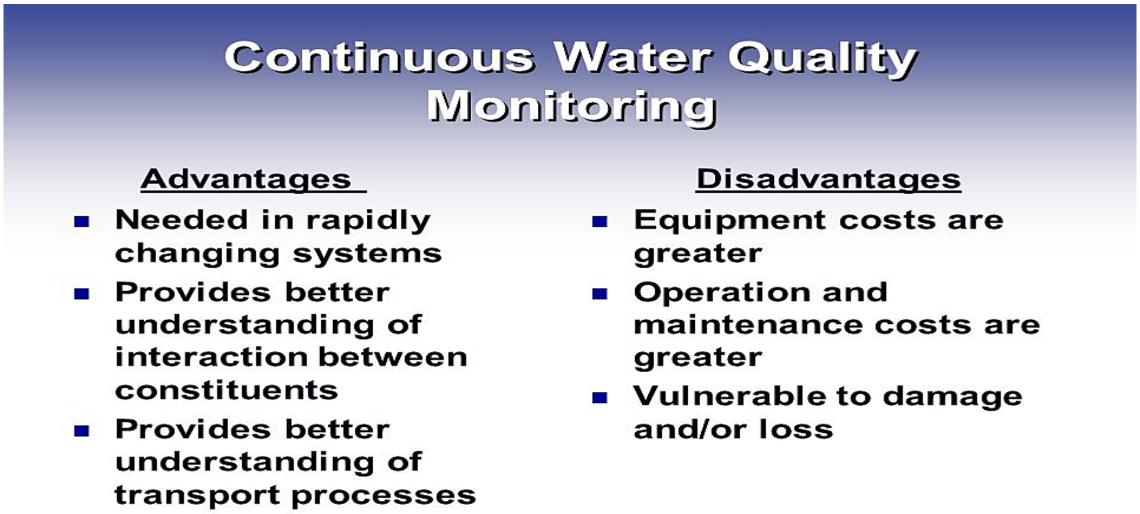
```
# Remove duplicates by converting to a set stations
= set(stations)

# Specify characteristics of interest
select_attributes = ['CAT_BASIN_AREA', 'CAT_ELEV_MAX',
'CAT_STREAM_SLOPE']


# Initialize a storage matrix
nldi_data = np.zeros((len(flow_data.columns), len(select_attributes)))


# Loop through all gages, and request NLDI data near each gage for
i, st in enumerate(flow_data.columns):


    # Navigate up all flowlines from gage
    flowlines = NLDI().navigate_byid(fsource = 'nwissite',
                                fid = f'{st}',
                                navigation="upstreamTributaries",
                                source = 'flowlines', distance = 10)

    # Get the nearest comid
    station_comid = flowlines.nhdplus_comid.to_list()[0]
```

```
# Source NLDI local data
nldi_data[i,:] = NLDI().getcharacteristic_byid(station_comid, "local", char_ids = select_attributes)
```

Conclusions and future works :

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.

ADVANTAGES& DISADVANTAGE:



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FUTURE SCOPE: