REAL-TIME RIVER WATER QUALITY MONITORING AND CONTROL SYSTEM

TEAM ID: PNT2022TMID15959

INTRODUCTION

PROJECT OVREVIEW:

we depict the design of Wireless Sensor Network (WSN) 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. 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. 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. In this research, we monitor the physical and chemical parameters of water bodies inside Chittagong city by using an IoT based sensor networkwe depict the design of Wireless Sensor Network (WSN) that assists to monitor the quality of water with the support of information sensed by the sensors dipped in water.

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 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.

PURPOSE

The main objective of this research is to monitor the river water level by using the internet of things. This system can keep a strict check on the pollution of the water resources and be able to provide an environment for safe drinking water. Water-quality monitoring is used to alert us to current, ongoing, and emerging problems; to determine compliance with drinking water standards, and to protect other beneficial uses of water

- available on the web in real-time.
- accurate measurements on pH.
- total dissolved salts.
- electrical conductivity.

LITERATURE SURVEY

EXISTING PROBLEM:

Traditional methods of inlet wastewater monitoring involve the manual collection of water samples and the manual reading of the sensors, followed by laboratory analytical techniques to enable early detection and warning in the event of impermissible inlet wastewater to the sewage plant. Such methods take a while to execute and are no longer considered efficient. The current system for monitoring industrial wastewater discharged into the wastewater treatment plant consists of the following components: 1. Analog pH electrode: This electrode is used to monitor the pH of the wastewater inflow. 2. pH transmitter with display: this device is used to display pH readings. 3. SCADA system screen: utilized to monitor all instrument measurements in real-time. The system works as follows: Throughout his shift, the worker checks the display numbers to determine whether they are less than 6.5 or greater than 9, indicating the presence of

industrial effluent. The existing technology is incapable of autonomously closing and opening the entrance gates and does not include an audible alarm, SMS notification, or alerts.

REFERENCE:

[1] R. Rond´on, M. Gidlund, and K. Landern¨as, “Evaluating bluetooth low energy suitability for time-critical industrial iotapplications,” International Journal of Wireless Information Networks, vol. 24, no. 3, pp. 278–290, Sep 2017.

[2] G. Patti, L. Leonardi, and L. L. Bello, “A bluetooth low energy real-time protocol for industrial wireless mesh networks,”in IECON 2016 - 42nd Annual Conference of the IEEE Industrial Electronics Society, Oct 2016, pp. 4627–4632.

[3] M. Marinoni, A. Biondi, P. Buonocunto, G. Franchino, D. Cesarini, and G. Buttazzo, “Real-time analysis and design ofa dual protocol support for bluetooth le devices,” IEEE Transactions on Industrial Informatics, vol. 13, no. 1, pp. 80–91,Feb 2017.

[4] A. Al-Fuqaha, A. Khreishah, M. Guizani, A. Rayes, and M. Mohammadi, “Toward better horizontal integration amongiot services,” IEEE Communications Magazine, vol. 53, no. 9, pp. 72–79, 2015.

[5] J. P. Tomas, “Thames water rolls out smart meter project in london,” 2017.

PROBLEM STATEMENT DEFINITION

Real-time data access can be done by using remote monitoring and Internet of Things (IoT) technology. Data collected atthe apart site can be displayed in a visual format on a server PC with the help of Spark streaming analysis through Spark ML

lib, Deep learning neural network models, Belief Rule Based (BRB) system and is also compared with standard values. Also it assures low cost efficient water quality monitoring and control over river water. Since its battery operated, it is much safer for the locality and people to use the river water that has low rate of electrical shocks as the battery is completely insulated and rechargable so that the system is continuous. By using this product people can predict , analyse the hardness of water and also the factors like temperature and turbidity of water for having a safe drinking and water with better consistancy for house hold purposes. Since water is an essential compound in our daily basis intake of itin an healthy manner is provided by our cost efficient quality monitoring and control system which is market affordable and greatly life saving factor for people using river water. 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.

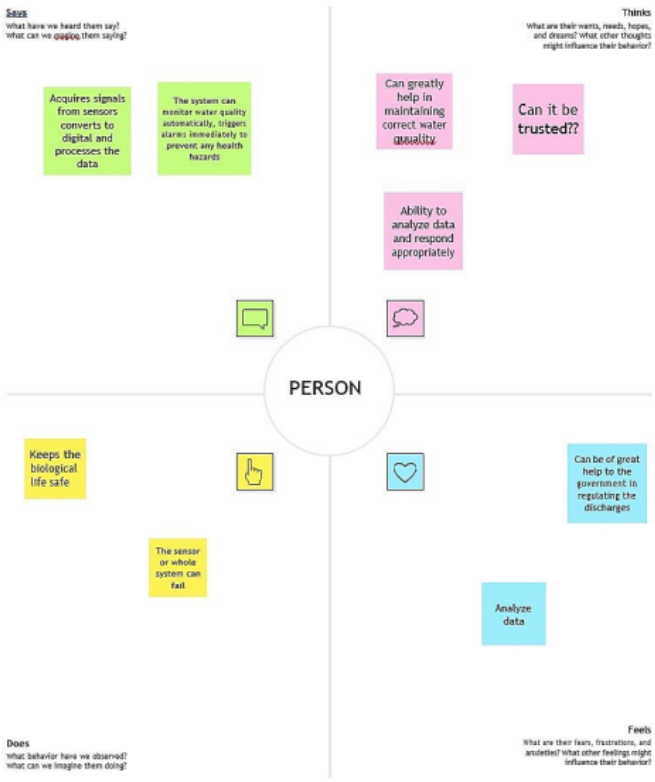
Whetherit is used for drinking,domestic use, and food production or recreational purposes, safe and readilyavailable water is the need for public health . So it is highly imperative for us to maintain water quality balance. Otherwise, it would severely damage the health ofthe humans and at the same time affect the ecological balance among other speciesUsing 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 . Though IoT is still under applied in the field of environment it has huge potential. It can be applied to detect forest fire

andearly 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 . 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 anefficient, cost-effective, realtime water quality monitoring system which will integrate wireless sensor network and internet of things.

IDEATION AND PROPOSED SOLUTION

EMPATHY MAP CANVAS:



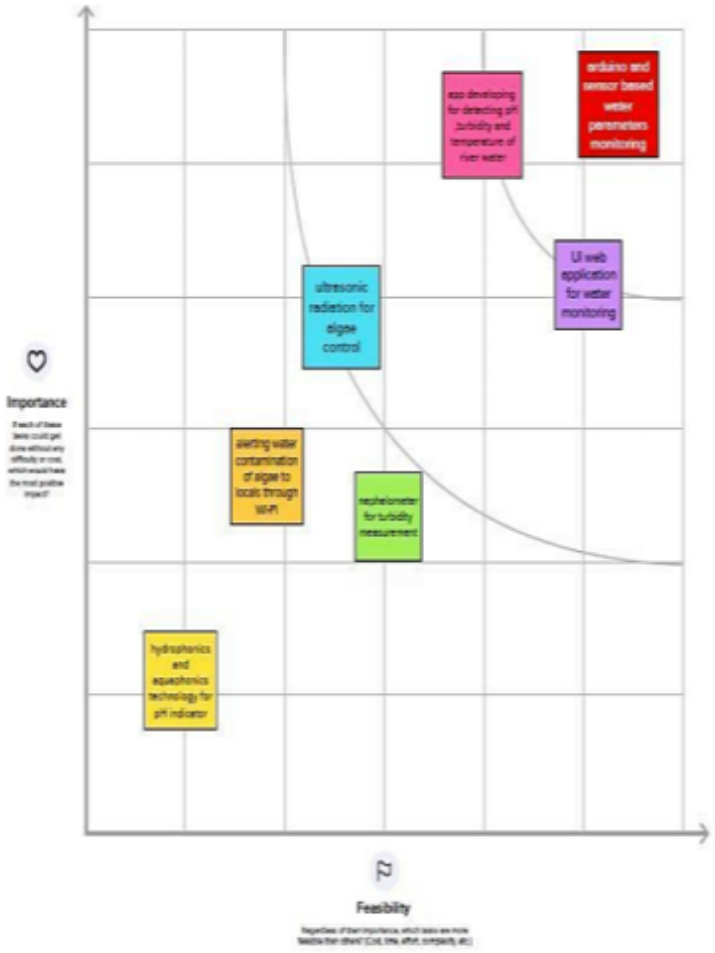
The empathy map is about is describing the project with a gain and pain in this regard the depicts about the outcome of our real time water monitoring system.

4

Prioritize

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

20 minutes

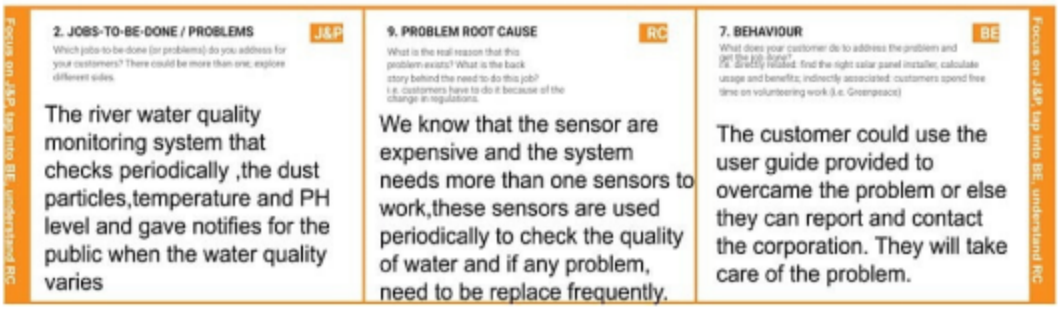


IDEATION AND BRAINSTROMING:

PROPOSED SOLUTION:

S.No.	Parameter	Description
1.	Problem Statement (Problem to besolved)	Massive growth of algae called eutrophication leadsto pollution(monitoring and controllin g the quality of river water)
2.	Idea / Solution descriptio n	Detecting the dust particles , PH level of water,Dissolved oxygen and temperature to be monitored and altering theauthorities if water quality is not good.
3.	Novelty / Uniqueness	River water quality can be monitored by webapplication. Quality parameter will track continuously with standard measurements.
4.	Social Impact / Customer Satisfaction	Localities will not get suffered by poor quality of waterby alerting them when the water quality is not good.
5.	Business Model (Revenue Model)	Waterquality monitoring systemby aeron systemsfor industrial water treatment plant, river bodies, aquaforming ,digital loggers.
6.	Scalability of the Solution	Measuring of real time values and continuous monitoring helps in maintaining the quality ofwater.

PROBLEM SOLUTION FIT:



REQUIREMENT ANALYSIS:

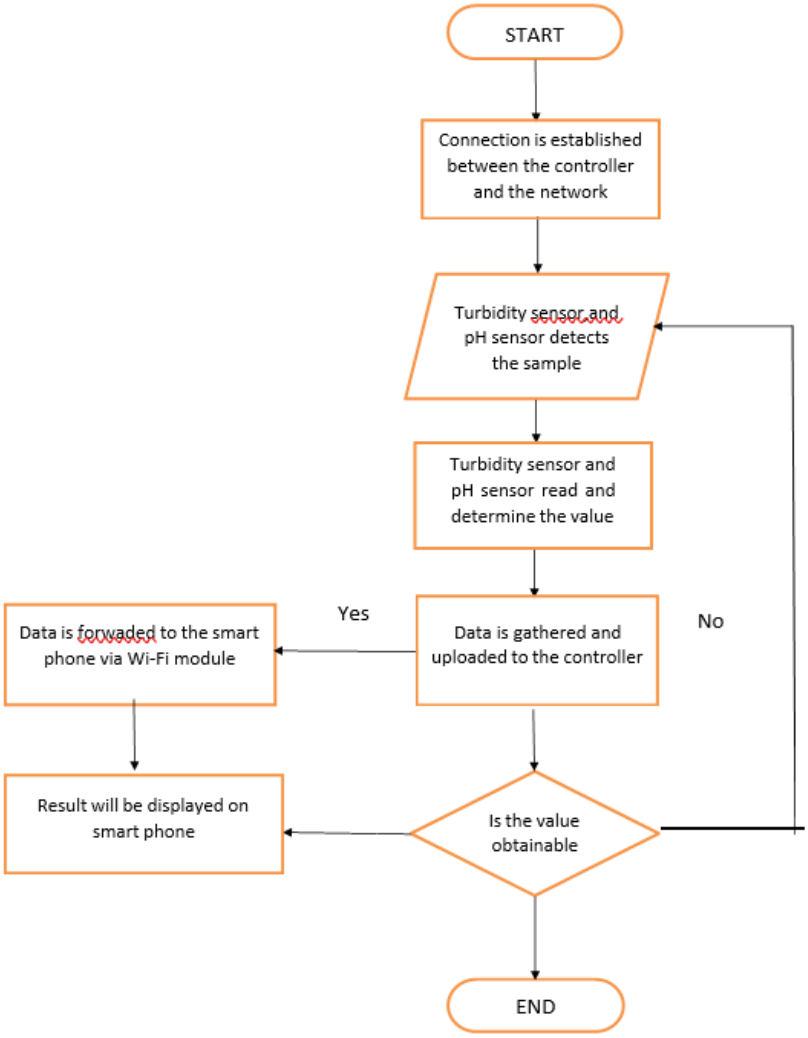
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Login	Confirmation through verified password
FR-2	View Water Details	View current water details in website View traditional water eligibility in website
FR-3	Logout	Logs outthe user successfully

NON FUNCTIONAL REQUIREMENTS:

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Load time for user interface screens shall not bemore than 2 seconds.
NFR-2	**Security**	User account is password protected Account creation doneonly after emailverification
NFR-3	**Reliability**	Users can access theiraccount 98% of the timewithout failure
NFR-4	**Performance**	Load time for user interface screens shall not bemore than 2 seconds. Login info verified within 10 seconds.
NFR-5	**Availability**	Maximum downtime will be about 4 hours
NFR-6	**Scalability**	System can handle about1000 users at any giventime

PROJECT DESIGN

DATA FLOW DIAGRAM:



SOLUTION & TECNICAL ARCHITECTURE:

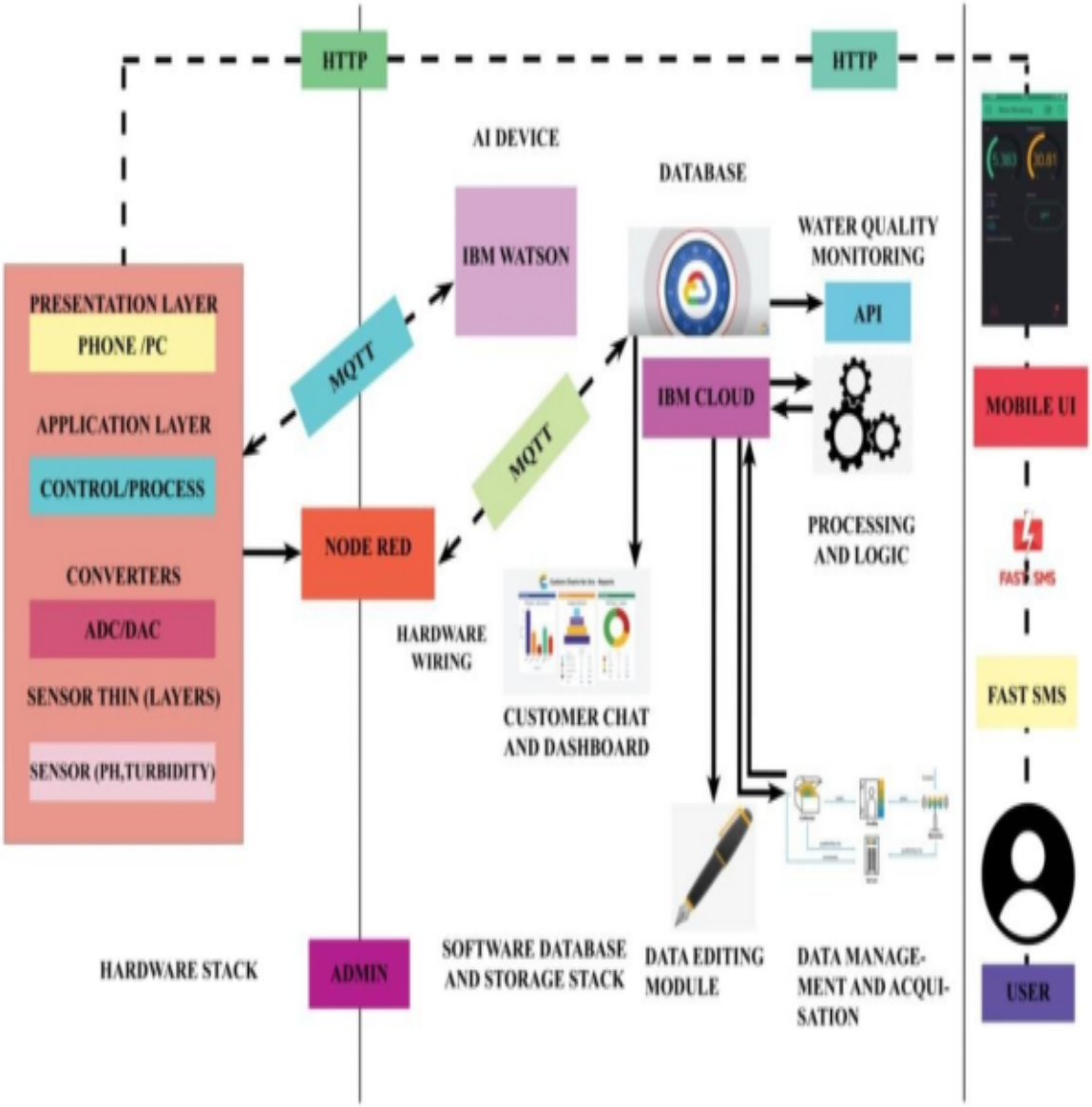


Table-1 : Components & Technologies:

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 waterparameters	Java
3	Application Logic-2(AI Application)	Forpredicting future valuesof water qualityrange	IBMWatson 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	IBMBlock Storage
7	External API-1	The data is used to compare the values for sensorwith threshold values	IBMwater quality API
8	External API-2	For the locals and authorities to know the waterquality	mobile API,
9	Machine Learning Model(node-red)	For interfacing hardware and softwa reapplication(a virtual wiring tool)	Platform: Node.js
10	Infrastructure (Server/ Cloud)	Application Deployment on cloud Cloud Server Configuration : application-client-bnd	IBMcloud

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

6. PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story/ Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, andconfirming my password.	2	High	1
Sprint-1	User Confirmation	USN-2	As a user, I will receive confirmation email once I have registered for theapplication	1	Medium	2
Sprint-1	Login	USN-3	As a user, I can log into the application by entering email& password	2	High	3
Sprint-2	Interface Sensor	USN-1	A sensor interface is a bridgebetween a device and any attached sensor. The interface takes data collected by thesensor and outputs it to the	2	High	2
Sprint-3	Coding (Accessing datasets)	USN-1	Coding is a set of instructions usedto manipulate information so that a certain input results in a particular output.	2	High	4
Sprint-4	Web Application	USN-1	As a user, I will show the current Information of the River water.	1	Medium	2

6.2 SPRINT DELIVERY SCHEDULE

Sprint	**Total Story Points**	**Duration**	**Sprint Start Date**	**Sprint End Date (Planned)**	**Story PointsCompleted (as on PlannedEnd 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

7.CODING & SOLUTIONING

7.1 FEATURE 1

```
import time

i=0

while (i<=10):

    i=i+1

    time.sleep(1)

    import random

    temperature=random.randint(0,30)

    humidity=random.randint(1,100)

    if temperature<=15:

        print(temperature, "temperature is low")

    elif temperature<=25:

        print(temperature, "temperature is normal")

    else :

        print(temperature, "temperature is high")

    if humidity<=30:

        print(humidity, "humidity is low ")

    elif humidity<=60:

        print(humidity, "humidity is normal")

    else :

        print(humidity, "humidity is high")
```

7.2 FEATURE 2

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(12, 13, 11, 10, 9, 8);
int pirPin=7;
int pirInput=0;
int bulbPin=6;
int photoValue=0;
int tempReading=0,temp1=0,temperature=0;
int fanPin=5;
int gasReading=0;
int greenLed=4;
int yellowLed=3;
int redLed=2;
int piezoPin=0;
void scrollScreenSaver() {
lcd.clear() ;
lcd.setCursor(15, 0);
lcd.print("Welcome");
lcd.setCursor(15, 1);
lcd.print("to my home");
   for (int positionCounter = 0; positionCounter < 22; positionCounter++) {
lcd.scrollDisplayLeft();
delay(50);
}
}  void setup(){
```

```
  lcd.begin(16, 2);
  lcd.print("hello, world!");
  pinMode(pirPin, INPUT);
  pinMode(bulbPin, OUTPUT);
}
void loop()
{
  lcd.setCursor(0, 1);
  lcd.print(millis() / 1000);
  pirInput=digitalRead(pirPin);
  photoValue=analogRead(A0);
  Serial.println(photoValue);
  tempReading=analogRead(A1);
  temperature=(5000.0/1024.0*tempReading/10.0);
  Serial.println(temperature);
  gasReading=analogRead(A2);
  Serial.println(gasReading);
  Serial.println(".....");
  digitalWrite(greenLed,gasReading>100 ? HIGH : LOW);
  digitalWrite(yellowLed,gasReading>200 ? HIGH : LOW);
  digitalWrite(redLed,gasReading>300 ? HIGH : LOW);
  if(pirInput==HIGH)
  {
    lcd.clear();
    lcd.setCursor(0,0);
```

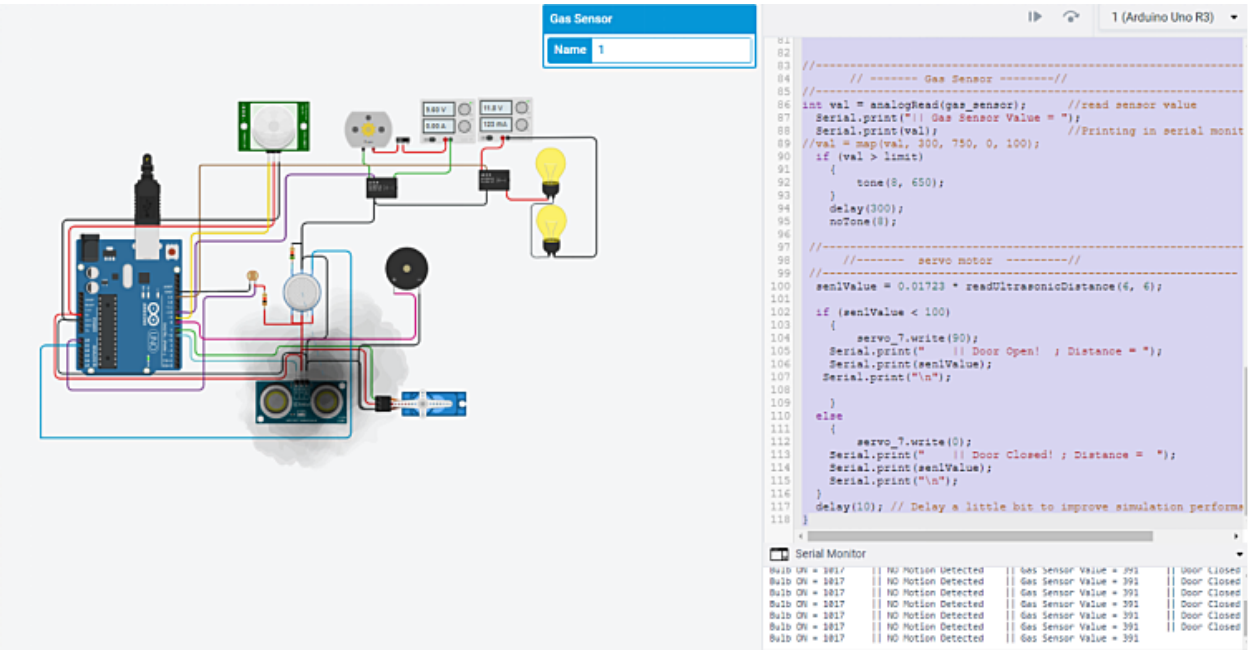
```
    lcd.print("Motion Detected");
    if(photoValue<300)
    {
      digitalWrite(bulbPin,HIGH);
      lcd.setCursor(0,1);
      lcd.print("Light is on");
      delay(1000);
    } if(temperature>25)
    {
      digitalWrite(fanPin,HIGH);
      lcd.setCursor(0,1);
      lcd.print("                ");
      lcd.setCursor(0,1);
      lcd.print("Fan is on");
      delay(1000);
    }
  }
  else
  {
    scrollScreenSaver() ;
  }
  delay(1000);
  digitalWrite(13, LOW);
  delay(1000);
}
```

8.TESTING

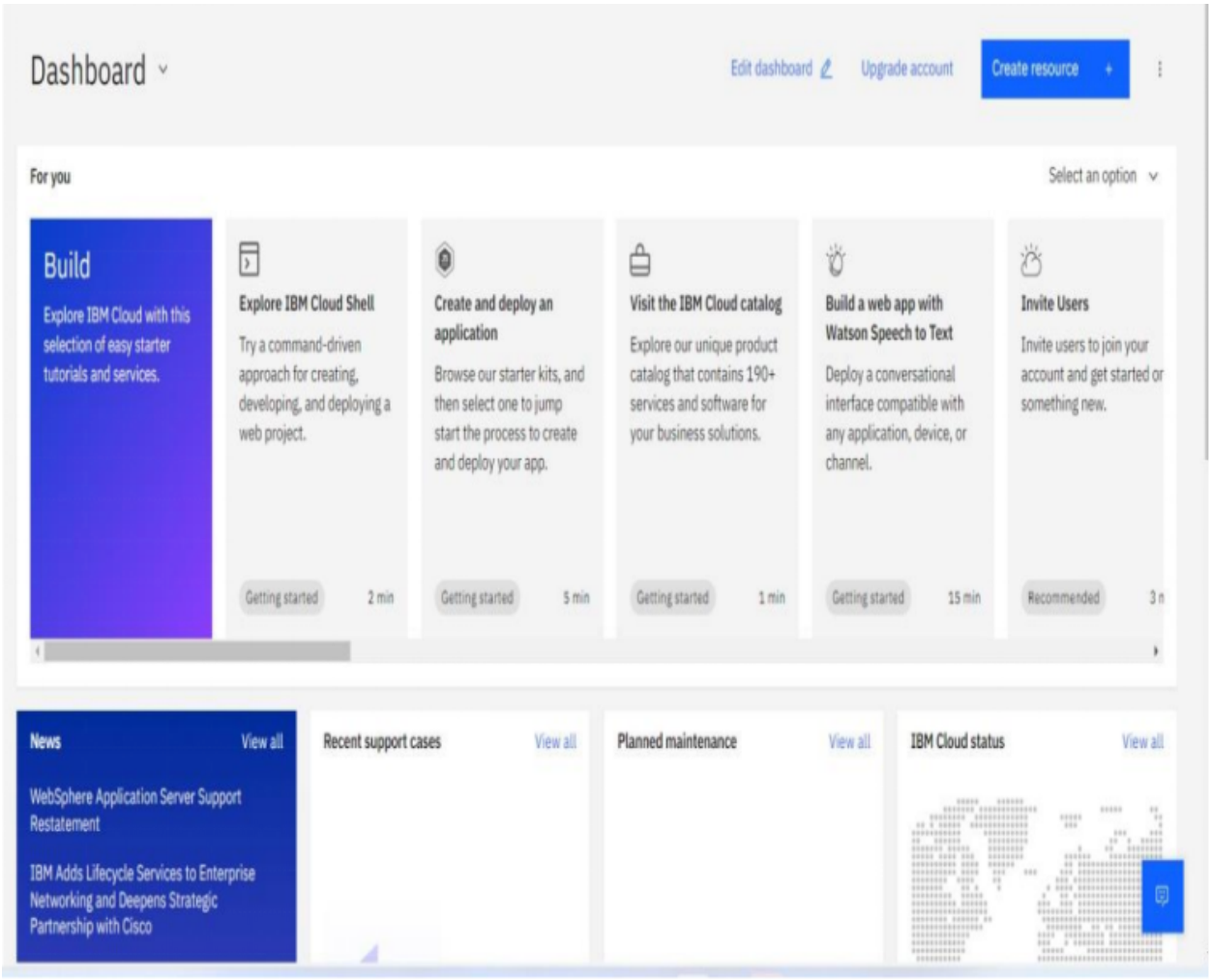
8.1 TEST CASES

```
6 temperature is low
88 humidity is high
1 temperature is low
25 humidity is low
11 temperature is low
79 humidity is high
20 temperature is normal
13 humidity is low
9 temperature is low
92 humidity is high
12 temperature is low
42 humidity is normal
17 temperature is normal
75 humidity is high
27 temperature is high
23 humidity is low
13 temperature is low
80 humidity is high
10 temperature is low
14 humidity is low
10 temperature is low
22 humidity is low


...Program finished with exit code 0
Press ENTER to exit console.
```



8.2 USER ACCEPTANCE TESTING



9. RESULTS

9.1 PERFORMANCE METRICES

The proposed system can provide an efficient IoT-based dynamic, continuous, and real time online monitoring of the industrial wastewater discharged into wastewater treatment plants, as well as remote control of the water's path to avoid all forms of damage. The system is designed for low cost, small size, high sensitivity, easy operation, and lightweight. It minimizes the time involved in lab testing. The results are recorded in the cloud so that any previous data of testing can be selected easily. No wired Networks were used. The system has more scalability of sensors and reduces power consumption: it is easy to add new sensorsand new IoTdevices, and more than two sensors can be connected to one IoT module. The wastewater department can easily analyse the data and make reports. Using IoT, an integrated sensor is used to analyse the accuracy of data in real-time. These sensors could share data among various wastewater stations in the city because they are connected to IoT networks. Further, SMS notifications keep all administrators up to date on all events and allow for continuous follow-up, making control, monitoring, and decision-making easier. It reduces the manpower as less manual work is needed. The government can identify the company that discharged illegal industrial wastewater based on the data and act against the guilty parties .Network management enables users to connect to any available WIFI network for flexibility of use in different locations, rather than being restricted to a fixed WIFI network in the current location. Communication management supportsautotransfermode between WIFI and GPRS connections in the case of WIFI disconnection to ensure continuous data transfer.The primary advantage of any systemis that the operators in each stationhave fast accessto various reportsto make decisions.The proposed system has the advantageof enabling remote ON/OFF Controlin different wastewater stations. The proposed system provides various alert options.

10. ADVANTAGES & DISADVANTAGES

ADVANTAGES:-

- ➤ The boat is mobile in nature and hence large number of samples are easily collected from different locations in less time.
- ➤ It is very easy to maintain the IoT based water quality monitoring system as all the electronic boards are available in the boat itself.
- ➤ The system is very cheap as the hardware and software does not cost much.

➤ Machine learning techniques have made it very easy to plot the data collected in various formats for proper analysis.

➤ Cloud storage platforms such as adafruit, azure helps in storing the sensor data immediately and wirelessly to the robust servers.

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 sensors are very expensive. Moreover their maintenance cost is also very high. This leads to higher cost on the regulatory body.

➤ The sensors which work on power source may often required to be replaced in case of malfunctioning.

11. CONCLUSION

Our main intentions of this research work were to create a small, economical, flexible,easily configurable, and portablesystem that could monitor, and control industrial wastewater discharged into waste water treatment plants and prevent damage in the treatment process and equipmentandprotect the workers which are not qualified to deal with such type of water. Realtime data accesscan be done by using remote monitoring and Internet of Things (IoT) technology.

Data collectedatthe apart site can be displayed in a visual format on a server PC with the help of Spark streaming analysis through SparkMLlib, Deep learning neural network models,Belief Rule Based (BRB) system and is also compared with standard values.Also it assures lowcost efficent water quality monitoring and control over river water.Since its battery operated,it is much safer for the locality and people to use the river water that has low rate of electrical shocks as the batteryis completely insulated and rechargable so that the system is continuous.By using this product people can predict ,analyse the hardness of water and also the factors like temperature and turbidityof water for having a safe drinking and water with better consistancy for house hold purposes.Since water is an essential compound in our daily basis intake of it in an healthy manner is provided by our cost efficient quality monitoring and control system.

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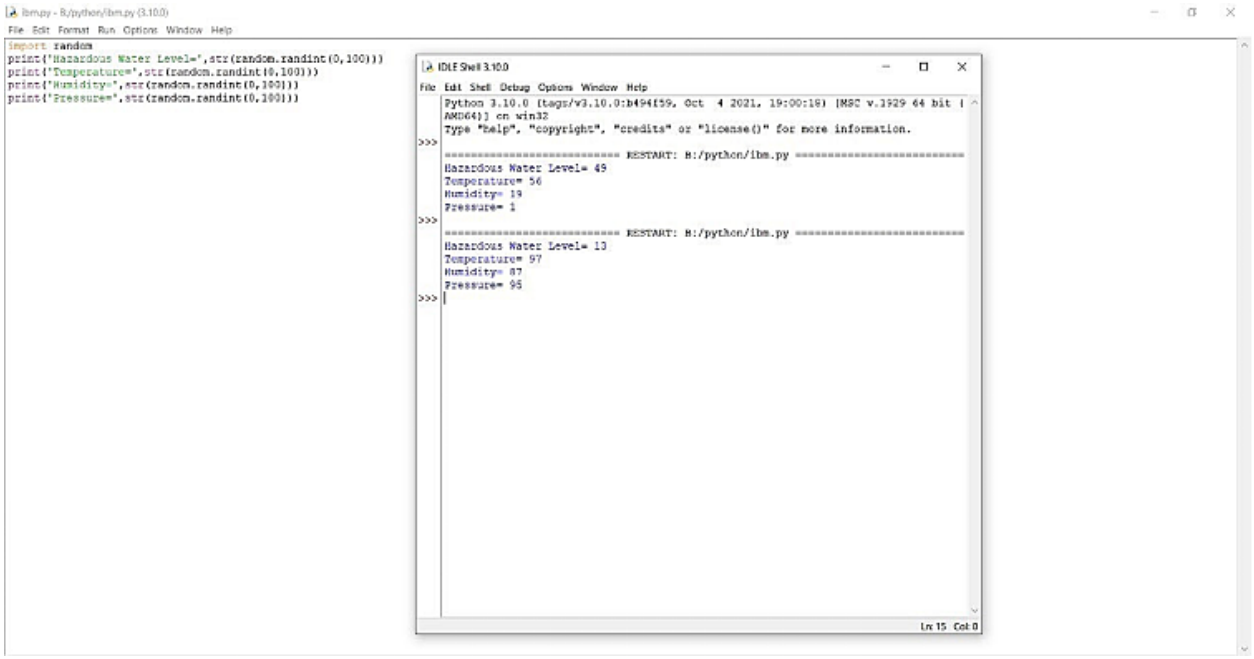
12. FUTURE SCOPE

More water parameters will hopefully be added in future work so that all water parameters can be analysed . Further improvisation will develop a custom dashboard using the mobile application would be ideal for such application in consumer networks. This research protects the natural ecosystem of water resources. Based on the compari-son study, the proposed system was found to outperform theexisting system and related work. Physical parameters such as DO, turbidity, conductivity, Residual Chlorine, waste water Flow willbe added to the system using additional sensors to propose acomplete SCADA system that integrates with IoT technology for real-time monitoring of all pumping stations and treatment plants. Automatic control of all equipment was done based on resultsand sending SMS notifications for abnormalvalues and necessary actions to be taken by the users. Further more it is vital to protect sensor data communication via wireless networks from intrusion. Machine learning will be used to supplement the system, which will be a terrific addition to the system in keeping .

13. APPENDIX

SOURCE CODE

```
import random
print('Hazardous Water Level=',str(random.randint(0,100)))
print('Temperature=',str(random.randint(0,100)))
print('Humidity=',str(random.randint(0,100)))
print('Pressure=',str(random.randint(0,100)))
```


ibm.py - B:/python/ibm.py (3.10.0)
File Edit Format Run Options Window Help
import random
print('Hazardous Water Level=',str(random.randint(0,100)))
print('Temperature=',str(random.randint(0,100)))
print('Humidity=',str(random.randint(0,100)))
print('Pressure=',str(random.randint(0,100)))
IDLE Shell 3.10.0
File Edit Shell Debug Options Window Help
Python 3.10.0 (tags/v3.10.0:b494f59, Oct 4 2021, 19:00:18) [MSC v.1929 64 bit (
AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
========== RESTART: B:/python/ibm.py ==========
Hazardous Water Level= 49
Temperature= 56
Humidity= 19
Pressure= 1
>>>
========== RESTART: B:/python/ibm.py ==========
Hazardous Water Level= 13
Temperature= 97
Humidity= 87
Pressure= 95
>>>
Ln: 15 Col: 0