

**SRI SAIRAM ENGINEERING COLLEGE**

West Tambaram , Chennai-44

**IBM-PROJECT-26192-1660020748**

***EFFICIENT WATER QUALITY ANALYSIS & PREDICTION  
USING MACHINE LEARNING***

***TEAM ID-PNT2022TMID03851***

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## **1.INTRODUCTION**

### **1.1 Project Overview:**

Water is considered as a vital resource that affects various aspects of human health and lives. The quality of water is a major concern for people living in urban areas. The quality of water serves as a powerful environmental determinant and a foundation for the prevention and control of waterborne diseases. However predicting the urban water quality is a challenging task since the water quality varies in urban spaces non- and depends on multiple factors, such as meteorology, water usage patterns and land uses, so this project aims at building a Machine Learning [ML] model to predict Water Quality by considering all water quality standard indicators.

### **1.2 Purpose:**

Water is the most significant resource of life, crucial for supporting the life of most existing creatures and human beings. Living organisms need water with sufficient quality to continue their lives. There are certain limits of pollution that we can tolerate. Exceeding these limits affects the existence of these creatures and threaten their lives. Therefore, it is very important to analyze and to predict the Water Quality (WQ).

## **2. LITERATURE SURVEY**

### **2.1 Existing Problem:**

In the existing system, implementation of machine learning algorithm is bit complex to build due to the lack of information about the data visualization. Mathematical calculations are used in existing system for model building this may takes the lot of time and complexity. To overcome this all, we use machine learning packages available in the scikit-learn library.

#### **Disadvantage:**

- High complexity
- Time complexity

### **2.2 References:**

[1] P. Zeilhofer, L. V. A. C. Zeilhofer, E. L. Hardoim, Z. M. . Lima, and C. S. Oliveira, "GIS applications for mapping and spatial modeling of urban-use water quality: a case study in District of Cuiabá, Mato Grosso, Brazil," *Cadernos de Saúde Pública*, vol. 23, no. 4, pp. 875–884, 2007.

[2] M. A. Kahlown, M. A. Tahir, and H. Rasheed, *National Water Quality Monitoring Programme, Fifth Monitoring Report (2005–2006)*, Pakistan Council of Research in Water Resources Islamabad, Islamabad, Pakistan, 2007, <http://www.pcrwr.gov.pk/Publications/Water%20Quality%20Reports/Water%20Quality%20Monitoring%20Re>

port%202005-06.pdf.

[3] UN water, “Clean water for a healthy world,” Development, 2010,  
<https://www.undp.org/content/undp/en/home/presscenter/articles/2010/03/22/clean-water-for-a-healthy-world.html>.

[4] K. Farrell-Poe, W. Payne, and R. Emanuel, Water Quality & Monitoring, of University Arizona Repository, 2000,  
<http://hdl.handle.net/10150/146901>.

[5] T. Taskaya-Temizel and M. C. Casey, “A comparative study of auto-regressive neural network hybrids,” Neural Networks, vol. 18, no. 5–6, pp. 781–789, 2005.

[6] C. N. Babu and B. E. Reddy, “A moving-average filter based hybrid ARIMA-ANN model for forecasting time series data,” Applied Soft Computing, vol. 23, pp. 27–38, 2014.

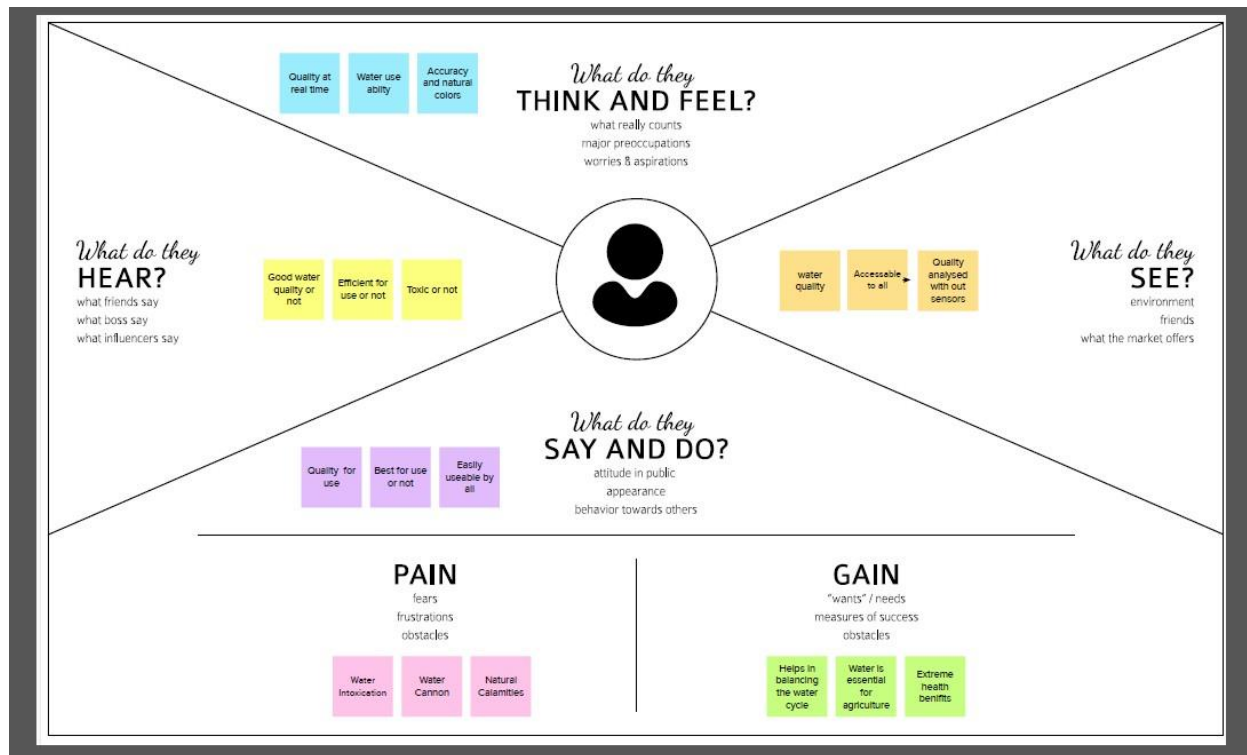
[7] X. Zhang, N. Hu, Z. Cheng, and H. Zhong, “Vibration data recovery based on compressed sensing,” Acta Physica Sinica, vol. 63, no. 20, pp. 119–128, 2014

### **2.3 Problem Statement Definition :**

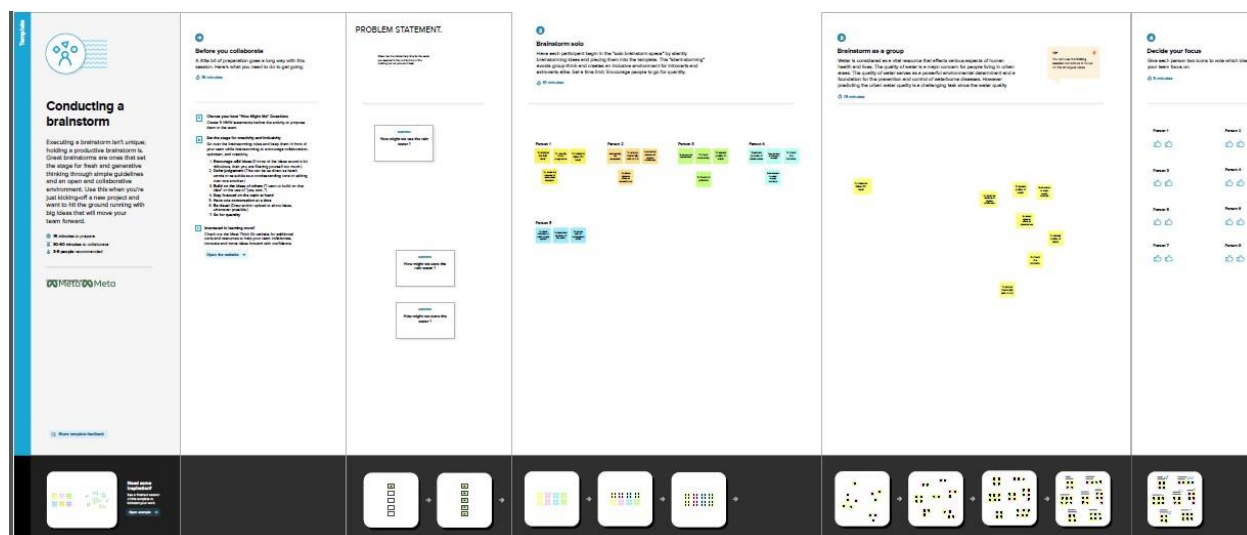
The quality of water is a major concern for people living in urban areas. Safe and readily available water is important for public health, whether it is used for drinking, domestic use, food production or recreational purposes. Better water supplies and sanitation, as well as better management of water resources, can contribute greatly to poverty reduction and economic growth. It is known that contaminated water and inadequate sanitation facilitate the transmission of diseases such as cholera, diarrhea, dysentery, hepatitis A, typhoid, and polio. Those without access to clean water and sanitation face preventable health risks.

### 3. IDEATION & PROPOSED SOLUTION

#### 3.1 Empathy Map Canvas:



#### 3.2 Ideation & Brainstorming:





### 3.3 Proposed Solution:

S.No	Parameters	Description
1.	Problem Statement	The quality of water is a major concern for people living in urban areas. The quality of water serves as a powerful environmental determinant and a foundation for the prevention and control of waterborne diseases. The water Quality is predicted using machine learning with high accuracy.
2.	Idea/Solution	To measure various chemical and physical properties of water like pH, temperature and particle density of water, Conductivity, Fecal Coliform, Total Coliform using the dataset.
3.	Novelty	There is no any physical sensors where used the prediction is done only by dataset using Machine Learning.
4.	Social Impact	The economic consequences of differing water quality standards. Cost effectiveness, cost benefit analysis, economics and ease of use.
5.	Business Model	Water Quality Index Modelling involves Water Quality based data Mathematical simulation techniques for assessing the water quality that can be efficient to use or not.
6.	Scalability of the Solution	High Scalability, High Accuracy, and Highest Prediction values with a provided dataset.

### 3.4 Problem Solution Fit:

<b>1. Customer Segment</b> <ul style="list-style-type: none"> <li>Urban peoples</li> <li>Industries</li> </ul>	<b>6. Customer Limitations</b> <ul style="list-style-type: none"> <li>Aging Infrastructure</li> <li>Kidney failure patients</li> </ul>	<b>5. Available Solution</b> <ul style="list-style-type: none"> <li>Reverse osmosis</li> <li>Cut down on chemicals.</li> </ul>
<b>2. Problems/Pains</b> <ul style="list-style-type: none"> <li>Quality of waters, Poor Sanitation.</li> <li>Water borne diseases</li> </ul>	<b>9. Root/Cause of a problem</b> <ul style="list-style-type: none"> <li>Water pollution</li> <li>Changing weather patterns</li> </ul>	<b>7. Behaviour</b> <ul style="list-style-type: none"> <li>Before -Dehydrated and tried</li> <li>After – Hydrated and feel energetic and relaxed.</li> </ul>
<b>3. Triggers</b> <ul style="list-style-type: none"> <li>Every living being needs</li> </ul>	<b>10. Your Solution</b> <ul style="list-style-type: none"> <li>High Water quality index</li> <li>pH level</li> </ul>	<b>8. Challenges in Behaviour</b> <ul style="list-style-type: none"> <li>Online – Observing the water colour.</li> <li>Offline – Taste of the water(Salty/unsalty)</li> </ul>
<b>4. Emotions</b> <ul style="list-style-type: none"> <li>Energetic</li> <li>Relaxation</li> </ul>		

## 4. REQUIREMENT ANALYSIS

### 4.1 FUNCTIONAL REQUIREMENTS:

#### Functional Requirements:

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 Registration through Gmail Registration through Linked in
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Machine learning model deployment	It is to predict the water quality index (WQI) and to predict water quality classification(WQC)
FR-4	Accessing datasets	Datasets are collected by data pre-processing method.
FR-5	Testing The Water Samples	Provides an option to test any kind of water samples with required parameters and to calculate the Water Quality Index and impurities present
FR-6	Compliance to Rules or Laws	Privacy Policy, Terms and Conditions and End User Agreement.

### 4.2 NON-FUNCTIONAL REQUIREMENTS:

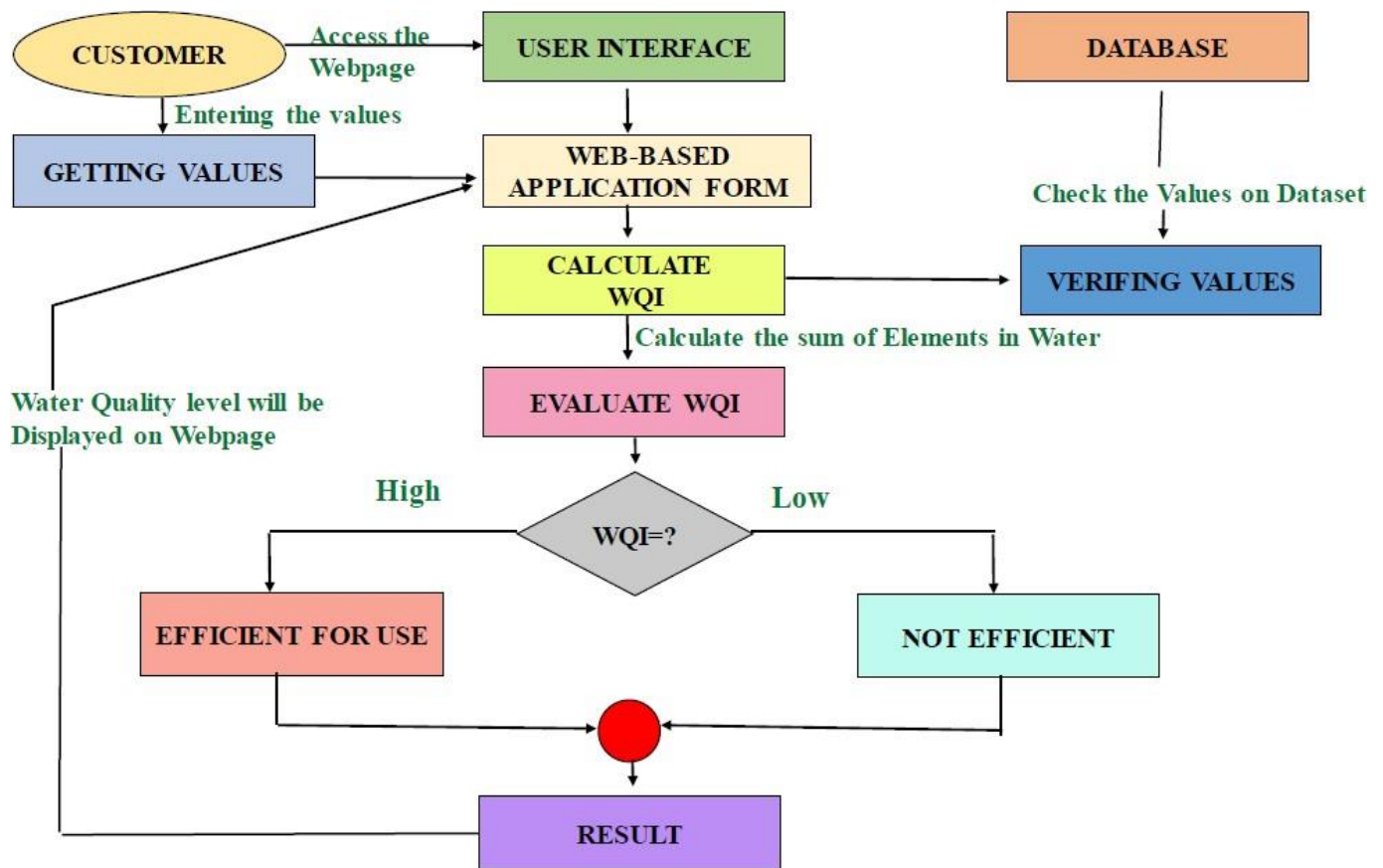
#### Non-functional Requirements:

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

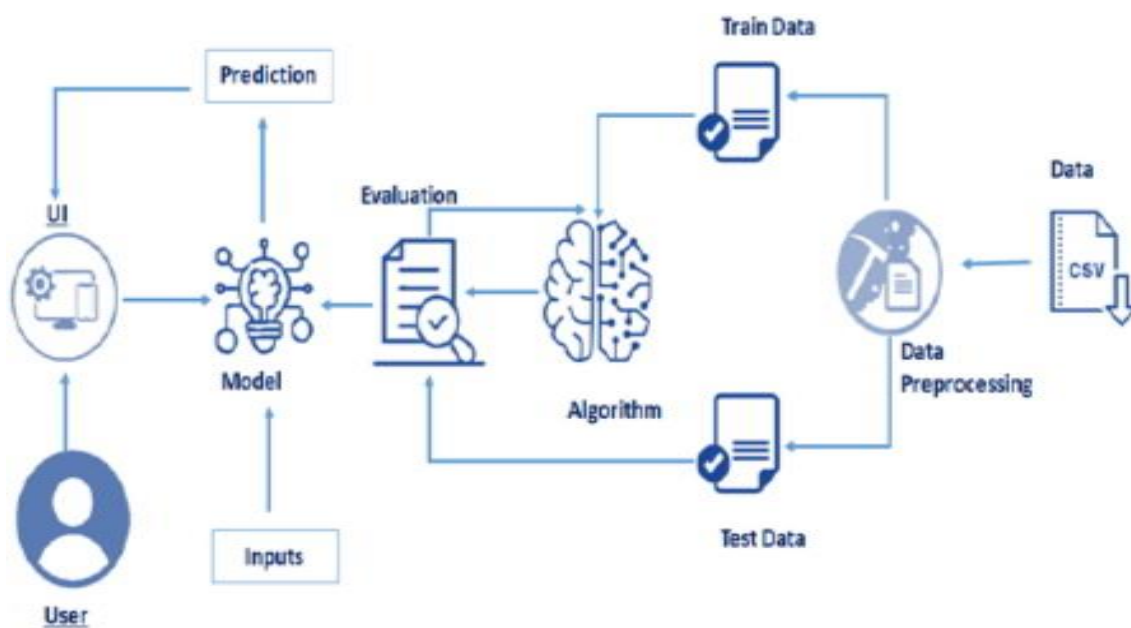
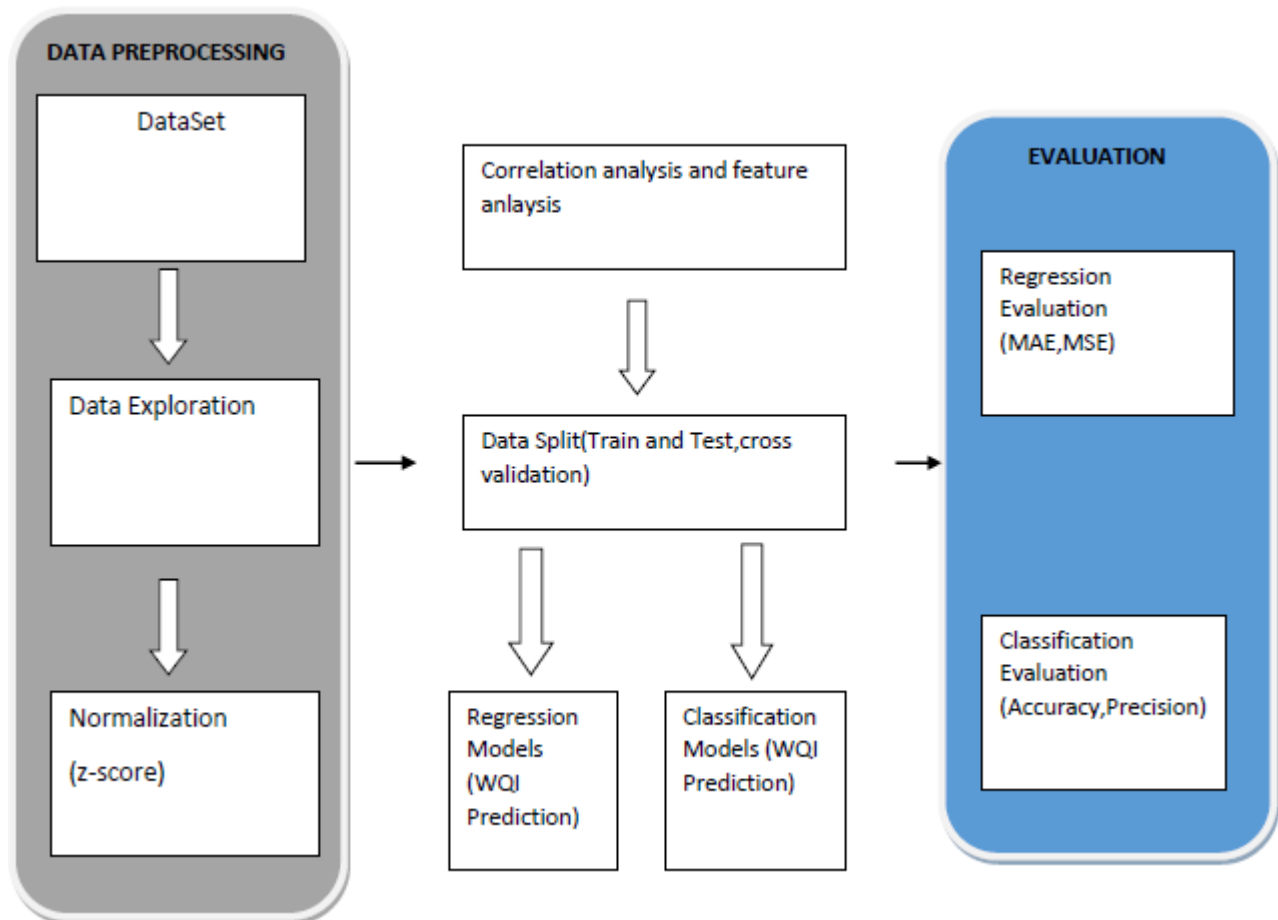
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The customers can have the opportunity to view a better interpretation of results. The customers are also recommended with the purification techniques based on the impurities.
NFR-2	Security	We have designed this project to secure the people from drinking the impurity water.
NFR-3	Reliability	The reliability should be in providing a efficient and quality drinking water.

## 5. PROJECT DESIGN

### 5.1 Data Flow Diagrams:



## 5.2 Solution & Technical Architecture:



## 5.3 User Stories:

### User Stories:

User Type	Functional Requirements (Epic)	User story No	User Story/ Task	Acceptance criteria	Priority	Release
Customer	Access the Web Page	USN -1	As a user, Anyone can access the webpage to check the Water Quality.	I Can access my webpage through online at any time.	High	Sprint-1
Customer	Usage of water	USN -2	As per the usage of user ,the quality of water should be predicted in easy way.	Prediction can be done in easy way.	High	Sprint-2
Customer	Accuracy of Water	USN -3	By using our prediction the user will Know the quality of water for is daily usage.	The Quality of water will be Accurate.	High	Sprint-1

## 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, and confirming my password.	2	High	R.Sriram
Sprint-1	User Confirmation	USN-2	As a user, I will receive confirmation email once I have registered for getting the dataset.	1	High	J.Mohanraj M.Dhanashekar
Sprint-1	Login	USN-3	As a user, I can login to the application by entering my email and password.	1	High	S.Sundhreshwar
Sprint-1	Home Page	USN-4	As a user, I can find the dataset to analyse water quality.	2	High	S.Shalini

## 6.2 Sprint Delivery Schedule:

Sprint	Total Story Point	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Point Completed (as on planned end date)	Sprint Release Date (Actual)
Sprint - 1	20	4 Days	24 Oct 2022	27 Oct 2022	20	27 Oct 2022
Sprint - 2	20	6 Days	29 Oct 2022	03 Nov 2022	20	03 Nov 2022
Sprint - 3	20	6 Days	04 Nov 2022	09 Nov 2022	20	09 Nov 2022
Sprint - 4	20	8 Days	10 Nov 2022	18 Nov 2022	20	18 Nov 2022

### Velocity:

Imagine we have a 10 day sprint duration and the velocity of the team is 20.

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

### 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.

BURNDOWN CHART			
Sprint	Date	Estimated Effort	Actual Effort
Sprint - 1	24 – Oct - 2022	20	20
	25 – Oct - 2022	19	20
	26 – Oct - 2022	18	19
	27 – Oct - 2022	17	19
	28 – Oct - 2022	17	18
Sprint - 2	29 – Oct - 2022	16	17
	30 – Oct - 2022	15	15
	31 – Oct - 2022	14	13
	01 – Nov - 2022	13	12
	02 – Nov - 2022	12	11
	03 – Nov - 2022	11	11
Sprint - 3	04 – Nov - 2022	11	11
	05 – Nov - 2022	10	9
	06 – Nov - 2022	9	8
	07 – Nov - 2022	8	7
	08 – Nov - 2022	7	6
	09 – Nov - 2022	6	6
Sprint - 4	10 – Nov - 2022	5	5
	11 – Nov - 2022	5	5
	12 – Nov - 2022	5	4
	13 – Nov - 2022	4	3
	14 – Nov - 2022	3	2
	15 – Nov - 2022	2	2
	16 – Nov - 2022	1	2
	17 – Nov - 2022	1	1
	18 – Nov - 2022	1	1







Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected R
TC_001	Functional	Home Page	Verify user is able to see the homepage		1.Enter URL and click go	Homepage Url	Login/Signup popup sh
TC_002	UI	Home Page	Verify the UI output in submit page		1.Enter URL and click go 2.Click on submit button	Homepage Url	Application should sho elements before click button : No.of Cylinde Displacement Horsepower Weight Modal Year Origin
TC_003	Functional	Home page	Verify user is able to get output		1.Enter URL and click go 2.Enter the vehicle parmeters for the prediction	No.of Cylinders : 8 Displacement : 110 Horsepower : 210 Weight : 3246 Modal Year : 70 Origin : 3	User should navigate t
TC_004	Functional	Submit page	Verify user is able to get output with InValid credentials		1.Enter URL and click go 2.Enter the vehicle parmeters for the prediction 3.Then click on the submit button	No.of Cylinders : 8 Displacement : 110 Modal Year : 70 Origin : 3	Application should sho and 'horsepower' valid
TC_004	Functional	Submit page	Verify user is able to get output with InValid credentials		1.Enter URL and click go 2.Enter the vehicle parmeters for the prediction 3.Then click on the submit button 4. Output page is visible with predicted value of the performance	No.of Cylinders : 8 Displacement : 110 Horsepower : 210 Weight : 3246 Modal Year : 70	Application should sho validation message.
					1.Enter URL and click go	Displacement : 110	Application should sho

## 7.CODING & SOLUTIONING

### 7.1 Feature 1:

```
1 metrics.r2_score(y_test, y_pred)
```

0.9692766700278257

The accuracy value will give over 97% to predict the water quality index value according tp the inputs given by the user.

### 7.2 Feature 2

```
1 from sklearn import metrics
2 print('MAE:',metrics.mean_absolute_error(y_test,y_pred))
3 print('MSE:',metrics.mean_squared_error(y_test,y_pred))
4 print('RMSE:',np.sqrt(metrics.mean_squared_error(y_test,y_pred)))
```

MAE: 0.9425563909774494

MSE: 5.63627572932331

RMSE: 2.374084187497004

The Mean Absolute Error (MAE) , Mean Squared Error and Root Mean Squared Error (RMSE) are all value is low.

## 8. TESTING

### 8.1 Test Cases:

				Date	3-Nov-22								
				Team ID	PUIT2002TH/IC23722								
				Project Name	Efficient User Analysis & Prediction Using Machine Learning								
				Maximum Marks	4 marks								
Test case ID	Feature Type	Component	Test Scenario	Pre-Requliste	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Comments	TC for Automation(Y/N)	BUG ID	Executed By
LoginPage_TC_O1	Functional	Home Page	Verify user is able to see the Login/signup popup when user clicked on My account button		1. Enter URL and click go 2. Click on My Account dropdown button 3. Verify login/signup popup displayed or not	<a href="https://127.0.0.1:5000/">https://127.0.0.1:5000/</a>	Login/signup popup should display	Working as expected	Pass				Dhanasekar
LoginPage_TC_O2	UI	Home Page	Verify the UI elements in Login/ Signup popup		1. Enter URL and click go 2. Click on My Account dropdown button 3. Verify login/signup popup with below UI elements: a. email text box b. password text box c. Login button d. New customer? Create account link e. Last password? Recovery password link	<a href="https://127.0.0.1:5000/">https://127.0.0.1:5000/</a>	Application should show below UI elements: a. email text box b. password text box c. Login button with orange colour d. New customer? Create account link e. Last password? Recovery password link	Working as expected	Fail	Steps are not clear to follow		BUG-1234	Mohanraj
LoginPage_TC_O3	Functional	Home page	Verify user is able to log into application with valid credentials		1. Enter URL( <a href="https://127.0.0.1:5000/">https://127.0.0.1:5000/</a> ) and click go 2. Click on My Account dropdown button 3. Enter Valid username/email in Email text box 4. Enter valid password in password text box 5. Click on login button	Username: admin@gmail.com password: Testing123	User should navigate to user account homepage	Working as expected	Pass				Sriram
LoginPage_TC_O4	Functional	Login page	Verify user is able to log into application with invalid credentials		1. Enter URL( <a href="https://127.0.0.1:5000/">https://127.0.0.1:5000/</a> ) and click go 2. Click on My Account dropdown button 3. Enter Invalid username/email in Email text box 4. Enter valid password in password text box 5. Click on login button	Username: admin@gmail.com password: Testing123	Application should show "incorrect email or password" validation message.	Working as expected	Fail				Shaini
LoginPage_TC_O4	Functional	Login page	Verify user is able to log into application with invalid credentials		1. Enter URL( <a href="https://127.0.0.1:5000/">https://127.0.0.1:5000/</a> ) and click go 2. Click on My Account dropdown button 3. Enter Valid username/email in Email text box 4. Enter Invalid password in password text box 5. Click on login button	Username: admin@gmail.com password: Testing12367866786676576	Application should show "incorrect email or password" validation message.	Working as expected	Pass				Shaini
LoginPage_TC_O5	Functional	Login page	Verify user is able to log into application with invalid credentials		1. Enter URL( <a href="https://127.0.0.1:5000/">https://127.0.0.1:5000/</a> ) and click go 2. Click on My Account dropdown button 3. Enter Invalid username/email in Email text box 4. Enter Invalid password in password text box 5. Click on login button	Username: admin@gmail.com password: Testing12367866786676576	Application should show "incorrect email or password" validation message.	Working as expected	Pass				Sundhreshwar

#### Test Scenarios

- 1 Verify user is able to see login page
- 2 Verify user is able to log into application or not?
- 3 Verify user is able to get an output or not?
- 4 Verify user is able to recovery password
- 5 Verify login page elements

#### Search

- 1 Verify user is able to search by entering the values
- 2 Verify user is able to see suggestions based on the values entered in the boxes?
- 3 Verify user is able to see such detailed page when nothing is entered in textbox?
- 4 Verify user is able to get Water condition in output page?
- 5 Verify user is able to get the predicted output value correctly?

## 8.2 User Acceptance Testing:

### 1. Purpose of Document

The purpose of this document is to search the quality of the water to use. The quality of the water is a major concern for people living in urban areas. Predicting the water quality is a challenging task. So, this project aims to build the ML to predict and analyse the water quality.

### 2. Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	2	3	19
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	10	2	4	13	29
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	23	14	13	19	69

### 3. Test Case Analysis


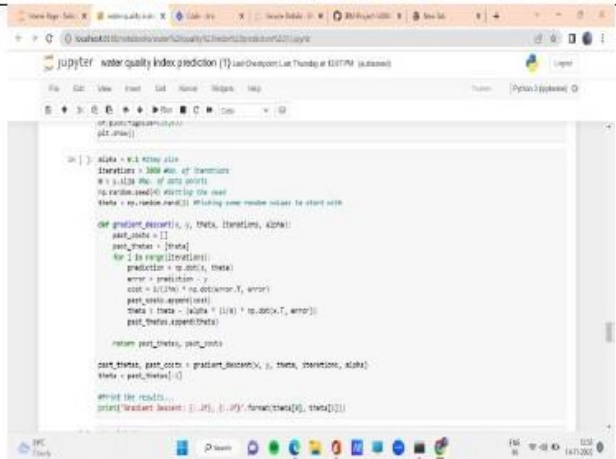
This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Home page	7	0	0	7
Client Application	45	0	0	45
Pop ups	2	0	0	2
Field Checking	3	0	0	3

Prediction	9	0	0	9
Final Report Output	4	0	0	4
Redirecting	2	0	0	2

## 9. RESULTS:

### 9.1 Performance Testing:

S.No.	Parameter	Values	Screenshot
1.	Metrics	<p><b>Regression Model:</b> MAE -, MSE -, RMSE -, R2 score -</p> <p><b>Classification Model:</b> Confusion Matrix -, Accuracy Score &amp; Classification Report -</p>	 <pre> from sklearn.metrics import mean_absolute_error, mean_squared_error, r2_score, confusion_matrix, accuracy_score, classification_report  # Regression Metrics print('MAE: ', mean_absolute_error(y_test, y_pred)) print('MSE: ', mean_squared_error(y_test, y_pred)) print('RMSE: ', np.sqrt(mean_squared_error(y_test, y_pred))) print('R2: ', r2_score(y_test, y_pred))  # Classification Metrics cm = confusion_matrix(y_test, y_pred) acc = accuracy_score(y_test, y_pred) print('Confusion Matrix: ', cm) print('Accuracy Score: ', acc) print('Classification Report: ') </pre>
2.	Tune the Model	Hyperparameter Tuning - Validation Method- Gradient descent	 <pre> def gradient_descent(X, y, theta, iterations, alpha):     cost_history = []     for i in range(iterations):         prediction = np.dot(X, theta)         error = prediction - y         cost = 1/(2*N) * np.dot(error.T, error)         cost_history.append(cost)         theta = theta - alpha * (1/N) * np.dot(X.T, error)     return cost_history, theta  cost_history, best_theta = gradient_descent(X, y, theta, iterations, alpha) theta = best_theta[0]  print('Cost History: ', cost_history, '\n', 'Best Theta: ', theta[0]) </pre>

# SCREENSHOTS :

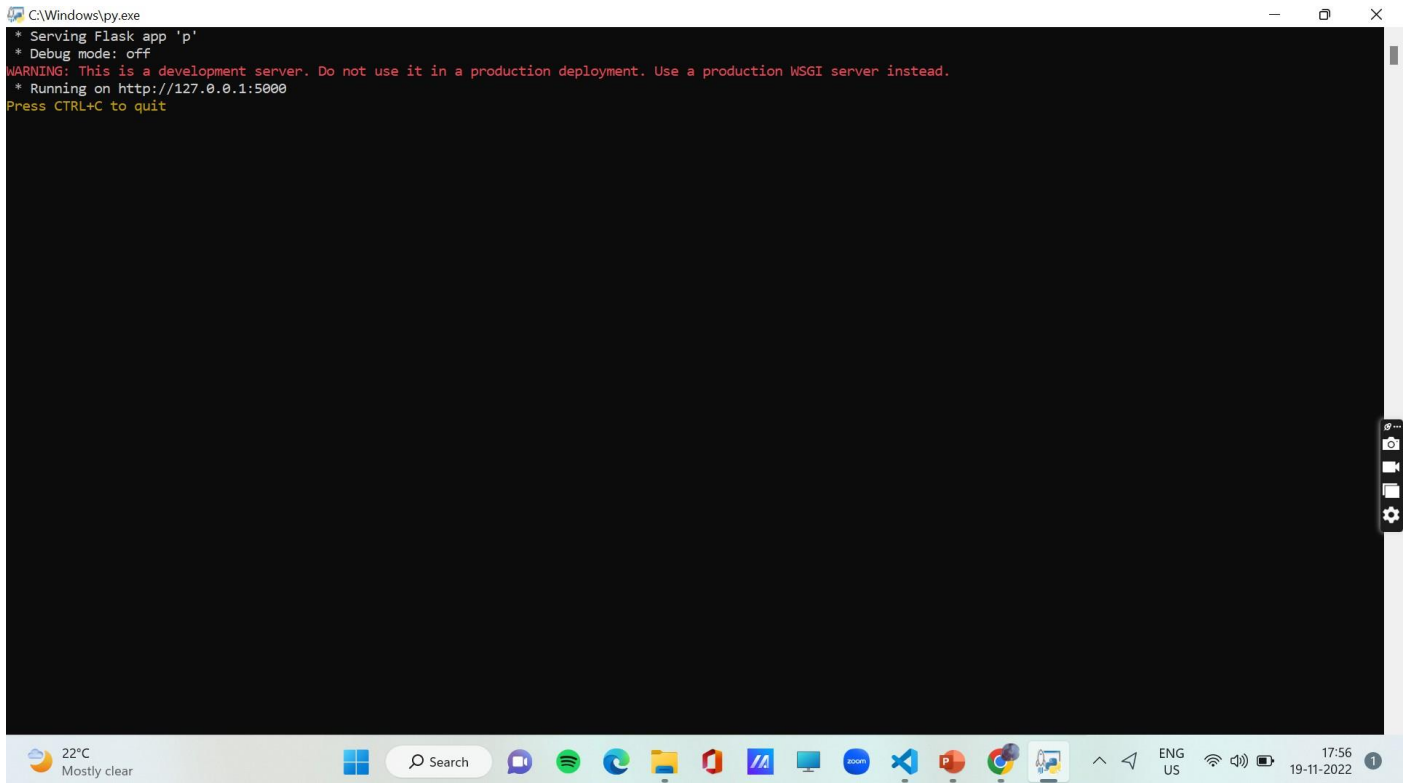


fig. Running flask code

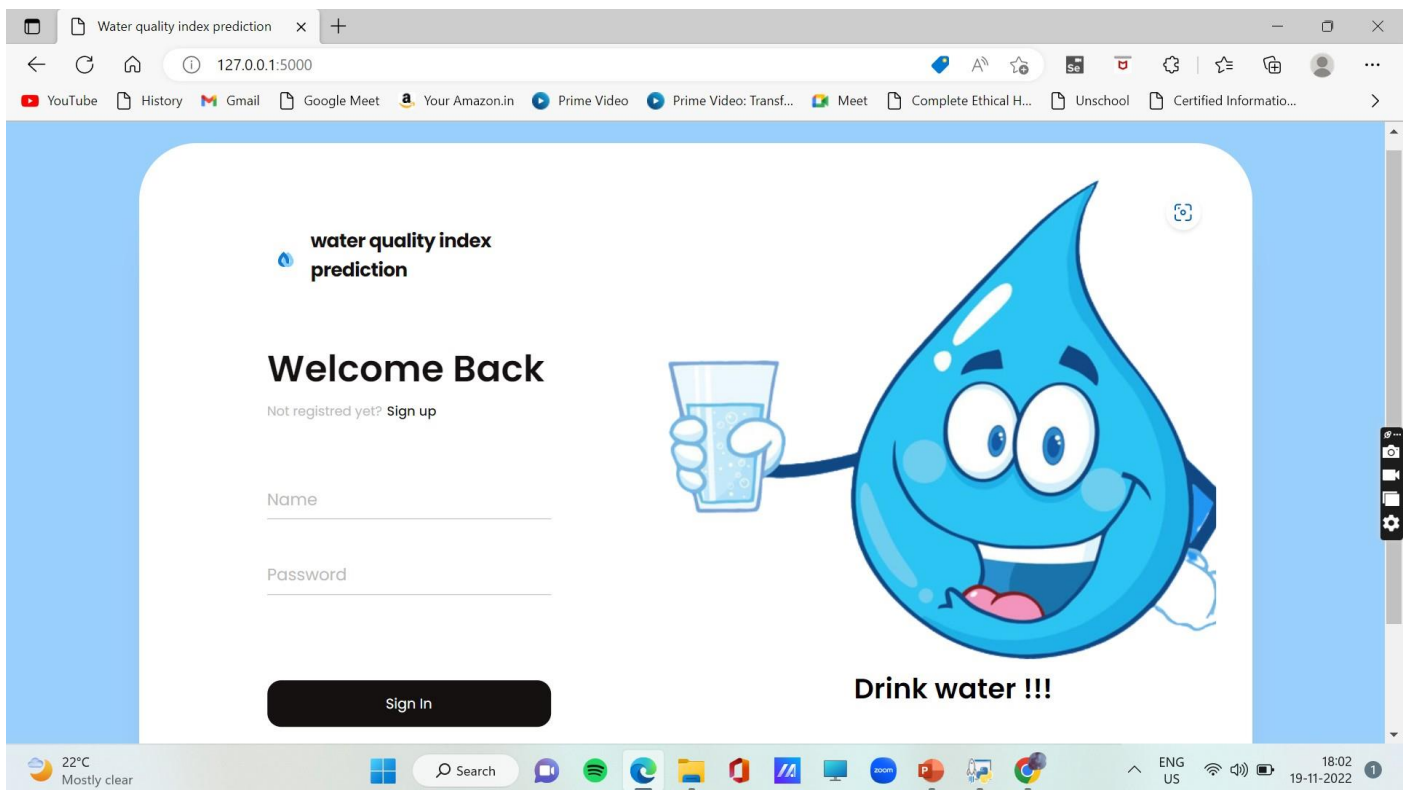


fig. Running login page



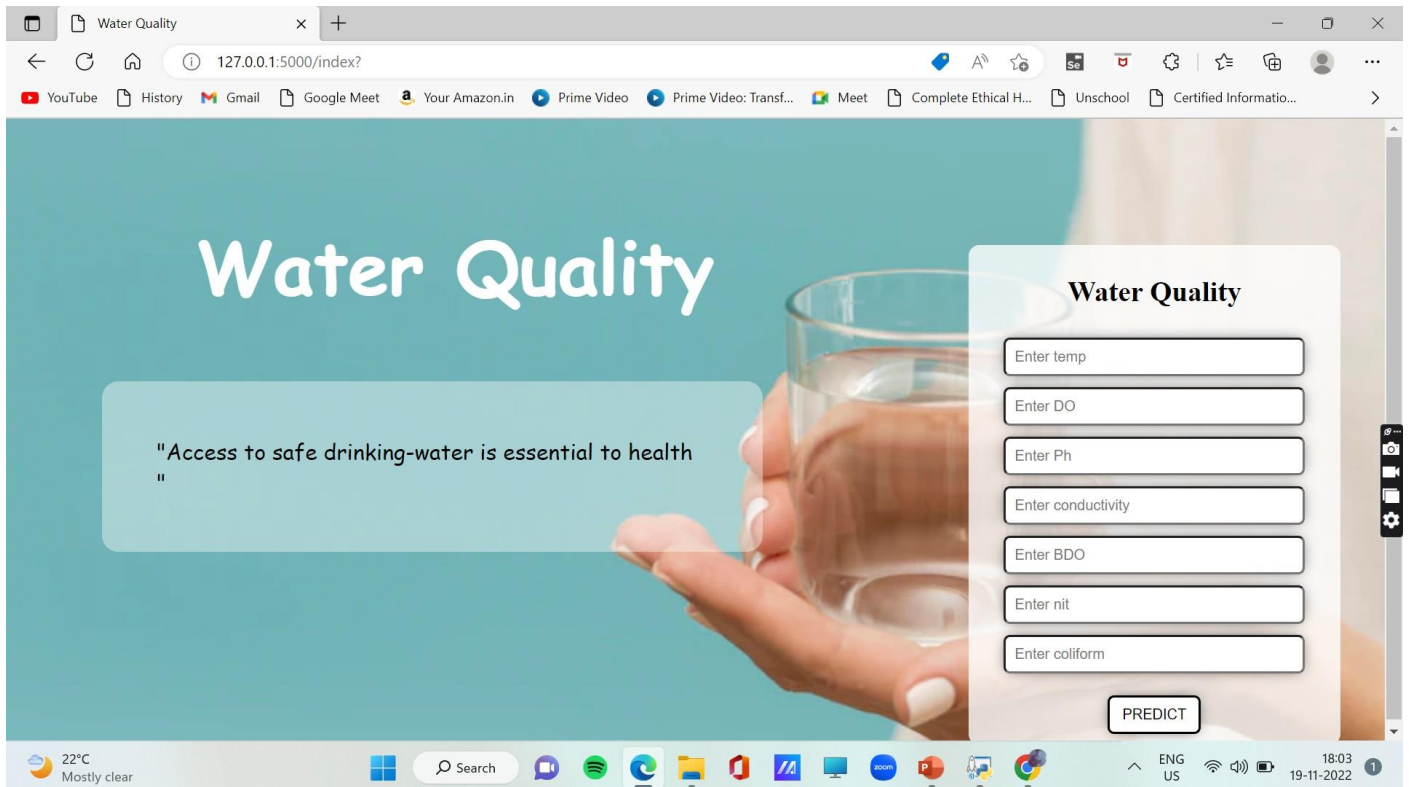


fig.Running html page

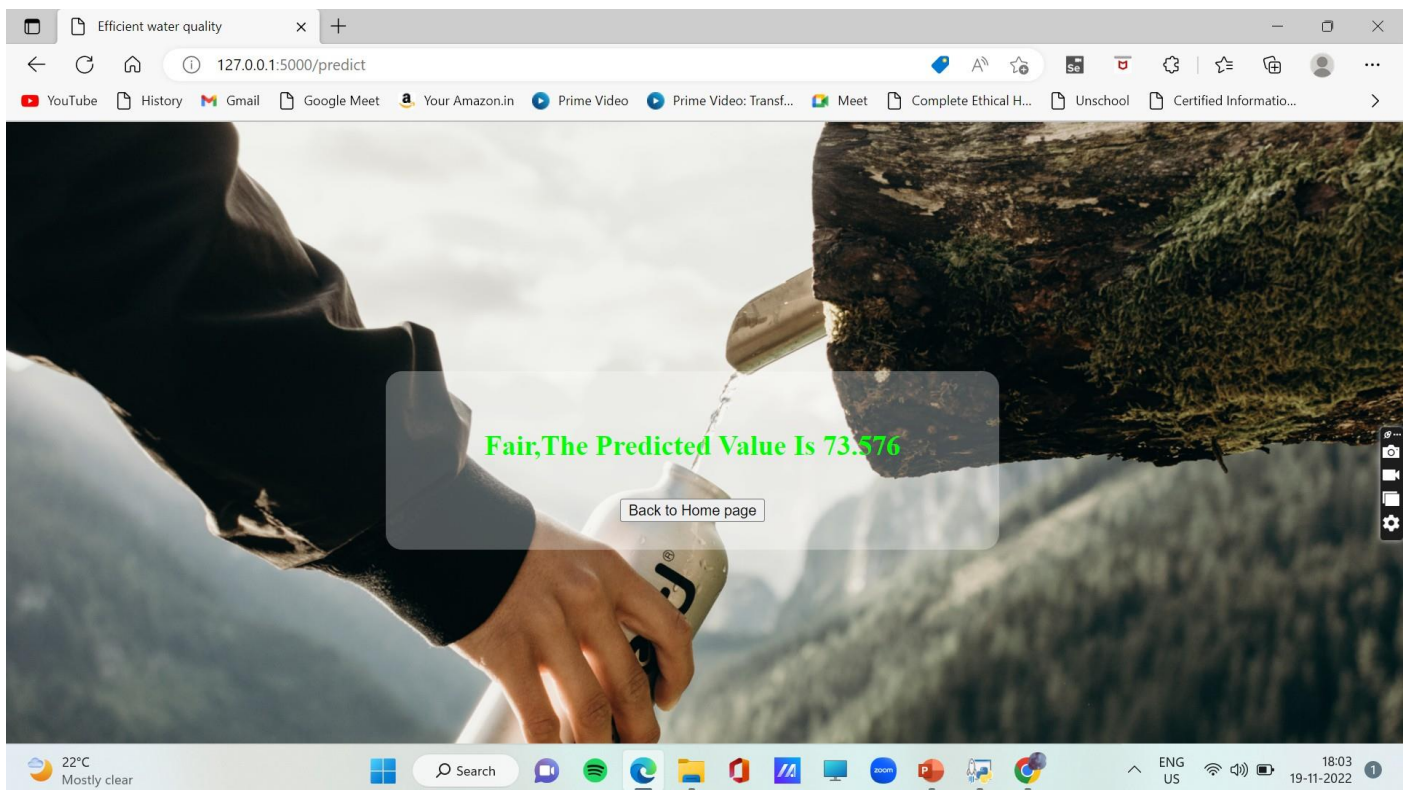


fig.Output page

## **10. ADVANTAGES & DISADVANTAGES**

### **Advantages:**

1. Water quality standards protect human health and avoid the costs related to medical care, productivity loss, and even loss of life.
2. Rainfall is unpredictable. Water tanks can be difficult to clean. Some cleaning systems cost numerous money. So, this water quality analysis can save the money.

### **Disadvantages:**

1. The prediction process will be varies based on the algorithm which is being used.
2. The accuracy level is not up to the maximum level.
3. The processing of data is quite difficult.

## 11. CONCLUSION

As we all know the importance of water for the human body. So knowing the quality of the water is very much necessary, because if we drink water without knowing that it is safe for drinking we could get sick. There are plenty of water-borne diseases like Cholera, Typhoid, Giardia, E.Coli, Hepatitis A, and so on. These types of diseases happen if we drink non-drinkable water. So knowing the quality of the water is the most important thing. For testing the water quality we have to conduct lab tests on the water which is costly and time-consuming as well. So, in this project, we propose an alternative approach using Machine Learning to predict the quality of water. The water metrics, including Temperature , D.O.(mg/l) , pH , Conductivity , B.O.D(mg/l) , Nitratenan N+ Nitratenan(mg/l) , fecal coliform (MPN/100ml) , total coliform(MPN/100ml) , Year were used in this study.

For data preprocessing, the median technique used to handle the null values and min–max scalar to scale the data. For the prediction purpose, we applied the Random Forest algorithm. After analyzing the performance, the accuracy will give over 90% .However, if the number of components reduced, then the random forest model proved to be more effective. For the Data visualization, we use the Matplotlib for the better result. Besides, to check the performance of the model, the proposed model is compared with state-of-art classifiers, including Random Forest Classifier. Despite the achievements outlined in this project, some improvements are still possible, including we can collect more training samples to make the model more stable and more progress is possible on the prediction model.



## **12. FUTURE SCOPE**

Water is one of the most essential resources for survival and its quality is determined through WQI. Conventionally, to test water quality, one has to go through expensive and cumbersome laboratory analysis. This research explored an alternative method of machine learning to predict water quality using minimal and easily available water quality parameters.

A set of representative supervised machine learning algorithms were employed to estimate WQI.

The proposed system would employ the parameter sensors of pH, temperature, dissolved oxygen, etc...It would identify poor quality water before it is released for consumption and alert concerned authorities. In this regard, the application of a prescriptive analysis from the expected values would lead to future facilities to support decision and policy makers.

## 13. APPENDIX

### *Source Code :*

#### **a) Home.html :**

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="UTF-8" />
    <meta http-equiv="X-UA-Compatible" content="IE=Edge"
/>
    <meta name="viewport" content="width=device-width,
initial-scale=1.0" />
    <title>Water quality index prediction</title>
    <link rel="stylesheet"
href="{ {url_for('static',filename='styles/style.css')}} ">
    <link rel="index" href="index.html" />

  </head>
  <body>
    <main>
      <div class="box">
        <div class="inner-box">
          <div class="forms-wrap">
```

```

    <form action="index.html" autocomplete="off"
class="sign-in-form">
    <div class="logo">
        <image src="{ {url_for('static',filename
='styles/logo.png')}}" alt="water quality prediction" />
        <h4>water quality index prediction</h4>
    </div>

    <div class="heading">
        <h2>Welcome Back</h2>
        <h6>Not registred yet?</h6>
        <a href="#" class="toggle">Sign up</a>
    </div>

    <div class="actual-form">
        <div class="input-wrap">
            <input type="text" minlength="4"
class="input-field" autocomplete="off" required/>
            <label>Name</label>
        </div>

        <div class="input-wrap">
            <input type="password" minlength="4"
class="input-field" autocomplete="off"required/>

```

```
        </form>
        <form action="\index">
        <input type="submit" value="Sign In" class="sign-
btn" />
```

```
        <p class="text">
        Forgotten your password or you login details?
        <a href="#">Get help</a> signing in
        </p>
        </div>
        </form>
```

```
        <form action="index.html" autocomplete="off"
class="sign-up-form">
        <div class="logo">
        <image src="{{url_for('static',filename
='styles/logo.png')}}" alt="water quality index prediction"
/>
```

```
        <h4>water quality index prediction</h4>
        </div>
```

```
        <div class="heading">
        <h2>Get Started</h2>
        <h6>Already have an account?</h6>
```

```
<a href="#" class="toggle">Sign in</a>
</div>
```

```
<div class="actual-form">
  <div class="input-wrap">
    <input type="text" minlength="4" class="input-
field autocomplete="off" required/>
    <label>Name</label>
  </div>
```

```
<div class="input-wrap">
  <input type="email" class="input-field"
autocomplete="off" required/>
  <label>Email</label>
</div>
```

```
<div class="input-wrap">
  <input type="password" minlength="4"
class="input-field" autocomplete="off" required/>
  <label>Password</label>
</div>
```

```
  </form>
  <form action="\index">
    <input type="submit" value="Sign Up"
```

```
class="sign-btn" />
```

```
<p class="text">
```

```
By signing up, I agree to the
```

```
<a href="#">Terms of Services</a> and
```

```
<a href="#">Privacy Policy</a>
```

```
</p>
```

```
</form>
```

```
</div>
```

```
</div>
```

```
<div class="carousel">
```

```
<div class="images-wrapper">
```

```
<image src="{{url_for('static',filename =  
'styles/image1.png')}}" >
```

```
</div>
```

```
<div class="text-slider">
```

```
<div class="text-wrap">
```

```
<div class="text-group">
```

```
<h2>Drink water !!!</h2>
```

```
<h2>save water!!</h2>
```

```
<h2>Benefits of drinking water</h2>
```

```
</div>
```

```
</div>
```

```
<div class="bullets">
```

```
  <span class="active" data-value="1"></span>
```

```
  <span data-value="2"></span>
```

```
  <span data-value="3"></span>
```

```
</div>
```

```
</div>
```

```
</div>
```

```
</div>
```

```
</div>
```

```
</main>
```

```
<!-- Javascript file -->
```

```
<script src="app.js"></script>
```

```
<script>
```

```
  const inputs = document.querySelectorAll(".input-  
field");
```

```
  const toggle_btn = document.querySelectorAll(".toggle");
```

```
const main = document.querySelector("main");
const bullets = document.querySelectorAll(".bullets
span");
const images = document.querySelectorAll(".image");
```

```
inputs.forEach((inp) => {
  inp.addEventListener("focus", () => {
    inp.classList.add("active");
  });
  inp.addEventListener("blur", () => {
    if (inp.value !== "") return;
    inp.classList.remove("active");
  });
});
```

```
toggle_btn.forEach((btn) => {
  btn.addEventListener("click", () => {
    main.classList.toggle("sign-up-mode");
  });
});
```

```
function moveSlider() {
  let index = this.dataset.value;
```



```
let currentImage = document.querySelector(`.img-
${index}`);
images.forEach((img) => img.classList.remove("show"));
currentImage.classList.add("show");

const textSlider = document.querySelector(".text-
group");
textSlider.style.transform = `translateY(${-(index - 1) *
2.2}rem)`;

bullets.forEach((bull) => bull.classList.remove("active"));
this.classList.add("active");
}

bullets.forEach((bullet) => {
  bullet.addEventListener("click", moveSlider);
});</script> </body>
</html>
```

## **b) Index.html :**

```
<!doctype html>
```

```
<html>
```

```
  <head>
```

```
    <title>Water Quality</title>
```

```
    <script
```

```
src="https://kit.fontawesome.com/0965dcd484.js"
```

```
crossorigin="anonymous"></script>
```

```
    <style>
```

```
      body {
```

```
        background-image:url('https://img.freepik.com/free-  
photo/woman-holding-glass-filled-with-water-copy-  
space_23-
```

```
2148728798.jpg?size=626&ext=jpg&ga=GA1.2.134267531  
0.1667012473&semt=sph');
```

```
        font-family: verdana;
```

```
        background-repeat: no-repeat;
```

```
        background-size: cover;
```

```
        animation: loadtransition 2s;
```

```
      }
```

```
h1 {
```

```
font-size: 26px;  
color: black;  
font-family: initial;  
padding: 10px;  
text-align: center;  
}
```

```
input{  
    display: block;  
    width: 75%;  
    border: aliceblue;  
    border-radius: 6px;  
    outline: 4px;  
    padding: 7px;  
    margin: 10px auto;  
    box-shadow: 0px 0px 13px -5px;  
    transition: all .25s;  
}
```

```
input:hover{  
    margin: 15px auto;  
    width: 80%;  
}
```

```
p{
  font-size: 20px;
  margin: 10px 10px 10px 10px;
  color: black
}
```

```
form{
  background: rgba(255, 255, 255, 0.06);
  box-shadow: 20px 20px 40px -6px rgba(0, 0, 0, 0.2);
  border-left: 1px solid rgba(255, 255, 255, 0.3);
  border-top: 1px solid rgba(255, 255, 255, 0.3);
  -webkit-backdrop-filter: blur(10px);
  backdrop-filter: blur(10px);
  border-radius: 10px;
  position: absolute;
  margin-top: 0px;
  width: 27%;
  height: auto%;
  margin: 1em 28em;
}
```

```
div.project{
  box-shadow: 0px 7px 60px -10px black;
  width: auto ;
```

```
font-size: 15px;
border-radius: 10px;
border: 1px solid rgba(255,255,255,0.3)
box-shadow: 2px 2px 15px rgba(0,0,0,0.3);
color: #ddd;
width: 400px;
margin: 100px auto 0px auto;

}
```

```
center input{
  display: inline-block;
  background-color: rgba(255, 255, 255);
  color: black;
  width: 20%;
  margin-top: 0px;
  margin-bottom: 10px;
  padding: 0.50em;
  transition: all .25s;
}
```

```
input.btn:hover{
  background-color: dark green;
  color: white;
```

```
letter-spacing: 2px;  
width:30%  
}
```

```
div.context{  
  display: inline-block;  
  width: 20%;  
  color: black;  
  position: absolute;  
  margin: 10em 12em;  
  font-size: 20px;  
  font-family: cursive;
```

```
background: rgba(255, 255, 255, 0.06);  
  box-shadow: 20px 20px 40px -6px rgba(0, 0, 0, 0.2);  
  border-left: 1px solid rgba(255, 255, 255, 0.3);  
border-top: 1px solid rgba(255, 255, 255, 0.3);  
-webkit-backdrop-filter: blur(10px);  
backdrop-filter: blur(10px);
```

```
padding: 15px;
```

```
border-radius: 7px;  
transition: all 1s;  
}
```

```
div.context:hover{  
    background-color:grey;  
    color:white;  
    padding: 30px;  
    margin: 8em 4em 1em ;  
}
```

```
div.name{  
    display: inline-block;  
    width: auto;  
    color: black;  
    position: absolute;  
    font-size: 67px;  
    font-weight: bold;  
    margin: -0.2em 1em;  
    color: white;  
    font-family: cursive;  
    padding: 0px 0px 0px 100px;  
    transition: all 1s;  
}
```

```
div.name:hover{
  letter-spacing: 2px;
  color:aquamarine;
}

@keyframes loadtransition{
  from{
    opacity:0;
    transform: rotateX(-10deg);

  }
  to{
    opacity:1;
    transform: rotateX(0deg);
  }
}
```

</style>

</head>

<body>

<div class="name">

Water Quality



```
</div>
```

```
<div class="context">
```

```
  <p style="font-family:courier;"><b>No Water, No  
Life<br>No Blue, No Green</b> </p>
```

```
</div>
```

```
<div class="project">
```

```
  <form method="post" action="/" enctype =  
"multipart/form-data">
```

```
    <p><i class="fa-sharp fa-solid fa-droplet">  
</i>Urban Water Quality Prediction </p><br>
```

```
      <input type="text" name="Temperature"  
id="Temperature" placeholder="Enter Temp" required>
```

```
      <input type="text" name="D.O. " id="D.O. "  
placeholder=" Enter D.O. (mg/l)" required>
```

```
      <input type="text" name="Ph" id="Ph"  
placeholder="Enter Ph" required>
```

```
      <input type="text" name="CONDUCTIVITY"  
id="CONDUCTIVITY" placeholder="Enter CONDUCTIVITY  
(µmhos/cm) " required>
```

```
      <input type="text" name="B.O.D." id="B.O.D."  
placeholder="Enter B.O.D. (mg/l)" required>
```

```
      <input type="text" name="NITRATENAN"
```

```

id="NITRATENAN" placeholder="Enter
NITRATENAN(mg/l)" required>
    <input type="text" name="COLIFORM"
id="COLIFORM" placeholder="Enter COLIFORM"
required><br>
    <center><input class="btn" type=submit
name="submit_button" value=PREDICT></center>
    </form>
</div>
</body>
</html>

```

### c) Predict.html

```

<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta http-equiv="X-UA-Compatible"
content="IE=edge">
    <meta name="viewport" content="width=device-width,
initial-scale=1.0">
    <title>Efficient water quality</title>
    <style>
        body

```

```
{
```

```
background:url('https://aquadreams.astemplatedesigns.com/assets/images/Home/Home-1.png');
```

```
background-repeat: no-repeat;
```

```
background-size: cover;
```

```
animation: load transition 2s;
```

```
}
```

```
h1 {
```

```
font-size: 26px;
```

```
color:#00ff00;
```

```
font-family: initial;
```

```
padding: 10px;
```

```
text-align: center;
```

```
}
```

```
div.context{
```

```
display: inline-block;
```

```
width: 40%;
```

```
color: black;
```

```
position: absolute;
```

```
margin: 11em 17em;
```

```
font-size: 20px;
```

```
        font-family: cursive;
        background-color:
rgba(255,255,255,0.3);
        padding: 25px;
        border-radius: 15px;
        transition: all 1s;
    }

</style>
</head>
<body>
    <div class="context">
        <h1>
            {{showcase}}</h1>
        <form action="\index">
            <center> <input type="submit" value="Back to Home
page" class="btn "></center>
        </form>
    </div>

</body>
</html>
```

#### d) Style.css

```
@import
url("https://fonts.googleapis.com/css2?family=Poppins:wght@200;300;400;500;600;700;800&display=swap");

*,
*::before,
*::after {
  padding: 0;
  margin: 0;
  box-sizing: border-box;
}

body,
input {
  font-family: "Poppins", sans-serif;
}

main {
  width: 100%;
  min-height: 100vh;
  overflow: hidden;
  background-color: #99c ;
  background-image:
```

```
url('https://www.google.com/url?sa=i&url=https%3A%2F%2Funsplash.com%2Fs%2Fphotos%2Fwater&psig=AOvVaw2zgcsq6oLt1Y5hBQ8Y18G&ust=1668233479227000&source=images&cd=vfe&ved=0CA8QjRxqFwoTCMCrhpK8pfsCFQAAAAAdAAAAABAE');
```

```
padding: 2rem;  
display: flex;  
align-items: center;  
justify-content: center;  
}
```

```
.box {  
  position: relative;  
  width: 100%;  
  max-width: 1020px;  
  height: 640px;  
  background-color: white;  
  border-radius: 3.3rem;  
  box-shadow: 0 60px 40px -30px rgba(0, 0, 0, 0.27);  
}
```

```
.inner-box {  
  position: absolute;  
  width: calc(100% - 4.1rem);
```

```
height: calc(100% - 4.1rem);  
top: 50%;  
left: 50%;  
transform: translate(-50%, -50%);  
}
```

```
.forms-wrap {  
  position: absolute;  
  height: 100%;  
  width: 45%;  
  top: 0;  
  left: 0;  
  display: grid;  
  grid-template-columns: 1fr;  
  grid-template-rows: 1fr;  
  transition: 0.8s ease-in-out;  
}
```

```
form {  
  max-width: 260px;  
  width: 100%;  
  margin: 0 auto;  
  height: 100%;  
  display: flex;
```

```
flex-direction: column;
justify-content: space-evenly;
grid-column: 1 / 2;
grid-row: 1 / 2;
transition: opacity 0.02s 0.4s;
}
```

```
form.sign-up-form {
  opacity: 0;
  pointer-events: none;
}
```

```
.logo {
  display: flex;
  align-items: center;
}
```

```
.logo img {
  width: 35px;
  margin-right: 0.3rem;
}
```

```
.logo h4 {
  font-size: 1.1rem;
}
```



```
margin-top: -9px;  
letter-spacing: -0.5px;  
color: #151111;  
}
```

```
.heading h2 {  
  font-size: 2.1rem;  
  font-weight: 600;  
  color: #151111;  
}
```

```
.heading h6 {  
  color: #bababa;  
  font-weight: 400;  
  font-size: 0.75rem;  
  display: inline;  
}
```

```
.toggle {  
  color: #151111;  
  text-decoration: none;  
  font-size: 0.75rem;  
  font-weight: 500;  
  transition: 0.3s;
```

```
}
```

```
.toggle:hover {  
  color: white;  
}
```

```
.input-wrap {  
  position: relative;  
  height: 37px;  
  margin-bottom: 2rem;  
}
```

```
.input-field {  
  position: absolute;  
  width: 100%;  
  height: 100%;  
  background: none;  
  border: none;  
  outline: none;  
  border-bottom: 1px solid #bbb;  
  padding: 0;  
  font-size: 0.95rem;  
  color: #151111;  
  transition: 0.4s;
```

```
}
```

```
label {  
  position: absolute;  
  left: 0;  
  top: 50%;  
  transform: translateY(-50%);  
  font-size: 0.95rem;  
  color: #bbb;  
  pointer-events: none;  
  transition: 0.4s;  
}
```

```
.input-field.active {  
  border-bottom-color: #151111;  
}
```

```
.input-field.active + label {  
  font-size: 0.75rem;  
  top: -2px;  
}
```

```
.sign-btn {  
  display: inline-block;
```

```
width: 100%;  
height: 43px;  
background-color: #151111;  
color: #fff;  
border: none;  
cursor: pointer;  
border-radius: 0.8rem;  
font-size: 0.8rem;  
margin-bottom: 2rem;  
transition: 0.3s;  
}
```

```
.sign-btn:hover {  
  background-color: #8371fd;  
}
```

```
.text {  
  color: #bbb;  
  font-size: 0.7rem;  
}
```

```
.text a {  
  color: #bbb;  
  transition: 0.3s;
```

```
}
```

```
.text a:hover {  
  color: #8371fd;  
}
```

```
main.sign-up-mode form.sign-in-form {  
  opacity: 0;  
  pointer-events: none;  
}
```

```
main.sign-up-mode form.sign-up-form {  
  opacity: 1;  
  pointer-events: all;  
}
```

```
main.sign-up-mode .forms-wrap {  
  left: 55%;  
}
```

```
main.sign-up-mode .carousel {  
  left: 0%;  
}
```

```
.carousel {  
  position: absolute;  
  height: 100%;  
  width: 55%;  
  left: 45%;  
  top: 0;  
  background-color: white;  
  border-radius: 2rem;  
  display: grid;  
  grid-template-rows: auto 1fr;  
  padding-bottom: 2rem;  
  overflow: hidden;  
  transition: 0.8s ease-in-out;  
}
```

```
.images-wrapper {  
  display: grid;  
  grid-template-columns: 1fr;  
  grid-template-rows: 1fr;  
}
```

```
.image {  
  width: 100%;  
  grid-column: 1/2;
```

```
grid-row: 1/2;  
opacity: 0;  
transition: opacity 0.3s, transform 0.5s;  
}
```

```
.img-1 {  
  transform: translate(0, -50px);  
}
```

```
.img-2 {  
  transform: scale(0.4, 0.5);  
}
```

```
.img-3 {  
  transform: scale(0.3) rotate(-20deg);  
}
```

```
.image.show {  
  opacity: 1;  
  transform: none;  
}
```

```
.text-slider {  
  display: flex;
```

```
align-items: center;
justify-content: center;
flex-direction: column;
}

.text-wrap {
  max-height: 2.2rem;
  overflow: hidden;
  margin-bottom: 2.5rem;
}

.text-group {
  display: flex;
  flex-direction: column;
  text-align: center;
  transform: translateY(0);
  transition: 0.5s;
}

.text-group h2 {
  line-height: 2.2rem;
  font-weight: 600;
  font-size: 1.6rem;
}
```



```
.bullets {  
  display: flex;  
  align-items: center;  
  justify-content: center;  
}
```

```
.bullets span {  
  display: block;  
  width: 0.5rem;  
  height: 0.5rem;  
  background-color: #aaa;  
  margin: 0 0.25rem;  
  border-radius: 50%;  
  cursor: pointer;  
  transition: 0.3s;  
}
```

```
.bullets span.active {  
  width: 1.1rem;  
  background-color: #151111;  
  border-radius: 1rem;  
}
```

```
@media (max-width: 850px) {  
  .box {  
    height: auto;  
    max-width: 550px;  
    overflow: hidden;  
  }  
  
  .inner-box {  
    position: static;  
    transform: none;  
    width: revert;  
    height: revert;  
    padding: 2rem;  
  }  
  
  .forms-wrap {  
    position: revert;  
    width: 100%;  
    height: auto;  
  }  
  
  form {  
    max-width: revert;  
    padding: 1.5rem 2.5rem 2rem;
```

```
    transition: transform 0.8s ease-in-out, opacity 0.45s  
linear;  
}
```

```
.heading {  
    margin: 2rem 0;  
}
```

```
form.sign-up-form {  
    transform: translateX(100%);  
}
```

```
main.sign-up-mode form.sign-in-form {  
    transform: translateX(-100%);  
}
```

```
main.sign-up-mode form.sign-up-form {  
    transform: translateX(0%);  
}
```

```
.carousel {  
    position: revert;  
    height: auto;  
    width: 100%;
```

```
padding: 3rem 2rem;  
display: flex;  
}
```

```
.images-wrapper {  
  display: none;  
}
```

```
.text-slider {  
  width: 100%;  
}  
}
```

```
@media (max-width: 530px) {  
  main {  
    padding: 1rem;  
  }  
}
```

```
.box {  
  border-radius: 2rem;  
}
```

```
.inner-box {  
  padding: 1rem;
```

```
}
```

```
.carousel {  
  padding: 1.5rem 1rem;  
  border-radius: 1.6rem;  
}
```

```
.text-wrap {  
  margin-bottom: 1rem;  
}
```

```
.text-group h2 {  
  font-size: 1.2rem;  
}
```

```
form {  
  padding: 1rem 2rem 1.5rem;  
}  
}
```

## e) Stylesheet.css

```
body {  
    background:url('https://img.freepik.com/free-  
photo/woman-holding-glass-filled-with-water-copy-  
space_23-  
2148728798.jpg?w=740&t=st=1668141155~exp=1668141  
755~hmac=524ca0d98510aedf53f4bff778ffe16118ca2713  
a1347cce986472b8a1c0cf88');  
    font-family: verdana;  
    background-repeat: no-repeat;  
    background-size: cover;  
    animation: load transition 2s;  
}  
h1 {  
    font-size: 26px;  
    color: black;  
    font-family: initial;  
    padding: 10px;  
    text-align: center;  
}  
  
input{  
    display: block;
```

```
width: 75%;
border: alice blue;
border-radius: 6px;
outline: 4px;
padding: 8px;
margin: 10px auto;
box-shadow: 0px 0px 13px -5px;
transition: all .25s;
}

input:hover{
    margin: 15px auto;
    width: 80%;
}

p{
    font-size: 20px;
    margin: 10px 10px 10px 10px;
    color: black
}

form{
    background: rgba(255, 255, 255, 0.8);
    border-radius: 10px;
```

```
position: absolute;
width: 27%;
margin: 1em 30em;
}
```

```
div.project{
  box-shadow: 0px 7px 60px -10px black;
  width: auto ;
  font-size: 15px;
  border-radius: 10px;
  border: 1px solid rgba(255,255,255,0.3)
  box-shadow:2px 2px 15px rgba(0,0,0,0.3);
  color: #ddd;
  width: 400px;
  margin: 100px auto 0px auto;
}
```

```
center input{
  display: inline-block;
  background-color: rgba(255, 255, 255);
  color: black;
  width:25%;
  transition: all .25s;
}
```



```
input.btn:hover{  
    background-color: dark green;  
    color: black;  
    letter-spacing: 2px;  
    width:30%  
}
```

```
div.context{  
    display: inline-block;  
    width: 40%;  
    color: black;  
    position: absolute;  
    margin: 7em 4em;  
    font-size: 20px;  
    font-family: cursive;  
    background-color: rgba(255,255,255,0.4);  
    padding: 50px;  
    border-radius: 15px;  
    transition: all 1s;  
}
```

```
div.context:hover{  
    background-color:grey;
```

```
color:white;
padding: 60px;
margin: 8em 4em 1em ;
}
```

```
div.name{
  display: inline-block;
  width: auto;
  color: black;
  position: absolute;
  font-size: 67px;
  font-weight: bold;
  margin: -0.2em 1em;
  color: white;
  font-family: cursive;
  padding: 0px 0px 0px 100px;
  transition: all 1s;
}
```

```
div.name:hover{
  letter-spacing: 2px;
  color:aquamarine;
}
```

```

@keyframes load transition{
  from{
    opacity:0;
    transform: rotateX(-10deg);

  }
  to{
    opacity:1;
    transform: rotateX(0deg);
  }
}

```

#### **f) Flask :**

```

if request.method == "POST":
    # request all the input fields
    Temperature= float(request.form['Temperature'])
    D.O. = float(request.form['D.O. '])
    Ph = float(request.form['Ph'])
    CONDUCTIVITY =
float(request.form['CONDUCTIVITY'])
    B.O.D. = float(request.form['B.O.D.'])
    NITRATENAN = float(request.form['NITRATENAN'])
    COLIFORM = float(request.form['COLIFORM'])

```

```
# create numpy array for all the inputs
val = np.array([Temperature, D.O. , Ph,
CONDUCTIVITY, B.O.D., NITRATENAN,COLIFORM])

# define save model and scaler path
model_path = os.path.join('models', 'xgboost.sav')
scaler_path = os.path.join('models', 'scaler.sav')

# load the model and scaler
model = pickle.load(open(model_path, 'rb'))
sc = pickle.load(open(scaler_path, 'rb'))

# transform the input data using pre fitted standard
scaler
data = sc.transform([val])

# make a prediction for the given data
res = model.predict(data)

if res == 1:
    outcome = 'Potable'
else:
    outcome = 'not potable'
```

```
    return render_template('index.html', result=outcome)
return render_template('index.html')
```

```
# run application
```

```
if __name__ == "__main__":
    app.run(debug=True)
```

## **b. Github & Project Demo Link :**

Github link

<https://github.com/IBM-EPBL/IBM-Project-54086-1661594235>

Project Demo link

<https://youtu.be/lIIQ7Whdb-w>