APPLIED DATA SCIENCE

EFFICIENT WATER QUALITY ANALYSIS AND PREDICTION USING MACHINE LEARNING

PROJECT REPORT

IBM PROJECT – TEAM ID:PNT2022TMID39608

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1. INTRODUCTION:

1.1PROJECT OVERVIEW:

Water (chemical formula H2O) is an inorganic, transparent, tasteless, odourless, and nearly colourless chemical substance, which is the main constituent of Earth's hydrosphere and the fluids of all known living organisms (in which it acts as a solvent). It is vital for all known forms of life, even though it provides neither food, energy, nor organic micronutrients. Its chemical formula, H2O, indicates that each of its molecules contains one oxygen and two hydrogen atoms, connected by covalent bonds. The hydrogen atoms are attached to the oxygen atom at an angle of 104.45°."Water" is also the name of the liquid state of H_2O at standard temperature and pressure.

A number of natural states of water exist. It forms precipitation in the form of rain and aerosols in the form of fog. Clouds consist of suspended droplets of water and ice, its solid state. When finely divided, crystalline ice may precipitate in the form of snow. The gaseous state of water is steam or water vapour.
Water covers about 71% of the Earth's surface, mostly in seas and oceans (about 96.5%). Small portions of water occur as groundwater (1.7%), in the glaciers and the ice caps of Antarctica and Greenland (1.7%), and in the air as vapour, clouds (consisting of ice and liquid water suspended in air), and precipitation (0.001%). Water moves continually through the water cycle of evaporation, transpiration (evapotranspiration), condensation, precipitation, and runoff, usually reaching the sea.
The aim of this study is the prediction of water quality components using Machine Learning techniques such as Regression algorithms to predict the Water Quality Index (WQI) value. Therefore, in the first part of this section, the studied area is introduced and then ranges of measured water quality components are presented. Overviews on applied ML models are then presented.

1.2 PURPOSE:

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. 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-linearly 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.
The main purpose of the project is to analyse and predict the urban water quality in which it consists of different florides and chlorides. These florides and chlorides should be in smaller portion.
In order to find these quantities we use methods like

Temperature testing:

Testing the temperature helps determine the rate of biochemical reaction in an aquatic environment and indeed whether they are able to occur at all. If the water temperature is too elevated, this can limit the water's ability to hold oxygen and decrease organisms' capacity to resist particular pollutants.

pH testing:

Measures the acidity of water. Most aquatic organisms are only able to survive within a pH range of 6 to 8.

Chloride Test:

Chloride is usually present in fresh and salt water. However, its levels can be exacerbated as a result of minerals dissolving and industrial pollution.

Turbidity test:

Measures the amount of particulate matter that is suspended in the water, or more simply, how clear the water is. If high levels of turbidity are present, photosynthesis is affected as light is unable to penetrate, increasing water temperature.

Dissolved oxygen test:

Measures the amount of oxygen dissolved in water. Without this, aquatic life is unable to conduct cellular respiration and is thus a key indicator of water health.

Nitrate and Phosphate test:

The presence of these essential nutrients is a good indicator of strong plant life. However, the addition of artificial nitrates and phosphates through detergents, fertilisers or sewage can be harmful and result in eutrophication, generally in the form of unwanted algal blooms.

Electrical conductivity test:

Estimates the total amount of solids dissolved in the water. This can be a good indicator of the level of salinity.

Salinity testing:

Measures the total of all non-carbonate salts dissolved in water. Measuring groundwater salinity indicates how salty your topsoil may become if the water table rises.

So to know the quality of water we use the above traditional methods. But in this we will predict the quality of water by machining learning model.

2. LITERATURE SURVEY:

2.1 EXISTING PROBLEMS:

Survey 1:

ALI, M. QAMAR, A.M. (2013):

DATA ANALYSIS, QUALITY INDEXING AND PREDICTION OF WATER QUALITY:

Ali and Qamar et al. used the unsupervised technique of the average linkage (within groups) method of hierarchical clustering to classify samples into water quality classes. However, they ignored the major parameters associated with WQI during the learning process and they did not use any standardized water quality index to evaluate their predictions.

Survey 2:

X.SUN ,Y.LI (2013):

PREDICTING DISSOLVED OXYGEN FLUCTUATIONS IN GOLDEN HORN BY FUZZY TIME SERIES:

A water quality data is a kind of time series dataset which is likely to have complicated linear and non linear relationships.

The Fuzzy time series (FTS) model was first proposed by Song et al. and Chissom et al. in 1993 to address an enrolment prediction problem.

Chen et al. improved this model by replacing complicated max-min composition operations with simplified arithmetic operations. A Heuristic Gaussian cloud transformation was integrated with an FTS model to forecast water quality.

The experimental results showed that their proposed model significantly improved the prediction accuracy. However, there were only 520 water quality samples available to build the cloud, and thus, the model was not reliable or robust.

Time series analysis is also proposed to address dissolve oxygen prediction, and the experimental results show that the proposed analysis method can find out valuable knowledge from water quality historical time series data.

This algorithm has the smallest error in training and testing stages for the parameter Dissolved oxygen.

Survey 3:

A.H.ZARE (2014):

PREDICTION OF WATER QUALITY INDEX USING MULTIVARIATE LINEAR REGRESSION (MLR):

It is a kind of statistical analysis method that estimates the target values based on set of independent variables .This model is used to measure the Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) based on the following four factors namely temperature, pH, total suspended solids and suspended solids.

This approach proposed that deterministic and multivariate linear regression models were used to speed up the process of predicting the water quality but as the dataset is considered as time series based, so it is likely to have a non-linear relationship. So, the performance of this algorithm is expected to be poor, with large prediction error.

Survey 4:

A.SARKAR AND P. PANDEY (2015):

RIVER WATER QUALITY MODELLING USING ARTIFICIAL NEURAL NETWORK TECHNIQUE:

This approach proposes that a time series prediction model was integrated with the ANN model to improve the prediction performance. A comprehensive comparision between ANN and MLR models in Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) prediction has shown that the ANN model is a better option.

The major disadvantage in this proposed model is that the input parameters are ambigious and neural network struggle to formulate a non linear relationship in some scenarios.

Survey 5:

A. A. M. AHMED AND S. M. A. SHAH (2017):

APPLICATION ADAPTIVE NEURO FIZZY INFERENCE SYSTEM (ANFIS) TO ESTIMATE THE BIOLOGICAL OXYGEN DEMAND (BOD) AND CHEMICAL OXYGEN DEMAND (COD):

Many studies have proven that ANFIS, which can integrate linear and non-linear relationships hidden in the dataset, is a better option in this scenario.

This proposed approach is also used in predicting the effluent water quality and also shows that the ANFIS model works better than the ANN model in predicting the Dissolved Oxygen content in the water sample to be tested.

Even though there are only 45 data samples available, an ANFIS model with eight input parameters is used to predict total phosphorus and total nitrogen, the experiment result based on 120 water samples shows the proposed model is reliable. The ANFIS model has also been applied to estimate the biochemical oxygen demand in the Surma River. The testing results from 36 water samples confirmed that the ANFIS model could accurately formulate the hidden relationship and correlation analysis can improve the prediction accuracy.

The disadvantage in this proposed models shows that this approach requires that the size of the training dataset should not be less than the number of training parameters and if the correlation between the data in the dataset are weak then it generates out of range errors.

It shows poor performance in testing because the limited training dataset cannot build a robust or reliable model.

Survey 6:

AHMAD, Z.; RAHIM, N.; BAHADORI, A.; ZHANG, J. (2017):

IMPROVING WATER QUALITY INDEX PREDICTION THROUGH A COMBINATION OF MULTIPLE NEURAL NETWORKS:

Ahmad et al. employed single feed forward neural networks and a combination of multiple neural networks to estimate the WQI. They used 25 water quality parameters as the input. Using a combination of backward elimination and forward selection selective combination methods, they achieved an R2 and MSE of 0.9270, 0.9390 and 0.1200, 0.1158, respectively. The use of

25 parameters makes their solution a little immoderate in terms of an inexpensive real time system, given the price of the parameter sensors.

Survey 7:

SHAFI, U.; MUMTAZ, R.; ANWAR, H.; QAMAR, A.M.; KHURSHID, H. (2018):

SURFACE WATER POLLUTION DETECTION USING INTERNET OF THINGS:

Shafi et al. estimated water quality using classical machine
learning algorithms namely, Support Vector Machines (SVM), Neural Networks (NN), Deep Neural Networks (Deep NN) and k Nearest Neighbors (kNN), with the highest accuracy of 93% with Deep NN.

The estimated water quality in their work is based on only three parameters: turbidity, temperature and pH, which are tested according to World Health Organization (WHO) standards. Using only three parameters and comparing them to standardized values is quite a limitation when predicting water quality.

2.2 REFERENCES:

Survey No: 1. Ali, M. Qamar, A.M. Data analysis, quality indexing and prediction of water quality for the management of rawal watershed in Pakistan. In Proceedings of the Eighth International Conference on Digital Information Management (ICDIM 2013), Islamabad, Pakistan, 10–12 September 2013; pp. 108–113.

Survey No: 2. X. Sun ,Y. Li "Predicting Dissolved Oxygen Fluctuations In Golden Horn By Fuzzy Time Series" International Journal of Nonlinear Science, vol. 17, no.3, pp. 234-240, Dec. 2013

Survey No: 3. A. H. Zare, "Evaluation of multivariate linear regression and artificial neural networks in prediction of water quality parameters," Journal of Environmental Health Science & Engineering, vol. 12, no. 1, pp. 1-8, Jan. 2014.

Survey No: 4. A. Sarkar and P. Pandey, "River Water Quality Modelling Using Artificial Neural Network Technique," Aquatic Procedia, vol. 4, pp. 1070-1077, 2015

Survey No: 5. A. A. M. Ahmed and S. M. A. Shah, "Application of adaptive neuro-fuzzy inference system (ANFIS) to estimate the biochemical oxygen demand (BOD) of Surma River," Journal of King Saud University - Engineering Sciences, vol. 29, no. 3, pp. 237-243, Jul. 2017.

Survey No: 6. Ahmad, Z.; Rahim, N.; Bahadori, A.; Zhang, J. Improving water quality index prediction in Perak River basin Malaysia through a combination of multiple neural networks. Int. J. River Basin Manag. **2017**, 15, 79–87.

Survey No: 7. Shafi, U.; Mumtaz, R.; Anwar, H.; Qamar, A.M.; Khurshid, H. Surface Water Pollution Detection using Internet of Things. In Proceedings of the 2018 15th International Conference on Smart Cities: Improving Quality of Life Using ICT & IoT (HONET-ICT), Islamabad, Pakistan, 8–10 October 2018; pp. 92–96.

2.3 PROBLEM STATEMENT DEFINITION:

Water is the most important of sources, vital for sustaining all kinds of life; however, it is in constant threat of pollution by life itself. Rapid industrialization has consequently led to the deterioration of water quality at an alarming rate .Poor water quality results have been known to be one of the major factors of escalation of harrowing diseases.

Water quality is currently estimated through expensive and time consuming lab which would require sample collection, transport these samples to the lab collected from one of the water sources and it takes a considerable amount of time for the calculation of results, which is quite ineffective if the water is polluted with waste that causes diseases.

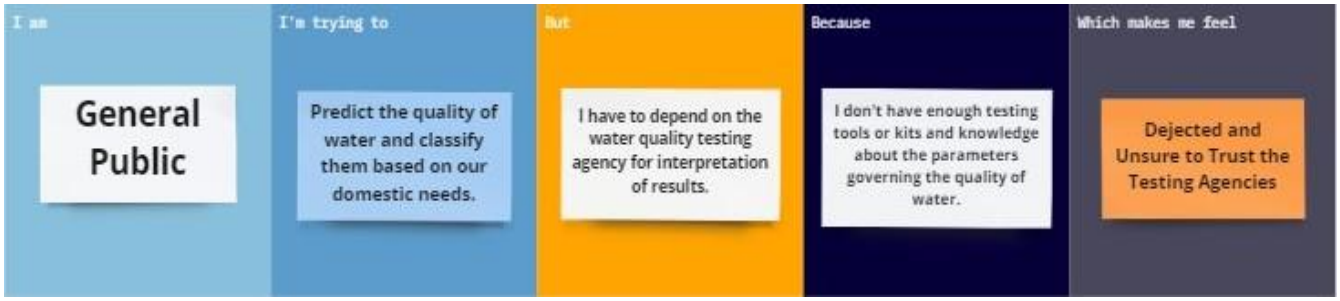
The main motivation is to propose and evaluate an alternative method based on **MACHINE LEARNING** for the efficient analysis and prediction of water quality in real time.

PROBLEM STATEMENT 1

PROBLEM STATEMENT 2

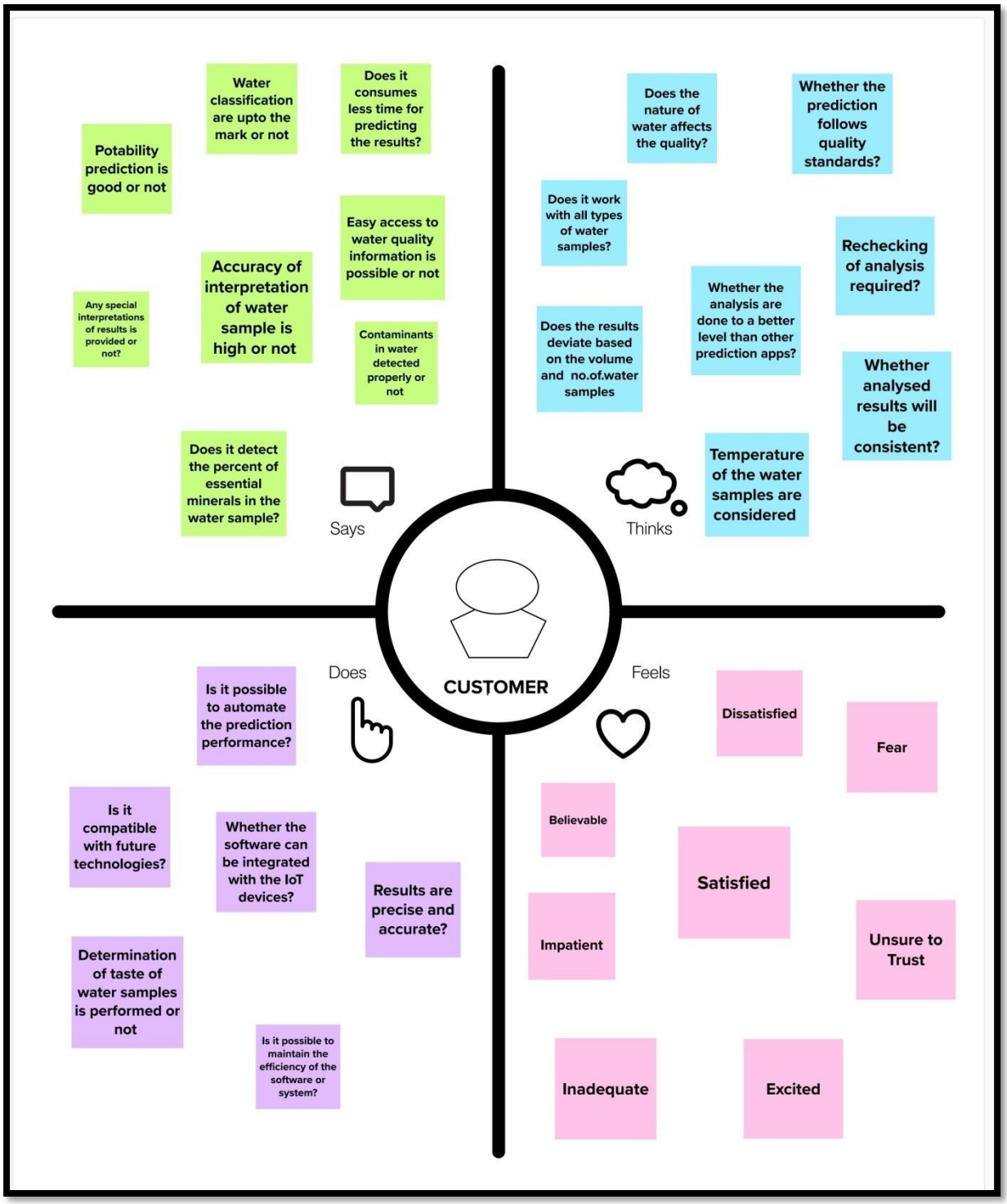
PROBLEM STATEMENT 3

PROBLEM STATEMENT 4



3. IDEATION AND PROPOSED SOLUTION:

3.1 EMPATHY MAP CANVAS:



3.2 IDEATION AND BRAINSTORMING:

Brainstorm Top 3 Ideas:

- **Idea 1:** It provides reliable service in determining the quality of water.

  The system should provide the results of the water quality prediction in a more accurate way and it should be reliable with all kinds of water samples to be analysed. It must predict the quality of water effectively as well as quickly. The customer can access and use this system at anytime and at anywhere.

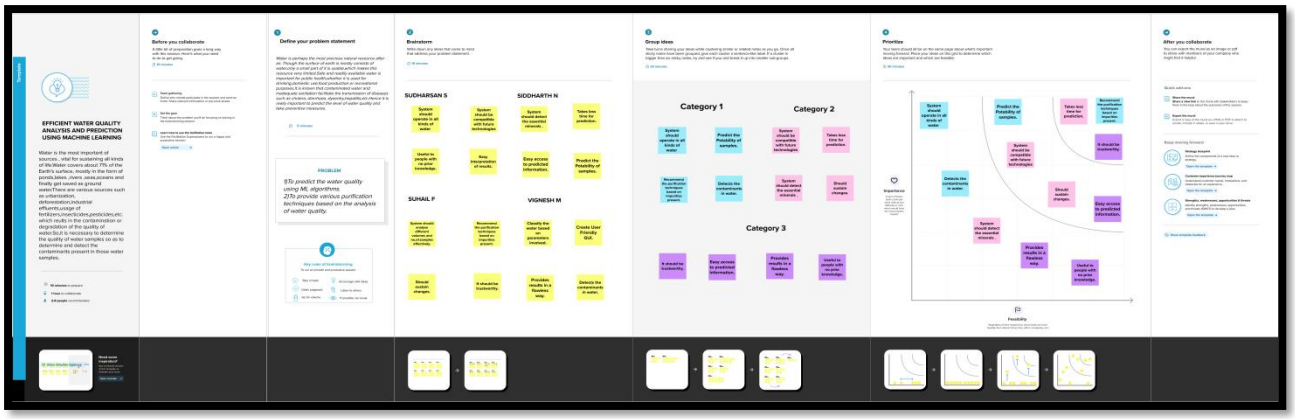
- **Idea 2:** It provides better representation of analysis and prediction of water quality.

  The application is designed in such a way that it provides user friendly interface where the users can easily gain access to the predicted results. This system also provides many useful interpretations for the analysis of water samples which makes it easy to understand.

- **Idea 3:** It ensures trust and is useful to people with no prior knowledge.

  The system should sustain and adapt to changes in technology, environment, etc. and perform the analysis in a consistent way to ensure the trust among wide variety of customers.
  For using a system or application we need to have some prior knowledge about it but our system can be used by those people who wish to test any kind of water samples.

BRAINSTORMING:



3.3 PROPOSED SOLUTION:

S.NO	PARAMETER	DESCRIPTION
1.	Problem Statement (Problem to be Solved)	Water is an indispensable resource and is vital for sustaining all kinds of life. Safe and readily available water is important for public health, whether it is used for drinking, domestic use, food production or recreational purposes. Due to rapid industrialization, the various sources of water is getting polluted and the quality of it is degraded day by day. So, it is necessary to predict the quality of water samples so as to determine and detect the contaminants present in those samples which may cause adverse effects on human health, environment, etc.
2.	Idea / Solution Description	This system is built by using the Regression and Classification algorithms of Machine Learning. By using this system, we can predict the level of quality of any kind of water samples at anytime and at anyplace. This system also provides the appropriate purification techniques that can be carried out based on the analysis of water quality.
3.	Novelty / Uniqueness	This system carries out the prediction in a flawless way and also provides various visualisations of the interpreted results. It also provides various information regarding the purification techniques to be employed.
4.	Feasibility of Idea	The feasibility of implementing this idea is moderate neither easy nor tough because the system needs to satisfy the basic requirements of

		the customer as well as it should act as a bridge towards achieving high accuracy water quality prediction considering all the necessary parameters.
5.	Business Model (Revenue Model)	This system provides more reliable service to the wide variety of customers who wish to test any kind of water samples and also the system ensures the trust to the customers who are using it.
6.	Social Impact / Customer Satisfaction	By using this system, the users can predict the nature and quality of water they are using and can learn the purification technique to be employed based on the nature of water sample analysed. It gives assurity on enhancing the level of water quality and reduces the ill effects of using the polluted or contaminated water for household works, food production, etc.
7.	Scalability of the Solution	By implementing this system, the people can efficiently and effectively predict the quality of water samples they wish to use at anytime. This system can also be integrated with the future technologies.

3.4 PROBLEM SOLUTION FIT:

1. CUSTOMER SEGMENT(S)	6. CUSTOMER STATE LIMITATIONS	5. AVAILABLE SOLUTIONS
▪ Water purifying agencies. ▪ Private and Public Laboratories. ▪ Various industries and places like hotels, restaurants and various textile factories who wish to test the water sources they use. ▪ Various educational institutions who utilize the purified drinking water. ▪ Customers who wish to have a water quality tester for household checking purpose. -	▪ Customer has to depend on the testing agencies in order to test the water quality. ▪ They don't get accustomed in using those testing tools. ▪ Testing using agencies can't be done at anytime and at anyplace. ▪ Customers cannot get access to the results when they want and they are unaware of the predicting parameters. ▪ The interpretation of the result of water quality analysis are done only by the testing agencies which may be trustable or not. ▪ The available tools predict the quality based on a few parameters which is not trustable as some important factors may not be considered.	▪ **Test strips:** Cheapest way to test the hardness, pH and salinity of water. ▪ **Colorimetric Test Kits:** Helps to understand the concentration of substance through specific colors. ▪ **Titrimetric Test Kits:** Determines the concentration of solids in a water sample. ▪ **Turbidimeters / Turbidity meters:** Determines how the concentration of suspended particulates affects the clarity of water. ▪ **Portable pH meters:** Determines the concentration of ions of hydrogen present in water and also whether it is acidic or basic. ▪ **Portable TDS Testers:** It determines the concentration of various types of organic salts like Magnesium, calcium, sodium bicarbonates, sulfates and chlorides. ▪ **Pocket ORP Tester:** It determines the sanitizing power of the water.

2. PROBLEMS / PAINS	9. ROOT/CAUSE	7. BEHAVIOUR
▪ Safe and readily available water is important for public health. So, it is necessary to detect the contaminants present in those samples. ▪ Customers are affected in various ways of life such as health, food production, environment, etc. due to contaminated water. ▪ Water quality has been estimated through expensive and time consuming lab and devices that does not consider all the necessary factors that has caused the deterioration in water quality.	▪ Rapid industrialization and urbanization has led to the deterioration of water quality at an alarming rate. ▪ Poor water quality have been known to be one of the major factors of escalation of harrowing diseases. ▪ The release of industrial effluents into water sources, the oil spills and leaks and deforestation are also the various reasons for the lack of water quality and created the necessity of monitoring the water quality.	▪ The consumption of polluted or contaminated water makes the people fall ill and causes various health issues which affect them economically, physically and mentally as well. ▪ The poor interpretation of results with tools considering less parameters causes distrust and reduces their hope in water quality prediction tools or methods.

3.TRIGGERS TO ACT

To enhance the standard of living of people by improving health aspects by providing water quality testing tools in order to reduce the water borne diseases and also to save time for predicting the quality and if possible to be integrated with future technologies.

4.EMOTIONS

BEFORE: Customers are in a doubtful state regarding the quality of water they consume or utilize based on their daily needs. They feel a little tentative on using available testing tools as it considers only a few parameters.

AFTER: Customers feel satisfied, contended and happy because they can test any kind of water samples at anytime and they can view a better representation of results of water quality analysis.

10. YOUR SOLUTION

To build an effective and efficient water quality prediction system for all kinds of water samples using the Regression and Classification algorithms of Machine Learning to provide a better and easy interpretation of analysis of water samples so that the people with no prior knowledge can understand the results of analysis process and can be made available at anytime and at anyplace.

8. CHANNELS OF BEHAVIOUR

ONLINE:

Through Advertising in social media, news platform makescustomer to know and realize the importance of monitoring the level of water quality that we consume for our needs and to provide awareness about the need for measuring the water quality level.

OFFLINE:

Words of mouth among customers.

4. REQUIREMENT ANALYSIS:

4.1 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.
FR-2	User Confirmation	Confirmation via Email. Confirmation via OTP.
FR-3	User Login/ Authentication	Validation of Login ID and password.
FR-4	Machine Learning Model Deployment	Develop the Machine Learning Regression Model to predict the Water Quality Index (WQI). Develop the Machine Learning Classification Model to predict the Water Quality Classification (WQC).
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	Interface Function	Provides an interface to : 1. View the Water Quality Index value. 2. Display the Water Sample type. 3. Produce any purification technique recommended for the sample.
FR-7	Reporting	If any issues are faced by the customer or user it will be directly notified to the developer.
FR-8	Compliance to Rules or Laws	Privacy Policy, Terms and Conditions and End User Agreement.

4.2 Non-functional Requirements:

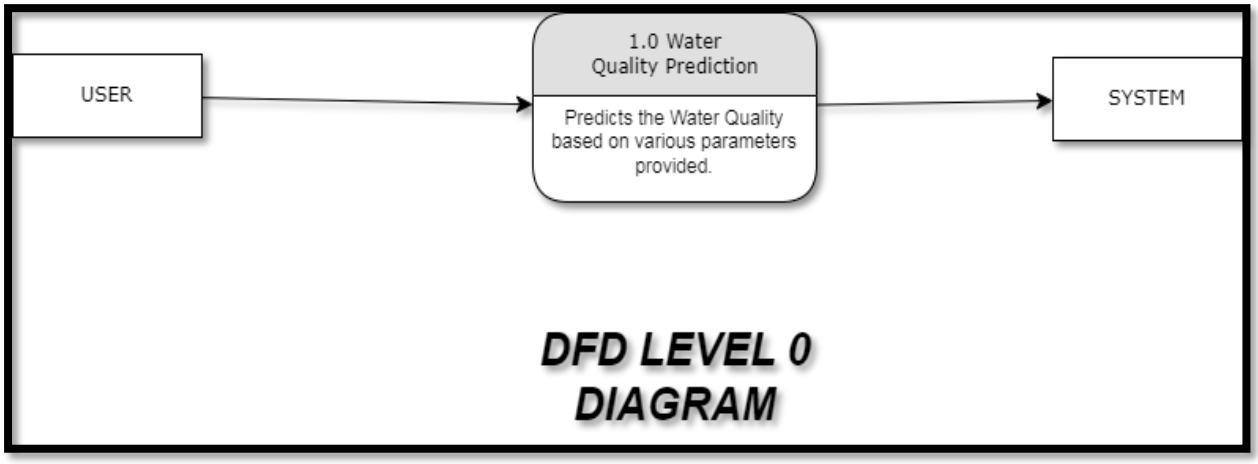
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Customers can access the system more efficiently and in a simpler way. 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**	All the predicted information is accessed only by the authenticated users.
NFR-3	**Reliability**	It should be reliable in producing effective and efficient water quality prediction results. It should ensure the trust and belief among people that this water quality prediction system produces correct results when used.
NFR-4	**Performance**	The system should be consistent in producing the prediction results of Water Quality Index (WQI) and also needs to ensure better throughput and response time compared to other systems.
NFR-5	**Availability**	The system can be utilised by the customers 24/7 and it should be availed to test any kind of water samples anywhere.
NFR-6	**Scalability**	It can be used by wide variety of users like testing agencies, private and public laboratories, restaurants and hotels and people who wish to test the quality of water they consume. The system should also be compatible enough so as to be integrated with the future technologies also.

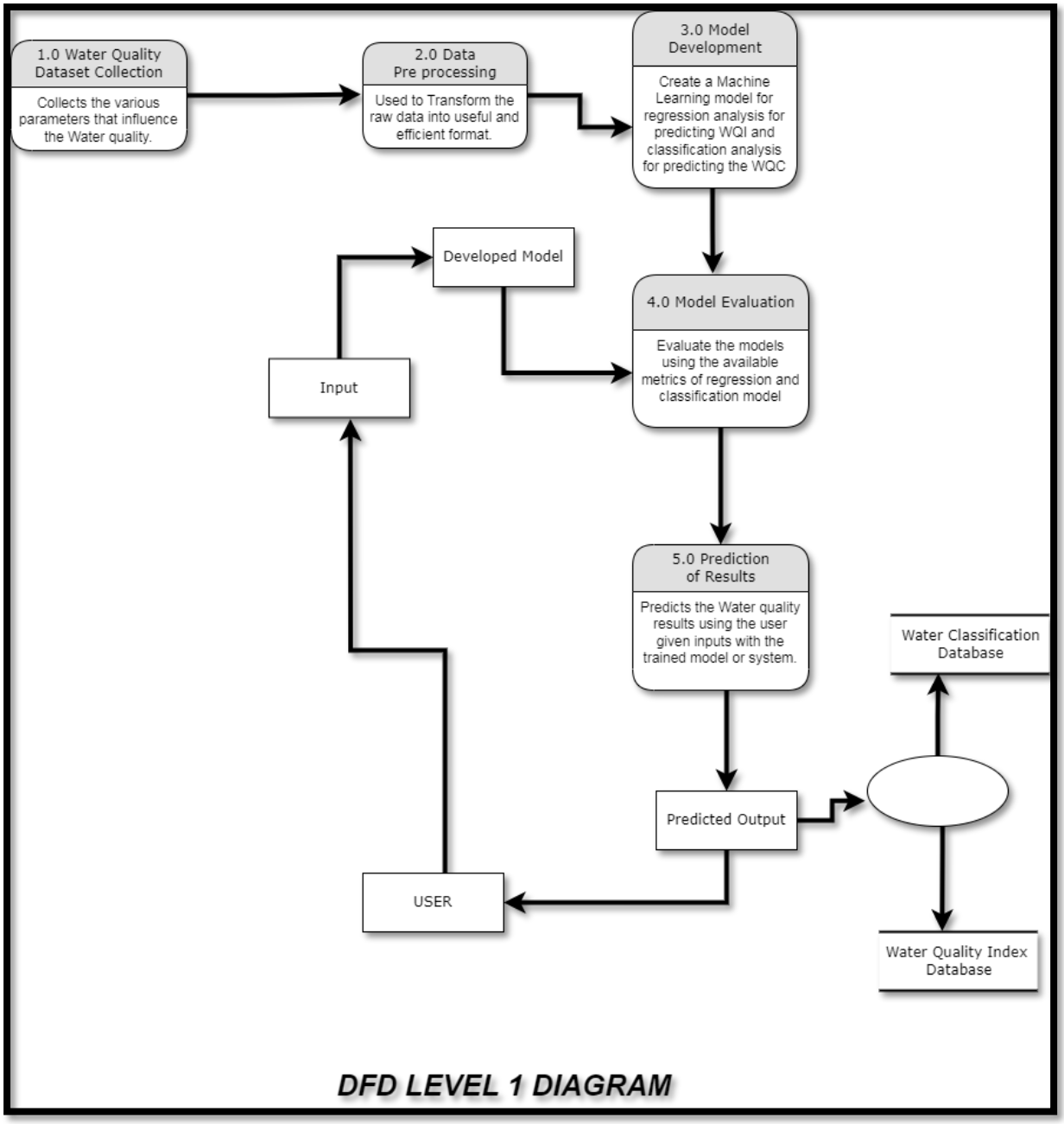
5. PROJECT DESIGN:

5.1 DATA FLOW DIAGRAMS:

DFD LEVEL 0 DIAGRAM:

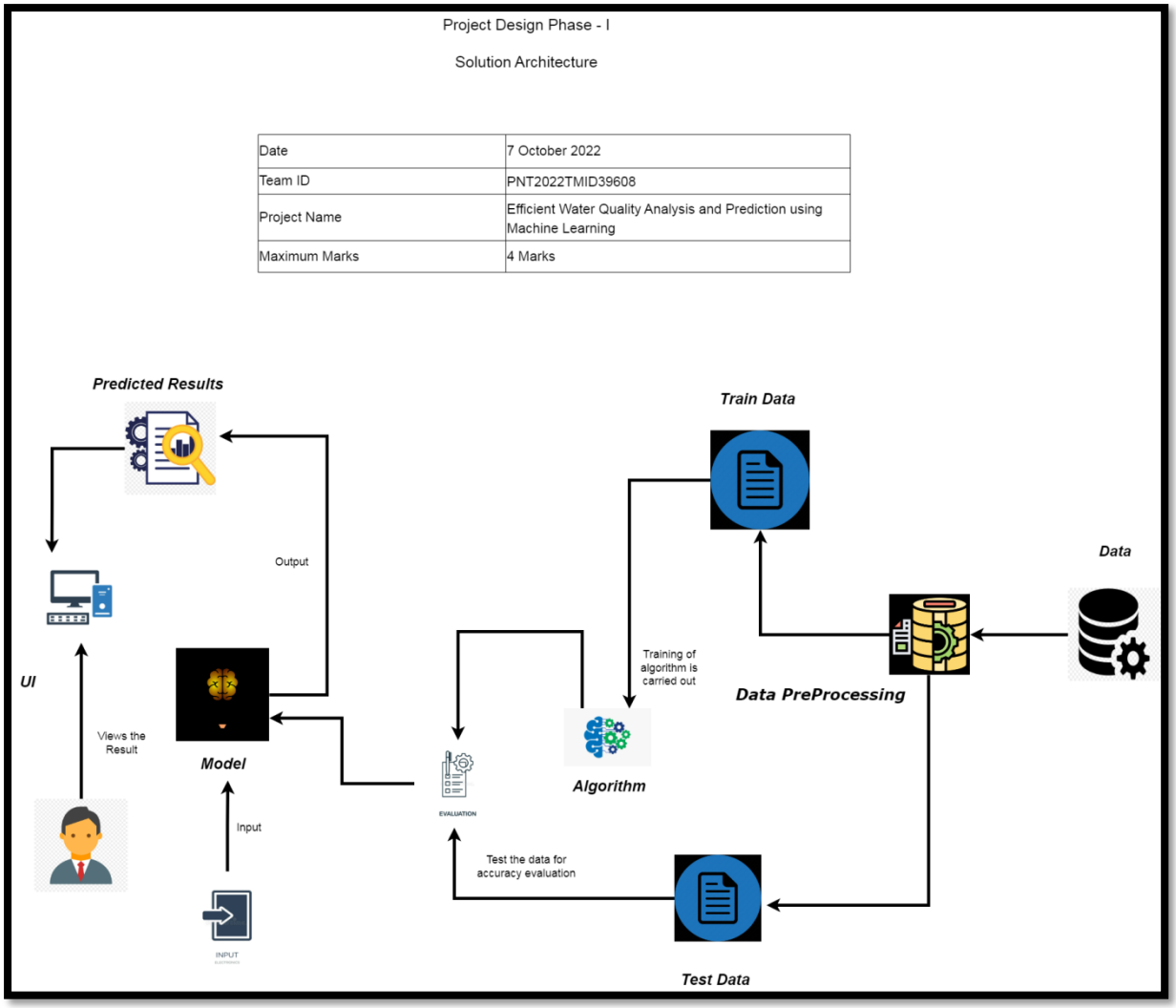


DFD LEVEL 1 DIAGRAM:



5.2 SOLUTION AND TECHNICAL ARCHITECTURE:

SOLUTION ARCHITECTURE:



TECHNICAL ARCHITECTURE:

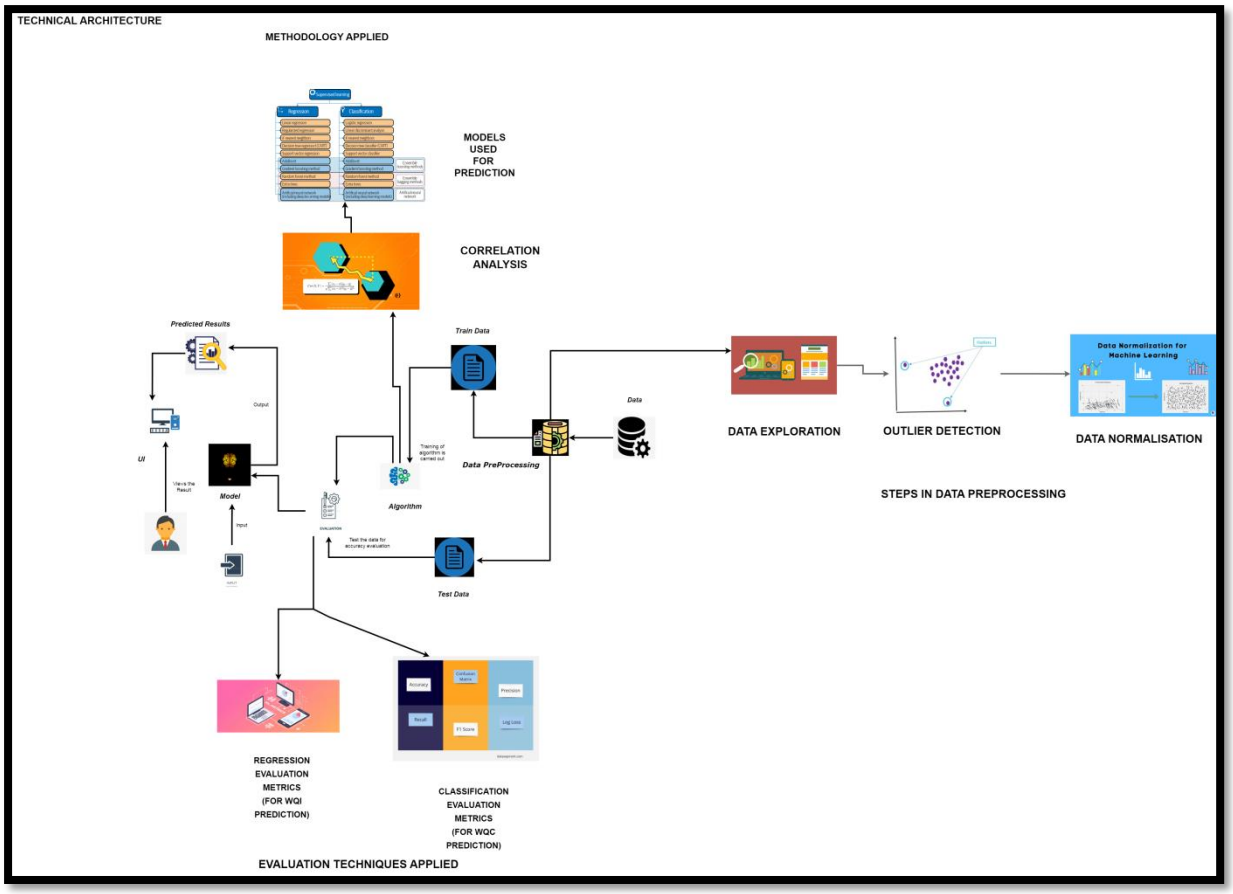


Table-1: COMPONENTS & TECHNOLOGIES:

S. No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g. Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Application Logic-1	Variety of frameworks, libraries and supports are required to develop the project.	Java / Python
3.	Application Logic-2	Helps in predicting the Water Quality Index (WQI) using various Regression and Water Quality Classification using various Classification algorithms based on various parameters involved. It also helps in predicting the potability of water samples and also recommends various purification methods based on the impurities present in the water sample.	IBM Watson STT service, Machine Learning Algorithms.
4.	Application Logic-3	Provides fast, accurate and consistent results of water quality analysis and interprets the results in a easy understandable manner.	IBM Watson Assistant
5.	Database	It can be numerical, categorical or time series data.	MySQL, NoSQL, etc.
6.	Cloud Database	Enables the user to host the database on his/herown hardware without buying additional hardware.	IBM DB2, IBM Cloudant etc.
7.	File Storage	File storage should be highly flexible, scalable, effective and a reliable one.	IBM Block/Object Storage or Other Storage Service or Local Filesystem

8.	External API-1	Used to access the information in the cloud.	IBM Weather API, etc.
9.	External API-2	Used to access the information for data driven decision making.	Aadhar API, etc.
10	Machine Learning Model	Purpose of Machine Learning Model	Regression and Classification Model, etc.
11	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Install the windows version and execute the installer.	Local, Cloud Foundry, Kubernetes, etc.

Table-2: APPLICATION CHARACTERISTICS:

S. No	**Characteristics**	**Description**	**Technology**
1.	Open-Source Frameworks	The Frameworks used in the project are:	Anaconda Navigator, Tensor Flow, Keras, Flask.
2.	Security Implementations	The security / access controls are implemented using firewalls, etc.	SHA-256, Encryptions, IAM Controls, OWASP etc.
3.	Scalable Architecture	The scalability of architecture (3 – tier, Micro-services)	Data, models operate at different sizes, speed, consistency and complexity.
4.	Availability	The availability of application (e.g. use of load balancers, distributed servers etc.)	It can be availed by all kinds of customers who wish to test the quality of water they consume.
5.	Performance	Design aspects for the performance of the application (number of requests per sec, use of Cache, use of CDN's) etc.	Gives correct and effective prediction, easy accessibility to the results using Machine Learning.

5.3 USER STORIES:

USER STORY NUMBER	USER STORY/TASKS
USN-1	Collect the appropriate dataset for predicting the water quality.
USN-2	Data Preprocessing – Used to transform the data into useful format.
USN-3	Calculate the Parameters from the basic parameters to determine the Water Quality Index (WQI).
USN-4	Calculate the Water Quality Index (WQI) using Regression algorithm of Machine Learning.
USN-5	Performing Various Visualisations on the parameters that determine the Water Quality Index (WQI).
USN-6	Splitting the Model into Training and Testing from the overall dataset.
USN-7	Train the Model using Regression algorithm and Testing the Performance of the model.
USN-8	Predict the Water Quality Index (WQI) and recommend the appropriate purification technique.
USN-9	Build the HTML code for creating a web application for the users to give their inputs and to calculate the WQI value.
USN-10	Build the Python code for integrating the HTML files created and to run the application python code using Flask server.
USN-11	Deploy the Model on IBM Cloud.

6. PROJECT PLANNING AND SCHEDULING:

6.1 SPRINT PLANNING AND ESTIMATION:

Project Tracker, Velocity & Burndown Chart:

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	10	6 Days	24 Oct 2022	29 Oct 2022	8	29 Oct 2022
Sprint-2	10	6 Days	31 Oct 2022	05 Nov 2022	7	05 Nov 2022
Sprint-3	10	6 Days	07 Nov 2022	12 Nov 2022	8	12 Nov 2022
Sprint-4	10	6 Days	14 Nov 2022	19 Nov 2022	7	19 Nov 2022

Velocity:

Imagine we have a 6 -day sprint duration, and the velocity of the team is 10 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day).

$$AV = \frac{\text{sprint duration}}{\text{velocity}} = 6/10=0.6$$

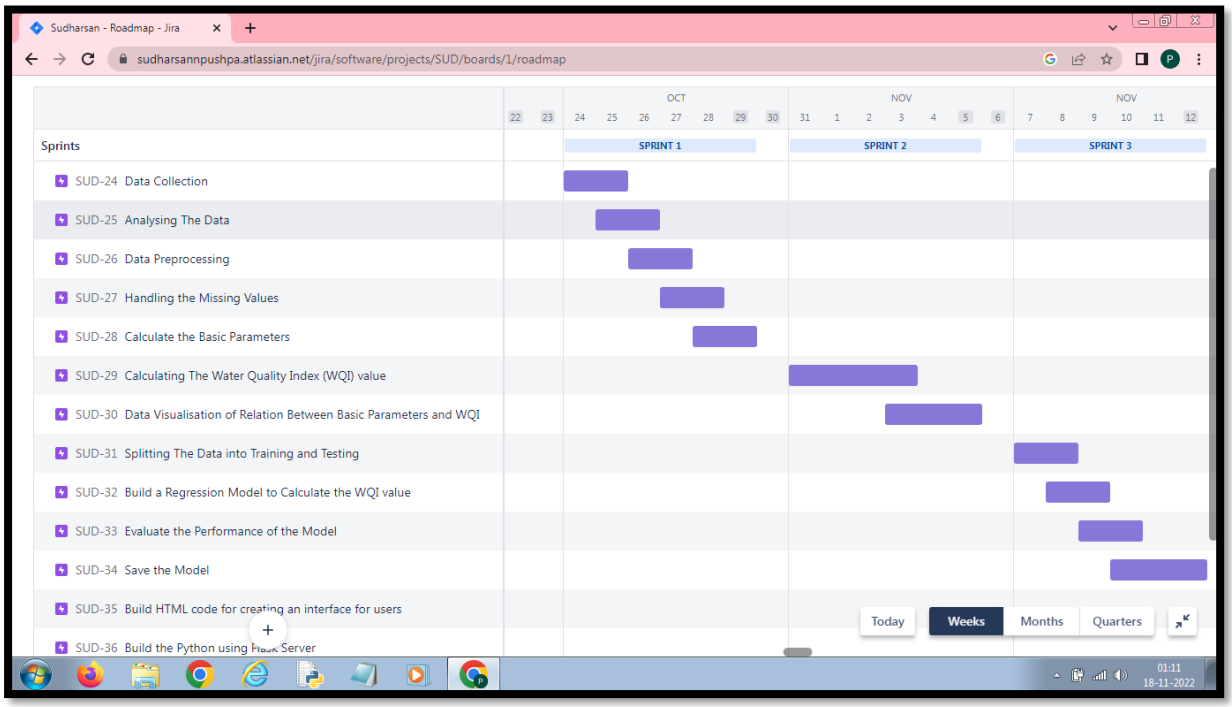
6.2 SPRINT DELIVERY SCHEDULE:

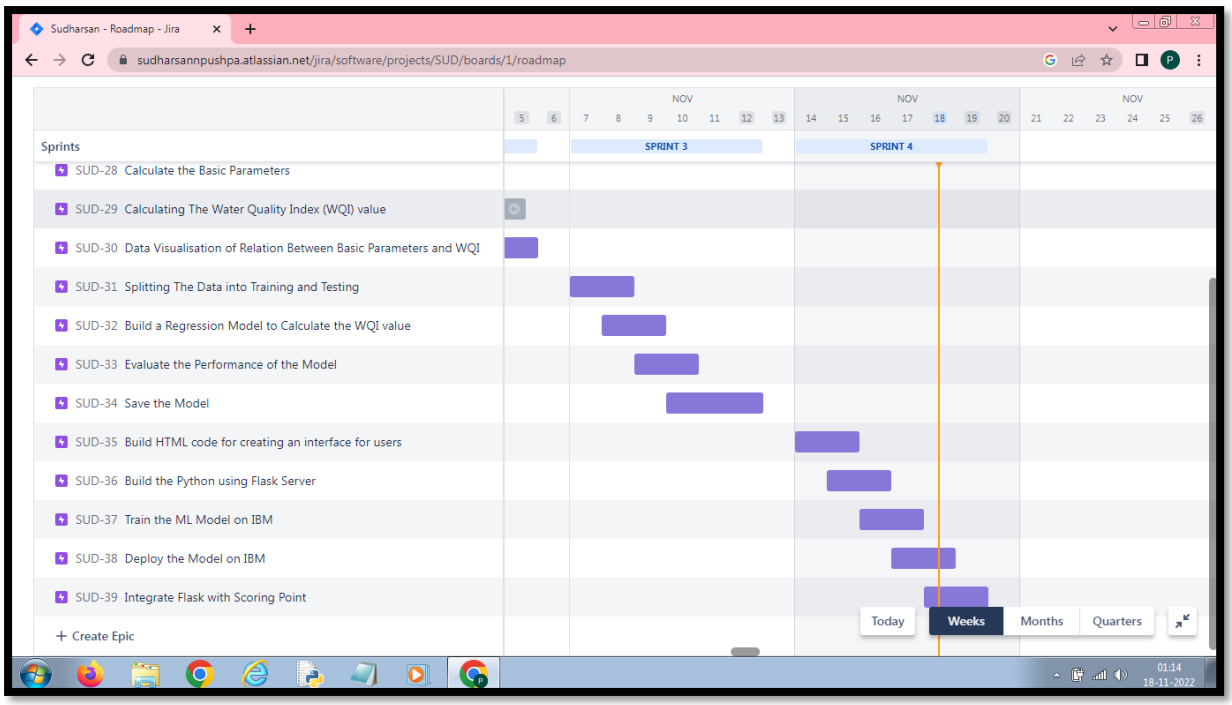
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Collection	USN-1	Collect the appropriate dataset for predicting the water quality.	10	High	Sudharsan S, Siddharth N.
Sprint-1		USN-2	Data Preprocessing – Used to transform the data into useful format.	7	Medium	Suhail F, Vignesh M.
Sprint-1		USN-3	Calculate the Parameters from the basic parameters to determine the Water Quality Index (WQI).	10	High	Sudharsan S, Suhail F.
Sprint-2	Model Building	USN-4	Calculate the Water Quality Index (WQI) using Regression algorithm of Machine Learning.	10	High	Sudharsan S, Suhail F.
Sprint-2		USN-5	Performing Various Visualisations on the parameters that determine the Water Quality Index (WQI).	7	Medium	Sudharsan S, Siddharth N.
Sprint-2		USN-6	Splitting the Model into Training and Testing from the overall dataset.	7	Medium	Siddharth N, Vignesh M.
Sprint-3	Training and Testing	USN-7	Train the Model using Regression algorithm and Testing the Performance of the model.	10	High	Sudharsan S, Vignesh M.
Sprint-4	Implementation of the Application	USN-8	Predict the Water Quality Index (WQI) and recommend the appropriate purification technique.	10	High	Siddharth N, Suhail F.
Sprint-4		USN-9	Build the HTML code for creating a web application for the users to give their inputs and to calculate the WQI value.	10	High	Sudharsan S, Siddharth N.
Sprint-4		USN-10	Build the Python code for integrating the HTML files created and to run the	10	High	Suhail F, Vignesh M.

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
			application python code using Flask server.			
Sprint-4		USN-11	Deploy the Model on IBM Cloud.	7	Medium	Sudharsan S, Siddharth N.

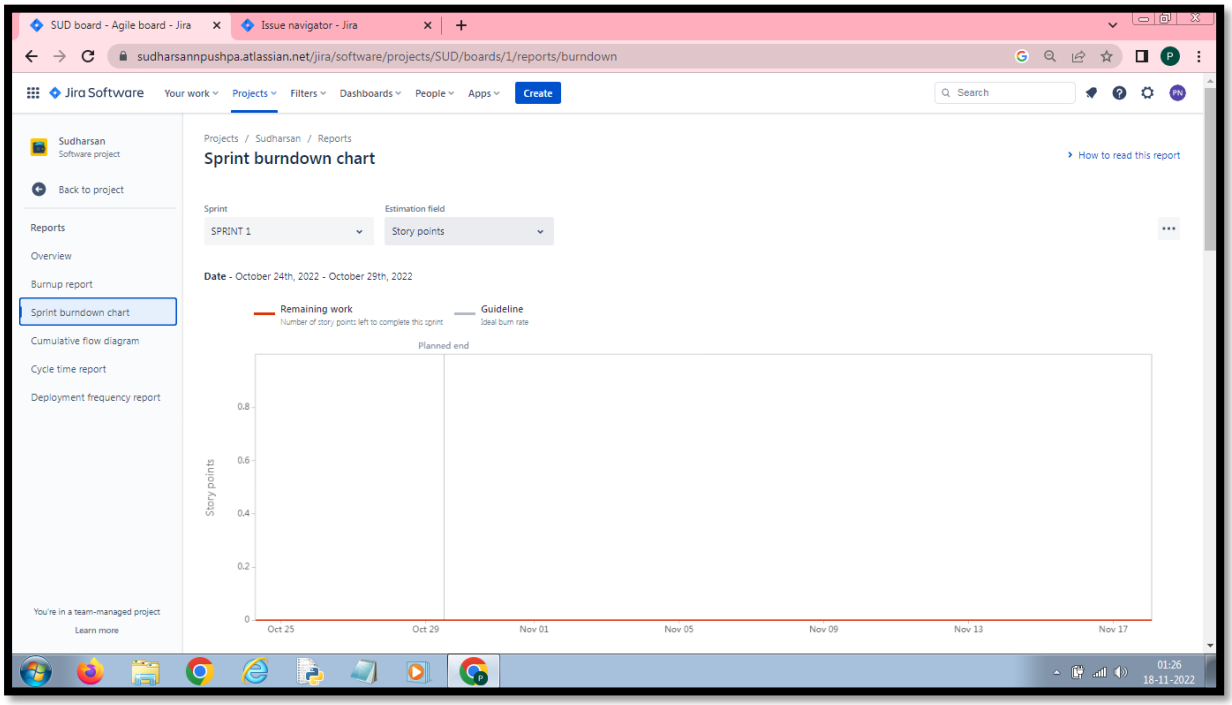
6.3 REPORTS FROM JIRA:

ROAD MAP

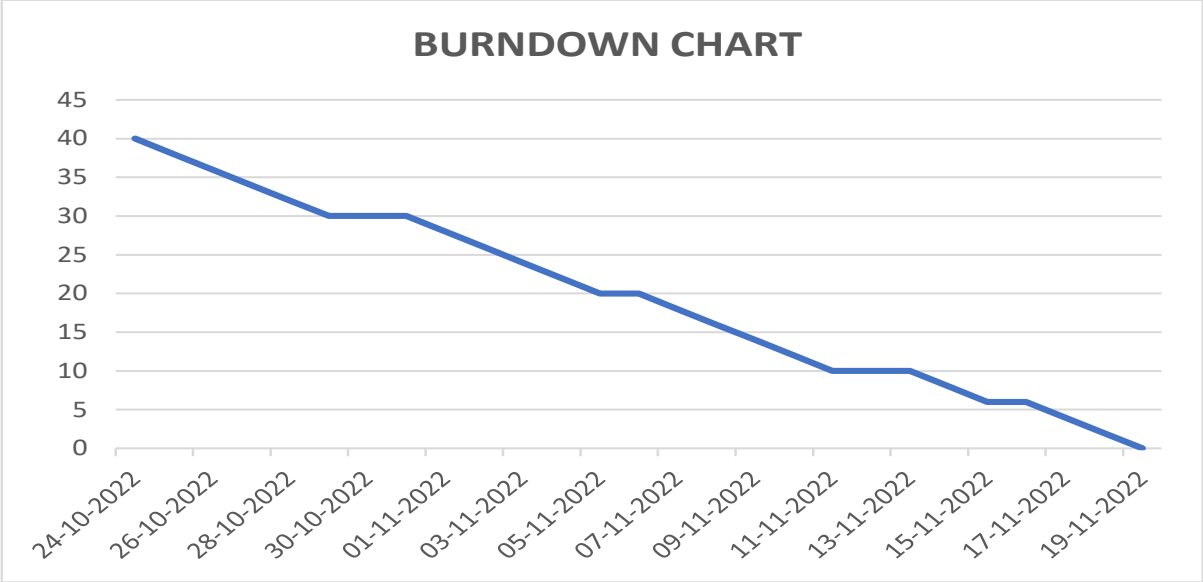




SPRINT BURNDOWN CHART



BURNDOWN CHART



7. CODING AND SOLUTIONING (Explain the features added in the project along with code):

7.1 UPLOADING OF WATER QUALITY PARAMETERS:

The user is given with a webpage which has an upload form linked to a Python Flask application.

When the user uploads the Water Quality Parameters values, the data gets stored in the server and used for prediction.

//**index.html** //used to get the Basic Water Quality Parameters as an input from the user.

```
<html>
<title>water quality prediction</title>
<style>
*{
    margin:0;
    padding:0;
    text-decoration:none;
    font-family:montserrat;
}
```

```css
.pd{
padding-bottom:100%;}
body
{
background-image:url('https://tenor.com/view/fallwater-gif-8021595.gif');
background-position: center;
font-family:sans-serif;
background-size:cover;
margin-top:40px;
}


.main{
    background-color:rgb(0,0,0,0.6);
    width:800px;
    height:500px;
    margin:auto;
    position:center;
    border-top-left-radius:100px;
    border-bottom-right-radius:100px;

}
.main input[type="text"],.main input[type="text"],.main
input[type="text"],.main input[type="text"],.main input[type="text"],.main
input[type="text"]{
    border:0;
    background:none;
    display:block;
    margin:20px auto;
    text-align:center;
    border:2px solid #3498db;
    padding:10px 3px;
    width:200px;
    outline:none;
    color:white;
    border-radius:24px;
    transition:0.25s;

}
.main input[type="text"]:focus,.main input[type="text"]:focus,.main
input[type="text"]:focus,.main input[type="text"]:focus,.main
input[type="text"]:focus,.main input[type="text"]:focus{
    width:280px;
    border-color:#8e44ad;
}
.logbtn{
    display:block;
    width:35%;
    height:50px;
```

```
    border:none;
    border-radius:24px;
    background:linear-gradient(120deg,#3498db,#8e44ad,#3498db);
    background-size:200%;
    color:#fff;
    outline:none;
    cursor:pointer;
    transition:.5s;
}
.logbtn:hover{
    background-position:right;
}


.predict{
  color:black;
  text-align:center;
}
</style>



<body>
<center><img
src="https://i.pinimg.com/236x/4b/bb/7d/4bbb7dae1470c8cdc3821b7c5b2f10fb.jpg"
height="100"><b class="pd"><font color="white" size="15" font-family="Comic
Sans MS" >Water Quality Prediction</font></b></center>
    <a href="/about" target="_blank"><font color="white" size="12" font-
family="Comic Sans MS" >Why To Find Water Quality</font></a>
    <form action="y_predict" class="main" method="post">
    <br>
    <center><input type="text" name="Station" placeholder="Station"
required="required" />
        <input type="text" name="Dissolved Oxygen" placeholder="Dissolved
Oxygen" required="required" />
        <input type="text" name="PH" placeholder="PH" required="required" />
        <input type="text" name="Carbon Monoxide" placeholder="Carbon
Monoxide" required="required" />
        <input type="text" name="Biochemical Oxygen Demand"
placeholder="Biochemical oxygen Demand" required="required" />
        <input type="text" name="Sodium" placeholder="Sodium"
required="required" />
        <input type="text" name="Technetium" placeholder="Technetium"
required="required" />
        <button type="submit" class="logbtn">Predict</button></center>

    </form>
```

```
    <br>
    <br>
     <h1 class=predict> {{ prediction_text }}</h1>


</body>
</html>
```

//**app.py** // used to control the application.

```
import numpy as np
from flask import Flask,render_template,request
import pickle


app = Flask(__name__)
model = pickle.load(open('wqi.pkl','rb'))
@app.route('/about')
def about():
    return render_template("about.html")
@app.route('/')
def home() :
    return render_template("predict.html")
@app.route('/bod')
def bod():
    return render_template("bod.html")
@app.route('/col')
def col():
    return render_template("col.html")
@app.route('/do')
def do():
    return render_template("do.html")
@app.route('/nit')
def nit():
    return render_template("nit.html")
@app.route('/ph')
def ph():
    return render_template("ph.html")
@app.route('/cond')
def cond():
    return render_template("cond.html")
@app.route('/analysis')
def analysis():
    return render_template("analysis.html")
@app.route('/login',methods = ['POST'])
```

```
def login() :
    year = request.form["year"]
    do = request.form["do"]
    ph = request.form["ph"]
    co = request.form["co"]
    bod = request.form["bod"]
    na = request.form["na"]
    tc = request.form["tc"]
```

7.2 PREDICTING THE WATER QUALITY INDEX VALUE AND ITS APPLICATIONS:

After the Basic Water Quality Parameters are uploaded, the data gets stored in the server. The Water Quality Data will be retrieved by the application and it is preprocessed before predicting.

The Basic Water Quality data is provided as the input to the trained model for predicting the regression Water Quality Index (WQI) value and redirecting the user to the appropriate Prediction page.

//**predict.html** //used to predict the Water Quality Index (WQI) value based on the saved model (i.e) Random Forest Regression Algorithm and the Basic Parameters given as an input.

```
<html>

<style>
div.header{
  top: 0;
  position: fixed;
  padding-left: 400px;}
div.header1{
```

```
  top:20;
  position: fixed;
  padding-left: 490px;
}

*{
        margin:0;
    padding:0;
    border:0;
    outline:0;
    text-decoration:none;
    font-family:montserrat;
}

body
{
background-image:url('https://images.squarespace-
cdn.com/content/v1/55fbb126e4b0518e8762e7c0/1452671039063-
DN1CGUUBHZ7KW8A96SNM/ke17ZwdGBToddI8pDm48kLk6AiHk3VCjVyx0bXHY-wpZw-
zPPgdn4jUwVcJE1ZvWQUxwkmyExglNqGp0IvTJZUJFbgE-
7XRK3dMEBRBhUpxFBdw5PXt5hvfhStZ7cvn0-
MX5Omk9VkquqZzsoZn3ZMqf1OgXybDooXHev_mqy80/tumblr_nbvmjgI5Eb1txly86o1_500.gif?
format=2500w');
background-position: center;
font-family:sans-serif;
background-size:cover;
margin-top:40px;
}


.main{
    background-color:rgb(0,0,0,0.6);

    width:800px;
    height:590px;
    margin:auto;
    position:center;
    border-top-left-radius:100px;
    border-bottom-right-radius:100px;

}
.main input[type="text"],.main input[type="text"],.main
input[type="text"],.main input[type="text"],.main input[type="text"],.main
input[type="text"],.main input[type="text"]{
    border:0;
    background:none;
    display:block;
    margin:20px auto;
    text-align:center;
```

```
    border:2px solid #3498db;
    padding:10px 3px;
    width:200px;
    outline:none;
    color:white;
    border-radius:24px;
    transition:0.25s;

}
.bor{
border:0;
    background:none;
    display:block;
    margin:20px auto;
    text-align:center;
    border:2px solid #8e44ad;
    padding:10px 3px;
    width:500px;
    outline:none;
    color:white;
    transition:0.25s;}
.main input[type="text"]:focus,.main input[type="text"]:focus,.main
input[type="text"]:focus,.main input[type="text"]:focus,.main
input[type="text"]:focus,.main input[type="text"]:focus,.main
input[type="text"]:focus{
    width:280px;
    border-color:#8e44ad;
}
.logbtn{
    display:block;
    width:35%;
    height:50px;
    border:none;
    border-radius:24px;
    background:linear-gradient(120deg,#3498db,#8e44ad,#3498db,#8e44ad);
    background-size:200%;
    color:#fff;
    outline:none;
    cursor:pointer;
    transition:.5s;
    font-size:25;
}
.logbtn:hover{
    background-position:right;
}

input::placeholder{
    color:#F5FFFA;
```

```
}
.bottom-text{
    margin-top:60px;
    text-align:center;
    font-size:13px;

}


</style>
<body>
    <center><div class="header"><img src="https://encrypted-
tbn0.gstatic.com/images?q=tbn:ANd9GcTYX9t6QQZ-NH5gqH7tiwlyK-Ni3krQ0zckj-
yjrO9X1l6h6CyJysWkxUxsH-tWDJhxwwE&usqp=CAU" width="100"
height="100"></div></center>
    <center><div class="header1"><font color="#FF0000" font-family="Fascinate
Inline" size=7 ><b>Urban Water Quality Prediction</b></font></div></center>
    <br><br><br>
    <a href="/about" target="_blank"><font color="white" size="12" font-
family="Comic Sans MS" >Why To Find Water Quality</font></a>
<br><br><br><br><br>
    <form class="main" action="/login" method="post">
        <br>
        <center><input type="text" name="year" placeholder="Enter Year"/>
        <input type="text" name="do" placeholder="Enter D.O "/>
        <input type="text" name="ph" placeholder="Enter PH"/>
        <input type="text" name="co" placeholder="Enter Conductivity"/>
        <input type="text" name="bod" placeholder="Enter B.O.D"/>
        <input type="text" name="na" placeholder="Enter Nitratenen"/>
        <input type="text" name="tc" placeholder="Enter Total Coliform"/>
        <input type="submit" class="logbtn" value="Predict"></center>
        <div class="bor"><center><b><font color="white"
size=5>{{showcase}}</font></b></center></div>
    </form>


</body>

</html>
```

//**app.py** // used to predict the classification and redirect to the appropriate predict page.

```
def login() :
    year = request.form["year"]
    do = request.form["do"]
    ph = request.form["ph"]
```

```
    co = request.form["co"]
    bod = request.form["bod"]
    na = request.form["na"]
    tc = request.form["tc"]
    total =
[[int(year),float(do),float(ph),float(co),float(bod),float(na),float(tc)]]
    y_pred = model.predict(total)
    print(y_pred)
    y_pred =y_pred[[0]]
    if(y_pred >= 95 and y_pred <= 100) :
        return render_template("predict.html",showcase = 'Excellent,The
predicted value is '+ str(y_pred)+' No Purification or Treatment of Water is
needed.')
    elif(y_pred >= 89 and y_pred <= 94) :
        return render_template("predict.html",showcase = 'Very good,The
predicted value is '+str(y_pred)+' Minor Purification or Treatment of Water is
needed.')
    elif(y_pred >= 80 and y_pred <= 88) :
        return render_template("predict.html",showcase = 'Good,The predicted
value is'+str(y_pred)+' Conventional Purification or Treatment of Water is
needed.')
    elif(y_pred >= 65 and y_pred <= 79) :
        return render_template("predict.html",showcase = 'Fair,The predicted
value is '+str(y_pred)+' Extensive Purification or Treatment of Water is
needed.')
    elif(y_pred >= 45 and y_pred <= 64) :
        return render_template("predict.html",showcase = 'Marginal,The
predicted value is '+str(y_pred)+' Doubtful in purifying and treating the
water so as to get Pure Water.')
    else :
        return render_template("predict.html",showcase = 'Poor,The predicted
value is '+str(y_pred)+' The Water is not fit for to be used for Drinking.')


if __name__ == '__main__' :
    app.run()
```

8. TESTING:

8.1 TEST CASES:

				Date	18-Nov-22								
				Team ID	PNT2022TMID39608								
				Project Name	Project -Efficient Water Quality Analysis and Prediction Using Machine Learning								
				Maximum Marks	4 marks								
Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Commnets	TC for Automation(	BUG ID	Executed By
Webpage_TC_001	UI	Home Page	Verify the user is able to view the page.	1. Latest Web Browser 2.Proper Internet Connection.	1. Enter the url of the website and click go. 2.Verify that the page is loading or not.	No Test Data Required	The Webpage should be visible to the user.	The webpage is visible .	Pass	The test case passed without any issues.	Y	1	Sudharsan S
Webpage_TC_002	UI	Home Page	Verify the page is responsive for all devices.	1. Mobile Device 2.Desktop Device 3.Tablet Device 4.Web Browser and Internet Connection.	1. Enter the url of the website and click go. 2.Verify that the page is loading properly with proper alignments in all the devices.	No Test Data Required	The Webpage should be visible to the user.	The webpage is visible in all the devices.	Pass	The test case passed without any issues.	Y	2	Siddharth N
Webpage_TC_003	UI	Home Page	Verify whether the UI elements work properly.	1. Latest Web Browser 2.Proper Internet Connection.	1. Enter the url of the website and click go. 2.After the page is loaded succesfully click the predict button.	Sample Water Quality Parameters data for testing.	The Webpage should accept the Water Quality Data from the user.	The webpage accepts the user input.	Pass	The test case passed without any issues.	Y	3	Suhail F
Webpage_TC_004	UI	Home Page	Verify the page is responding for every user action.	1. Latest Web Browser 2.Proper Internet Connection.	1. Enter the url of the website and click go. 2.Verify that the page is loading and working properly during prediction and reset.	Sample Water Quality Parameters data for testing.	The Webpage should be stable during uploading and predicting process.	The webpage is responding stably.	Pass	The test case passed without any issues.	Y	4	Vignesh M
Webpage_TC_005	UI	Home Page	Verify that the page accepts only Numeric Data.	1. Latest Web Browser 2.Proper Internet Connection.	1. Enter the url of the website and click go. 2. After the page is loaded try to upload the non numeric formats like text, special characters,etc.	Non Numeric Data	The Webpage should reject the user and prompts the user to upload the proper	The webpage prompted with an error message when wrong	Pass	The test case passed without any issues.	Y	5	Sudharsan S

Flask_TC_001	Functional	Flask App	Verify that the flask app uses the Saved Model.	1. Latest Web Browser 2.Proper Internet Connection.	1. Enter the url of the website and click go. 2. Verify the page is accepting inputs and predicting according to the regression model developed.	Sample Water Quality Parameters data for testing.	The Webpage should predict the Water Quality Index (WQI) value.	The webapp predicts the WQI value accurately.	Pass	The test case passed without any issues.	Y	6	Siddharth N
Flask_TC_002	Functional	Flask App	Verify that the Uploaded Data gets saved on the Server.	1. Latest Web Browser 2.Proper Internet Connection. 3. Storage in the server for storing the uploaded data.	1. Enter the url of the website and click go. 2. Verify that the page is loaded try to upload the water quality determining parameters values and wait for prediction.	Sample Water Quality Parameters data for testing.	The Webpage should accept the Data and save it locally on the server.	The app stored the Water Quality Data.	Pass	The test case passed without any issues.	Y	7	Suhail F
Flask_TC_003	Functional	Flask App	Verify that the Uploaded Data gets retrieved from the Storage.	1. Latest Web Browser 2.Proper Internet Connection. 3. Storage in the server for storing the uploaded data.	1. Enter the url of the website and click go. 2. Verify the page is accepting inputs and predicting according to the regression model developed.	Sample Water Quality Parameters data for testing.	The webpage should be able to store and retrieve the data that is uploaded by the user.	The app retrieved the Water Quality Parameter successfully.	Pass	The test case passed without any issues.	Y	8	Vignesh M
Flask_TC_004	Functional	Flask App	Verify that the app directs the user to appropriate parameter influencing Water Quality Description pages whenever the user requires.	1. Latest Web Browser 2.Proper Internet Connection. 3. Sample Hyperlinks text to be tested.	1. Enter the url of the website and click go. 2. Verify the page is redirecting to the appropriate Parameters page.	Sample Water Quality Parameters data for testing.	The webapp should redirect to the appropriate parameters page.	The app should redirected successfully.	Pass	The test case passed without any issues.	Y	9	Sudharsan S

8.2 USER ACCEPTANCE TESTING:

DEFECT ANALYSIS:

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

Resolution	Low Severity	Medium Severity	High Severity	Subtotal of Bugs
By UI	1	2	2	5
By Functionality	0	2	2	4
Duplicate	0	5	8	13
External	0	0	0	0
Fixed	1	4	5	10
Not Reproduced	0	0	0	0
Skipped	0	0	0	0

Won't Fix	0	0	0	0
Totals	2	13	18	33

TEST CASE ANALYSIS:

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

Section	Total Cases	Not Tested	Fail	Pass
User Interface	5	0	0	5
Flask Application	4	0	0	4
Exception Reporting	2	0	0	2
Final Report Output	1	0	0	1
Version Control	2	0	0	2

9. RESULTS:

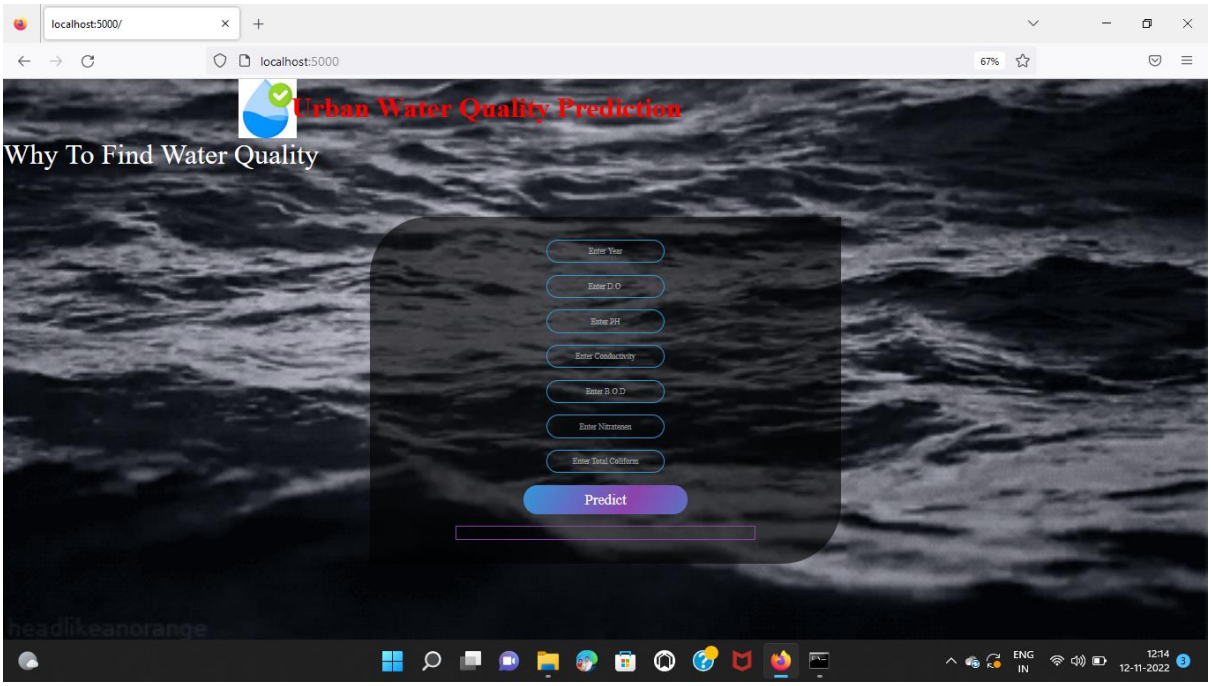
RUNNING APP:

```
import numpy as np
from flask import Flask,render_template,request
import pickle


app = Flask(__name__)
model = pickle.load(open('wqi.pkl','rb'))
@app.route('/about')
def about():
    return render_template("about.html")
@app.route('/')
def home() :
    return render_template("predict.html")
@app.route('/bod')
def bod():
    return render_template("bod.html")
@app.route('/col')
def col():
    return render_template("col.html")
```

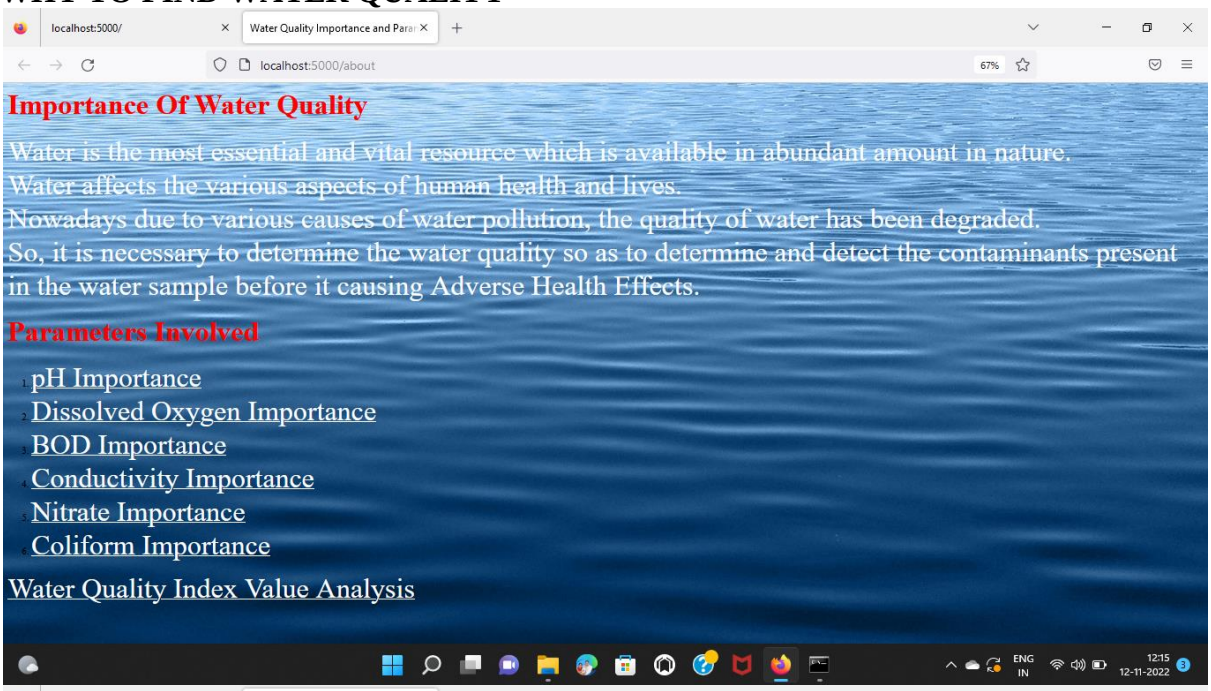
```
@app.route('/do')
def do():
    return render_template("do.html")
@app.route('/nit')
def nit():
    return render_template("nit.html")
@app.route('/ph')
def ph():
    return render_template("ph.html")
@app.route('/cond')
def cond():
    return render_template("cond.html")
@app.route('/analysis')
def analysis():
    return render_template("analysis.html")
@app.route('/login',methods = ['POST'])
def login() :
    year = request.form["year"]
    do = request.form["do"]
    ph = request.form["ph"]
    co = request.form["co"]
    bod = request.form["bod"]
    na = request.form["na"]
    tc = request.form["tc"]
    total =
[[int(year),float(do),float(ph),float(co),float(bod),float(na),float(tc)]]
    y_pred = model.predict(total)
    print(y_pred)
    y_pred =y_pred[[0]]
    if(y_pred >= 95 and y_pred <= 100) :
        return render_template("predict.html",showcase = 'Excellent,The
predicted value is '+ str(y_pred)+' No Purification or Treatment of Water is
needed.')
    elif(y_pred >= 89 and y_pred <= 94) :
        return render_template("predict.html",showcase = 'Very good,The
predicted value is '+str(y_pred)+' Minor Purification or Treatment of Water is
needed.')
    elif(y_pred >= 80 and y_pred <= 88) :
        return render_template("predict.html",showcase = 'Good,The predicted
value is'+str(y_pred)+' Conventional Purification or Treatment of Water is
needed.')
    elif(y_pred >= 65 and y_pred <= 79) :
        return render_template("predict.html",showcase = 'Fair,The predicted
value is '+str(y_pred)+' Extensive Purification or Treatment of Water is
needed.')
    elif(y_pred >= 45 and y_pred <= 64) :
```

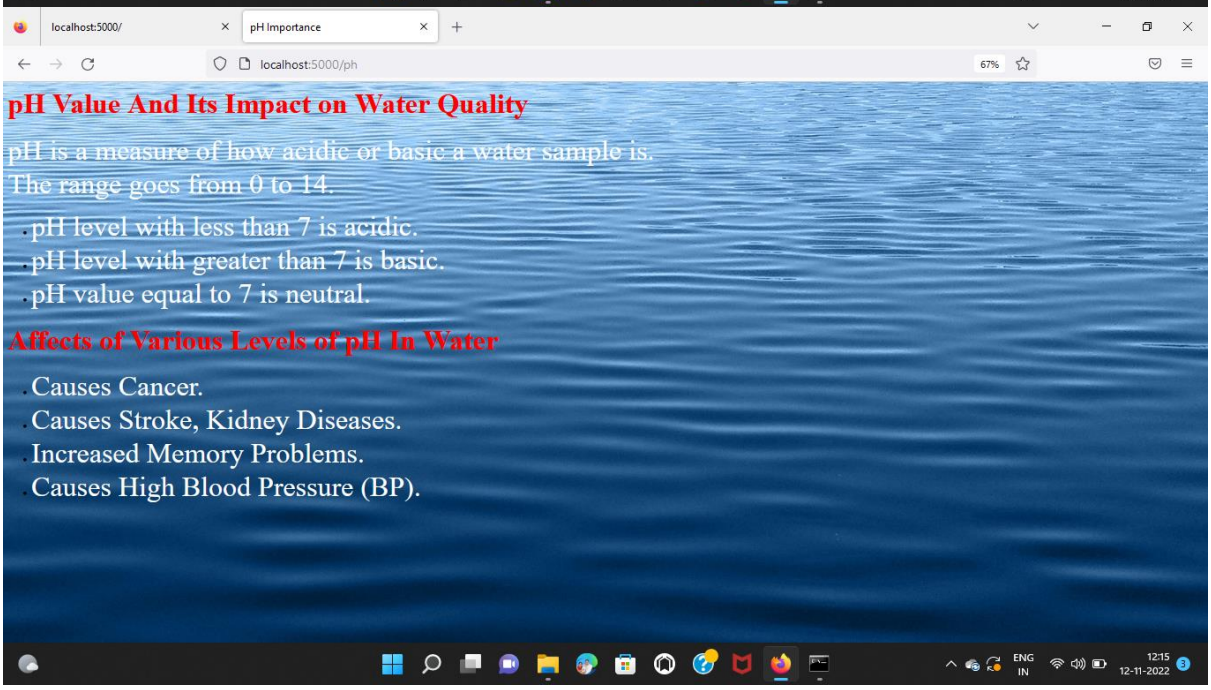
```
        return render_template("predict.html",showcase = 'Marginal,The
predicted value is '+str(y_pred)+' Doubtful in purifying and treating the
water so as to get Pure Water.')
    else :
        return render_template("predict.html",showcase = 'Poor,The predicted
value is '+str(y_pred)+' The Water is not fit for to be used for Drinking.')


if __name__ == '__main__' :
    app.run()
```

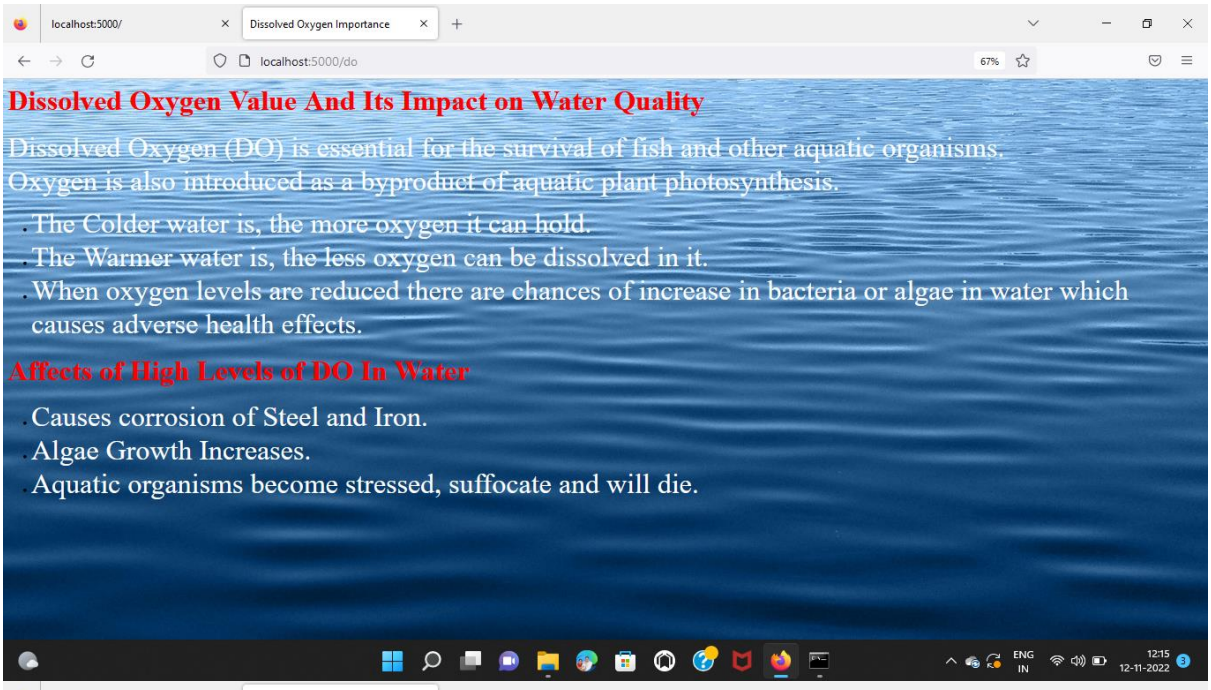
OUTPUT:

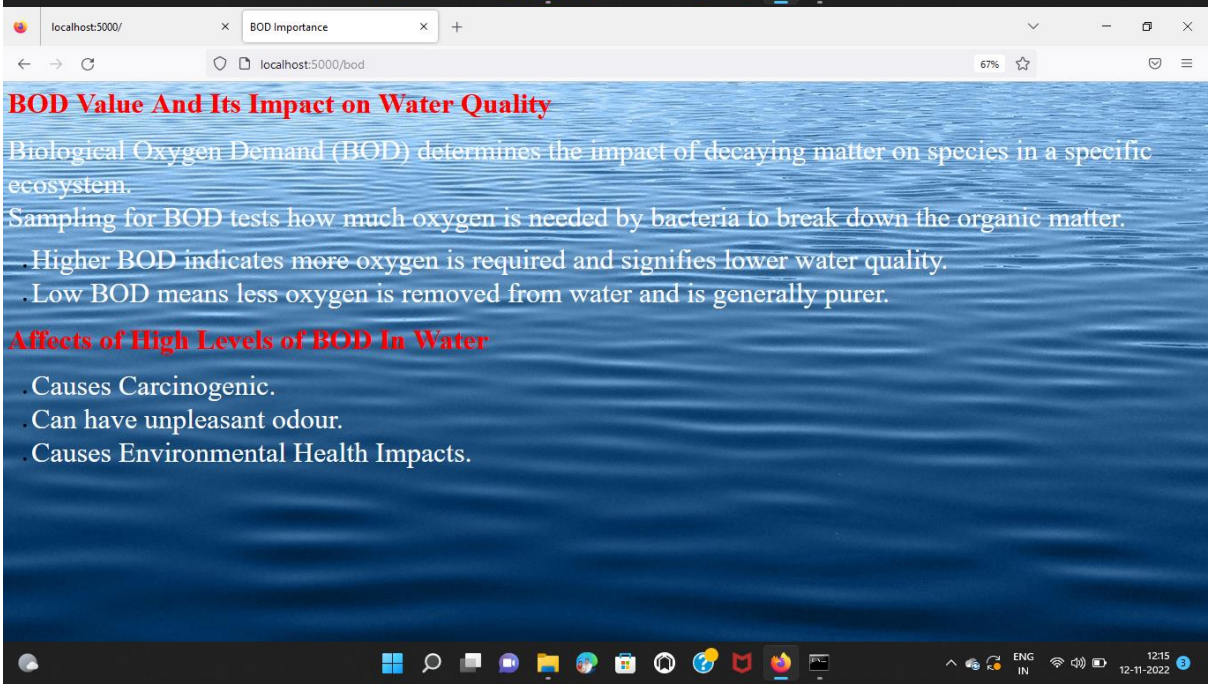


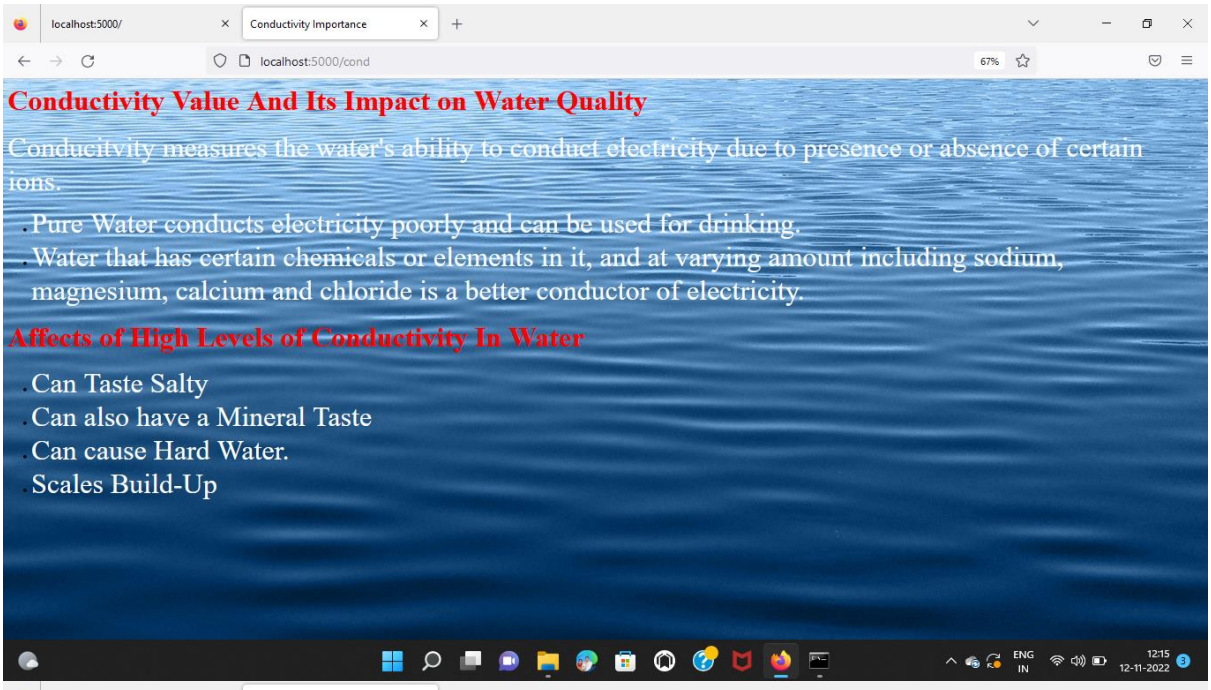
WHY TO FIND WATER QUALITY

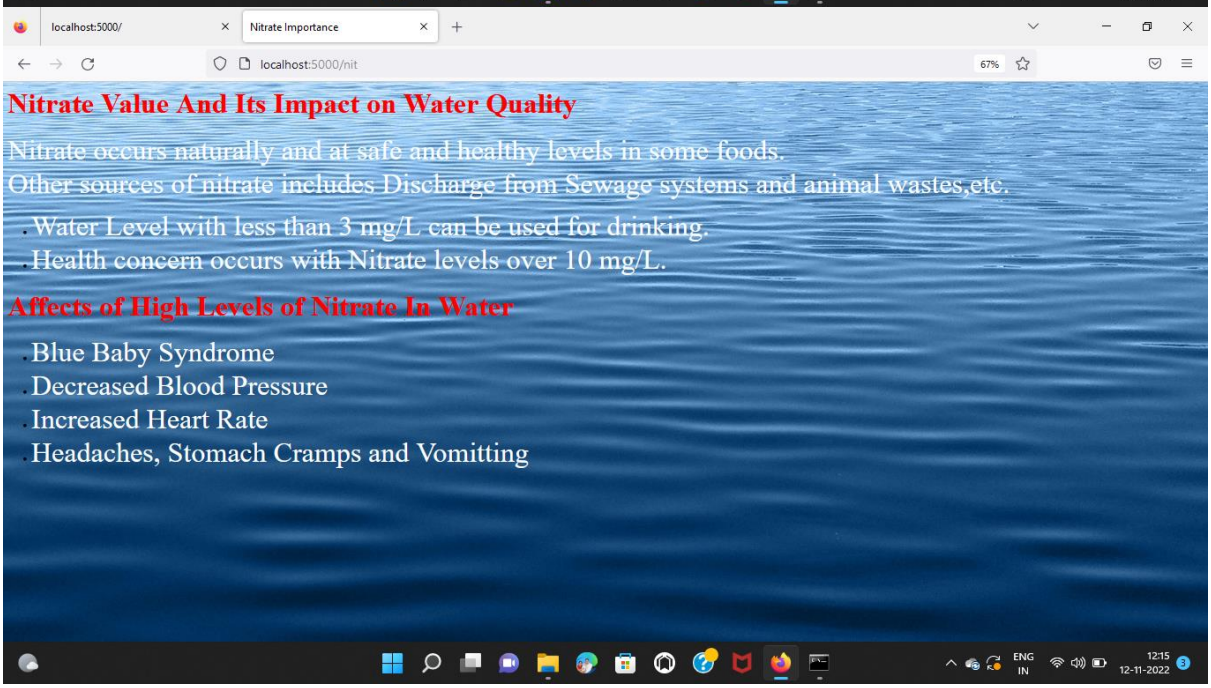


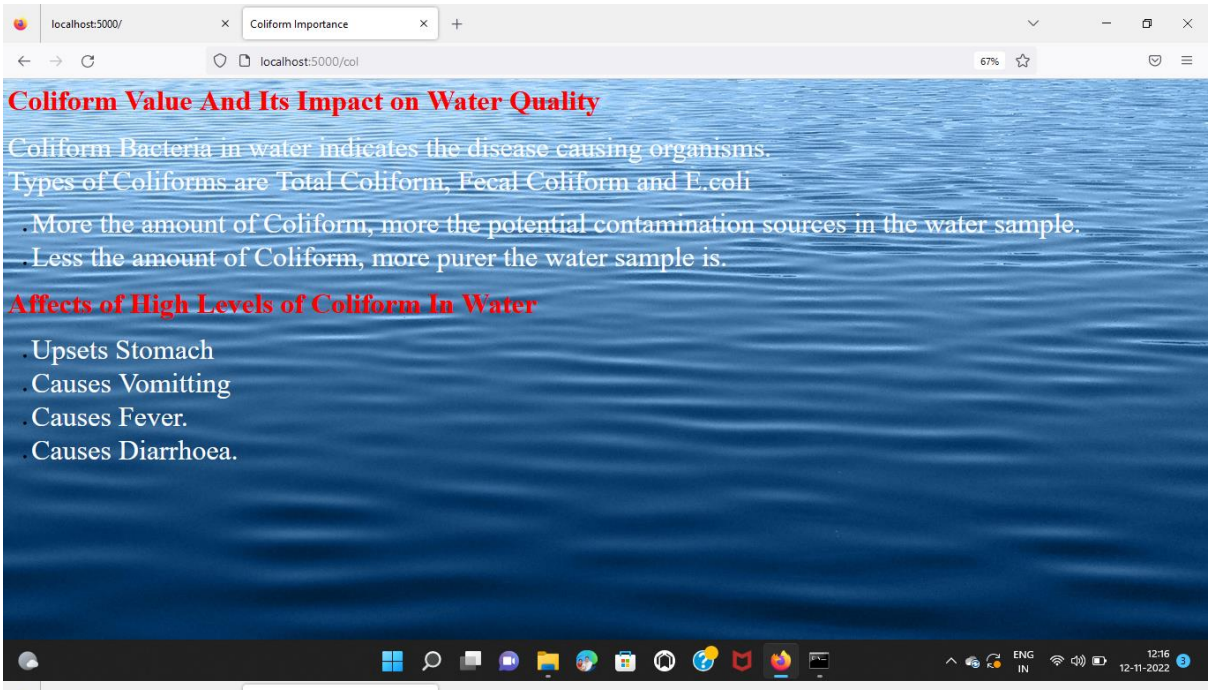


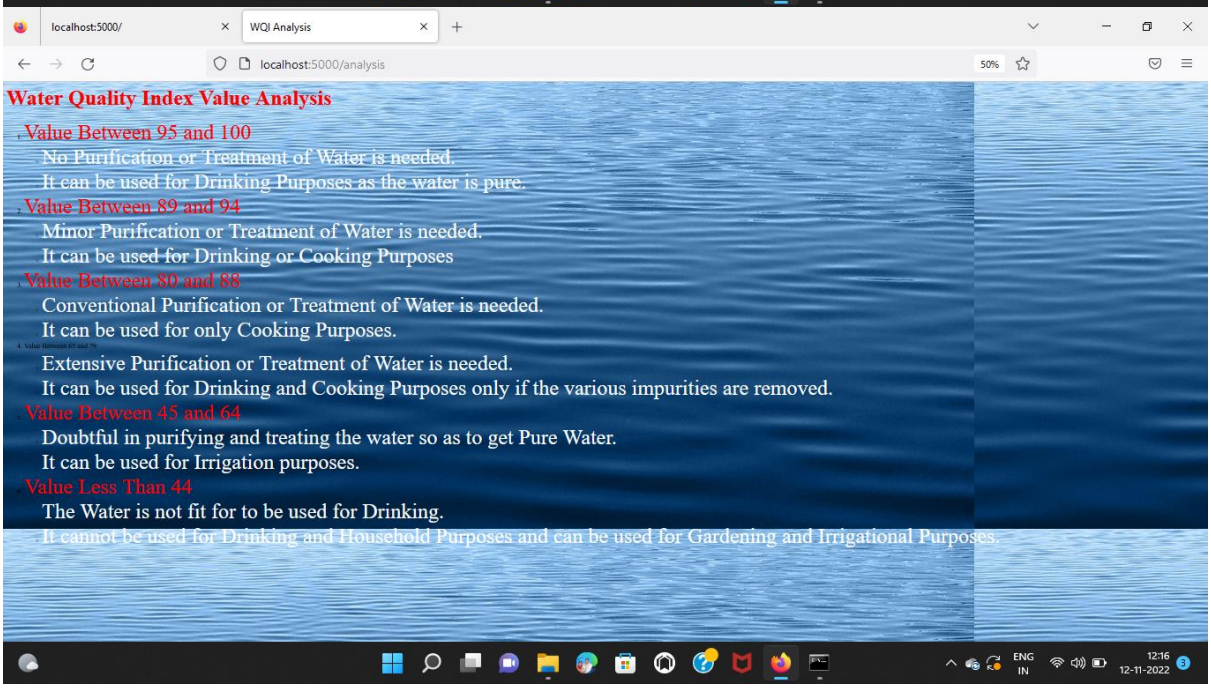

localhost:5000/
Dissolved Oxygen Importance
localhost:5000/do
67%
Dissolved Oxygen Value And Its Impact on Water Quality
Dissolved Oxygen (DO) is essential for the survival of fish and other aquatic organisms.
Oxygen is also introduced as a byproduct of aquatic plant photosynthesis.
. The Colder water is, the more oxygen it can hold.
. The Warmer water is, the less oxygen can be dissolved in it.
. When oxygen levels are reduced there are chances of increase in bacteria or algae in water which causes adverse health effects.
Affects of High Levels of DO In Water
. Causes corrosion of Steel and Iron.
. Algae Growth Increases.
. Aquatic organisms become stressed, suffocate and will die.
ENG
IN
12:15
12-11-2022


localhost:5000/
BOD Importance
localhost:5000/bod
67%
BOD Value And Its Impact on Water Quality
Biological Oxygen Demand (BOD) determines the impact of decaying matter on species in a specific ecosystem.
Sampling for BOD tests how much oxygen is needed by bacteria to break down the organic matter.
. Higher BOD indicates more oxygen is required and signifies lower water quality.
. Low BOD means less oxygen is removed from water and is generally purer.
Affects of High Levels of BOD In Water
. Causes Carcinogenic.
. Can have unpleasant odour.
. Causes Environmental Health Impacts.
ENG
IN
12:15
12-11-2022

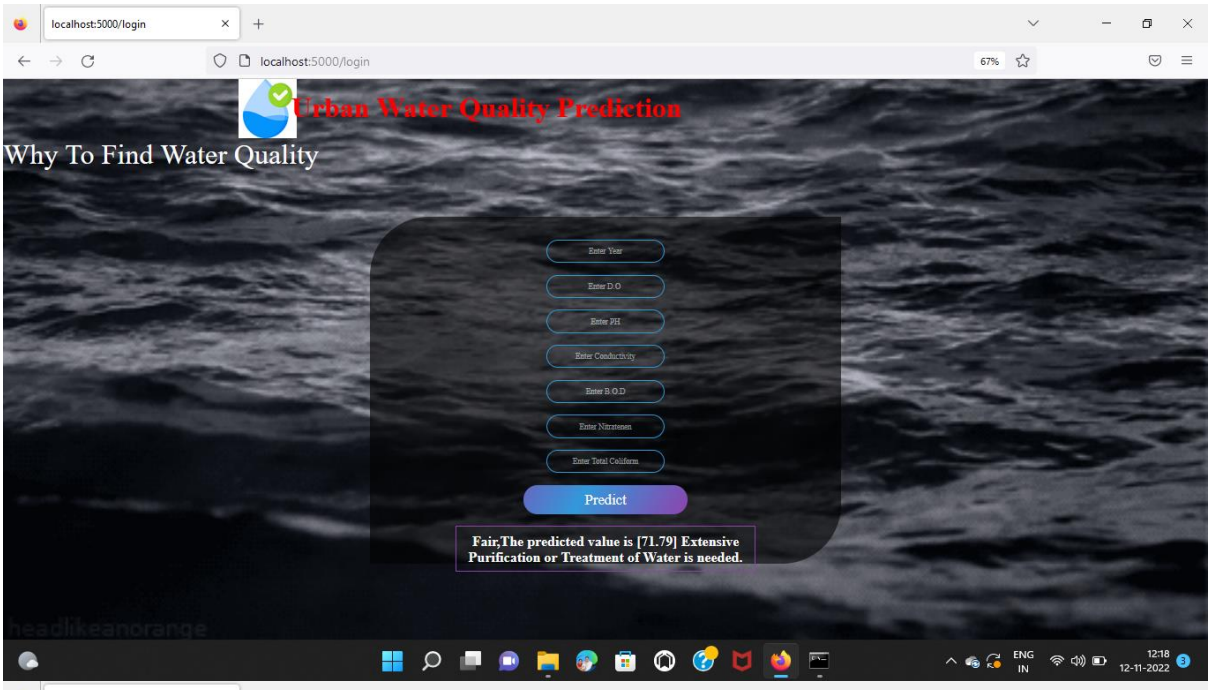

localhost:5000/
Conductivity Importance
localhost:5000/cond
67%
Conductivity Value And Its Impact on Water Quality
Conducitvity measures the water's ability to conduct electricity due to presence or absence of certain ions.
. Pure Water conducts electricity poorly and can be used for drinking.
. Water that has certain chemicals or elements in it, and at varying amount including sodium, magnesium, calcium and chloride is a better conductor of electricity.
Affects of High Levels of Conductivity In Water
. Can Taste Salty
. Can also have a Mineral Taste
. Can cause Hard Water.
. Scales Build-Up
ENG
IN
12:15
12-11-2022

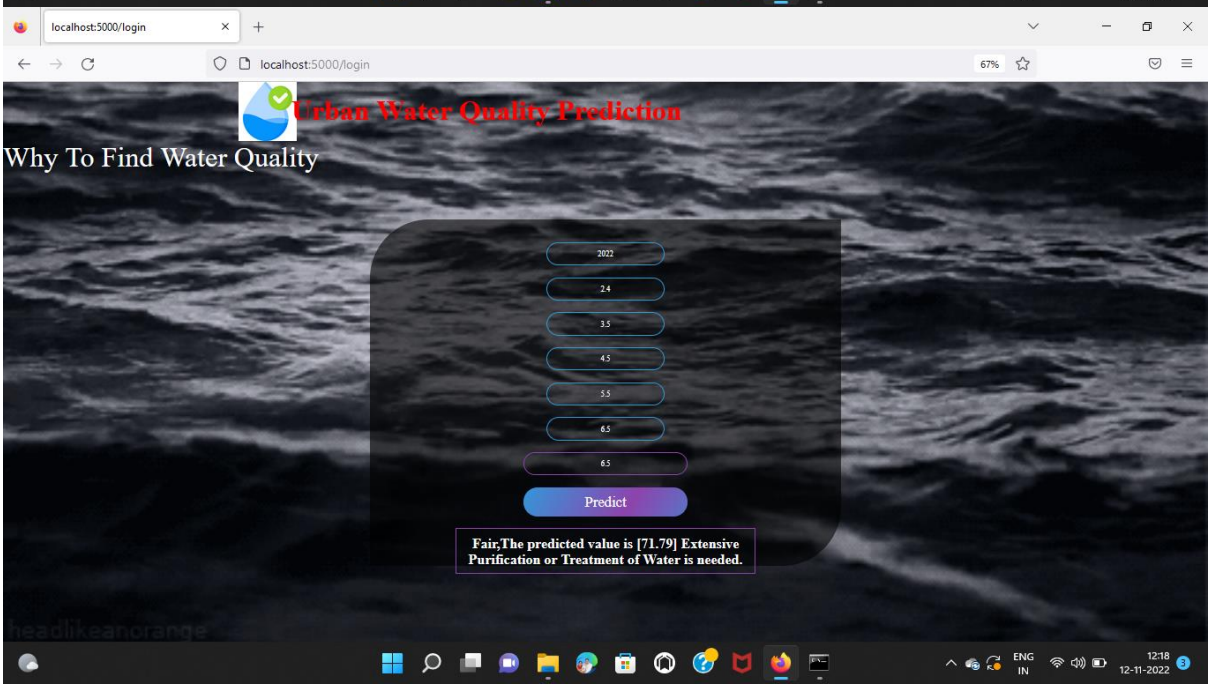

localhost:5000/
Nitrate Importance
localhost:5000/nit
67%
Nitrate Value And Its Impact on Water Quality
Nitrate occurs naturally and at safe and healthy levels in some foods.
Other sources of nitrate includes Discharge from Sewage systems and animal wastes,etc.
. Water Level with less than 3 mg/L can be used for drinking.
. Health concern occurs with Nitrate levels over 10 mg/L.
Affects of High Levels of Nitrate In Water
. Blue Baby Syndrome
. Decreased Blood Pressure
. Increased Heart Rate
. Headaches, Stomach Cramps and Vomitting
ENG
IN
12:15
12-11-2022

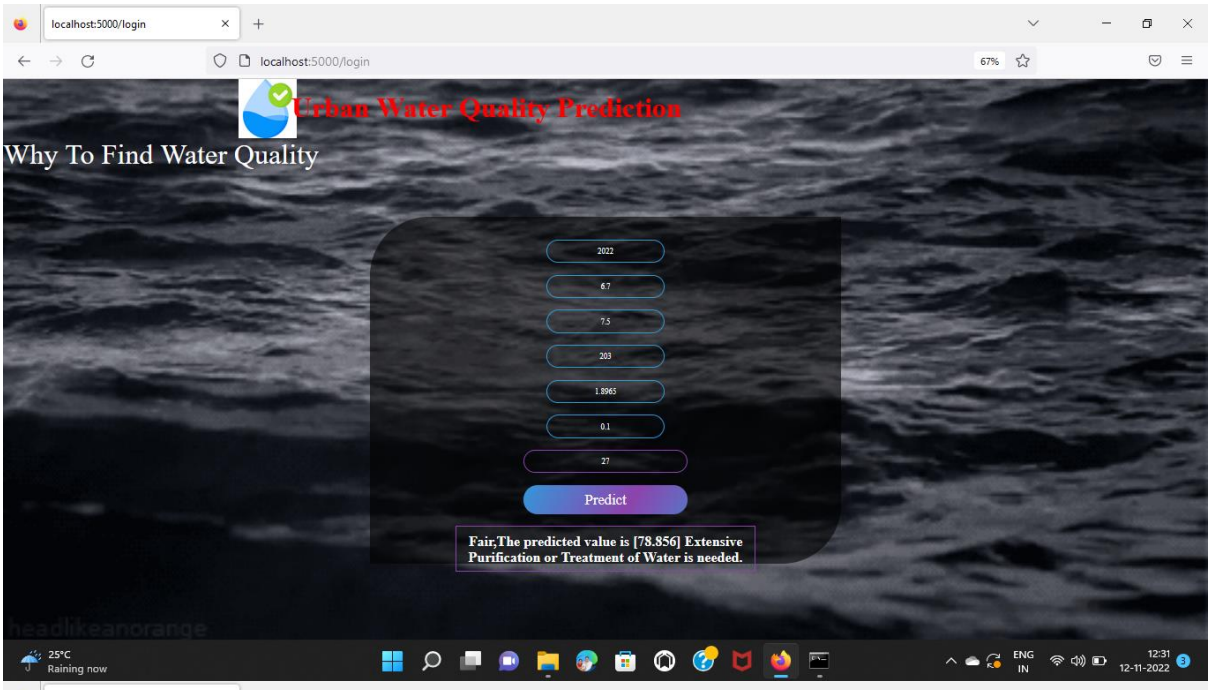

localhost:5000/
Coliform Importance
localhost:5000/col
67%
Coliform Value And Its Impact on Water Quality
Coliform Bacteria in water indicates the disease causing organisms.
Types of Coliforms are Total Coliform, Fecal Coliform and E.coli
.More the amount of Coliform, more the potential contamination sources in the water sample.
.Less the amount of Coliform, more purer the water sample is.
Affects of High Levels of Coliform In Water
.Upsets Stomach
.Causes Vomitting
.Causes Fever.
.Causes Diarrhoea.
ENG
IN
12:16
12-11-2022

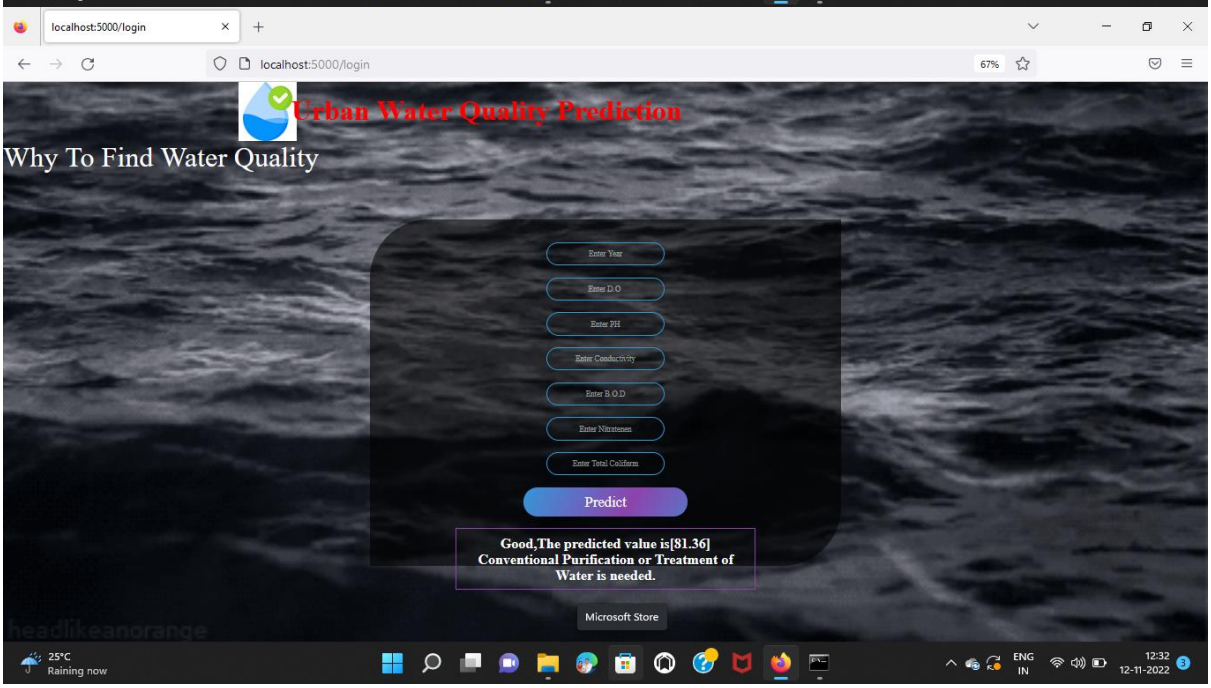

localhost:5000/
WQI Analysis
localhost:5000/analysis
50%
Water Quality Index Value Analysis
.Value Between 95 and 100
No Purification or Treatment of Water is needed.
It can be used for Drinking Purposes as the water is pure.
.Value Between 89 and 94
Minor Purification or Treatment of Water is needed.
It can be used for Drinking or Cooking Purposes
.Value Between 80 and 88
Conventional Purification or Treatment of Water is needed.
It can be used for only Cooking Purposes.
Extensive Purification or Treatment of Water is needed.
It can be used for Drinking and Cooking Purposes only if the various impurities are removed.
.Value Between 45 and 64
Doubtful in purifying and treating the water so as to get Pure Water.
It can be used for Irrigation purposes.
.Value Less Than 44
The Water is not fit for to be used for Drinking.
It cannot be used for Drinking and Household Purposes and can be used for Gardening and Irrigational Purposes.
ENG
IN
12:16
12-11-2022

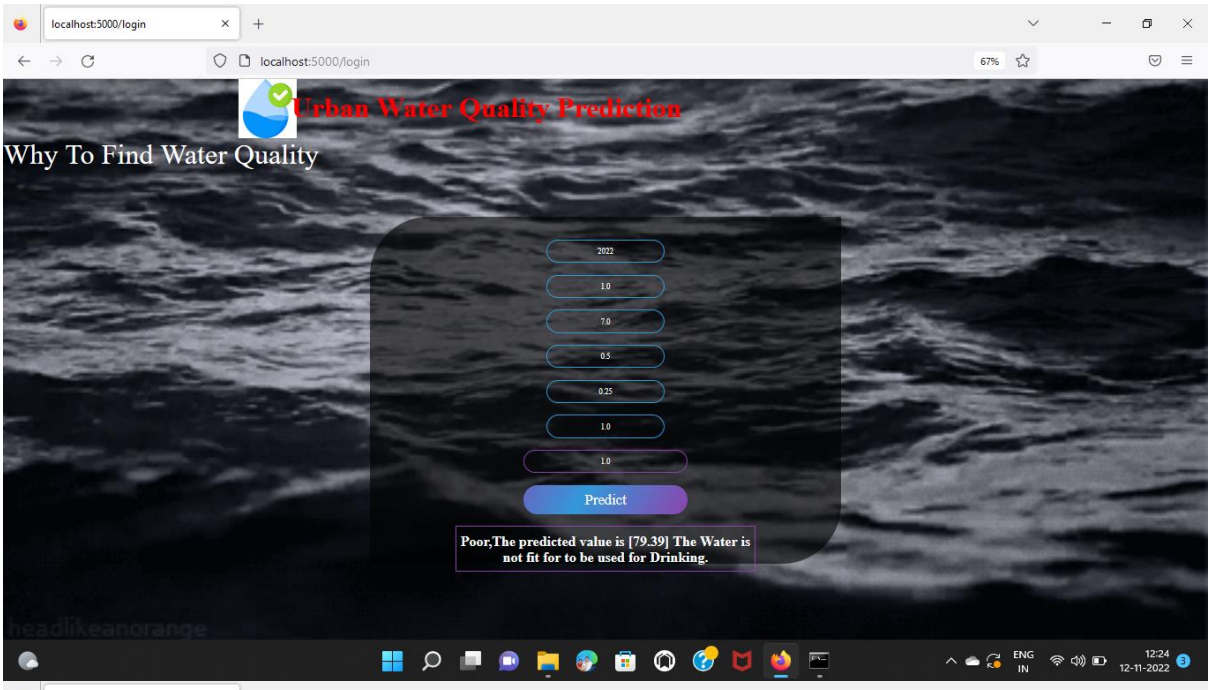
VARIOUS PREDICTION RESULTS:

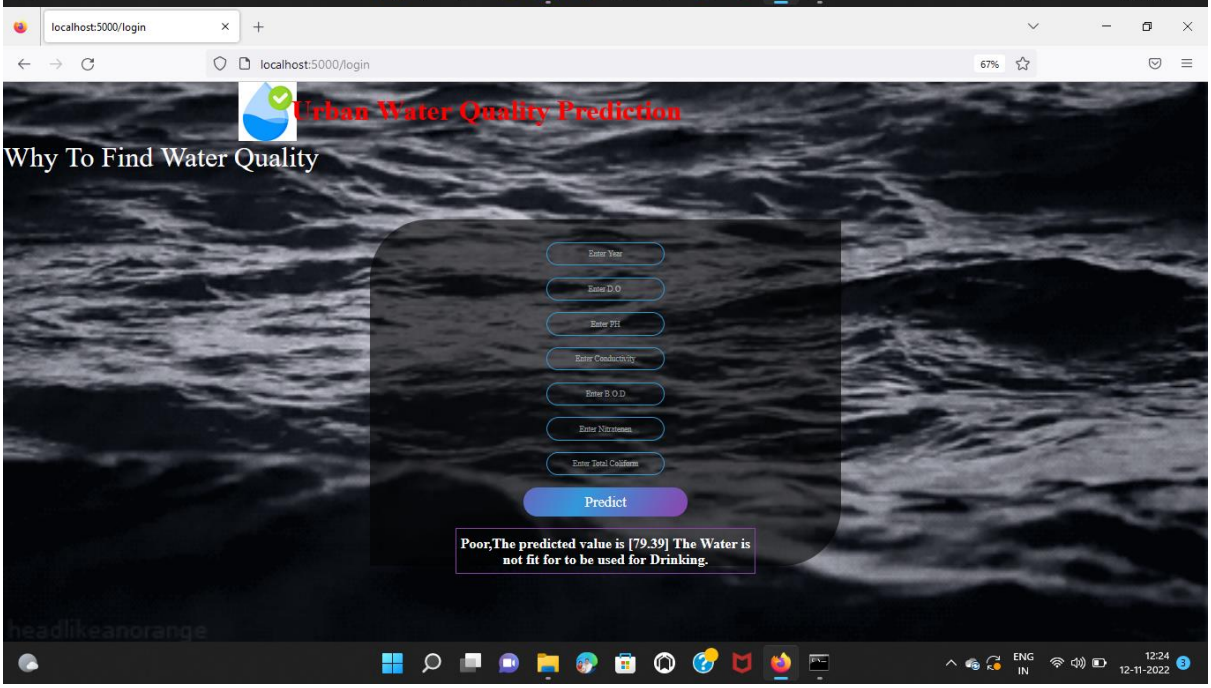

localhost:5000/login
localhost:5000/login
67%
Urban Water Quality Prediction
Why To Find Water Quality
Enter Year
Enter D.O
Enter PH
Enter Conductivity
Enter B.O.D
Enter Nitratenen
Enter Total Coliform
Predict
Fair,The predicted value is [71.79] Extensive Purification or Treatment of Water is needed.
ENG
IN
12:18
12-11-2022


localhost:5000/login
localhost:5000/login
67%
Urban Water Quality Prediction
Why To Find Water Quality
2022
2.4
3.5
4.5
5.5
6.5
6.5
Predict
Fair,The predicted value is [71.79] Extensive Purification or Treatment of Water is needed.
ENG
IN
12:18
12-11-2022


localhost:5000/login
localhost:5000/login
67%
Urban Water Quality Prediction
Why To Find Water Quality
2022
6.7
7.5
203
1.8965
0.1
27
Predict
Fair,The predicted value is [78.856] Extensive Purification or Treatment of Water is needed.
25°C
Raining now
ENG
IN
12:31
12-11-2022


localhost:5000/login
localhost:5000/login
67%
Urban Water Quality Prediction
Why To Find Water Quality
Enter Year
Enter D.O
Enter PH
Enter Conductivity
Enter B.O.D
Enter Nitratenen
Enter Total Colifarm
Predict
Good,The predicted value is[81.36] Conventional Purification or Treatment of Water is needed.
Microsoft Store
25°C
Raining now
ENG
IN
12:32
12-11-2022


localhost:5000/login
localhost:5000/login
67%
Urban Water Quality Prediction
Why To Find Water Quality
2022
1.0
7.0
0.5
0.25
1.0
1.0
Predict
Poor,The predicted value is [79.39] The Water is not fit for to be used for Drinking.
ENG
IN
12:24
12-11-2022

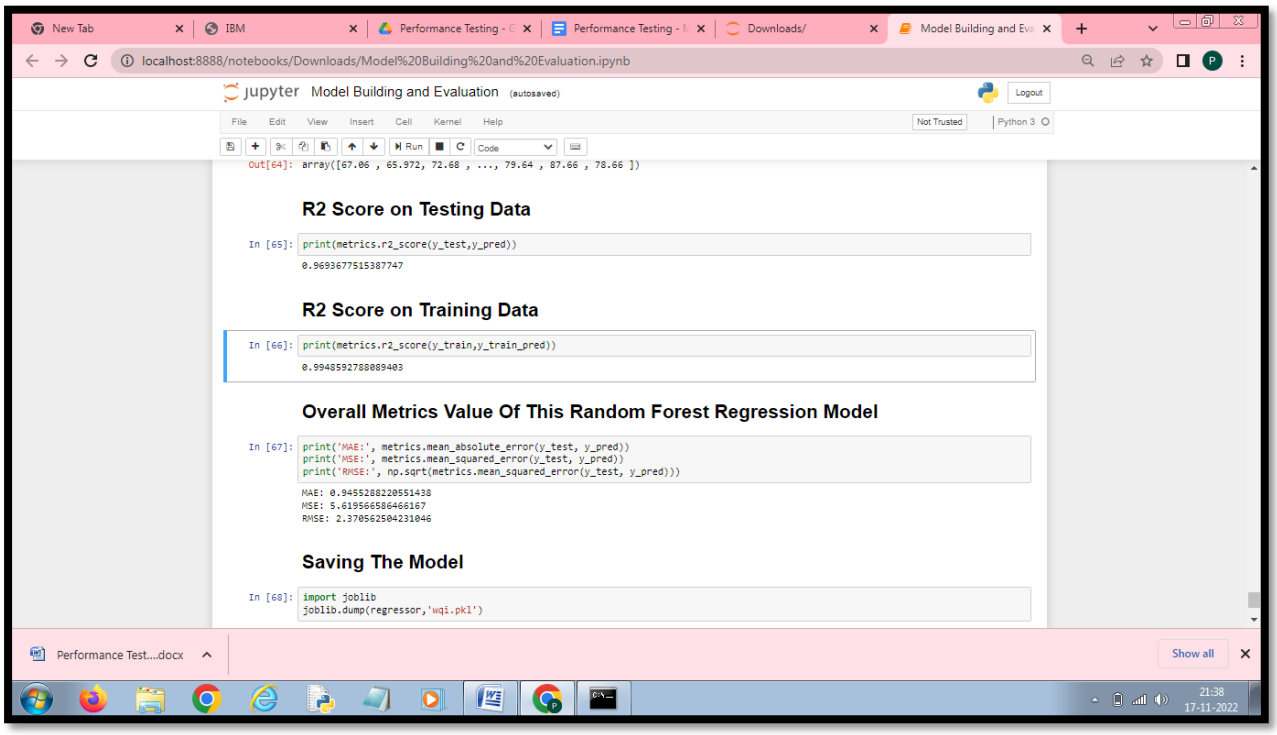

localhost:5000/login
localhost:5000/login
67%
Urban Water Quality Prediction
Why To Find Water Quality
Enter Year
Enter D.O
Enter PH
Enter Conductivity
Enter B.O.D
Enter Nitrates
Enter Total Coliform
Predict
Poor,The predicted value is [79.39] The Water is not fit for to be used for Drinking.
ENG
IN
12:24
12-11-2022

9.1 PERFORMANCE METRICS:

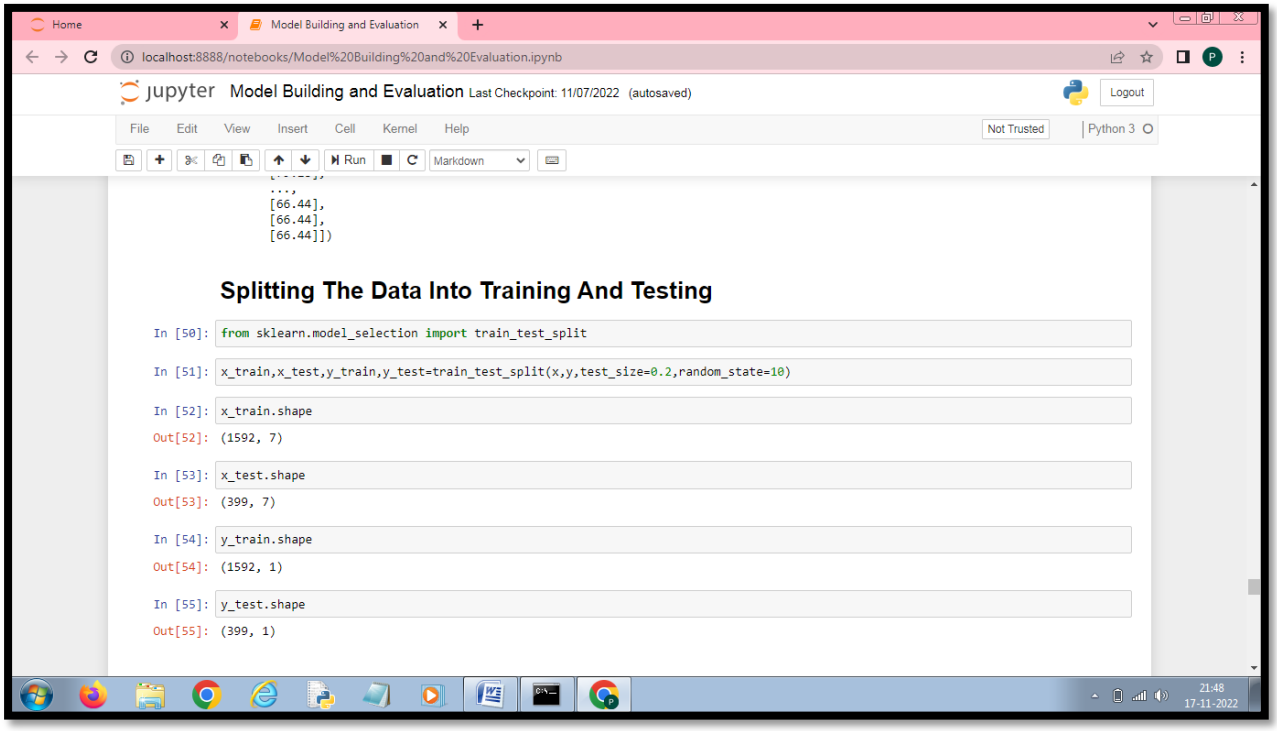
Project team shall fill the following information in model performance testing template.

S. No	Parameter	Values	Screenshot
1.	Metrics	**Regression Model:** MAE -0.9455288220551438 , MSE - 5.619566586466167, RMSE - 2.370562504231046, R2 score : Training: 0.9948592788089403 Testing: 0.9693677515387747	Screenshot 1
2.	Tune the Model	Hyper parameter Tuning - NIL Validation Method – Split Sample/ Data Validation.	Screenshot 2

Screenshot 1:



Screenshot 2:



10. ADVANTAGES AND DISADVANTAGES:

ADVANTAGES:

- The predicted values are accurate.
- It will analyse the given water sample.
- It is the advanced technology used for prediction.
- We can also get the graphical representation by using the data visualization.

DISADVANTAGES:

- Accuracy should be maintained to get exact values.
- Difficult to built the model.

11. CONCLUSION:

The performance of machine learning techniques which was used to predict the Water Quality Index were evaluated to predict the water quality components of Urban Water which is used for various purposes. To this end most dataset related well-known components, such as pH, SO_4, Na, Ca, Cl, Mg, HCO_3 etc., were collected. Results indicated that the applied models have suitable performance for predicting water quality components, however, the best performance was related to the Random Forest Regression Model.

12. FUTURE SCOPE:

This paper presents the economical solution to avoid contamination of water in residential overhead tanks. The quality of water is monitored using Internet Of Things (IoT) devices and the future prediction of water contamination is achieved using Artificial Intelligence algorithms. The proposed system consists of multi sensors connected to NodeMcU to collect the water parameters. And the alert message is sent to the user before the water gets contaminated. The system helps to save the water from contamination and is also cost effective. The future scope for this project is to detect the diseases caused by different parameters and finding the appropriate solution for to clean the tank. Also biosensors can be used to detect the micro bacteria for better quality of water.

13. APPENDIX:

SOURCE CODE:

about.html:

```
<html>
<head>
<title>Water Quality Importance and Parameters</title>
<style>
body
{
background-image:url('https://images.pexels.com/photos/355808/pexels-photo-
355808.jpeg?cs=srgb&dl=pexels-pixabay-355808.jpg&fm=jpg');
}
</style>
</head>
<body>
<h1><font color="red" size="10" font-family="Comic Sans MS" >Importance Of
Water Quality</font></h1>
<p>
<font color="white" size="10" font-family="Comic Sans MS" >Water is the most
essential and vital resource which is available in abundant amount in
nature.</font><br/>
<font color="white" size="10" font-family="Comic Sans MS" >Water affects the
various aspects of human health and lives.</font><br/>
<font color="white" size="10" font-family="Comic Sans MS" >Nowadays due to
various causes of water pollution, the quality of water has been
degraded.</font><br/>
<font color="white" size="10" font-family="Comic Sans MS" >So, it is necessary
to determine the water quality so as to determine and detect the contaminants
present in the water sample before it causing Adverse Health Effects.</font>
</p>
<h1><font color="red" size="10" font-family="Comic Sans MS" >Parameters
Involved</font></h1>
```

```
<ol>
<li><a href="/ph" target="_self"><font color="white" size="7" font-
family="Comic Sans MS" >pH Importance</font></a></li>

<li><a href="/do" target="_self"><font color="white" size="7" font-
family="Comic Sans MS" >Dissolved Oxygen Importance</font></a></li>

<li><a href="/bod" target="_self"><font color="white" size="7" font-
family="Comic Sans MS" >BOD Importance</font></a></li>

<li><a href="/cond" target="_self"><font color="white" size="7" font-
family="Comic Sans MS" >Conductivity Importance</font></a></li>

<li><a href="/nit" target="_self"><font color="white" size="7" font-
family="Comic Sans MS" >Nitrate Importance</font></a></li>

<li><a href="/col" target="_self"><font color="white" size="7" font-
family="Comic Sans MS" >Coliform Importance</font></a></li>
</ol>
<a href="/analysis" target="_self"><font color="white" size="10" font-
family="Comic Sans MS" >Water Quality Index Value Analysis</font></a></li>

</body>
</html>
```

analysis.html:

```
<html>
<head>
<title> WQI Analysis </title>
<style>
body
{
background-image:url('https://images.pexels.com/photos/355808/pexels-photo-
355808.jpeg?cs=srgb&dl=pexels-pixabay-355808.jpg&fm=jpg');
}
</style>
</head>
<body>
<h1> <font color="red" size="10" font-family="Comic Sans MS" >Water Quality
Index Value Analysis</font></h1>
<ol>
<li><font color="red" size="10" font-family="Comic Sans MS" >Value Between 95
and 100</font></li>
    <ul>
        <li><font color="white" size="8" font-family="Comic Sans MS" >No
Purification or Treatment of Water is needed.</font></li>
```

```
        <li><font color="white" size="8" font-family="Comic Sans MS" >It can be used for Drinking Purposes as the water is pure.</font></li>
    </ul>
<li><font color="red" size="10" font-family="Comic Sans MS" >Value Between 89 and 94</font></li>
    <ul>
        <li><font color="white" size="8" font-family="Comic Sans MS" >Minor Purification or Treatment of Water is needed.</font></li>
        <li><font color="white" size="8" font-family="Comic Sans MS" >It can be used for Drinking or Cooking Purposes</font></li>
    </ul>
<li><font color="red" size="10" font-family="Comic Sans MS" >Value Between 80 and 88</font></li>
    <ul>
        <li><font color="white" size="8" font-family="Comic Sans MS" >Conventional Purification or Treatment of Water is needed.</font></li>
        <li><font color="white" size="8" font-family="Comic Sans MS" >It can be used for only Cooking Purposes.</font></li>
    </ul>
<li><font color="red" size="10" font-family="Comic Sans MS" ></font>Value Between 65 and 79</li>
    <ul>
        <li><font color="white" size="8" font-family="Comic Sans MS" >Extensive Purification or Treatment of Water is needed.</font></li>
        <li><font color="white" size="8" font-family="Comic Sans MS" >It can be used for Drinking and Cooking Purposes only if the various impurities are removed.</font></li>
    </ul>
<li><font color="red" size="10" font-family="Comic Sans MS" >Value Between 45 and 64</font></li>
    <ul>
        <li><font color="white" size="8" font-family="Comic Sans MS" >Doubtful in purifying and treating the water so as to get Pure Water.</font></li>
        <li><font color="white" size="8" font-family="Comic Sans MS" >It can be used for Irrigation purposes.</font></li>
    </ul>
<li><font color="red" size="10" font-family="Comic Sans MS" >Value Less Than 44</font></li>
    <ul>
        <li><font color="white" size="8" font-family="Comic Sans MS" >The Water is not fit for to be used for Drinking.</font></li>
        <li><font color="white" size="8" font-family="Comic Sans MS" >It cannot be used for Drinking and Household Purposes and can be used for Gardening and Irrigational Purposes.</font></li>
    </ul>
</ol>
</body>
</html>
```

bod.html:

```
<html>
<head>
<title>BOD Importance</title>
<style>
body
{
background-image:url('https://images.pexels.com/photos/355808/pexels-photo-355808.jpeg?cs=srgb&dl=pexels-pixabay-355808.jpg&fm=jpg');
}
</style>
</head>
<body>
<h1> <font color="red" size="10" font-family="Comic Sans MS" >BOD Value And Its Impact on Water Quality</font></h1>
<p>
<font color="white" size="8" font-family="Comic Sans MS" >Biological Oxygen Demand (BOD) determines the impact of decaying matter on species in a specific ecosystem.</font><br/>
<font color="white" size="8" font-family="Comic Sans MS" >Sampling  for BOD tests how much oxygen is needed by bacteria to break down the organic matter.</font><br/>
<ul>
<li><font color="white" size="8" font-family="Comic Sans MS" >Higher BOD indicates more oxygen is required and signifies lower water quality.</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Low BOD means less oxygen is removed from water and is generally purer.</font></li>
</ul>
<h1><font color="red" size="10" font-family="Comic Sans MS" >Affects of High Levels of BOD In Water</font></h1>
<ul>
<li><font color="white" size="8" font-family="Comic Sans MS" >Causes Carcinogenic.</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Can have unpleasant odour.</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Causes Environmental Health Impacts.</font></li>
</ul>
</body>
</html>
```

col.html:

```
<html>
<head>
```

```
<title>Coliform Importance</title>
<style>
body
{
background-image:url('https://images.pexels.com/photos/355808/pexels-photo-355808.jpeg?cs=srgb&dl=pexels-pixabay-355808.jpg&fm=jpg');
}
</style>
</head>
<body>
<h1> <font color="red" size="10" font-family="Comic Sans MS" >Coliform Value And Its Impact on Water Quality</font></h1>
<p>
<font color="white" size="8" font-family="Comic Sans MS" >Coliform Bacteria in water indicates the disease causing organisms.</font><br/>
<font color="white" size="8" font-family="Comic Sans MS" >Types of Coliforms are Total Coliform, Fecal Coliform and E.coli</font><br/>
<ul>
<li><font color="white" size="8" font-family="Comic Sans MS" >More the amount of Coliform, more the potential contamination sources in the water sample.</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Less the amount of Coliform, more purer the water sample is.</font></li>
</ul>
<h1><font color="red" size="10" font-family="Comic Sans MS" >Affects of High Levels of Coliform In Water</font></h1>
<ul>
<li><font color="white" size="8" font-family="Comic Sans MS" >Upsets Stomach</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Causes Vomitting</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Causes Fever.</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Causes Diarrhoea.</font></li>
</ul>
</body>
</html>
```

cond.html:

```
<html>
<head>
<title>Conductivity Importance</title>
<style>
body
{
```

```
background-image:url('https://images.pexels.com/photos/355808/pexels-photo-355808.jpeg?cs=srgb&dl=pexels-pixabay-355808.jpg&fm=jpg');
}
</style>
</head>
<body>
<h1> <font color="red" size="10" font-family="Comic Sans MS" >Conductivity Value And Its Impact on Water Quality</font></h1>
<p>
<font color="white" size="8" font-family="Comic Sans MS" >Conducitvity measures the water's ability to conduct electricity due to presence or absence of certain ions.</font><br/>
<ul>
<li><font color="white" size="8" font-family="Comic Sans MS" >Pure Water conducts electricity poorly and can be used for drinking.</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Water that has certain chemicals or elements in it, and at varying amount including sodium, magnesium, calcium and chloride is a better conductor of electricity.</font></li>
</ul>
<h1><font color="red" size="10" font-family="Comic Sans MS" >Affects of High Levels of Conductivity In Water</font></h1>
<ul>
<li><font color="white" size="8" font-family="Comic Sans MS" >Can Taste Salty</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Can also have a Mineral Taste</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Can cause Hard Water.</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Scales Build-Up</font></li>
</ul>
</body>
</html>
```

do.html:

```
<html>
<head>
<title>Dissolved Oxygen Importance</title>
<style>
body
{
background-image:url('https://images.pexels.com/photos/355808/pexels-photo-355808.jpeg?cs=srgb&dl=pexels-pixabay-355808.jpg&fm=jpg');
}
</style>
```

```
</head>
<body>
<h1> <font color="red" size="10" font-family="Comic Sans MS" >Dissolved Oxygen Value And Its Impact on Water Quality</font></h1>
<p>
<font color="white" size="8" font-family="Comic Sans MS" >Dissolved Oxygen (DO) is essential for the survival of fish and other aquatic organisms.</font><br/>
<font color="white" size="8" font-family="Comic Sans MS" >Oxygen is also introduced as a byproduct of aquatic plant photosynthesis.</font><br/>
<ul>
<li><font color="white" size="8" font-family="Comic Sans MS" >The Colder water is, the more oxygen it can hold.</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >The Warmer water is, the less oxygen can be dissolved in it.</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >When oxygen levels are reduced there are chances of increase in bacteria or algae in water which causes adverse health effects.</font></li>
</ul>
<h1><font color="red" size="10" font-family="Comic Sans MS" >Affects of High Levels of DO In Water</font></h1>
<ul>
<li><font color="white" size="8" font-family="Comic Sans MS" >Causes corrosion of Steel and Iron.</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Algae Growth Increases.</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Aquatic organisms become stressed, suffocate and will die.</font></li>
</ul>
</body>
</html>
```

index.html:

```
<html>
<title>water quality prediction</title>
<style>
*{
    margin:0;
    padding:0;
    text-decoration:none;
    font-family:montserrat;
}
.pd{
padding-bottom:100%;}
body
```

```
{
background-image:url('https://tenor.com/view/fallwater-gif-8021595.gif');
background-position: center;
font-family:sans-serif;
background-size:cover;
margin-top:40px;
}


.main{
    background-color:rgb(0,0,0,0.6);
    width:800px;
    height:500px;
    margin:auto;
    position:center;
    border-top-left-radius:100px;
    border-bottom-right-radius:100px;

}
.main input[type="text"],.main input[type="text"],.main
input[type="text"],.main input[type="text"],.main input[type="text"],.main
input[type="text"]{
    border:0;
    background:none;
    display:block;
    margin:20px auto;
    text-align:center;
    border:2px solid #3498db;
    padding:10px 3px;
    width:200px;
    outline:none;
    color:white;
    border-radius:24px;
    transition:0.25s;

}
.main input[type="text"]:focus,.main input[type="text"]:focus,.main
input[type="text"]:focus,.main input[type="text"]:focus,.main
input[type="text"]:focus,.main input[type="text"]:focus{
    width:280px;
    border-color:#8e44ad;
}
.logbtn{
    display:block;
    width:35%;
    height:50px;
    border:none;
    border-radius:24px;
    background:linear-gradient(120deg,#3498db,#8e44ad,#3498db);
```

```
    background-size:200%;
    color:#fff;
    outline:none;
    cursor:pointer;
    transition:.5s;
}
.logbtn:hover{
    background-position:right;
}


.predict{
  color:black;
  text-align:center;
}
</style>



<body>
<center><img
src="https://i.pinimg.com/236x/4b/bb/7d/4bbb7dae1470c8cdc3821b7c5b2f10fb.jpg"
height="100"><b class="pd"><font color="white" size="15" font-family="Comic
Sans MS" >Water Quality Prediction</font></b></center>
    <a href="/about" target="_blank"><font color="white" size="12" font-
family="Comic Sans MS" >Why To Find Water Quality</font></a>
    <form action="y_predict" class="main" method="post">
    <br>
    <center><input type="text" name="Station" placeholder="Station"
required="required" />
        <input type="text" name="Dissolved Oxygen" placeholder="Dissolved
Oxygen" required="required" />
        <input type="text" name="PH" placeholder="PH" required="required" />
        <input type="text" name="Carbon Monoxide" placeholder="Carbon
Monoxide" required="required" />
        <input type="text" name="Biochemical Oxygen Demand"
placeholder="Biochemical oxygen Demand" required="required" />
        <input type="text" name="Sodium" placeholder="Sodium"
required="required" />
        <input type="text" name="Technetium" placeholder="Technetium"
required="required" />
        <button type="submit" class="logbtn">Predict</button></center>

    </form>



    <br>
    <br>
     <h1 class=predict> {{ prediction_text }}</h1>
```

```
</body>
</html>
```

nit.html:

```
<html>
<head>
<title>Nitrate Importance</title>
<style>
body
{
background-image:url('https://images.pexels.com/photos/355808/pexels-photo-355808.jpeg?cs=srgb&dl=pexels-pixabay-355808.jpg&fm=jpg');
}
</style>
</head>
<body>
<h1> <font color="red" size="10" font-family="Comic Sans MS" >Nitrate Value And Its Impact on Water Quality</font></h1>
<p>
<font color="white" size="8" font-family="Comic Sans MS" >Nitrate occurs naturally and at safe and healthy levels in some foods.</font><br/>
<font color="white" size="8" font-family="Comic Sans MS" >Other sources of nitrate includes Discharge from Sewage systems and animal wastes,etc.</font><br/>
<ul>
<li><font color="white" size="8" font-family="Comic Sans MS" >Water Level with less than 3 mg/L can be used for drinking.</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Health concern occurs with Nitrate levels over 10 mg/L.</font></li>
</ul>
<h1><font color="red" size="10" font-family="Comic Sans MS" >Affects of High Levels of Nitrate In Water</font></h1>
<ul>
<li><font color="white" size="8" font-family="Comic Sans MS" >Blue Baby Syndrome</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Decreased Blood Pressure</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Increased Heart Rate</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Headaches, Stomach Cramps and Vomitting </font></li>
</ul>
</body>
</html>
```

ph.html:

```
<html>
<head>
<title>pH Importance</title>
<style>
body
{
background-image:url('https://images.pexels.com/photos/355808/pexels-photo-355808.jpeg?cs=srgb&dl=pexels-pixabay-355808.jpg&fm=jpg');
}
</style>
</head>
<body>
<h1> <font color="red" size="10" font-family="Comic Sans MS" >pH Value And Its Impact on Water Quality</font></h1>
<p>
<font color="white" size="8" font-family="Comic Sans MS" >pH is a measure of how acidic or basic a water sample is.</font><br/>
<font color="white" size="8" font-family="Comic Sans MS" >The range goes from 0 to 14.</font><br/>
<ul>
<li><font color="white" size="8" font-family="Comic Sans MS" >pH level with less than 7 is acidic.</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >pH level with greater than 7 is basic.</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >pH value equal to 7 is neutral.</font></li>
</ul>
<h1><font color="red" size="10" font-family="Comic Sans MS" >Affects of Various Levels of pH In Water</font></h1>
<ul>
<li><font color="white" size="8" font-family="Comic Sans MS" >Causes Cancer.</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Causes Stroke, Kidney Diseases.</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Increased Memory Problems.</font></li>
<li><font color="white" size="8" font-family="Comic Sans MS" >Causes High Blood Pressure (BP).</font></li>
</ul>
</body>
</html>
```

predict.html:

```
<html>

<style>
div.header{
  top: 0;
  position: fixed;
  padding-left: 400px;}
div.header1{
  top:20;
  position: fixed;
  padding-left: 490px;
}

*{
        margin:0;
    padding:0;
    border:0;
    outline:0;
    text-decoration:none;
    font-family:montserrat;
}

body
{
background-image:url('https://images.squarespace-
cdn.com/content/v1/55fbb126e4b0518e8762e7c0/1452671039063-
DN1CGUUBHZ7KW8A96SNM/ke17ZwdGBToddI8pDm48kLk6AiHk3VCjVyx0bXHY-wpZw-
zPPgdn4jUwVcJE1ZvWQUxwkmyExglNqGp0IvTJZUJFbgE-
7XRK3dMEBRBhUpxFBdw5PXt5hvfhStZ7cvn0-
MX5Omk9VkquqZzsoZn3ZMqf1OgXybDooXHev_mqy80/tumblr_nbvmjgI5Eb1txly86o1_500.gif?
format=2500w');
background-position: center;
font-family:sans-serif;
background-size:cover;
margin-top:40px;
}


.main{
    background-color:rgb(0,0,0,0.6);

    width:800px;
    height:590px;
    margin:auto;
    position:center;
    border-top-left-radius:100px;
    border-bottom-right-radius:100px;
```

```
}
.main input[type="text"],.main input[type="text"],.main
input[type="text"],.main input[type="text"],.main input[type="text"],.main
input[type="text"],.main input[type="text"]{
    border:0;
    background:none;
    display:block;
    margin:20px auto;
    text-align:center;
    border:2px solid #3498db;
    padding:10px 3px;
    width:200px;
    outline:none;
    color:white;
    border-radius:24px;
    transition:0.25s;

}
.bor{
border:0;
    background:none;
    display:block;
    margin:20px auto;
    text-align:center;
    border:2px solid #8e44ad;
    padding:10px 3px;
    width:500px;
    outline:none;
    color:white;
    transition:0.25s;}
.main input[type="text"]:focus,.main input[type="text"]:focus,.main
input[type="text"]:focus,.main input[type="text"]:focus,.main
input[type="text"]:focus,.main input[type="text"]:focus,.main
input[type="text"]:focus{
    width:280px;
    border-color:#8e44ad;
}
.logbtn{
    display:block;
    width:35%;
    height:50px;
    border:none;
    border-radius:24px;
    background:linear-gradient(120deg,#3498db,#8e44ad,#3498db,#8e44ad);
    background-size:200%;
    color:#fff;
    outline:none;
```

```
    cursor:pointer;
    transition:.5s;
    font-size:25;
}
.logbtn:hover{
    background-position:right;
}

input::placeholder{
    color:#F5FFFA;
}
.bottom-text{
    margin-top:60px;
    text-align:center;
    font-size:13px;

}


</style>
<body>
    <center><div class="header"><img src="https://encrypted-
tbn0.gstatic.com/images?q=tbn:ANd9GcTYX9t6QQZ-NH5gqH7tiwlyK-Ni3krQ0zckj-
yjrO9X1l6h6CyJysWkxUxsH-tWDJhxwwE&usqp=CAU" width="100"
height="100"></div></center>
    <center><div class="header1"><font color="#FF0000" font-family="Fascinate
Inline" size=7 ><b>Urban Water Quality Prediction</b></font></div></center>
    <br><br><br>
    <a href="/about" target="_blank"><font color="white" size="12" font-
family="Comic Sans MS" >Why To Find Water Quality</font></a>
<br><br><br><br><br>
    <form class="main" action="/login" method="post">
        <br>
        <center><input type="text" name="year" placeholder="Enter Year"/>
        <input type="text" name="do" placeholder="Enter D.O "/>
        <input type="text" name="ph" placeholder="Enter PH"/>
        <input type="text" name="co" placeholder="Enter Conductivity"/>
        <input type="text" name="bod" placeholder="Enter B.O.D"/>
        <input type="text" name="na" placeholder="Enter Nitratenen"/>
        <input type="text" name="tc" placeholder="Enter Total Coliform"/>
        <input type="submit" class="logbtn" value="Predict"></center>
        <div class="bor"><center><b><font color="white"
size=5>{{showcase}}</font></b></center></div>
    </form>


</body>

</html>
```

app.py:

```
import numpy as np
from flask import Flask,render_template,request
import pickle


app = Flask(__name__)
model = pickle.load(open('wqi.pkl','rb'))
@app.route('/about')
def about():
    return render_template("about.html")
@app.route('/')
def home() :
    return render_template("predict.html")
@app.route('/bod')
def bod():
    return render_template("bod.html")
@app.route('/col')
def col():
    return render_template("col.html")
@app.route('/do')
def do():
    return render_template("do.html")
@app.route('/nit')
def nit():
    return render_template("nit.html")
@app.route('/ph')
def ph():
    return render_template("ph.html")
@app.route('/cond')
def cond():
    return render_template("cond.html")
@app.route('/analysis')
def analysis():
    return render_template("analysis.html")
@app.route('/login',methods = ['POST'])
def login() :
    year = request.form["year"]
    do = request.form["do"]
    ph = request.form["ph"]
    co = request.form["co"]
    bod = request.form["bod"]
    na = request.form["na"]
    tc = request.form["tc"]
    total =
[[int(year),float(do),float(ph),float(co),float(bod),float(na),float(tc)]]
    y_pred = model.predict(total)
    print(y_pred)
```

```
    y_pred =y_pred[[0]]
    if(y_pred >= 95 and y_pred <= 100) :
        return render_template("predict.html",showcase = 'Excellent,The
predicted value is '+ str(y_pred)+' No Purification or Treatment of Water is
needed.')
    elif(y_pred >= 89 and y_pred <= 94) :
        return render_template("predict.html",showcase = 'Very good,The
predicted value is '+str(y_pred)+' Minor Purification or Treatment of Water is
needed.')
    elif(y_pred >= 80 and y_pred <= 88) :
        return render_template("predict.html",showcase = 'Good,The predicted
value is'+str(y_pred)+' Conventional Purification or Treatment of Water is
needed.')
    elif(y_pred >= 65 and y_pred <= 79) :
        return render_template("predict.html",showcase = 'Fair,The predicted
value is '+str(y_pred)+' Extensive Purification or Treatment of Water is
needed.')
    elif(y_pred >= 45 and y_pred <= 64) :
        return render_template("predict.html",showcase = 'Marginal,The
predicted value is '+str(y_pred)+' Doubtful in purifying and treating the
water so as to get Pure Water.')
    else :
        return render_template("predict.html",showcase = 'Poor,The predicted
value is '+str(y_pred)+' The Water is not fit for to be used for Drinking.')


if __name__ == '__main__' :
```

GITHUB AND PROJECT DEMO LINK:

GITHUB LINK: https://github.com/IBM-EPBL/IBM-Project-18343-1659683489

PROJECT DEMO LINK: https://youtu.be/aHdQDpY7A-g