PROJECT REPORT

CHENNAI INSTITUTE OF TECHNOLOGY

PROJECT TOPIC

Real Time Air Quality Monitoring & Weather Forecasting System

Abstract:

The Real-time Air Quality Monitoring and Weather Forecasting System is a novel project that aims to develop a system for real-time monitoring and forecasting of air quality and weather conditions. The system uses various sensors to monitor air quality parameters such as particulate matter (PM2.5 and PM10), ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), and sulfur dioxide (SO2), as well as weather parameters such as temperature, humidity, pressure and wind speed.

The project includes the development of a web-based platform that displays real-time air quality and weather data from various monitoring stations. The platform will also provide users with historical data, air quality indices, and weather forecasts. The system will also have an alert system that notifies users of critical air quality conditions, such as high pollution levels and adverse weather conditions.

The proposed system will be useful for various stakeholders, including government agencies, environmental organizations, and the general public. The system will provide valuable insights into air quality and weather conditions in real-time, enabling users to take necessary precautions to protect their health and well-being.

The project will involve the development of hardware and software components, including sensor networks, data acquisition and processing systems, and web-based applications. The project team will also conduct extensive field testing to validate the accuracy and reliability of the system.

In conclusion, the Real-time Air Quality Monitoring and Weather Forecasting System is an essential project that aims to develop a system for real-time monitoring and forecasting of air quality and weather conditions. The system will provide valuable insights into air quality and weather conditions, enabling users to take necessary precautions to protect their health and well-being.

Team Name: Team Perceptron

College: Chennai Institute of Technology, Kundrathur, Chennai

Name	Dept	Email Address	Phone No
Tharun Balaji R	CSE	tharunbalajir.cse2021@citchennai.net	8248052472
Surya Prakash V	CSE (CyberSec)	suryaprakashv.cse2022@citchennai.net	9884671340
Nadeem M	CSE (CyberSec)	nadeemm.cse2022@citchennai.net	9176766442
Harshithaa RG	IT	harshithaarg.it2022@citchennai.net	6379059924

PROJECT PRESENTATION

HACKATHON PROJECT ABSTRACT

Domain: Machine Learning & Environment

PROJECT TITLE

Real Time Air Quality Monitoring & Weather Forecasting System

TEAM PERCEPTRON

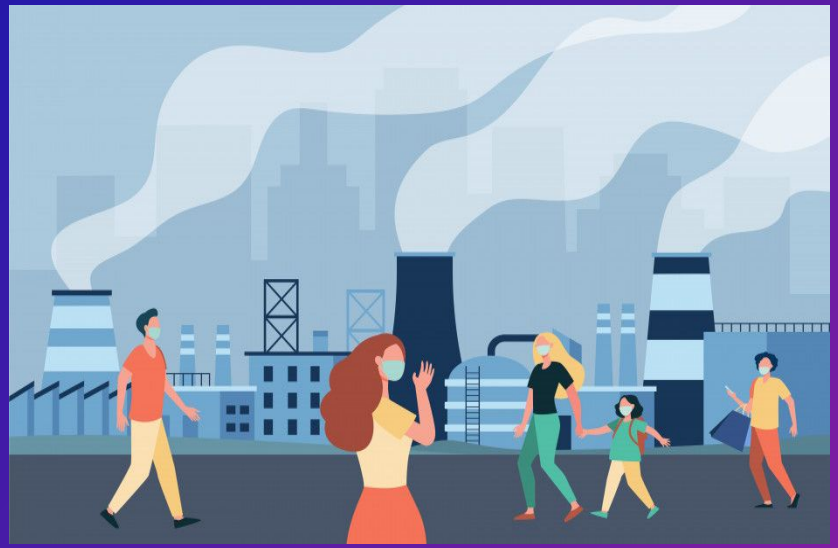
1) Tharun Balaji R – II yr – CIT Chennai (BE CSE)
2) Surya Prakash – I Yr – CIT Chennai (BTech Cybersec)
3) Nadeem – I Yr – CIT Chennai (BTech Cybersec)
4) Harshitha – I Yr – CIT Chennai (BTech IT)

TABLE OF CONTENTS

PROJECT DESCRIPTION

Air pollution represents a serious environmental problem. Each year, millions premature deaths are attributed to air pollution, with huge economic consequences . Furthermore, air pollution is detrimental for ecosystems, damages property, impacts visibility and haze, and threatens food and water security.

It will provides real-time notifications about prevailing and expected weather conditions which helps governments and local administrations prepare for natural disasters and save lives.

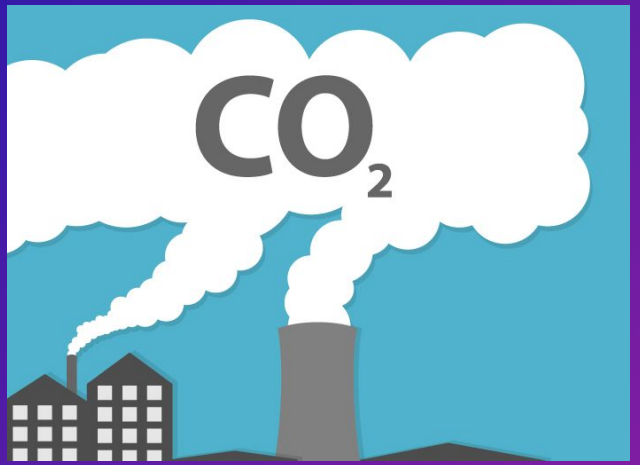


PROJECT BRIEFING

PROJECT BRIEFING

PHASE 1: Analysis of Air Quality measurements & Weather forecast data

- To begin with developing a deployable system, analysis of air quality data such as CO2 emission index, Particulate matter index, UV radiation, Industrial emissions has to be considered.
- By diving into these datasets, we have found that these factors play an important role in contaminated air and polluted environment.
- We analyze the details of these factors for each cities such as Chennai, Bangalore, Hyderabad, Mumbai, etc and designed an analysis chart based on the data to explore more about Air Quality measurement and the causes of environmental issues,



PROJECT BRIEFING

PHASE 2: Developing Machine Learning Model

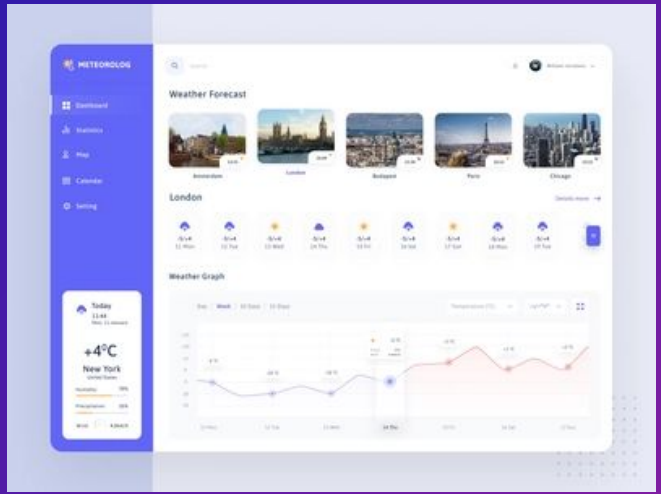
- Prediction of the air quality is of at most importance. So, building a Machine Learning model that can predict Real Time Air Quality & that are reliable and sufficiently accurate, can play an important role as part of an air quality management system.
- Using Support Vector Machine (SVM) or Random Forest Classifier, the contaminated gases from the dataset are segregated and analyzed.
- Using Data Visualization and Analyzing, the contaminated gases from the dataset are segregated and analyzed.

PROJECT BRIEFING

PHASE 3: Model Integration with UI

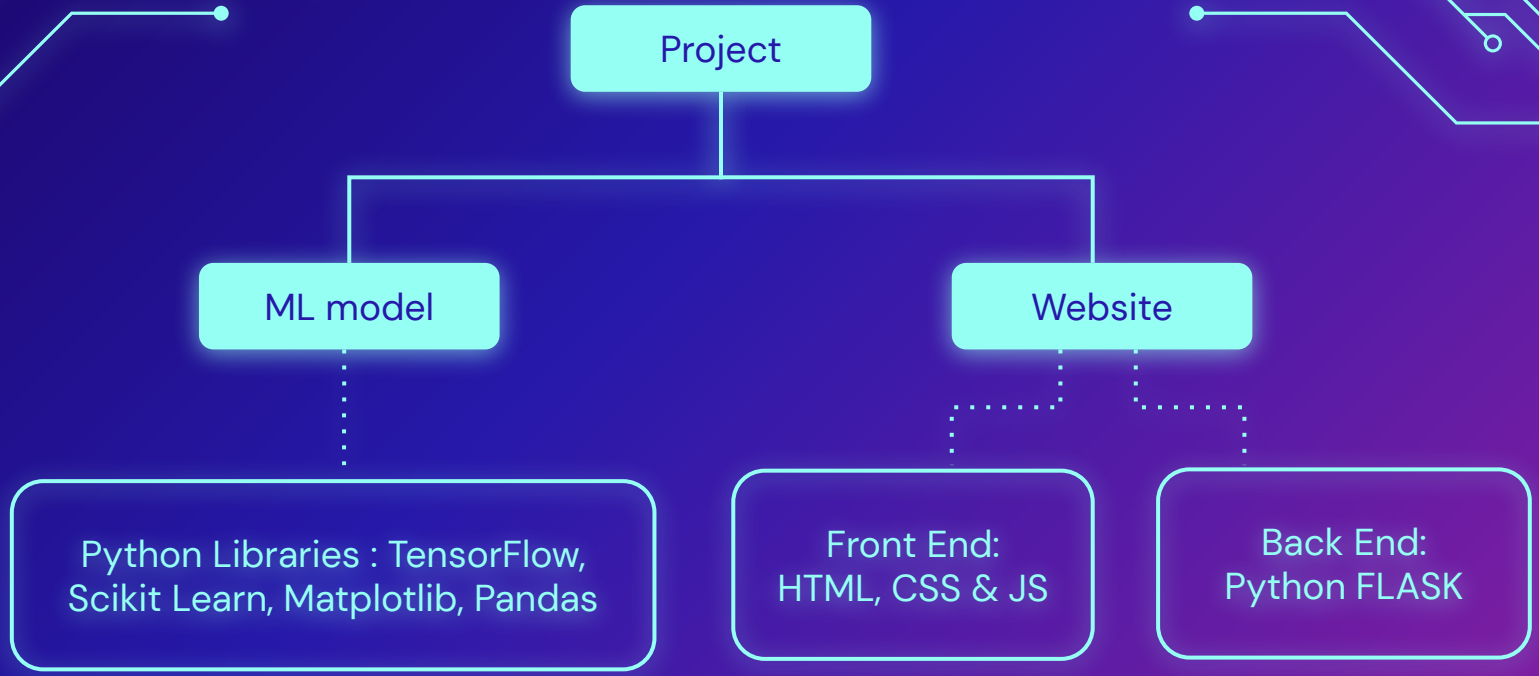
- With the help of WeatherAPI we can get immediate access to local weather conditions and upcoming forecast, It will Providing real-time notifications about prevailing and expected weather conditions which helps governments and local administrations prepare for natural disasters and save lives.

- After completing the model, a sophisticated UI model (Dynamic website)is used to integrate the ML model and Weather API to display the prediction for the user.



PROJECT TECH STACK

TECH STACK


Project
ML model
Website
Python Libraries : TensorFlow, Scikit Learn, Matplotlib, Pandas
Front End: HTML, CSS & JS
Back End: Python FLASK

PROJECT IMPACT

PROJECTS IMPACT

On a larger extent, The air quality (AQ) Forecast lets the public know expected air quality conditions for next 72 hours so that Government authorities can take action to manage the air quality and issue health advisories. With the help of WeatherAPI we can get immediate access to local weather conditions and upcoming forecast, It will Providing real-time notifications about prevailing and expected weather conditions, which helps governments and local administrations prepare for natural disasters and save lives.

THANK YOU

PROJECT INSIGHTS

Project Description:

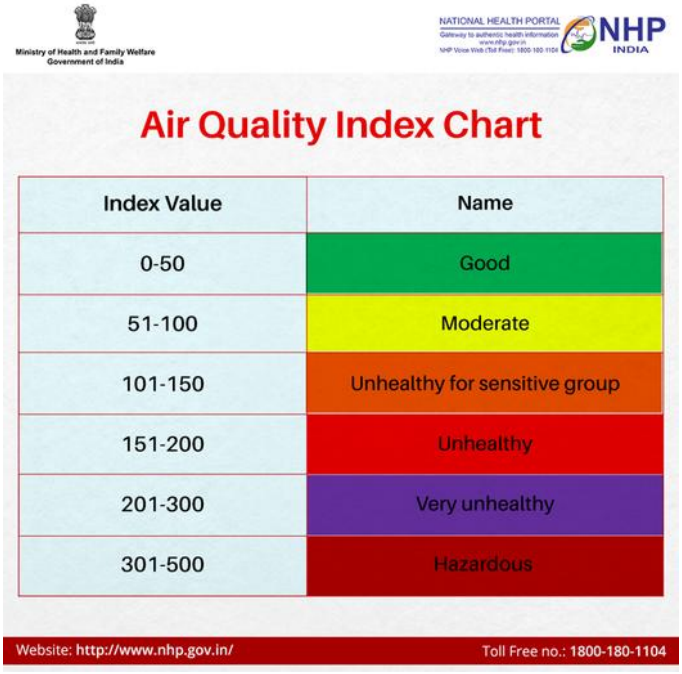
The Real-Time Air Quality Monitoring & Weather Forecasting System is a project that employs HTML, CSS for front-end, Python **Flask** for back-end, and **OpenWeather** API for fetching live weather forecasting data and air quality values for any city in Tamil Nadu. The project utilizes a machine learning model based on **Random Forest** Classifier, which has achieved an accuracy rate of **90%** and minimal error percentage.

The project directly forecasts weather data fetched from the API and provides daily, hourly, and monthly order weather forecasts. For air quality, the project fetches data about air pollutant values such as **CO, NO, NO2, O3, PM2.5, PM10**, etc. The project predicts the Air Quality Index (**AQI**) value and provides recommendations based on the prediction. The system is designed to provide valuable insights into air quality and weather conditions in real-time, enabling users to take necessary precautions to protect their health and well-being.

Project Tech Stack used:

Front End	Back End	Machine Learning
HTML5, CSS	Python Flask	Numpy, Pandas, Random Forest Classifier

AQI Index Chart:



Index Value	Name
0-50	Good
51-100	Moderate
101-150	Unhealthy for sensitive group
151-200	Unhealthy
201-300	Very unhealthy
301-500	Hazardous

Project Code:

GITHUB Repository Link - Click Here

Project Deploy:

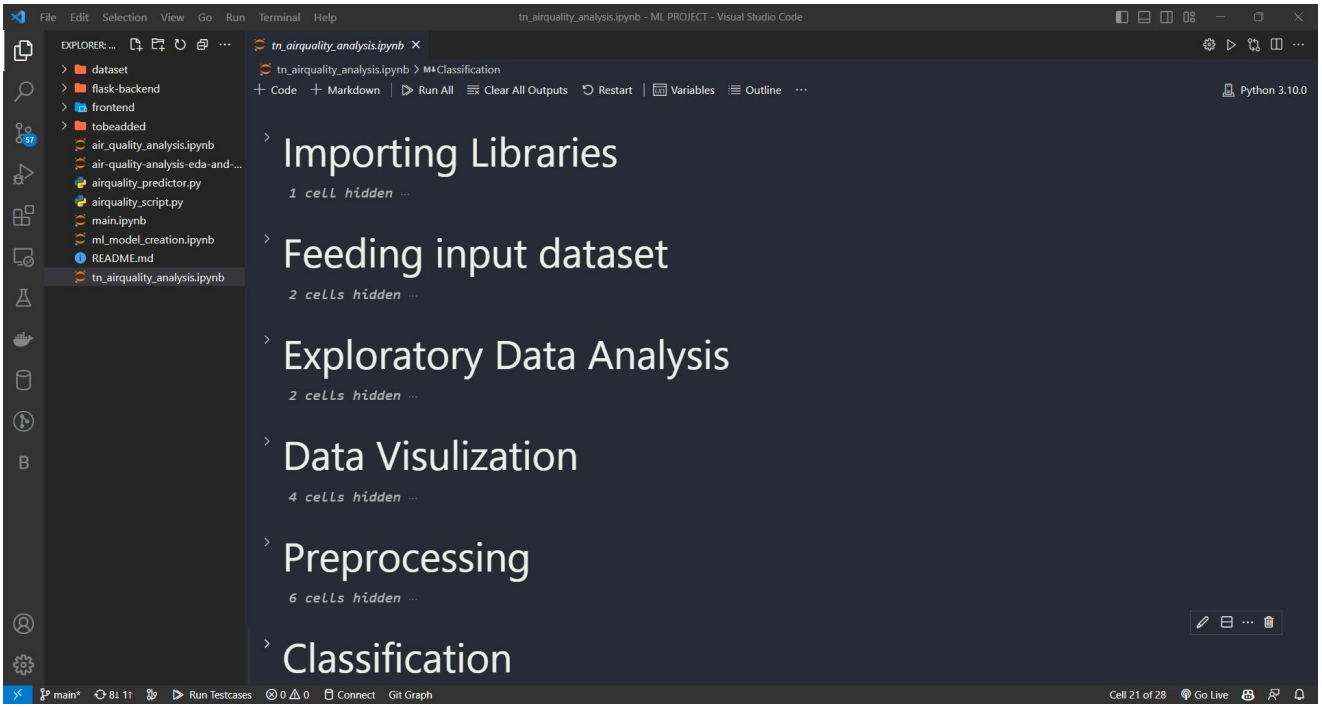
WEBSITE Name - AirCast
Link - https://aircast.onrender.com

API Links:

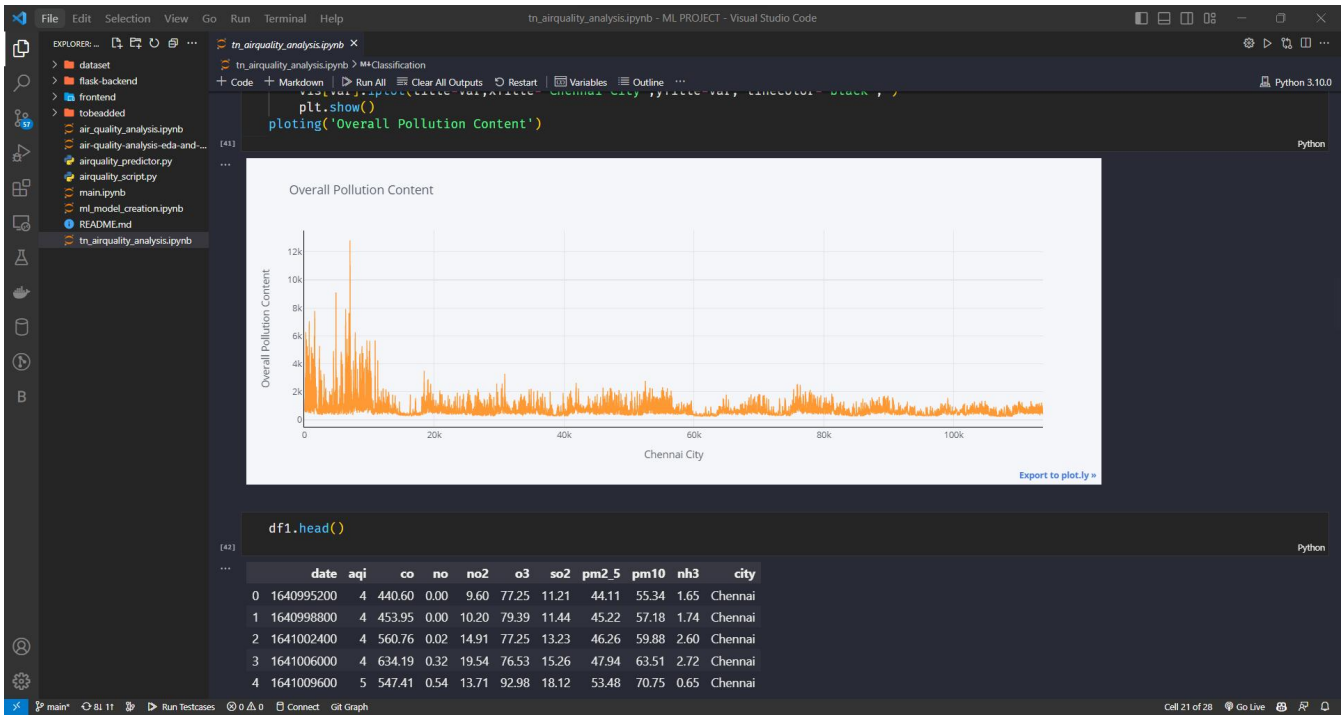
1) OpenWeather Weather Forecast API
2) OpenWeather Air Quality Data API
3) OpenWeather Geo Coding API

PROJECT SCREENSHOTS

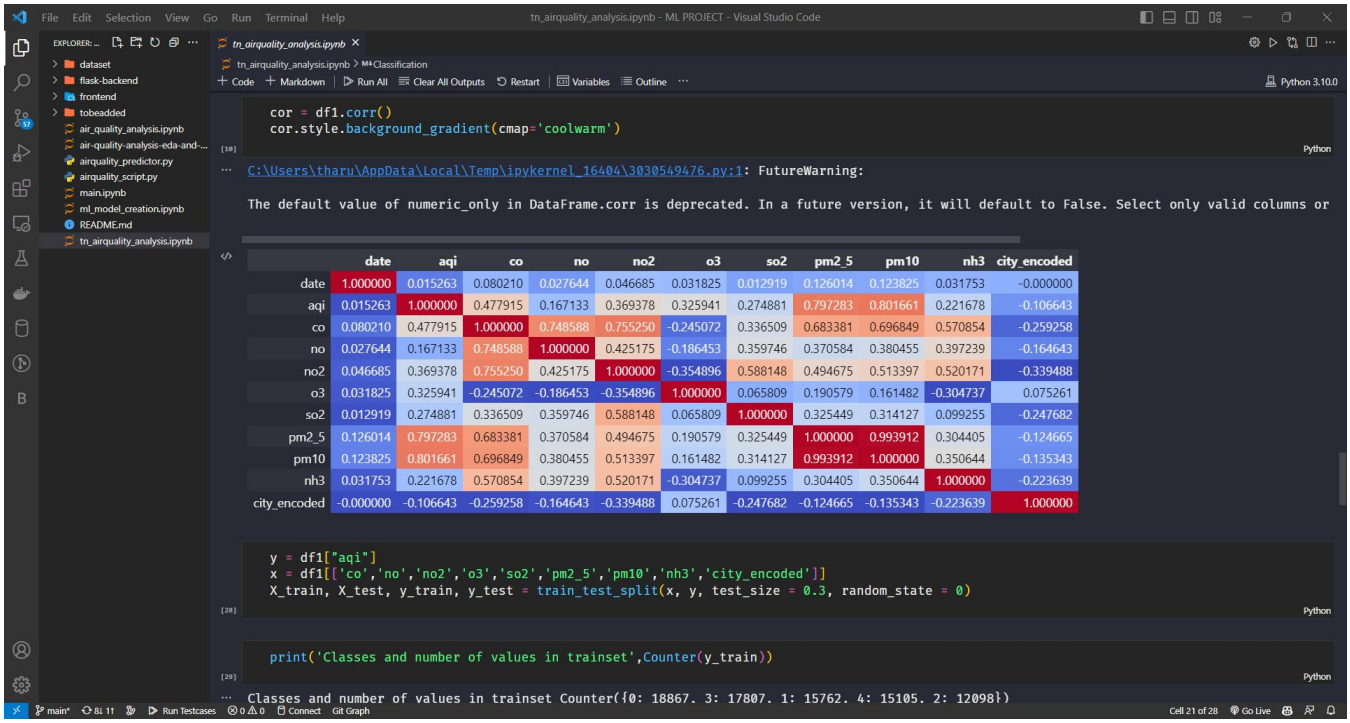
1) Project NoteBook Hierarchy Structure



2) Project Data Visualization



3) Project Data Preprocessing



```
cor = df1.corr()
cor.style.background_gradient(cmap='coolwarm')
```

```
C:\Users\tharu\AppData\Local\Temp\ipykernel_16404\3030549476.py:1: FutureWarning:

The default value of numeric_only in DataFrame.corr is deprecated. In a future version, it will default to False. Select only valid columns or
```

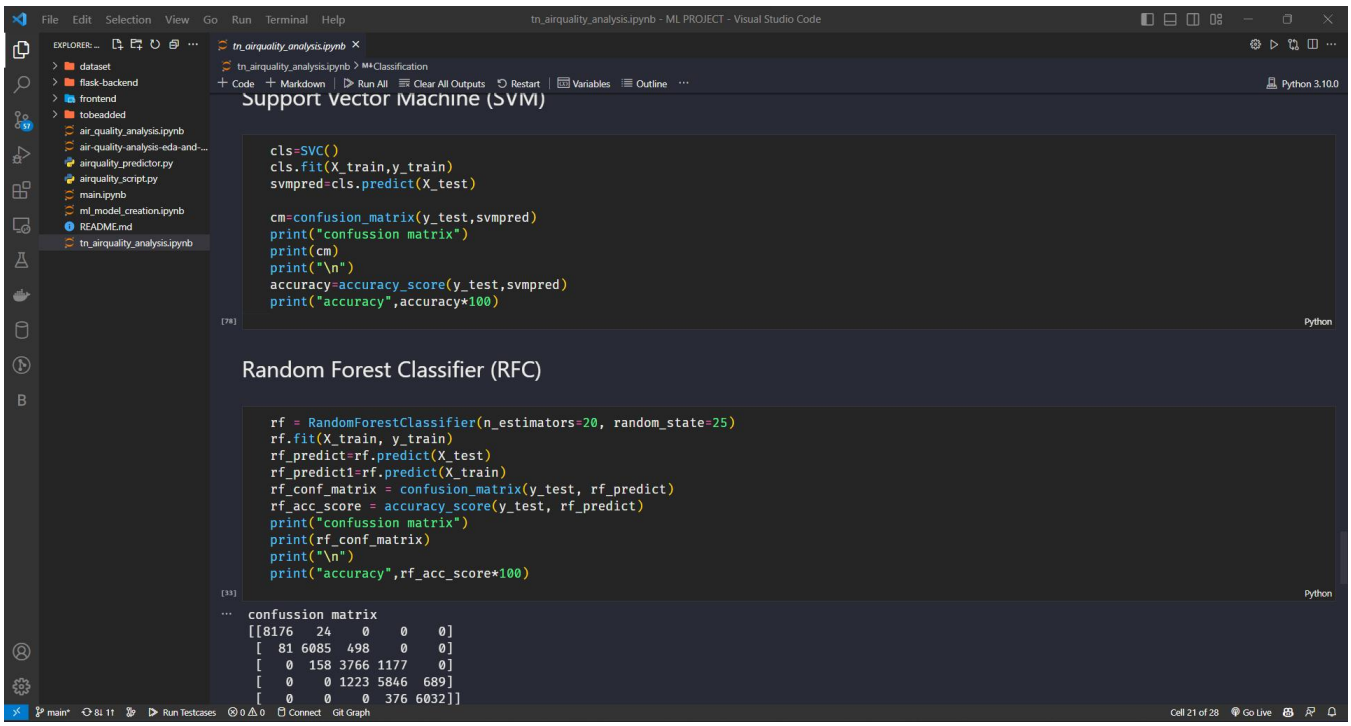
	date	aqi	co	no	no2	o3	so2	pm2_5	pm10	nh3	city_encoded
date	1.000000	0.015263	0.080210	0.027644	0.046685	0.031825	0.012919	0.126014	0.123825	0.031753	-0.000000
aqi	0.015263	1.000000	0.477915	0.167133	0.369378	0.325941	0.274881	0.797283	0.801661	0.221678	-0.106643
co	0.080210	0.477915	1.000000	0.748588	0.755250	-0.245072	0.336509	0.683381	0.696849	0.570854	-0.259258
no	0.027644	0.167133	0.748588	1.000000	0.425175	-0.186453	0.359746	0.370584	0.380455	0.397239	-0.164643
no2	0.046685	0.369378	0.755250	0.425175	1.000000	-0.354896	0.588148	0.494675	0.513397	0.520171	-0.339488
o3	0.031825	0.325941	-0.245072	-0.186453	-0.354896	1.000000	0.065809	0.190579	0.161482	-0.304737	0.075261
so2	0.012919	0.274881	0.336509	0.359746	0.588148	0.065809	1.000000	0.325449	0.314127	0.099255	-0.247682
pm2_5	0.126014	0.797283	0.683381	0.370584	0.494675	0.190579	0.325449	1.000000	0.993912	0.304405	-0.124665
pm10	0.123825	0.801661	0.696849	0.380455	0.513397	0.161482	0.314127	0.993912	1.000000	0.350644	-0.135343
nh3	0.031753	0.221678	0.570854	0.397239	0.520171	-0.304737	0.099255	0.304405	0.350644	1.000000	-0.223639
city_encoded	-0.000000	-0.106643	-0.259258	-0.164643	-0.339488	0.075261	-0.247682	-0.124665	-0.135343	-0.223639	1.000000

```
y = df1["aqi"]
x = df1[['co','no','no2','o3','so2','pm2_5','pm10','nh3','city_encoded']]
X_train, X_test, y_train, y_test = train_test_split(x, y, test_size = 0.3, random_state = 0)
```

```
print('Classes and number of values in trainset',Counter(y_train))
```

```
Classes and number of values in trainset Counter({0: 18867, 3: 17807, 1: 15762, 4: 15105, 2: 12098})
```

4) Project Model Training using SVM, RFC and XGBC Classifier (**RFC choosen**)



Support Vector Machine (SVM)

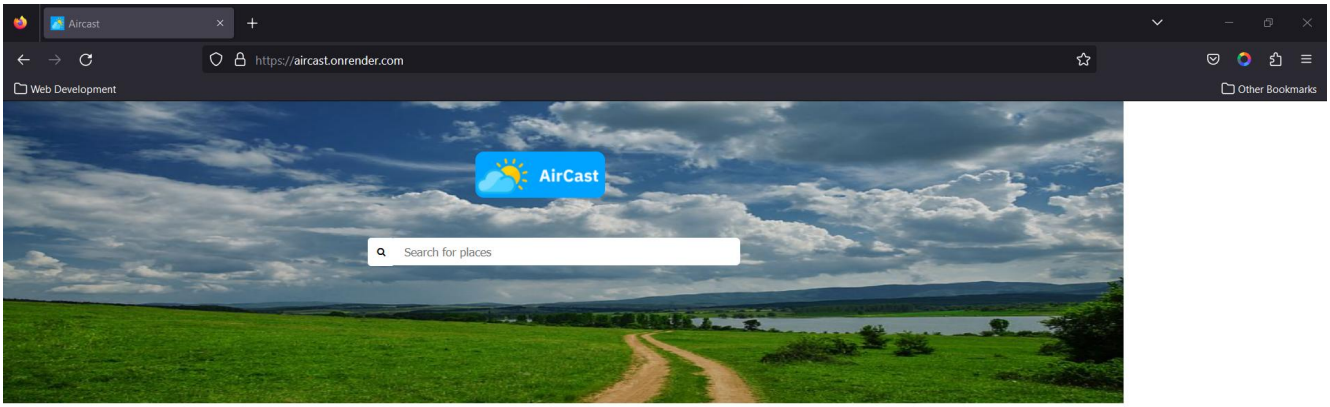
```
cls=SVC()
cls.fit(X_train,y_train)
svmpred=cls.predict(X_test)

cm=confusion_matrix(y_test,svmpred)
print("confussion matrix")
print(cm)
print("\n")
accuracy=accuracy_score(y_test,svmpred)
print("accuracy",accuracy*100)
```

Random Forest Classifier (RFC)

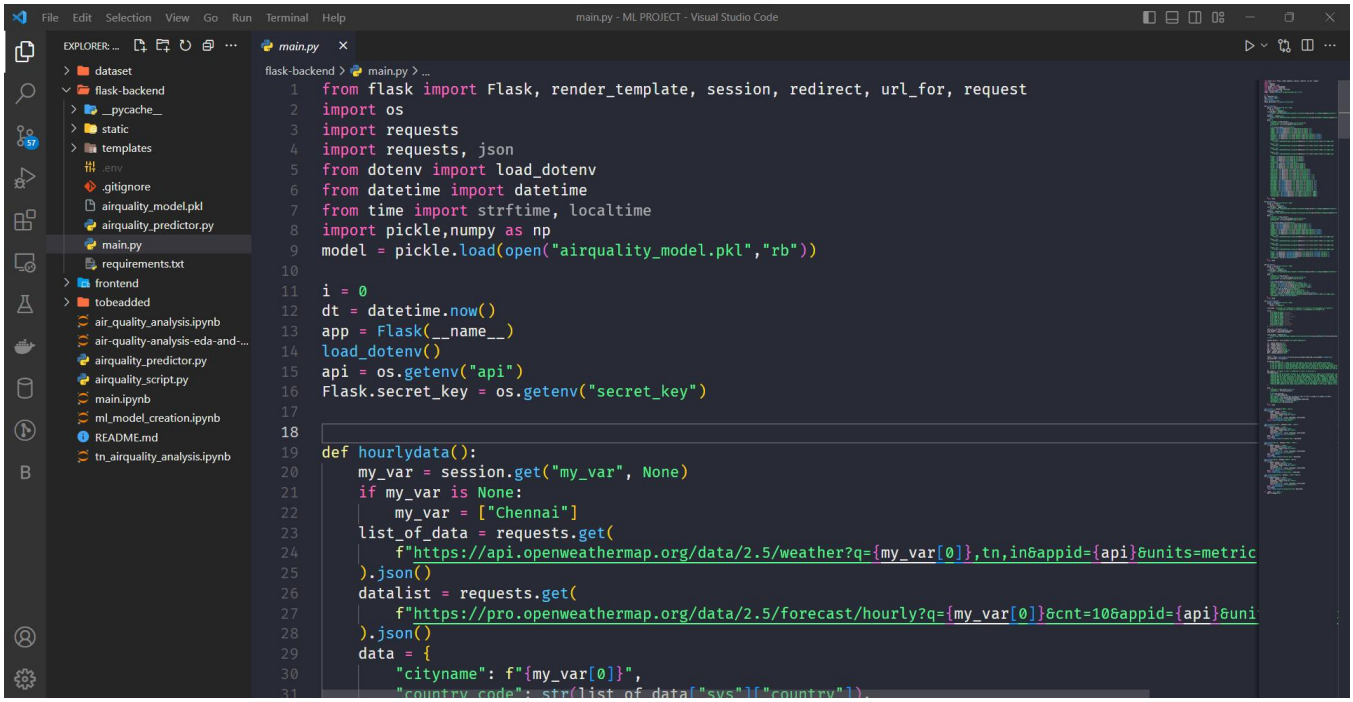
```
rf = RandomForestClassifier(n_estimators=20, random_state=25)
rf.fit(X_train, y_train)
rf_predict=rf.predict(X_test)
rf_predict1=rf.predict(X_train)
rf_conf_matrix = confusion_matrix(y_test, rf_predict)
rf_acc_score = accuracy_score(y_test, rf_predict)
print("confussion matrix")
print(rf_conf_matrix)
print("\n")
print("accuracy",rf_acc_score*100)
```

```
confussion matrix
[[8176   24    0    0    0]
 [  81 6085  498    0    0]
 [   0  158 3766 1177    0]
 [   0    0 1223 5846  689]
 [   0    0    0  376 6032]]
```

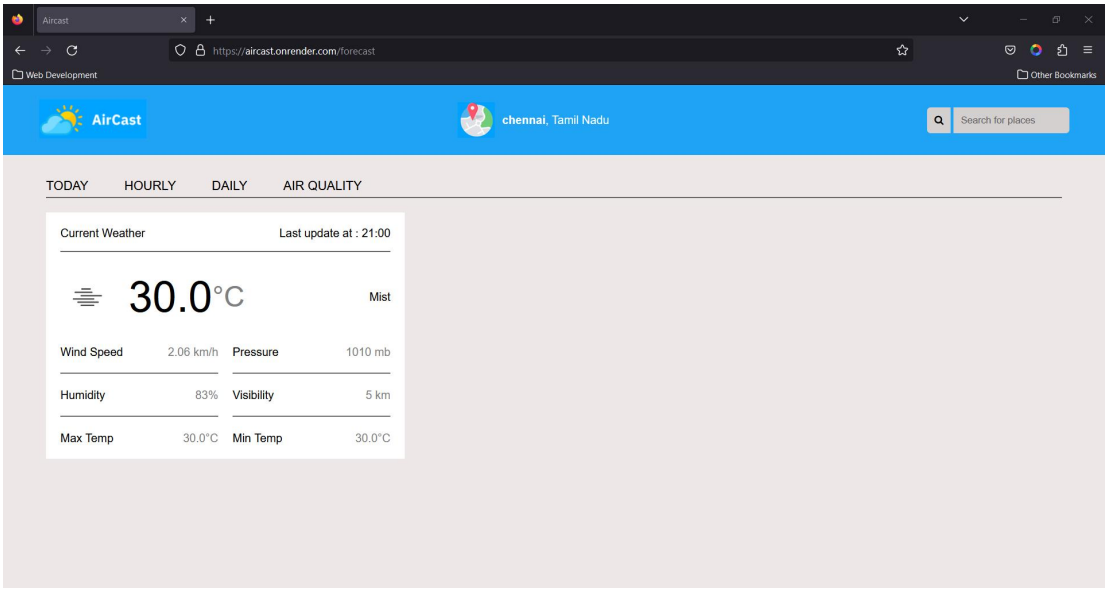
5) Developed UI part



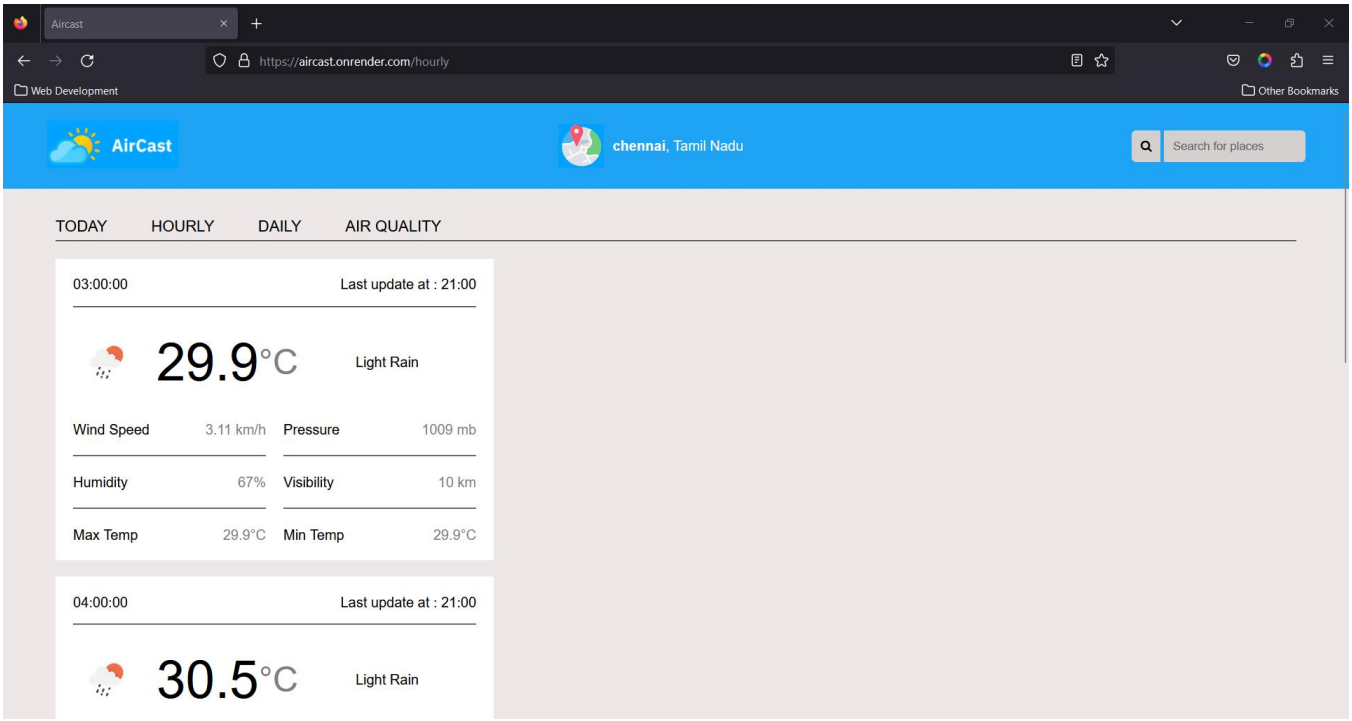
6) Integrated Backend with Flask



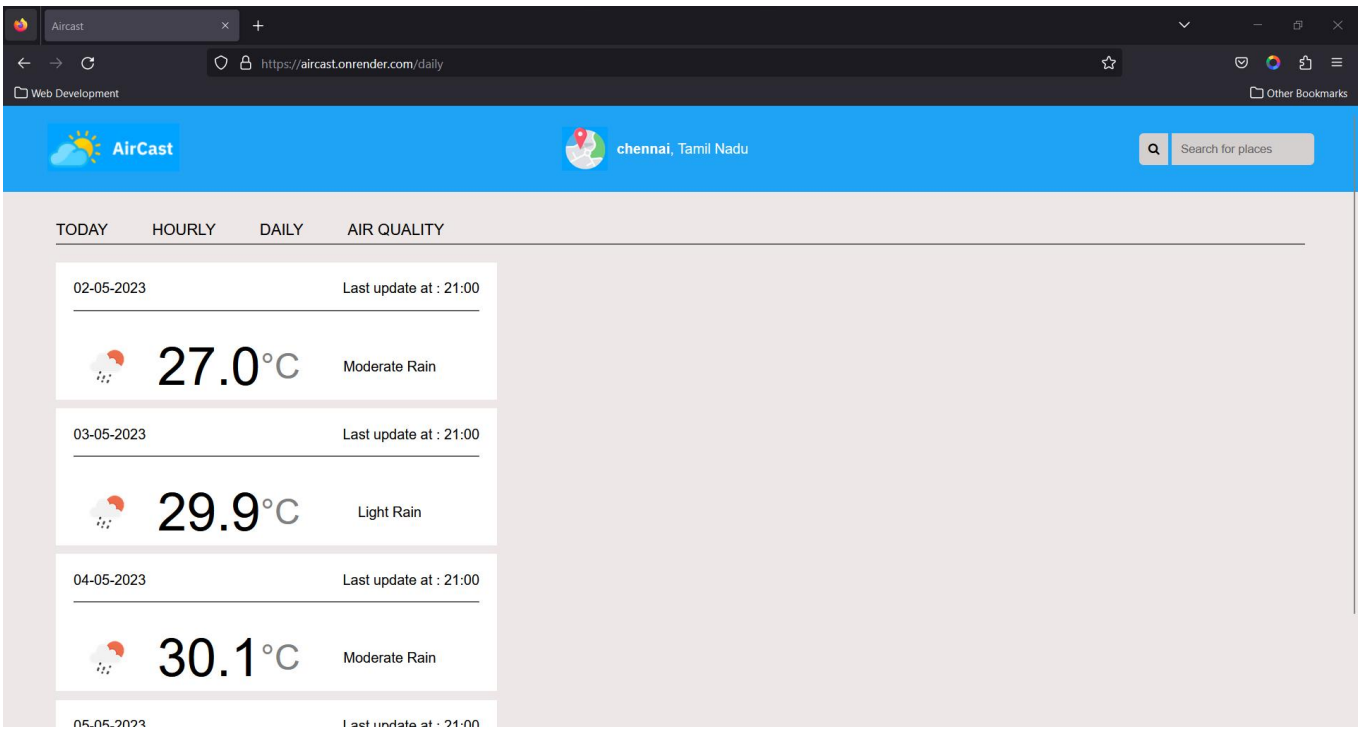
7) Fully functioning Dynamic Website (Weather Forecasting - Today)



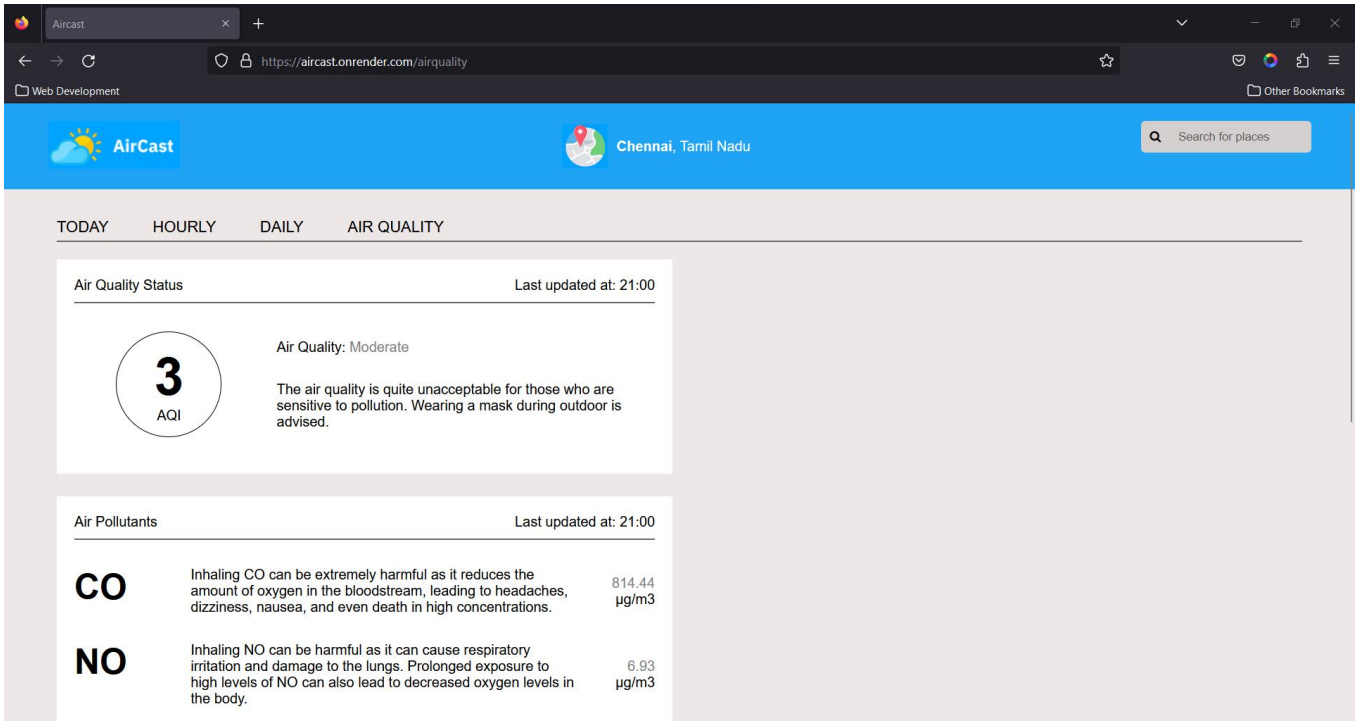
8) Fully functioning Dynamic Website (Weather Forecasting - Hourly)



9) Fully functioning Dynamic Website (Weather Forecasting - Daily)



10) Fully functioning Dynamic Website (Air Quality Prediction)



Project Keyvalues:

- The project forecasts live Weather forecasting using OpenWeather API, as mentioned in project Insights, for any location in Tamil Nadu state or any other Indian states. Since the location of the user input city will be converted to corresponding latitude and longitude of that city by Geo Coding OpenWeather API. The results are fetched by the website.

- The project contains a well trained ML model for Air Quality Prediction and currently it has been trained for Tamil Nadu's top 10 cities: Chennai, Coimbatore, Madurai, Tiruchirappalli, Salem, Tirunelveli, Erode, Thoothukudi, Dindigul with an accuracy of 90% and can predict Air Quality Index (AQI) precisely by using the values of air pollutants fetched from API (CO,NO,PM2.5,PM10,etc) as per Indian Government standard.

- The project is equipped with a Recommendation System and Weather related alerts which lets the public know expected air quality conditions for next 72 hours so that Government authorities can take action to manage the air quality and issue health advisories.

- The project can also be integrated with other applications such as Health & Fitness Tracker, Pollution Tracker, etc which enables users to take necessary precautions to protect their health, well-being and reschedule their work.

THANK YOU