PROJECT REPORT

ARTIFICAL INTELLIGENCE AND MACHINE LEARNING

APSCHE - Project Report: Artificial Intelligence & Machine Learning

Project Title: TrafficTelligence: Advanced Traffic Volume Estimation with Machine Learning

Internship Provider: APSCHE & SmartBridge

Team Members:

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1. INTRODUCTION

1.1 Project Overview

TrafficTelligence is an advanced system that uses machine learning algorithms to estimate and predict traffic volume with precision. By analyzing historical traffic data, weather patterns, events, and other relevant factors, TrafficTelligence provides accurate forecasts and insights to enhance traffic management, urban planning, and commuter experiences

Traffic congestion in urban areas has become a growing challenge due to increasing vehicle density. Traditional traffic management systems lack predictive capabilities. Our project leverages machine learning to estimate traffic volume based on real-time and historical weather and time-based data, thereby enabling smarter traffic decisions.

1.2 Purpose

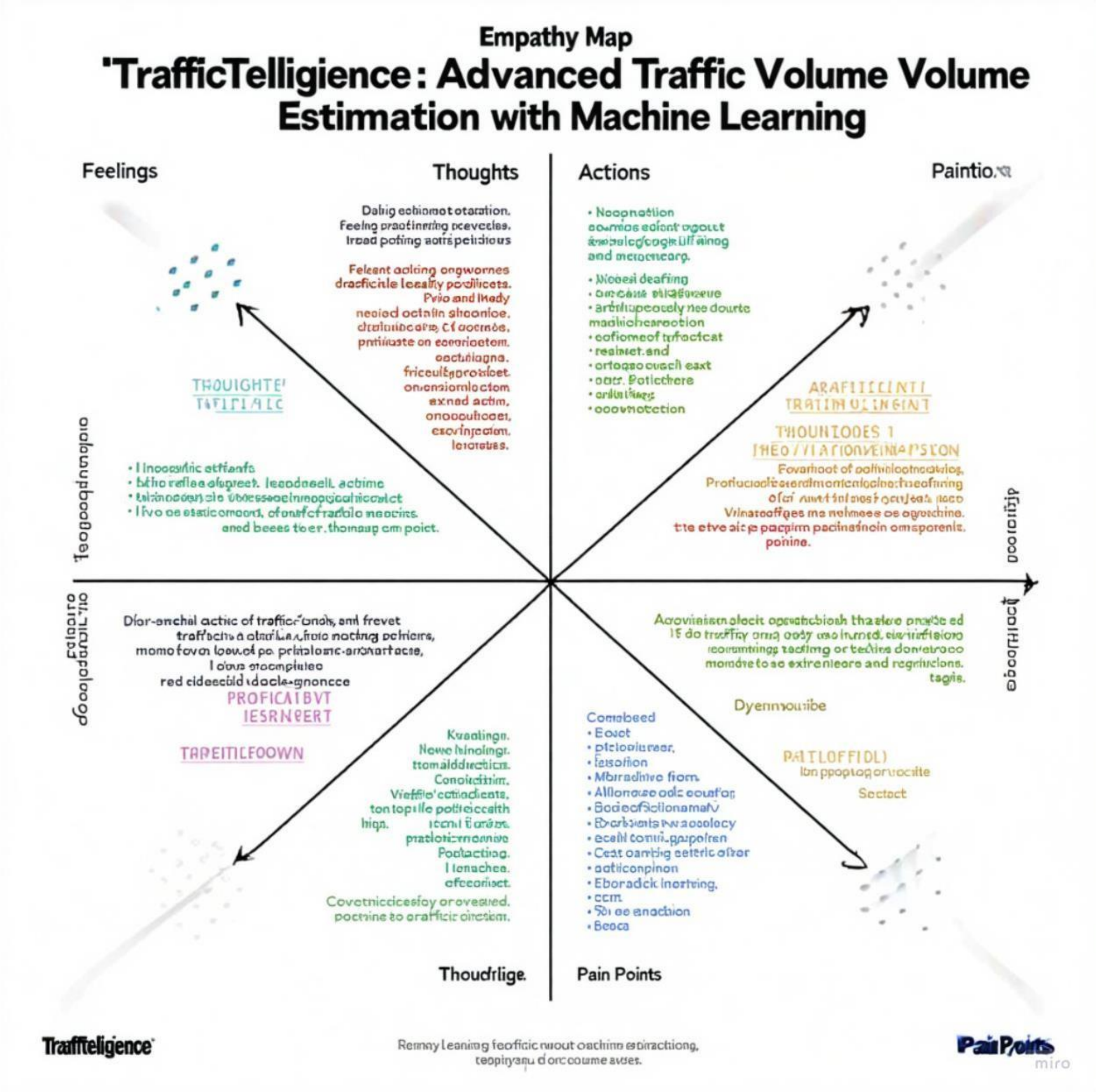
The primary aim is to build a predictive system that can assist in planning and managing traffic flow more effectively. This will help civic authorities, urban planners, and citizens alike by providing proactive traffic volume estimations.

2. IDEATION PHASE

2.1 Problem Statement

There is no system to predict traffic volume using real-time factors like weather and time. This leads to inefficient routing, increased congestion, and delays.

2.2 Empathy Map



2.3 Brainstorming

Our team considered multiple solutions including IoT sensors, camera-based traffic systems, and weather-integrated models. We finalized the use of a machine learning-based approach due to scalability and ease of integration with existing data.

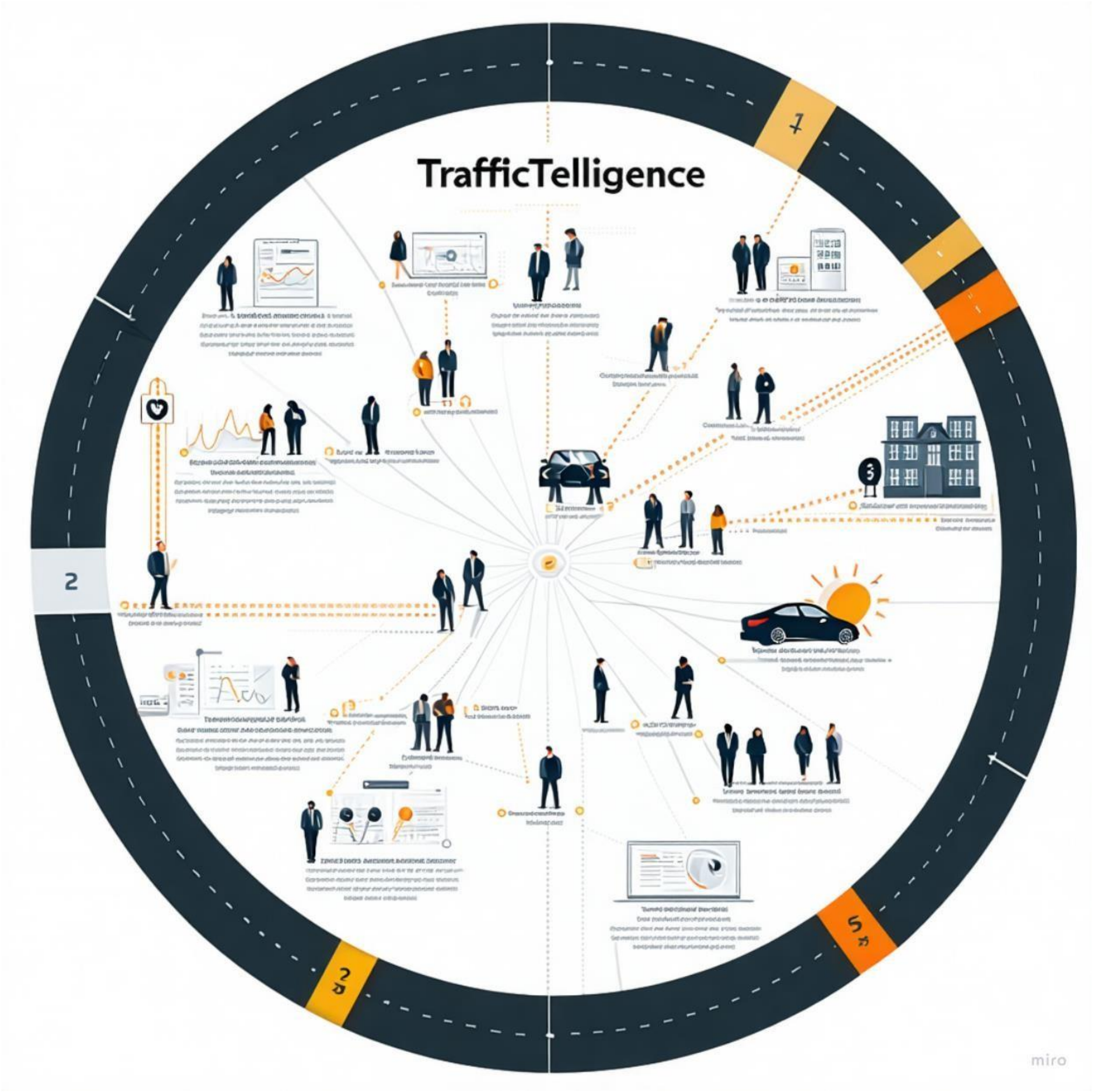
TrafficTelligence enables dynamic traffic management by providing real-time traffic volume estimations. Transportation authorities can use this information to implement adaptive traffic control systems, adjust signal timings, and optimize lane configurations to reduce congestion and improve traffic flow.

City planners and urban developers can leverage TrafficTelligence predictions to plan new infrastructure projects effectively. By understanding future traffic volumes, they can design road networks, public transit systems, and commercial zones that are optimized for traffic efficiency and accessibility.

Individual commuters and navigation apps can benefit from TrafficTelligence's accurate traffic volume estimations. Commuters can plan their routes intelligently, avoiding congested areas and selecting optimal travel times based on predicted traffic conditions. Navigation apps can provide real-time updates and alternative routes to improve overall travel experiences.

3. REQUIREMENT ANALYSIS

3.1 Customer Journey Map



3.2 Solution Requirement

1. Clean and structured dataset
2. ML model (Random Forest/XGBoost)
3. Python-based development
4. Front-end using HTML/CSS
5. Flask framework for deployment

3.3 Technology Stack

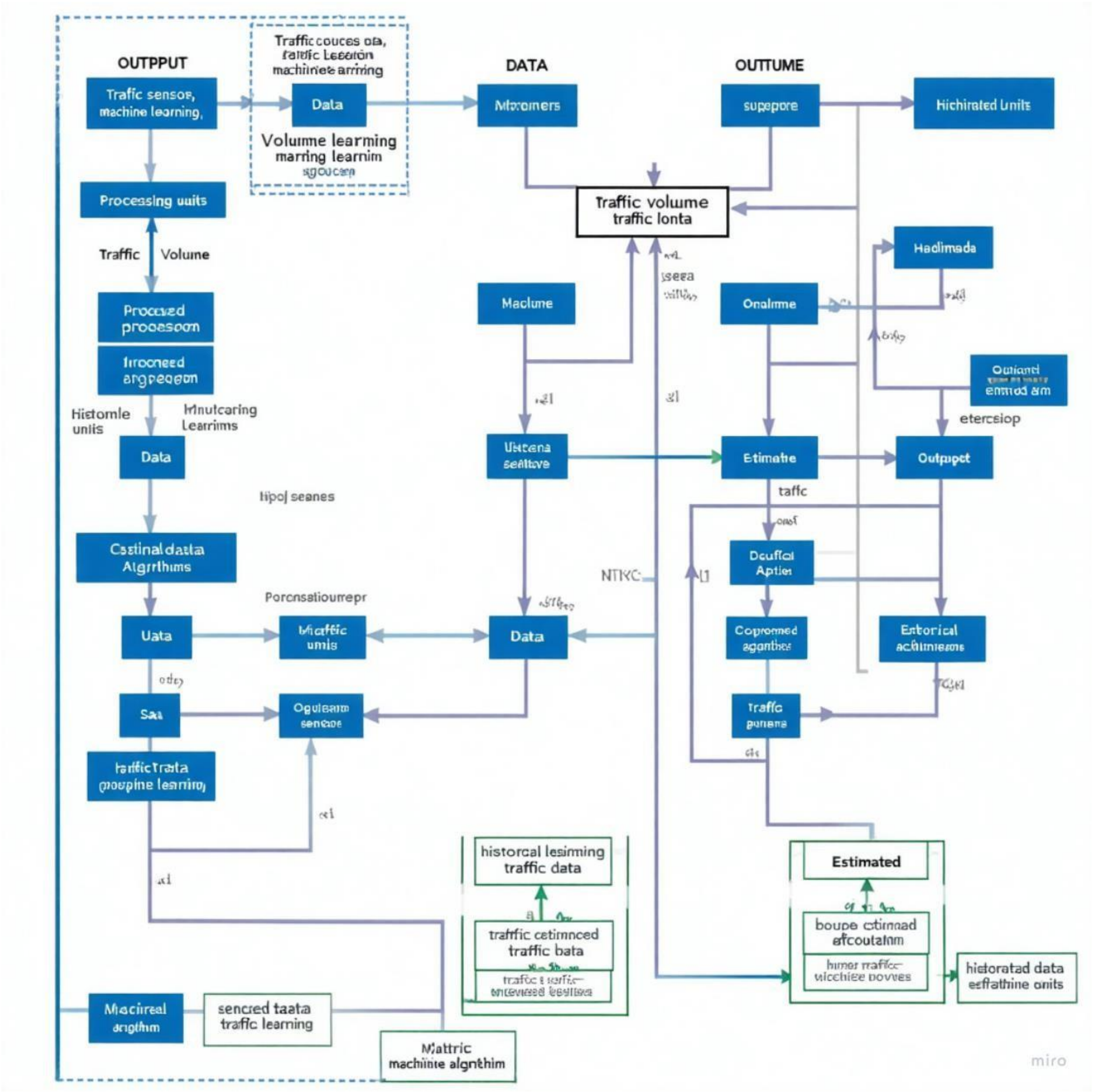
a) Python, Pandas, NumPy

b) Scikit-learn, XGBoost

c) Flask, HTML, CSS

d) GitHub, Anaconda

3.4 Data Flow Diagram



4. PROJECT DESIGN

4.1 Problem-Solution Fit

ML models help reduce reliance on manual traffic estimation. Our system automates this with a prediction engine.

- ➢ User interacts with the UI (User Interface) to enter the input values.
- ➢ Entered input values are analyzed by the model which is integrated.
- ➢ Once the model analyses the input the prediction is showcased on the UI.

- Data Collection.
    - Collect the dataset or Create the dataset

- Data Pre-processing.
    1. Import the Libraries.
    2. Importing the dataset.
    3. Checking for Null Values.
    4. Data Visualization.
    5. Taking care of Missing Data.
    6. Feature Scaling.
    7. Splitting Data into Train and Test.

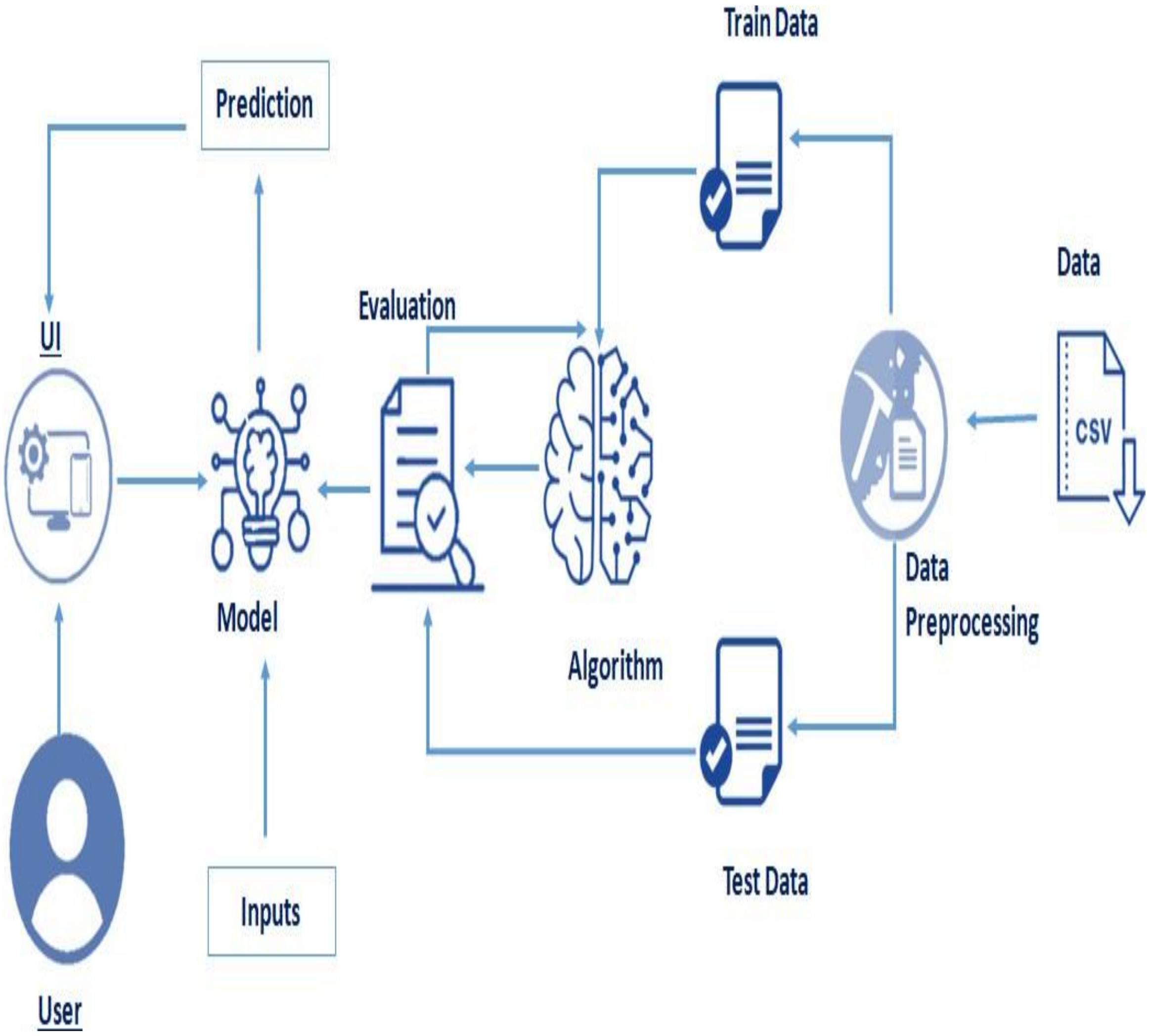
- Model Building
    a. Import the model building Libraries
    b. Initializing the model
    c. Training and testing the model
    d. Evaluation of Model
    e. Save the Model

- Application Building
    a. Create an HTML file
    b. Build a Python Code
    c. Run the App

4.2 Proposed Solution

Train a Random Forest model on weather and time-based features and deploy it using a Flask web app for interactive user access.

4.3 Solution Architecture



5. PROJECT PLANNING & SCHEDULING

5.1 Project Planning

Phase	Tasks	Duration
Data Preprocessing	Clean, Encode, Scale	2 Days
Model Training	Train 5 ML models	2 Days
Evaluation	Select best model (RF)	1 Day
Web Development	Build Flask app, UI integration	2 Days
Testing & Debugging	Error handling, UI validation	1 Day
GitHub & Report	Push code, write documentation	1 Day

6. FUNCTIONAL AND PERFORMANCE TESTING

6.1 Performance Testing

Evaluated all models using R2 score and RMSE:

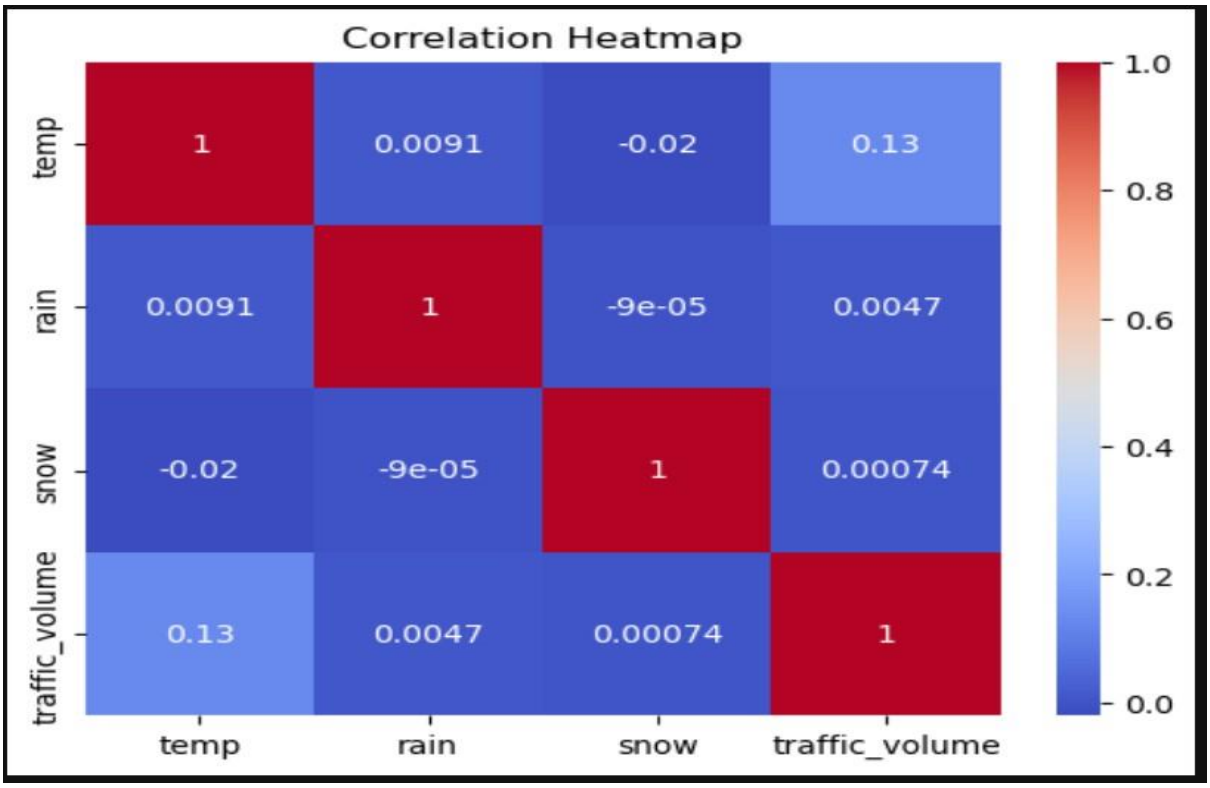
- Random Forest: R2 = 0.97, RMSE = 799.27
- XGBoost: R2 = 0.84

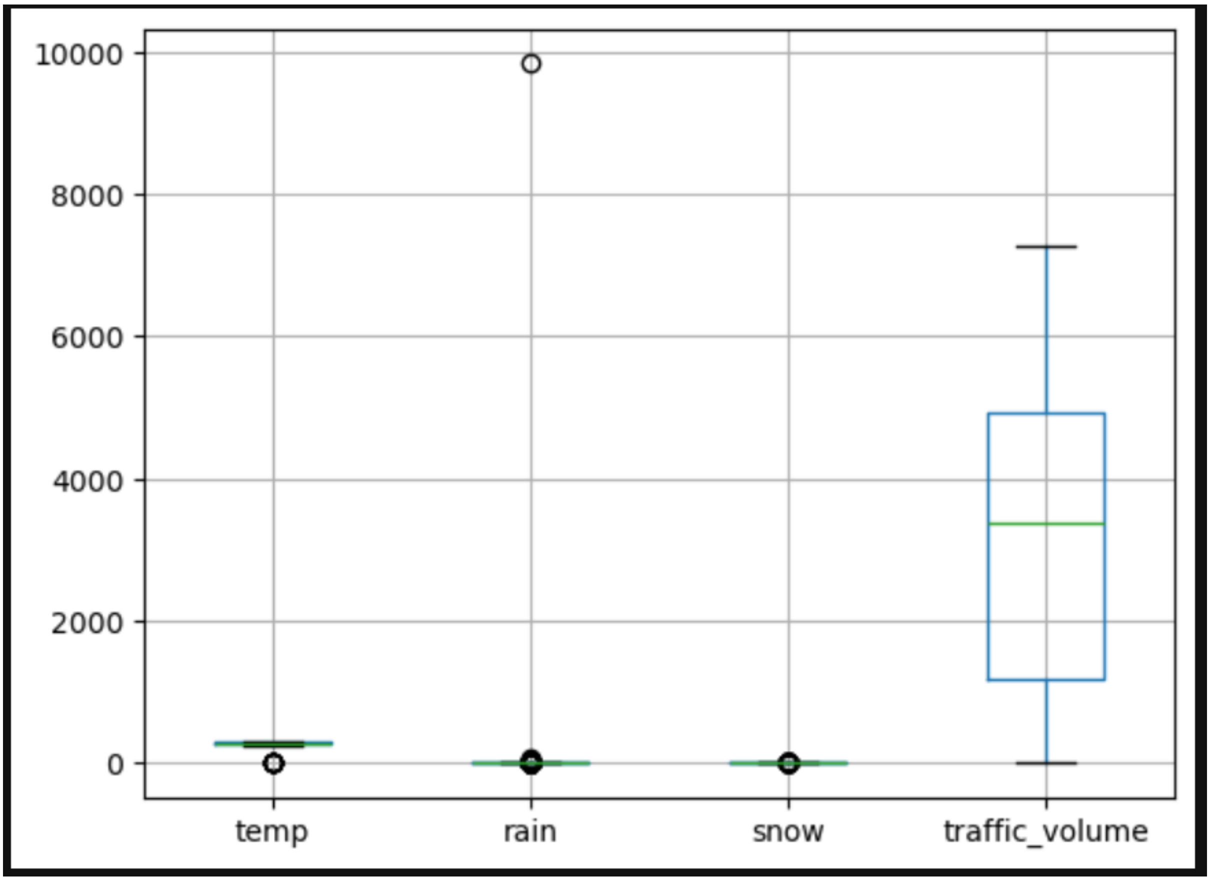
Training and Testing the Model

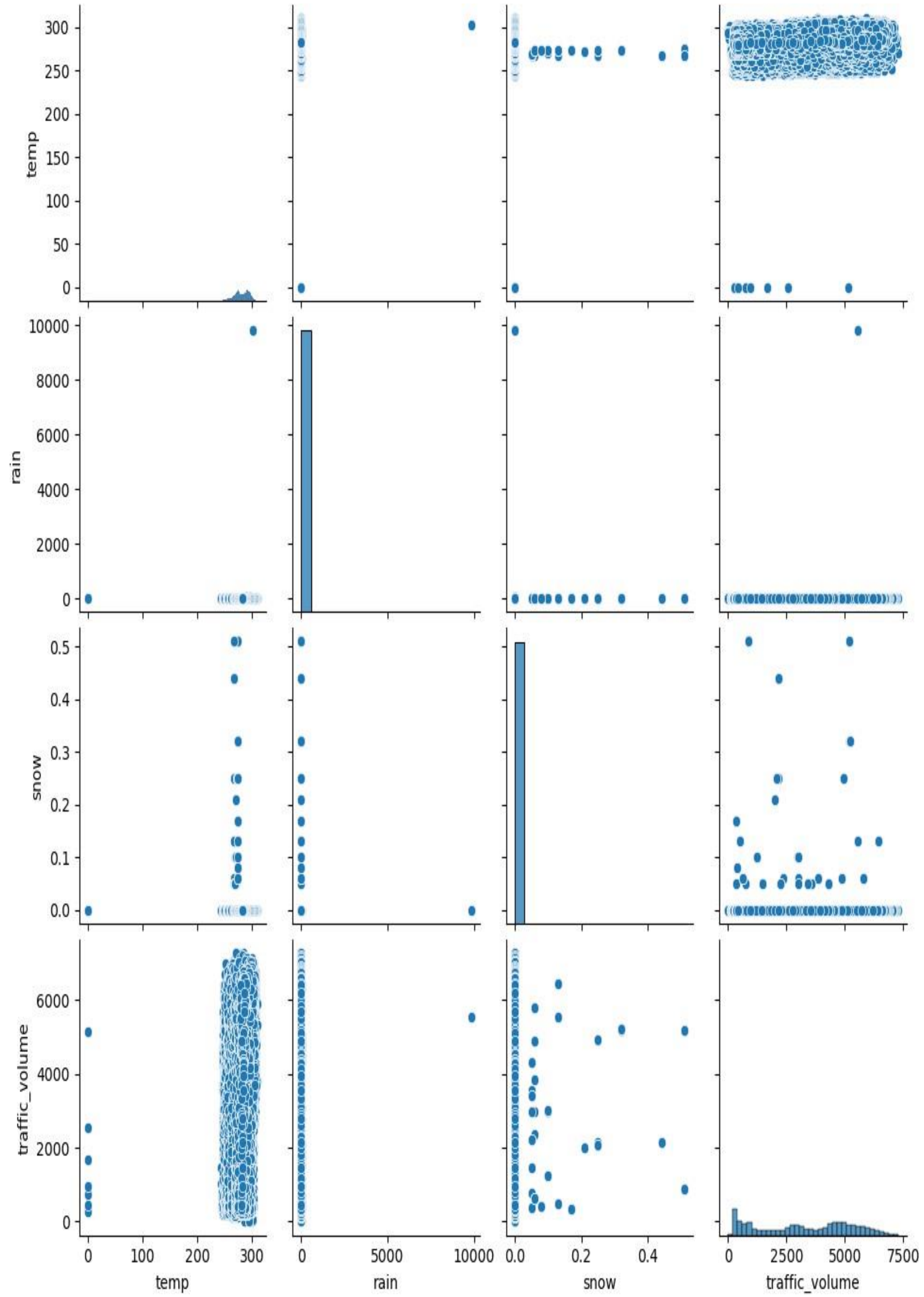
- Once after splitting the data into train and test, the data should be fed to an algorithm to build a model.
- There are several Machine learning algorithms to be used depending on the data you are going to process such as images, sound, text, and numerical values. The algorithms that you can choose according to the objective that you might have it may be Classification algorithms are Regression algorithms.
  1. Linear Regression
  2. Decision Tree Regressor
  3.Random Forest Regressor
  4.KNN
  5.svm
  5.xgboost

7. RESULTS

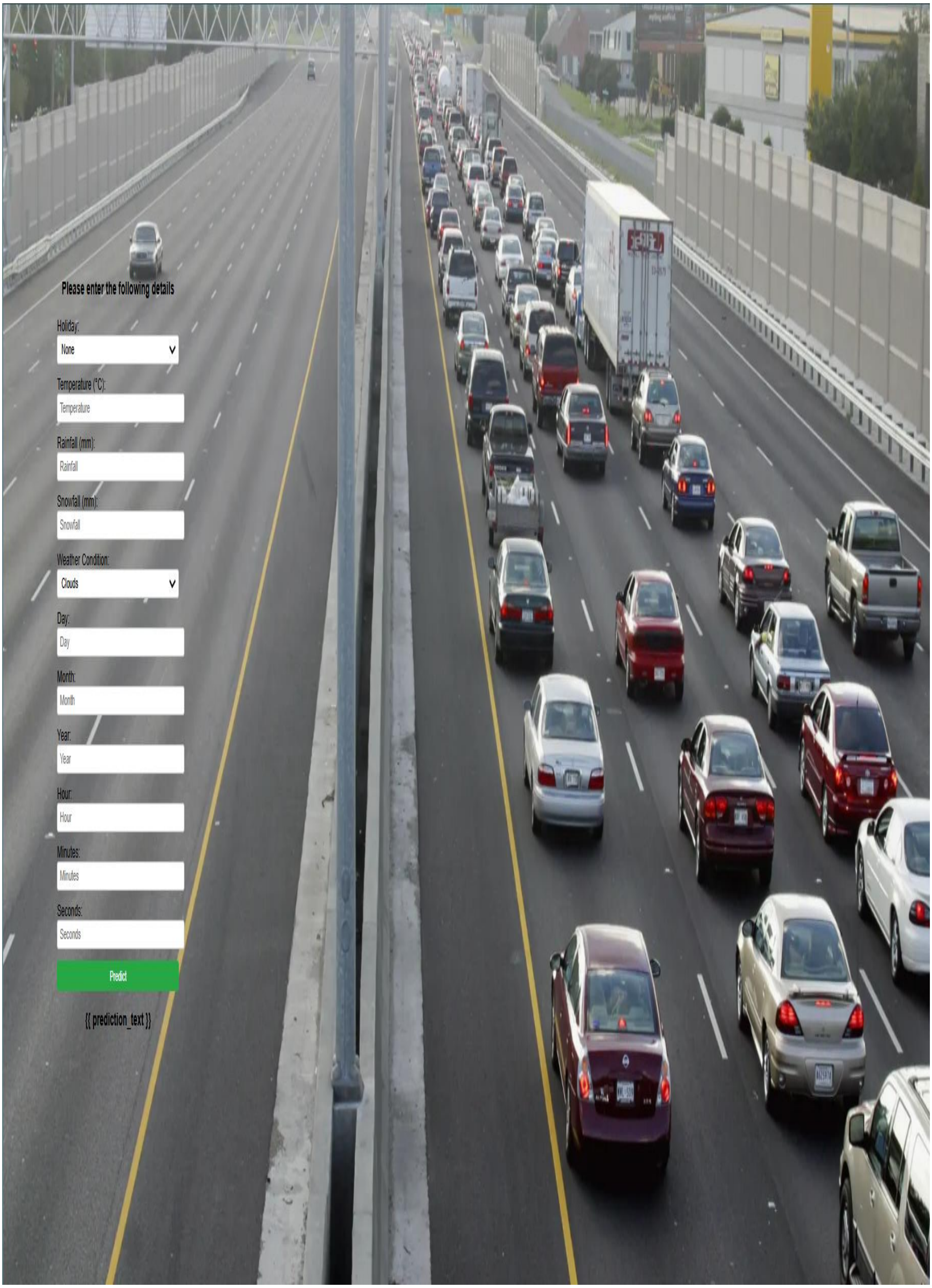
7.1 Output Screenshots







temp
300
250
200
150
100
50
0
rain
10000
8000
6000
4000
2000
0
snow
0.5
0.4
0.3
0.2
0.1
0.0
traffic_volume
6000
4000
2000
0
0
100
200
300
temp
0
5000
10000
rain
0.0
0.2
0.4
snow
0
2500
5000
7500
traffic_volume



Please enter the following details

Holiday: None

Temperature (°C): Temperature

Rainfall (mm): Rainfall

Snowfall (mm): Snowfall

Weather Condition: Clouds

Day: Day

Month: Month

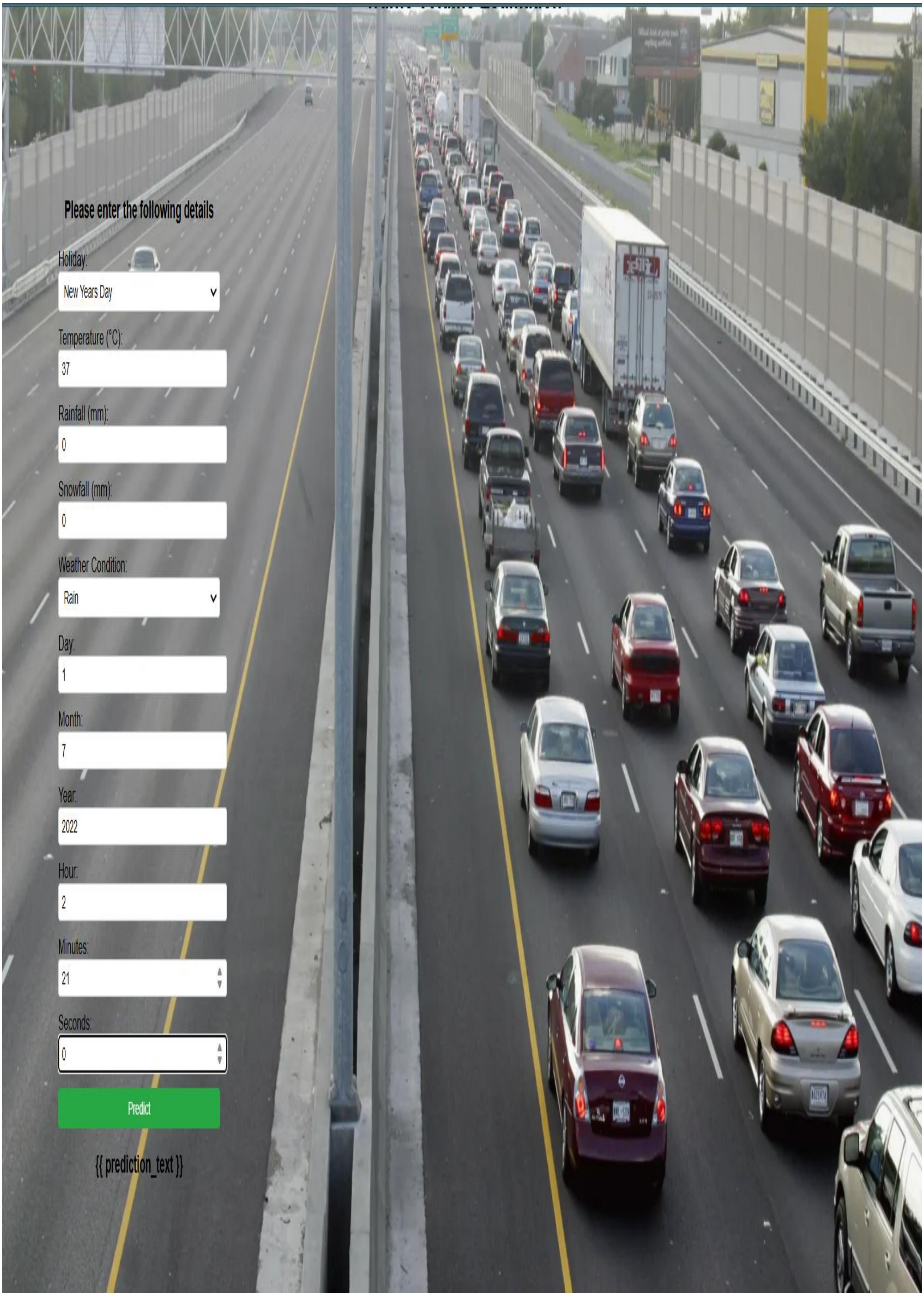
Year: Year

Hour: Hour

Minutes: Minutes

Seconds: Seconds

{{ prediction_text }}



Please enter the following details

Holiday: New Years Day

Temperature (°C): 37

Rainfall (mm): 0

Snowfall (mm): 0

Weather Condition: Rain

Day: 1

Month: 7

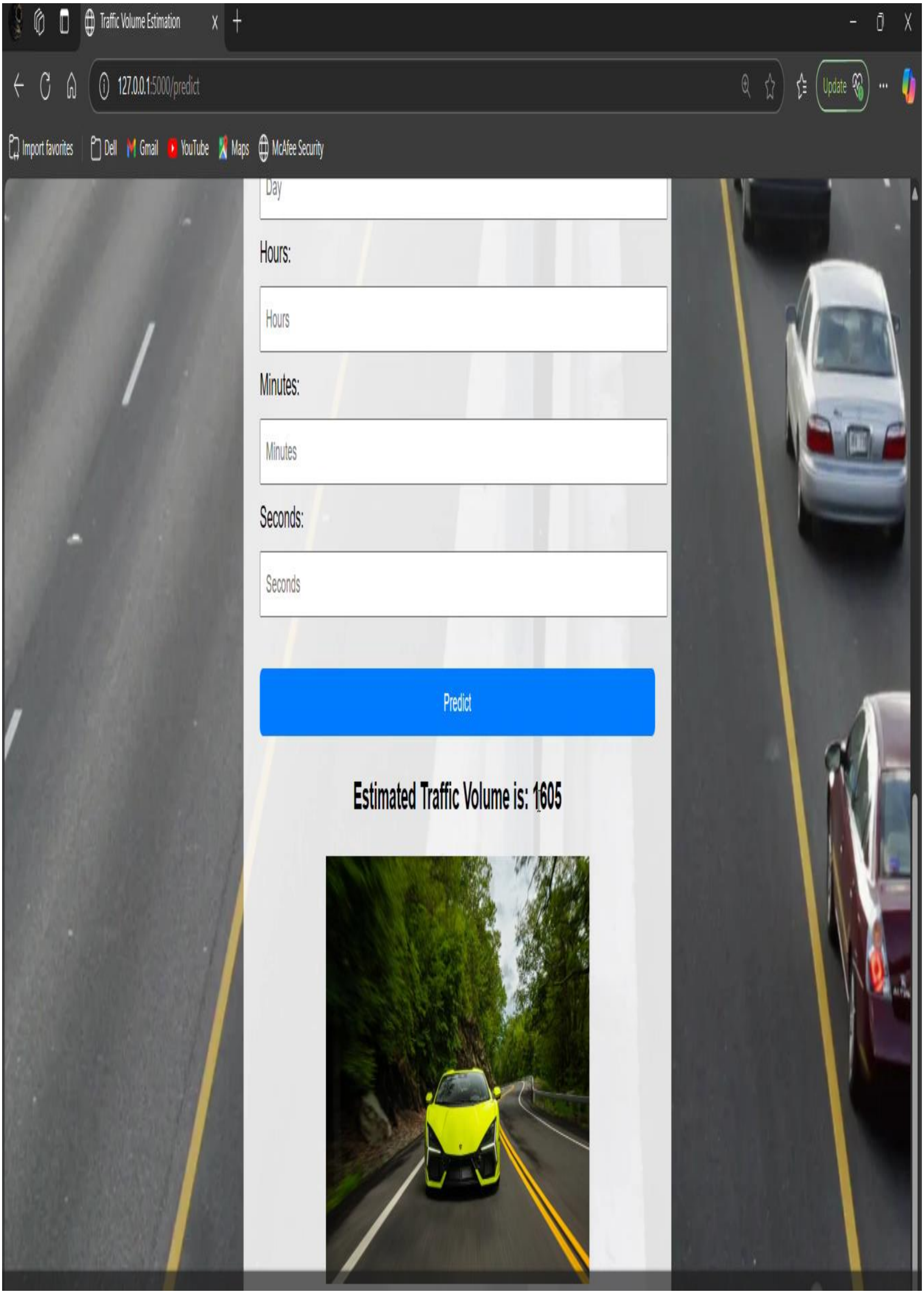
Year: 2022

Hour: 2

Minutes: 21

Seconds: 0

{{ prediction_text }}



Day

Hours:

Hours

Minutes:

Minutes

Seconds:

Seconds

Estimated Traffic Volume is: 1605

8. ADVANTAGES & DISADVANTAGES

Advantages:

1. Real-time predictions
2. Web-based user interface
3. Scalable and modular design

Disadvantages:

1. Depends on past weather patterns
2. Accuracy reduces with unseen conditions

9. CONCLUSION

Our AIML-based solution effectively predicts traffic volume with high accuracy. The web interface makes it accessible for end users. With more data and features, this can be adopted by municipal authorities.

10. FUTURE SCOPE

1. Deploy the application to cloud (Heroku/Render)
2. Use live weather and Google Maps API
3. Add SMS/email alerts for peak hours
4. Extend to multiple cities

11. APPENDIX

Source Code: Included in GitHub repo

GitHub Repo: https://github.com/katarikapil/TrafficTelligence-Advanced-Traffic-Volume-Estimation-With-Machine-Learning

Project Demo Video: Included in GitHub repo