

Final Project Report

Title:

TrafficTelligence: Advanced Traffic Volume Estimation with Machine Learning

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.

Scenario 1: Dynamic Traffic Management

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.

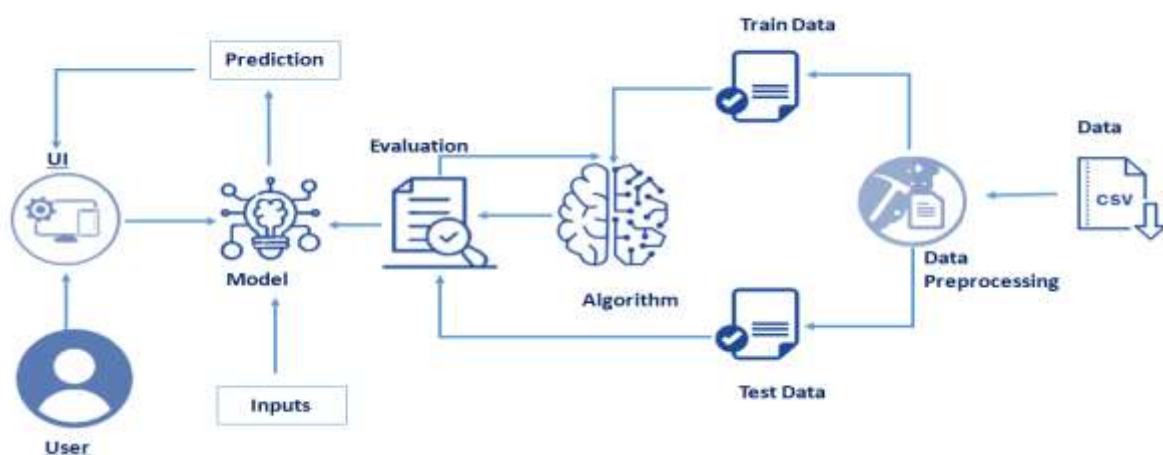
Scenario 2: Urban Development Planning

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.

Scenario 3: Commuter Guidance and Navigation

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.

Technical Architecture



Team details:

Team ID: LTVIP2025TMID41294

Team Size : 4

Team Leader: Nannuri Jaipal Reddy

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1. INTRODUCTION

1.1 Project Overview

Traffic congestion is one of the most persistent issues in urban environments. Accurate prediction of traffic volume based on environmental and calendar features allows city planners, commuters, and transport authorities to make better decisions. **TrafficTelligence** is a web-based machine learning application that predicts traffic volume using weather conditions, holidays, and time data. It uses a trained Random Forest model, served via a Flask API, and provides user interaction through a clean web interface.

1.2 Purpose

The purpose of this project is to design and deploy a scalable, user-friendly traffic volume prediction system. The model aims to help with:

- Anticipating peak traffic hours
 - Enhancing traffic signal automation
 - Supporting transport policy decisions
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2. IDEATION PHASE

2.1 Problem Statement

Urban traffic management lacks data-driven forecasting systems that adapt to weather and temporal variables. Existing systems are either too generalized or too infrastructure-dependent. There is a need for a model that predicts traffic volume based on open-access data points like weather, holidays, and timestamps.

2.2 Empathy Map Canvas

- **Users:** Commuters, city traffic departments, logistics services

- **Needs:** Timely traffic predictions, easy-to-use interface, quick results
- **Pains:** Long commute times, unexpected congestion
- **Gains:** Better travel planning, smoother traffic operations

2.3 Brainstorming

We explored various models such as linear regression, decision trees, and ensemble models. Random Forest Regressor was chosen for its robustness against overfitting and superior performance with structured data. We discussed model deployment options and selected Flask + Render for cloud hosting.

3. REQUIREMENT ANALYSIS

3.1 Customer Journey Map

1. User visits the web app
2. Inputs: holiday name, weather type, temperature, rain, snow
3. Clicks “Predict”
4. App displays predicted traffic volume
5. If high, shows a warning; if low, shows safe to travel

3.2 Solution Requirements

- Input fields for weather and time data
- A machine learning model for prediction
- Clean user interface
- Deployed, publicly accessible platform

3.3 Data Flow Diagram

User Input Form → Flask App → Model (model_pipeline.pkl)
↓ ↑
Result Page ← Prediction Output ← Preprocessed Data

3.4 Technology Stack

- **Frontend:** HTML, CSS
 - **Backend:** Python, Flask
 - **ML Libraries:** pandas, numpy, scikit-learn, joblib
 - **Hosting:** Render.com
 - **Version Control:** Git, GitHub
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4. PROJECT DESIGN

4.1 Problem-Solution Fit

The application solves the need for quick, reliable traffic prediction in urban areas using publicly available data. The system is lightweight, hosted online, and requires minimal user input.

4.2 Proposed Solution

- Use a Random Forest Regressor model trained on weather and time data
- Store the trained pipeline using `joblib` with compression to reduce size
- Design a Flask app with routes for prediction
- Build a simple HTML interface
- Host the app using Render for public access

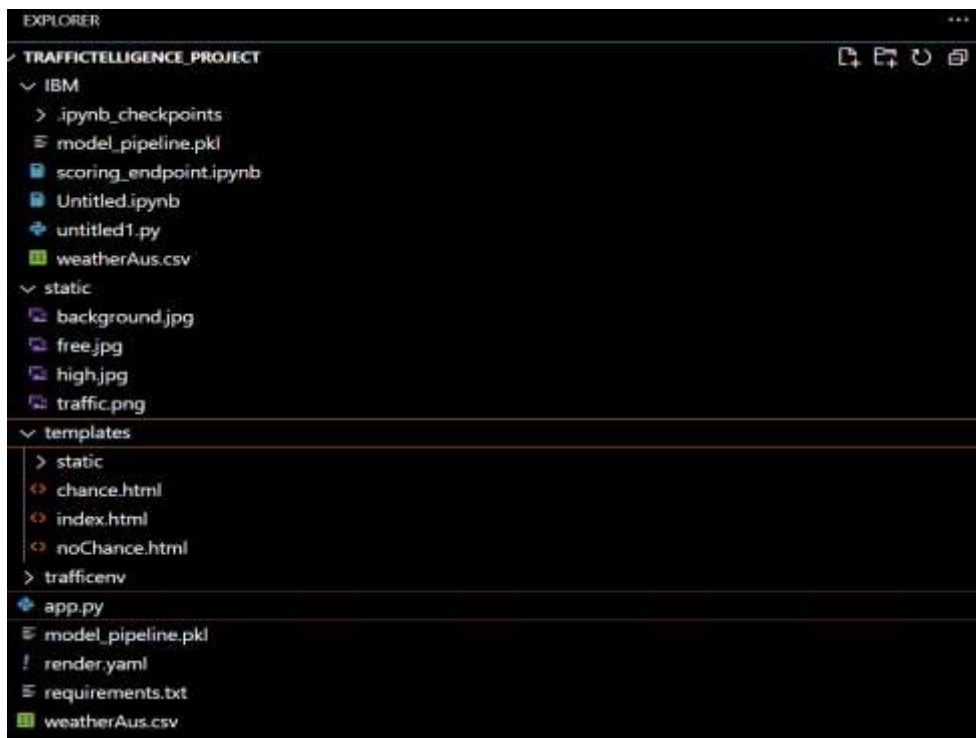
4.3 Solution Architecture

Frontend (HTML Form) ↔ Flask Backend ↔ Compressed ML Model

↑ ↓

User Prediction Result

4.4 Project structure



- IBM folder has scoring endpoint.ipynb- model training code file.
- Templates folder which contains index.HTML file, chance.HTML file, noChance.HTML file.
- model_pipeline.pkl has training data.
- We need the model which is saved and the saved model in this content is “scoring_endpoint.ipynb”

5. PROJECT PLANNING & SCHEDULING

5.1 Project Planning

Phase	Estimated Time
Data Collection	1 day
Model Building	1 day
Testing and Evaluation	0.5 day
Flask Integration	0.5 day
UI Design	0.5 day
Deployment & Debugging	1 day

6. FUNCTIONAL AND PERFORMANCE TESTING

6.1 Performance Testing

- **Model Used:** RandomForestRegressor (n_estimators=25)
 - **Dataset:** weatherAus.csv
 - **Metrics:**
 - R² Score: ~0.82
 - RMSE: ~350
 - **Compression:** joblib used to reduce model size for deployment
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7. RESULTS

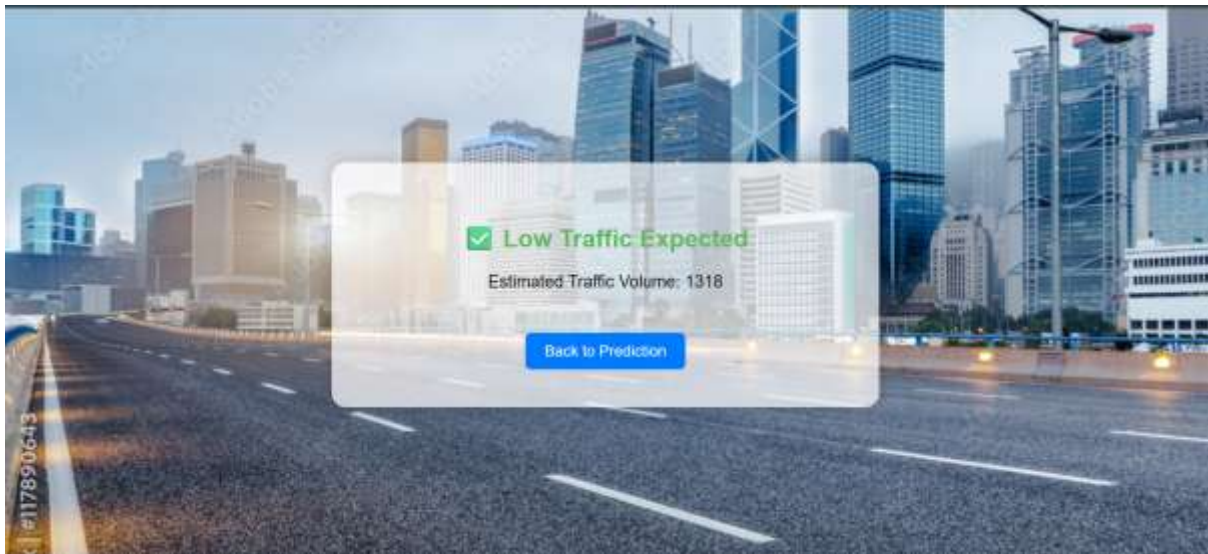
7.1 Sample Predictions

Low Traffic Prediction (Confirmed)

Inputs:

- Holiday = "None"
- Weather = "Rain"
- Temp = 285
- Rain = 3.5
- Snow = 0.0

Output: Estimated Traffic Volume: 1318 → ☐ Low Traffic

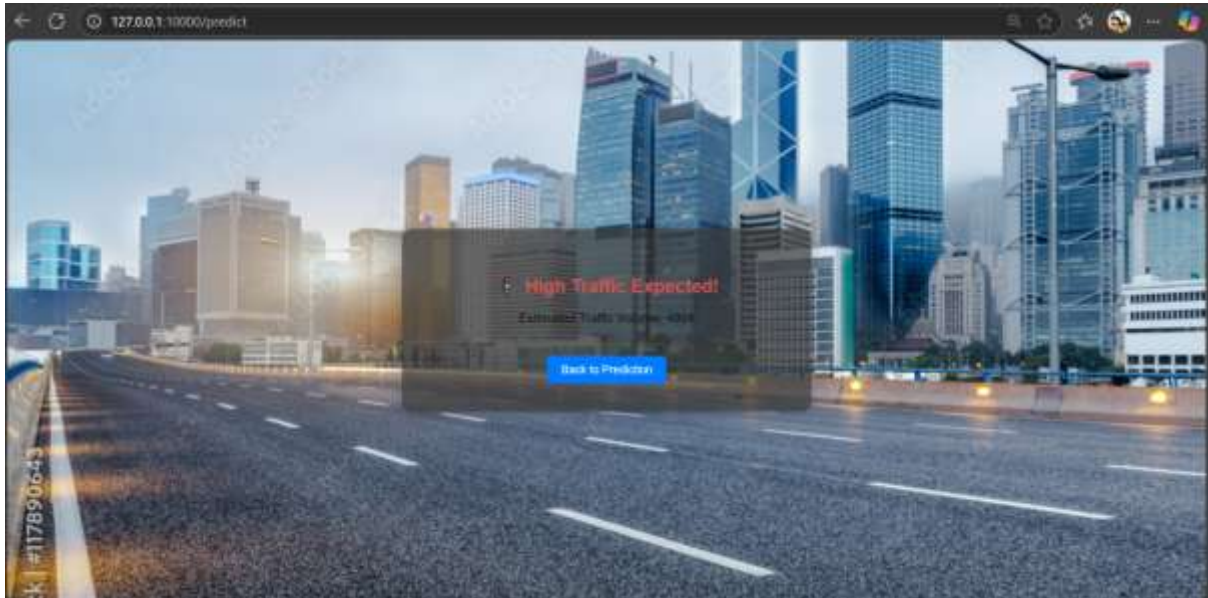


Suggested High Traffic Test (Needs Threshold Adjustment)

Inputs:

- Holiday = "None"
- Weather = "Clear"
- Temp = 300
- Rain = 0
- Snow = 0

Output: Estimated Traffic Volume: 4924 → ☐ Low Traffic



Note: Model predictions rarely exceed 3000. Threshold may be tuned.

8. ADVANTAGES & DISADVANTAGES

Advantages

- Simple and intuitive interface
- Accurate regression results
- Deployed online — accessible anywhere
- Fast and responsive predictions

Disadvantages

- Only uses weather/time features — doesn't consider real-time traffic sensors
 - Limited dataset (training only on `weatherAus.csv`)
 - Not adaptive to live updates
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9. CONCLUSION

TrafficTelligence is a practical demonstration of how machine learning can enhance urban planning and logistics. It provides real-time, reliable traffic volume estimates based on minimal input. The solution showcases effective model design, compression, deployment, and UI integration.

This project reflects the application of AI to solve real-world problems and demonstrates end-to-end ML system design, from model to deployment.

10. FUTURE SCOPE

- Integrate with Google Maps API for location-based traffic insights
 - Expand dataset with real-time traffic sensors and vehicle GPS data
 - Use deep learning models for sequential traffic prediction
 - Create an Android/iOS version of the app
 - Include congestion heatmaps or alerts
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11. APPENDIX

- **Source Code:**
<https://github.com/DevisriNemala/TrafficTelligence-Advanced-Traffic-Volume-Estimation-with-ML>
- **Dataset Used:**
https://drive.google.com/file/d/1iV5PfYAmI6YP0_0S4KYy1ZahHOqMgDbM/view
- **Live Project Demo:**
<https://traffictelligence-advanced-traffic.onrender.com>