Project Report

Traffic Telligence: Advanced Traffic Volume Estimation with Machine Learning

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1. INTRODUCTION

1.1 Project Overview

TrafficTelligence is an advanced AI-based system designed to **Estimate and Predict traffic volume** using historical traffic datasets, weather data, and temporal features. The system leverages multiple **Machine Learning Algorithms** to analyze:

- Traffic data patterns
- Weather conditions (rain, snow, temperature, clouds)
- Temporal features (day, month, year, time)
- Holiday effects

This predictive system empowers **urban planners**, **traffic management authorities**, and **smart city projects** with **accurate forecasts** to improve:

- Traffic signal timings
- Route optimizations
- Emergency planning
- Commuter convenience

1.2 Purpose

The primary purpose is to:

- Predict traffic volume with high accuracy.
- Minimize congestion by optimal signal scheduling.
- Enhance smart city planning.
- Enable data-driven decisions for emergency management.
- Integrate with IoT sensors for real-time dynamic predictions.

2. IDEATION PHASE

2.1 Problem Statement

“Traffic congestion causes daily productivity loss, increased pollution, and economic loss worldwide. An ML-based traffic volume prediction system is necessary to address these urban challenges.”

Real-time impacts:

- Increased commuter stress and health issues.
- Increased fuel consumption and carbon emissions.
- Delays in emergency vehicle movements.

2.2 Empathy Map Canvas

WHO	Urban commuters, Traffic police, City planners, Emergency responders
WHAT THEY SAY	“Traffic jams waste our time daily.”
WHAT THEY THINK	“There should be a way to plan routes efficiently.”
WHAT THEY DO	Use Google Maps, leave early to avoid traffic.
WHAT THEY FEEL	Frustrated, stressed, anxious during peak hours.

2.3 Brainstorming

Key brainstormed ideas:

- Use traffic sensors and CCTV data (future scope).
- Integrate weather APIs for real-time predictions.
- Develop a web dashboard with live forecasts.
- Create an alert system for peak congestion.

3. REQUIREMENT ANALYSIS

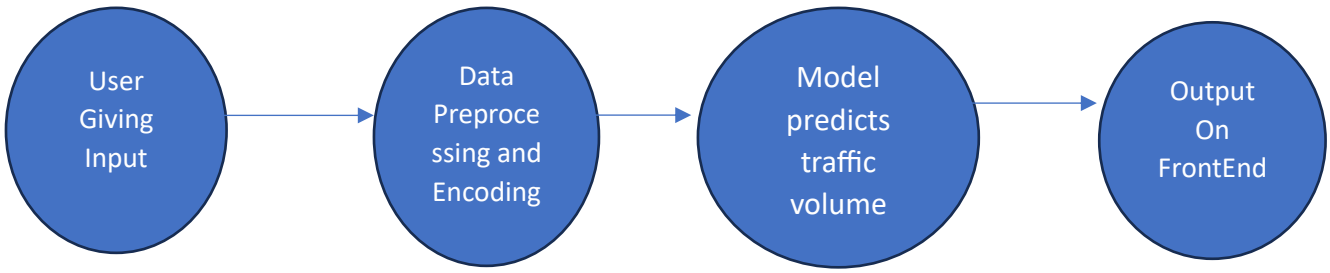
3.1 Customer Journey Map

Stage	Action	Pain Points	Improvement by TrafficTelligence
Home	Plan travel	Unpredictable congestion	Accurate traffic forecast
Enroute	Adjust route	Delays due to jams	Alternative route suggestions
Destination	Arrival	Late arrival stress	On-time planning

3.2 Solution Requirement

- **Functional Requirements:**
  - Predict traffic volume given weather, time, date inputs.
  - Display results on a web interface.
  - Store datasets securely.
- **Non-functional Requirements:**
  - <1 second prediction latency.
  - Scalable model deployment.
  - Responsive UI for mobile and desktop.

3.3 Data Flow Diagram



Explanation:

1. User inputs date, time, weather.
2. Data preprocessing and encoding.
3. Model predicts traffic volume.
4. Output displayed on frontend.

3.4 Technology Stack

Category	Tools & Technologies
Programming Language	Python
ML Libraries	Pandas, Scikit-Learn, XGBoost
Web Framework	Flask
Frontend	HTML, CSS, Bootstrap
Version Control	Git, GitHub

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4. PROJECT DESIGN

4.1 Problem Solution Fit

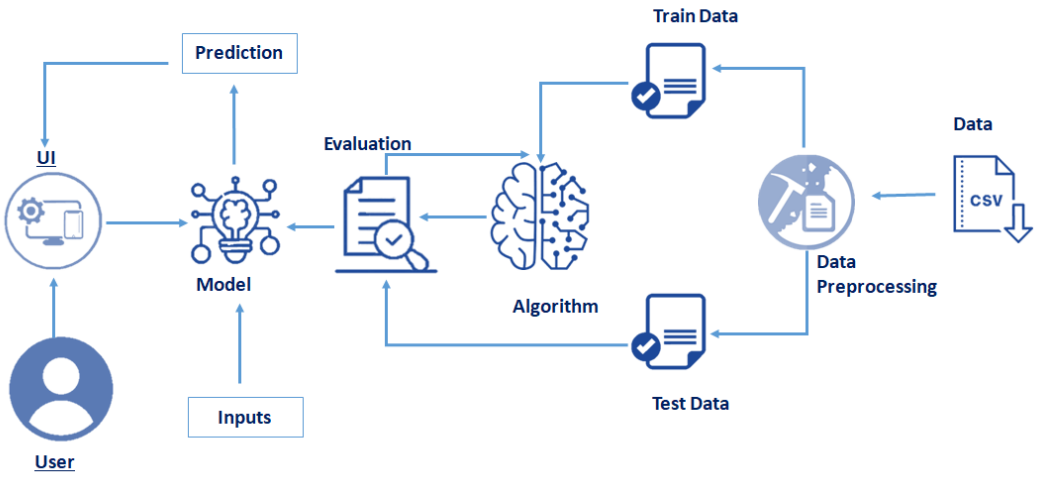
- **Problem:** Unpredictable traffic volume.
- **Solution:** ML model trained on historic + weather data to forecast traffic volume.

4.2 Proposed Solution

TrafficTelligence's solution includes:

1. **Data preprocessing**: Handling nulls, encoding categoricals.
2. **Model training**: Random Forest, Decision Tree, SVR, XGBoost.
3. **Model evaluation**: R^2 scores for selection.
4. **Running**: Flask API with HTML frontend.

4.3 Solution Architecture



Flow:

1. User submits form.
2. Flask API routes input to ML model.
3. Model returns prediction.
4. Result rendered on result.html.

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5. PROJECT PLANNING & SCHEDULING

5.1 Project Planning

Week	Task
1	Problem analysis, dataset understanding
2	Data preprocessing & EDA
3	Model building & evaluation
4	Flask app development
5	Frontend design
7	Report preparation

6. FUNCTIONAL AND PERFORMANCE TESTING

6.1 Performance Testing

Model	R^2 Score
Decision Tree	0.7197
Random Forest	0.8418
SVR	0.2448
XGBoost	0.8411

Observation: Random Forest and XGBoost performed best with $R^2 > 0.84$ indicating high accuracy.

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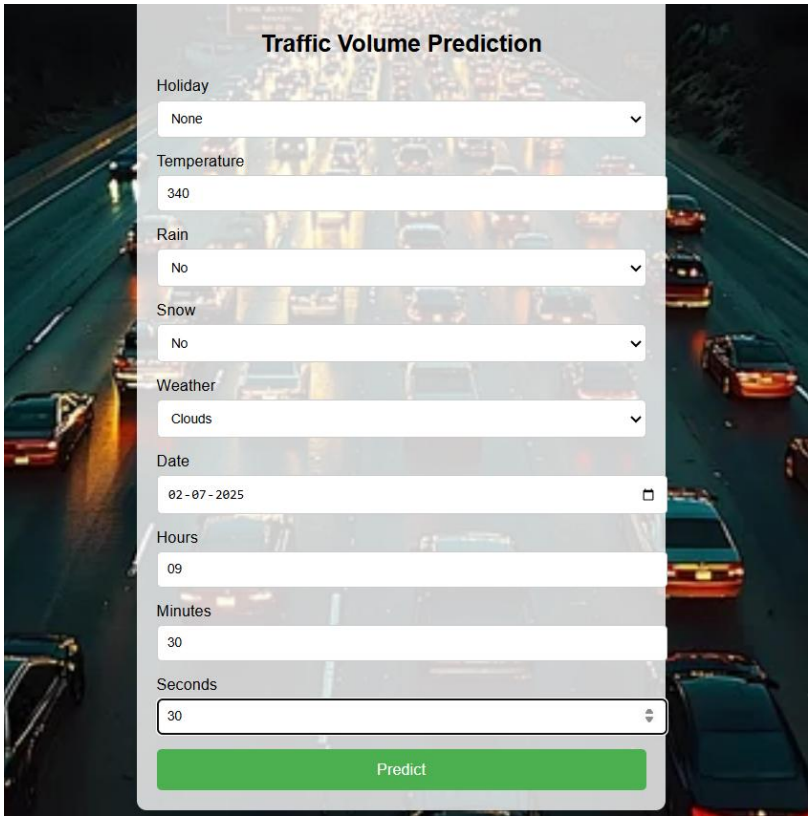
7. RESULTS

7.1 Output Screenshots

Input Page :



Output Page/Prediction Page :

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8. ADVANTAGES & DISADVANTAGES

Advantages

- High accuracy traffic volume predictions.
- Easy-to-use web interface.
- Scalable and deployable on cloud.
- Reduces travel time and fuel consumption.

Disadvantages

- Relies on historical data; real-time sensor integration pending.
- Accuracy may vary during extreme weather conditions.
- Requires periodic retraining with new data.

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9. CONCLUSION

TrafficTelligence successfully demonstrates that **machine learning can solve real-world urban challenges** by accurately predicting traffic volume. It aids in creating smarter, safer, and more sustainable cities, reducing economic and health burdens of congestion.

10. FUTURE SCOPE

- Integration with **IoT real-time traffic sensors**.
- Development of **mobile app version**.
- Addition of **route optimization module**.
- Integration with **Google Maps API** for rerouting.
- Deployment on **Kubernetes cluster** for auto-scaling.

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11. APPENDIX

Dataset Link

Original dataset :

https://drive.google.com/file/d/1iV5PfYAmI6YP0_0S4KYy1ZahHOqMgDbM/view

GitHub Link

https://github.com/vinayreddy4940/Traffic-Voume-Estimation.git