Project Documentation

# TrafficTelligence: Advanced Traffic Volume Estimation Using Machine Learning

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Team Size: 5

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# TrafficTelligence: Advanced Traffic Volume Estimation Using Machine Learning

## 1. Abstract

This project aims to estimate traffic volume accurately using machine learning techniques. By utilizing historical traffic data and real-time sensor inputs, our model predicts traffic density and helps in managing road congestion effectively. The goal is to support smart city development with intelligent transportation solutions.

## 2. Introduction

Traffic congestion is a growing problem in urban areas. Traditional methods for traffic monitoring are often expensive and limited in scope. This project explores machine learning models for traffic volume prediction using publicly available datasets and real-time feeds.

## 3. Objectives

* Collect and preprocess traffic data.
* Train machine learning models to estimate traffic volume.
* Evaluate the performance of different algorithms.
* Provide visual insights using dashboards.

## 4. Technologies Used

* Languages: Python
* Libraries: Pandas, NumPy, Scikit-learn, Matplotlib, Seaborn
* Tools: Jupyter Notebook, Power BI (for visualization), GitHub
* Dataset: Example: PeMS (Performance Measurement System) Traffic Data

## 5. System Architecture

Traffic Data (CSV/API)  
 ↓  
Data Preprocessing (Cleaning, Normalization)  
 ↓  
Feature Engineering  
 ↓  
Model Training (ML Algorithms)  
 ↓  
Prediction & Visualization

## 6. Methodology

### 6.1 Data Collection

Collected data from traffic sensors and public datasets (like Caltrans PeMS or Kaggle datasets).

### 6.2 Data Preprocessing

Handled missing values, performed normalization, encoded categorical data.

### 6.3 Model Building

Tried multiple models:  
- Linear Regression  
- Decision Tree Regressor  
- Random Forest  
- XGBoost

### 6.4 Evaluation

Used metrics such as MAE (Mean Absolute Error), RMSE (Root Mean Squared Error), and R² score.

## 7. Results

| Model | MAE | RMSE | R² Score |
| --- | --- | --- | --- |
| Linear Regression | 42.1 | 56.3 | 0.71 |
| Random Forest | 27.8 | 35.4 | 0.89 |
| XGBoost | 25.4 | 32.1 | 0.91 |

\*XGBoost performed the best in terms of accuracy and stability.\*

## 8. Conclusion

The project demonstrated how machine learning can be effectively used for traffic volume estimation. With accurate predictions, city planners and authorities can manage congestion proactively.

## 9. Future Work

* Integrate with real-time traffic APIs like Google Maps.
* Include weather and event-based features.
* Deploy a live dashboard for public or government use.

## 10. References

* Scikit-learn Documentation: https://scikit-learn.org/
* Caltrans PeMS: https://pems.dot.ca.gov/
* Machine Learning Blogs and GitHub repositories