PROJECT DOCUMENTATION

TrafficTelligence: Advanced Traffic Volume Estimation with Machine Learning

TEAM ID : LTVIP2025TMID41777

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TrafficTelligence: Advanced Traffic Volume Estimation with Machine Learning

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1. Introduction

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

Team Members:

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- Behara V N Abhinay Bharadwaj

2. Project Overview

Purpose:
The core objective of this project is to build a predictive system capable of estimating traffic volume using multiple regression models. The purpose includes:

- Automating traffic estimation based on multiple variables.
- Improving urban traffic control through predictive modeling.
- Serving as a decision support tool for smart city applications.

Key Features:

- **Comprehensive historical data analysis** for feature engineering.
- **Preprocessing and encoding** of both categorical and numerical features.
- **Training and evaluation** of various regression models.
- **Deployment** using a lightweight Flask web application.

 Graphical visualization for comparative analysis between predicted and actual traffic volumes.

3. Architecture

The architecture of TrafficTelligence follows a modular and layered approach, making it scalable and maintainable.

Layers of the Application

- **Frontend (Presentation Layer):**
    - HTML pages (index.html, output.html) for input and displaying predictions.
- **Backend (Application Logic Layer):**
    - app.py written in Flask framework handles routing, input processing, and invoking the machine learning model.
- **Model Layer (Business Logic Layer):**
    - Trained ML model (model.pkl) and feature encoder (encoder.pkl) used for making predictions.
- **Database (optional):**
    - A lightweight, file-based database (e.g., SQLite) can be used to store session history or logs.

4. Setup Instructions

Prerequisites

- Python 3.8+ and pip
- Git
- Streamlit and FastAPI
- (Optional) Virtual environment tool (`venv` or `conda`)

Installation

1. **Clone the Repository**

```
git clone https://github.com/ramyamudiyam/trafficTelligence.git
```

2. **Navigate to the project folder:**

```
cd trafficTelligence
```

3. **Run the Flask application:**

```
python app.py
```

4. **Access the app in your browser:**

```
http://localhost:5000
```

5. Folder Structure

```
Traffic Intelligence Project/
│
├── templates/
│   ├── index.html              # User form for input
│   └── output.html             # Results visualization
│
├── app.py                      # Flask backend
├── trafficIntelligence.ipynb   # Jupyter notebook for EDA, preprocessing, and model training
├── traffic volume.csv          # Raw dataset
├── encoder.pkl                 # Pre-trained encoder for categorical data
├── model.pkl                   # Trained regression model
```

```
├──── output.png                  # Visual comparison of predicted vs actual

├──── input1.png                  # Screenshot of input form

└──── input2.png                  # Alternate form screenshot
```

6. Running the Application

Launch Flask app using:

```
python app.py
```

Use your browser to access index.html.

Submit the form with required inputs (hour, temperature, weather type, etc.).

View the predicted traffic volume on output.html, along with a graphical result.

7. Model Documentation & Interaction Flow

Machine Learning Pipeline

- **Model Type:** Supervised Regression (Random Forest, Linear Regression, etc.)
- **Target Variable:** Traffic volume (numerical)
- **Features:**
    - **Temporal:** Hour of day, weekday/weekend, holiday
    - **Weather:** Temperature, rain, snow, cloud cover
    - **Categorical Encoding:** One-hot encoding for categorical features like weather type, season, holidays
- **Pipeline Steps:**

1. Data preprocessing and encoding

2. Model training and tuning

3. Saving model using joblib

4. Integration with Flask via app.py

Prediction Flow

1. User provides input via the web form.
2. Flask backend receives the data and preprocesses it using encoder.pkl.
3. Preprocessed data is fed into model.pkl.
4. Model outputs the estimated traffic volume.
5. Prediction is displayed with visual context (output.png).

8. User Interface

index.html

- Accepts inputs such as:
    - Date
    - Hour of the day
    - Temperature
    - Rainfall/snowfall
    - Holiday/Event indicator

output.html

- Displays:
    - Numerical prediction

- Graph comparing actual vs predicted values
- Recommendations based on traffic volume (can be enhanced)

9. Testing

Manual Testing

- Tested for:
  - Peak hour traffic
  - Public holidays
  - Rainy/snowy weather conditions

Automated Testing (Optional)

- Can be done using:
  - pytest
  - Flask's test client for integration tests

Evaluation Metrics

- **MAE (Mean Absolute Error)**
- **RMSE (Root Mean Squared Error)**
- **R^2 Score** for model performance validation

10. Known Issues

1. **Limited generalization:** Model may underperform on unseen holidays or sudden events (e.g., accidents).

2. **Local-only hosting:** Current setup is not cloud-deployed.

3. **Model dependence on data quality:** Poorly structured or noisy data affects prediction accuracy.

11. Future Enhancements

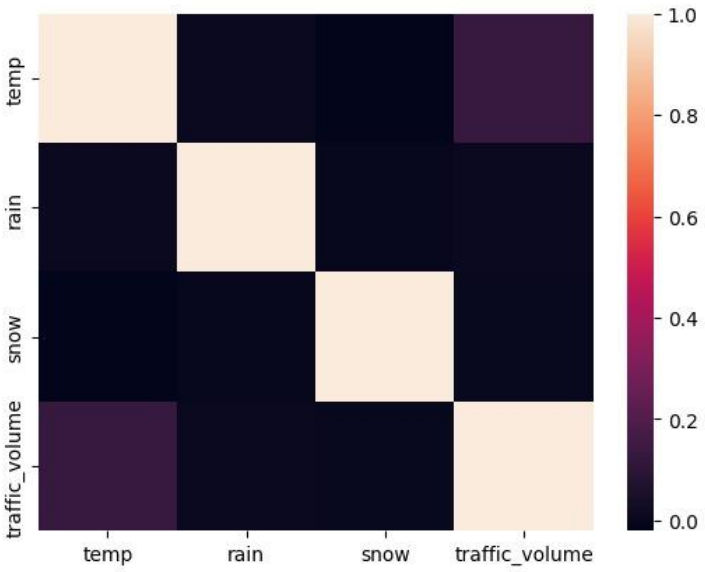
- **Cloud deployment:** Enable global accessibility via platforms like AWS, Heroku, or Azure.
- **Real-time traffic data:** Integrate with live feeds from traffic sensors, Google Maps API, or city databases.
- **Advanced modeling:** Explore deep learning (e.g., LSTM) and ensemble techniques (e.g., XGBoost).
- **Interactive features:**

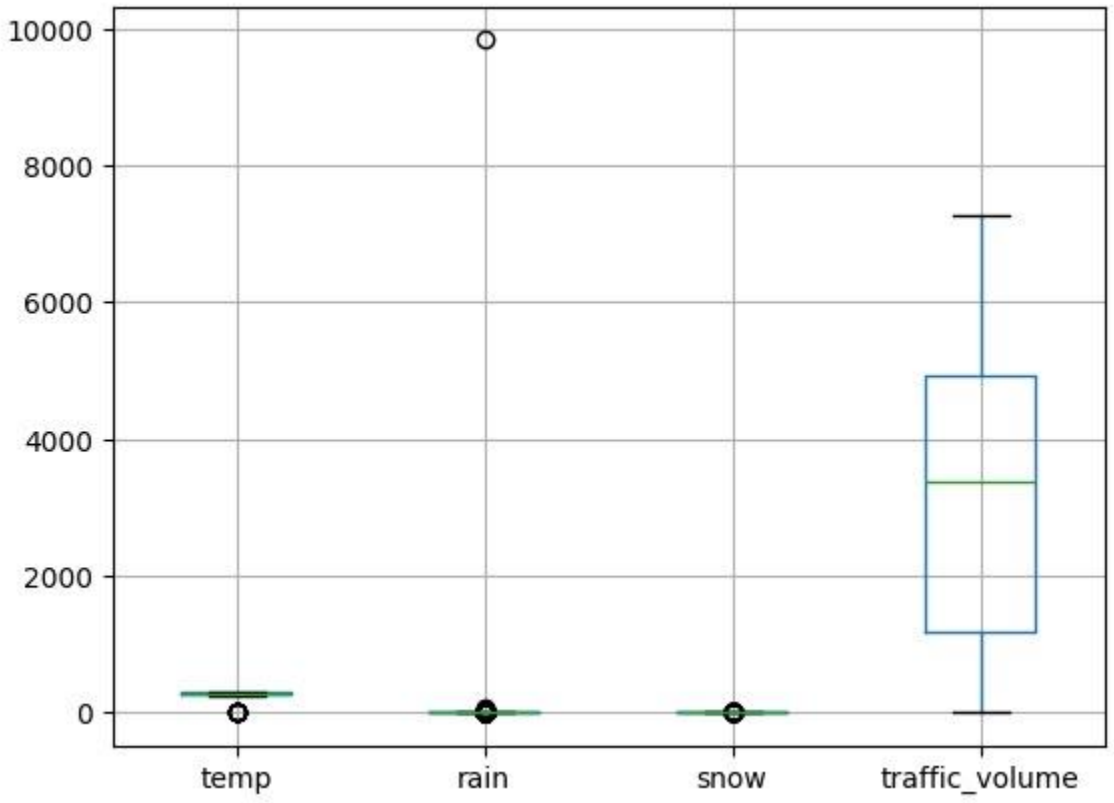
  Route-based traffic suggestions

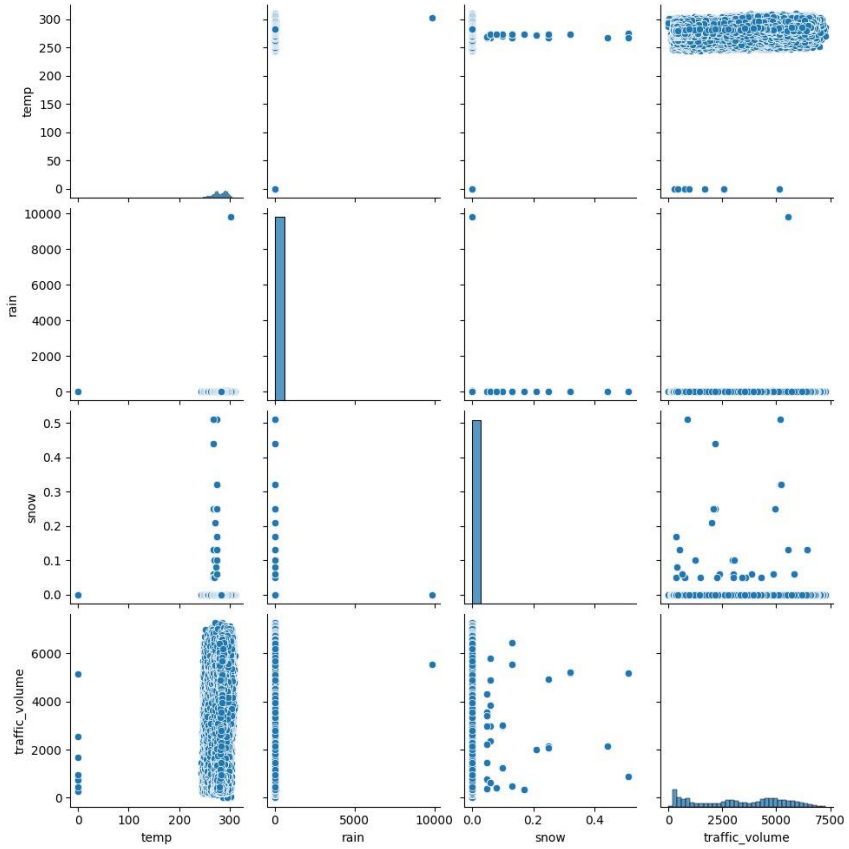
  Mobile-responsive frontend

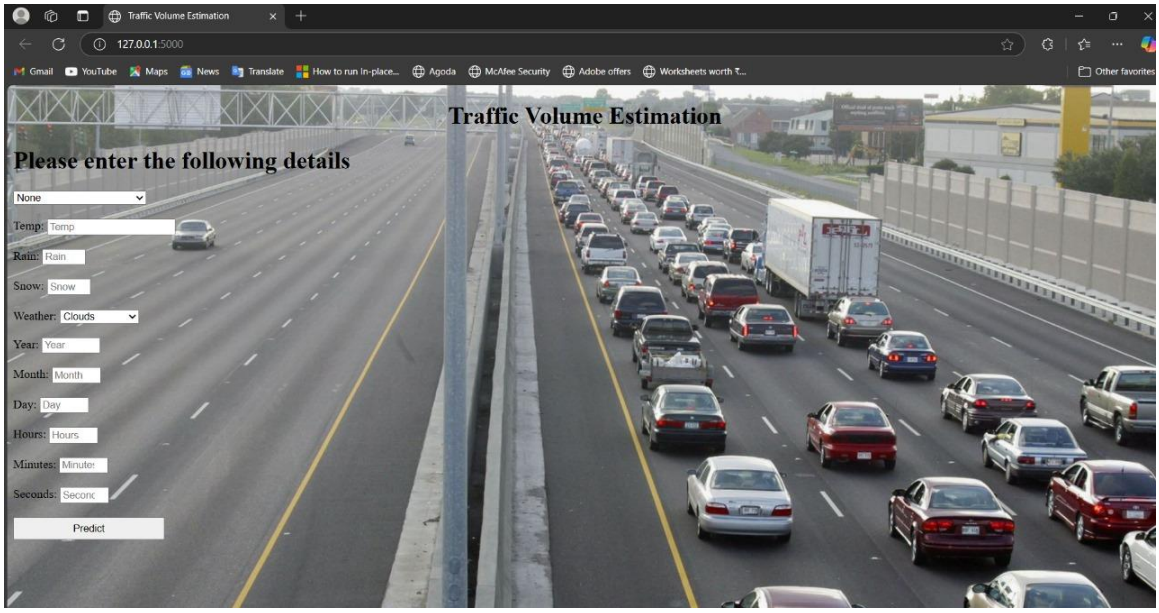
  Real-time alerts for heavy congestion

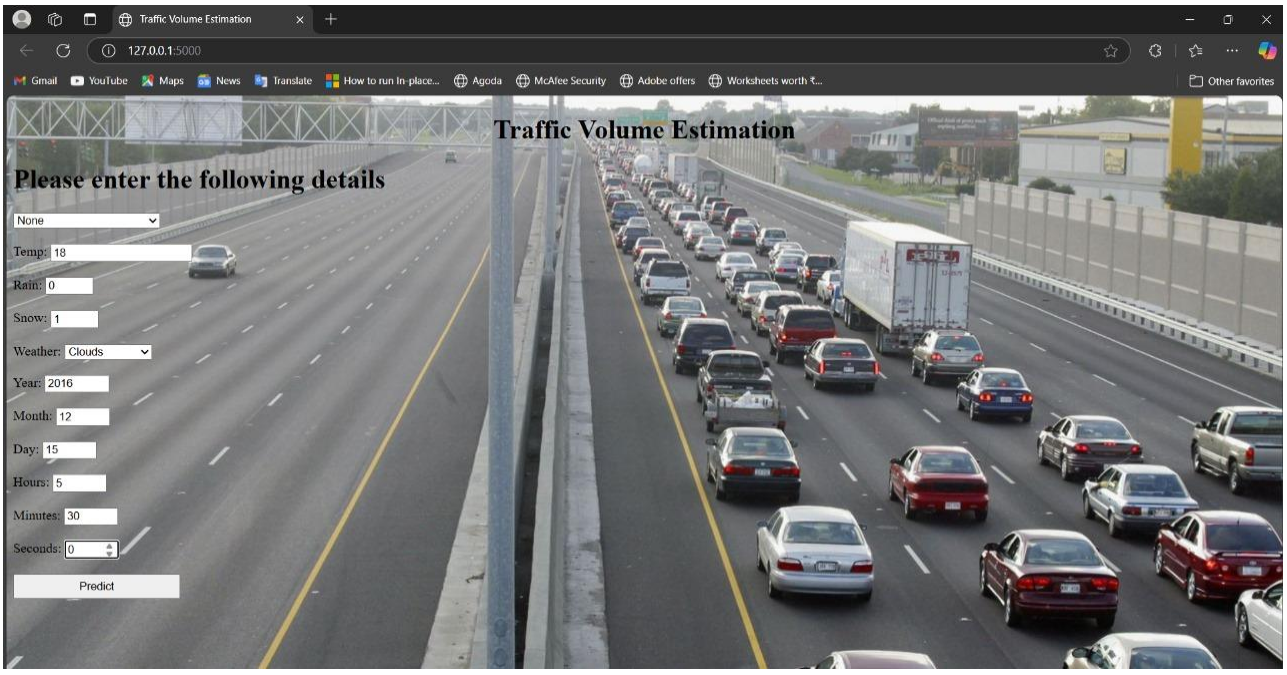
12. Screenshots or Demo




10000
8000
6000
4000
2000
0
temp
rain
snow
traffic_volume


temp
rain
snow
traffic_volume


Traffic Volume Estimation
127.0.0.1:5000
Traffic Volume Estimation
Please enter the following details
None
Temp: Temp
Rain: Rain
Snow: Snow
Weather: Clouds
Year: Year
Month: Month
Day: Day
Hours: Hours
Minutes: Minute
Seconds: Second
Predict


Traffic Volume Estimation
127.0.0.1:5000
Traffic Volume Estimation
Please enter the following details
None
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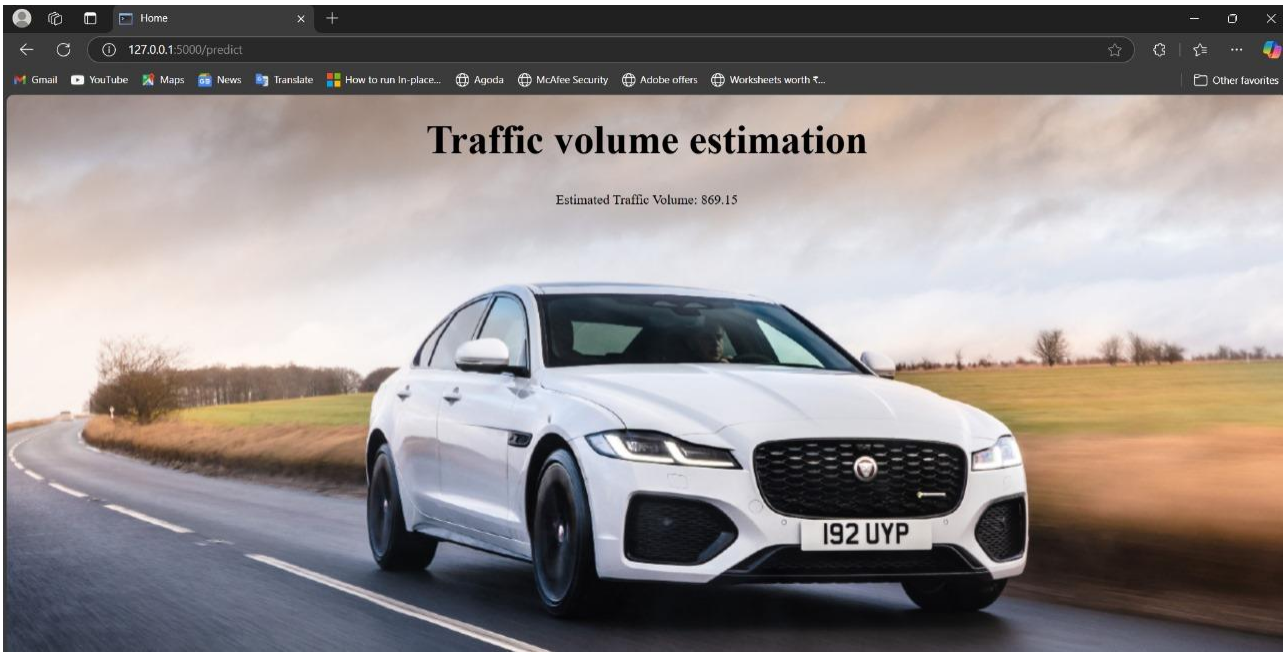
Rain: 0
Snow: 1
Weather: Clouds
Year: 2016
Month: 12
Day: 15
Hours: 5
Minutes: 30
Seconds: 0
Predict



13. License

This project is for educational purposes only.

No part of this code may be used, copied, or distributed without explicit permission from the authors.

14. Contact

For questions or contributions, please contact the team via GitHub issues or [Allammanikanta.22.Csm@anits.edu.in].

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