Traffic Volume Estimation Using Machine Learning

Submitted By

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1. Project Overview

Traffic volume estimation is crucial for urban planning, traffic management, and reducing congestion. This project utilizes machine learning techniques to predict traffic volume based on various environmental and time-based parameters such as temperature, rain, snow, weather condition, holiday indicator, and timestamp (year, month, day, etc.). The model was deployed as a web application using Flask to allow easy interaction and input via a user-friendly form.

2. Objectives

- To collect and preprocess relevant data for traffic volume prediction.
- To build and train a machine learning model for predicting traffic volume.
- To deploy the model using Flask as a web application.

- To make the UI interactive and visually appealing with a responsive background.

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3. Tools & Technologies Used

- **Programming Language:** Python
- **Libraries:** pandas, numpy, sklearn, matplotlib, Flask
- **Model Deployment:** Flask Web Framework

- **Frontend:** HTML, CSS
- **Data Visualization:** matplotlib (optional, for debugging and analysis)
- **Platform:** Jupyter Notebook / Anaconda / VS Code

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4. Dataset Description

The dataset contains the following features: - `holiday`: Whether the day is a holiday or not (encoded numerically) - `temp`: Temperature in degrees - `rain`: Rainfall amount - `snow`: Snow level - `weather`: Encoded weather condition - `year`, `month`, `day`: Date of the record

Target Variable: `traffic_volume` (number of vehicles passing during a specific time frame)

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5. Workflow

1. **Data Preprocessing**
    - Handled missing values
    - Encoded categorical features
    - Feature selection
2. **Model Training**
    - Chosen algorithm: Linear Regression / Decision Tree / Random Forest (based on experimentation)
    - Trained on historical traffic data
    - Evaluated using metrics like MAE, RMSE
3. **Scaling**
    - Used StandardScaler to normalize feature values
    - Saved the scaler using pickle
4. **Model Serialization**
    - Saved trained model and scaler as `model.pkl` and `scale.pkl` using pickle
5. **Flask App**
    - Created Flask routes for home and prediction

- Collected user input from HTML form
- Used scaler and model to predict output
- Displayed prediction on the same page

6. **Frontend UI**
   - Used HTML & CSS for designing the input form
   - Set background to a high-quality image of a car to enhance user experience

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6. Screenshots

Add screenshots of: - Home Page - Filled form before submission - Prediction result displayed

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7. Results

The model successfully predicts traffic volume based on the input parameters. Sample prediction:

Input: - Holiday: 1 - Temperature: 25°C - Rain: 0.1 mm - Snow: 0 mm - Weather: Clear - Year: 2022 - Month: 6 - Day: 15

Output: > Estimated Traffic Volume is: 4123 vehicles

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8. Challenges Faced

- Handling NaN values during scaling
- Mismatch between scaler and model input features
- Ensuring UI input matches the backend features

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9. Conclusion

This project provides a practical example of how machine learning can be applied to real-world traffic management systems. With further enhancement and integration with live data sources, this system can be made dynamic and scalable.

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10. Future Work

- Integrate real-time traffic API for live predictions
- Add more features like day of the week, time windows

- Improve accuracy with ensemble models or deep learning
- Host the model using cloud platforms like Heroku or AWS

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11. References

- scikit-learn documentation
- Flask documentation
- SmartBridge

Thank You!
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