TrafficTelligence: AI-Powered Traffic Volume Prediction System

📘Project Overview

TrafficTelligence is a smart traffic volume predictor powered by machine learning. It forecasts hourly traffic volume based on time, temperature, weather conditions, and public events. The complete pipeline includes data simulation, preprocessing, model training, and a fully interactive web dashboard with dark mode support and rich visualizations.

📁Project Structure

```
TrafficTelligence/
├── app.py                    # Flask web server
├── run_all.py               # Pipeline automation script
├── requirements.txt         # Dependencies list
├── README.md                # Project overview
├── data/
│   ├── synthetic_data.csv    # Simulated input data
│   ├── processed_data.csv    # Cleaned & encoded data
│   └── predictions.csv       # Prediction results
├── model/
│   └── traffic_model.pkl     # Trained ML model (Random Forest)
├── notebooks/
│   └── notebook_dGUv2.ipynb  # Jupyter analysis notebook
├── scripts/
│   ├── generate_data.py      # Data simulation logic
│   ├── preprocess.py         # Data transformation and encoding
│   ├── train_model.py        # Model training script
│   └── predict.py            # Script to predict from model
├── templates/
│   └── index.html            # Tailwind-based dashboard
├── static/                   # For static files (optional)
└── visualizations/
    └── traffic_analysis.png  # Output image/graph
```

⚙️Features Used for Prediction

- Hour (from datetime)

- Day of Week (from datetime)
- Temperature (°C)
- Weather Condition (Clear, Cloudy, Rainy, Fog — encoded)
- Event (binary: Yes/No Event)

Model Details

- **Model Type**: Random Forest Regressor
- **Training Size**: 8,760 synthetic hourly samples (1 year)
- **Metrics:**
- R^2 Score: 0.9617
- RMSE: 21.13
- **Output**: Predicted vehicle count (volume per hour)

🖥️Web Dashboard Highlights

- Built using **Flask** + **Tailwind CSS**
- 🌙**Dark Mode** toggle (persistent)
- 🌞Date & Time picker + dropdown inputs
- ⚡**Quick Scenario** presets (Rush Hour, Event Night)
- 🐃Static feature importance bars
- 🏜️Interactive traffic volume chart (Chart.js)

🗜️How to Run the Project

1. **Install required packages**:

```
pip install -r requirements.txt
```

1. **Generate synthetic dataset**:

```
python scripts/generate_data.py
```

1. **Preprocess data**:

```
python scripts/preprocess.py
```

1. **Train the model**:

```
python scripts/train_model.py
```

1. **Run the full pipeline** (optional):

```
python run_all.py
```

1. **Launch the Flask web server**:

```
python app.py
```

1. **Access the dashboard**:

```
http://127.0.0.1:5000
```

📈 Visual Outputs

- 🐃 `predictions.csv`: Model's forecasted traffic
- 🕊️ `traffic_model.pkl`: Reusable model file
- 🐃 `traffic_analysis.png`: Chart or heatmap saved output

🔮 Quick Scenario Buttons

- **Rush Hour**: 8:00 AM, Clear, High Volume
- **Event Night**: 7:00 PM, Event
- **Quiet Time**: 3:00 AM, Clear, Low Activity

🔧 Future Enhancements

- Integrate real-time APIs for weather/traffic
- Add Google Maps-based location predictions
- Enable PDF/Excel export of reports
- Host live app via Render or PythonAnywhere
- Include prediction history & user login

💻 Author

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