**Project Documentation:**

**Project Title:-**

**Traffic-Telligence: Advanced Traffic Volume Estimation With Machine Learning**

**Abstract:-**

**This project presents a machine learning-based approach to estimate traffic volume using historical data. By extracting temporal features from datetime information and applying ensemble regression techniques, it aims to accurately predict traffic congestion trends. The solution supports traffic planning, congestion control, and smart city development.**

**Objective:-**

**To develop an intelligent system that estimates traffic volume based on historical traffic data using supervised machine learning algorithms.**

**Technologies & Tools Used:-**

* **Programming Language: Python**
* **Libraries:**
  + **pandas, numpy (Data handling)**
  + **matplotlib, seaborn (Visualization)**
  + **scikit-learn (Machine learning algorithms)**
* **Model: Random Forest Regressor**

**Dataset:-**

* **Source: [Your dataset name or source here, e.g., UCI, Kaggle, etc.]**
* **Features Used:**
  + **date\_time: Timestamp of data collection**
  + **traffic\_volume: Actual number of vehicles (target variable)**
* **Engineered Features:**
  + **Hour of day**
  + **Day of week**
  + **Month**

**Workflow Overview:-**

**1. Data Loading**

* **Load CSV file using pandas.**

**2. Data Preprocessing**

* **Handle missing values.**
* **Convert date\_time to datetime format.**

**3. Feature Engineering**

* **Extract time-based features: hour, day\_of\_week, month.**

**4. Model Preparation**

* **Define input X and target y.**
* **Split dataset into training and test sets (80/20).**

**5. Model Training**

* **Use RandomForestRegressor from scikit-learn.**
* **Fit the model on training data.**

**6. Evaluation**

* **Calculate Mean Absolute Error (MAE).**
* **Compute R² score to assess model accuracy.**

**7. Visualization**

* **Plot actual vs. predicted traffic volume to interpret performance visually.**

**Results:-**

* **MAE: Measures how close predictions are to actual values.**
* **R² Score: Indicates how well the model explains variance in traffic volume.**

**Sample Output:-**

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**Mean Absolute Error: 356.23**

**R² Score: 0.88**

***(Example values)***

**Advantages:-**

* **Easy to implement and scale.**
* **Can be improved with more data (e.g., weather, roadwork, holidays).**
* **Suitable for real-time forecasting applications.**

**Future Improvements:-**

* **Include external features like:**
  + **Weather conditions**
  + **Events or holidays**
  + **Sensor location data**
* **Use deep learning (e.g., LSTM, GRU for time series).**
* **Deploy as a web app using Flask or Streamlit.**

**Conclusion:-**

**The proposed system effectively predicts traffic volume using historical data and temporal features. With further improvements and real-time integration, it can assist urban planners and smart transportation systems in managing congestion and optimizing traffic flow.**

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