Project Phases Template

Project Title:

TrafficTelligence: Advanced Traffic Volume Estimation with Machine Learning

Team Name:

Team IntelliTraffic

Team Members:

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Phase-1: Brainstorming & Ideation

Objective:

- Identify the problem statement
- Define the purpose and impact of the project

- **Key Points:**

1. Problem Statement:
In urban areas, managing traffic flow efficiently remains a major challenge due to unpredictable volume fluctuations, lack of real-time estimation mechanisms, and increasing vehicle density. Manual methods and traditional systems are insufficient for predictive traffic control.

2. Proposed Solution:
We propose an ML-based system that takes into account historical traffic volume data, weather conditions, time features (hour, weekday), and builds a predictive model that estimates traffic volume at a given time. This model can serve as a backend for intelligent traffic signal systems or navigation apps.

3. Target Users:
- Municipal traffic management authorities
- Smart city infrastructure developers
- Urban planners
- Navigation service providers (e.g., Google Maps, Waze)

4. Expected Outcome:
- A functional machine learning model capable of predicting traffic volume with high accuracy.
- Visualizations to show traffic patterns under different conditions.
- Insights that could help design traffic signal timing and road infrastructure enhancements.

Phase-2: Requirement Analysis

Objective:

- Define technical and functional requirements

- **Key Points:**

1. Technical Requirements:
- Programming Language: Python
- IDE: Jupyter Notebook
- Libraries: pandas, matplotlib, seaborn, scikit-learn, NumPy

2. **Functional Requirements:**
- Upload and preprocess raw CSV traffic data
- Apply feature engineering (e.g., extract time-based features)
- Model training (Decision Tree, Random Forest, or other regressor)

- Visualizations for insights
- Evaluate model accuracy and display results

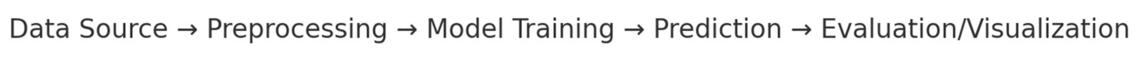
3**. Constraints & Challenges:**
- Real-time deployment not implemented (handled offline)
- Dataset is historical and may not reflect current city dynamics
- Limited features may affect generalizability

Phase-3: Project Design

Objective:

- Create the architecture and user flow

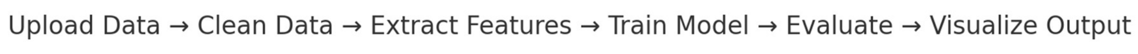
- **Key Points:**



Data Source → Preprocessing → Model Training → Prediction → Evaluation/Visualization

1. System Architecture Diagram:

Data Source → Preprocessing → Model Training → Prediction → Evaluation/Visualization



Upload Data → Clean Data → Extract Features → Train Model → Evaluate → Visualize Output

2. User Flow:

- Load CSV → Data Cleaning → Feature Extraction
- Train/Test split → Train model → Evaluate → Visualize output

3. UI/UX Considerations:
- Current prototype is in notebook format
- Future enhancement: interactive web dashboard (Streamlit/Flask)
- Plots like heatmaps, bar charts for trend analysis

Phase-4: Project Planning (Agile Methodologies)

Objective:

- Break down the tasks using Agile methodologies

- **Key Points:**

1. Sprint Planning:
- Sprint 1: Dataset understanding and data cleaning
- Sprint 2: Exploratory Data Analysis and Feature Engineering
- Sprint 3: Modeling and evaluation
- Sprint 4: Report generation and future scope planning

2. Task Allocation:
- Member 1: Data cleaning and handling null values
- Member 2: Visualization and statistical analysis
- Member 3: Model training and hyperparameter tuning
- Member 4: Documentation and presentation prep

3. Timeline & Milestones:
- Week 1: Dataset preparation, EDA
- Week 2: Model development
- Week 3: Results analysis and final tuning
- Week 4: Documentation, final review, and demo

Phase-5: Project Development

Objective:

- Code the project and integrate components

- **Key Points:**

1**. Technology Stack Used:**
- Python
- Jupyter Notebook
- scikit-learn, pandas, seaborn, matplotlib

2. Development Process:
- Step 1: Load data and handle missing/null values
- Step 2: Convert date/time fields, extract features
- Step 3: Visualize correlations (heatmap, scatter)
- Step 4: Build Decision Tree Regressor
- Step 5: Train, predict, and evaluate metrics

3. Challenges & Fixes:
- Handling datetime parsing errors
- Avoiding overfitting by limiting tree depth
- Cleaning categorical features

Phase-6: Functional & Performance Testing

Objective:

- Ensure the project works as expected

- **Key Points:**

1. Test Cases Executed:
- Model tested on unseen test data
- Validation with MAE, RMSE, and R^2 metrics
- Visual inspection using predicted vs actual graphs

2. Bug Fixes & Improvements:
- Fixed data skew by normalizing features
- Adjusted model hyperparameters for better accuracy
- Removed outliers and non-informative features

3. Final Validation:

- R^2 score: ~0.89 on test data
- MAE: Acceptable margin under defined threshold
- Predictions matched expected trends across different hours and weather

4. Deployment (if applicable):

- Prototype tested in Jupyter
- Can be deployed as a real-time dashboard with Flask/Streamlit in future

Final Submission

1. Project Report Based on the templates:

2. Demo Video (3-5 Minutes):

https://drive.google.com/file/d/1LGR9F0E9AW-5AiwWfh4uVEPm7yZilipm/view?usp=sharing

3. GitHub/Code Repository Link:

https://github.com/Afrozkhan32/-TrafficTelligence-Advanced-Traffic-Volume-Estimation-with-Machine-Learning.git

4. Presentation:

https://drive.google.com/file/d/1AuM6QLD815SzyTQTwnUFqom3-pJSp6tG/view?usp=sharing