Final Report: AI-powered Sustainable Transport Optimizer for Smart Cities

# Category

Cloud Application Development

# Skills & Technologies Used

• Programming & Frameworks: Python, FastAPI, Streamlit, Pydantic  
• AI & ML: IBM Watsonx Granite LLM, Linear Regression for KPI forecasting  
• Databases & Data Handling: Pinecone vector database, JSON, CSV, text file integration  
• Visualization & UI: Plotly, interactive Streamlit dashboard  
• Configuration: dotenv for environment management

# Project Overview

The AI-powered Sustainable Transport Optimizer is an intelligent digital assistant designed to help city planners and citizens make data-driven, eco-friendly decisions in urban transport planning. By analyzing traffic data, public transport usage patterns, and citizen feedback, the tool provides actionable recommendations to improve sustainability in smart cities.  
  
The solution combines machine learning, natural language processing, and semantic search to create a unified, user-friendly platform. With a modular backend built in FastAPI and a visual interface developed in Streamlit, the system supports dynamic data analysis, forecasting, and interactive querying.

# Core Modules & Features

✅ Traffic Data Summarizer  
- Upload traffic CSV reports.  
- Summarizes complex datasets into key actionable insights using IBM Watsonx Granite LLM.  
  
✅ Eco Route Recommendation  
- Analyzes public transport and road data to recommend greener, optimized travel routes.  
  
✅ Citizen Feedback Analyzer  
- Collects and categorizes feedback from citizens (e.g., reports of delays or overcrowding).  
- Helps planners identify recurring problems.  
  
✅ EV Charging Placement Optimizer  
- Forecasts demand for EV charging stations.  
- Suggests optimal new locations based on historical and real-time data.  
  
✅ KPI Forecasting  
- Predicts ridership, traffic density, and estimated CO₂ savings using Linear Regression.  
  
✅ Anomaly Detection  
- Detects unexpected spikes or drops in key transport KPIs.  
  
✅ Chat Assistant  
- AI-powered chatbot allows users to ask questions such as “How can I make my commute greener?” and receive real-time suggestions.

# Advanced & Mentor-Attracting Features

- Integration with live traffic APIs for real-time data insights.  
- Natural language querying through the AI chatbot.  
- Automated PDF/HTML report generation.  
- Interactive visualization dashboard with dynamic maps and graphs.  
- Alignment with sustainability goals, including SDG indicators for CO₂ reduction.  
- Feedback loop: citizens can rate AI recommendations to improve accuracy.

# Use Case Scenarios

- Summarizing yearly or monthly traffic data to inform city decisions.  
- Suggesting optimized, lower-emission routes for public and private transport.  
- Analyzing and visualizing citizen complaints for better service planning.  
- Planning and forecasting demand for new EV charging stations.  
- Predicting ridership and environmental impact for upcoming periods.  
- Detecting anomalies like sudden traffic surges.  
- Supporting citizens with eco-friendly travel advice via chatbot.

# Project Deliverables

- Complete, modular codebase uploaded to a GitHub repository.  
- Comprehensive documentation and this final project report.  
- Screenshots and sample outputs demonstrating features.  
- Demo links or a live hosted dashboard.  
- (Optional) Demo video walkthrough.

# Completion Workflow

- Move modules to “Review” in the Kanban board once implemented.  
- Submit for mentor review upon reaching ~90% completion.  
- Final mentor approval and issuance of project completion certificate.

# References

- IBM Watsonx Granite LLM documentation  
- Pinecone vector database docs  
- Streamlit and FastAPI official documentation  
- scikit-learn ML libraries  
- Sustainable urban planning resources