PROJECT OVERVIEW STATEMENT	Project Name: Predicting Smart Parking Availability Using ML and AI-Powered Chatbot Assistance	Student Name: Harshavardhan reddy Rangareddy gari

Problem/Opportunity:

Urban centers like Harrison face daily parking shortages, where users struggle to find nearby open parking spots. Although mobile parking applications exist, they often lack predictive capabilities and real-time insights. We identified an opportunity to build a machine-learning powered solution enhanced by natural language interaction to predict parking slot availability and provide safety context, offering real-time assistance and forecast-based planning.

Goal:

Our goal is to build a smart parking assistant capable of predicting parking slot availability using advanced machine learning techniques. It leverages Harrison's municipal data combined with NLP-driven safety analysis and provides answers to user queries via an AI chatbot. This end-to-end solution spans data preprocessing, ML modeling, sentiment analysis, UI development, and full-stack deployment.

Objectives:

Objective 1:
Outcome: Ingest and engineer features from Harrison municipal parking datasets retrieved from the city's parking dashboard API, complemented with dummy synthetic records for coverage. This approach enhanced model training by compensating for the absence of data from commercial parking apps.
Action: Integrated structured geospatial and temporal attributes such as slot number, timestamp, latitude, longitude, paid/free indicator, cleaning schedule risk, safety category, and encoded status for intelligent model training.

Objective 2:
Outcome: Train and optimize a Random Forest Regressor model to estimate future slot availability with high accuracy.
Action: Employed data normalization, hyperparameter tuning, model persistence (.pkl), and validation for performance.

Objective 3:
Outcome: Implement NLP-based sentiment classification using Reddit data to categorize street safety.
Action: Used transformer models and rule-based sentiment scoring for real-time street sentiment tagging using user-generated content.

Objective 4:
Outcome: Design a dynamic and responsive chatbot interface using Next.js, Tailwind CSS, and Framer Motion.
Action: Developed intuitive UX animations, integrated user inputs with ML output, and ensured a seamless flow for interactive parking guidance.

Objective 5:
Outcome: Full-stack deployment of backend and ML inference API on Render, exposing endpoints consumed by frontend.
Action: Created Flask API to serve model predictions, tested latency, and secured endpoints for production readiness.

Success Criteria:

- High-accuracy ML model integrated into production API.
- Sentiment-based safety ratings included per street.
- Frontend chatbot correctly serves user queries with correct predictions.
- Seamless deployment of full-stack app using Flask, Next.js, Tailwind, and Render.
- Real-time responses confirmed via testing and end-user feedback.

Assumptions, Risks, Obstacles:

Assumes availability of location-based datasets with accurate timestamps and status indicators. Risks include dataset incompleteness, model overfitting on dummy data, and chat UI integration issues. Obstacles included limited documentation on municipal APIs, ensuring performance under deployment constraints, and harmonizing safety NLP labels from noisy textual data. Continuous testing, augmentation strategies, and modular coding mitigated these risks.

Prepared By	Date	Approved By	Date
Harshavardhan reddy Rangareddy gari	6 February 2025		