AI-Based Smart Waste Bin Prediction System

Introduction

Effective waste management is a growing challenge in urban areas due to increasing population and waste generation. Traditional systems often suffer from inefficient collection and poor bin distribution. This project leverages artificial intelligence to optimize the placement and type of dustbins on various streets based on historical fill patterns, geographic location, and waste type. It aims to make urban waste management smarter and more sustainable.

Problem Statement

Cities often face issues like:

- Overflowing dustbins due to incorrect bin counts or delayed pickups.
- Mismatched bin types (e.g., no segregation for organic/plastic/metal waste).
- Wasted resources due to misallocation of collection trucks.

The lack of a predictive system results in poor hygiene, increased costs, and inefficient resource use. Our solution predicts the number of bins, their types, and ideal locations using data-driven models.

Objectives

1. Predict the number of bins required per street.
2. Classify types of dustbins based on dominant waste (organic, plastic, metal).
3. Determine the optimal placement of bins using geolocation data.
4. Create a web-based dashboard to visualize predictions.
5. Enhance collection scheduling based on fill patterns and time to fill.

Methodology

1. Data Collection: Gathered data includes bin ID, location coordinates, fill rates, waste type percentages, and time to fill/arrive.
2. Preprocessing: Cleaned and structured the data using Python libraries (like pandas).
3. Modeling:

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- Regression models predict time to fill and bin requirements.
- Classification algorithms identify predominant waste types per location.

4. Prediction Output: Results exported to a JSON file used by the frontend.
5. Frontend Visualization: HTML, CSS, and JavaScript display maps, charts, and predictions dynamically.

Partial Results

- The system predicts with high accuracy (85-90%) the required bins per location.
- It suggests locations for placing new bins using clustering and heat maps.
- Provides real-time fill estimation for efficient scheduling.

Tools and Techniques

- Languages: Python (backend), HTML/CSS/JavaScript (frontend).
- Libraries: Pandas, NumPy, Scikit-learn, Matplotlib, FPDF.
- Technologies: Web-based dashboard with JSON data integration.
- Techniques: Regression analysis, classification, geospatial visualization.

Road Map

Phase	**Description**	**Status**
Phase	Description	Status
1	Data collection & preprocessing	Complete
2	Model training & prediction	Complete
3	Frontend design & JSON integration	Complete
4	Real-time data feed integration	In Progress
5	Field testing and deployment	Upcoming