Smart Garbage Collection Management System for Karnataka Using Machine Learning

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Abstract: This project introduces a Smart Garbage Collection and Complaint Management System built using python and the Streamlit framework, tailored for municipalities in Karnataka. The system combined GPS-based tracking, data analytics, and active citizen participation to tackle the challenges of urban waste management. Citizens can easily register and log in to report complaints with location details, monitor the progress of their requests, and access area-wise cleanliness ratings. In addition, they receive useful waste classification insights and seasonal tips encourage eco-friendly practices.

For municipal administrators, the platform provides a secure, role-based system to handle complaints, monitor dustbin status, evaluate area cleanliness, and manage staff activities. Features such as worker assignment, shift scheduling, salary management, and instant notifications help improve coordination and accountability. A dedicated notification system also ensures smooth communication between municipal authorities and ground-level workers. Moreover, real-time vehicle tracking, waste analytics, and cleanliness metrics give administrators a complete overview of sanitation activities across the city.

By bridging the gap between citizens and municipal authorities, this system not only improves transparency and operational efficiency but also fosters greater community involvement in keeping cities clean. Ultimately, it supports the vision of "Clean Karnataka, Green Karnataka" and serves as a scalable framework that can be adapted for other cities to promote sustainable and smart urban waste management.

Keywords: *Smart City, Waste Management, Streamlit, Complaint Tracking, Vehicle GPS, Citizen Feedback, Urban Cleanliness.*

How to Cite: Srushti T.; Swarnalatha (2025) Smart Garbage Collection Management System for Karnataka Using Machine Learning. *International Journal of Innovative Science and Research Technology*, 10(8), 1211-1213. https://doi.org/10.38124/ijisrt/25aug928

I. INTRODUCTION

Rapid urbanization and population growth have made it increasingly difficult to maintain clean and sustainable cities. Waste management is one of the biggest challenges faced by municipal authorities, as traditional collection methods often result in inefficiencies, delays, and a lack of transparency. Citizens commonly experience issues such as overflowing bins, irregular garbage collection, and poor complaint redressal systems, which impact not only the environment but also public health and the overall quality of urban living. To overcome these challenges, there is a growing need for technology-driven solutions that bring together citizen participation, smart monitoring, and effective administrative control.

This paper presents a Smart Garbage Collection and Complaint Management System, developed using Python and the Streamlit framework, that serves as a unified platform for both citizens and municipal authorities. The system allows citizens to register, log in, and easily report waste-related issues by providing descriptions, location details, and images. They can also track the real-time status of their complaints, rate cleanliness in their locality, and receive useful seasonal tips to promote eco-friendly practices.

For administrators, the platform provides a secure dashboard with role-based access to manage complaints, monitor dustbin levels, track garbage collection vehicles, and manage worker assignments. Features such as instant notifications and task scheduling help ensure accountability and smooth operations. Additionally, the use of data analytics and visualization tools offers valuable insights into waste trends, enabling authorities to allocate resources more efficiently and plan long-term strategies for better waste management.

By combining citizen engagement, operational efficiency, and data-driven decision-making, this system supports the vision of Clean and Smart Cities while offering a scalable and sustainable model for urban development.

II. RELATED WORKS

In recent years, several technology-driven approaches have been introduced to improve the efficiency and transparency of municipal waste management. IoT-enabled solutions, such as those proposed by Al Mamun et al. (2016) and Longhi et al. (2012), use sensor-based bins to monitor fill levels and optimize garbage collection routes. Similarly, GPS-integrated tracking systems, like the one described by Patil and Kamble (2017), have been employed to monitor vehicle movements and strengthen fleet management in waste collection services.

Alongside these, mobile and web-based complaint management platforms have been developed under various smart city initiatives. A well-known example is India's **"Swachhata-MoUD"** application, which allows citizens to report issues with location data and image uploads while integrating with administrative workflows. However, such platforms often miss key features like real-time vehicle tracking or citizen feedback after complaint resolution.

Data visualization and waste analytics have also been explored as part of recycling and segregation efforts. Deep learning-based systems for automatic waste classification, such as those demonstrated by Yang et al. (2019), show promise in identifying waste categories but require high computational power, making them less practical for smaller municipalities.

The system proposed in this work addresses these gaps by combining real-time vehicle tracking, complaint management with multimedia support, user ratings and feedback, waste classification insights, and seasonal management tips into a single lightweight platform. Built with Python and Streamlit and using CSV-based storage, it provides a cost-effective, portable, and easily deployable solution ideal for small to medium-sized municipalities.

III. METHODOLOGY

The proposed Smart Garbage Collection and Complaint Management System is implemented using Python and the Streamlit framework, offering an interactive, web-based platform for both citizens and municipal administrators. The methodology involves the following key stages:

➢ *System Architecture*

The system is designed as a modular, role-based platform with two primary user roles—citizen (user) and administrator (admin). All data is stored in CSV files for ease of access, portability, and minimal deployment requirements.

➢ *User Interface Design*

The frontend is built with Streamlit, providing an intuitive and responsive interface. Citizens access features such as complaint submission, live vehicle tracking, and waste analytics, while administrators manage user data and review complaints.

➢ *Complaint Submission & Tracking*
- Users submit complaints by specifying location, type, description, and optionally uploading images.
- Complaints are stored in user_complaints.csv with status set as "Pending" by default.
- The system allows users to track their complaint status using their registered phone number.
- Once resolved, users can rate the service and provide feedback, which is stored for performance evaluation.

➢ *Live Vehicle Tracking*

Real-time garbage vehicle locations are displayed on an interactive map using the Folium library. Vehicle data, including ID, driver name, speed, and district, is read from a dataset and represented as map markers with custom icons.

➢ *Administrator Functions*
- View registered user details (excluding passwords).
- Filter complaints by status, type, or rating.
- Update complaint status (Pending, In Progress, Resolved) and add remarks.
- Export complaints data as CSV for reporting purposes.

➢ *Waste Classification Analytics*

The system visualizes waste data by type, hazardous status, and recyclability using bar charts and metrics. This module helps in understanding waste distribution and guiding awareness campaigns.

➢ *Awareness & Seasonal Tips*

A dedicated section provides citizens with seasonal waste management guidelines for summer, monsoon, and winter to promote better community practices.

➢ *Data Management*

All records—users, complaints, and vehicle tracking data—are maintained in CSV format for ease of backup and compatibility. This design choice ensures that the system remains lightweight and easily deployable in small to medium municipal settings.
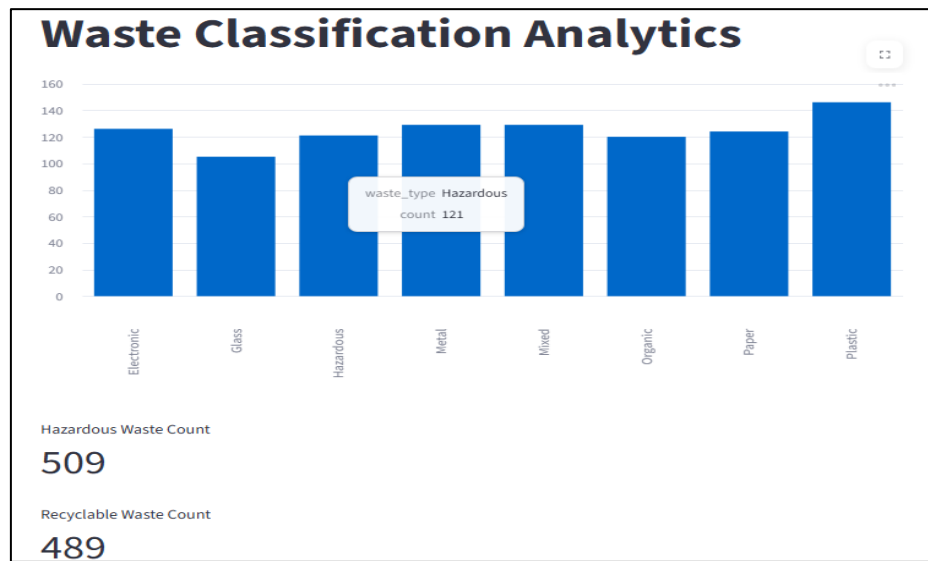
IV. RESULT

Fig 1: Waste Classification Analytics

V. CONCLUSION

The Smart Garbage Collection and Complaint Management System offers a practical, user-friendly, and transparent approach to tackling urban waste management challenges. By combining features such as complaint registration, GPS-enabled vehicle tracking, waste classification analytics, and citizen feedback, the system effectively bridges the gap between the public and municipal authorities.

Through real-time updates, cleanliness ratings, and awareness tips, it not only improves the efficiency of waste collection but also motivates citizens to take an active role in maintaining their surroundings. The use of Python with the Streamlit framework and simple CSV-based storage makes the system lightweight, portable, and easy to deploy, without the need for complex infrastructure.

Overall, this work demonstrates how digital tools, when combined with active citizen participation, can significantly improve waste collection services, strengthen accountability, and contribute to building cleaner and healthier cities.

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