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**Application Engineering and Development**

## **Final Project Proposal**

**Topic: Garbage Collection and Tracking System**

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## **1. Problem Statement**

**Urban waste management poses significant challenges in cities worldwide. Overflowing garbage bins and inefficient waste collection methods lead to environmental hazards, public health concerns, and logistical inefficiencies. Traditional methods rely heavily on manual monitoring and predetermined schedules, which fail to address real-time variations in waste generation. This often results in missed collections, underutilization of resources, and citizen dissatisfaction.**

**The primary challenges include:**

* **Overflowing bins causing hygiene issues and pollution.**
* **Inefficient routing of garbage collection vehicles.**
* **Lack of actionable insights into waste patterns for city planners.**
* **Minimal citizen engagement and feedback in waste management systems.**

## **2. Solution**

**The Garbage Collection and Tracking System is a data-driven platform designed to optimize urban waste collection. It integrates citizen reporting and data aggregation to streamline waste management. The system allows for real-time monitoring, basic route prioritization, and efficient task management, enabling seamless collaboration between citizens, administrators, and drivers.**

**Core Focus Areas:**

* **Citizen Reporting: Develop a desktop Java application for citizens to report full bins.**
* **Data Aggregation: Use a simple database (e.g., SQLite or MySQL) to store bin reports.**
* **Route Assignment: Implement a basic rule-based prioritization instead of complex optimization algorithms.**
* **Driver Interaction: Provide a simple module for drivers to mark bins as collected.**
* **Admin Monitoring: Allow administrators to view reports and assign bins to drivers.**
* **Authentication Module: Robust role-based authentication.**
* **Configuration Module: Integration with Faker for test data and validation.**
* **Reporting Module: Expanded insights and visuals.**

#### **Citizen Reporting**

* **Users (citizens) can log reports about overflowing bins using a simple GUI built with Java Swing.**
* **Each report includes:**
  + **Bin ID or location (user inputs or dropdown selection).**
  + **Report timestamp (auto-generated).**
  + **Bin type (organic, recyclable, etc.).**

#### **Data Aggregation**

* **Reports are consolidated into a database table.**
* **Administrators can view all reports, filter by bin type or priority (e.g., overflowing).**

#### **Route Assignment**

* **Administrator assigns bins to drivers based on simple prioritization rules:**
  + **Overflowing bins (manual selection or timestamp-based sorting).**
  + **Vehicle capacity limits (manual input).**

#### **Driver Interaction**

* **Drivers view assigned bins on a separate interface.**
* **Mark bins as "Collected" to update their status in the database.**

#### **Admin Monitoring**

* **Admin can:**
  + **Add or manage drivers and bins.**
  + **View collection logs for accountability.**

#### **Reporting Module**

* **Basic insights generated (e.g., count of bins collected, most reported bins).**
* **Use simple bar charts or textual summaries.**

#### **Tech Stack**

1. **Programming Language: Java (for desktop applications using Swing for GUI).**
2. **Database: SQLite or MySQL (for storing and managing reports, bin data, and logs).**
3. **Libraries and Tools:**
   * **Java Swing: For GUI development.**
   * **JDBC: For database connectivity.**
   * **Charting Library: For creating bar charts in the reporting module.**
   * **bcrypt library for authentication.**
4. **Development Environment: NetBeans**
5. **Version Control: GitHub for collaboration and version tracking.**

### **3. High Level Component Diagram**

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### **4. Ecosystem Hierarchy**

#### **Network**

* **A unified network overseeing waste management across the city, facilitating communication between stakeholders, and acting as a centralized system for logging and tracking garbage bin reports. This network ensures collaboration among various entities in waste management.**

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#### **Enterprises**

* **Municipal Corporation: Manages waste collection logistics, ensures adherence to waste management policies, and oversees operations, ensuring smooth functioning across all zones.**
* **Collection Contractors: Independent organizations responsible for garbage collection vehicles and drivers, contracted by the municipal corporation for operations in specific city zones.**
* **Recycling Plants: Enterprises responsible for processing recyclables. They receive segregated waste from collection contractors and manage its sorting and processing.**
* **Environmental NGOs: NGOs working on community outreach, awareness programs, and supporting sustainable waste management initiatives. They collaborate with the municipal corporation to promote recycling and waste reduction.**

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#### **Organizations**

* **Waste Collection Zones: Divisions across the city where waste collection services are organized and tracked for effective management.**
* **Driver Associations Independent associations managing drivers working for collection contractors, ensuring quality control and safety during operations.**
* **Bin Maintenance Units: Organizations ensuring proper maintenance and replacement of waste bins throughout the city.**
* **Data Aggregation Teams: A team responsible for collecting and analyzing the data from reports and usage trends, ensuring the system's accuracy.**
* **IT Support Teams: Support teams managing the technical aspects of the platform, ensuring smooth operations and resolving technical issues.**
* **Regulatory Bodies: Government bodies that enforce local waste management regulations, monitor compliance, and provide oversight.**

**Roles**

* **Citizens: Use the desktop Java application to report full bins and provide feedback on waste collection services, enhancing community engagement.**
* **Administrators (Municipal Corporation): Monitor incoming reports and bin statuses, assign bins to collection vehicles based on priority, and generate and analyze performance reports. They ensure smooth operations by tracking waste collection data and making informed decisions.**
* **Drivers (Collection Contractors): Access assigned collection routes through a desktop module, mark bins as "Collected" during their route, and update the database to maintain accurate records of waste collection.**
* **Supervisors: Oversee the work of drivers and manage the collection operations in specific zones to ensure timely and efficient waste management.**
* **Analysts: Analyze waste collection data to identify trends, make predictions, and provide insights to improve overall system efficiency.**
* **Maintenance Staff: Responsible for the upkeep and replacement of bins, ensuring that the waste collection system remains operational and efficient.**
* **Zone Managers: Manage operations within specific geographic zones, ensuring the smooth collection of waste and resolving any zone-specific issues.**
* **Recycling Coordinators: Work with contractors and citizens to ensure recyclables are correctly identified and processed, facilitating the city's sustainability efforts.**

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#### **Use Cases**

**Citizen Reporting:**

* **Citizens use the desktop application to report full bins, contributing to waste management by providing real-time data on bin statuses. This improves public engagement and responsiveness in the waste collection process.**

**Data Aggregation and Prioritization:**

* **The system consolidates bin reports and prioritizes bins for collection based on fill levels, urgency, and bin type (organic, recyclable). Administrators can view and filter the data to allocate resources efficiently.**

**Route Assignment:**

* **Administrators assign bins to drivers based on prioritization (e.g., overflowing bins) and available resources. Simple manual input or automated timestamp-based sorting helps in the route allocation.**

**Driver Interaction:**

* **Drivers access the desktop module to view their collection routes. They update the bin status (collected) and log any issues during collection, which is updated in real time in the database.**

**Administrative Oversight:**

* **Administrators monitor system performance, including bin collection status and waste generation patterns. They generate performance reports to analyze trends, such as collection efficiency, and identify areas for improvement.**