



Smart Waste Management System

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Introduction

Efficient waste management is a crucial aspect of urban and campus planning. This project aims to track waste collection, monitor bin capacities, and optimize collection routes using a relational database. It helps reduce overflow, improves resource allocation, and supports sustainability.



Problem Statement

Many cities and campuses face problems with overflowing waste bins.

Manual tracking of waste collection is inefficient and error-prone.

It is difficult to know which bins are full or which worker collects the most.

There is no system to generate reports or analyze collection trends.

This project aims to track bins, workers, and routes to manage waste efficiently.



Objectives

- To maintain a digital record of bins, waste collection, workers, and routes.
- To track daily waste collection per bin and worker.
- To identify bins that frequently overflow.
- To use SQL queries for predictive analysis and optimization.



Database Design

Table Name	Columns & Description
Bins	bin_id (PK), location, bin_type (plastic/organic/e-waste), capacity
Workers	worker_id (PK), name, assigned_bin_id (FK)
Collections	collection_id (PK), bin_id (FK), date, amount_collected
Routes	route_id (PK), worker_id (FK), date, total_waste_collected



How Tables Work

- **Bins:** Stores details about all waste bins in the area, including type and capacity.
- **Workers:** Contains information about employees responsible for collection.
- **Collections:** Tracks waste collected from each bin on specific dates.
- **Routes:** Records which worker collected waste on a given day and total collected, allowing performance analysis.

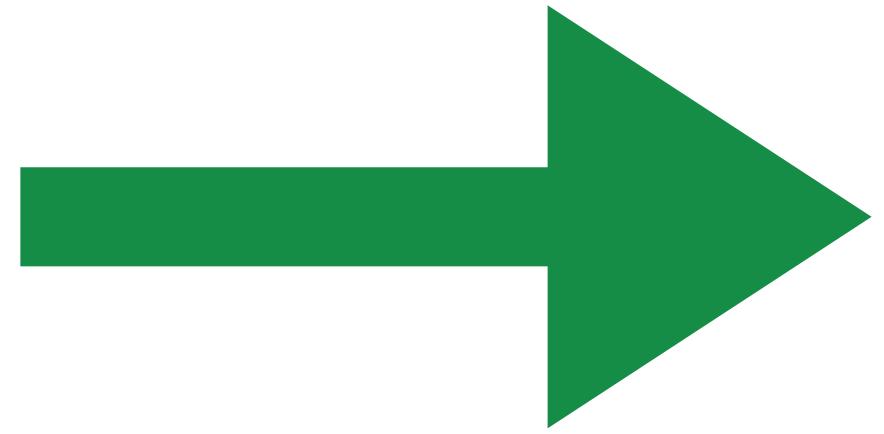


Sample SQL Features Used

- **Aggregate Functions:** SUM, AVG, COUNT (for total waste, average per bin, etc.)
- **JOINS:** To combine bin, worker, and collection data for analysis
- **GROUP BY / HAVING:** To identify high-performing workers or overflowing bins
- **Date Functions:** MONTH, WEEK to extract month and week



SQL Queries





To Create Database:

```
CREATE DATABASE Project
```

To Create Bins Table:

```
CREATE TABLE Bins (
    bin_id INT PRIMARY KEY,
    location VARCHAR(255) NOT NULL,
    bin_type ENUM('plastic', 'organic', 'e-waste') NOT NULL,
    capacity INT NOT NULL
);
```

To Create Workers Table:

```
CREATE TABLE Workers(
    worker_id INT PRIMARY KEY,
    name VARCHAR(100) NOT NULL,
    assigned_bin_id INT,
    FOREIGN KEY (assigned_bin_id) REFERENCES Bins(bin_id)
);
```



To Create Collections Table:

```
CREATE TABLE Collections (
    collection_id INT PRIMARY KEY,
    bin_id INT NOT NULL,
    date DATE NOT NULL,
    amount_collected INT NOT NULL,
    FOREIGN KEY (bin_id) REFERENCES Bins(bin_id)
);
```

To Create Routes Table:

```
CREATE TABLE Routes (
    route_id INT PRIMARY KEY ,
    worker_id INT NOT NULL,
    date DATE NOT NULL,
    total_waste_collected INT NOT NULL,
    FOREIGN KEY (worker_id) REFERENCES Workers(worker_id)
);
```



1. Total wastage collected from all bins:

```
SELECT SUM(amount_collected) AS TOTAL_WASTAGE  
FROM Collections;
```

	TOTAL_WASTAGE
▶	14155

2. Worker-wise total waste collected

```
SELECT w.worker_id, w.name, SUM(r.total_waste_collected) AS  
total_waste  
FROM Routes r  
JOIN Workers w ON r.worker_id = w.worker_id  
GROUP BY w.worker_id, w.name  
ORDER BY total_waste DESC;
```

	worker_id	name	total_waste
▶	24	Sanjay Deshmukh	850
	6	Ramesh Jadhav	850
	18	Mahesh Raut	850
	30	Manoj Kadam	850
	12	Nikhil Wagh	850
	36	Rohit Shirsat	850
	32	Rajendra Shelke	840
	2	Ashish Gole	840



3. Bin-wise total and average waste

```
SELECT b.bin_id, b.location, b.bin_type,  
SUM(c.amount_collected) AS total_waste,  
ROUND(AVG(c.amount_collected),2) AS avg_waste  
FROM Collections c  
JOIN Bins b ON c.bin_id = b.bin_id  
GROUP BY b.bin_id, b.location, b.bin_type  
ORDER BY total_waste DESC;
```

bin_id	location	bin_type	total_waste	avg_waste
12	Nigdi	e-waste	330	82.50
16	Koregaon Park	plastic	330	82.50
8	Hinjewadi	organic	320	80.00
4	Deccan	plastic	320	80.00
7	Baner	plastic	315	78.75
20	Camp	organic	310	77.50
19	Bavdhan	plastic	300	75.00
6	Aundh	e-waste	295	73.75

4. Identification of overflowing bins

```
SELECT b.bin_id, b.location, b.capacity, SUM(c.amount_collected)  
AS total_collected  
FROM Collections c  
JOIN Bins b ON c.bin_id = b.bin_id  
GROUP BY b.bin_id, b.location, b.capacity  
HAVING SUM(c.amount_collected) > b.capacity  
ORDER BY total_collected DESC;
```

	bin_id	location	capacity	total_collected
	12	Nigdi	120	330
	16	Koregaon Park	135	330
	8	Hinjewadi	105	320
	4	Deccan	110	320
	7	Baner	140	315
	20	Camp	105	310
	19	Bavdhan	110	300
	6	Aundh	130	295



5. Monthly waste trends

```
SELECT MONTH(c.date) AS month,  
       SUM(c.amount_collected) AS total_waste  
  FROM Collections c  
 GROUP BY MONTH(c.date)  
 ORDER BY month;
```

	month	total_waste
▶	1	2075
	2	1870
	3	2225
	4	2185
	5	2240
	6	2185
	7	1375

6. Weekly waste trends

```
SELECT YEAR(c.date) AS year, WEEK(c.date, 1) AS week_number,  
       SUM(c.amount_collected) AS total_waste  
  FROM Collections c  
 GROUP BY YEAR(c.date), WEEK(c.date, 1)  
 ORDER BY year, week_number;
```

	year	week_number	total_waste
▶	2025	1	300
	2025	2	485
	2025	3	480
	2025	4	465
	2025	5	460
	2025	6	475
	2025	7	470
	2025	8	485



7. Top-performing workers and routes

```
SELECT w.worker_id, w.name, r.route_id, r.date,  
r.total_waste_collected  
FROM Routes r  
JOIN Workers w ON r.worker_id = w.worker_id  
ORDER BY r.total_waste_collected DESC  
LIMIT 10;
```

	worker_id	name	route_id	date	total_waste_collected
▶	6	Ramesh Jadhav	6	2025-01-06	290
	12	Nikhil Wagh	12	2025-01-12	290
	18	Mahesh Raut	18	2025-01-18	290
	24	Sanjay Deshmukh	24	2025-01-24	290
	30	Manoj Kadam	30	2025-01-30	290
	36	Rohit Shirsat	36	2025-02-05	290
	42	Sunil Thorat	42	2025-02-11	290
	48	Ajay Gaikwad	48	2025-02-17	290

8. Bin type analysis (plastic, organic, e-waste)

```
SELECT b.bin_type, SUM(c.amount_collected) AS total_waste,  
ROUND(AVG(c.amount_collected),2) AS avg_waste  
FROM Collections c  
JOIN Bins b ON c.bin_id = b.bin_id  
GROUP BY b.bin_type  
ORDER BY total_waste DESC;
```

	bin_type	total_waste	avg_waste
▶	plastic	4840	72.24
	e-waste	4665	70.68
	organic	4650	69.40



9. Workers assigned to the bin that collected the maximum waste

```
SELECT worker_id, name  
FROM Workers  
WHERE assigned_bin_id = (  
    SELECT Collections.bin_id  
    FROM Collections  
    INNER JOIN Bins  
    ON Collections.bin_id = Bins.bin_id  
    GROUP BY Collections.bin_id  
    ORDER BY SUM(amount_collected) DESC  
    LIMIT 1  
);
```

worker_id	name
12	Nikhil Wagh
72	Kiran Patil 2
112	Bhavesh Kadam
172	Anand Kadam
HULL	HULL

10. Locations with the lowest bin capacity

```
SELECT location, capacity  
FROM Bins  
WHERE capacity = (  
    SELECT MIN(capacity) AS MINIMUM_CAPACITY  
    FROM Bins  
);
```

location	capacity
Pune Station	90
Hadapsar	90



Expected Analysis

- Worker-wise total waste collected
- Bin-wise total and average waste
- Identification of overflowing bins
- Monthly and weekly waste trends
- Top-performing workers and routes
- Bin type analysis (plastic, organic, e-waste)
- Location with lowest bin capacity



Thank You !