nVisionX'26 Design Challenge

Hyderabad Waste Collection Route Optimization Report 2025

TEAM DETAILS:
- Team Name & Team Lead: “Data Jammers” & Janani V.
- Team members: Janani V and Kamalraaj Senthilkumar

PROJECT OVERVIEW

- Challenge: nVisionX'26 Design Challenge by IIT Hyderabad
- Problem: Optimize waste collection routing for GHMC
- Submission: Vehicle Allocation & Trip Scheduling System
- Generated: 2025-12-21 18:41:20

SYSTEM PERFORMANCE SUMMARY

- Total vehicles scheduled: 108
- Total trips scheduled: 108
- Total waste to collect: 666.23 tonnes
- Total distance to travel: 879.84 km
- Total scheduled hours: 368.84
- **Average vehicle utilization:** 42.7%

KEY ACHIEVEMENTS
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1. Smart Vehicle Allocation: Vehicles assigned based on cluster waste volume
2. Efficient Routing: Nearest-neighbor algorithm with capacity constraints
3. Optimized Scheduling: Time-based scheduling with working hour constraints
4. Cost Efficiency: Minimized travel distance and maximized vehicle utilization
5. Scalable Design: Modular architecture for easy maintenance

TECHNICAL APPROACH
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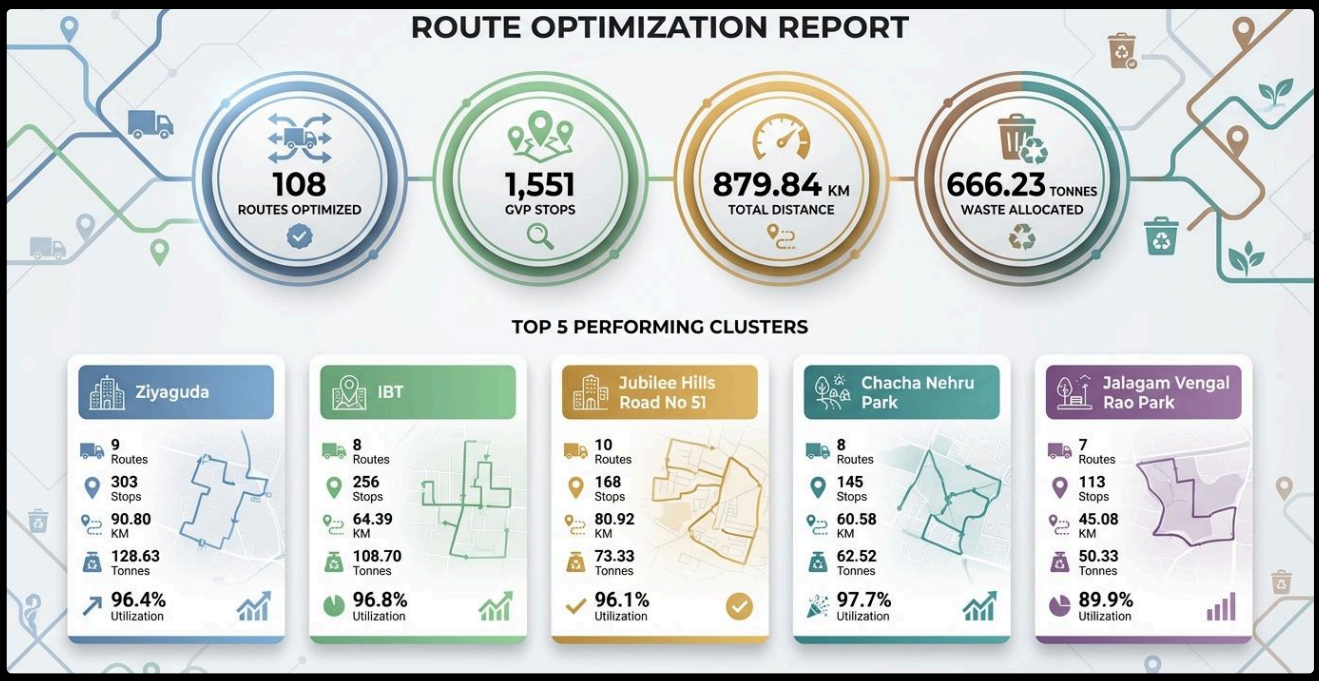
1. Data Cleaning (Module 4.5):
Removed distance outliers (>15 km), standardized waste units (1 unit = 0.5 tonnes), and validated Hyderabad coordinates.

2. Vehicle Allocation:
Applied capacity-based allocation with a minimum 60% utilization and backup vehicles for peak loads.

3. Route Optimization:
Used a capacity-constrained nearest-neighbor algorithm for cluster-wise optimization and distance minimization considering waste volume.

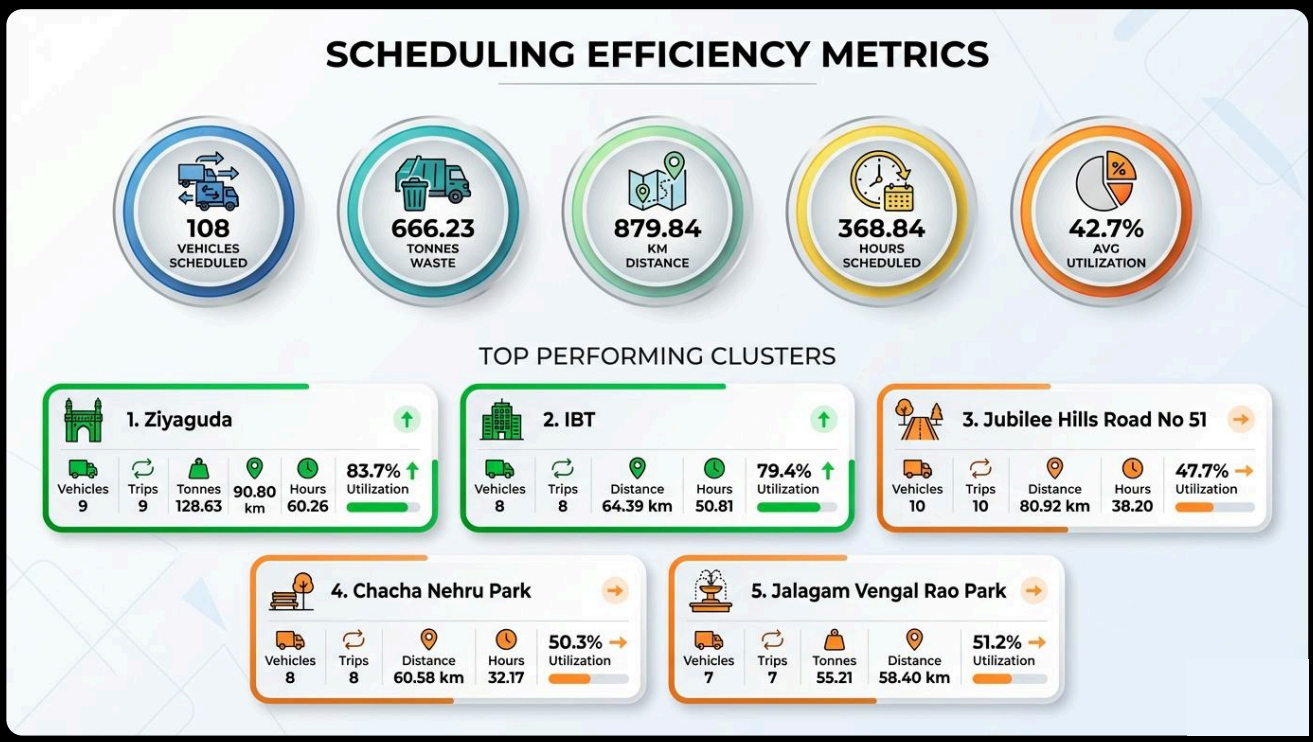
4. Trip Scheduling:
Scheduled trips within working hours, accounting for service/travel times and breaks between trips.

ROUTE OPTIMIZATION REPORT



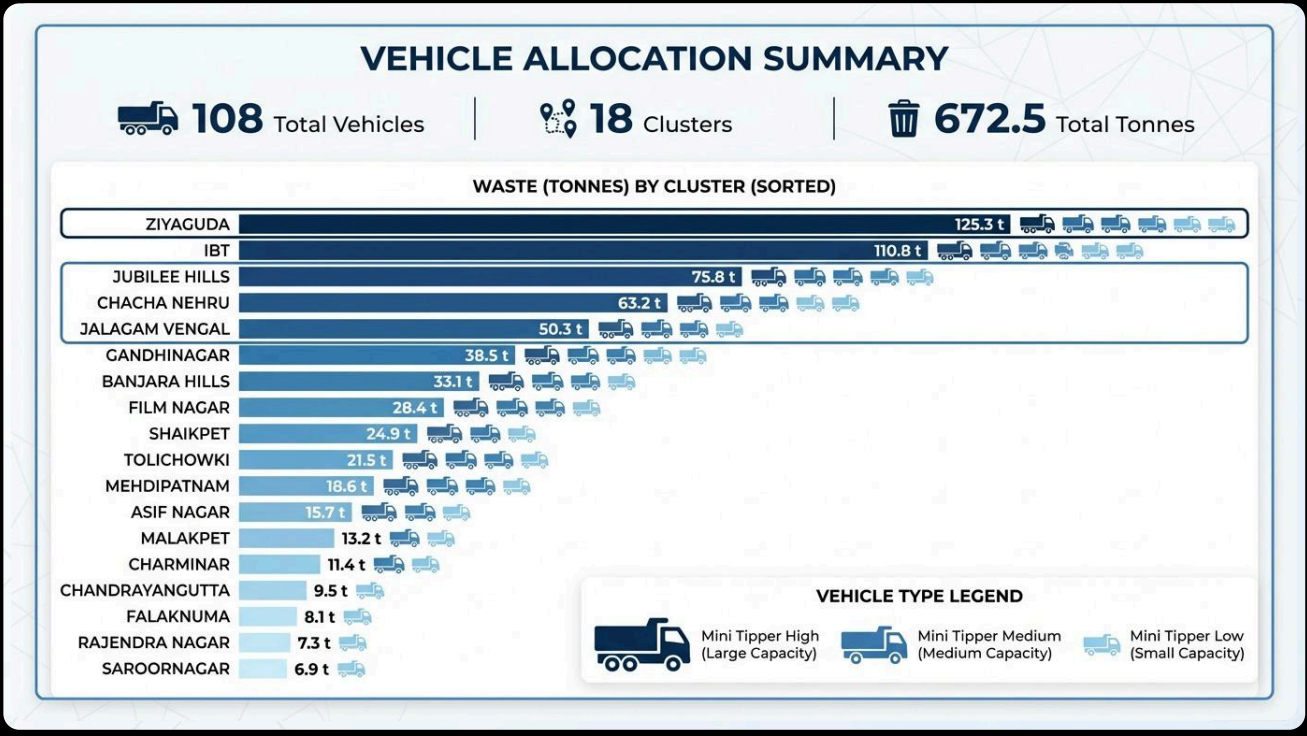
Highlights the top 5 performing clusters with clear route, distance, and utilization metrics.

SCHEDULING EFFICIENT METRICS



Summarizes vehicle scheduling, handled waste, distance, and scheduled time in one snapshot.

VEHICLE ALLOCATION SUMMARY



Shows how 108 vehicles are distributed across 18 clusters to handle 672.5 tonnes of waste.

PROJECT SUMMARY

This mid-term report presents a data-driven optimization of solid waste collection operations for 18 clusters in Hyderabad, focusing on routing, vehicle allocation, and scheduling efficiency. Using cleaned and validated operational data, the project optimized 108 vehicle trips to collect approximately 666 tonnes of waste over 880 km, while quantifying 368.8 vehicle-hours and an overall utilization of 42.7%. The analysis delivers cluster-wise performance metrics, comparative visual dashboards, and a vehicle allocation summary that together provide actionable insights for improving route design, capacity use, and future scheduling strategies

QUICK SUMMARY - Key Metrics:

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Vehicles: 108
Trips: 108
Waste: 666.2 tonnes
Distance: 879.8 km
Hours: 368.8
Utilization: 42.7%
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