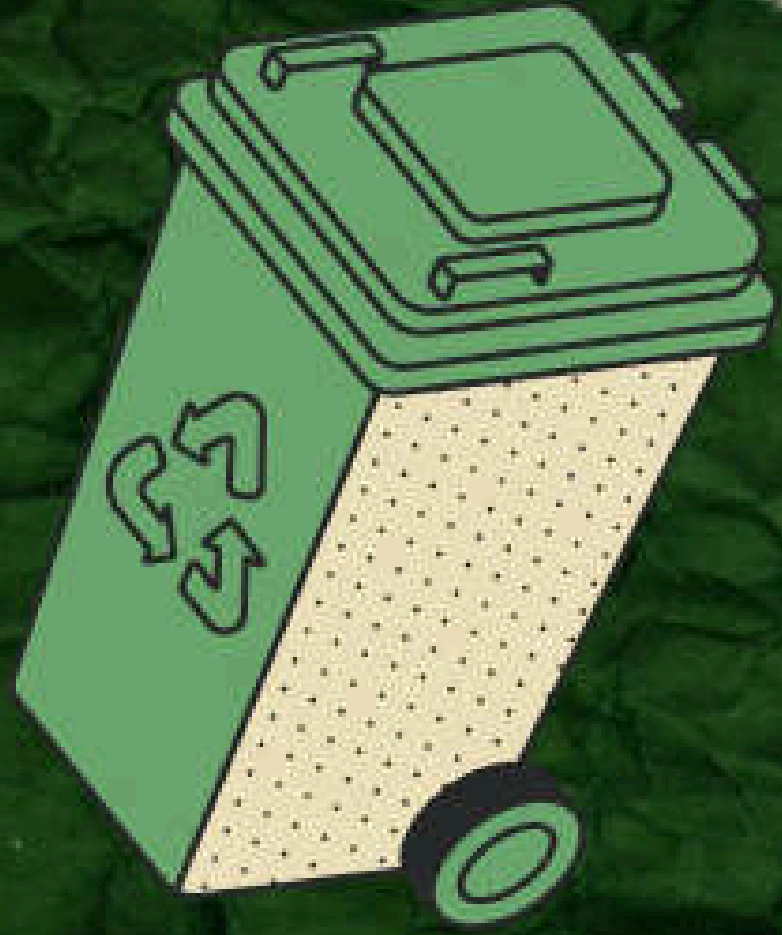




Smart Waste Management System



R26-IT-126

PROGRESS PRESENTATION 1



Veo

PROPOSAL COMMENTS & IMPROVEMENTS



Proposal Feedback	Improvements Added
Need to forecast for whole municipal council, not for a particular institute or company.	The system was redesigned to forecast waste generation for the entire municipal council by considering multiple zone categories and municipal operational factors.
Improve the component (Ex" Give notifications to Waste truck location)	Implemented real-time driver GPS tracking with geofence-based arrival notifications — residents receive automatic alerts when the waste truck approaches within 50 meters of their pickup location.



Problem and Impact

Traditional waste collection systems use fixed schedules and manual coordination, leading to overflowing bins, delayed pickups, inefficient routes, lack of future waste generation insights and increased fuel costs. These issues negatively affect urban cleanliness, operational efficiency, and public health.

Who Will Benefit from the Solution

- **Municipal Councils** — Improved waste collection efficiency and reduced operational costs
- **Waste Collection Drivers** — Optimized routes and real-time pickup updates
- **Residents** — Easy waste pickup requests and faster collection services
- **Public Health & Environmental Authorities** — Cleaner and safer urban environments

Research Objective

Main Objective

To develop a smart waste management system that improves municipal waste collection efficiency using IoT, machine learning, predictive analytics, and route optimization .

Sub-Objectives

- Develop a real-time smart bin monitoring system
- Predict future wet and dry waste generation using machine learning
- Estimate waste composition for recycling preparation
- Enable map-based waste pickup requests for residents
- Implement optimized waste collection routing for drivers
- Reduce fuel usage, overflow risks, and collection delays





IT22213358 | JAYAWARDHANE K. G. M. S.

Machine Learning-Based Waste Prediction & Composition Estimation Engine

Bachelor of Science (Hons) in Information Technology
Specializing in Information Technology



Problem Definition:

- Lack of predictive waste forecasting in municipal waste management
- Difficult to prepare recycling and waste processing resources in advance
- Waste collection planning is mostly reactive
- Limited data-driven decision support for municipal operations



The Solution Addresses the Sub-Problem/ Prototype:

- Predicts next-week wet and dry waste generation using ML models
- Estimates waste composition patterns before collection
- Supports proactive recycling preparation and resource allocation
- Provides predictive insights for municipal waste planning

Design Excellence / Contribution:

- Introduces predictive analytics into smart waste management
- Uses machine learning for municipal waste forecasting
- Supports data-driven operational planning
- Improves recycling and waste processing preparation
- Enhances smart city waste management capabilities

User Feedback on Prototype:

- Prototype provides useful waste prediction insights
- Helps improve waste collection planning
- Supports proactive municipal decision-making
- Considered practical for smart city waste management applications





IT22202772 | GAMAARIYA C. C.

Smart Fill-Level & Occupancy Monitoring

Acts as the core sensing layer by generating real-time fill and occupancy intelligence for downstream analytics.
Transforms passive fill sensing into behavior-aware smart waste monitoring

Bachelor of Science (Hons) in Information Technology
Specializing in Information Technology

The Solution Addresses the Sub-Problem/ Prototype

- HC-SR04 ultrasonic sensor monitors bin fill level
- Magnetic reed switch detects lid activity
- ESP32 sends real-time data to Firebase Realtime Database
- React web application displays live bin status
- Alert system warns when fill level exceeds 95%
- Green / Yellow / Red light system indicates bin fill status physically

Problem Definition:

- Traditional bins cannot detect fill level automatically
- Overflowing bins create hygiene and environmental issues
- Manual monitoring wastes time and effort
- No real-time smart waste monitoring system



Design Excellence / Contribution:

- ESP32-based smart monitoring system
- Firebase enables real-time data synchronization
- Real-time Firestore streams — instant cross-device sync without polling
- React web application provides live visualization
- OK / WARNING / CRITICAL alert system implemented

User Feedback on Prototype:

- Helps waste collectors monitor bins easily
- Alerts help prevent overflow conditions
- Web application useful for remote monitoring
- System considered simple and user-friendly





IT22548528 | HEMSARA K.D.S

IoT-Based Environmental Sensing Smart Bin

Bachelor of Science (Hons) in Information Technology
Specializing in Information Technology

The Solution Addresses the Sub-Problem/ Prototype:

- ESP32-based environmental sensing smart bin system
- MQ135 and MQ4 sensors used for harmful gas detection
- DHT22 sensor used for temperature and humidity monitoring
- Firebase Realtime Database used for real-time cloud data storage
- Sensor data transmitted in JSON format through WiFi communication
- React web application developed for live sensor monitoring dashboard
- Real-time environmental monitoring with cloud integration

Problem Definition:

- Traditional waste bins do not monitor harmful environmental conditions
- Harmful gases inside bins can create health and safety risks
- No real-time monitoring for temperature and humidity conditions
- Manual monitoring methods are inefficient and unreliable
- Lack of cloud-based smart waste monitoring systems
- No live dashboard visualization for environmental sensor data
- Difficulty identifying hazardous waste conditions remotely
- Need for IoT-based environmental monitoring solution for smart waste management

Design Excellence / Contribution:

- ESP32 microcontroller used for low-cost IoT environmental monitoring
- Firebase Realtime Database enables real-time cloud synchronization
- React web application provides live environmental monitoring dashboard
- Integration of multiple environmental sensors into a single smart monitoring system
- Real-time WiFi communication established between ESP32 and cloud database
- Hazard-level monitoring implemented using OK / WARNING / CRITICAL status logic ,
Smart alert system developed to identify critical environmental conditions



User Feedback on Prototype:

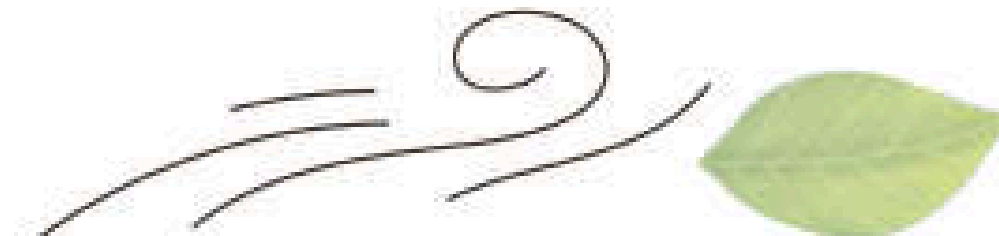
- Real-time dashboard helps waste collectors monitor hazardous conditions
- Live gas detection improves waste handling safety
- Critical-level alerts help identify dangerous conditions quickly
- Cloud monitoring enables remote bin condition tracking
- Real-time Firebase updates preferred over manual monitoring
- Dashboard interface considered simple and user-friendly



IT22088482 | WIJESIRI A. M

Smart Waste Pickup Coordination & Driver Routing System for Residential Communities

Bachelor of Science (Hons) in Information Technology
Specializing in Information Technology





The Solution Addresses the Sub-Problem/ Prototype:

- Flutter Web mobile app — residents pin pickup locations on interactive OpenStreetMap
- Firebase Authentication — secure role-based access for Residents and Drivers
- Cloud Firestore — real-time pickup request sync across all devices
- Priority-coded bin markers — Red (urgent), Yellow (moderate), Green (low) — on live driver map
- Nearest-neighbor routing algorithm — generates optimized routes following real road networks
- Geofence notifications — auto-alerts residents when driver arrives within 50m



Problem Definition:

- On-demand pickup requests via map interface
- Selectable time-windows (1, 2, or 4 hours)
- Real-time pickup status tracking
- Cross-platform — desktop + mobile from single codebase
- Priority-based optimized route plans for drivers
- Live GPS tracking shared with residents
- Bin metadata — fill %, methane status, last update
- Auto arrival notifications — no manual coordination

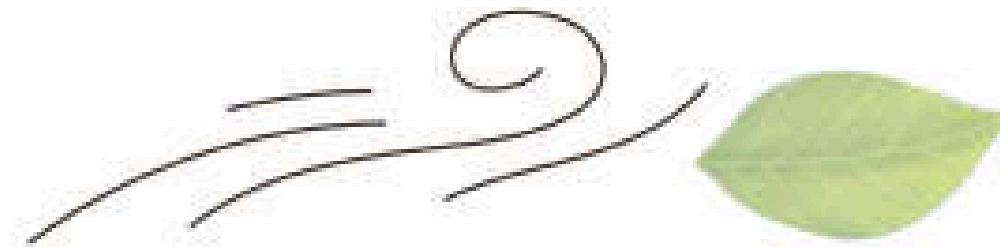
Design Excellence / Contribution:

- Hybrid routing algorithm — nearest-neighbor + priority constraints solves constrained TSP variant
- Cost-conscious mapping — OpenStreetMap replaces Google Maps, zero billing required
- Real-time Firestore streams — instant cross-device sync without polling
- HTTPS tunneling (ngrok) — enables mobile GPS testing bypassing browser restrictions
- Haversine geofencing — battery-efficient arrival detection without background services



User Feedback on Prototype:

- Visual map placement — more intuitive than text-address inputs for narrow lanes
- R/Y/G priority markers — drivers prefer at-a-glance urgency assessment
- Stop numbering on bins — added in iteration based on driver requests
- Arrival notifications — rated most valuable feature by residents



Smart Waste Management System

Commercialization

Sell as a smart waste monitoring and prediction platform

Investment/Cost

Development, cloud, hardware, and maintenance costs

Pricing

Subscription-based plans for different customer types

Target Market

Municipalities, campuses, waste companies, recycling facilities

Customer Profile

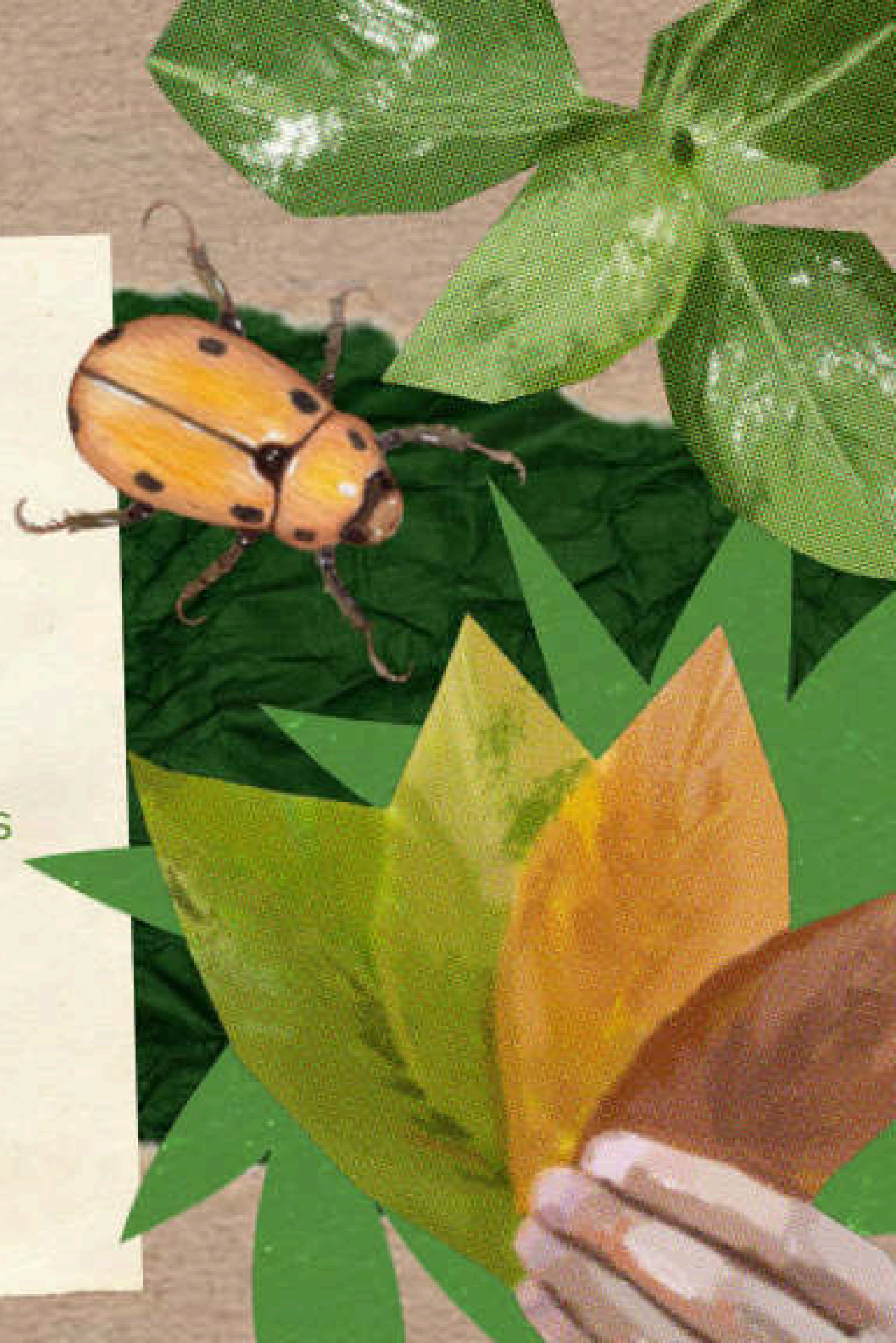
Waste management authorities and facility managers

Value Proposition

Lower cost, better planning, improved recycling

IP Rights

Software, ML models, and analytics dashboard



Thank You.

