

SUSTAINABLE WASTE MANAGEMENT APP: ENHANCING COMMUNITY COORDINATION FOR EFFICIENT GARBAGE DISPOSAL

Project Reference No.: 48S_MCA_0038

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Keywords:

Smart Notification, Waste Management, Community Coordination, Garbage Tracking

Introduction:

Managing waste effectively is one of the biggest challenges cities face today. A clean and hygienic environment isn't just about how often waste is collected, but also how well people and waste collection services work together. Unfortunately, in many urban areas, there's a serious disconnect between garbage trucks and residents. Many people don't know when collection trucks are arriving, which leads to missed pickups, overflowing bins, and ultimately unhealthy surroundings. This lack of coordination adds pressure on city workers and affects the overall cleanliness of neighborhoods. In today's world, almost everyone carries a smartphone. So, we thought—why not use that to fix the communication gap? Our project introduces a mobile app that sends real-time alerts to residents when a garbage truck is on its way. These alerts give people a heads-up, so they can keep their waste ready for collection, making the process faster and smoother for everyone involved. But it doesn't stop there. The app also helps the municipality plan better routes by collecting useful data from both residents and drivers. It's designed to make life easier, cleaner, and more organized for urban communities. More than just a tool, the app is a step toward encouraging responsible habits and sustainable living. When people are informed and involved, managing waste becomes a shared responsibility—and that's when real change happens.

Objectives:

- Design a mobile app that sends alerts when garbage trucks are near.

- Help residents stay informed to avoid missed garbage pickups.
- Reduce litter and unsanitary conditions in local areas.
- Create a reliable line of communication between the city and its people.
- Collect useful data for better route and schedule planning.
- Encourage community involvement in responsible waste disposal.
- Support local governments in managing resources more efficiently.
- Set a foundation for integrating more civic services into one platform

Methodology:

1. Understanding User Needs:

- Talked to local residents, municipal staff, and garbage truck drivers to gather real-life issues and practical expectations.
- Prioritized problems like missed pickups, lack of timely info, and communication breakdowns.

2. Feature Planning:

- Decided on essential app features: GPS tracking, instant notifications, and user profile setup.
- Considered ease of use and compatibility across different smartphones.

3. Designing the System:

- Sketched user interface layouts for both resident and driver apps, focusing on simplicity.
- Planned a cloud-based system to store and manage location, alert, and user data.

4. Technology Stack Selection:

- Chose Flutter for building both Android and iOS apps using a single codebase.
- Integrated Firebase for backend services like database management and push notifications.

5. App Development – Resident Side:

- Created features allowing users to register, add their home location, and receive timely alerts.
- Built in settings for notification preferences and language selection.

6. App Development – Driver Side:

- Developed tools for drivers to log in, share current locations, and signal when they're nearing collection zones.
- Added a simple dashboard for route tracking and stop confirmation.

7. Backend Integration:

- Connected the apps through a central system that monitors driver locations and triggers alerts for nearby users.
- Ensured data was synced in real-time to avoid delays or mismatches.

8. Testing the Apps:

- Carried out lab testing to make sure basic features worked without errors.
- Ran live field tests to check if alerts were accurate and the interface was easy to use.

9. Feedback and Fixes:

- Collected feedback from early users—both residents and drivers—and fixed bugs and UI issues.
- Tweaked the timing and content of notifications for better clarity and reliability.

10. Public Release and Onboarding:

- Uploaded the resident app to the Play Store and App Store.
- Provided the driver app directly to municipal teams with instructions for setup.

11. Community Awareness:

- Created posters and ran short sessions to help people understand how to download and use the app.
- Shared QR codes and app links through local networks and noticeboards.

12. Training Municipal Workers:

- Trained garbage truck drivers to update routes and use the app effectively during collections.
- Provided printed guides and demo videos for ease of learning.

13. Ongoing Updates and Support:

- Set up a feedback form within the app and monitored bug reports.
- Rolled out regular updates to improve performance and fix reported problems.

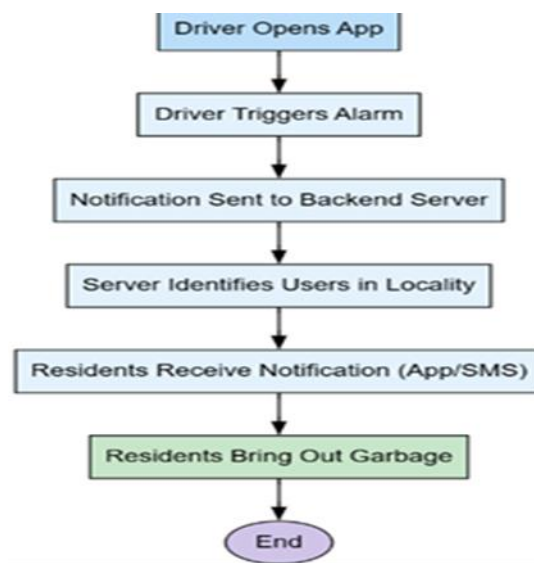


Figure 1: Flow Chart for the application

Results & Conclusions:

The initial rollout and testing of our waste management app brought in promising results. In neighborhoods where the app was introduced, people reported fewer missed pickups and cleaner surroundings overall. Residents found the alerts helpful and said it made them more aware of their role in the waste disposal process. On the city's side, municipal teams noticed smoother garbage collection routes and less confusion about timing. Drivers appreciated having a system that let them update their

status and notify residents easily. The two-way communication helped both sides stay better informed.

We also found that when people receive timely notifications, they're more likely to act on them. The feedback was overwhelmingly positive, with users describing the app as "simple and useful." Our tests showed that GPS tracking and notifications worked reliably, even in different localities. In short, the project succeeded in connecting the community and the waste management system in a simple, tech-driven way. It showed that even small changes—like timely alerts—can lead to a cleaner and more organized city life. This app proves how practical tech solutions can solve every day urban issues effectively.

Project Outcome & Industry Relevance:

The project offers a simple yet powerful way to modernize how cities handle waste collection. By using smartphones and GPS tracking, we've created a solution that fits perfectly into everyday life and is easy for anyone to use. It reduces missed pickups, helps the city keep things running smoothly, and encourages people to take more responsibility for their surroundings.

From an industry point of view, this project aligns with smart city goals and has potential for wide-scale adoption. Local governments can use it to manage resources better and improve public satisfaction. Since it's built on scalable technology, the same framework could be extended to other services like water supply alerts, roadwork updates, or emergency communication systems. What makes this project valuable is its practicality. It doesn't require major infrastructure changes or huge investments—just a smartphone and internet access. That's why it's not only useful for big cities but also a great fit for smaller towns looking to step into smarter governance without a high cost. Overall, it bridges the gap between technology and civic life in a way that's meaningful and easy to adopt.

Working Model:

This project was developed as a fully functional working model. We created and deployed two mobile applications—one for residents and another for garbage truck drivers. These apps were not just theoretical or limited to simulations; they were tested in real-world settings with actual users. The system was actively used in selected localities, where we monitored performance, user feedback, and live data handling.

The goal was to make the solution usable from day one, and the working model proved effective during test deployments. The experience helped us refine the application and confirm its practicality. While we used simulated inputs during the initial stages of testing, the final product was designed to function in real-time environments, reflecting real scenarios and user interactions.

Key Learnings:

- The app reduced missed garbage pickups and improved coordination between residents and municipal staff.
- Drivers reported smoother routes and better time management with the help of the alert system.
- We learned how to build real-time mobile apps using Flutter and Firebase.
- Gained experience in handling real-user feedback and refining app features.
- Improved teamwork, communication, and problem-solving while working on a live project.
- Learned the value of simple tech solutions in solving everyday public issues.

Future Scope:

There's a lot of potential to build on what we've developed. One major improvement could be adding AI to suggest the most efficient routes based on live traffic and past data. This would help reduce fuel costs and improve pickup speed.

Another useful addition could be integrating waste categorization—so users can get reminders based on dry, wet, or recyclable waste. This encourages proper segregation right at the source. We also plan to include multi-language support, making the app more accessible to a wider group of people. From an admin perspective, a live dashboard could be created for city officials to monitor routes, check for delays, and gather feedback directly from residents. For residents, adding features like reporting missed pickups or viewing collection history could give them more control.

Over time, this app can evolve into a broader civic utility tool. The same platform could help with alerts for water supply timings, street cleaning schedules, or e-waste pickups. With wider adoption, deeper insights from user data could help city planners make smarter, data-driven decisions.

We also see opportunities for partnerships with smart city initiatives, where this app could be integrated with IoT sensors and GPS devices installed on municipal vehicles. With more testing and community input, this system could truly redefine how cities handle waste and communicate with their people.

(Formal large-scale testing pending.)