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Waste2Worth: A Smart Mobile-Based Solution for Real-Life Waste Management, Recycling Awareness and Urban Sanitation

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Abstract: Waste management has become one of the most serious urban challenges in India today. Even though our cities are growing fast, the basic systems of waste collection, segregation, and disposal have not kept pace. People see garbage lying on the roads but do not know whom to report it to. They want to recycle old items but do not know how. They need to find nearby scrap dealers or public toilets, but there is no single platform available for all these things together. In this paper, we present Waste2Worth — a mobile application developed as part of Smart India Hackathon 2025 (Problem Statement SIH25060) for providing real-life solutions in waste management. The proposed system integrates five core functionalities: (1) photo-based waste reporting with GPS location tagging that sends alerts directly to municipal authorities, (2) a detailed step-by-step recycling guide for common household waste products, (3) a nearby scrap center locator that sorts available centers from shortest to longest distance within a 5 km radius, (4) a Sauchalay (public toilet) finder with live navigation support, and (5) a user profile management module. The application is built on a mobile-first architecture using React Native for the front-end, Node.js for backend services, and Google Maps API for location-based features. The paper describes the system design, module details, and the social impact expected from the deployment of this solution.

Index Terms – Waste Management, Smart Cities, Mobile Application, GPS Location Tracking, Recycling Guide, Scrap Center Locator, Sauchalay Finder, Municipal Reporting, SIH2025, Urban Sanitation

I. INTRODUCTION

India generates more than 62 million tonnes of solid waste every single year. Out of this, only about 43 million tonnes are actually collected, and even less — around 12 million tonnes — is properly treated before disposal. The remaining waste ends up in open drains, roadsides, vacant plots, and water bodies, causing severe environmental and public health damage. This is not just a statistic found in government reports; this is something every Indian citizen sees with their own eyes every morning when they step outside their home.

The Swachh Bharat Mission, launched in 2014, made significant progress in building toilets and raising awareness, but waste management on the ground still remains weak in execution. The common citizen often wants to help but does not have the tools. They see a heap of garbage in the street and want to report it, but do not know the phone number or website of their local municipality. They want to recycle their old newspapers and plastic bottles but do not know where the nearest scrap dealer is. They are looking for a public toilet in an unfamiliar area but cannot find it easily.

B. DIY Tutorials

A special sub-section called "Jugaad from Waste" (inspired by the Indian concept of innovative low-cost solutions) features simple do-it-yourself tutorials for converting waste into useful household items. For example: turning plastic bottles into planters, making cloth bags from old sarees, and creating compost bins from wooden crates. These tutorials use simple language and visual step illustrations to make the process easy to follow even for users with limited education.

C. Content Management

The recycling content is managed through an admin CMS (Content Management System) that allows municipal authorities or NGO partners to add new articles, update existing steps, and push notifications to users about new recycling techniques. This ensures that the knowledge base remains current and relevant.

VI. NEARBY SCRAP CENTER LOCATOR

India has a massive informal recycling economy. There are hundreds of thousands of kabadiwallas (scrap dealers) across the country who collect and trade in paper, metal, plastic, electronics, and other recyclable materials. However, finding the nearest scrap dealer is still largely done

This paper proposes Waste2Worth, a comprehensive mobile-based waste management system that solves these day-to-day problems by putting the right tools directly in the hands of citizens. This application was developed in response to Smart India Hackathon 2025 Problem Statement SIH25060, which called for real-life technical solutions in waste management. The system brings together waste reporting, recycling education, scrap center navigation, sanitation facility finder, and user profile management in one easy-to-use mobile platform.

The rest of this paper is arranged as follows. Section II gives a review of related earlier work done in this area. Section III describes the system architecture and design. Sections IV to VIII explain each of the five main features in detail. Section IX discusses implementation and technology choices. Section X covers expected results and social impact. Section XI gives the conclusion and scope for future work.

II. RELATED WORK

Several researchers and developers have worked on digital solutions for waste management in recent years. This section briefly reviews some of the most relevant work.

Anagnostopoulos et al. [1] proposed a crowdsourcing platform for citizen-based waste reporting in smart city environments. Their work showed that mobile apps with photo upload and GPS tagging can significantly improve the speed of municipal response to waste complaints. However, their system was purely for reporting and did not include any recycling or sanitation features.

Pardini et al. [2] developed an IoT-based smart bin system using ultrasonic sensors to monitor fill levels and send alerts to waste collection teams. While their solution is effective for large cities with smart bin infrastructure, it requires heavy hardware investment and cannot be easily deployed in smaller Indian towns.

Navghane et al. [3] presented a mobile application specifically for Indian cities that allowed users to register complaints about garbage dumping. The application integrated with government grievance portals, which is an important feature. But it did not offer any guidance on what to do with recyclable waste at the household level.

Kumar and Singh [4] studied the potential of mobile applications in improving public sanitation behavior in rural India. Their research found that easy-to-use, vernacular-language apps with visual instructions significantly increased citizen participation in waste segregation.

Existing work on Sauchalay or public toilet finders includes the Swachhata App launched by the Ministry of Housing and Urban Affairs. While this app is useful, it is limited only to toilet-related complaints and does not connect with waste management or scrap recycling.

The gap in existing literature and practice is clear: no single application combines waste reporting, recycling education, scrap center discovery, and sanitation facility location in one integrated citizen-facing platform. Waste2Worth fills this gap.

III. SYSTEM ARCHITECTURE

by memory or asking neighbors. Waste2Worth digitizes this process.

A. Location-Based Search

When the user opens the Scrap Center section, the application fetches their current GPS coordinates and queries the backend for all registered scrap centers within a radius of 5 kilometers. The results are displayed as a list sorted from the shortest distance to the longest distance, so the user always sees the most convenient option at the top.

B. Scrap Center Profiles

Each scrap center listing includes: name of the dealer or center, full address, distance from user's current location, operating hours, types of scrap accepted (e.g., paper only, metals, e-waste, all types), contact phone number, and user ratings. Users can also add reviews and feedback for scrap centers they have visited, which helps other users make better choices.

C. Navigation Support

A "Take Me There" button on each listing opens the route to the selected scrap center directly in Google Maps (or the default maps application on the user's phone) with turn-by-turn navigation. This removes the last barrier between the user's intention to recycle and their ability to actually do it.

D. Center Registration

Scrap center owners can register their business in the app through a simple online form available on the Waste2Worth website. The registration process requires verification of location and basic business details. Once verified, the center appears in the app for all nearby users to discover.

VII. SAUCHALAY FINDER MODULE

Open defecation and lack of sanitation facilities remain significant public health challenges in India, particularly in dense urban areas and near transportation hubs. The Sauchalay Finder module helps users locate the nearest available public toilet quickly and without confusion.

A. Facility Database

The application maintains a database of all types of sanitation facilities: government-built Sulabh Shauchalay complexes, pay-and-use toilet blocks near bus stands and railway stations, mobile toilet vans parked at event locations, and permanent public conveniences built under AMRUT and Smart Cities Mission. Each facility is categorized by type of usage — separate sections for male, female, and differently-abled persons.

B. Real-Time Status

Wherever smart sensors or manual check-in systems are available, the application displays real-time cleanliness status reported by maintenance staff or recent users. A simple color code system is used: Green for Clean and Functional, Yellow for Available but Needs Attention, and Red for Out of Service. This saves citizens the frustration of traveling to a facility only to find it non-functional.

C. Search and Filter Options

The Waste2Worth application follows a three-tier mobile application architecture consisting of: (1) the Mobile Client Layer, (2) the Backend API Layer, and (3) the Data and Services Layer.

A. Mobile Client Layer

The front-end of the application is built using React Native, which allows the same codebase to run on both Android and iOS devices. The mobile client handles user interactions, captures images using the device camera, accesses GPS coordinates, and renders maps and lists. The interface is designed to be simple and accessible to users with low digital literacy, with large buttons and clear visual indicators throughout.

B. Backend API Layer

The server-side logic is implemented using Node.js with Express.js framework. REST APIs handle all communication between the mobile app and the database. JWT (JSON Web Token) based authentication ensures secure user sessions. The backend processes waste report submissions, retrieves nearby facilities using geo-queries, and manages user profile data.

C. Data and Services Layer

MongoDB is used as the primary database, chosen for its flexible document-based structure which is well-suited for storing variable forms of data such as waste reports with photos, recycling articles, and location coordinates. Firebase Cloud Storage is used to store uploaded waste images. Google Maps Platform APIs — specifically the Maps SDK, Places API, and Directions API — power all location-based features in the application.

IV. WASTE REPORTING MODULE

This is the most important feature of Waste2Worth. It allows any registered citizen to report a waste problem in their locality by simply clicking a photograph of the garbage and submitting it along with their current GPS location to the municipal authorities.

A. How It Works

When the user opens the reporting section, the application automatically fetches their current location coordinates using the device GPS. The user then clicks a photo of the waste using the in-app camera. Before submission, the user can optionally add a short description of the problem — for example, whether it is a pile of construction debris, overflowing dustbin, or illegal dumping spot.

Once submitted, the system packages the photo, GPS coordinates, timestamp, and user ID into a structured waste report object and sends it to the backend. The backend then forwards this report via email or API webhook to the designated municipal authority account for that geographic zone. The user receives a submission confirmation along with a unique Complaint Reference Number (CRN) which they can use to track the status of their report.

B. Municipal Dashboard

On the receiving end, municipal officers can access a web-based admin dashboard (a companion portal, not part of the Users can filter the Sauchalay results by: distance from current location, availability of water, 24-hour access, facilities for women and children, and wheelchair accessibility. This is especially useful for families with small children, elderly persons, and people with disabilities who have specific needs.

VIII. USER PROFILE MODULE

The User Profile module stores and displays all personal information and activity history for each registered user of Waste2Worth. It serves both as a personal dashboard and as a motivation tool to encourage continued civic participation.

A. Profile Information

Each user profile contains: full name, registered mobile number, email address, home area or ward number, and a profile photo. Users can edit their information at any time from the Profile settings screen.

B. Activity History

The profile shows the user's complete activity history within the app: total number of waste reports submitted, status of each report (Pending, Under Review, Resolved), bookmarked scrap centers and Sauchalay locations, and recycling articles read. This history helps users track the impact of their own civic actions over time.

C. Swachh Score

A gamification element called "Swachh Score" assigns points to users for each activity: 10 points for submitting a waste report, 5 points for reading a recycling article, 2 points for rating a scrap center. The score is displayed prominently on the profile page. Users with high scores receive a "Swachh Champion" badge that appears on their profile. This creates positive social recognition around civic participation, which is a well-known behavioral motivator in community programs [4].

IX. IMPLEMENTATION DETAILS

A. Technology Stack

The complete technology stack used in Waste2Worth is as follows. For mobile development: React Native with Expo framework for cross-platform support. For backend: Node.js v18 with Express.js, running on a cloud server (AWS EC2 or equivalent). For database: MongoDB Atlas for cloud-hosted NoSQL data storage. For file storage: Firebase Cloud Storage for waste report images. For location services: Google Maps Platform — Maps SDK, Places API, Directions API, and Geocoding API. For authentication: Firebase Authentication with OTP-based phone number login, which eliminates the need for users to remember passwords.

B. Security Considerations

All API communications happen over HTTPS. User location data is stored only for as long as needed to process the waste report and is never shared with third parties. Images uploaded by users are stored with restricted access permissions and are only visible to the relevant municipal

mobile app scope) that displays all incoming reports on a city map, sorted by time and area. This gives the field team a clear visual overview of where the waste problems are concentrated on any given day.

C. Social Impact

The waste reporting module fundamentally changes the relationship between citizens and their local governance. Instead of a passive bystander, the citizen becomes an active participant in maintaining the cleanliness of their own neighborhood. Studies have shown that communities where residents actively report civic problems see significantly faster municipal response times [1].

V. RECYCLING INFORMATION MODULE

The second module of Waste2Worth is a comprehensive recycling guide that educates users on how to recycle and reuse common household waste items. In Indian households, a huge volume of recyclable material — paper, plastic, glass, metal, e-waste, and organic kitchen waste — is unnecessarily thrown into general garbage because people simply do not know how to handle it differently.

A. Content Structure

The recycling guide is organized into categories of common waste types found in Indian homes: Paper and Cardboard, Plastic Bottles and Containers, Glass Jars and Bottles, Metal Cans and Foils, Electronic Waste (e-waste), Organic Kitchen Waste, and Old Clothes and Textiles. Each category has its own dedicated section in the app.

For each waste type, the guide provides: (a) a brief explanation of why this type of waste is harmful if not recycled, (b) a step-by-step process on how to prepare the item for recycling at home, (c) what products can be made from this waste, and (d) where to send the waste — linking directly to the Scrap Center Locator module for items like e-waste and metals.

XI. CONCLUSION AND FUTURE SCOPE

This paper has presented Waste2Worth, a mobile application that brings together five critical waste management and sanitation functions in one citizen-facing platform. The system addresses real, everyday problems faced by ordinary Indians: not knowing where to report garbage, not knowing how to recycle, not being able to find a scrap dealer or a public toilet nearby.

The design is deliberately simple and accessible. The features do not require any special hardware or technical knowledge from the user. Any person with a smartphone and a basic internet connection can use the application. The authority. The application complies with the provisions of India's Information Technology Act, 2000 and the draft Personal Data Protection guidelines.

C. Offline Capability

A key design decision was to make some features available offline. The recycling guide articles are pre-cached on first load so that users in areas with poor internet connectivity can still access them. Waste reports that fail to upload due to connectivity issues are queued locally and automatically submitted when the connection is restored.

X. EXPECTED RESULTS AND IMPACT

While Waste2Worth is currently in the development and prototype stage (as of SIH 2025 submission), the following outcomes are projected based on the problems it addresses and comparable solutions that have been deployed in other Indian cities.

From the waste reporting module, it is expected that the average time for municipal authorities to respond to a waste complaint will reduce from the current average of 5–7 days (based on manual complaint channels) to 24–48 hours due to GPS-tagged, photo-documented automated alerts. This projection is consistent with findings from similar crowdsourced reporting platforms in Pune and Surat [3].

The recycling guide is expected to increase household-level waste segregation and recycling activity, especially in urban middle-class neighborhoods where residents have smartphones and basic digital literacy. If even 10% of app users in a medium-sized city of 5 lakh population begin to segregate and recycle their dry waste, the resulting reduction in municipal solid waste load could be measured in hundreds of tonnes per month.

The Scrap Center Locator addresses a genuine friction point: many Indian households accumulate recyclable waste at home for months because they do not know where to take it. By making the nearest kabadiwalla discoverable with one tap, the app removes this friction and accelerates the flow of recyclable material back into the economy.

The Sauchalay Finder is particularly valuable in high-density public areas — railway stations, bus terminals, markets, and religious fair grounds — where people urgently need sanitation facilities but cannot find them. Reduction in open defecation in public spaces has direct and measurable public health benefits.

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backend architecture is scalable and can be extended to cover multiple cities and millions of users with cloud infrastructure.

In terms of future scope, the team plans to add multilingual support in Hindi, Gujarati, Marathi, Tamil, and other regional languages to make the application truly accessible across India. Integration with official municipal complaint portals (like CPGRAMS or city-specific grievance platforms) will make the waste reporting feature more powerful. An AI-based waste classifier that can automatically identify the type of waste from a photo and suggest the correct recycling method is also being explored as a future enhancement. A community forum where residents can share recycling ideas and organize local cleanup drives is another planned addition.Waste2Worth is not just a technology project. It is a statement that every citizen has the right to clean public spaces and the power to do something about it. With the right tools, ordinary people can be the most effective agents of change in the fight for a cleaner, healthier India.

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