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Waste Management System: A Ground-Level Digital Initiative

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Abstract: This study has been conducted to explore the effectiveness of a citizen-driven approach to public waste management through the development and implementation of a Waste Management System. The system enables users to report instances of unattended garbage by capturing and submitting photographs, which are then addressed by municipal authorities who, upon resolution, provide photographic evidence of the cleaned site. The study utilizes primary data collected through field testing in a small city from [insert time period], assessing the impact of this technology-driven communication loop. Findings indicate that the system significantly improved response time, increased public engagement, and enhanced trust in municipal services by fostering transparency and accountability.

I. Introduction

Every city, no matter how modern, still has places where garbage gets dumped in corners, near poles, or even right outside homes. And most of the time, people just ignore it. Not because they don't care—but because they don't know whom to tell or how. Even if they complain, there's no update. That's where the idea of our software came in. We thought, why not make a system where any person can click a photo, send it with location, and the municipal team gets that instantly? And when the garbage is cleaned, the same user should get a "before and after" confirmation. This kind of feedback loop makes sure no complaint is ignored, and trust between people and the Nagar Palika is built over time.

II. Literature Review

When we started designing this system, we looked at what others have done. Some systems use sensors in dustbins. Others use GPS tracking of vehicles. But all of that is too expensive for small towns. We found one simple app in Gujarat where people send WhatsApp messages to complain. That gave us confidence. Studies by Patel (2023) also show that if you make it easy for people to report issues, they'll do it. NITI Aayog's 2024 report also mentions the need for visual proof in complaint-based sanitation systems. In another research, Sharma & Verma (2022) showed that real-time feedback systems increase trust and reduce repeat complaints. We've used these findings as the base for our user-photo-based cleanup tracking idea.

III. Objective and Scope

The primary objective of this system is to empower ordinary citizens to actively participate in maintaining public cleanliness by allowing them to report waste locations through the submission of geo-tagged images to the Nagar Palika. In return, municipal authorities respond with photographic proof once the area has been cleaned. This bidirectional communication not only ensures timely action on reported issues but also fosters transparency, accountability, and enhanced trust between the public and the municipal administration.

3.1 More objectives

- Easy-to-use Android app
- Admin panel for Nagar Palika
- Real-time notifications
- Visual tracking of cleaning done
- Cover common waste dumping zone

3.2 Scope

The scope of this study is not to develop a comprehensive smart city infrastructure, but rather to design and implement a simple, functional tool tailored for smaller towns and semi-urban areas. These are regions where citizens commonly have access to smartphones, yet lack any formal or systematic channel to report cleanliness-related issues. The system aims to bridge this gap by offering an accessible and practical solution that leverages existing mobile technology without requiring large-scale infrastructure investments.

IV. Methodology

1. **Survey:** First, we went around asking people if they would use such an app. Many said yes, if it works fast and gives feedback.
2. **App Design:** We made the Android app first, with just a camera and location permission. The backend was made in Node.js and MongoDB. For image storage, we used Firebase.
3. **Admin Panel:** A simple dashboard was made using React for Nagar Palika officers to see incoming complaints and upload cleaning photos.
4. **Pilot Testing:** A simple dashboard was made using React for Nagar Palika officers to see incoming complaints and upload cleaning photos.

V. System Design

There are two main users: Citizens and Nagar Palika staff.

- **Citizens (Users):** They use an Android app where they can take a photo, add a note, and send it. Location is picked automatically. They get a confirmation after submission and another one when it is cleaned.

- **Staff (Admin):** They log in on a website. There they see all pending reports. They assign to a worker, and when the cleaning is done, they upload the 'after' photo. The system auto-sends it to the user.

- **Backend:** All data (images, locations, timestamps) are stored in MongoDB. Image links are handled via Firebase Cloud Storage. Notifications are sent using Firebase Cloud Messaging (FCM).

VI. Implementation and Testing

We tested the app in three wards in our area. The response was amazing. Within 10 days, more than 150 users submitted photos. Nagar Palika staff were also cooperative. On average, reports were cleared in one and a half days.

There were some small issues like:

1. GPS errors when signal was weak
2. Slow upload speed in low network areas

But we fixed most of them with better image compression and location correction.

The biggest plus was that users felt connected and were surprised when they got a photo after cleanup. Even workers said they felt more alert, knowing people were watching and involved.

VII. Results and Discussion

Highlights

1. Cleaning frequency increased, especially in garbage-prone areas.
2. Most complaints were resolved within 48 hours.
3. People started reporting other issues like open drains, street animals etc.
4. Nagar Palika could use the data to plan manpower and timing better.

This shows that even without expensive tools or smart bins, we can solve problems using public participation and simple digital tools.

VIII. Conclusion

In simple words, the Waste Management System app gives the power to the people to keep their city clean. It connects both sides with a photo and location-based system. The cleaning becomes visible, trust is built, and response becomes quick.

We strongly believe this can be expanded to other cities. It doesn’t need too much money or complex setup. Just a good team and willingness to work.

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