

CleanSpot: A Smart Web-Based Garbage Detection and Reporting System for Urban Cleanliness

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Abstract- Purpose of the Study: This research addresses the increasing challenge of urban waste accumulation by proposing a tech-based solution named "CleanSpot"—a user-centric web application that enables individuals to report garbage by uploading photos. This approach intends to foster civic engagement and streamline the communication channel between the public and municipal authorities like BBMP (Bruhat Bengaluru Mahanagara Palike).

Research Questions/Objectives:

- How can technology be used to streamline waste reporting in urban areas?
- What impact does a real-time, image-based reporting system have on municipal efficiency?
- Can digital solutions like CleanSpot increase community participation in civic maintenance?

Methodology: The project utilizes modern web technologies including CSS, Java, JavaScript, Python with Django for the front end, and SQL for data handling and storage. The system is built to be intuitive and mobile-responsive, encouraging frequent use among citizens.

Key Findings: CleanSpot proved to be efficient in facilitating quick and reliable garbage reporting. The use of visual evidence through image upload enhances the credibility of the reports. Users found the interface user-friendly and effective in generating responses.

Conclusion: The CleanSpot project validates the hypothesis that citizen-friendly digital platforms can significantly improve waste management practices in urban areas. By bridging the communication gap, CleanSpot has the potential to influence long-term behavioral and policy changes.

INTRODUCTION

Background Information:

In the fast-paced development of urban spaces, especially in metropolitan cities like Bengaluru, garbage accumulation and improper waste management remain persistent problems. Traditional methods of complaint filing are slow and often ineffective due to bureaucratic bottlenecks. There is a strong need for a more responsive, user-

friendly system that empowers citizens to take initiative. CleanSpot was conceived as a tool to fill this gap.

The idea was born from frequent observations of unattended garbage piles in public spaces. Often, there is no easy way for a passerby to report such issues. CleanSpot allows users to upload a photo of the garbage, which is then used as a prompt to inform BBMP to address the situation. In this sense, the platform acts as a bridge between concerned citizens and the authorities responsible for sanitation.

Problem Statement:

Urban areas are facing a crisis in managing waste efficiently. The lack of accessible communication tools between citizens and municipal bodies contributes to delays in waste removal. CleanSpot aims to solve this by creating an interactive web portal that allows visual garbage reporting, thus initiating quicker responses and higher accountability.

LITERATURE REVIEW

Several studies have discussed the potential of mobile and web technologies in facilitating urban governance. Research on civic technology shows that the more accessible a reporting system is, the higher the citizen participation rates are. Initiatives like SeeClickFix in the US and Swachhata App in India provided strong reference points for designing CleanSpot. However, CleanSpot differentiates itself by offering a hyperlocal, image-first, and simplified reporting experience tailored to Bengaluru's civic infrastructure.

The literature also highlights common barriers to successful civic tech adoption: lack of awareness, complicated UI, and weak government integration.

CleanSpot's design directly addresses these challenges.

METHODOLOGY

System Architecture:

CleanSpot's architecture is divided into three main layers: the frontend user interface, backend processing with business logic, and a relational database system.

Frontend Technologies Used:

- HTML/CSS: Used to create and style the user interface.

- Java & JavaScript: Handle client-side interactivity and form validations.
- Django (Python): Used to structure the front end through templates and manage server-side logic.

Backend Technologies Used:

- Python & Django: For routing, handling HTTP requests, authentication, and integrating the database with views.
- SQL: Used for storing structured data including image files (in base64 or blob format), location data, timestamps, and user information.

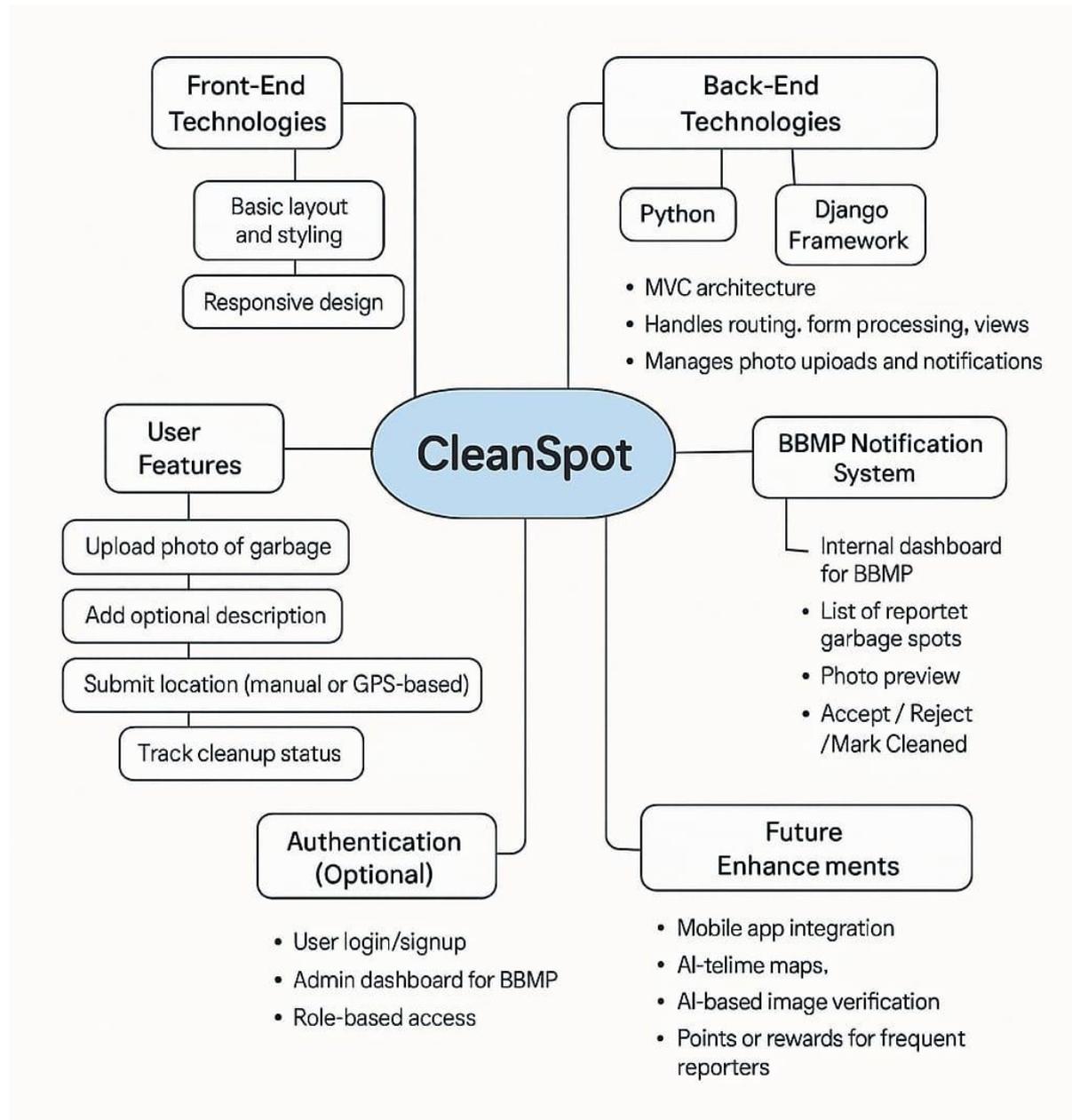


Fig. Mindmap of the methodology and working process

Working Process:

1. User captures or uploads an image of the garbage.
2. Image and optional location data are submitted to the server.
3. Backend processes the request and stores the details.
4. Notification is generated and sent to BBMP (either via email or simulated alert system).
5. User receives confirmation and tracking options for follow-up.

Security Measures:

- Captcha verification to avoid spam submissions.
- File size and type restrictions to manage storage and security.
- User authentication layer for personalized submissions.

Implementation

The application was developed in four stages:

1. Designing the UI/UX: Using Figma and Bootstrap grids for mobile-first responsiveness.
2. Backend API Development: Django’s Model-View-Template (MVT) pattern facilitated rapid prototyping.
3. Image Handling: Pillow library for image validation, and Django’s media directory for storage.
4. Notification System: SMTP email client for alerts to simulated BBMP mail addresses.

Database Schema:

- Users: Name, email, phone, password (hashed).
- Reports: Image, timestamp, location (lat, long), user ID.
- Status: Pending, Acknowledged, Resolved (updated by admin).

RESULTS AND ANALYSIS

System Performance:

Initial beta testing with 20+ users demonstrated a high rate of submission success. Users were able to report garbage within an average of 45 seconds. The system processed and stored data efficiently without lag.

User Experience:

Feedback highlighted that CleanSpot was simple to use, especially on smartphones. The photo upload feature added credibility to complaints. The submission tracking feature was appreciated as it made the process transparent.

Scalability and Flexibility:

The modular backend structure allows integration with other civic systems such as GPS mapping, real-time updates, and API-based municipal communication. The use of Django ensures easy scalability to other cities.



Fig: Benefits of this webapp

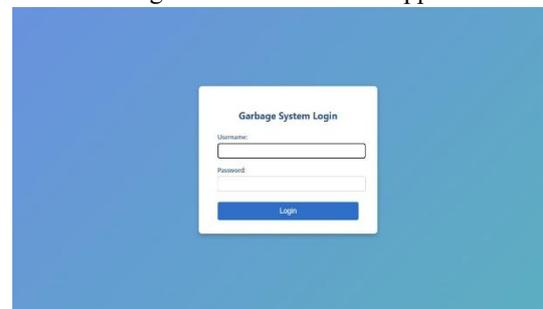


Fig: Login portal of CleanSpot

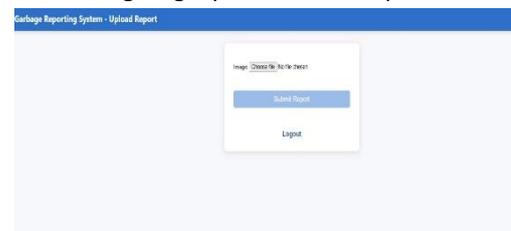


Fig: Image Uploading Portal

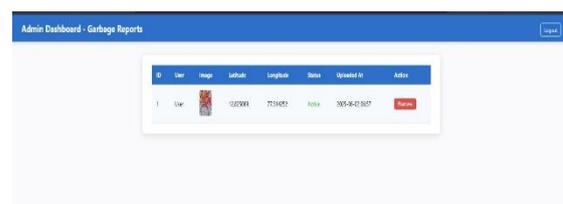


Fig: location with data and time of detected garbage

LIMITATIONS

- Currently, there is no real-time integration with BBMP databases.
- Location accuracy is dependent on user input or device GPS.
- Requires manual verification to prevent false or inappropriate submissions.

DISCUSSION

Civic Engagement through Technology:

CleanSpot encourages active citizen participation in maintaining public hygiene. By lowering the barrier to reporting, it enables a more collaborative effort between individuals and civic bodies.

Comparative Advantage:

Compared to traditional phone calls or emails, CleanSpot provides visual documentation, leading to faster acknowledgment and higher chances of resolution.

Role in Smart Cities:

CleanSpot aligns with the Indian Government's Smart City initiative. By integrating real-time environmental monitoring and citizen participation, the app exemplifies digital governance models.

Future Enhancements:

- Implementing AI to detect and classify garbage images.
- Integration with Google Maps API for automatic location tagging.
- Role-based access for BBMP officials to mark tasks as completed.
- Building a mobile app version for broader reach.
- Reward systems for users who consistently report issues.

CONCLUSION

CleanSpot is a step forward in promoting civic responsibility using accessible technology. It proves that even a small project can make a meaningful difference when designed with social impact in mind. The successful deployment and positive user feedback confirm that there is a real demand for such tools.

This project also opens pathways for collaboration with governmental bodies to adopt and scale the solution further. As cities continue to grow, smart, participative tools like CleanSpot will play a crucial role in keeping urban areas clean, efficient, and responsive.

CleanSpot not only meets technical learning outcomes but also demonstrates how engineering skills can be applied to solve real-world problems. This balance of technical execution and social impact makes it a project of both academic and civic value.

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