

Smart Location-Based Service for E-Waste Disposal Awareness and Center Navigation

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Abstract: *The rapid growth of electronic devices has resulted in a significant increase in electronic waste (e-waste), creating serious environmental and health concerns. Improper disposal of e-waste leads to pollution and hazardous effects due to toxic materials such as lead, mercury, and cadmium. Despite government initiatives, public awareness and accessibility to authorized disposal centers remain limited. This paper proposes a Smart Location-Based Service for E-Waste Disposal Awareness and Center Navigation, which helps users identify nearby e-waste collection centers using GPS technology and provides real-time navigation. The system also includes an awareness module to educate users about proper disposal methods and environmental impact. The proposed solution integrates Google Maps API, Firebase, and cloud-based technologies to ensure scalability and real-time data access. This system bridges the gap between awareness and action, promoting sustainable e-waste management practices.*

Keywords: E-waste, Location-Based Services, GPS, Google Maps API, Recycling, Sustainability

I. INTRODUCTION

In the modern digital era, the use of electronic devices such as smartphones, laptops, tablets, and home appliances has increased rapidly. While these devices have improved human life and productivity, they have also led to the generation of a large amount of electronic waste (e-waste). E-waste consists of discarded electronic products that are no longer useful and often contain hazardous materials such as lead, mercury, cadmium, and other toxic substances. Improper disposal of these materials can cause serious environmental pollution and health issues.

With the rapid advancement of technology and frequent upgrades in electronic devices, the lifespan of devices has reduced significantly. As a result, people tend to replace their devices more frequently, leading to an exponential increase in e-waste generation. According to recent studies, millions of tons of e-waste are generated globally every year, and a large portion of this waste is not managed properly. Instead, it is either dumped in landfills or handled by informal recycling sectors using unsafe methods.

One of the major challenges in e-waste management is the lack of awareness among people regarding proper disposal methods. Many individuals are unaware of the harmful effects of e-waste and do not know where to dispose of their old electronic devices safely. Even though governments and environmental organizations have introduced policies and guidelines for e-waste management, their implementation remains limited due to the absence of accessible and user-friendly systems.

Another key issue is the lack of proper infrastructure and guidance systems that can help users locate authorized e-waste collection centers. Existing solutions often focus only on awareness or only on recycling, but they fail to combine both aspects effectively. There is a clear need for a smart system that not only educates users but also provides practical assistance in locating and reaching disposal centers.

To address these challenges, this paper proposes a Smart Location-Based Service for E-Waste Disposal Awareness and Center Navigation. The system utilizes GPS-based location tracking and Google Maps integration to identify nearby authorized e-waste disposal centers and provide real-time navigation assistance. In addition, the system includes an



awareness module that educates users about the environmental impact of improper e-waste disposal and promotes responsible recycling practices.

The proposed system leverages modern technologies such as cloud computing, Firebase database, and location-based services to ensure scalability, real-time updates, and secure access. By combining awareness, navigation, and technology into a single platform, this system aims to bridge the gap between knowledge and action in e-waste management.

In conclusion, this work presents a practical and technology-driven solution to one of the most pressing environmental issues of the modern world. It demonstrates how smart applications can play a significant role in promoting sustainable practices and encouraging responsible behavior among users.

II. PROPOSED SYSTEM

2.1 System Architecture

The system architecture of the proposed Smart Location-Based Service for E-Waste Disposal Awareness and Center Navigation defines the interaction between user, location services, database, and application modules.

The process begins when the user logs into the application. After authentication, the system captures the user's current location using GPS. The captured location is processed and sent to the backend, where nearby e-waste disposal centers are fetched from the Firebase database.

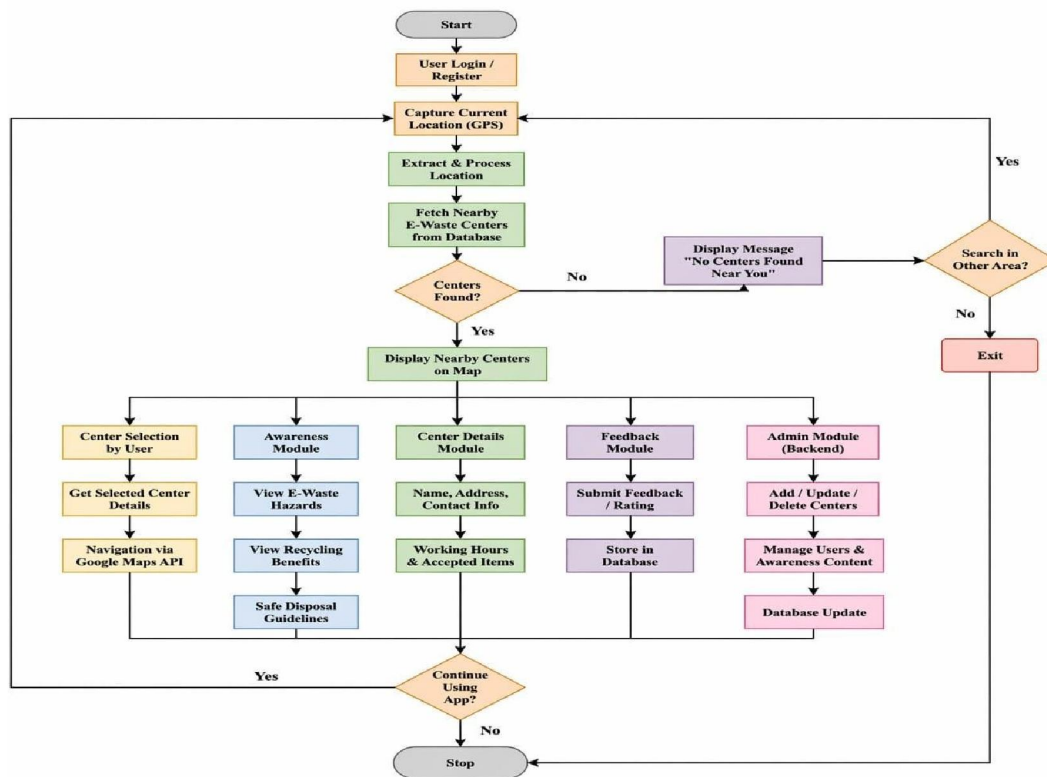


Fig. 1. Architecture of the proposed E-Waste Disposal and Navigation System.

The retrieved data is displayed on an interactive map using the Google Maps API. If no centers are found, the system allows the user to search in another location. When centers are available, users can select a center and view its details such as address, contact information, and working hours.



The system also provides real-time navigation to the selected center. Along with this, an awareness module educates users about e-waste hazards and recycling practices. A feedback module allows users to submit their experience, which is stored in the database.

An admin module is included to manage e-waste center data and update system information. Overall, the architecture ensures efficient data flow, real-time interaction, and a user-friendly experience.

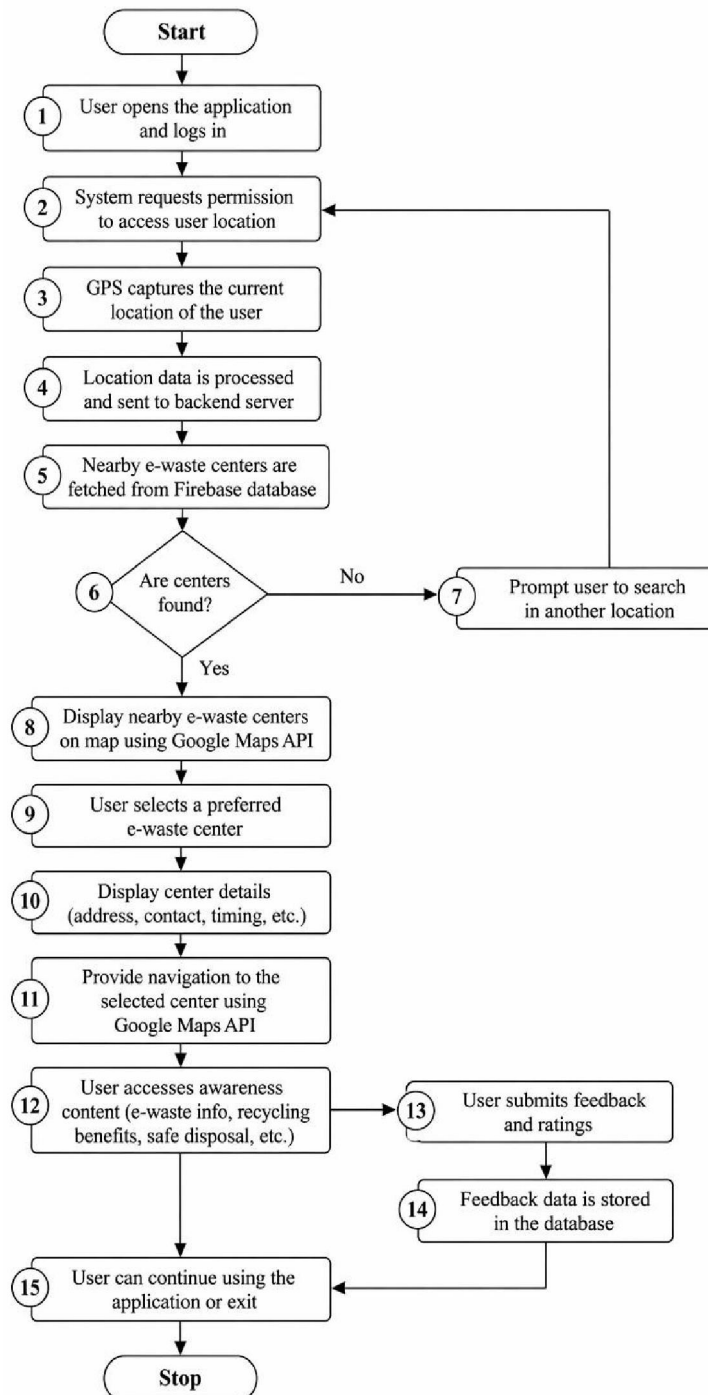
2.2 Modules Description

The proposed system consists of several functional modules to ensure efficient operation and user interaction.

- User Module: Handles user registration, login, and interaction with the system.
- Location Detection Module: Captures the user's real-time location using GPS.
- Database Module: Stores and manages e-waste center data using Firebase.
- Navigation Module: Provides route guidance using Google Maps API.
- Awareness Module: Displays information about e-waste hazards and recycling practices.
- Feedback Module: Collects user feedback and ratings for system improvement.
- Admin Module: Manages system data, including adding and updating e-waste centers.



2.3 Working Flow



III. RESULTS AND DISCUSSION

The proposed system was successfully developed and tested to evaluate its performance in identifying nearby e-waste disposal centers and providing navigation support. The application was able to accurately detect the user's location using GPS and retrieve relevant data from the Firebase database in real-time.

The system effectively displayed nearby e-waste centers on the map using Google Maps API. Users were able to select a center and receive proper navigation guidance without any major delay. The integration between frontend, backend, and APIs worked smoothly, ensuring a seamless user experience.

In cases where no e-waste centers were available in the user's location, the system correctly prompted the user to search in another area. This feature ensured that users were not left without options and improved overall usability.

The awareness module played an important role in educating users about the harmful effects of improper e-waste disposal and the benefits of recycling. Users were able to access informative content easily, which helped in increasing awareness and encouraging responsible behavior.

The feedback module allowed users to submit their experiences and ratings. This data was successfully stored in the database and can be used for future improvements of the system.

Overall, the system demonstrated good performance in terms of accuracy, response time, and usability. The results indicate that the proposed solution is effective in bridging the gap between awareness and action in e-waste management.

IV. CONCLUSION AND FUTURE WORK

The proposed Smart Location-Based Service for E-Waste Disposal Awareness and Center Navigation provides an effective solution to the growing problem of improper e-waste disposal. The system integrates GPS-based location tracking, Firebase database, and Google Maps API to help users easily locate nearby authorized e-waste collection centers and navigate to them in real time.

The application also includes an awareness module that educates users about the harmful effects of e-waste and promotes responsible recycling practices. The system was tested and demonstrated good performance in terms of accuracy, usability, and response time. It successfully bridges the gap between awareness and practical action, encouraging environmentally sustainable behavior.

In the future, the system can be enhanced by adding features such as doorstep e-waste pickup services, reward-based recycling systems, and AI-based recommendations for users. Integration with government portals and support for multiple languages can further improve accessibility and reliability. Additionally, data analytics can be used to monitor user participation and improve system efficiency.

Overall, the proposed system has the potential to evolve into a comprehensive and scalable platform for promoting responsible e-waste management and contributing to environmental sustainability.

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