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E-Waste Facility Locator using Integrated Map Interface

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Abstract

The E-Waste (Electronic Waste) Facility Locator application utilizes the user's current location to help find a nearby e-waste disposal center. The application features a user-friendly map interface that allows the user to select an e-waste facility based on their preferences. The user can either go to the facility to dispose of the e-waste or request the facility to pick up the waste at their doorstep. The entire system is managed by a system admin. Overall, the E-waste Facility Locator app helps users dispose of electronic waste responsibly, reducing pollution and conserving resources.

Keywords: E-waste, Recycling Facilities, Waste Management, Geolocation, Resource Recovery, Waste Electrical and Electronic Equipment (WEEE).

1. Introduction

E-waste is a significant health and environmental issue. In 2019, nearly 45 million metric tons of electronic waste, or "e-waste," were produced worldwide. Predictions indicate this number will rise to 60 million tons by 2030. Therefore, e-waste should be more effectively managed to reduce pollution and conserve resources. To address this issue, the proposed solution is the E-waste Facility Locator application with a user-friendly map interface. The application allows users to either select a preferred facility for disposal or request a pick-up of the e-waste at their doorstep [1].

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According to recent studies, the E-Waste Facility Locator facilitates proper disposal practices by making it simple for anyone to locate e-waste disposal facilities. The application helps users in locating nearby disposal locations by utilizing GPS data and linked maps. It assists and speeds up the process of locating the appropriate disposal sites by incorporating real-time geolocation services and more features.

The platform not only connects users with facilities but also spreads awareness about environmental problems. It encourages users to dispose of their e-waste appropriately by creating awareness to the consequences of inappropriate disposal, hence promoting sustainable habits and a sense of environmental responsibility. The E-Waste Facility Locator platform includes a logistics support system for e-waste disposal and an innovative incentive system. When the gadgets are properly recycled, users can receive points based on how much valuable metal is extracted from them. This strategy in e-waste management highlights the financial benefits of recycling devices and encouraging proper disposal practices.

Through the use of an efficient interface to locate local facilities and the encouragement of collaboration among diverse stakeholders, the E-waste Facility Locator platform improves e-waste management. It integrates technology with environmental responsibility, emphasizing sustainability and the circular economy while motivating consumers to actively participate in recycling.

1.1 Objective

To develop a web site that makes disposing of electronic waste simple. To provide a user-friendly map interface, geolocation services, that allows user to make proper decision.

2. Related Works

The term 'e-waste' refers to worn-out electronic devices that are no longer in use. Improper disposal of e-waste can harm human health and the environment, making proper e-waste disposal a major issue that needs to be addressed. A brief overview of existing studies shows the steps taken to handle e-waste and enhance environmental sustainability. Waste electrical and electronic equipment (WEEE) is a critical waste stream due to its valuable

materials and increasing annual generation rates. Effective WEEE management is essential for achieving the Sustainable Development Goals, a circular economy, and resource efficiency, especially for developing countries [5]. Many developing countries follow informal methods for e-waste disposal, causing significant impacts on human health and the environment [1]. A survey was conducted to identify reasons for disposal and the disposal methods followed. Awareness programs were created about incorrect disposal, stating the correct disposal methods to develop sustainable e-waste management [3,7].

A smart information technology (IT) tool-based smart reverse system for e-waste from end-of-life electronics holders to local recycling infrastructures is developed in [6]. This system involves local delivery services to collect e-waste and connects to interactive online maps of users' demands.

In order to collect electronic waste efficiently, the behavior-based swarm model with fuzzy controller (BSFC) is suggested in [2]. This model yields significant improvements in vehicle routing plans for the collection of electronic waste, taking into account the beneficial social effects of waste collection, especially in urban areas.

In emerging economies, electronic waste poses health and environmental risks, highlighting the importance of locating sustainable collection centers. This study [4] uses Fuzzy BWM and Fuzzy TOPSIS methods to evaluate economic, social, and environmental criteria, identifying Çiğli as the best location, followed by Gaziemir and Manisa.

Sahoo et al. [8] and his colleagues, have made major progress in managing electronic waste. They have created a platform integrating blockchain technology that will connect different entities that are involved in e-waste management across the globe. The software platform enhances the tracking of e-waste recycling processes. It also contains efforts to develop a map that displays the locations of e-waste facilities, which is intended to make managing e-waste even more efficient.

Ylä-Mella et al.[9] delved into electronic waste (e-waste) recovery in Finland, focusing on consumers' perspectives regarding the recycling and reusing of mobile phones, laptops, and other significant electronic devices. The findings suggest that understanding consumer perceptions and behaviors toward e-waste recycling can guide the development of

e-waste facility locators. These locators aim to improve user participation in recycling and reuse programs.

Kumar et al. [10] presents detailed analysis of e-waste generation, collection, laws and rules, and recycling techniques. Their detailed study creates a solid foundation for the creation of the integrated map interface because it can be used to guide the inclusion of pertinent legal obligations and proven best practices and solutions.

Research by Lu et al. [11] examined e-waste management in China, a significant producer of electronic waste. Analyzing their findings offers the opportunity to gain valuable insights that can be applied to the development of a tool that helps people find e-waste recycling facilities. This will ensure the tool's practicality and effectiveness in various global settings.

This information from the study helps in customizing the proposed waste management system's functionality and design to match user preferences and demands. The proposed system is currently designed to handle the requests of few localities in Tamilnadu.

3. Proposed Work

The proposed e-waste facility locator provides personalized services to help users find nearby e-waste disposal centres. The system verifies the user's location to suggest available facilities nearby and authenticates users with a user ID and password. It also stores information about registered users and e-waste facilities in a database. Currently, the system is designed to handle requests for a few localities in Tamilnadu.

The user interface developed for the proposed system includes the complete details including complete details about the locality, the type of e-waste that is accepted, time taken to complete the service etc. Additionally, the interface includes the helps instruction to guide the users.

Based on the user's present location, the proposed system utilizes K-Nearest Neighbors (KNN) to find the closest e-waste facilities when choosing a disposal site. Mapbox GL ensures optimal travel paths by generating the most efficient routes to these closest facilities. By facilitating real-time tracking of e-waste disposal status and updates on the

recycling process, the platform links users with facilities. Users receive credit points for each approved disposal, which are verified by a secure OTP system, in an effort to promote responsible disposal. With its quick facility identification and flexible disposal options, the "Online E-Waste Facility Locator" will improve user experience.

Users can choose to drop off their e-waste at the selected facility themselves or use a pickup service provided by the facility. When users choose the pickup option, the facility will send staff to collect the e-waste from their location. The facility will confirm receipt, process the disposal, and reward the user with credits in their account. This rewarding element system aims to boost active participation percentage and promotes sustainable waste management practices. Overall, the application provides a user-friendly, secure, and efficient way to dispose of e-waste.

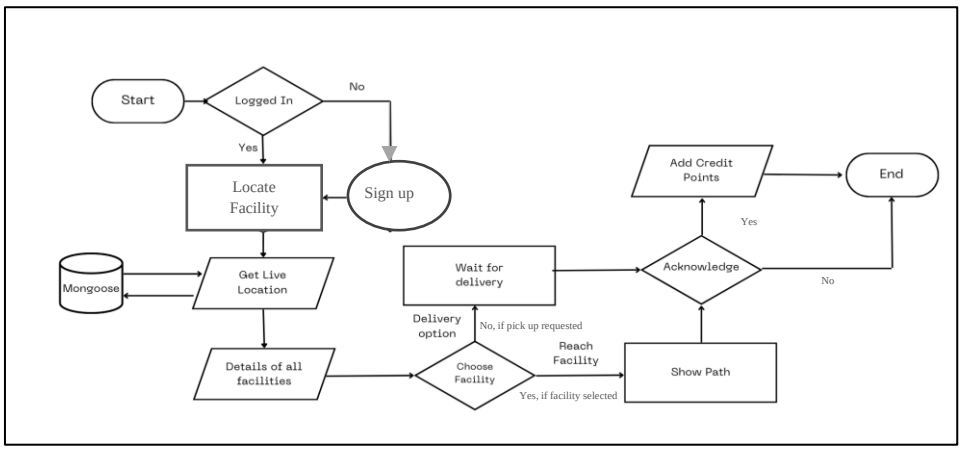

Figure 1. E-Waste Facility Locator Flow Chart

The process begins by checking if the user is logged in. If not, they are prompted to sign up. Once logged in, the system uses the Geolocation API to obtain the user's current location. The K-Nearest Neighbors (KNN) algorithm is then applied to find the nearest e-waste facilities based on this location and the data retrieved from the Mongoose database. Details of these nearest facilities are provided to the user, who then selects a facility and chooses a delivery option. If delivery is selected, the system uses Mapbox GL to show the route to the chosen facility. Upon reaching the facility, the user confirms the delivery or arrival. If confirmed, credit points are added to the user’s account. If not confirmed, the

process ends. This system ensures efficient facility location and navigation while rewarding users for their engagement. The Figure 1 shows the flowchart of the proposed system.

The Table 1 below shows the hardware and the software specification of the proposed system design.

Table 1. Hardware and Software Specification

Hardware Specification	Software Specification
Processor: Intel Core i3 or AMD Ryzen	Visual studio code
Memory: 4GB of RAM	GitHub and Git hosting support (Vercel)
Storage: HDD or SSD	NodeJS
	React JS
	MongoDB

4. Results and Discussion

React.js was utilized in the development of the user interface's frontend because of its flexibility in creating interactive components. Node.js and Express.js were used to provide the backend, providing scalability for server-side JavaScript code execution. These technologies manage real-time updates and tracking, which is essential to continually monitoring on the status of e-waste disposal. Node.js makes server-side programming scalable and effective, providing settings that are ideal for tasks requiring real-time data processing.

Clerk authentication is used in the proposed work to ensure secure user data management and access control. It provides an additional layer of security by enabling multifactor authentication. It effectively handles user session, ensuring secure access and session control. Its built-in encryption protocols protect sensitive information and reduce the risk of unauthorized access. clerk authentication is integrated into the website to enhance security measure while maintaining a user-friendly experience.

Figure 2 shows the home page of the developed user interface.

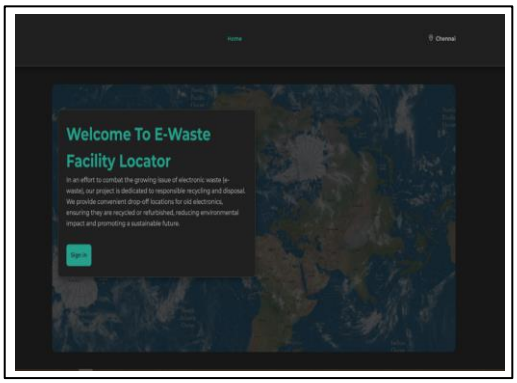

Figure 2. Home Page

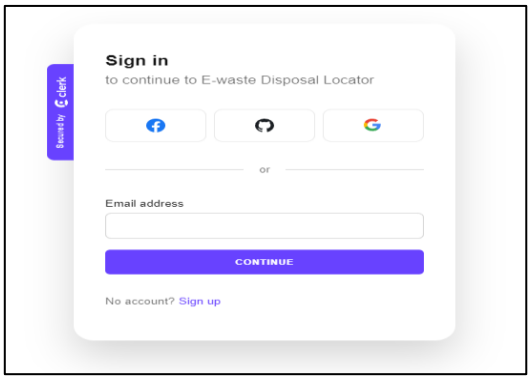

Figure 3. Login Page

Figure 3 shows the login page of the e-waste disposal locator.

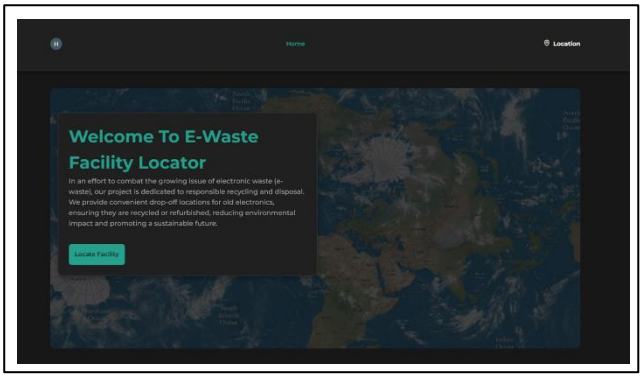

Figure 4. User Home Page

Figure 4 shows the user home page for the e-waste dispose facility locator.

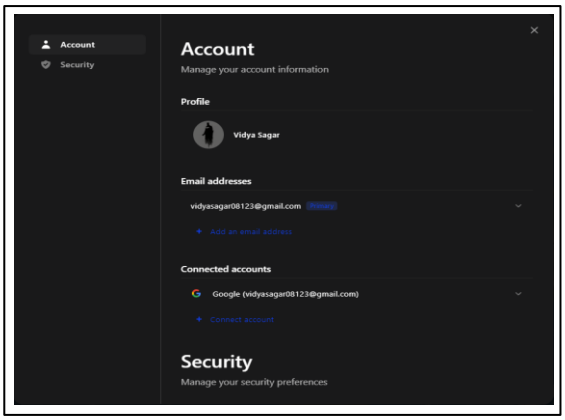

Figure 5. User Login

Figure 6. Map Interface

Figure 5 the user login page, and Figure 6 shows route generated using the Mapbox GL to the selected e-waste disposal facility. Figure 7 displays the details of e-waste facility.

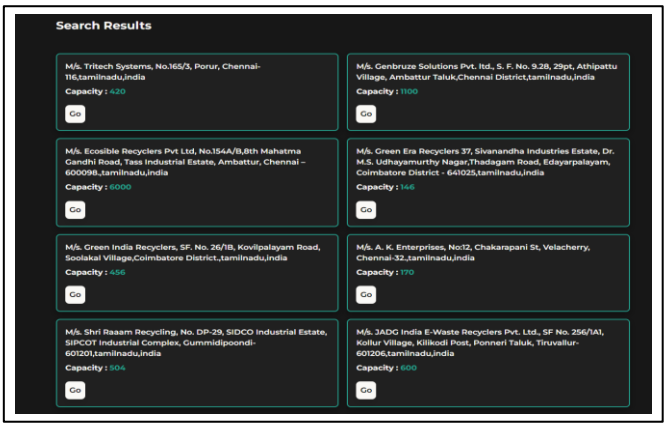

Figure 7. Details of E-waste Facility

Figures 8-12 show screenshots of the user request and the admin response in handling e-waste.

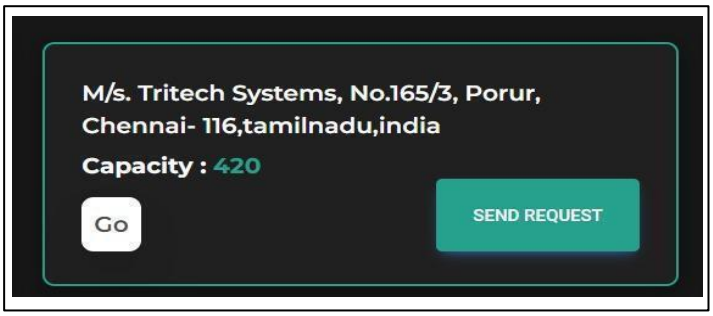

Figure 8. Send Request for Pick Up

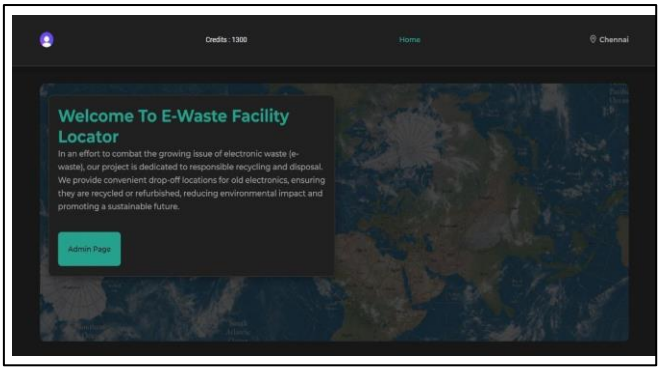

Figure 9. Admin Login Page

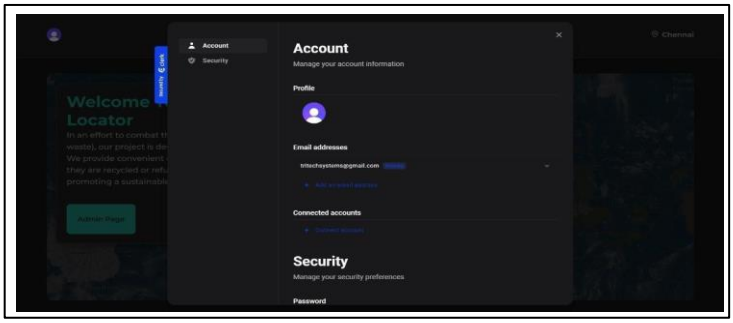

Figure 10. Admin Account Management

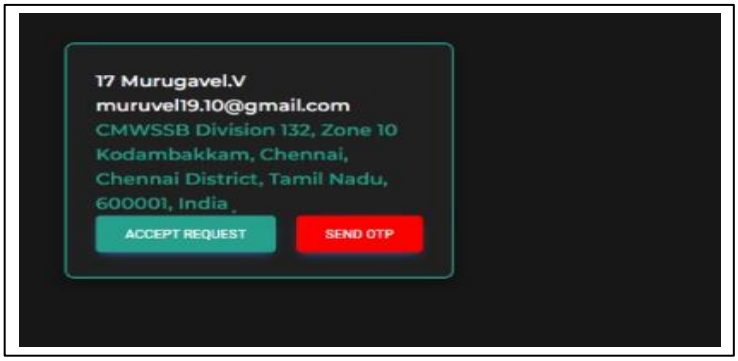

Figure 11. Pending Requests

Figure 12. OTP Verification

5. Conclusion

The Online E-Waste Facility Locator research intends to go beyond Tamil Nadu and eventually become a national resource for finding e-waste disposal facilities. In order to establish a nationwide network of e-waste facilities, the research intends to cooperate with enterprises, government agencies, and environmental organizations. The platform will be modified to accommodate local laws, customs, and linguistic requirements. In addition to managing e-waste, the research plans to track and locate other waste categories like paper, plastic, and hazardous items. It also hopes to apply its approach to other fields like biodiversity preservation, renewable energy, and water conservation. Making connections with organizations, institutions, and research teams. By connecting with companies, schools, and research groups, the research will adopt new technologies, such as blockchain for reliable waste tracking, IoT devices for real-time monitoring, and big data analytics and machine learning for optimizing resource allocation and policy decisions. Through continuous improvement and innovation, the research aims to promote sustainability and create a more responsible and resourceful society in India and globally.

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