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Advanced E-Waste Facility Locator: Harnessing Convolutional Neural Networks for Sustainable Environmental Impact and Recycling Solutions

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Abstract

This research paper focuses on addressing the environmental harm caused by the increasing number of electronic devices in the modern world. As technology advances, the usage of electronic devices such as smartphones, tablets, and laptops has surged. While some of these devices can be repaired when damaged, many are either left unused at home or discarded in regular waste bins, leading to significant environmental hazards in the coming years. Although e-waste facility centres are available, users are often reluctant to visit these locations. To tackle this issue, we propose a solution in the form of an application that utilizes an API to connect users with vendors located in specific areas. The key features of this application include user interaction, mapping, and a reward system. This will be beneficial for both the user and the vendor who are present at that location, and it will also reduce the impact on the environment.

Keywords: *API; CNN; E-waste management; Facility locator; Geolocation; Reward system; Sustainable recycling; User interaction.*

1. Introduction

The problem of e-waste recycling is growing nowadays. If we continue to live like this, it will cause a huge impact in the coming years. The number of electronic devices is increasing rapidly; for example, there are often more electronic devices than people— such as three mobile phones for every two individuals [1-3]. This solution can help mitigate this problem and reduce the environmental impact that might occur in the future. The key components of our application include front-end technologies like HTML, CSS, and JavaScript for the UI/UX, while the backend uses Node.js, Express, and MySQL to store data in the database. The API is used to find the nearest locations on the map for the user.

2. Research Background

The rapid advancement in technology has led to an exponential increase in the production and consumption of electronic devices such as smartphones, tablets, and laptops [4]. While these devices have significantly improved our quality of life, they also pose a significant environmental challenge when they reach the end of their lifecycle. E-waste, or electronic waste, is one of the fastest-growing waste streams globally, with millions of tons of discarded electronics being generated each year [5]. Unfortunately, a substantial portion of this waste ends up in landfills, leading to hazardous environmental consequences due to the toxic materials contained in these devices. Despite the existence of e-waste recycling centers, the process of disposing of e-waste responsibly is often neglected by consumers. The reasons for this include a lack of awareness about recycling facilities, inconvenience in accessing these centers, and the absence of incentives for individuals to recycle. As a result, many electronic devices are either left unused in households or improperly discarded, exacerbating the e-waste problem. Recognizing the need for an accessible and efficient solution, our project aims to bridge the gap between

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users and e-waste recycling vendors through an innovative API-based e-waste facility locator. This application leverages modern technologies to provide users with a convenient way to locate and connect with nearby recycling centers. The application integrates front-end technologies, including HTML, CSS, and JavaScript, to create an intuitive user interface, while the backend is powered by Node.js and Express, with MySQL used for data storage. A Convolutional Neural Network (CNN) is utilized to identify the nearest recycling facilities based on the user's location [6]. In addition to facilitating the recycling process, the application introduces a reward system where users earn "super coins" for recycling their electronic waste. These coins can be redeemed for products, thus incentivizing users to participate in sustainable practices. By targeting the root causes of improper e- waste disposal, our project aims to reduce the environmental impact of electronic waste and promote a culture of responsible recycling. This application acts a bridge between the users and the vendors present at the e-waste disposal center.

3. Solution

The solution to this problem is to create an application that acts as a bridge between the user and the service provider at the meeting point. The application is not only good for users but also the environment [7-9]. The application simplifies the e-waste recycling process, supporting the responsible disposal of e-waste, and making it easier for users to find local recycling centers nearby and ready to write. This convenience, together with the promotion of recycling gifts, encourages users to participate in the reduction of e- waste and thus contribute to the clean health of the world [10].

4. Interface

This work aims to keep the interface as simple as possible for users to easily navigate and understand the flow.

A user can:

- Upload a photo.
- Select the nearest vendors.

Choose a time slot. A vendor can:

- Fetch user responses.
- Accept requests.
- Proceed with the user interaction.

5. UI/UX

Figure 1 The Landing Page of Website

Figure 2 The Login Page of Website

Figure 3 Nearest Vendors Detail

Figure 4 Directions of the Selected Vendor

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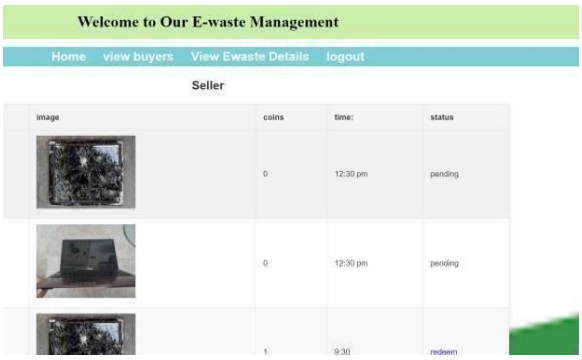

Figure 5 The Requests of the Users

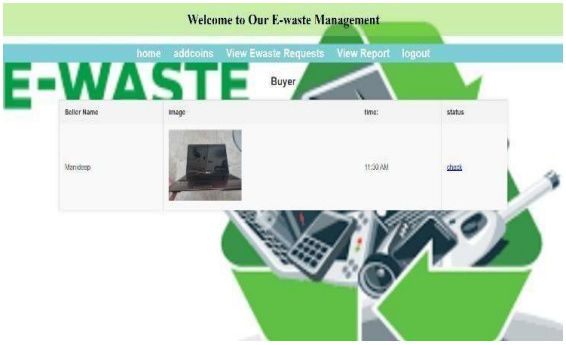

Figure 6 Accepting the Request

5.1. The Landing Page of Website (Fig 1)

The landing page of our e-waste facility locator is designed to be user-friendly and visually engaging [11-13]. It offers a clean and intuitive interface that immediately directs users to key functions, such as logging in or accessing specific roles like seller or buyer. The page prominently features a welcoming message and provides easy navigation through a top menu, allowing users to explore various sections like vendor selection, item details, and coin rewards. The background image reinforces the theme of e-waste recycling, making it clear what the platform is about while maintaining a professional and straightforward design that encourages user interaction.

5.2. The Login Page of Website (Fig 2)

The login page of the e-waste facility locator is designed to accommodate both users and vendors, ensuring a streamlined and efficient authentication process. It features distinct sections for each type of user, allowing them to easily input their credentials. The design is simple yet effective, with clear labels for username and password fields, ensuring that both users and vendors can quickly and securely log into their respective accounts. Additionally, a prompt for new account creation is available, guiding new users or vendors to register effortlessly. The layout is intuitive, making it accessible for users with varying levels of technical expertise.

5.3. Nearest Vendor Details (Fig 4)

The "Nearest Vendor Details" feature allows sellers to access comprehensive information about buyers who have selected them. Upon receiving a request, the seller can view all relevant buyer details, including contact information and item specifics. Additionally, a direct link is provided within the interface. When clicked, this link will redirect the seller to the buyer's location, facilitating easy navigation and ensuring timely pickups or service. This feature is designed to enhance the efficiency of transactions, making it easier for sellers to fulfill requests with precision and speed.

5.4. Directions of The Vendor (Fig 5)

The "Directions of the Selected Vendor" feature enables users to easily navigate to the vendor they have chosen. [14] Once a user selects a vendor, they receive detailed directions on a map that outlines the route and distance between their current location and the vendor's facility. This map-based guidance ensures that users can find the vendor with ease, providing a visual representation of the journey and helping them plan their travel time accordingly. The integration of this feature enhances the user experience by offering clear and accurate navigation assistance.

5.5. The Request of the Users (Fig 3)

The platform allows multiple users to send requests to a vendor, all of which are conveniently accessible to the vendor through their account. The vendor can view a comprehensive list of all incoming requests, making it easy to manage and respond to each one effectively [15-17]. This system is designed to streamline the communication process between users and vendors, ensuring that vendors can quickly review, accept, or proceed with requests based on their availability and preferences. The clear organization of requests helps vendors efficiently manage their workload and maintain a smooth operation.

5.6. Accepting The Request (Fig 5 & 6)

Once the vendor reviews the details and confirms the availability, they can choose to accept the

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request. Upon acceptance, the system notifies the user, confirming that their e-waste items will be collected or processed as agreed. This final step ensures a smooth and transparent transaction between the user and the vendor, facilitating efficient e-waste management.

6. Working of Application

6.1. User Input

Users enter their search queries or commands related to e-waste disposal into a web-based interface. This interface is built using HTML for structure, CSS for styling, and JavaScript for interactive features.

6.2. Request Handling

When the user submits their query, JavaScript captures the input and prepares a request to be sent to the backend or directly to an API. This can involve querying for nearby e-waste facilities or scheduling a pickup [18].

6.3. Backend Processing

The backend server receives the user's request. It processes the input, interacts with external APIs, and performs any necessary operations, such as querying a database or making requests to the Google Maps API to get facility data or location information.

6.4. API Integration

The backend or frontend may use the Google Maps API to get information about nearby e-waste facilities. This includes sending a request with the user's location or search parameters to the API, which returns relevant facility data.

6.5. Interaction with External APIs

If the user query requires interaction with external services (like Google Maps API), the backend handles these requests and retrieves the necessary data. For example, querying Google Maps API for nearby e- waste facilities [19[.

6.6. User Feedback

The frontend updates the user interface with the data retrieved. This could involve displaying a map with markers for e-waste facilities, showing facility details, or providing translated information in the user's preferred language.

6.7. Optimization

The application continuously optimizes the user experience by refining how data is displayed and ensuring that API interactions are efficient (Figure 7). This might include optimizing map performance, improving response times, and ensuring the interface is user-friendly.

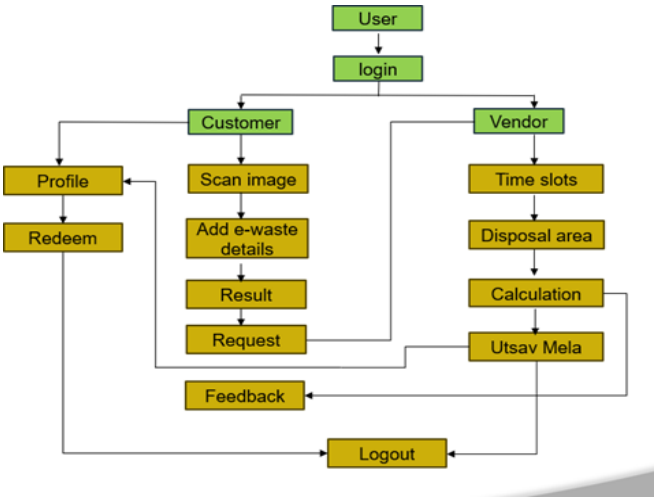

Figure 7 Explain The Working Environment of the Application

LIST OF E-WASTE RECYCLERS AND DISMANTLERS

Sl. No.	Name & Address of unit	Activity	Working/YTC
1	M/s. Ash Recyclers, No. 94, Thimmaiah Road, Bangalore - 01	E-waste recycler	Working
2	M/s. E-Parisara Pvt Ltd, No 30-P3 Dabaspet Bangalore.	E-waste recycler	Working
3	M/s. Eco-Ewaste Recyclers India Pvt Ltd,No.41/1, 42/2, 19 & 20, 2nd Cross, Mutachari Industrial Estate, Hanumanthappa Layout, Mysore Road, Bangalore-560039	E-waste Dismantler	Working
4	M/s. Sriram Eco Raksha Computer Services Pvt Ltd.,. No. B-29, KSSIDC Indl. Estate, Bommasandra, Hosur Road, Anekal Taluk, Bangalore – 560 099.	E-waste Dismantler	Working
5	M/s. E-Ward & Co., No.6/1B, 14th Cross, Hosur Road, Bommanahalli, Bangalore – 560 068.	E-waste recycler	Working
6	M/s. K.G Nandini Enterprises, No.46/4, 46/5, Billakempanahalli village, Bidadi Hobli, Ramanagaram District.	E-waste recycler	Working
7	M/s. Eco Bird Recycling Company Pvt. Ltd., No. 185, Azeez Sait Industrial Area, Nayandahalli, Mysore Road, Bangalore – 39.	E-waste recycler	Working
8	M/s. FA Enterprises, No. B-08, KIADB Industrial Area, Tamaka, Kolar Dist.	E-waste recycler	Working

Figure 8 E-Waste Facility Locators in Bangalore

7. Necessity of This Application

The e-waste facility locator application is essential for promoting environmental sustainability by helping users find certified recycling centers and

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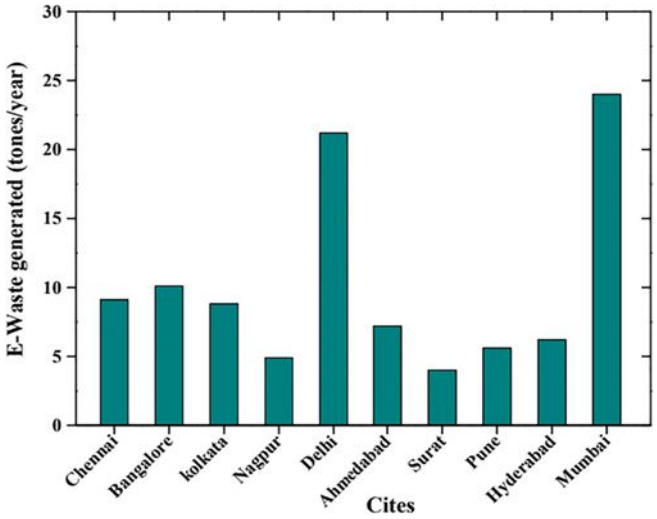
proper disposal methods for hazardous e-waste materials. It increases public awareness of the importance of responsible recycling, offers convenience through easy location finding and scheduling pickups, supports regulatory compliance, and enhances recycling efficiency by directing e-waste to appropriate facilities [20[. By integrating advanced technologies such as GPS and multilingual support, the application ensures real-time, accessible, and user-friendly solutions for managing e-waste, ultimately contributing to reduced environmental impact and improved resource recovery.

8. Results and Discussion

The graphical representation of Table 1 presented herein (a form of Graph 1) illustrates the increasing of E-Waste across various states of India.



Graph 1 Results

9. Working of The CNN

9.1. Conventional Neural Network

Convolutional Neural Networks (CNNs) are utilized to enhance the accuracy and efficiency of locating e-waste facilities. CNNs process and analyze images of e-waste items submitted by users to identify and categorize them, enabling the application to match these items with appropriate recycling facilities. This image recognition capability ensures that users receive accurate recommendations based on the specific type of e-waste they are disposing of. Additionally, CNNs can aid in visualizing facility locations on maps, improving the user experience by providing precise and relevant information about nearby e-waste recycling options (Figure 9). Convolutional Neural Networks (CNNs) help process images of e-waste items submitted by users. Here's how it works in simple terms:

- **Image Upload:** Users upload pictures of their e- waste items into the app [21].
- **Preparing Images:** The app adjusts these images to make sure they're consistent and ready for analysis.
- **Finding Features:** CNNs look at these images and use special filters to find important details, like shapes and textures. Think of it like identifying different parts of a picture to understand what's in it.
- **Simplifying Data:** CNNs then reduce the complexity of the images while keeping the most important information. This helps the system focus on the crucial details without getting bogged down by unnecessary information.
- **Classifying Items:** The system uses what it has learned to figure out what type of e-waste is in the image (Figure 8). It matches the e-waste to known categories, like old phones or computer parts.
- **Finding Facilities:** Based on the type of e-waste, the app finds and suggests nearby recycling facilities where the user can dispose of the item properly.
- **Showing Results:** The app presents the user with a list of recommended recycling centers and their locations.

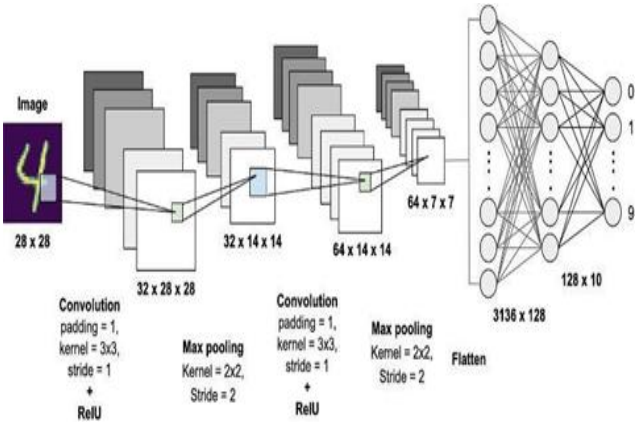


Figure 9 Working of CNN for Image

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Classification

10. Challenges Faced

Integrating with external APIs like Google Maps and ensuring that they provide accurate geolocation data can sometimes be unreliable and it was overcome by using multiple geolocations APIs

11. The Statistical Data

After using the application, the first 100 users were asked to give their feedback. The statistical data of their responses is shown in Table 1 (Graph 1) and Table 2 (Graph 2):

Table 1 The Result of the First Question of theSurvey

How was the translation of your text?	Votes
It was perfect, translated word to word	65
It was good, but there were a few errors	7
It was all wrong	2

Graph 2 The Graph for The First Question of the Survey

Conclusion

In Conclusion, the e-waste facility locator project represents a significant step toward promoting sustainable waste management and environmental protection. By leveraging advanced technologies such as CNNs, APIs, and geolocation services, the project aims to make e-waste disposal more accessible and efficient for users. Despite the challenges, such as data accuracy, API integration, and user engagement, the project has the potential to greatly enhance e-waste recycling efforts. It not only simplifies the process of finding and utilizing e-waste facilities but also incentivizes responsible behavior through a rewards system. With careful planning, ongoing maintenance, and user-centric design, the project can contribute meaningfully to reducing e- waste and fostering a culture of sustainability.

References

[1]. Ackah, M. (2017). Informal E-waste recycling in developing countries: review of metal (loid) s pollution, environmental impacts and transport pathways. Environmental Science and Pollution Research, 24(31), 24092-24101.

[2]. Hazra, A., Das, S., Ganguly, A., Das, P., Chatterjee, P. K., Murmu, N. C., & Banerjee, P. (2019).

[3]. "Plasma Arc Technology: A Potential Solution Toward Waste to Energy Conversion and of GHGs Mitigation". In Waste Valorisation and Recycling 7 th IconSWM— ISWMAW 2017, Volume 2 (pp.203-217). Springer Singapore.

[4]. Sahoo, S., Mukherjee, A., & Halder, R. (2021). "A unified blockchain-based platform for global e- waste management". In International Journal of Web Information Systems, 17(5), 449–479.

[5]. Lopez Alvarez, J. L., Aguilar Larrucea, M., FernandezCarriÅLon Quero, S., & Jimenez del Valle, A. (2008). "Optimizing the collection of used paper from small businesses through GIS techniques: The LeganÅLes case (Madrid, Spain)". In Waste Management, 28(2), 282–293.

[6]. Mishima, K., Rosano, M., Mishima, N., & Nishimura, H. (2016). "End-of-Life Strategies for Used Mobile Phones Using Material Flow Modeling". In Recycling, 1(1), 122–135. https://www.mdpi.com/23134321/1/1/122

[7]. Alvarez-de-los-Mozos, E. and Renteria, A. (2017). Collaborative robots in e-waste management. Procedia Manufacturing, 11, 55-62.

[8]. S. Sudarmo, A. Arifin, P.J, Pattiasina, V.Wirawan, A.Asian," The Future of Instruction Media in Indonesian Education: Systematic Review," Al-

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https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2024.0339

Ishlah: Jurnal Pendidikan ,13(2), 1302-1311, 2021.

[9]. S.Herat, "E-waste management in Asia Pacific region: review of issues, challenges and solutions.," Nature Environment and Pollution Technology, 20(1), 45-53, 2021.

[10]. H.Ghimire, & P.A.Ariya, "E-wastes: bridging the knowledge gaps in global production budgets, composition, recycling and sustainability implications," Sustainable Chemistry, 1(2), 154-182, 2020.

[11]. S.H.Ghosh, "Electronic waste management in the Asia Pacific region," Electronic Waste Management, 49, 166-184, 2019.

[12]. P.D.Riyanto, "Limbah Bahan Berbahaya dan Beracun (Limbah B3)," Deepublish, 2014.

[13]. K.M.Atthariq, & M.Kahfindra, "Analisis Timbulan Sampah Elektronik Sektor Rumah Tangga Di Kecamatan Ngaglik Kabupaten Sleman," Dspace UII, 2022.

[14]. G.Bhattacharya, S.J.Fishblock, J.A.McLaughlin, & S.S.Roy, "Metal-oxide nanomaterials recycled from E-waste and metal industries: A concise review of applications in energy storage, catalysis, and sensing," International Journal of Energy Research, 45(5), 8091-8102, 2021.

[15]. M.Shahabuddin, M.N.Uddin, J.I.Chowdhury, & S.F.Ahmed, "Overview of electronic waste (e- waste)," International Journal of Environmental Science and Technology, 20(4), 4513-4520, 2023.

[16]. S.I.El-Hout, S.Y.Attia, S.G.Mohamed, & S.M.Abdelbasir, "From waste to value-added products: Evaluation of activated carbon generated from leather waste for supercapacitor applications," Journal of Environmental Management, 304, 114222, 2022.

[17]. L.Halim, & Y.O.Suharyanti, "E-waste: Current research and future perspectives on developing countries," International Journal of Industrial Engineering and Engineering Management, 1(2), 25- 42, 2019.

[18]. L.Andeobu, S.Wibowo, & S.Grandhi, "A systematic review of e-waste generation and environmental management of Asia Pacific countries," International Journal of Environmental Research and Public Health, 18(17), 9051, 2021.

[19]. J.A.Kalana, "Electrical and electronic waste management practice by households in Shah Alam, Selangor, Malaysia," International Journal of Environmental Sciences, 1(2), 132-144, 2010.

[20]. S.Pramila, M.Fulekar, & P.Bhawana, "E-waste: A challenge for tomorrow," Research Journal of Recent Sciences, 2277, 2502, 2012.

[21]. R.Heeks, L.Subramanian, & C.Jones, "Understanding e-waste management in developing countries: Strategies, determinants, and policy implications in the Indian ICT sector," Information Technology for Development, 21(4), 653-667, 2015.