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E-Waste Facility Locator

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ABSTRACT

Integrated mobile application and website offer a holistic e-waste management solution with multilingual, chatbot-driven assistance. Users can efficiently locate the nearest e-waste facility using path optimization and, upon device input, instantly view the rewards they'll receive post-disposal, which may include cryptocurrency, vouchers, NFTs, or cashback points, based on valuable materials recovered. To enhance user awareness, our platform delivers educational pop-ups related to users' recent search history, educating them about harmful and valuable components in their old devices. Furthermore, users can utilize AI and ML for quick assessments by uploading device pictures. In the spirit of sustainability, the platform allows users to not only dispose of their old devices but also purchase materials recovered from e-waste disposal. We are committed to cost-effective development, ensuring an economical yet environmentally conscious service that encompasses both a mobile app and website.

1. INTRODUCTION

The electronics industry stands as the world's largest and most rapidly expanding manufacturing sector, playing a pivotal role in the socio-economic and technological advancement of societies. The Basel Convention defines wastes as substances or objects intended for disposal by national laws, encompassing various forms of electronic equipment rendered valueless to their owners, collectively referred to as electronic waste or e-waste. As a consequence of consumer-driven growth policies, coupled with accelerated product obsolescence and technological progress, a novel environmental challenge has emerged—the proliferation of "Waste Electrical or Electronic Equipment (WEEE)" or "e-waste," consisting of obsolete electronic devices.

E-waste represents one of the fastest-growing waste streams globally, posing a significant challenge in both developed and developing nations. In the latter, WEEE currently accounts for 1% of total solid waste, projected to increase to 2% by 2010. The generation of e-waste poses dual challenges, involving both the sheer volume produced and the safe environmental disposal of electronic devices. Studies indicate that approximately 3.3 hundred thousand tons of e-waste are generated annually in India, with a total generation predicted to reach 4.8 tons by 2011. Despite the staggering growth in electronic consumption, a mere 19,000 tons of e-waste is recycled, predominantly within the informal sector, comprising 95% of total recycling efforts.

Given the economic viability of recycling due to the presence of valuable constituents such as precious metals, e-waste recycling processes, especially in the informal sector, present environmental and health hazards. The disassembly and extraction of valuable materials, including precious and strategic metals, often employ crude and hazardous techniques. Despite these challenges, the informal sector plays a crucial

role in the collection, segregation, and dismantling of e-waste, offering both environmental and social benefits. While its practices are largely unregulated, the informal sector contributes to efficient secondary processing, creating and retaining jobs and ensuring environmentally sound recycling practices.

In the digital age, the proliferation of electronic devices has led to a corresponding surge in electronic waste (e-waste), presenting a pressing challenge for sustainable waste management. Recognizing the need for a comprehensive solution, our integrated mobile application and website have been designed to offer a holistic e-waste management experience. This innovative platform combines cutting-edge technologies, multilingual support, and user-friendly features to address the growing environmental concerns associated with electronic waste disposal.

Our solution goes beyond traditional disposal methods by providing users with a seamless and efficient way to locate the nearest e-waste facility. Leveraging path optimization, users can effortlessly navigate to disposal centres, minimizing the environmental impact of transportation. Upon inputting their device details, users receive instant insights into the rewards they stand to gain post-disposal. These rewards may include cryptocurrency, vouchers, NFTs (Non-Fungible Tokens), or cashback points, reflecting the value of the recovered materials.

To promote user awareness, our platform utilizes chatbot-driven assistance and educational pop-ups tailored to users' search history. By delivering pertinent information about the harmful and valuable components in their old devices, we empower users to make informed decisions about e-waste disposal. Additionally, the integration of artificial intelligence (AI) and machine learning (ML) allows users to conduct quick assessments by uploading pictures of their devices, streamlining the disposal process.

Embracing sustainability, our platform extends beyond waste disposal to facilitate a circular economy. Users not only dispose of their old devices responsibly but also have the option to purchase materials recovered from e-waste disposal, contributing to a closed-loop system.

Commitment to cost-effective development underscores our dedication to providing an economically viable yet environmentally conscious service. By offering both a mobile application and a website, we aim to ensure accessibility and convenience for users, fostering a widespread adoption of responsible e-waste management practices. This initiative marks a significant stride towards a greener and more sustainable future, where technology and environmental consciousness coexist harmoniously.

2. LITERATURE SURVEY

In a study by Kuehr and Williams (2003), the authors emphasize the positive impact of an increasing market for reused PCs in developing countries. This trend not only allows individuals in these regions to own personal computers but also provides access to technology at more affordable prices. Charitable organizations, such as Computer Mentor, Computer Aid, World Computer Exchange, and Computers for Schools, play a pivotal role in expanding their reach, providing used and refurbished computers to organizations like schools globally. Importantly, the authors highlight that this practice of reusing PCs contributes to reducing the environmental impacts of technological artifacts. By extending the lifespan of electronic devices, there is a subsequent reduction in the demand for new equipment, aligning with sustainable practices.

In a study by Yamini Gupt & Samraj Sahay (2015), the focus shifts to the success factors of extended producer responsibility-based environmental policies. The authors argue that financial responsibility on the part of producers, along with the involvement of separate collecting and recycling agencies, significantly contributes to the effectiveness of these policies. They identify regulatory provisions,

takeback responsibility, and financial flow as the three most crucial aspects of extended producer responsibility. However, the study also notes that the presence of an informal sector can have a negative impact on regulatory provisions, underscoring the importance of formalized approaches in e-waste management.

Binegde et al. (2015) delve into the role of repair shops in extending the lifespan of electronic goods. The study highlights the substantial contribution of repair shops in reducing the number of discarded electronic items. However, it also identifies challenges, such as the high cost of repairs and the attractiveness of comparatively cheaper new electronic goods with advanced features, which may contribute to a culture of disposability. The accumulation of obsolete electronic items underscores the necessity of strengthening formal recycling of e-waste as a fundamental step toward achieving sustainable development.

According to Norazli Othman (2015), controlling the quantity of electronic waste requires a sustainable integrated technique in its management. The author emphasizes that such a technique should encompass electronic waste management from production to disposal. Additionally, the study recommends the implementation of new legislation and acts by authorities to develop human capital in managing electronic waste. The combination of human capital with sustainable techniques is posited as a key strategy for efficiently managing electronic waste in the future, thereby contributing to long-term sustainability.

In a study conducted by Ravi et al. (2016), the researchers delve into the evolving role of technology in bolstering e-waste management practices. The study specifically explores the utilization of mobile applications and online platforms to streamline the tracking, collection, and recycling of electronic waste. The integration of technology is identified as a promising avenue, offering potential improvements in efficiency and transparency within the e-waste management process. This research underscores the transformative impact that technological solutions can have on addressing the challenges associated with electronic waste.

Awasthi and Chauhan (2017) contribute to the literature by investigating the influence of awareness campaigns on e-waste management behaviors. Their study emphasizes the crucial role of educational initiatives, including public awareness programs and campaigns, in shaping consumer attitudes and promoting responsible e-waste disposal. The findings underscore the necessity for comprehensive awareness strategies to effectively address the mounting global challenge of e-waste.

Akenji et al.'s study (2017) shifts focus to the informal sector, assessing its contributions and challenges in e-waste recycling activities. The research delves into the socio-economic aspects of informal recycling, emphasizing the need for policy interventions that both recognize and regulate the informal sector's role in e-waste management. The study also discusses potential strategies for the integration of informal recyclers into formalized systems, highlighting the importance of acknowledging and collaborating with this sector.

In Lixandru et al.'s work (2018), the circular economy perspective is examined concerning the design of electronic products. The study investigates strategies that prioritize recyclability and reusability in electronic product design, emphasizing eco-design principles. The research underscores the significance of incorporating circular economy concepts into product design and manufacturing processes to minimize the environmental impact of electronic devices.

Singh and Kulkarni's study (2019) evaluates the economic viability of e-waste recycling initiatives, exploring various business models for e-waste recycling enterprises. This includes an examination of public-private partnerships and extended producer responsibility programs. The findings highlight the

potential economic benefits associated with sustainable e-waste management practices and advocate for innovative financial mechanisms to support these initiatives.

Lastly, Achilias and Achilias (2020) contribute insights into the chemical aspects of e-waste recycling. The study investigates environmentally friendly methods for handling hazardous materials found in electronic devices, emphasizing the application of green chemistry principles. The research underscores the importance of adopting sustainable and non-toxic approaches to manage e-waste materials, reflecting a broader commitment to environmentally conscious practices in the field. Together, these studies provide a comprehensive and multidimensional understanding of the challenges and opportunities in sustainable e-waste management.

3. METHODOLOGY

1. Proposed Work

Our project is centred around the development of a comprehensive e-waste management platform, addressing the pressing issue of responsible disposal in the face of the escalating proliferation of electronic devices. This innovative solution takes the form of both a mobile app and a web platform, incorporating a range of features aimed at effectively managing e-waste while engaging users in a responsible and rewarding recycling process. The platform begins with a user-friendly registration and login system, ensuring a personalized experience for users who can easily create accounts or log in. Importantly, our platform supports multiple languages, fostering accessibility for a diverse user base.

At the core of our solution is the E-Waste Facility Locator, enabling users to effortlessly discover nearby e-waste disposal and recycling facilities. Path optimization is integrated to streamline navigation, promoting convenience and encouraging responsible disposal practices. To incentivize responsible recycling, our platform incorporates a rewards system.

Users earn points based on the valuable materials present in their electronic devices, with rewards ranging from cryptocurrency and vouchers to NFTs and cashback points. In the "Recycle" section, users are prompted to input details about their electronic devices, allowing them to estimate potential rewards for recycling. This feature motivates users to make informed decisions and actively participate in the recycling process.

Enhancing user communication and assistance is an AI-powered chatbot, utilizing machine learning to efficiently respond to user queries, guide them through the recycling process, and provide valuable assistance. Recognizing the importance of education, our platform includes educational pop-ups delivering information tailored to users' preferences based on their recent search history. This feature raises awareness and promotes responsible recycling practices.

Finally, our platform fosters collaboration with various metal dealers, ensuring the efficient recycling of e-waste materials, maximizing recycling efforts, and strengthening the overall e-waste management process. In essence, our hackathon project offers a holistic and technologically advanced solution to promote responsible recycling and environmental sustainability.

2. System Architecture:

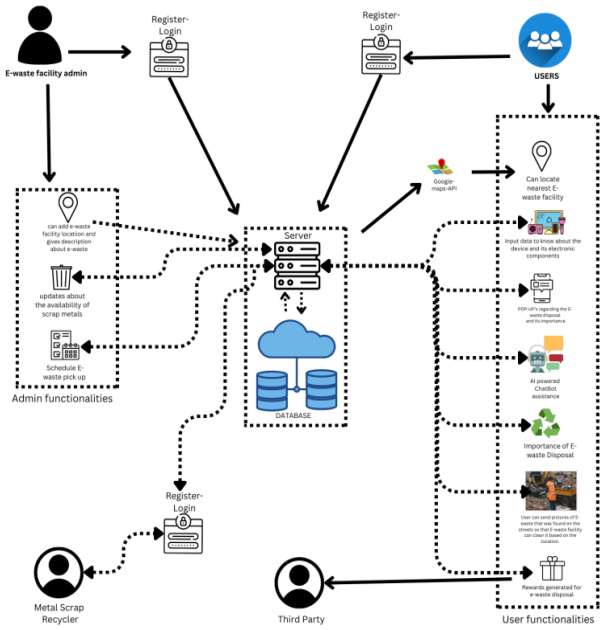

Fig 2.1: E-waste management system

In the e-waste facility locator system architecture, users are empowered to easily find the nearest e-waste facility for responsible disposal of their electronic waste. They have the capability to input data, gaining insights into the components of e-waste and understanding its environmental impact. Educational pop-ups within the system further enhance their awareness by providing valuable information on sustainable recycling practices. Moreover, users may receive rewards for actively participating in recycling initiatives, encouraging their engagement in environmental conservation efforts.

On the other hand, e-waste facility administrators wield comprehensive features to efficiently manage facility details within the system. They possess the authority to add, remove, or update information about recycling facilities, ensuring that users have access to accurate and up-to-date information. Administrators can seamlessly update the status of recycling activities, providing users with real-time information about the availability of recycling services. Additionally, the system enables administrators to schedule pickups for e-waste collection, streamlining the logistics of recycling operations and enhancing user convenience.

3. Algorithms:

Firstly, we employed the Haversine Formula, a mathematical formula utilized to compute the distance between two sets of geographical coordinates on the Earth's surface. This formula plays a pivotal role in determining the distance between the user's current location and other points of interest stored in the database, such as recycling facilities or nearby users. By leveraging the Haversine Formula, we were able to accurately calculate distances and ascertain proximity, facilitating location-based decision-making within the application.

Additionally, we utilized MongoDB's $geonear operator, which enables efficient querying for locations near a specified point based on their geospatial coordinates. This operator proved invaluable in our project for identifying nearby locations within a certain radius of the user's current position or any other reference point. By leveraging the $geonear operator, we could seamlessly query the MongoDB database to retrieve locations that are in close proximity to the user's current position, enhancing the user experience by providing relevant and timely information about nearby points of interest, such as recycling facilities. Together, the integration of the Haversine Formula and MongoDB's $geonear operator empowered our

backend to effectively handle location-related functionalities, contributing to the overall success and utility of our application.

4. EXPERIMENTAL RESULTS

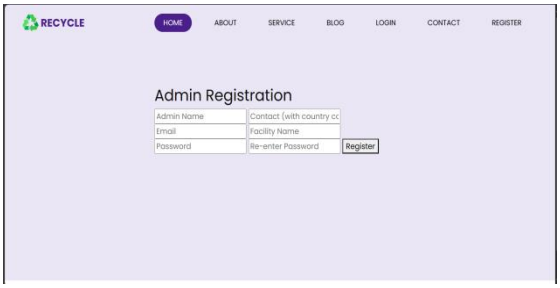

Fig 4.1: Admin Registration page

The Admin Registration Page (Fig 4.1) serves as the gateway for administrators to create accounts and access administrative functionalities in the e-waste facility locator system.

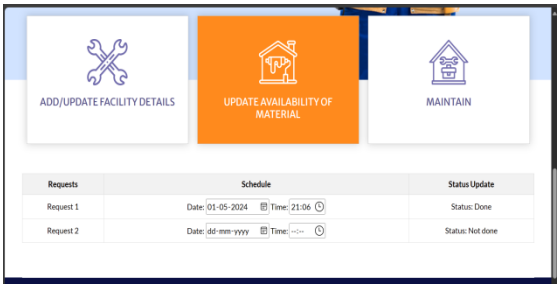

Fig 4.2: User requests

Users can submit inquiries and provide feedback through the User Requests page (Fig 4.2), facilitating communication between users and administrators regarding the e-waste facility locator system.

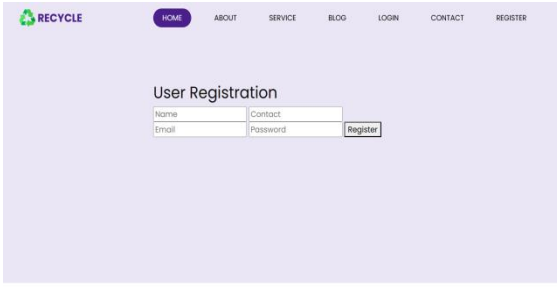

Fig 4.3: User registration page

The User Registration Page (Fig 4.3) allows individuals to create accounts, enabling access to personalized features such as saving favorite facilities and receiving updates on e-waste recycling events within the locator system.

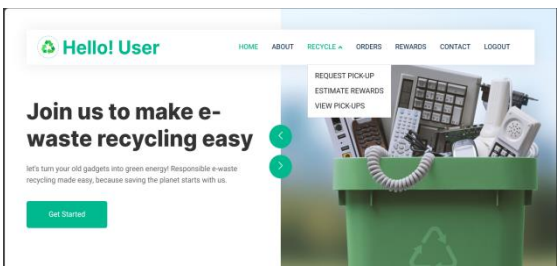

Fig 4.4: User landing page

Upon logging in, registered users are directed to the User Landing Page (Fig 4.4), which serves as a central

hub for accessing key functionalities, including searching for nearby e-waste recycling facilities and managing user profiles.

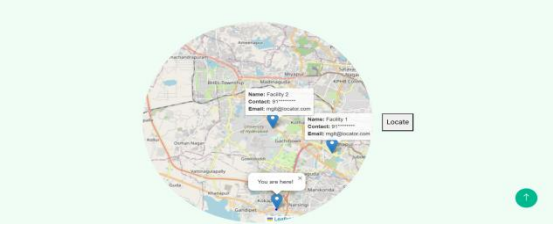

Fig 4.5: Map Container

The Map Container (Fig 4.5) provides an interactive map interface within the e-waste facility locator system, allowing users to visualize the locations of nearby recycling facilities and plan their recycling activities efficiently.

5. CONCLUSION

In summary, our e-waste management platform represents a comprehensive solution to the pressing challenges posed by the increasing proliferation of electronic devices. Designed as a versatile mobile app and web platform, it incorporates a multitude of features aimed at fostering responsible e-waste disposal practices and engaging users in a rewarding and educational recycling process. The platform begins by offering users a personalized experience through user registration, login functionalities, and multilingual support, ensuring accessibility to a diverse user base. At the core of the platform is the E-Waste Facility Locator, coupled with path optimization, providing users with an easy and convenient way to discover nearby disposal and recycling facilities, thereby encouraging responsible disposal practices. To incentivize users, a rewards system has been integrated, allowing users to earn points based on the valuable materials present in their electronic devices. This not only motivates users to actively participate in recycling but also introduces an element of gratification for their environmentally conscious actions.

The inclusion of an AI-powered chatbot enhances user communication and assistance, offering guidance through the recycling process. Educational pop-ups and a dedicated informational hub contribute to raising user awareness about the environmental impact of e-waste, fostering a deeper understanding and promoting responsible recycling practices. Administrative privileges for e-waste facility administrators ensure efficient facility management, contributing to the seamless operation of the platform. Users are encouraged to actively contribute to environmental safety through a reporting feature for roadside e-waste, aligning with the platform's commitment to minimizing environmental harm. Collaboration with third-party scrap recyclers for metal recycling demonstrates a commitment to maximizing the value of recycling efforts. The platform's multilingual interface, path optimization, and referral system prioritize accessibility, user convenience, and community expansion. Utilizing data scraping and personalized suggestions based on users' search history, the platform aims to provide a tailored and informative experience. Collaboration with various metal dealers underscores the commitment to the efficient recycling of e-waste materials, strengthening the overall e-waste management process.

In essence, our e-waste management platform integrates technological innovation, user engagement, and environmental responsibility to offer a holistic and impactful solution for e-waste management. By addressing challenges associated with e-waste while promoting user awareness and participation, we believe our platform has the potential to significantly contribute to responsible recycling practices and environmental sustainability.

6. FUTURE SCOPE

Looking ahead, our project holds promising potential for future enhancements and expansions, paving the way for a more comprehensive and user-centric recycling ecosystem. The addition of the "Snap and Send" feature represents a significant advancement, enabling users to upload images of electronic gadgets for automated analysis and categorization, thereby streamlining the recycling process. Furthermore, future iterations could incorporate machine learning algorithms to continually improve image recognition accuracy, ensuring precise identification of recyclable items. Expanding the geographical coverage to include more recycling facilities and partnering with local authorities and businesses can enhance accessibility and encourage widespread adoption.

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