Revolutionizing Recycling: The Impact of the Recycle App on Sustainable Practices

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Abstract *The rapid growth of urbanization and consumption has led to an unprecedented surge in waste production, posing a significant threat to our environment and natural resources. To address this global challenge, we introduce a mobile application designed to empower individuals and communities to embrace sustainable recycling practices. It offers users a comprehensive database of nearby recycling centers, collection points, and waste management facilities, making it easier than ever to find convenient recycling options. The app provides a rich resource of articles, videos, and tips on recycling best practices, waste reduction, and environmental conservation, aiming to raise awareness and knowledge among users. It incorporates gamification elements, encouraging users to participate in recycling challenges, earn badges, and receive rewards from local businesses, thus making recycling an engaging and rewarding experience. Users can join a vibrant recycling community where they can share their achievements, experiences, and ideas, fostering a sense of belonging and collective action. It allows users to monitor their recycling efforts, tracking the number of items recycled, waste diverted from landfills, and the environmental impact of their actions. The main objective of this research is to develop and evaluate the effectiveness of the "Recycle app" in promoting sustainable recycling practices among users.*

Keywords- Recycling practices, Community engagement, Smart Cities, Sustainable development

INTRODUCTION

The rapid pace of urbanization and increased consumption patterns have significantly contributed to the surge in waste production, posing severe threats to our environment and depleting natural resources. As cities continue to expand, the challenge of managing waste effectively becomes increasingly critical. Smart cities, which integrate advanced technologies and innovative solutions to enhance the quality of urban life, present an opportunity to address these challenges through sustainable practices. One promising solution within this framework is the "Recycle app," a mobile application designed to empower individuals and communities to adopt and maintain sustainable recycling practices. The Recycle app aims to tackle the barriers to effective recycling by offering a comprehensive and user-friendly platform that combines education, convenience, and motivation. The app provides users with a detailed database of nearby recycling centers, collection points, and waste management facilities, simplifying the process of finding convenient recycling options. It also includes a wealth of educational resources such as articles, videos, and tips on recycling best practices, waste reduction, and environmental conservation, aimed at raising awareness and knowledge among users. To further encourage user engagement, the Recycle app incorporates gamification elements. The app provides a comprehensive guide on what can be recycled, where, and how. It educates users about proper recycling techniques, ensuring that every effort counts towards a cleaner environment. Users can locate the nearest recycling centers, drop-off points, or pick-up services based on their current location. This feature ensures that recycling is not only accessible but also convenient. Recycling should be rewarding. Recycle App offers a unique rewards system where users earn points for every item recycled. These points can be redeemed for discounts, eco-friendly products, or even donated to environmental causes. The app features articles, videos, and infographics about recycling, climate change, and sustainable living. Knowledge is power, and the app ensures users are well informed advocates for the environment.

LITERATURE SURVEY

In 2022, P. Deepa, Kavitha Subramani, M. Shanvanthi from Panimalar Engineering College published a paper in IEEE titled " Design and Development of Mobile Application for Waste Management " This paper presents a method for the collection of waste in the city. With the help of proper technology we can guide the trucks in selecting the shortest path for garbage collection. This paper helps in development of an application that reduces the time of garbage collection, delay in collecting it and alerting the neighbourhood about it. This system helps both the management and the residents to track the real time location and process of emptying the garbage and rewarding and fining the residents as part of dry and wet waste concepts.

In 2023, Nicola Farronato, Veronica Scuotto , Marco Pironti, and Manlio Del Giudice published "The Green Frontier of Mobile Applications in Improving Recycling Consumers' Behavior" in IEEE. In this article, we provide a new insight into overcoming resistance to emerging green technologies through mobile app users' environmental engagement.

In 2021, Laura Pivoto Ambrosio, Elaine Cristina de C assia Silva, Guilherme Pedro Aquino, Evandro C esar Vilas Boas contributedpaper " Recycling as a Service: A Mobile Application for Circular Economy " This paper proposed an IoT mobile-based application to allow recycling as a service in developing and emerging countries, which have cities with deficient or inexistence systems of selective collection for waste recycling.

The paper "Designing a Mobile Application Framework as an Innovative IT Solution for Waste Recycling " by Ma. Melanie Ablaza-cruz Institute of Engineering and Applied Technology, Bulacan agriculture State college, Bulacan, Philippines introduces the purpose of this paper is to support everyone in strengthening their waste recycling practices within the community. This study focusses on designing a mobile application by integrating the hybrid architectural framework.

The paper "How to Encourage Recycling Behaviour? The Case of Waste App: A Gamified Mobile Application" by Aguiar-Castillo Lidia, ID, Rufo-Torres Julio, De Saa-Pérez Petra and Perez-Jimenez Rafael results of this paper demonstrate the influence that different factors exert on the intention to use a sustainability application based on gamification. The purpose of this paper was to determine the effect that several factors have on the intention to use Waste App.

The paper "Current Applications of Recycled Aggregates from Construction and Demolition: A Review" by Glaydson Simões dos Reis, Marco Quattrone , Weslei Monteiro Ambrós , Bogdan Grigore Cazacliu and Carlos Hoffmann Sampaio introduces a discusses the generation and recycling of construction and demolition waste (CDW) as well as its main uses as raw materials for the construction engineering sector.

The paper "Addressing the complex challenge of understanding and quantifying substitutability for recycled plastics" by Ruben Demets a,b , Karen Van Kets a , Sophie Huysveld c , Jo Dewulf c , Steven De Meester b , Kim Ragaert proposes a concept for calculating the effective technical substitutability, in which application specific functions generate a score for processability and mechanical recycling quality. To illustrate this concept, the substitutability of three commercially available recycled plastics is determined for four different application categories.

The paper "Sustainable development of waste tires recycling technologies e recent advances, challenges and future trends" by Krzysztof Formela to report the recent progress in sustainable development of waste tires recycling technologies. A special attention was focused on current advances in waste tire rubber grinding technologies; ground tire rubber treatment methods and characteristics of ground tire rubber and reclaimed rubber.

The paper "Recycling of medical plastics" by Blessy Joseph a , Jemy James b , Nandakumar Kalarikkal a , Sabu Thoma focuses on classification at waste generating sources, depending upon infection chance and or plastic component, could be a method for the improved recycling of plastic wastes in hospitals.

The paper "Recent advances in waste-recycled nanomaterials for biomedical applications: Waste-to-wealth" by Mohamed Abd Elkodous, Hussein M. El-Husseiny, Gharieb S. El-Sayyad, Amr Hosny Hashem introduces shed light on valuable NMs that can be extracted from waste sources originating from everyday life, including biomass wastes, cooking oil, and industrial wastes.

PROPOSED WORK

The app begins with user management where users can register and log in using their email, phone number, or social media accounts. Secure login mechanisms are implemented, along with support for password recovery and account verification. Each user can create and

manage their profiles, tracking their recycling activities and viewing rewards. The profile includes personal information, recycling history, points earned, and achievements.

Educational content is a significant part of the app, providing users with articles, videos, and tips on recycling and environmental conservation. This content is regularly updated and categorized by material type, such as plastic, metal, and paper. To engage users, the app may integrate quizzes or challenges. Additionally, the app uses image recognition to help users identify recyclable materials from photos, offering instructions on proper recycling methods. The Recycle app includes a recycling center locator, which uses GPS to show nearby centers with details like operating hours, accepted materials, and contact information.

Users can also schedule pickups for recyclable materials, partnering with local recycling services for convenience. The app tracks the status of these pickups. Incentive and rewards are vital for encouraging user participation. The app features a points system where users earn points based on the quantity and type of material recycled. These points can be tracked in user profiles. Rewards are offered for accumulated points, such as discounts, coupons, or donations to environmental causes. The app also includes challenges or competitions to further motivate users, with leaderboards displaying top recyclers.

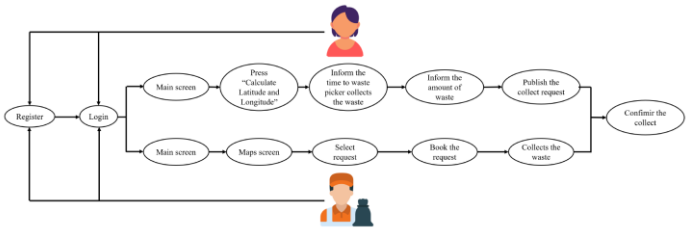

Fig. Proposed system architecture

A. Recycle App objectives:

1. Promote environmental awareness and sustainable practices.
2. Simplify the process of identifying recyclable materials.
3. Provide users with information on nearby recycling centers.
4. Offer incentives to encourage recycling.
5. Track and report user recycling habits.

B. User Registration and Profile Management

1. Sign Up/Login: Users can register using email or social media accounts.
2. Profile Management: Users can manage personal information and track their recycling activity.

C. Waste Categorization and Information

1. Barcode Scanning: Scan product barcodes to determine recyclability.
2. Manual Entry: Users can manually search and input items to check if they are recyclable.

D. Recycling Tips:

1. Provide tips and best practices for recycling various materials.
2. Recycling Center Locator
3. GPS Integration: Locate nearby recycling centers using GPS.
4. Center Information: Provide details such as operating.

SYSTEM FLOWCHART

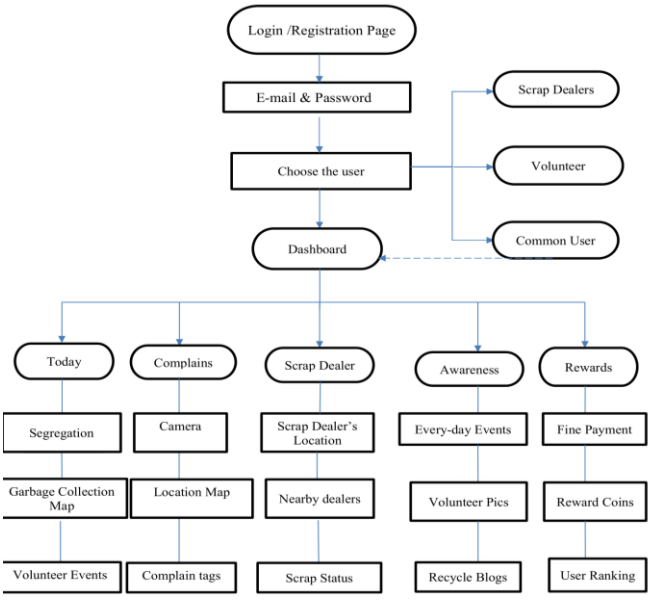

Fig 2. System Flow

SETUP FOR APP DEVELOPMENT

1. Android Studio Jellyfsh: Integrated Development Environment (IDE) for Android app development.
2. Java: Programming language used for app development.
3. XML: Markup language for designing user interfaces.
4. SQLite: Relational database management system for local data storage on the device.
5. APIs: Application Programming Interfaces for integration with external systems.
6. Cloud-based solutions: Utilized for scalability, flexibility, and resilience.
7. Web server: Hosts the app's API for handling user requests and responses.
8. Database server: Stores user account information, recycling data, and other relevant information.
9. Python for the dataset's testing and training with CNN.

SEQUENCE DIAGRAM

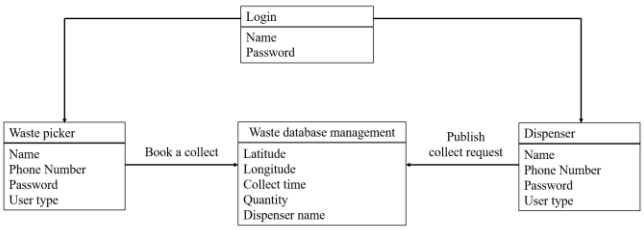

Fig 3. Sequence Diagram

SYSTEM IMPLEMENTATION

Fig 4. Login & registration page

CONCLUSION

In conclusion, the development of a recycling app for Android holds immense potential to drive positive environmental change and sustainability. With the ever-growing global concern for environmental preservation and the urgent need to reduce waste and conserve resources, such an app can serve as a powerful tool for individuals and communities alike. By providing users with easy access to information about recycling centers, guidelines on proper disposal, and the ability to track their recycling efforts, the app empowers people to make informed and eco-conscious choices. Furthermore, gamification elements and incentives can motivate users to adopt more eco-friendly habits, ultimately contributing to a cleaner and greener planet. In a world where the importance of recycling and responsible waste management cannot be overstated, the development and widespread adoption of a recycling app for Android represents a significant step towards a more sustainable and environmentally-conscious future.

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