Public Participation in Municipal Solid Waste Management: A Mobile Persuasive App

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Abstract. Effective waste management relies on active public participation, yet engaging citizens in sustainable waste management remains a challenge. This study introduces a novel approach by developing a mobile application to support public involvement in waste management processes. Drawing upon the Persuasive Systems Design (PSD) framework, the application incorporates persuasive strategies to motivate users to adopt responsible waste handling behaviors. The developed mobile application features a set of functionalities aimed at facilitating user engagement and behavior change. These include a leaderboard to foster competition and motivation among users, a chat room for community interaction, a sorting guide for proper waste categorization, and a module for locating nearby waste collectors, thereby promoting accessibility. To assess the effectiveness and user satisfaction of the application, a structured walkthrough evaluation method was employed, complemented by questionnaire items based on the Attention, Relevance, Confidence, and Satisfaction (ARCS) model. Through this evaluation process, the study measured users' attention to the application's features, the relevance of its content to their needs, their confidence in using the application, and their overall satisfaction with the experience. The findings of the evaluation demonstrate the potential of the mobile application in effectively engaging users and promoting positive changes in waste management behaviors.

Keywords: waste management · public participation · persuasive technologies

1 Introduction

1.1 Background to the Study

Municipal solid waste (MSW) management has become a major worldwide concern with broad consequences for public health, urban development, and environmental sustainability (Hoornweg & Bhada-Tata 2012; Kaza et al. 2018). Globally, the rates at which municipal garbage is generated have significantly increased due to factors such as population growth, rapid urbanization, and changing consumer habits. According to World Bank projections, the amount of MSW generated worldwide is expected to soar by 70% between 2016 and 2050, reaching an estimated 3.4 billion tons annually by that time (Kaza et al. 2018). This increase is especially noticeable in emerging nations, such as

K. Cheikh M. F. Kebe et al. (Eds.): InterSol 2024, LNICST 610, pp. 9–25, 2025.
https://doi.org/10.1007/978-3-031-86493-3_2

those in sub-Saharan Africa, where urbanization is happening at a rate never seen before. Urbanization rates in sub-Saharan Africa have surpassed the development of waste management infrastructure, creating significant issues for the processing of municipal waste (Pai et al. 2013; Paul et al. 2019). Inadequate garbage collection services, careless dumping, and open burning of rubbish characterize the ensuing situation, which worsens environmental contamination and poses serious risks to public health (Alfthan et al. 2016; Parrot et al. 2009). Many developing countries in the region confront waste management difficulties that are exacerbated by inadequate financial resources and ineffective policies (Parrot et al. 2009; Wilson 2007). The environmental and health risks associated with improper waste disposal are of particular concern. Open burning of waste releases harmful pollutants into the air, contributing to respiratory diseases and air quality degradation (Awino & Apitz 2023). Improperly managed landfills can contaminate soil and water, posing long-term risks to ecosystems and human populations (Parrot et al. 2009). These challenges underscore the urgency of developing sustainable waste management strategies, especially in the context of developing countries where the impacts are most pronounced.

Public participation one of strategies for tackling the difficulties associated with managing municipal solid waste (Kaza et al. 2018). Involving communities in waste management initiatives promotes awareness, accountability, and group effort. However, ensuring public participation is a difficult task, especially in developing nations due to lack of knowledge and instruction on waste management techniques (Kaza et al. 2018; Wilson 2007), poor attitude towards waste management initiatives (Tennakoon et al. 2023) and lack of enforcement of policies (McAllister 2015). To overcome these obstacles and enable communities to actively participate in sustainable waste management practices, innovations and approaches related to behavioral change need to be explored. In the realm of Information communication technologies (ICT), persuasive technologies have a potential to motivate behavioral change to adopt sustainable practices without coercion or deception (B. J. Fogg 2003a).

The integration of persuasive technologies into waste management strategies presents a promising avenue for enhancing public participation. Persuasive technologies leverage principles from behavioral psychology and human-computer interaction to influence attitudes and behaviors (B. J. Fogg, 2003a). Mobile applications, in particular, have become ubiquitous and provide a convenient platform for delivering persuasive interventions (Aldenaini et al. 2020). By leveraging the reach and accessibility of mobile platforms, persuasive applications can effectively communicate information, provide real-time feedback, and encourage positive behavior change related to waste management practices. Therefore, this study seeks to explore the potential of a mobile persuasive application to enhance public participation in municipal solid waste management. Specifically, the study addressed the following specific objectives; To identify persuasive strategies based on behavioral theories that are implemented in mobile persuasive interventions. To develop a mobile persuasive application that support public participation in municipal solid waste management.

The rest of the paper is organized as follows; Sect. 2 presents related work. Section 3 presents materials and methods, Sect. 4 presents results, Sect. 5 concludes the paper.

2 Related Literature

2.1 Waste Management in the Post COVID-19 Era

The advent of the COVID-19 pandemic has significantly altered the landscape of municipal solid waste (MSW) management, introducing novel challenges and opportunities that warrant close examination. According to (Torkashvand et al. 2021) there is a need for adaptive strategies to navigate the complexities of waste management in the post-COVID. A notable effect of the epidemic has been an increase in the production of medical waste. The amount of infectious waste generated has increased as a result of people using personal protective equipment (PPE), disposable masks, and other medical items more frequently (Torkashvand et al. 2021). This calls for a reassessment of waste management techniques to take into account the particular difficulties associated with the sustainable and safe disposal of medical waste. Also, lockdowns and changes in consumer behavior during the pandemic have further influenced waste composition and generation patterns. Patrício Silva et al. (2020) highlight that altered consumption habits, increased reliance on home deliveries, and shifts in product packaging have led to changes in the types and amounts of waste being generated. This dynamic shift requires waste management systems to be agile and responsive to evolving patterns, prompting the need for innovative approaches to waste collection, sorting, and disposal. In addition, Singh et al. (2022) advocate for the development of resilient waste management systems capable of withstanding shocks and disruptions, such as those caused by a global health crisis. Resilience in waste management involves not only the ability to adapt to sudden changes in waste streams but also to withstand systemic challenges, ensuring the continuity of essential waste management services. Therefore, the post-COVID era calls for a comprehensive re-evaluation of waste management policies.

2.2 Municipal Solid Waste Management

Managing municipal solid waste (MSW) is one of the core services that any municipal authority should offer to the citizens. However, in the context of urban governance, offering sustainable MSW services is a challenging due to several interconnected factors, such as population growth, urbanization, and shifting consumption habits amidst poor infrastructure, inadequate funds and poor attitude towards waste management initiatives (Kaza et al. 2018; McAllister 2015). As noted by Parrot et al. (2009) most developing countries are characterized by inadequate infrastructure to manage the growing volumes of waste generated in urban areas. Also, the rate of urbanization is faster than the development of waste management infrastructure, leading to insufficient waste collection services and inefficient disposal techniques. The absence of infrastructure is particularly apparent in developing countries, such those in sub-Saharan Africa, where the region's meagre waste management capabilities are being taxed by an increasing number of urban residents (Pai et al. 2013). In addition, insufficient funding for waste collection, recycling initiatives, and the establishment of proper disposal facilities hinders the implementation of sustainable waste management practices in regions with limited economic resources (Wilson 2007). Finally, inconsistent and poorly enforced waste management policies contribute to a lack of standardization and coordination in waste disposal practices (Parrot et al.

2009). Thus, the absence of robust regulations can foster unregulated dumping and open burning of waste, further intensifying environmental pollution and jeopardizing public health.

The challenges in MSW management extend beyond mere logistical and infrastructural concerns. Thus, (Parrot et al. 2009), noted that there is a need for a nuanced approach that addresses the social and economic dimensions of waste management. Recognizing waste management as a complex socio-technical system, they advocate for a comprehensive understanding of local contexts, including the livelihood implications and community dynamics associated with waste management practices. This perspective aligns with the broader recognition that addressing MSW challenges requires integrated solutions that consider the cultural, economic, and social fabric of the communities involved (Daniel Hoornweg et al. 2013).

2.3 Persuasive Technologies Design

The field of persuasive technologies has evolved as a powerful tool for positively influencing user behavior through thoughtful and strategic design. Central to this evolution is Fogg's Behavior Model (B. J. Fogg 2003a), which lays the foundation for understanding the factors that drive behavior change through technology. Fogg's Behavior Model identifies three primary components that contribute to behavior change: motivation, ability, and triggers. Motivation refers to the user's desire to perform a behavior, ability involves the user's capability to execute the behavior, and triggers act as the catalysts that prompt the behavior (B. J. Fogg 2003a). Successful persuasive technology design leverages these components to create interventions that are not only effective but also engaging and user-friendly. In addition, designing persuasive technologies involves the intentional integration of design principles tailored to specific behaviors, motivations, and contexts as outlined in the persuasive systems design (PSD) framework (Oinas-Kukkonen & Harjumaa 2009). Thus, the persuasive systems design framework (PSD) is a valuable tool in persuasive technology design. PSD outlines several persuasive strategies that should implement in a persuasive intervention. The PSD 28 principles are categorized into four groups based on the task the principle is set to accomplish. The principles and their respective categories are described in Table 1.

User-centered approaches are also important in persuasive technology design because they ensure that interventions resonate with the target audience. Understanding the motivations, preferences, and challenges of users is fundamental to crafting persuasive strategies that align with their needs (Oinas-Kukkonen & Harjumaa, 2009). This involves conducting thorough user research to gather insights into the context in which the technology will be used and the behaviors it seeks to influence. In addition, feedback mechanisms play a crucial role in persuasive technology design, providing users with real-time information about their actions and progress. Positive reinforcement through feedback enhances user engagement and motivation by offering a sense of accomplishment and recognition (Chatterjee et al. 2009). Incorporating persuasive strategies such as reminders, rewards, and social influence further enhances the efficacy of these interventions. Reminders prompt users to perform desired behaviors, rewards provide incentives for compliance, and social influence leverages the power of social connections to foster behavior change (Oinas-Kukkonen & Harjumaa, 2009).

Table 1. Principles in PSD framework

Primary task support	Dialogue Support	Social support	System credibility support
Reduction	praise	Social learning	Trustworthiness
Tunneling	rewards	Social comparison	Expertise
Tailoring	reminders	Social facilitation	Surface credibility
personalization	Suggestion	Normative influence	Real world feel
Simulation	Similarity	cooperation	Authority
Self-monitoring	Liking	Competition	Third part endorsement
	Social role	Recognition	Verifiability

2.4 Application of Persuasive Technologies in Waste Management

Persuasive technology applications in waste management are still in infancy stages, with lots of potential for encouraging positive behavioral changes. Particularly, mobile persuasive applications have become powerful instruments that may encourage recycling, reduce waste, and enhance waste management practices generally (Bocken et al. 2014; Bretter et al. 2023). Persuasive technologies in waste management leverages social norms, gamification elements, and customized feedback to support environmentally friendly waste management practices (Bretter et al. 2023; Nkwo et al. 2018). For instance, gamification incorporates gaming features, such contests, challenges, and prizes, into waste management applications to boost user enthusiasm and involvement (Helmefalk & Rosenlund 2019). Therefore, gamification approaches transform waste reduction and recycling duties into enjoyable and competitive experiences that encourage community engagement and a sense of accomplishment. In addition, social norms play a pivotal role in shaping individual behaviors, and persuasive technologies leverage this influence to drive positive change. By highlighting and reinforcing socially desirable waste management practices, applications can create a sense of collective responsibility and encourage users to align their behaviors with accepted norms within their communities (Bretter et al. 2023). Finally, personalized feedback mechanisms within persuasive technologies provide users with tailored information about their waste management behaviors, fostering self-awareness and accountability (Suruliraj et al. 2020).

Successful implementation of persuasive technologies in waste management necessitates a comprehensive understanding of the local context, waste generation patterns, and community dynamics. Tailoring interventions to specific cultural and socioeconomic conditions ensures that persuasive strategies resonate with the target audience, increasing the likelihood of sustained behavior change (Thaler & Sunstein 2009). Also, iterative design processes, guided by user feedback and ongoing evaluation, are essential for the continuous improvement of persuasive technologies. This adaptive approach was employed by Suruliraj et al. (2020) to develop an initial medium-fidelity and also high-fidelity prototype of Bota App.

2.5 Behavioral Theories and Persuasive Strategies

In the design of persuasive technologies, several behavioral theories such as the Theory of Planned Behavior (TPB), Fogg's Behavioral Model (FBM), and the Transtheoretical model (TTM) have been used to analyze factors that motivate behavioral change. In this study we reviewed of persuasive strategies associated TPB and FBM. TPB has been used to influence attitudes and behaviors in the design of persuasive technologies. For example, (Sanabrian et al. (2023) used TPB to understand the determinants of physical activity in a HIV self-management intervention. In their study, self-monitoring/tracking, encouragement and achievement of goals were some of the persuasive strategies related to attitude, social norms and behavioral intention respectively. On the other hand, FBM has been used as a guiding framework to motivate target behaviors in various areas of persuasive technologies, such as smoking cessation (Abdul Karim et al. 2017) and banking (Lockton et al. 2010). Commonly employed persuasive strategies based on FBM includes; reminders that are associated with the trigger factor, simplifying a task (reduction) that is associated with ability factor and social learning that is related to motivation (Fogg 2009). TPB and FBM were adopted in this study because they are well established theories studying behavior change (Won 2018). Table 2 presents a review of persuasive strategies based on these theories.

Table 2. Persuasive strategies.

Theory	Persuasive strategies
Fogg's Behavioral Model (FBM)	**Triggers** Kairos (Fogg 2009), Reminders, pop-messages and auditory cues (Mallawaarachchi et al. 2023) **Ability** Simplification (Fogg 2003; Mallawaarachchi et al. 2023), Suggestions, repetitive tasks (Mallawaarachchi et al. 2023) **motivation** Reinforcement, rewards, social acceptance (Mallawaarachchi et al. 2023; Fogg 2003)
Theory of Planned Behavior (TPB)	**Emotional support** Tailoring, Liking, Reward, Similarity Surface, Credibility and Praise (Won 2018) **Social support** Authority, Expertise, Real-world feel, 3rdParty endorsements, Verifiability, Social Comparison, Normative Influence, Social learning, Recognition, Cooperation, Social facilitation, Competition, Surveillance (Won 2018) **Ability support** Tunneling, Reduction, Self-Monitoring, Simulation, Personalization, Rehearsal, Conditioning, Suggestion, Prompt, Call to action, Reminder, Cue, Request Offer, feedforward, feedback, Kairos (Won 2018), Social clues (Parmar et al. 2008)

3 Materials and Methods

3.1 Requirements Gathering

The process of developing a mobile persuasive application for supporting public participation in municipal solid waste management presented in this study started with gathering the functional requirements. Based on the persuasive strategies presented in Table 2, we reviewed literature to identify the system features that align with those persuasive strategies. Therefore, following functional requirements were identified and subsequently integrated into the application:

- Leaders Board: The application includes a leaders' board that not only ranks the highest-performing waste collectors but also provides detailed statistics and achievements for each collector. Leaderboards leverage principles of social comparison and competition to motivate users to engage more with the application (Hamari et al. 2014; Sánchez-Martín et al. 2017).
- Sorting Guide: In its commitment to promoting responsible waste disposal, the application features a highly informative sorting guide. This guide comprehensively educates users on the various waste types, their associated environmental impacts, and the recommended colours of bins for proper waste segregation. This feature is based on tailoring strategy (Oinas-Kukkonen, H., & Harjumaa 2009).
- Locate Nearby Collectors: The user-friendly app employs geolocation technology to assist users in locating nearby waste collectors who specialize in specific types of waste. Users can select collectors based on their proximity and specialization, ensuring that their waste is handled responsibly and expediently. This feature is based on the reduction persuasive strategy (Suruliraj et al. 2020; Nkwo et al. 2020)
- Schedule Pickup: Recognizing the importance of convenience and timeliness in waste management, the application offers a scheduling option. Users can set a date for waste collection, specifying their preferred time. When the scheduled date approaches, the app sends proactive notifications to remind the user to request a waste collector. This feature is based on the reduction and reminders strategy proposed by Fogg, (2003) and Oinas-Kukkonen & Harjumaa (2009).
- Chat Forum: To foster a sense of community and knowledge sharing among users and waste collectors, the application hosts a robust and moderated chat forum. Users can engage in discussions, share valuable tips and insights, and collectively address challenges related to waste collection. This feature is based on the social facilitation persuasive strategy (Nkwo et al. 2020).
- Impact Reporting: In an era where transparency and accountability are paramount, the application empowers waste collectors to provide comprehensive impact reports. Waste collectors can use the app to document what has been done with the waste they have collected, including whether it has been recycled, repurposed, or otherwise responsibly managed. This reporting feature not only promotes transparency but also encourages waste collectors to prioritize sustainable waste disposal practices.
- Rate Us Page: User feedback is integral to enhancing the application's quality and functionality continually. To facilitate this, the application includes a dedicated "Rate Us" page. Here, users can provide detailed feedback, suggestions, and ratings based on their experiences. These ratings and comments are displayed within the app, providing transparency and demonstrating a commitment to continuous improvement.

3.2 System Design and Implementation

The development of a mobile app presented in this study leverages the Flutter framework for the front-end and Firebase for the back-end infrastructure. The user interface design, facilitated by Flutter's flexibility and cross-platform capabilities, prioritized user experience through collaborative efforts with waste management experts and potential users (citizens), resulting in an intuitive and visually appealing interface. Key aspects included user-centered design, visually appealing aesthetics, responsive layouts, and accessibility features to ensure inclusivity for all users, while the robust back-end powered by Firebase facilitated real-time database interactions, secure user authentication, and efficient cloud functions.

Furthermore, specialized features such as the sorting guide, scheduling feature, and chat forum moderation were implemented in collaboration with environmental experts and waste management professionals. These features enhance user engagement and contribute to the application's differentiation by providing valuable resources on waste sorting, seamless scheduling capabilities, and fostering a supportive community within the chat forum. Overall, the application's development process prioritized both functionality and user experience, resulting in a comprehensive solution poised to address contemporary waste management challenges effectively.

4 Presentation of Results (Mobile App)

This section offers an in-depth overview of the application's key features, functions, and its overarching objective of transforming waste management practices by actively involving both waste collectors and the wider public.

Leaders Board: Fostering Healthy Competition
The achievements of waste collectors. This feature serves not only as a source of motivation but also as a mechanism to encourage healthy competition within the community. Waste collectors can view their rankings, track their progress, and vie for the top spots, ultimately driving them to collect more waste and contribute to a cleaner environment. Figure 1 presents a leader board implemented in this study.

Sorting Guide: Promoting Proper Waste Disposal
The Sorting Guide feature provides users with invaluable information about different waste types and the corresponding colours of bins for proper waste segregation. By equipping users with knowledge, this feature plays a pivotal role in mitigating the environmental impact of waste mismanagement. Figure 1 presents a sorting guide.

Locate Nearby Collectors: Facilitating Convenient Waste Disposal
Users seeking to dispose of specific types of waste can effortlessly locate nearby waste collectors specialized in handling their particular waste category. The integration of geolocation technology ensures the accuracy of results, connecting users with collectors in their vicinity. This feature streamlines waste disposal, making it more efficient and convenient for the public. This feature is shown in Fig. 2.

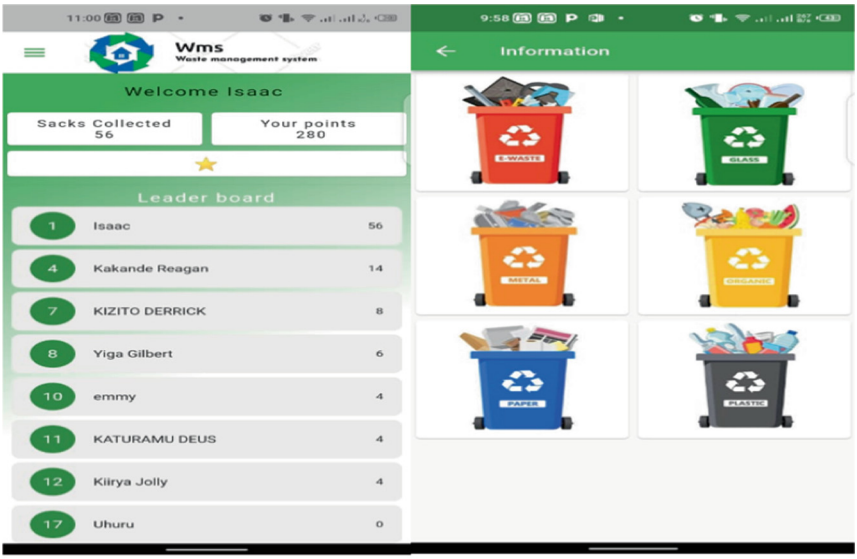


Fig. 1. A leader board and a sorting guide

Schedule Pickup: Timely and Hassle-Free Waste Collection

The Scheduling feature empowers users to set waste collection dates at their convenience. As the scheduled date approaches, the application issues notifications to remind users to request a waste collector. This proactive approach to waste collection ensures that waste is disposed of in a timely and hassle-free manner, contributing to cleaner neighborhoods.

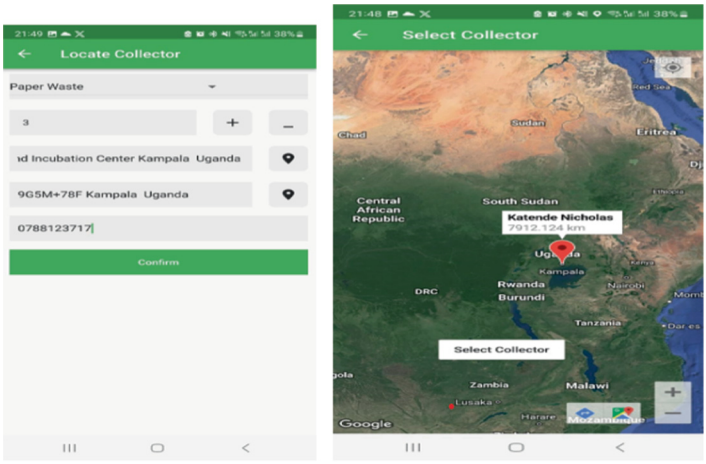
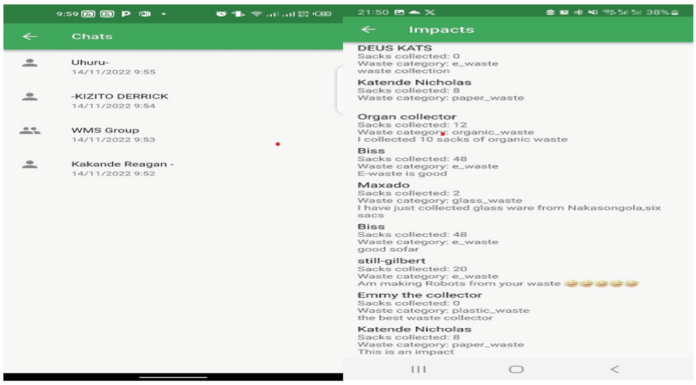


Fig. 2. Locating a waste collector and scheduling pickup.

Chat Forum: Community Collaboration and Knowledge Sharing
The Chat Forum fosters a sense of community among waste collectors. It serves as a virtual space where collectors can engage in discussions, share tips, and address challenges related to waste collection. This collaborative environment not only empowers collectors with valuable insights but also strengthens the bonds within the waste management community. The chat room feature is presented in Fig. 3.



d) The chat room and impact rating feature

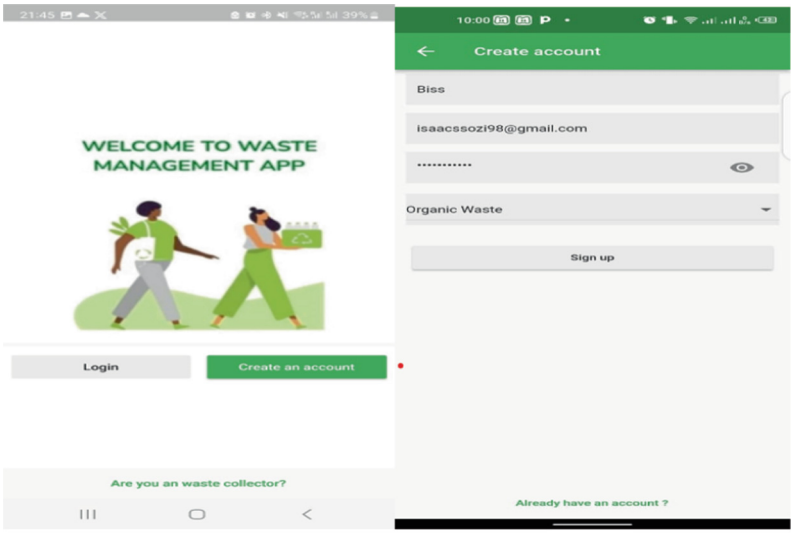
Fig. 3. The chat room

The login screen is designed to cater to users' preferences, offering personalized options for logging in using either their email address, or phone number. Additionally, new users have the flexibility to sign up using their email, phone number, or Facebook accounts. This approach ensures that users can access the application through their preferred method of authentication, whether it be via social media credentials or traditional email and phone authentication methods. This method of authentication leverages the tailoring strategy. The login feature is presented in Fig. 4.

4.1 Evaluation of the App

This study adopted the (Attention, Relevance, Confidence, and Satisfaction) ARCS model to evaluate the app. The ARCS model is a widely used motivational model that emphasizes four essential qualities that systems must possess to foster and maintain motivation in individuals: Attention, Relevance, Confidence, and Satisfaction (Keller 1987). These components are integral in ensuring that a system effectively engages users and cultivates a sense of motivation by capturing their attention, demonstrating relevance to their needs, instilling confidence in their abilities, and ultimately satisfying their desires or goals. The ARCS motivation model is extensively utilized to guide the creation and assessment of the motivational appeal in persuasive and behavior change systems (Derbali & Frasson 2010).

A.



e) creating an account

Fig. 4. Login page

A total of 50 participants were conveniently sampled from the students of Makerere University, college of computing and information sciences to participate in the evaluation of the app. Participants were given the opportunity to interact with the system independently for a period of three weeks. Following this period, two walkthrough sessions were conducted by the researcher and a research assistant, each lasting 45 min. During the sessions, participants explored all app features and completed tasks such as locating waste collectors, engaging in chat room discussions with fellow participants, and brainstorming on the waste sorting guide.

After the walkthrough sessions, participants completed online survey questionnaire, which included questions about the app's ability to capture their attention, the relevance of the information provided, their level of satisfaction with app features, and their confidence in the app. The study adopted a motivational appeal questionnaire based on the ARCS model proposed by Orji et al. (2019). A total of 31 responses were downloaded and analysed. The subsequent subsections present the results from the evaluation of the prototype.

In this section we present findings of prototype evaluation. The findings are arranged based on ARCS model constructs as follows.

Attention

In persuasive applications, the attention concerns attracting and engaging the target audience to persuade them effectively. It involves using visual and multimedia elements, emotional appeal, intriguing questions or challenges, personalization and relevance, as well as attention-grabbing headlines and openings to stimulate curiosity, evoke emotions. The study responses in relation to the ability of the app to user's attention is presented in Fig. 5.

Fig. 5. Ability of the app to capture the user's attention.

Relevance

Relevance concerns the extent to which the persuasive app aligns with the needs, interests, and values of the target audience. Assessing relevance involves considering whether the app addresses a problem that is important and meaningful to the audience, whether it provides information that are applicable to their context, and whether it resonates with their beliefs, attitudes, and priorities. The study findings on the relevance of the app are presented in Fig. 6.

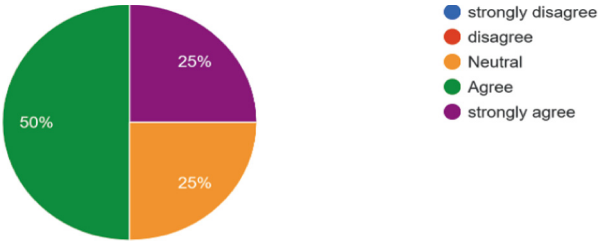


Fig. 6. Relevance of the app

Based on the findings illustrated in Fig. 6, 25% of the respondents expressed strong agreement regarding the application's relevance and its effective addressing of significant issues. Additionally, 50% of the respondents indicated agreement that the app provided crucial and pertinent information. Meanwhile, another 25% of the respondents remained neutral in their assessment.

Confidence

Confidence refers to the level of trust and assurance that users have in the app's effectiveness, reliability, and usability. Assessing confidence involves examining factors such as the app's functionality, ease of use, security measures, and the credibility of the information provided. Users need to feel confident that the app will accurately collect and process data, provide valuable insights or solutions, and facilitate meaningful contributions to waste management efforts. The study findings in relation to how participants felt confident in using the app is presented in Fig. 7.

Fig. 7. Users perceived confidence in the app

The findings presented in Fig. 7 show that all the respondents agreed that the app had the necessary functionalities and was easy to use.

Satisfaction

Satisfaction refers to the degree to which users feel content and fulfilled with their experience using the app. Evaluating satisfaction in this study involved assessing user experience, ease of navigation, responsiveness, and the effectiveness of features in addressing users' needs and preferences. Users should feel satisfied with the app's performance, functionality, and the value it provides in facilitating their engagement in waste management activities. The study findings on ease of use and pleasure and enjoyment interacting with the app are presented in Fig. 8 and Fig. 9 respectively.

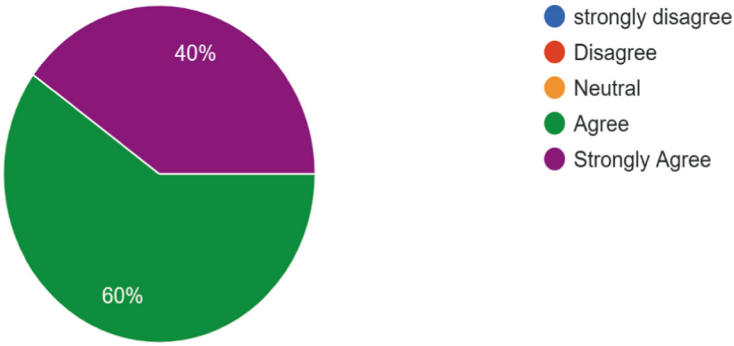


Fig. 8. Ease of use of the app

Based on the study findings in Fig. 8, 40% of the respondents strongly agreed that the app was easy to use. Also, 60% of the participants agreed that the system was easy to use.

The study findings depicted in Fig. 9 reveal that 20% of the participants found pleasure and enjoyment in using the app. Conversely, 80% of the participants remained neutral in their assessment.

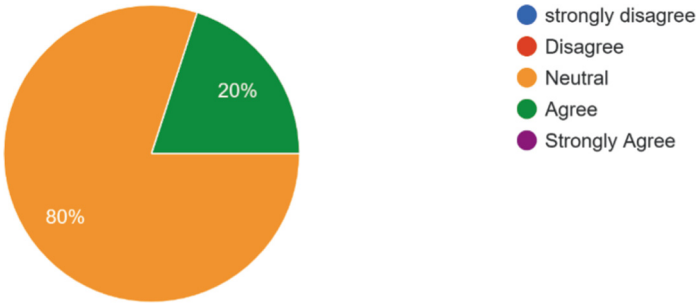


Fig. 9. Enjoyment using the app

5 Limitations and Future Work

The features incorporated into the mobile application detailed in this study were drawn from a review of existing apps in relevant literature. However, there remains a necessity to further refine this application by incorporating both functional and non-functional requirements identified during field studies. Additionally, customization of the application is essential to address contextual challenges specific to engaging citizens in municipal waste management processes.

The evaluation of the application was conducted among university students from the College of Computing and Information Sciences, who possessed computing knowledge. Nonetheless, to comprehensively assess its effectiveness, further evaluation is required involving citizens and municipal authorities' staff in major cities across Uganda.

6 Conclusion

The development of a mobile persuasive application aimed at supporting citizen involvement in waste management represents a significant stride towards leveraging technology to address pressing environmental challenges. Persuasive solutions can take various forms, ranging from mobile applications like the one developed in this study to interactive websites, social media campaigns, and community-based initiatives. These solutions capitalize on behavioral theories and persuasive strategies to induce positive changes in attitudes and behaviors towards sustainable practices. By integrating features derived from literature on persuasive strategies, specifically aligned with constructs from the theory of planned behavior and Fogg's behavioral model, the application offers a nuanced approach to promoting pro-environmental behaviors. The evaluation of the application through a walkthrough session and Likert scale questionnaire yielded promising results, indicating favorable perceptions among participants regarding attention, relevance, confidence, and satisfaction levels—essential components of the ARCS model. This positive reception underscores the potential efficacy of employing persuasive technology in fostering meaningful engagement with waste management practices. As we continue to explore the intersection of technology and behavior change, it becomes increasingly evident that mobile applications hold immense potential as vehicles for promoting positive environmental stewardship. By harnessing the principles of persuasion and leveraging

insights from behavioral theories, such applications can empower individuals to make informed choices and contribute meaningfully to the collective effort towards waste reduction and environmental sustainability.

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