EFFICIENT DONATION, SUSTAINABLE IMPACT: UNVEILING THE CLOTHES RECYCLE MANAGEMENT SYSTEM

N.S.H. Abdul Rahim[1] and H. Rahmalan[1]

[1]Fakulti Teknologi Maklumat dan Komunikasi, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia.

Corresponding Author's Email: hidayah@utem.edu.my

ABSTRACT: This paper presents the development of the Clothes Recycle Management System (CRMS), designed to address the inefficiencies in the current methods of promoting and managing clothing donations, which rely heavily on manual processes and social media. The objective of this study is to create and implement a unified, user-friendly platform that streamlines the donation process, enhances accessibility, and improves the overall efficiency of clothing donation activities. Key features of the system include event organization, item tracking, automated reporting, and a points-based incentive scheme that encourages donations. Additionally, the system provides transparency by informing users about the destination of their donations, fostering trust and engagement. The findings demonstrate that CRMS significantly simplifies donation coordination, increases donor participation through the incentive scheme, and offers reliable data for stakeholders to assess the impact of their efforts. This study concludes that CRMS is a viable solution for enhancing sustainability and community involvement in clothing donations, with the potential for broader application in other donation-driven initiatives.

1.0 INTRODUCTION

The issue of clothing waste and the need for sustainable practices in managing it have gained significant attention in Malaysia, particularly as the country

grapples with a growing solid waste problem. Fabric trash accounted for 31%, or 432,901 metric tonnes, of all waste created in Malaysia in 2021, according to SWCorp and KlothCares (Harinderan, 2023). Despite existing recycling initiatives, a substantial portion of this textile waste continues to end up in landfills, underlining the urgent need for more effective and sustainable solutions. Clothing donation has emerged as a viable strategy to divert textiles from landfills while simultaneously supporting those in need. Malaysians are diligent about recycling fabric, according to Nik Suzila Hassan, co-founder of Kloth Circularity, but there are not enough bins in the nation for this reason (Huda, 2024).

The purpose of this study is to address these challenges by developing the Clothes Recycle Management System (CRMS), a comprehensive and user-friendly platform designed to streamline the entire clothing donation process, from initial promotion to final distribution. The CRMS is envisioned as a centralized hub for coordinating donation activities in Penang and Melaka, providing essential tools for event organization, item tracking, and donor engagement. By leveraging advanced technology, the system aims to enhance the overall efficiency, reach, and impact of clothing donation initiatives, ensuring more textiles diverted from landfills and are instead used to benefit those in need.

A central feature of the CRMS is its innovative points-based incentive scheme, which encourages donations by rewarding users with redeemable points, thus boosting participation. The system also enhances transparency by providing users with detailed information about the destination and impact of their donations, fostering greater trust and continued engagement. This study aligns closely with the United Nations' Sustainable Development Goal 12: Responsible Consumption and Production, which emphasizes the importance of reducing waste and promoting sustainable practices.

The significance of this study lies in its potential to transform clothing donation management in Malaysia. By addressing the inefficiencies of current methods, the CRMS empowers organizations to manage resources more effectively and to expand their impact. Moreover, the principles underlying the CRMS can be adapted for other donation-focused initiatives, offering a scalable solution that enhances sustainability and community engagement across diverse contexts. This study not only contributes to the ongoing efforts to manage textile waste but also promotes a culture of responsible consumption and production, with the potential for broader application in other areas of social and environmental sustainability.

2.0   LITERATURE REVIEW

The increasing accumulation of textile waste has garnered significant scholarly attention, particularly in the context of sustainable waste management and circular economy principles. Malaysia's alarming rate of textile waste disposal, with approximately 2,000 tons discarded daily, underscores the need for innovative approaches to clothing waste management (Manaf et al., 2018). This literature review explores the key themes of waste management, digital solutions for donation systems, and the role of community engagement in enhancing sustainability practices.

The literature on textile waste management often emphasizes the circular economy model as a sustainable solution to the growing problem of waste. The circular economy, as defined by MacArthur (2013), promotes the continuous use of resources through recycling, repurposing, and reducing waste. Within the circular economy framework, the concept of 'closing the loop' is crucial, where products at the end of their life cycle are reintegrated into the production process or redistributed for reuse (Ghisellini et al., 2016).

In Malaysia, studies have indicated a pressing need for effective systems to manage textile waste sustainably (Noraziah et al., 2016). Current recycling initiatives are fragmented and lack the integration required to make a significant impact. Various recycling programs may operate independently, with different organizations, NGOs, or community groups each handling textile waste management in their own way. These initiatives often lack coordination, meaning they do not share resources, data, or a unified strategy to tackle the issue comprehensively. This fragmentation results in inefficiencies such as overlapping efforts, gaps in coverage, and a lack of standardization in the way donations are collected, processed, or distributed. The CRMS aims to address this gap by providing a structured approach to clothing donation, which not only diverts textiles from landfills but also supports the circular economy by promoting the reuse of clothing. For donation systems, this translates into better coordination, reduced waste, and enhanced transparency. The CRMS, as a centralized platform, builds on these findings by offering a digital solution to manage clothing donations more efficiently, thus contributing to sustainable waste management practices.

Incentive-based approaches to encourage participation in recycling

and donation activities have also been widely studied. For example, Tonglet et al. (2004) found that incentive schemes, such as reward points and recognition, can significantly boost recycling rates. These findings are particularly relevant to the CRMS, which incorporates a points-based incentive scheme to motivate users to donate more regularly. By rewarding positive behavior, the system not only increases participation but also fosters a sense of community and shared responsibility.

Although digital donation systems have potential benefits, they encounter various challenges during implementation. One major concern is the digital divide, which is the disparity between individuals who have access to digital technologies and those who do not (Hilbert, 2011). This division may hinder the ability of digital platforms to reach a wide audience, especially in underdeveloped regions. Moreover, data privacy and security concerns are crucial, as emphasized in study on digital trust and user acceptance of online platforms (Bélanger & Crossler, 2011).

In order to tackle these difficulties, the CRMS needs to make sure its platform can be used by a diverse group of people and includes strong security features to safeguard user information. Furthermore, offering guidance and assistance to individuals who are not as proficient in technology can aid in narrowing the gap between those who are digitally literate and those who are not, ultimately increasing the overall involvement in the donation process.

3.0 METHODOLOGY

The design of the Clothes Recycle Management System (CRMS) relied on an Agile approach combined with PHP and MySQL to construct a versatile and user-oriented solution. The Agile method facilitated continuous development, enabling consistent user feedback and adjustments in accordance with evolving user requirements and input. PHP was employed for server-side coding to implement key functionalities like user registration, donation processing, and event management, while MySQL managed data storage and retrieval, ensuring efficient handling of donation records and inventory. The development process included iterative sprints for feature development, thorough testing which included unit testing, integration testing, user acceptance testing, and regular updates based on

stakeholder feedback. Safety measures, such as data verification were integrated to safeguard sensitive information. This methodology ensured that CRMS was adaptable, secure, and effectively catered to the needs of its users while maintaining a superior standard of performance and reliability.

3.1   RESEARCH METHOD

The development of the Clothes Recycle Management System (CRMS) followed the Database Life Cycle (DBLC) methodology, ensuring a systematic approach to creating a robust and reliable database system. The process began with the Initial Study phase, where a comprehensive analysis of existing clothing donation systems was conducted. This phase identified key inefficiencies in manual processes and the reliance on social media for event promotion, highlighting challenges such as limited audience reach, poor coordination in event organization, and the absence of a centralized management platform. These insights led to the definition of the CRMS's primary goal: to create a user-friendly, centralized platform that streamlines the donation process, enhances donor engagement, and ensures transparency in the distribution of donated items.

The Design phase then translated these business requirements into a detailed blueprint for the CRMS. A conceptual design was developed using Entity-Relationship Diagrams (ERDs) to map out the essential data entities and their relationships. This high-level model informed the selection of an appropriate Database Management System (DBMS), which needed to meet performance, scalability, and security requirements. The logical design phase followed, where the conceptual model was transformed into a logical schema within the chosen DBMS. This involved defining tables, columns, data types, and constraints, and normalizing the data to maintain integrity and eliminate redundancy. The final step in this phase was the physical design, which detailed the storage of data to optimize performance and retrieval efficiency.

In the Implementation and Loading phase, the CRMS database was created, starting with the installation of the DBMS. Database administrators then set up the database structure, configured user accounts and permissions, and loaded the data after thorough cleaning to ensure consistency and accuracy. Testing and Evaluation followed,

where the system underwent rigorous testing to identify and rectify any issues. This phase included functionality, performance, and security tests, as well as user feedback to ensure the system met all requirements. Fine-tuning was also conducted to optimize performance through adjustments in configuration, indexing, and query optimization.

Once testing was complete, the CRMS entered the Operation phase, where it was deployed for actual use. This phase focused on ensuring the system effectively supported the daily operations of clothing donation management, including generating reports, optimizing performance, and providing user training. Continuous monitoring was essential to promptly address any issues and maintain smooth operation.

Finally, the Maintenance phase ensured the CRMS's long-term success. This phase involved gathering regular feedback from users and stakeholders to identify areas for improvement and implementing necessary enhancements. Ongoing monitoring, updates, and optimizations ensured the system remained efficient, secure, and adaptable to changing needs. By following the DBLC methodology, the CRMS was developed to be not only effective upon deployment but also capable of evolving in response to future challenges, making it a reliable and scalable solution for managing clothing donations.

3.2   SYSTEM DESIGN

The system design for the Clothes Recycle Management System (CRMS) is structured to optimize functionality and user experience through a well-defined architectural framework and database schema. The architecture is divided into three key layers: Presentation, Business Logic, and Data. The Presentation Layer provides a user-friendly interface through which users can interact with the system, including functionalities for donating clothes, viewing recycling events, and tracking donation status. This layer ensures that the system is accessible and intuitive, enhancing user engagement. The Business Logic Layer manages the core processing and operational functions, including donation handling, event management, and points calculation. This layer enforces business rules and processes user actions, ensuring that the system operates smoothly and efficiently. The Data Layer is responsible for data storage and management, utilizing MySQL for

handling all data operations such as retrieval, updates, and reporting. The database design follows a structured approach with three main phases: Conceptual Design, Logical Design, and Physical Design. The Conceptual Design includes an Entity-Relationship Diagram (ERD) that illustrates the primary entities such as users, donations, and events and their relationships, which supports the system's data management needs. Logical Design refines this conceptual model into a detailed schema, specifying tables, columns, and relationships to ensure data integrity and eliminate redundancy. Physical Design translates this schema into actual database structures optimized for performance and storage. Business rules guide the design, such as ensuring each donation is associated with a single user and managing pickup sessions effectively. This comprehensive design approach ensures that CRMS is both functional and scalable, meeting the needs of users and stakeholders while providing a robust foundation for future enhancements.

4.0 RESULTS AND DISCUSSION

The Clothes Recycle Management System (CRMS) was developed and tested in the context of Penang and Melaka to assess its effectiveness in streamlining clothing donation processes. The CRMS was designed with three distinct modules catering to its main user groups: donors, administrators, and lorry drivers. Each module was developed to address the specific needs and responsibilities of these users, ensuring a streamlined and efficient donation process.

The donor module was created to simplify the donation process. Users can easily register, log in, view upcoming donation events, and donate items through an intuitive interface. The system also allows donors to track the status of their donations, providing transparency and building trust in the process.

The admin module plays a crucial role in managing and overseeing donation activities. Administrators can add, update, and delete events, manage inventory, and generate reports on donation activities. The automated reporting feature has proven to be highly effective, reducing the time and effort required for data analysis.

The lorry driver module was developed to facilitate the pickup of donated items. Drivers can log in to view their assigned tasks, including pickup locations and schedules. The system also allows them to input duty times and lorry details, ensuring smooth coordination. Figure 1, Figure 2 and Figure 3 display the dashboard interface for all three users.
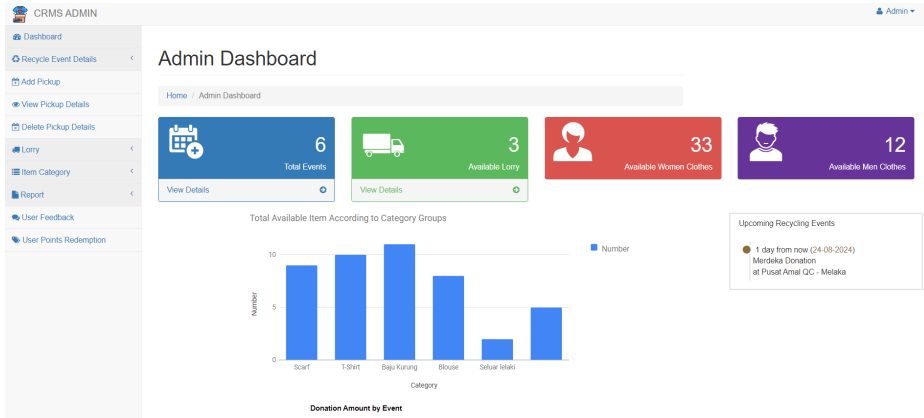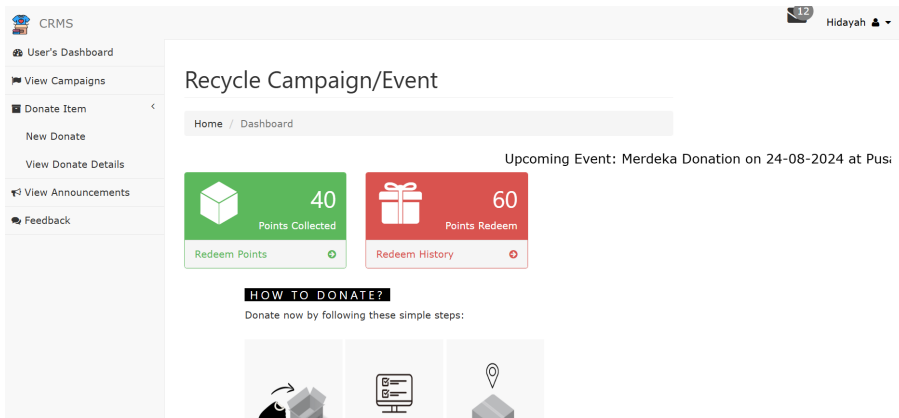

Figure 1: Admin Dashboard
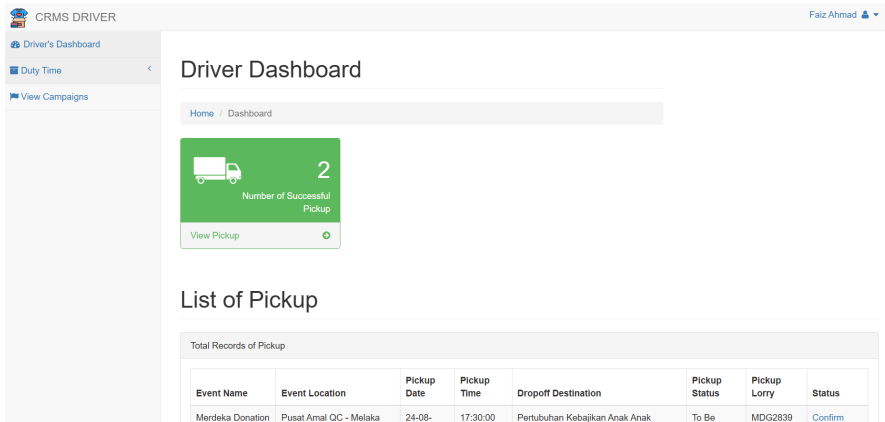

Figure 2: Donator Dashboard

Figure 3: Lorry Driver Dashboard

The automated reporting feature is another major strength of the CRMS. Traditionally, reporting on donation activities and inventory status required considerable manual effort, often leading to delays and errors. The automation of this process not only saves time but also ensures that the data generated is accurate and up-to-date. This capability is vital for administrators who rely on timely information to make informed decisions about resource allocation and event planning.

Additionally, the centralized platform effectively streamlined clothing donation management by integrating event promotion, inventory management, and real-time notifications. This enhanced coordination and communication among all stakeholders, making the donation process more efficient. However, a key limitation is the reliance on physical drop-off points for donations, which may be inconvenient for some users. This could deter participation from donors who cannot access these locations at scheduled times. Addressing this issue in future versions, such as by introducing alternative collection methods, would improve accessibility and likely increase donation rates. Overall, while CRMS has made significant strides in enhancing the efficiency of clothing donation activities, there is room for improvement in making the system more accessible and user-friendly.

5.0   CONCLUSION

In conclusion, it effectively tackles the difficulties associated with managing clothing donations by incorporating a user-friendly platform, effective business procedures, and a powerful data management system. The system's three-tier structure guarantees smooth operation and expandability, while its meticulous database structure facilitates precise data handling and reporting. Through the use of iterative development and the integration of user input, CRMS streamlines donation procedures, increases user interaction, and offers pertinent information to stakeholders, thereby playing a substantial role in promoting sustainability and community participation in clothing recycling.

ACKNOWLEDGEMENTS

REFERENCES

[1]   F. Bélanger and R. E. Crossler, "Privacy in the digital age: A review of information privacy research in information systems," MIS Quarterly, vol. 35, no. 4, pp. 1017-1041, 2011.

[2]   P. Ghisellini, C. Cialani, and S. Ulgiati, "A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems," Journal of Cleaner Production, vol. 114, pp. 11-32, 2016.

[3]   H. K. Harinderan, "Waste management in Malaysia: Generate less, separate more," Business Today, 2023. [Online]. Available: https://www.businesstoday.com.my/waste-management-in-malaysia.

[4]   M. Hilbert, "The end justifies the definition: The manifold outlooks on the digital divide and their practical usefulness for policy-making,"

Telecommunications Policy, vol. 35, no. 8, pp. 715-736, 2011.

[5]   A. Huda, "Make fabric recycling more accessible to public, govt told," Free Malaysia Today, 2024. [Online]. Available: https://www.freemalaysiatoday.com/category/nation/2024/07/21/make-fabric-recycling-more-accessible-to-public-govt-told/.

[6]   E. MacArthur, Towards the circular economy, economic and business rationale for an accelerated transition, 1st ed., Cowes, UK: Ellen MacArthur Foundation, 2013.

[7]   L. A. Manaf, M. A. A. Samah, and N. I. M. Zukki, "Municipal solid waste management in Malaysia: Practices and challenges," Waste Management, vol. 29, no. 11, pp. 2902-2906, 2018.

[8]   A. Noraziah, H. Noorina, and Z. M. Ahmad, "Textile waste recycling practices: A review of the Malaysian context," Procedia CIRP, vol. 40, pp. 552-556, 2016.

[9]   M. Tonglet, P. S. Phillips, and A. D. Read, "Using the theory of planned behaviour to investigate the determinants of recycling behaviour: A case study from Brixworth, UK," Resources, Conservation and Recycling, vol. 41, no. 3, pp. 191-214, 2004.