

# G-Waste: A smart waste collection system with GPS technology for real-time tracking

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## Abstract

This study presents the development and evaluation of G-Waste, a real-time garbage scheduling and collection system designed to address inefficiencies in traditional waste management in Bogu City, Philippines. Findings from surveys conducted among the LGU, garbage collectors, and residents reveal a lack of real-time communication between residents and collectors, an inefficient waste collection process, improper waste categorization, and delayed reporting of waste issues. Hence, the system aimed to address the issues by providing features such as real-time location and notification, waste categorization guide, waste generation prediction to recommend admin where and when garbage tends to overflow, and AI chatbot for reporting and help. Using a mixed-method approach, the study focused on stakeholder experiences and system performance under real-world conditions through User Acceptance Testing based on ISO 25010 standards. The findings indicate an overall weighted mean of 4.3 (Strongly Agree), which indicates that the app feature meets the needs of the residents. A rating of 3.7 (Agree) indicates that collectors find the app difficult to use, as the majority of garbage collectors do not have mobile phones or do not use them regularly. Meanwhile, a rating of 4.3 (Strongly Agree) shows that the LGU is satisfied and supports operational needs, and a rating of 4.5 (Strongly Agree) indicates strong technical approval from IT experts. These results demonstrate that G-Waste effectively enhances communication, optimizes collection schedules, and supports proper waste management practices. However, the system has limitations, the system dependent on the internet connectivity being stable to operate. These results have practical implications for local governments and communities seeking to implement data-driven, sustainable, and citizen-friendly waste collection.

**Keywords:** *waste management, smart collection, real-time monitoring, waste generation prediction*

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## 1. Introduction

Modern society is very fast-moving, and this is largely a result of the technological revolution by which society is characterized. The introduction of innovations such as smart home devices and wearable gadgets has fundamentally altered how individuals manage daily life by shifting household labor toward "digital housekeeping" (Aagaard, 2022; Alloui & Mourdi, 2023). However, the issue of the failure of waste management systems to keep up with rapid urbanization is still experienced in the Philippines, with annual solid waste production approximately doubling between 2000 (9.07 million metric tons) and 2020 (16.63 million metric tons) (Commission on Audit, 2023). The situation is further worsened by inconsistent local waste management practices; as Verzosa et al. (2024) indicate, the lack of awareness among the local population and the large amount of waste produced have contributed to significant environmental degradation in coastal and urban areas. These point to a critical need for technological interventions to fill the gap between national policy and local implementation. As urbanization grows at a rapid pace, populations become denser, and landfill space becomes limited, countries such as the Philippines are experiencing serious waste management issues. Nevertheless, much of the waste is still not collected, segregated, or disposed of in the most appropriate way.

Existing systems may struggle to adapt to contemporary demands, which highlights the need for technology-driven solutions. In most cases, traditional waste management systems are not responsive to the demands of a modernized society due to rigid timescales and a lack of communication (Kaza et al., 2018). These inefficiencies impact operational costs and play a significant role in environmental degradation and health issues. In this regard, the present study introduces the G-Waste application, designed to address existing issues in the waste management system by enabling real-time, data-driven garbage collection. The study shows the relationship between garbage collection and scheduling, as both must be adjusted to improve system performance. A mobile phone application in waste management is useful for enhancing coordination between residents and collectors, as it informs users and encourages residents to dispose of litter appropriately (Paudel et al., 2024). This would assist in improving the existing system, resulting in optimized collection schedules and, ultimately, a more effective waste management system.

Waste can be collected at the right time by allowing residents to track the position of the garbage truck and receive updates on the type of garbage to be collected on a specific day.

With this shift toward digital platforms, machine learning can be deployed. As Ganesh et al. (2025) note, by using past data to predict patterns of waste accumulation, municipalities can move from reactive cleaning responses to proactive scheduling, ensuring that bins do not reach full capacity before collection. Integrating collection processes can lead to more efficient systems, thereby reducing missed garbage collection. Paudel et al. (2024) and Punse et al. (2024) highlight how a technology-oriented approach to waste management processes enables smooth communication, better coordination, and improved decision-making. This is further supported by Addas et al. (2024), who describe “Waste Management 2.0” as a significant intersection of IoT and urban planning that facilitates the transition to more sustainable and eco-friendly cities.

The combination of technology and waste management enhances communication between residents and collectors, enables real-time tracking, notifications about scheduled collection times, and digitalizes records for better schedule management. Moreover, the increasing adoption of smart waste management solutions reflects a trend toward data-driven and proactive decision-making, which ultimately benefits both service providers and the public. In this regard, a waste management system can assist in streamlining waste management processes. G-Waste represents a significant advancement in addressing problems in contemporary waste management, as it enables real-time GPS monitoring of garbage trucks. This allows operations managers to track movement progress in relation to schedules. As Krishna et al. (2025) demonstrate, a multi-layered IoT-ML architecture is one of the most effective models for ensuring scalability and processing complex, real-time data streams.

The system also sends notifications to residents regarding collection schedules. Such an innovative solution exemplifies how technology-driven approaches can help maintain clean, productive, and sustainable cities as urban areas continue to expand. The practical usefulness of tracking is highlighted in the study by Liao et al. (2025), which found that real-time monitoring leads to significant improvements in collection efficiency and a considerable reduction in unnecessary vehicle mileage. Thus, through its real-time implementation and user-friendly model, G-Waste aims to establish new standards in waste management and pave the way for future public service innovations.

## 2. Literature Review

The needs of society change with the development of cities and population growth; therefore, modifications are necessary to meet the demands of a modernized society, particularly in waste management systems. These limitations lead to inefficiencies in the collection process, often resulting in delayed and missed pickups, as traditional waste management systems rely on fixed schedules and lack communication between residents and collectors. Various studies have identified key loopholes in conventional waste management systems, including the absence of real-time technology and effective communication between the population and waste collectors. As Chauhan et al. (2020) emphasized, waste management processes cannot be efficiently organized without real-time GPS tracking, which often leads to delayed pickups. Similarly, K et al. (2023) highlighted the environmental and health impacts of excessive garbage accumulation due to the inability to track garbage bin locations in real time. Another issue raised by Chaudhari et al. (2023) is the limited participation of residents and the absence of reporting tools, which result in problems remaining unaddressed and unmonitored. Moreover, Lloren (2023) pointed out the consequences of not receiving timely updates on routes and collection schedules, leading to situations where residents miss garbage collection times.

To address the problems, recent studies have proposed smart approaches to waste collection. For example, Punse et al. (2024) suggested a garbage collection system with GPS tracking, which allows residents to monitor the location of garbage trucks and receive real-time updates. This concept was further developed by Shaikh et al. (2024), who presented an Android-based application that utilizes geofencing and Firebase integration to enable real-time tracking. They argue that engaging residents through mobile technology transforms traditional municipal services into an interactive, community-based system. Similarly, to reduce overflows and optimize collection routes, Pawar et al. (2024) designed an IoT-based system incorporating sensors and GPS, integrated into an Android application. In the same vein, Wijethilaka et al. (2025) developed an application that allows residents to report waste issues to municipal authorities using geo-tagged images, thereby promoting active participation, transparency, and accountability, and improving service efficiency. Basilio et al. (2023) also explored the implementation of a mobile application in the Southern Philippines, highlighting how localized digital solutions can address the unique geographic and logistical challenges of waste collection in Philippine urban centers by fostering improved communication between

communities and municipal authorities. These systems demonstrate that real-time tracking and notification features can be effectively integrated into waste management systems to enhance their performance.

With the advancement of artificial intelligence and IoT-based solutions, several waste management systems have been developed and proven effective in improving waste management processes. Vageesh (2024) illustrates the effective use of IoT and mobile applications in simplifying coordination between administrators and collectors, thereby enhancing collection efficiency. In waste management systems, artificial intelligence supports decision-making through predictive and automated processes, using predictive analytics to improve the efficiency of collection (K et al., 2023; Olawade et al., 2024). Reshika (2024) proposed an independent garbage tracking system that operates on real-time data to provide accurate updates on collection processes, thereby enhancing user experience and system feedback. Additionally, Sankar et al. (2025) demonstrated that IoT- and cloud-powered route optimization significantly contributes to sustainable solutions by reducing fuel consumption and preventing bin overflow. These studies contribute to improving waste collection procedures by enhancing garbage truck monitoring, time management, reporting, and system integration. They highlight the importance of combining real-time tracking, predictive alerts, resident reporting, and educational features into a single mobile platform to meet the evolving demands of modern society, particularly in addressing gaps in real-time coordination, transparency, and community engagement.

Empirical evidence provides insight into how the integration of technology, including real-time notifications on collection processes, optimized waste pick-up routes, IoT, and AI, can significantly enhance waste management systems. Shelke et al. (2024) highlighted the importance of automation in improving the efficiency of current waste management systems, enabling more efficient, timely, and sustainable waste collection processes. This aligns with the findings of Khan et al. (2024), who reported that IoT and real-time monitoring reduce missed pickups and operational expenses while improving overall efficiency. Although automation greatly enhances operational efficiency, the involvement of residents remains critical in ensuring a healthier and less polluted environment, particularly through the use of mobile alerts. The integration of mobile platforms with real-time monitoring helps bridge gaps in waste collection processes. The effectiveness and feasibility of these studies strongly support such initiatives and confirm the importance of adopting smart waste collection systems. They

further emphasize the critical role of technology in mitigating collection challenges and promoting the development of smarter and cleaner cities.

### 3. Methodology

The study used Agile software development, allowing for continuous assessment and refinement throughout the development process by breaking the project up into smaller, more manageable parts (Laoyan, 2025). Agile provided a suitable framework to refine features like route tracking, status monitoring, and garbage reporting based on ongoing user feedback and operational insights.

#### 3.1. Plan

The researchers have collected required requirements and assessed what major functionality is needed for *G-Waste* to be able to function well. Planning schedules and scheduling activities were done with the help of such tools as ClickUp. The research design employed was mixed method, which involved both quantitative surveys and qualitative interviews. The planning phase involved the application of the qualitative methods to obtain some interesting information regarding the waste management problems. This included interviews with the operational managers in City Environment and Natural Resources (CENRO) to better understand current waste collection process, operational stoppage/delays, and concerns regarding the waste collection process. This interview helped identify the current problems faced with the waste collection process and the user needs that the system has to address.

The quantitative component made practical and effective use of questionnaires distributed to 100 respondents using purposive sampling, which included residents, garbage collectors, and operations managers in Bogo City, Cebu, Philippines. The data gathering instrument used was User Assessment Survey (UAS) that was conducted to assess problems that were currently faced with waste management collection, together with an interview that was conducted among operation managers to better understand the waste collection processes. After identifying user needs, the researchers came up with the following functional requirements:

***User registration.*** *G-Waste* allows residents to register an account for them to access the location tracking of garbage trucks within their area, and the drivers log in using the

accounts created by the operations manager to access the map ensuring that they follow their assigned routes and schedules. Meanwhile, Operation Managers monitor and manage waste collection processes, and respond to alerts such as overflows or missed pick-ups.

***Real-time location and notification.*** *G-Waste* allows residents to track the garbage truck location on a map and receive push notifications on actual pick-ups within a 1-kilometer radius of their location to keep residents informed of the collection status and also residents without internet access can receive updates via SMS.

***Waste categorization guide.*** *G-Waste* provides residents with a digital guide of waste that helps residents sort waste properly.

***Waste generation prediction.*** *G-Waste* provides an AI to predict when and where waste bins are likely to be full, helping prioritize collection schedules and avoid overflows.

***AI chatbot for reporting and help.*** *G-Waste* provides a way to report full bins or missed pickups and can ask questions about schedules or waste categories to get real-time updates about their area. All reports and inquiries will be received and monitored by the operation managers to ensure timely response and resolution.

However, the system has limitations on its given features. The system is very dependent on the internet connectivity and being stable to operate. Other features like real-time tracking, notifications and submitting of reports require a steady internet connection. Finally, the AI Predictive analysis ability depends on the gathered information. These shortcomings are an indication of potential future enhancement since the system is still on the rise.

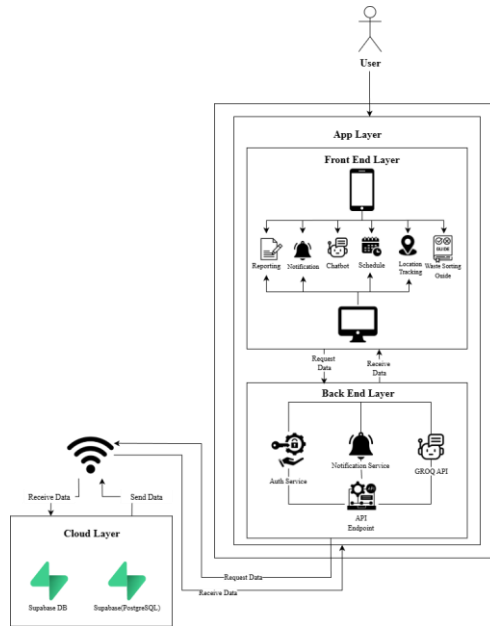
### ***3.2. Design***

The researchers were also interested in the needs and technical requirements of the project that is why every functionality corresponded to its purpose. The identification and definition of key system features (tracking of routes and reporting, collection schedule, and others) were performed at this stage with the help of such a tool as Figma to visualize the system user interface (UI) and user experience (UX) better. This step was quite important in the determination of a clear and organized system design, such that the project was well equipped to move to the development stage.

***System architecture diagram.*** As illustrated in Figure 1, the study focused on how the user interacts with *G-Waste* through the front-end, while the back-end manages the system's

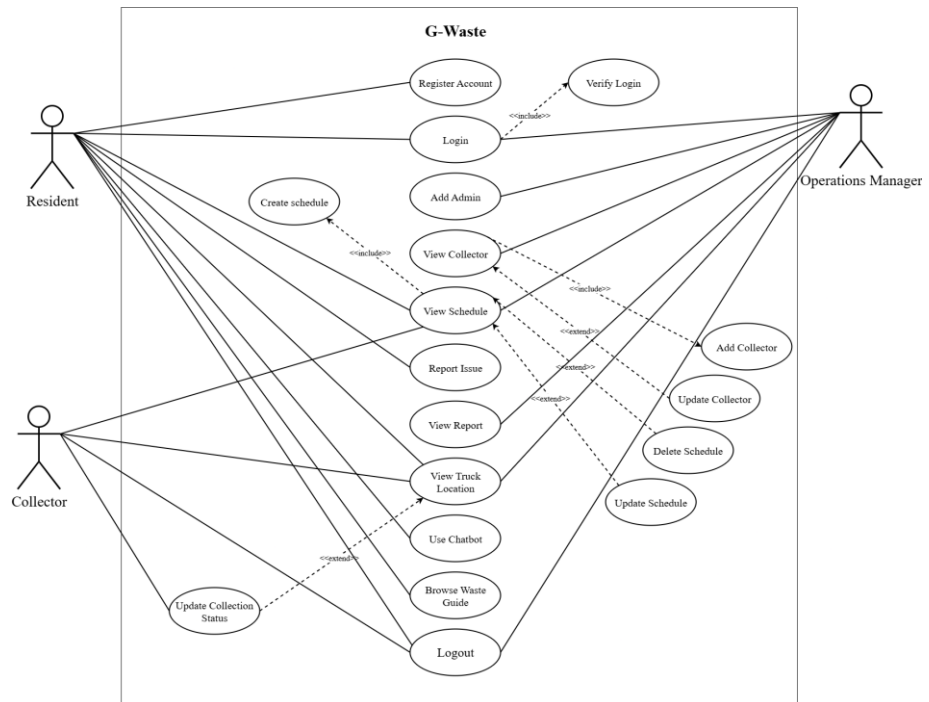
functions and connects to a secured database for better report management, route tracking, and user access.

**Figure 1**  
System architecture for G-Waste



*Use case diagram.* Figure 2 shows how different users interact with the system. Representing three main users, the operations manager, residents, and collectors, having access to different features, captures the scope of the system from the user’s perspective.

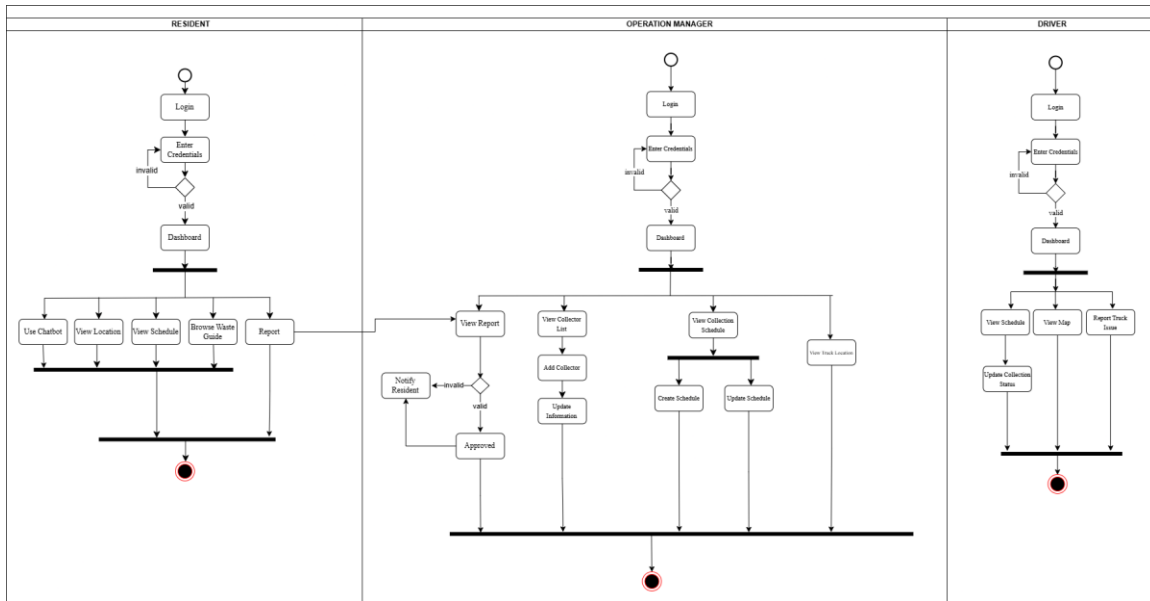
**Figure 2**  
Use case diagram for G-Waste



**Activity diagram.** Figure 3 shows the step-by-step actions of users within the system. Each user role follows a different sequence of actions based on their access within the system. This differentiation ensures that the workflow accurately represents the unique interactions and processes relevant to each user type.

**Figure 3**

*Activity diagram for G-Waste*



### 3.3. Develop

*G-Waste* was implemented using a comprehensive technology stack: ReactJS for the web application and React Native for mobile application. The backend infrastructure is powered by Supabase which provides a PostgreSQL database, handles Role-Based Access Control (RBAC), and manages real-time data streams. The predictive feature of the system was developed using TensorFlowJS and its machine learning libraries to analyze historical data and forecast bin fullness. Finally, the system leverages the MapTier API along with MapLibre-gl, a Javascript map library for real-time GPS tracking and route visualization.

**Description of the prototype.** This served as a prototype for *G-Waste*, designed to show the basic functionalities of the system and user interfaces. Both the resident and the collectors interacted through an application allowing them to efficiently access *G-Waste*, whereas the admin interacted with the system through a web-based system.

**Figure 4**  
*Admin login page*

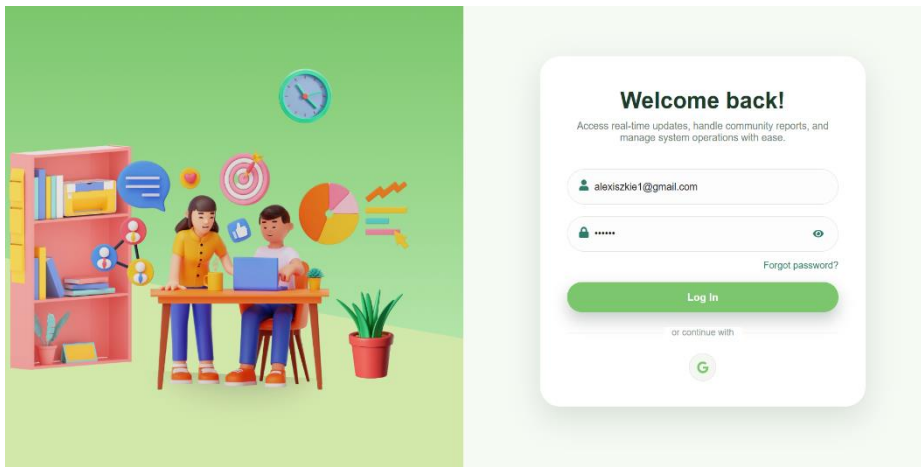


Figure 4 shows the login page of admin which prompts them to enter their email and password to access and the system.

**Figure 5**  
*Admin dashboard*

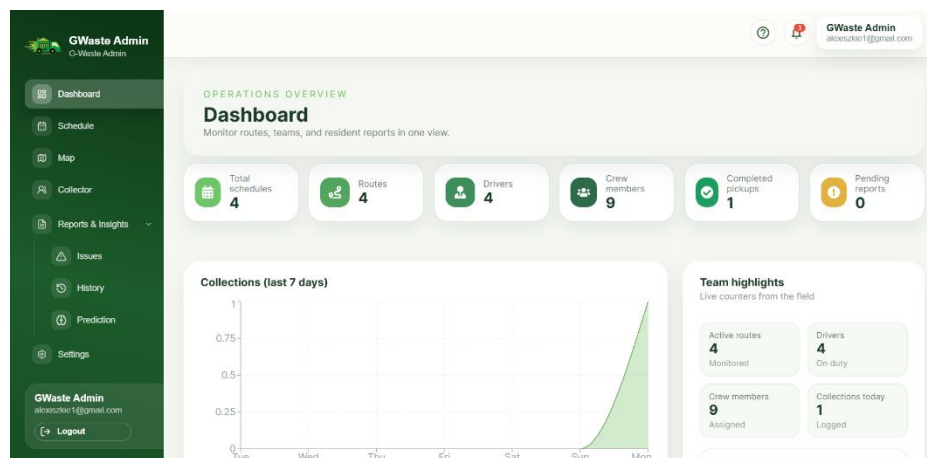


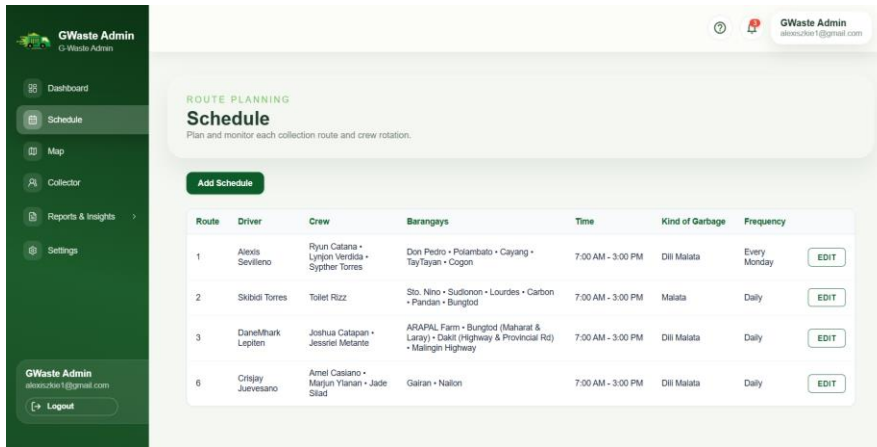
Figure 5 shows the admin’s dashboard which provides them control for monitoring and managing the *G-Waste* system, such as location tracking, resident reports, and garbage collection schedules.

The Schedule page, illustrated in Figure 6, allows the admin to add and manage collection schedules, thereby organizing the waste collection process in each barangay.

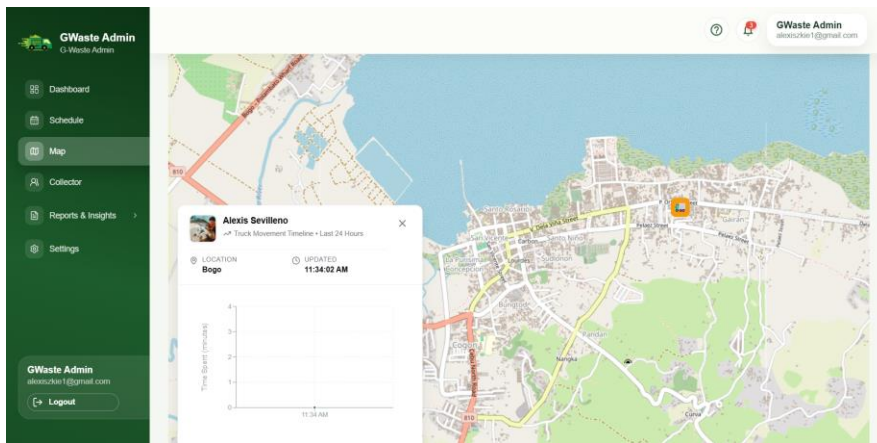
The map, illustrated in Figure 7, allows the admin to monitor and track the location of garbage trucks, ensuring well-coordinated waste collection operations.

Figure 8 presents a list of garbage collectors, allowing the admin to add collectors and identify which ones are currently active or inactive.

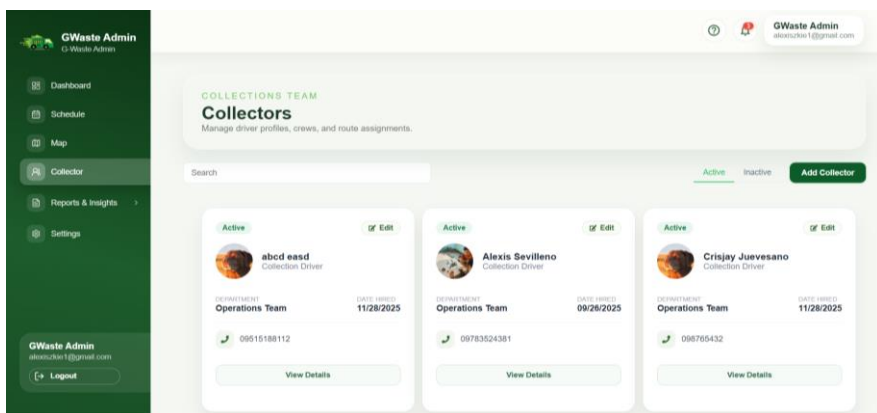
**Figure 6**  
*Schedule*



**Figure 7**  
*Map*



**Figure 8**  
*Collector list*



**Figure 9**  
*Resident complaints*

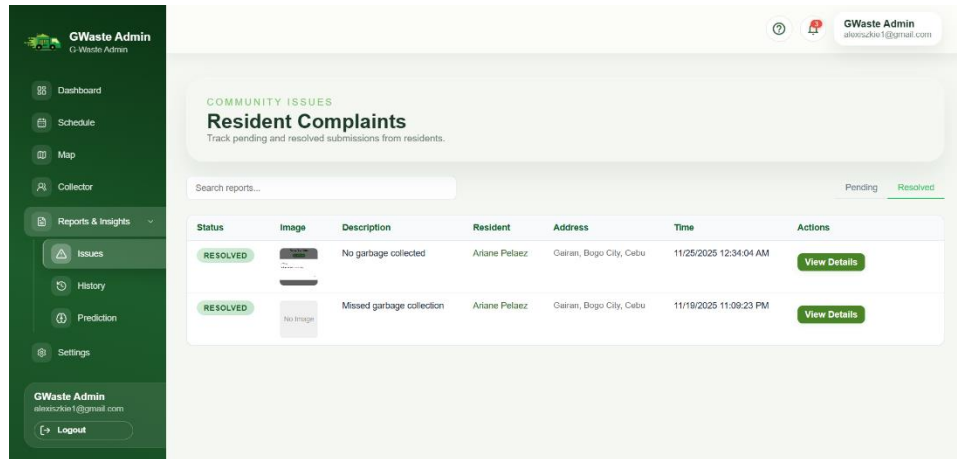


Figure 9 presents the Resident Complaints page, allowing admin to monitor and manage complaints from residents, including the ability to view the resolved and unresolved reports.

**Figure 10**  
*History*

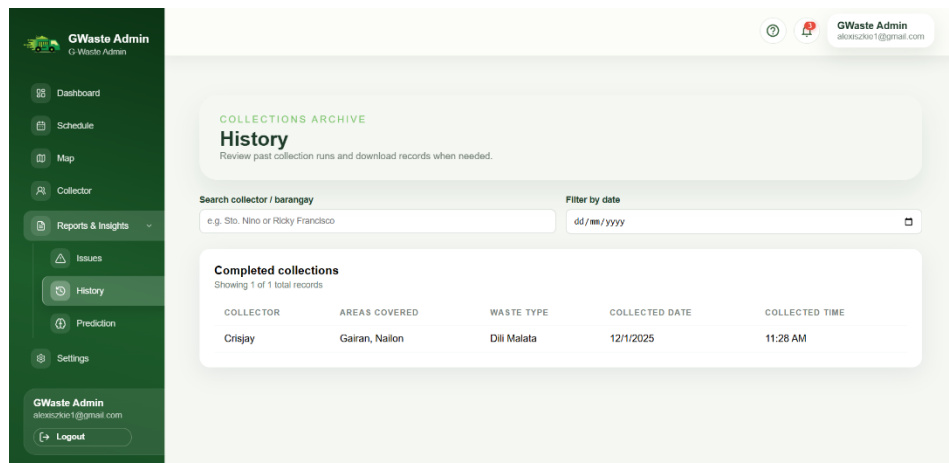


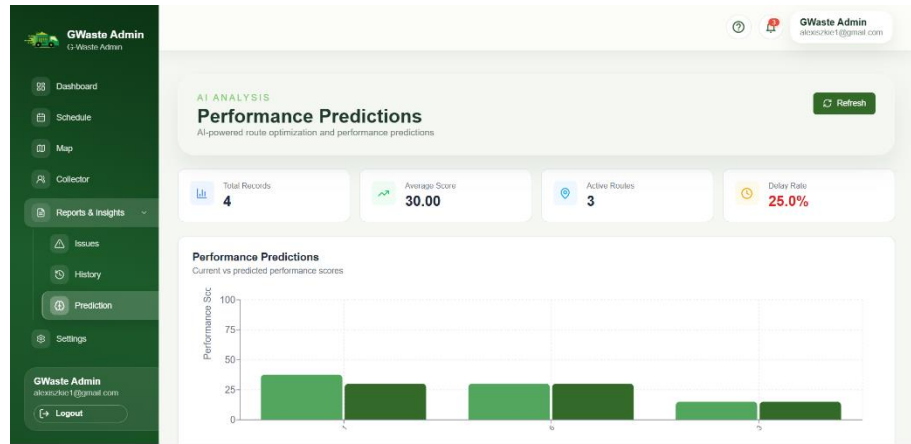
Figure 10 presents the collection history, allowing admin to view completed collections and review past collections.

Figure 11 presents Prediction Analysis page, allowing the admin to view performance predictions and AI-powered route optimization.

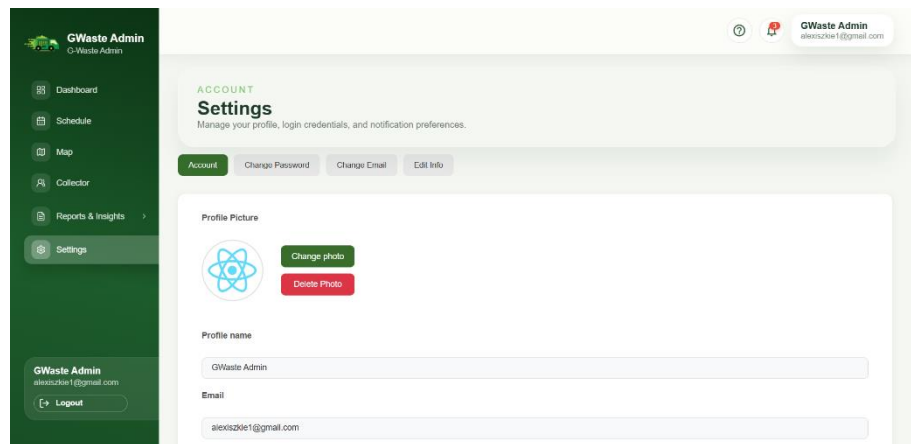
The Settings page, illustrated in Figure 12, enables the admin to view and change user information.

The Landing page, illustrated in Figure 13, guides residents to create an account, and sign into the *G-Waste* app.

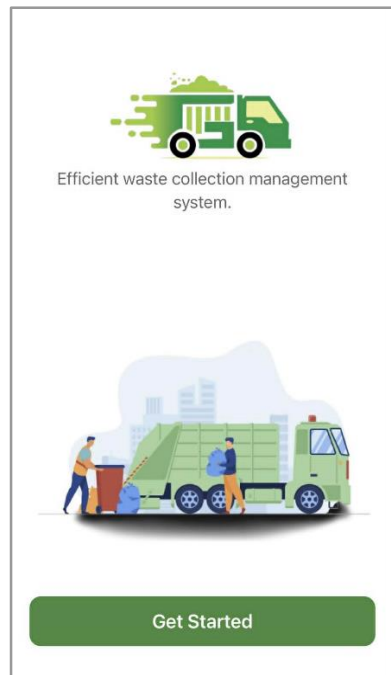
**Figure 11**  
*Prediction*



**Figure 12**  
*Settings*

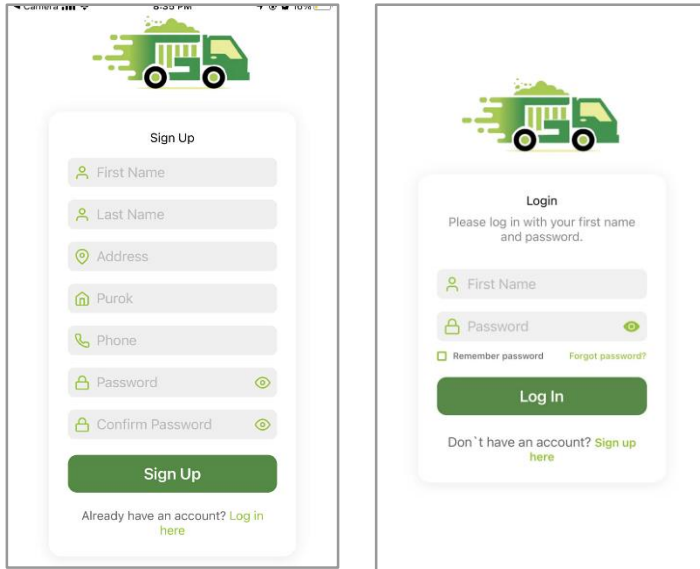


**Figure 13**  
*Landing page*



**Figure 14**

*Sign in and sign up*



**Figure 15**

*Collector dashboard*

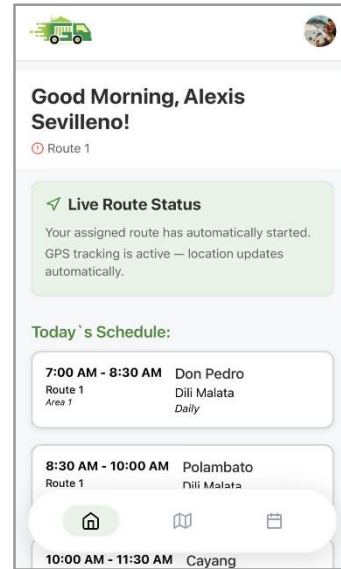
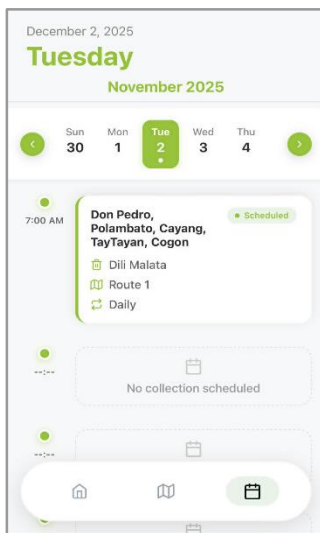


Figure 14 shows the Sign Up and Log In pages, allowing residents to create an account, and sign into the *G-Waste* app, respectively. Both garbage collectors and residents can sign in to their accounts by inputting their credentials.

Figure 15 shows the Collector's dashboard, enabling garbage collectors to view location and collection schedule.

**Figure 16**

*Collector schedule*



**Figure 17**

*Collector map*

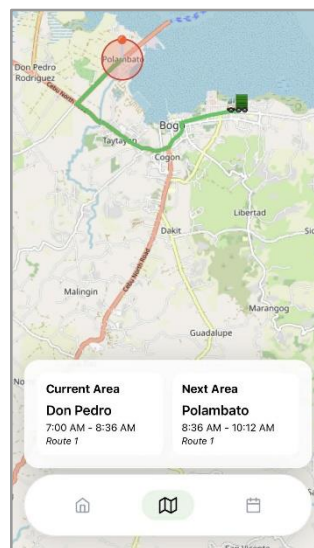


Figure 16 presents the collection schedule, enabling garbage collectors to check the type of waste that will be collected on a specific day.

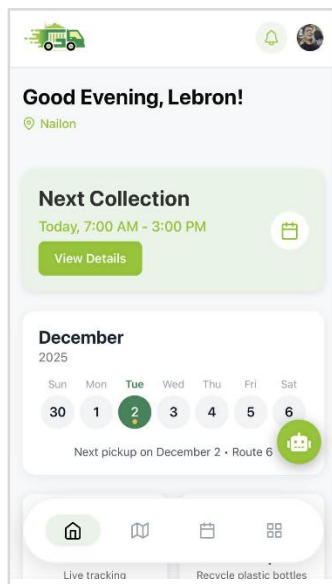
Figure 17 illustrates the map, allowing garbage collectors to view their route and track the area where they collect.

The resident's dashboard, illustrated in Figure 18, provides an overview for residents on what to access within the system.

The map, illustrated in Figure 19, enables residents to view the location of the garbage truck in real time and get a real-time notification.

**Figure 18**

*Resident dashboard*



**Figure 19**

*Resident map*

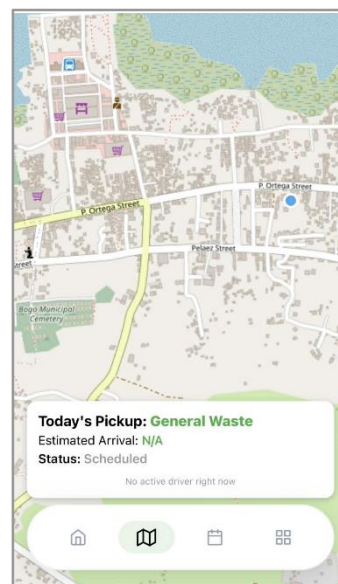


Figure 20 presents the Collection Schedule page, where residents view the schedule to avoid missing their collection.

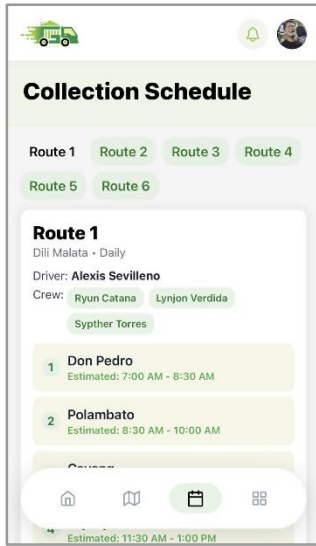
The Waste Sorting Guide, illustrated in Figure 21, helps residents properly sort their waste by providing clear icons for each waste type.

Figure 22 presents settings and profile, allowing residents to manage their account preferences and personal information.

The resident chatbot, shown in Figure 23, allows residents to quickly report, get information, and assistance through the *G-Waste* chatbot.

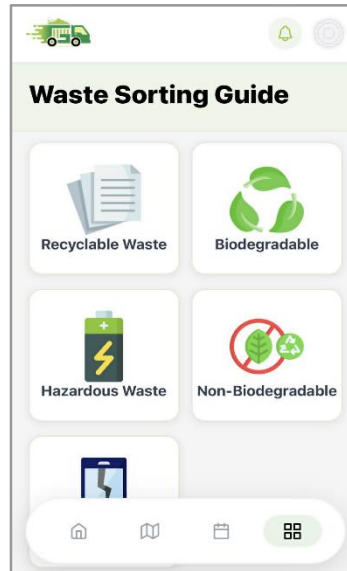
**Figure 20**

*Resident schedule*



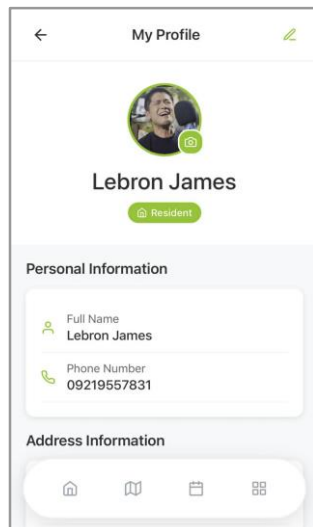
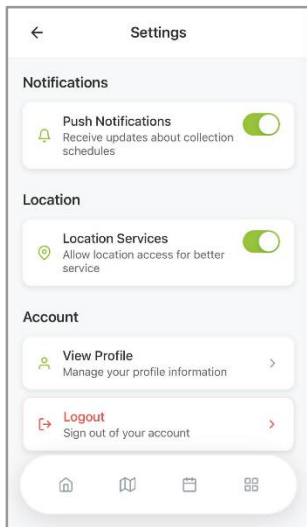
**Figure 21**

*Resident waste guide*



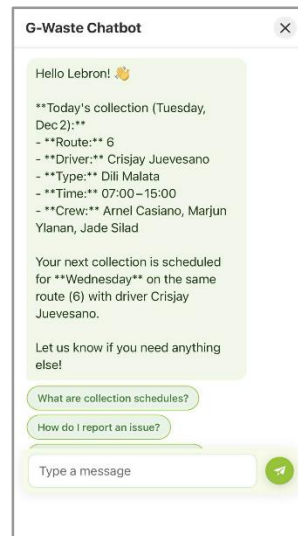
**Figure 22**

*Use setting & profile*



**Figure 23**

*User chatbot*



### 3.4. Testing

Throughout this phase, the researchers conducted various tests, including performance monitoring and issue troubleshooting, using User Acceptance Testing (UAT) implemented through a 5-point Likert scale survey, based on ISO 25010 from the different stakeholders, including 2 members for each barangay and 5 drivers which evaluated the system functional sustainability, performance efficiency, interaction capability, reliability and also 3 from LGU,

3 IT Experts which assessed the system functional sustainability, performance efficiency, compatibility, interaction capability, reliability, security on how the system worked under real-world conditions. Researchers assessed how the system met their needs and used their feedback to further refine the system.

**Table 1**

*Distribution of UAT participants*

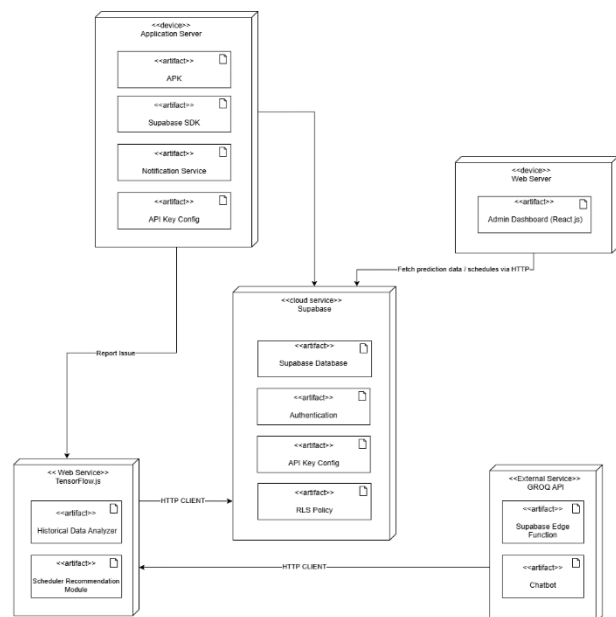
Participant Group	Number of Participants	Percentage
LGU	3	4.3%
Garbage Truck Drivers / Collectors	5	7.2%
Barangay Residents	58	4.3%
IT Experts	3	84.1
<b>TOTAL</b>	<b>69</b>	<b>100%</b>

### 3.5. Release

At this point, the system is finalized for release to end-users, ensuring the smooth transition from development to live operations. Before the release of the system, the researchers will first provide training sessions to end-users and will also require them to be properly trained to make sure that all stakeholders understand the flow and functions of the system. Continuous monitoring is essential to ensure the *G-Waste* system remains stable, efficient, and user-friendly after deployment.

**Figure 24**

*Deployment diagram for G-Waste*



As illustrated in Figure 24, *G-Waste* distributes different platforms and devices. The system is composed of two main components: a mobile application for residents and garbage collectors, and a web-based interface for the operations manager. Both connect to a central application server that processes data and stores information in a cloud-based database.

### 3.5. Feedback

User feedback was gathered in this phase, and the feedback gathered was analyzed to determine the system's possible refinements and to create a more improved system. Feedback is gathered through surveys and app ratings from users with their experience using the system. The data gathered was analyzed and used weighted means to determine overall satisfaction. Through this, the researchers were able to understand and identify recurring issues, areas for improvement, which will mainly prioritize the user-centric views within the system, additionally they are able to add features that might be needed for the system.

## 4. Findings and Discussion

This section presents, analyzes, and interprets the data collected from the User Acceptance Testing (UAT) of the *G-Waste* in Bogor City and quantitative data to get the weighted mean calculations to determine the overall interpretation of system quality. The survey was conducted among four types of groups which are LGU, drivers, residents, and IT experts across different characteristics of ISO 25010. The results reflect how effectively the system manages real-world waste collection processes and user needs.

**Table 2**

*Resident evaluation result*

Characteristic	Weighted Mean	Interpretation
Functional Suitability	4.6	Strongly Agree
Performance Efficiency	4.4	Strongly Agree
Interaction Capability	3.6	Agree
Reliability	4.4	Strongly Agree
<b>Overall Weighted Mean</b>	<b>4.3</b>	<b>Strongly Agree</b>

**Legend:** Strongly Agree (4.21–5.00); Agree (3.41–4.20); Neutral (2.61–3.40); Disagree (1.81–2.60); Strongly Disagree (1.00–1.80)

Table 2 shows the overall weighted mean of 4.3, indicating “Strongly Agree.” The system effectively meets the ISO/IEC 25010 quality standards and is able to manage all the essential needs of the users. Functional Suitability scores (4.6) which means “Strongly Agree”, indicating that the system’s functions met the users’ needs. Performance Efficiency scores (4.4) which means “Strongly Agree”, which shows that the system performs efficiently without bugs and lags. Reliability scored (4.4) which means “Strongly Agree”, indicates that the system performs its functions correctly without failures. Only Interaction Capability scored lower (3.6), suggesting that the interface and user interaction can still be improved. Overall, the system performs effectively and meets user needs.

**Table 3**

*Collector evaluation result*

<b>Characteristic</b>	<b>Weighted Mean</b>	<b>Interpretation</b>
Functional Suitability	4.6	Strongly Agree
Performance Efficiency	4.2	Strongly Agree
Interaction Capability	3.5	Agree
Reliability	2.6	Neutral
<b>Overall Weighted Mean</b>	<b>3.7</b>	<b>Agree</b>

**Legend:** Strongly Agree (4.21–5.00); Agree (3.41–4.20); Neutral (2.61–3.40); Disagree (1.81–2.60); Strongly Disagree (1.00–1.80)

As shown in Table 3, the overall weighted mean is 3.7, which corresponds to “Agree.” This indicates that collectors find the app difficult to use, as the majority of garbage collectors do not have mobile phones or do not use them regularly. Additionally, many collectors have limited exposure to modern digital tools, which affects their ability to use the system effectively. This lack of technological familiarity impacts their productivity when using the application. As new users, they struggle with navigating the app, generating reports, and fully utilizing its features in their daily tasks, which contributes to the lower overall rating.

Functional Suitability scored high at 4.6, showing that the system’s features meet user requirements. However, Performance Efficiency (4.2) and Reliability (2.6) scored lower, indicating performance issues and inconsistent system behavior. Interaction Capability received a neutral rating of 3.5, suggesting that the user interface requires improvement. Based on these findings, garbage collectors recommend improving the system’s processes. Overall,

while the system is functional, it requires further refinement to enhance performance and usability.

**Table 4**

*Admin evaluation result*

<b>Characteristic</b>	<b>Weighted Mean</b>	<b>Interpretation</b>
Functional Suitability	4.4	Strongly Agree
Performance Efficiency	4.5	Strongly Agree
Compatibility	4.3	Strongly Agree
Interaction Capability	4.3	Strongly Agree
Reliability	4.2	Agree
Security	4.2	Agree
<b>Overall Weighted Mean</b>	<b>4.3</b>	<b>Strongly Agree</b>

**Legend:** Strongly Agree (4.21–5.00); Agree (3.41–4.20); Neutral (2.61–3.40); Disagree (1.81–2.60); Strongly Disagree (1.00–1.80)

As shown in Table 4, the overall weighted mean is 4.3, which corresponds to “Strongly Agree.” This indicates that the system is effective and aligned with ISO/IEC 25010 standards. Functional Suitability scored 4.4 (“Strongly Agree”), indicating that the system’s functions meet users’ needs. Performance Efficiency scored 4.5 (“Strongly Agree”), showing that the system performs efficiently and smoothly. Compatibility scored 4.3 (“Strongly Agree”), demonstrating that the system works effectively without conflicts or issues. Interaction Capability scored 4.3 (“Strongly Agree”), indicating user satisfaction with the interface. Reliability scored 4.2 (“Agree”), suggesting that the system performs its functions correctly and consistently. Security also scored 4.2 (“Agree”), indicating that the system maintains confidentiality and integrity.

Based on these findings, the administrator recommends adding a Material Recovery Facility (MRF) to the map to identify where waste can be sorted and processed for reuse rather than being discarded. Additionally, they recommend including updated pick-up point locations and a timeline graph to track the movement of garbage trucks.

As shown in Table 5, the overall weighted mean is 4.5, which corresponds to “Strongly Agree.” This indicates high user satisfaction and strong alignment with ISO/IEC 25010 standards. Functional Suitability obtained a weighted mean of 4.6 (“Strongly Agree”), proving that the system’s functions meet the needs of users. Performance Efficiency scored 4.4

(“Strongly Agree”), indicating that the system performs its functions efficiently. Compatibility achieved a weighted mean of 4.5 (“Strongly Agree”), showing that IT experts found the system works effectively with other systems, such as the G-Waste mobile app and web platform, without conflicts or issues.

**Table 5**

*IT expert evaluation result*

<b>Characteristic</b>	<b>Weighted Mean</b>	<b>Interpretation</b>
Functional Suitability	4.6	Strongly Agree
Performance Efficiency	4.4	Strongly Agree
Compatibility	4.5	Strongly Agree
Interaction Capability	4.4	Strongly Agree
Reliability	4.8	Strongly Agree
Security	4.3	Strongly Agree
<b>Overall Weighted Mean</b>	<b>4.8</b>	<b>Strongly Agree</b>

**Legend:** Strongly Agree (4.21–5.00); Agree (3.41–4.20); Neutral (2.61–3.40); Disagree (1.81–2.60); Strongly Disagree (1.00–1.80)

Interaction Capability received a weighted mean of 4.4 (“Strongly Agree”), demonstrating that the system allows users to effectively exchange information and perform tasks through its interface. Reliability scored 4.8 (“Strongly Agree”), indicating that the system performs its intended functions correctly under specified conditions over time. Security obtained a weighted mean of 4.3 (“Strongly Agree”), showing that the system maintains strong confidentiality and integrity. Based on these findings, IT experts recommend improving the user interface to make it more user-friendly, consistent, and intuitive.

## 5. Conclusion

*G-Waste*, a smart waste management platform for Bogo City, successfully addresses key challenges in traditional waste collection. Through real-time GPS tracking, predictive scheduling using AI, and instant notifications, the system improves communication and coordination between residents, garbage collectors, and operations managers. User Acceptance Testing (UAT) revealed that collectors and residents find the app generally functional, user-friendly, and reliable for daily waste management tasks. Features such as digital waste

categorization guides and reporting tools enhance proper waste disposal and promote community engagement. However, the system's effectiveness depends on stable internet connectivity, limited geographic coverage, and data availability for AI predictions. Despite these limitations, *G-Waste* demonstrates significant potential to streamline waste collection, reduce missed pickups, optimize routes, and support sustainable urban cleanliness initiatives.

The following recommendations would help increase the overall efficiency of waste management in Bogo City:

***Strengthen both mobile and web application features.*** The resident mobile application and the web app supporting the administrator/collector position should be continually upgraded to enable faster reporting, more convenient navigation, and more precise data monitoring. Enhanced UI/UX will enable people with fewer digital skills to adapt to it.

***Establish a standardized Materials Recovery Facility (MRF).*** The LGU must establish a full-fledged MRF with receiving, segregation, composting, recycling, storage for residual waste, and hazardous waste storage and weighing areas.

***Integrate MRF data into the G-Waste dashboard.*** All MRF logs (quantity of waste, number of recyclables processed, quantity of compost generated) must be coded or automatically synchronized into the web application. This guarantees real-time monitoring, improved planning, and reporting to the LGU.

***Use graphs and visual data tools for better decision-making.*** The graphs required for both the admin web application and official reports include bar, pie, and line charts. Such images will help determine waste production trends, barangay performance, and the use of the system, thereby making the planning and policymaking process more efficient.

***Conduct continuous training and awareness campaigns.*** Collectors and administrators should receive regular training on using the web dashboard. Resident awareness campaigns are also suggested to promote reporting, correct segregation, and the use of the mobile app.

***Prioritize system reliability, maintenance, and security.*** The mobile app, along with the website, should be updated regularly, bugs fixed, back-ups maintained, and security maintained. This makes the system stable, safe, and reliable as the number of users grows.

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**Institutional Review Board Statement**

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**AI Declaration**

The author declares the use of Artificial Intelligence (AI) in writing this paper. In particular, the author used ChatGPT, Microsoft Copilot, and QuillBot in summarizing key points, paraphrasing ideas, searching for relevant literature, and improving the clarity and structure of sentences. The author takes full responsibility in ensuring proper review and editing of content generated using AI.

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