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Improving Junk Sale and Purchase Transactions Using a Spiral Model-Based System

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Abstract

Traditionally, individuals looking to sell junk or recyclable materials often rely on waiting for roaming junk collectors, a process that is inefficient and lacks transparency. Furthermore, the fluctuating prices of junk goods frequently leave sellers uninformed, creating uncertainty in transactions. To address these issues, this research developed a smartphone-accessible system designed to facilitate junk goods transactions. The system was developed using the Spiral Model, ensuring iterative refinement and reliability. Key features of the system include real-time price updates for junk items, enabling customers to stay informed about the latest market values, and a Location-Based Service (LBS) feature that allows customers to share their location with collectors. This feature enhances the efficiency of junk collection by providing real-time location tracking, enabling collectors to locate and reach customers seamlessly. The implementation of this system aims to make junk buying and selling transactions more effective, transparent, and satisfying for customers. The results of this study demonstrate that the developed system significantly streamlines the transaction process, ensuring improved service delivery and customer satisfaction.

Keywords: Spiral, Sale, Purchase, Junks

1. INTRODUCTION

Junk goods are often equated with rubbish, rubbish itself is something that is useless, cannot be used, is not liked or is something that is thrown away that comes from human activities and does not occur by itself [1]. In Indonesia, rubbish is found everywhere, especially in urban areas and has now become a big problem. Rubbish in Indonesia is a very serious problem and is also a social, economic and cultural problem. Almost all cities in Indonesia experience problems in processing waste [2]. Junk goods are usually defined as used goods that have been thrown away or are no longer used, these goods are usually just thrown away, burned or left to pile up [3]. Junk goods are often found both in households and workplaces.

Junk goods that look trivial make them suitable and usually destroyed by throwing away or burning [4]. When viewed from the positive side, used goods can be made into a profitable business, and of course, there are many industries that require recycling [5]. For a businessman who collects or collects junk goods, junk can be used as income and a promising business by buying and selling it, such as used paper, plastic, iron, aluminum, brass, copper or any goods made from these raw materials that are sold [6]. In Hanafi mazhab, it is permissible to buy and sell used or damaged goods or junk goods, but when there is buying and selling of junk goods, even though the value is not subject to a price, because it will be used as a buying and selling community and while it is useful, the price needs to be shown [7]. In buying and selling junk goods, buyers are often referred to as collectors or freelancers, while sellers are members of the public or people who work as freelancers or simply pick up junk and then resell it when there is enough to sell [8]. Currently the price is determined by the supplier at the customer's location, because there are no clear rules for buying and selling scrap so each supplier has a different way of determining the selling price [9].

Having junk dealers around can make it easier for people to sell their junk because they don't need to look for a collector's location and don't have to bother bringing the junk they want to sell themselves [10]. By having junk dealers who want to buy used goods, including plastic, they can reduce the amount of waste that is found in society [11]. Mobile trash collectors will also sort out the trash that can still be sold and then sell it to scrap collectors [12]. The existence of junk collectors who want to buy used goods that are considered rubbish by society is very helpful in the green world movement [13]. Sellers usually just wait for junk dealers to pass by their homes or businesses and some keep the contacts of regular junk dealers. Many junk items often change in price, for example metal, paper and others, this is rarely known by prospective sellers [14]. From the existing problems, a solution is needed, one of which is a scrap buying and selling system that can bridge the gap between the community and scrap collectors. In this research a system was developed that can be accessed using a smartphone to facilitate service in junk goods transactions. The system was developed using one system development method, namely the spiral model.

The spiral model describes processes that occur with many obstacles to create and maintain a system. This is achieved by accurately representing the various stages of the software development process. The spiral model is organized into several functional units as a framework and most of these activities are divided into 3 to 6 work groups [15]. The Spiral Model is a model that focuses on prototyping and risk management which is very flexible compared to the waterfall method. The advantages of the spiral method make it more widely used by developers. [16].

The research results that have been published in the form of a journal by Utomo and Fauzi develop a web-based system for buying and selling waste. There are several features in the system that has been created, including waste collection, information services, point, waste sales, waste sorting, and waste savings. The system focuses more on waste bank management rather than on junk collectors. [17]. Proceedings of research results by Putra S.Z et al developing an application called go-trash to improve the efficiency of waste management in Surabaya city. The system is developed using a prototype model. The android-based system created is only provides information about the nearest waste collection point location, types of waste that can be recycled, and tips for reducing waste. The system developed is more focused on waste management [18]. Scientific articles from research written by Aulia and Kurniawan create an information system to monitor junk goods sale. The web-based system was developed using the Agile model. The research object is CV Sumber Baja which is engaged in buying and selling used or junk goods. The resulting system only focuses on the sale and delivery of goods with 3 users, namely admin, leader and driver. Reports produced by the system include: sales reports, goods arrived reports and goods difference reports [19]. The research results, which have been published in journal form by Galuh Priya Kinanti et al, created a system design for managing incoming and outgoing goods at CV Abdullah Berkah Jaya, which operates in the junk goods business. The resulting system aims to assist owners in monitoring sales and purchase transactions and producing the necessary reports. The system was developed using the Java programming language which is still desktop-based and uses MySQL as a database [20].

Based on the previous research, there is no feature for information on goods prices and collector profiles that can be accessed by the public. A feature that also doesn't exist is a location map that customers can send to collectors to find out the location of the goods that will be picked up by the junk collector. In the system produced in this study, the current price of scrap can be accessed by the public or customers and there is a location sharing feature by customers to facilitate the collection of goods to be sold to scrap collectors. This feature is in the form of Location Based Service (LBS) to determine the location of collectors and customers in real-time so that it makes it easier for collectors to find the location of customers who want to sell junk goods.

2. METHODS

2.1. Research Stages

The research stages start from conducting observations at the research location while conducting interviews, literature studies by studying related books and

journals, then conducting a needs analysis until producing an online scrap buying and selling system.

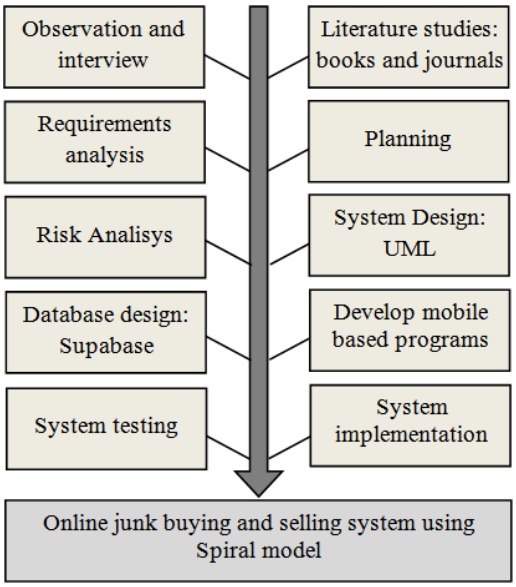

Figure 1. Research stages

2.2. Data Collection Methods

The methods used in this research to gather the required data include observation, interviews, and literature studies. Observation involved direct fieldwork at the research site to examine the existing processes. This included understanding the workflow of mobile junk collectors, analyzing how purchase and sales transactions are conducted, assessing the process of picking up goods when customers visit the site, studying the media used for transactions, and identifying the types of junk items being collected. Interviews were conducted in conjunction with observations to facilitate direct communication with junk collectors, allowing the researchers to gather firsthand information about the challenges and processes involved in junk collection activities. The questions focused on understanding the transaction processes, collection methods, management of goods, and other necessary information. Finally, literature studies were carried out to collect theoretical insights by consulting books, journals, and other academic resources. This approach provided a scientific foundation for analyzing the topics relevant to the research and complemented the field data with established knowledge. Together, these methods ensured a comprehensive understanding of the junk collection system and its challenges.

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2.3. Systems Development Method

The system development model used is a spiral with stages presented in Figure 2.

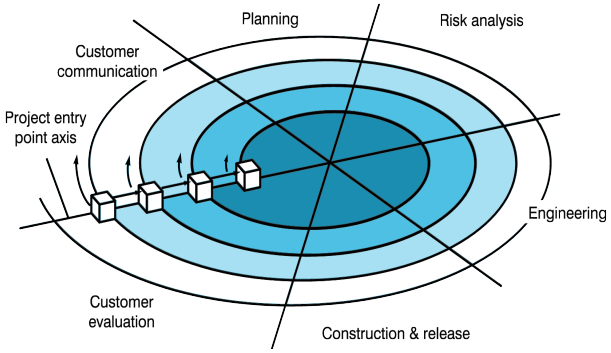

Figure 2. Spiral model stages [21]

According to the stages of the spiral model presented in Figure 2, the planned stages to be carried out in developing this research system are as follows.

1) Customer Communication

Conduct client interviews to collect all relevant data regarding business operational processes and assess emerging problems and system requirements. Data processing and ongoing transactions at junk goods collectors still use semi-manual methods. Processing customer data, goods data and buyer data still uses conventional methods, only the communication process already uses the WA application on smartphones. This still causes several limitations and obstacles, such as managing the price of goods that often change and are not known to the public, data is still recorded using books and cannot produce fast and complete reports, picking up goods process if there are people who want to be picked up on the spot. Based on analysis findings of ongoing system problems, this research offers solutions that can handle these problems, namely: developing a mobile-based system that can help the process of managing customer and buyer data, purchasing and sales transactions, picking up goods process at customer locations using location sharing. The system was developed using a framework and MySQL as a database, while system development method used was a spiral model.

2) Planning

At this stage, determine the things needed to conduct research, including research time location, research tools and research materials. The location in this research is a junk collector in Bulakrejo Village, Sukoharjo Regency. Hardware research tools used in this research includes an ASUS Zenfone Android smartphone, an Acer Aspire laptop, and 4 GB DDR3 RAM. The software used includes Windows 10 Pro, Microsoft Word 2019, framework, MySQL, Rational

Rose, Google Chrome browser, and Android 9.1 Pie operating system. The materials required for research consist of customer data, buyer data, purchase data, sales data and procedures for purchasing and selling junk goods.

3) Risk Analysis
The risk that definitely occurs is the incurring of operational costs for procuring Android mobile according to the specified specifications, namely a minimum of operating system version 10, costs for procuring internet quota. The risk of longer processing time than planned due to several additions or changes to features. Risks related to technical matters such as errors in programming and database design so that the system does not run effectively.

4) Engineering
General requirement for the system is that it can be accessed by consumers, collectors and admins anywhere. Can display location and navigation to the place where goods are collected. Able to produce transparent transactions according to current conditions. Using Unified Modeling Language (UML), create a visual application design at this stage. The object-oriented application improvement framework is described, built, and reported using UML, a language with illustrations and images.

5) Construction and Release
At this stage, software creation implementation is carried out. Creating display designs, building databases and writing program codes with programming languages and devices that have been previously determined.

6) Customer Evaluation
Activities required to obtain input from users or clients in response to engineering stage evaluation of system representation that has been built and system implementation installation during development and release stages. The system that has been developed is then tested using black box method. In this test, the testing process begins by examining the user interface or external display of the program, process performance, input, process, and output produced by the application, and ways in which the application features are used in the user environment.

3. RESULTS AND DISCUSSION

3.1. System Design

To better understand the functionality of the developed system and the roles of the involved actors, a use case diagram has been created, as illustrated in Figure 3. This diagram highlights the interactions between the three primary actors in

the system: the admin, the collector, and the user (community). The admin is tasked with managing the system's master data, which includes user data, junk categories, scrap goods, and service fee information. Additionally, the admin has access to oversee transactions and manage reports to ensure the system operates effectively and maintains accurate records.

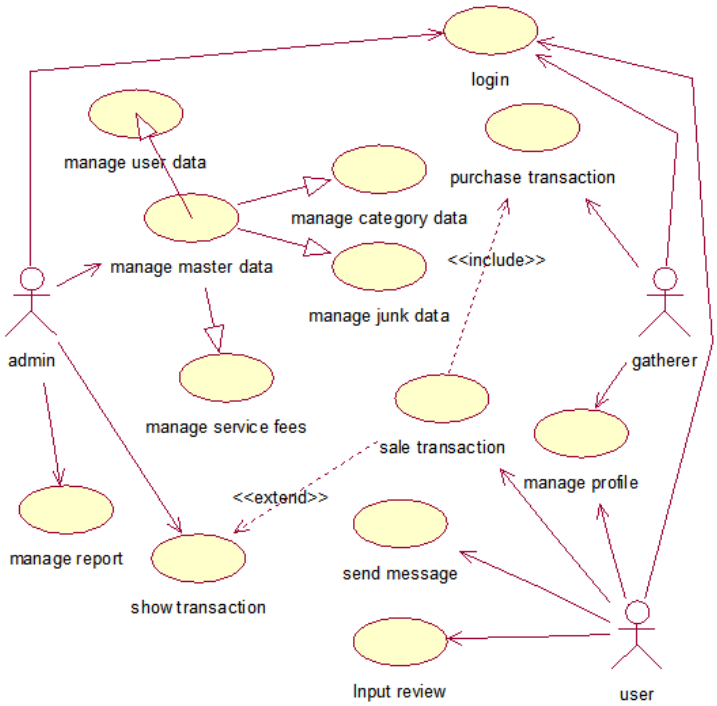

Figure 3. Developed system use case diagram

The user, representing members of the community, engages with the system to access price information, sell their scrap goods, and facilitate transactions. During these transactions, users can communicate with collectors via a messaging feature and are required to provide a review or assessment of the collector's performance after completing the transaction. This feedback mechanism ensures accountability and enhances service quality over time. The collector, on the other hand, primarily facilitates the purchase of scrap goods from users. Collectors handle purchase transactions, which are initiated by users, and coordinate with them to finalize the transaction efficiently.

In addition to the use case diagram, a class diagram (as shown in Figure 4) is provided to detail the structural design of the system. The system comprises eight distinct classes, each representing key components that interact to ensure

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functionality. These include the user class, which stores user profiles and credentials, and the admin class, responsible for managing system-wide operations. The collector class maintains information about collectors and their activities, while the junk goods class manages data on the categories and pricing of scrap items. The transaction class records transaction details, ensuring traceability, while the service fee class tracks applicable charges. To enhance user interaction, the messaging class facilitates communication between users and collectors, and the review class stores user feedback and ratings. Together, the use case and class diagrams provide a comprehensive understanding of the system's functionality. The use case diagram focuses on the interactions between actors and the system, while the class diagram offers an internal structural perspective, ensuring that the system is robust, efficient, and aligned with its intended objectives.

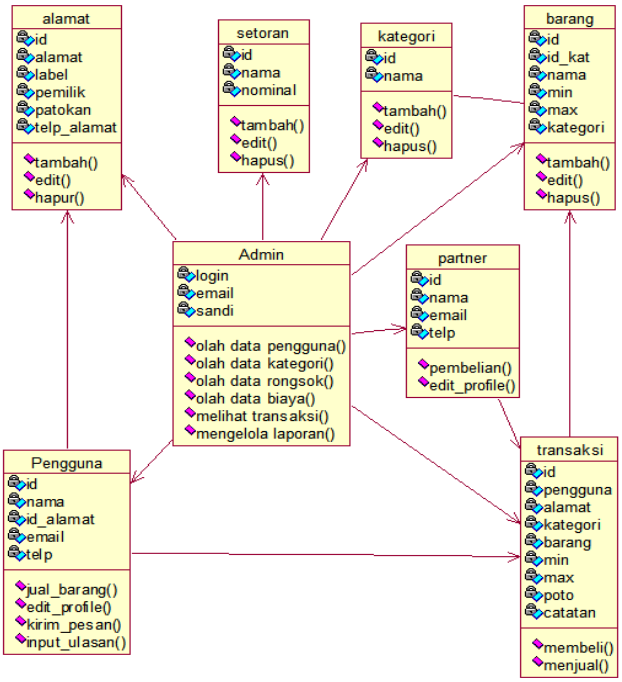

Figure 4. Developed system class diagram

3.2. Junk Sale and Purchase Implementation

The system has been successfully developed and implemented, focusing on enhancing the efficiency of junk collection and transaction processes for users, collectors, and administrators. The results demonstrate the effectiveness of the system's interface, functionality, and features across various user scenarios.

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Below is an expanded explanation of the results based on the system's displays and user interactions.

The initial system display (Figure 6) is designed to offer a user-friendly and straightforward interface. When users first access the application, they are prompted to grant notification and location access. This step ensures that the system can deliver updates and support real-time location-based services for smoother operation. The home screen provides options to either log in or register. New users can navigate to the registration page, where they input personal information, including name, email, phone number, and password. Once registered, users can log in to view their profile page, where they can update their profile photo, address details, and passwords. This feature ensures that users have control over their personal information and can easily update it as needed.

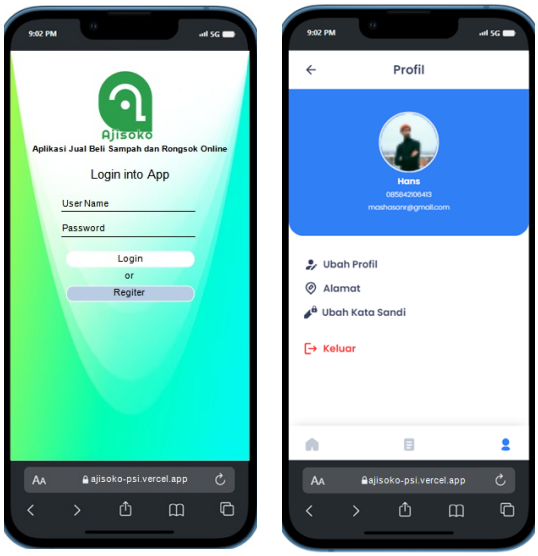

Figure 6. Initial system and profile

For administrators, the system offers an intuitive interface to manage junk goods data (Figure 7). The junk goods management page displays all items currently available in the system, with options to search, add, edit, or delete entries. This comprehensive feature set enables administrators to maintain up-to-date data on available junk items, facilitating better organization and system efficiency. The administrator can also manage other master data, such as user data, cost structures, and item categories, following the same process used for junk goods management. Figure 8 highlights the junk goods addition process, where administrators can input item details, which are then reflected in the main junk goods table for users and collectors to view.

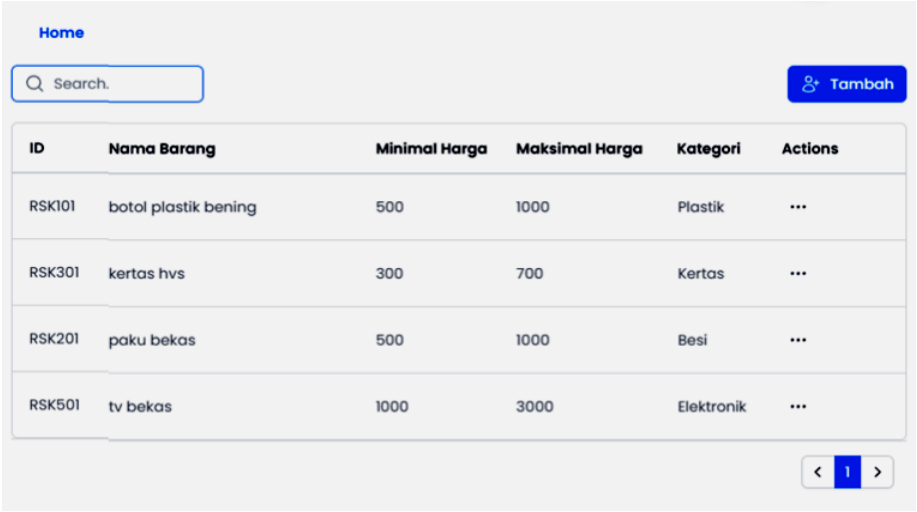

Figure 7. Managing junk goods

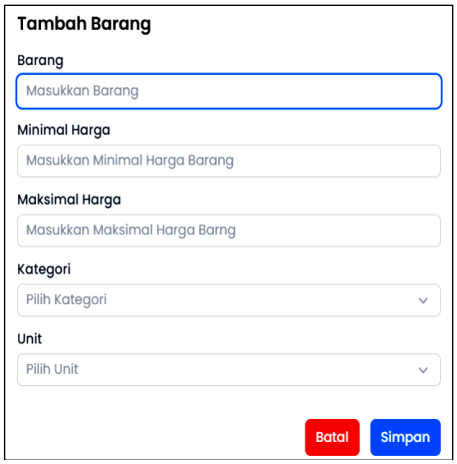

Figure 8. Append junk data

The sales transaction process is a core feature of the system, offering users a streamlined way to sell their junk items. Figure 9 illustrates the sales transaction interface, where users can upload photos of their items, select appropriate categories, and add descriptive notes. If a user's address is not yet updated in their profile, the system triggers a warning, prompting the user to complete their profile information. Once all details are entered, the system calculates and displays the estimated total price, service fees, and expected income for the transaction. Users can review these details and confirm the transaction through the confirmation page (Figure 10). This step ensures transparency and provides users with a clear understanding of their earnings.

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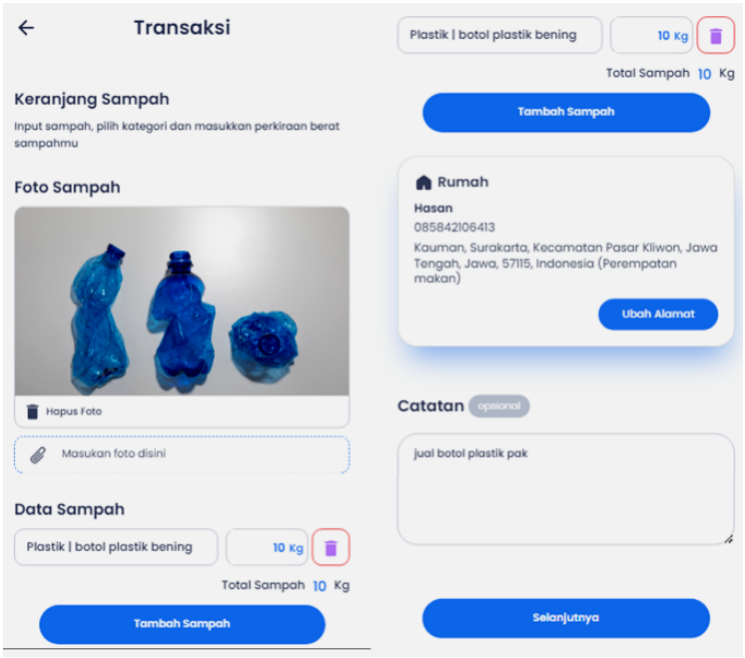

Figure 9. Sales transaction

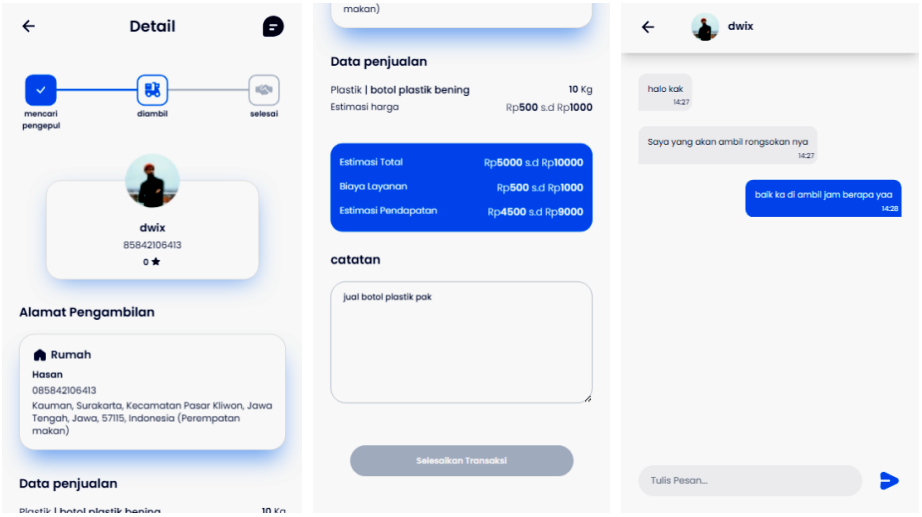

Figure 10. Sales transaction confirmation

Collectors interact with the system through a request page that lists junk items available for purchase within their designated service area. The system ensures efficiency by allowing collectors to view item details, including the seller's address, uploaded photos, item descriptions, and any additional notes. If a

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collector decides to proceed with a purchase, they can click the "Take" button, which initiates the process. The system provides a map-based route display (Figure 11), enabling collectors to navigate to the user's location efficiently. This real-time location-based feature simplifies the collection process and ensures timely transactions.

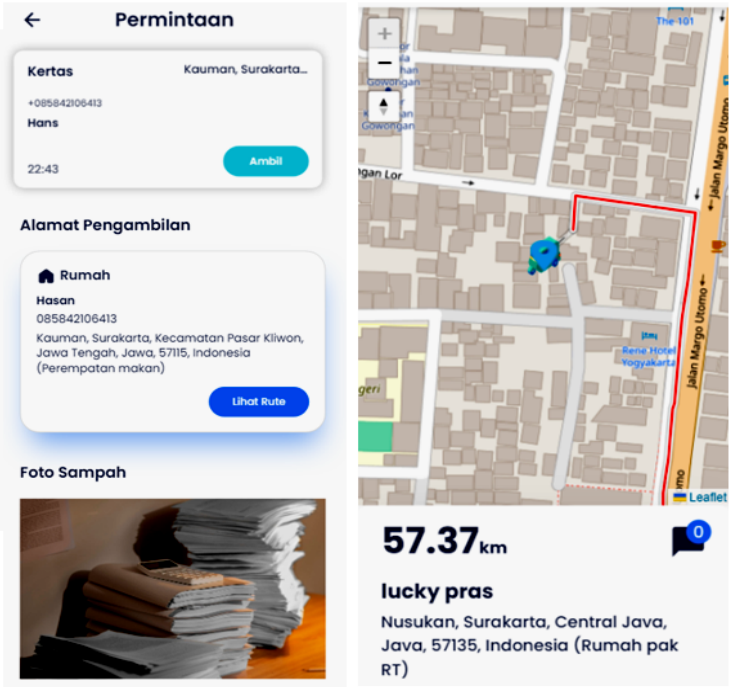

Figure 11. Purchase process display

After completing a transaction, the system facilitates a feedback mechanism to ensure accountability and continuous improvement. Users are prompted to rate the collector's performance and provide a written review, as shown in Figure 12. This feedback helps maintain service quality and allows collectors to improve their interactions with users. On the collector's side, the system requires transaction completion reports, ensuring that all transactions are properly documented and closed. This dual accountability mechanism fosters trust between users and collectors while providing administrators with valuable data for system analysis.

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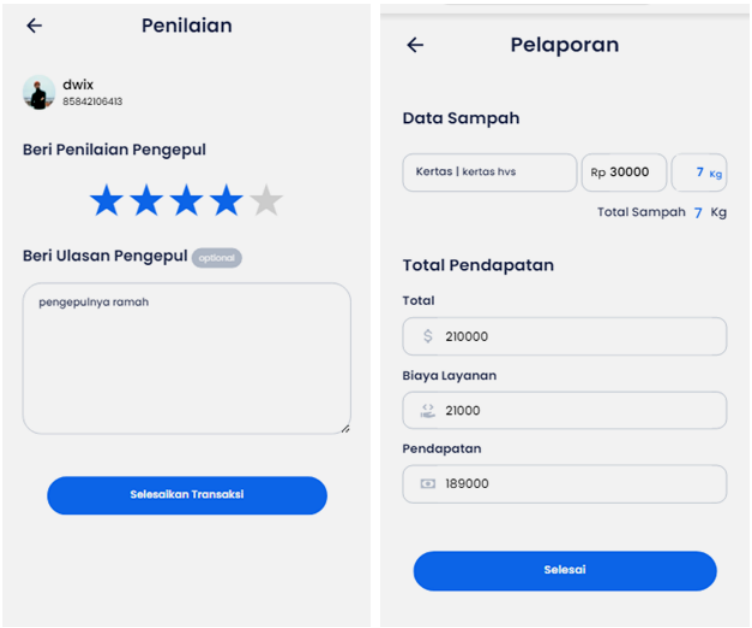

Figure 12. User rating and transaction reporting

3.3. System Testing

The black box method is used for testing the system. Table 1 presents an example of testing for transactions. The results of the system testing, as described in Table 1, demonstrate the functionality and reliability of the developed application across various scenarios. The table outlines three primary testing scenarios, including input validation, transaction submission, and user review completion. In the first scenario, the system effectively identified missing inputs and displayed appropriate alerts, ensuring users provide all necessary information before proceeding. The second scenario confirmed the system's ability to save transaction data to the database and display success messages, reflecting its efficiency in handling transactions. Finally, the third scenario validated the system's capability to record user reviews and ratings, enhancing transparency and accountability. These results, summarized in Table 1, highlight the system's robustness and its potential to improve the junk collection and recycling process.

Table 1. Testing for transactions

Testing Scenarios	Test Case	Expected Results	Result
Input Image, trash data (category, subcategory, weight), notes are	Image:(empty), Category:(empty), Waste sub category:(empty), Waste weight:(empty), Note:(empty)	The system will check and display a toast or alert that the image cannot be	As expected

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Testing Scenarios	Test Case	Expected Results	Result
not filled in and then click next button		empty	
Click the confirm button after adding a transaction	Image:blabla.jpg, Category:plastic, Subcategory: plastic bottles, Waste weight: 2 kg, Address: { Label: Boarding house, Telephone number: 085865412191, Complete address: tawangsari, sukoharjo, Central Java, 57561, Indonesia, Reference: in front of the mosque}, Note: mineral water bottles	System will save to the database and a success message title will appear and the message "thank you, once again you have contributed to the waste recycling chain"	As expected
Click complete button as a user with the input already filled in and correct when assessing the partner.	Star Rate: 5 stars, Review notes: collectors are very friendly and on time	The system will display the message title “success”, and the message “thank you, once again you have contributed to the waste recycling chain”	As expected

3.4. Discussion

The development and implementation of the system demonstrate significant improvements in streamlining the processes of junk collection and transaction management, as reflected in the system design, user interface, and testing outcomes.

The system design, illustrated through the use case diagram in Figure 3, highlights the interactions between the three primary actors: admin, collector, and user (community). Each actor has clearly defined roles that contribute to the system’s functionality. The admin oversees master data, including user and junk data, service fees, and transaction reports, ensuring that the system operates effectively and maintains accurate records. Users interact with the system to sell scrap items, access real-time price information, and provide feedback, while collectors facilitate purchases and ensure efficient coordination with users. The class diagram in Figure 4 complements this by detailing the system’s structural components, ensuring a robust and interconnected framework for data management and operational efficiency.

The junk sale and purchase implementation focuses on enhancing the user and collector experience. The initial system interface (Figure 6) ensures ease of access with options to register, log in, and manage user profiles. This user-centric approach is further supported by intuitive admin functionalities, such as managing junk goods data (Figure 7) and adding new junk items (Figure 8). For users, the sales transaction process (Figure 9) simplifies the selling of junk items by providing tools to upload item details, calculate prices, and confirm transactions. Collectors benefit from a dedicated request page (Figure 11) that includes real-time navigation features, streamlining the junk collection process and ensuring timely service. After each transaction, the system fosters accountability through its feedback mechanism (Figure 12), where users can rate and review collectors, contributing to continuous improvement and service quality.

The results from system testing, summarized in Table 1, confirm the system's functionality and reliability across key scenarios. The system successfully validates user inputs, ensuring that required fields are completed before proceeding, thereby enhancing data integrity. Transactions are efficiently saved to the database, with the system providing users with clear confirmation messages that reinforce their contribution to recycling efforts. Additionally, the feedback mechanism ensures transparency by allowing users to evaluate collectors, which fosters trust and accountability among all stakeholders.

These outcomes highlight the system's potential to address inefficiencies in traditional junk collection methods. The integration of real-time features, user feedback, and robust data management aligns with the goal of creating a transparent and efficient recycling ecosystem. The use of black-box testing further validates the system's reliability and its ability to handle diverse scenarios effectively. The system has successfully enhanced the junk collection and transaction process by prioritizing user needs, improving coordination, and ensuring transparency. These results provide a solid foundation for further scalability and the potential addition of features, such as advanced analytics or predictive route optimization, to further improve system functionality and user satisfaction.

4. CONCLUSION

The developed application integrates multiple functionalities to streamline the junk collection and transaction process. By incorporating mapping features, the system simplifies the process of locating seller locations, enabling collectors to efficiently pick up junk items. The inclusion of an estimated revenue feature assists collectors in projecting potential profits, while a rating and review system allows users to evaluate collectors' performance, fostering accountability and

service improvement. Real-time chat and notification features further enhance communication between users and collectors, ensuring seamless coordination. For administrators, the system provides tools to manage user data and generate detailed sales reports, enabling better oversight and operational efficiency. By offering transparent pricing for different types of junk, the system promotes fairness in transactions and ensures that users and collectors can make informed decisions. Additionally, the integrated mapping feature provides collectors with navigation assistance to streamline the collection process, enhancing overall efficiency.

One significant benefit of the application is its potential to promote sustainable waste management practices, supporting broader environmental initiatives such as the "go green" program. For future system development, enhancements could include integrating a cashless payment system to modernize transactions and introducing a loyalty rewards feature to retain customers by offering annual gifts. These advancements would further improve user satisfaction and encourage long-term engagement, aligning with the goal of fostering a sustainable and efficient junk management ecosystem.

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