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Development of a web-based waste bank information system using the waterfall method

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Abstract: Waste management issues in Indonesia, particularly household waste which contributes 38.2% of the total national waste, demand a more systematic approach through waste banks. However, current waste bank operations are still dominated by manual recording, which is susceptible to human error, data loss, and inefficiency in generating periodic reports for the Environmental Office (DLH). This study aims to develop a Web-Based Waste Bank Information System to optimize customer data management, transaction accuracy, and financial report integration. The research methodology employed is Research and Development (R&D) using the Waterfall development model, which includes stages of requirements analysis, system design, implementation, and testing. The research population involves waste bank administrators and customers as the primary subjects for operational trials. The results are expected to produce a digital platform capable of enhancing customer balance transparency, minimizing data entry errors, and accelerating administrative reporting processes, thereby supporting more efficient urban environmental governance.

Keywords: Waste Bank, Information System, Web Development, Waterfall, R&D.

1. Introduction

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Waste remains a critical national challenge, especially regarding the intensifying complexity of urban ecological problems. The accumulation of household waste represents one of the most prevalent environmental challenges faced by society today. As the population grows, both the volume and diversity of waste types continue to escalate. This issue is primarily driven by a lack of public awareness regarding the benefits of environmental sustainability and its subsequent impact on public health[7].

Waste is an inseparable aspect of human life and its environment. According to data from the 2020 National Waste Management Information System (SIPSN), household waste is the primary source, accounting for 38.2% of the total volume. In terms of composition, food waste is the most significant contributor at 40%, followed by plastic waste, which ranks second at 17% [9] .

However, in reality, at present the management of customer savings is not yet supported by an integrated information system. The reliance on manual bookkeeping is considered sub-optimal for both data management and the transparent communication of balance information to customers. This situation frequently leads to operational issues in transactions and monthly reporting, such as discrepancies in recording waste weight and classifications. Furthermore, poor data storage practices pose a significant risk to the integrity and accuracy of customer records and their accumulated savings[8].

The sustainable development of waste banks necessitates effective and efficient data management. The implementation of an information system serves as a crucial solution to transform manual, paper-based processes that are susceptible to human error and data loss. Functionally, this system facilitates the automation of customer profiling, savings calculations, and waste weight accumulation with high accuracy. To implement this solution, the development of the waste bank application utilizes the Waterfall model. This methodology is highly appropriate for this project as the system requirements are clearly defined and stable, ensuring a systematic, measurable, and well-organized development process [1].

2. Research Methodology

2.1 Research Design

This study employs the Research and Development (R&D) methodology. Conceptually, R&D is a research method designed to produce a specific product and subsequently test its effectiveness. This approach is widely utilized in pure sciences, particularly in natural sciences and engineering, due to its systematic focus on developing measurable solutions[5].

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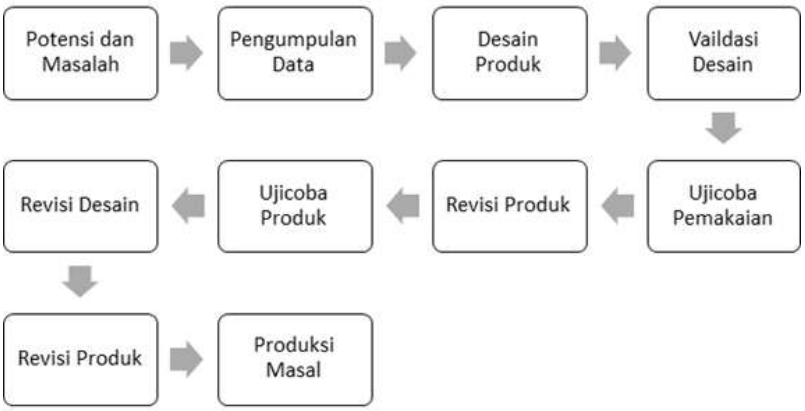

Figure 1. Steps for Using the Method (R&D) According to Borg and Gall.

The research steps used in this research are the material development procedure according to Borg and Gall. The following are 10 steps of the Research and Development (R&D) research procedure according to Borg and Gall. These steps are (1) potential and problems, (2) data collection, (3) product design, (4) design validation, (5) design revision, (6) product trial, (7) product revision, (8) usage trial, (9) product revision, (10) mass production. The steps of the development procedure will be explained in the chart above.

2.2 Population and Sample

Population is defined as the entire set of individuals, objects, or events that constitute the primary subject of investigation in a study [3]. For this research, the target population comprises waste bank administrators and customers who are actively involved in operational activities, specifically concerning data recording and transaction processes.

2.3 Method of Collecting Data

Data collection methods are the ways researchers gather data to obtain the information needed to achieve research objectives. Data collection instruments are the tools used to collect data. Data collection instruments can include checklists, questionnaires, interviews, and even cameras to record images or take photographs [6]. Some of the data collection methods/techniques include: Observations [10] were conducted to directly understand the activities of waste bank managers in carrying out the waste management process, particularly regarding customer data and transaction processes. Interviews, Structured and semi-structured interviews were conducted with waste bank managers who participated in the study. The goal was to obtain in-depth information regarding their needs, expectations, and experiences using the waste bank information system. Questionnaire, A questionnaire was distributed to waste bank managers or potential application users to obtain quantitative data for analysis. The questionnaire contained closed-ended and open-ended questions regarding user preferences, ease of use of the technology, and interest in the web-based waste bank application. Documentation Study, This technique involved collecting

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secondary data from various literature sources, journals, and other documentation relevant to the research topic. Documentation study helped strengthen the theoretical foundation and support the system requirements analysis.

2.4 Data Analysis Methods

The data gathered from field-based needs assessments served as the foundation for articulating the research background and justifying the necessity of the development program. This analysis subsequently informed the determination of the system's technical specifications. The study employed both qualitative and quantitative data analysis techniques. Methodologically, this mixed-methods approach incorporates philosophical assumptions that guide the trajectory of data collection and analysis, integrating both research perspectives across multiple stages of the investigative process.

2.4.1 Qualitative Data Analysis

Based on a comprehensive understanding of the research site, data is systematically mapped and described through the construction of analytical matrices to provide meaningful insight[4]. This process follows three primary flows of descriptive qualitative analysis consist of: (1) data reduction, (2) data display, and (3) conclusion drawing or verification.

Data Reduction, Reducing data means summarizing, selecting the main points, focusing on important points, looking for themes and patterns, and discarding unnecessary data. Data Presentation, Data presentation is intended to identify meaningful patterns and provide the possibility of drawing conclusions and taking action. Drawing Conclusions, Analysis of data collected during and after data collection is used to draw conclusions, thereby describing a pattern of events that occurred during the product trial. Conclusions in qualitative research may be able to answer the problem formulation formulated from the start, but may also not, because as has been stated, the problems and problem formulation in qualitative research are still temporary and will develop after the research is in the field.

2.4.2 Quantitative Data Analysis

Quantitative data was obtained from the scores of respondents who completed the distributed questionnaire. The data was collected from respondents using a Likert scale. This instrument is constructed to assess individual attitudes by requiring respondents to indicate their degree of agreement with a series of statements presented on a graded scale[2].

The questionnaire data refers to a Likert scale with four numerical options: 4, 3, 2, and 1. These numbers were then qualitatively analyzed to determine the validity of the product. The following table shows the criteria for questionnaire responses using a Likert scale.

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3. System Analysis and Design

3.1 System Requirements Analysis

System requirements analysis is carried out to determine what elements are needed in developing a waste bank information system, both in terms of hardware and software.

3.1.1 System Software

The computer hardware required to develop this waste bank information system includes the following:

a. Processor: Intel Core 2 Duo 3.2 GHz.
b. 320 GB hard drive.
c. 14" monitor.
d. Printer.
e. Mouse and keyboard

3.1.2 System Hardware

In addition to hardware, system development requires software specifications to support the system. The software specifications used include:

a. Microsoft Windows 10 operating system.
b. Visual Studio Code.
b. PHP programming language (Laravel framework).
c. XAMPP and MySQL.
d. Browsers: Google Chrome and Mozilla Firefox.

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3.2 System Design

3.2.1 Use Case Diagram

The following is a description of the use case diagram for the waste bank information system admin:

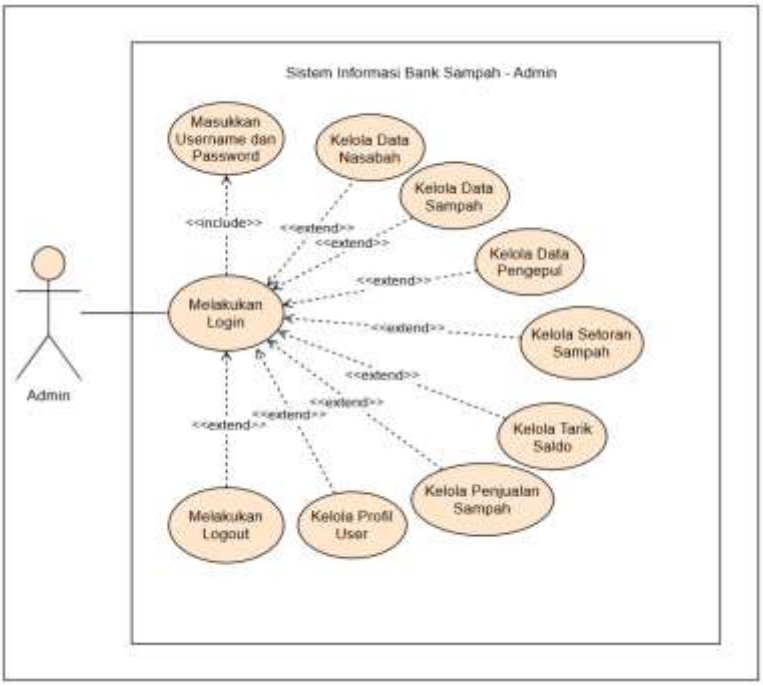

Figure 2. Use Case Diagram of Admin Page

The Admin Page module encompasses comprehensive master data and transaction management for a waste bank system. The admin user role possesses full authority to manage seven critical functional areas: customer data, waste types, collector information, waste deposits, balance withdrawals, waste sales, and user profiles. All administrative operations require prior authentication through system login.

3.2.2 Sequence Diagram

In the Waste Bank system, the sequence diagram explains the interaction between the admin, the sole user of the system, and several system components, such as forms and databases, to carry out four main processes: Customer Registration, The admin inputs customer data through the registration form. This data is sent to the database for storage. This process occurs when a new customer joins the waste bank. Waste Deposit, The admin records the customer's waste deposit by entering the type of waste, weight, and price per kg. The system calculates the subtotal and total deposit, then stores it in the database and adds the balance to the customer's account. Balance Withdrawal, The admin processes the customer's balance withdrawal. The

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system validates whether the balance is sufficient. If it is, the system saves the withdrawal data and reduces the customer's balance by the amount withdrawn. Waste Sales, The admin records the sale of waste to the collector by entering the collector, waste, and weight data. The system calculates the subtotal and total sales proceeds based on the price per kg, then stores them in the database.

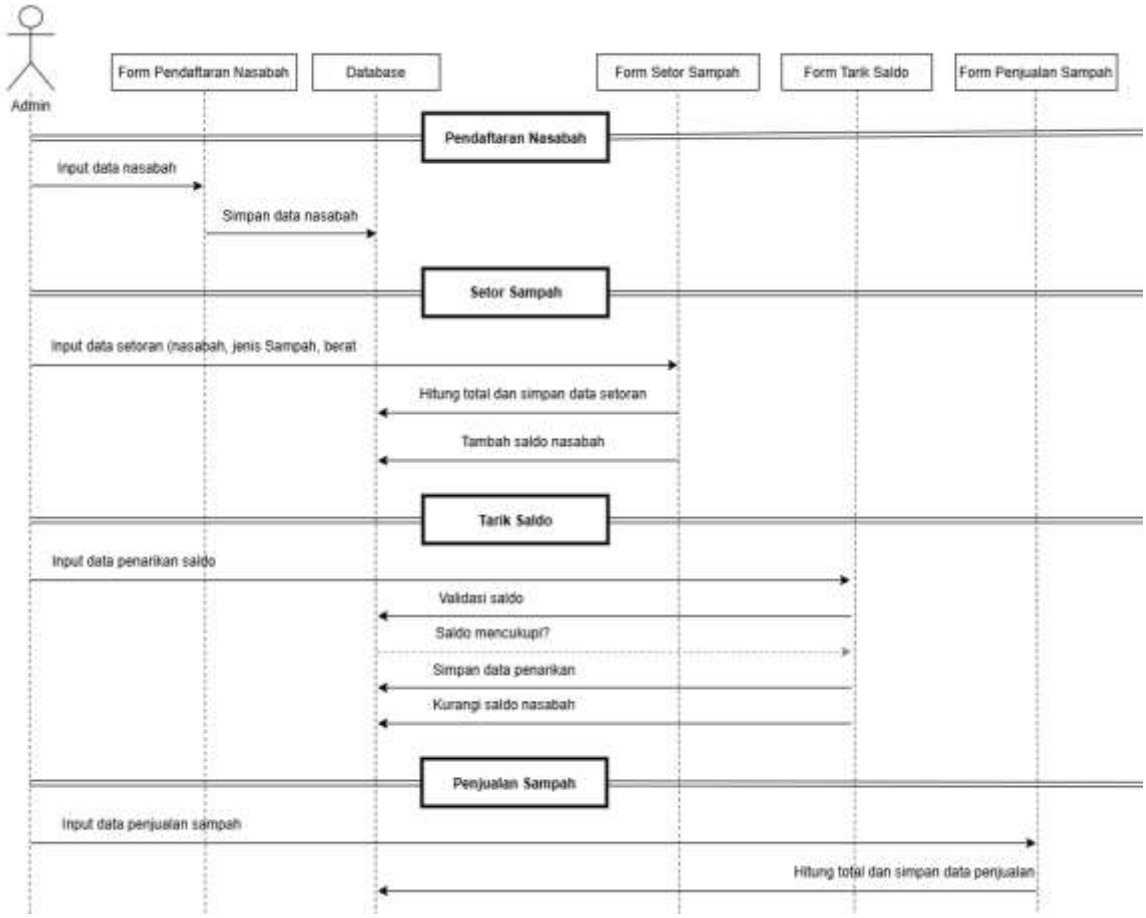

Figure 3. Sequence Diagram

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3.2.3 Class Diagram

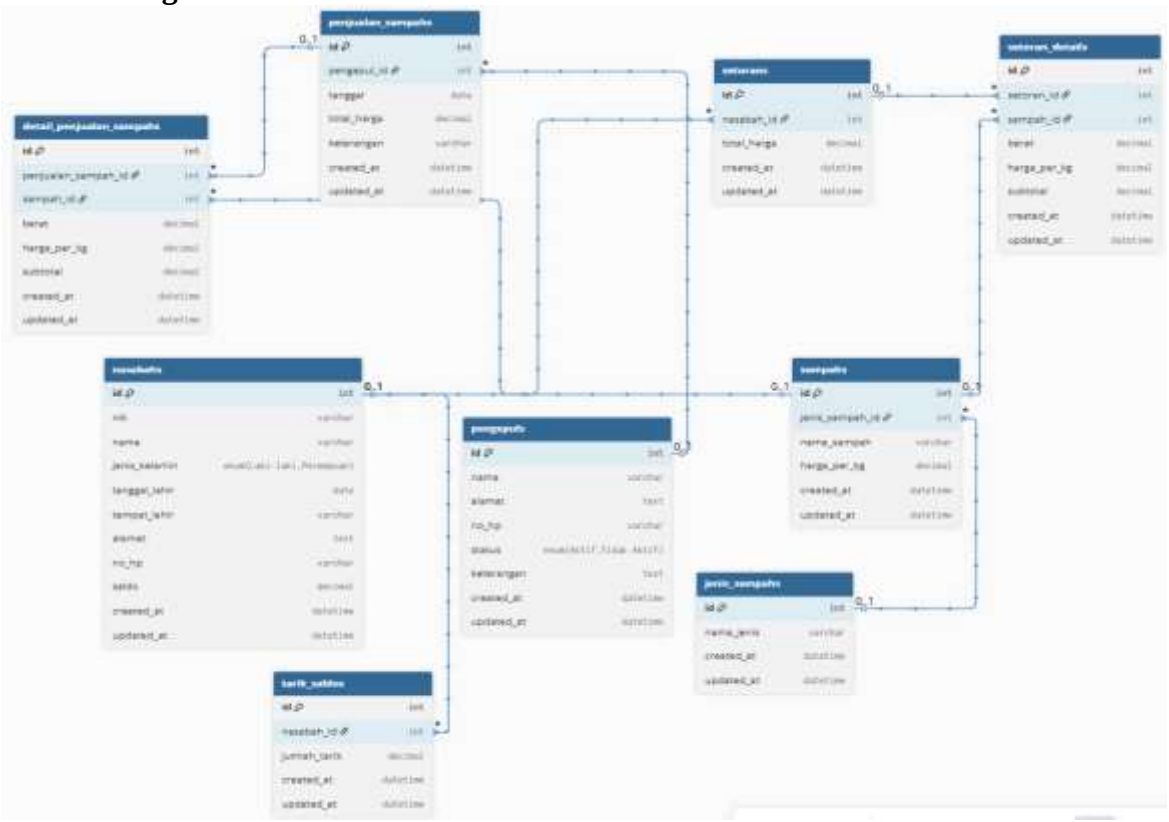

Figure 4. Class Diagram

3.3 User Interface

3.3.1 Login Page

Before entering the main page of the waste bank information system, the admin is asked to log in first using the registered username and password.

Figure 5. Login Page

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3.3.2 Dashboard Page

After successfully logging in, you will be directed to the main page or dashboard which contains information on the number of customers, the number of collectors, the total amount of waste deposited, the total amount of customer savings, the total balance withdrawn, the total amount of waste sold to collectors, and the total proceeds from waste sales.

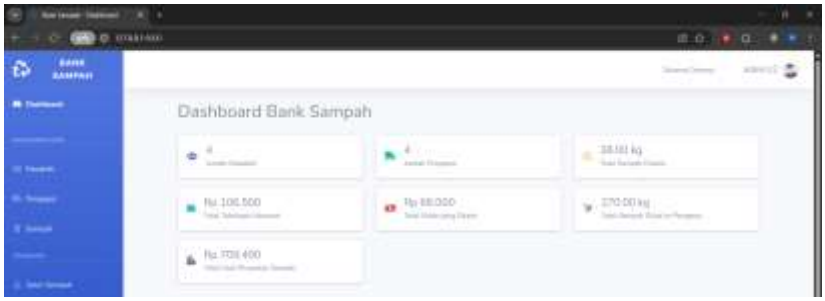

Figure 6. Dashboard Page

3.3.3 Waste Page

The waste page displays data on waste that can be deposited by customers based on the type of waste, and each waste has a price per kg that has been set by the waste bank.

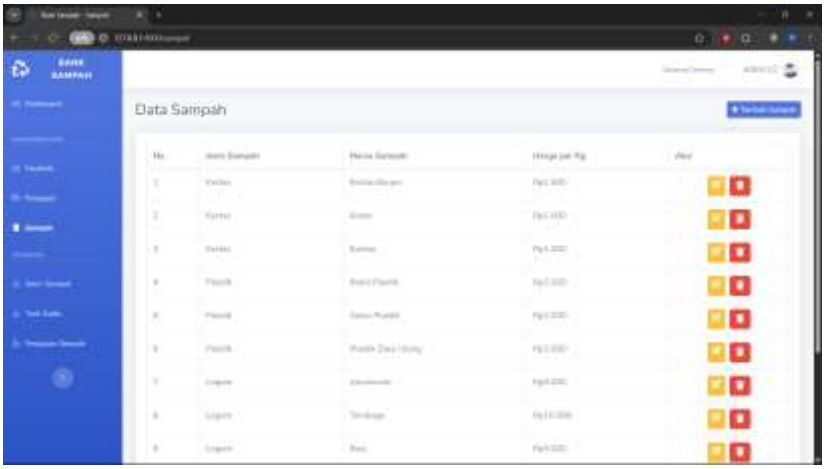

Figure 7. Waste Page

3.3.4 Waste Deposit Page

The waste deposit page displays data on waste deposits made by customers through the waste bank administrator. This page allows you to filter data by customer name or deposit date, and allows you to print reports in PDF format.

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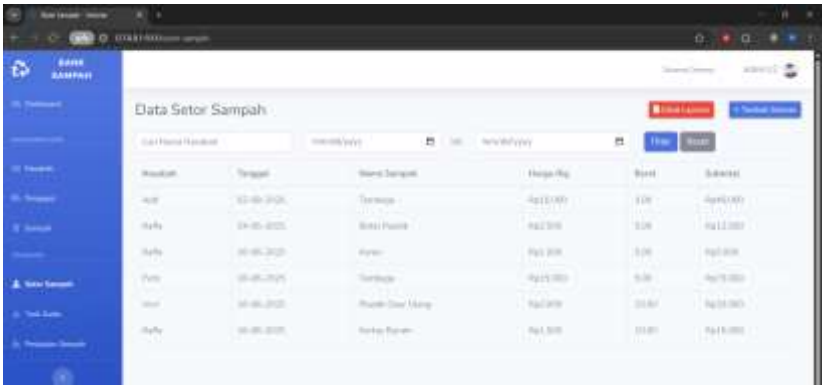

Figure 8. Waste Deposit Page

3.3.5 Withdraw Balance Page

The Withdraw Balance page displays data on withdrawals made by customers through the bank sampah administrator. This page allows you to filter data by customer name or withdrawal date, and allows you to print reports in PDF format.

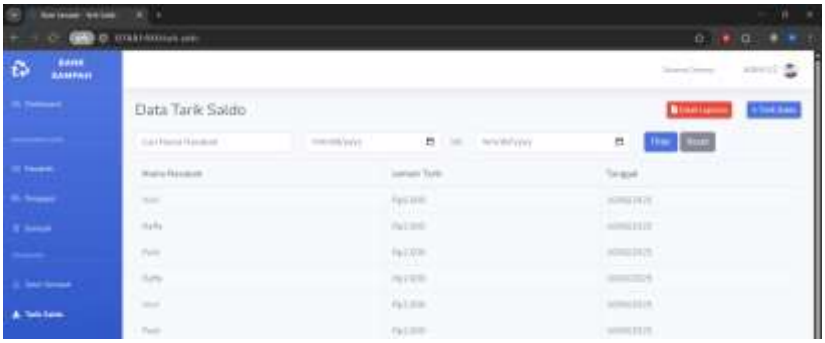

Figure 9. Withdraw Balance Page

3.4 System Testing

3.4.1 Black Box Testing

The waste bank system was tested using the black box testing method, which involves providing input to the system and matching it with the expected output without examining the internal structure of the program code. The following are the system test results:

Table 1. Black Box Testing Results Table

No.	Tested Features	Input/Step	Expected Output	Results	Remarks
1	*Login* admin	*Valid email*	Successfully	Success	Login

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		and *password*	*logged in* and was redirected to the *dashboard page*		validation went well
2	Failed *login*	*Incorrect email* or *password*	An *alert* appears "An error occurred! *Incorrect username* or *password* "	Suskses	System blocks unauthorized access
3	Add customers	Fill out *the add customer* form	New customer data saved	Success	Customer data is stored in the *database*
4	Edit client	Change customer data	Changes to stored data	Success	*Successful customer data* update
5	Remove customers	Click the delete button	An *alert appears* "Are you sure? Deleted data cannot be deleted!"	Success	Customer data is removed from *the database*
6	*Filter* nasabah	*Input* the customer's name and click *the filter*	Customer data is displayed by search	Success	*Filters* work well
7	Add collector	Fill out *the add collector* form	New collector data saved	Success	Collector data is stored to *the database*
8	Edit collector	Change collector data	Changes to stored data	Success	*Collector data* update successful
9	Remove collector	Click the delete button	An *alert appears* "Are you sure? Deleted data	Success	Collector data is deleted from *the database*

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			cannot be deleted!"		
10	*Collector filter*	Select the name of the collector in the *dropdown*	Collector data is displayed according to the selected collector name	Success	*Filter* runs well and appropriately
11	Add garbage	Fill out *the add garbage* form	Waste data is successfully stored	Success	Data stored to *the database*
12	Edit trash	Change junk data	Saved changes	Success	*Waste data update* was successful
13	Delete garbage	Click the delete button	An *alert appears* "Are you sure? Deleted data cannot be deleted!"	Success	Junk data is removed from the *database*
14	Waste deposit	Select the type and name of the garbage, weight (kg)	Data saved, customer balance automatically increases	Success	Accurate balance calculation
15	Withdraw balance	Enter the withdrawal amount, save	The customer's balance decreases according to the withdrawal amount	Success	Balance validation available
16	Incomplete garbage input	Form sector kosong	Validation *error* notification appears	Success	Form validation is going well
17	Add sales to collectors	Select collector	Stored sales data	Success	Relationship data is stored

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		and name of garbage, weight (kg)			correctly
18	View sales list	Go to *the sales* index page	View all waste sales data	Success	Full data displayed
19	*Download* sales report	Select the print report button	Downloaded PDF file containing sales details	Success	Report data is compliant
20	*Sales filter* per collector	Select the name of the collector	The table shows sales data based on that collector	Success	*Filters* work according to *inputs*
21	*Logout*	Click the *Login button*	A validation of "Are you sure you want to Log Out?" appears, the user logs out and is redirected to the *login page*	Success	*The session* was deleted and the token was *reset.*

4. Conclusion

Based on the analysis, design, implementation, and testing of the waste bank information system, the following conclusions can be drawn: This information system successfully provides key features for waste bank operations, namely data management for customers, collectors, and waste, waste deposit transaction data, balance withdrawals, and waste sales to collectors. Testing using black box testing methods showed that all key features and functions of this system functioned well, achieving the expected output, without any critical errors. The waste bank information system used by the waste bank, specifically the system administrator, facilitates waste bank operational processes.

References

[1] Algiffary, A., & Sutabri, T. (2023). Indonesian Journal of Computer Science. Indonesian Journal of Computer Science, 12(2), 284–301. http://ijcs.stmikindonesia.ac.id/ijcs/index.php/ijcs/article/view/3135

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[2] Antoro, B. (2025). Kesalahan Sistematis Penggunaan Skala Likert Dalam Penelitian: Analisis Systematic Literature Review. Jurnal Multidisiplin Sosial Dan Humaniora, 2(2), 63–81. https://jurnal.ananpublisher.com/index.php/jmsh/article/view/163
[3] Candra Susanto, P., Ulfah Arini, D., Yuntina, L., Panatap Soehaditama, J., & Nuraeni, N. (2024). Konsep Penelitian Kuantitatif: Populasi, Sampel, dan Analisis Data (Sebuah Tinjauan Pustaka). Jurnal Ilmu Multidisplin, 3(1), 1–12. https://doi.org/10.38035/jim.v3i1.504
[4] Jailani, S., Risnita,Saksitha, Syahran, M., & Arestya, D. (2024). Teknik Analisis Data Kuantitatif dan Kualitatif dalam Penelitian Ilmiah. Journal Genta Mulia, 15(2), 79–91.
[5] Lulud Oktaviani, & Mutiara Ayu. (2021). Pengembangan Sistem Informasi Sekolah Berbasis Web Dua Bahasa SMA Muhammadiyah Gading Rejo. Jurnal Pengabdian Pada Masyarakat, 6(2), 437–444. http://www.ppm.ejournal.id/index.php/pengabdian/article/view/731
[6] Nafisatur, M. (2024). Metode Pengumpulan Data Penelitian. Metode Pengumpulan Data Penelitian, 3(5), 5423–5443.
[7] Palahudin, P., Awa, A., Asmin, E. A., Alam, S., Faujiah, S. N., Fadilah, S. N., & Agustin, A. (2024). Sistem Manajemen Bank Sampah : Peran Bank Sampah Sebagai Solusi Berkelanjutan Bagi Ekonomi Sirkular. Archive: Jurnal Pengabdian Kepada Masyarakat, 4(1), 146–155. https://doi.org/10.55506/arch.v4i1.145
[8] Sopian, A., & Wiyatno, A. (2021). Perancangan Sistem Informasi Bank Sampah Menggunakan Framework Codeigniter dan Bootsrap dengan Metode Prototype. Jurnal Teknologi Informasi, 6(2), 157–167. https://doi.org/10.52643/jti.v6i2.1138
[9] Utami, K., Rialmi, Z., Nugraheni, R., & Ekonomi, F. (2021). Analisis Perencanaan Aplikasi Bank Sampah Digital Studi Kasus pada Bank Sampah Solusi Hijau. Jurnal Penelitian Manajemen Terapan (PENATARAN), 7(1), 34–49.
[10] Kristiyanto Y, Sugiyono S, Sarah S, Muzaeni A. 2024. Implementasi dan Evaluasi Ujian Berbasis CBT Menggunakan Moodle di Sekolah XYZ: Menggunakan Metode Survei Primer Berbasis Observasi untuk Mengetahui Kendala, Manfaat, dan Solusi Teknologi Informasi. Information System for Educators and Professionals. Vol 9(2): 207-216.