



Development of Waste Fee Management System for Village-Owned Enterprise Using Agile Approach

Fadila Aura Isnaeni ¹, Aditya Dwi Putro Wicaksono ¹ and Lisda ¹

¹ Department of Informatics Engineering, Telkom University, Indonesia

* Korespondensi: adityaw@telkomuniversity.ac.id

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Abstract: In the era of digital development, effective public services are essential, one of which is in West Mejasem Village through the Spirit Mejabar Village-Owned Enterprise (BUMDes). This research focuses on developing a website-based system that makes it easier for BUMDes administrators to manage waste fees and increase transaction transparency. The system development method uses the agile process, which allows development to be done flexibly and iteratively. The phases in this research include problem identification, literature study, planning, design, development, release, and system review. This system was built using the PHP programming language, Laravel framework, and MySQL as a database. System testing was conducted using the black-box testing method, which resulted in a success value of 97.76%, indicating that the features on the system run well. In addition, the questionnaire results given to users showed a satisfaction level of 90.67%, which scored "Very Good" on a Likert scale. The result of this research is a website that facilitates BUMDes administrators in managing waste fees more efficiently, increases transparency in data management, and is a platform that introduces BUMDes and its services to the community. This system can be an effective solution for managing waste fees in West Mejasem Village and can be implemented.

Keywords: Laravel; MySQL; PHP; Village-Owned Enterprise; Waste Fee



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1. Introduction

In the current era of technological advancement, digitalization is transforming various aspects of society. Digitalization of information refers to the conversion of data from analog formats into digital formats and facilitating its production, storage, management, and distribution [1]. Information technology is widely adopted in numerous sectors, including commerce, business enterprises, healthcare, and many more [2]. As a result, access to information has become a priority for institutions to enhance and deliver public services.

According to Article 1 of the Law of the Republic of Indonesia Number 25 of 2009 concerning Public Services, public service is defined as an activity or series of activities aimed at fulfilling service needs by statutory regulations for every citizen and resident regarding goods, services, and/or administrative services provided by public service providers. A service is considered satisfactory when it meets the needs and expectations of the community [3]. Village-level public services are evolving through establishing and

managing Village-Owned Enterprises (BUMDes). By Article 87 paragraph (1) of Law Number 6 of 2014, village governments approved the establishment of BUMDes based on principles of kinship and cooperation, with operations spanning economic activities and public service delivery aimed at improving the welfare of communities [4].

One of the enterprises is BUMDes Spirit Mejabar, established in 2019 and located at Jalan Pala Barat 7 No.19, West Mejasem, Tegal Regency, Central Java. Based on interviews and observations, BUMDes Spirit Mejabar faced several service limitations, particularly in waste collection management. Waste collection management is a critical service as it contributes to maintaining the cleanliness and health of the village environment [5]. However, the current management practices remain manual and are often ineffective.

To address these challenges, A web-based information system will be designed for the Village-Owned Enterprise, allowing users to access the platform anytime and anywhere. A website is a group of linked web pages, typically containing multimedia content, that is hosted on a server and accessed through the Internet [6]. This system will use the Agile methodology to support iterative development and flexible adaptation to changing requirements [7]. Moreover, this methodology promotes dynamic collaboration between the researcher, BUMDes administrator, and system users.

Integrating information technology can improve resource efficiency and transparency in BUMDes West Mejasem operations. To support sustainable waste service management, this study proposes developing a web-based information system titled "Design and Development of a Web-Based Information System for Village-Owned Enterprise (BUMDes) Services in West Mejasem Village, Tegal Using the Agile Method."

Several previous studies have examined the development of digital-based systems for public service and financial management in local communities. Sutrisno et al. developed an Android-based application for managing neighbourhood waste fees using the Rapid Application Development method; however, the platform dependency limited accessibility [5]. Ashari et al. implemented an Agile-based retribution recording system accessible via a website and mobile application, but it lacked institutional integration with BUMDes structures [7]. Juliastuti et al. proposed a web-based e-billing system with good usability, yet it did not address transparency or stakeholder collaboration [8]. Afandi et al. developed a responsive mobile web system for BUMDes Sidokayo, focusing on information access rather than service-specific workflows [9]. Mahendra introduced a dashboard-based website for neighbourhood management, though it was not designed for public service functions [10].

From the comparison above, it is evident that a gap exists between the research conducted in this study and the existing works. Previous studies have not focused on developing an integrated waste service system tailored to BUMDes' operations. Moreover, although some applied Agile or rapid development methods, stakeholder collaboration and iterative user feedback were not emphasized.

Based on these considerations, this research aims to develop a web-based information system specifically for BUMDes Spirit Mejabar, focusing on waste collection service management. The system will be built using Agile methodology to ensure iterative development. This research is expected to make a practical contribution by improving service efficiency, increasing transparency, and supporting the sustainability of BUMDes operations.

2. Materials and Methods

The research used a qualitative method with the subject of Village-Owned Enterprises (BUMDes) Spirit Mejabar, West Mejasem Village, and the people of West Mejasem

Village to provide data and feedback on the system developed. The object used in this research is the BUMDes West Mejasem garbage fee service information system. The study adopts the Agile method, applying its stages to guide system development. As a widely adopted approach, Agile offers a structured yet flexible framework for conducting software development. Like other methods, the Agile method also has advantages and disadvantages, but it is still widely used in developing information system software. The agile method has gained widespread use among developers due to its ability to follow iterative principles, offer flexibility, and support more efficient collaboration [11]. The stages of the research include problem identification, literature study, system planning, system design, system development, system testing, system deployment, and system review. Beneath is an implementation in system development according to the agile model.



Figure 1. Agile Method

1. Planning

At this stage, the goals, objectives, and research schedule will be determined to ensure that the research can run according to the agreement that was agreed upon at the beginning [11]. At the planning stage, this system development is focused on preparing functions and features as well as user and system needs that must be met by the system.

2. Design

The next step is to design a solution to the problems raised. At this stage, system designs, technical details, and system prototyping are carried out [11]. The design stage process includes using case diagrams, activity diagrams, class diagrams, and initial system mockups.

3. Development

The next stage is to develop the system, the main activities of which are writing code and integrating the system [11]. System development uses the PHP programming language, the Laravel framework, and MySQL as a database storage at this stage.

4. Testing

After completing the code development stage, the researcher performs system testing to identify potential failures and implement prompt improvements, ensuring the software meets the desired quality standards [11]. In this stage, black-box testing is used to verify that all system functions operate correctly. Following the black-box testing, the team gathers user feedback and evaluates it using a Likert scale.

5. Deployment

After the system has been tested and approved, the next stage is deployment. This process makes the system or software available and accessible [11].

6. Review

The last stage is to review the entire process and results of the system that has been built. If improvements or additional features are needed to the system, then the steps can continue to the initial stage (iteration) [11].

3. Results

By building the BUMDes Spirit Mejabar website, the developers aimed to optimize waste fee administration, improve information accessibility, and ensure transparency. To enable a flexible and iterative development process, the team implemented the agile method, allowing adjustments based on continuous feedback and testing. In addition, the website was built using PHP programming language and the Laravel framework.

3.1. Iteration 1

This phase focuses on describing the results of the system development process carried out iteratively using the agile method. Furthermore, at the end of the iteration, the researcher will make improvements based on test results and discuss user feedback to build a more optimized and comfortable system.

3.1.1. Planning

The system planning at the first iteration focuses on optimizing waste fee management. Critical functions include generating waste fee bills, verifying payment uploads, and providing digital reports.

3.1.2. Design

After the system planning stage, the next stage is designing the system. In this stage, the system's flow, architecture, interface, and database design are made. At this stage, various diagrams such as use case diagrams, activity diagrams, and class diagrams that apply the Unified Modeling Language as system modelling are made. In addition, a mockup will be built as an initial design of the user interface that will be implemented.

1. Use Case Diagram

A use case diagram is a form of UML that describes the relationship between use cases and actors [12]. Figure 2 (a and b) shows the use cases on the system according to the role of the user who accesses it. In the West Mejasem resident actor diagram (a), the user can check the garbage fee bill, pay the garbage fee, view the payment history, and other information. Meanwhile, in the BUMDes manager administrator diagram (b), the user can manage the garbage fee bill, confirm the payment, and manage the data.

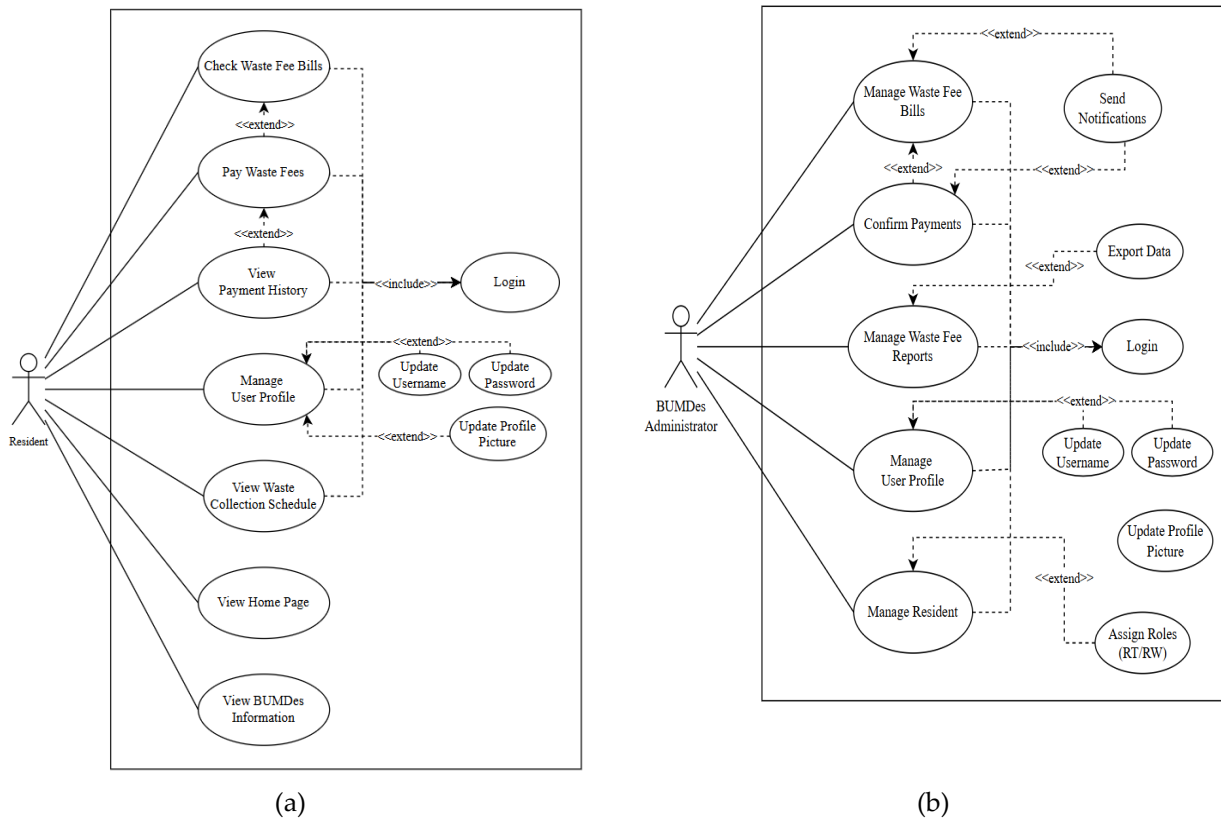
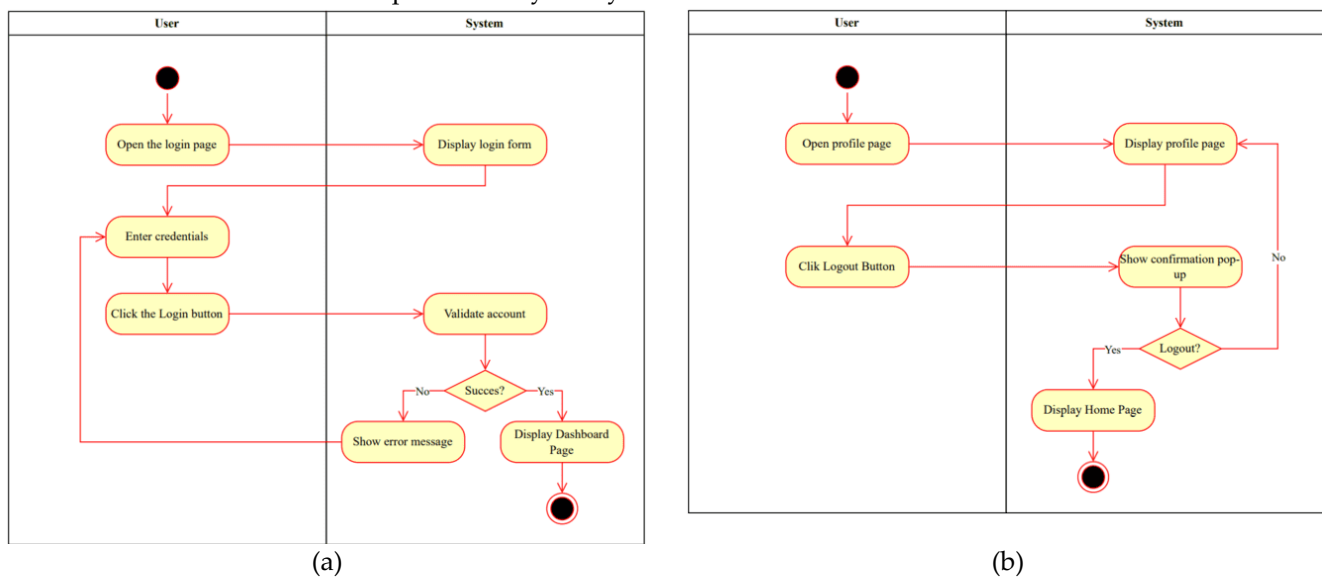
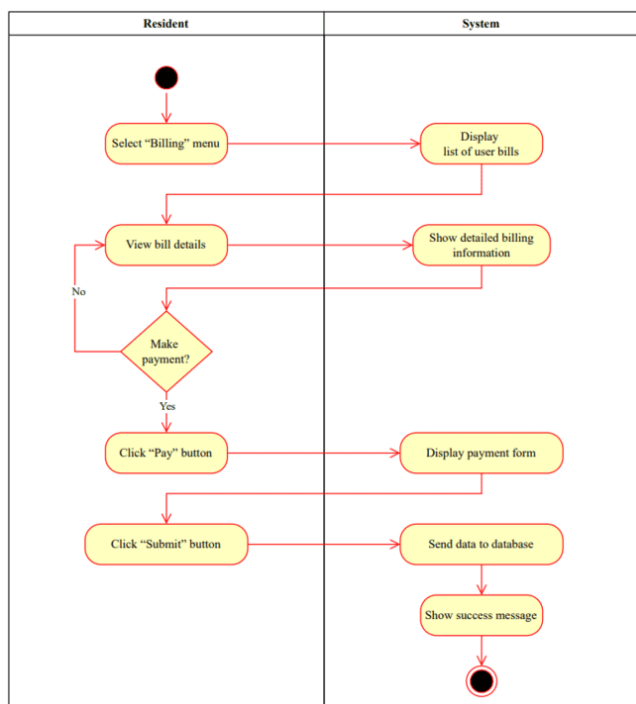


Figure 2. Use Case Diagram (a) Resident, (b) BUMDes Administrator

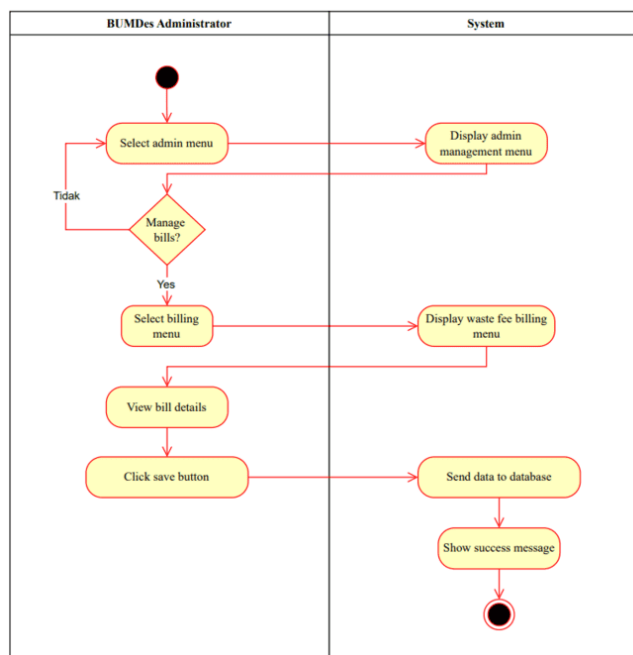
2. Activity Diagram

Activity diagrams explain the details of an operation in a class diagram [13]. Each diagram in Figure 2 illustrates the user's activities and the corresponding changes processed by the system.

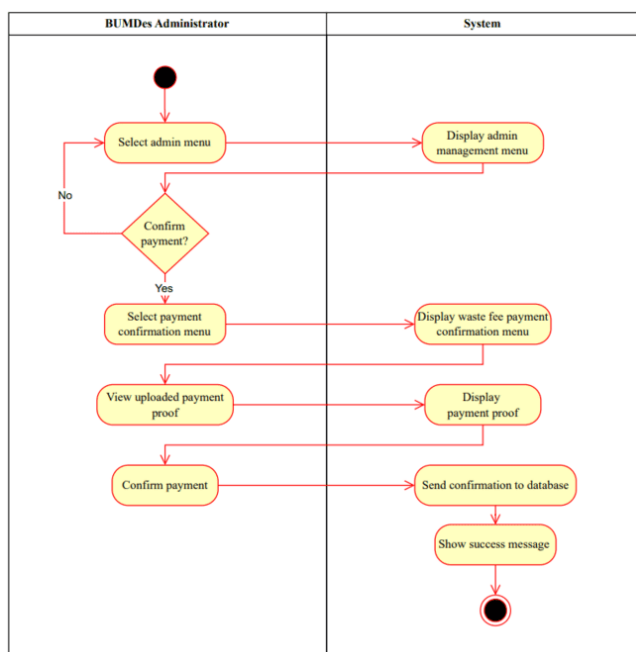




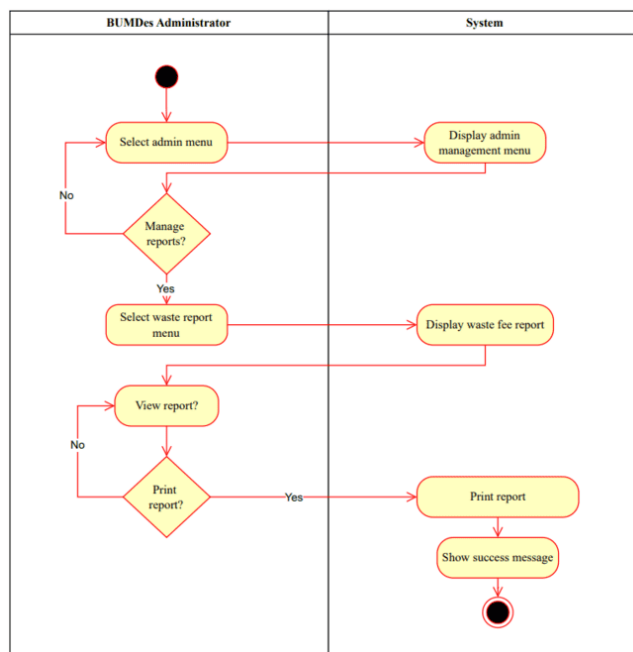
(c)



(d)



(e)



(f)

Figure 3. Activity Diagram (1) Login, (2) Logout, (3) Waste Fee Payment, (4) Bill Management, (5) Bill Confirmation, (6) Report Management

3. Class Diagram

The class diagram represents the system's classes and relationships [13]. In this system, it illustrates entities such as RW, RT, Head of Family, Bill, Payment, and BUM-Des Administrator.

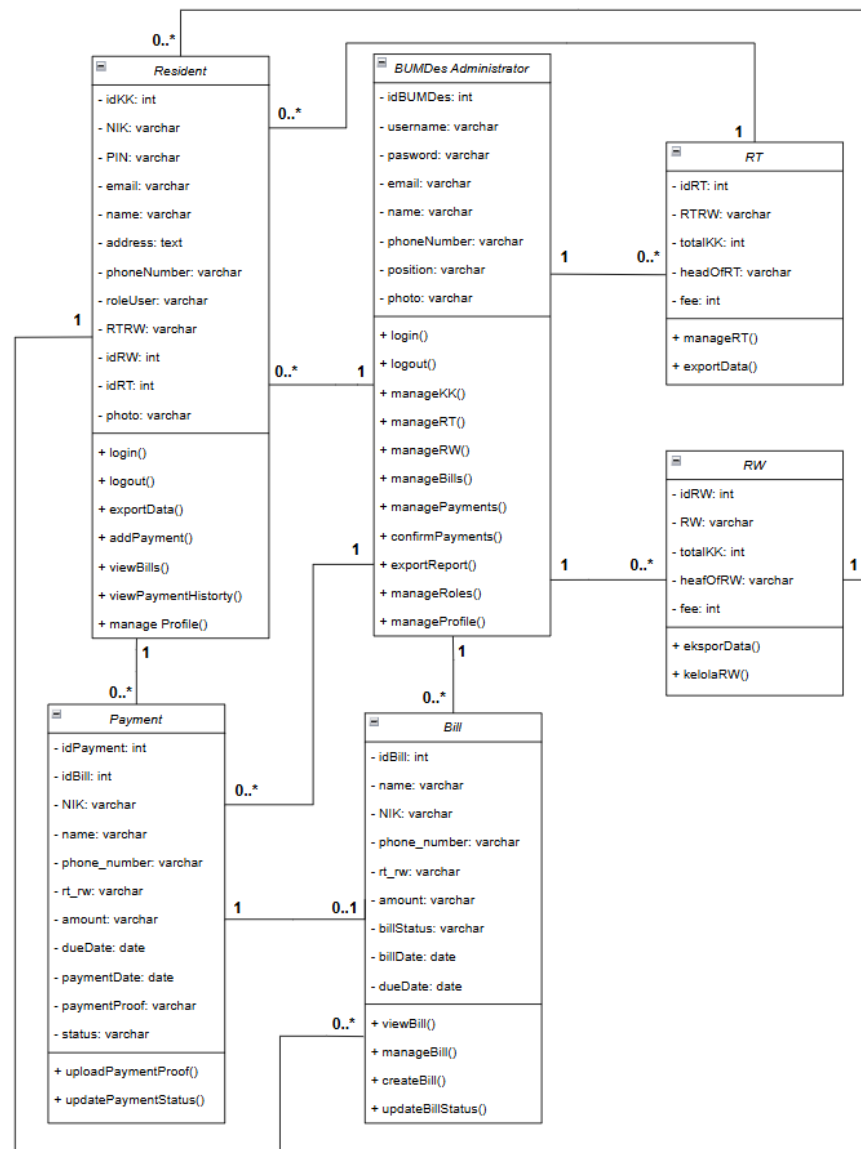


Figure 4. Class Diagram BUMDes Spirit Mejabar System

4. Mockup

The BUMDes Spirit Mejabar website was designed to manage waste payments, citizen data, and BUMDes service information through a well-planned interface.

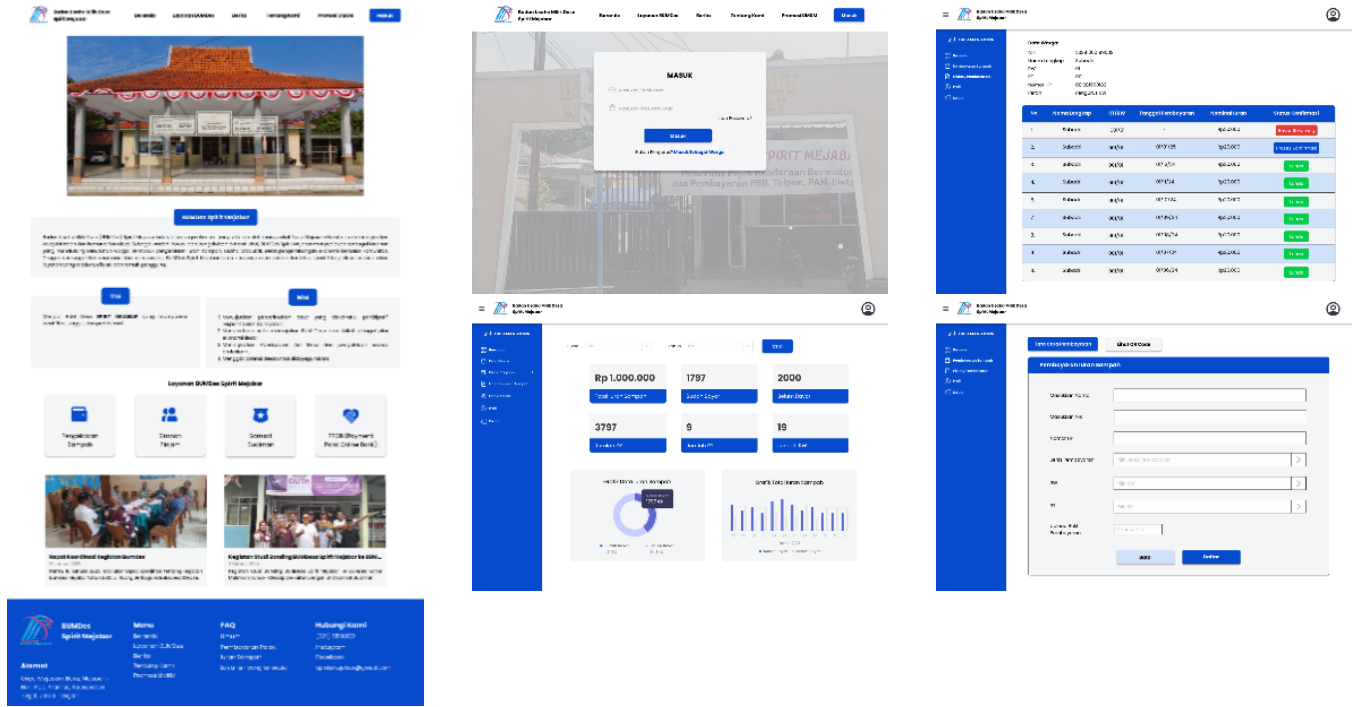


Figure 5. Mockup BUMDes Spirit Mejabar System

3.1.3. Development

The Spirit Mejabar Village-Owned Enterprise information system was developed using the Model-View-Controller (MVC) architecture, in line with the Laravel framework, to separate logic from the user interface.

1. Home Page

The home page provides general information about BUMDes Spirit Mejabar, including its vision, mission, and available services.

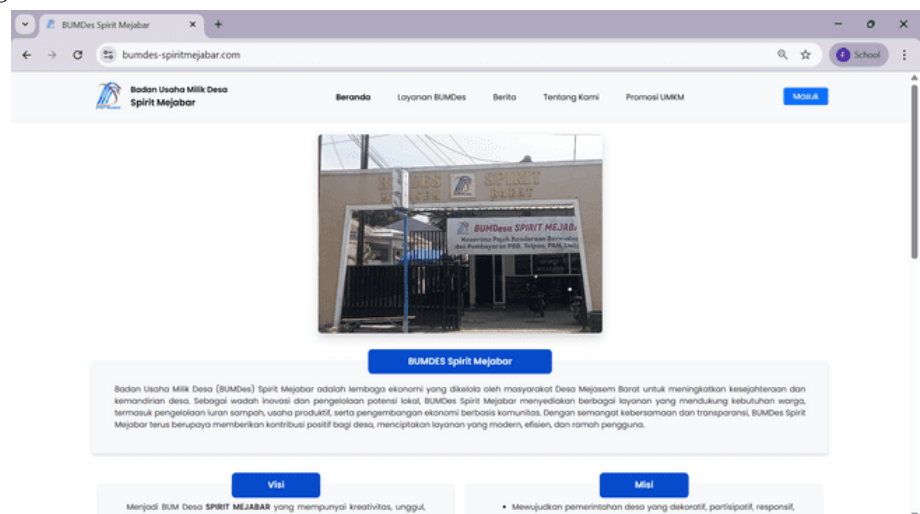


Figure 6. Home Page

2. Login Page

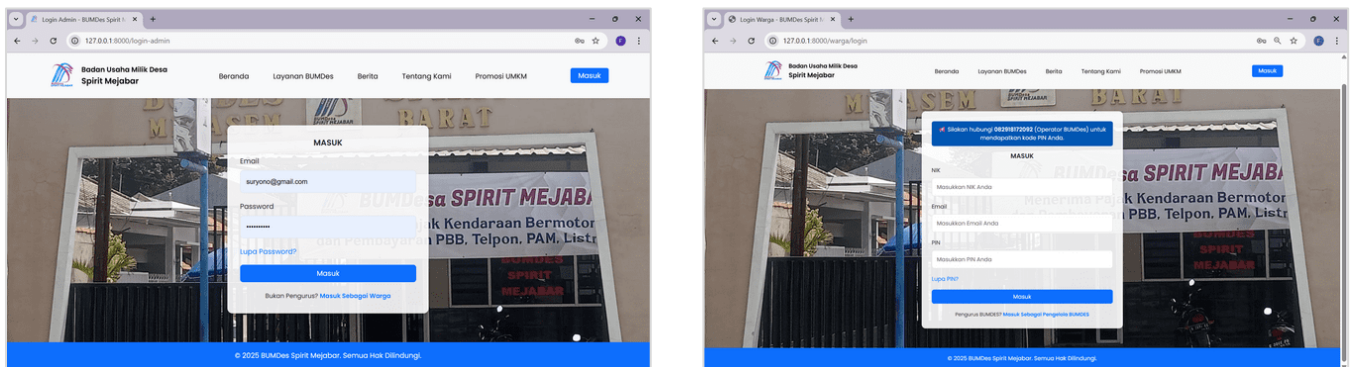


Figure 7. Login Page (a) BUMDES Administrator, (b) Resident

3. Billing Management Page

No	Nama	NIK	Nomor HP	RT/RW	Jumlah	Tanggal Jatuh Tempo	Status	Aksi
1	Budi Santoso	3328154907030002	088233297715	001/04	20000	2025-04-03	Belum Dibayar	Kirim WhatsApp, Ubah, Hapus
2	Fadila Aura Isaeni	3328154907030002	088233297716	001/01	200000	2025-04-05	Lunas	Kirim WhatsApp, Ubah, Hapus
3	Budi Santoso	33102849210240003	0881729201811	001/02	20000	2025-04-06	Lunas	Kirim WhatsApp, Ubah, Hapus
4	Anisa Imut	32100123456789011	088233297716	001/04	20000	2025-04-06	Lunas	Kirim WhatsApp, Ubah, Hapus
5	Stephanie	3328154907032222	088233297716	001/02	20000	2025-04-	Lunas	Kirim WhatsApp

Figure 8. Billing Management Page

4. Payment Confirmation Page

This page shows uploaded payment data from residents.

No	Nama	NIK	Jumlah	Tanggal Jatuh Tempo	Bukti Pembayaran	Status	Aksi
1	Tina Agustin	3328154907031119	Rp 20.000	20-03-2026	Uihat Bukti	Menunggu Konfirmasi	Konfirmasi, Tolak
2	Tina Agustin	3328154907031119	Rp 20.000	20-04-2026	Uihat Bukti	Menunggu Konfirmasi	Konfirmasi, Tolak

Figure 9. Payment Confirmation Page

5. Report Management Page

HALAMAN ADMIN

- Beranda
- Data Master
- Kelola Tagihan
- Laporan Iuran Sampah
- Kelola Peran
- Profil
- Keluar

Tanggal Awal: dd/mm/yyyy s/d Tanggal Akhir: dd/mm/yyyy

Pilih Data: Pilih Data

RW: Pilih RW

RT: Pilih RT

Cetak Laporan

Figure 10. Report Management Page

6. Waste Fee Payment Page

HALAMAN WARGA

- Beranda
- Retribusi Sampah
- Riwayat Pembayaran
- Profil
- Keluar

Pembayaran Iuran Sampah

ID Tagihan

Nama Lengkap

RT/RW

NIK

Tanggal Jatuh Tempo: dd/mm/yyyy

Jumlah Pembayaran (Rp)

Upload Bukti Pembayaran

Choose File No file chosen

Batal Kirim Pembayaran

Figure 11. Waste Fee Payment Page

7. Payment History Page

HALAMAN WARGA

- Beranda
- Retribusi Sampah
- Riwayat Pembayaran
- Profil
- Keluar

Data Warga:

NIK : 3328154907031119

Nama Lengkap : Tina Agustin

RT/RW : 001/01

Nomor HP : 088233297716

Peran : Pengurus RW

No.	NIK	Tanggal Jatuh Tempo	Jumlah	Status
1	3328154907031119	20-05-2026	Rp20.000	Bayar Sekarang
2	3328154907031119	20-04-2026	Rp20.000	Menunggu Konfirmasi
3	3328154907031119	20-03-2026	Rp20.000	Menunggu Konfirmasi
4	3328154907031119	20-02-2026	Rp20.000	Lunas
5	3328154907031119	20-01-2026	Rp20.000	Lunas
6	3328154907031119	20-12-2025	Rp20.000	Lunas
7	3328154907031119	20-11-2025	Rp20.000	Lunas
8	3328154907031119	20-10-2025	Rp20.000	Lunas

Figure 12. Payment History Page

3.1.4. Testing

The BUMDes Spirit Mejabar system was tested using the black-box testing method. To strengthen the system, testing was expanded by defining specific testing parameters. The parameters include both normal scenarios (valid input) and error-handling scenarios (invalid input, empty fields, or incorrect data format). This ensures that the system provides appropriate responses not only in successful cases but also when users perform incorrect actions. Table 1 presents the test scenarios and the outcomes for each page in the system.

Table 1. Testing (Iteration 1)

Page	Testing Scenario	Expected Result	Result
Home Page	User opens the Home page	The Home page is successfully opened	Success
Home Page	User navigates to another menu from the Home page	The other menu is successfully opened	Success
Login Page	User logs in with valid credentials	User is successfully logged in	Success
Login Page	User logs in with invalid credentials or leaves it blank	The system displays an error message	Success
Billing Management Page	BUMDes administrator creates a bill	Data is successfully stored in the database	Success
Billing Management Page	BUMDes administrator leaves mandatory field empty	System shows error message and bill not saved	Success
Billing Management Page	BUMDes administrator enters letters in numeric field (phone number)	System rejects input and shows correction message	Success
Payment Confirmation Page	BUMDes administrator confirms a payment	Bill status updates to "Paid"	Success
Payment Confirmation Page	BUMDes administrator confirms payment with missing data	System displays error and does not update status	Success
Report Page	BUMDes administrator prints a report	The report is successfully exported with the selected format requirements	Success
Report Page	BUMDes administrator tries to export without selecting data	System displays warning and report not generated	Success
Payment Page	Resident fills payment form	Data is sent and status set to "Awaiting Confirmation".	Success
Payment Page	Resident submits payment form with empty required fields	System displays error message, form not submitted	Success
Payment Page	Resident uploads invalid proof of payment (e.g., wrong file type/size)	System rejects file and shows error message	Success
Payment History Page	Resident accesses payment history	List of bills and statuses is displayed.	Success
Payment History Page	Resident tries to access history without logging in	System redirects to login page	Success

The testing results from the first iteration indicate that all system features and functions were successfully developed and operated. Overall, the first iteration ensured that the system was ready for release.

3.1.5. Deployment

After launching the BUMDes Spirit Mejabar website, users could access it via <https://bumdes-spiritmejabar.com>.

3.1.6. Review

In the system review phase, the development team evaluated feedback from BUMDes administrators and residents regarding the implemented and tested system. Table 2 presents the feedback collected during the first iteration of system development.

Table 2. Feedback (Iteration 1)

Name	Role	Feedback
Edi Winarno	BUMDes Administrator	Add filter on bill status (paid/unpaid) on the bill page.
Suryono	BUMDes Administrator	Remove background photo at login page and make auto-pay oldest unpaid bills for residents.
Endang Kusumowati	Resident	Use NIK instead of bill numbers for easier bill payments.

This system review phase is the final step in the current development cycle. However, some user feedback and suggestions gathered during this stage would be valuable input for future improvements in the next iteration.

3.2. Iteration 2

In the second iteration's design phase, several existing features were refined with minor revisions. Due to the specific changes, developers skipped the planning and release stages. The process began with system design and continued with direct development on the release server, followed by testing and review.

3.2.1. Design

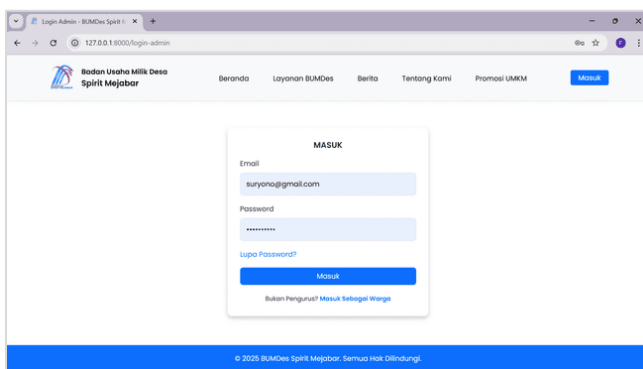
Several existing features were refined with minor revisions in the second iteration's design phase. Since the changes were insignificant, the system's main architecture and workflow remained unchanged.

3.2.2. Development

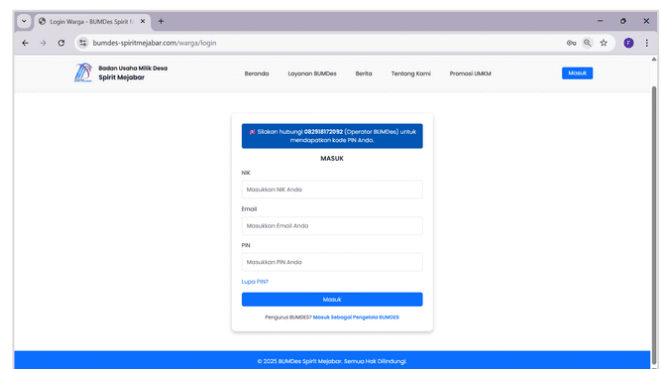
The second iteration focused on implementing feature improvements. Since most changes were minor, backend and frontend code modifications were carried out simultaneously on both local host and the production server to shorten development time.

1. Login Page Adjustment

The background image was removed to simplify the interface, allowing users to focus on the login process.



(a)

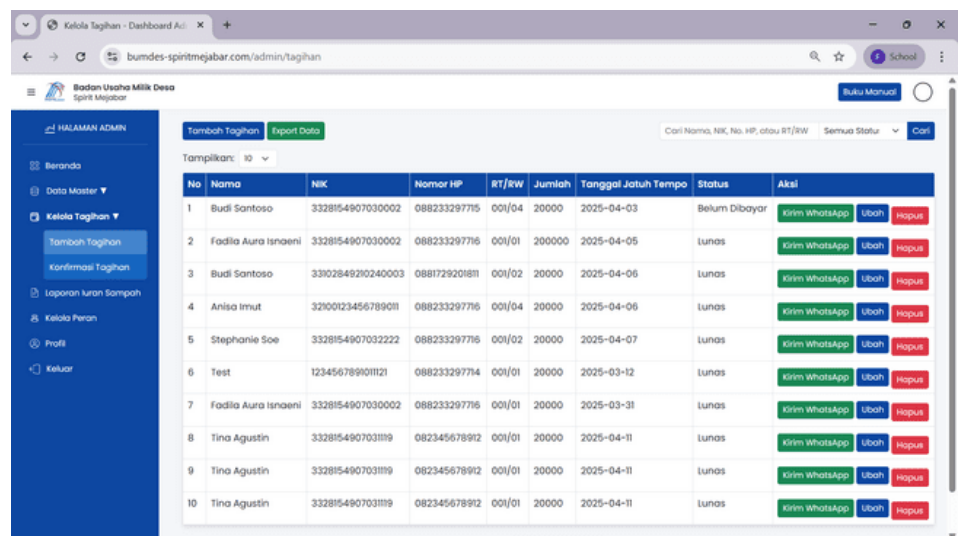


(b)

Figure 13. Login Page (1) BUMDES Administrator, (2) Resident (Iteration 2)

2. Filter Feature at Billing Management Page

A filter was added to the page, enabling administrators to display bills by status—either “Unpaid” or “Paid.”



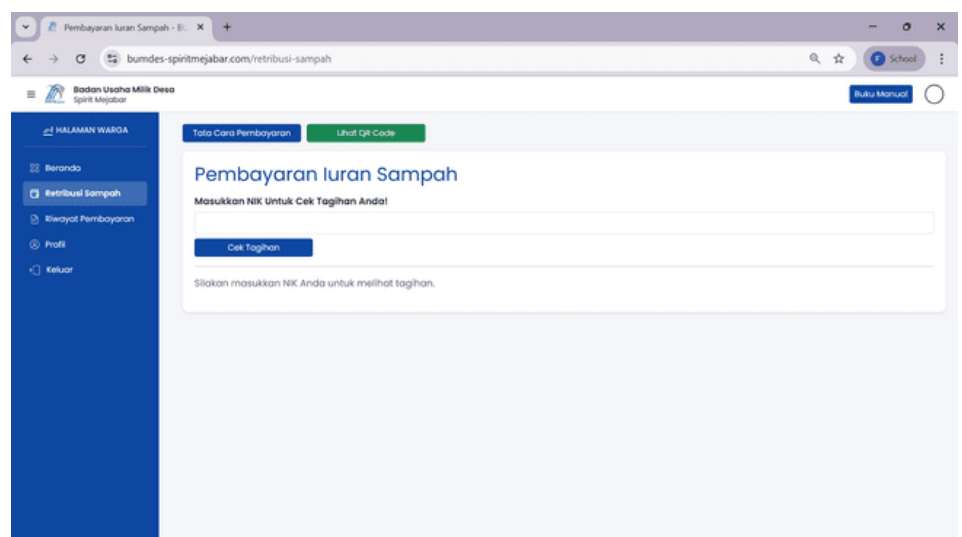
The screenshot shows the 'Kelola Tagihan' (Manage Bills) page. The sidebar menu includes: Beranda, Data Master, Kelola Tagihan (active), Konfirmasi Tagihan, Laporan Luran Sampah, Kelola Peran, and Keluar. The main content area has a search bar and a table of bills.

No	Nama	NIK	Nomor HP	RT/RW	Jumlah	Tanggal Jatuh Tempo	Status	Aksi
1	Budi Santoso	3328154907030002	088233297715	001/04	20000	2025-04-03	Belum Dibayar	Kirim WhatsApp Ubah Hapus
2	Fadila Aura Isnani	3328154907030002	088233297716	001/01	20000	2025-04-05	Lunas	Kirim WhatsApp Ubah Hapus
3	Budi Santoso	330284920240003	088172920181	001/02	20000	2025-04-06	Lunas	Kirim WhatsApp Ubah Hapus
4	Anisa Imut	3200123456789011	088233297716	001/04	20000	2025-04-06	Lunas	Kirim WhatsApp Ubah Hapus
5	Stephanie Soe	3328154907032222	088233297716	001/02	20000	2025-04-07	Lunas	Kirim WhatsApp Ubah Hapus
6	Test	123456789011121	088233297714	001/01	20000	2025-03-12	Lunas	Kirim WhatsApp Ubah Hapus
7	Fadila Aura Isnani	3328154907030002	088233297716	001/01	20000	2025-03-31	Lunas	Kirim WhatsApp Ubah Hapus
8	Tina Agustin	3328154907031119	082345678912	001/01	20000	2025-04-11	Lunas	Kirim WhatsApp Ubah Hapus
9	Tina Agustin	3328154907031119	082345678912	001/01	20000	2025-04-11	Lunas	Kirim WhatsApp Ubah Hapus
10	Tina Agustin	3328154907031119	082345678912	001/01	20000	2025-04-11	Lunas	Kirim WhatsApp Ubah Hapus

Figure 14. Billing Management Page (Iteration 2)

3. Waste Fee Payment Update

The payment process was modified to prioritize the oldest unpaid bill using a FIFO (First In, First Out) approach. Besides, the system now uses NIK instead of Bill ID to identify payments, allowing residents to find relevant bills more easily.



The screenshot shows the 'Pembayaran Luran Sampah' (Waste Fee Payment) page. The sidebar menu includes: Beranda, Retribusi Sampah (active), Riwayat Pembayaran, Profil, and Keluar. The main content area has a search bar and a form to check bills.

Pembayaran Luran Sampah

Masukkan NIK Untuk Cek Tagihan Anda!

Silakan masukkan NIK Anda untuk melihat tagihan.

Figure 15. Waste Fee Payment (Iteration 2)

3.2.3. Testing

The BUMDes Spirit Mejabar system was tested using the black-box testing method. To enhance system reliability, testing covered both normal cases (valid input) and error-handling cases (invalid, empty, or incorrect data), ensuring the system responds appropriately in all situations. Table 1 presents the test scenarios and the outcomes for each page in the system.

Table 3. Testing (Iteration 2)

Page	Testing Scenario	Expected Result	Result
Login Page	User access login page	Login page can be accessed with new display	Success
Billing Management Page	BUMDes administrators filters bills by payment status	System displays bills based on selected status	Success
Billing Management Page	BUMDes administrators leaves filter field empty and submits	System displays default list	Success
Payment Page	Resident pays using NIK	System auto-pays oldest unpaid bill, proof is submitted, and status updates	Success
Payment Page	Resident enters invalid NIK	System shows a message: "Bill not found for this NIK"	Success
Payment Page	Resident leaves NIK field empty	System displays validation error	Success

According to the test scenario, all new and main features developed successfully ran well. With the results of this test, the system is ready to enter the system review stage.

3.2.4. Review

At the second iteration review, users expressed satisfaction with the system. No further suggestions or revisions were submitted, implying that the previous improvements had successfully addressed previous issues. As a result, the development process for the BUMDes Spirit Mejabar web-based service system is considered complete, with no immediate need for further iterations unless new conditions arise in the future.

4. Discussion

Table 4. Black-box Testing Recap (Iteration 2)

Role	Respondent	Testing Scenario	Testing	Success	Fail
BUMDes Administrator	6	38	228	221	7
Resident	5	25	125	124	1
Total	11	63	353	345	8

Black-box testing evaluated system functionality; 353 tests were executed: 345 passed and eight failed. Based on the black-box testing recap's results, the following is the feasibility percentage of the BUMDes Spirit Mejabar system.

$$\text{Feasibility Rate} = \left(\frac{\text{Total Successful Tests}}{\text{Total Test Cases}} \right) \times 100\%$$

$$\text{Successful Testing} = \left(\frac{345}{353} \right) \times 100\% = 97,76\%$$

$$\text{Unsuccessful Testing} = \left(\frac{8}{353} \right) \times 100\% = 2,27\%$$

The calculation's feasibility score of 97.76% shows that the BUMDes Spirit Mejabar website is ready for implementation. In addition to technical testing, a Likert scale-based questionnaire is distributed to users to measure user satisfaction.

Table 5. User Satisfaction Questionnaire Results

Questionnaire	Criteria				
	5	4	3	2	1
The BUMDes system is easy to use by all users (Admin & Residents)	7	23	-	-	-
The BUMDes system loads data quickly and efficiently.	5	25	-	-	-

Questionnaire	Criteria				
	5	4	3	2	1
I can access the BUMDes system easily using my device.	20	4	6	-	-
The BUMDes system rarely experiences errors during use.	21	5	4	-	-
The BUMDes system has complete features and is suitable for the needs of administrators and residents.	23	6	1	-	-
The BUMDes system makes it easy for me to make payments and view bill status (for residents) or manage bills (for administrator).	25	5	-	-	-
Information on the status of waste fee payments is clear and easy for users to understand.	23	7	-	-	-
Manual waste fee management takes longer and is prone to errors compared to a digital-based system.	24	6	-	-	-
The BUMDes system improves transparency in waste contribution management and payment, making it easier for managers and residents to monitor their status.	25	4	1	-	-
The BUMDes system helps managers to provide public services such as waste fee payments, which are more efficient and accessible than before the system.	23	4	3	-	-
The BUMDes system makes it easier for me to access information and services related to waste fee payments and other service management, without having to come directly to the BUMDes office.	27	3	-	-	-
Overall, I am satisfied with the use of the BUMDes system and the results obtained from this system.	20	9	1	-	-
I feel that the BUMDes website is useful as a promotional platform to increase the visibility and services of the BUMDes.	24	6	-	-	-
The BUMDes system improves the quality of public services in the village, especially in waste contribution management and business promotion.	23	6	1	-	-
I would recommend using the BUMDes system to friends or family.	19	7	4	-	-
Total	309	120	21	0	0

The overall questionnaire data for the BUMDes Spirit Mejabar web-based information system was analyzed using the average percentage score. The total score calculation was as follows:

$$\text{a. Score 5 (Strongly Agree)} = 5 \times 309 = 1545$$

$$\text{b. Score 4 (Agree)} = 4 \times 120 = 480$$

$$\text{c. Score 3 (Neutral)} = 3 \times 21 = 63$$

$$\text{d. Score 2 (Disagree)} = 2 \times 0 = 0$$

$$\text{e. Score 1 (Strongly Disagree)} = 1 \times 0 = 0$$

$$\text{Total Score} = 2088$$

$$\begin{aligned} \text{Maximum Possible Score} &= 5 (\text{max score}) \times 15 (\text{questionnaire}) \times 30 (\text{respondent}) \\ &= 2250 \end{aligned}$$

$$\begin{aligned} \text{Percentage} &= \left(\frac{\text{Total Score}}{\text{Maximum Possible Score}} \right) \times 100\% \\ &= \left(\frac{2088}{2250} \right) \times 100\% \\ &= 92,8\% \end{aligned}$$

This result indicates a high level of user satisfaction, placing the system in the “Very Good” category based on the Likert scale. The score reflects that the website features successfully met the users' needs and expectations.

The use of the agile method contributed significantly to this outcome by enabling flexibility in system development. It allowed iterative improvements based on feedback collected, which is especially valuable in rural system contexts where user needs may develop gradually. For example, residents asked for a payment form that was easier to use, so the interface was simplified. BUMDes administrators also requested better tools for making reports, which led to adding filter and export features. These improvements were made gradually in each iteration, helping the system match users' needs and expectations.

5. Conclusions

The BUMDes Spirit Mejabar web-based information system has been successfully designed and developed to address the operational needs of waste fee management, citizen data handling, and business promotion in West Mejasem Village. The system was built iteratively and adaptively using the agile method, ensuring it met user expectations and functional goals. The Agile method helped design and develop the BUMDes Spirit Mejabar system in a more structured, simple, and adaptive way by responding to user needs. Future improvements that need to be made include adding manual user registration, automating monthly billing and notifications, and integrating digital payment APIs to streamline transactions. Overall, the system meets the research objectives and can effectively support BUMDes operations without needing further development unless new issues occur.

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