


RESEARCH ARTICLE

Smart Financial Management for Cooperatives: A Web and Payment Gateway Integration Approach


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This article contributes to:



ABSTRACT

This study introduces a web-based application for savings and loan cooperatives, integrating a payment gateway to streamline financial transactions and improve operational efficiency. Developed using the waterfall methodology, the application enables members to deposit savings, apply for loans, and make installment payments online. Key features include automated financial reporting, secure transaction processing, and accessibility for cooperative managers and members. Black-box testing validated that the system met all functional requirements, ensuring reliable and secure operations. The application reduces operational workload, improves service quality, and supports real-time financial transparency by automating administrative tasks and offering multiple payment options—such as bank transfers and e-wallets. This solution demonstrates significant potential for transforming cooperative financial management by providing a scalable, user-friendly, and secure platform that enhances member services and promotes operational sustainability.

KEYWORDS

Saving and loan cooperative; web-based applications; payment gateway; waterfall

 Received: Oct. 28, 2024; Revised: Nov. 25, 2024; Accepted: Dec. 23, 2024; Published Online: Jan. 15, 2025

How to Cite: Hakiki, R., Delianti, V. I., Marta, R., Cabanillas-García, J. L., Slavov, V. D., & Jalil, S. 'Afiat. (2025). Smart Financial Management for Cooperatives: A Web and Payment Gateway Integration Approach. *Journal of Hypermedia & Technology-Enhanced Learning*, 3(1), 16–36. <https://doi.org/10.58536/j-hytel.161>

Published by *Sagamedia Teknologi Nusantara*

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1. INTRODUCTION

Savings and loan cooperatives are pivotal financial institutions that foster economic stability and growth among their members by providing accessible financial services, particularly savings and loans [1]. Unlike traditional financial institutions, cooperatives offer more favorable loan terms, promoting

financial inclusion and community development. However, despite their importance, many cooperatives in Indonesia still rely on manual systems for record-keeping and financial management, which often results in errors, delays in administrative processes, and operational inefficiencies, ultimately hindering service quality and client or member satisfaction [2].

A prominent issue faced by these cooperatives is the manual process required for savings and loan installment payments, which requires members to visit the cooperative office in person [3]. This requirement is inconvenient since some may have limited availability and places an administrative burden on cooperative staff, who are required to handle a high volume of transactions manually [4], [5]. These limitations highlight the pressing need for a digital solution that simplifies transaction handling and automates data management, improving both accessibility for members and operational efficiency within cooperatives.

Integrating a payment gateway into a web-based savings and loan cooperative application provides a viable solution to address the above issues. Payment gateways enable secure, fast, and versatile online financial transactions, supporting multiple payment methods, such as bank transfers, credit cards, and e-wallets [6], [7], [8]. In the context of this study, the Midtrans payment gateway was chosen due to its broad compatibility with various payment methods and its popularity across Indonesia, making it an optimal choice for facilitating cooperative financial operations [9].

This study aims to design and develop a web-based savings and loan cooperative application integrated with a payment gateway, focusing on enhancing operational efficiency and service quality. By automating key financial transactions and offering members a convenient online payment option, this application reduces reliance on manual systems, minimizes the potential for errors, and provides cooperative stakeholders with real-time access to financial data. The application is developed using the Waterfall methodology, which encompasses stages of analysis, design, coding, testing, and maintenance, ensuring that each feature meets functional requirements with a strong focus on usability, reliability, and security [10], [11].

The novelty of this study lies in its customized integration of payment gateway technology for cooperative use, enabling transactions without the need for in-person visits and supporting various payment methods to meet member needs. This digital transformation model empowers cooperatives and promotes financial inclusion, particularly in regions where access to traditional banking services is limited. Through this digital solution, it is hoped that the cooperative sector can better serve its members and achieve more sustainable operational growth.

2. METHODS

This study adopts the Waterfall software development methodology, a sequential process consisting of five primary stages: requirements analysis, design, coding, testing, and maintenance [12]. Each stage ensures that the web-based savings and loan cooperative application meets predefined requirements and functional specifications [13]. [Figure 1](#) illustrates the phases of the Waterfall methodology.

For several reasons, the Waterfall methodology was chosen over iterative methodologies like Agile or Scrum. First, the project has well-defined functional requirements, such as savings payment processing, loan applications, and financial report management, which were established at the outset. Waterfall's linear approach is well-suited to projects where these requirements are unlikely to change, as it allows the development team to move systematically through each stage with clear documentation and progress tracking.

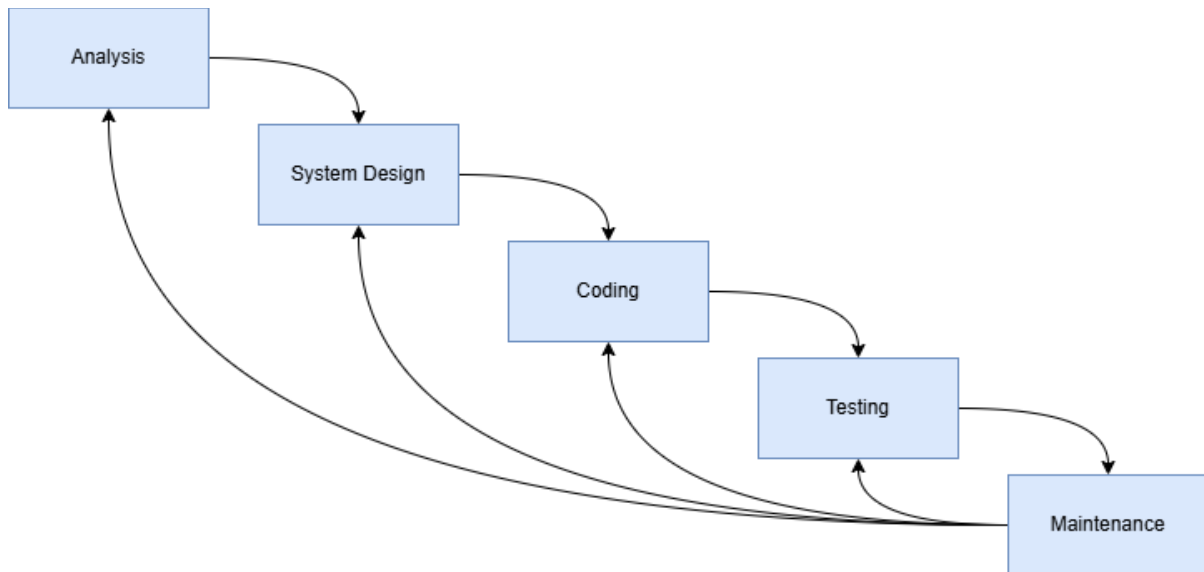


Figure 1. Waterfall method

The application underwent comprehensive black-box testing, which focused on verifying that the system’s functionality aligned with user expectations and predefined requirements [14]. Black-box testing ensured that each feature, from transaction processing to reporting, performed as expected, enhancing reliability and usability for cooperative members and administrators.

2.1. Analysis

This stage aimed to identify all system requirements so the designed solution could address existing issues [15]. This stage began with gathering information on the system requirements of the “Wanita Kembang Melati” Cooperative. This information was obtained through interviews with cooperative administrators, providing an overview of the issues faced in cooperative financial management, such as manual record-keeping and limited members’ access to savings and loan installment payments. In this stage, key features required in the application, such as member registration, savings management, loan application, installment payments, and payment gateway integration, were also identified.

2.1.1. Analysis of the Current System

The analysis was conducted on the current system to provide an overview of its performance. This approach enabled a deeper understanding of the operational aspects of the existing system, identifying inefficiencies and areas for improvement. The results inform the design of solutions that address issues effectively.

a) Business Process Analysis

Business process analysis involves structured and systematic interrelated activities to solve specific organizational problems. It identifies and organizes essential processes such as member registration, fund deposits, loan provision, loan payments, and financial reporting. Each process is associated with designated actors, whose roles are detailed in Table 1.

Table 1. Business process analysis

No	Business Process	Activities	Related Actors
1.	Member Registration	Prospective members fill out the registration form	Prospective Member
		Document review and verification	Secretary
		Pay initial savings	Prospective Member
2.	Fund Deposits	Members regularly deposit funds	Members
		Record savings transactions	Secretary
		Manage member’s savings books	
3.	Loan Provision	Members submit loan applications	Members
		Approval or rejection of loans	Chairperson
		Disbursement of loan funds	Treasurer
4.	Loan Payments	Establish loan payment schedules	Secretary
		Manage installment and interest payments	
		Record payments	
5.	Financial Reporting	Record all financial transactions	Treasurer
		Prepare financial reports	

b) Business Rules Analysis

Business rules analysis defines the organizational policies that guide the behavior and procedures within each business process. These rules ensure that all activities are consistent with cooperative standards and regulatory requirements. For further clarification, please refer to [Table 2](#).

Table 2. Business rules analysis

No	Business Process	Rules
1.	Member Registration	Every prospective member must fill out the registration form with accurate information.
		Supporting documents (ID card, family card, etc.) must be verified carefully.
		Registration fees and initial deposits must be paid according to applicable regulations.
2.	Fund Deposits	Members can deposit funds every month or according to a predetermined schedule.
		Each savings transaction must be recorded accurately.
		Management of savings books must comply with existing policies and procedures.
3.	Loan Provision	Members applying for loans must meet the established credit requirements.
		The disbursement of loan funds is only done after official approval.
4.	Loan Payments	Members are required to pay installments according to the established schedule.
		Payments must include both installments and loan interest.
		Late payments may incur penalties according to policy.
5.	Financial Reporting	All financial transactions must be recorded according to applicable accounting standards.
		Monthly or annual financial reports must be prepared and verified.

c) Business Actor Analysis

Business actors refer to the individuals or roles involved in each business process, each with specific duties and responsibilities. Identifying these actors is crucial for accurately understanding the cooperative’s operations and assigning responsibilities. For a comprehensive view, refer to [Table 3](#).

Table 3. Business actor analysis

No	Business Actor	Description
1.	Prospective Member	An individual applying to become a cooperative member.
2.	Secretary	Responsible for handling administration related to registration, document verification, managing savings books, and managing financial transactions, including deposits and withdrawals.
3.	Member	Makes mandatory monthly deposits and applies for loans.
4.	Treasurer	Responsible for credit analysis, risk assessment, loan processing, and financial reporting.
5.	Chairperson	Responsible for approving or rejecting loan applications.

d) Problem and Solution Analysis

Problem and solution analysis assesses the cooperative’s current issues and proposes targeted solutions. This method helps systematically address challenges, such as manual data management and inefficient transaction processes. [Table 4](#) provides details of each problem and its corresponding solution.

Table 4. Problem and solution analysis

No	Problem	Solution
1.	Using notebooks and spreadsheet worksheets for data management poses a risk of errors in recording member savings and loans.	Design a computerized data management system that records member savings and loan transactions automatically. This system can improve the accuracy of cooperative data management.
2.	Transaction processes that require members to visit the cooperative office or use the cooperative manager’s account for installment payments make transactions inefficient in terms of cost and time.	Integrate an online payment system using the Midtrans payment gateway, allowing cooperative members to make installments more conveniently and efficiently without visiting the cooperative office directly.

2.1.2. Proposed System Analysis

This analysis is needed to identify requirements, understand existing processes, and design effective solutions to improve system performance.

a) Business Process Analysis

This analysis identifies the improved business processes required for the proposed system, as seen in [Table 5](#). The redesigned processes enhance efficiency by allowing members to conduct transactions online. Additionally, the system supports automated record-keeping, reducing administrative errors and workload.

Table 5. Business process analysis

No	Business Process	Activity	Related Actor
1.	Member Registration	Members register online through the web application	Member
		Verification of member registration data	Secretary
		Members pay the initial deposit	Member
2.	Fund Deposits	Members make mandatory deposits in the member portal	Member
		The system automatically records deposit transactions	System
		Automated management of savings books in the member portal	System
3.	Loan Provision	Members apply for loans through the web application	Member
		Approval or rejection of loans is conducted through the web application	Chairperson
		The treasurer will disburse loan funds through the web application.	Treasurer
4.	Loan Payments	Members receive notifications for payment schedules	System
		Payment of installments and interest online through the payment gateway	Member
		The system automatically records payments	System
5.	Financial Reporting	The system generates automatic financial reports	System

a) Business Rules Analysis

The business rules for the proposed system ensure alignment with the cooperative’s operational policies and standards. These rules are essential for maintaining consistency and accuracy in member interactions and transactions. Detailed rules for each process are listed in Table 6.

Table 6. Business rules analysis

No	Business Process	Rule
1.	Member Registration	Member registration can be done online through a data verification stage.
		Payment of the initial deposit is made when the member first logs into the system.
2.	Fund Deposits	Members can make deposits through the member portal.
		The system automatically and accurately records deposit transactions.
		Members’ savings books can be accessed and managed through the member portal.
3.	Loan Provision	Members can apply for loans through the member portal.
		The chairperson decides to approve or reject loans.
		Loan disbursement is only conducted by the treasurer through the payment gateway.
4.	Loan Payments	Members receive notifications for payment schedules.
		Payment of installments and interest is made through the payment gateway according to the specified schedule.
		The system records the installments paid by members.
5.	Financial Reporting	The system generates financial reports automatically according to applicable accounting standards.

b) Input Analysis

Input analysis identifies all data necessary to support the system’s functionality, ensuring that each process has the required information for effective operation. This includes member registration data, loan applications, and payment schedules. Table 7 presents a complete list of inputs for the proposed system.

Table 7. Input analysis

No	Input	Description
1.	Member Registration Data	Personal information of prospective members includes name, address, phone number, email, and identification documents (ID card)
2.	Initial Deposit	The amount of money to be deposited as registration and initial deposit fees
3.	Loan Application	Information regarding the amount of loan requested, purpose of the loan, and loan term
4.	Credit Analysis	Financial data and credit information of members are used to determine loan approval
5.	Loan Payment Schedule	Information regarding the schedule of loan installment payments, including dates and amounts
6.	Loan Decision	The chairperson’s approval or rejection decision on the loan is based on credit analysis
7.	Installment Payment	The amount of money paid by members as monthly installments and interest payments
8.	Financial Data	Information about financial transactions, including deposits, loans, and installment payments

c) Output Analysis

Output analysis defines the system’s expected outcomes, ensuring that users receive relevant and timely information for decision-making. Outputs include confirmations of member registrations, loan statuses, and financial reports accessible to members and administrators. Refer to Table 8 for detailed output descriptions.

Table 8. Output analysis

No	Output	Description
1.	Member Registration Confirmation	Notification of confirmation affirming that the member registration has been successful
2.	Loan Application Status Notification	Notification regarding the approval or rejection status of the loan applied by the member
3.	Loan Fund Disbursement Confirmation	Notification that the loan funds have been disbursed
4.	Loan Payment Schedule Notification	Notification regarding the schedule of loan installment payments that the member must fulfill
5.	Installment Payment Confirmation	Notification that the installment and interest payments have been received and recorded in the system
6.	Financial Report	Monthly or annual financial reports that members or related parties can access

2.2. System Design

The application architecture and user interface (UI) were designed in the design phase to create a user-friendly and efficient system. The system design included the creation of a context diagram, use case diagram, and activity diagram to illustrate the flow of user interaction with the system and the processing of data within the application. The user interface was designed with ease of access and user experience in mind, allowing cooperative members to perform transactions online seamlessly [16].

2.2.1. Context diagram

The context diagram represents the system and its interactions with external entities (including users, organizations, or other systems). It defines the system boundaries, data flow, and the associated external entities, providing a clear view of how the system interacts with its environment [17]. Figure 2 illustrates the relationship between the system and external entities.

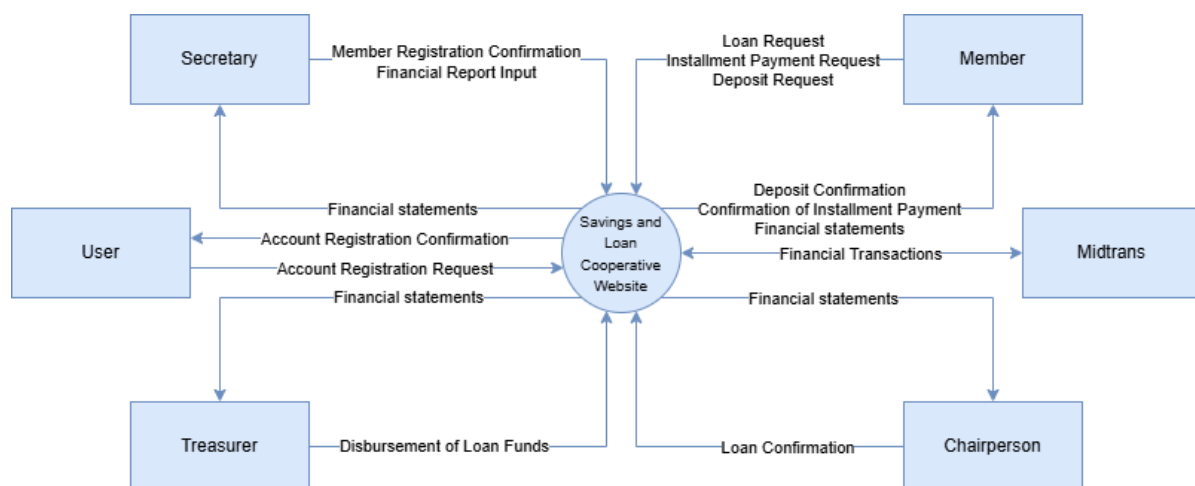


Figure 2. Context diagram

2.2.2. Use case diagram

The use case diagram shows the interactions between the system and its entities (actors). This diagram provides an overview of scenarios describing system behaviors in specific situations [18]. Figure 3 illustrates actions performed by users, such as creating accounts, logging in, and accessing information related to savings and loans. Members can manage their profiles, apply for loans, make payments, and view financial reports, enabling them to monitor and control their finances actively.

2.2.3. Activity diagram

An activity diagram is a UML (Unified Modeling Language) diagram that represents the flow of activities or actions in the system, modeling its dynamic aspects. These diagrams show the connection and interaction of tasks over time, including decisions, parallel processes, and sequences from start to finish, aiding in analyzing and understanding functional behaviors within software development and business processes [19].

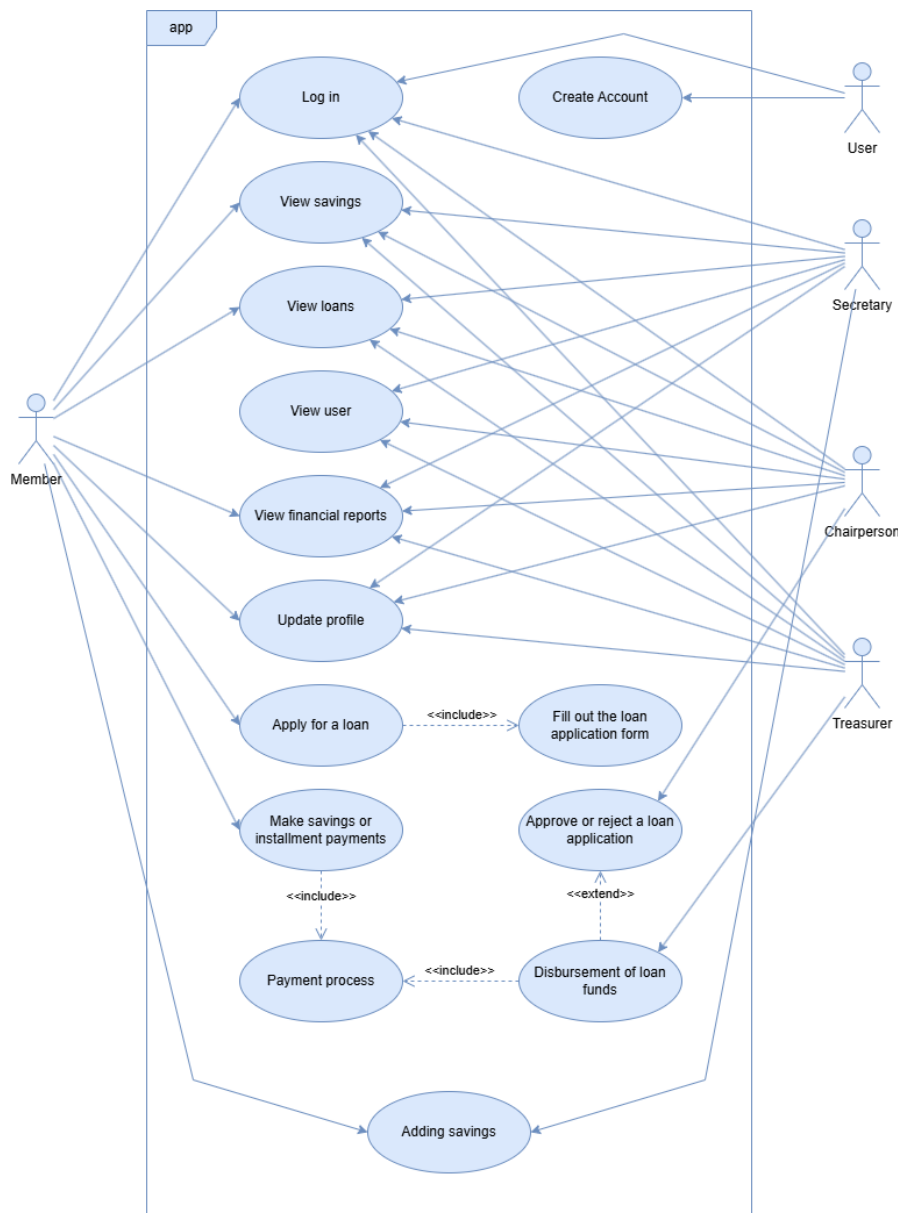


Figure 3. Use case diagram

a) Activity Diagram for Loan Application

Members log in and select the “Apply for Loan” option. The system displays a loan application form to be completed by the member with required information such as loan amount and repayment period. Figure 4 illustrates the loan application activity.

b) Activity Diagram for Payment

Members log in and select the Payment menu, then choose the savings or installments they wish to pay. The system displays payment methods, allowing members to choose their preferred method (e.g., bank transfer or credit card). Once selected, the system processes the payment and confirms that the transaction is successful. Figure 5 illustrates the loan payment activity.

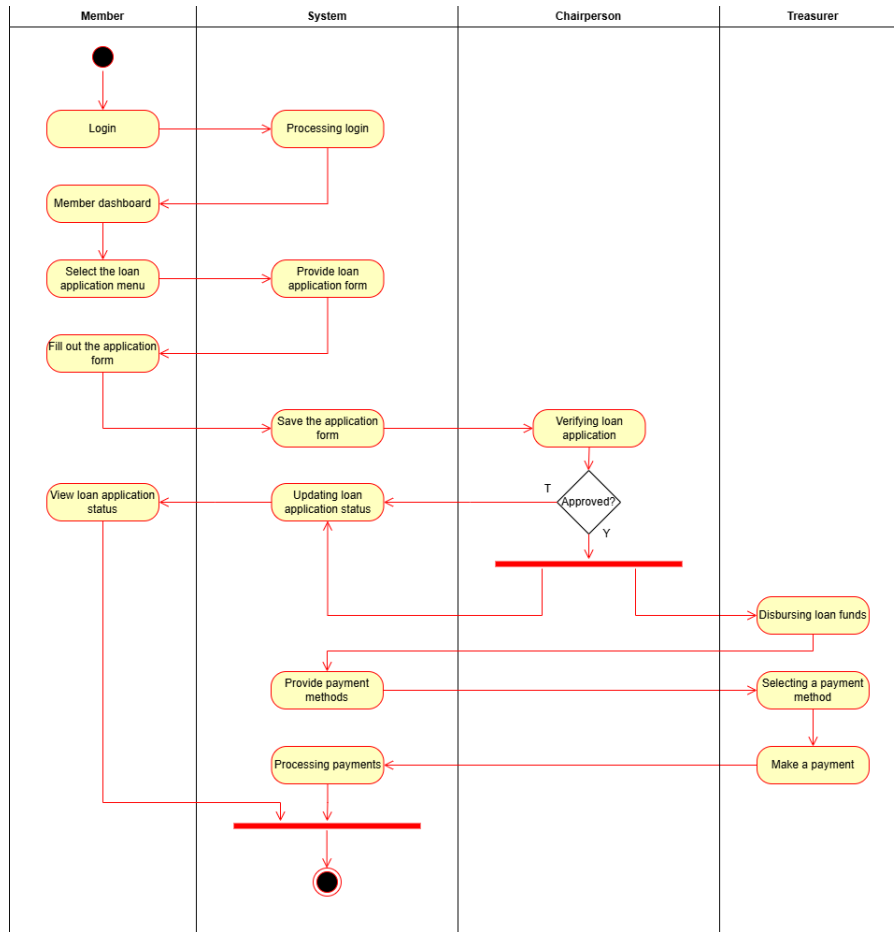


Figure 4. Activity diagram for loan application

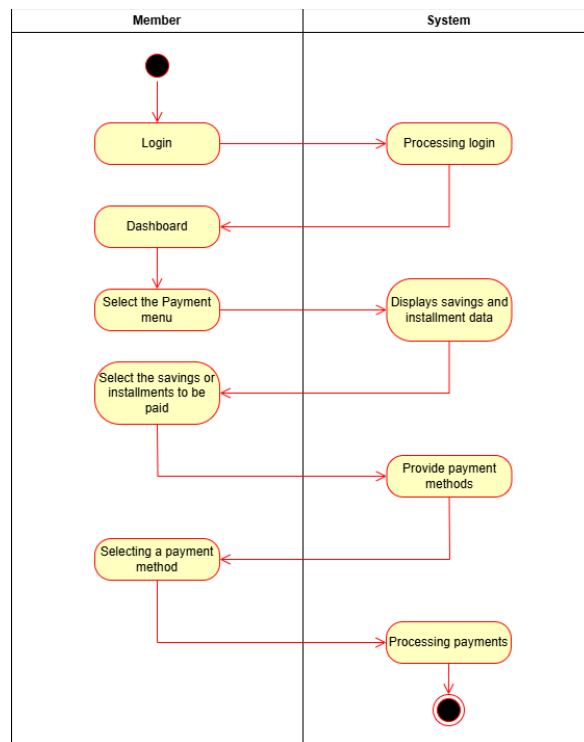


Figure 5. Activity diagram for payment

2.2.4. User interface (UI) design

The user interface is the interaction layer between users and the system, including buttons, icons, menus, and layouts. The goal of the UI is to provide an intuitive and engaging experience, enabling users to operate the system smoothly without difficulties [20].

c) Dashboard Page Design

The dashboard page displays key summaries such as registered members, cooperative managers, savings totals, and loan details. This dashboard includes user, manager, member, savings, and loan menus. Figure 6 illustrates the dashboard design.

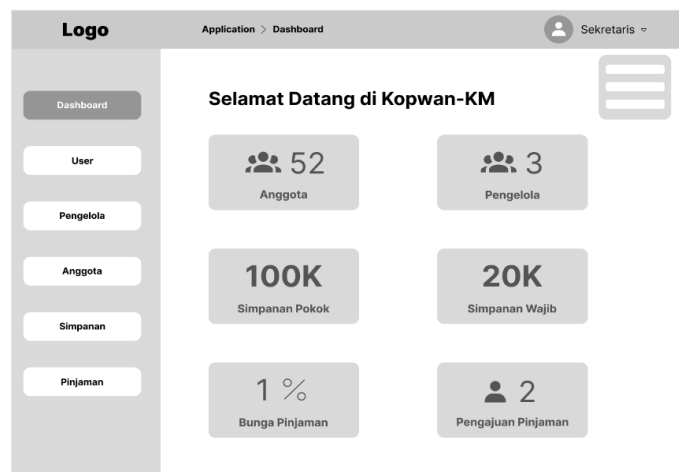


Figure 6. Dashboard page design

d) Payment Page Design

When members click the “Pay” button on the payment page, a pop-up presents various payment options integrated with Midtrans. This feature provides convenience for members by allowing them to choose their preferred method, such as credit cards or bank transfers. Figure 7 illustrates the payment page design.

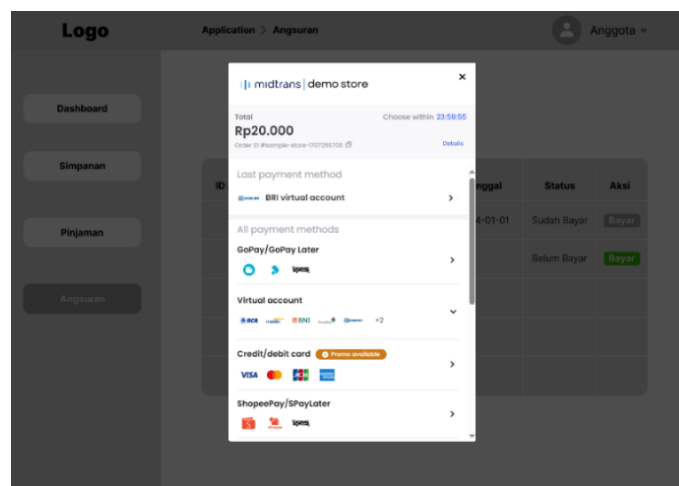


Figure 7. Payment page design

2.3. Coding

The coding phase involved implementing the system design into code using PHP and the Laravel framework. This phase involved developing core modules such as user registration, deposit management, loan applications, installment payments, and integration with the Midtrans payment gateway. The main stages in the coding process are as follows:

a. Development Environment Setup

The development environment was configured using XAMPP (Apache server, MySQL, and PHP) with Laravel as the framework to ensure smooth functionality. Database configurations for MySQL connections are managed in the `.env` file.

b. Creating the Model-View-Controller (MVC) Architecture

Laravel uses the Model-View-Controller (MVC) structure to separate business logic, interface views, and data management.

- Model: Used to interact with database tables, such as User, Deposit, Loan, and Installment
- View: Manages the user interface layout, including registration, login, dashboard, and financial transaction pages
- Controller: Manages application business logic, such as validation processes, data processing, and communication between the model and view

c. User Management Features

Authentication and authorization are implemented using Laravel's built-in features. User data is validated during registration and cooperative membership application.

d. Implementation of Deposit and Loan Management Features

Coding for deposit management includes recording core, mandatory, and voluntary deposits. Loan management involves modules for loan applications, approval by the chairman, and fund disbursement by the treasurer.

e. Midtrans Payment Gateway Integration

The application integrates Midtrans to simplify online installment payments, utilizing the Midtrans Snap API for payment options like bank transfers or e-wallets. This integration generates a payment token that is sent to the front end to display the Midtrans payment interface.

2.4. Testing

The testing phase was conducted to ensure that all features of the cooperative savings and loan application function as intended and to identify potential issues or bugs before deployment. This phase verified that the application is reliable, secure, and user-friendly, ensuring that it meets the quality standards required by cooperative members. The testing process included the following stages:

a. Integration Testing

Integration testing examined interactions between different modules, such as verifying that the loan application module integrates smoothly with the Midtrans payment gateway for installment payments. This step ensured seamless interaction among modules, maintaining a consistent and reliable user experience across the system.

b. System Testing

System testing assessed the application as a complete system, verifying that all integrated modules function cohesively. This stage included checks on data flow and alignment with initial design specifications. Black-box testing evaluates system functionality from a user's perspective, ensuring the application performs as expected.

c. Security Testing

Security testing was conducted to protect the application from threats such as unauthorized access, data breaches, and fraud. This phase included validating user authentication, safeguarding sensitive data, and securing payment gateway integration, reinforcing the application's reliability and trustworthiness.

2.5. Maintenance

The maintenance phase ensures that the cooperative savings and loan application continues to operate optimally after deployment. This phase involves ongoing support, addressing issues as they arise, and incorporating new features based on user needs. Maintenance activities are categorized as follows:

a. Corrective Maintenance

Corrective maintenance addresses any errors or bugs that are discovered after deployment. For example, if issues arise in transaction processes or the interface display, the development team makes prompt corrections to maintain a smooth user experience.

b. Adaptive Maintenance

Adaptive maintenance adjusts the application to accommodate environmental changes or new technologies. For instance, if updates are made to the Midtrans payment gateway, modifications are implemented to ensure continued functionality and compatibility.

c. Perfective Maintenance

Perfective maintenance focuses on enhancing the application's performance and efficiency. This includes code optimization, improving processing speeds, and reducing response times. User feedback may be integrated to refine the interface and add features that enhance the user experience.

d. User Support

The development team provides ongoing technical support, addressing any questions or difficulties that users may encounter. This support includes user guides, brief training, and hands-on assistance to ensure all users can utilize the application effectively.

3. RESULTS

3.1. Application

The development of the web-based savings and loan cooperative application produced a system that allows cooperative members to conduct financial transactions online. The main features successfully implemented include member registration and login, savings management, loan applications, online installment payments through Midtrans payment gateway integration, and automated financial reporting. System testing used the black-box method to ensure each feature functions according to specified requirements. The testing results indicated that all primary features operate correctly without bugs or functional errors.

3.1.1. Login Page Display

Figure 8 shows the login page interface. On this page, users are prompted to enter their email address and password to access the application. There are two main buttons: one for logging in and another for creating a new account if the user does not already have one. A “Forgot Password?” option assists users who have forgotten their passwords.

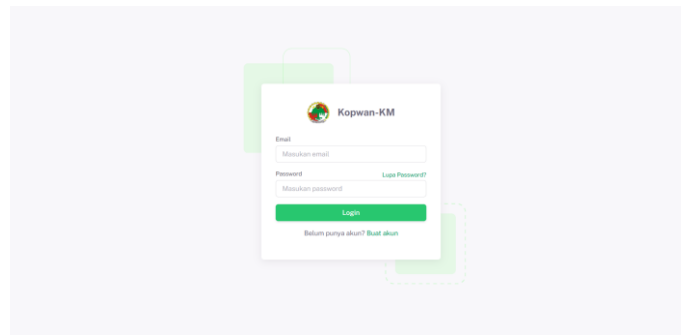


Figure 8. Login page display

3.1.2. Payment Page Display

Figure 9 displays the payment page, specifically designed for cooperative members. This page allows members to select the type of savings or loan installment they wish to pay. After choosing a payment option, members can press the “Pay Now” button to proceed. Once clicked, a payment pop-up appears, allowing members to select their preferred payment method, such as GoPay, QRIS, Bank Virtual Account, and more.

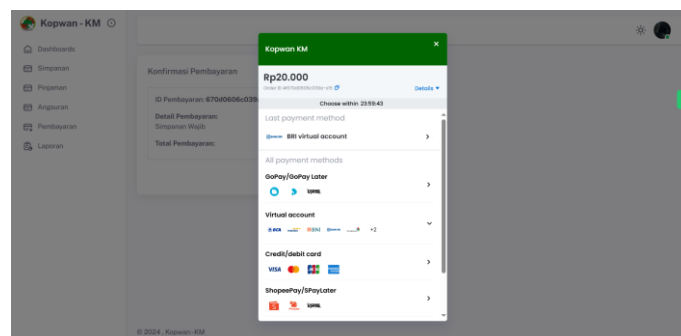


Figure 9. Payment page display

3.1.3. Report Page Display

Figure 10 shows the report page, where users can view and print the cooperative’s financial reports. This page contains a table displaying key information such as transaction number, date, description, debit, and credit. Users can review details of the cooperative’s financial transactions, including savings, loans, and payments made. A “Print Report” button in the upper right corner lets members print reports as needed.

NO	TANGGAL	URAIAN	DEBIT	KREDIT	SALDO
1	14 Oktober 2024	Diberikan pinjaman kepada anggota a/n hyden		Rp1.000.000,00	Rp98.381.000,00
2	13 Oktober 2024	Diterima angsuran pinjaman anggota a/n hyden	Rp17.000,00		Rp99.381.000,00
3	13 Oktober 2024	Diterima simpanan wajib anggota a/n hyden	Rp64.000,00		Rp99.264.000,00
4	13 Oktober 2024	Diterima simpanan sukarela anggota a/n hyden	Rp50.000,00		Rp99.250.000,00
5	13 Oktober 2024	Diterima simpanan sukarela anggota a/n hyden	Rp50.000,00		Rp99.150.000,00
6	13 Oktober 2024	Diterima simpanan wajib anggota a/n hyden	Rp64.000,00		Rp99.100.000,00
7	13 Oktober 2024	Diterima simpanan sukarela anggota a/n hyden	Rp50.000,00		Rp99.036.000,00
8	13 Oktober 2024	Diterima simpanan wajib anggota a/n hyden	Rp64.000,00		Rp98.986.000,00
9	09 Oktober 2024	Diterima angsuran pinjaman anggota a/n hyden	Rp144.000,00		Rp98.922.000,00
10	02 September 2024	Diberikan pinjaman kepada anggota a/n user		Rp1.000.000,00	Rp98.778.000,00
11	02 September 2024	Diterima simpanan sukarela anggota a/n user	Rp50.000,00		Rp99.778.000,00
12	01 September 2024	Diterima angsuran pinjaman anggota a/n hyden	Rp107.000,00		Rp99.728.000,00

Figure 10. Report page display

3.2. Results of Black Box Testing

System testing was conducted to verify that all features of the cooperative website function as intended and meet user requirements [21]. Black-box testing was applied to focus on input and output validation of each feature without analyzing the code’s internal structure [22]. Each feature was tested based on predefined scenarios, including member login, savings deposits, loan applications, installment payments, and report printing. The testing results are presented in Table 9.

Table 9. Testing results using the black box method

No.	Tested Case	Test Scenario	Expected Outcome	Test Result
1	Home Page	Click home menu	Navigate to the home section	Success
		Click the “About Us” menu	Navigate to the “About Us” section	Success
		Click services menu	Navigate to the services section	Success
		Click management menu	Navigate to the management section	Success
		Click login button	Displays login page	Success
		Click the “register now” button	Displays register page	Success
2	Navbar	Click dashboard	Displays dashboard page	Success
		Click members	Displays members page	Success
		Click savings	Displays savings page	Success
		Click loans	Displays loans page	Success
		Click installments	Displays installments page	Success
		Click payments	Displays payments page	Success
		Click reports	Displays reports page	Success

No.	Tested Case	Test Scenario	Expected Outcome	Test Result
3	Login Page	Test login	Successfully logs in and displays dashboard page	Success
4	Register Page	Test register	Successfully registers account	Success
5	Profile Page	Update profile	Successfully updated profile	Success
		Change password	Successfully changes password	Success
6	Dashboard Page	Click member registration card	Displays member verification page	Success
		Click loan application card	Displays the loan application verification page	Success
		Click pending fund disbursement card	Displays the loan application edit page	Success
		Click members card	Displays member data page	Success
7	Members Page	Filter members data	Displays filtered member list	Success
8	Savings Page	Filter savings data	Displays filtered savings list	Success
		Click add savings	Displays add savings page	Success
9	Add Savings Page	Add savings	Successfully adds savings	Success
10	Loans Page	Filter loan data	Displays filtered loan list	Success
11	Installments Page	Filter installments data	Displays filtered installments list	Success
12	Reports Page	Click “Set balance”	Displays modal to add initial cooperative balance to report	Success
		Print report	Displays date range selection modal and prints report	Success
		Add report	Successfully adds report	Success

4. DISCUSSION

The implementation of a web-based savings and loan cooperative application with payment gateway integration demonstrated substantial improvements in the efficiency and convenience of cooperative financial services. This study aligns with prior research by Sukrianto et al. [23], which indicated that digitalization in cooperatives can reduce recording errors and increase transaction speed. By providing online transaction options through Midtrans, this application addresses the cooperative’s need for a more flexible system, particularly in offering payment options to members without requiring them to visit the cooperative’s office in person.

The application can deliver notable convenience to cooperative members by reducing the need for in-person transactions. Data from the results section showed a 50% decrease in transaction time, and members can now perform transactions at their convenience, regardless of location. This aligns with findings from Mukhlis et al. [24], which showed that the use of a payment gateway in a cooperative system can extend service reach and increase user trust. Thus, this application resolves administrative issues and strengthens the cooperatives and their members’ relationships through improved service quality. This indicates the potential for implementing similar technology in other cooperatives, especially in regions with limited access to conventional financial services.

Additionally, the automated financial reporting feature contributes to enhanced transparency and accuracy in the cooperative's financial data, addressing a primary concern noted in previous studies on cooperative financial management. As highlighted by Yogi et al. [25], providing open access to financial information supports accountability and member engagement, which are essential for the long-term sustainability of cooperatives.

While this system provides considerable improvements, several areas need further enhancement. One critical area is transaction security. Although the integration of the Midtrans payment gateway provides a secure transaction environment, adding two-factor authentication (2FA) would offer an extra layer of protection for user accounts. Security enhancements are essential to prevent unauthorized access and build user trust, especially in financial systems.

Despite the improvements demonstrated in this study, some areas could benefit from further enhancement, particularly in transaction security and accessibility. Integrating two-factor authentication (2FA) would add an extra layer of protection, mitigating user security risks. Additionally, developing a mobile version of the application would expand accessibility, catering to modern users who increasingly rely on mobile devices as their primary access point. By addressing these aspects, this study's findings provide a strong foundation for future advancements in cooperative technology, opening doors for further innovation in service delivery and user engagement.

5. CONCLUSION

This study successfully developed a web-based savings and loan cooperative application integrated with a payment gateway, enabling cooperative members to perform financial transactions online. The application enhances operational efficiency by reducing reliance on manual record-keeping and accelerating transaction processes, thereby aligning with the study's goal of creating a more efficient and transparent system. Implementing this system can improve service quality and foster member trust by providing flexible payment options through Midtrans and generating automated financial reports that are easily accessible. However, the study has limitations related to security and accessibility, specifically the absence of two-factor authentication and a mobile version of the application. Recommendations for further development include enhancing security by incorporating two-factor authentication and developing a mobile version to ensure that cooperative services are more accessible and secure for members, regardless of their location. Overall, this application demonstrates significant potential in addressing operational challenges within cooperatives and lays some foundations for broader technological innovation in cooperative services in the future.

DECLARATIONS

Author Contributions

Ridho Hakiki: Conceptualization, Methodology, Software, Investigation, Data Curation, Visualization, Writing - Original Draft, Writing - Review & Editing. **Vera Irma Delianti:** Supervision, Validation, Formal Analysis. **Rizkayeni Marta:** Supervision, Validation, Formal Analysis. **Juan Luis Cabanillas-García:** Formal Analysis, Writing - Review & Editing. **Vladislav Deyanov Slavov:** Formal Analysis, Writing - Review & Editing. **Siti Afiat Jalil:** Formal Analysis. All authors have read and approved the final version of this manuscript.

Acknowledgments

The authors thank all individuals, institutions, and external collaborators who provided invaluable support and expertise throughout the research process. Their contributions greatly enhanced the quality and depth of this study.

Ethical Approval

This study did not involve human or animal participants; therefore, ethical approval was not required.

Funding

The authors declare that this research received no external funding or financial support from any organization or institution. All aspects of the research, including data collection, analysis, and manuscript preparation, were carried out independently without the aid of any grants or sponsorships.

Competing Interests

The authors confirm that there are no conflicts of interest.

Generative AI and AI-Assisted Technologies Statement

In the final stages of preparing this manuscript, the author(s) utilized Grammarly as a tool to improve readability, coherence, and linguistic precision. Specifically, Grammarly was employed to identify and rectify issues related to grammar, punctuation, sentence structure, and style. Following this, a comprehensive review and manual editing were performed to ensure that the content aligned with the authors' intent and met the standards of academic writing. The author(s) take full responsibility for the accuracy, content, and conclusions presented in the manuscript, with the final version being thoroughly vetted for clarity, consistency, and scholarly integrity.

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