ISSN: 3026-4596
Journal of Computer-based Instructional Media, Vol. 3, No. 1, pp. 41-57, 2025

Designing and developing a web-based information system for incoming and outgoing letters management

Silvia Agusfiani Putri, Indah Kusuma Dewi and Afrina*

Study Program of Informatics Engineering, Faculty of Science and Technology, Universitas Ibnu Sina, **Indonesia**

*Corresponding Author: afrina@uis.ac.id
Received 26th January 2025; Revised: 14st April 2025; Accepted: 16th April 2025

https://doi.org/10.58712/jcim.v3i1.143

Abstract: This study aims to design and develop a web-based information system for incoming and outgoing letter management at the Baloi Permai Subdistrict Office to enhance administrative efficiency and service transparency. A need analysis was conducted to identify key system requirements, including data collection, processing, and functional and non-functional design. The data were collected through documentation and interviews with primary stakeholders, such as the subdistrict head and administrative staff. The findings indicate that the current manual system has several drawbacks, including the absence of an integrated system, delays in document processing, and limited public accessibility. The system was developed by using the Laravel framework employing PHP and MySQL to ensure efficient development and maintenance. Unified Modeling Language (UML) was applied, incorporating Use Case, Activity, Sequence, and Class diagrams to illustrate user interactions. Black-box testing was conducted to assess system functionality, confirming its ability to streamline correspondence management with key features, such as user management, document tracking, and report generation. The system implementation is expected to improve record accuracy, accelerate document processing, and enhance public accessibility. Additionally, it is potential to be adopted by other government institutions as a digital solution for administrative management.

Keywords: information system; document management; web-based system; administrative efficiency

1. Introduction

The rapid advancement of information technology has significantly transformed various sectors, including public administration (Ahn & Chen, 2022; Kassen, 2022; Rosenbloom et al., 2022). Information technology encompasses hardware and software that facilitate data processing tasks such as storage, retrieval, transmission, and manipulation. Its integration into governmental operations enhances organizational efficiency, optimizes public service delivery, and fosters community engagement (Kulal et al., 2024; Latupeirissa et al., 2024). An information system is a structured mechanism for collecting, organizing, and processing data into meaningful information. It consists of interrelated components designed to support decision-making, coordination, and analysis within an organization (Gunasekaran et al., 2023). Automating traditionally manual processes through information systems improves efficiency, accuracy, and accessibility of real-time data, ensuring seamless information flow across various sectors (Haleem et al., 2021).

In the era of digital transformation, the Indonesian government has been actively promoting **e-**Government initiatives to enhance public service efficiency and transparency (Aprilina et al., 2025; Sabani, 2020). However, many local government offices still rely on conventional paper-based administration, which poses significant challenges, including data mismanagement, slow document processing, and excessive storage demands. The lack of a standardized digital documentation system has resulted in inefficiencies, particularly in urban village offices that manage large volumes of incoming and outgoing letters (Marlina & Radhitya, 2024).

Furthermore, public expectations for faster and more transparent government services have increased, driven by the widespread adoption of digital services in other sectors. The COVID-19 pandemic has accelerated the need for contactless and remote government services, making it essential to develop web-based solutions that allow citizens to access administrative services without physically visiting government offices (Jabarulla & Lee, 2021; Modgil et al., 2022). However, many small-scale government offices, such as urban village administrations, lack the necessary infrastructure and expertise to transition from manual to digital systems effectively. While previous studies have explored the development of digital information systems in government institutions, most focus on large-scale municipal or provincial administrations (Lin, 2025; Nguyen & Nielsen, 2023; Spicer et al., 2023). There is limited research on web-based information systems specifically tailored for urban village offices, which play a crucial role in local governance and community services. Additionally, existing research primarily addresses general e-Government adoption rather than providing practical implementations of digitized administrative processes for small government units (Umbach & Tkalec, 2022).

This study aims to bridge this gap by designing and implementing a customized web-based information system for managing incoming and outgoing letters in a local urban village office. Unlike previous studies, this research will provide a detailed framework for system development, addressing specific administrative challenges at the urban village level and ensuring scalability for future enhancements such as digital payments and IoT-based monitoring.

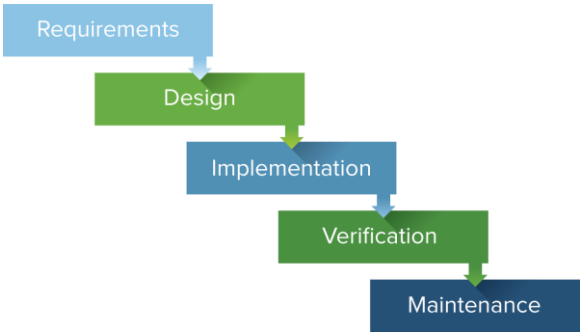
This study contributes to the field of e-Government and information systems by providing a practical implementation model for a web-based document management system specifically designed for urban village offices. It enhances administrative efficiency and transparency by digitizing letter management processes, reducing reliance on paper, and enabling real-time document tracking. Furthermore, this research supports the Indonesian government's digital transformation agenda by demonstrating how small-scale local government units can effectively adopt web-based technologies. Additionally, the study offers a scalable and adaptable system architecture, which can be extended with additional features such as digital payments and automated workflow integration. To address these challenges, this study will develop the E-email system, a web-based information system designed to facilitate document processing, improve data accuracy, and provide real-time tracking of submitted documents. By adopting this digital solution, the Baloi Permai Urban Village Office can improve administrative efficiency, enhance service delivery, and provide a more responsive public service experience.

2. Methods

2.1 Research design

This study employs the Waterfall model, which consists of several systematic phases, where each phase must be completed before proceeding to the next. This approach ensures quality and accuracy in system development, as illustrated in Figure 1.

Figure 1. Stages of the waterfall model



The first stage of the research involves requirements analysis, which aims to collect and evaluate the system requirements for development. Data is gathered through literature reviews, interviews, and observations

of user needs, as well as an analysis of existing systems. The outcome of this stage is a set of functional and non-functional system requirements. Following this, the system design phase is carried out, encompassing several key aspects. First, the system architecture is designed to define the structure of the system and the interactions between its components. Subsequently, database design is undertaken to develop a structured data storage system using an appropriate database management system. Additionally, the user interface is designed to ensure ease of use for office staff, thereby enhancing efficiency and usability in system operations. Once the system design is finalized, the implementation phase begins with the development of software in accordance with the specified design requirements. The programming process adheres to established standards to ensure seamless integration between system components. After the system is developed, a testing phase is conducted to identify and rectify any errors before full deployment.

Testing is performed using several methods, including unit testing to assess individual components, integration testing to evaluate interactions between components, and user acceptance testing (UAT) to verify that the system meets user needs based on predefined usage scenarios. Additionally, Black-Box Testing is employed to assess system functionality without examining the source code, ensuring that the system operates as expected. The final stage involves system deployment and maintenance, where the fully tested and validated system is implemented on a broader scale. Maintenance is conducted continuously to ensure optimal system performance, addressing bug fixes, feature enhancements, and adaptations to evolving user requirements. By employing this systematic research methodology, the information system for managing incoming and outgoing correspondence at Kelurahan Baloi Permai is expected to improve the efficiency and effectiveness of administrative correspondence processes.

2.2 Data collection

The data collection process in this study employs three primary methods: literature review, interviews, and observations. The literature review is conducted to analyze previous studies related to information system development, particularly those utilizing the Waterfall model. This review helps identify best practices, common challenges, and effective solutions in similar system implementations. Additionally, interviews are carried out with key stakeholders, including office staff at Kelurahan Baloi Permai, to gather insights into their requirements and expectations for the new system. The interview questions focus on identifying workflow inefficiencies, current challenges in managing correspondence, and desired system improvements. The responses are recorded and documented for further analysis. Furthermore, observations are conducted to directly examine the existing document management process. This method provides a comprehensive understanding of office operations, user interactions with the current system, and potential areas for system optimization. The combination of these data collection techniques ensures that the study captures accurate and relevant information for system development.

2.3 Data analysis technique

The collected data is analyzed systematically to define the functional and non-functional requirements of the proposed system. Initially, a requirement analysis is performed by compiling and categorizing data obtained from interviews and observations. Functional requirements specify the essential features the system must provide, while non-functional requirements address performance, security, and usability aspects. Following this, the identified requirements are cross-checked against the literature review findings to ensure alignment with industry best practices and technological feasibility. Once the system is developed, a usability evaluation is conducted through User Acceptance Testing (UAT) to assess whether the system meets user needs and improves efficiency. Additionally, Black-Box Testing is utilized to evaluate system functionality without examining the internal code, ensuring that the system operates as expected from a user's perspective. This structured data analysis approach ensures that the developed information system for managing incoming and outgoing correspondence at Kelurahan Baloi Permai is well-validated, user-centered, and aligned with best practices in system development.

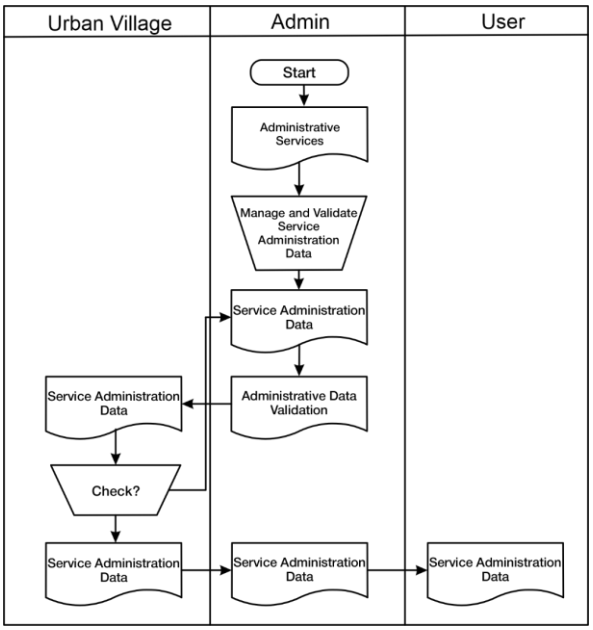
3. Results and discussion

3.1 Need analysis

The needs analysis phase aims to comprehensively identify the essential aspects required for developing an information system for managing incoming and outgoing letters at the Baloi Permai Urban Village Office. This process includes data collection, data processing, system analysis, problem identification, and functional and non-functional requirements analysis. Data collection was conducted through documentation and interviews, with primary data obtained from interviews with the village head, providing insights into office administration services. Secondary data consisted of administrative documents from January to July 2024 and relevant literature reviews.

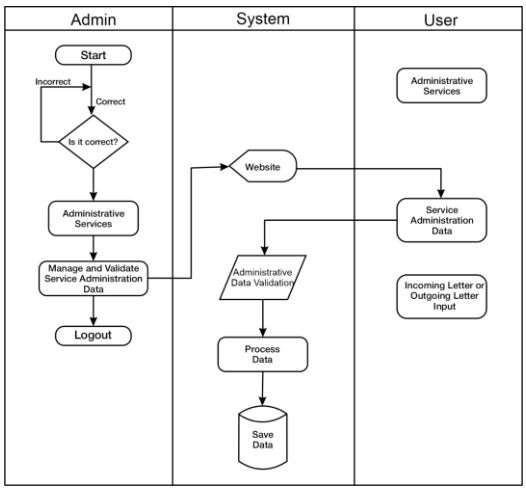
The collected data was analyzed to identify inefficiencies in the current manual system and served as the foundation for designing an optimized digital system. The proposed web-based system will be developed using PHP and MySQL, with Laravel as the primary framework to enhance development efficiency and system maintenance. The analysis revealed that the office lacks an integrated digital system, requiring residents to visit in person to process documents and track letter statuses. The new system aims to address these issues by providing a digital solution for efficient letter management and monitoring. The system is designed to meet both functional and non-functional requirements. Functional requirements include administrative data management, such as user and staff information, role management, institution records, and letter processing, allowing users to add, update, delete, and generate reports. Non-functional requirements focus on usability, security, and flexibility. The system must feature an intuitive user interface, secure authentication mechanisms, and an organized data structure to facilitate efficient data retrieval and management.

By transitioning from a manual to a structured digital system, this initiative seeks to enhance administrative efficiency, service transparency, and overall public service quality at the Baloi Permai Urban Village Office. The implementation of this system is expected to streamline document processing, improve accessibility, and minimize challenges in managing incoming and outgoing letters.



(a)

Figure 2. (a) Old Information System Analysis and (b) New Information System Analysis



(b)

3.2 Design

3.2.1 Use case diagram

Figure 3 the design of the information system for managing incoming and outgoing letters at the Baloi Permai Urban Village Office is structured using the Unified Modeling Language (UML) to represent system requirements. The UML modeling includes a Use Case Diagram, which illustrates the interactions between system actors and their respective roles.

Figure 3. Use Case Diagram of Registration and Monitoring.

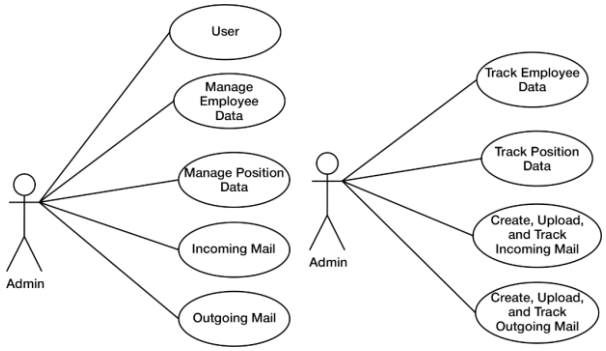


Table 1. Actor Use Case Diagram of e-Letter Service

Use case	Description
Admin	Has full access to the system, allowing them to add, edit, delete, print reports, and manage accounts and access levels. The admin oversees various menus, including user management, employee records, job positions, institutions, incoming letters, outgoing letters, and reporting.
Staff	Can view, add, and edit data related to incoming and outgoing letters through the system.
Secretary of the Urban Village	Has the authority to view, add, edit, and forward document dispositions to the village head for further actions.
Village head	Can review, edit, and take necessary actions on received document dispositions..
Head of public administration	Has read-only access to the system.
Head of Community Empowerment and Development	Also has read-only access to the system.

By implementing this structured system, administrative efficiency at the Baloi Permai Urban Village Office is expected to improve, ensuring better document tracking and management while enhancing transparency and accessibility for staff and officials.

Table 2. Use Case Diagram of e-letter service

Use case	Description
User Management	Allows the admin to add, edit, and delete user accounts.
Incoming Letter Management	Facilitates the addition, editing, and tracking of incoming letters.
Outgoing Letter Management	Enables the creation, modification, and tracking of outgoing letters.
Institution Management	Allows the admin to add, edit, and delete institution records.
Job Position Management	Provides functionalities for adding, editing, and deleting job position records.

3.2.2 Activity diagram

The activity diagram illustrates the flow of events in the design of the information system for managing incoming and outgoing letters at the Kelurahan Baloi Permai office, depicted in Figure 4 and 5.

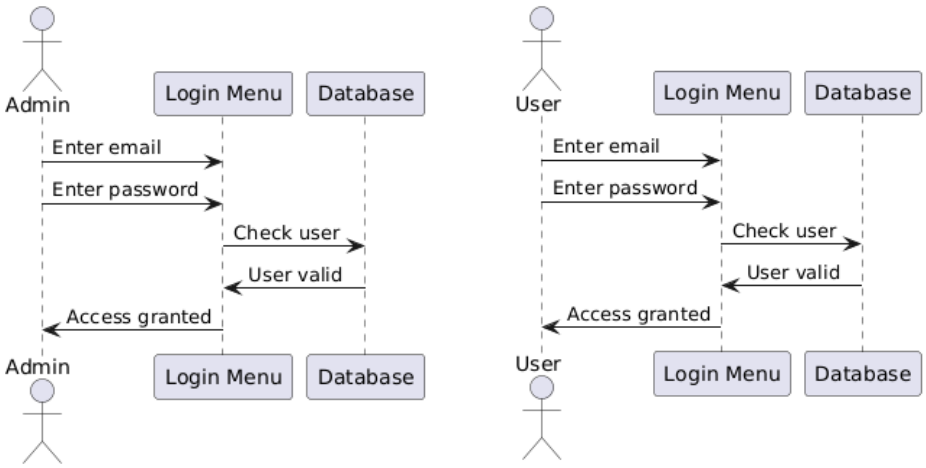
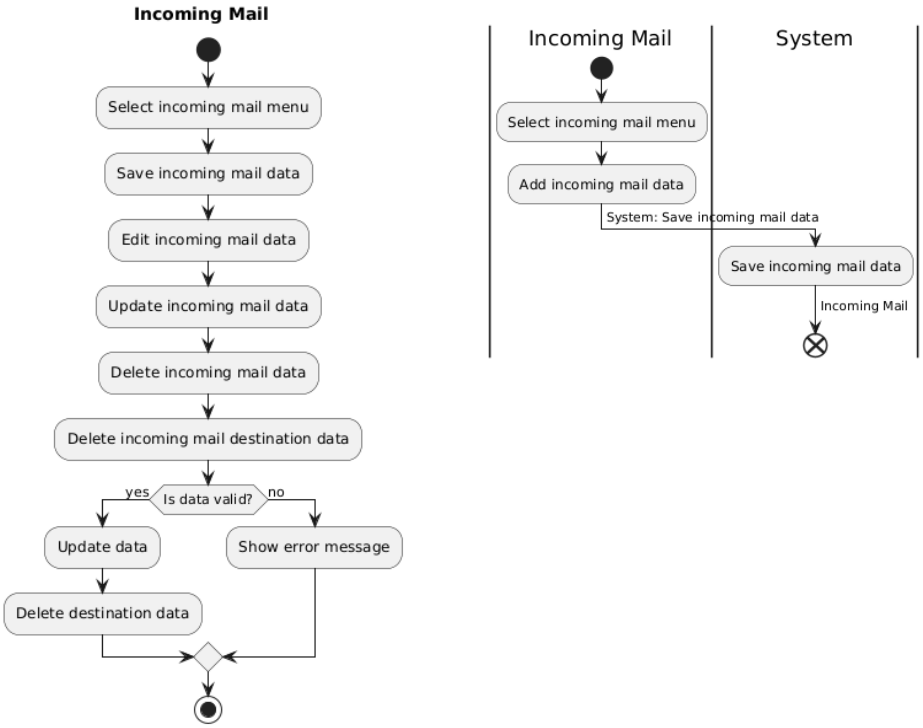


Figure 4. (a) Activity Diagram for Admin Login and (b) Activity Diagram for User Login

Figure 4a illustrates about the Admin Login Activity Diagram represents the process through which the admin accesses the system and is directed to the login page. To proceed, the admin must enter a valid username and password stored in the database. If the credentials are correct, the system grants access to the admin's main dashboard. However, if the credentials are incorrect, the system remains on the login page and displays a notification stating, “Incorrect username or password”.

Similarly, the User Login Activity Diagram, illustrated in Figure 4b regarding follows the same process, where users must input the correct credentials to access the system. Upon successful authentication, they are directed to the user dashboard; otherwise, they receive an error notification and remain on the login page.

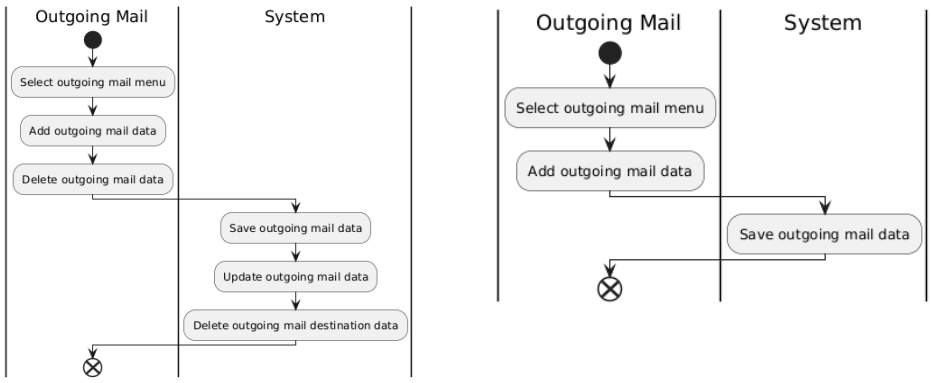
Figure 5. (a) Incoming Mail Activity Diagram for Admin and (b) Incoming Mail Activity Diagram for User



(a) (b)

Figure 5 shows about the Incoming Letter Activity Diagram for Admin illustrates the workflow for managing incoming letters. Admins have the ability to add, modify, delete, and search for letter records within the system. Meanwhile, the Incoming Letter Activity Diagram for Users depicts a simplified workflow, where users can only add and save incoming letter data.

Figure 6. (a) Outgoing Mail Activity Diagram for Admin and (b) Outgoing Mail Activity Diagram for User



(a) (b)

Figure 6 depict concerning the Outgoing Letter Activity Diagram for Admin outlines the process through which admins handle outgoing letters. Similar to incoming letter management, admins can add, edit, delete, and search for outgoing letter records. In contrast, the Outgoing Letter Activity Diagram for Users allows users to add and save outgoing letter data but with limited administrative privileges. These activity diagrams provide a comprehensive visualization of the system's workflow, ensuring clarity in the roles and functionalities available to both admins and users in managing letter transactions effectively.

3.2.3 Sequence diagram

The login sequence diagram illustrates in Figure 7 how the admin can access the incoming and outgoing mail service information system at the Baloi Permai Village Office. The system displays the login page,

where users must enter their credentials correctly. If the username and password match the stored data in the database, the system grants access to the admin's main page. However, if the credentials are incorrect, the system remains on the login page and displays a notification stating, "Your username or password is incorrect".

Figure 7.
Sequence Diagram – Login

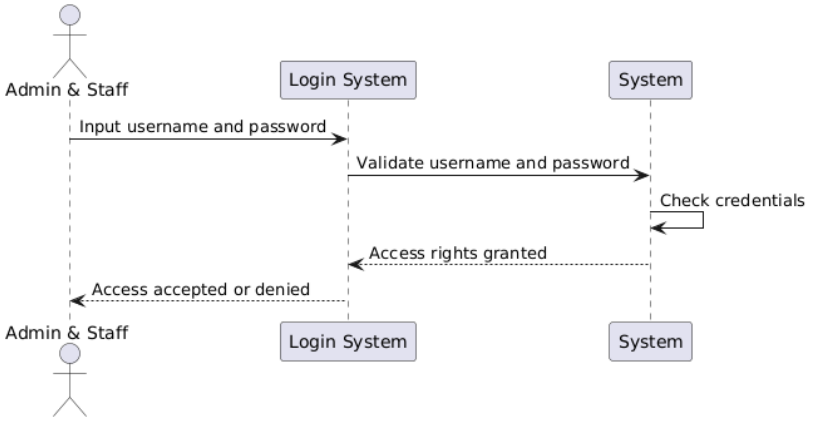


Figure 8.
Sequence diagram E-letter application

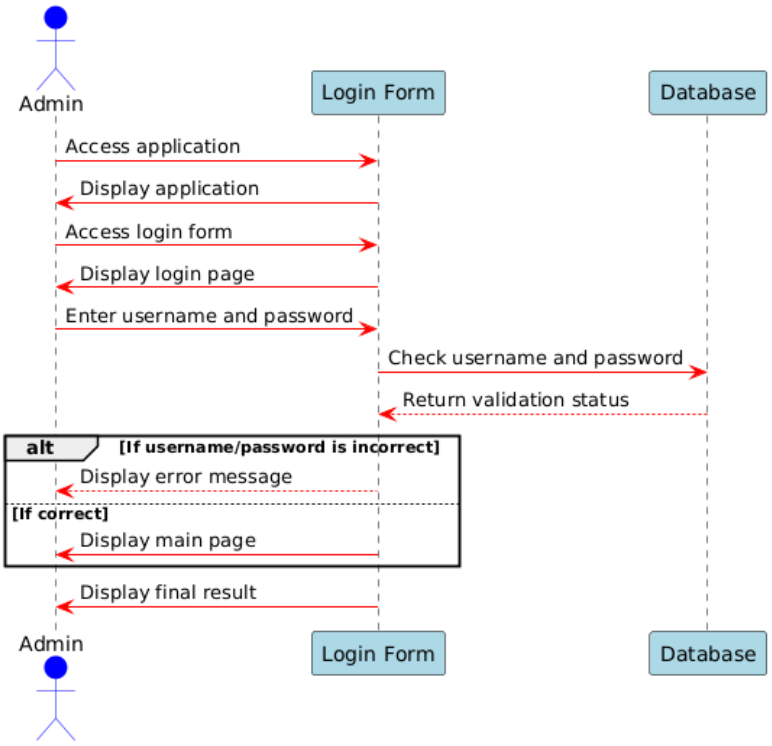


Figure 9.
Sequence Diagram – Incoming letter (Admin)

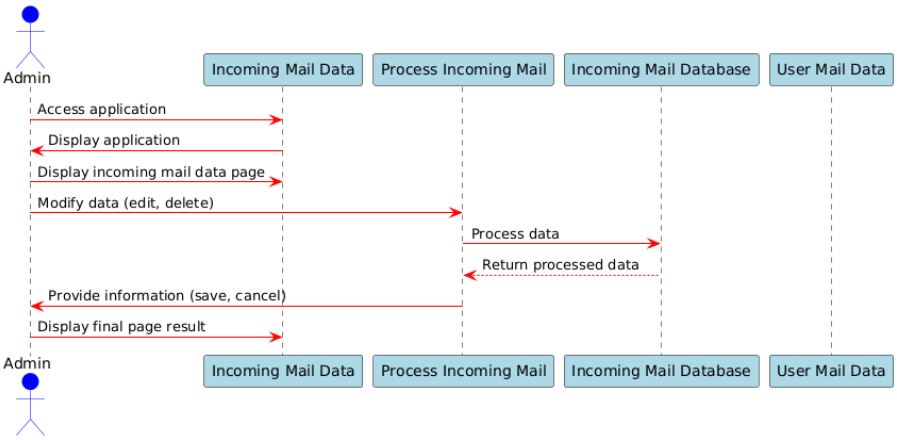


Figure 10. Sequence Diagram – Incoming letter (User)

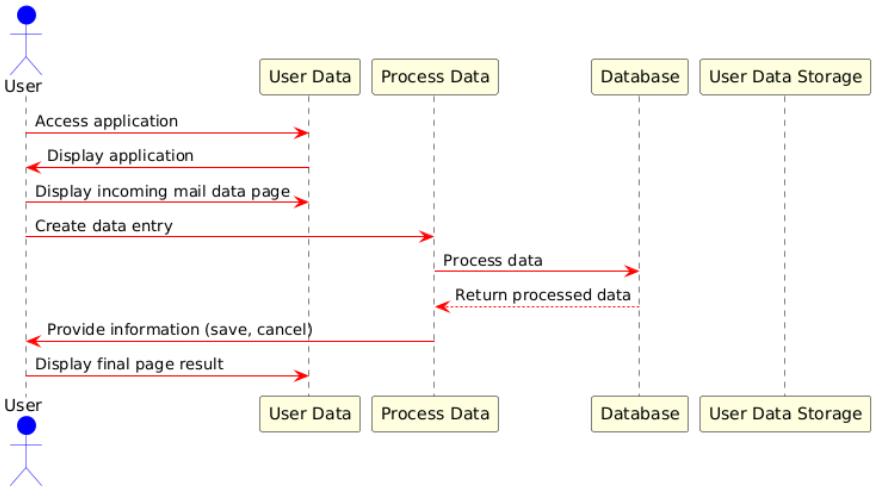


Figure 11. Sequence Diagram – Outgoing letter (Admin)

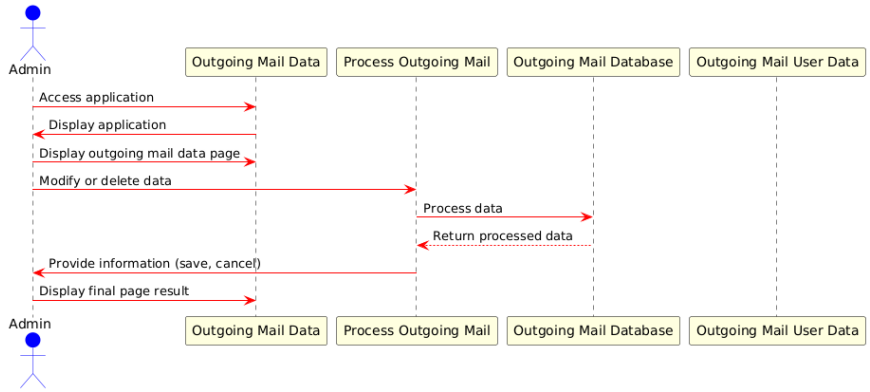
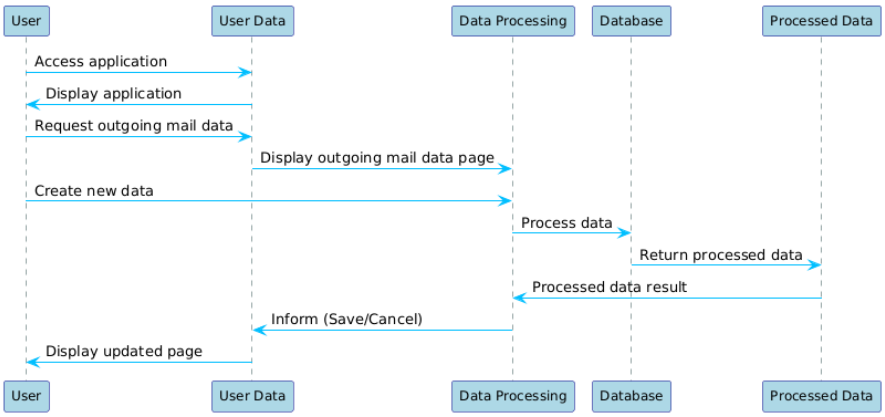


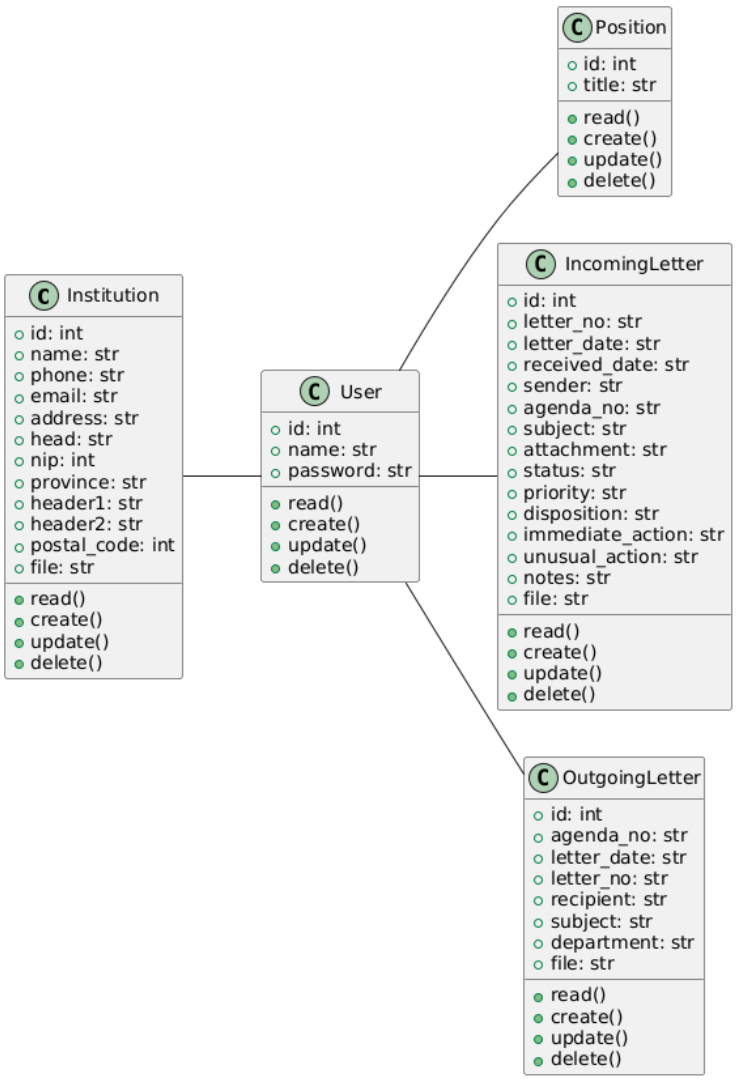
Figure 12. Sequence Diagram – Outgoing letter (User)



3.2.4 Class diagram

The Class Diagram of the Information System for Incoming and Outgoing letter Services at the Baloi Permai Village Office, as illustrated in Figure 13, consists of several interconnected entities that support efficient letter data management. This diagram represents the database structure and information flow within the system.

Figure 13.
Class Diagram – E-latter



The Institution entity represents organizational data, including contact information and institutional identity. The User entity acts as the system operator, with the ability to read, create, update, and delete information. Each user can have a Position that defines their access rights within the system. Incoming mail is managed through the IncomingLetter entity, which records key details such as letter number, receipt date, sender, status, and attachments. Meanwhile, outgoing letter is represented by the OutgoingLetter entity, storing recipient details, agenda number, and related departments. The relationships between these entities reflect the workflow of the letter service, ensuring that every document can be tracked from reception to archiving. With this system, the village office can enhance document management efficiency, minimize data loss risks, and accelerate the distribution of information.

To support the efficient management of incoming and outgoing letter, a well-structured database design has been developed for the E-letter Information System at the Baloi Permai Village Office. This database design plays a crucial role in ensuring seamless data storage, retrieval, and processing within the system. The database structure includes key relational schemas and table designs, which facilitate organized data management. The E- letter database consists of several essential tables, as outlined in Table 3, including:

Table 3.
E-letter Database

Table name	Description
Users	Stores system user data
Positions	Records employee position data
Institutions	Contains institutional data
Incoming Letter	Manages incoming letter records
Outgoing Letter	Tracks outgoing letter records

Table 4. Incoming Letter Data Structure for Efficient Document Management

Field name	Type	Size	Description
Id	Bigint	-	Data sequence
letter_no	Varchar	255	Letter number
letter_date	Date	-	Creation date
received_date	Date	-	Reception date
sender	Varchar	255	Sending institution
agenda_no	Varchar	255	Activity agenda number
subject	Varchar	255	Purpose
attachment	Varchar	255	Document attachment
letter_status	Varchar	255	Status
letter_nature	Varchar	255	Letter nature
disposition	Varchar	255	Letter disposition
urgent_action	Varchar	255	Urgent action
regular_action	Varchar	255	Regular action
notes	Varchar	255	Notes
file	Varchar	255	Attachment storage location
created_at	Timestamp	-	Creation time
updated_at	Timestamp	-	Update time

Table 5. Outgoing Letter Data Schema for Streamlined Communication Tracking

Field name	Type	Size	Description
Id	Bigint	-	Data sequence
agenda_no	Varchar	255	Activity agenda number
letter_date	Varchar	255	Letter date
letter_no	Varchar	255	Letter number
recipient	Varchar	255	Letter recipient
subject	Varchar	255	Purpose
department	Varchar	255	Department
file	Varchar	255	Attachment storage location
created_at	Timestamp	-	Creation time
updated_at	Timestamp	-	Update time

3.3 User interface

The user interface design of the E-letter Information System is tailored to accommodate different user roles, including administrators and general users. The interface is structured to provide intuitive navigation and efficient access to system features. Detailed interface and navigation designs for the incoming and outgoing letter service system at the Baloi Permai Village Office are illustrated in the following figures.

Figure 12. Login page design

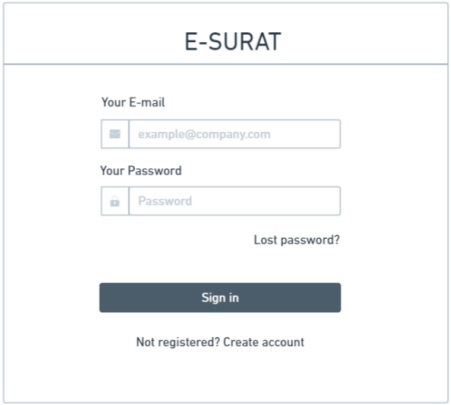


Figure 13. Employee data management page

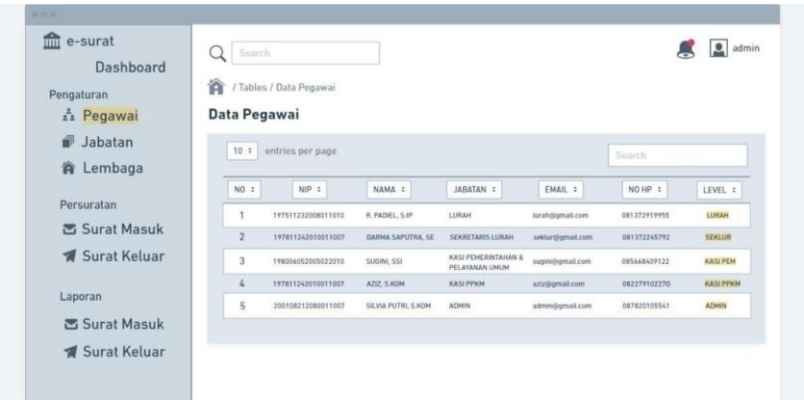


Figure 14. Institution management page

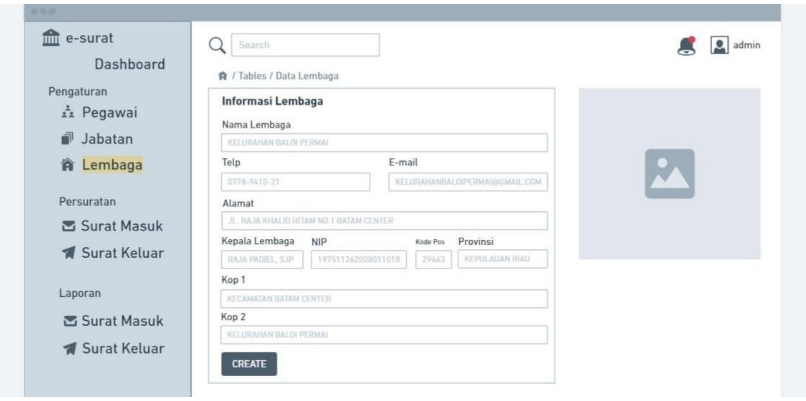


Figure 15. Incoming letter report page

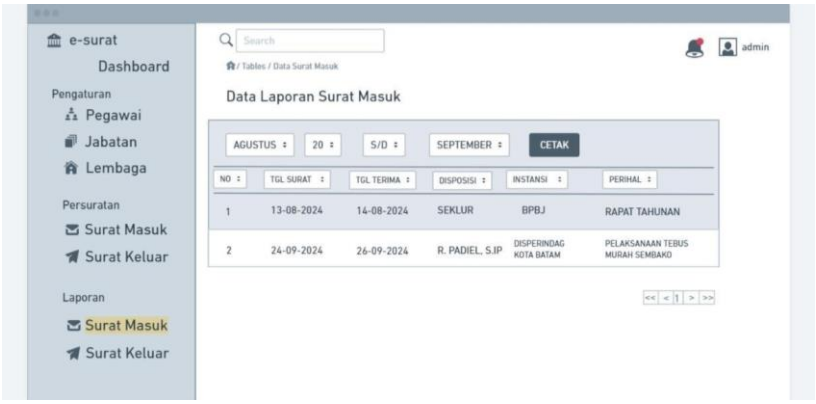
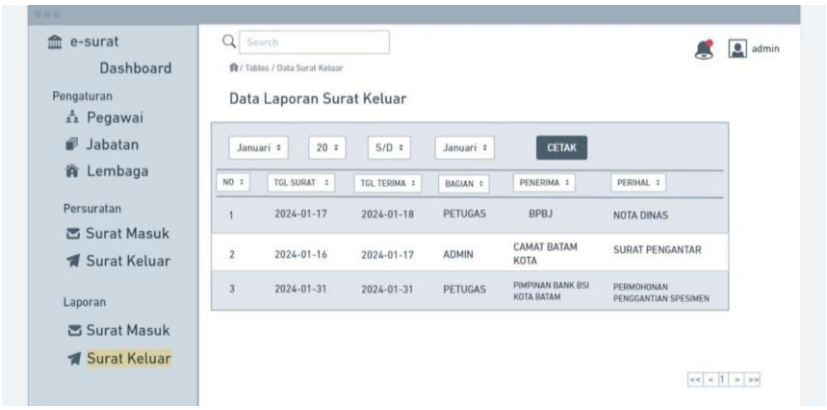


Figure 16. Outgoing letter report page



3.4 Implementation of program code

The program code is implemented using PHP for backend development and MySQL for database management. The coding process is carried out using Notepad++ as the text editor for writing and running the application, showned in Coding 1.

Coding 1. Optimized PHP & MySQL Implementation for Seamless E-letter Management

```
'connections' => [

    'sqlite' => [
        'driver' => 'sqlite',
        'url' => env('DATABASE_URL'),
        'database' => env('DB_DATABASE', database_path('database.sqlite')),
        'prefix' => '',
        'foreign_key_constraints' => env('DB_FOREIGN_KEYS', true),
    ],

    'mysql' => [
        'driver' => 'mysql',
        'url' => env('DATABASE_URL'),
        'host' => env('DB_HOST', '127.0.0.1'),
        'port' => env('DB_PORT', '3306'),
        'database' => env('DB_DATABASE', 'forge'),
        'username' => env('DB_USERNAME', 'forge'),
        'password' => env('DB_PASSWORD', ''),
        'unix_socket' => env('DB_SOCKET', ''),
        'charset' => 'utf8mb4',
        'collation' => 'utf8mb4_unicode_ci',
        'prefix' => '',
        'prefix_indexes' => true,
        'strict' => true,
        'engine' => null,
        'options' => extension_loaded('pdo_mysql') ? array_filter([
            PDO::MYSQL_ATTR_SSL_CA =>
env('MYSQL_ATTR_SSL_CA'),
        ]) : [],
    ],
];
```


3.5 System testing

The system underwent rigorous testing to ensure its functionality and compliance with the specified requirements. The testing phase focused on black-box testing, which evaluates whether the developed system aligns with the functional specifications. This method was applied to assess various system features, particularly those involved in managing incoming and outgoing correspondence within the E-letter Information System at the Baloi Permai Urban Village Office. The black-box testing approach was used to verify whether each module functioned correctly and met user expectations. The primary goal was to confirm that all features, including user management, document tracking, and report generation, operated as intended. Table 6 presents the results of the black-box testing conducted on the E-letter Admin Page, detailing the expected outcomes and actual test results for each system functionality.

Table 6. Incoming letter Data Structure for Efficient Document Management

Testing activity	Expected outcome	Result
Main Page	Display login menu	Success
Dashboard	Display dashboard data	Success
User Management	Display user data	Success
Employee Management	Display employee data	Success
Job Positions	Display job position data	Success
Institutions	Display institution information	Success

User Search	Display user search results	Success
Incoming Letters	Display incoming letter data	Success
Add Incoming Letter	Display add incoming letter form	Success
Outgoing Letters	Display outgoing letter data	Success
Add Outgoing Letter	Display add outgoing letter form	Success
Incoming Letter Report	Display incoming letter reports	Success
Outgoing Letter Report	Display outgoing letter reports	Success
Edit Incoming Letter	Display incoming letter edit form	Success
Delete Incoming Letter	Display delete incoming letter command	Success
Print Incoming Letter	Display print incoming letter command	Success
View Outgoing Letter	Display outgoing letter data	Success

The testing was conducted in collaboration with the Baloi Permai Urban Village Office, where multiple sample test cases were executed to evaluate the system's reliability. The results confirmed that the system functions as expected and fulfills the intended operational requirements. However, it is important to note that this testing phase was limited to black-box testing and was conducted from a single perspective. Despite this limitation, the test cases adequately represent the core functionalities of the E-letter Information System, ensuring its usability and effectiveness in managing official correspondence. Future testing phases should include more comprehensive evaluations, such as performance testing, security testing, and user acceptance testing, to further enhance the system's robustness and reliability.

3.6 Discussions, benefits, limitations and and future directions

The findings of this study highlight the significant impact of digitizing the administrative processes in urban village offices, particularly in the management of incoming and outgoing letters. The implementation of the E-letter system has demonstrated improvements in efficiency, accuracy, and accessibility, which are critical for modernizing public administration at the local level. One of the key benefits observed from this study is the enhancement of administrative efficiency. The traditional paper-based system posed several challenges, including slow processing times, frequent data mismanagement, and excessive reliance on manual documentation. By transitioning to a web-based system, the Baloi Permai Urban Village Office has reduced the burden of manual paperwork and enabled real-time tracking of document processing. This aligns with previous research emphasizing the role of digital transformation in improving government service delivery (Filgueiras et al., 2019; Latupeirissa et al., 2024; Shibambu & Ngoepe, 2024). Another significant outcome is the improvement in transparency and accountability in document management. The E-letter system allows real-time monitoring of letter status, ensuring that documents are processed promptly and minimizing the risk of data loss or manipulation. This feature addresses public concerns regarding slow government response times and inefficient bureaucracy, as highlighted in earlier studies on e-Government adoption (Umbach & Tkalec, 2022). Furthermore, the system's ability to generate automated reports enhances accountability by providing a verifiable record of document processing.

The study also demonstrates that a modular and scalable system architecture can facilitate further enhancements, such as integrating digital payments, automated workflow approvals, and IoT-based tracking for document security. The adoption of PHP and MySQL with the Laravel framework ensures system flexibility, allowing for future improvements without extensive restructuring. This finding is in line with previous research indicating the importance of scalable digital solutions for local government offices (David et al., 2023; Xu & Dai, 2024). Despite its benefits, the implementation of E-letter faced some challenges, particularly in terms of user adoption and training. The transition from a manual system to a digital platform required significant staff training and adaptation, as some employees had limited experience with digital tools. Additionally, the lack of internet infrastructure in some areas posed occasional barriers to system accessibility. These findings suggest that successful digital transformation in government offices requires comprehensive capacity-building initiatives and investment in IT infrastructure (David et al., 2023; Xu & Dai, 2024).

Future research on web-based information systems for government offices can explore expanding system capabilities beyond managing correspondence, incorporating digital signatures, automated workflows, and integration with national e-Government platforms. Implementing AI and blockchain technology could enhance document classification, security, and verification, ensuring efficiency and data integrity. Additionally, studies on scalability for larger administrative units, mobile accessibility, and IoT integration could improve system adaptability and user convenience. Evaluating user experience and addressing legal and policy challenges would further support the effective implementation of digital government services.

4. Conclusion

This study successfully designed and implemented a web-based information system for managing incoming and outgoing correspondence at the Baloi Permai Subdistrict Office. A comprehensive needs analysis revealed significant limitations in the previous manual system, particularly in terms of document processing efficiency and information transparency. Consequently, the new system was developed with a focus on improving service speed, accessibility, and administrative transparency. Utilizing the Laravel framework, PHP, and MySQL, the system provides essential features such as user management, digital recording of incoming and outgoing correspondence, and document status tracking. The UML-based system design ensures a well-structured approach to user requirements, while black-box testing confirms that the system functions according to the expected specifications. The implementation of this system has had a positive impact on administrative management by enhancing data recording accuracy, accelerating document processing, and facilitating public access to correspondence-related information. Furthermore, the system's flexibility allows for future development and potential adoption by other government institutions facing similar challenges in document management. By integrating this digital solution, the Baloi Permai Subdistrict Office can offer more efficient, transparent, and responsive public services.

Author's Declaration

Author contribution

Silvia Agusfiani Putri: Conceptualization, Methodology, Investigation, Formal analysis, and Writing - Original Draft. **Indah Kusuma Dewi:** Validation, Data Curation, and Review & Editing-Original Draft. **Afrina:** Supervision, Conceptualization, Methodology, and Review & Editing-Original Draft.

Funding statement

This research does not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgement

The authors would like to thank those who have helped during the research.

Conflict of interest

The authors declare that they have no identifiable financial or personal conflicts of interest that could have influenced the results presented in this paper.

Ethical clearance

This research does not involve humans as subjects.

AI Statement

This article is the original work of the authors without assistance of AI tools in generating sentences, creating, and/or editing images and/or tables presented in this manuscript. The grammar of the manuscript was improved using ChatGPT, and the authors have carefully reviewed the generated suggestions to ensure consistency with the topic and data of the study. The language use and data presented in this article have been validated and verified by an English language expert.

Publisher's and Journal's Note

Researcher and Lecturer Society as the publisher, and the editor of Journal of Computer-Based Instructional Media state that there is no conflict of interest towards this article publication.

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