


Design and Development of a Web-Based Library Application for Sawah Subdistrict, South Tangerang

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Article Info	ABSTRACT
<p>Keywords: Library Information System, Web-Based Application, Waterfall Model, Public Service, Information Technology</p>	<p>The rapid advancement of information technology has encouraged public service institutions, including libraries, to adopt digital systems to enhance service efficiency and accessibility. This study aims to design and implement a web-based library information system for the Sawah Subdistrict Office in South Tangerang. The research employs the System Development Life Cycle with the Waterfall model, covering stages of requirement analysis, system design, coding, and testing. Data were obtained through field observations, interviews, and literature reviews. The developed system enables library staff to manage book collections, member data, and loan transactions more efficiently, while allowing users to access real-time information on book availability. The implementation of the system improves data accuracy, expands service reach, and facilitates automatic report generation. The findings demonstrate that integrating a web-based system into library management can optimize operations, enhance transparency, and provide better services to the community.</p>
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INTRODUCTION

Libraries play a central role in the dissemination of knowledge, not only as repositories of books but also as community learning centers that support education, research, and information access for all members of society. In the digital era, the role of libraries is no longer limited to physical collections; rather, it extends to providing seamless access to various information sources through digital platforms (Saputra & Nugroho, 2017). This transformation aligns with the global movement toward creating more inclusive and accessible public services.

The integration of information and communication technology into library operations has been shown to improve efficiency, data accuracy, and user satisfaction (Nugraha, 2014). Digital library systems allow users to search for and borrow resources online, receive updates on availability, and interact with library services without being constrained by time or location.

This level of flexibility reflects the evolving needs of communities in an increasingly connected world.

However, in many local government offices in Indonesia, including village and subdistrict administrations, library services still operate manually. Such systems are prone to recording errors, inefficient book searches, and delays in updating collection availability, which hinder the delivery of effective services (Maryono & Darwati, 2017). These challenges highlight the urgency of adopting digital solutions to modernize library operations.

The Sawah Subdistrict Office in South Tangerang is an example of a public service institution facing these operational challenges. Despite its strategic role in providing educational resources, its library continues to rely on manual systems. As a result, service quality is affected, and public engagement with the library remains low. A shift toward a web-based information system could address these limitations and significantly enhance service delivery.

Previous studies have demonstrated the benefits of adopting web-based systems for library management. For instance, Dari, Sari, and Astrilyana (2019) emphasized that real-time access to book availability improves operational efficiency and user experience. Moreover, digital systems streamline administrative processes, enabling library staff to focus more on service improvement rather than manual record-keeping.

The development of such systems often follows structured methodologies to ensure reliability and effectiveness. The System Development Life Cycle (SDLC) with the Waterfall model is one such methodology, known for its clear, sequential stages from requirement analysis to system testing (Rosa & Shalahuddin, 2015). This approach has been widely applied in the development of information systems in various sectors, including education and public services.

In designing a library information system for the Sawah Subdistrict Office, it is essential to consider not only functional requirements such as catalog browsing and transaction recording but also non-functional aspects like security, data integrity, and ease of use. As highlighted by Santoso and Iskandar (2020), an application's success depends on its ability to meet both technical specifications and user expectations.

Another critical factor is the role of user interface design in ensuring system adoption. According to Wahyudin et al. (2021), intuitive and user-friendly interfaces encourage consistent use and reduce the learning curve for both staff and the public. For library systems, this means creating accessible navigation for various user roles, including administrators, librarians, and visitors.

The shift toward digital systems in public libraries also aligns with the government's broader agenda to promote e-government and improve public service transparency. By enabling online access to library resources, the Sawah Subdistrict can extend its reach beyond physical visitors, thus fostering a more informed and literate community (Indahsari & Roni, 2022).

Given these considerations, this study aims to design and implement a web-based library information system tailored to the needs of the Sawah Subdistrict Office. The system is expected to enhance operational efficiency, improve service quality, and expand the

library's accessibility to a wider audience. In doing so, it contributes to the ongoing digital transformation of public services in Indonesia.

METHODS

This study adopts the System Development Life Cycle (SDLC) approach, specifically applying the Waterfall model, which provides a structured and sequential process for system development. The Waterfall model was chosen because of its clarity in defining each stage of development, from requirement analysis to system maintenance, ensuring that each phase is completed before moving on to the next (Rosa & Shalahuddin, 2015). This method is particularly suitable for projects with well-defined requirements and minimal anticipated changes during development.

The requirement analysis stage involved identifying and documenting the functional and non-functional needs of the library system. Functional requirements focused on features such as user authentication, book catalog browsing, loan and return transaction management, and report generation. Non-functional requirements emphasized security, system reliability, and ease of navigation. Data collection for this stage was conducted through direct observation and structured interviews with library staff and administrators, ensuring that the system would meet the specific needs of the Sawah Subdistrict Office.

During the system design stage, the identified requirements were translated into a detailed design blueprint using the Unified Modeling Language (UML). Use case diagrams, activity diagrams, and class diagrams were created to represent the system's architecture and workflow. This stage also included database design, ensuring that data could be stored, retrieved, and updated efficiently. The design phase played a crucial role in preventing misinterpretations during the coding process (Prihandoyo, 2018).

The coding and implementation stage transformed the system design into a working application. The system was developed using PHP as the primary programming language, supported by a MySQL database for data management. Following the design specifications, each module—such as member management, book management, and transaction processing—was coded and integrated to ensure smooth operation. Attention was given to maintaining clean, documented code to facilitate future updates and maintenance (Sianipar, 2015).

In the testing phase, the system underwent black-box testing, a method that focuses on evaluating system functionality without examining internal code structures. This approach ensured that the system's outputs matched the expected results for given inputs. Test scenarios covered critical functionalities, including login authentication, book search, transaction processing, and report generation. Any detected errors were addressed promptly to guarantee the system's reliability before deployment (Wijaya & Astuti, 2021).

The data collection methods comprised both field and literature studies. Field studies included direct observation of library operations to identify existing challenges, while interviews with staff provided deeper insights into operational workflows. Literature studies involved reviewing books, academic journals, and online resources to gather theoretical

foundations for system design and to benchmark against similar implementations in other public service institutions (Rahmawati & Bachtiar, 2018).

System evaluation was conducted to ensure that the developed application aligned with its intended goals of improving efficiency, accessibility, and service quality. Feedback from staff during the testing phase was crucial for refining the user interface and optimizing navigation. The evaluation also examined how well the system supported the generation of automatic reports, an essential feature for library performance monitoring.

RESULTS AND DISCUSSION

Software Requirements Analysis

There are three types of users who can directly interact with the system: staff, members, and administrators, each with different access rights and needs.

1. Staff can log in to manage loan transactions, returns, book data, and member records, and log out of the system.
2. Administrators have full access, including transaction management, book and member data management, report generation, and system exit.
3. Members/Visitors can register as members, browse the library catalog, and view book details such as title, author, publisher, category, and availability.

The application must fulfill essential system requirements to ensure smooth and secure operation:

1. Login & Security – All users must log in with a username and password to secure data and separate access rights.
2. Logout – Users must log out after use to prevent unauthorized access.
3. Transaction & Payment Management – The system should record transactions in real time and process payments.
4. Automatic Reporting – The system should generate reports automatically for administrators, with export options to formats such as Excel or PDF.

Design

At this stage, the system design is carried out using Unified Modeling Language (UML) diagrams, including use case and activity diagrams, to translate software requirements from the analysis phase into a well-structured and clearly defined design. This ensures that the program can be implemented effectively in the next stage. The resulting software design documentation serves as a crucial element in guaranteeing smooth implementation and future system maintenance.

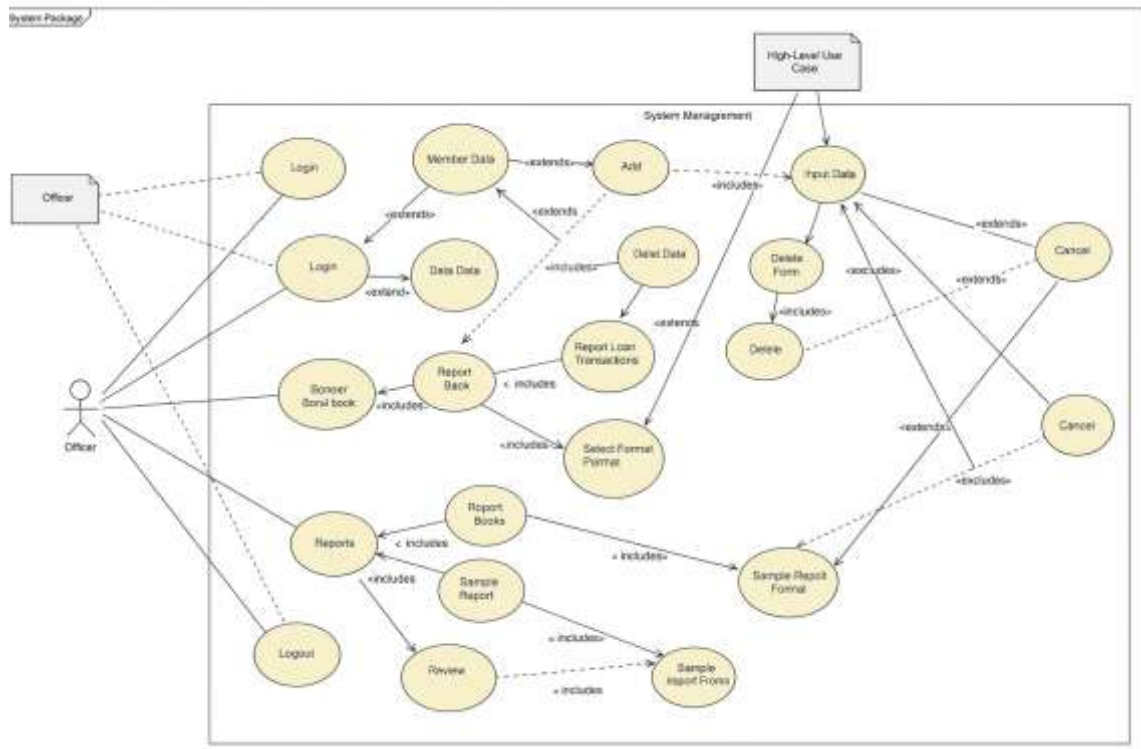


Figure 1. Use Case Diagram for Library Management System

This diagram illustrates the interactions between the "Officer" actor and various system functions, including member management, book transactions, and report generation. It uses UML notation to depict relationships such as include and extend between use cases for structured system design.

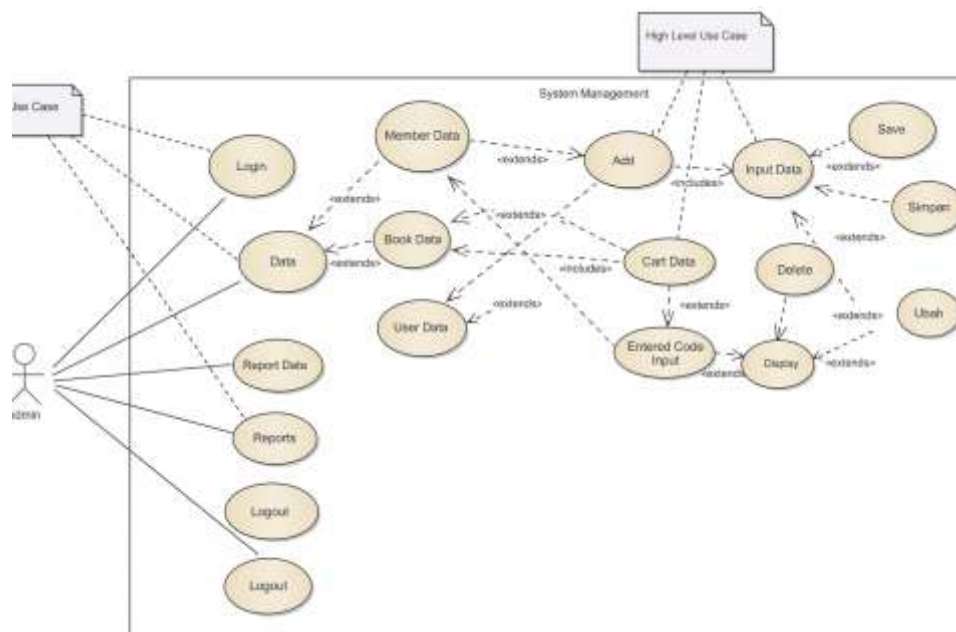


Figure 2. Use Case Diagram for Library Management System (Admin Access)

This diagram shows how the "Admin" interacts with system functions such as managing member data, book data, and user data, as well as performing transactions like data input, deletion, and updates. It uses UML notation to illustrate include and extend relationships, ensuring a clear representation of system workflows.

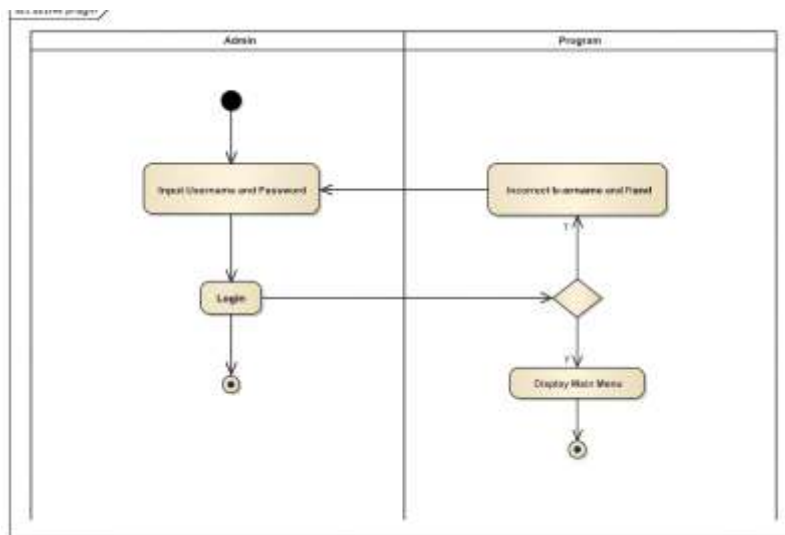


Figure 3. Activity Diagram for Admin Login Process

This diagram illustrates the steps in the admin login process, starting from entering a username and password, verifying credentials, handling incorrect input, and displaying the main menu upon successful login. It uses UML swimlanes to separate admin actions from program responses.

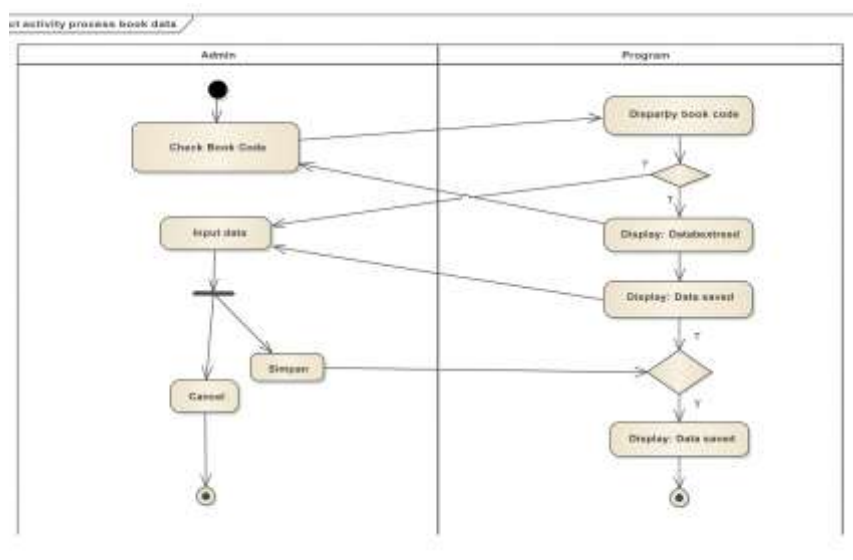


Figure 4. Activity Diagram for Processing Book Data

This diagram shows the steps in processing book data, starting from checking the book code, entering data, and deciding whether to save or cancel. It uses UML swimlanes to distinguish actions performed by the admin from processes handled by the program.

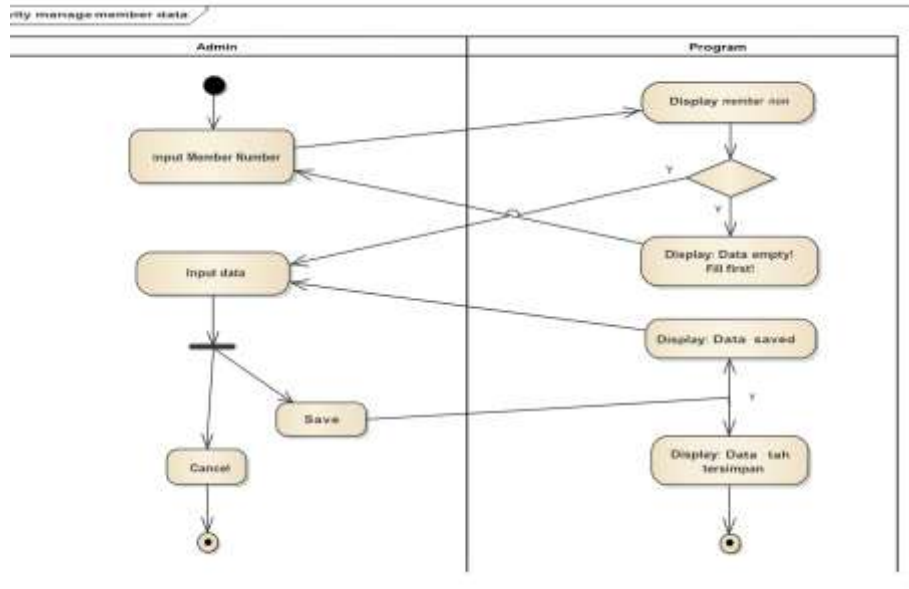


Figure 5. Activity Diagram for Managing Member Data

This diagram illustrates the process of managing member data, beginning with entering a member number, verifying its existence, and handling empty or duplicate data. It uses UML swimlanes to differentiate admin actions from system processes, ending with either saving or canceling the data entry.

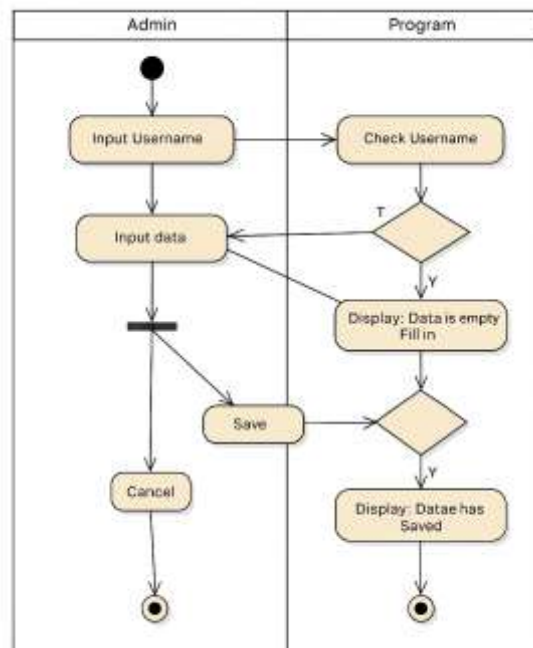


Figure 6. Activity Diagram for Managing User Data

This diagram illustrates the process of managing user data, starting from entering a username, verifying it, and handling empty data entries. It uses UML swimlanes to separate admin actions from program processes, ending with either saving or canceling the data entry.

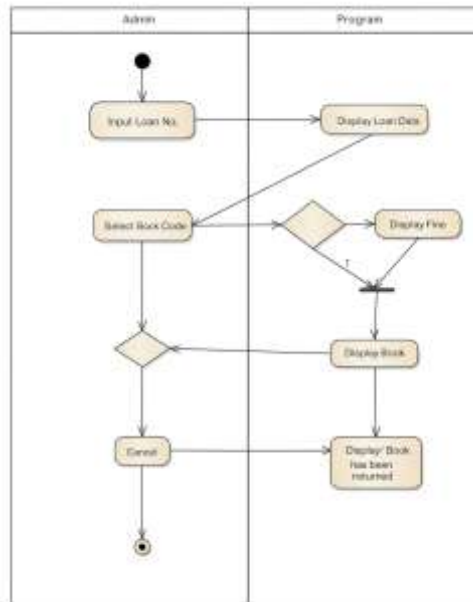


Figure 7. Activity Diagram for Processing Book Returns

This diagram illustrates the process of returning books, starting from entering the loan number, selecting the book code, and checking for fines. It uses UML swimlanes to separate admin actions from program processes, ending with confirmation that the book has been returned.

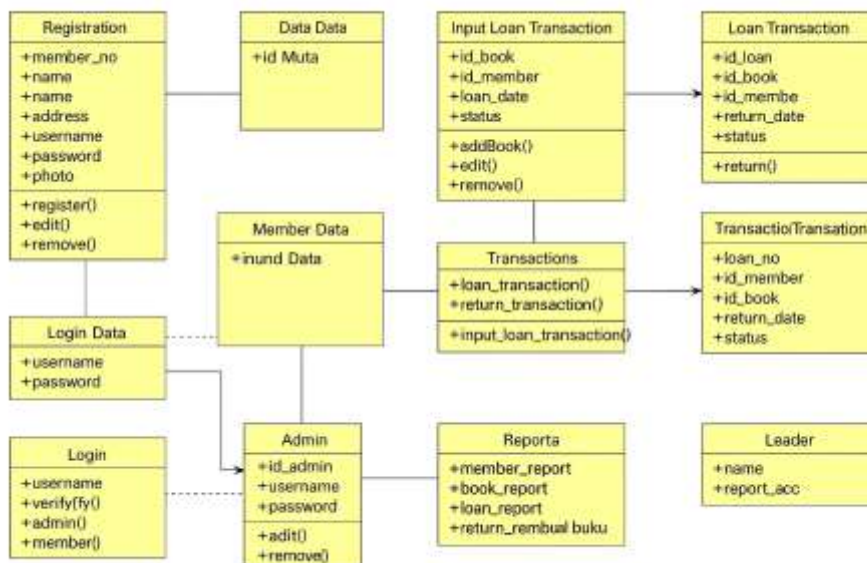


Figure 8. UML Class Diagram of Library Management System

This diagram illustrates the structure of a library management system, showing nine interconnected classes such as Registration, Book Data, Borrowing Transactions, and Reports. Each class includes its attributes and methods, representing the relationships and functions within the system.

User Interface

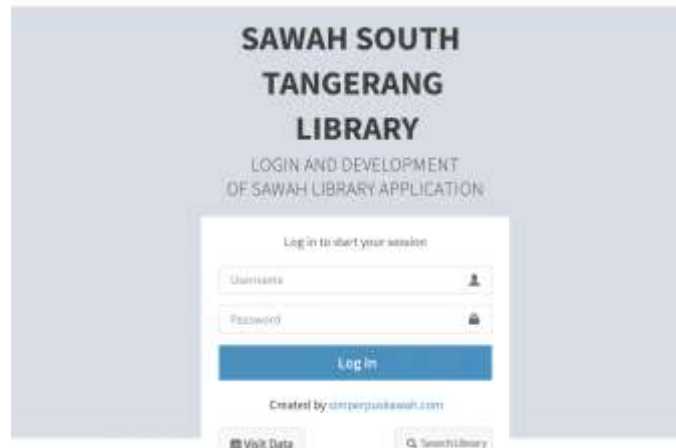


Figure 9. Sawah South Tangerang Library Login Page

This image shows the login interface for the Sawah South Tangerang Library application. Users can enter their username and password to start a session, with additional options to view visit data or search for library materials.

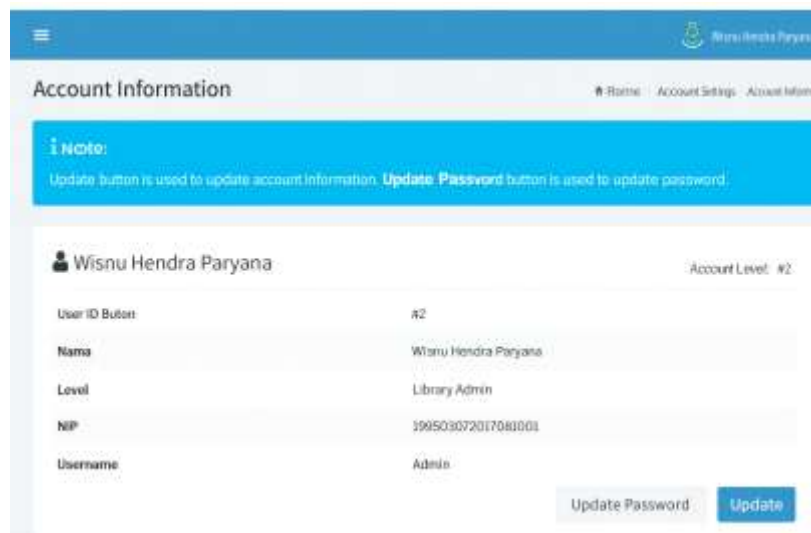


Figure 10. Account Information Page

This image shows the account information page for Wisnu Hendra Paryana, displaying details such as user ID, name, role, NIP, and username. It also features options to update account details or change the password.

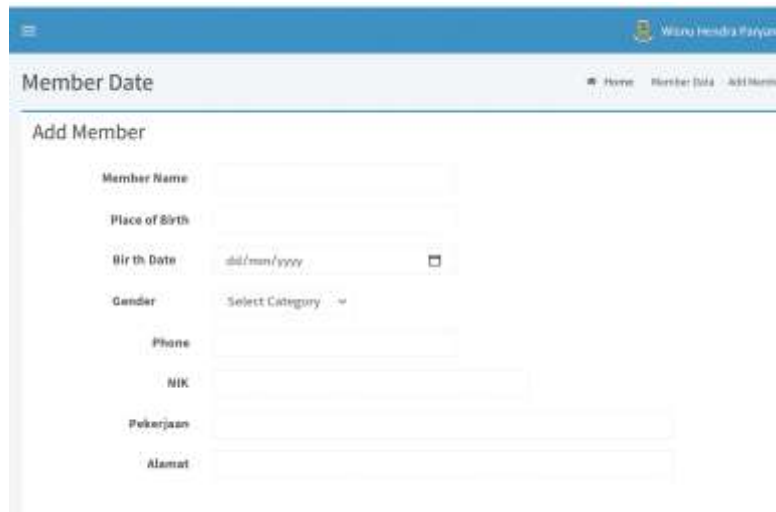


Figure 11. Add Member Form – Library Management System

This image shows the "Add Member" page of a library management system with fields for personal information such as name, birth details, gender, contact, and address. The layout is clean and minimalistic, making it user-friendly for data entry.

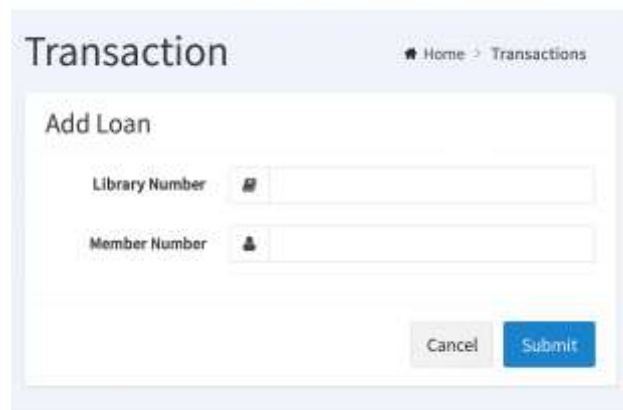


Figure 12. Add Loan Transaction Form

This image shows the "Add Loan" form in a library management system, allowing users to input the library item number and member number. It features action buttons for completing or canceling the loan entry.

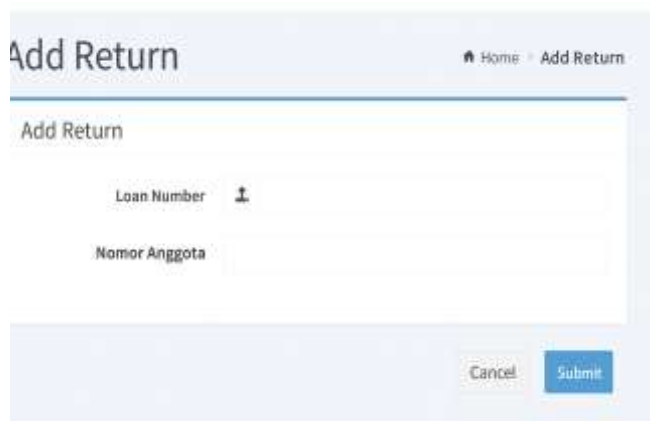


Figure 13. Add Return Transaction Page

This screenshot displays the "Add Return" interface in a library management system. It allows staff to input a loan number to record the return of borrowed library materials.

Table 1. Loan Report Print Form

No	Date	ID	Borrower Name	Book Title
1	22/01/24	15288	Desi Ambarwati	Radar Performance Analysis; Modeling Process Stage
2	22/01/24	22149	Edi Supriyanto	Android & Database Programming
3	22/01/24	38007	Abdullah	Radar Performance Analysis; Modeling Process Stage
4	17/01/19	72797	Adi Permana Putra	Radar Performance Analysis; Modeling Process Stage
5	13/01/19	44519	Wira Eka Indradjaja	Installation Techniques and Re-mastering Windows Operating System
6	12/1/2019	77250	Utari Ida Chandra	Introduction to Basic Android Programming
7	12/1/2019	88582	Wira Eka Indradjaja	Introduction to Basic Android Programming
8	12/1/2019	88569	Sudomo Purama Tan	Introduction to Information Systems Revised Edition
9	11/1/2019	52188	Bambang Kuwat Setiawan	Introduction to Information Systems Revised Edition
10	11/1/2019	88560	Sudomo Purama Tan	Introduction to Information Systems Revised Edition
11	11/1/2019	56987	Limjatmi Xiu Chandra	Radar Performance Analysis; Modeling Process Stage
12	9/1/2019	89567	Adi Permana Putra	Introduction to Information Systems Revised Edition

This table presents the loan transactions recorded on January 23, 2024, listing borrower details such as date, ID, name, and the borrowed book title. It provides a clear summary of library borrowing activities for that specific period.

Table 2. Book Return Table

No.	Date	ID	Borrower Name	Book Title	Delay (days)
1	16/01/19	88567	Wira Eka Indradjaja	Windows System Installation Techniques and Re-mastering	0
2	12/1/2019	22699	Adi Permana Putra	Introduction to Basic Android Programming	0
3	12/1/2019	24347	Adi Permana Putra	Introduction to Information Systems (Revised Edition)	3
4	12/1/2019	22642	Bambang Kuwat Setiawan	Introduction to Information Systems (Revised Edition)	0
5	12/1/2019	66598	Sudomo Purama Tan	Introduction to Information Systems (Revised Edition)	0
6	12/1/2019	54678	Limijanti Xiu Chandra	Radar Performance Analysis: Modeling Process Stage	0
7	12/1/2019	31000	Adi Permana Putra	Introduction to Basic Android Programming	2
8	12/1/2019	52978	Wira Eka Indradjaja	Introduction to Basic Android Programming	0
9	10/1/2019	22691	Adi Permana Putra	Introduction to Information Systems (Revised Edition)	0
10	10/1/2019	78984	Adi Permana Putra	Radar Performance Analysis: Modeling Process Stage	0
11	30/12/18	54670	Adi Permana Putra	Introduction to Information Systems (Revised Edition)	0

This table shows the record of returned library books, including the return date, borrower details, book titles, and any delay in days. It provides a summary of borrowing compliance, with a total accumulated delay of 11 days across all transactions.

User Interface Design Testing

The system testing was conducted to ensure that the designed user interface functions according to user needs. Black-box testing was applied to the login form and the borrowing form, with the following being the list of test results.

Table 3. Login Form Testing Results

No	Testing Method	Test Input	Expected Outcome	Re- sult
1	Leaving all login input fields empty	Username: (empty) Password: (empty)	The system rejects login and displays the message "Username and password must be filled in."	OK
2	Entering username and leaving password empty	Username: (entered) Password: (empty)	The system rejects login and displays the message "Username and password must be filled in."	OK
3	Entering incorrect username but correct password	Username: (incorrect) Password: (correct)	The system denies access and displays the message "Username and password must be filled in."	OK
4	Entering correct username but incorrect password	Username: (operator) Password: (incorrect)	The system denies access and displays the message "Username and password must be filled in."	OK
5	Entering correct username and correct password	Username: (operator) Password: (123)	The system validates the login and displays the application's main menu.	OK

This table presents the borrowing form testing results, showing various input scenarios for library and member numbers. It confirms that the system correctly validates required fields and displays appropriate messages, ensuring accurate borrowing transactions.

Table 4. Borrowing Form Testing Results

No	Testing Method	Test Input	Expected Outcome	Result
1	Leaving both library number and member number empty	Library No: (empty) Member No: (empty)	The system displays the message "Library No must be filled in" and "Member No must be filled in."	OK
2	Entering library number but leaving member number empty	Library No: (1) Member No: (empty)	The system displays the message "Member No must be filled in."	OK
3	Leaving library number empty but entering member number	Library No: (empty) Member No: (1)	The system displays the message "Library No must be filled in."	OK

4	Entering both library number and member number	Library No: (1) Member No: (1)	The system displays the message "BOOK AVAILABLE."	OK
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This table outlines the borrowing form testing process, detailing different input conditions for library and member numbers. The results show that the system consistently enforces required field validations and provides appropriate feedback messages to guide users.

CONCLUSION

The testing of the login and borrowing forms demonstrates that the system's user interface functions effectively in validating input fields and providing accurate feedback to users. Through black-box testing, various scenarios were evaluated to ensure that the system responds appropriately to both correct and incorrect inputs. For the login form, the system successfully rejected empty or incorrect username and password entries by displaying clear error messages, while granting access only when both credentials were valid. Similarly, the borrowing form tests confirmed that the system consistently enforced the completion of mandatory fields, namely library number and member number, before allowing transactions to proceed. When both fields were left empty or partially filled, the system displayed relevant prompts to alert the user, and when both were completed, it confirmed the availability of the requested book. These results indicate that the input validation mechanisms are reliable and aligned with the intended design objectives. The system's ability to provide precise and informative feedback helps prevent user errors, improves operational efficiency, and enhances the overall user experience. Therefore, the interface design and functionality meet the defined requirements, ensuring the application's readiness for implementation in a real operational environment.

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