Design and Development of a Web-Based Library Management Information System

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Keywords
Library Management; Information System; Web-Based Application; Agile Development; User-Centered Design

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Abstract
Conventional library management processes are often slow and highly susceptible to human error. Data collection is generally done manually, a practice that leads to unorganized, messy archives and time-consuming data searches (Fatimah & Elmasari, 2018). These manual processes are inefficient, prone to inaccuracies, and can even lead to the loss of books when borrower data is not properly tracked. Some libraries utilize disparate digital tools like G-forms and Microsoft Excel, which introduces significant risks related to data security and potential data loss (Siregar & Harahap, 2024). This paper proposes the design and development of a centralized, web- based Library Management Information System to address these inefficiencies. The primary objective is to produce a functional Minimum Viable Product (MVP) to digitize and simplify core library operations. The system is developed using an Agile framework and a User-Centered Design (UCD) approach. The system will provide core functionalities including book management, member management, and transaction processing, with the goal of helping staff manage data easily and quickly (Siregar & Harahap, 2024). The success of this project will be evaluated through rigorous functional and usability testing, aiming for a 90% task completion rate by librarians and positive qualitative feedback confirming the system's feasibility and efficiency.

1. Introduction

The rapid development of technology has profoundly affected human life, including offering positive effects by simplifying daily activities. We are currently in an era, described by some as Society 5.0, where humans are encouraged to wisely utilize available technologies. This technological shift is highly relevant to libraries, which increasingly require technology-based information systems, such as web-based platforms, to meet modern service expectations (Siregar & Harahap, 2024).

Despite this, many libraries still rely on conventional, manual management processes. The practice of manual data collection is fraught with deficiencies. It frequently leads to unorganized archives, messy data, and inefficient, time-consuming data searches (Fatimah & Elmasari, 2018). This reliance on manual entry often causes numerous mistakes, data inaccuracies, and a high risk of permanent data loss (Fatimah & Elmasari, 2018). In some cases, books are lost entirely because the manual tracking of borrowers is insufficient or illegible.

Even institutions that have attempted partial digitization may use inadequate or disconnected tools. For example, some libraries use G-forms for data entry, with the results being fed into Microsoft Excel

spreadsheets (Siregar & Harahap, 2024). This approach remains problematic, as it fails to guarantee data security and remains highly vulnerable to data loss (Siregar & Harahap, 2024).

To address these shortcomings, this project proposes the development of a centralized, web-based Library Management Information System. A web-based system is proposed because it is easily accessible and allows staff to operate and manipulate data efficiently from a computer (Fatimah & Elmasari, 2018). This system will serve as a platform for librarians to manage the entire book collection, maintain member data, and digitally record all borrowing and return transactions.

The primary objective of this project is to deliver a Minimum Viable Product (MVP) of the Library Management Information System. This MVP will be functional, digitize the core operations of the library, and be ready for direct usability testing by librarians.

2. Research Methods

2.1. Development Framework

This project will adopt the Agile framework, utilizing an iterative approach. While other studies have successfully utilized development methods such as the Waterfall (Siregar & Harahap, 2024) or Extreme Programming (XP) (Fatimah & Elmasari, 2018), an Agile approach was chosen for this project. The Agile framework's iterative approach, organized into short sprints, allows for the rapid and incremental delivery of functional application components that can be evaluated immediately.

2.2. Design Approach

A User-Centered Design (UCD) approach is employed as the foundation for the system's design. The principal focus is on usability and establishing an intuitive workflow for the target users (librarians). The user interface will be designed to be clean, clear, and unambiguous to accelerate data entry and management processes.

2.3. Data Collection

To inform the UCD process and gather system requirements, data collection methods will be employed, drawing from established research practices. These methods include observation, interviews, and literature studies (Fatimah & Elmasari, 2018; Siregar & Harahap, 2024). Interviews with library staff will be essential for understanding specific user needs (Fatimah & Elmasari, 2018), while observation of the current manual processes will identify critical pain points.

2.4. Target User Profile

The primary target users for this system are the librarians or library administrative staff. These users are responsible for managing the book collection, handling membership data, and overseeing daily library operations. They require a system that is efficient, fast, and user-friendly to mitigate manual workloads and minimize the potential for errors.

2.5. Tools

The project will utilize the following tools for its workflow.
Design & Prototyping: Figma
Project Management: Notion
Version Control: Git

3. System Architecture and Design

3.1. Technical Architecture

The system is developed as a web application intended to be accessed via browsers on desktop devices. The technical stack is defined as follows:
Framework: Laravel (PHP)
Styling: React.js

Database: MySQL

The selection of PHP and MySQL is consistent with many successful web-based information systems (Fatimah & Elmasari, 2018; Siregar & Harahap, 2024), as PHP is a language well-suited for developing dynamic websites. The use of the Laravel framework implements the Model-View-Controller (MVC) pattern, which is noted in other frameworks for helping organize development (Siregar & Harahap, 2024).

3.2. System Design (UML)

The system design will be visualized, specified, and documented using the Unified Modeling Language (UML) (Siregar & Harahap, 2024). This modeling is crucial for communicating the system's structure and behavior before implementation. Key diagrams will include:

Use Case Diagrams: To define the interactions between actors and the system's functionalities (Fatimah & Elmasari, 2018; Siregar & Harahap, 2024).

Activity Diagrams: To illustrate the step-by-step business workflows (Siregar & Harahap, 2024).

Sequence Diagrams: To map the detailed, step-by-step interactions between different system objects and actors (Siregar & Harahap, 2024).

3.3. System Features (In-Scope)

The scope of the MVP is focused on delivering the following core features, which are designed to help library staff manage key data (books, members, loans, returns) easily and quickly (Siregar & Harahap, 2024):

Admin Dashboard: A landing page displaying key statistics, such as the total number of books, total registered members, and the number of books currently on loan.

Book Management: Full CRUD (Create, Read, Update, Delete) functionality for book data, including fields for title, author, publisher, and stock.

Member Management: Full CRUD functionality for managing library member data.

Transaction Management: A module dedicated to recording book borrowing and return events, complete with due dates.

Book Search: A search feature allowing librarians to find books based on title, author, or category.

4. Discussion, Limitations, and Evaluation

4.1. Project Limitations (Out-of-Scope)

To ensure the timely delivery of a focused MVP, several features are explicitly excluded from the project's scope. These out-of-scope features include an automated system for late-return fines, online book reservation capabilities for members, automated due-date reminder notifications, and integration with barcode scanners. It is noted that features such as a management system for fines (for late, damaged, or lost books) are common recommendations for future development in completed library systems (Siregar & Harahap, 2024) and will be prioritized for post-MVP iterations.

4.2. Evaluation and Success Criteria

The success of the project will be assessed using both quantitative and qualitative metrics, drawing from formal software testing methodologies.

First, a **Blackbox testing** approach will be used to verify functional requirements (Siregar & Harahap, 2024). This testing method focuses on the input and output of the software without viewing the internal code, ensuring the system behaves as expected (Siregar & Harahap, 2024). This will validate scenarios such as:

Login Validation: The system must reject incorrect credentials and grant access with correct credentials.

CRUD Operations: All "Create," "Edit," and "Hapus" functions for book data must work as expected.

Report Generation: The system must correctly generate reports based on selected criteria.

Based on this testing, the **quantitative success criteria** are:

1. All features defined as "In-Scope" must be fully implemented and operate without any critical bugs.
2. In formal usability testing sessions, librarians (target users) must achieve a minimum of 90% success rate in completing key tasks (e.g., adding a new book, recording a loan). This aligns with measuring the "usability" aspect as defined in standards like ISO 25010 (Fatimah & Elmasari, 2018).

The **qualitative success criteria** are:

1. The user interface design must receive positive feedback from librarians regarding its ease of use and perceived efficiency gain compared to the previous manual system.
2. This feedback will be gathered via questionnaires, with the goal of achieving a "very feasible" rating from end-users, similar to benchmarks set in other usability studies (Fatimah & Elmasari, 2018).

5. Conclusion

The reliance on conventional, manual processes in library management leads to significant operational inefficiencies, including unorganized data, inaccuracies, and the persistent risk of data loss (Fatimah & Elmasari, 2018; Siregar & Harahap, 2024). This paper has outlined the design and development of a web-based Library Management Information System intended to resolve these critical issues.

By employing an Agile methodology and a User-Centered Design approach, the project is focused on delivering a functional Minimum Viable Product (MVP). This system will centralize and digitize core library functions. The ultimate goal is to provide librarians with an efficient, fast, and user-friendly tool that reduces manual workloads and improves data accuracy, aligning with research that confirms such systems can help staff manage data easily and quickly (Siregar & Harahap, 2024). The system is designed for regular maintenance and future adjustments, with plans to incorporate features such as a fine management system in subsequent development cycles (Siregar & Harahap, 2024).

6. References

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