

Design and Implementation of a Web-Based Library Management System

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Abstract— Education plays a crucial role in the development of a nation, and for its successful implementation, quality reading resources, such as books, magazines, journals, dictionaries, and other reading materials, are required to facilitate the teaching and learning process. A library serves as a hub for educational institutions that house diverse collections of books, periodicals, and documents. However, the conventional manual library management system utilized by some private schools in Jakarta City has limitations, such as time-consuming processes for searching, borrowing, returning books, and generating reports. This study proposes the implementation of a web-based library management system employing cutting-edge technology to address these issues. This paper's primary objective is to design a web-based library management system that enables efficient book borrowing and return. To achieve this objective, the study employs a use-case diagram, an entity-relationship diagram, and library web design. A questionnaire survey is used to collect data, which is appropriate for the research context and offers a cost-effective, efficient, and quick method for collecting data from a large sample size. Designing the library web, creating a questionnaire, distributing it to testers, and analyzing their responses comprise the research methodology.

Keywords— library, library management system, web-based system, library information system, library service.

I. INTRODUCTION

Education is indispensable to the growth of a nation. Teaching and learning are essential to the development of education. Essential to this process are high-quality references such as books, magazines, dictionaries, and other reading materials [1]. A library is a room or building that contains a vast collection of books, periodicals, and documents that can be read and borrowed by individuals. The library serves as a repository for physical information. However, many libraries, including school libraries, continue to use paper-based manual management systems [2].

There are a number of issues with manual book transactions, including the increased time required for searching, borrowing, and returning books, as well as report compilation. Additionally, human error, such as the loss or destruction of written records, can occur. Additionally, book management can be problematic, resulting in a time-consuming search for documents and limited storage space. The implementation of

computerized systems is capable of resolving these difficulties. By utilizing computerized systems, library staff can more efficiently manage the library, including searching for books, examining records, and completing other tasks [3].

Traditional manual library management systems have a number of limitations that can have a negative effect on library operations. These include the inefficiency of manual book transactions, which can result in delays and errors in record-keeping and make it difficult to effectively manage the library. In contrast, computerized systems can make management more organized and efficient by streamlining the process. Such systems can facilitate faster and more accurate book transactions, and digital record-keeping can prevent the loss of vital data. The computerized system can also provide an enhanced search function, allowing library staff to quickly and easily locate books. Overall, the incorporation of computerized systems can contribute to the enhancement of the library's overall efficiency and the patrons' user experience.

There have been numerous advancements in library management systems, ranging from the incorporation of Radio-Frequency Identification (RFID) to accelerate the development process to Hadoop. However, the implementation of these technologies presents a disadvantage, as their high implementation costs make them unsuitable for smaller institutions [4]– [6]. Although implementing RFID and Hadoop can improve the operational efficiency of a library, their high implementation costs can prevent smaller institutions from adopting them. Small schools and public libraries, for instance, may lack the funds to invest in such technologies. In contrast, larger institutions may have the resources to implement these technologies, whereas for smaller institutions, the benefits of these innovations may not justify their high implementation costs.

In addition to these existing innovations, a web-based library management system is a viable alternative. Adopting this system can increase the effectiveness of library data management and decrease the time required to complete the borrowing procedure. The web-based approach is gaining popularity due to its accessibility across multiple platforms and its lower cost [7]. Numerous libraries provide Internet access and position computers and other devices in a corner of

the library to facilitate access and search for books and other materials [8].

Using frameworks such as AngularJS and Bootstrap, which are HTML, CSS, and JS frameworks, it is possible to develop a web-based library management system. However, it is essential to monitor the system's development and keep it current by identifying information and system deficiencies through evaluations [9]. Implementing a web-based library management system can offer a number of benefits. The ability to access library resources from anywhere and at any time is a major advantage. It also eliminates the need for physical records and paperwork, reducing the possibility of records being lost or damaged. This system can also improve the search function and provide an easily accessible and manageable record-keeping system. In addition, it can enhance the user experience by providing a more intuitive interface and decreasing the time required to borrow books.

This article is divided into four sections where Section II describes the Methods used in this study, Section III describes the result and analysis and Section IV explains the conclusions drawn from this study.

II. METHODS

This section is divided into two stages, namely Requirement Analysis and Database Design.

A. Requirement Analysis

The process of identifying the necessary features of an application based on user or customer requirements is known as requirements analysis [10]. In this study, the requirement analysis was conducted using a literature review on library management systems and direct observation of library management tasks at a private school in Jakarta. The literature review helped to identify academic paper topics such as methods, results, and evaluation materials. After observing scientific papers and direct library management tasks, the primary functions of the library management system were determined to be managing book data, handling loan, extension, and return, generating reports, and checking the status of books. In addition, the system has been updated to permit students to search for books and check their availability, as well as to display book descriptions including title, author, publisher, publication date, and category.

The results of the requirement analysis were illustrated using a use case diagram, which depicts actors, use cases, boundaries, and relationships to illustrate the primary system tasks [11]. The information system includes three actors with varying levels of access: the administrator, the staff, and the student. As shown in Fig 1, the administrator has complete control over the library system, while staff and students have restricted access.

B. Database Design

To ensure the integrity of the data, the database is structured to prevent any potential damage during implementation, such as update and delete anomalies. The database design is presented visually using an Entity Relationship Diagram (ERD) [12], which depicts the relationship between tables (entities) and the system's multiplicity.

The Library information system consists of a single database, Library, with six tables: students (MsStudent), staff (MsStaff), books (MsBook and Category), and transactions

(Transaction and TransactionDetail). The relationship between each table and the other tables is illustrated in Fig 2.

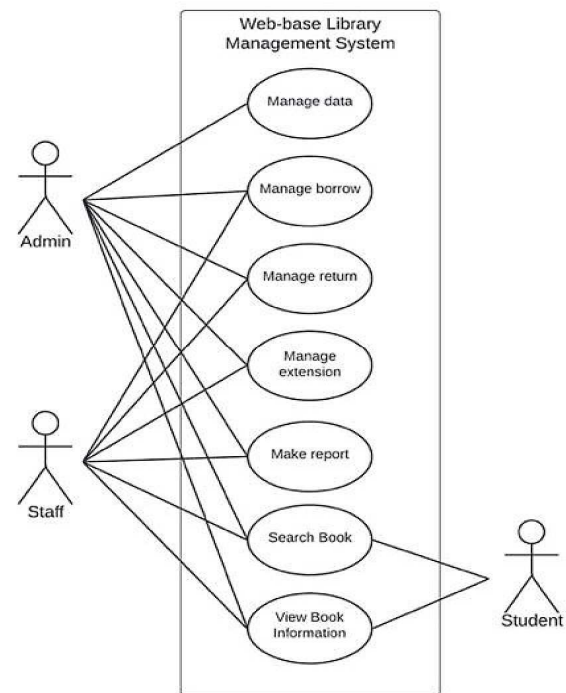


Fig. 1: Use Case Diagram of Library Management System

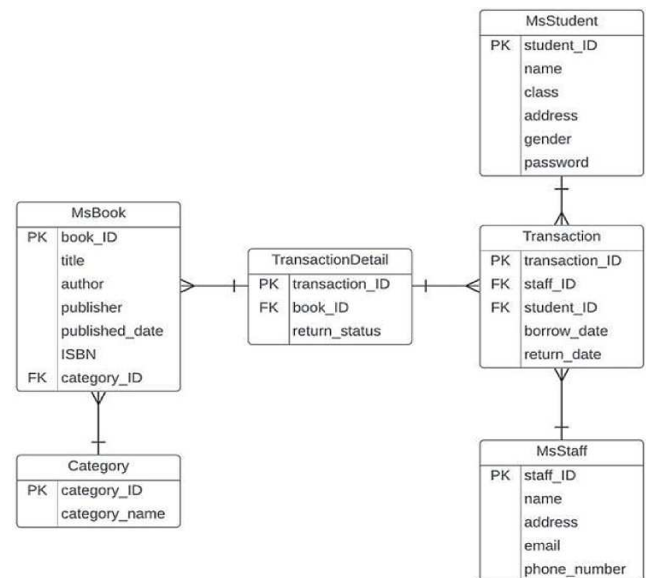


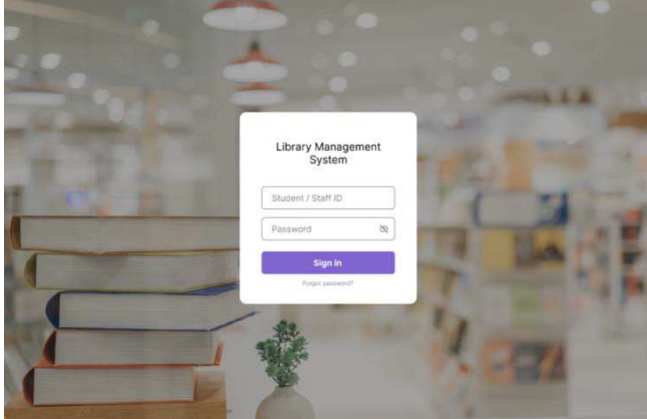
Fig. 2: Use Case Diagram of Library Management System

By carefully designing the database and implementing an ERD, the Library's information system can avoid anomalies that may result from data updates and deletions, ensuring that the data remains safe and secure.

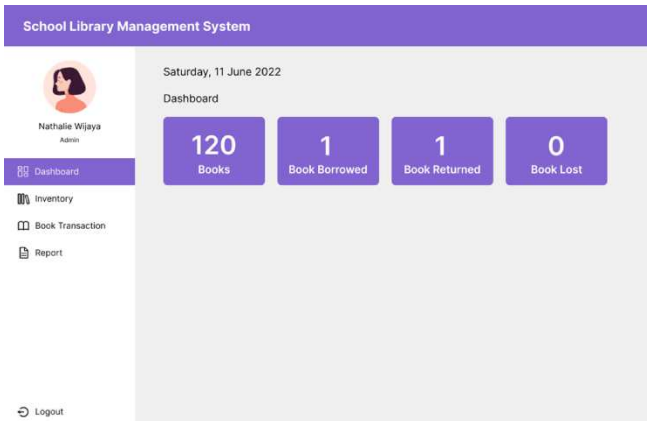
The six tables included in the Library database provide a comprehensive platform for managing the library's transactions, student and staff information, and book categories.

III. RESULT AND ANALYSIS

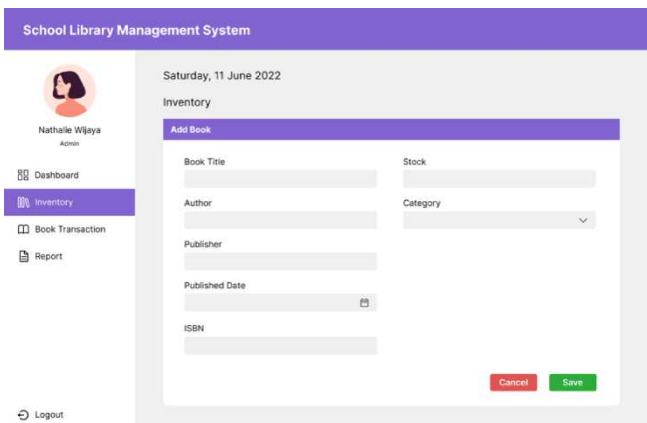
Fig 3 depicts the prototype of this software. According to Fig. 3, the dashboard page displays (Fig 3a) the total number of library transactions and available books. In addition, the administrator is able to add or remove books and categories as shown in Fig 3c and Fig 3d, as well as edit their specifics. However, staff members are not permitted to add, remove, or modify books.



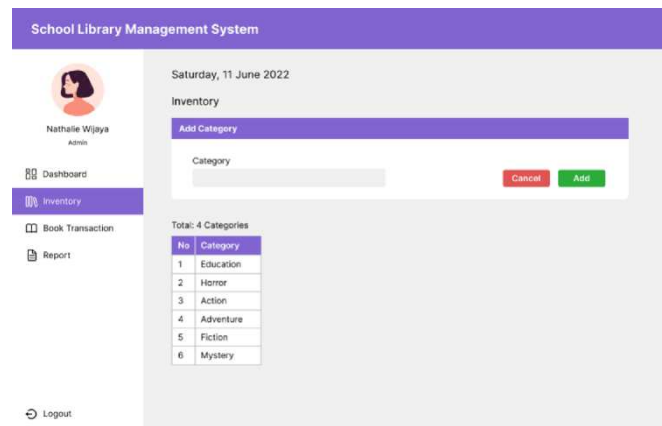
(a) Main Form



(b) Form Dashboard



(c) Form Add Book Page



(d) Form Add Book Page

Fig. 3: Application User Interface

We evaluated our prototype application using user acceptance testing. The Measurement based on the questionnaire consisted of six questions that used Likert measurement and the total correspondents are 14 people which are randomly selected. Table 1 states the questions asked to the respondents.

TABLE I: QUESTIONNAIRE'S QUESTIONS

No	Questions
1	Do all the menus and information on the web meet the needs for managing the library?
2	Is the web view easy to understand?
3	Are the menus and information on the web well organized?
4	Is the web interface easy to use in managing the library?
5	Does the web page color selection look comfortable?
6	Criticisms and suggestions for the existing UI

The responses of the Table 1 questionnaire was shown in Fig 4

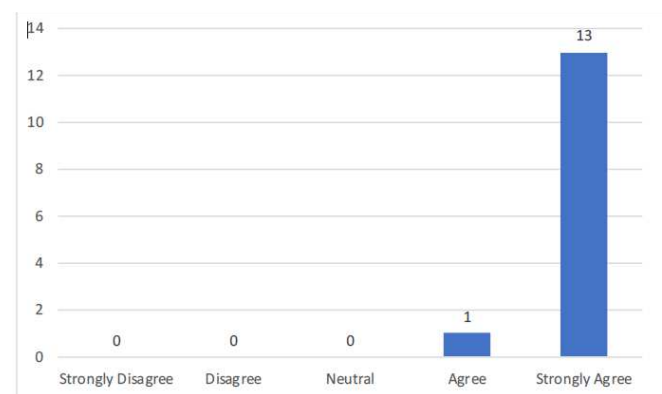


Fig. 4: Questionnaire's answer number 1

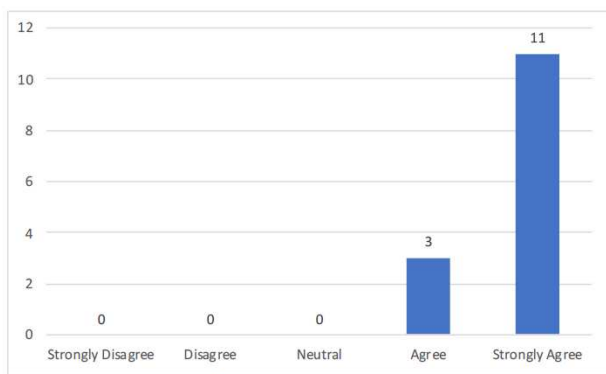


Fig. 5: Questionnaire's answer number 2

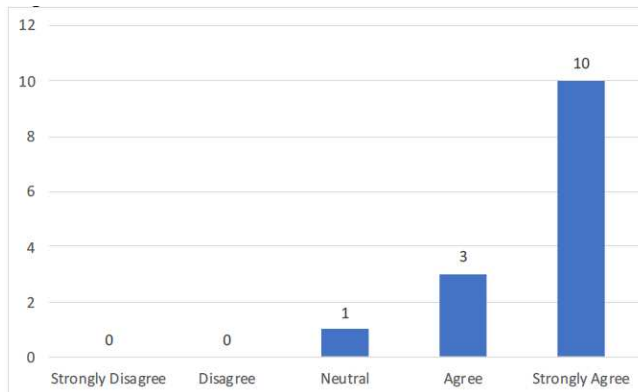


Fig. 6: Questionnaire's answer number 3

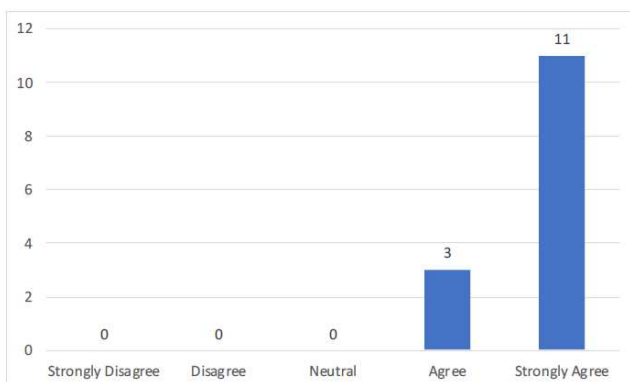


Fig. 7: Questionnaire's answer number 4

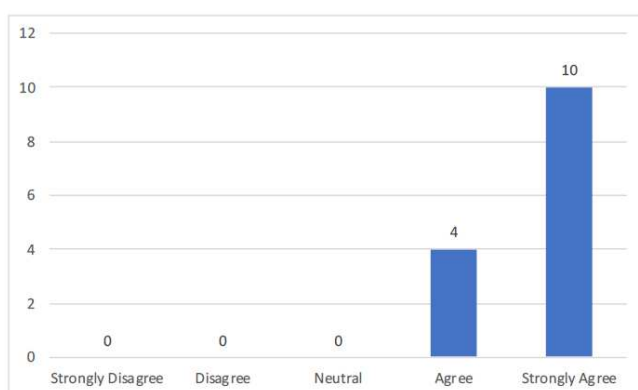


Fig. 8: Questionnaire's answer number 5

Based on the responses from Fig 4-Fig8. 93% of respondents strongly agreed, followed by 7% who agreed, that the web-based menus and information meet their requirements for managing the library. Therefore, it can be concluded that the online menus and information satisfy the requirements for library management. 79% of respondents strongly agreed and 21% agreed that the web interface is simple to comprehend. No one selected the options neutral, disagree, or strongly disagree. On the basis of these data, it can be determined that the web interface is straightforward. Concerning the organization of menus and information on the web, 72% of respondents strongly agreed, 21% agreed, and 7% were neutral. Thus, it can be concluded that the menus and information on the web are well-organized enough. Regarding the user-friendliness of managing the library, 79% of respondents strongly agreed, followed by 21% who agreed. It can be concluded from this information that the web interface for managing the library is simple to use. Regarding aesthetics, 71% of respondents strongly agreed and 21% agreed that the color scheme of the website is pleasing to the eye. Therefore, it can be concluded that the color of the website's display does not affect the user's ease of use.

The majority of respondents agreed that the website's interface is good, straightforward, and meets users' needs, based on the comments and criticism gathered in response to question 6. Some respondents advocated for the addition of information about available book stock and the use of more varied colors on the interface. From these statements, it can be deduced that the web interface is adequate, but could be enhanced by incorporating stock data as a functional requirement. To improve aesthetics without jeopardizing user comfort, it is possible to use a wider range of colors.

IV. CONCLUSION

Libraries are essential centers for acquiring knowledge and information. They are essential in promoting education and research. Nonetheless, the majority of libraries, including school libraries, continue to use manual management systems, such as paper and pencil, to track customer information and transactions. Utilization and administration of library systems have expanded rapidly as technology and human resources have advanced. A web-based library management system has emerged as a more efficient and effective option that can shorten the time required to borrow books.

Including a use-case diagram and an entity-relationship diagram, this paper describes the architecture of a web-based library management system. The results of the user acceptance test indicate that the system was well received by the testers and can enhance the quality of library services for students.

Adopting a web-based library management system can help educational institutions eliminate the inaccuracies and inefficiencies of manual management systems. This system provides an interface that is more accessible and user-friendly, allowing students to search for and access library resources from anywhere. It also provides a secure and organized record-keeping system that eliminates the risks associated with paper documents and physical records.

In conclusion, the implementation of a web-based library management system can significantly enhance the overall efficacy and efficiency of library services, to the advantage of both educational institutions and students. It offers a user-friendly interface that facilitates students' access to library resources while ensuring the accuracy and security of their

records. Utilizing technology in library management systems can enhance the quality of education and research while fostering the expansion of knowledge and innovation.

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