

JTBC: Jurnal Teknologi dan Bisnis Cerdas

Volume 2 Nomor 2, Juni 2026

e-ISSN : 3109-8924

DOI: 10.64476/jtbc.v2i2.47



DESIGN AND IMPLEMENTATION OF A WEB-BASED DIGITAL LIBRARY WEBSITE USING HTML, CSS, JAVASCRIPT, AND LOCALSTORAGE

PERANCANGAN DAN IMPLEMENTASI WEBSITE PERPUSTAKAAN DIGITAL BERBASIS WEB MENGGUNAKAN HTML, CSS, JAVASCRIPT, DAN LOCALSTORAGE

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ABSTRACT

Libraries are one of the important facilities in supporting educational activities, research, and information dissemination. However, conventional library management still faces various challenges, such as inefficient record-keeping processes, difficulties in searching book data, and limitations in monitoring borrowing status. Therefore, a digital library system is needed to manage data in a computerized manner and provide easy access for users. This study aims to design and implement a web-based digital library website using HTML, CSS, and JavaScript by utilizing LocalStorage as the data storage medium. The developed system provides user authentication features (login and registration), book data management, book searching and sorting, book borrowing and returning, as well as real-time statistics on book availability. The system development process was carried out using the prototype method, which allows system adjustments based on user requirements. The implementation results indicate that the developed digital library website is able to improve the effectiveness of library data management and facilitate users in accessing book information and performing borrowing processes. With an interactive interface and a system that runs directly through a web browser without requiring a server-side database, this application is expected to serve as an alternative solution for managing small- to medium-scale libraries.

Keywords: Digital library, Website, Javascript, Localstorage.

ABSTRAK

Perpustakaan merupakan salah satu sarana penting dalam mendukung kegiatan pendidikan, penelitian, dan penyediaan informasi. Namun, pengelolaan perpustakaan secara konvensional masih memiliki berbagai kendala, seperti proses pencatatan yang kurang efisien, kesulitan dalam pencarian data buku, serta keterbatasan dalam pemantauan status peminjaman. Oleh karena itu, diperlukan sebuah sistem perpustakaan digital yang mampu mengelola data secara terkomputerisasi dan mudah diakses. Penelitian ini bertujuan untuk merancang dan mengimplementasikan website perpustakaan digital berbasis web menggunakan HTML, CSS, dan JavaScript dengan memanfaatkan LocalStorage sebagai media penyimpanan data. Sistem yang dikembangkan menyediakan fitur autentikasi pengguna (login dan pendaftaran), pengelolaan data buku, pencarian dan pengurutan buku, peminjaman dan pengembalian buku, serta penyajian statistik ketersediaan buku secara real-time. Proses pengembangan sistem dilakukan dengan metode prototype yang memungkinkan penyesuaian sistem berdasarkan kebutuhan pengguna. Hasil implementasi menunjukkan bahwa website perpustakaan digital yang dibangun mampu meningkatkan efektivitas pengelolaan data perpustakaan serta mempermudah pengguna dalam mengakses informasi buku dan melakukan proses peminjaman. Dengan antarmuka yang interaktif dan sistem yang berjalan langsung melalui browser tanpa memerlukan database server, aplikasi ini diharapkan dapat menjadi solusi alternatif dalam pengelolaan perpustakaan skala kecil hingga menengah.

Kata Kunci: Perpustakaan digital, Website, Javascript, Localstorage.

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INTRODUCTION

The rapid development of information technology has brought significant changes to various aspects of life, particularly in education and information management. One sector experiencing transformation is the library. Libraries no longer function only as places for storing physical books, but also as information service centers that are required to provide fast, accurate, and easy access for users. The utilization of digital technology in library management has become a strategic solution to improve the quality of information services in the digital era (Sutarno, 2016).

Several studies have shown that the implementation of web-based digital library systems can improve the efficiency of data management and facilitate the information retrieval process. Research conducted by Suryani and Wibowo (2018) stated that a web-based library information system can accelerate the recording of book data and borrowing transactions, as well as reduce errors that often occur in manual systems. In addition, Rahmawati (2019) revealed that library digitization provides convenience for users in accessing book collections without being limited by time and location.

Nevertheless, in practice, many libraries are still managed conventionally or semi-digitally, resulting in various problems. Some common obstacles include difficulty in monitoring book availability status, delays in recording borrowing data, and the lack of statistical information that can be used as material for evaluating library management. Studies by Pratama et al. (2020) and Hidayat and Putri (2021) showed that library systems that are not properly computerized can lead to low service effectiveness and user satisfaction.

Several previous studies have discussed the development of web-based digital library systems using various technologies. Putra and Nugroho (2020) developed a web-based library system using PHP and MySQL that was able to manage book data and borrowing transactions in an integrated manner. Meanwhile, Aini et al. (2021) stated that the use of web-based technology with an interactive interface can increase user interest in utilizing digital library services.

In addition to the use of database servers, several studies have also begun to examine the use of local browser storage as an alternative data storage medium for small-scale systems. Saputra and Kurniawan (2022) stated that LocalStorage can be used as an effective simple data storage medium for web applications without requiring a database server. Recent studies also show that local browser storage technology is increasingly being applied to small-scale web applications due to its ease of implementation and resource efficiency (Rahman et al., 2023; Putri & Santoso, 2024).

The novelty of this study lies in the use of LocalStorage technology as the main storage medium in the development of a web-based digital library system. Unlike previous studies that generally used database servers such as MySQL or PostgreSQL, the system developed in this study is designed to run entirely through a browser without dependence on a database server. This approach makes the system lighter, easier to implement, and suitable for small-to medium-scale libraries with limited technological infrastructure.

METHODS

1. Type and Research Approach

This study uses a software engineering approach with a design and development method, aiming to produce a web-based digital library website. This approach was chosen because the research focuses on the process of designing, developing, and testing a system capable of managing book data and borrowing activities in a computerized manner.

This study is descriptive and applied in nature, where the final result is a system that can be used by users to access book information, borrow and return books, and monitor book availability status. The system is designed to involve two main actors, namely users as borrowers and admins as library data managers.

2. System Development Method

The system development method used in this study is the Waterfall method. This method was selected because it has structured, systematic stages and is easy to apply in the development of small- to medium-scale systems. The system development stages were carried out sequentially as follows.

a. System Requirements Analysis

The requirements analysis stage was conducted to identify the functional and nonfunctional requirements of the system. User functional requirements include registration and login, book searching and sorting, book borrowing and returning, and loan status monitoring. Meanwhile, admin functional requirements include book data management, borrowing data monitoring, and presentation of book availability statistics.

The nonfunctional requirements of the system include ease of use, an interactive user interface, and the system's ability to run directly through a browser without requiring installation or an additional database server.

b. System Design

The system design stage was carried out based on the results of the requirements analysis. The design aimed to provide an overview of the system workflow, data structure, and interactions between actors and the system. At this stage, several modeling diagrams were used, namely Use Case Diagram, Class Diagram, and Flowchart, which function to visualize system functions, relationships between classes, and the workflow of borrowing and returning books.

In addition, user interface design was also carried out by considering aspects of comfort, ease of navigation, and clarity of information so that the system could be used effectively by users.

Use Case Diagram

The Use Case Diagram is used to describe the interaction between actors and the system. The main actors in this system are users and admins. Users have access rights to log in, view book lists, search and sort books, borrow and return books, and view borrowing status. Meanwhile, admins are responsible for managing book data, viewing book details, and monitoring borrowing data. The Use Case Diagram helps explain the main system functions and the access limitations of each actor.

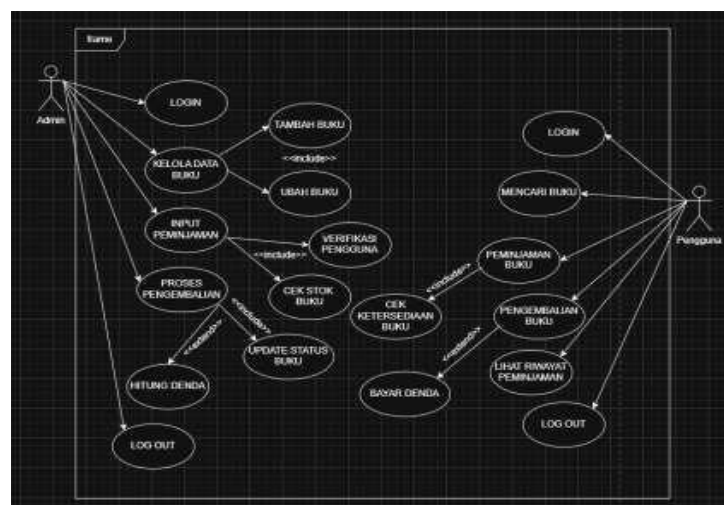


Figure 1. Use Case Diagram

Class Diagram

The Class Diagram is used to describe the data structure and relationships between classes in the digital library system. The Class Diagram in this system consists of several main classes, including User, Book, and Borrowing. Each class has attributes and methods that support data management processes, such as storing user information, book data, and borrowing and returning status. This Class Diagram serves as the basis for designing the data structure stored using LocalStorage.

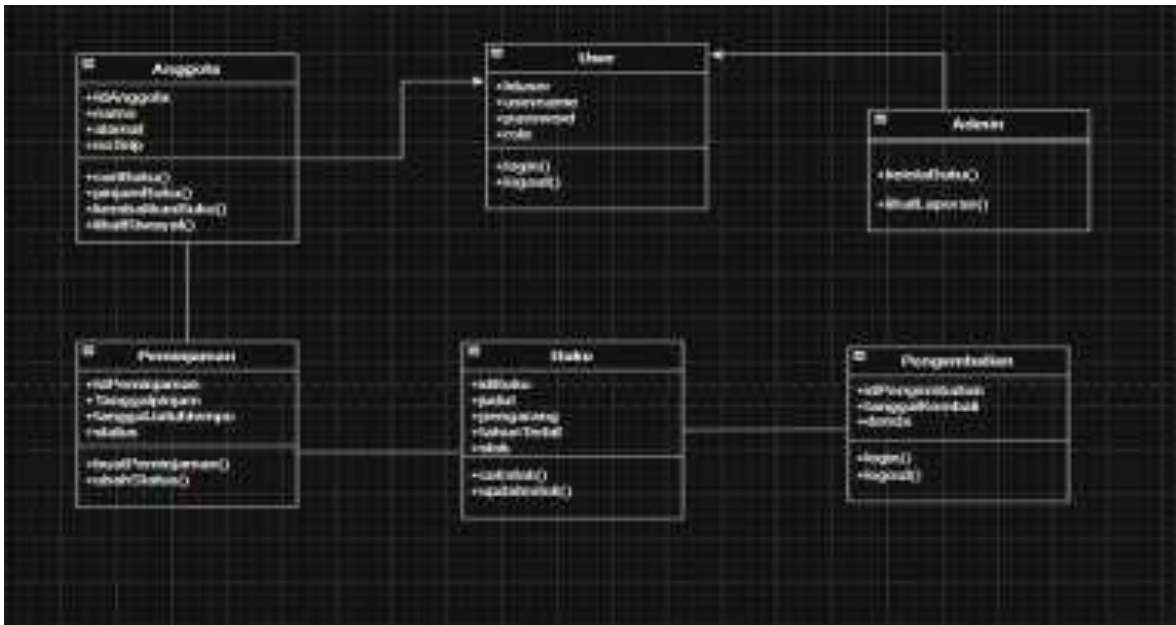


Figure 2. Class Diagram

Flowchart

The Flowchart is used to describe the system process flow in detail, particularly in the borrowing and returning processes. The Flowchart shows the steps performed by users, starting from selecting a book, filling in borrower data, and allowing the system to update the book availability status. With the flowchart, the system workflow can be understood more clearly and systematically.

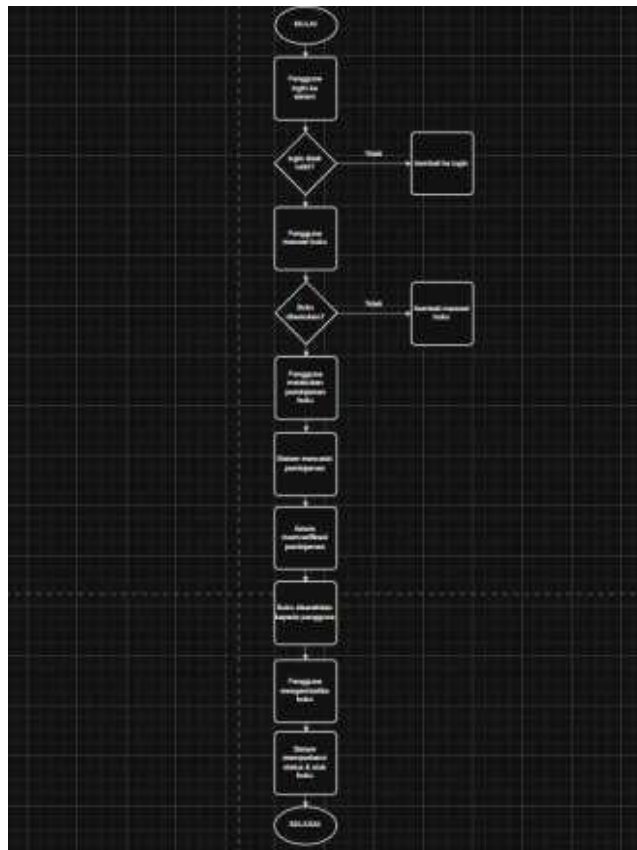


Figure 3. Flowchart

c. System Implementation

The implementation stage is the stage of applying the design results into program code. The system was developed using HTML as the page structure, CSS for visual appearance, and JavaScript as the main programming language for managing system logic. All user data, book data, and borrowing transactions are stored using LocalStorage, allowing the system to run without using a database server.

d. System Testing

System testing was conducted to ensure that all system functions work according to the specified requirements. The testing method used was functional testing or black box testing, focusing on the suitability of system output against input provided by users and admins. Testing covered registration and login features, book data management, book searching and sorting, borrowing and returning, and statistical presentation. The test results were used to assess the reliability and accuracy of the system.

e. System Maintenance

The maintenance stage is carried out after the system has been implemented to ensure that the system continues to run properly. Maintenance includes bug fixing, system performance improvement, and feature adjustments if there are changes in user requirements in the future.

3. Research Tools and Materials

The tools and materials used in this research include:

- Hardware: A computer or laptop for the system development and testing process.
- Software: Windows or Linux operating system, web browser such as Google Chrome

or Mozilla Firefox, and Visual Studio Code text editor.

- Development technologies: HTML, CSS, JavaScript, and LocalStorage as the data storage medium.

System Testing

System testing in this study was carried out directly on the web-based digital library application that had been developed to ensure that all features could run according to user needs. The testing method used was scenario-based functional testing, namely testing by running the application through a web browser and observing the performance of each feature based on user roles.

Testing was carried out by simulating user activities according to each role, namely user and admin.

- Testing on users included account registration, login, book searching, viewing book lists, borrowing books, and returning books.
- Testing on admins included managing book data by adding, deleting, and updating books, monitoring borrowing data, and displaying book availability statistics.

Each testing scenario was executed directly on the web application to ensure that the system could receive input, process data, and display output according to expectations. The test results were recorded to determine whether the system functions worked properly or whether errors still needed to be corrected.

System Accuracy Testing

System accuracy testing was conducted based on 15 functional testing scenarios covering registration, login, book data management, book searching, borrowing, returning, and updating book availability statistics. Of all the scenarios tested, 14 scenarios ran according to the expected results, while 1 scenario had a minor mismatch in the interface display but did not affect the main function of the system.

Based on these results, the system accuracy level was calculated using the success percentage formula, resulting in an accuracy value of:

$$\text{Accuracy} = (14 / 15) \times 100\% = 93,3\%$$

Table 1. Summary of System Accuracy Testing

No.	Testing Scenario	Expected Result	Actual Result	Status
1	User registration	Account data are saved	Successful	Appropriate
2	User login	The system accepts valid login	Successful	Appropriate
3	Add book data	Book data are saved	Successful	Appropriate
4	Edit book data	Book data are updated	Successful	Appropriate
5	Delete book data	Book data are deleted	Successful	Appropriate
6	Book searching	Books are found according to keywords	Successful	Appropriate
7	Book sorting	Books are arranged according to criteria	Successful	Appropriate
8	Book borrowing	Book status changes to borrowed	Successful	Appropriate
9	Book returning	Book status returns to available	Successful	Appropriate
10	Borrowing history	History is displayed according to data	Successful	Appropriate

No.	Testing Scenario	Expected Result	Actual Result	Status
11	Total book statistics	Statistics are displayed accurately	Successful	Appropriate
12	Borrowed book statistics	Statistical data are appropriate	Successful	Appropriate
13	Available book statistics	Statistical data are appropriate	Successful	Appropriate
14	User logout	The system returns to the login page	Successful	Appropriate
15	Empty input validation	The system rejects empty input	Not perfect	Not appropriate

Summary:

- Number of scenarios: 15
- Successful: 14
- Not appropriate: 1

Accuracy calculation:

$$\text{Accuracy} = \frac{14}{15} \times 100\% = 93.3\%$$

The result shows that the developed web-based digital library system has a high level of accuracy and is sufficiently reliable for use in managing small- to medium-scale libraries.

RESULTS AND DISCUSSION

The result of this study is a web-based digital library website developed using HTML, CSS, and JavaScript with LocalStorage as the main data storage medium. This system is designed to support computerized library management without dependence on a database server, so it can be accessed directly through a web browser.

The developed system consists of three main modules, namely the user or borrower module, the book management module for admins, and the statistics module. Each module was designed based on the functional requirements analyzed during the system design stage.

In the user or borrower module, the system provides registration and login features, book searching and sorting based on title and author, book borrowing and returning, and loan status monitoring. Based on functional testing results, users can carry out all these processes smoothly. The system is able to automatically update book availability status after borrowing and returning processes are completed, so the information displayed remains real-time and accurate.

In the book management module, the admin has access to add, edit, and delete book data, as well as monitor user borrowing activities. The testing results show that the book data management process becomes more efficient compared with manual recording because the system can minimize input errors and speed up the process of searching and updating collection data.

Meanwhile, the statistics module presents information on the total number of books, books currently borrowed, and books available. Statistical data are displayed automatically based on data stored in LocalStorage. The test results show that the statistical information generated is consistent with the actual data condition, so it can be used as material for evaluation and decision-making by library managers.

The system accuracy testing results show that out of 15 testing scenarios, 14 scenarios ran according to the expected results, with an accuracy level of 93.3%. The mismatch found was

minor and occurred only in the interface display, without affecting the main function of the system. This indicates that the developed system has good reliability to support digital library operations.

Discussion

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a. Login Page Interface

This is the login page of the Digital Library, which functions as the initial page before users enter the system dashboard. On this page, users are required to enter their registered username and password. If the data entered are correct, the system allows the user to log in and redirects them to the main dashboard to access various digital library features. In addition, a Sign Up option is also available for users who do not yet have an account and need to register first.

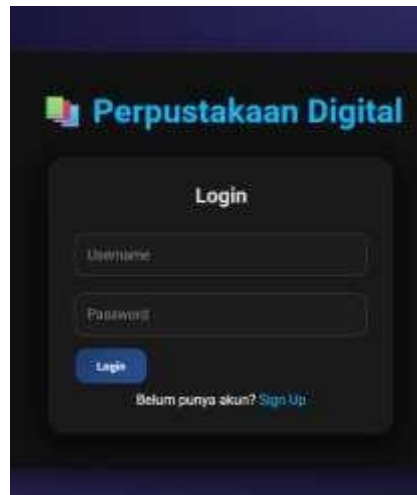


Figure 4. Login Page

b. Dashboard Page Interface

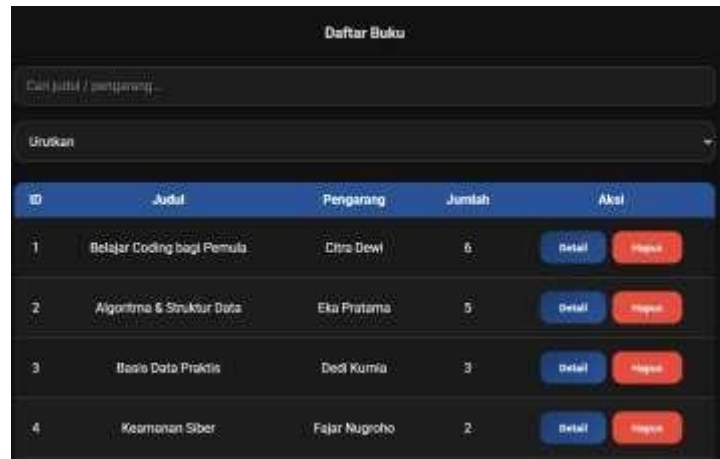
This is the admin dashboard page of the Digital Library, which is displayed after a successful login. On this page, admins can view a summary of library data, such as total books, the number of borrowed books, and available books. In addition, the dashboard provides management menus such as book list, add book, borrowing, and borrowing list. Admins can also log out to exit the system. This page functions as the main control center for managing all digital library activities.



Figure 5. Dashboard Page

c. Book List Page Interface

This is the Book List page in the Digital Library system, which is used to display all book data available in the system. This page provides a search feature that allows admins to search for books by title or author, as well as a sorting feature to arrange the display of book data according to user needs.



ID	Judial	Pengarang	Jumlah	Aksi
1	Belajar Coding bagi Pemula	Citra Dewi	6	Detail Hapus
2	Algoritma & Struktur Data	Eka Pratama	5	Detail Hapus
3	Dasar Data Praktis	Dedi Kumia	3	Detail Hapus
4	Kesamanan Siber	Fajar Nugroho	2	Detail Hapus

Figure 6. Book List Page

d. Add Book Page Interface

This is the Add Book page in the Digital Library system, which is used by admins to add new book data into the system. This page contains several input fields, namely Book Title, Author, and Quantity, which must be filled in according to the book data to be added. After all data are filled in correctly, the admin can click the Add button to save the book data into the system, so that the book will appear in the book list and can be managed in the digital library system.



Figure 7. Add Book Page

e. Borrowing Page Interface

This is the Book Borrowing page in the Digital Library system, which is used to record the book borrowing process by users. On this page, the admin can select the title of the book to be borrowed, then fill in the borrower's name, contact or phone number, and borrowing date. After all data are filled in correctly, the admin can click the Borrow button to save the borrowing data into the system, so that the book status will be recorded as borrowed and entered into the borrowing list.



Figure 8. Borrowing Page

CONCLUSION

Based on the results of the research and discussion, it can be concluded that the web-based digital library application using HTML, CSS, JavaScript, and LocalStorage has been successfully developed and functions properly according to the research objectives. This application is able to perform login, add book, and borrowing page effectively.

The use of LocalStorage as a data storage medium allows the application to run without requiring a server or external database. Therefore, the application is suitable as a learning medium for web application development or for small-scale data management. Data stored using LocalStorage are persistent and remain available even when the web page is reloaded or the browser is closed.

The simple and structured application interface makes it easy for users to operate the system. The results of testing using the black box testing method show that all application functions run according to the predetermined system requirements.

Nevertheless, this application has limitations in terms of data security and scalability because it uses LocalStorage and a simple login system. For future research, it is recommended to develop the system using a database server, implement data encryption, provide a more secure authentication system, and add export and import features to improve system functionality and security.

ACKNOWLEDGMENT

The authors would like to express their gratitude to all parties who supported the implementation of this research.

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