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A Modern Web Application for Library Management: Design and Development of a Digital Inventory System

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ABSTRACT

Libraries are essential resources for both educational institutions and public use. However, manual methods of managing books and members often result in inefficiency, errors, and poor tracking of records. To overcome these challenges, we developed a Digital Library Management System with a focus on inventory management and book transaction handling. The system is built using the MERN stack (MongoDB, Express.js, React.js, Node.js), offering a user-friendly interface and real-time updates. It allows librarians to manage books, register members, issue and return books, and automatically calculate fines for late returns. The project improves accuracy, efficiency, and transparency in library operations, replacing traditional manual methods with a modern digital solution.

Keywords: Library Management System, MERN stack, Inventory Management, Book Transactions, Automation.

Introduction

In today's world, many libraries still depend on manual registers or old-fashioned software to manage their books and member details. This method is slow, filled with errors, and hard to maintain, especially when the library has thousands of books. Librarians often face problems like tracking which books are available, finding records of who borrowed a book, and calculating fines for late returns. Students also find it difficult to check availability and may have to wait for the librarian to provide details.

To solve these challenges, our project introduces a Library Management System (Inventory Management). It is a digital platform that brings all book and member activities under one system. The main purpose is to make the library process faster, more accurate, and easy to use.

With this system, librarians can easily add, update, delete, or search books. Each book contains details like title, author, genre, total copies, and available copies. A special member management module allows librarians to register new members and store their information such as ID, name, email, and contact number.

The system also includes a borrow and return module. Books can be borrowed for 7 days, and the system automatically sets a due date. If a student returns a book late, the system calculates a fine of ₹2 per day. Every borrow and return action is recorded with proper timestamps, which makes the process transparent and reliable.

Unlike other complex systems that use multiple roles like admin, staff, and student dashboards, our project is simplified for open libraries where a librarian controls all operations. This makes it easier to use in both small and large libraries.

The project is developed using the MERN stack (MongoDB, Express.js, React.js, Node.js). This ensures the system is modern, scalable, and responsive. It updates information in real-time, which reduces mistakes and increases efficiency.

Literature Survey

Several research studies have proposed modern digital solutions for library management. We compare three major works with our system:

Patidar et al. (2024): Library Management System

A MERN-based system for educational institutions, featuring role-based dashboards, book reservation, and analytics.

Strength: Role-based access and analytics.

Difference: Our system focuses on *simpler inventory management* without multi-role complexity.

Gupta et al. (2022): BookBea – A Web-based Book Application

Built with MongoDB and Node.js, enabling users to share, rent, and exchange books with chat and payment integration.

Strength: Community-driven features.

Difference: Our system focuses on *library operations*, not community sharing or payments.

Mary et al. (2017): Enhanced Library Management System

A PHP/MySQL-based system focusing on digital catalogs, user authentication, and reporting.

Strength: Basic automation of cataloging and fine calculation.

Difference: Our system uses the *MERN stack with real-time updates* and simplified librarian-driven management.

These studies highlight the importance of automation, but our project is unique for its *lightweight, librarian-controlled, inventory-focused design*.

Methodologies

Existing Methodology

In many educational institutions, libraries still follow a manual or semi-digital system to manage books and student records. In the traditional method, librarians use registers or spreadsheets to write down which student borrowed which book, on what date, and when it is due. These records are later checked manually to track late returns, available copies, or missing books.

In some cases, basic software tools like MS Excel or outdated desktop applications are used, but these lack advanced features like search filters, real-time updates, or user roles. Book entries, student details, and borrow/return activities have to be updated manually, which is time-consuming and prone to human errors.

When students need to find books, they either ask the librarian or look manually through shelves, as there is no efficient search or filter system in place. Calculating fines for late returns is also done manually, which can lead to mistakes and misunderstandings.

Another drawback of existing systems is the lack of transparency and organization. There is no proper record of student transactions or book availability in real time. Also, there is no way for students to track which books they have borrowed or when they are due.

Overall, the existing methods are slow, inefficient, and outdated, making it difficult for librarians and students to manage library operations smoothly. These problems increase the workload and reduce the overall efficiency of the library.

Proposed Methodology

Our project introduces a Digital Library Management System that mainly focuses on inventory management and borrow/return activities. The goal of this system is to make library operations easier, reduce manual work, and improve the accuracy of records in daily tasks. By digitizing the process, both librarians and students benefit from faster, more organized, and transparent operations.

The system provides a clear workflow that covers all major library activities. Librarians have complete control to manage books and member records. They can add, update, delete, or view books with details such as title, author, genre, total copies, and available copies. This makes it simple to track which books are available at any time. A separate member management module allows librarians to register students with their ID, name, email, and contact number. They can also edit or remove member records when required.

The borrow and return module is one of the most important features. Students can borrow books for 7 days, and the system automatically generates the due date. If a book is returned late, the system calculates a fine of ₹2 per day and records it along with the return timestamp. Every borrow and return action is stored in a transaction history, making it easy to track member activity and book movement. This provides transparency and accuracy while removing the chances of human error.

The system also includes search and filter options, allowing books to be found instantly by title, author, or genre. This feature saves time for both librarians and students. Compared to existing manual systems, our project ensures real-time updates, automatic fine calculation, and an easy-to-use interface. Built using the MERN stack (React.js, Node.js, Express.js, and MongoDB), the system is scalable, reliable, and user-friendly, eliminating the need for paperwork and outdated registers.

Results

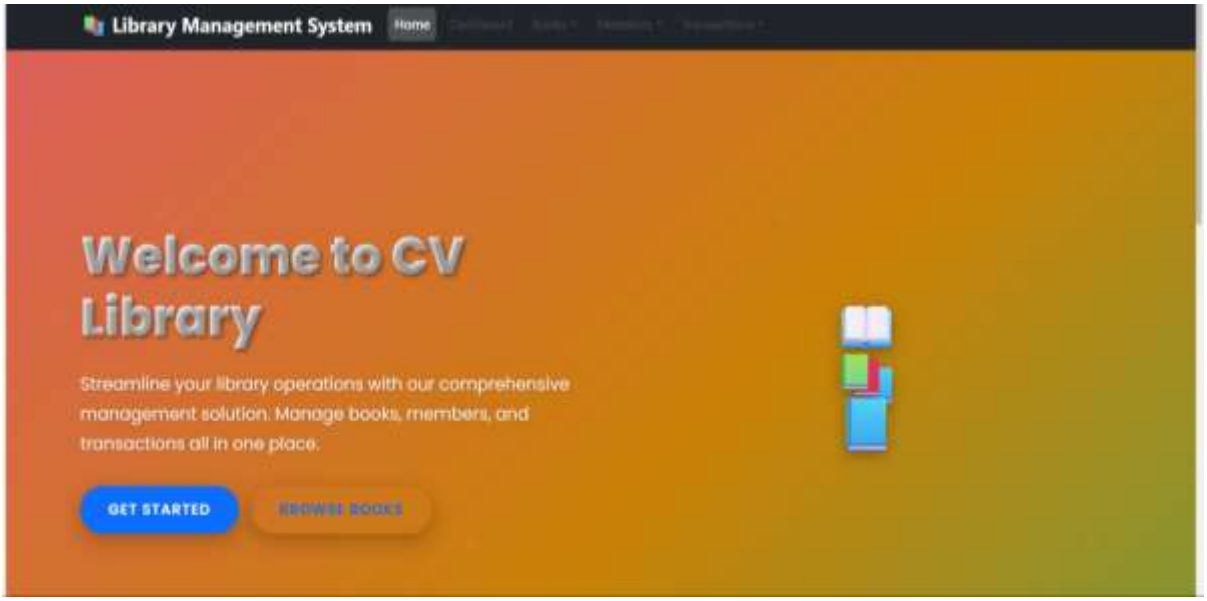

Fig 1 Welcome page

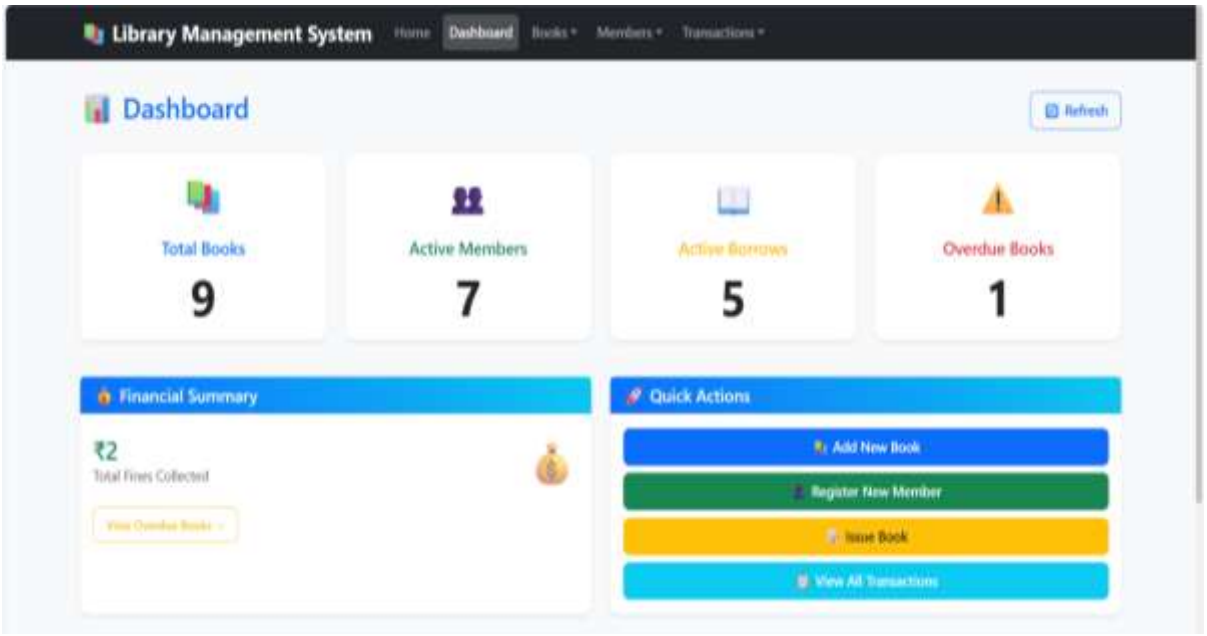

Fig 2 Dashboard

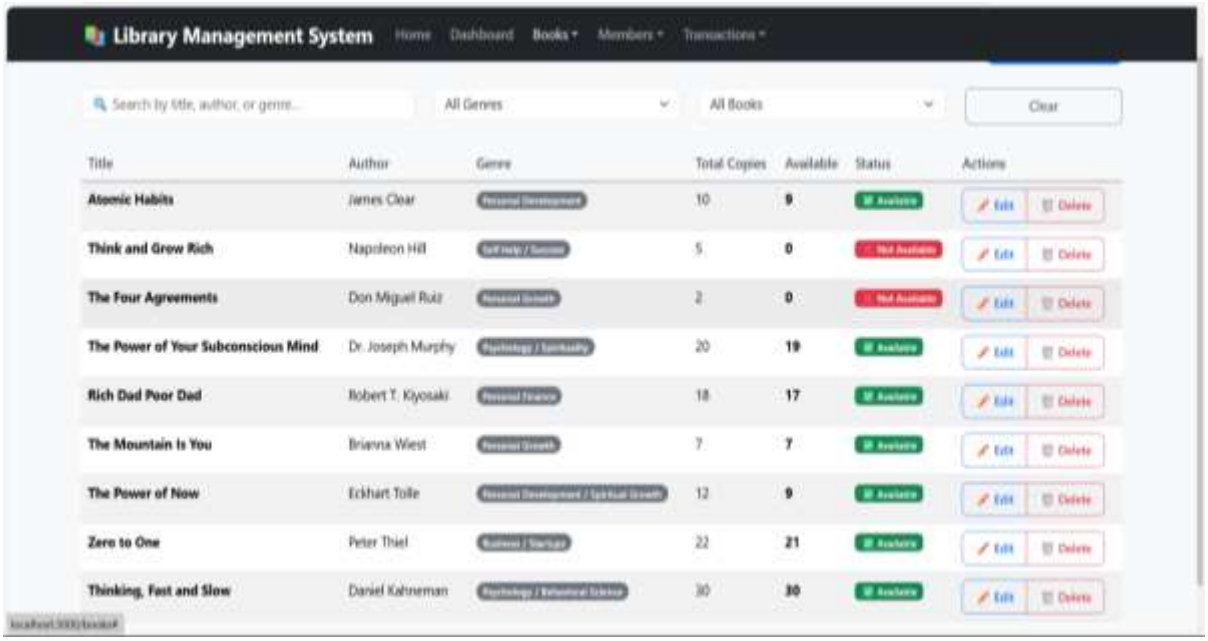

Fig 3: List of Books

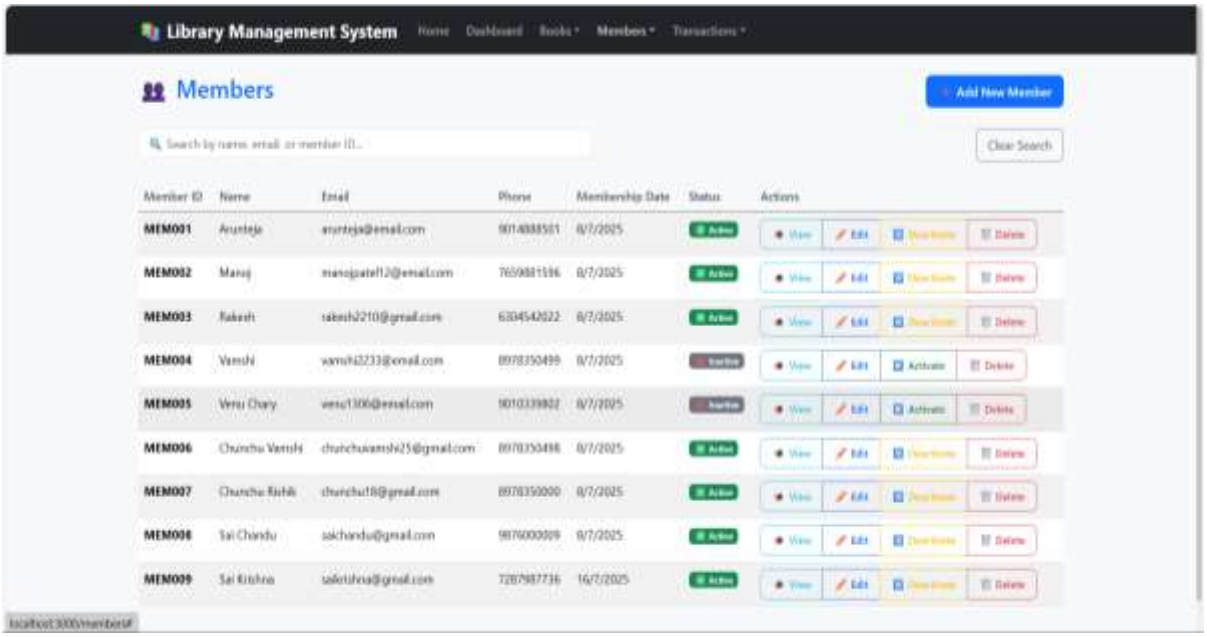

Fig 4: Registered Members

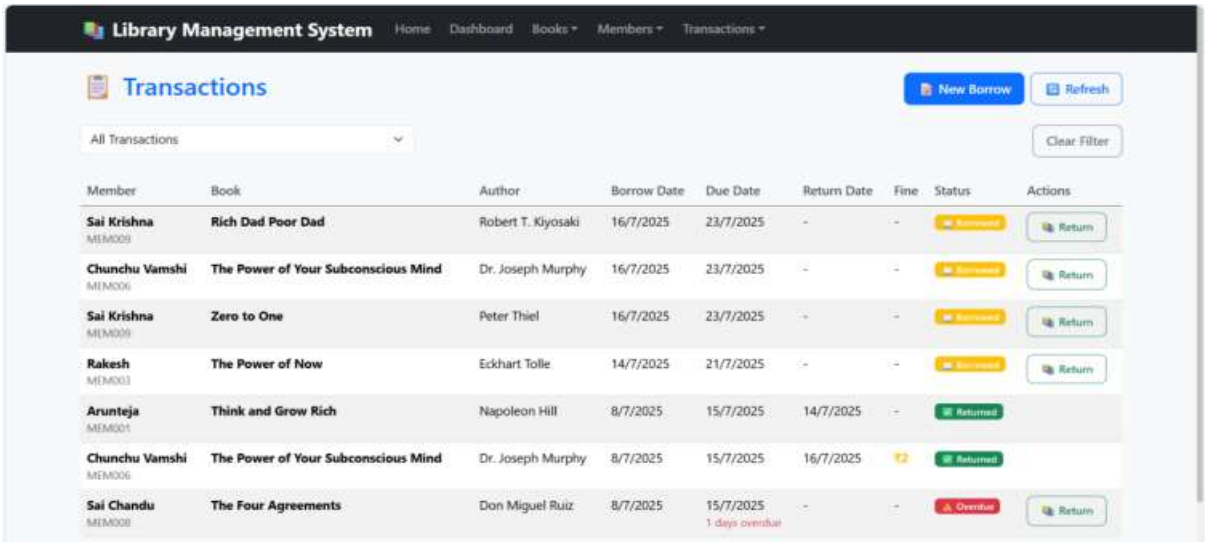

Fig 5: Transactions

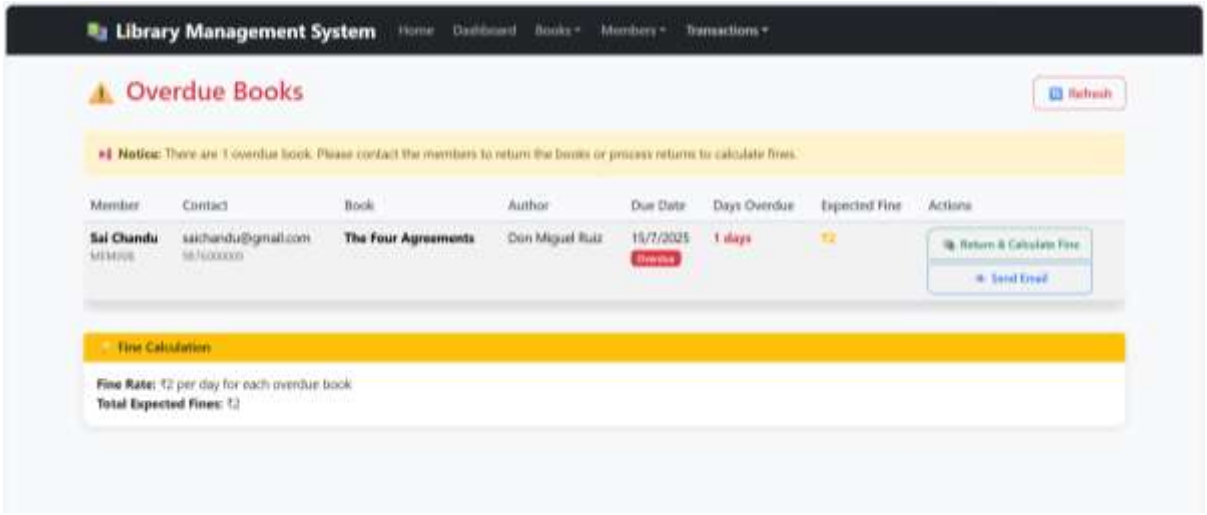

Fig 6: Overdue Books

Discussion

The development of the Library Management System (Inventory Management) was aimed at creating a reliable, efficient, and user-friendly platform that simplifies daily library operations. Traditional methods of managing books often rely on registers, spreadsheets, or outdated software. These methods are slow, error-prone, and make it difficult to track book availability, member records, and borrow/return activities. With the rise of digital technologies, building a centralized online system for library management has become both practical and necessary.

This project addresses real-world problems faced by libraries such as tracking which student has borrowed a book, calculating fines for late returns, and keeping accurate records of transactions. By using React.js for the frontend, the system provides a modern, responsive, and intuitive interface for both librarians and students. The Node.js and Express.js backend ensures smooth request handling, book operations, and secure data management. MongoDB is used as the database to store book inventories, member details, and transaction histories, ensuring flexibility and scalability.

One of the most important features of the system is its automated borrow and return module. Each time a student borrows a book, the system generates a due date of 7 days. If the book is returned late, it automatically calculates a fine of ₹2 per day and records the timestamp. This automation reduces the burden on librarians and prevents mistakes in manual fine calculations. The system also maintains a detailed transaction history, which logs every borrow and return action for transparency and easy tracking.

Another highlight of the project is its search and filter functionality. Students and librarians can instantly find books by title, author, or genre, which saves time compared to manual searching on shelves. The member management module allows librarians to register new members, update their details, and maintain accurate student records. Unlike multi-role systems that include separate dashboards for admins or teachers, this project is simplified for open libraries where a librarian manages all operations.

From the user's perspective, the system is easy to use and eliminates the need to depend on the librarian for every detail. Students can check book availability, borrowed history, due dates, and pending fines on their own, promoting better responsibility in handling books. For librarians, the system removes the dependency on paperwork, provides real-time updates, and ensures accuracy in daily operations.

During development, key challenges included designing an efficient borrow/return flow, implementing accurate fine calculations, and ensuring that book copies are tracked correctly. These were solved by combining backend validations, real-time database updates, and clear workflows.

In conclusion, the system successfully transforms the traditional manual process into a modern, automated, and transparent solution that benefits both students and librarians while laying the foundation for future enhancements such as notifications, reservations, and analytics.

Conclusion

The Library Management System (Inventory Management) developed in this project provides a complete and practical digital solution to the problems faced in traditional library operations. Manual systems using registers or spreadsheets are often slow, error-prone, and hard to maintain. Our system removes these challenges by offering automation, real-time updates, and a user-friendly interface that makes book and member management easier.

Through this system, librarians can perform essential tasks such as adding, updating, deleting, and viewing books with details like title, author, genre, and available copies. The borrow and return module improves accuracy by automatically generating due dates and calculating a fine of ₹2 per day for late returns. Every borrow and return is recorded in the transaction history, ensuring transparency and accountability.

For students, the system provides easy access to check book availability, borrowed history, due dates, and fines. This reduces their dependency on the librarian and makes the process faster and more convenient. The search and filter options further help both students and librarians quickly locate books by title, author, or genre, saving valuable time.

The project is developed using the MERN stack (MongoDB, Express.js, React.js, Node.js), which ensures flexibility, scalability, and responsiveness. It not only improves efficiency but also reduces paperwork and errors, making daily library operations more reliable.

In conclusion, this project brings a smart and modern approach to library management. It benefits both librarians and students by ensuring smooth operations, accurate records, and an overall better library experience.

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