

# **LibHub Project – Technical Report**

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## **Application URL:**

We've deployed the application on vercel (frontend) and AWS (backend and database), a library for building user interfaces, allowing for efficient development, deployment, and management in the cloud.

**URL:** <https://libhub-fe.vercel.app>

## **Full GitHub URL:**

We've posted the application source code on github.com accessible at the following URL.

**Backend URL:** <https://github.com/Pushkal-9/libhub>

**Frontend URL:** <https://github.com/Pushkal-9/libhub-fe>

## **Project Summary:**

This project's objective is to develop a user-friendly web application for a library catalog; we will be using the "Seattle Library Checkout Records" from [Kaggle](#) as the initial data for this application. The application will allow users to conduct searches, view details, create new entries, update existing entries, and delete entries for library resources. This project involves creating a Library Management System with an interactive web interface that connects to a robust database. The user-friendly interface will allow both library staff and patrons to update, delete, create new entries, and visualize data, making the library experience more efficient and convenient for all.

## **Project Objectives and Usefulness:**

### **Objectives:**

- Design and develop a user-friendly web interface for managing library resources.
- Integrate the interface with a relational database to store and manage resource information.
- Implement functionalities for searching, creating, updating, and deleting library entries.

- Develop data visualization tools to analyze check-out trends and identify popular resources.
- Create a centralized system for managing resources, tracking checkouts, and providing insightful data analytics.
- Simplify tasks for library staff and enhance the overall user experience for patrons.

#### **Usefulness:**

- The current library catalogs often have limited search and interaction options.
- This application aims to offer several benefits for both patrons and librarians.
- Patrons can enjoy an improved user experience by easily searching, viewing details, and managing resource information.
- Librarians can streamline resource management by adding new resources, updating details, and removing outdated entries.
- The application also provides visualization tools for librarians to identify popular items and optimize collection management.
- Existing online library catalogs offer basic search functionalities, but this application is more interactive.
- Users can create, update, and delete entries, and data visualization tools are also provided.
- The application targets both library patrons and librarians.
- Patrons can manage their library accounts (optional) and enjoy an enhanced search experience.
- Librarians can make use of streamlined resource management tools and data insights.

#### **Technical Description:**

##### **Data:**

For this project, we used the “Seattle Library Checkout Records” downloaded from [Kaggle](#), and this dataset is comprised of records of all physical item checkouts that span from April 2005 to April 2024. One of the datasets, “Checkouts\_By\_Title\_Data\_Lens\_2024.csv,” includes records of library resources such as BibNumber, ItemBarcode, ItemType, Collection, CallNumber, and CheckoutDateTime. The library staff collected this dataset to keep accurate records of their resources and transactions. The other dataset, “Library\_Collection\_Inventory.csv” includes information on the books such as the BibNumber, Title, Author, PublicationYear, Publisher, Subjects, ItemType, ItemCollection, and FloatingItem. It's essential to note that the data used in this project is legitimate and appropriately documented, ensuring the privacy and security of library users.

We imported the CSV data files into a Pandas DataFrame and performed the following preprocessing steps:

1. Filtered the dataset to have the most recent data, from January-April 2024.
2. Removed data points with null values.

### **Tools:**

**Architecture Pattern:** We have designed and implemented the entire application using the MVC (Model View Controller) architecture pattern. For the back end, we use Java with Spring Boot, which provides robust server-side functionality. On the front end, we use React, a powerful library for building user interfaces. React helps manage the View layer by efficiently updating and rendering components based on user interactions and data changes, promoting a dynamic and responsive experience. This architecture allows for clear separation of concerns, enhancing both development efficiency and application maintainability.

### **Model:**

The model is developed using Spring Data JPA for seamless MySQL database integration, ensuring robust and efficient data management.

### **View:**

The views are developed using React, creating dynamic and responsive user interfaces. This setup leverages JSX, JavaScript (including React libraries such as React Router for navigation, Re-charts for Visualizations), and CSS for styling.

### **Controller:**

The controllers are developed using Spring Boot, which handles HTTP requests and routes them to appropriate services and responses, effectively managing the application's workflow.

### **Deployment Platform:**

Vercel and AWS (Amazon Web Services).

### **Tools Used:**

**Front End:** React, JSX, CSS

**Back End:** Spring Boot (Java), Spring Data JPA

**Database:** MySQL

**Tools:** IntelliJ IDEA, Visual Studio Code, Table Plus, Postman for API Testing

## **User Functionalities:**

The application provides a comprehensive suite of functionalities for effectively managing library record data:

- Inventory Management Interface
  - Browse through a comprehensive list/catalog of available books.
  - Access detailed information about each book including barcode, title, call number/location, status, and availability.
- User Authentication
  - Secure sign-up/sign-in pages tailored for both library staff and patrons.
  - Seamless pop-up notification upon successful login.
  - Convenient book checkout process for users once logged in, with immediate feedback on availability.
    - Pop-up confirmation upon successful checkout.
    - Real-time status update from “available” to “unavailable” for checked-out books.
- Exclusive Admin Portal
  - Restricted access for administrators, facilitating book and item management tasks:
    - Ability to add, update, and delete book entries.
    - Manage item entries with options for addition, modification, or removal.
- Interactive Inventory Analytics
  - Dynamic visualization of inventory data with insightful charts:
    - Bar chart showcasing “Checkouts Per Day (Last 30 Days)” for trend analysis.
    - Pie chart highlighting “Most Popular Titles (Last 30 Days)” for informed decision-making.
- Efficient Transaction Navigation
  - Convenient drop-down menu offering easy access to transactions and sign-out functionalities.
  - User-friendly dashboard displaying previous transaction history and current borrowed books.
  - Intuitive “return item” button triggering a prompt confirming successful returns.

## **Technical/Design Issues:**

1. A notable challenge we encountered was ensuring efficient database connections between Spring Boot and MySQL, especially with scalability in mind. We addressed this by integrating Spring Data JPA for its robust ORM capabilities and implementing

connection pooling via HikariCP, which significantly optimized our database operations and supported our scaling needs.

2. We faced issues with CORS when our React frontend needed to interact with our Spring Boot backend hosted on different domains or ports. The solution involved configuring CORS settings in Spring Boot to allow specific origins, methods, and headers, which enabled secure and effective cross-origin communication.

### **Future Enhancements:**

We plan to make several improvements to LibHub in the near future. These include:

1. Enhanced User Profiles: Develop user profile features that allow patrons to customize their preferences, save favorite items, and receive personalized recommendations based on their borrowing history and interests.
2. Advanced Search Functionality: Implement advanced search features such as faceted search, keyword highlighting, and advanced filtering options to help users quickly find relevant resources based on their specific criteria.
3. Social Features: Introduce social features such as user reviews, ratings, and discussion forums to facilitate community engagement and collaboration among library patrons.
4. Accessibility Features: Incorporate features such as screen reader compatibility, text-to-speech functionality, and adjustable font sizes to make the application accessible to users with disabilities.
5. Data Analytics and Reporting: Expand the data analytics capabilities of LibHub to provide librarians with insights into patron behavior, circulation trends, and collection usage, enabling data-driven decision-making and collection development strategies.

### **Conclusion:**

LibHub is a new and innovative library management platform that focuses on users and simplifies resource management for better access to information. By working together and utilizing advanced technologies such as React and Spring Boot, we have created a powerful and scalable solution that meets the diverse needs of libraries in the digital age. We value user feedback and use it to continuously refine and improve LibHub, ensuring that it remains relevant and adaptable to evolving library requirements.

Looking ahead, we believe that LibHub has enormous potential for further innovation and enhancement. By integrating advanced search functionality, social features, and expanded analytics capabilities, we aim to provide libraries with powerful tools for data-driven decision-

making and community engagement. Our goal is to empower libraries to provide equitable access to knowledge and information.

In conclusion, LibHub represents a commitment to leveraging technology to support libraries in their mission to provide equitable access to knowledge and information. We are confident that with ongoing development and collaboration, LibHub will revolutionize the library experience, making it more efficient, accessible, and responsive to the needs of patrons and communities worldwide.

**Teamwork:**

Name:	Overall Contribution:	Time Spent (Hours):
Thy Kieu	Conceptual diagram and summary, Prepared the initial technical report, Technical description of the data, and User functionalities in the report, Proofreading, Editing	10 Hrs
Kasturi Disale	Preparing project proposal documentation, Presentation, Draw E-R diagram, perform EDA for the dataset, Final Project – Future Scope and Conclusion	12 Hrs
Pushkal Mudhapaka	Database Design, Deployment of the Applications, Designing and Implementation of backend APIs, Frontend webpages and integration of backend and Frontend. Sourcing the dataset.	20 Hrs