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Systems Engineering

BookWiseUD Architecture Document

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Library System (BookWiseUD)

1. Introduction

This document presents the initial specification for a Library System, whose purpose is to digitalize and optimize the management of bibliographic resources and lending services. The system will allow administrators to register, update, and consult books, manage user data, and efficiently control the borrowing and returning of copies. Likewise, it seeks to offer a user-friendly web interface to facilitate interaction for both librarians and registered users. The solution will be developed on a modular and scalable architecture that allows the integration of new functionalities in the future.

2. Objectives

2.1 General Objective

To develop a library management system that allows the administration of books, users, and loans in an organized and centralized manner, improving control and information query processes.

2.2 Specific Objectives

- Define the structure of the database.
- Implement basic management functionalities for books and users.
- Include a loan module to manage borrowings and returns.
- Design the main use cases and interaction diagrams.
- Develop an intuitive web interface for users.

3. Problem / Justification

Small libraries (schools, institutions, and communities) often manage their book inventory and loan records manually or with impractical tools such as spreadsheets. This leads to information loss, confusion about the status of items, and difficulties in performing quick queries. The system seeks to solve this problem by providing a digital tool that allows:

- Register and consult books with their main data.
- Register and manage library users.
- Control loans and returns with a usage history.

4. Scope

- Complete CRUD for books and users.
- Loan registration (create loan and mark return).
- REST API for frontend consumption.
- React frontend with views to list, create, and edit books and users.

5. Functional Requirements (summary)

1. RF-01: Register book (title, author, ISBN, year, category, status, quantity).
2. RF-02: Edit / Delete / Query book.
3. RF-03: Register user (name, ID, email, phone, role).
4. RF-04: Edit / Delete / Query user.
5. RF-05: Register loan (user, book, loan date, expected return date).
6. RF-06: Mark return (actual return date, change book status).

6. Non-Functional Requirements

- RNF-01: Documented REST API.
- RNF-02: Basic authentication in the backend (JWT) to protect endpoints.
- RNF-03: Modular architecture with separated layers.
- RNF-04: Possibility to expand with new functionalities.

7. Business Model

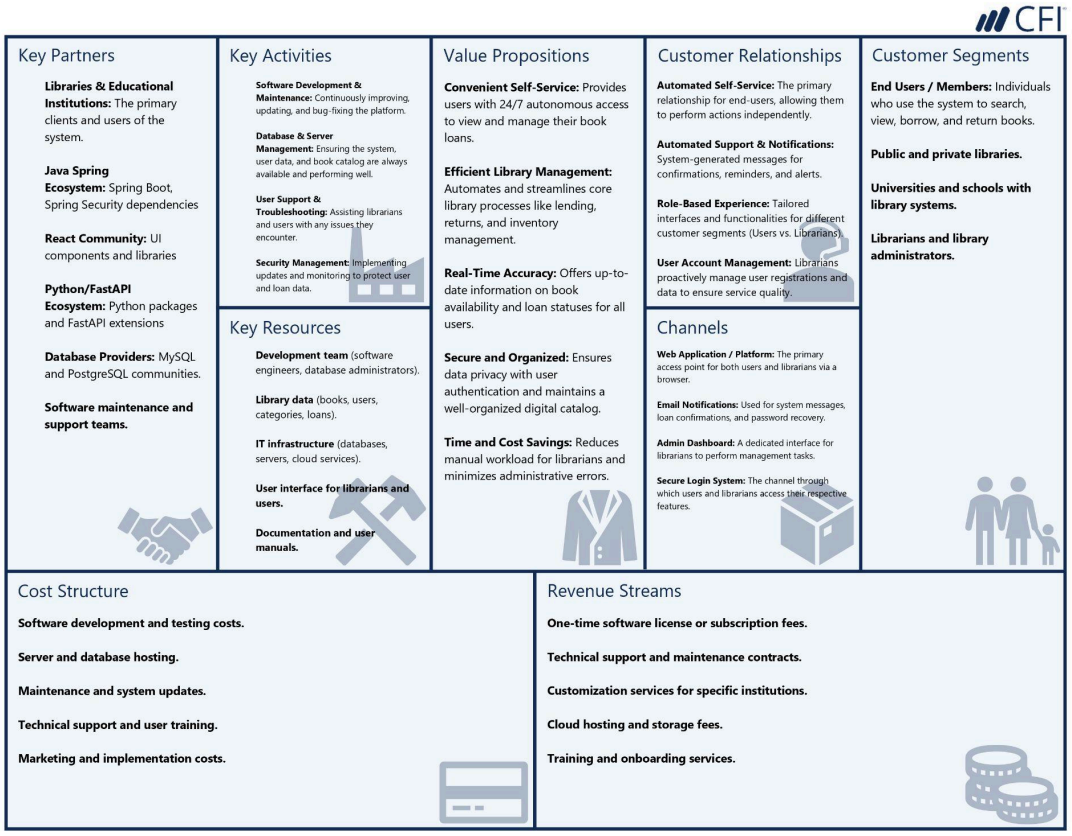

Image 1. Business Model.

The following Business Process Model illustrates the general workflow of the Library Management System. It represents the main interactions between the User, the Librarian, and

the System, describing how information and actions flow during the main library operations such as book registration, loans, returns, and account management. This diagram provides a high-level view of the system's business logic, showing the sequence of activities, decisions, and responsibilities among the actors. It serves as a conceptual reference that connects user needs with the system's functional processes, ensuring that every interaction follows a consistent and traceable workflow aligned with the project requirements.

8. Use case diagram

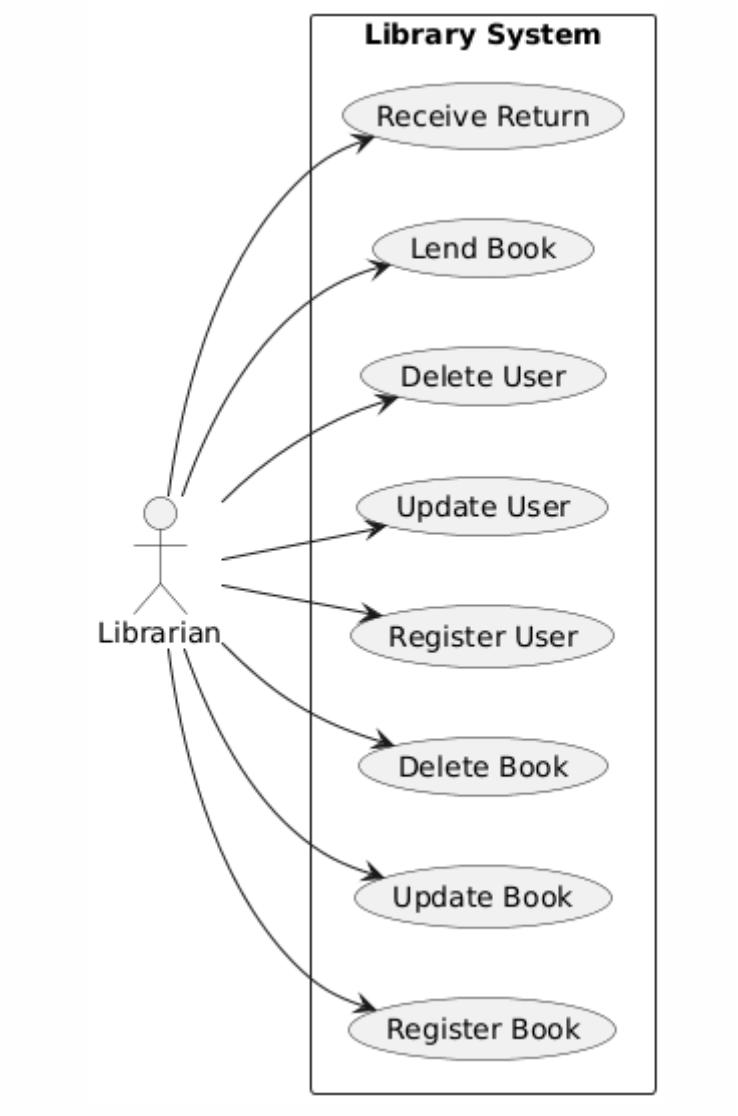

Image 2. Use Case Diagram for the Librarian.

The librarian is responsible for the comprehensive administration of the system. Their main functions include registering new books in the database, ensuring that information such as title, author, category, and availability is up to date. They can also modify or delete book records when necessary, guaranteeing proper inventory management. In addition, the librarian is responsible for managing users, allowing the registration, updating, or deletion of

their personal information. Another essential task is to control loans: assigning a book to a user, verifying its availability, and recording the return date. Finally, the librarian also receives users' returns, updating the status of each copy and ensuring it becomes available in the system again.

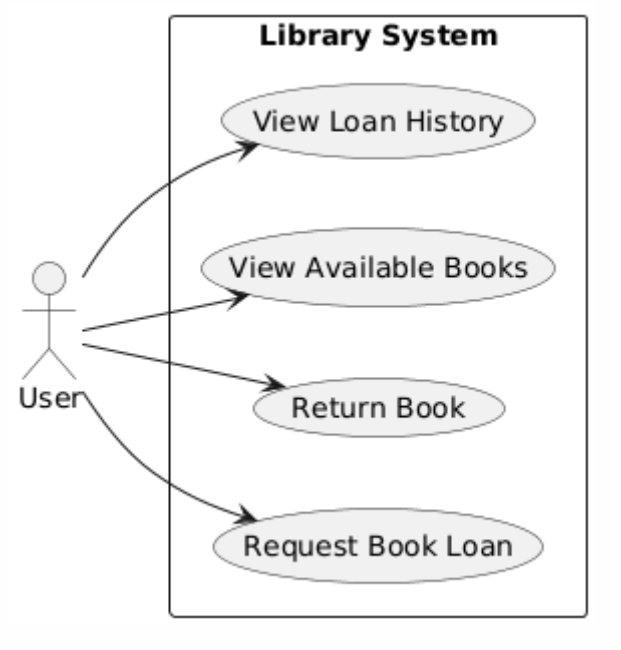

Image 3. Use Case Diagram for the User.

The user interacts with the system to access library services. They can consult the catalog of available books to see which copies are on loan or available. They have the option to request a loan, which is recorded in the system along with the corresponding dates. Once finished, they must return the book, allowing the librarian to update the inventory. Additionally, they can review their history of previous loans.

9. User Stories

Librarian User Stories

USER STORY	
ID: US01	**Role:** Librarian / User
Story Name: Receive Return	
Business Priority: High	**Development Risk:** None
Sprint: 1	**Story Points:** 3
Description: As a librarian, I want to receive returned books from users, so that the book inventory is updated and the return process is recorded correctly.	
Acceptance Criteria: The librarian must have an active session There must be an active loan associated with a book and a user The librarian requests the list of active loans The system displays the active loans The librarian selects a loan The system shows the loan details The librarian confirms the return The system updates the book status to available The system records the return date and user information The system notifies if the return could not be processed The system validates that all required information is correct	

Image 4. User Story US01 Receive Return.

USER STORY	
ID: US02	**Role:** Librarian / User
Story Name: Lend Book	
Business Priority: High	**Development Risk:** None
Sprint: 1	**Story Points:** 5
Description: As a librarian, I want to lend books to users, so that the loan process is tracked and books are issued correctly.	
Acceptance Criteria: The librarian must have an active session There must be a book available for loan The librarian requests the list of available books The system displays available books The librarian selects a book and the user The system records the loan details The system updates the book status to loaned The system notifies if the loan could not be processed The system validates that all required information is correct	

Image 5. User Story US02 Lend Book.

USER STORY	
ID: US03	**Role:** Librarian
Story Name: Delete User	
Business Priority: High	**Development Risk:** Low
Sprint: 2	**Story Points:** 2
Description: As a librarian, I want to delete a user from the system, so that inactive or incorrect accounts are removed.	
Acceptance Criteria: The librarian must have an active session The librarian searches for a user The system displays user details The librarian confirms deletion The system removes the user from the database The system notifies if deletion was successful or failed The system validates that the user exists before deletion	

Image 6. User Story US03 Delete User.

USER STORY	
ID: US04	**Role:** Librarian
Story Name: Update User	
Business Priority: High	**Development Risk:** Low
Sprint: 2	**Story Points:** 3
Description: As a librarian, I want to update user information, so that user records are accurate and up to date.	
Acceptance Criteria: The librarian must have an active session The librarian searches for a user The system displays user details The librarian edits the user information The system saves the updated information The system notifies if update was successful or failed The system validates all required fields before saving	

Image 7. User Story US04 UpdateUser.

USER STORY	
ID: US05	**Role:** Librarian
Story Name: Register User	
Business Priority: High	**Development Risk:** Low
Sprint: 2	**Story Points:** 3
Description: As a librarian, I want to register new users, so that they can borrow books and access library services.	
Acceptance Criteria: The librarian must have an active session The librarian fills out the registration form The system validates all required information The system saves the new user The system notifies if registration was successful or failed The system prevents duplicate registrations	

Image 8. User Story US05 Register User.

USER STORY	
ID: US06	**Role:** Librarian
Story Name: Delete Book	
Business Priority: High	**Development Risk:** Low
Sprint: 3	**Story Points:** 2
Description: As a librarian, I want to delete books from the system, so that obsolete or damaged books are removed from inventory.	
Acceptance Criteria: The librarian must have an active session The librarian searches for a book The system displays book details The librarian confirms deletion The system removes the book from inventory The system notifies if deletion was successful or failed The system validates that the book exists before deletion	

Image 9. User Story US06 Delete User.

USER STORY	
ID: US07	**Role:** Librarian
Story Name: Update Book	
Business Priority: High	**Development Risk:** Low
Sprint: 3	**Story Points:** 3
Description: As a librarian, I want to update book information, so that the catalog is accurate and up to date.	
Acceptance Criteria: The librarian must have an active session The librarian searches for a book The system displays book details The librarian edits the book information The system saves the updated information The system notifies if update was successful or failed The system validates all required fields before saving	

Image 10. User Story US07 Update Book.

USER STORY	
ID: US08	**Role:** Librarian
Story Name: Register Book	
Business Priority: High	**Development Risk:** Low
Sprint: 3	**Story Points:** 3
Description: As a librarian, I want to register new books, so that they can be borrowed by users and tracked in the system.	
Acceptance Criteria: The librarian must have an active session The librarian fills out the registration form for the book The system validates all required information The system saves the new book The system notifies if registration was successful or failed The system prevents duplicate book entries	

Image 11. User Story US08 Register Book.

User User Stories

USER STORY	
ID: US09	**User:** User
Story name: View available books	
Business priority: High	**Development risk:** Low
Sprint: 1	**Story Points: 3**
Description: As a user, I want to view the catalog of available books so that I can know which ones I can borrow.	
Acceptance Criteria: The user can access the complete list of books. The system displays relevant information (title, author, category, status). The user can filter books by title, author, or category. Only books with available copies are shown as available. If there are no available books, the system displays an informative message.	

Image 12. User Story US09 View available books.

USER STORY	
ID: US10	**User:** User
Story name: Request a book loan	
Business priority: High	**Development risk:** Medium
Sprint: 2	**Story Points: 5**
Description: As a user, I want to request the loan of an available book so that I can read it for a specific period.	
Acceptance Criteria: The user can select a book from the catalog and request it. The system validates the book's availability before confirming the loan. The loan is recorded with start and expected return dates. The system displays a confirmation message upon successful request. If the book is unavailable, the system displays an error message.	

Image 13. User Story US10 Request a book loan.

USER STORY	
ID: US11	**User:** User
Story name: Return a borrowed book	
Business priority: Medium	**Development risk:** Low
Sprint: 3	**Story Points: 3**
Description: As a user, I want to register the return of a borrowed book so that my loan history remains updated and the book becomes available for others.	
Acceptance Criteria: The user can view the list of currently borrowed books. The user can mark a book as returned. The system automatically updates the book status to "available." The system notifies the user that the return was successfully registered. If the loan does not exist or was already returned, the system shows an error message.	

Image 14. User Story US11 Return a borrowed book.

USER STORY	
ID: US12	**User:** User
Story name: View loan history	
Business priority: Medium	**Development risk:** Low
Sprint: 3	**Story Points: 2**
Description: As a user, I want to view my past loan history so that I can check the books I have borrowed and their return dates.	
Acceptance Criteria: The user can access a section displaying their past loan history. The system shows key data: book title, loan date, and return date. The user can sort the history by date or title. If the user has no previous loans, the system displays a corresponding message. The displayed data must match the information stored in the system.	

Image 15. User Story US12 View loan history.

USER STORY	
ID: US13	**User:** User
Story name: Log in to the system	
Business priority: High	**Development risk:** Medium
Sprint: 1	**Story Points: 3**
Description: As a user, I want to log in to the system using my credentials so that I can access the features available for my role.	
Acceptance Criteria: The user can enter their email and password. The system validates the credentials and grants access if they are correct. If the email or password is incorrect, the system shows an error message. The system keeps the session active for a configurable period. When the user logs out, the system securely removes the active session.	

Image 16. User Story US13 Log in to the system.

USER STORY	
ID: US14	**User:** User
Story name: Recover account or password	
Business priority: High	**Development risk:** Low
Sprint: 1	**Story Points: 3**
Description: As a user, I want to recover my account when I forget my password so that I can regain access without losing my data.	
Acceptance Criteria: The user can enter their registered email and request account recovery. The system sends a verification link or code to the registered email. The user can reset the password through a secure form. The system notifies the user if the email is not registered. Once completed, the system confirms that the new password has been successfully set.	

Image 17. User Story US14 Recover account or password.

10. User Story Mapping

Librarian Story Mapping

Image 18. Librarian Story Mapping.

User Story Mapping

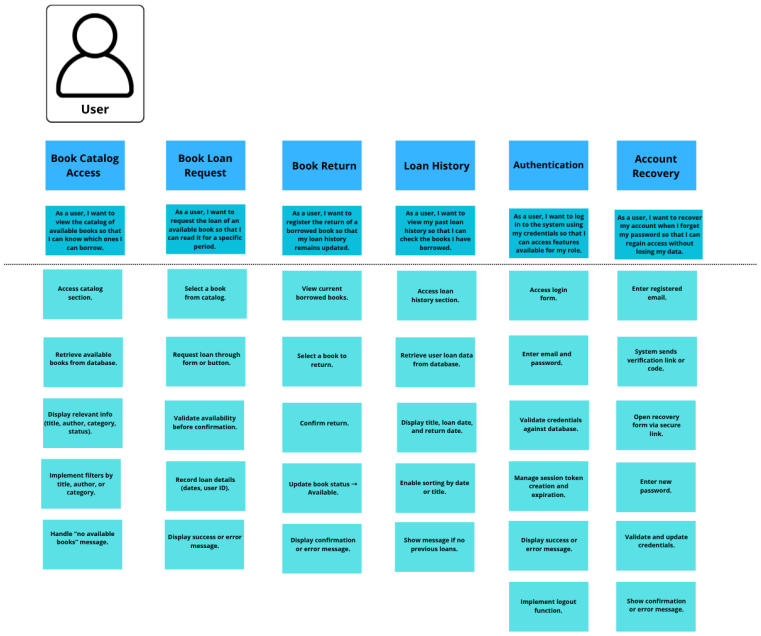

Image 19. User Story Mapping.

11. CRC Cards

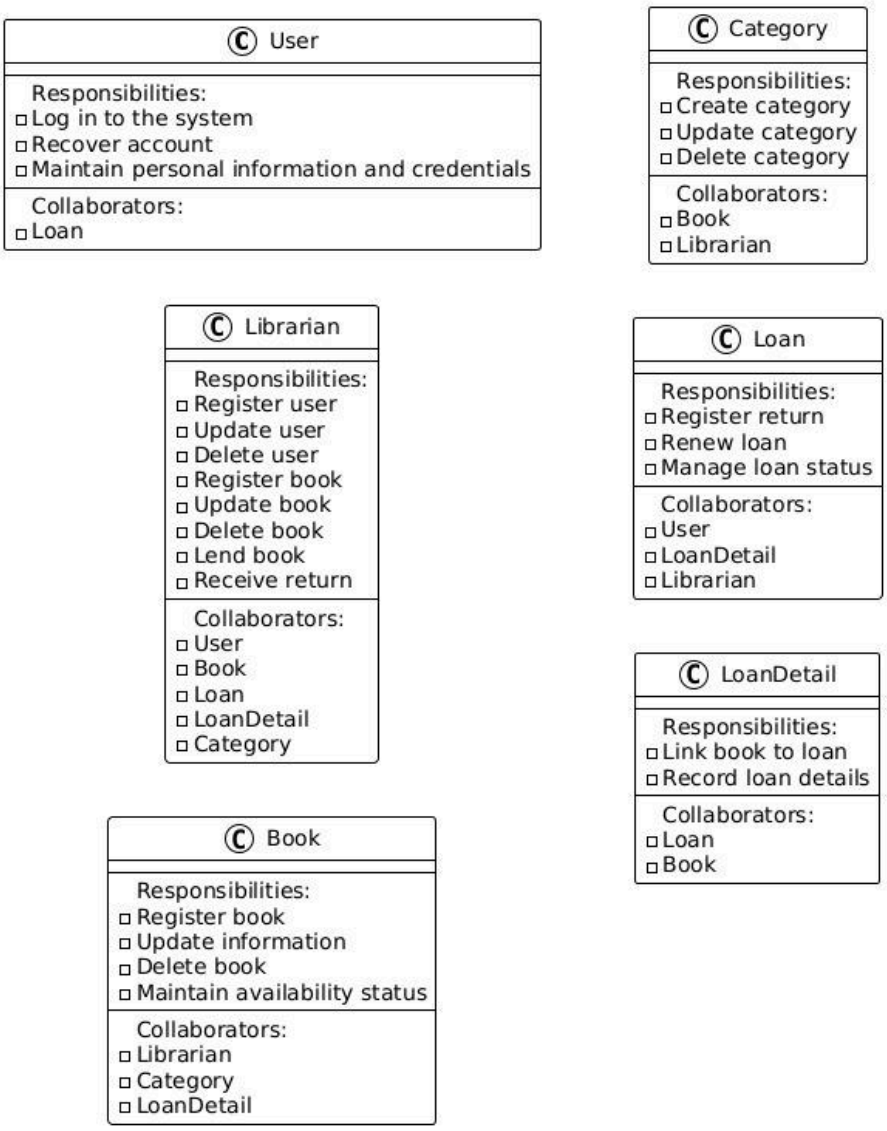

Image 20. CRC Cards.

The CRC (Class–Responsibility–Collaborator) cards describe the main classes of the Library Management System, their key responsibilities, and how they interact with each other. Each card defines the role of a class in terms of data handling and process execution. The Librarian manages users, books, and loans; the User accesses and maintains personal information and requests services. Book, Loan, LoanDetail, and Category support the system's core operations by handling records and relationships between entities. Together, these cards represent a concise and structured overview of the system's object-oriented design and collaboration model.

Conclusions

The development of the library management system represents a modern and efficient technological solution that strengthens the management of bibliographic resources and optimizes institutional processes. Through the integration of models such as the Business

Process Model, the User Story Mapping, and the CRC Cards, the project achieved a coherent alignment between functional requirements, user needs, and software architecture. These elements facilitated the definition of responsibilities, workflows, and interactions among users, librarians, and system components, ensuring a consistent and traceable structure that supports the system's usability, scalability, and logical operation.

The system's design, based on software engineering principles and supported by modern technologies such as React,FastAPI,MYSQL, and PostgreSQL, provides a robust foundation for future enhancements and adaptability to institutional needs. The combination of process modeling, class design, and user-centered development promotes maintainability and efficiency while allowing for the integration of new functionalities without affecting system stability. Overall, this project not only digitalizes traditional library operations but also demonstrates the value of structured design and engineering methodologies in creating reliable and sustainable technological solutions.