Automated Library System

Software Systems Architecture

Group 4 - Class 3

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Index

Introduction

To figure out the best setup for our library system, we've carefully considered what it needs. Our suggested plan is like a strong and flexible structure that fits the various requirements of a modern library. It focuses on being efficient, secure, and easy for users to navigate.
We're planning to keep things modular, so it's easy to add or change stuff later on. Breaking the system into separate parts makes updates and expansions straightforward without messing up everything. This way, we're set up to adapt to new needs or tech improvements without a hassle, keeping the library system up-to-date and efficient in the long run.

Requirements

User Authentication and Account Management

- Users must have library cards associated with their account;
- Users' accounts require a name, phone number (which must be verified), email, password and credit card;
- Users can log in either by scanning NFC on their library card or by entering their credentials;
- User’s library card becomes invalid if they delete their account.
- In case the user forgets his library card, to authenticate himself a code could be sent to the phone number registered to his account.

Book Check-Out and Return

- Users can checkout and return books;
- Upon checking out users receive an email with a due date reminder;
- Staff facilitates the check-out and return process by scanning book barcodes and library cards;
- Users can choose the duration for book checkouts;
- Users receive an SMS when the return date is approaching (reminder) and also when they are late already;

Catalog Search

- Users (patrons and staff) can search the catalog by various criteria;
- The application enables users to efficiently filter, search, and sort information according to their needs;
- Search results display availability and location within the library.

Book Reservation

- Users can reserve books that are currently checked out;
- Reservation can be done via the website or library stations using library cards.

Inventory Management

- Staff can add and remove books from the inventory;
- Each book is associated with a barcode (unique), so that they can be scanned and easily identified;
- Digital books also are associated with unique IDs;
- Staff needs authorization to remove books.

Media Types

- System supports various media types (e.g. physical books, magazines, DVDs, and electronic books). As long as each item is associated with a unique ID, there won't need to be many changes to handle these types.

Mobile Interaction

- Users can interact with the library system via their phones using the web application

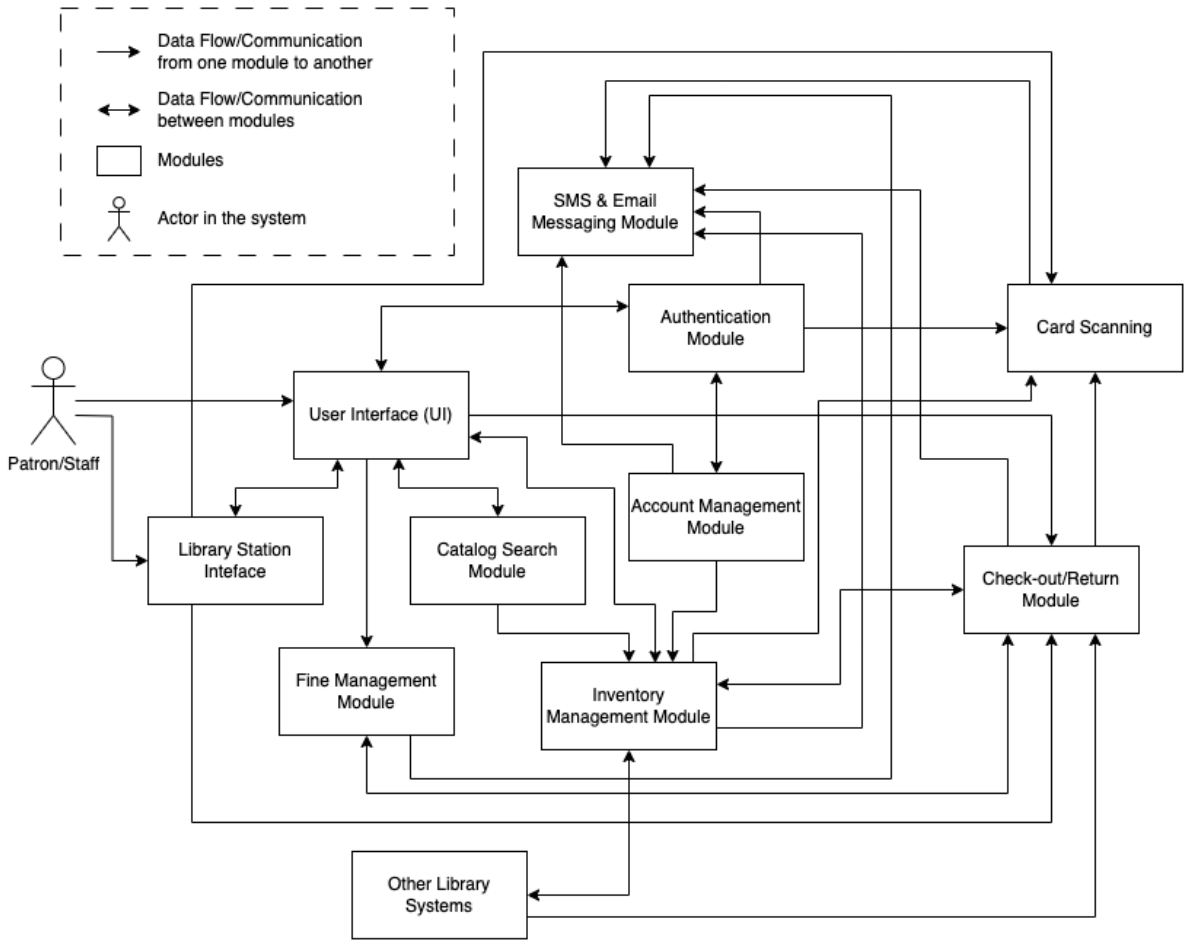
Collaboration with Other Libraries

- System needs to connect with other libraries for shared inventory management and resource pooling.

Late Fees

- Users are fined for late returns, charged to their credit cards, and notified via SMS.

Logic Diagram



User Interface (UI)

Purpose and Functionality: The User Interface module serves as the primary interaction point for patrons and staff to access various functionalities of the library system. It provides a user-friendly interface for tasks such as searching the catalog, checking out books, managing accounts, and receiving notifications.

Interactions: The UI interacts with most of the other modules/components in the system, facilitating communication and data exchange between them. For example, it interfaces with the Authentication Module for user login, the Catalog Search Module for searching the library catalog, the Check-out/Return Module for book transactions, and the Fine Management Module to notify the user of late return charges.

Rationale: The UI is essential for ensuring a seamless user experience and maximizing usability. Its integration with other modules allows patrons and staff to efficiently access and utilize various features of the library system.

Authentication Module

Purpose and Functionality: The Authentication Module manages user authentication processes, including registration, login, and credential validation. It ensures secure access to the system by verifying user identities and authorizing access to specific functionalities based on user roles.

Interactions: This module interacts closely with the Account Management Module for user account creation and authentication. It also interfaces with the UI to facilitate user login and with other modules to validate user access permissions.

Rationale: Authentication is critical for ensuring the security of the system and protecting user data. By centralizing authentication processes within this module, the system can enforce access controls effectively and safeguard against unauthorized access.

Account Management Module

Purpose and Functionality: The Account Management Module handles user account creation, profile management, and association of library cards with user accounts. It allows patrons to manage their personal information and access library services tailored to their preferences.

Interactions: This module interacts with the Authentication Module for user authentication and indirectly with the UI (through the Authentication module) for account management functionalities. It also interfaces with other modules to ensure seamless integration of user account data across the system.

Rationale: Centralizing account management functionalities simplifies user administration and ensures consistency in user data across the system. By integrating with the Authentication Module, this module facilitates secure access to user accounts and enhances the overall user experience.

Catalog Search Module

Purpose and Functionality: The Catalog Search Module enables patrons to search the library catalog using various criteria such as author, title, genre, and topic. It provides functionalities for retrieving item availability information, locating items within the library, and accessing detailed item descriptions.

Interactions: This module interacts with the UI, users, and stations, to provide catalog search functionalities and with the Inventory Management Module to retrieve item availability and location information. It also interfaces with other modules to ensure consistent catalog data across the system.

Rationale: A robust catalog search module is essential for patrons to discover and access library resources efficiently. By centralizing catalog search functionalities, this module enhances the discoverability of library materials and improves the overall patron experience.

Inventory Management Module

Purpose and Functionality: The Inventory Management Module is responsible for managing the library's inventory, including adding new items, removing items, and updating item status. It ensures that inventory information is accurate and up-to-date, facilitating efficient management of library resources.

Interactions: This module interacts with the Catalog Search Module to provide item availability information and with the Check-out/Return Module to update inventory status during book transactions. It also interfaces with other modules to maintain consistency in inventory data across the system.

Rationale: Effective inventory management is crucial for optimizing library operations and providing patrons with access to desired materials. By centralizing inventory management functionalities, this module streamlines inventory-related processes and improves overall system efficiency.

Check-out/Return Module

Purpose and Functionality: The Check-out/Return Module manages processes related to book check-out and return, including setting due dates, sending notifications, and updating inventory status. It facilitates patron transactions, ensures compliance with borrowing policies, and maintains accurate records of item circulation.

Interactions: This module interacts with the Inventory Management Module to update inventory status during check-out and return processes and with the Fine Management Module to handle fines related to late returns. It also interfaces with the Authentication Module to validate patron identities during transactions.

Rationale: Efficient management of check-out and return processes is essential for providing patrons with seamless access to library resources. By centralizing these functionalities within this module, the system can ensure consistency in transactional procedures and enhance user satisfaction.

Fine Management Module

Purpose and Functionality: The Fine Management Module handles fines for late returns, including charging fines to patrons' accounts, sending notifications, and managing fine

payments. It ensures compliance with library policies, encourages timely return of borrowed materials, and facilitates fine resolution.

Interactions: This module interacts with the Check-out/Return Module to manage fines related to late returns and with the Email and SMS Messaging Module to send notifications to patrons regarding fines incurred. It also interfaces with the Authentication Module to validate patron identities during fine-related transactions.

Rationale: Effective fine management is crucial for promoting responsible patron behavior and maintaining the integrity of library resources. By centralizing fine-related functionalities within this module, the system can streamline fine-resolution processes and enhance patron accountability.

Email and SMS Messaging Module

Purpose and Functionality: The Email and SMS Messaging Module facilitates communication with patrons via email and SMS messages, including notifications for late books, upcoming due dates, account updates, and fine reminders. It ensures timely dissemination of information and enhances patron engagement.

Interactions: This module interacts with various other modules, including the Authentication Module, Account Management Module, Check-out/Return Module, and Fine Management Module, to trigger notifications based on specific events or actions within the system.

Rationale: Email and SMS messaging functionalities are essential for keeping patrons informed about important events and updates related to their library accounts. By centralizing messaging capabilities within this module, the system can effectively communicate with patrons and enhance the overall user experience.

Library Station Interface

Purpose and Functionality: The Library Station Interface provides access to library services and functionalities for patrons using physical library stations. It offers a user-friendly interface for patrons to interact with the library system, conduct catalog searches, reserve books, and access other services available at library stations.

Interactions: This module interfaces with the UI to provide access to catalog search functionality and other features available at library stations. It also interacts with Check-out/Return Module, to facilitate patron interactions and transactions.

Rationale: The Library Station Interface enhances accessibility to library services by providing patrons with additional access points within the library. By centralizing station-based functionalities within this module, the system can ensure consistency in user experience across different interaction channels.

Card Scanning

Purpose and Functionality: The Card Scanning component enables patrons to scan their library cards for authentication and transaction purposes. It provides a convenient method for patrons to access their accounts, check out books, and perform other actions requiring authentication.

Interactions: This component interfaces primarily with the Authentication Module to authenticate patrons' identities based on the scanned card information. It may also interact with other modules, such as the Check-out/Return Module and Account Management Module, to facilitate various transactions based on card authentication. On top of that, it interacts with the SMS Messaging Module for the backup system of authenticating users.

Rationale: Card scanning functionality enhances the efficiency and convenience of patron interactions with the library system. By incorporating this component, the system can streamline authentication processes and provide patrons with seamless access to library services.

Other Library Systems

Purpose and Functionality: The Other Library Systems box represents the collaboration between multiple libraries.

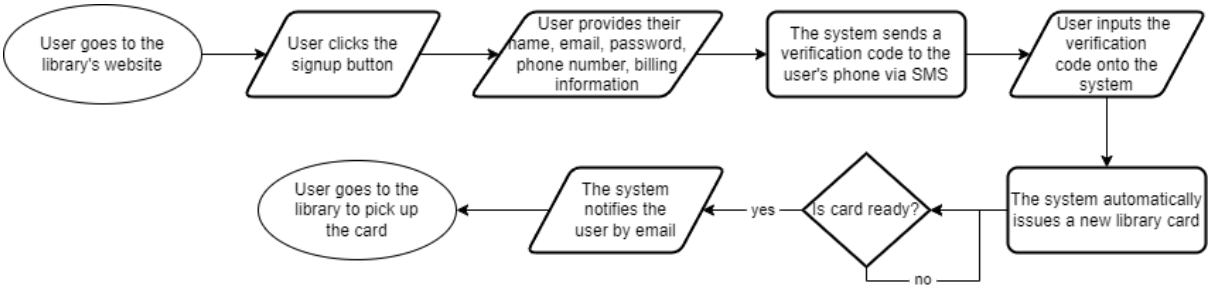
Interactions: This box interacts with the Inventory Management Module and the Check-out/Return Module. We believe that these modules will be used across different libraries to allow for resource pooling. The rest of the system at another library will be up to them and not related to our system.

Rationale: By connecting to other libraries, we can have better allocation of resources, as well as, more variety. On top of that, the other libraries only share our Inventory Management and Check-out/Return Module allowing them to have freedom over the implementation of the rest of their system.

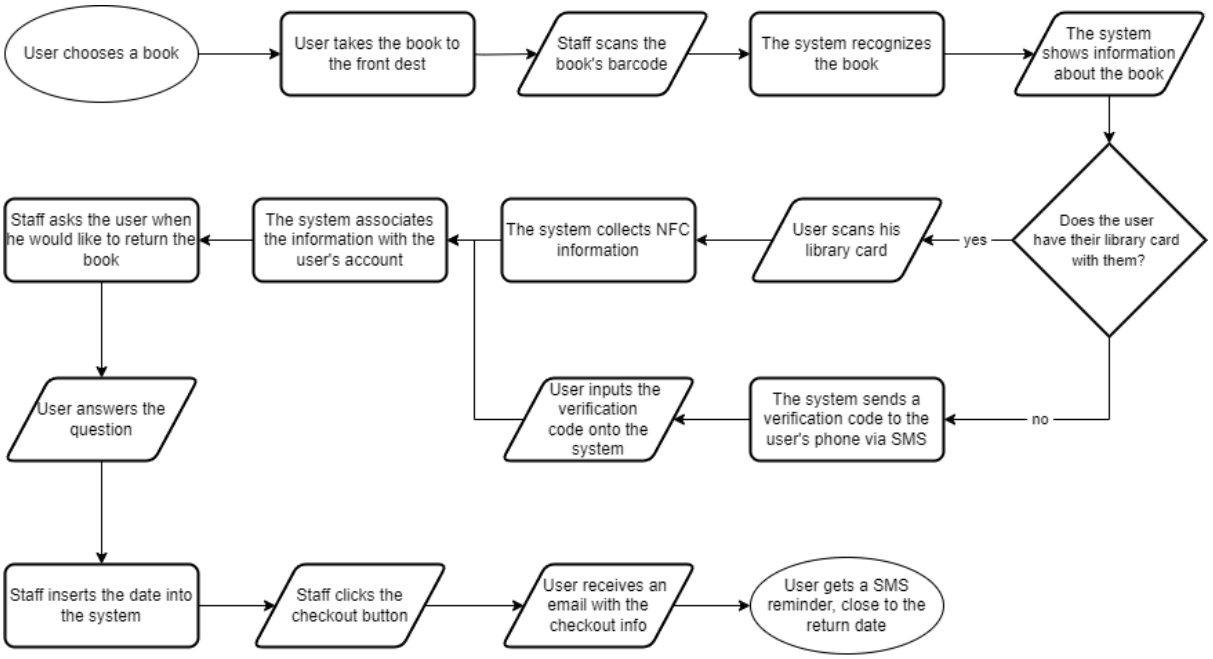
Typical Scenarios

In this section, we are going to demonstrate a few typical scenarios that may occur in the system, to better understand the problem.

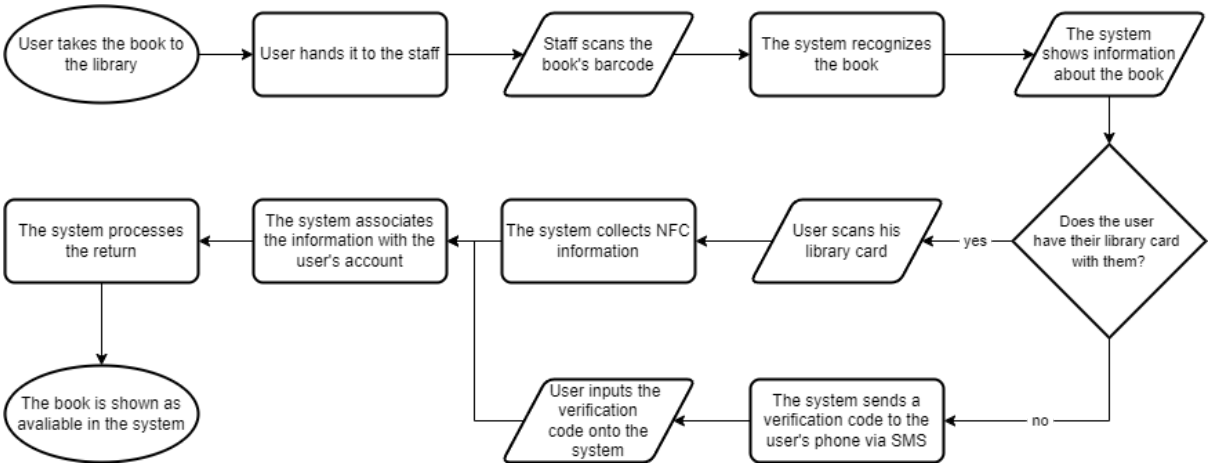
Creating Account



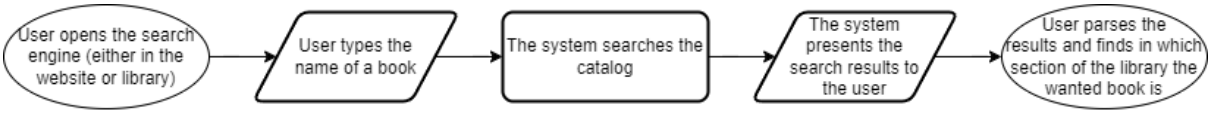
Checkout Book



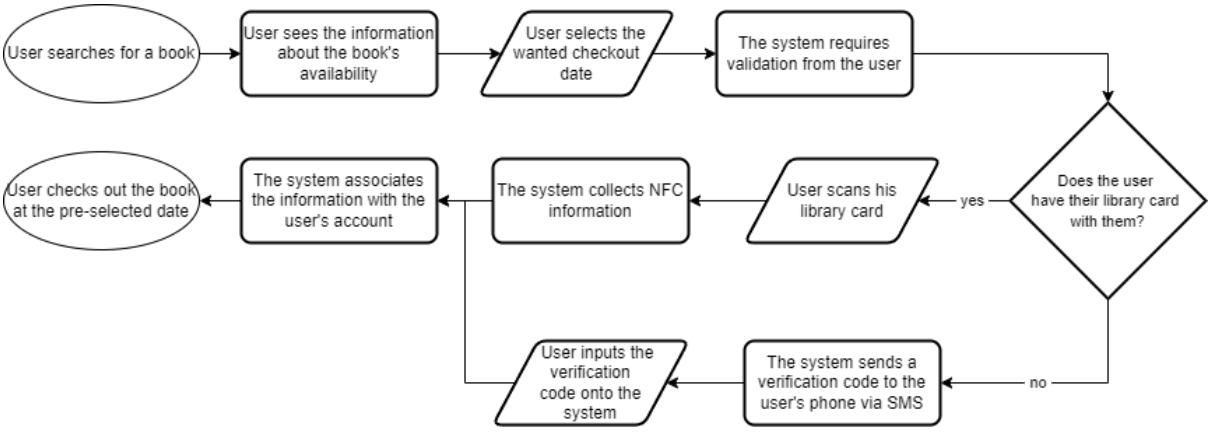
Return Book



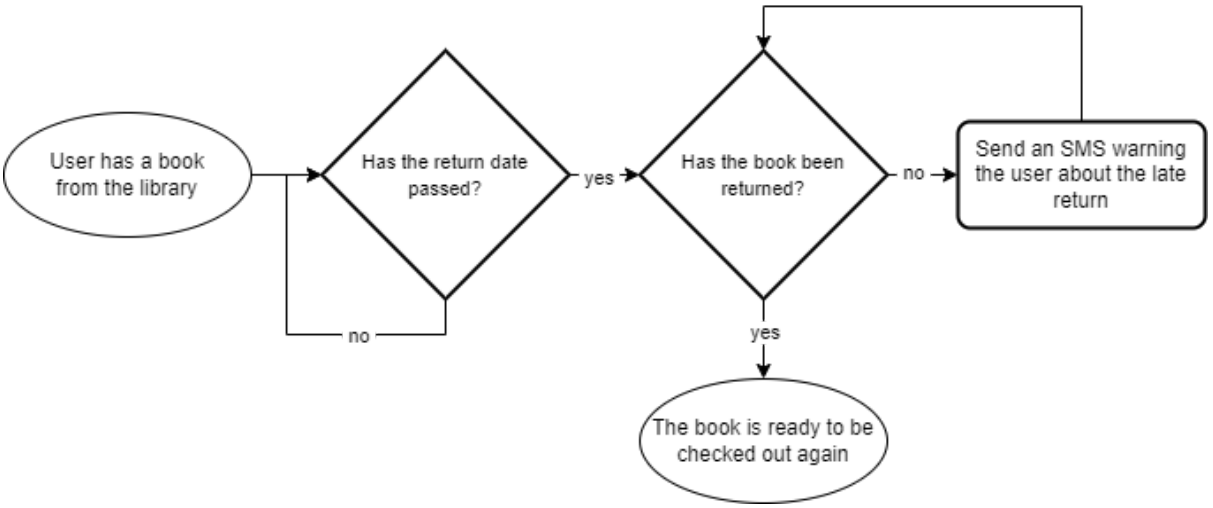
Searching for a book



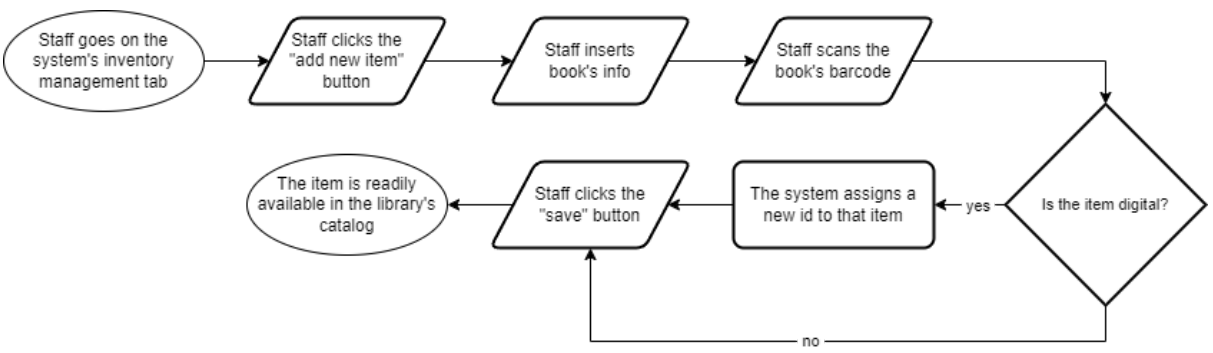
Reserve a book



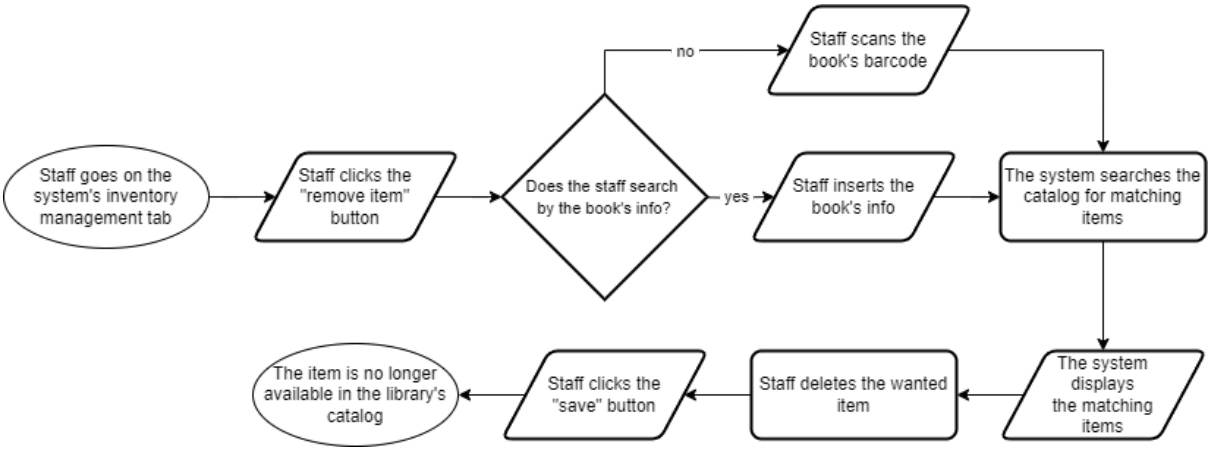
Late books



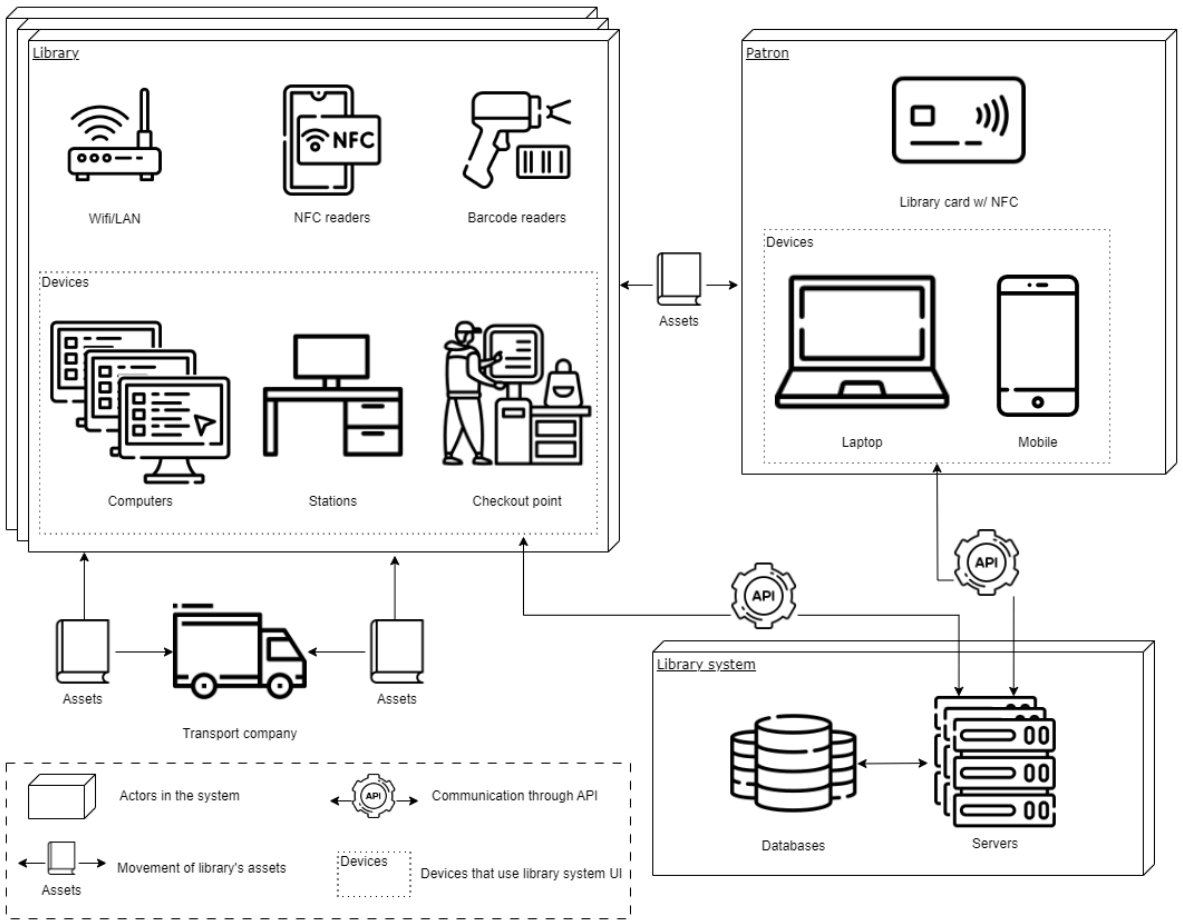
Staff adding an item to the Inventory



Staff removing an item to Inventory



Physical System Diagram



Library Stations

- Computers or touchscreen devices for patrons to access the library's web application.
- NFC scanners and keypads for users to interact with their library cards.
- Monitors or screens to display search results, book availability, and other information.

Staff Workstations/Checkout points

- Computers or tablets for library staff to manage check-outs, returns, and inventory.
- Barcode scanners to scan book barcodes and library cards.
- Printers for generating receipts and reports.

Networking Infrastructure

- Local area network (LAN) infrastructure to connect all devices within the library.
- Internet connection for accessing online resources and sending notifications.

Inventory Management Tools

- Barcode scanners for adding and removing items from the inventory.
- Label printers for generating barcode labels for new items.

Physical Media

- Books, magazines, DVDs, and other physical media items for the library's collection.
- Barcode labels or ISBN stickers on each physical item for inventory tracking.

Library Cards:

- Physical library cards with embedded NFC chips or barcodes for user authentication.
- Card readers or scanners for library staff to associate cards with user accounts.

Transport Infrastructure:

- Trucks, vans, or dedicated courier services used to transport library materials.
- Packing materials to ensure the safe transport of library items.

Notification System

- SMS gateway for sending notifications to patrons' phones.
- Email server for sending email notifications.

Backup and Storage

- Server or cloud storage for storing user account information, transaction records, and inventory data.
- Backup servers or storage solutions to ensure data redundancy and recovery in case of failures.