

Library Circulation System App Development Proposal

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1. Requirement Analysis

A. Problem Definition:

The library circulation system deals with the movement of information resources (summed up as "books" in this paper for simplicity) and comprises three main entities: books, librarians, and borrowers. The borrower, who carries a library card containing a barcode or unique number, is loaned a book that contains a barcode using their library card. The librarian scans the barcode of the borrower and the book and enters the information of the book into a database as borrowed. Upon return, the status of the book in the database is changed.

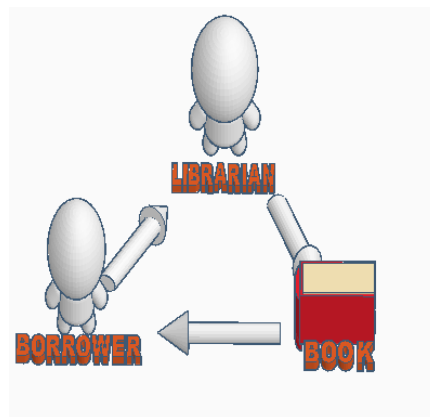


Figure 1: Image of a simplified library circulation system.

The problem lies in records' manual keeping and the borrower's access to information. Real-time circulation must be linked to the online catalog free of error or confusion so borrowers can fully utilize the books available to them along with the loaning of eBooks. In addition, the library must have options to deliver books to reach a more extensive customer base.

B. Issues:

Implementation will be an issue. Borrowers might not need or be aware of the need for this alternative to the library circulation system they interact with. In addition,

resources will have to be allocated for training library circulation workers to operate the new system.

C. Objective

This project aims to approach paperless operations and develop a library circulation system app that can be accessed fully online by the borrower and reach a broader customer base. Remote borrowers will receive the same services as in-person borrowers. In addition, the new circulation system will be easier to manage transactions and details of borrowers and staff. A first-of-a-series prototype will initially be given to local participants and a monetary incentive who will test out the app and offer feedback.

D. Constraints:

The new information system is to be completed and implemented by the end of Q3 2021.

E. Requirements and Description of the Proposed System:

The new information system will have a login page for users and staff. The management staff is given back-end administrative privileges, the circulation desk operates transactions, and the user is given front-end privileges. Borrowers require an efficient and updated process of monitoring the booking and user status at ease. An app made through the library that can be accessed via the borrower's phone to view their library card, current borrowed book status, option to extend the time borrowed through the new LCSReserve feature, readings recommended by the staff, and to view general membership information.

Users with existing library membership will register using their library card number, email address, phone, and password. New users may apply remotely for library

membership registration by submitting digital copies of their ID and proof of membership through a secure VPN from the library server. Three business days are allowed for verification. The applicant will be notified upon approval. Upon registration, users will have access to the library circulation service. Books can be shipped or delivered locally to the borrower upon request to borrow the book through the app. The borrower will be subjected to a small shipment fee. The history of the book and the number of times it has been borrowed are made available to the borrower when browsing the catalog online. Dues to the library for overdue or lost books can be paid through the website and the app. In addition, the borrower may reserve books, see books out of circulation, and reserve books awaiting collection online or through the app.

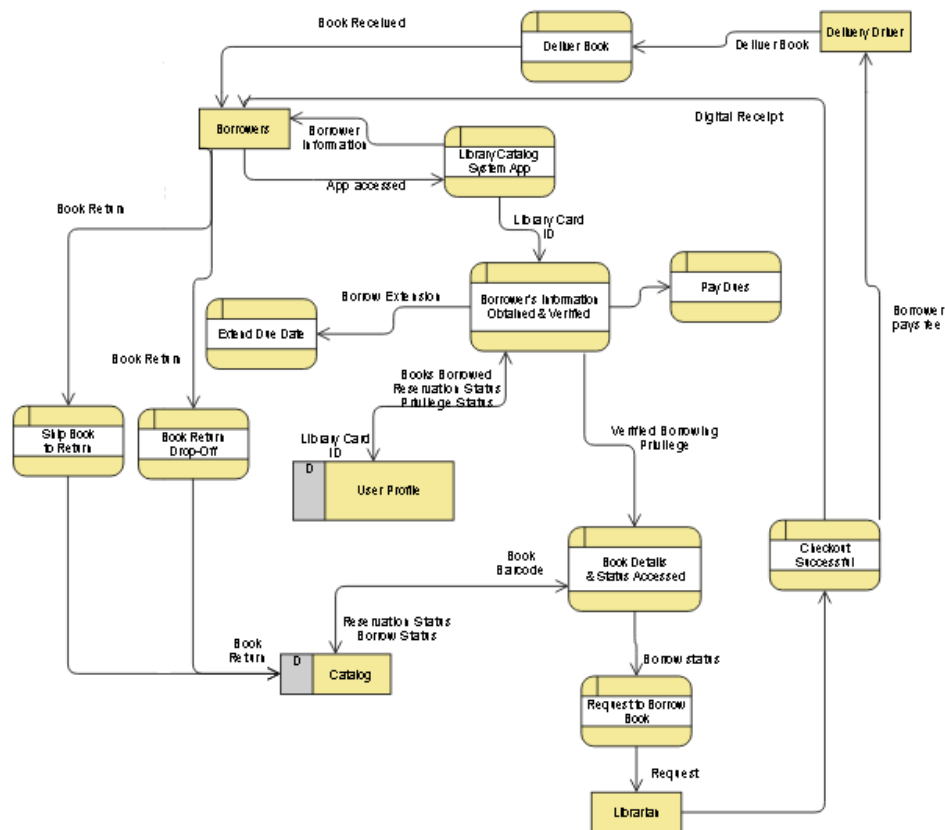


Figure 1: Data Flow Diagram level 1 of the library circulation system for book checkout created using Visual Paradigm.

F. Descriptions of outputs/inputs/performance/security or controls

- a. **Output:** The librarian checks out the book requested by the borrower. The borrower puts the book on hold or requests it through the app; a library worker will deliver the book to the borrower. The online catalog shows call no., description, reservation status, borrow status, and book information such as publisher, author, subject, etc. Real-time delivery is displayed for the borrower. In addition, language, FAQs, customer service, and user profile information are outputted for the user.
- b. **Input:** Borrower inputs library card information to log in and view membership, requests, and payment. Online catalog updates when database changes have been made.
- c. **Processes:** The library system calculates fines, fees, and blacklist eligibility based on overdue borrow terms and provides the data through the app for the borrower.
- d. **Performance:** The system must support any number of users online simultaneously.
- e. **Security:** The app will log the borrower out after 10 minutes of inactivity to safeguard the borrower from session hijacking or cookie thefts. On top of this, the app is accessed through the library's virtual private cloud upon user login. Only library members can log in successfully. New users will not have access to features unless they apply through the app on a secure channel.
- f. **Control:**

The librarian may alter app features or users' blacklist status.

G. Specific Requirements

- a. **Interface:** Main user interfaces are the login interface, browsing interface, and checkout interface. Drafts of some of the interfaces are drawn using MockFlow.
- b. **Operational:** The local library requested the new system for a better functioning circulation for customers and librarians alike. Circulation desk technicians will be trained to operate the system on the back-end; customers will have access to the app on the front end. The library service will have its dedicated VPC. It will be connected to a front-end user who can access the app from the customer-facing application remotely from anywhere with a wireless network connection. In addition, the new application must handle: any given amount of library members on the server, borrow, reserve, or payment transactions, and occasional maintenance.
- c. **Resource:** Personnel will be trained during the deployment stage. The estimated time to finish the project is 76 business days, from 6/8/21 to 9/21/21, just before Q3 ends on the 30th of September. The estimated budget is approximately \$101,100. The space will be the local library for application and server implementation and remote video calls. In addition, there will be an update to the library server room with a new implementation of amazon web services—a move from on-site to the cloud.
- d. **Performance:** Server speeds for inputting and outputting information is at a maximum of 5000 milliseconds, else the server will time out. As many as a hundred users may use the library circulation system server at one time before server response begins to slow, and 100 transactions can be processed in one minute. These are estimates. The Amazon Web Service apps, Amplify, EC2, and

RDS, are being used in conjunction and will increase server speed. The workload is defined using the Amazon Web Service Well-Architected Framework tool.

High-risk issues include users, third-party servers such as, etc.

2. System and Database Design

A. User Interface

The following are drafts of the user interfaces. The login screen shows as-is:

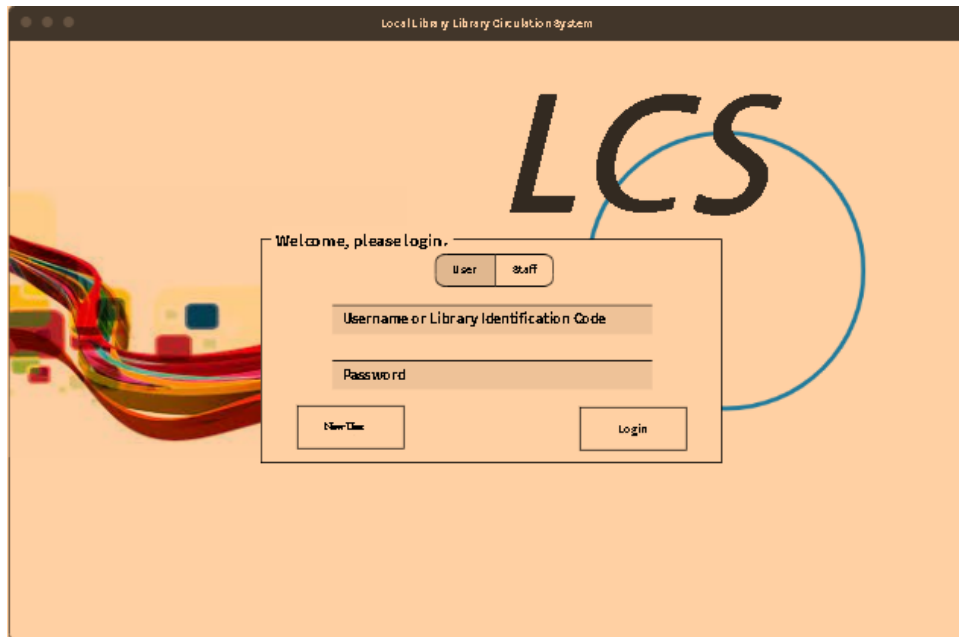


Figure 2: This is the first screen upon opening the new library circulation system application.

The login will be for borrowers or staff. Upon entering credentials, the user or staff will gain access to the system. New users will click the "New User" button to the left of the "Login" screen to start the new user application.

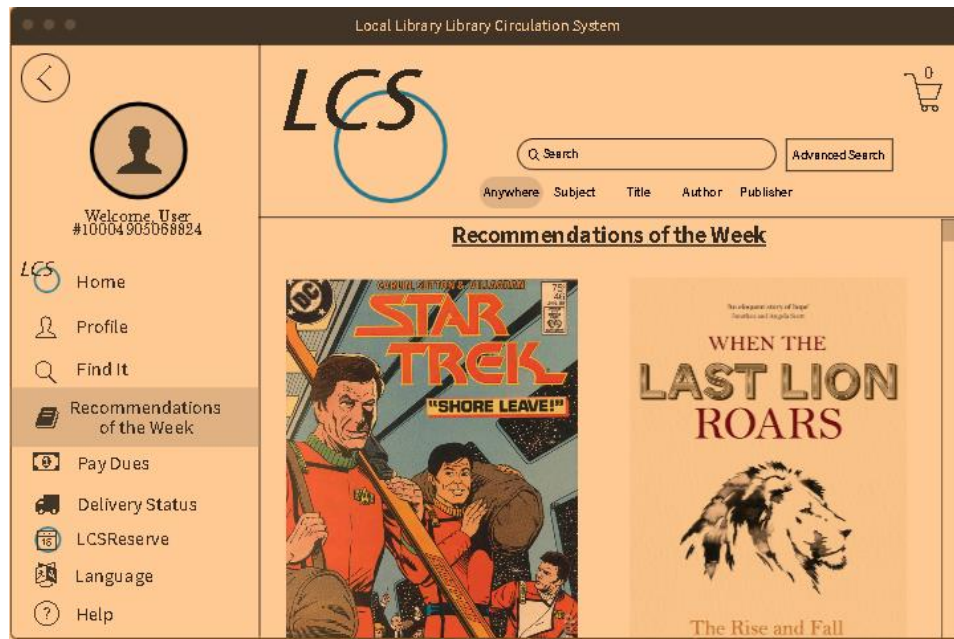


Figure 3: When the system verifies the user, the user is allowed to browse features of the library circulation system service. The "Start Trek: Shore Leave" image available from:

<https://www.mycomicshop.com/search?q=Star%20Trek%202046&minyr=1987&maxyr=1989> [Accessed 27 July 2021] and "When the Last Lion Roars" image available from : <https://www.amazon.com/When-Last-Lion-Roars-Beasts/dp/1472916131> [Accessed 27 July 2021].

The login will be for borrowers or staff. Upon entering credentials, the user or staff will gain access to the system. The home feature will take the user to the homepage, displaying any new application update information. The search bar above the logo is a basic search function through the catalog. "Profile" allows users to view their membership information and edit or add any contact or personal information. "Find It" is an advanced search function that takes the user to the same page as the "Advanced Search" button next to the search bar. It allows for a more detailed search with more than one keyword and a catalog search by title, call number, author, and subject.

"Recommendations of the Week" is a page where the user can view selected staff picks. Staff picks change at the start of the work week every week. Users can select a

book chosen by the staff from that page and will be taken to the book's respective information page. Books can be reserved or borrowed from any book's information page. The "Pay Dues" function will allow users to view their outstanding balance and pay any due through a secure TLS/SSL payment page. The "Delivery Status" page offers real-time tracking powered by GPSWOX, where users can view and get time estimates on their delivery. "LCSReserve" is a service created for library users to reserve any book in a quick and timely manner. "Language" directs the user to a page to change the interface's language to any other supported language. Finally, "Help" directs the user to a frequently asked question page and options to interact with a librarian through live chat, email, or phone call.

B. Data Design

The figure below shows 14 tables that are below in the database:

User	User Account	Staff	StaffAccount	Fine	Reservation
ID (pk)	ID	ID (pk)	ID (pk)	ID (pk)	ID (pk)
UserAccountID (fk)	Username	FirstName	Username	UserID (fk)	ItemID (fk)
FirstName	Password	LastName	Password	CatalogID (fk)	ReserveDate
LastName	Password Expiry Date	StaffAccountID (fk)	Password Expiry Date	ItemID (fk)	ReturnDate
MemberStatus	SecQA			Amount	DueDate
Phone	SecQA2			ReturnDate	
Email					
LocationID (fk)					

Item	Catalog	Author	Subject	Checkout	Location	Country	Region
ID (pk)	ID (pk)	ID (pk)	ID (pk)	ID (pk)	ID (pk)	ID (pk)	ID (pk)
UserID (fk)	IdentifierType	FirstName	CatalogID (fk)	UserID (fk)	Address	Name	Name
CatalogID (fk)	AuthorID (fk)	LastName	Subject	StaffID (fk)	City	RegionID (fk)	
Status	Title	LocationID (fk)	Language	CheckoutDATE	Zip		
	Publisher				State		
	CallNo				CountryID (fk)		

Figure 4: The tables are made using LaTeX. The database is composed of the tables user, useraccount, staff, staffaccount, fine, reservation, item, catalog, author, subject, checkout, location, country, and region. The primary key column in each table is designated by "(pk)"; the foreign key(s) in the appropriate table is designated by "(fk)".

The database follows normalization rules. Each table in the database has atomic valued attributes. Data in the column is of the same domain and have unique names.

Moreover, the order of the data in the table is irrelevant when using data manipulation language in structured-query language applications. A functional dependency exists for each table to achieve the second normalization stage. Prime attributes are functional foreign keys to achieving the third normalization stage. Below is the physical entity relationship diagram of the database.

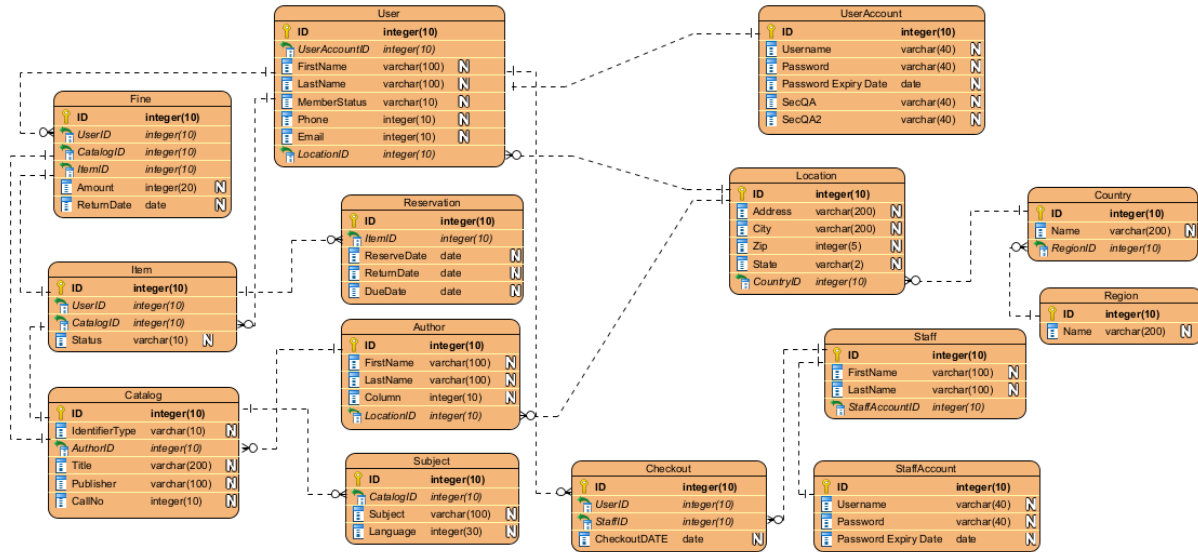


Figure 5: The entity relationship diagram created for the database design step.

Data will be stored and accessed through the Amazon Web Server cloud. Amazon Relation Database Service (Amazon RDS) is chosen to remotely store all data necessary to run the application due to ease of setup to operate in the cloud, cost-efficiency, and resizable capacity. The library circulation system operating on the RDS will allow it to focus on fast performance, high availability, and security. Amazon's virtual private cloud allows control of network space and its exposure to the internet. The system's database runs on the MySQL Community Server 8.0.25 engine. Library employees will gain remote access through a VPN. Access, both front-end, and back-end, will require multi-factor authentication.

C. System Architecture

The HRMS web and mobile application is developed using AWS Amplify on Windows 10 operating system. Back-end processes are integrated into the application and are compatible with HTML, Android, and macOS. AWS Amplify app is chosen due to its simple front-end setup and compatibility with implementing the Amazon Simple Workflow Service. The client will use the UI created from Amplify to request a response from the Amazon EC2, acting as a client-server architecture. The system is developed using MySQL Community Server 8.0.25 Engine connected to the AWS RDS for the Amazon Elastic Compute Cloud application server.

3. Project Phase

A. Project Schedule

The project mapped out using Microsoft Project 2013 will have two phases: the planning phase and the implementation phase. The planning phase will take 14 days and consist of: receiving client requests / brainstorming ideas and themes with the team; discourse with the local library client for project approval; drafting a budget, the client approves or negotiates the budget, and drafting a full whitepaper and receive whitepaper approval. The implementation phase will consist of an application and database design stage followed by a small testing phase; an application development composed of testing, first-as-a-series prototyping and deployment, feedback gathering, and implementation; the application development stage is followed by a deployment stage consisting of quality assurance, documentation, and library employee training to use the app. Total costs estimate round to \$101,100

LCSPProject	76 days	Tue 6/8/21	Tue 9/21/21	\$101,100.00
1 Planning Phase	14 days	Tue 6/8/21	Fri 6/25/21	\$2,900.00
2 Implementation Phase	62 days	Mon 6/28/21	Tue 9/21/21	\$98,200.00

Figure 6: The phases of the project.

Below is the Gantt chart outlying the different phases:

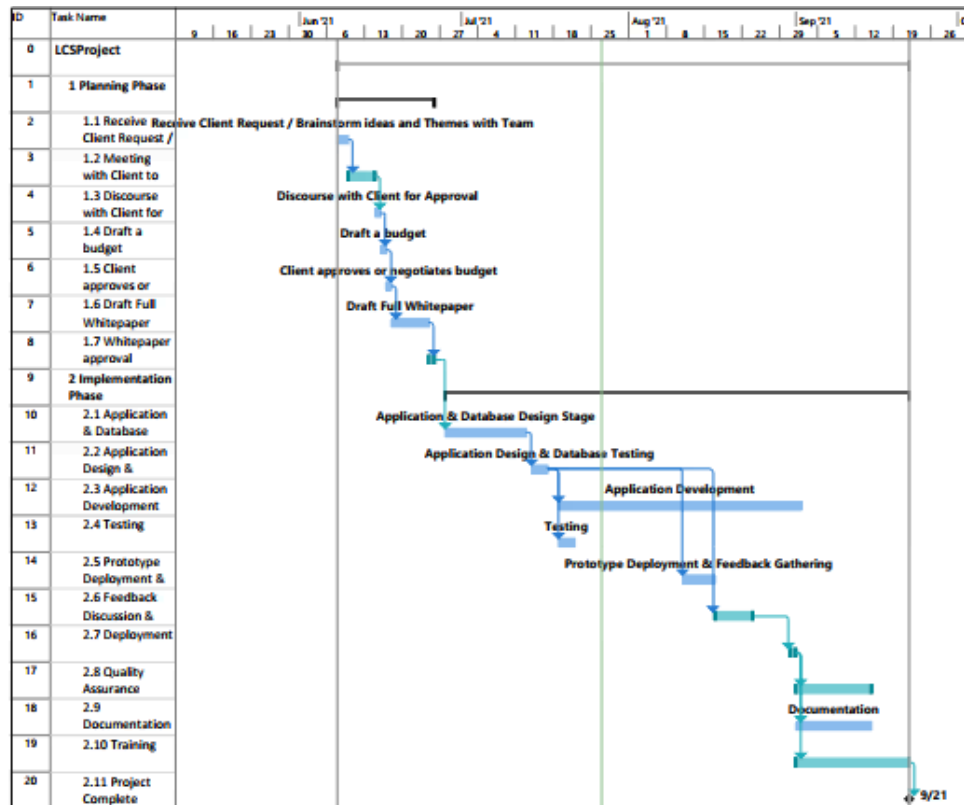


Figure 7: Gantt chart of the project.

Below, is a timeline that simplifies the Gantt chart above.

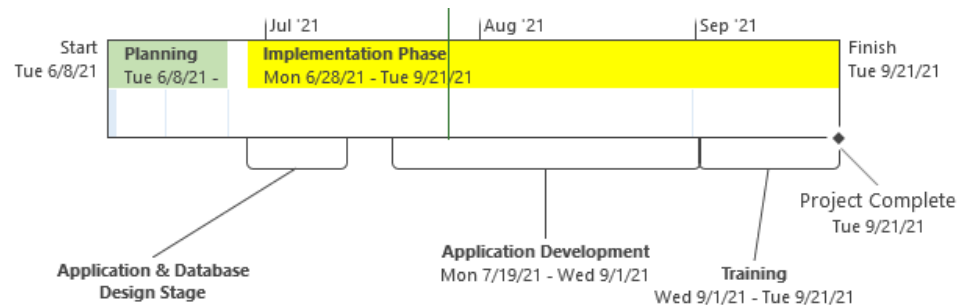


Figure 8: The entity relationship diagram created for the database design step.

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