Internal Document

For

Digital Library Management System

Prepared by: Harshil(88975332), Smera(56643079), Vaishnav(59768213)

Table of contents 2

1. Abstract 3
    1.1 client specification 3
    1.2 scope 3
    1.3 Intended audience 3
    1.4 Final Goal 4
2. Feasibility study 4
    2.1 Qualitative & Quantitative Study 4
        2.1.1 Qualitative Study 4
        2.1.2 Quantitative Study 4
    2.2 Joint Report 5
        2.2.1 References 5
        2.2.2 SWOT Opportunities 5
        2.2.3 Operational Feasibility 5
        2.2.4 Operational Issues 6
        2.2.5 Technical Feasibility 6
        2.2.6 Technical Issues 6
    2.3 Keywords and Recommendations 7
3. Scenario Modeling and Analysis 7
    3.1 Main Scenario 7
    3.2 Sub-Scenario 7
    3.3 Analysis Output 8
    3.4 Specification Level 2 9
        3.4.1 Functional Requirements 9
        3.4.2 Non-Functional Requirements 9
        3.4.3 Risk Analysis 9
        3.4.4 Repositories Required 10
4. Requirement Definition 11
    4.1 Workflow 11
    4.2 Data Structure 12
    4.3 Metadata 13
    4.4 Number of classes and objects 14
5. Design Phase 15
    5.1 UML Diagram 15
        5.1.2 Class Diagram 15
        5.1.3 Use Case Diagram 16
    5.2 FSM Behavioral model 16
        5.2.1 User FSM 16
        5.2.2 Sequence Diagram 17

1. Abstract

1.1 Client Specification

The Digital Library Management System will provide efficient management of library resources and user activities. It includes the following core components:

User Management	Handles user registration, authentication, and roles (e.g., students, faculty, librarians).
Material/Book Interaction	Supports searching, borrowing, and returning of materials
User Activity Tracker	Tracks user interactions with the system, including borrowing history and activity logs.
Material/Book Manager	Allows librarians to add, update, and delete materials in the library system.
Types of Books/Materials	Supports categorization and management of distinct types of resources, including books, journals, and e-resources.
Search for Materials	Implements a keyword-based search engine with filtering options for quick and accurate resource retrieval.
Administrative Monitoring	Enables administrators to oversee system performance, manage roles, and generate detailed reports.

1.2 Scope

The project aims to design a scalable system to handle thousands of resources (books, research papers, etc.), categorize materials effectively, and provide access based on user roles (students, faculty, librarians).

1.3 Audience

This project aims at the specified audience:

University students and faculty for resource access.

Librarians for resource management.

Administrators for system monitoring.

1.4 Goal

Develop a system that ensures seamless access, reduces manual errors, and maintains proper tracking of materials.

2. Feasibility Study

2.1 Qualitative & Quantitative Study

2.1.1 Qualitative Study

User Needs and Expectations	Interviews with stakeholders to gather user needs and expectations.
Operational Feasibility	Identifying the compatibility of the system with existing infrastructure
Usability	Feedback from librarians and students on current library issues.

2.1.2 Quantitative Study

System Load	Analysis of current library operations
Performance Metrics	Target system response time: <2 seconds per query. Target uptime: 99.9% availability.
Data Security	Measures to prevent data leaks
System Requirements	Basic requirements to run this system
Scalability	Measures to make this system easily scale-able in the future

2.2 Joint Report

2.2.1 References

1.Lyngsoe System:
.https://lyngsoesystems.com/library?gad_source=1&gclid=Cj0KCQiAhbi8BhDIARIsAJLOludmCzyzUNfSf2pB1tt8kcd4X3GG81NJYICtGs8mpDABC2kWmYvsmeMaAnRbEALw_wcB

2. KOHA: https://koha-community.org

3. BiblioteQ : https://biblioteq.en.lo4d.com/windows

2.2.2 Swot Opportunities

Strength	Resource management tools Easy to access materials
Weakness	Dependent on internet High Initial Setup Cost Staff Training Required
Opportunity	Integrated with e-learning Supports research Growth
Threat	Cyber Security Server Downtime Electrical Outage Data Loss

2.2.3 Operational Feasibility

Ease of Use	Designed for non-technical users.
Training	Minimal training required for basic operations.

2.2.4 Operational Issues

User Training:	Proper training and support may be needed for users unfamiliar with digital library systems.
System Downtime and Availability:	Extended periods of downtime or outages could severely impact the operational efficiency of the system.
User Role Management and Permissions:	Mismanagement of user roles and permissions could lead to unauthorized access or restrictions for legitimate users.

2.2.5 Technical Feasibility

Technology Stack:	Frontend: React.js. Backend: Node.js with MongoDB. Hosting: Cloud-based (AWS or Azure).
Tools for Development:	Git for SCM, Jira for task tracking.

2.2.6 Technical Issues

System Scalability:	As the university grows, the system must be able to scale and handle an increasing number of users and materials.
Data Security:	Sensitive user data (e.g., borrowing history, personal details) must be encrypted and stored securely to prevent data breaches.
System Downtime	The system must be available 24/7, and contingency plans must be in place for maintenance or downtime
Integration with Legacy Systems:	Integrating with existing, outdated systems may pose compatibility and data exchange challenges.
Application Performance and Response Time:	Long response times and performance degradation could negatively impact user experience, especially under high traffic.

2.3 Keywords & Recommendations

Keywords	Recommendations
Scalability	Implement modular and scalable database design to handle growth.
Security	Implement role-based access control (RBAC) for different user types.
Reliability	Ensure system uptime of 99.9% and conduct regular system performance testing. Implement disaster recovery and regular off-site data backups.
Performance	Use caching and indexed searches to optimize query response time (<2 seconds).
GDPR Compliance	Ensure system compliance with GDPR and implement features for users to manage their personal data.

3. Scenario Modeling and Analysis

3.1 Main Scenario

Domain: Digital Library System

1. Manage library materials.
2. Enable user access and borrowing.
3. Administer roles and resources.

3.2 Sub Scenario

User Registration and Login: Authentication and profile management.

Search and Borrowing: Keyword-based material search and borrowing process.

Resource Management: Librarian-driven material addition, removal, and update.

3.3 Analysis Output:

Users	Functions	Activities	Metrics
Students/Faculty	Search, borrow, return	Material search, reservation	Session time Duration Time User engagement
Librarians	Manage library resources	Add, remove, update materials	Update Frequency: Number of updates to materials per day/week Material Availability: Percentage of materials successfully added or updated Resource Management Efficiency: Time taken for librarians to complete material updates
Administrators	Oversee system functionality	Monitor user activities, generate reports	System Uptime: Percentage of time the system is available Report Generation Time: Average time taken to generate reports Security Incidents: Number of unauthorized access attempts or data breaches
Guest	Search	Material Search	Session time Search queries

3.4 Specification Level 2

Integration of Sub-Scenarios:

User registration is linked to borrowing processes through unique user IDs.

Material search integrates with borrowing and returning workflows to ensure updated availability.

Resource management by librarian's updates data accessible to users in real time.

Performance Benchmarks:

Metric	Target Value
Search response time	Less than 2 seconds for 10,000 items
Borrow/return processing	Completed within 1 second
System uptime	99.9% availability

3.4.1 Functional Requirements

Allow users to register and authenticate.

Enable keyword-based search and filtering.

Track and display borrowing history for each user.

3.4.2 Non-Functional Requirements:

Data Ensure data security through role-based access controls.

Maintain scalability for a growing number of resources.

Provide a user-friendly interface for all roles.

3.4.3 Risk Analysis

Risk	Mitigation Strategy
Unauthorized access to data	Implement multi-factor authentication.
System downtime	Use load balancing and regular monitoring.
Data loss due to server failure	Schedule regular backups and replication.

3.4.4 Repositories Required

Material Repository

Field	Description
Type	Type of material (Book, Magazine, Report, Article)
category	Category of the material (Fiction, Science, Technology)
title	Name of the material
author	Author of the material
Availability	Current availability status (Available, Checked Out)
Metrics	Metrics related to material usage (e.g., borrow count)

User Repository

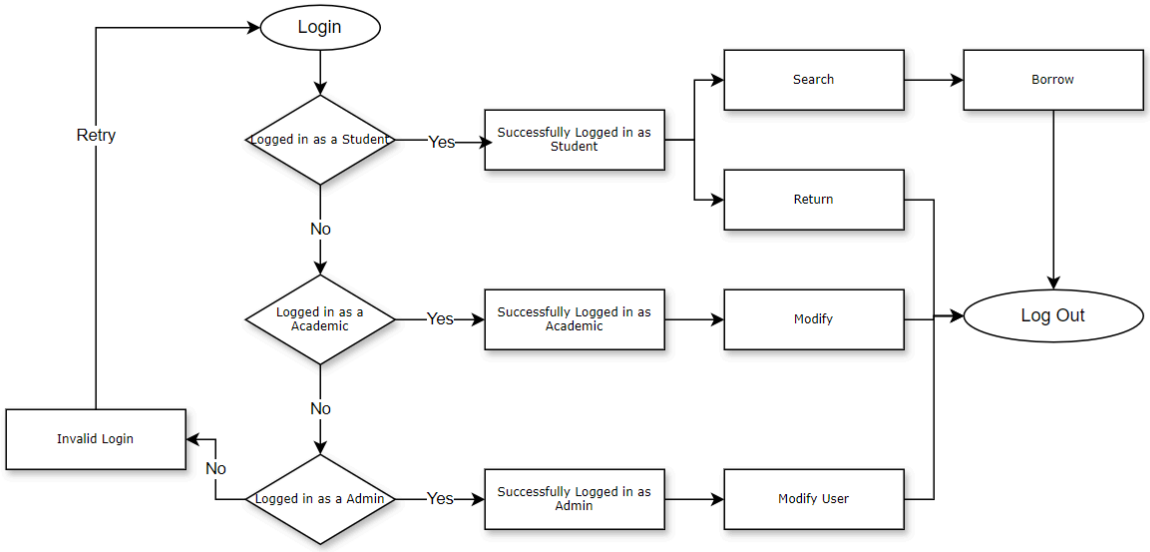
User type	Identification system	Access Level
Students	First Name Last Name Email Matriculation No. Password Semester Course	Search Engine Borrow Book View Book
Guests	-	Search Engine View Book
Academic	First Name Last Name Email Employee Id Password	Search Engine Add Book Remove Book Modify Book
Admin	First Name Last Name Email Employee Id Password	Add User, Delete User, Modify User Type

Borrow Record Repository

Field	Description
Record_ID	Unique identifier for each borrowing record
User_ID	Reference to the user who borrowed the material
Material_ID	Reference to the borrowed material
Borrow_Date	Date and time when the material was borrowed

4. Requirement Definition

4.1 Workflow



4.2 Data Structure

User Type	Attributes	
Student	First Name, Last Name, Email, Password, Matriculation No., Semester, Course	John, Doe, john.doe@university.com, password123, 2023001, 3rd, Computer Science
Guest	- (No personal details)	-
Academic	First Name, Last Name, Email, Password, Employee ID	Jane, Smith, jane.smith@university.com, securepassword, EMP123
Admin	First Name, Last Name, Email, Password, Employee ID	James, Smith, james.smith@university.com, securepassword, AD123

4.3 Metadata

Entity	Attribute	Description	Data Type	Constraints
User	ID	Unique identifier for each user	Integer	Primary Key, Auto-Increment
	Name	Full name of the user	String	Not Null
	Role	Role of the user (e.g., Student, Faculty, Admin)	String	Not Null, Enum (Student, Faculty, Admin)
	Email	Email address of the user	String	Unique, Not Null
	Password	Password for user authentication	String	Not Null, Hashed for security
	GivenID	Employee ID/ Matriculation No.	Integer	Unique, Not Null
	Semester	Current Semester	Integer	-
	Course	Current Course	String	Not Null
Material	ID	Unique identifier for each material/resource	Integer	Primary Key, Auto-Increment
	Title	Title of the material (e.g., book, article)	String	Not Null
	Author	Author(s) of the material	String	Nullable
	Category	Category or type of material (e.g., Book, Journal)	String	Not Null
	Availability	Current availability status (Available, Checked Out)	String	Not Null, Enum (Available, Checked Out)
BorrowingRecord	RecordID	Unique identifier for each borrowing record	Integer	Primary Key, Auto-Increment
	UserID	Reference to the user who	Integer	Foreign Key (User)

		borrowed the material		
	MaterialID	Reference to the borrowed material	Integer	Foreign Key (Material)
	BorrowDate	Date and time when the material was borrowed	DateTime	Not Null
	ReturnDate	Date and time when the material is returned	DateTime	Nullable

4.4 Number of classes and objects

User Class: Handles user data.

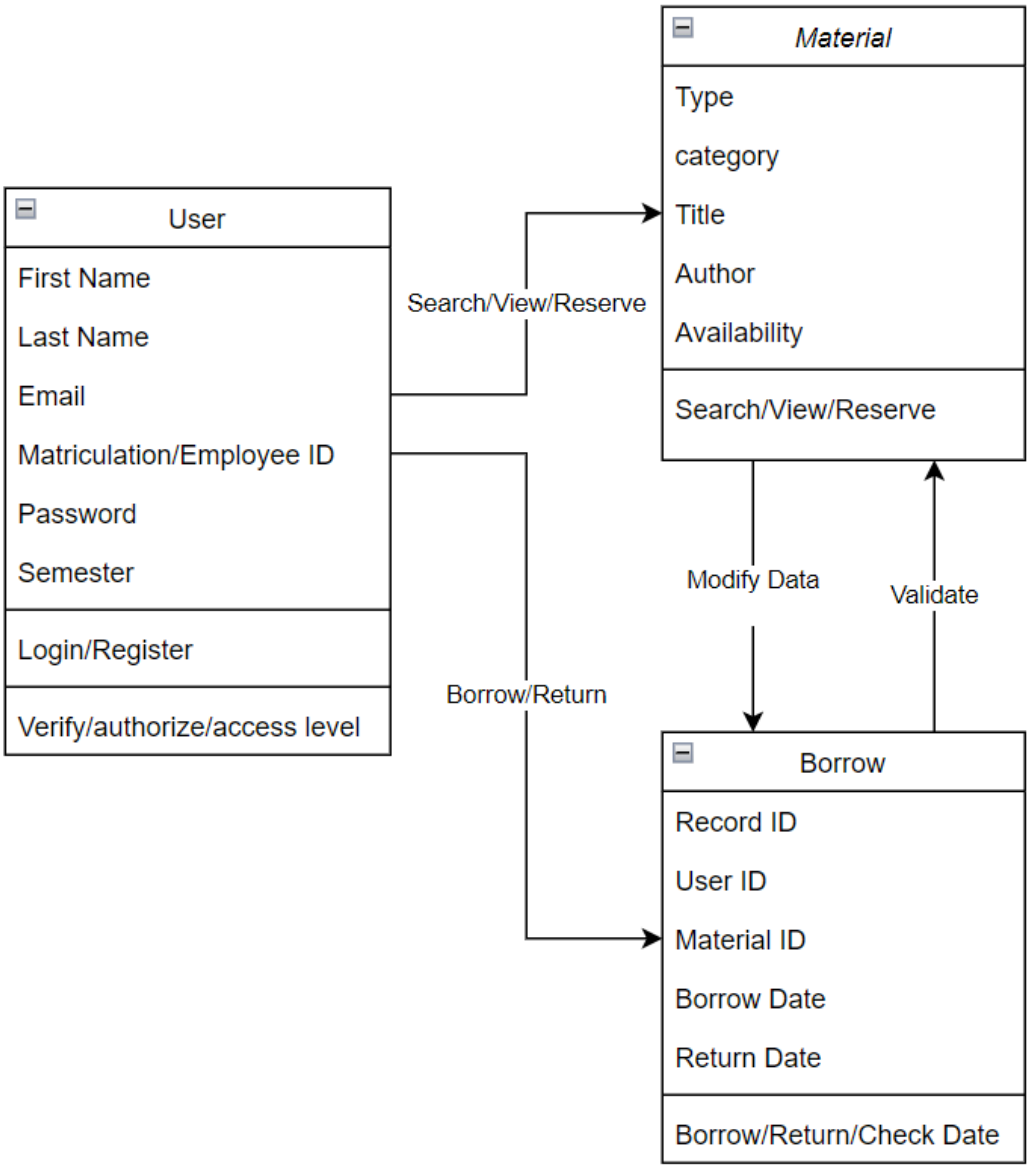
Material Class: Manages library items.

BorrowClass: Tracks borrow/return records

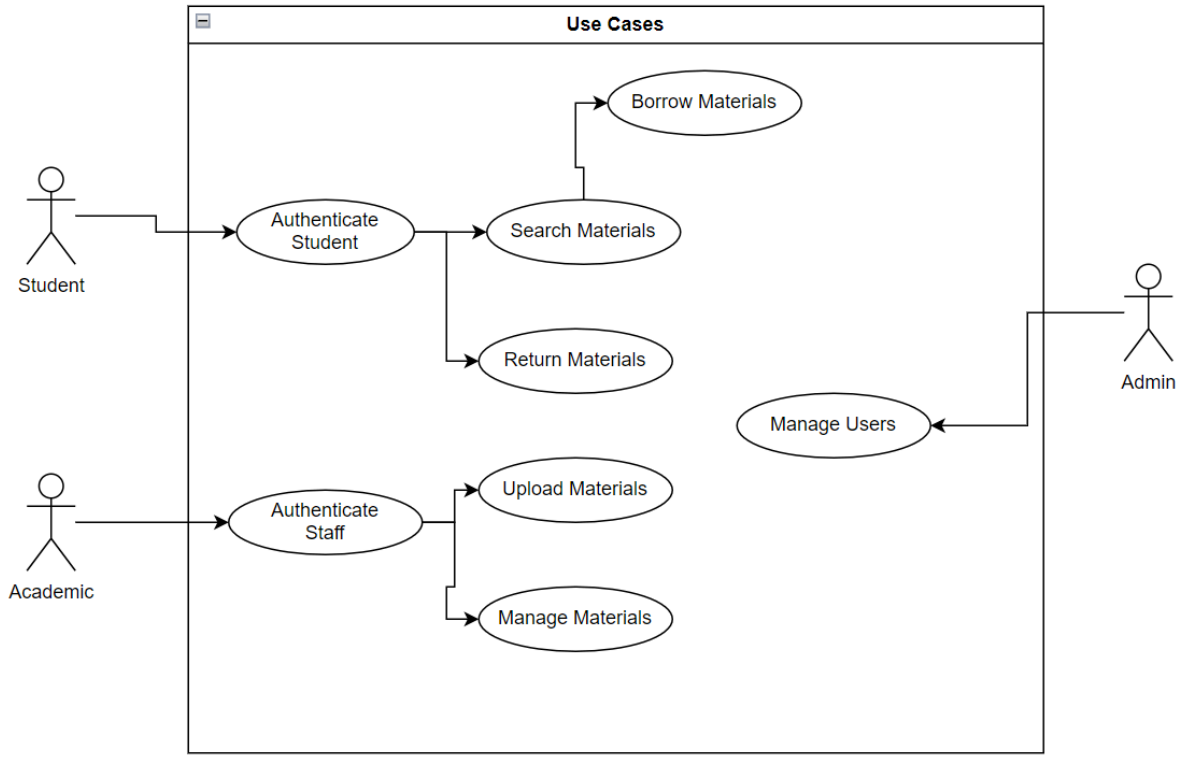
5. Design Phase

5.1 UML Diagram

5.1.2 Class Diagram

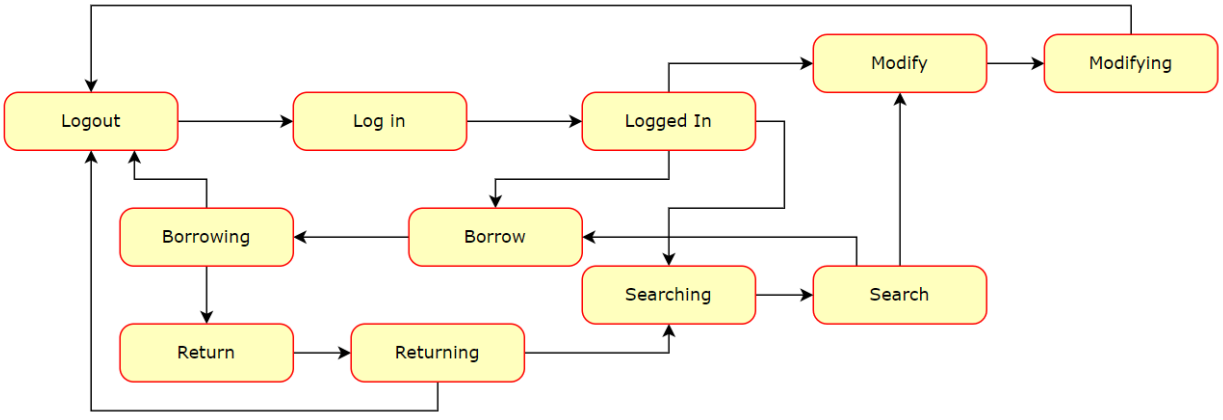


5.1.3 Use Case Diagram



5.2 FSM Behavorial model

5.2.1 User FSM



5.2.2 Sequence Diagram