UNIVERSITY OF RWANDA

COLLEGE OF SCIENCE AND TECHNOLOGY

SCHOOL OF ICT

DEPARTMENT OF COMPUTER & SOFTWARE ENGINEERING

PROGRAM: COMPUTER ENGINEERING

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List of abbreviations

-RBAC: Role-Based Access Control
-SMS: Short Message Service
-2FA: Two Factor Authentication
-WCAG: Web Content Accessibility Guidelines
-LMS: Library Management System
-UI: User Interface
-HTML: HyperText Mark-up Language
-JS: JavaScript
-API: Application Programming Interface
- ISBN: International Standard Book Number
- CRUD: Create Read Update and Delete
- UCD: User-Centered Design
- SQL: Structured Query Language
- Java EE: Java Enterprise Edition
- MVC: Model View Controller
- CSS: Cascading Stylesheet
- JWT: JSON Web Token

PROJECT TITLE: SOMA LMS

SOMA- Project Proposal

1. Background of the Case Study

The University of Rwanda - Nyarugenge Campus library is a crucial resource for students, lecturers, and faculty members. However, current manual processes such as book borrowing, user registration, and book tracking are inefficient. Issues include misplacement of resources, lack of access to past papers (***Ibicupuri***), delayed book borrowing, and the absence of real-time updates. The SOMA system aims to digitize these processes, increasing efficiency and providing better access to library resources.

2. Problem Statement

The University of Rwanda - Nyarugenge Campus faces several challenges related to its library management:

- Manual tracking of books, leading to issues like misplaced or lost materials.
- Inefficient search and borrowing system, causing delays in accessing required resources.
- No timely notifications for book due dates and overdue books, leading to confusion.
- Limited remote access to digital resources such as e-books and research papers.
- Security risks, as unauthorized access to library data and books could compromise the system.

3. Project Objectives

3.1. General Objective

To develop a modernized, automated library management system that enhances book tracking, accessibility, and security, while improving efficiency in managing library operations at the University of Rwanda - Nyarugenge Campus.

3.2. Specific Objectives

- Automate book borrowing, returning, and tracking.
- Provide real-time search for books and materials.
- Enhance security through role-based access control (RBAC).
- Send timely notifications via email and SMS.
- Offer insightful analytics for library administrators.
- Enable seamless digital access for e-books and research papers.

4. Project Rationale

The SOMA system is essential for improving the efficiency of libraries. It will reduce human errors, improve resource utilization, enhance security, and ensure accessibility. By implementing this system, libraries can shift towards a more digital and automated approach, saving time for librarians, students, and faculty.

5. System Features

5.1. User Authentication & Authorization

- Secure login and registration for Admins, Librarians, Students, and Lecturers.
- Role-based access control (RBAC) ensuring users can only access authorized functionalities.
- Two-factor authentication (2FA) for added security.

5.2. Book Management (CRUD Operations)

Create: Librarians can add books with complete details (Title, Author, ISBN, Category, Copies, etc.).

- Read/Search: Users can search for books using filters (Title, Author, Genre, etc.).
- Update: Modify book details (availability, edition, metadata).
- Delete: Remove outdated, damaged, or lost books from the catalog.
- E-Book Support: Integration for digital books and research papers.

5.3. User Management

- User Registration: Users can sign up with predefined roles (Student, Lecturer, Librarian, Admin).
- User Role Management: Admins manage user permissions and accounts.
- Profile Customization: Users can update their details and preferences.

5.4. Book Borrowing & Returning System

- Borrow Requests: Students/Lecturers can borrow available books.
- Return Processing: Books are tracked for timely return, and fines are imposed for late returns.
- Reservation Feature: Users can reserve books when all copies are checked out.
- Digital Borrowing: Secure access to e-books for online reading.

5.5. Notification System

- Email alerts for book due dates, late returns, and important announcements.
- SMS reminders for urgent notifications.
- Push notifications for real-time system updates.
- Admin notifications for system updates and user activity.

5.6. Dashboards

5.6.1. Student Dashboard

- View borrowed books and return deadlines.
- Search and reserve books.
- Access e-books and digital resources.
- Receive system notifications.

5.6.2. Librarian Dashboard

- Manage books (add, edit, delete, track borrowing records).
- Approve or reject book reservations.
- Notify users about overdue books.
- Track borrow history and trends.

5.6.3. Admin Dashboard

- Oversee user accounts and permissions.
- Monitor library analytics and statistics.
- Manage librarian activities and perform system upgrades.
- Generate custom reports on library operations.

5.7. Security Measures

To ensure data security and protect against cyber threats, the following security measures will be implemented:

- Password Hashing: All passwords will be securely hashed using most secure hashing algorithm like BCrypt.
- Role-Based Access Control (RBAC): Prevents unauthorized access.
- Data Encryption: Sensitive user data will be encrypted.
- Regular Audits & Logging: System logs will be maintained to track activities and detect anomalies.

5.8. User-Centered Design (UCD) Principles

The LMS will be designed with User-Centered Design (UCD) principles, ensuring:

- Ease of Use: A simple and intuitive interface for all users.
- Accessibility: Complies with WCAG (Web Content Accessibility Guidelines).
- Efficiency: Reduces the time required for book management.
- Continuous Feedback Integration: System improvements will be based on user suggestions.

5.9. User Cases diagrams & Interactions

Flow chart:

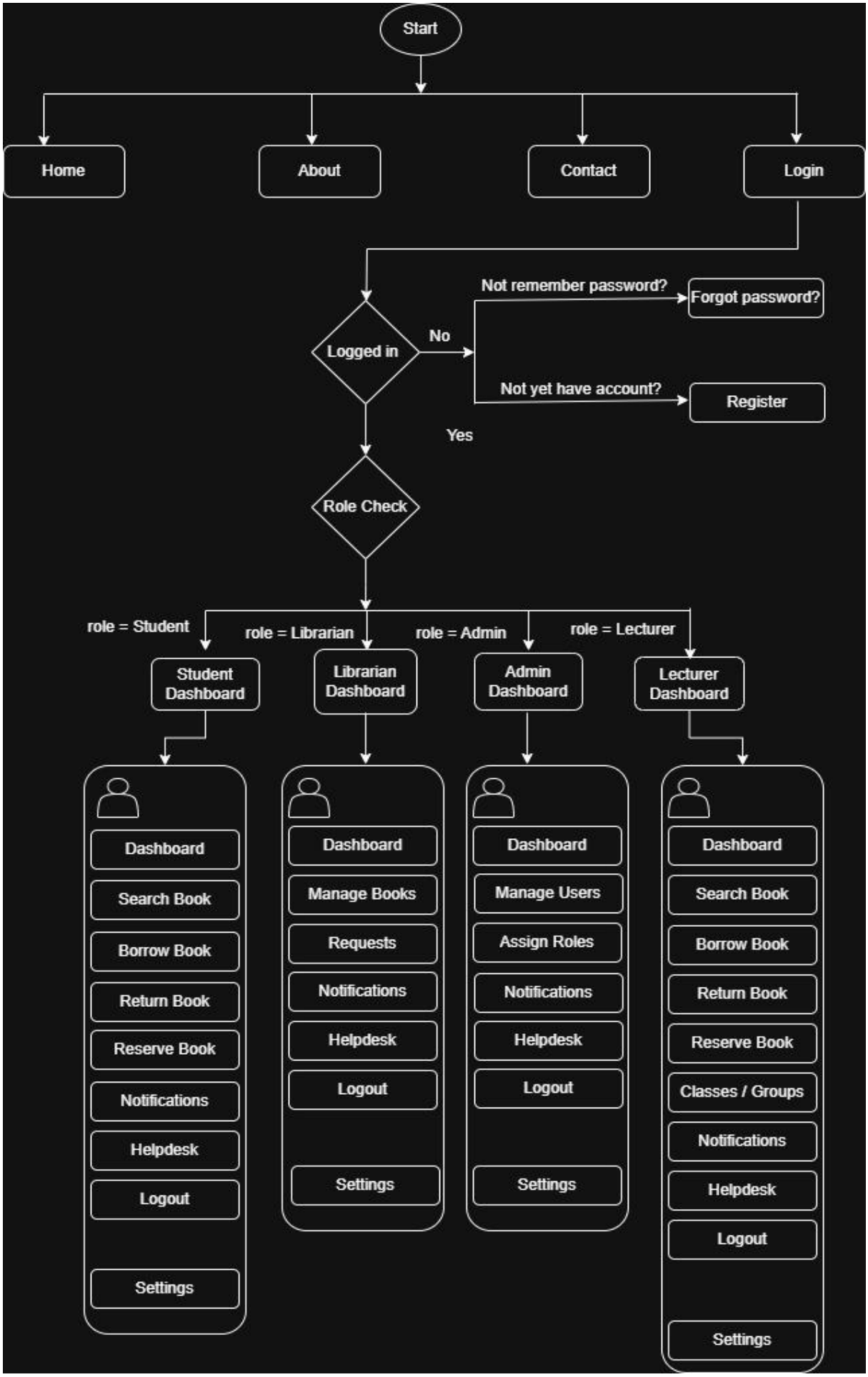

Figure 1: System flow chart

5.10. System Actors

This part concerns with both internal & external system actors/users.

5.10.1. Internal users

- Students
- Librarians
- Admins
- University staff including lecturers, ….

5.10.1. External user

- Stakeholders
- Developers

6. Implementation Plan

The development and deployment of the LMS will follow these phases:

- Requirement Gathering & Analysis – Collect user needs and define system specifications.
- System Design & Architecture – Create wireframes, database schema, and system architecture.
- Development – Build backend, frontend, and database.
- Testing – Perform unit testing, integration testing, and user testing.
- Deployment – Deploy on a secure cloud-based environment.
- User Training – Provide user manuals and training sessions.
- Maintenance & Updates – Continuous improvement based on feedback.

7. System Design & Analysis

7.1. System design

The LMS architecture will follow the MVC (Model-View-Controller) framework, ensuring scalability, maintainability, and security. The system will have:

- Database Layer: Stores book records, user data, transactions.
- Application Layer: Handles business logic, authentication, and system functions.
- Presentation Layer: User-friendly UI for web and mobile users.

7.1. Technology Stack

The project will be developed using the following technologies:

Component	Technology
Frontend	HTML, CSS, JS, Bootstrap
Backend	Java EE (JSP & Servlets)
Database	MYSQL
Deployment	Apache Tomcat
Notifications	JavaMail API (Email)

8. Functional & Non-Functional Requirements

8.1. Functional Requirements

- User registration and authentication.
- Book management (CRUD operations).
- Borrowing, returning, and reservation system.
- Notification system (email, SMS, push notifications).
- User roles and permissions.
- Dashboard analytics and reports.

8.2. Non-Functional Requirements

- Scalability – The system should handle an increasing number of users and books.
- Security – Implementation of data encryption, access control, and secure transactions.
- Performance – Fast response time for book search and transactions.
- Usability – Intuitive UI for all users.
- Availability – 99.9% uptime for accessibility.

9. Future Enhancements

To make LMS more intelligent and efficient, the following features will be added in future versions:

- AI-powered book recommendation system based on user reading history.
- Automated book categorization using machine learning algorithms.
- Predictive analytics to determine book demand and acquisitions.
- Mobile app support for iOS and Android users.

10. Recommendations to Lecturers & Students

To maximize the benefits of LMS:

For Lecturers:

- Encourage students to use the LMS for research and book access.
- Utilize the e-book repository for sharing learning materials.
- Monitor student borrowing history to guide research directions.

For Students:

- Actively use the book search and reservation features.
- Return borrowed books on time to avoid penalties.
- Utilize the e-learning and digital book section for better learning resources.

11. Conclusion

The SOMA system modernizes library operations through automation, security, and accessibility, enhancing efficiency and the digital transformation of university libraries.