DESIGN AND IMPLEMENTATION OF A DIGITAL RIGHTS MANAGEMENT (DRM) PROTECTED INSTRUCTIONAL LEARNING SYSTEM
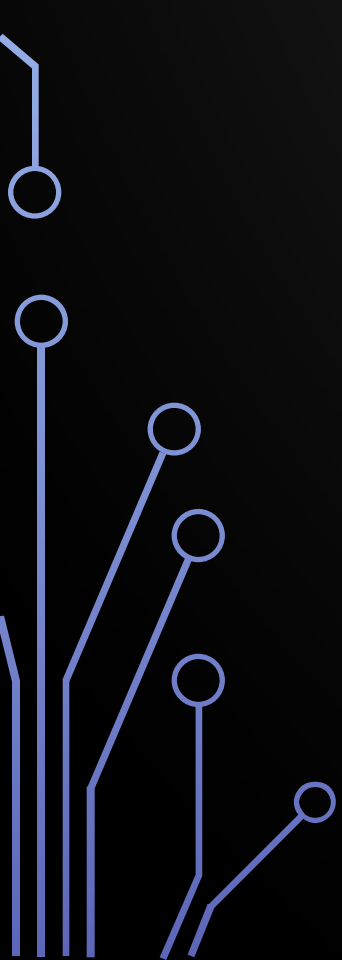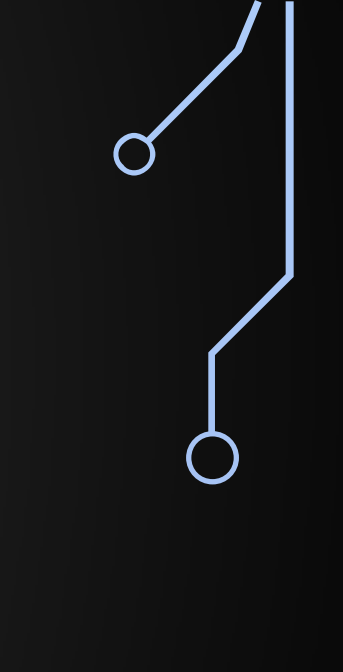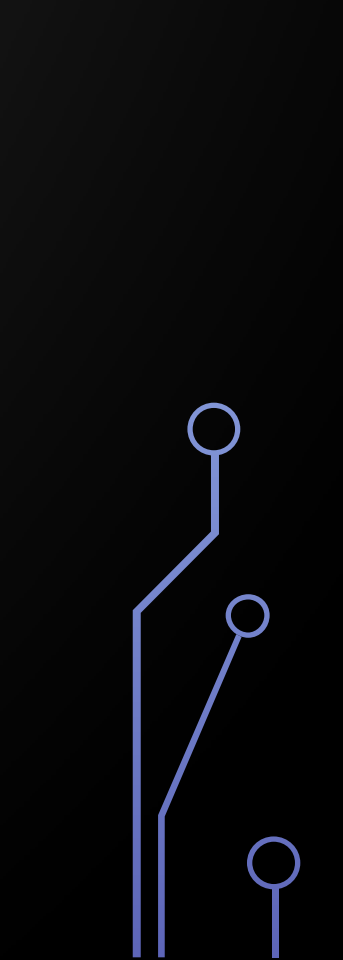
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INTRODUCTION

The rapid advancement of digital technology has driven a significant shift in educational resources, prompting a reevaluation of traditional printed textbooks. As the financial burden of physical textbooks continues to grow, there is an increasing need to explore digital alternatives that offer both cost-effectiveness and enhanced functionality. The transition to secure digital copies of educational materials presents a promising solution, addressing concerns of copyright protection while potentially revolutionizing the way students access and interact with learning content.

The adoption of digital textbooks in universities varies across different regions, with the global shift being more pronounced in developed countries than in developing regions like Africa and Nigeria. Globally, the use of digital textbooks has gained significant traction, particularly in higher education institutions. In countries like the United States, the United Kingdom, and parts of Europe, digital textbooks have become a common feature of university curricula. According to Hollands and Tirthali (2014), digital textbooks offer substantial cost savings for students, who can pay up to 60% less for digital versions compared to printed copies.

INTRODUCTION

In Nigeria, the adoption of digital textbooks is still in its early stages. Many Nigerian universities continue to rely on traditional printed textbooks due to the cost of digital alternatives and infrastructural limitations. Olaniran et al. (2015) highlight that Nigerian students often face challenges such as inconsistent power supply, lack of access to personal computers, and unreliable internet connectivity, all of which hinder the widespread use of digital textbooks.

Research conducted at various Nigerian universities indicates that while some students express a preference for digital formats due to their cost-effectiveness and accessibility (Osih & Singh, 2020), many still favor traditional textbooks due to familiarity and concerns over usability.

However, while e-textbooks present significant opportunities for improving accessibility and affordability in education, they also raise concerns about data security and intellectual property rights. As more educational resources are digitized, protecting sensitive information becomes paramount. Encryption serves as a vital tool in safeguarding digital content. It ensures that only authorized users can access educational materials while preventing unauthorized sharing.

STATEMENT OF THE PROBLEM

The persistent increase in cost of educational books and materials call for innovative solutions to learning. As universities seek innovative solutions to reduce costs and improve accessibility, digital alternatives to traditional hardcopy textbooks have gained considerable attention.

Textbook affordability has become a critical issue in higher education, particularly in the United States. A study conducted by the (Florida Virtual Campus ,2016) revealed that more than 70 percent of students spent at least $300 on textbooks during a single term. Alarmingly, a growing percentage of students over 30 percent opted not to purchase required textbooks due to their high cost, while others delayed purchasing or reduced the number of courses they enrolled in to manage expenses   . These trends have a direct impact on student performance, retention, and graduation rates, raising concerns among educators and administrators alike. (Florida Virtual Campus, *2016).* Studies indicate that districts like Lorain City Schools saved $1.2 million by switching to digital formats (EdTech Magazine).

The transition from traditional hardcopy textbooks to digital alternatives presents both opportunities and challenges. While previous research underscores the potential benefits of e-textbooks regarding cost savings, significant gaps remain concerning long-term impacts on academic performance and systemic barriers to adoption. Addressing these weaknesses will be crucial for developing effective strategies that enhance educational accessibility through digital resources.

SCOPE OF STUDY

This scope of study focuses on designing and implementing an instructional learning system for higher education institutions(specifically babcock university Nigeria) primarily targeting students and educators . The system will leverage Digital Rights Management (DRM) to secure instructional content, preventing unauthorized access, copying, sharing, and screenshotting.

Key components include user authentication, content encryption, and licensing controls to manage permissions. The project will involve research into existing DRM solutions, followed by system design, implementation, and testing for usability and security. Ethical and legal compliance, along with considerations of copyright and user rights, will guide development. Future enhancements will explore stronger encryption methods and broader platform integration.

AIM AND OBJECTIVES

The aim of this project is to design and implement a DRM protected instructional learning system for higher institutions.

The objectives of this project are to:

I. enhance accessibility to educational materials by providing a cost-effective digital platform, reducing the financial burden associated with traditional printed materials for students and institutions.

II. implement user-friendly encryption mechanisms that ensure seamless access to authorized users while preventing unauthorized duplication, sharing, or piracy of instructional materials.

III. promote the adoption of digital materials in educational institutions by demonstrating the advantages of encrypted systems in terms of cost, convenience, and content security.

IV. Enhance the user experience by providing a seamless and intuitive interface for reading, searching, and annotating materials, as well as offline access capabilities.

S/N	AUTHOR(s)	YEAR	TITLE	SUMMARY OF WORK	GAP IDENTIFIED
1	Rahat Kahn	2021	Importance of Digital Library in Education	This study explores the significance of digital libraries in the educational sector, emphasising their role in improving access to information, promoting resource sharing, and overcoming traditional limitations of physical libraries	Rahat Khan's article on digital libraries does not cover Digital Rights Management (DRM), which is essential for preventing unauthorized copying and distribution of eBooks.
2	Nancy M. Foasberg	2019	Adoption of E-Book Readers Among College Students: A Survey	This survey explores how college students use e-book readers, analysing factors influencing adoption, usability concerns, and preferences. It offers recommendations for enhancing the adoption of e-book technologies in higher education	The study does not address the integration of interactive features, such as multimedia elements and annotation tools, which could enhance the educational value of e-books for college students

S/N	AUTHOR(s)	YEAR	TITLE	SUMMARY OF WORK	GAP IDENTIFIED
3	Yusuf Shogbesan	2024	Digital Literacy in Education: Preparing Students for the Future Workforce	This work focuses on the importance of digital literacy in education and how it plays a critical role in equipping students with skills relevant for a technology-driven workforce. It outlines current shortcomings and strategies to enhance digital literacy teaching practices within schools.	The study emphasizes the general importance of digital skills for future workforce readiness but does not deeply explore practical methods for embedding digital literacy into specific subject areas or curricula.
4	Kathryn Matthew	2020	e-Books on Campus: Trends, Issues, Possibilities	This work analyses the trends and issues surrounding the adoption of e-books in higher education. It explores possibilities for improving engagement with e-books on campus and highlights strategies for addressing student and faculty concerns.	This study overlooks the need for integrating secure payment systems, crucial for protecting financial transactions if the platform involves selling or renting eBooks.

S/N	AUTHOR(s)	YEAR	TITLE	SUMMARY OF WORK	GAP IDENTIFIED
5	Kiteworks	2024	Digital rights management (DRM) protecting intellectual property in the information age	This work explores digital rights management (DRM) in the context of safeguarding sensitive digital information and intellectual property. It discusses methods for controlling access, usage, and distribution of digital assets, with a focus on enhancing security and compliance.	The study lacks detailed exploration on the scalability and affordability of DRM solutions in educational environments, where budget constraints are common
6	Anandhi Deva Amirtharaj, Divya Raghavan, Judie Arulappan	2023	Preferences for printed books versus E− books among universitystudents in a Middle Eastern country	The study investigates the preferences for printed books versus e-books among university students in a Middle Eastern context, analysing the factors such as ease of use, note-taking capability, and reading comfort. The findings reveal a mixed preference, with students favouring e-books for portability and convenience, but printed books for note-taking and exam preparation. This research highlights the need to balance digital and traditional resources in educational strategies.	The research examines only a specific Middle Eastern context and does not explore how global trends and preferences for e-books might differ across various cultural and educational environments. A more global perspective would provide valuable insights into how diverse regions adopt and integrate eBook systems, which is particularly relevant when developing an educational eBook system that needs to be scalable and adaptable to different international markets

SYSTEM MODEL AND DESIGN

A software development process model outlines the activities involved in the design, development, and deployment of a software product. For the purpose of developing the DRM protected instructional learning system, **the Incremental Process Model** will be used. This model functions as a multi-phase approach, starting with a basic version of the system that includes core necessary features. Successive increments will enhance functionality, including advanced user access control and content protection. Requirements are divided into modules built incrementally. This method allows flexibility and easier integration of user feedback, ensuring the system's security is progressively refined.
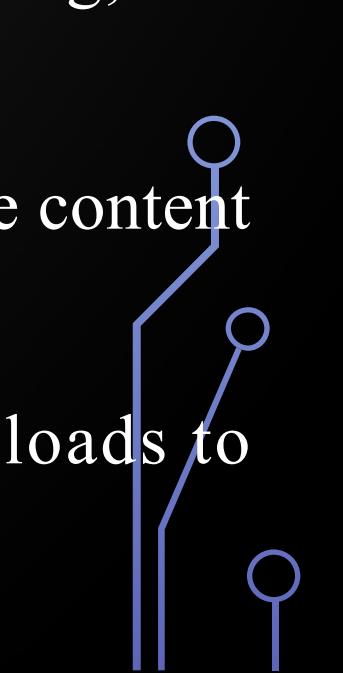
SYSTEM MODEL AND DESIGN

Activities Involved in Incremental Model:

I. **Requirements Gathering and Analysis**: This step involves understanding the needs and goals of the educational eBook system, focusing on user requirements and defining system objectives.

II. **Design**: The system's architecture is planned, detailing how different components will work together to ensure a seamless experience for users.

III. **Implementation**: Development begins with core features, and additional functionalities are incrementally added, improving the system progressively.

IV. **Testing**: The system is thoroughly tested in each increment to identify and resolve potential issues, ensuring it meets user expectations and requirements.

FUNCTIONAL REQUIREMENT

I. The system shall provide a search and filter functionality, enabling users to easily locate and access specific instructional materials by title, author, subject, or keyword.

II. The system shall track user reading history to allow users to resume reading from where they last stopped.

III. The system shall prevent users from downloading instructional materials in formats that allow sharing, ensuring that files remain accessible only within the secure application environment.

IV. The system shall provide features within the eBook section such as bookmarking, searching, and highlighting, without compromising the security and integrity of the eBook content.

V. The system shall provide synchronization for the instructional materials to ensure that offline content is up-to-date when the user reconnects to the internet.

VI. The system shall enforce access control policies to restrict instructional materials uploads to authorized personnel only, requiring administrative approval for new content uploads.

FUNCTIONAL REQUIREMENT

I. The system shall provide a secure payment gateway for users to purchase access to instructional materials based on a subscription or one-time purchase model.

II. The system shall ensure that instructional materials can be accessed both online, offline through a secure and dedicated application.

III. The system shall implement a digital rights management (DRM) mechanism to prevent unauthorized sharing, downloading, or distribution of materials.

IV. The system shall grant access to purchased materials only to the user's authenticated account, ensuring that access is non-transferable.

V. The system shall disable the ability to copy, paste, take screenshots while an instructional material is being read, accessed, both in online and offline modes.

NON-FUNCTIONAL REQUIREMENT

I. The system shall have a maximum response time of 2 seconds for user actions

II. The system shall support up to 5,000 concurrent users without exceeding a 5-second response time.

III. The system shall lock user accounts after 5 failed login attempts

IV. The system shall provide clear, concise instructions to users for seamless navigation and operation.

V. The system shall be compatible with the latest 3 versions of Google Chrome, Mozilla Firefox, Apple Safari, and Microsoft Edge.

VI. The system shall be compatible with the latest 3 versions of Android and iOS operating systems.

VII. The system shall implement Digital Rights Management to prevent unauthorized sharing of materials.

SYSTEM MODEL AND DESIGN: ARCHITECTURE OVERVEIW

Client-Server Architecture is a network design model that divides system functions into two main entities: clients and servers. Client-Server Architecture is a model where client devices (such as smartphones, tablets, or computers) interact with a central server to access resources, process data, and perform tasks.

The client-side consists of applications (such as a web-based interface or mobile app) that students, educators, and administrators use to interact with the system. Students use the client to access educational content and review their progress under the DRM protection. Educators can instructional learning materials through the same interface, while administrators have access to system logs, user records, and overall content management.

On the server side, a central server handles requests from clients, manages the data, and performs core tasks such as authentication, content retrieval, and storage management. The **server** processes user logins, verifies credentials, retrieves eBooks from the database, records user activities. An **API gateway** and **DRM protection module** are utilized to ensure secure data transmission between clients and the server.
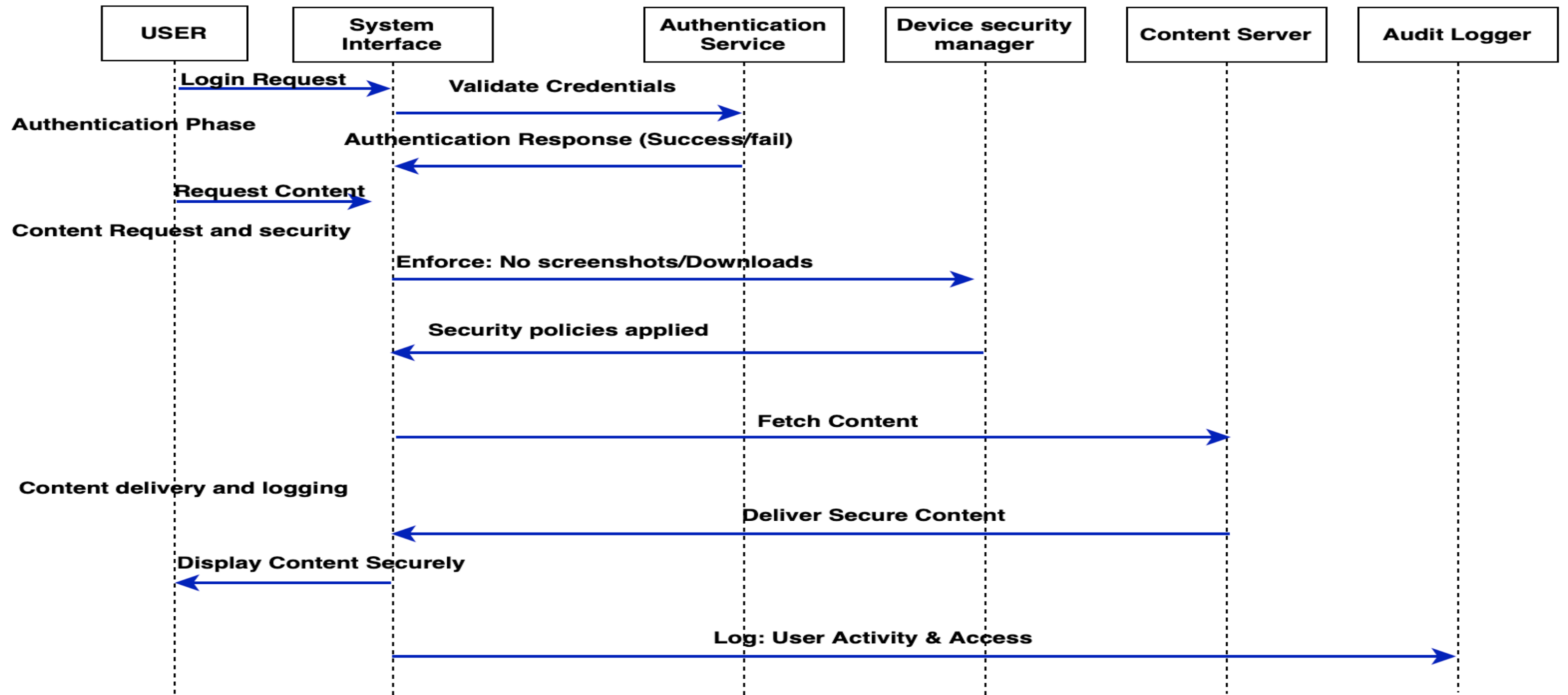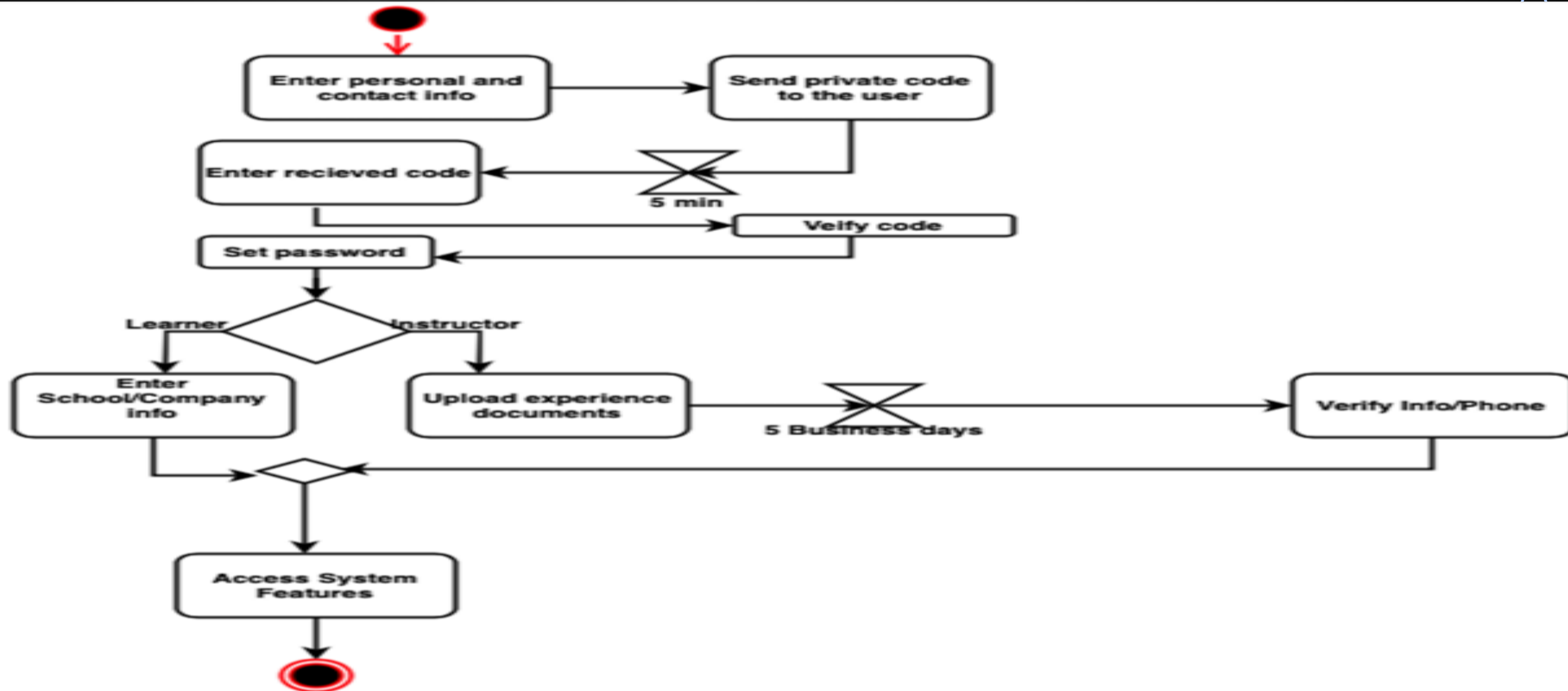
SYSTEM MODEL AND DESIGN: ARCHITECTURE DIAGRAM
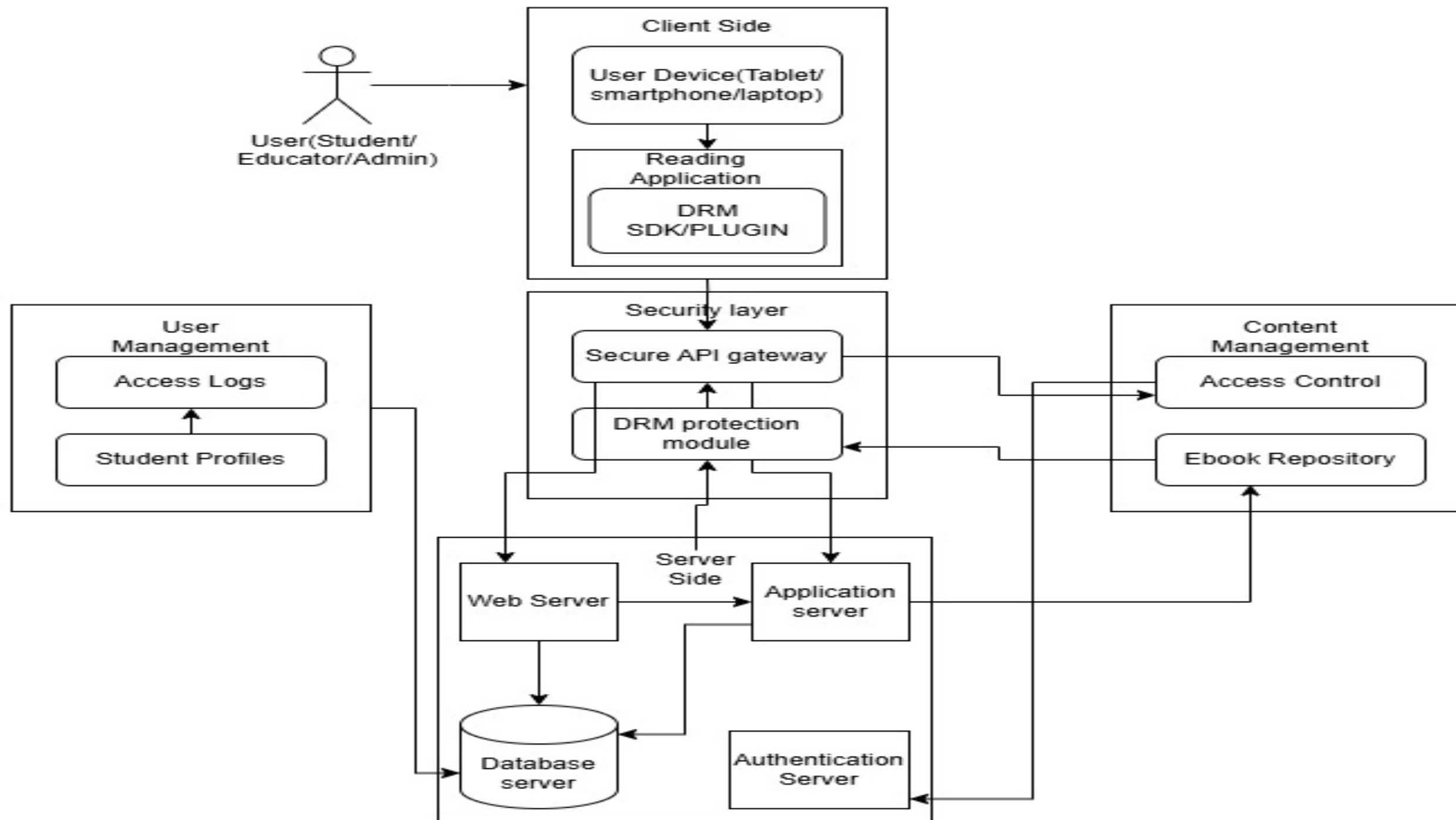
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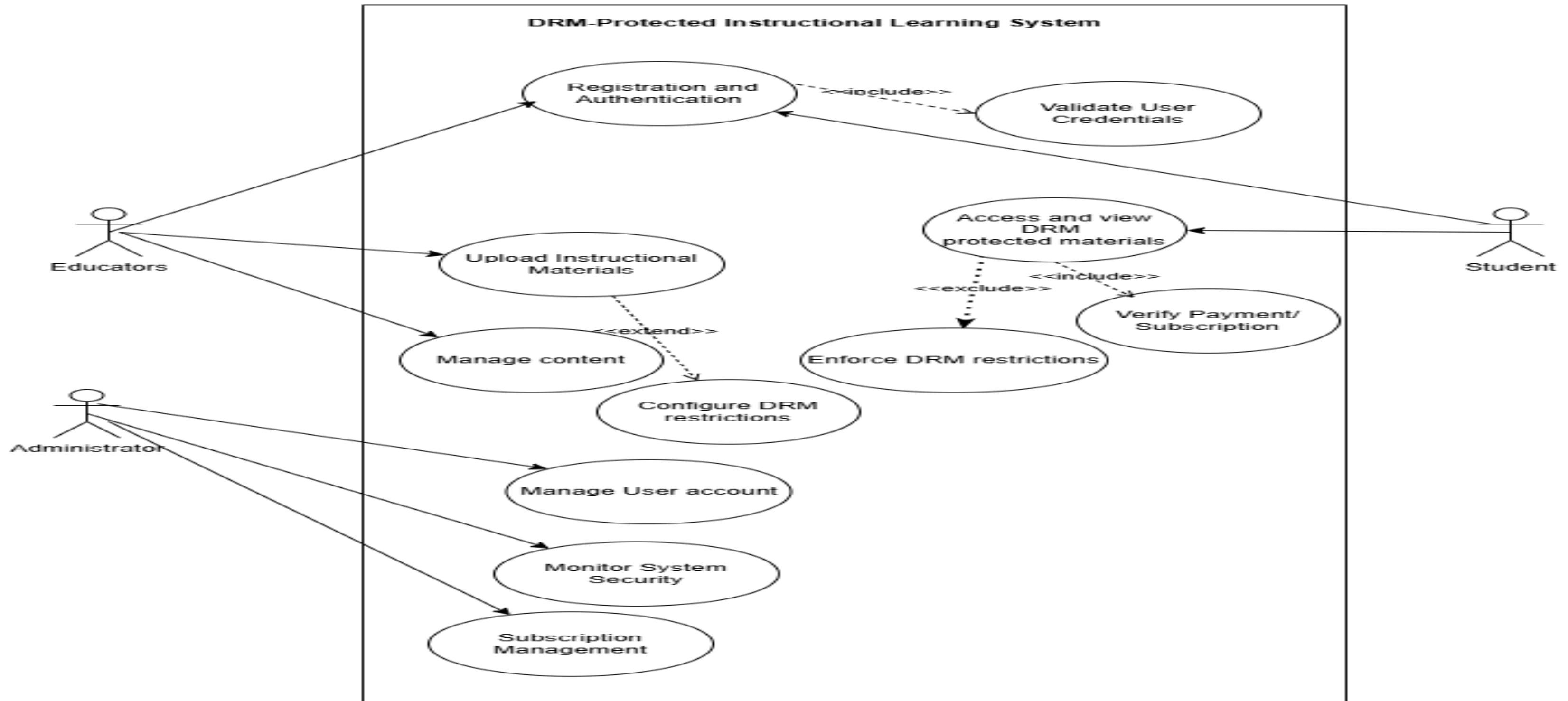
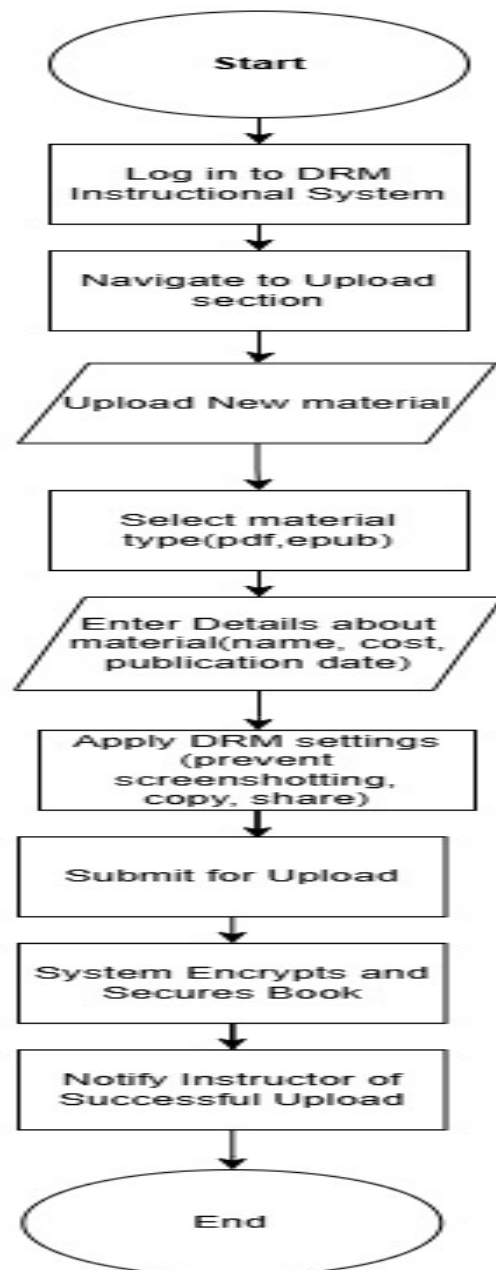# SYSTEM MODEL AND DESIGN: SEQUENCE

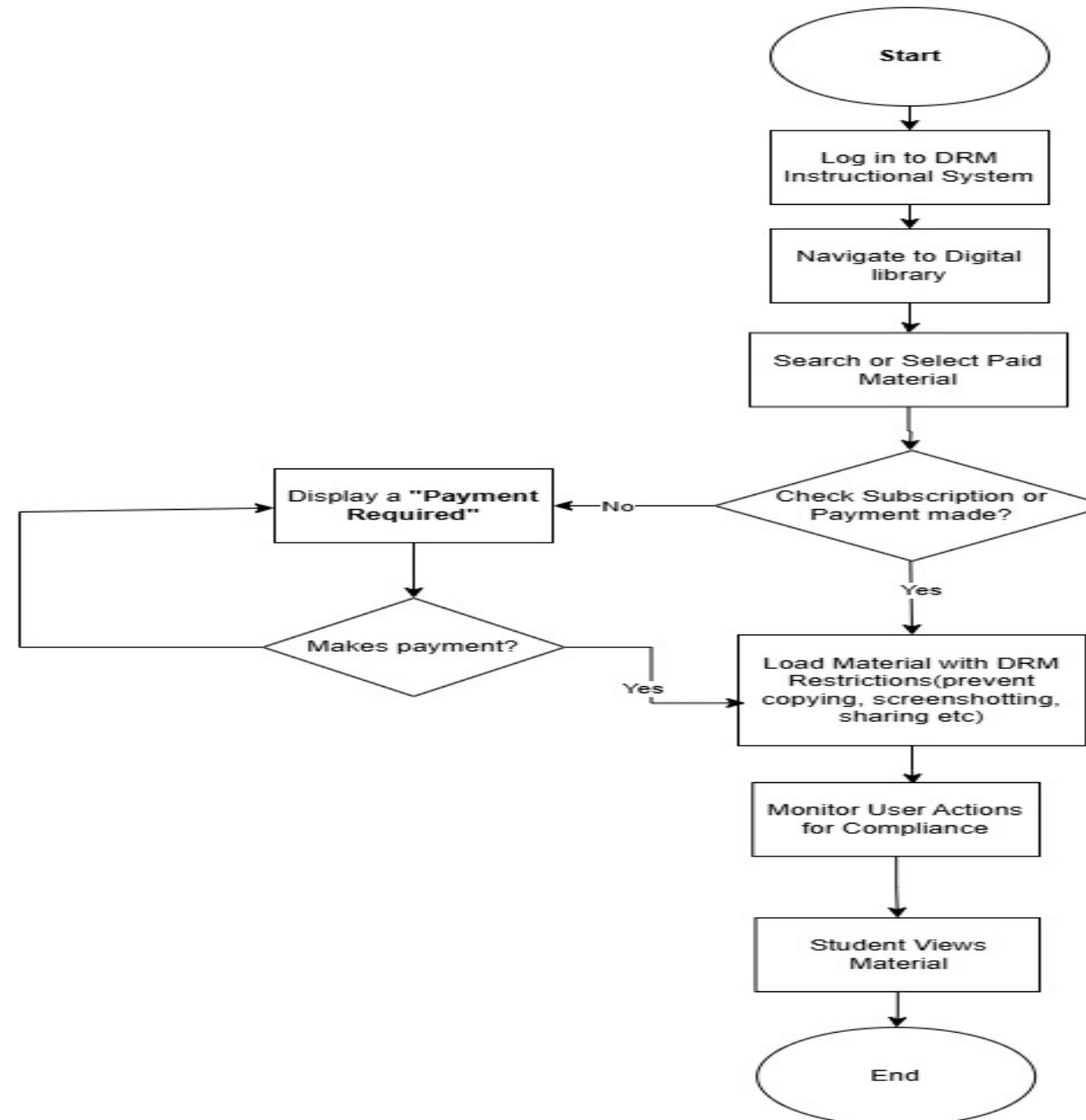# SYSTEM MODEL AND DESIGN: ACTIVITY DIAGRAM
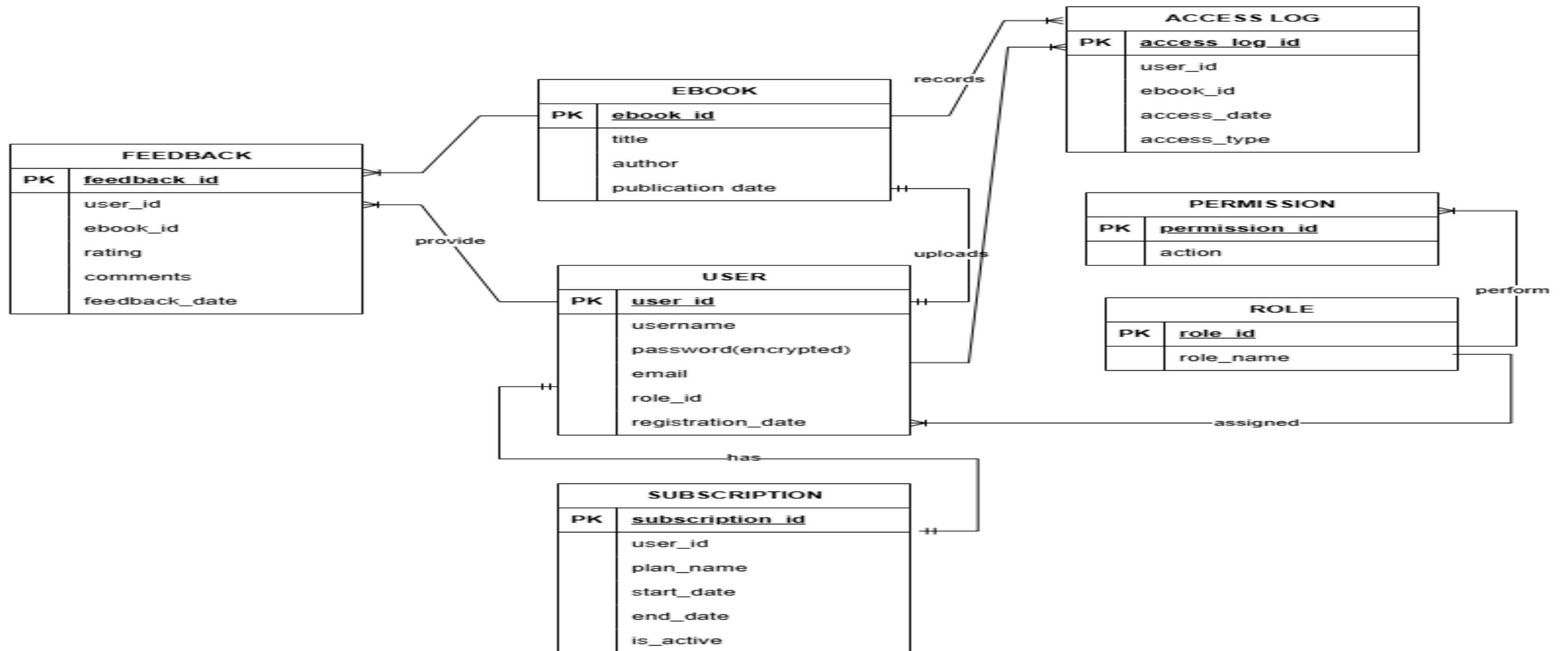
SYSTEM MODEL AND DESIGN: FLOWCHART

Flowchart of the process an instructor takes to upload instructional materials

- Start
- Log in to DRM Instructional System
- Navigate to Upload section
- Upload New material
- Select material type(pdf,epub)
- Enter Details about material(name, cost, publication date)
- Apply DRM settings (prevent screenshotting, copy, share)
- Submit for Upload
- System Encrypts and Secures Book
- Notify Instructor of Successful Upload
- End

Flowchart of a User(Student) navigating through the application

- Start
- Log in to DRM Instructional System
- Navigate to Digital library
- Search or Select Paid Material
- Check Subscription or Payment made?
  - No → Display a "Payment Required" → Makes payment? → Yes
  - Yes → Load Material with DRM Restrictions(prevent copying, screenshotting, sharing etc)
- Monitor User Actions for Compliance
- Student Views Material
- End

PROPOSED METHODOLOGY

- The methodology for developing this secure educational eBook system will follow a structured approach using the **Incremental Process Model** combined with the **System Development Life Cycle (SDLC)** framework:

1 **Literature Review**:
Gather research on digital libraries, eBook systems, and DRM technologies to identify gaps and guide system design and security needs.

2 **System Development Life Cycle (SDLC)**:

I. **Requirements Gathering**:
Identify and document user needs, focusing on DRM features to prevent unauthorized access, copying, sharing, and screenshotting.

II. **Design**:
Create flowcharts, use case diagrams, ERDs, activity diagrams, and sequence diagrams to outline system architecture, user interactions, data flow, and DRM components.

III. **Implementation**:
   A. **Frontend**: Develop a user-friendly interface using HTML, CSS, and JavaScript.
   B. **Backend**: Use PHP for server-side operations, data management, and authentication.
   C. **DRM Integration**: Implement content encryption, access controls, and permissions to protect against unauthorized distribution.

IV. **Testing**:
Conduct unit, integration, and user acceptance testing to ensure functionality, user experience, and DRM effectiveness.

PROPOSED METHODOLOGY

1. Microsoft Visual Studio Code (VS Code): A popular, free code editor developed by Microsoft that supports multiple programming languages. It offers features such as syntax highlighting, code suggestions, debugging, and integration with version control (like Git). Highly customizable with extensions and themes, it's widely used for web development, data science, and various other applications.

2. XAMPP: An open-source, cross-platform web server solution package developed by Apache Friends. It includes Apache server, MySQL database, PHP, and Perl, which makes it ideal for local web development and testing. XAMPP is easy to install and configure, allowing developers to create and test web applications on their local machines.

3. PHP: A popular server-side scripting language mainly used for web development. PHP is used to create dynamic and interactive web pages and is often integrated with databases like MySQL. PHP scripts run on the server and generate HTML that is sent to the client.

PROPOSED METHODOLOGY

4. PHPMyAdmin: A free, open-source tool written in PHP for managing MySQL and MariaDB databases. It provides a web-based interface to handle databases, tables, users, and data easily. PHPMyAdmin simplifies tasks like creating, editing, and deleting databases, making it popular for database administration.

5. HTML (Hypertext Markup Language): The standard language for creating web pages and web applications. HTML defines the structure and layout of a webpage through various tags and elements, working alongside CSS and JavaScript to build and style modern web interfaces.

6. CSS (Cascading Style Sheets): A stylesheet language used to describe the presentation and layout of HTML elements. CSS enables the design and customization of web pages by specifying colors, fonts, and positioning. It also supports responsive web design, allowing pages to look good on different devices and screen sizes.

7. JavaScript: A high-level programming language primarily used to make web pages interactive. JavaScript runs on the client side, allowing for dynamic content, form validation, and animations in web browsers. It is widely compatible with libraries and frameworks like React and Angular for enhanced functionality.

CONCLUSION

The development of a DRM protected instructional learning system addresses the evolving needs of modern educational platforms by providing a digital solution tailored for enhanced learning experiences. By adopting the **Incremental Process Model** and following the **System Development Life Cycle (SDLC)**, this project ensures a structured, flexible, and iterative approach to building a robust system. The methodology encompasses gathering insights from existing literature, identifying gaps in current solutions, and leveraging detailed system design (including flowcharts, ERD, and use case diagrams) to streamline implementation. Utilizing **HTML, CSS, and JavaScript** for the frontend and **PHP** for backend development offers a solid foundation for creating a user-friendly and efficient platform. It also makes use of the DRM approach to ensure contents are protected. This approach not only enhances accessibility and usability but also aligns with contemporary educational needs, setting a precedent for future advancements in digital learning tools.

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APPRECIATION