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## DEVELOPMENT OF AN ELECTRONIC LIBRARY MANAGEMENT SOFTWARE FOR EFFECTIVE SERVICES DELIVERY

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### ABSTRACT

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*This project involved the design and development of an **e-library management solution** for the Federal Polytechnic of Oil and Gas, Bonny, Rivers State, Nigeria. The primary objective was to **enhance accessibility** and **streamline management** of the institution's expanding collection of **Electronic Information Resources (EIRs)**. The solution delivers a **web-based platform** that enables students and faculty to remotely access digital library resources—including **e-books, e-journals, online catalogues, reservation systems, and renewal services**—from any location at any time. Additionally, the platform facilitates direct interaction between users and librarians via **real-time chat and email support**, improving research assistance and user engagement. Developed using the **waterfall methodology**, the project followed structured phases: **requirements analysis, system design, implementation, testing, and maintenance**. To ensure cost-effectiveness, **open-source technologies** were employed, minimizing development and operational expenses. A collaborative effort between **software developers and professional librarians** ensured the solution aligns with institutional needs. The e-library system is anticipated to **optimize library operations, boost user satisfaction, and enrich the academic experience** for both students and staff at the Federal Polytechnic of Oil and Gas, Bonny.*

Keywords: E -library Management Solution, digitization, Software Development, and ICT

## Introduction

The digital revolution has necessitated a shift in library operations, rendering traditional management systems inadequate for modern demands (Orakpor & Ezekwibe, 2025). Users now expect seamless access to Electronic Information Resources (EIRs), requiring libraries to adopt advanced cataloging, indexing, and retrieval systems (Orakpor et al., 2014). This shift aligns with broader trends in democratic governance, where access to information plays a critical role in societal development (Okoye & Ibeh, 2013). The proliferation of EIRs—such as e-books, online databases, and multimedia content—has revolutionized information access (Orakpor, 2020). Key drivers of this growth include:

Internet expansion and digital device adoption (Orakpor, 2007).

Cloud computing, enabling scalable and cost-effective data storage (Jayakumara, 2022).

Mobile technology, fostering demand for on-the-go access (Orakpor & Igwilo, 2024).

Digitization of print materials, preserving and expanding access to knowledge (Hawthorne, 2008). Studies by Edem & Egbe (2016) and Osinulu (2020) highlight how EIRs enhance research, learning, and personal development. Additionally, the COVID-19 pandemic underscored the importance of digital libraries, as academic institutions relied on online resources to sustain education (Orakpor & Omoruyi, 2022). To

remain competitive, libraries must implement e-library management systems that:

Track usage and manage licenses for digital resources (Orakpor et al., 2014).

Ensure secure, remote access (Uche & Muokebe, 2019).

Optimize costs through resource sharing (Orakpor, 2006).

Enhance user experience with responsive designs (Orakpor & Anyaoku, 2012).

Librarians must also develop ICT competencies to maximize these systems (Uche & Muokebe, 2024). Furthermore, preservation strategies must evolve to safeguard digital collections (Usiedi et al., 2022). This article details the design and development of an e-library system for the Federal Polytechnic of Oil and Gas, Bonny, addressing challenges like: Diverse user needs (Orakpor & Modili, 2024); Integration of ICT in library services (Utor et al., 2008) and Information literacy gaps among users (Orakpor & Ezekwibe, 2025). The solution aims to align with global digital trends while catering to local educational demands (Orakpor et al., 2025).

## 2.0 The Federal Polytechnic of Oil and Gas, Bonny Rivers State

Following a lot of the restlessness and agitations witnessed and heightened in the oil rich Niger Delta region of Nigeria, between 2007 and 2012, the Federal

Polytechnic of Oil and Gas, Bonny Rivers State was established in June 2014 by former President Goodluck Jonathan. The establishment of the Polytechnic was also in response to the growing needs for technically trained middle level manpower that would serve the oil and gas sector in the Nigerian economy and the African continent at large. However, full academic activities began during the 2017/18 academic session with interim accreditation given for five academic programmes namely: Electrical/Electronic Engineering, Industrial Safety / Environmental Engineering, Petroleum Marketing and Business Studies, Computer Science and Statistics.

The Polytechnic library which is saddled with the main responsibility of supporting the academic and research activities of the Polytechnic, began in earnest, the acquisition of information resources that would assist the Polytechnic in fulfilling its vision of being recognized as a leading institution in the Middle-level manpower training and developments for the Oil and Gas Industry in Africa. The library has over the years acquired electronic information resources but had not gotten any e-library management software in place until recently a team of professional librarians and software engineers from the department of Computer science was assembled to embark upon the project of designing and deploying a solution to help manage the available e-resources.

(Handbook of the Federal Polytechnic of Oil and Gas, Bonny 22017)

### **Key Features of E-Library Management Solution**

Key innovations include:

Patron-centric interfaces supporting diverse user groups (Ibeh & Ekereuche, 2019)

COVID-19 responsive features for remote learning continuity (Alumona & Ibeh, 2021)

Community engagement tools aligning with national development goals (Anizor et al., 2021)

Electronic records preservation mechanisms (Ibeh & Ifeka, 2024)

The system's data flow architecture enables efficient processing of library transactions while maintaining detailed activity logs for administrative oversight (Ezebasili & Ibeh, 2018). Functional modules include registration portals, digital repository management, and real-time communication channels (Orakpor & Igwilo, 2024), addressing both conventional library operations and emerging digital demands (Anike et al., 2023).

This implementation demonstrates how academic libraries can leverage technology to enhance information democracy (Okoye & Ibeh, 2013) while meeting the specific needs of Nigerian tertiary institutions (Ezeofor et al., 2007). The project establishes a replicable model for resource-constrained environments seeking to modernize their information

services (Agwuna & Enweani, 2018), with measurable improvements in access efficiency, operational transparency, and user satisfaction (Esoswo & Muokebe, 2024). This architecture supports the institution's strategic goals of creating an inclusive information environment (Ekereuche & Ibeh, 2019) while preparing for future technological advancements (Anike et al., 2023). The solution's design principles align with global best practices in library automation (Esoswo & Muokebe, 2024) while addressing local operational constraints (Agwuna & Enweani, 2018).

Key Features Table

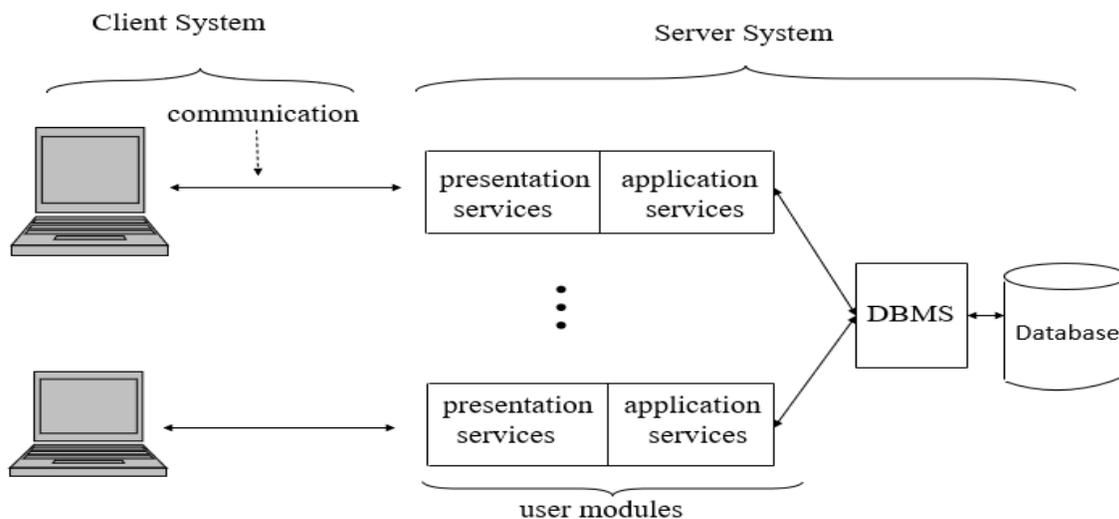
Feature Category	Implementation Theoretical Basis
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User Management	Hierarchical access controls	Ibeh et al. (2019)
Resource Tracking	MARC-compliant metadata	Anaehobi & Muokebe (2014)
Discovery Services	Faceted search algorithms	Ezekwe & Muokebe (2011)
Usage Analytics	Custom reporting dashboards	Esoswo & Muokebe (2024)
Preservation	Digital archiving protocols	Ibeh & Ifeka (2024)

The system's development demonstrates effective application of library science principles (Alumona et al., 2021) to solve practical challenges in Nigerian academic settings (Ezeofor et al., 2007), offering a model for similar institutions undergoing digital transformation (Anike et al., 2023).

5.0 Methodology

The 2-tier client-server architecture is used in which the client is described as the network application which applied the services of the server. The server proffers services to another host upon a network.



**Figure 1:2-tier architecture**

In web system technology, web interface will be demanded by the client before necessary interaction can occur. Through the system logic the servers administer the clients' requests. Web server offers the services such as authentications, web pages generation on request and database operations. The server/client interaction occurs through Hyper – text – transfer protocol (HTTP), a protocol on the Transmission Control Protocol/ Internet Protocol (IP/TCP) suite.

### 5.1 Functional requirements

The system is modularized into the following functions in the form of user interfaces for easy information about the timing of progress or information about whether processes will operate in sequence or in parallel.

interactivity; user and administrator login, student registration, staff registration, book or journals upload, administrator to activate user, search for books or journals, open or download books or journals.

### 5.2 Data Flow Diagram

A Data Flow Diagram is often used as a preliminary step to create an overview of the system, which can later be elaborated. It can also be used for the visualization of data processing. It shows what kind of information will be input to and output from the system, where the data will be stored. It does not show

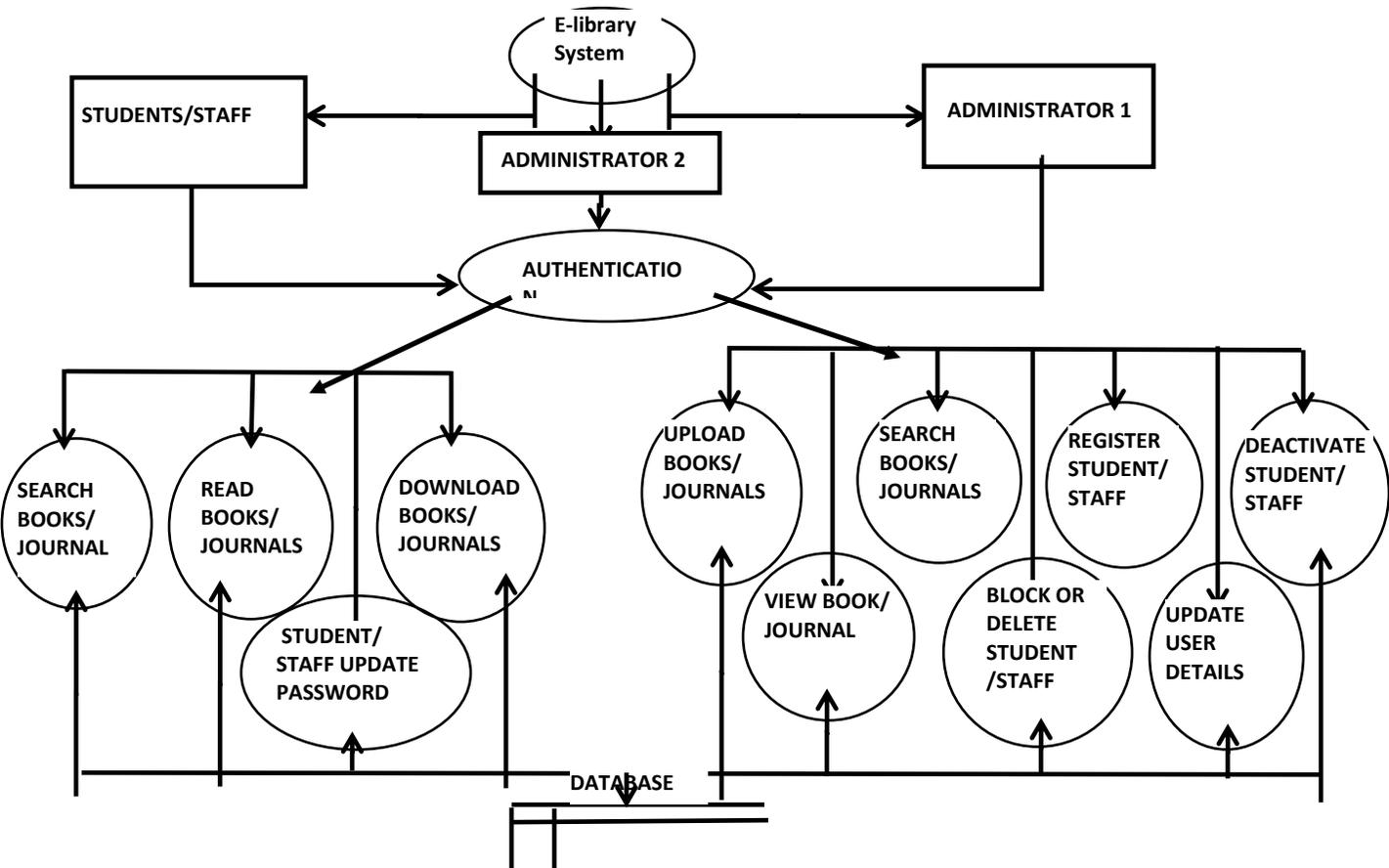


figure 2: DFD of the e-learning system

### 5.3 Entity Relationship Diagram

The Entity Relationship Diagram (ERD) shows the relationship of entity set stored in a database. An entity in this context is a component of data. In other words, ER Diagram

illustrates the logical structure of database. The ER Diagram can also be seen as a means of visualizing how the information in a system is related.

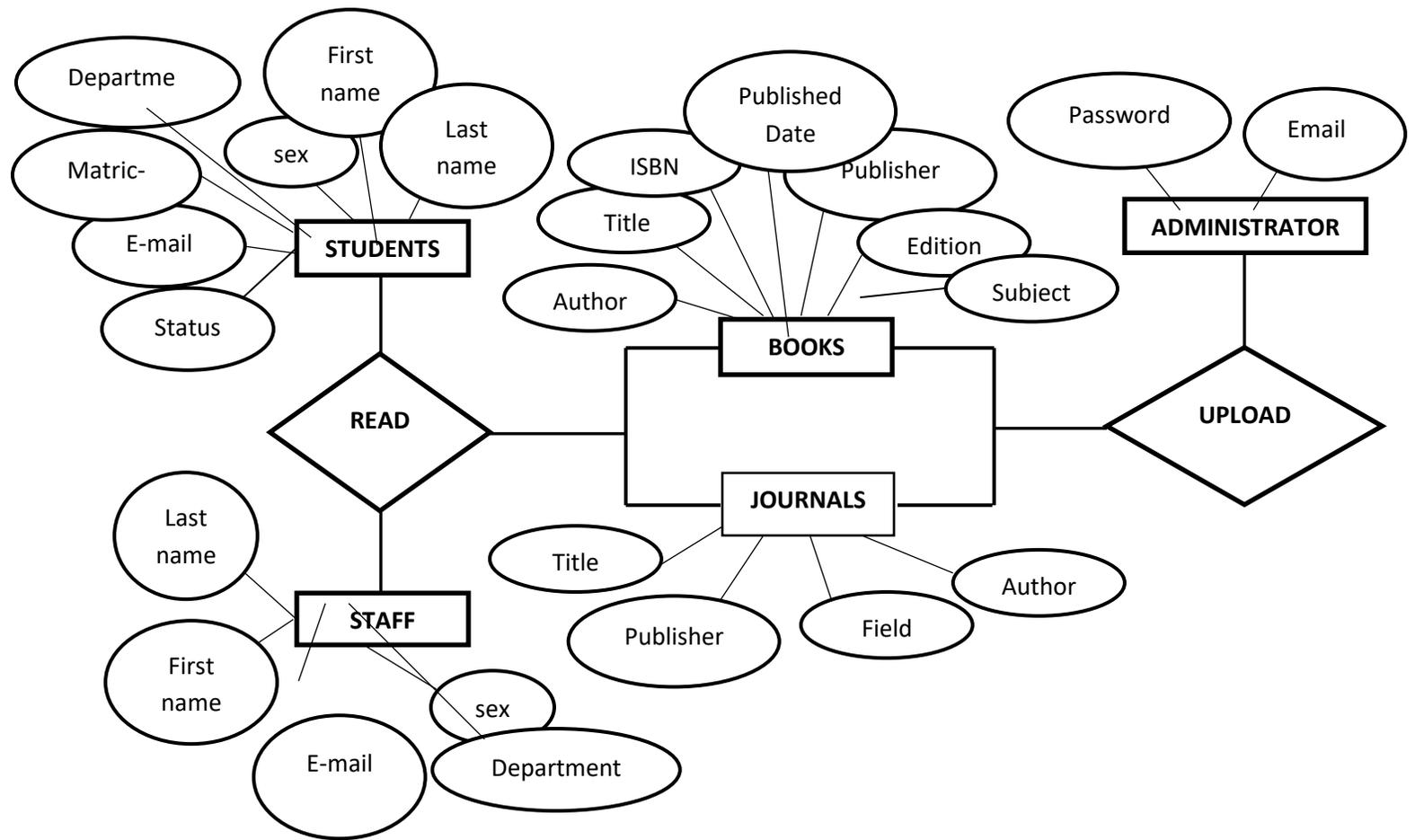


Figure 3: Entity Relationship Diagram of e-library

### 5.4 Implementation and Testing

The system's functional requirement modules are implemented with web programming languages. The system will be managed by an administrator in the institution. The administrator will manage the system by providing resources (uploading books and journals in to the database) for users (staff and students), controlling user's access where necessary by activating or deactivating. The administrator has an email and password to manage the e-library.



Figure 4: index page

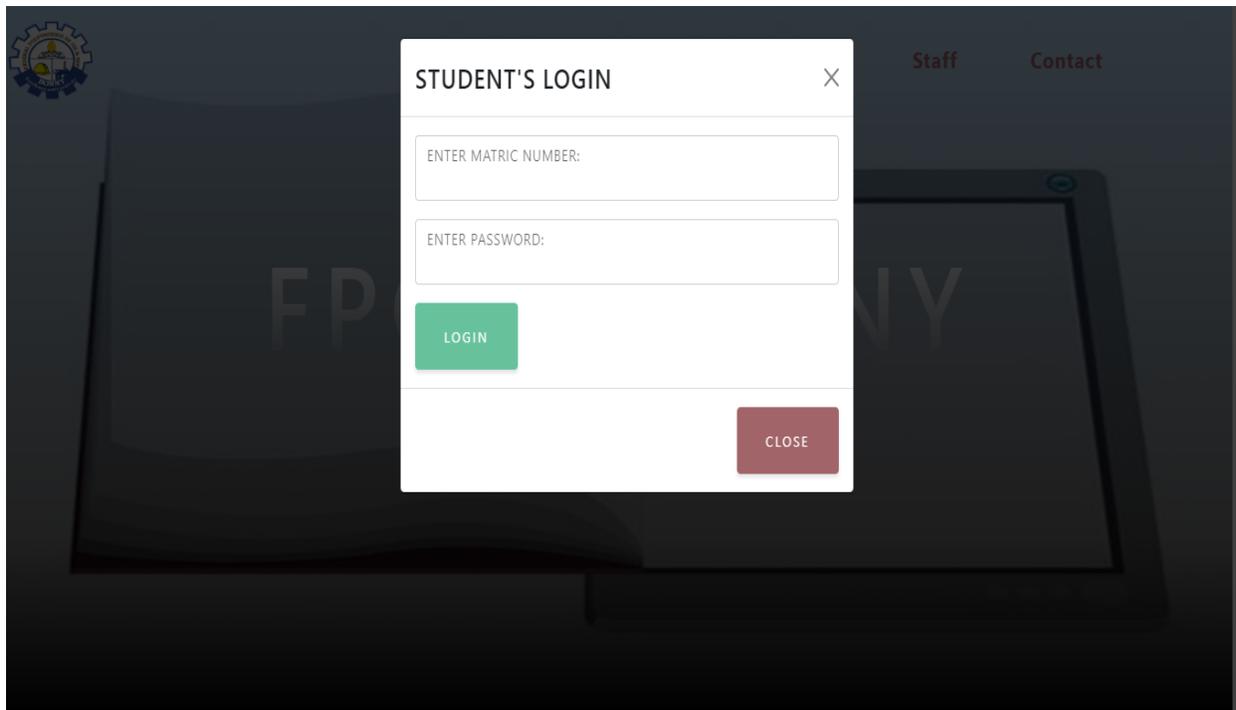


Figure 5: Login popup form on index page for students

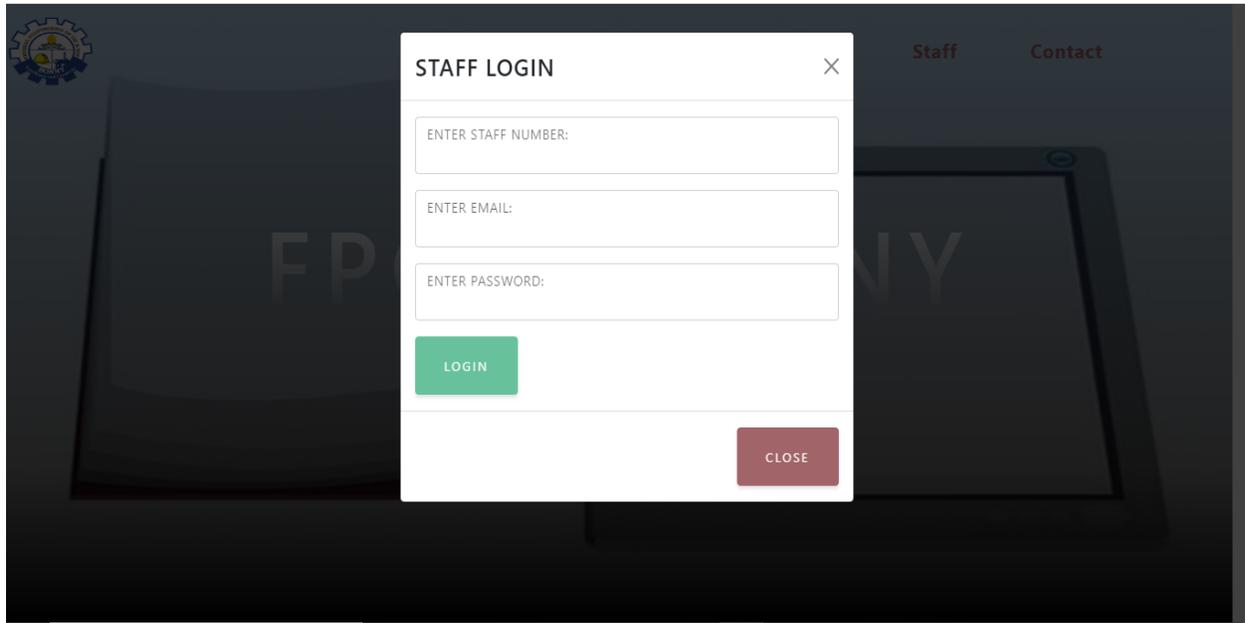


Figure 6: Login popup form on index page for staff



Figure 7: home page

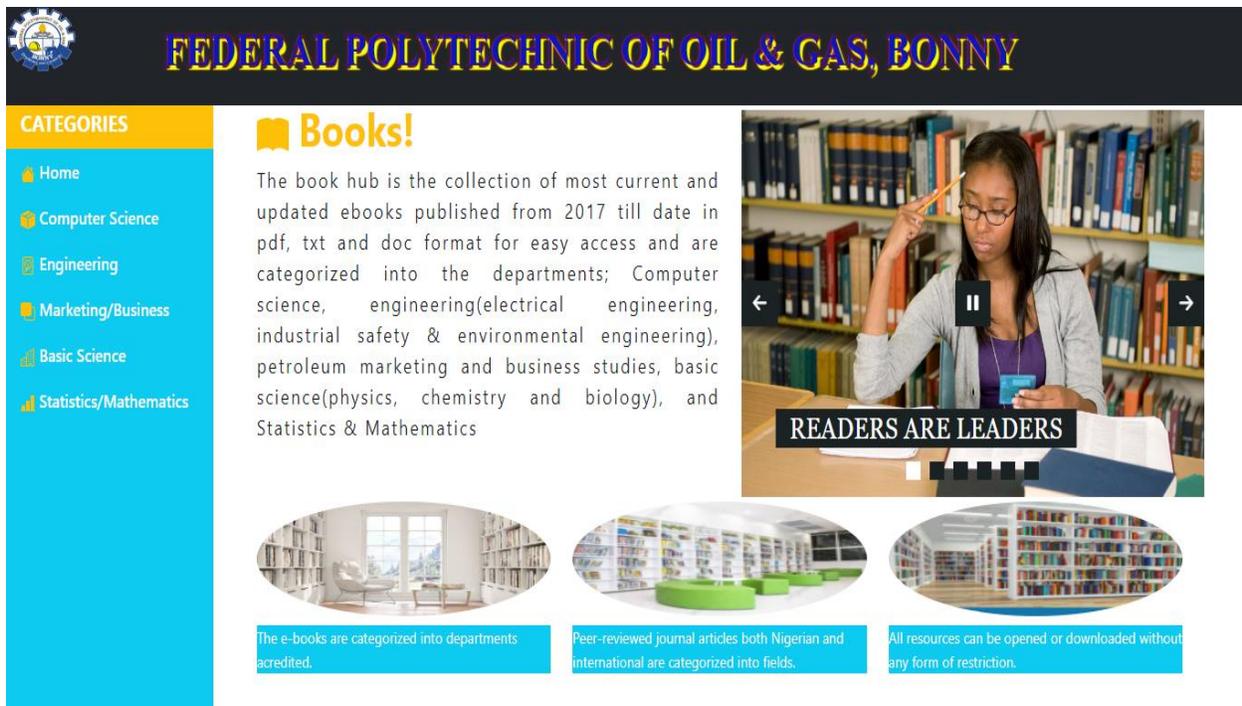


Figure 8: e-book page

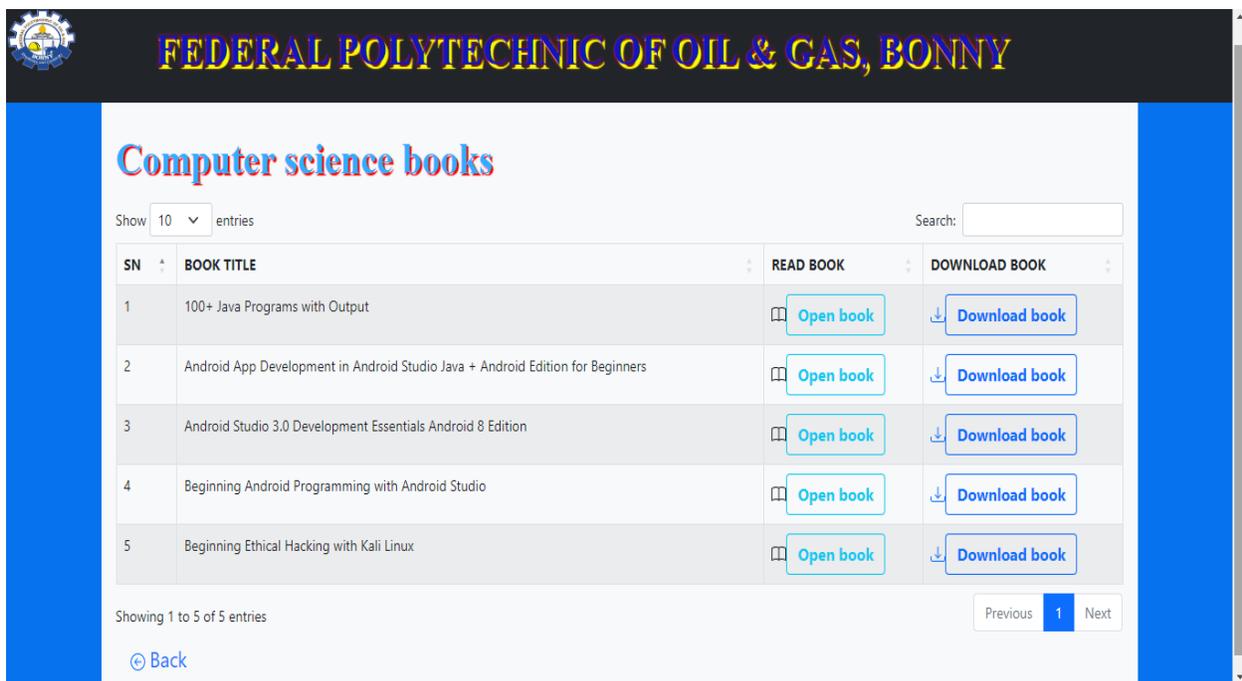


Figure 9: Computer science e-book page with open and download features



Figure 10: admin login page

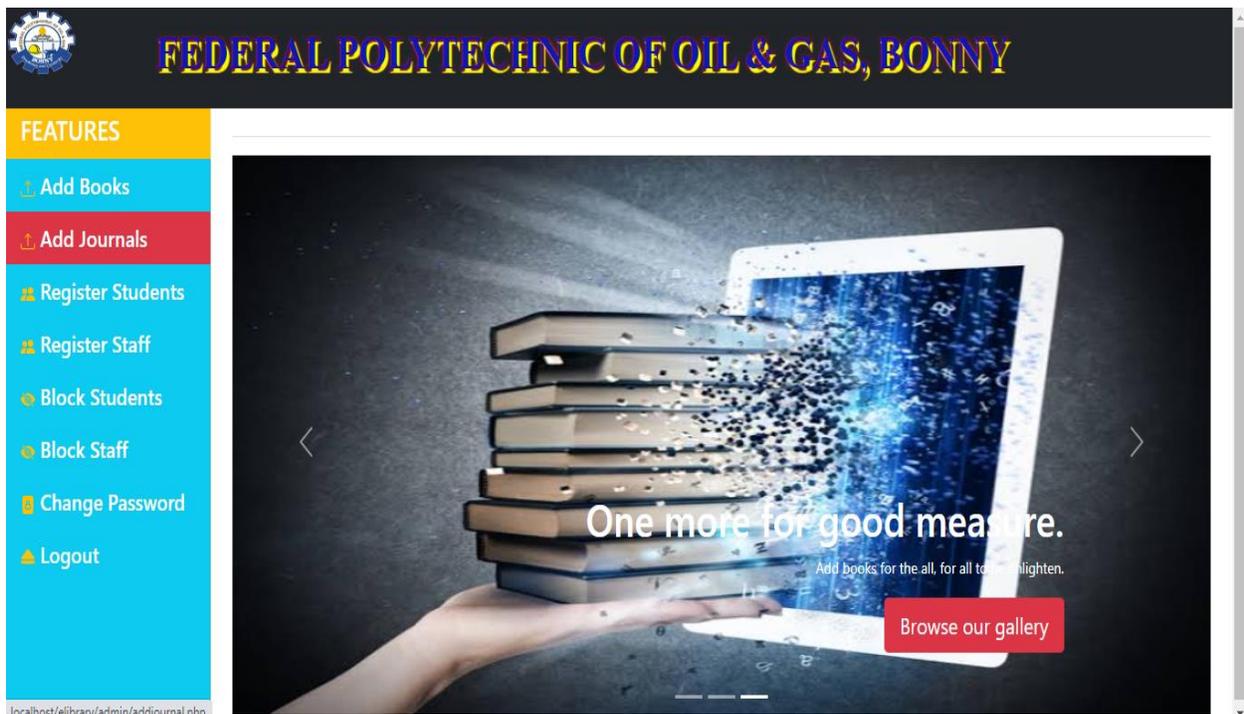
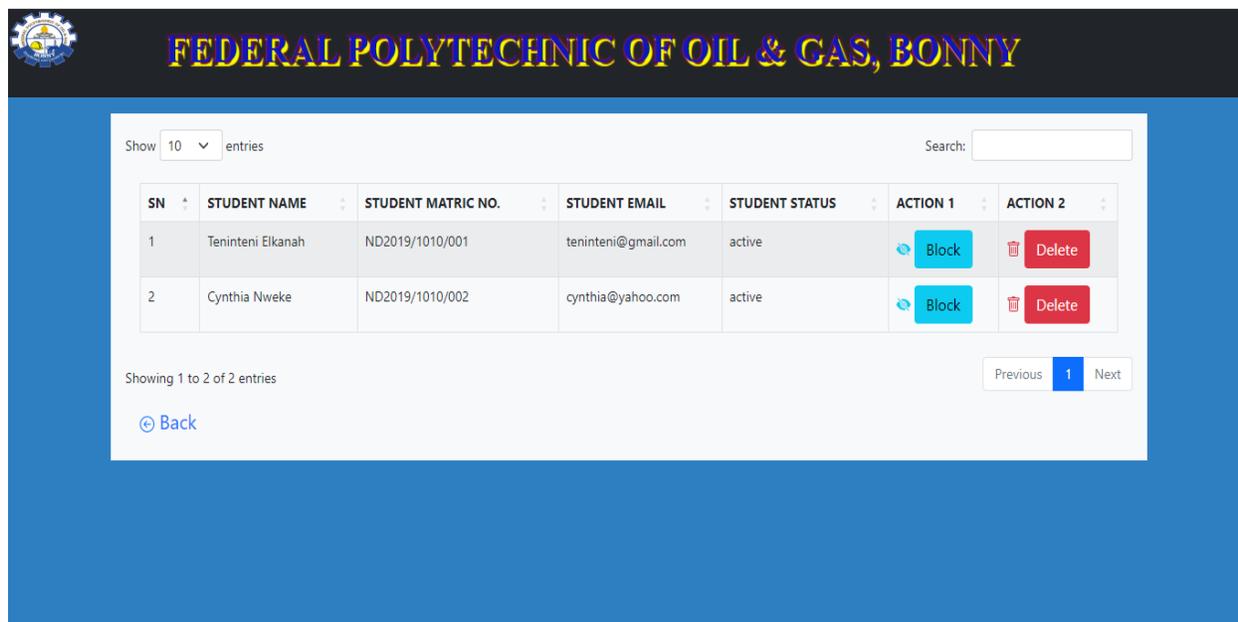


Figure 11: home page with different features



**Figure 12: admin page for block or delete student actions**

### 5.5 The possible use cases for the e-library

The e-library application is developed with web technologies and is best hosted online on the internet, but since web apps are developed for browsers so it can also be used on the local server as an offline version, and the android version.

### 6.0 Conclusion

This project has highlighted the essence of having an e-library management solution in this information age. The need for an effective e-library management solution is clear. E-library management solutions provide libraries with better ways to manage their resources digitally especially their Electronic Information Resources, make it easier for users to access library resources, and increase user engagement. By investing in an e-library

management solution, libraries can stay ahead of the competition and continue to provide reliable, up-to-date services. It enhances the functions of traditional libraries by providing an unlimited storage of library resources and also providing better form of security. The design and development of an e-library management solution is an essential undertaking that requires a comprehensive approach. The solution should be designed to meet the specific needs of the library and should include key features such as user management, resource management, search and discovery, access control, and reporting and analytics. The development process should include requirements analysis, design, development, and deployment. The e-library management solution helps in automating library processes, reduce costs, and improve the quality of service offered to users

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