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Design and Development of an e-Library Management Solution at Federal Polytechnic of Oil and Gas, Bonny, Nigeria

[1]George Azubuike Onwueme 0009-0009-5968-6522
[2]Simeon Olumide Ogunnusi
[3]Kekebou Erefaghe October Lambert
[3]Babayemi Samuel Olaiya

[1]Admiralty University of Nigeria, Ibussa
[2]Federal Polytechnic, Ado-Ekiti
[3]Federal Polytechnic of Oil and Gas, Bonny
[3]Federal Polytechnic of Oil and Gas, Bonny

Abstract
The design and development of an e-library management solution at the Federal Polytechnic of Oil and Gas, Bonny Rivers State, Nigeria was a project aimed at improving access and taking better control of the growing collection of Electronic Information Resources (EIRs) acquired over the recent years. The e-library management solution provides a web-based platform that allows students and staff to access the library's collection of electronic information resources remotely from any location, at any time.The solution was developed using a waterfall software development methodology, which involved the stages of requirements gathering, analysis and design, implementation, testing, and maintenance. The solution was also developed using open source technologies, which has helped in reducing the cost of development and maintenance. The e-library management solution includes features such as online catalogues, e-books, e-journals, online renewals, and online reservations. The solution also provides a platform for students and staff to interact with the library through online chat and email, making it easier for them to get assistance with their research needs.The project was implemented by a team of software developers and professional librarians who worked together to ensure that the e-library management solution meets the needs of the institution. The project is expected to improve the efficiency of library operations, increase user satisfaction, and enhance the learning experience of staff and students at the Federal Polytechnic of Oil and Gas, Bonny

Keywords
E-library, digitization, software development, electronic information resources,

CONTACT GEORGE Azubuike Onwueme @ gonwueme-lib@adun.edu.ng

Introduction

As the world continues to grow more digital, Libraries are being forced to develop new strategies for managing and organizing information. Traditional library management systems are no longer enough to keep up with the demands of the modern library user. With the vast amount of information available and in different formats, it is important for libraries to have effective systems in place for not only cataloging, indexing, and retrieving information but also acquiring and managing Electronic Information Resources (EIRs). The growth of electronic information resources has been one of the most important advancements in the field of information science and technology in recent years. Electronic information resources have become a crucial component of our everyday lives as a result of the internet's widespread acceptance and the rise in the use of digital gadgets. A wide variety of digital items, such as online databases, e-books, e-journals, multimedia content, and web resources, are regarded as electronic information resources. Users have access to a wealth of knowledge and information through these resources, which may be rapidly and readily accessible.

The expansion of electronic information resources has fundamentally transformed how we search for, access, and utilize information. This shift has significantly increased our access to knowledge and opened up new avenues for study, learning, and personal development. In recent years, the growth of electronic information resources has been exponential, propelled by continuous technological advancements and an ever-growing demand. (Edem & Egbe 2016; Onwueme & Lulu-Pokubo, 2017; Bamigboye et al 2018, Pati 2018; Osinulu 2020; Moses, Malgwi, & Joshua 2022). Hawthorne (2008) noted that Electronic information resources became more readily available thanks to the World Wide Web and internet's development in the 1990s. As a result, print resources like books and journals could be digitally preserved, and new born-digital resources like online databases, e-books, and e-journals might be produced. In addition to digitization, technological advancements in storage, processing power, and networking have also contributed to the growth of electronic information resources. For example, Jayakumara (2022) noted that Cloud computing has made it easier and more cost-effective to store and access large amounts of digital data. The proliferation of mobile devices, such as smartphones and tablets, has also increased demand for electronic information resources that are accessible on-the-go. This has led to the development of mobile apps and responsive web designs that optimize electronic information resources for smaller screens.

This development is expected to continue in the future as technology continues to evolve.With the increasing number of electronic resources available, e-library management solutions have become a necessity for libraries to acquire in order to remain relevant and provide quality services to their users. E-library management solutions provide libraries with the tools they need to stay ahead of the competition and continue to provide reliable, up-to-date services.

In this era of digitization, E-library management solutions provide a wide range of benefits to libraries, including the ability to manage licenses, track usage, and ensure the security of electronic information resources. These solutions also allow libraries to provide seamless access to electronic resources from anywhere at any time. Additionally, e-library management solutions help libraries to optimize their resources and reduce costs by allowing them to efficiently manage and share electronic resources among different libraries. E-library management solutions have become an essential tool for libraries to manage and organize their electronic resources effectively. (Ayomide 2022; Udo-Okon&Esiere 2022).

Therefore, the design and development of an e-library management solution is an essential undertaking in this current digital age. The advent of digital libraries and the vast amount of information available online makes it necessary to develop a comprehensive solution that can handle the diverse needs of users and help libraries to operate effectively. This article intends to detail the steps and processes taken in designing and developing an e-library management solution for the Federal Polytechnic of Oil and Gas, Bonny Library.

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

The e-library management solution should be designed to meet the specific needs of the library. The key features of an e-library management solution include:

1. User Management: The solution should provide user management functionality that allows library managers to create and manage user accounts, including user authentication, user roles and permissions, and user activity tracking.
2. Resource Management: The solution should provide resource management functionality that allows library managers to create and manage resources such as books, journals, and other materials. The system should also have features for tracking the availability of resources and managing borrowing and lending activities.
3. Search and Discovery: The solution should provide an intuitive and easy-to-use search and discovery interface that allows users to search for resources using various criteria such as author, title, subject, and keyword.
4. Access Control: The solution should provide access control functionality that allows library managers to control access to resources based on user roles and permissions. The system should also have features for tracking user access to resources.
5. Reporting and Analytics: The solution should provide reporting and analytics functionality that allows library managers to monitor library activities, track resource usage, and generate reports on various aspects of library management.

4.0 Development Process

The development process of an e-library management solution is complex and requires a comprehensive approach. The processes were carefully selected and followed in the course of embarking on this project:

1. Requirements Analysis: The first step is to analyze the requirements of the library and identify the key features and functionality that the solution should provide.
2. Design: The next step is to design the system architecture and user interface based on the requirements analysis. The design should include the database schema, user interface design, and system integration architecture.
3. Development: The development phase involves the actual implementation of the design, including the development of the front-end and back-end systems, integration with other systems, and testing of the system.
4. Deployment: The final step is to deploy the system and provide training to the library staff and users.

System Design

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.

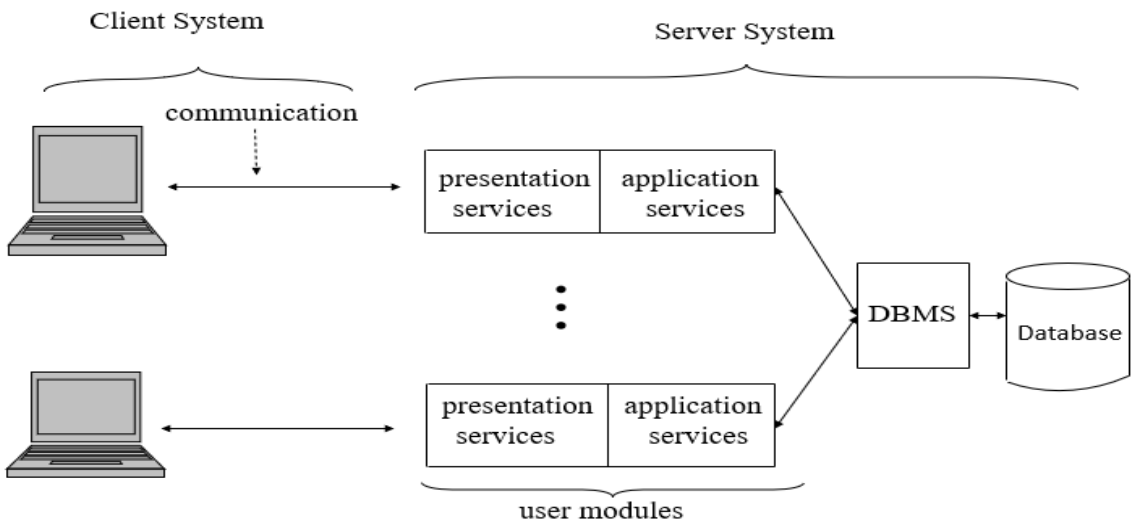


Figure 1:2-tier architecture source: https://slideplayer.com/slide/5207275/

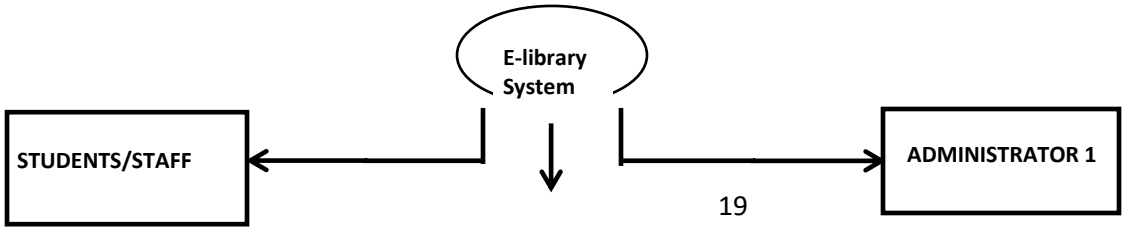
In web system technology, web interface will be demanded by the client before necessary interaction can occur. Through the system logic the servers administer the clients' requests. Web server offers the services such as authentications, web pages generation on request and database operations. The server/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

Functional requirements

The system is modularized into the following functions in the form of user interfaces for easy 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.

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 information about the timing of progress or information about whether processes will operate in sequence or in parallel.



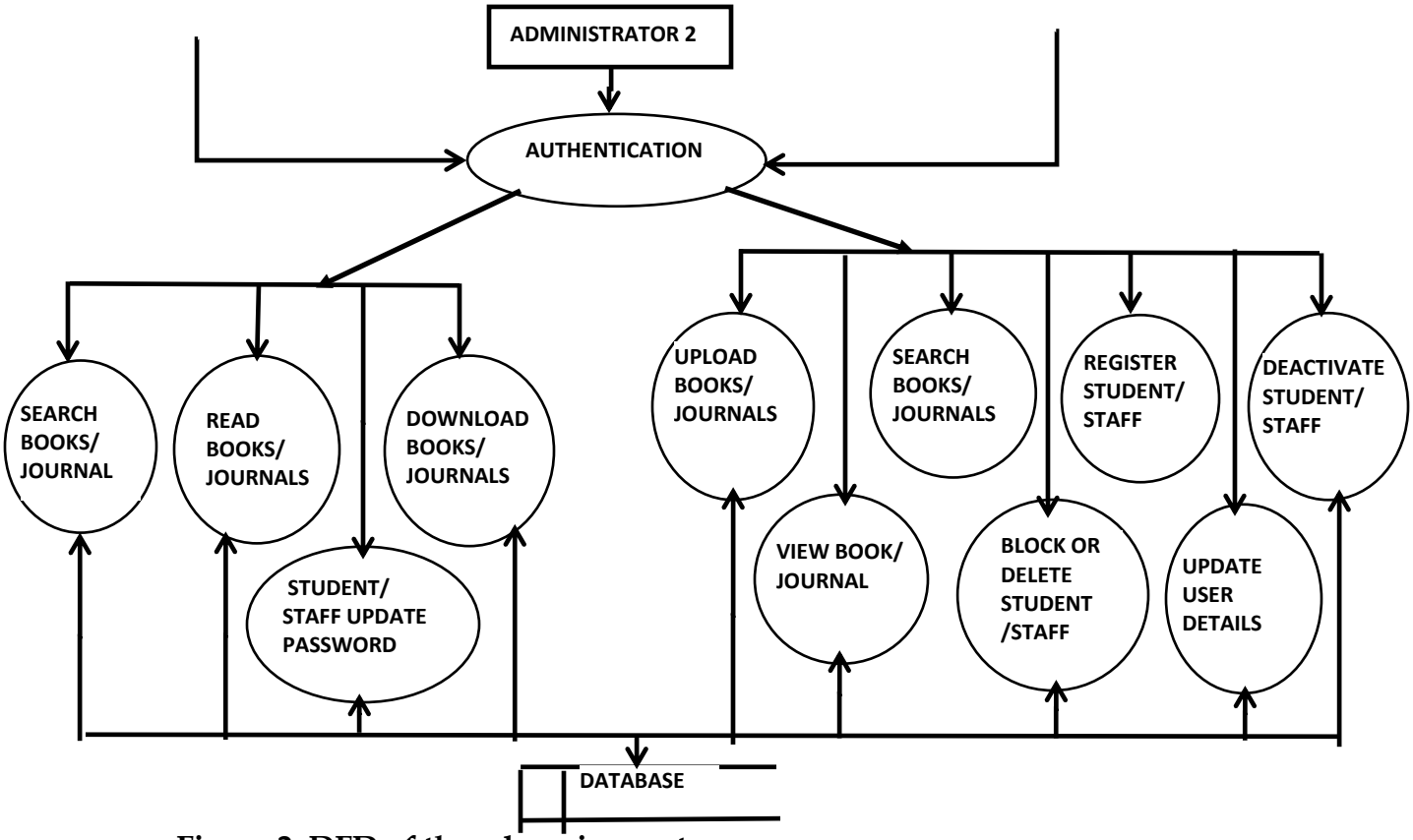


Figure 2: DFD of the e-learning system

Source: Skinner, Katherine; Halbert, Martin & Battle, Mary. Strategies for Sustaining Digital Libraries, book, April 2008; [Atlanta, Georgia]. (https://digital.library.unt.edu/ark:/67531/metadc97962/m1/62/ University of North Texas Libraries,

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.

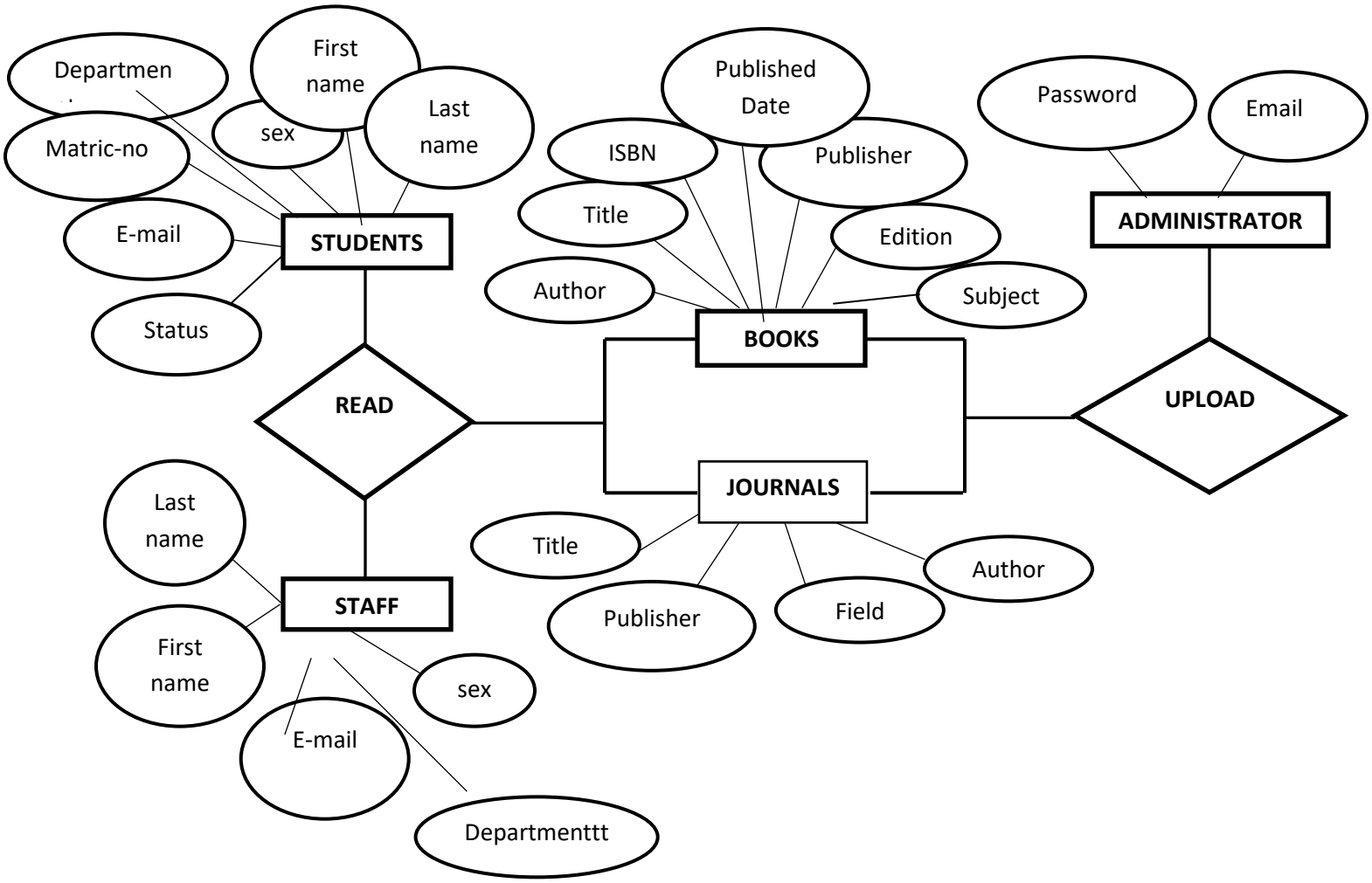


Figure 3: Entity Relationship Diagram of e-library
Source: WSEAS Transactions on Information Science and Applications · June 2010

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

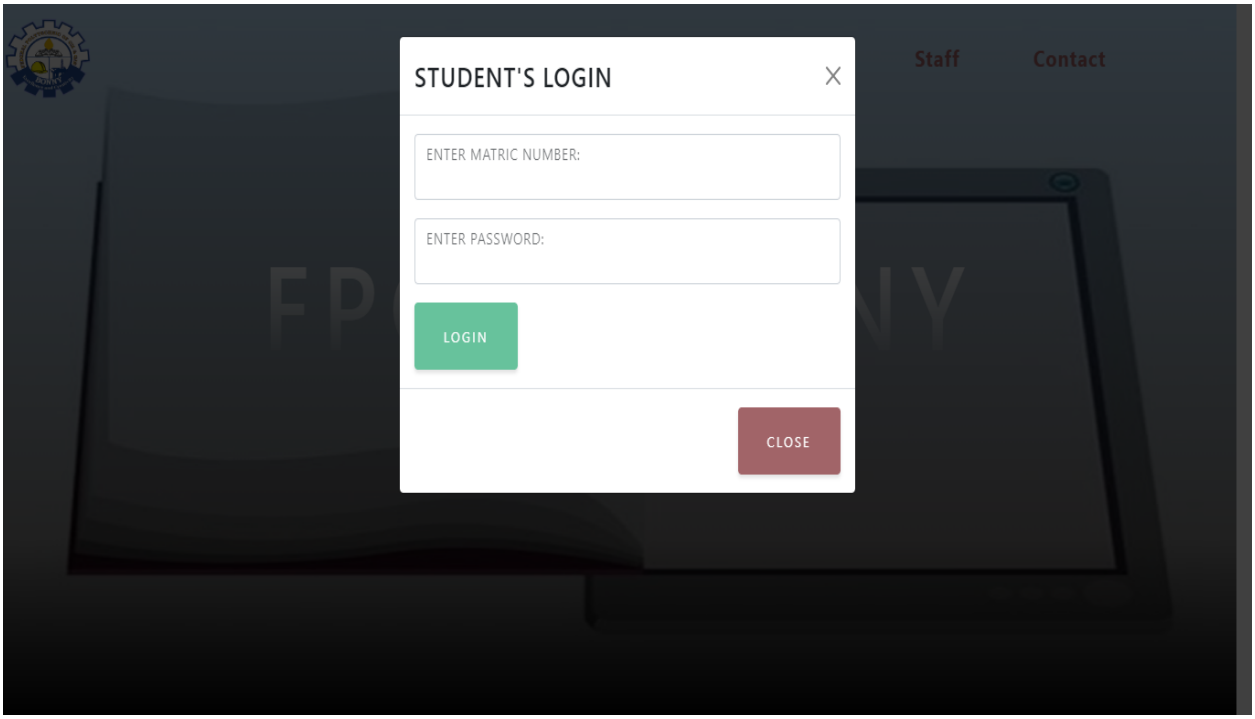


Figure 5: Login popup form on index page for students

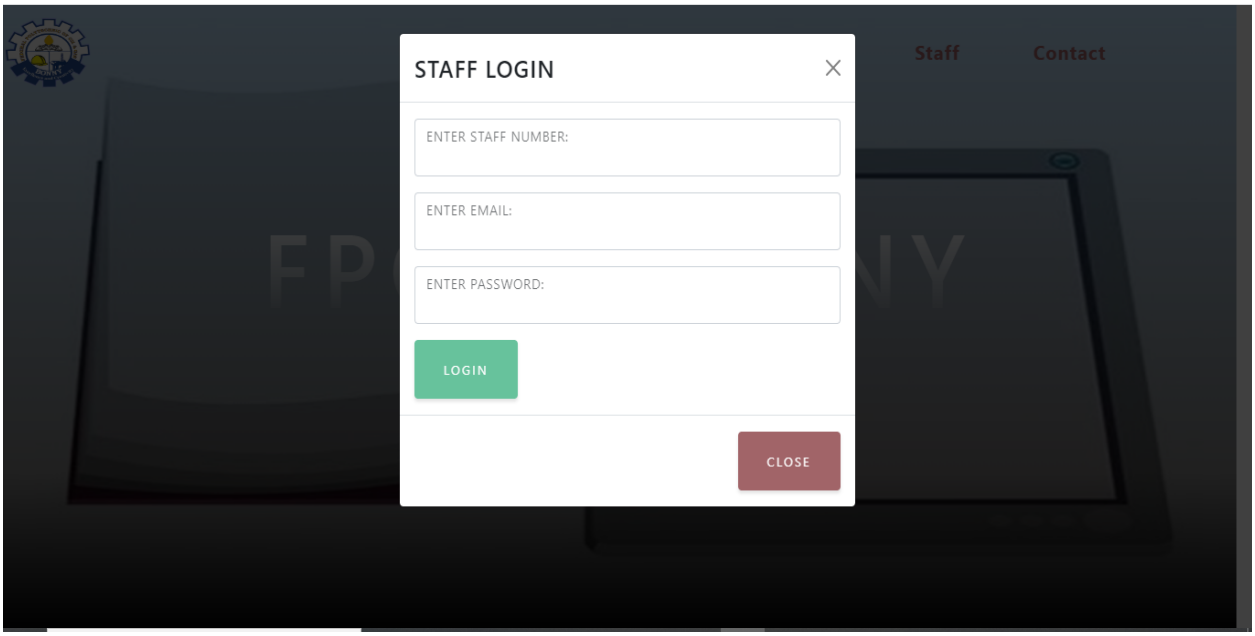


Figure 6: Login popup form on index page for staff

Figure 7: home page

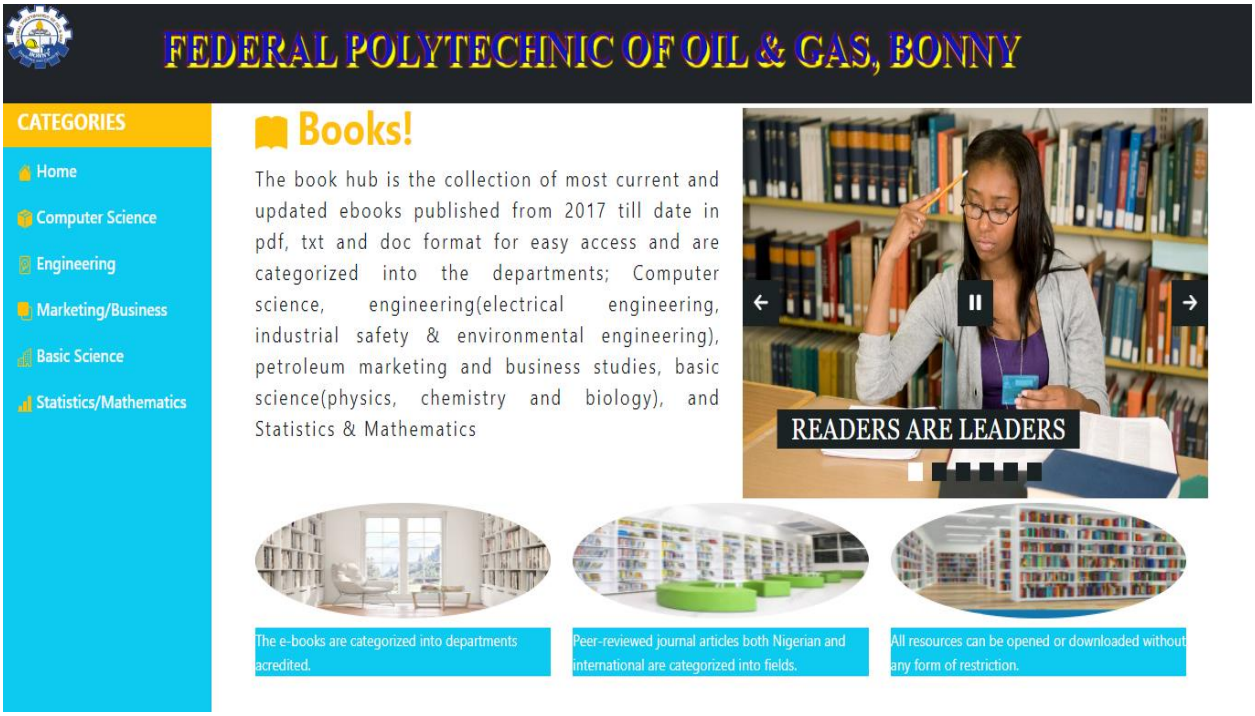


Figure 8: e-book page

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

Figure 10: admin login page

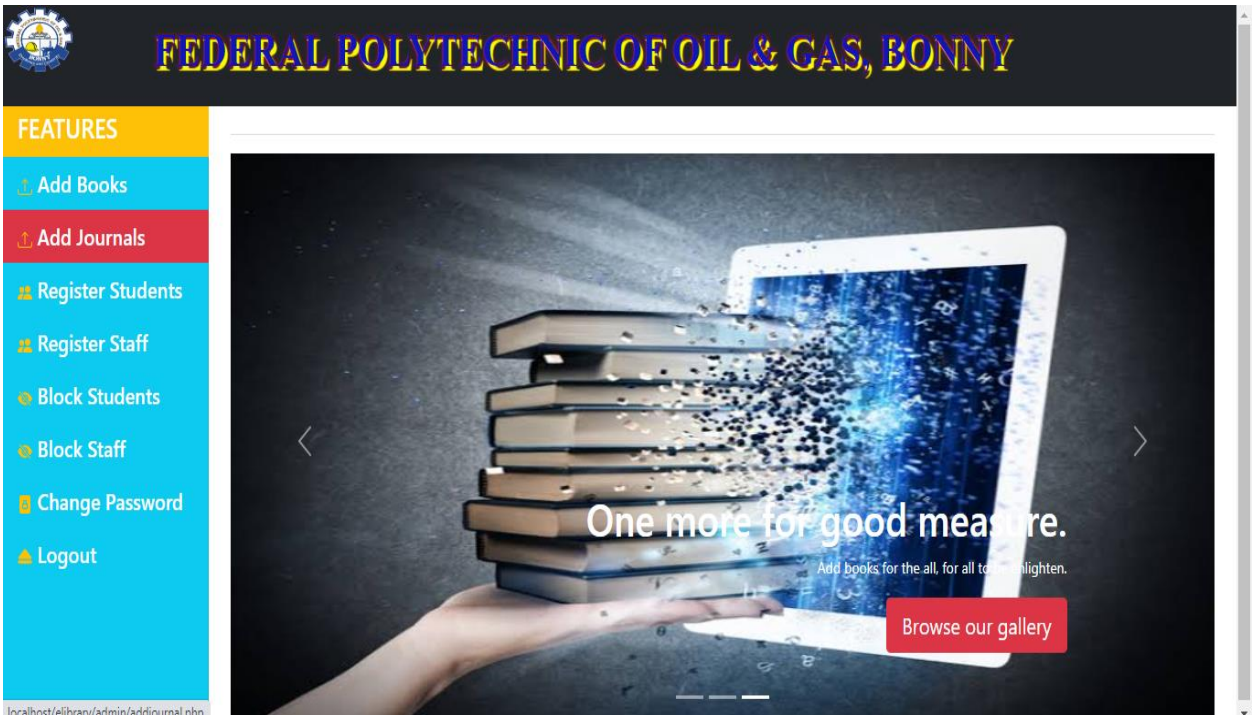


Figure 11: home page with different features

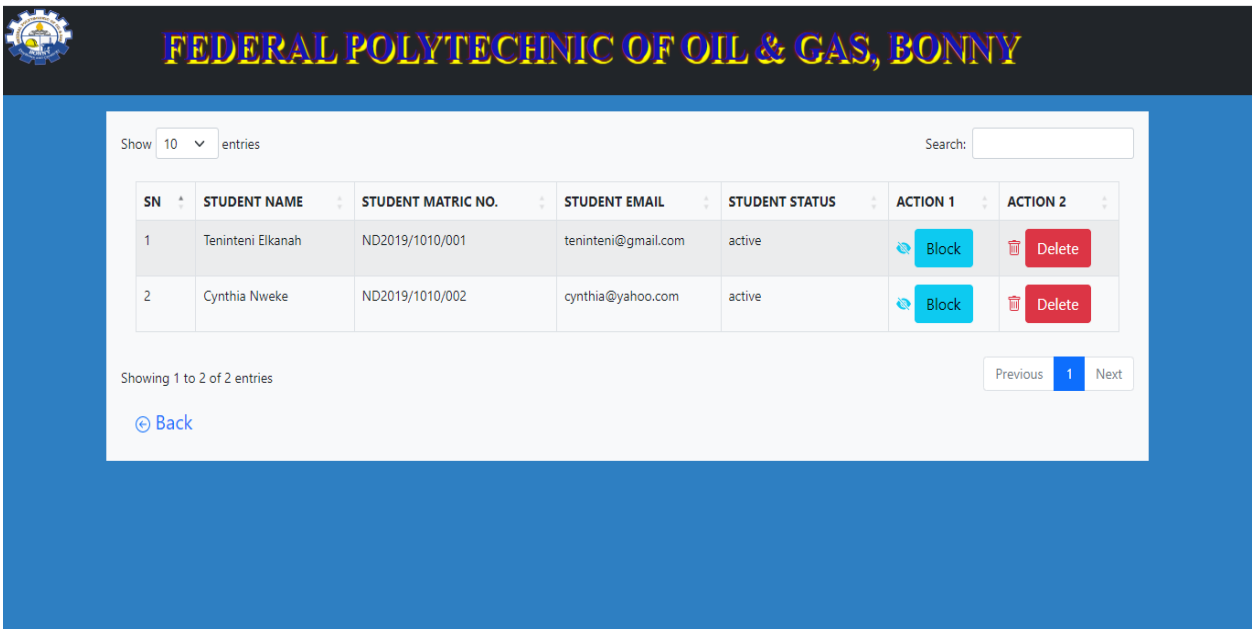


Figure 12: admin page for block or delete student actions

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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About the Authors

Onwueme, George Azubuike is a Librarian and Head of Library Staff Administration and Extension Services at the Admiralty University of Nigeria (ADUN) Library, Ibusa, Delta State. Previously, he served as the Acting Polytechnic Librarian at the Federal Polytechnic of Oil and Gas in Bonny, Rivers State and was for some years the E-Librarian at the same institution. He earned his Bachelor of Library and Information Science and Master of Information Science degrees from the University of Ibadan. George is a member of the Nigerian Library Association and a certified librarian by the Librarians' Registration Council of Nigeria (LRCN). His work includes publications in both national and international journals, as well as presentations at some conferences. He can be contacted via email at gonwueme-lib@adun.edu.ng.

Ogunnusi, Simeon Olumide PhD is a Chief Lecturer at the Federal Polytechnic, Ado-Ekiti, currently on sabbatical at the Federal Polytechnic of Oil and Gas, Bonny, Rivers State, where he also serves as the Acting Rector. He holds a Bachelor's and a Master's degree in Computer Science from the Federal University of Technology Akure (FUTA), and earned his Doctorate from Universiti Teknologi Malaysia in 2016. Dr. Ogunnusi is an active member of the Nigeria Computer Society (NCS), the Computer Professional (Registration Council) of Nigeria (CPN), and the Research and Development Network of the International Research and Development Institute. He has published over 30 academic articles in both local and international journals and has presented 25 academic papers at conferences worldwide. Additionally, he has participated in numerous national and international training workshops. He has authored, co-authored, and contributed chapters to six international standard textbooks, including one currently used by students in the Department of Computer Science at Universiti Teknologi Malaysia (UTM). His research interests include Computer Networking, Information Security, and Mobile Agent Technology. Dr. Ogunnusi can be contacted via email at ogunnusi_os@fedpolyado.edu.ng.

October, Lambert K. E is a lecturer and a web developer in the Department of Computer Science at Federal Polytechnic of Oil and Gas, Bonny Rivers State. He obtained his BSc and MSc degrees in Computer Science from Niger Delta University, Bayelsa State and Ignatius Ajuru University of Education, Port Harcourt, Rivers State respectively. He has some academic papers published in learned journals. He can be reached at octoberlambert@gmail.com

Olaiya, S. Babayemi is a lecturer, Department of Computer Science, and doubles as the Director of ICT, Federal Polytechnic of Oil and Gas, Bonny, Rivers State, Nigeria. He was

previously a System Analyst, ICT Unit, Wesley University Ondo city, Ondo State, Nigeria. He holds a Bachelor of Technology, B.Tech (Hons) in Computer Science from the Ladoke Akintola University of Technology (LAUTECH), Ogbomosho, Oyo state, Nigeria. His has research interests in Smart technologies, cyber security, Information systems, Hardware repairs and maintenance. He has some publications to his credit. His contact details are olaiyasuitable@gmail.com and 08037283921