LiBile: Mobile-Based Library Management System

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Abstract

The growing dependence on digital technology has considerably affected the modernization of traditional systems. This paper discusses the development of a mobile-based library information system named LiBile. The system aims to improve the accessibility, efficiency, and involvement of users in library services. Traditional library information systems usually employ manual approaches and desktop applications. This has limited their accessibility and increased the risk of errors and time consumption. LiBile aims to overcome these limitations by offering a mobile-based system that allows users to access library services anywhere and at any time. The system allows users to search for books, check availability, borrow and return books, and receive timely updates on due dates and other information. Additionally, it offers efficient services to librarians for managing books, transactions, and users. The system employs a cloud-based database to ensure real-time data synchronization. It also includes a user-friendly interface to facilitate both users and librarians. The process of developing LiBile involves a systematic approach to system development, which includes requirement analysis, system design, implementation, and testing. The results have shown improvements in terms of efficiency, human effort, and user satisfaction compared to traditional systems. LiBile offers a viable solution for modern libraries through the use of mobile technology and real-time data management. The system not only provides quality service to users but also meets the growing trend of digitalization within institutions.

Keywords: Mobile Library Management, Digital Library System, Real-Time Database, User-Friendly Interface, Library Automation.

1. Introduction

Each person has his own chief field of activity in which he feels properly employed. In libraries, as we have noted, this is the domain of the work of acquisition, provision of reading materials, orientation, lending, etc. The modern means employed in the mechanization of this work and in making possible the retrieval of information at a moment's notice through the use of card indexes and indexes on micro-cards in combination with machinery have already been alluded to. In a great many libraries, the old record system of accounting for books has not yet been replaced by a more modern and efficient one. For example, card catalogues and catalogues on micro-cards in conjunction with machinery have yet to replace the old way of describing books on cards and in loose-leaf catalogues; the number of libraries that use reliable computer systems to run their library activities, which have brought about efficiency and more convenient service to readers, is very small.

The regular catalog of the library is still in the library; the user has to spend a lot of time looking for what they want. Even more tedious is the work of finding out whether the book is on the shelf or has been borrowed; this is usually only possible by going to the library. With the tremendous growth of mobile technology and the popularity of using mobile smartphones, there is a need for the library to rethink its services to meet the changing needs of its users. There is a possibility of using mobile applications to provide library services at the convenience of the user. There is also the potential for mobile technology to bring a change in the way library routine work is carried out. The current method of managing library resources by most learning institutions is facing a number of challenges; these challenges are mainly related to high costs, inefficient management, and lack of reliability. In order to eradicate these challenges, the project developed a mobile application system for the library: this is LiBile.

LiBile is an acronym formed from the combination of the words "Library" and "Mobile." The application is primarily created to simplify the accessibility of learning resources for students. LiBile provides a platform through which students can search for books, check if the books are available, issue books, return books, and receive mobile notifications. On the other hand, the system provides a platform for administrators to manage books, track all transactions that take place in the library, and maintain records of all users. The main focus of LiBile is to make the library work effectively and simplify the users' experience through the automation and online handling of the data processing system. LiBile uses mobile technology coupled with cloud server technology to make it compatible with information technology,

closing the gap between conventional library operations and modern technology, thus making library services modern, effective, and expandable.

2. Related Work

The development in library management system development has seen significant changes in recent times with the integration of digital and mobile technologies. Marcel et al. [1] introduced an online integrated library management system to facilitate improved accessibility and efficiency in the administration of academic institutions. Similarly, Sugashini et al. [11] and Lankipalli et al. [12] introduced web-based e-library system development to facilitate enhance the management of books, users, and databases. Moruf and Abu Zibiri [13] discussed the evolution in library system development towards cloud computing and next-generation library systems.

Mobile library solutions have also received attention in recent years. Eke and Salihu [14] developed a mobile library management system to support service delivery, especially concerning real-time access and ease of use. Rafique [10] studied various factors that influence student acceptance of mobile library solutions, which showed that usability, usefulness, and accessibility are critical determinants of mobile library application acceptance. Moreover, Kushwah et al. [8] discussed how traditional libraries are being replaced by next-generation digital libraries.

Besides mobile library systems, a number of research studies have been conducted on mobile applications in different domains. In their study, Ramtohul and Khedo [2] discussed mobile positioning techniques, which are critical for mobile application development. Another study by Ceylan and Karakus [3] presented an intelligent mobile application platform based on AI, which demonstrates the efficiency of intelligent systems in improving engagement and learning. Mobile health applications for hearing impairment detection were presented by Swanepoel et al. [4], while guidelines for digital health interventions aimed at improving healthcare systems were presented by the World Health Organization [5]. The effectiveness of digital health interventions has also been validated by Kouvari et al. [6], who conducted a systematic review of digital health interventions for weight management.

New technologies like augmented reality and mobile financial services are also part of the digital ecosystem. Brilakis [7] introduced markerless BIM registration for mobile

augmented reality applications, resulting in advanced inspection systems. Kabir et al. [9] have worked on mobile financial services and highlighted the importance of these services, especially in developing regions.

Moreover, existing digital library infrastructures like Libby [15] and libraries like Invenio [16] demonstrated the practical applicability of mobile and web-based library infrastructures, which provide functionalities like digital borrowing, cataloging, etc.

Overall, these research papers illustrate the trend towards mobile, cloud, and AI-based infrastructures in the domain of library management and related areas. However, there are some issues that need to be addressed in the future.

3. Research Gap

The evolution of library automation systems with digital technology has revealed some inadequacies in existing library management systems (LMS) that result in user dissatisfaction and poor system performance in academic libraries. Firstly, all existing traditional and digital library management systems are desktop-oriented. This limits access for users who wish to access library resources anywhere and at any time. Secondly, the user interface in existing LMS is poorly designed. In existing LMS, most of the features are not student-centered and, hence, not user-friendly. Thirdly, data in existing systems are not updated in real time. In these systems, information regarding the availability of books, borrowing status, return status of books, etc., is not updated in real time. Fourthly, communication in existing systems is not properly cnducted. In these systems, users are unable to receive important information regarding due dates for returning borrowed books, charges to be paid as fines, availability of books they requested to borrow. Moreover, most LMS are not scalable in a way that they can accommodate a large number of users and data. Therefore, a student-oriented mobile library management system based on digital technology is required to bridge the gaps in access, real-time data updates, user interface, and communication with users and library systems. The LiBile system is a student-oriented mobile library management system that addresses these gaps in access, real-time data updates, user interface, and communication with users and library systems.

4.   Methodology

The design and development of LiBile, a mobile library management system for students, have a structured and modular design, similar to that of the functional design as depicted by the workflow diagram of the system, as shown in Figure 1. The LiBile mobile library management system design focuses on the home screen, which acts as the hub of navigation to other significant functional areas of the system. These areas are book search, my account, digital library, notifications, and real-time communications. The requirements have been translated into functional modules that comprise significant areas of the system. These areas include book search, my account, digital library, real-time communications, and many more.

The process involves a client-server concept, where the mobile application acts as a frontend interface to interact with backend services and a cloud database. As shown in the figure above, the Book Search module enables users to search for books based on title, author, and category. This will allow users to view detailed book information along with issue/return functionality using a QR code scan. The My Account module will handle borrowed books, fines, and reading history. The Digital Library module will be used to access digital books, journals, and downloads. The Notifications module will allow users to receive timely reminders and announcements. Common interface components are added to ensure consistency throughout all the modules.
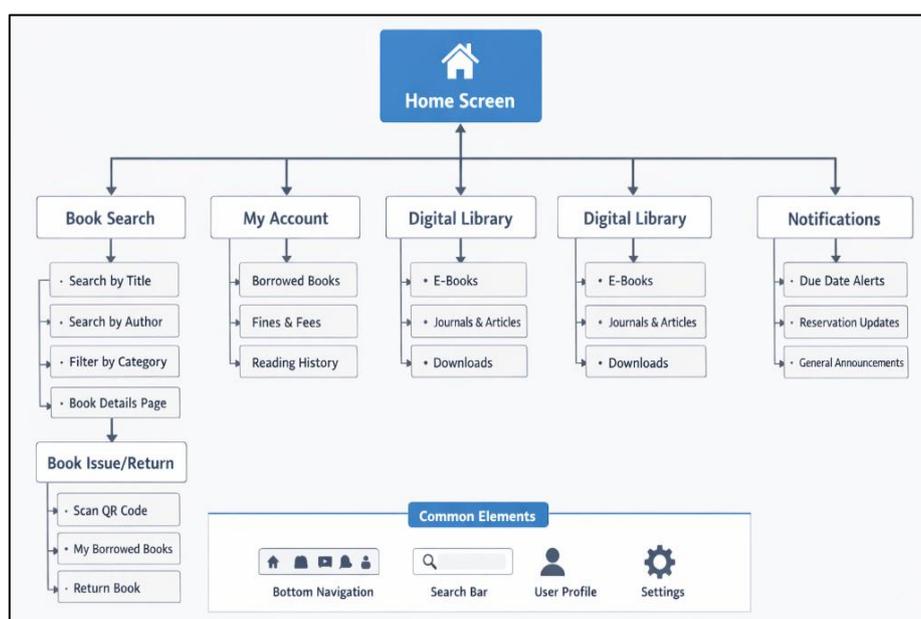

Figure 1. UI Design of the Proposed Work

Each module is individually created to ensure that it functions properly and that it interacts properly with other modules. The system testing also ensured that the whole process, from searching for books to the return process, functions properly. User testing is also conducted to ensure that the system is user-friendly for the students. The modularity of the system, as depicted in the figure above, enables it to be scalable to incorporate future enhancements such as advanced search.

5. System Architecture

The system architecture for the LiBile system is based on a three-tier client-server architecture. The design of the LiBile system architecture has several benefits. It consists of three major components: the presentation layer, application layer, and data layer. The presentation layer includes the mobile application, which acts as an interface for the students and administrators.

The presentation layer, as depicted in the system design, includes the home screen that acts as the interface to access other components such as book search, my account, digital library, and notifications among others. Users can interact with the mobile application through various features such as book search, account details, digital library, and notifications, among others. The user interface includes various components such as navigation, search box, and user profile, among others.
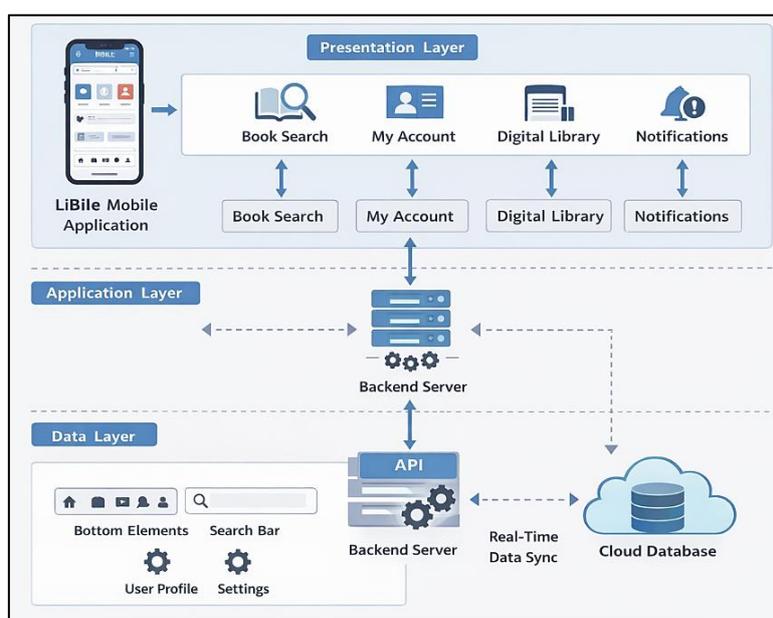

Figure 2. Proposed System Architecture

The application layer, which is the backend server, is responsible for handling all the requests from users. This includes managing all the business logic and interactions between the frontend and the database. The processes involved include user authentication, the issuance and return of books, calculation of fines, and generation of notifications. APIs are used to facilitate data exchange between the mobile app and the server, ensuring that all transactions are processed correctly in real time.

The data layer includes a cloud database that stores all the data in the system. This data encompasses information about users, books, transaction records, and e-resources. The data in the system is considered real-time, meaning that any changes made by users, such as borrowing a book, are updated instantly. This system allows us to develop the application in a modular way with real-time handling and smooth interactions, ensuring that the application is scalable, secure, and efficient. Students can access the library at any time and from anywhere.

6. Results and Discussion

6.1 Home Screen

Home Screen of LiBile: The Home Screen of LiBile is a major feature of the system that allows users to access all the main features efficiently. This feature has been added primarily to enhance the system's usability. The home screen contains a personalized greeting message, a global search bar, statistical information, and quick access to the system's features, enabling users to access their favorite features efficiently.
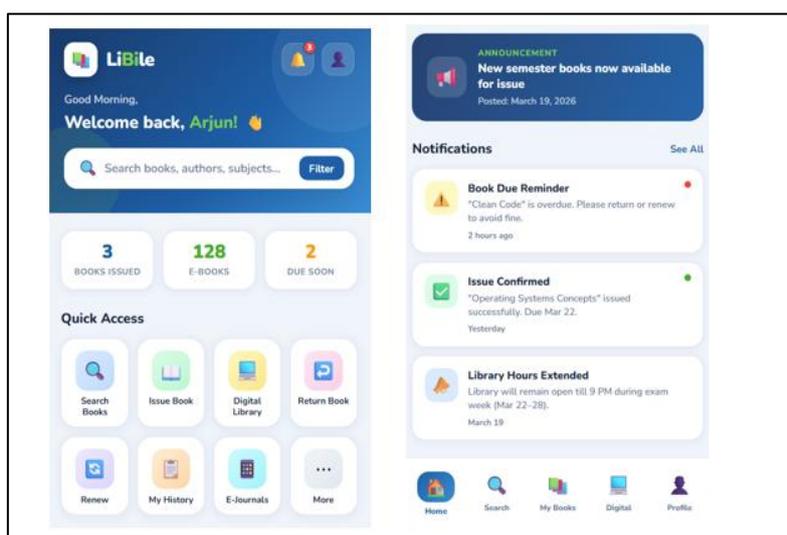

Figure 3. Home Screen

The home screen also includes a panel to display users with notifications such as reminders to return books, confirmation messages to issue books, and updates about the library. The bottom navigation bar is also included to enable users to navigate between prominent features such as Home, Search, My Books, Digital Library, and Profile.

6.2 User Interface

The User Interface (UI) of LiBile is designed to provide a better user experience for users, specifically students. The User Interface is modular in nature, meaning that all parts of the interface are separately defined in terms of screens. The Profile section of the interface contains detailed information about the user, including whether they are a member, the department to which they belong, and limits for borrowing books. The Dashboard section of the interface helps users efficiently access information regarding books they have borrowed, reading status, fine status, and more.
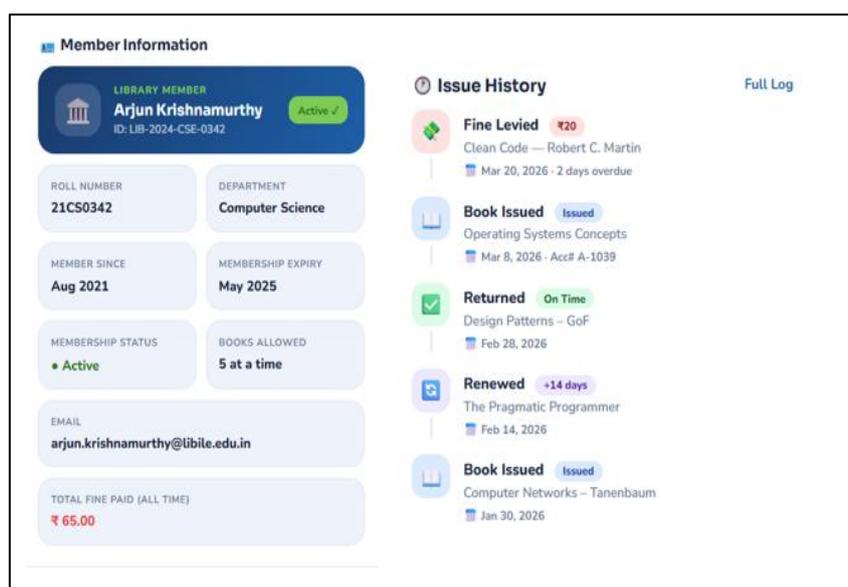

Figure 4. User Interface

The issue history interface will display a list of transactions that have taken place, such as issued books, returned books, renewed books, or paid fines. Each of these transactions will be visually distinct from one another to make it easier to read. The section for borrowing books will be designed like a card to display the details. The interface for this section will be designed to promote ease of use by employing features that are consistent throughout, such as navigation bars, icons, and color schemes. This will help the user navigate through different sections of the interface without compromising usability. The performance of the system was tested on

factors such as response time, database sync time, and user satisfaction. The response time of the system, on average, was found to be less than 2 seconds. Real-time updates were possible with minimal lag due to cloud sync.

Table 1. Comparison with Existing Methods

Ref	Platform	Key Features	Limitations	Proposed work (LiBile)
[11]	Manual / Physical	Cataloging, book issue/return	Requires physical presence, time-consuming	Mobile access, automation, real-time interaction
[12]	Web/Desktop	Book search, database access, automation	Limited mobility, no real-time notifications	Anytime access via mobile and instant alerts
[13]	Web and Cloud	Remote access, scalability, real-time updates	Security concerns, limited mobile-centric design	Mobile-first design and user-friendly interface
[14]	Mobile	Remote access, basic automation	Limited features, less integration of modules	Integrated system (search, notifications, digital library)
[15]	Mobile/Web	E-book access, borrowing digital content	Focus only on digital resources (no full LMS features)	Combines physical and digital library management
[16]	Web-based	Repository management, large-scale data handling	Complex, not student-friendly, lacks mobile focus	Simple UI and student-focused mobile system

A comparison of existing library management systems is presented in Table 1. The existing library management systems are traditional systems, web-based library management systems, cloud-based library management systems, and mobile-based library management systems. Though existing library management systems provide basic facilities like cataloging, online access, digital resource management, etc., they are not mobile-based, not interactive in real-time, and not user-centric. The proposed system aims to overcome these shortcomings with a mobile-based system with cloud integration in real-time and user-centric facilities in a single system, which is named "LiBile.".

7. Conclusion

The LiBile mobile-based library information system has successfully demonstrated the potential to transform existing conventional library information system services into a new, efficient, and user-friendly system. The integration of mobile technology and real-time data management has ensured timely and anywhere accessibility of library information to students. The main features of this system, such as book search, issue/return, and digital library, have ensured efficient library information system operations. The module-based approach and three-tier structure of this system have ensured scalability, reliability, and maintainability. The system has also provided a high level of user experience through personalized features, real-time information, and user-friendly interfaces. The incorporation of administrative features has further enhanced the efficiency of library information system operations. Despite the numerous advantages offered by the LiBile mobile-based library information system, there are some limitations. This system has been internet-dependent, which poses a challenge. It has also required an initial setup, which has been another challenge. These issues can be addressed in the future by incorporating offline functionality, enhanced search tools, and recommendation systems. In conclusion, LiBile provides a system that is not only feasible but also tailored to meet student needs while bridging the gap between traditional library systems and digital demands. The system offers a robust foundation that can be further enhanced to accommodate additional features.

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