

## DESIGN OF A LIBRARY BOOK LENDING INFORMATION SYSTEM USING QR CODE TECHNOLOGY

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**Abstract:** The aim of this research is to explain the practical application of QR code technology in the library environment, with a particular focus on how the technology can revolutionize the way books are borrowed, returned and managed. This system aims to increase the efficiency and comfort of library operations for both library staff and users. This research seeks to explore and present the design of a Library Book Lending Information System that utilizes the potential of QR code technology to improve user experience and make library operations more effective. QR codes have gained widespread popularity due to their ease of use, speed and flexibility. They offer a practical way to bridge the gap between the physical and digital worlds, creating a seamless connection between library visitors and the resources they seek.

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### INTRODUCTION

Libraries have long served as essential repositories of knowledge and information, playing a pivotal role in facilitating access to a vast array of resources for education, research, and personal enrichment.

In the rapidly advancing digital era, libraries face the challenge of integrating modern technologies to streamline their operations. With the widespread use of smartphones and the increasing demand for instant accessibility, implementing QR code technology has emerged as a promising solution. This research is aimed at designing a sophisticated library book lending information system, leveraging the potential of QR codes to enhance the efficiency and convenience of book borrowing and tracking processes.

QR Codes, also known as Quick Response codes, are a type of two-dimensional (2D) matrix barcodes. These codes can be scanned using modern smartphones equipped with a camera and a QR reader application. This technology enables users to access various pre-encoded information, including website URLs, email addresses, details of items in a catalog, and phone numbers (Shettar, 2016).

The primary objective of this study is to present a comprehensive design for a

Library Book Lending Information System (LBLIS) that utilizes QR code technology. This system will encompass a seamless process for users to borrow, return, and track books, providing librarians with an automated and organized approach to manage the library's resources effectively. The research aims to bridge the gap between traditional library systems and modern technological advancements, ensuring a user-friendly experience for both library staff and patrons.

This research is significant as it addresses the pressing need for integrating advanced technologies into traditional library management systems. By utilizing QR code technology, the proposed system aims to streamline the book lending process, reduce administrative burden, and improve the overall user experience. The findings of this study will contribute to the enhancement of library services, fostering a more efficient and engaging environment for both librarians and library users.

Key components that explored in this research include:

1. QR Code Integration: Examining how QR codes can be generated and associated with library books and users, thereby simplifying the borrowing process.
2. User Experience Enhancement: Evaluating how the utilization of QR codes can make the borrowing and returning of library books a more intuitive and user-friendly process.
3. Inventory Management: Investigating how the system can improve the tracking and management of library resources, ensuring a well-organized collection.
4. Security and Data Privacy: Addressing concerns regarding the security of user information and library assets in a QR code-based system.

## **RESEARCH METHODS**

### **Research Stages**

Research on the development of a Library Book Lending Information System using QR Code technology would involve the following stages:

1. Literature Review: Conduct an extensive review of existing literature to understand the current trends, challenges, and best practices in library management systems and the integration of QR code technology.
2. Data Collection: Gather data through interviews and surveys from librarians, library users, and technology experts to understand their needs, preferences, and challenges

in the current library systems.

3. **System Analysis:** Perform a detailed analysis of the current library book lending process to identify key areas for improvement and the potential integration of QR code technology.
4. **System Design:** Propose a comprehensive design of the Library Book Lending Information System, including the user interface, database management, QR code generation, and integration with existing library management software.
5. **Prototyping and Testing:** Develop a prototype of the LBLIS to test its functionality, usability, and effectiveness in a controlled environment. Gather feedback from librarians and users to refine the system's design and features.
6. **Implementation Plan:** Create a detailed plan for the implementation of the LBLIS in various libraries, considering factors such as infrastructure requirements, staff training, and user education.

### **QR Code Technology**

Quick Response (QR) code technology has gained significant attention and implementation in various fields due to its ability to store large amounts of data and facilitate quick and seamless information transfer. In the context of library systems, QR code technology has emerged as a valuable tool for enhancing book lending processes, improving inventory management, and providing a user-friendly experience. This literature review aims to explore the existing research and literature on the applications, benefits, challenges, and future prospects of QR code technology in library settings.

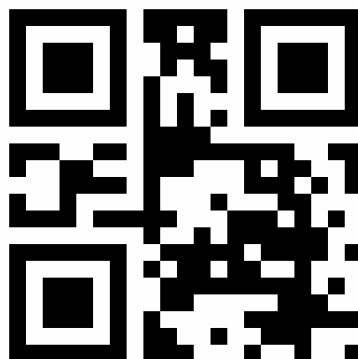


Figure 1. Showing QR Code Bitmap (Parabhoi et al., 2017)

Elements of QR Code There are five basic elements which are used for QR code functionality. These elements are Pattern, Alignment Pattern, Timing Pattern, Quiet Zone and Data Area (Parabhoi et al., 2017).

1. Pattern The Three big squares which are found in the corners of a QR Code are used for identifying size, position and angle.
2. Alignment Pattern It is used for modifying the distortion of QR code.
3. Timing Pattern The pattern made up with black and white modules. This pattern is used for determining the central coordinate of each cell in the QR code.
4. Quiet Zone It is part of a QR Code. It is a margin space which is used to detect the QR code. It consists of four cells and is used for quiet zone.
5. Data Area This element has error correction functionality. It stores data converting into binary digits 0-1. It consists of array of rows and columns.

Researchers have highlighted several key applications of QR code technology in libraries, including but not limited to book borrowing, book return, catalog access, and library event promotion. Studies by Ashford (2010) and Hampton et al. (2011) illustrate how QR codes streamline the book borrowing process, allowing users to scan codes for quick access to book information and availability (Ashford, 2010; Hampton et al., 2011; Pathak & Jain, 2018).

The integration of QR code technology in library systems has demonstrated various benefits. Scholars such as Wara (Wara & Dugga, 2014) have emphasized the enhanced user experience and convenience resulting from the use of QR codes for book borrowing. Additionally, improved inventory management and resource tracking have been cited as key advantages, leading to more efficient library operations and a better-organized collection (Ajab Mohideen et al., 2022).

Despite its benefits, the implementation of QR code technology in libraries is not without challenges. Security concerns related to user data privacy and the potential for unauthorized access have been identified by several researchers (Schultz, 2013). Additionally, issues related to the accessibility of QR code technology for visually impaired users have also been raised, highlighting the need for inclusive design practices in library systems (Baker et al., 2014)

Future Directions and Emerging Trends:

Recent studies have pointed towards the potential evolution of QR code technology

in libraries, envisioning its integration with augmented reality (AR) and virtual reality (VR) to provide users with an immersive and interactive library experience (Lund & Agbaji, 2018). Furthermore, the utilization of QR codes for data analytics and user behavior tracking is emerging as a promising avenue for enhancing library services and tailoring offerings to meet the specific needs of patrons.

### System Models with UML

In this diagram, there are two primary actors: the Library Member and the Library Staff. Each actor has specific use cases associated with them:

#### 1. Library Member:

- Borrow Book: The member can use the system to borrow books by scanning the QR code associated with the desired book.
- Return Book: The member can use the system to return books by scanning the QR code on the book or at the designated return point.

#### 2. Library Staff:

- Manage Inventory: The staff can use the system to manage the library inventory, update book information, and track book availability.
- Manage Member: Library staff can manage user accounts, including creating new accounts, updating user information, and handling user issues. Include generate QR Code for member id Card.
- Generate QR Code: The staff can generate QR codes for new books, assigning unique codes to each item in the inventory.

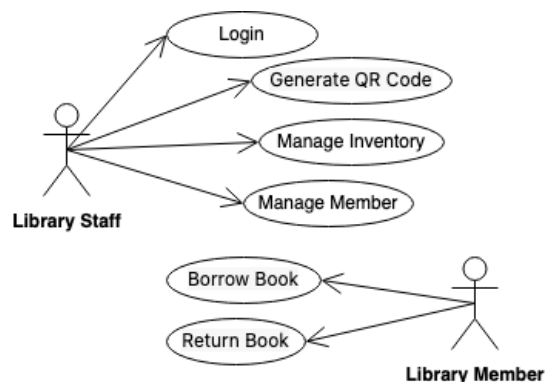


Figure 2. Library Book Lending Information System Use Case Diagram

## RESULTS AND DISCUSSION

The implementation of QR code technology in the library's book lending system resulted in a significant improvement in user experience. The streamlined process of borrowing and returning books through QR code scanning reduced the time and effort required for these tasks. User feedback indicated a high level of satisfaction with the intuitive nature of the QR code system, as it facilitated quick access to book information and availability.

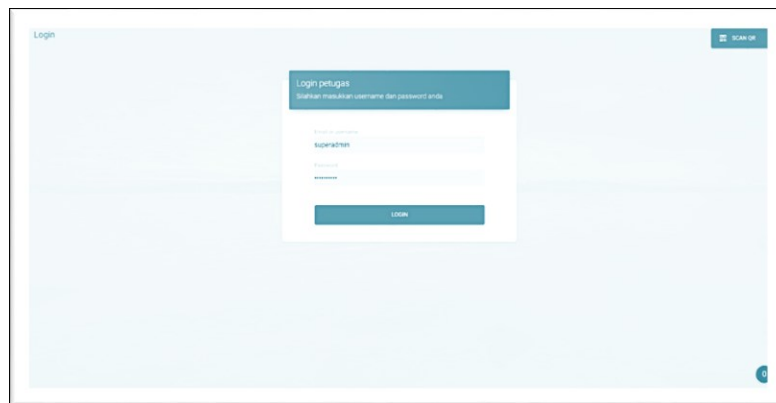


Figure 3. Officer Login Display

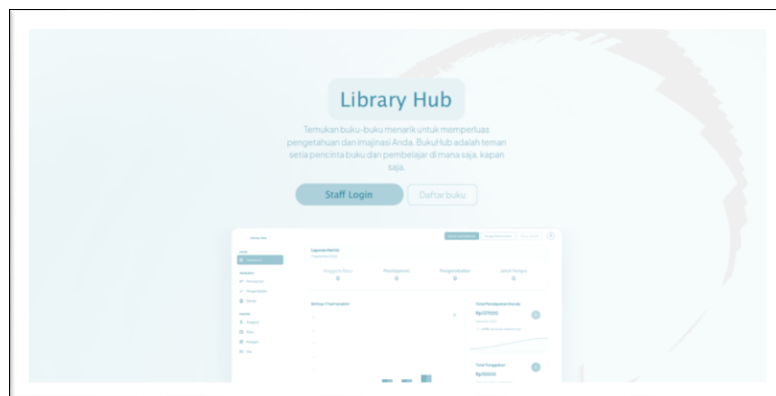


Figure 4. Library Book Lending Information System website interface

The QR code-based system also proved instrumental in enhancing inventory management within the library. The ability to track and manage the circulation of books through QR codes enabled the library staff to efficiently monitor the availability and location of each book in the collection. Moreover, robust security measures were implemented to safeguard user data and ensure the integrity of the library's resources. Encryption protocols and authentication mechanisms were integrated to prevent unauthorized access and protect user privacy.

The adoption of QR code technology led to a notable increase in the overall efficiency of library operations. The reduction in manual processes and paperwork resulted in improved staff productivity and resource allocation. Furthermore, the user-friendly nature of the system attracted a broader user base, including individuals who were previously less inclined to utilize library services. This shift towards a more technologically advanced and accessible library environment holds promising implications for the future of library services, with potential expansions into augmented reality and data analytics for further enhancement.

While the QR code system demonstrated significant benefits, several challenges were encountered during the implementation phase. Issues related to the compatibility of older smartphone models with the QR code reader application were reported, limiting accessibility for certain user demographics. Additionally, concerns regarding the readability of QR codes under poor lighting conditions highlighted the need for improved scanning capabilities or alternative solutions for optimal functionality.

The importance of QR code technology in modern library systems emphasizes its role in improving user experience, simplifying operations, and facilitating efficient information management. Despite the challenges and considerations, emerging trends and future directions point to promising directions for the continued integration and advancement of QR code technology in libraries, paving the way for increased accessibility and innovative library services.

## **CONCLUSION**

By designing a robust Library Book Lending Information System with QR code technology, this research endeavors to revolutionize the conventional library experience, making it more convenient, accessible, and user-friendly. The implementation of this system has the potential to set a new standard for modern library management, ensuring the seamless integration of technology into the core operations of libraries worldwide.

The findings of this research are anticipated to provide valuable insights for libraries looking to adapt to the digital age and elevate their services. By harnessing the power of QR codes, libraries have the potential to not only streamline their operations but also offer an improved and more accessible experience to their visitors.

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