EFFICIENT LIBRARY MANAGEMENT WITH RFID: ENHANCING USER EXPERIENCE AND MAXIMIZING PRODUCTIVITY

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ABSTRACT

Humans rely heavily on libraries. They are necessary for a person to acquire and retain knowledge. Libraries hold hundreds of books and must be handled properly by the librarian alone. As a result, this becomes a time-consuming process requiring a significant amount of manual labour. However, the earlier library management system causes numerous issues. As a result, the solution to these issues is to use Radio Frequency Identification technology to automate the existing manual system. The paper presents a proposal for an efficient library management system using RFID. The primary objective is to utilize radio waves to identify a substantial quantity of tagged books. Efficient library management with RFID allows for quick book transactions while also providing the library with benefits in terms of traceability and security. The database displays the books availability in the library. The switches can be used to find the location of the books, and the LEDs can be used to notify the users about the location of the books. RFID Tags and RFID readers are primarily used to identify books. Using GSM, users will receive information about the books issued and returned. In the event that the student fails to return the book by the return date, a fine will be levied. In the event of unauthorized users, a buzzer will be activated.

Keywords: Library Management, Arduino, LCD, Buzzer, LED, RFID Reader, RFID Tag, GSM.

INTRODUCTION

RFID was developed in 1969 and is now used in a variety of applications. When RFID is used in industries or retail stores, it typically holds the cost of the product. Furthermore, in a grocery store, once goods are issued, they are unlikely to return. This is not the case when used in library, because books are issued and have a time limit within which they must be returned. Depending on the needs of the users, the same book can be taken again and again. In addition, each user is assigned a unique identification code. Users can use the library multiple times, and the reader must read the same tag multiple times. Modern readers are capable of reading up to 15 tags at once. The frequency range is up to 13.5 Hz, and the range is approximately 2 meters.

In educational institutions, libraries play a crucial role, but the current library management systems often rely on manual processes or barcode technology to access books. However, as the number of books increases, these methods become prone to human errors, time-consuming, and efficiency is low. Hence, it is crucial to modernize the current library system and overcome the constraints associated with barcode technology. An effective solution to overcome these challenges is the implementation of RFID (Radio frequency identification) technology. RFID technology combines radio frequency and microchip technology to create a more advanced system. RFID offers significant benefits for library operations. By adopting an RFID system, the library can enhance the efficiency of book collection, management, and distribution processes. It enables accurate tracking of books and simplifies the issue and return procedures. Additionally, a comprehensive database is created to store detailed information about the library's book inventory, making it easily accessible to users. Another advantage of RFID technology is its ability to authenticate registered users, preventing unauthorized access to library resources. To facilitate the return process, the system incorporates a GSM module that sends alert messages to registered users. Furthermore, the RFID system includes a theft detection feature, effectively identifying any instances of theft within the library premises.

The RFID system comprises three essential components: an RFID reader (scanning antenna), a transceiver, and an RFID tag (transponder) that stores programmed information. Data communication between the RFID reader and tag takes place through electromagnetic coupling. As the RFID tag comes in proximity to the scanning antenna, it recognizes the signal, activates the embedded chip, and transmits the relevant information. The proposed RFID system enhances operational efficiency and offers users a wide range of choices and increased flexibility.

LITERATURE SURVEY

In a survey conducted by Akanbi [1] focusing on the use of barcode technology in libraries, it was found that the primary objective of adopting barcode technology is to enhance library processes and offer valuable services to library users. Although barcode technology improves library processes, it often requires more time to execute.

In another study by S. Balakrishnan, P. Hemalatha, and S. Gridharan [2], the authors explored the application of

RFID technology for book tracking and theft detection in libraries. The RFID system offers automation and addresses the limitations of barcode technology, eliminating the need for manual intervention. Additionally, this system enhances library security.

Terence Jerome Daim and Razak Mohd Ali Lee from University of Malaysia [3] enforced an RFID search system in which they bandied the identification of books size, length, and other characteristics. This system employs antennas placed in each book rack to identify the book. Therefore, the paper describes book identification grounded on book size.

In a study conducted by Sree Lakshmi Addepalli and Sree Gowri Addepalli [4], it was noted that radio frequency identification (RFID) technology is rapidly emerging as a means to identify various tagged objects, including books, using radio waves. Their proposed system utilized RFID readers and tags to electronically store and retrieve book data, enabling quick and efficient book transactions for issuing and returning books.

Another study by Bansode, Mhatre, Patil, and Talkar [5] focused on integrating RFID and Internet of Things (IoT) technologies to create a smart library system. Their aim was to address challenges such as slow systems, data loss, and information management difficulties. The proposed system streamlined library operations, providing fast and effective solutions that benefited both staff and scholars

Chethan, Jadhav, Shivani, and Jadhav [6] developed a system that utilized infrared sensors installed in book racks to reduce manual labor and track book positions. The infrared sensors continuously monitored book availability and stored the data in the cloud, enhancing accessibility for library users.

Geetha, Pereumal, Hariharan, and Jayakumar [7] designed an Android smartphone application to facilitate library access. The objective was to provide users with an easy way to access their library accounts using their Android devices. The application allowed users to check book availability and stored the data in the cloud, improving accessibility for library users.

In a separate study, Dinesh, Arun Pravin, Aravindham, and Rajeshwari [8] investigated use of QR codes in academic libraries to engage mobile users and enhance the effectiveness and efficiency of delivering library services. QR codes were found to store more data than traditional barcodes, ensuring reliable and readable information transmission.

Santosh AbajiKharat, [9] Emphasizes several barcode ways and determines whether or not large quantities of data can be encoded into the same dimension. Encoding data into barcodes allows for secure data transmission. This paper investigates the current barcode fashion.

In their research, Pooja, Amita Wankhade, Vivek Shimpi, and Ajit Wale [10] provided an overview on current state and emerging trends of RFID technology. Their research focused on the challenges faced by organizations in implementing RFID, particularly in automating customer service records. The study highlighted the technical and security issues involved in compiling fully automated customer service records.

PROPOSED SYSTEM

The proposed system incorporates biometric (fingerprint) authentication, which streamlines the library entry process, significantly reducing the time required for verification. RFID technology is utilized with RFID tags attached to the books, allowing RFID readers to efficiently read and track them. Switches equipped with LEDs assist in locating books within the library. Additionally, the system utilizes a GSM module to provide users with notifications regarding borrowed books, return due dates, and applicable fines for late returns. To enhance security and prevent theft, the system includes an alerting feature that triggers a buzzer if a student attempts to remove a book without registering it first.

The proposed system aims to achieve the following objectives:

- Verify the identity of registered users through authentication.
- Provide accurate book location information to facilitate easy access.
- Ensure the database is continuously updated to reflect real-time information.
- Implement an alert system to notify users of relevant updates or events.

Methodology for Objective 1:

To accomplish Objective 1, the user is required to register their fingerprint for biometric authentication. Once registered, the user is granted access to the library. RFID tags are assigned to users for book access, and these tags store relevant student information. Upon library entry, the RFID tag is scanned, and if deemed valid, the user is granted access to both the library premises and its extensive collection of books.

Methodology for objective 2

Objective 2 focuses on the student's utilization of the library's database to check the availability of required books. Upon finding the book to be available, the student then navigates to the library and utilizes switches and LEDs to efficiently locate the desired book. Each book is associated with a specific switch and LED, facilitating efficient book retrieval. The switches assist in locating the book, while the LEDs provide visual cues to guide the user towards its location. Once the book is identified, the user can proceed with the book issuing process using RFID tags and readers.

Methodology for objective 3

To address Objective 3, the database must be promptly updated after book issuance and return. The library management team closely monitors these updates. Any relevant information regarding the issue and return of books, including fines generated for late returns, is promptly recorded and updated in the system.

Methodology for objective 4

In order to enhance security and deter theft within the library, an alerting function is incorporated into the system for Objective 4. If a student attempts to remove a book thelibrary without properly registering it, an activated buzzer serves as an immediate alert, deterring potential theft and promoting
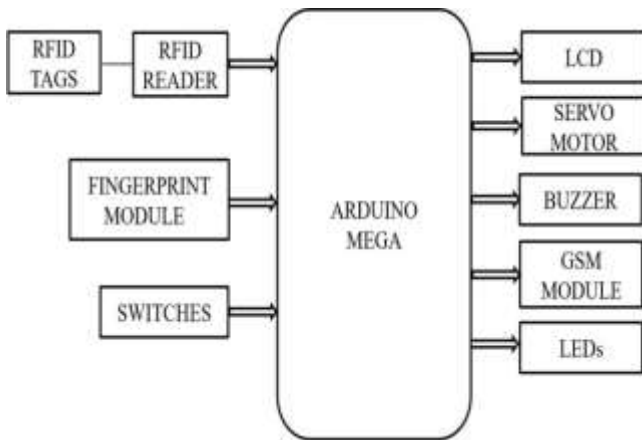
Fig 1: Block diagram of the proposed system

Advantages of the Proposed System
- Easier transaction of books.
- Reduce the work load for the librarian.
- Easier to search location of books.
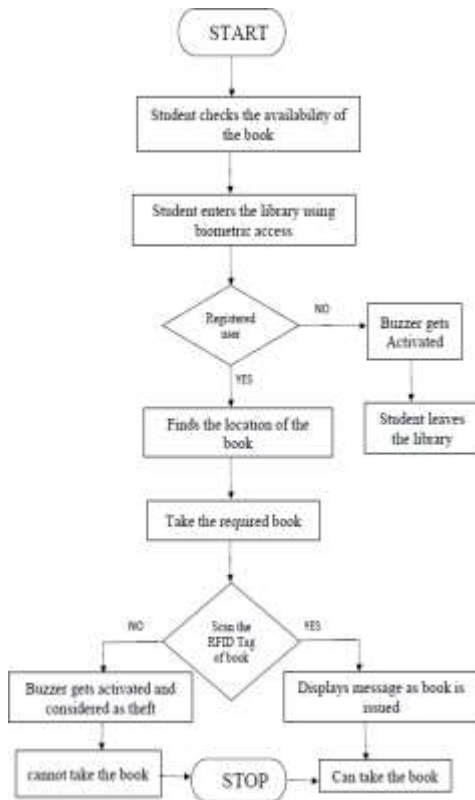- Theft detection is easier.
- Improved Security.

Fig 2: Flowchart of proposed system

The system flow initiates as users check the availability of books in the database prior to entering the library for book access. In the event of unauthorized users, the system activates a buzzer, prompting them to exit the

library. Once users locate the desired book, they proceed to take it and scan the corresponding RFID tag. Successful scanning of the book's RFID tag triggers the display of a message indicating that the book has been issued.
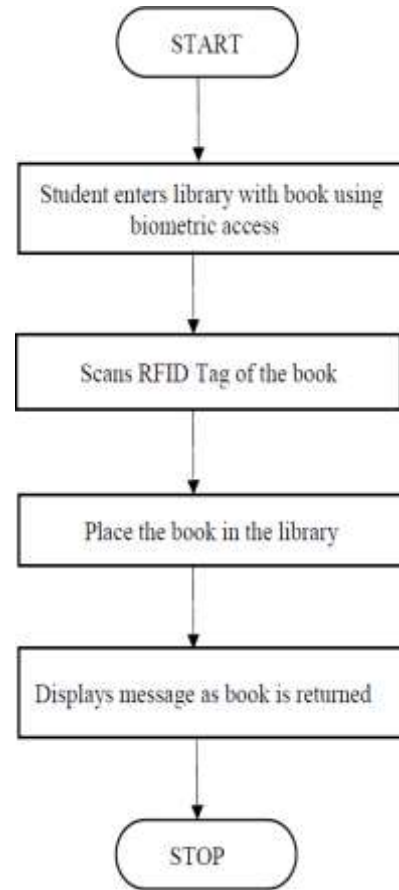

Fig 3: Flowchart of book return process

During the return process, students gain access to the library using biometric authentication and bring the book they wish to return. They then proceed to scan the RFID tag of the book and place it in the designated location within the library. A message confirming the successful return of the book is displayed, indicating the completion of the return process.

RESULTS

As a result, in order to handle books automatically and effectively, libraries must implement a special Radio Frequency identification-based library management system. Using biometric authentication for library access will be more beneficial to users and provide more security. RFID readers and RFID tags are used to efficiently identify and handle books. The location of the books is easily found. The due date will be communicated to users via GSM.

The user enrolling counts starts with zero, after user is enrolled access is granted and indicated with the servo motor rotation. When student id card is scanned student details are displayed on the LCD screen. Book tag is scanned for issues and return and books. GSM sends message to the users registered mobile numbers. Each LED specifies one book in the library.

Fig 4: Hardware setup of RFID library management system

Fig 5: Result of enrolling a student and granting access

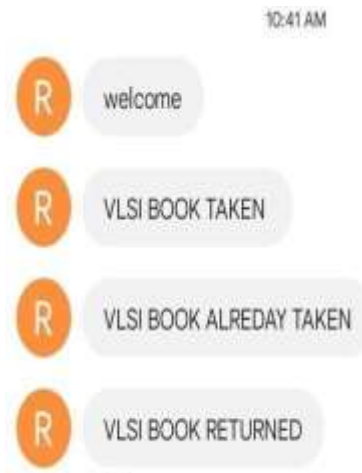**Fig 6: Result of Scanned RFID tags of student and book**

Fig 7: Message through GSM through the users registered number

CONCLUSION

RFID technology continues to advance, offering larger memory capacities and faster processing speeds. It holds immense potential to revolutionize library management processes and enhance efficiency. The proposed RFID-based system is highly efficient, user-friendly, and time-saving, automating various tasks in the library and reduction in the workload of librarians. By implementing RFID in the library, the entire process of book borrowing, monitoring, and locating is accelerated, allowing library staff to focus on providing better customer service. To ensure optimal results, it is crucial to utilize high-quality RFID tags and readers. One of the key advantages of this system is the swift and automatic updating of all activities, including book issuance, renewals, and returns, in the database. The information stored in the RFID tags plays a vital role in maximizing the benefits of this technology. Such applications not only save costs associated with labor but also improve customer service, mitigate book theft, and provide real-time updates on new collections.

FUTURE SCOPE

The future of Radio frequency identification in libraries is primarily dependent on eliminating those drawbacks and focusing more on the benefits associated with it. The rapid evolution of radio frequency identification (RFID) technology has brought about significant advancements, including increased memory capacities, extended reader ranges, and faster processing. The continuous innovation, application, and standardization of RFID technology offer promising possibilities. With RFID tags containing detailed information like book title and material type, there is no longer a need for a separate database. Leveraging the benefits and versatility of RFID, we can effectively enhance the automation and tracking of documents in the library, making it a superior solution. This technology is expected to be adopted in the book publishing industry in the future, which means that the books will be tagged with RFID labels before being shipped to libraries. RFIDs Future in library management will become clearer and more promising as a result of this.

REFERENCES

[1] Akanbi, M.T. Bashorun, Salihu, G.O. Babafemi, K. Sulaiman, and S.O. Kolajo. Application of barcode technology for learning resources. Philosophy and Practice in libraries (e-journal).

[2] "A Study on Smart Library Management System", AJSAT, Vol. 2, Issues 1, January 2018. S. BalaKrishnan, P. Hemalatha, and S. Gridharan.

[3] Terence Jerome Daim and Razak Mohd Ali Lee of the university of Malaysia, Proceedings of the 2010 international institute of electrical and electronics engineers Student Conference, Putrajaya, Malaysia, December 13-14, 2010.

[4] Sree Gowri Addepalli and Sree Lakshmi Addepalli, "Library management system with RFID", IJCSIT, Vol 5 (6), 2014.

[5] Bansode, S. Mhatre, A.N. Patil, and G.C. Talkar, 'smart library Using Near field communication", IJARCET, Vol 5, Issue 5, May 2016.

[6] Chethan J. Jadhav and Shivani, "Smart Library Management System RFID technology", IRJER, Vol 4, Issue 5, May 2017.

[7] B.T. Geetha, V. Pereumal, S. Hariharan, and T. Jayakumar, "A library's smart book access system that uses IR and radio frequency identification technology", IJPAM, Vol 4, Issue 24, May 2018.

[8] R. Dinesh, S.R. Arun Pravin, M. Aravindham, and D. Rajeshwari, "Library Access System Smartphone Application Using Android", IJCSMS, Vol 4, issues1, January 2013.

[9] Quick response (QR) Codes and Academic Libraries: Best Practice's for Reaching Out to Users of the Mobile, Santhosh AbajiKharat, IJLIS, Vol 2, Issue 1, January 2013.

[10] Pooja, Amita Wankhade, Vivek Shimpi, and Ajit Wale, "A check on being barcodes and barcode generation fashion", IJCSIT, Vol 7, Issue 5, July 2016.