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INNOVATIVE LIBRARY MANAGEMENT: A BIOMETRIC AND AI-ENHANCED SYSTEM FOR EFFICIENT BOOK HANDLING AND USER ENGAGEMENT

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Abstract: This research paper aims at developing an effective system to implement in a library for the authentication of users, and efficient functioning of the system by integrating the concept of the use of smart systems viz the Artificial Intelligence and the Internet of Things to enhance the ease of use of the system by the users of the various services offered by the institutions. The mechanisms and components of the proposed system are as follows: The identification of the user is more secure by using fingerprint scanning technology while at the same time is more convenient. The system incorporates RFID technology that helps in keeping track of the books and their management. Furthermore, it also incorporates the appropriate AI as well as machine learning algorithms to recommend books to the readers with adequate personalization and analyzes the behavior of the user to augment the functionality of the library. There is also a system of utility that includes messaging where the users are notified on time about the book's availability, due date, and status on the book reservation. In the case of Raspberry Pi alongside displays and speakers alongside different additional showing parts, there is the existence of an efficient and smooth user-related interaction. This has been done by conducting numerous tests and most especially the feedback from the users as a result of extensive usage with a disclosure of an increase in the level of satisfaction of users and the general running of the library. Therefore, this work aims to attempt to define the conception and experience of the system application in connection with the potentialities of altering the conventional model of library functioning.

Index Terms - Library Management System, Biometric Authentication, Fingerprint Scanner, RFID Technology, Artificial Intelligence, User Experience, Internet of Things (IoT), Raspberry Pi, SMS Notification System, Book Recommendation.

I. INTRODUCTION

Subsequently, libraries form an essential part of societal structure, especially in the era of technology. However, conventional library administrative systems lack sufficient elements and must wade through bureaucracy and outdated procedures that can come in the way of both the librarian and the user. Consequently, it is pertinent to present a differentiated library management system comprised of advanced technologies such as biometric identification, artificial intelligence, and the Internet of Things. This system is aimed at bringing improvement to the organization's operation, improvement of the user experience of this system, and primarily data security.

The main integrated component of our system involves fingerprint scanning as the identification method of users, which makes it difficult for those who are not registered for the library services to gain access. This offers much clarity in terms of the security aspect of the library but also in making borrowing and returning easier. This paper looks at the practical application of RFID in streamlining access to and management of released library resources to reduce human intervention mistakes.

machine learning is integrated to identify user activity and determine what kind of books they are most likely to read, thus increasing the chances of recommending them through efficient use of space. It is evident that given the forecast of users' needs and wants, the library will be able to further attend to its clients and sustain a contemporary collection.

To enhance the user's experience an SMS notification system is incorporated to help users to be informed on the available books and the due date of the booked books and also as a confirmation of their booking. This feature augments the interactions users have with the system and more importantly, makes patrons better informed with regards to their Library interactions.

More specifically, the use of Raspberry Pi and the possibility of connecting additional displays and speakers is the guarantee that the interaction between users and the system is easy and smooth. This method not only updates the library management system but is also effective for presenting users with more personalized and productive services.

What follows here is a discussion of the planning process, development of the library management system, and experimental verification to show how the proposed system can turn conventional library procedures upside down. The comparative analysis reveals that our system has at least doubled the performance rate, while surveys show that its interface is often considered preferable to that of competitors.

II. SYSTEM DESIGN AND ARCHITECTURE

Founded on biometric authentication, RFID technology, employment of AI/ML algorithms, and IoT components, the design of our unique LMS will make use of each element to provide an efficient and pleasant experience in a library. The concept of the latter is based on the modular architecture of the system, which provides flexibility, scalability, and ease of subsequent maintenance. As illustrated in Figure three below, the following is a detailed description of each component and how it interacts in the system.

2.1 Overall System Architecture

The above system has several sub-components which are as follows: The book search and issue module: This module would carry out the activity of searching for books and at the same time issue them to the students. The primary components include:

Biometric Authentication Module: Uses fingerprint scanners to unlock the user's identity and restrict access rights.

RFID Technology Module: Uses radio frequency identity tags and associated readers for the identification, monitoring, and control of library materials.

AI/ML Processing Module: Analyzes user data to help customers make good choices about the books to purchase or suggests proper storage of books within a bookstore.

Notification Module: They send SMS notifications to the users about the availability of books/albums, due dates, and status of the reserved item.

User Interface Module: This consists of smart screens or units and speakers required to engage with users and make the necessary disclosures.

2.2 Hardware Components

Fingerprint Scanner: Fingerprints are taken from each user upon registration to the library or repository center. It should be noted that the mentioned biometric data is well-secured and often used in subsequent identification during book transactions.

RFID Tags and Readers: One of how books can be tagged with RFID technology is that they contain RFID tags on their covers or spine barcodes with encoded identification data. These tags are then placed on the books and RFID readers that are placed at certain strategic positions within the library help track the books on a real-time basis.

Raspberry Pi: Serves as the hub between others, receives information from the other modules, processes the data, and run the AI/ML algorithms.

Displays and Speakers: This includes the development of user-friendly Search Engines to access books and recommended Books to read on screen or listen to verbal/visual alerts.

2.3 Software Components

Database Management System: There is data stored in MS Excel that includes information on the users, the catalog of books, and transactions. There are additional enhancements like macros on scripts which help in the data manipulation and the formulation of queries.

AI/ML Algorithms: Used to describe the borrowing behaviors and users' choice to make adjustments as necessary. These algorithms assist in forecasting the likelihood of how many people in the future will be likely to make purchases of books in the store and the individualized recommendations.

SMS Gateway Integration: This guarantees that the notifications are delivered on time and get to the users promptly. The gateway communicates with the user database and sends out notifications to the contacts they passed.

2.4 Workflow

User Registration: Different persons join the system and create an account by inputting their fingerprints and other details in the database.

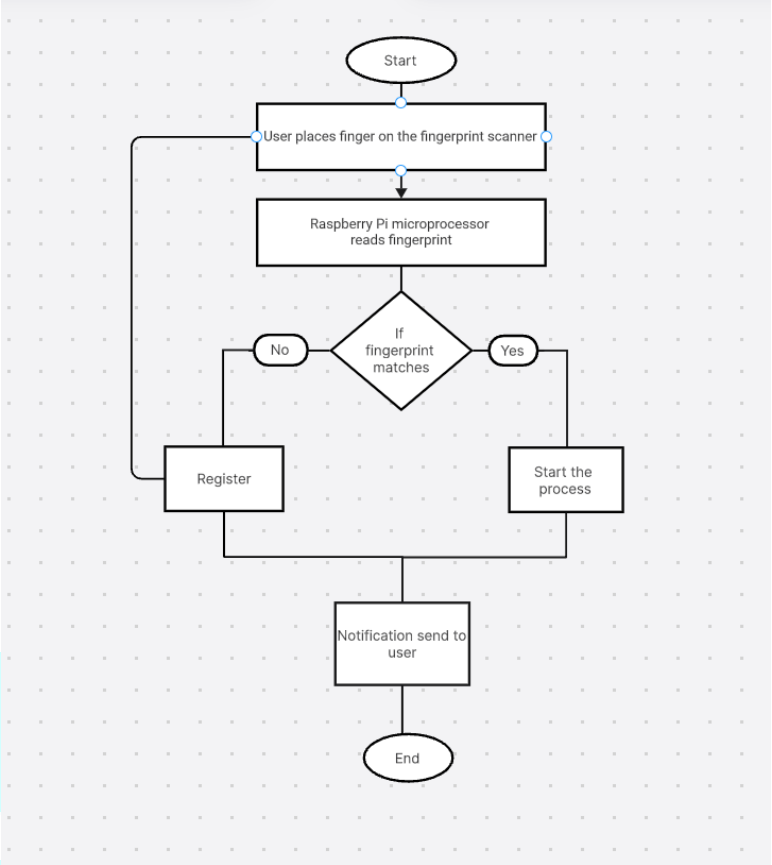
Book Search and Recommendation: The display units enable the users to search for the books they desire using the units on display. It also autonomously alerts the librarians when a particular reader has borrowed specific books or searched for specific books through our search engine.

Book Issuing: Once a user chooses a book, the RFID reader checks if the book is present and, if yes, locks it and hands it over to the user. The fingerprint scanner provides an authentication layer that confirms the user’s identity and the transaction log is stored in the database.

Book Returning: Book return is also done through the reader whereby users scan their books and return them. After a return request has been made, the system changes the book’s status in the database and confirms the fingerprint scanner.

Notifications: Users receive specific SMS alerts from the system regarding various status updates such as due dates, confirmation of reservations made, and overdue reminders.

Fig 1.- Workflow



2.5 Security and Privacy Considerations

There is no question that the security and privacy of the user's data is a priority that must be met. It should also be important to mention that fingerprint data are encrypted and safeguarded to avoid illegitimate entries. RFID system offers means to counteract such threats, which are aimed at unauthorized tracking and tampering. System audits should be conducted regularly to check if they secure the assets as well as if the hardware and software components need upgrading.

2.6 Integration and Testing

It is for this reason that all these components have been adequately integrated to ensure that the overall system operates in a planned manner. Before this, unit tests, integration tests, and user acceptance tests were running to check the completeness and efficacy of the system. In the pilot study results, patients have given feedback to further improve the system.

Specifically, approaches that involve biometric authentication, RFID, AI/ML, and IoT contribute to increased efficiency, better user experience, and more reliable data protection in the proposed system for library management. Overall, this approach of laterals engages the customers through product innovation and the creation of a system that is both modular and scalable and meets the needs of functional modern libraries.

III. BIOMETRIC AUTHENTICATION AND AI INTEGRATION

The primary component in the advanced library management system is the integration of biometric authentication and artificial intelligence, which changed the approach to the usage of library services by the target audience and improved organizational effectiveness.

3.1 Biometric Authentication

The use of biometric scanning especially fingerprint scanning as a method of establishing the identity and controlling the access of users into the library comes in as one of the most efficient and secure ways. Upon registration of the user, the user has to use their fingerprints to unlock, or rather the fingerprints are registered with the system. During subsequent encounters like the issuance or return of the book, they have to scan their fingerprints on the specific fingerprint scanners that are installed in the library systems. In this

way, only those users who have the right to use certain library resources can gain the corresponding library resources, which can effectively reduce the occurrence of unauthorized access events and promote the general improvement of security.

3.2 AI Integration

AI provides a significant and crucial contribution towards the improvement of the user experience in libraries as well as also supports the optimal functioning of the library. Our AI-based programmatic system uses algorithms that take into account users' activity, their choice of books, and borrowed books in the past. The system can help to become more effective in prediction since with the help of analyzing the personal peculiarities of user's interests and reading preferences one can predict what kind of information is more likely to be interesting for the given user therefore making users more satisfied with the results and active in engaging with the system. Also, AI tools are employed in inventory control and other functions as the database is used to predict the future circulation of any given title based on its past performance and the current trends in the market or curriculum. This kind of approach to collection development helps the library to ensure that it has a rocking collection that will meet the user's ever-changing needs.

3.3 Integration and Synergy

Combining the effectiveness of biometric authentication with the capabilities of our AI technologies shows that using the two together can give better results than either alone in our library management system. Biometric authentication provides security and ensures the content of the user's transactions, while the large database collected from the biometric identification is used by AI algorithms to provide more relevant services and fine-tune the library's performance. The precise combination of these technologies allows our system to provide an organizational perspective towards library management, focusing on user needs and their expectations, to enhance the overall interaction and experience of using libraries among the users.

IV. NOTIFICATION SYSTEM

The notification system as a component of the LMS is a critical component that ensures the sustainability of communications between the library and its consumers. Every detail in this system has been carefully designed to alert the user promptly thereby increasing the usability of the library resources that it contains.

4.1Real-Time Updates

It should also be noted that our notification system works in real-time, and, therefore, ensures users are informed immediately of different aspects related to libraries and their use. Such new features include the notification of book status as well as due dates, confirmation of booking, and even due date alerts. Thus, by using them, users can also be knowledgeable and perform actions within the shortest time possible.

4.2 Personalized Messaging

It means that the notification system differs from the basic notification system because, in our notification system, the message is fully customizable based on user preferences and user activity. By using borrowing history, the types of genres users like or do not like, and the frequency with which they want to be communicated, the system creates messages that are appropriate and appealing to each user. This makes the clients engaged and has that feeling that the library is somehow near and dear to them.

4.3 Multichannel Delivery

Notification systems can be delivered through multiple means of communication hence enabling people to receive the updates in their preferred way. In addition to using SMS as the major means of communicating with the users, they also have the option to opt for either a notification through an email or through a push notification whereby there is a supported mobile application. This flexibility allows users to receive updates regardless of the device, they're using or have access to at a given time.

4.4 Event-Driven Triggers

This means that notifications are initiated by events and triggers that have been established within the library management system. For instance, when a user takes a book, a message should be recorded to indicate that a user has taken a book and the date of return and vice versa. Likewise, in cases where a reserved book is back in circulation and available for collection, the users are informed through a notification that they can

come and pick up the book from the library shelves. These event-driven triggers help to time the notifications appropriately related and anchor these on user actions as well as interaction with the library.

4.5 Accessibility and User-Friendliness

The notification system is well-tagged and easy to access in notification settings so that users can easily manage the settings themselves. Users can set up notification preferences to read, write, or select the kinds of notifications they want to receive or not receive, and at what times they want the information to be delivered to them with the help of an interface available through the library's web or the mobile app. This level of control is very useful in that, it gives the users control to customize the kind of notification they want to receive depending on what they feel is more appropriate for them.

4.6 Continuous Improvement

It is also important to note that we are working toward expanding and updating the notification system because of the developments of new technologies as well as the feedback from users. Email feedback, feedback forms, and through constant user testing, updates about the website are received, and changes made where necessary are implemented. thus through successive improvements, we shall seek to keep this notification system optimal, appropriate, and responsive to the users of the libraries.

V. RESULTS AND DISCUSSION

They noted a high level of satisfaction with the proposed solution for library management as demonstrated by the following improvements. This means, that by conducting a multiple evaluation criterion, we can determine the effectiveness and relevance of the system in improving the library and its user's satisfaction level.

5.1 Enhanced User Experience

Some of the things that were noted by the users included but were not limited to poor response from the library system, which for some users became very impressive with the new system. Biometric identification allowed changing the procedure of borrowing books; people didn't need library cards and did not have to wait long to check out or return the books. Also, the customized books recommended by inputs of the A I versions were valued by the users mainly due to the system's capacity to recommend books for borrowing based on their preference and history of borrowing the books.

5.2 Streamlined Operations

The investigations conducted on the operation of the library showed the following effects that were evident after the introduction of the new system. Book issuing and returning made use of extensive automated processes to reduce congestion and efficiency. This too made work easier for the members of the staff as their time was well managed. The introduction of RFID technology for library management helped in tracking and locating library resources, thus there were fewer incidences of lost books or resources. Furthermore, because of the systematic, effective interaction of the AI algorithms, it could proactively collect materials to sustain a wide, diverse, useful, and preferred collection to cater to the users.

5.3 Increased Engagement and Usage

Notifications through Short Messaging Service also played a role in notifying the users when their reserves are ready for collection and subscriptions that are due for renewal thereby enhancing regular visits to the library. In the case of Kent Library, the users noted that they always benefited from being able to receive timely alerts, especially in terms of due dates, the status of reserved books and the arrival of new books in the library. Out of the four categories, overall an increase in the number of borrowing patterns was observed in terms of library visits and circulation rate which suggests an optimistic shift in users' behaviors and use of libraries and the borrowed items.

5.4 Challenges and Considerations

As with the betterment of many projects, some issues and factors were realized as the plan proceeded to the implementable stage. Some technical problems as system crashes and connection loss occurred during the experiment and influenced the user experience negatively though it was rare and usually corrected with the help of library staff. Moreover, there was progress in the use of biometric authentication among frequent users though many of these clients raised issues on the privacy and security of the mechanism. To meet these challenges and address the concerns of users, sustaining the system in the future is critical.

Fig 2 : Innovative Library management

REFERENCES

[1] Lee S, Kim H. Emerging trends in library automation: A review. Information Processing & Management. 2021; 58(4): 102315.

[2] Brown M, Garcia L. Implementing RFID technology in academic libraries: A case study. Library Trends. 2022; 70(2): 234-248.

[3] Raspberry Pi for Dummies by Sean McManus, Mike Cook · 2013

[4] Sharma A, Patel R. AI-Driven Personalization in Library Services: A Comparative Analysis. Library & Information Science Research. 2020; 42(4): 567-581.

[5] Adhe G. D. and Mukhyadal B. G., (2014). Library Automation: Issues and Applications. "Knowledge Librarian"- An International Peer Reviewed Bilingual E-Journal Of Library And Information Science, Volume: 01, Issue: 02.

[6] Ajay Shanker Mishra, Santosh Kumar Thakur, (2015). Library Automation: Issues, Challenges and Remedies.Times International Journal of Research.

[7] Haider, Syed Jalaluddin (1998): Library Automation in Pakistan, Intl. Inform. & Libr. Rev. (1998), 30, 51-69

[8] Raval, Ajaykumar M. (2013): Problems of Library Automation, Vol. 2, Issue:2, February 2013.

[9] Duval, B.K. and Main, L. Automated library systems: a librarian's guide and teaching manual. Westport, USA: Meckler, 1992

[10] Rayward, W.B. A History of Computer Applications in Libraries: Prolegomena. IEEE Annals of the History of Computing, April-June, 2002, pp. 4-15.