SMART LIBRARY MANAGEMENT SYSTEM

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Abstract—**The Smart Library Management System implements RFID technology along with QR code scanning to automate book transactions for issuing and returning. Students get identified through RFID-enabled ID cards and books receive tracking through QR codes. The microcontroller unit (ESP32) controls the system through Wi-Fi communication links to a central server. Students perform QR code scanning through the web app which manages transactions while showing them their issued book status along with return dates. A system that uses RFID technology and QR code scanning enables library operations to become faster while also achieving higher accuracy across all management tasks.**

Keywords— **ESP32, I2C, RFID, QR, Wi-FI, 16X2 LCD display.**

I. INTRODUCTION

Modern libraries need both efficiency and improved usability to keep up with the current fast speed of the world. The traditional student record management systems operate at a slower speed and display frequent mistake occurrences. Our Smart Library Management System uses contemporary technology to solve such operational issues.

The system implements automated book transactions for students and staff members to receive improved service at the library. The system uses RFID technology together with QR codes to improve book management through faster and more precise operations. RFID technology enables students to have ID cards with easy scanning capability for quick identification purposes. Librarians have applied QR codes to each book so users can perform scans to retrieve book-related information.

The system becomes more accessible through the creation of our user-friendly mobile Android application. Students can easily view their book records through the mobile application which presents both issued books and their due dates alongside alerting them about late returns. The app integrates perfectly with RFID and QR code technology to deliver an effortless utilization experience to users.

II. LITERATURE REVIEW

The study [1] aimed to minimize labor work by using IR sensors which track book locations across each rack. An IR sensor monitors the presence of books in racks to maintain information storage in the cloud. This system provides users with simple book accessibility features.

A library access system through a smartphone application for android devices was presented in the published paper [2]. The system implements an easy-to-use library account access method for android devices. Through its system users can verify which books are presently available in their library while simultaneously minimizing their time requirements. The system creates a database to save stored data.

The article [3] demonstrates how RFID technology tracks books and detects thefts. This solution implements automation which lets processes run independently from

human involvement to remove the limitations of bar code technology.

The authors in [4] conducted research about developing a smart library system based on IOT technology. A solution aims to address library transaction challenges through combining RFID and IOT technologies to overcome slow systems and information data loss and regular update challenges. The system controls the complete library data while delivering benefits to staff members and students.

Academic libraries serve mobile students through QR codes in a paper that demonstrates effective user reach and future service delivery potential for the new student generation [5]. The system has higher storage capacity than regular bar codes do.

III. MODULES AND THEIR FUNCTIONALITIES:

1. RFID Module:
- The RFID module uses student IDs which are read with RFID cards.
- The RFID system conveys the student's individual identification to the server for authentication purposes.

QR Code Module:
- Scans QR codes on books.
- The system retrieves data about books before it transmits this information to the server in order to update issue/return.

Web Application Module:
- The system enables students and personnel to access real time information about books and all book-related transactions.
- Users access the interface to monitor and handle books after they have been either returned or issued through the system.

Server Module:
- This module operates as the prime processing component that receives data from both RFID and QR code devices and the mobile application through the server.
- The mobile application and database exchange information through this system.
- Processes book issue/return operations.

Database Module:
- The database stores information about students and books together with transaction data.
- The system performs automatic real-time database updates for both student records and transaction logs and book availability status changes.

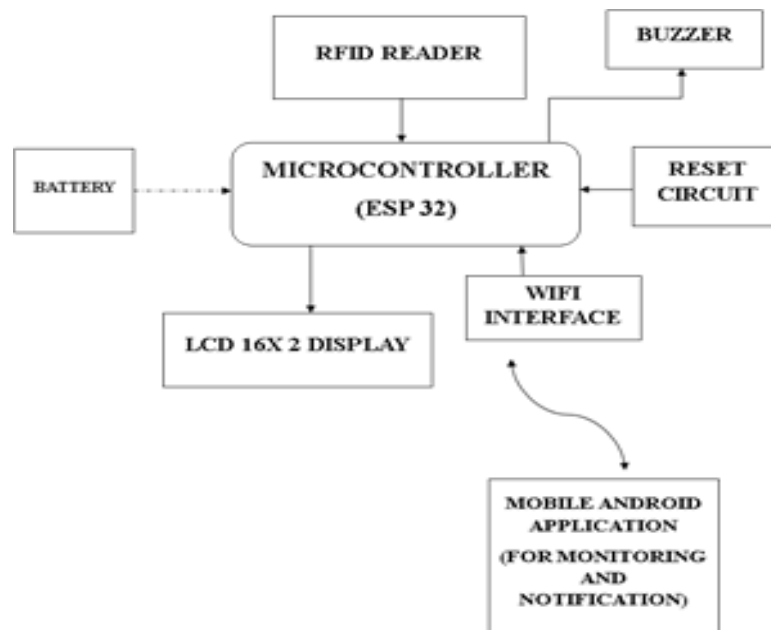### IV. BLOCK DIAGRAM AND DATA AQUSITION DIAGRAM:

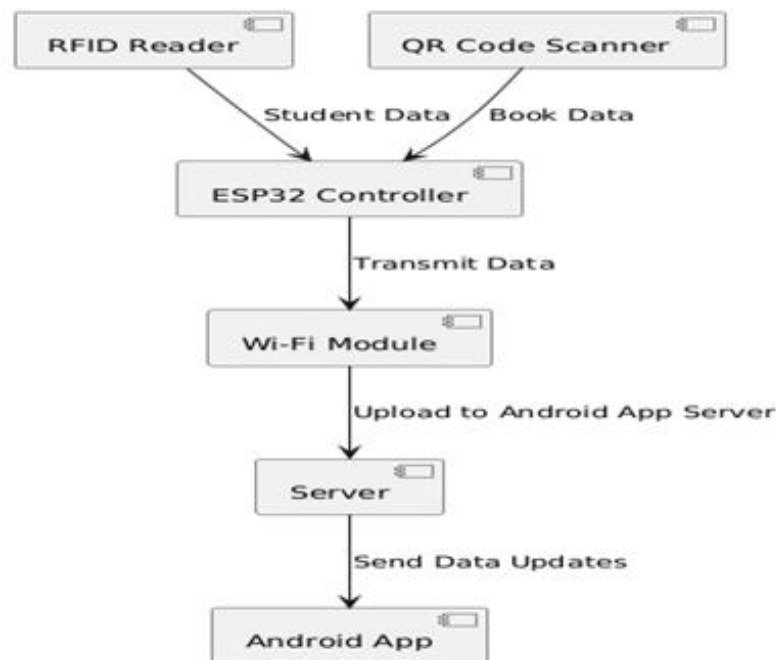Fig. a) Shows block diagram of our system

Fig. b) Shows data acquisition diagram

V.   SOFTWARE REQUIREMENT SPECIFICATION:

The project needs an Arduino IDE software to program the ESP32 microcontroller alongside Streamlit software to develop the web application through C/C++ programming for the microcontroller alongside Python for the web interface. The field operational components consist of ESP32, RFID module, tags, scanner, LCD, power supply, PCB, Wi-Fi and laptop as well as USB wire and I2C communication.

The system needs to have three main functionalities including student registration and RFID-based identification for book transactions and book details retrieval through QR code scanning.

The system needs to support both book borrowing and returning through its interface which will update availability records and modify due dates. The web application gives students tools to track and interact with their checked-out materials through features that deliver alert messages.

VI.   PROPOSED METHODOLOGY:

The process starts by enabling student users to register while RFID cards connect their database profiles to their accounts. Book registrations include QR codes that contain fundamental information points.

The student starts book issuing by scanning their RFID card followed by scanning the QR code on the book to update the system-recorded status.

User transactions will show immediate feedback on the LCD display which verifies the outcome of their interactions. Students need to perform the same RFID and QR code scanning procedure for book returns which modifies the database entry of the book's availability status.

Through the mobile app students automatically receive notification alerts about upcoming due dates as well as books that become late.
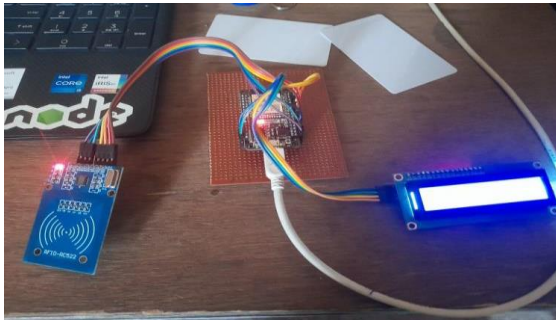
Through their web-based admin dashboard library staff members can perform three main actions including registering new books as well as managing student accounts and checking transaction records.

Error handling within this system maintains system performance since data storage temporarily occurs when the Wi-Fi connection fails until connection restoration.

Through its convergence of RFID and QR code systems the solution establishes an efficient student-staff library process that delivers instant notifications and real-time updates.

VII.   RESULT ANALYSIS:

- Following fig. shows actual circuit implementation of our system (Hardware):
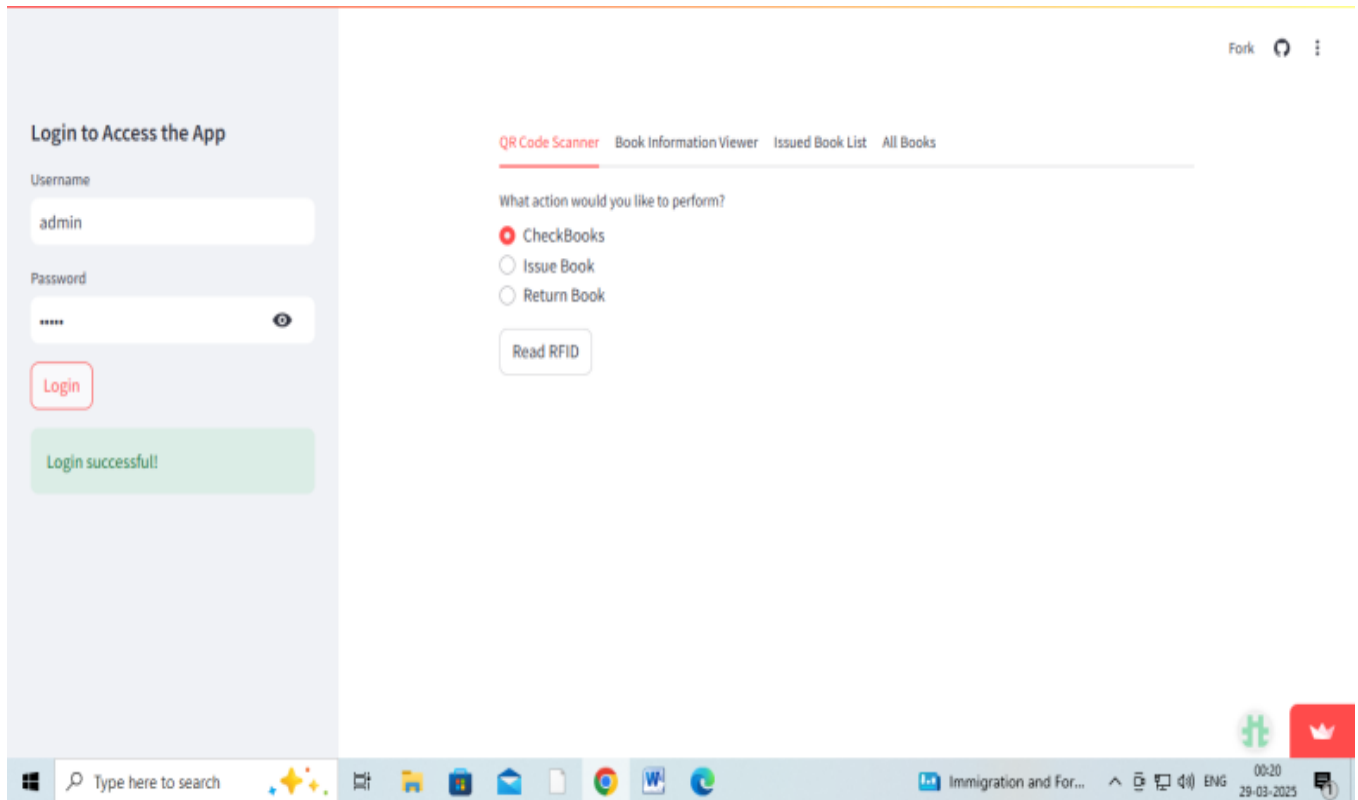
VIII. SNAPSHOTS OF OUR WEBSITE:

Fig. a) Login page

Fig. b) Fetch all books
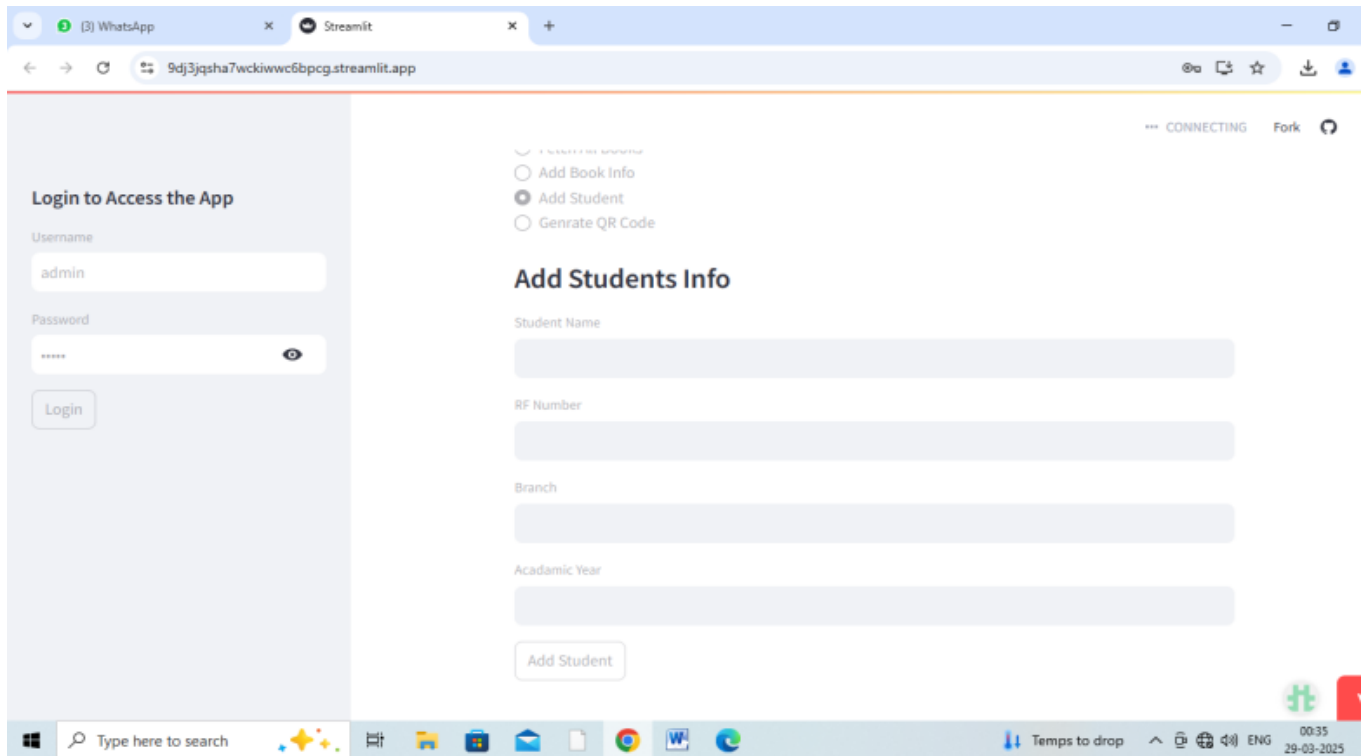

Fig. c) Add book information
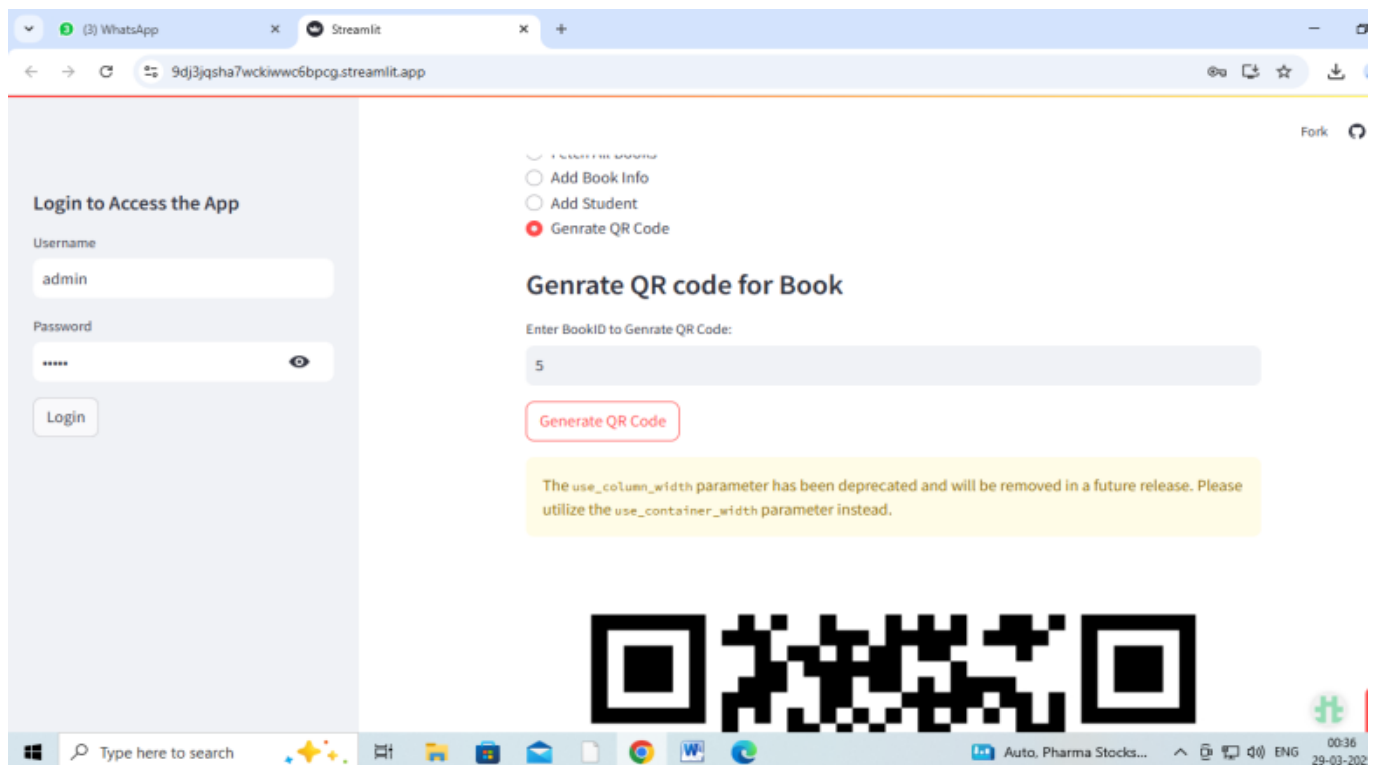
Fig. d) Add student information

Fig. e) Generation of QR code

IX. CONCLUSION:

The smart library management system implements two modern innovations in RFID technology and QR codes to streamline library procedures the system accelerates both borrowing and returning processes and it decreases staffing requirements for manual tasks the system enhances user experience since students and staff can examine their book status through a mobile application the project delivers a smarter organized library environment through real-time updates and secure data handling which assists administrators and users to handle their tasks with ease.

X. REFERENCES:

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