

Automating Library Management with RFID and GSM-Based Alerting

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ABSTRACT: Traditional library management systems rely on manual or barcode-based methods, which are time-consuming and prone to human errors. This paper presents a low-cost automated library management system using Radio Frequency Identification (RFID) technology integrated with a GSM-based alert mechanism. The system utilizes RFID tags for user and book identification, while an Arduino Uno microcontroller controls the overall operation. A 16x2 LCD is used to display real-time system status, and PLX-DAQ is employed to log transaction data directly into Microsoft Excel for monitoring and record maintenance. Additionally, a SIM900A GSM module is used to send SMS notifications for book issue, return, and overdue alerts. The proposed system reduces manual intervention, improves transaction accuracy, and ensures efficient library operations. The developed prototype demonstrates reliable performance and is suitable for implementation in academic libraries.

Keywords: RFID, Arduino UNO, Library Automation, GSM, SIM900A, PLX-DAQ, MFRC522, LCD 16x2

I. INTRODUCTION

Radio Frequency Identification (RFID) is an automated technique for identifying, tracking, and managing objects using radio waves. In library environments, RFID improves circulation operations such as book issue/return, inventory tracking, and anti-theft measures. RFID-enabled automated libraries can function as self-service stations requiring minimal assistance from librarians. By adopting RFID-based check-in and check-out systems, operational delays reduce significantly, improving user satisfaction and overall efficiency.



Fig.1. RFID Technology Implementation

II. OBJECTIVE

The primary objective of this project is to design and implement a smart library management system using RFID technology and embedded controllers to streamline routine library processes. The system focuses on (i) automating book issue and return operations, (ii) minimizing human errors, (iii) providing real-time user feedback via LCD display, (iv) enabling secure and reliable transactions, and (v) improving overall operational efficiency with alerts and structured record keeping.

III. EXISTING SYSTEM

Traditional library management relies on manual registers or barcode-based methods for recording issue/return transactions. Users must depend on staff for availability checks and transaction updates. This approach can lead to misplaced books, delays in processing, and higher probability of human error. Overdue tracking and fine management also require manual effort, affecting efficiency.

IV. PROPOSED SYSTEM

The proposed automated library management system integrates RFID, PLX-DAQ, and a SIM900A GSM module for efficient book transactions. Users borrow or return books by scanning RFID-tagged user cards and book tags. The Arduino UNO verifies the inputs, updates the transaction status, and displays real-time messages on a 16x2 LCD. PLX-DAQ logs the transaction details directly into MS Excel for on-premise record storage. The GSM module sends SMS notifications for successful transactions and overdue reminders, thereby enhancing security and compliance.

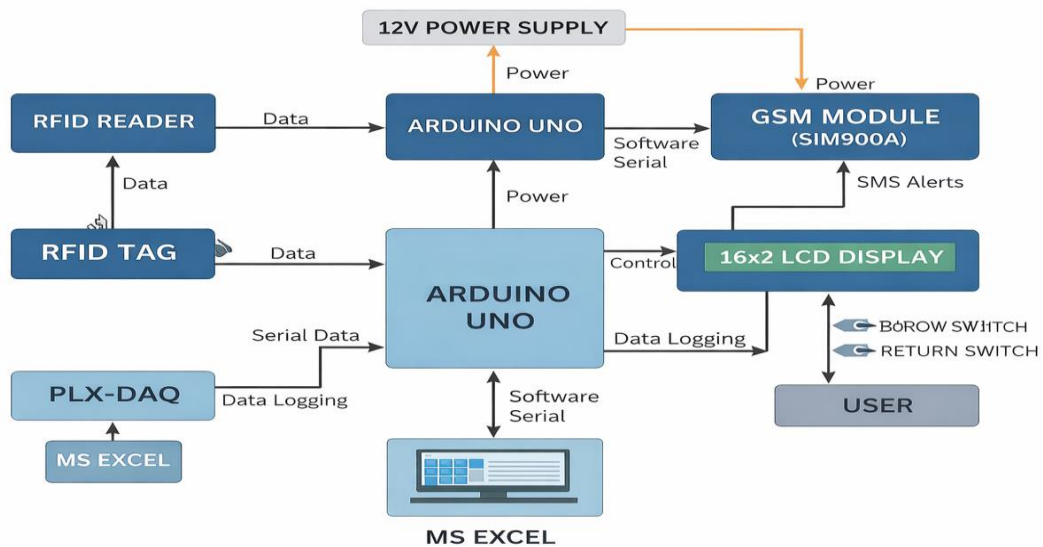


Fig. 2. Block Diagram of Proposed RFID-Based Library Management System

The block diagram illustrates the overall architecture of the proposed system. The RFID reader scans user and book tags, and the Arduino Uno processes the data. The GSM module sends SMS alerts, while the LCD displays system status. PLX-DAQ is used for real-time data logging into Microsoft Excel.

Implementation Details

The RC522 RFID module is interfaced with the Arduino Uno through the SPI interface, where the slave select and reset lines are connected to digital pins 10 and 9 respectively. The SIM900A GSM module is connected using software serial communication on digital pins 6 and 7. Two tactile switches used for borrow and return operations are connected to digital pins 2 and 3. A 16x2 LCD module is employed to display transaction and system status messages to the user.

System Workflow

- 1) User scans RFID ID card.
- 2) Book tag is scanned.
- 3) System validates authorization and transaction rules.
- 4) Issue/Return status is updated.
- 5) Records are logged to Excel using PLX-DAQ.

6) SMS alerts are sent for successful transactions and overdue reminders.

V. SYSTEM DESCRIPTION AND METHODOLOGY

The proposed automated library management system is implemented using an Arduino Uno controller, MFRC522 RFID reader, 16×2 I2C LCD display, SIM900A GSM module and PLX-DAQ based data logging. The system operates by first scanning the user RFID card followed by scanning the book RFID tag. Based on the selected operation using the borrow or return switch, the controller verifies the user authorization and the book status.

The MFRC522 RFID reader is interfaced with the Arduino through the SPI interface, where the slave select and reset pins are connected to digital pins 10 and 9 respectively. The GSM module is interfaced using software serial communication on digital pins 6 and 7 to transmit SMS notifications. The borrow and return switches are connected to digital pins 2 and 3, and the LCD module is connected through the I²C interface for displaying system messages.

After successful verification, the transaction details such as user ID, book ID, action type and time are transmitted through the serial interface to the PLX-DAQ tool, which logs the data automatically into a Microsoft Excel sheet. In case of unauthorized access or overdue conditions, the system generates alert messages and sends SMS notifications to the respective user or librarian.

This step-by-step procedure ensures reliable identification, automated transaction handling, real-time data logging and secure monitoring of library activities.

VI. HARDWARE IMPLEMENTATION

The hardware includes Arduino UNO as the control unit, MFRC522 RFID reader and tags/cards for identification, a 16×2 LCD for status display, tactile switch for operation control, and SIM900A GSM module for SMS communication. The design supports low-cost implementation and is scalable for institutional library environments.

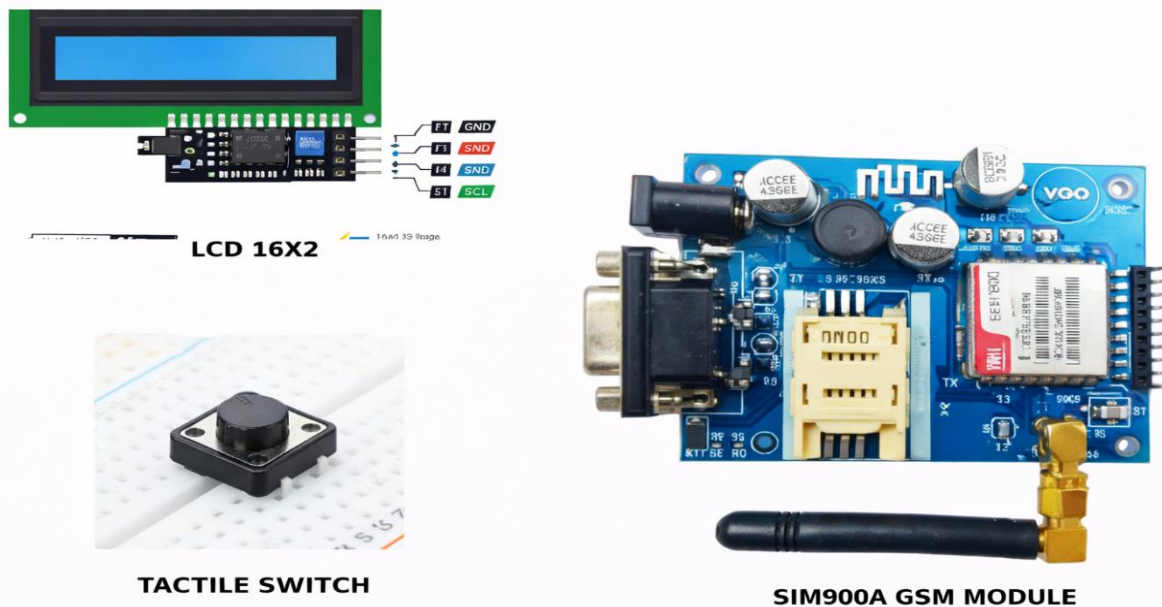


Fig. 3. Components

VII. RESULTS AND DISCUSSION

The prototype was tested using multiple user cards and book tags. The system performed quick RFID identification and transaction logging. Real-time Excel logging was successfully obtained using PLX-DAQ, and SMS notifications were received for transaction confirmation and reminders. The overall system reduces manual workload and improves transaction accuracy.

Practical issues and challenges

During real-time implementation, practical issues such as occasional RFID tag detection failures, LCD communication address mismatch, GSM network availability problems and PLX-DAQ data logging errors were observed. These issues were resolved by verifying wiring connections, confirming correct I²C addressing, matching serial baud rate settings and validating GSM AT command responses. After these corrections, the system operated reliably under repeated testing conditions.

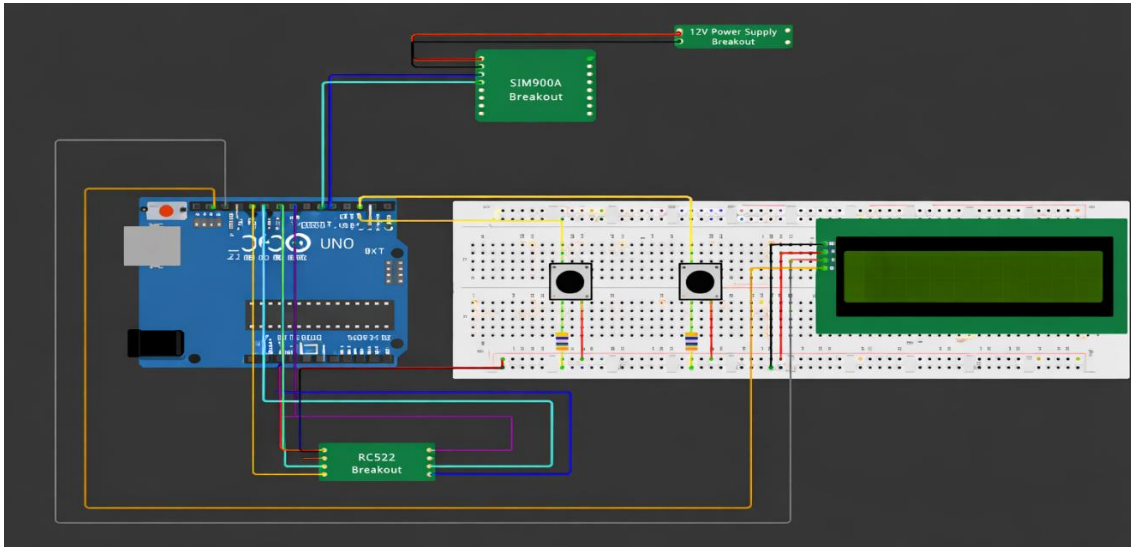


Fig. 4. Wokwi-Software realization

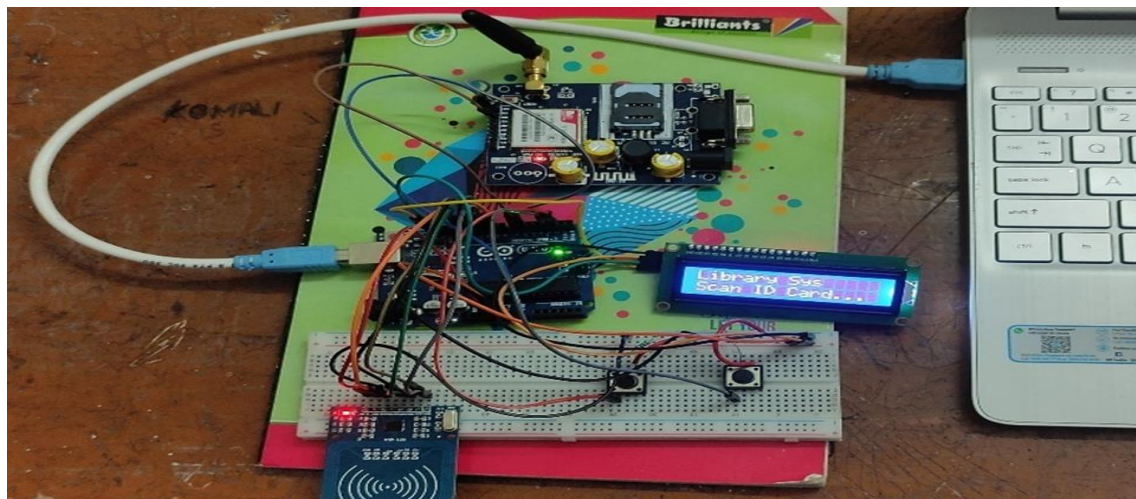


Fig. 5. Working prototype

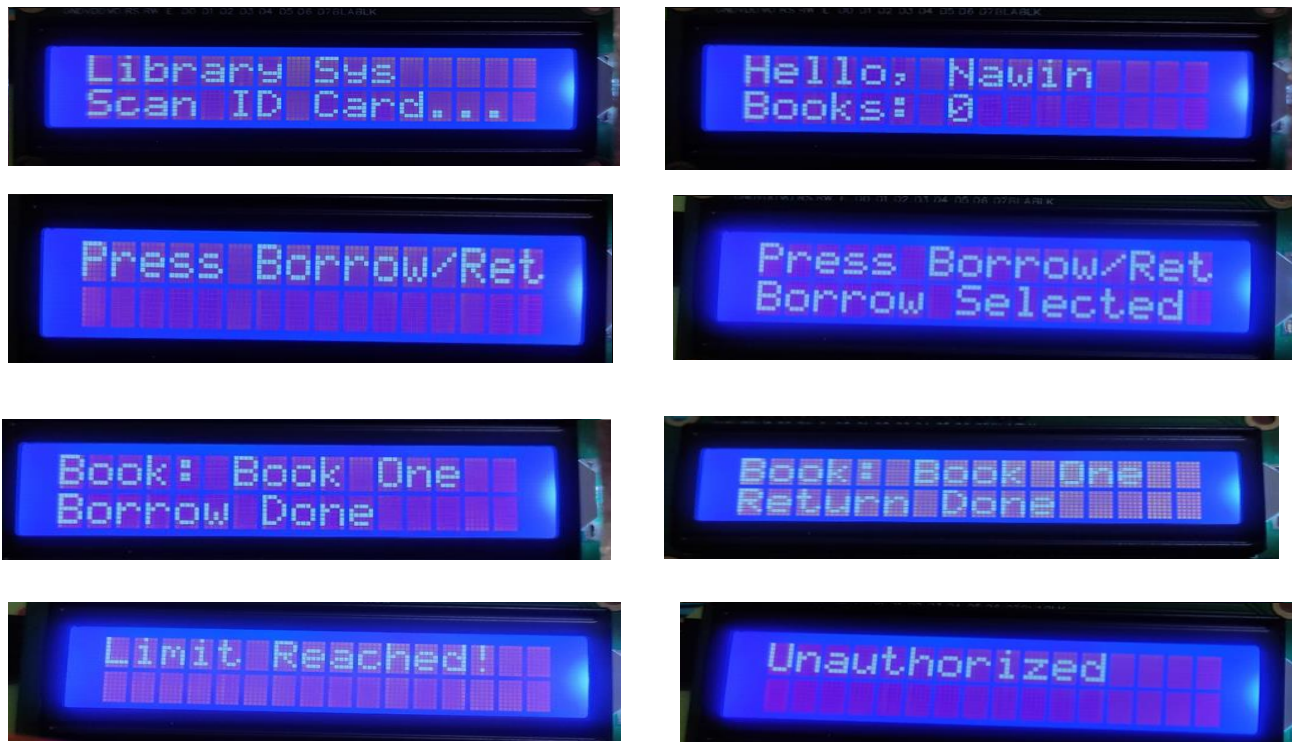


Fig.6. Outputs of LCD While Working

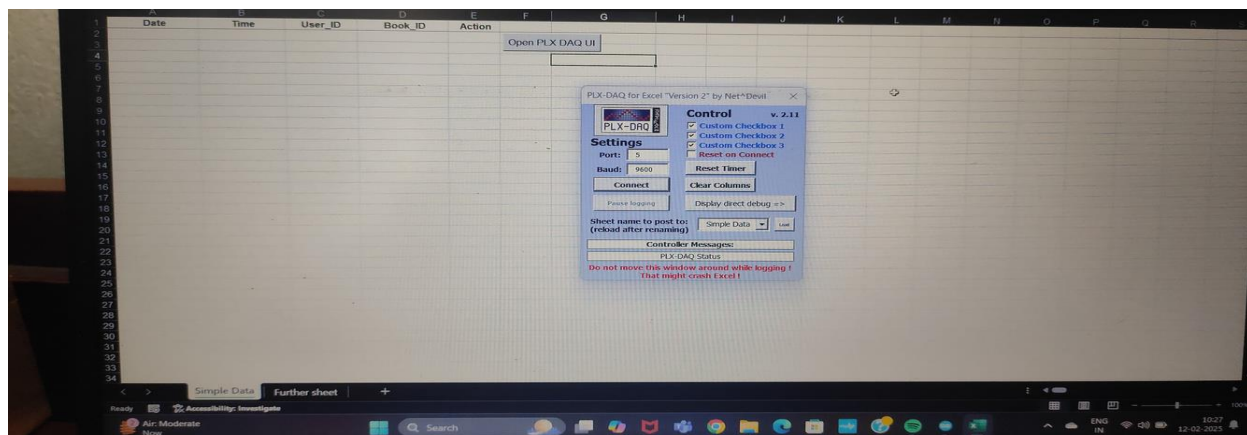


Fig. 7. PLX-DAQ interface

A	B	C	D	E
Date	Time	User_Name	Book_Name	Action
13-03-2025	10:36:05 AM	Nawin	Book One	Borrow
13-03-2025	10:36:22 AM	Nawin	Book One	Return

Fig .8. Logging Of Data in PLX-DAQ

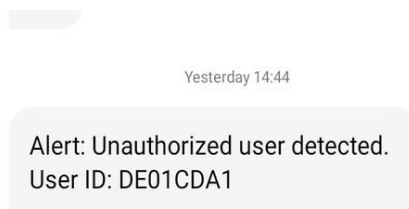
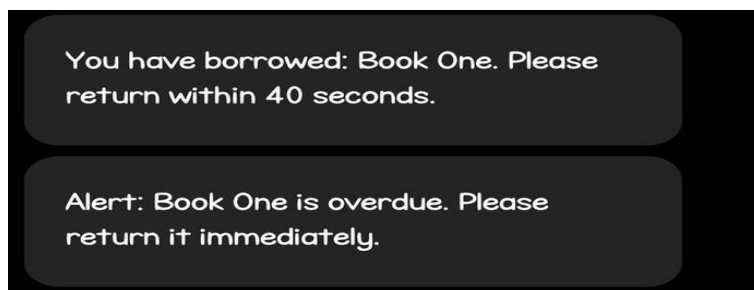


Fig .9. Alert messages from SIM900A

Advantages of the proposed system

The proposed RFID-based library management system reduces manual intervention, improves transaction accuracy and enables faster book issue and return operations. Automatic record logging using PLX-DAQ simplifies data management, while GSM-based alerts enhance security and help in monitoring overdue and unauthorized activities.

VIII. CONCLUSION

This paper presented an RFID-based library management automation system integrating GSM alerts and PLX-DAQ based data logging. The prototype demonstrates faster processing, reduced errors, and improved monitoring of library activities. The approach enhances user experience and can be extended further for advanced smart-library applications.

IX. FUTURE SCOPE

Future enhancements include cloud-based database integration, web/mobile interfaces for students to check availability and due dates, improved security using additional authentication, and integration with IoT dashboards for centralized monitoring.

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