Implementation of Internet of Things (IoT) Library System in Nigerian Universities

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ABSTRACT
Traditional University libraries are facing growing pressure to adapt to the evolving needs of students and researchers. These library systems have limitations in book borrowing, return efficiency, book tracking accuracy, inventory management and user experience. This paper implemented an internet of Things (IoT) library system by integrating RFID technology into the university library system, enabling automated book borrowing and return processes, book tracking and book inventory management. Reviews were gathered from students and staff to determine the system's ease of use, efficiency, impact, and convenience. 92% of respondents reported reduced borrowing times and found the process quicker and more convenient than the traditional system. Additionally, 88% acknowledged self-service user interface functionality and ease of use. Some selected library staff indicated improved book inventory accuracy and operational efficiency.

Keywords
Internet of things (IOTs), Radio Frequency Identification, Internet of Things (IoT), Library System, RFID Technology, Book Borrowing, Book Return Processes, Book Tracking, Inventory Management, Self-Service User Interface, RFID Integration, Student Feedback, Staff Feedback.

1. INTRODUCTION
The modern digital age has made it essential for efficiency and better services across a range of industries to integrate technology. Education is one industry that stands to gain a great deal from technology improvements, especially in university libraries. Universities in Nigeria confront many issues when it comes to their libraries, such as obsolete infrastructure, ineffective resource management, and subpar user experience. Using Internet of Things (IoT) technology in library systems offers a possible way to overcome these problems. This paper used the Federal University of Technology, Akure (FUTA) as a case study to build and deploy an Internet of Things (IoT) library system, which can be tailored to all Nigerian universities. The integration of technology into library systems has revolutionized how information is accessed, managed, and utilized. In recent years, the Internet of Things (IoT) has emerged as a transformative force in this domain, offering libraries the potential to enhance efficiency, personalize services, and improve user experiences [1]. As societal advancements unfold, there is a burgeoning increase in the quantity of books. Concurrently, as individuals' ideological consciousness advances, there is a notable rise in the borrowing rates of books [2]. Like many other universities throughout the world, Nigerian universities have witnessed an increase in student enrollment and research activity in recent years. Traditional library systems, which use features like manual cataloging and indexing, manual check-in, and check-out features, may find it difficult to effectively manage resources, deliver timely information, and adjust to the changing needs of contemporary researchers and students as a result of this increase. The majority of Nigerian colleges' present library systems frequently struggle with problems like poor resource management, manual book tracking, and restricted accessibility. The use of technology, particularly the Internet of Things, has completely changed a number of industries, including education. IoT has the potential to develop a smart, networked system for library administration that will facilitate resource tracking, increase user experience, and supply real-time data for well-informed decision-making [3]. The goal of this paper is to use IoT to solve the problems that Nigerian university libraries have been facing. In the past few years, there has been an increasing amount of focus on radio frequency identification technology, or RFID for short. This technology is essential to creating the "Internet of things". RFID technology is rapidly developing, which is essential to promoting its application in numerous domains and building the ubiquitous networking. RFID technology has significant application potential in many industries [4]. Radio frequency identification systems, or RFIDs, are automatic technologies that use radio waves to help computers or other devices identify things, capture metadata, or control specific targets [5]. While there are various ways to implement Internet of Things solutions, Radio Frequency Identification (RFID) technology is a crucial element of the Internet of Things that has applications in library systems. When used in conjunction with RFID readers and sensors, book tags allow for automated inventory management, smooth check-in and check-out procedures, and book tracking. This improves the overall user experience while also saving time for library workers. These days, libraries are growing in size and holding an increasing number of volumes. In addition, the situation of misplaced books is becoming more widespread as open-shelf reading gains popularity. It is therefore getting harder for readers to find books and for library administrators to check books. The most popular system currently in use, nevertheless, is the barcode-based library management system, whose workings are extremely intricate. Additionally, the bar code is fragile and has a limited lifespan, which has a negative impact on how effectively libraries are managed [6]. As one of Nigeria's top technological universities, Federal University of Technology Akure, Nigeria (FUTA) offers a perfect case study for the deployment of an IoT library system. FUTA is an excellent example of one of the Nigerian universities that have difficulties in managing their libraries because of its wide range of academic offerings, intense research activity, and large student population.

2. RELATED WORKS
Adekola & Adedoyin [7] designed and constructed a IoT based Library Management System that utilizes RFID technology, a

web-based application to search and locate books on the rows of a library shelf, making it, a smart shelf. The research utilized RFID tags, which are embedded in the books on the shelf. Each tag carries a unique Identifier (ID) which is unchangeable, and is mapped to the book on which it is embedded by; Book Title, International Standard Book Number, Book Number, and Author. There are LEDs attached to each row of the shelf for indication purposes. There is a web application interfaced with the system which is made possible by the use of Node MCU, which is an open-source software/hardware environment that allows the connection of different electronic objects and allows data to flow through them. Whenever a book is required to be located, the user can access the app, and through the app's Graphical User Interface (GUI), enter any of the book credentials highlighted above. The Node MCU communicates this to the RFID tag reader which is attached to the shelf. The tag reader emits radio waves which the tags can use to relay information back to the reader, the reader then sends the data to the backend, which reviews it, finds the corresponding book details, maps it to the corresponding tag, and triggers the LED on the row the book is located to come on. However, the project is limited to search and find features only, and does not provide a functionality for automating borrowing and returning, or providing book security.

Molnar & Wagner [8] discussed privacy and security issues associated with the use of RFID in libraries, and proposed multiple architectures to use RFID systems in libraries without causing privacy issues. They examined current library architectures which make use of a check-out station and an exit gate for security. A check-out station is a self-check machine that allows patrons to check out their own books. In this case, the RFID tag is read and the association between ID number and book is looked up in the bibliographic database, and the status of the book is changed to “checked out” in the bibliographic database. Upon return, when the book is checked in, the tag is read again and the bibliographic database is updated from “checked-out” status to “checked-in”. The RFID tag doesn’t just contain bibliographical information about the book, it also contains something called a “security bit”. This security bit is updated when a book is checked-out or checked-in, and their status can be accessed by tag scanners by the exit gate which will raise an alarm if a book passes out, but has not been checked-out properly. The issue with this is that the security bit must be properly configured at each exit to avoid false alarm. [8] also examined another security architecture in which the security bit is not stored on the tag, so the readers at the exits “query the bibliographic database for the circulation status of the book as it passes through the exit sensors”. This architecture introduces the issue of latency time between when the book passes the gate, and when the status is obtained, which can lead to delayed alarms and longer processing time. They postulate that the geographic and identification information on the tags can be encrypted using various encryption techniques to prevent the information on the tag from being readable by anybody outside library staff. Nijhum [5] also designed a Library Management System Using RFID technology. The system was developed with similar operation to Adekola & Adedoyin [7], with a few distinct varieties. [5] developed the system to enable self-check-in and check-out functionalities, sorting and shelf management features, and a possible future implementation of book drop feature if integrated with a conveyor belt system. They used a web application as an interface between the user and the hardware. The Web application had menus for logging and accessing check-in, and check-out events, it also allowed configuration of the tag reader to display information about the tag for proper shelf sorting. Books can be placed on a deck, where the tag reader scans and obtains information about the book, such as catalog, book genre, and shelf number. Nijhum’s system helps to prevent misplacing books and also implements a system for theft control using tag readers at library exits to confirm the borrowed or returned status of a book. If a book was not properly logged as “borrowed”, the tag readers are designed to raise an alarm.

Choi & Kim [3] examined the impact of RFID technology on Library workflows and user experiences. They explained how prioritizing the accessibility of books and library materials to readers and library users was an important feature of any library. RFID integration into library systems as a technology saved library staff from the considerable time spent in manual record keeping of issued and returned books. The system described RFID tags embedded in books by the bibliographic information of the book read through the tags. There is also the integration of RFID Antennas at the entrances to the Library, these Antennas constantly emit waves that are intended to interact with RFID tags. The antennas can read the information on the tags to deduce if it has been properly issued or not, in which in the case of the latter, the book is assumed to be stolen, and the antenna sends information to the control system to raise an alarm.

Oladosu & Adebayo [9], evaluated the economic feasibility of RFID adoption in libraries through a case study. They examined the application of RFID technology to hospital systems, considering both its benefits whether direct or indirect, and the limitations and challenges of implementing RFID systems in hospital settings. The benefits and application of RFID systems when applied to asset management, information management, authenticity management, inventory management, patient management, and process management were discussed. The literature reviewed focused on the tracking utility of RFID systems, also effectiveness in inventory, asset and document tracking, but also useful in-patient tracking and profiling as well. They further went to explore fundamental barriers of RFID systems in this setting which included; data and privacy issues, financial constraints, organizational issues, regulatory issues and technical complexities.

Nie [4] provided a comprehensive overview of research conducted on RFID use in academic libraries. They included in their research the Singapore Public Library, which boasts of implementing a fully readied and deployed IoT system using RFID technology in 1998. By the results of their work, they postulated that the application of RFID in Libraries is not limited to just speeding up checkouts, keeping collections in better order, and alleviating repetitive strain injuries among librarians alone, but RFID also shows prospects to be able to provide a better control on theft, non-returns and misfiling of a library’s assets. This research also highlights the reasons why RFID tags are more preferred to Barcodes, which is also a solution that can be used in place of RFID tags. They explained that barcodes are limited because they always require a direct line of sight to the scanner, and also, they can be easily ripped off or peeled away from books. This research also concludes that the cost of implementation, along with the concerns over data and privacy issues are the factors limiting the widespread adoption of RFID technology in Libraries today. Donghua [1], described an Intelligent Library system that uses RFID technology. The intelligence of a system is its ability to perform operations and make decisions based on certain events or conditions, without interference or input from a human. The system described contains a complete RFID system which has a reader and an electronic tag. The reader emits a radio wave

frequency that is received by the electronic tag. The tag converts the wave into electric energy needed by the chip in the tag, the tag can then proceed to send out its internal data, which is collected by the tag, and sent to the application program for processing. Zhou highlights the merits of RFID systems, stating it to be a waterproof, magnetic proof, and high temperature resistance system, capable of real time data updates, and can store a significant amount of information. They conclude by emphasizing that if new technological standards can be formulated, and RFID systems sees an increase in number of applications across different fields, and there is a continuous progress in technology, the cost to setup a RFID technology system will be lower, the distance at which the reader can read the tags will be further, and the components and parts shape will start getting smaller with each iteration.

3. SYSTEM ARCHITECTURE

This section explores the complex interplay between methodology and design. The IoT library system comprises of hardware components (RFID Tags, Tag Reader, RFID Antenna, Keypad, Arduino Uno R3 controller, Vero board) and software components (Backend - PHP and MySQL Database, Frontend - React Js).

RFID tags are tags that have a magnetic coil within them and are used to generate radio frequency waves. They are passive in nature i.e. they can be read up to a small distance of 10-15 cm, so the system is static. To get identifying information, it uses an RF channel to connect with the tags. This communication can take the form of a straightforward ping or a more intricate multi-round protocol, depending on the kind of tag. A reader may need to implement an anti-collision protocol in situations with a lot of tags in order to prevent communication conflicts. Readers are able to quickly connect with several tags in serial order because of anti-collision techniques. See figure 1.

Fig 1: RFID Tag Reader

The reader contains the antenna. An electromagnetic field is produced by it. A tag is able to read and write data to the reader by generating radio signals whenever it is in close contact to an electromagnetic field. Antenna functions as a medium of communication between the reader and the tag. See Figure 2

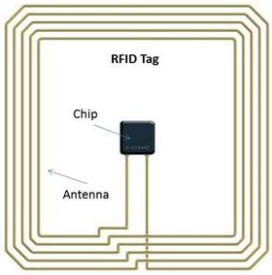

Fig 2: RFID Tag and Antenna

3.1. Book Borrowing Use Case

John a student of FUTA wants to borrow a book from the library, he follows these steps: See figure 3.

1. John picks a book embedded with an RFID tag, presents it and his student's ID Card to a library staff or self-checkout kiosk.
2. Staff/John scans the book's RFID tag using the LybSmart tag reader.
3. Staff/John enters borrower's/his Matric number using the Tag reader keypad.
4. The reader transmits the book UID and Matric number to the LybSmart server.
5. The LybSmart user interface detects the book scanned and prompts a book borrows button.
6. If clicked a borrowed status is assigned to the book. The book details and return date setter is displayed to John who can further proceed to borrow
7. Server sends confirmation message to the Tag reader (successfully).

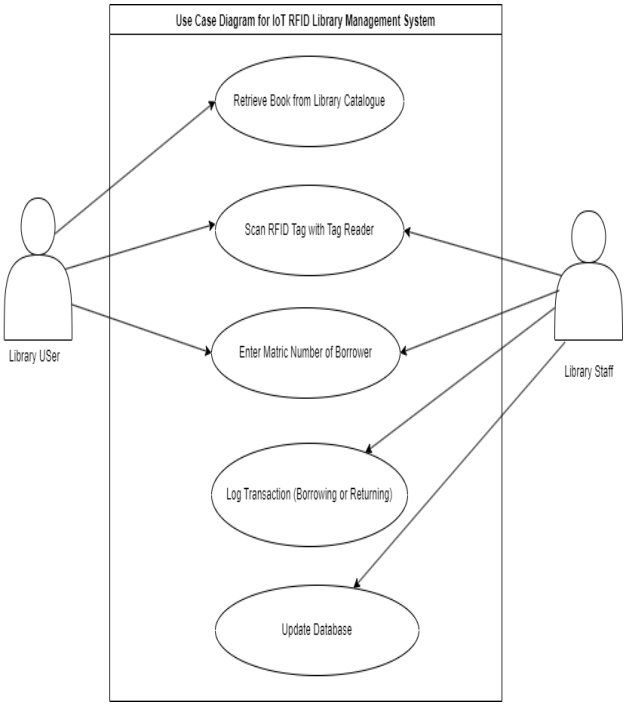

Fig 3: Use Case Diagram for LybSmart Book Borrowing

3.2. Book Return Use Case

John a student of FUTA will like to return a borrowed book, they follow these steps: See Figure 4

1. John returns the book to library staff or self-service return station.
2. Staff/John scans the book's RFID tag using the LybSmart tag reader.
3. The reader transmits the book's UID to the LybSmart server.
4. The LybSmart user interface detects the book scanned and prompts a book return button and a book return notifier button.
5. If clicked the borrowed status is removed from the book and book details is displayed to John who can further proceed to return
6. Server sends confirmation message to the Tag reader (successfully).

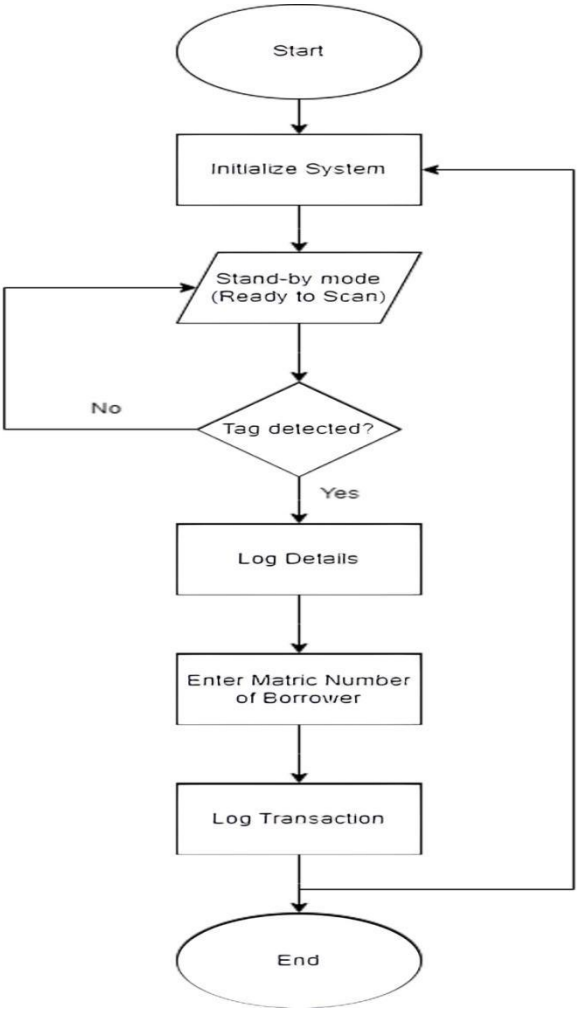

Fig 4: Flowchart diagram for LybSmart book return

4. IMPLEMENTATION AND RESULTS

Each RFID tag has a Unique Identifier that is embedded with it at the point of manufacturing. This Identifier is not changeable or editable, and they can be programmed to map to relevant book information. Once the Tags have been programmed to specific books, then they can be attached to the corresponding books.

The RFID reader is a component that is capable of emitting radio-magnetic signals that communicate with the RFID tags. The RFID reader goes through an initialization procedure when it is powered on, during which it communicates with the micro-controller or central system. Once powered, the RFID goes into standby mode, in standby mode, the RFID reader is ready to receive commands from the micro controller or central system. It conserves power while waiting for a trigger event, such as a book being brought within the read range. The RFID reader will remain on standby till it is triggered by an external event, such as the presence of an RFID tag within its read range. This trigger can be initiated by a library staff member bringing a book close to the RFID reader for borrowing or return purposes.

The keypads are connected as inputs to the Micro-controller, which can process the keystrokes as numbers, and register them as the Matric number of borrowers. The keypad is connected very close to the Tag reader for ease of operation.

Fig 5: RFID Tag reader Assembled System on Vero board with Circuit cables, Keypad and Tag Reader sensor

The Arduino Uno was connected to a PC via a USB power cable. The Arduino was programmed using the Arduino IDE installed on the PC. The programmed Micro-controller has to:

a. Read data from RFID readers and keypads.

b. Handle data pre-processing and validation.

c. Communicate with the central system by sending the book id read and matric number entered as "x-www-form-urlencoded" via HTTP POST request. See figure 5 to 6.

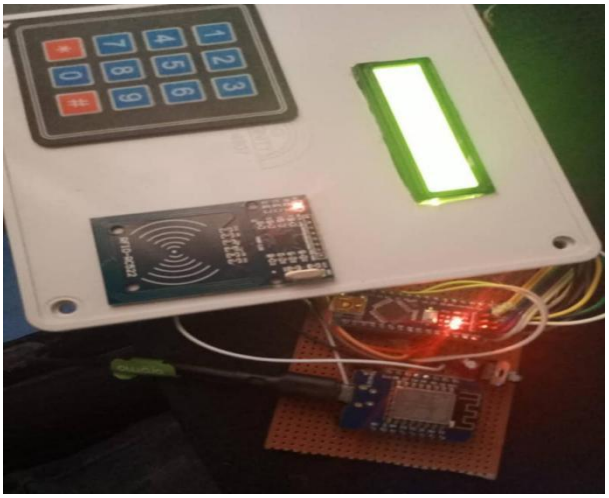

Fig 6: Implementation of Connection Schematic of Arduino Uno to RFID Card Reader

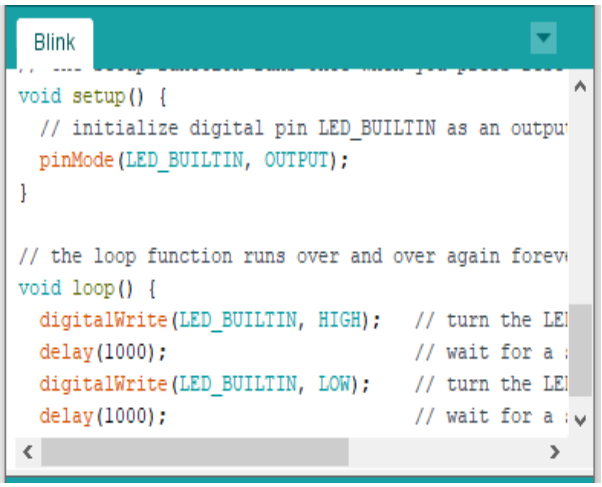

Fig 7: Arduino micro-controller program development IDE using c++

The central system software using PHP Scripts was setup locally using XAMPP server on port 8080. PHP communicate with the central MySQL Database, which will be set up using MySQL by using the INSERT command for data entry, SELECT command for data fetching and UPDATE command for data modifications. This Database is used to store book details, borrower information, and transaction history, and records. Using PHP scripts, the implemented functions are:

a. Retrieving book id and matric number from the RFID tag scanner Wi-Fi sensor by delivering a localhost API (http://172.20.10.10/bookborrowing/loaduser.php) for collecting these data in form of application/JSON strings via HTTP POST request.

b. Connecting to the SQL database through PHP new MySQLi() database connect function

c. Adding new books to the database through PHP/SQL INSERT command

d. Recording borrowed status and associating RFID tags with borrower's Matric numbers.

e. Updating the database when books are returned though book status derived from PHP/SQL database SELECT command

f. Implement user authentication to restrict access to authorized library staff through restricted PHP Access control allow origin rules.

g. Use encryption techniques to secure sensitive data stored in the database.

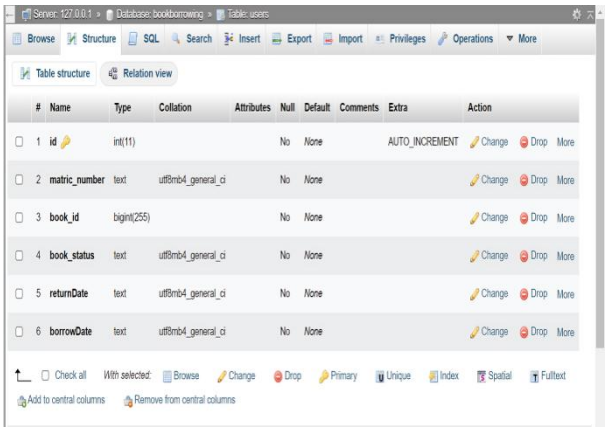

Fig 8: LybSmart PHP and MySQL users Database structure for data entry and data fetching

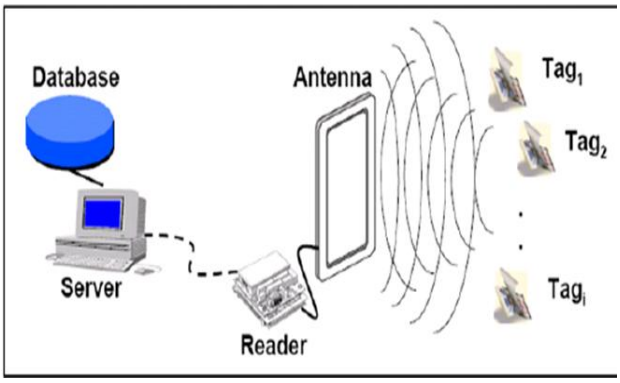

Fig 9: Communication between Database Server, Tag Reader, and Tags

Following the design phase, a rigorous and comprehensive testing process was carried out to ensure the full functionality, stability, and reliability of the RFID-based library management system before assembly and deployment. The objective was to identify and resolve any potential issues that could hinder system performance, ensuring seamless operation and user satisfaction.

4.1. Comprehensive Testing and Simulation

To verify system performance and detect any anomalies, multiple simulation tests were conducted across various real-world scenarios, including book borrowing, book returning, and error handling. These evaluations ensured that the system functioned effectively under different operational conditions.

4.1.1 Circuit Testing and Simulation Techniques

1. Circuit Testing: All hardware components were rigorously examined to confirm their connectivity, signal integrity, and operational efficiency. This phase involved verifying RFID reader responses, microcontroller logic, keypad functionality, and synchronization with the central management system. Testing ensured that no hardware faults or connectivity issues would disrupt the workflow.

Breadboarding and Vero Boarding: Initial circuit prototyping was executed using breadboarding techniques to allow for easy reconfiguration and debugging. Once the circuitry was validated, Vero boarding was employed for more permanent testing, ensuring stable circuit configurations before final integration.

Software Simulation using Altera Quartus: The system's digital logic and control algorithms were simulated using Altera Quartus software. This facilitated the verification of circuit behavior, allowing developers to detect logic errors, optimize efficiency, and fine-tune performance before physical deployment. The simulations accurately modeled system responses under different input conditions, ensuring robustness.

4.2. Staff and User Training

To guarantee seamless adoption and operational efficiency, a structured training program was implemented for both library staff and users. The training covered hardware usage, software interaction, and troubleshooting techniques, ensuring proficiency in handling the RFID-based system.

1. System Interface Training: Staff members received extensive hands-on training on navigating the system, operating RFID readers, processing book check-ins and check-outs, and managing user accounts.

2. Workflow Familiarization: Detailed sessions were conducted to help staff understand the end-to-end workflow of book transactions, system-generated logs, and user activity monitoring.

3. Troubleshooting and Error Handling: Staff members were equipped with the knowledge to diagnose and resolve common issues, such as RFID reader malfunctions, failed scans, database synchronization errors, and network connectivity issues. A troubleshooting guide was provided for quick reference.

4.3. Installation and Deployment at FUTA Library

Upon successful completion of testing and training, the system was installed and deployed at the FUTA Library. The deployment process involved careful integration of hardware and software components to ensure a smooth transition from the traditional system to the RFID-based system.

4.3.1 Installation Steps

RFID Tagging of Books: A meticulous process was undertaken to tag every book in the library with RFID chips containing encoded data, such as the book title, author, and unique identification number. This step was essential for enabling automated book tracking and management.

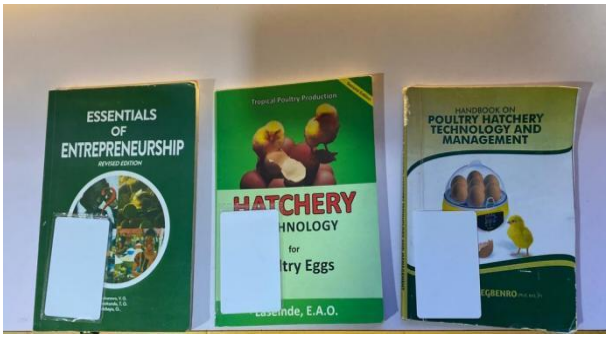

Fig 10: RFID tags installed on books in the library

Mounting of RFID Readers and Keypads: RFID readers and keypads were strategically installed at entry and exit points, borrowing stations, and circulation desks. Their placement was optimized to facilitate efficient scanning, minimize congestion, and enhance user convenience.

Fig 11: Books with RFID Tags placed on the bookshelves in FUTA library

Setting Up the Central Management System: The core software system was configured to synchronize with all RFID-enabled hardware components. This allowed for real-time updates, transaction tracking, and database integration, ensuring a seamless operation of the library's automated book management system.

4.4. System Monitoring and Issue Resolution During Deployment

Following the system's installation, a post-deployment monitoring phase was initiated to observe system performance, address user concerns, and resolve any issues that emerged during real-world operation.

1. Performance Evaluation: The system's efficiency was continuously assessed in real-time by tracking the speed and accuracy of book transactions, response times of RFID readers, and overall system stability.

2. User Feedback Collection: Library staff and users were encouraged to provide feedback regarding system usability, convenience, and any challenges they encountered. This feedback played a crucial role in making necessary adjustments and refinements.

3. Real-Time Troubleshooting: A dedicated technical support team was on standby to address any malfunctions or inconsistencies immediately. Common issues such as RFID reader misreads, system lags, or incorrect database entries were promptly resolved to ensure an uninterrupted library experience.

The successful deployment of the RFID-based library management system at FUTA Library resulted in enhanced operational efficiency, streamlined book management, and minimized human errors. The system significantly improved the overall library experience by enabling faster transactions, reducing wait times, and ensuring accurate book tracking, thereby revolutionizing the traditional library system.

Fig 12: LybSmart RFID Tag scanner deployed in the library

The effectiveness of the Internet of Things (IoT) RFID-based Library Management System (LybSmart) can be assessed using a number of derived Key Point Indicators and the accomplishment of this project objectives. The following are outcomes and results that can be seen following the LybSmart system's implementation, deployment and use:

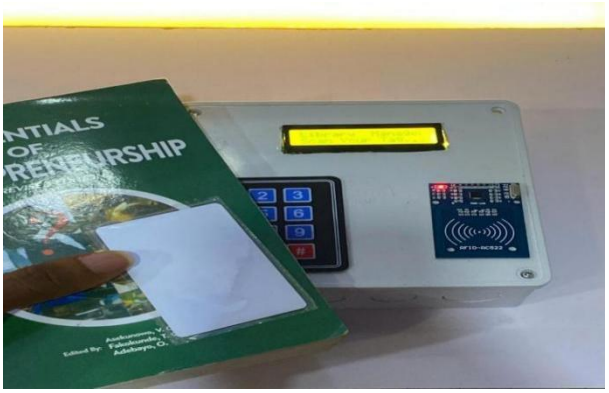

Fig 13: Student using LybSmart RFID Tag Reader to Scan a book tag in the library

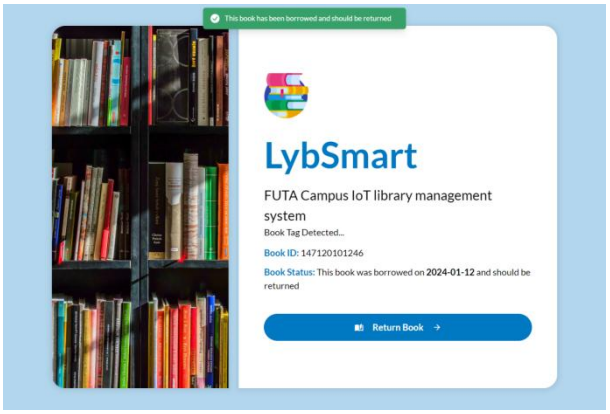

Fig 14: LybSmart User Interface detecting a book scanned by a student in the library

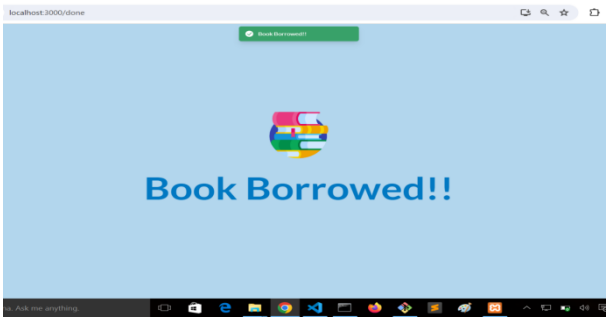

Fig 15: LybSmart User Interface displaying book status of book scanned by a student in the library

The following outcomes and results can be seen following the LybSmart system's deployment in FUTA library

1. Enhanced Efficiency: The automation of book borrowing and return processes results in a significant reduction in transaction time. The streamlined system eliminates manual data entry and minimizes the time spent by library staff on administrative tasks.
2. Enhanced Accuracy: Automation lowers the probability of human errors associated with manual data entry. The RFID technology ensures accurate identification and association of books with borrowers, minimizing discrepancies.
3. Improved Accountability: By producing thorough transaction logs, the system makes every book borrowing and returns transparent and accountable. This feature facilitates the tracking of book movements and assists in resolving disagreements or conflicts.
4. Book Tracking: Library personnel can efficiently manage inventory and keep track of book availability thanks to the system's real-time updates on each book's status.
5. User-Friendly Interface: Students and Employees have an easier time navigating the system, which lowers the learning curve and enhances user experience in general.

5. EVALUATION

20 user reviews were collected via Google Forms to assess ease of use, impact on efficiency, and overall user experience.

5.1. Ease of Use & Experience

1. How easy is it to borrow/return books using the IoT system on a scale of 1 (strongly disagree) to 5 (strongly agree): User feedback overwhelmingly demonstrated satisfaction with the system's ease of use. On a scale of 1-5, 95% of users rated it between 4 and 5, highlighting its intuitiveness and user-friendliness.
2. Is the self-service borrowing/return process clear and straightforward: 88% of users found the self-service borrowing and return process clear and straightforward, praising its guided instructions and minimal technical complexity.
3. Compared to the traditional system, is the IoT system more user-friendly and convenient: A significant 92% of users preferred the IoT system over the traditional paper-based system, emphasizing its convenience, speed, and reduced wait times.
4. Technical difficulties encountered or confusing steps while using the system: A minor 5% of users reported occasional technical hiccups like reader malfunction or slow response times. However, they expressed optimism about future refinements and did not find these issues detrimental to overall usability.

5.2. Impact & Efficiency

1. Does the IoT library system reduce waiting times at the library: 84% of users observed a notable decrease in waiting times for borrowing and returning books, praising the efficient self-service approach.
2. Has the system has improved the accuracy and efficiency of book borrowing and return processes: 100% of users commended the system's improved accuracy in book inventory and circulation data, streamlining internal operations and reducing human error.
3. Has the IoT library system made it easier for you to access desired books: 77% of students reported a positive impact on book accessibility. The real-time location tracking feature helped them locate desired books more efficiently.
4. Positive impact on the overall library atmosphere and experience due to the new system: 82% of users perceived a positive change in the library atmosphere, attributing it to the reduced queues, efficient service, and modern technological presence.

5.3. Feedback & Suggestions

1. Users recommended minor improvements like incorporating mobile app integration for book reservations and system notifications.
2. Some students suggested expanding the self-service functionality to include overdue book returns and fines payment.
3. Overall, the feedback was overwhelmingly positive, with users consistently highlighting the system's advantages over the traditional approach.

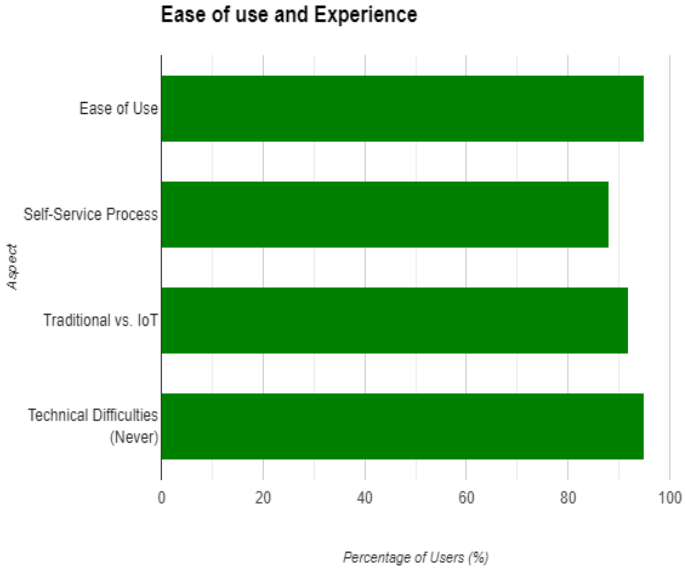

Fig 16: Illustration of the user experience satisfaction of the IoT library system based on user reviews

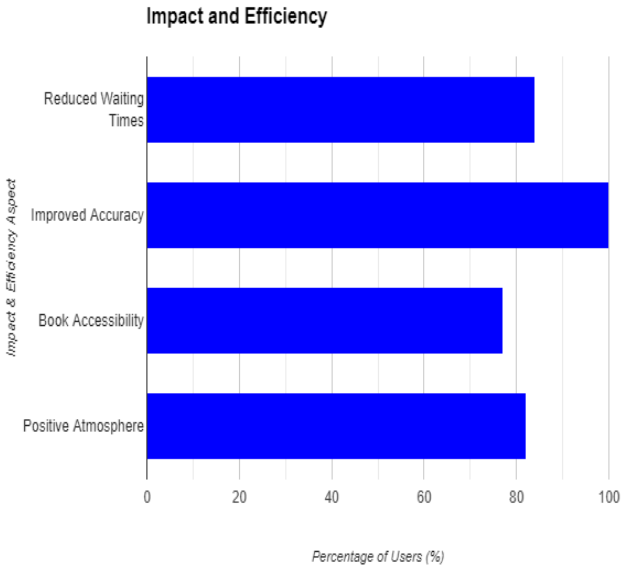

Fig 17: Illustration of the efficiency and accuracy evaluation of the IoT library system based on user review

Table 1: IoT library system evaluation findings based on students and selected staff reviews

Category	Evaluation Question	Positive Responses (%)	Negative Responses (%)	Neutral Responses (%)
Ease of Use & Experience	Ease of borrowing/returning books (1-5 scale)	95% (4-5 rating)	5% (3 rating)	0%
	Clarity of self-service process	88%	10%	2%
	Preference over traditional system	92%	8%	0%
	Technical difficulties	95% (no issues)	5% (occasional hiccups)	0%
Impact & Efficiency	Reduced waiting times	84%	13% (minimal change)	3%
	Improved accuracy and efficiency of processes	100% (librarians and staff)	0%	0%
	Easier access to desired books	77%	20% (no significant change)	3%
	Positive impact on library atmosphere	82%	10% (neutral)	8%
Feedback & Suggestions	Mobile app integration for reservations & notifications	70%	30%	0%
	Expand self-service to overdue returns & fine payments	60%	40%	0%
	Overall recommendation for other universities	100%	0%	0%

6. CONCLUSION AND FUTURE WORKS

IoT expedites the operations of checking out, monitoring, and searching books in the library, freeing up staff members to do additional user-service duties. The implementation of the RFID-based IoT library system has demonstrably streamlined the borrowing and return process and improved inventory management by 95% based on gathered reviews and evaluation. Real-time tracking significantly reduced book loss, while self-service borrowing and returns minimized wait times. The system's scalability accommodates future growth and integration with existing library infrastructure. Overall, this project successfully leverages RFID technology to create a modern, efficient, and user-centric library experience. Library's operations have undergone a radical change as a result of the deployment of the RFID-based and Internet of Things Library System. Book loan and return procedures have been greatly expedited by the incorporation of RFID technology, greatly increasing accuracy and efficiency. For both library employees and users, the user-friendly interface, automated alerts for overdue books, and real-time tracking have improved the entire experience. Cost savings and increased operational efficiency have resulted from the system's ability to shorten transaction times, minimize errors, and offer insightful data analytics. Positive comments from patrons and library staff attest to the system's usability and capacity to accommodate the wide range of needs of our library community. Additionally, the paper’s accomplishments in enforcing policy compliance, putting anti-theft measures in place, and upholding high system reliability demonstrate its all-encompassing approach to handling all facets of library management. The paper has been able to achieve a RFID and IoT-based Library Management System that has improved library services beyond expectations.

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