



RFID TECHNOLOGY IN LIBRARY MANAGEMENT SYSTEMS

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Abstract: RFID is the most recent technology to be employed in library theft detection systems. This page gives information on RFID security systems. It is one of the most rapidly expanding and helpful technologies used by academic libraries to increase efficiency and improve safety, security, productivity, accuracy, and convenience. This technique is also useful for detecting missing objects and identifying misfiled goods. This page also describes the many components of the RFID system, how the system works, the system's advantages and limitations, and numerous points to consider when using the RFID Library Management System.

Index terms - RFID, Library Management System, Security Systems, RFID Antenna

1. Introduction

RFID is an ingenious automated system that automatically identifies sorts, arranges, and tracks various things. Currently, RFID applications span from book tracking and stock management to theft detection and automated book sorting in libraries. Radio frequency identification (RFID) technology is a dynamic link between people, items, and processes, and it will play an increasingly important role in data collecting, identification, and analysis for specialized library operations soon. An automated library that uses RFID technology would be a "self-service station" that requires minimal involvement from library professionals. Efforts are being undertaken to implement self-service "check-in" and "checkout" systems that will eliminate long delays in the delivery of library materials while also increasing operational efficiency.

It is largely used in libraries to automate book handling procedures such as checkout, inventory control, check-in, shelf management, and anti-theft. When paired with computer-assisted sorting equipment, RFID simplifies and accelerates even book sorting. Automating the library material processing process helps librarians to spend more time with their clients, enhancing 'user happiness'.

2. Brief History of RFID

Radio Frequency Identification was first used in the early 1980s for item tracking and access control applications. Materials are tracked using radio frequency-based technology paired with microchip technology, known as RFID (Radio Frequency Identification). These contactless and wireless automatic identification data-collecting devices are extremely successful in hostile situations such as manufacturing, logistics, textiles, and libraries, where barcode labels cannot survive and inventory control and waste management are required. Because of its capacity to follow moving things, RFID has become widely used in livestock identification and automated vehicle identification systems. In recent years, it has become increasingly popular for tracking books, audio/video recordings, and other multimedia collections in libraries. Libraries are investigating RFID technology now that they have realized its advantages. After recognizing the benefits of RFID technology, libraries are adopting it as a more effective flow control tool than barcodes and other identification technologies.

In 1945, Léon Theremin developed a listening device for the Soviet Union that retransmitted incident radio waves with additional audio information. Sound waves vibrated a diaphragm, slightly changing the

form of the resonator and modulating the reflected radio frequency. Even though this gadget was a clandestine listening device rather than an identification tag, it is regarded as a forerunner of RFID because it was passive, powered and activated by waves from an external source.

Mario Cardullo's technology, patented on January 23, 1973, was the first true forerunner of current RFID, as it had a passive radio transponder with memory. It consisted of a transponder with 16-bit memory that could be used as a toll device. The basic Cardullo patent protects the use as a toll device. The basic Cardullo patent covers the use of RF, sound and light as transmission media.

3. What is RFID?

RFID technologies are categorized as Automatic Identification technologies. This technology comprises smart cards and barcodes. RFID is frequently referred to as next-generation bar coding due to its clear advantages over barcodes. It is a means of remotely storing and retrieving data via RFID tags. This tag is a little object, similar to an adhesive sticker, which can be incorporated into a product. RFID tags have antennae, which allow them to receive and reply to radio-frequency requests from an RFID transceiver.

4. Objectives of the study

1. To understand RFID Technology's working process.
2. To illustrate RFID technology's impact on library administration.
3. To examine the competitive benefits of RFID technology.
4. To understand the ramifications of adopting RFID technology.
5. To identify the role of librarians in adopting RFID technology in libraries.

5. Components of RFID

The entire radio frequency identification system is built on four materials, which are generally referred to as RFID system components. These components are described as follows:

Tags: These are tags that contain a magnetic coil and are used to produce radiofrequency waves. They are passive, which means they can only be read from a short distance of 10-15 cm, implying that the system is static. A passive tag is an RFID tag that does not have a battery and is powered by the reader. When radio waves from the reader interact with a passive RFID tag, the coiled antenna within the tag generates a magnetic field. The tag draws power from it, activating its circuits. The tag then transmits the information recorded in its memory. The tag is usually cheaper to create. Each tag has a unique identification number (15 characters) which is quite useful and these tags can be reused.

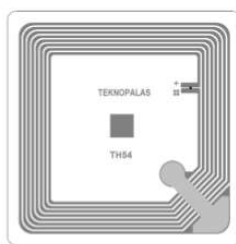


Fig: RFID Tag

Reader: It connects with the tags via an RF channel to obtain identification data. Depending on the type of tag, this communication could be a simple ping or a more complicated multi-round protocol. In situations with many tags, a reader may need to use an anti-collision technique to avoid communication issues. Anti-collision techniques allow readers to communicate with multiple tags in serial order.

The antenna is located inside the reader. It generates an electromagnetic field. When a tag comes into proximity with an electromagnetic field, it is active and can read and send data to the reader via radio waves. Antenna functions as a communication medium between the tag and the reader.

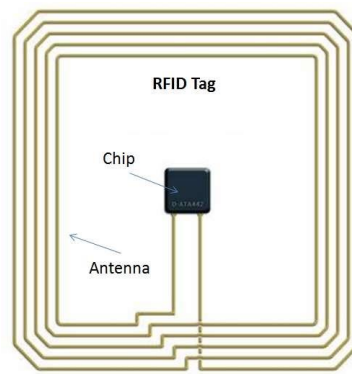


Fig: RFID Chip with Antenna

Server: The server is the focal point of a comprehensive RFID system, serving as a communication gateway for many components. It receives data sent by the antenna and exchanges it with the circulation database.

6. RFID Standards

The International Organization for Standardization (ISO) has ratified some RFID technology standards, making it globally recognized and usable. The standards are described below:

- ISO 14443 is a high frequency (HF) standard with a short read range and encryption. This standard primarily addresses the security of payments and proximity cards.
- ISO 15693: A high-frequency standard for proximity cards. It has no encryption and a greater read range than ISO 14443-based systems. It is often utilized in access control systems. It's also been used for inventory management and other purposes.
- ISO 18000-3, a high-level standard for item management, has not gained popularity. Most businesses still utilize ISO 15693 for item management.

7. RFID Protocols

RFID mostly uses two protocols for its data communication and interoperability. They are:

- Application Programming Interface Protocol (API)
- Reader Interoperability Module Protocol (RIM)

8. How does RFID work?

Every RFID system has three components: a scanning antenna, a transceiver, and a transponder. An RFID reader or interrogator is a combination of a scanning antenna and a transceiver. There are two types of RFID readers: fixed readers and mobile readers. RFID readers are network-connected devices that can be either portable or permanently affixed. It uses radio waves to send impulses that activate the tag. Once engaged, the tag emits a wave back to the antenna, which is translated into data.

The RFID tag contains its transponder. The read range of RFID tags varies depending on parameters such as the type of tag, type of reader, RFID frequency, and interference in the surrounding environment or from other RFID tags and readers. Tags that have a stronger power source also have a longer read range.

An RFID system consists of a reader with a transmitter and a receiver, an antenna, and an integrated circuit transponder tag attached to the antenna. The transmitter uses the antenna to broadcast a radio signal at a certain frequency. If the tag is within the reading range of the transmitter, it will recognize this signal. The tag then sends a signal that is recognized by the receiver. The significance of modern RFID technology is that most tags are battery-free and get their energy from the transmitter signal. This not only reduces the cost of the tags but also saves the environment, as most applications demand low-cost, single-use discard tags.

A smart label or tag (microchip) can be inserted virtually into any object, including books and other library stock, and each book is identified by a unique, unalterable code. The chip communicates with a library's circulation database to determine where each item is located, whether it is on the shelves, checked out, or being processed. Clients and staff members can use a hand-held reader to scan the shelves for misplaced things using radio pulses.

When RFID tags are passed in front of a reading station, a radio field charges the chip, allowing it to transmit data. Thus, the information stored in the microchips, inside the tags and attached to the library materials is "captured" and recovered using radio frequency technology, regardless of its location.

9. Future System

An RFID system consists of several components, including transponders, handheld or fixed readers, data input units, and system software. Transponders, also known as ID tags, are the technology's backbone and come in a variety of shapes, sizes, and reading ranges. A comprehensive RFID system includes the following key components:

- RFID tags programmed with unique information.
- Reader linked to the Library Information System.
- An antenna connected to the reader.
- A server that receives and decodes information and communicates with the automated library system.

10. RFID in library management system

By automating operations, RFID technology in libraries saves staff members' time. By using RFID library management, book readers can save time. It's crucial to take good care of books and make them accessible to readers. The majority of the library staff's time was devoted to maintaining track of the volumes that came in and went out.

It is possible to insert RFID tags within each book's cover. Every book's bibliographic details are input into the library management software. Without the help of library employees, a document is issued in a matter of seconds when a user delivers a book for issue-return purposes. The RFID reader from the tag reads the information relevant to that book and transfers the data into the software. The RFID tag on the document is immediately scanned by the antenna at the exit gate as soon as the user takes it outside the library to confirm that it was issued correctly. If it is not provided to the user under library policies or is taken from the library, the antenna senses it and gives an instant alert. Thus, it results in the successful theft reduction of documents.

RFID technology is utilized in libraries not just for circulation but also for inventory management. RFID is used for theft detection systems and library circulation operations. Material handling is charged and discharged more quickly and easily. By using this technology, librarians can spend less time on personnel reading barcodes when things are being charged or withdrawn from the shelf. Barcodes can be substituted with RFID targets in several services.

11. Implemented functions in the library system

Self-Check Out: The RFID check-out technology shortens lines and is very intuitive and user-friendly. The books to be checked out at this station are arranged on the deck, and the patron card and book stack can be read concurrently to record the ID of the customer and the borrowed materials, and deactivate the anti-theft device. The database of the library is automatically updated, even when a borrower checks out numerous items. A printed receipt is provided, attesting to the specifics of the borrowed material and its due date.

Check in: Books can be stacked on the deck station individually without assistance from workers. The anti-theft is set on and the returned item is instantly updated in the ILS. Both patrons and librarians profit more from this automated book return. Because the library database is updated in real time, patrons have greater access to books and are given significant freedom in returning materials when desired. An optional printed receipt is included to attest to the loaned material's return. Additionally, since several entries may be read or written quickly, it saves librarians time by eliminating some repeated chores. The robust book sorting mechanism it provides is made possible by the rapid and independent reading of RFID tags, irrespective of their orientation or position.

Sorting & Shelf Management: Integrated Library Software (ILS) using RFID illuminates the accession and shelf numbers when a book is placed on the deck, making it easier to shelve things. Additionally, it offers details like if the item is reserved or belongs to another location, among other things. Additionally,

each shelf has an RFID scanner that aids in sorting the books according to call number, either ascending or descending.

Book Drop: The smart labels on books returned through a library's "Book Drop" service are automatically read, updating the patron record and the library database. Simultaneously, the smart labels' theft detection mechanism is turned on. Customers can return items at this Book Drop seven days a week, 24 hours a day. It is possible to implement a conveyor sorting system for books returned via the Book Drop.

Item identification and theft prevention: RFID smart tags or labels are dependable and simple to use. Flexible, paper-thin tags containing an electrical chip that can be written on and read wirelessly are available. Radio frequency technology, which works without contact or line of sight, can read them. In addition to being built to survive the lifetime of the object they detect, they can also be used for theft detection by carrying out the EAS (Electronic Article Surveillance) function. A four-lane EAS (Electronic Article Surveillance) exit gate, which employs RFID to check items being taken through, is used by library patrons as they exit the facility. Alarms from the security system sound when something is taken that is not permitted.

12. Advantages of RFID systems

- Automation of issue/return;
- Quick charging/discharging;
- Automated materials handling;
- Simplified patron self-charging/discharging;
- High reliability; High-speed inventorying;
- Automated materials handling;
- Miss-shelve easy identification;
- RFID tags replace both bar codes and traditional security systems;
- Thus, reducing library material tosses, such as CDs, DVDs, books, etc.;
- Automation of materials handling;
- Automated materials handling;
- High level of security; Easy stock verification;
- Automated sorting of books on return;
- Technology standards to drive down costs;
- RFID tags replace both bar codes and traditional security systems.

13. Disadvantages of RFID Systems

- Expensive;
- Accessible to compromise;
- Vulnerable to compromise
- Issues with the exit gate sensor (reader)
- Exit gate sensor issues;
- Exposed tag removal;
- Frequency block;
- Possibility of exposed tag removal
- Concern over user privacy;
- Absence of standards.

14. Conclusion

Librarians are integrating several novel inventory technologies in their libraries, including RFID, to improve circulation services and protect library resources. It is a more efficient, convenient, and cost-effective system for library security. This technology has replaced traditional barcodes on library materials. Libraries are increasingly using RFID systems, however, costs, a lack of standards, and user privacy remain significant barriers to more libraries using RFID technology. In terms of budget constraints, if libraries install such a technology, the benefits can be measured in terms of "Return on Investments" because it will speed up the circulation process and allow staff to undertake other user-centered activities.

REFERENCES

- [1] Chavan S.P. (2012). Use of RFID Technology in Libraries, Online International Interdisciplinary Research Journal, Volume-II, Issue-IV, 235-241.
- [2] Deshmukh R.K. & Deshmukh S.B. (2013). The Research Productivity at the 'Researchgate' Score on Sant Gadge Baba Amravati University: An Analysis. Research Journey, 210-217.
- [3] Khanna, Sunaina. (2014). Impact of RFID Technology on Library Services: A Case Study of A.C.Joshi Library, Panjab University, Chandigarh, International Journal of Digital Library Services, Vol.4, Issue - 4, 117-126.
- [4] Narayanan A., Singh, Sanjay and Somasekharan M. Implementing RFID in Library: Methodologies, Advantages and Disadvantages, Scientific Information Resource Division, 271-281.
- [5] Pujari, V. and Gadgay, B. (2018). Smart library system using IoT. International Journal for Research in Applied Science and Engineering Technology, Vol. 6(7), 471-476.
- [6] Singh, Neeraj. Kumar & Mahajan, Preeti. (2014). Application of RFID Technology in Libraries, International Journal of Library and Information Studies, Vol.4 (2), 1-9.
- [7] Sivasankar, V., Soundararajan, E. and Rajeswari, S. (2020). Challenges and impacts of RFID technology in a research library. Advances in Communication Systems and Networks, Springer, Berlin, Germany.
- [8] Solanke, D. S., Deshmukh Rahul K., (2018), Analyses on the "Six Sigma" Methodological Approaches Traced in Web of Science database during 2007- 2018, International Journal of Scientific Research in Computer Science, Engineering and Information Technology, Vol. 3(3), Pp. 128-133. Available at:
https://www.researchgate.net/publication/331023840_The_Research_Productivity_At_the_Research_gate'_Score_on_Sant_Gadge_Baba_Amravati_University_An_Analysis
- [9] Syed, Shahid. (2005). Use of RFID Technology in Libraries: A New Approach to Circulation, Tracking, Inventorying, and Security of Library Materials. Library Philosophy and Practice, Vol. 8(1).
- [10] Yu, Shien-Chiang. (2007). RFID implementation and benefits in libraries. Emerald, Vol. 25 No. 1, 54-64.

