

Role of RFID Technology in Libraries

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Abstract

The study aims to identify the prospective and difficulties associated with managing and implementing RFID systems in libraries. RFID (Radio Frequency Identification) is the newest technology implemented in library theft detection systems. Although this technology was first introduced in the 1940s and 1950s, there has been a significant rise in its applications and implementations in recent years. RFID integrates radio-frequency technology with microchip technology. The data stored on the microchips embedded in tags attached to library items is accessed using radio frequency technology. A reader, also known as a sensor, scanner, or interrogator, detects the antennae on the tags and obtains data from the microchips through them. There are many kinds of RFID, ultra-high frequency RFID, high-frequency RFID, passive RFID, and active RFID each with different properties. The RFID system provides automation, accuracy, real-time data, durability, and security with some limitations such as its very costly, and encrypted. The study focuses on the use of RFID technology in libraries, outlining its elements, advantages, and the librarian's function.

Keywords: RFID, Security System, Tags, Theft detection, IoT (Internet of Things).

INTRODUCTION

The study aims to identify the prospective and difficulties associated with managing and implementing RFID systems in libraries. RFID (Radio Frequency Identification) is the newest technology implemented in library theft detection systems. Although this technology was first introduced in the 1940s and 1950s, there has been a significant rise in its applications and implementations in recent years. RFID integrates radio-frequency technology with microchip technology. The data stored on the microchips embedded in tags attached to library items is accessed using radio RFID technology, which stands for Radio-Frequency Identification, which is a wireless system that employs radio waves to identify and monitor objects through the use of an RFID tag or transponder. It operates without requiring contact or a direct line of sight, enabling precise identification of items at the moment they are activated

by a nearby electronic device, which transmits previously stored electronic data to the reader. Specifically, an RFID tag sends a unique identifier to a reader device when it receives a radio signal from that reader. RFID tags consist of a microchip or integrated circuit (IC) along with an antenna. The IC houses non-volatile memory that keeps data and a distinctive identification number. RFID tags function across various frequency ranges, including low frequency (LF: 125 kHz and 134 kHz), high frequency (HF: 13.56 MHz), and ultra-high frequency (UHF: 860-960 MHz). Each frequency range offers specific benefits regarding read distance, data transfer rate, and susceptibility to interference. When the tag's antenna picks up the radio waves from an RFID reader, it receives power and turns on the integrated circuit (IC). The IC subsequently modulates these radio waves and reflects them to the reader, allowing for the transmission of stored data such as the UID and other information. When the tag's antenna picks up the radio waves from an RFID reader, it receives power and turns on the integrated circuit (IC). The IC subsequently modulates these radio waves and reflects them to the reader, allowing for the transmission of stored data such as the UID and other information. The management of libraries using RFID technology is both simple and efficient. An RFID library management system includes books that have RFID tags attached, an RFID reader, a computer network, and specialized software. Library personnel manage activities such as lending, returning, sorting, and tagging books by utilizing RFID tags within this system. A user can find library books equipped with an RFID tag by using the RFID reader, which helps in identifying and locating the specific book. When the book is brought to the checkout counter, library staff can either activate or deactivate the electronic article surveillance component in the book's tag. If a book is being borrowed, the surveillance component is turned off.

LITERATURE REVIEW

It outlines the viewpoints that have been previously articulated by other authors. This constitutes the literature review:

Shien-Chiang Yu (2007). Radiofrequency identification (RFID) applications that provide batch access, storage of mass data, and reprogramming are better than barcodes. Applying RFID can promote operational efficiency and precision. The cost is one of the major factors influencing whether or not RFID will be accepted in libraries. Although RFID has improved the efficiency of libraries, the essence of the library service has not changed. [1]

Ahmad, Hilal (2016). The study aims to describe how reducing the time and staff required for the circulation of books simultaneously increases book transactions per hour. The study reveals that most users (80.70%) use self-check-in/out, while a small percentage (19.29%) still rely on manual issues and returns. Though a fully RFID-enabled library system is in place, the manual circulation counter has not been abandoned. An important finding is that inventory control had never been conducted before RFID, and was carried out easily by handheld inventories within a short time. [2]

ShamshulBahri Amir Ibrahim (2013). The study discovered that favorable circumstances, such as the RFID vendor's technical assistance, greatly aided the rollout of the technology. The research also indicated that factors related to the user's situation, such as training and mindset, played a role in the effective implementation

of RFID. The quality of the system (or the absence of it) nearly put the RFID project at risk. [3]

Yusof, M. K. (2016). RFID technology makes it possible to track library resources, lowers risks to the collection, increases data collecting accuracy, and shortens the time needed to complete circulation tasks, including check-in, check-out, inventory control, and shelf management. RFID tags allow several things in a stack to be scanned simultaneously, and they can read information faster than bar codes. Another security feature of RFID systems is the ability to identify theft. RFID technology is transforming the services and operations of libraries. [4]

HISTORY OF RFID

Swedish researcher and innovator Harry Stockman investigated RFID in his publication, "Communication Utilizing Reflected Power" (1948). During that period, radio technology was still in its developmental stages, and it would take several more decades for RFID technology to become practical. Radar, which similarly involves a transmitter capturing reflected signals from objects, was created before the application of this concept on a smaller scale. In the 1960s, companies like sensormatic began implementing basic tags for item tracking and theft prevention. During the 1970s, academic institutions such as Northwestern University, along with organizations like RCA and Fairchild, began funding RFID research. Their main emphasis was on vehicle tracking for toll collection, monitoring animals, and enhancing assembly line automation. By the 1980s, RFID was being adopted on a global scale, mostly for toll collection, but also for access control and various industrial processes. The first instance of RFID use for toll collection occurred in Norway in 1986, and in 1989, the Dallas North Turnpike in the U.S. began to utilize RFID technology. In 1990, seven toll agencies in the northeastern U.S. created the E-Z Pass Interagency Group to establish a compatible toll collection system that allowed a single tag to be used across different toll agencies. The TIRIS system, which was created by Texas Instruments in the 1990s, has been utilized in various sectors, including gas stations, managing vehicle access, ski pass verification, and even casinos. Within the Dallas–Fort Worth metropolitan area, one toll tag grants entry to freeways, airport parking lots, and downtown parking garages, as well as many gated communities and corporate campuses. Further innovations by companies like IBM enabled RFID tags to be manufactured with a single integrated circuit, allowing for a reduction in size and an increase in possible applications. RFID technology operates at frequency ranges that differ across countries, with standards primarily established by the ETSI (European Telecommunications Standards Institute) in Europe and the FCC (Federal Communications Commission) in the United States. For instance, in the U.S., the frequency range for RFID is from 902 to 928 megahertz. In Europe, this frequency range is already allocated for other uses, which restricts RFID mainly to alternative frequency bands to avoid interference with other technologies. Many other nations have adopted these standards, but some have developed their own regulations.

OBJECTIVES

The main goal of libraries and information centers is to adhere to all five principles of library science. It's important to acquire books that align with the needs of the readers. Books should be aesthetically pleasing to enhance the reader's satisfaction. The

second principle gives library managers some direction regarding the selection of books. Thus, it is essential to understand the preferences of the readers when selecting books. The library must ensure open access, a strong selection of books, appropriate shelf organization, and outreach services.

- i. RFID system helps with the self-check-in and check-out of the books.
- ii. RFID provides an open access system in the library.
- iii. The RFID technology helps users save time
- iv. The RFID technology facilitates stock verification.
- v. The primary objective of the RFID system is to enhance security against theft.

TYPES OF RFID

There are various types of RFID, each possessing unique characteristics, but one of the most intriguing features of RFID technology is that the majority of RFID tags do not require an electric plug or battery. Instead, the energy necessary for their operation is provided by RFID readers in the form of radio waves. This method is referred to as passive RFID, in contrast to (less frequently seen) active RFID, where the tag includes its own power source.

UHF RHID (Ultra-High Frequency RFID) - It is utilized on shipping pallets and certain types of driver's licenses. Readers transmit signals within the 902-928 MHz frequency range. Tags transmit information over distances of several meters by altering how they reflect the signals from the reader; the reader can detect these reflections. This method of operation is known as backscatter.

HF RFID (High-Frequency RFID) - It functions at a frequency of 13.56 MHz and is probably found in your passport, credit cards, books, and contactless payment systems. HF RFID has a limited range, generally around one meter or less, since its physical operation relies on induction instead of backscatter.

Passive RFID – This type of tag does not possess its own power supply. They derive energy from the reader instead. In this system, RF tags operate without an external power source, relying on stored energy. When emitted from active antennas, these RF tags utilize specific frequencies, such as 125-134 kHz for low frequency, 13.56 MHz for high frequency, and 856 MHz to 960 MHz for ultra-high frequency. Requires no built-in power source. Used for inventory tracking. Contains a unique identification number. Prone to interference, Semi-passive RFID

Active RFID - In this apparatus, RF tags are connected to a power supply that sends out a signal, along with an antenna that captures the data. This indicates that an active tag operates using a power source such as a battery. It possesses its own power supply and does not need to draw energy from an external source or reader. Embedded power enables communication over considerable distances. Each tag has a distinct identifier or identification number. It can work with other devices like sensors. Active tags perform better than passive tags in environments with metal.

RFID LIBRARY MANAGEMENT SYSTEMS

Implementing RFID technology in libraries reduces the time library staff spends on manual tasks. A library that adopts an RFID management system saves patron's valuable time they would otherwise spend waiting in line to borrow or return books.

Ensuring the proper management of books and making them accessible to patrons is a crucial responsibility. A significant portion of the library staff's time is dedicated to documenting the details of books that are being checked in and out. The process of borrowing and returning books can be completely automated through self-check-in/out systems. This system requires the implementation of specialized software. When a user wants to borrow books using this system, they will see options displayed on a computer screen. The individual needs to verify their identity using a code, which is ideally a personal identification number or any unique identity code. The books chosen by the user are recognized by the RFID reader integrated into the system. The tracking feature in the book's tag is disabled by the system. Upon returning a book, the check-in/out system reactivates the tracking feature.

UTILIZATION OF RFID IN LIBRARY MANAGEMENT SYSTEMS

- i. RFID tags serve as a substitute for both EM security strips and barcodes.
- ii. Streamline the process for patrons to check out and check in items themselves.
- iii. Capability to manage materials, including video and audio tapes, without exception.
- iv. The innovative and secure radio frequency anti-theft detection technology.
- v. Conduct rapid inventories and identify misplaced items.
- vi. Assurance of long-term development when utilizing Open Standards.

COMPONENTS OF AN RFID SYSTEM

Tags - RFID Tag is the most important part of the system. There are three categories of tags: "read-only," "WORM," and "read/write." Tags are classified as "read-only" when their identification is set during production and cannot be changed later. This type of tag only includes item identification. It is suitable for items obtained after the initial rollout of RFID and for libraries that possess collections lacking barcodes. These tags typically need to hold a maximum of 96 bits.

"WORM" (Write-Once-Read-Many) tags are created by the organization that uses them, but they cannot be modified afterward. These tags can be useful when converting a previously bar-coded collection. A key benefit of these tags compared to read-only ones is that they allow for the inclusion of more information beyond just the identification number. Nonetheless, this must be information that will not require any modifications. Examples of such information could include the author's name and/or an abbreviated title, provided the tag has sufficient capacity, but not details like library location or circulation status. Typically, these tags have a minimum capacity of 256 bits. "Read/write tags," selected by an increasing number of libraries, allow for information to be modified or appended.

Reader - A standard system comprises various types of readers, also referred to as sensors when they are placed at library exits. These devices operate on radio frequency technology to identify and read tags and retrieve the information contained within them. The reader energizes an antenna to create an RF field. As a tag moves through this field, the reader decodes the data stored on the tag's chip and either saves it, transmits it to a server, or shares it with an integrated library system if the RFID

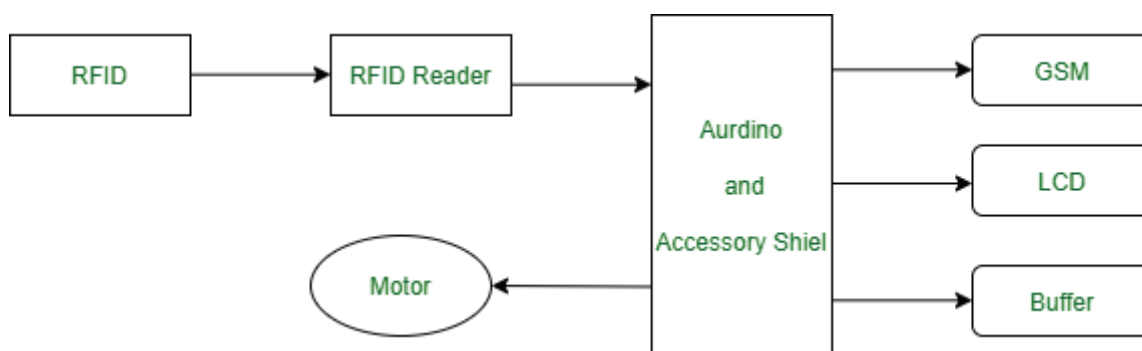
system is connected to one. In cases where there is no server, the majority of the software resides on the readers themselves.

Antenna - A reader is linked to an antenna that assists in identifying items and simultaneously activates or deactivates the antitheft tag function. Extra antennas can be incorporated to enhance the number of items processed during larger transactions.

Server - A server can be set up with an RFID system, serving as the communication hub for its various components. It collects data from one or more readers and verifies this information against its own database or interacts with the library's integrated library system's circulation database. Typically, a server contains a transaction database that allows for the generation of reports. The minimum cost of a server, including software, is around 302153 Indian rupees. Alternatively, a vendor might opt not to use a server and instead employ a more affordable docking station while enhancing the software capabilities of the readers.

PRINCIPLES OF THE RFID

RFID utilizes radio waves to execute functions related to Automatic Identification and Data Capture (AIDC) technology, which is responsible for identifying objects and gathering and organizing data. An antenna is a device that transforms power into radio waves, facilitating communication between the reader and the tag. RFID readers extract information from the RFID tag, which detects the tag and either reads from or writes data to it. This may consist of a processor, package, storage, and both transmitting and receiving units.



BENEFITS / ADVANTAGES

RFID is unlikely to completely supplant widely used barcodes in the foreseeable future; the benefits listed below indicate that employing RFID can enhance the value of identification:

- i. Automated tag detection minimizes labor costs and reduces mistakes in data collection.
- ii. As there is no need for direct sight, the placement of tags is less restricted.

- iii. RFID tags offer a longer reading range compared to barcodes, for instance.
- iv. Unlike barcodes, tags can possess read/write memory capabilities.
- v. An RFID tag can hold a significant amount of data in addition to a unique identifier.
- vi. Implementing unique item identification is simpler with RFID than with barcodes.
- vii. RFID provides the advantage of identifying individual items as opposed to generic identification.
- viii. Tags are more resilient to challenging conditions such as dust, chemicals, and physical damage.
- ix. Multiple tags can be read at the same time.
- x. RFID tags can also be integrated with sensors.
- xi. Automatic reading at various locations decreases time delays and improves accuracy in inventory management.
- xii. Tags have the ability to store extra information locally, and this approach to distributed data storage can enhance the overall system's fault tolerance.
- xiii. It reduces the costs associated with inventory management and provisioning.
- xiv. It decreases expenses related to processing warranty claims.

DISADVANTAGES

While numerous cases of RFID implementation have been documented, the extensive adoption of the technology and the fullest utilization of its capabilities still need to address technical, procedural, and security challenges in advance. Current obstacles related to the technology are expected to be resolved, and experts are already addressing various aspects of these concerns.

- i. High cost
- ii. Frequency block
- iii. Chances of removal of exposed tags exit
- iv. Gate sensor problems
- v. User privacy concern
- vi. Reader collision
- vii. Tag collision
- viii. Interoperability

ROLE OF THE LIBRARIAN

Librarians should be familiar with the RFID system before its implementation in the library. The librarian and technical staff utilize all those systems, so they should receive proper training in the RFID system. The librarian has to be responsible for using this system very carefully because it is a costly and sensitive system. Accurately label all library documents and input the appropriate information into the system. RFID system equipment like an antenna and self check in – check out system and other peripherals installed properly fixed placed in the library. Librarians should be providing training to the users on how to use the all processes of the system.

CONCLUSION

The future of RFID technology is expected to be revolutionary, fueled by the merging of RFID with new and developing technologies. These advancements are poised to revolutionize libraries and unlock new possibilities for automation, connectivity, and data-driven decision-making. A major trend is the incorporation of RFID technology with the Internet of Things. With the growing number of connected devices, RFID will facilitate effortless data collection, communication, and management among a diverse array of physical items. Integrating IoT sensors with RFID tags will facilitate the immediate tracking, oversight, and administration of library resources, documents, and infrastructure.

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