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Application of RFID Technology in Academic Libraries Revolutionized Library Management.

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ABSTRACT

This study demonstrates how the automation and improvement of several operations brought about by RFID technology has revolutionised library management. By doing away with human scanning, RFID chips inserted inside books have made check-ins and check-outs more accurate and efficient. Self-service kiosks equipped with RFID technology have enabled customers to check out and return goods on their own. RFID systems also offer real-time inventory tracking, which lowers the amount of misplaced items and makes stocking simple.

Keywords: *RFID technology, RFID tags, books, Library management.*

Introduction

RFID stands for radio frequency identification. Radio waves allow for the tracking and communication of inanimate objects, such as library books. The basic idea behind this technology is the same as that of a mobile phone. Broadly speaking, "RFID" refers to a variety of technical solutions that automate item or person identification via the use of radio waves. There are other methods for identifying objects or people, but the most common one involves using a microchip coupled with an antenna to store a unique serial number and maybe other data; this setup is known as an RFID transponder or tag. The chip may transmit its unique identifier to a reader. After receiving radio waves reflected from the tag, an RFID reader converts them into digital data usable on personal computers.

What is RFID (Radio Frequency Identification) ?

To uniquely identify an item, animal, or person, radio frequency identification (RFID) uses electromagnetic or electrostatic coupling in the radio frequency portion of the electromagnetic spectrum. This method tracks or identifies an object by using radio broadcasts via the internet. The reader may be able to decipher data that is digitally encoded on an RFID tag. This device reads data from tags that are recorded in the database via the reader, acting as a tag or label in contrast to standard barcodes and QR codes. RFID is commonly scanned from outside the line of sight, either passively or actively.

RFID for Libraries:

RFID is used in theft detection and library circulation systems. RFID-based solutions provide faster and easier material handling, inventorying, and charging, as well as increased security and resource tracking within the

library (Booss 2004).By using this technology to scan barcodes while things are being charged or emptied, librarians can save staff time. RFID is a hybrid of microchip and radio frequency technologies. Regardless of the item's position or alignment, radio frequency technology may read data from microchips connected to library resources. This means that, unlike traditional theft detection systems, the method can scan tags even when there is no clear line of sight or flat surface. There are two sets of sensors at the library's exits that can read RFID tags from up to two feet away, allowing for gates that are as wide as four feet.

Components of RFID System:

The RFID system consists of the following four major components.

(a) RFID tag

Recognized by many names, including transponder, smart tag, radio barcode, and smart label, an RFID tag is a tiny radio device. You can't make an RFID tag without the two main components. The first component is an identifier, which is an integrated circuit, which is a little silicon chip. An antenna that can send and receive radio waves is ranked next. A flat metallic conducting coil and a chip less than half a millimeter make up the antenna.

(b) Readers

Part two of an RFID system is the interrogator, which is often called a reader. Technically speaking, reader units are transceivers, a hybrid of transmitter and receiver. Their main purpose is to extract data from tags via queries. The radio waves emitted by RFID tags are converted by readers into a format that middleware programs can understand. A reader for radio frequency identification tags connects to the RFID chip via an antenna. It can read information from the RFID tag and also add new information to it. Consequently, the RFID reader communicates with tags and receives instructions from the application software.

(c) Antenna

The antenna transmits radio signals that activate the tag and allow it to read and write data. Antennas are the pathways that provide data collection and transmission between the tag and the system manager, the reader. The constant presence of an antenna's electromagnetic field is possible when several tags are expected on a frequent basis. After individuals pass through a door, their possessions may be scanned for tag data by inserting antennae into the doorframe.

(d) Server

It is possible to put an RFID system on a server. The various components are able to communicate with one another via it. Upon receiving data from a reader or readers, it does one of two things: checks the data against its own database or exchanges it with the circulation database of the library management system. For the reports to be generated, it is common practice to include a transaction database into the server.

Components of Library RFID System :

The typical components of an RFID system in a library are RFID tags, self-checkout kiosks, book drop kiosks, staff workstations, tagging and programming stations, security gates, digital library assistants, conveyor belts, and inventory scanners.

1. RFID tags

The tiny, bendable paper tag, which is about 2" by 2", may be discreetly attached to the inside cover of every book in a library's collection. An antenna connects to a small chip that stores crucial bibliographic information, such as an item's unique identification number.

2. Self Check-Out Station :

Among the features of the Self Check-out station are a touch screen computer, an RFID reader, software for managing documents and circulation, and software for personal identification. Due to the high amount of books cycled daily, the staff is continually stressed when it comes to lending and returning books. With the use of the self-checkout technology, customers may use the touch screen menu to check out papers without the need for library staff assistance.

3. Book Drop (Return Station)

A screen and receipt printer are part of the book drop system. Users may automate the process of returning library books. The book drop is equipped with an RFID tag reader, which enables the reading of tags upon client document deposit. The time-consuming procedures of checking users in and disabling security measures are rendered obsolete. The security measure is restored, the document is automatically checked in, and the user's library account is canceled.

4. Security gates:

The use of security gates and electronic article surveillance (EAS) is one way that libraries combat theft. Important library resources that have not been borrowed or checked out incorrectly must be located. The RFID tag's chip serves as both an identifier and a deterrent against theft; it also has built-in theft detection capabilities.

5. Automated Sorting Station:

An automated sorting station gathers books from the return station and sorts, distributes, and inspects them prior to reorganizing them into various storage containers. Restocking books that are already in their proper places on the shelf requires less time and effort from the staff. A combination of a sorter and one or more book drop readers allows large circulation libraries to do away with the need to check out and organize returned library goods. A conveyor is an integral part of the sorters that transfers items from the book return(s) to the sorter.

6. Staff Work Station:

Tasks such as programming new documents, sorting documents, and charging and discharging documents are carried out at staff work stations, which are staffed workstations in a library. All you need is a computer and a reader. Using a staff workstation to program or tag a new library document is not possible until it has been put on the reader. After that, a barcode scanner reads the document's accession number, and the information is obtained from the library's management system.

7. Inventory Control

A portable reader can read inventory and shelves. The library management software receives the unique number from the reader and sends it to the server. After that, a prompt response is obtained. Alternatively, data for inventory control can be downloaded into library management software. Library staff members can locate and identify documents on the shelves more easily thanks to the shelf management system.

Types of RFID:

The most interesting aspect of radio frequency identification (RFID) technology—which comes in many different varieties, each with its own set of advantages—may be the fact that most RFID tags can function without batteries or power sources. In fact, the radio waves emitted by RFID readers provide all the power needed to operate them. This technique is called passive RFID to distinguish it from the more common active RFID, which uses a power source on the tag.

(a) UHF- RFID (Ultra High Frequency RFID)

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(b)HF- RFID (High Frequency RFID)

Books, credit cards, passports, and other noncontact payment methods probably include it. At 13.56 MHz, it operates. The induction-based physical process, instead of backscattering, limits the range of high-frequency radio frequency identification to less than one meter.

(c)Passive RFID:

Passive radio frequency identification tags do not need a power source to function. Using the power of the reader is what it does. This device makes use of passive RF tags, which don't need an external power supply and instead store energy. Active antennas and RF tags use certain frequencies while radiating it; they include low frequency bands (125–134 MHz), high frequency bands (13.56 MHz), and ultra-high frequency bands (856–960 MHz).

(d)Active RFID:

An antenna receives data, and a power source transmits signals to attach radio frequency tags, in this gadget. suggests that there is some kind of power source, such as a battery, enabling an active tag to function. Its own power supply means it may function independently of either the source or the reader. Besides High-Frequency RFID, there are other varieties of RFID, such as Low-Frequency RFID (LF RFID), which was developed earlier and is used for tracking.

Advantages of RFID tags:

•RFID tags have a longer reading range than barcodes.
•RFID tags don't have to be placed such that they are directly in front of the scanner.
• Approximately 40 RFID tags can be scanned simultaneously, making RFID tags faster to read than barcodes.
• RFID tags have substantially longer working ranges; data can be read from a tag up to 300 feet away.
•RFID tags has read/write capabilities.
• RFID has great security; data can be password-protected, encrypted, or configured with a "kill" capability that deletes data permanently.
• RFID tags can be programmed with a wide range of data functions, including expiration dates, shipping histories, and product maintenance.
• Once these are configured, it can be operated with little assistance from humans. • Because they are covered in a plastic covering, RFID tags are more durable and reusable.

Disadvantages of RFID tags:

• Because of their nature, RFID tags allow unauthorised scanners to read the data they carry. This is the reason that most RFID tags used in libraries have very little data on them, essentially just the same information as the barcode. However, RFID devices raise privacy issues even in cases where the tag is limited to a unique identification (such as a bar code). Information about anything is available to everyone.
•Information is difficult for RFID readers to read through liquid or metal. • When many tags in the same region react simultaneously, this is known as a tag collision. • When two signals from separate readers overlap and the tag is unable to react to both, a reader collision may occur.
•RFID technology is expensive despite its many advantages.
• There are still two distinct RFID chips—read-only and readable/writable—that need to be read by different machines.
• To block the radio signal in an RFID system, two or three layers of regular household foil are used**.**

RFID Challenges:

There are two primary concerns with RFID:
• Reader collision: Reader collision is the result of one RFID reader's signal interfering with another. It can be prevented by putting in place an anti-collision protocol that compels RFID tags to alternately broadcast to the appropriate reader.
• Tag collision: This happens when an RFID scanner becomes confused by too many tags broadcasting data at once. By using a reader that gathers tag data one at a time, this issue can be avoided.

Conclusion:

Radio frequency identification (RFID) technology has improved and automated several processes, radically altering library administration. Books with RFID tags within have made check-in and check-out faster and more

accurate by eliminating the need for human scanners. With the use of RFID-enabled self-service kiosks, customers can now check out and return things without assistance. There will be fewer misplaced products and easier stocking thanks to RFID devices' real-time inventory monitoring. In order to better protect their collection and provide circulation services, libraries are using RFID systems. Cost, lack of standards, and user privacy remain the main obstacles to RFID's greater use by libraries, despite the technology's tremendous growth in recent years. Since the technology will streamline the lending process and free up personnel to attend to other user-centric activities, it may be justified in terms of "Return On Investments" even with the limited budgets of the libraries who implement it. Because no universally accepted standards exist, libraries that are interested in using RFID must utilize tags that comply with a number of international standards and protocols provided by NISO, including ISO 28560-3, ISO 18000-3, and ISO 15693. Protecting patron privacy requires libraries to adhere to certain protocols, one of which is to refrain from keeping any personally identifiable information on RFID tags. Book wholesalers currently give books that are already tagged for free, so libraries have little choice but to use RFID technology.

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