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EMERGING CHALLENGES IN RFID IN LIBRARY: A REVIEW

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ABSTRACT

A library is a living, breathing entity. Because of the advancement of the Internet and new information technology, library and information workers now have tremendous potential. RFID (Radio Frequency Identification), the pinnacle of ubiquitous computer technology, has long been the talk of the town and is employed by a variety of organizations, including libraries and information centers. RFID is a cutting-edge automated library technology that automatically identifies and tracks library goods. RFID technology aids in inventory management, detecting lost things, and identifying misplaced items. It also specifies the necessary fundamental and optional components for the exercise to function properly. RFID is the most modern library theft detection technology, and it is now being employed by many libraries and information centers. It combines radio frequency technology with microprocessor technology. The efficiency benefits that this technology can provide libraries are not to be underestimated. The document outlines the system's fundamental and optional components, as well as the processes required to properly construct and run it. A comparison between barcodes and RFID is provided. This article presents a brief summary of new radio frequency identification technology, its application in libraries, and how it works. RFID has several advantages, including inventory efficiency, library collection security, and minimal vulnerability to harm. Despite its benefits, RFID technology has certain downsides and concerns, one of which is the possible threat of viruses. This article intends to address the developing problems associated with RFID technology implementation, giving significant insights for LIS professionals contemplating deploying RFID in their libraries and information centers, and emphasizing the significance of taking precautionary precautions.

KEYWORDS: RFID, Library security, Inventory control, Computer Virus, Information technology, RFID tags, RFID Technology, Library Security, Theft detection, Automatic identification technology, Smart library.

INTRODUCTION

Radio Frequency Identification (RFID) technology has advanced significantly in terms of its wide variety of applications and prospective uses. While RFID has found applications in industries like logistics, inventory management, aviation security, and transportation, its use in libraries is still in its early stages, particularly in developing nations such as India.

Library theft detection systems have progressed due to the advancement of RFID (Radio Frequency Identification) technology. RFID-based solutions, as opposed to traditional EM (Electro-Mechanical) and RF (Radio Frequency) systems not only provide security but also increased tracking capabilities. These systems allow for more effective tracking of library items, making activities like charge and discharge, inventorying, and materials handling easier and faster.

RFID blends radio frequency and microchip technology. This enables radio frequency technology to obtain information from microchips in library material tags independent of the position or arrangement of the objects. In contrast to traditional theft detection systems, RFID does not require direct vision or a stationary surface to scan the tags. Furthermore, particularly in the case of broader exit gates, the distance between the scanner and the object is not a vital consideration. Because the tags can be read by the parallel exit sensors from a distance of up to two feet, the escape corridors in this scenario can be up to four feet wide.

In RFID systems, the targets employed have the capability to serve as substitutes for both EM or RF theft detection targets and barcodes.

Due to the huge rise of information in our modern society, librarians play a critical role in organizing knowledge centers. They are constantly looking for methods to improve services by implementing cutting-edge technology. RFID is one such technology that has transformed different library services, making them more comfortable and efficient for both patrons and professionals. However, in a developing nation like India, the high costs of adopting and maintaining RFID technology continue to be a substantial barrier to wider adoption. RFID technology has increasingly replaced conventional barcodes and has the ability entirely transform inventory control. Because of its wireless identifying capabilities, it is a very promising and versatile technology that has been projected as an effective automatic identification and surveillance system since the 1980s.

What is RFID

RFID technology, which was developed in 1948, took more than half a century to realize its full potential. Developers were able to include smart features into the movement of commodities along the supply chain thanks to the advent of microscopic integrated circuits. As a result, RFID "Tags" were developed by attaching a chip and an antenna to an adhesive label. RFID entails scanning physical tags on individual items, cases, pallets, or reusable containers, which produce radio signals that reader equipment can detect. Advanced software architecture is necessary to properly gather and deliver real-time location-based information to support this procedure.

Definition: According to World English Dictionary

“RFID is a technique that uses tiny computer chips to monitor different objects, including consumer products, remotely.”

“RFID”: RFID, which stands for Radio Frequency Identification, refers to technologies that employ radio waves to automatically detect and distinguish individual items.

“Tag”: A tag is a tiny electronic chip attached to an antenna that may send and receive identifying data to and from a reader.

“Reader”: A reader, in the context of RFID technology, refers to a device that has the ability to extract data from an RFID tag or send data to it.

“RFID Subject”:or **“Individual”**:An RFID subject is a person who interacts with a product that is equipped with or has an RFID tag, such as a consumer or customer.

“RFID User”: RFID users are entities that employ RFID technology, such as RFID readers and tags. Stores, warehouses, hospitals, libraries, and other similar enterprises are examples of these entities.

“Premises”: Premises refer to various locations such as stores, warehouses, hospitals, libraries, or any similar spaces that accommodate RFID tags and the corresponding readers, enabling communication between them.

“Content”: The term "content" refers to a person's voluntary, precise, and well-informed statements of desire for their personal information to be processed via RFID technology.

RFID tags are miniature electronic devices that can hold and transmit data over short distances. They are typically very small, resembling a seed or a thin sheet of paper. When a reading device sends out a signal, the RFID tag detects it and sends its stored information back to the reader. Unlike barcodes, RFID tags don't require their own power source and instead, draw power from the query signal. The data obtained by the reader is then sent to a server for further processing. RFID tags offer two main advantages compared to barcodes. RFID tags have unique identifiers, as opposed to barcodes, which often provide a generic product code. Because RFID tags are unique, sellers may give a serial number to each individual item, allowing for more control over the distribution process. Multiple RFID tags may be read concurrently without the requirement for visibility by human or mechanical reading equipment, unlike barcodes, which need one-by-one scanning in close proximity.

OPERATIONS OF RFID IN LIBRARIES

RFID, the most modern technology used in library theft detection systems, outperforms older EM and RF systems in use for many years. RFID-based solutions, unlike their predecessors, not only increase security but also provide enhanced tracking capabilities for library goods. This includes more effective charge and discharge procedures, inventory keeping, and materials handling, all of which result in simpler and quicker operations.

- RFID is a combination of radio-frequency and microchip technology where data stored on microchips in library resources is accessed using radio-frequency, regardless of the object's position or vicinity. The sole exception to this is for larger exit gates.

- RFID targets can perform the same function as targets for preventing theft or barcodes.

RFID technology uses special stickers (flexible paper thin-RFID tags) that can be put on documents. These stickers have information about the documents stored in Library Management software. When a device called an RFID reader looks for these stickers, it sends out a signal that wakes up the sticker and makes it share the information with the reader.

When a library patron checks out a set of books, each label on the books immediately generates its own distinct item ID number, which matches the one shown on the barcode used by numerous libraries. The RFID technology transmits the ID number to the library's system for managing, which locates the correct book title, finalizes the checkout process, and provides a receipt to the patron.

If a visitor wishes to return a book to the library, the tag affixed to the book will disclose the item's identification number. Furthermore, the library's system will recognize the return by crediting the user's account. If the library has an automated material handling system, this technology will direct the book to the appropriate container for proper shelving. A portable reader, on the other hand, will produce light and sound to inform a librarian when it identifies a missing or wrongly placed item during a shelf inventory check. This reader will also alert the librarian of any materials that have been marked for special attention or action.

An RFID system's range is customized to each unique use case. When used in the setting of a library, high-frequency RFID devices can only scan tags from a few inches to a few feet away. This level of closeness guarantees that library items are processed correctly. In a huge warehouse, on the other hand, RFID systems must be able to scan tags on pallets that may be as distant as 15 feet away or moving quickly along conveyance systems. Ultra-high frequency RFID technology is used to do this. If someone tries to leave the library with an item that hasn't been properly checked out, the reader will request the tag for that item. The gate reader will sound a warning if the tag does not react, indicating that the item has not been checked out. This notice acts as a reminder to the user to either return or correctly check out the item. Additionally, the library personnel may receive an alert identifying the precise item that is creating the alarm.

RFID technology has various benefits over barcodes in libraries. Unlike barcodes, which must be presented and aligned with a scanner individually, RFID enables for the simultaneous processing of several items without the requirement for alignment. Furthermore, barcoded objects frequently require repeated scans to register, but RFID technology offers a more efficient and precise

scanning procedure. Furthermore, because barcodes are often put on the exterior surface of library objects, they can easily become scratched or destroyed over time.

CHALLENGES FACING RFID LIBRARIES

Despite the various benefits RFID technology provides libraries, it is not without difficulties and security concerns. As a result, library and information science (LIS) personnel face a variety of obstacles when adopting RFID technology in a library context. While there are various generic RFID risks, such as identity spoofing, data tampering, repudiation, information exposure, denial of service, and privilege elevation, the introduction of viral threats is a recent addition to this list. This is a considerable hurdle for RFID implementation professionals. Some of the most common challenges that LIS professionals experience while implementing RFID technology.

- **Impact of Viruses on RFID Libraries** RFID technology uses unique chips to track objects. However, there is now an issue since these chips may become contaminated with viruses. This virus has the potential to corrupt the computer that reads the information from the chip. People used to believe that scanning the chip couldn't affect the computer, but we now know that's not the case. The virus has the potential to propagate to other chips. This is quite concerning since the virus may be used to perform unpleasant things such as modify retail pricing or conceal dangerous items in luggage at an airport. We must ensure that RFID systems are secure and immune to these viruses.
- **Data Privacy and Protection** RFID automates the collecting of data about the whereabouts and behavior of individuals, and shops, hackers, and even the government may misuse this information. Numerous well-known RFID security and sequestration issues exist. As a result, civil rights organizations are quite concerned about the potential for sequestration using RFID technology. The US Department of State intends to provide passports equipped with RFID chips that store specific data. But because of the potential for revealed specific information, the American Civil Liberties Union has expressed passionate objection. They have refocused on the possibility that an RFID contagion could emerge, making markers vulnerable. It is critical to emphasize that RFID tags enable unscrupulous individuals to eavesdrop on people and acquire information about them without their knowledge or permission.
- **Bleeding Edge Technology** The young age of the industry presents another significant difficulty. The development of standards for RFID technology has only begun. Tags and readers, on the other hand, are developing and changing quickly. Additionally, there are still incompatible systems and rival technologies. Under these conditions, ongoing development could render investments in earlier technology unusable and necessitate costly retrofits and upgrades in order to keep up, rendering devices and labels obsolete. This is a major issue, especially for libraries with multiple units and locations that might roll out branches one at a time over many years. Therefore, keeping RFID technology up to date is a major challenge.

- The intention behind replacing bar coding with RFID technology is to enhance efficiency, but it is worth noting that placing a bar code on a package incurs no cost. Conversely, affixing an RFID tag carries a minimum cost of Rs.20+, and this is without factoring in the additional expenses associated with acquiring the necessary technology and software tools. While RFID vendors argue that the implementation of this technology becomes more affordable over time, the price of the tags remains relatively high. Consequently, the majority of libraries, including academic ones, are unable to adopt RFID technology. In India, only a select few libraries, such as those at IITs, IISc, IIMs, Anna University in Chennai, and the Indira Gandhi Centre for Atomic Research (IGCAR) in Kalpakkam, have managed to implement RFID due to its ongoing expense.
- The susceptibility of Fragile Tags to damage and vandalism poses a challenge for LIS professionals during the implementation of RFID. However, advancements in technology offer a potential solution to this issue. New technologies are being developed that allow for the creation of smooth labels without any bumps or protrusions, thereby addressing the problem of Fragile Tags. The susceptibility of tags to harm and intentional damage is worth mentioning, as the raised areas and projections on the chip and antenna are prone to being tampered with. Although this issue persists with older tags in libraries, newer designs have successfully mitigated this problem by minimizing protrusions and reducing the risk of potential damage. It is worth noting that advancements in technology within this industry may lead to future tags becoming as thin as paper.
- The utilization of Dual Use Tags poses a threat to security. When the same tag is employed for both circulation and security purposes, it essentially means that once the tag system is compromised, the security measures are rendered ineffective.
- The vulnerability known as Tag Interference is a well-established concept. It is widely understood that radio waves are unable to penetrate through metal. As a result, a straightforward method to bypass security systems is to envelop an item in multiple layers of aluminum foil. Additionally, it has been observed that when two tags are positioned in close proximity to one another, they can disrupt the signal and render the scanner unable to read either tag. Even though the majority of RFID vendors have software mechanisms in place to reduce this risk, interference cannot currently be completely eliminated; however, future technological advancements may be able to resolve this issue.

SOLUTIONS FOR RFID PITFALLS

There's no one-size-fits-all solution when it comes to RFID. Every technology has its pros and cons, pros and cons, so we need to figure out how to get around them. In this situation, we, the LIS experts, need to be really careful about how to get around the issues with RFID. The following actions, according to the literature, will aid in our self-defense against RFID threats.

- All middleware applications should be compiled with bounds checking enabled for languages that provide indexes that extend beyond the boundaries of an array.
- Ensure that your RFID input is accurate and current. Make careful to inform the system or your security admin if you encounter any strange characters or strings of characters so they can take the required action to resolve the problem.

- Turn off the client-side scripts when you want to avoid script injection (cross-site scripting). This can be done by disabling the scripting languages that are used by back-end scripts, which are based on Hypertext transmission protocols.
- Limiting Database Access and Separating Users You shouldn't be able to execute several SQL queries in one query due to database implementation. Making SQL statements on the fly is too risky. To ensure everything is secure, you should employ databases with stored procedures and parameter binding.
- Assure the isolation of your middleware server from the rest of your network. Ensure that your middleware servers are located in a secure area, just like any other perimeter equipment.
- To ensure that you don't have any vulnerabilities that could manifest themselves during routine maintenance or significant system upgrades, it's crucial to keep a watch on the code of your middleware application. You should conduct regular code reviews, just like you would with any other program, to ensure your security.

LIS specialists can stay ahead of any potential RFID risks by using the security precautions outlined above. To ensure that RFID security is as strong as it can be, new standards and protocols must be developed. Given that RFID is still in its infancy, more standards and protocols will emerge to fulfill the requirements of users, particularly given the expanding market for RFID.

HOW DOES RFID HELPS LIBRARY PATRONS AND STAFF

PATRONS

Faster, easier checkout and check-in. An RFID-tagged stack of materials can be read and checked out at the same time, either by a member of the library staff or a patron. As a result of the technology's effectiveness and usability, library users are more inclined to finish their own transactions. Additionally, RFID technologies greatly speed up and simplify the check-in process. RFID and an AMH returns system work together to significantly boost productivity. While the library librarian is on the floor dealing with library users, an AMH system can receive returned library materials, credit them to the user's account, and arrange them into re shelves.

Increased attention from library staff. The increased interaction with library personnel is one of many people's favorite benefits of RFID in libraries. As a result, when librarians spend less time on manual labor, they have more time for interpersonal interactions and improving the customer experience.

A more productive visit to the library. Maintaining inventory of numerous objects, including books and other items, is a difficult task for libraries. Anyone who intends to use something values it. Libraries can quickly locate these items thanks to RFID. When libraries adopt RFID, they frequently discover lost items that they had previously assumed were gone.

STAFF When librarians allocate more time to assisting individuals and less time to processing books and other

library resources, they experience a significant boost in job satisfaction, while also witnessing a decline in repetitive stress injuries. This correlation suggests that prioritizing human interaction over administrative tasks can lead to improved well-being and reduced physical strain among librarians. People can go to the library for free learning opportunities. Everyone may feel comfortable there, regardless of where they are from or how much money they have. The library makes a lot of effort to develop new programs, collaborate with other organizations, and engage the community. The library can help the staff do their duties more effectively and ensure that they have adequate time to assist everyone in the community by employing a unique technology called RFID.

CONCLUSION

In some libraries, there aren't enough staff members to handle the rising demand for library services and book loans. The libraries still desire to provide more programs and provide better services, nonetheless. As a result, they are adopting a unique technology called RFID to make processes quicker and more precise. Additionally, this technology ensures that patrons make the most of the library and keeps the books safe. Although some people are concerned about technology, it can also be incredibly beneficial for libraries and ensure the safety of their holdings with careful preparation. The future of libraries can be greatly enhanced by giving considerable funds to assist the adoption of RFID technology in libraries across the nation. Given that RFID provides long-term security for libraries, it is not overstated to claim that it is a good investment for all parties involved. Academic libraries have the possibility to receive assistance from national level organizations in India that are in charge of library and information science, like INFLIBNET, in order to deploy RFID technology more successfully. These organizations can concentrate on making sure that RFID technology is successfully implemented, with a focus on attaining cost effectiveness and perfect installation.

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