Review Article

RFID USE FOR MEDICAL LIBRARY MANAGEMENT SYSTEM TO AID DOCTORS/USERS

I. A. Ansari
Dayalbagh Educational Institute (Deemed University),
Dayalbagh, Agra-282005,

ABSTRACT

New technologies always enable any systems functionality in the effective and efficient manner, in the same way Radio Frequency Identification (RFID) technology is wireless non-contact use of radio-frequency electromagnetic fields to transfer data with the aim to automatically identify and track tags attached to objects. RFID based medical library system manages and automates the functions of library. Library automation and library security is an important aspect of any library. The system is intended to reduce the manual intervention to the utmost level possible. This system uses RFID tags to secure access. It also enables efficient positioning and identification of documents in the library selves who are unable to communicate is done efficiently by the use of RFID cards. The paper provides the helpful information to understand and implementation of RFID based library management and security system for medical library. By the help of this paper you can better understand how to use RFID for your library operation? How can save the time of doctors/users? The paper also discussed some advantages and disadvantage and comparisons with barcode system. This paper gives a brief design of the medical library system using RFID.

Keyword: RFID, Library Management System, Library Automation, Library Security.

Address for correspondence

I. A. Ansari
Faculty Librarian
Gr-I, Dayalbagh Educational Institute
(Deemed University), Dayalbagh,
Agra-282005
E.mail: iqbal360@gmail.com

INTRODUCTION

Technology has been advancing with a rapid rate and most of countries have leveraged on its potential. More and more people now use tracking and tagging devices for safety and security of various objects. In 1945, Leon Theremin, a Russian inventor, invented one of the first covert listening devices, also known as "bugs." The device was a predecessor of the Radio-frequency identification (RFID) technology. It was introduced in the 1950's, and it presents advantages over its predecessor the barcode.(2) RFID system requires small electronic devices to transmit an Identification code (ID) and non-line of sight is needed to operate. This technology proposes a set of solutions that allow tracking and tracing persons, animals and practically any item wirelessly. The RFID architecture is configured by Tags, which provide an Identification code, RFID Readers obtain wirelessly that code, and Middleware that provides a platform to interpret and utilize the collected information.(6) RFID technology enables unique identification which enables efficient identification, positioning, and tracking of objects. RFID technology has generated much hype in the last few years. The major driver for its development has been the tagging of physical objects like people, places, and things – with single chip radios so they can interface with computers. At present, RFID technology is used in almost all the industries in India. For example, identification badges containing RFID tags are used as anti-shoplifting technology.(1) RFID tags attached with books in order to detect the actual position of books in the library and in the circulation (issue/return) process of books. RFID tags attached to automobiles during the production process allow the auto producers to track the progress of the automobiles through the assembly line. RFID tags are placed on casino chips in order to detect counterfeit chips and mistakes of dealers. Cows and other livestock may carry injected RFID tags which allow the identification of the animals. The position of library resources is recorded in accordance with the reader that has read the tag most recently with the library database by implementing RFID on the books. *Fig.1* explains the general operation of RFID technology based System.(1)

Fig.1: Operations of RFID based System (source:http://daphne-systems. blogspot. in/2015/05/ growing-usages-of-rfid-readers-in-india.html)

CONCEPT AND DEFINITIONS OF RFID

The concept of RFID (Radio Frequency Identification) technology was developed in 1948 but it has had to wait fifty years before it has been able to deliver on its original promise.(1)The advent of tiny integrated circuits called 'chips' allowed solution designers to add intelligence to the movement of goods through the supply chain and when a chip and an aerial were attached to a sticky label the RFID "Tag" was born. (Edwards and Fortune, 2008).(7) The concept of RFID can be simplified to that of an electronic barcode. "It is a method of remotely storing and retrieving data using devices called RFID tags/transponders that can be attached to or incorporated into a product. RFID tags contain antennae to enable them to receive and respond to Radio-Frequency (RF) queries from an RFID transmitter/receiver." (Ansari and Sonker, 2011.(1) RFID can be defined as the wireless non-contact use of radio-frequency electromagnetic fields to transfer data with the aim to automatically identify and track tags attached to objects. Simply, RFID is a technology that uses radio waves to automatically identify people or objects.(2)

RFID SECURITY FOR LIBRARY THEFT DETECTIONS SYSTEM

RFID is a combination of radio-frequency-based technology and microchip technology. The information contained on microchips in the tags affixed to library materials is read using radio frequency technology regardless of item orientation or alignment (i.e., the technology does not require line-of-sight or a fixed plane to read tags as do traditional theft detection systems) and distance from the item is not a critical factor except in the case of extra- wide

exit gates. The corridors at the building exit(s) can be as wide as four feet because the tags can be read at a distance of up to two feet by each of two parallel exit sensors. The targets used in RFID systems can replace both EM or RF theft detection targets and barcodes. RFID-enabled systems have moved beyond security to become tracking and management systems that combine security with more efficient tracking of materials throughout the library, including easier and faster charge and discharge, inventorying, and materials handling. Documents are invaluable objects generally medical books are very costly whose safety is needed at all cost. Many a time, precious and rare books are stolen by the same people who are least expected to do the same. Libraries the world over have faced a lot of trouble in keeping their assets safe and secure from the risks of theft. RFID in Library has brought the desired respite, and the use of such a system has brought down the cases of theft. It is the latest technology to be used in library theft detection systems. Unlike EM (Electro-Mechanical) and RF (Radio Frequency) systems, which have been used in libraries for decades.(3-4)

RFID AND LIBRARY

Libraries began using RFID systems to replace their electro-magnetic and bar code systems in the late 1990s. What is the role of such a system, or what kind of technology is used therein? RFID in Library is as simple as it can get, simpler to install, simple to monitor and even simplest to maintain. It helps to track and tag the objects that need safety, i.e. the books. Once installed, the entire process of library becomes standardized where a constant watch is had on the object. Many libraries have already installed barcode systems where a barcode is placed in each book and the Library Management System (LMS) uniquely identifies the book by reading the barcode, using a barcode scanner.(6) RFID technology has enabled self service for the users like for circulation of book self issue/return of documents in the library. The main aim for today's libraries in adopting RFID technology is the need to increase efficiency and reduce time of the user. Automation and self-service can help libraries of all sizes achieve these aims, and RFID has the added advantage that it can also provide security for the range of different media offered in libraries. RFID can be used library circulation operations and theft detection systems. *Fig.2* explains an overview of RFID based LMS and security in the library system.(2-3)

Fig.2: Overwiew of RFID based Library Management System and Security (source:www.rifd-library.com)

PROCESS AND WORKFLOW OF RFID

There are several methods of identification, but the most common is to store a serial number in case of Library Accession number is important that identifies a person or object, and perhaps other information, on a microchip that is attached to an antenna (the chip and the antenna together are called an RFID transponder or an RFID tag). The antenna enables the chip to transmit the identification information to a reader.(9)The reader converts the radio waves reflected back from the RFID tag into digital information that can then be passed on to computers that can make use of it. Such a system works in unison with readers which decode the signal, means the specific chips are attached to the objects whose 'movement' get recorded with the readers in automatic way.[14] Users in RFID based library system are uses in the following ways-(8)

- Conversion station: where library data is written to the tag
- Staff workstation at circulation: used to charge and discharge library materials
- Self check-out station: used to check out library materials without staff assistance
- Self check-in station: used to check in library materials without staff assistance
- Exit sensors: to verify that all material leaving the library has been checked out
- Book-drop reader: used to automatically discharge library materials and reactivate security
- Sorter and conveyor: automated system for returning material to proper area of library Hand-held reader: used for inventorying and verifying that material is shelved correctly.(5-7)

RFID FUNCTIONS AND COMPONENTS

RFID functions by using radio waves to automatically identify people or objects. The primary use of RFID is in the form of a tag, which is created by using an antenna that transmits the information found on the microchip within the RFID tag to a reader. The reader then converts the radio waves into digital information that is passed on to computers, which will store and use the information as needed. RFID tags and readers must be tuned to the same frequency to communicate and there are three types of RFID frequencies, low, high, and ultra-high. The range of a RFID tags varies dependant on the frequency. Generally the range is anywhere between 1 foot (low frequency) to 300 feet (ultra-high frequency). In addition to three varieties of frequencies, a RFID tag can be designed either as a passive tag or active tag. Passive RFID tags do not contain batteries and instead draw power from the reader, while the opposite holds true for active RFID tags which have their own battery power source. Furthermore, the microchip within the RFID tag has two capabilities as well. First being read-only; the information stored on a read-only microchip is established during the manufacturing process and can never be changed. The second type is a read-write chip which allows the existing information to be changed or added when the tag is within range of a reader. Generally RFID have four basic components: Tag, Reader, Antenna and Server.(11-12)

RFID Tag:RFID tags are also known as transponders, which can be fixed inside the book's back cover or directly onto CDs/DVDs. The tags are basically active and passive library used passive. The information contained on microchips in the tags affixed to library materials are read using RFID reader.(1) This tag is equipped with a electronically programmable chip and an antenna encapsulated in glass or plastic. Each paper-thin tag contains an engraved antenna and a microchip with a capacity of at least 64 bits.(9)These components are available in various shapes and sizes. Each of the Tag contains and antenna. The energy required for the activation of the transponder comes from the detector. *Fig. 3* showing different type s of RFID tags.(11-12)

Antenna: The antenna produces radio signals to activate the tag and read and write data to it. Antennas are the channels between the tag and the reader, which controls the system's data acquisitions and communication. The electromagnetic field produced by an antenna can be constantly present when multiple tags are expected continually. Antennas can be built into a doorframe to receive tag data from person's things passing through the door.(1-2)

RFID Tag for Insertion

RFID-Label Construction-Inlay with Antenna and Chip

Antenna

Chip

Capacitor

Substrate

RFID Reader: RFID readers also known as receivers are composed of a radio frequency module, a control unit and an antenna to interrogate electronic tags via radio frequency (RF) communication. It provides an interface that communicates with an application.(1)The reader powers an antenna to generate an RF field. When a tag passes through the field, the information stored on the chip in the tag is interpreted by the reader and sent to the server, which, in turn, communicates with the ILM system when the RFID system is interfaced with it. RFID exit gate sensors (readers) at exits are basically two types. One type reads the information on the tags going by and communicates that information to a server. The server, after checking the circulation database, turns on an alarm if the material is not properly checked out. Another type relies on a "theft" byte in the tag that is turned on or off to show that the item has been charged or not, making it unnecessary to communicate with the circulation databae.(6)Fig. 4 shows the different type of readers.

RFID READER

Handheld Reader For verification & Issuing

Kiosk with PC

Anti-Theft Detection Door

Fig.4: RFID Readers

Hand held Reader: Handheld reader can be used to conduct audit process which will be helpful for inventory management of It is basically used in stock verification and location the documents in the library. It scans the tags

of documents on the self and sends the information to the server to check the exact status of documents. Searching of documents is very easy even in large libraries.(10)

Anti theft Detector Door: Anti theft Detector Door or Exit sensor (reader) is installed at the exit point of library. It checks the circulation status of books with server.(12)

Server: the server is the nervous system of the whole RFID system. In the server the supporting software is installed. Software that interfaces with the Integrated Library Management Software (ILMS) is loaded for its operation. The server is the main and important part of RFID systems where the software is installed to communicate the readers that control the whole system. It is the communications gateway among the various components. It receives the information from one or more of the readers and exchanges information with the circulation database.(1)

STANDARDS USED
- ISO 15693 operates at 13.56 MHz frequency having maximum read distance of 1.5 meters approximately 59 inches.
- ISO-18000-3 an international standard for Air Interface Communications at 13.56 MHz published in 2009 for read/write passive tags covering a range of 24 inches.
- SIP2 is the de facto standard makes it possible to verify that patron is a valid borrower and has not exceeded any of the library defined limits on borrowing. SIP2 is gradually being replaced by NCIP.
- ISO 28560 was still a draft standard as of mid 2009, is essential to interoperability among RFID systems (Boss, 2009)).(7-8)

PRACTICAL GUIDELINES FOR LIBRARIES
As libraries are implementing RFID systems, it is important to develop best practices guidelines to utilize the technology in best way and to keep the privacy concern away. The following may be the best practices guidelines for library RFID use(10-11)
- The Library should be open about its use of RFID technology including providing publicly available documents stating the rational for using RFID, objectives of its use and associated policies and procedure and who to contact with questions.
- Signs should be pasted at all facilities using RFID. The signs should inform the public that RFID technology is in use, the types of usage and a statement of protection of privacy and how this technology differs from other

information collection methods.**7**

- Only authorized personnel should have access to the RFID system.
- No personal information should be stored on the RFID tag.
- Information describing the tagged item should be encrypted on the tag even if the data is limited to a serial number
- No static information should be contained on the tag (bar code, manufacturer number) that can be read by unauthorised readers
- All communication between tag and reader should be encrypted via a unique encryption key and all RFID readers fixed in the library should be clearly marked.
- Updates parameters such as ISO 18000-Mode-3 or ISO 28560 should be applied.(2)
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WHY RFID TECHNOLOGY FOR LIBRARIES?

- Reduces staff stress and increases management efficiency.9
- Radio Frequency anti-theft detection is innovative and safe, can help prevent theft
- Fastest, easiest and most efficient way to track, locate and manage library materials
- Efficient book circulation and management
- Library inventory tracking like stock verification in very shot of time
- High-speed inventory and identify items which are out of proper order.
- Multiple books can be read simultaneously
- Unique identity of the RFID tag prevents counterfeiting
- Automated material handling
- Simplify patron faster self check-in/check-out
- Longevity of tags-shelf life equivalent to the books(9-10)

DIFFERENCE BETWEEN RFID AND BARCODE

The main differences between using barcodes or RFID tags are-

- RFID is able to read multiple items simultaneously and to allow items to be read without having to open them to find the barcodes.(1)
- RFID tags and workstations can also identify multi-part sets to detect whether these are complete on return or issue. This is a useful function of RFID assuming the LMS knows to look for all the parts which make up a complete item.
- Barcodes use standards that can be read by most scanners. While RFID transmission protocols are well established tags are, at present, not governed by similar standards, meaning that some tags may only be read by a specific reader.
- Barcode data is uni-directional (i.e. you can only read it, not write it). RFID not only reads from, but can also write information to, the tag.

- Stock verification made easier as no need of taking the books out from shelf. It can read multiple books out from the shelf, whereas Barcode System takes time because of the fact that each book has to take out from shelf and then scanner with scanner.(12)
- Information can be read from RFID tags much faster than from barcodes.
- Several items in a stack/counter can be read at the same time using RFID.
- Items do not have to be handled one-by-one nor removed from the shelves.
- More information can be written in the RFID tag on incremental basis
- RFID tags last longer than barcodes because nothing comes into contact with them. Most vendors claim a minimum of 100,000 transactions before a tag may need to be replaced.(11,1)

Advantages of RFID System

RFID system provides ample efficiency and free-flow functioning in every house keeping process of the library. We have discussed some important advantages of RFID technology use in library they are-

Rapid check-out / check-in: The use of RFID reduces the amount of time required to perform circulation operations. The most significant time savings are attributable to the facts that information can be read from RFID tags much faster than from barcodes and that several items in a stack can be read at the same time. While initially unreliable, the anti-collision algorithm that allows an entire stack to be check-out or check-in now appears to be working well.(12)

Patron self check-out/check-in: simple and easy way for patrons to self-checking for material loans and returns. RFID will promote Library efficiency by self-check-out and faster check-in service by providing an effective, integrated security system. For patrons using self- charging, there is a marked improvement because they do not have to carefully place materials within a designated template and they can charge several items at the same time. Patron self-discharging shifts that work from staff to patrons. Staff is relieved further when readers are installed in book- drops.(13)

High reliability: RFID library systems claim an almost 100% detection rate using RFID tags. There is no false alarm than with older technologies once an RFID system is properly tuned. RFID systems encode the circulation status on the RFID tag. thisis done designating a bit as the "theft" bit check-out/check-in. If the material that has not been properly check-out cannot pass the exit sensors, an immediate alarm is triggered, traceability of books and library members as they move.

High-speed inventorying: A unique advantage of RFID systems is their ability to scan books on the shelves without tipping them out or removing them. A unique advantage of RFID systems is their ability to scan books on the shelves without tipping them out or removing them with the help of hand held reader. A hand-held inventory reader can be moved rapidly across the a shelf of books to read all of the unique identification information using wireless technology, it is possible not only to update the inventory, but also to identify items which are out of proper order. Searching of misplaced books is very easy with hand held reader for very large library.12

Automated materials handling: Another application of RFID technology is automated materials handling. Automated return of materials that speeds up sorting of materials and re- shelving for the next patron to access. This includes conveyer and sorting systems that can move library materials and sort them by category into separate bins or onto separate carts. This significantly reduces the amount of staff time required to ready materials for re-shelving.(13)

Rapid Locate: increases productivity of staff and enhances the customer experience, can be classified by title, author, subject, or other characteristics, allowing customers to search for books and identify which shelf in the library they are on, even if they are misplaced in a different section.(6)

Long tag life: Finally, RFID tags last longer than barcodes because nothing comes into contact with them. Most RFID vendors claim a minimum of 100,000 transactions before a tag may need to be replaced.

Open System: RFID technology helps to improve utilization of resources like manpower, infrastructure and management system of any organization etc. This may sometimes have been acceptable for internal systems, but as information management moves ever further into cyberspace, modern systems have had to adopt a more "Open Systems" approach.(14-15)

DISADVANTAGES/POSSIBLE BARRIERS

RFID technology has the most of the advantages but it has some disadvantages also. they are

- RFID technology is more expensive than the more traditional combination of barcode and electromagnetic strip (Hopkinson and Chandrakar, 2006).
- RFID tags are typically affixed to the inside back cover and are exposed for removal.(15)
- Denial of service: means RFID system cannot provide normal services to valid users; service of an RFID system may be denied by 'signal jamming',

where the communication between a tag and reader is clouded.

- Information disclosure or sniffing occurs when RFID tags are read surpassing the tag bearer, therefore leaking information to unauthorised users. This destroys the integrity of the service and also infringes patron's privacy.
- Moisture presents during rains affects the RFID tags, thus will not responds to the reader.
- Lack of interoperability of tags.
- Tags can be easily damaged by users if proper surveillance is not done in library.
- Power deficit is a major concern in India. Without power the exit sensor can't work

CONCLUSION

In the present day researchers, doctors, users not have much time to go for library. So the RFID is the solution to saves their time somehow of their circulation and searching activity, i.e. they can self issue and return activity and easy searching of documents in the library. The system is a comprehensive RFID system that combines RFID security and the tracking of materials throughout the library; or it is a hybrid system that uses EM for security and RFID for tracking. The time savings are less for check-out than for check-in because the time required for check-out usually is extended by social interaction with patrons. RFID in library saves a whole lot of trouble and inconvenience to the staff, cuts down a lot of time that otherwise goes in manual handling. With such a system in place, no books go missing ever, or more precisely, none dares to misplace a book. Technology has been advancing with a rapid rate and most of countries have leveraged on its potential. Most of the library now uses tracking and tagging devices for safety and security of various objects. The growing usages and popularity of RFID in India is a true testimony of the changing times. RFID stands to benefit the greatest number of uses within society. With so much significance, it is obvious to witness a rise in the use of RFID readers in India. More people are now aware of the technology that can save them their objects. From jewelry tracking to library documents tracking, RFID readers in India are finding takers from diverse industries. In overall, the scenario of tracking and tagging looks good in India, and makers can feel the joy. The market is set to expand further, and more such devices would be needed in the days to come. The overall RFID system and is much costly you need to the proper assistance.

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