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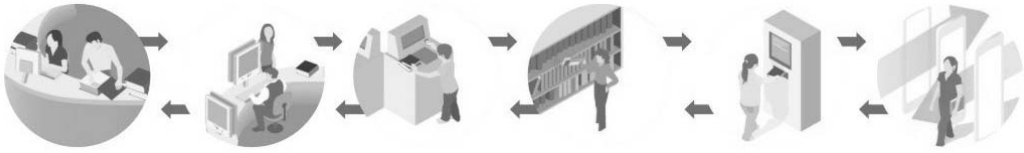
RFID (Radio Frequency Identification): Its Principles, Applications and Implementation in Library



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Abstract

According to father of library science Dr Ranganathan fifth law "library is the growing organism". As it grows in size the problems associated with the maintenance and security of the documents also grows. In this case we need a system for security of document. This era is the digital era so the every library activities become automated. To automate the counter activities they gave us bar-codes. Bar-codes have served the librarians and libraries for a long time, and now it is slowly getting replaced by RFID. RFID is a new generation of Auto Identification and Data collection technology which helps to automate business processes and allows identification of large number of tagged objects like books, using radio waves. RFID Technology changing the way of Issue/Return Process in Libraries. So now Radio Frequency Identification (RFID) systems are a technology many libraries use to make materials handling more efficient and to reduce staff workload. Here we gives an overview of the current state of the art in the radio frequency identification (RFID) technology and discusses the benefits and challenges of this technology.

Keywords: RFID, Barcode, Library, Security, Privacy, Application of RFID**.**

1. Introduction

Libraries have changed with the times and so have their collections. Today, a library's collection contains a wide variety of materials such as expensive CDs and DVDs, hard-to-replace reference volumes and popular books and magazines. Without an effective security system in place, many libraries risk the problems associated with the temporary and permanent loss of materials. To solve this problem libraries using different security system like as EM (Electro-Mechanical) and RF (Radio Frequency) systems, which have been used in libraries before year ago?

RFID (Radio Frequency Identification) is the latest technology to be used in library theft detection systems so that is being implemented in a number of industries therefore the latest addition of technology to be used in the libraries for a combination of automation and security activities in the well maintenance of documents either inside the library or goes out-of library. RFID is a technology that facilitates non line of sight identification of items. RFID systems carry data in suitable transponders, generally known as tags, and retrieve data, by machine-readable means, at a suitable time and place to satisfy particular application needs. Implementing RFID system in libraries will aid tasks such as circulation, re-shelving and it has several other important advantages. It can either replace or supplement existing library barcode systems and improve efficiency in library activities. In short RFID streamlines workflow in the area of self, books return, self management and inventory. This library security system is a perfect mix of design and performance, combining flexibility and style with state-of-the-art technology to help provide excellent detection and reliability.

1.1 RFID Origins

The origins of RFID technology lie in the 19th century when luminaries of that era made great scientific advances in electromagnetism. Of particular relevance to RFID is Michael Faraday's discovery of electronic inductance, James Clerk Maxwell's formulation of equations describing electromagnetism, and Heinrich Rudolf Hertz's experiments validating Faraday and Maxwell's predictions. Their discoveries laid the foundation for modern radio communications. Precursors to automatic radio frequency identification systems were automatic object detection systems. One of the earliest patents for such a system was a radio transmitter for object detection system designed by John Logie Baird in 1926 [4]. Better known is Robert Watson-Watt's 1935 patent for a "Radio Detection and Ranging" system, or RADAR. The passive communication technology often used in RFID was first presented in Henry Stockman's seminal paper "Communication by Means of Reflected Power" in 1948.One of the first applications of a radio frequency identification system was in Identify Friend or Foe (IFF) systems deployed by the British Royal Air Force during World War II .IFF allowed radar operators and pilots to automatically distinguish friendly aircraft from enemies via Radio Frequency signals. IFF systems helped prevent "friendly fire" incidents and aided in intercepting enemy aircraft. Advanced IFF systems are used today in aircraft and munitions, although much of the technology remains classified. Electronic detection, as opposed to identification, has a long history of commercial use. Byte mid to late 1960s, Electronic Article

Surveillance (EAS) systems were commercially offered by several companies, including Checkpoint Systems and Sensormatic. These E-Systems typically consisted of a magnetic device embedded in a commercial product and would be deactivated or removed when an item was purchased. The presence of an activated tag passing through an entry portal would trigger an alarm. These types of systems are often used in libraries, music stores, or clothing stores, like RFID tags are used by the U.S. Department of Defense (DOD) and by retailers such as Wal-Mart that need to track global shipments and deliveries and so many libraries. Unlike RFID, these types of EAS systems do not automatically identify a particular tag they just detect its presence. FID tags differ in terms of type or technology, as well as communications interface Performance specifications and optional features are also important to consider when selecting these RFID products.

1.2 Decades of RFID

1940-1950	Rader rebind and used, major world war II development effort, RFID invented in 1948
1950-1960	Early exploration of RFID technology, laboratory experiment
1960-1970	Development of the theory of RFID, start of application field trials
1970-1980	Explosion of RFID development, Test of RFID accelerate, Very early adopter implementation
1980-1990	Commercial application of RFID enter mainstream
1990-2000	Emergence of standards now RFID widely deployed

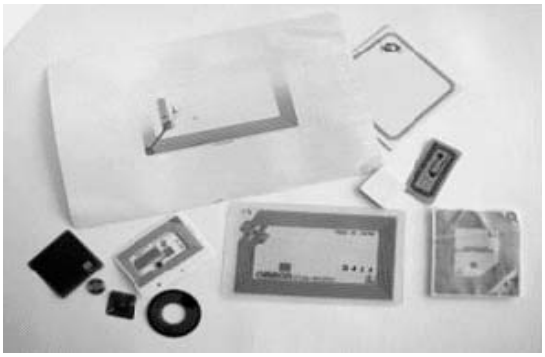
2. **Main components of RFID System**

- RFID Tags
- Antenna
- Reader
- Host Computer (PC)

2.1 RFID Tag or Transponders

RFID tags are microchips that attach to an antenna and are designed to receive signals from tags and send Signals to RFID readers. Each radio frequency identification device tag has a unique serial number, like RS232, RS422, RS485, or universal serial bus (USB) but may also contain other information, such as a user account number. Others use transistor-transistor logic (TTL) or even wireless communications. In terms of performance, specifications to consider when selecting RFID tags include frequency, memory, read rate, and detection range. Many RFID products support low, high, ultra-high, and/or microwave frequencies. Each frequency range has advantages or disadvantages that make it either more or less suitable for particular applications. Applications include logistics, aerospace, security, agriculture, and apparel. Each RFID tag contains a tiny chip, which is both readable and writable and can store information to identify items in your collection. In library applications, it also stores a security bit and if needed, information to support sorting systems.

The tag is paper thin flexible and approximately "2x2" in size which allows it to be placed discreetly on the inside cover of any books in the library. It is usually covered by label and tag can be applied on all materials formats, including print, audiotape, videotape, CD/CD and DVD etc, and information on tag would be Author, Title, self number, self location, library code, category, status etc. The communication process between the reader and the tag is by wireless. When these tags pass through a Radio Field generated by a reader, the transponder in the tag transmits the stored information back to the reader, thereby identifying the object.



(Tag for the CD/DVD)

(Tag for the Book)

Figure 1: Different Format of RFID Tags

2.1.1 Types of Tags or Transponders

There are three main types of RFID tags or transponders, as they are sometimes called:

- Passive
- Active
- Semi-passive

➢ Passive RFID tags have microchips that contain a single bit. These tags are referred throughout the world as "electronic article surveillance (EAS)" tags. Passive RFID tags do not have a battery. Instead, they draw power from the magnetic field that is created when radio waves from the RFID reader reach the chip's antenna. By drawing power from this field, passive tags can transmit information stored on the chip. Passive tags systems are reader talk first. The tags are mute until a signal is received from a reader. Also, only one reader at a time can energize passive tag but if more than reader tries to 'light up' a passive tag a condition known as 'Reader collision' occurs so RFID tags may support anti-collision or multi-read technologies that are designed to prevent radio waves from one device from interfering with radio waves from another that means passive RFID system can read multiple tags at once and that process called "singulation". There are many method of simulation, but the principle of identifying a single tag is the same.

Passive tags have several advantages over active tags. First, they are less expensive. Second, they are usually smaller and thinner and every battery eventually runs down; the absence of a battery significantly extends the useful life of a passive tag.

Passive tags operate at a low, high or ultra-high frequency. This frequency

Determines number of performance characteristics, including the distance at which tag can be read. These frequency bands are being used for RFID:

Table 1: Tag Frequency, Range, Characteristics and Performance

Frequency	**Range**	**Characteristics**	**Performance**
Low 125/134 KHz	10-20 cm	Short to medium read range Low reading speed inexpensive	Access control Inventory control Animal Identification Car immobilizer
High 13.56 MHz	10-20 cm	Short to medium read range Medium reading speed Potentially inexpensive	Access control Smart cards
Ultra High 850/910 MHz	3 Meters	Long read range High reading speed Expensive	Railroad car monitoring Toll collection systems
Microwave 2.45 & 5.8 GHz	3 Meters	High reading speed High data transfer speed High Tag code Battery replacement	Container or rail car Toll collection Pallet level and Tagging
Ultra-wide Band (UWB) 3.1-10.6 GHz	10 Meters	Very Long read range High reading speed Compatible with metal or liquid	Active container seals Container tracking for DLA

2.1.2 Work Process of Tag

1. Tag enters RF field created by the antenna
2. Antenna's RF signal activates the tag
3. Reader sends a modulated signal
4. Tag demodulates the signal and returns its data to the reader
5. Reader sends data to the computer
6. Computer transmits new data through the reader to the tag

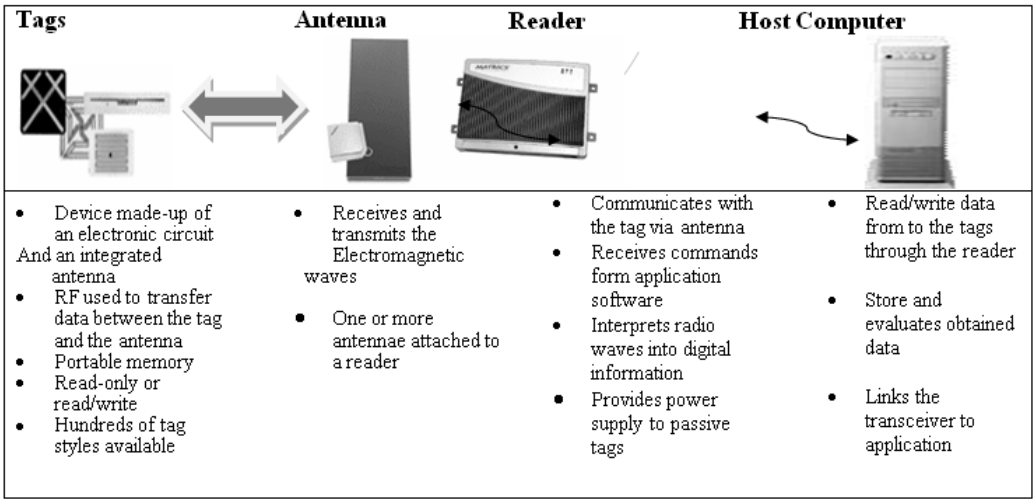


Figure 2: Components of a Passive Tag with their features

- Active RFID tags are equipped with a battery that is used to power the microchip's circuitry and transmit signals to RFID readers. Active tags can be read from a distance of 100 feet or more. They are very useful for toll road collections and tracking hospital equipment, railcars and other valuable assets. Because of their bulk and expense, active tags are not used on library or retail items.

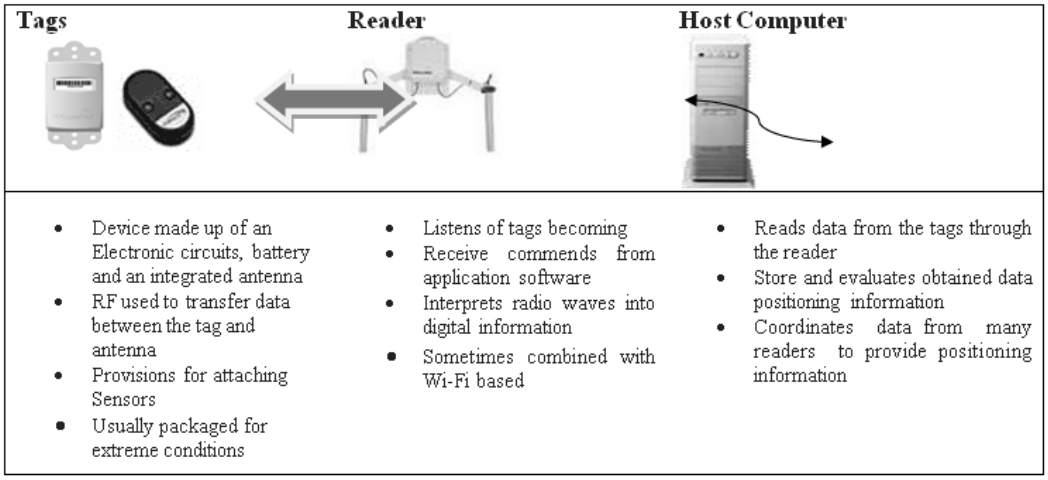


Figure 3: Components of an Active Tag with their features

- Semi-passive RFID tags are similar to active tags, but only use the battery to run the microchip's circuitry. Some semi-passive tags "sleep" until they are "wakened" by a signal from the RFID reader. This technology conserves battery life.

2.1.3 Format of information in Tag

Tag	Description	Example
Library Member Tag	Library member tag contains a 16 digit, first 7 characters are 'CDAC001' which will be followed by the 9 digit for employee ID	CDAC001119313003 So "119313003" is an employee ID
Book Tag	Book tag contains a 16 digit, first 6 characters are 'CDACFF' followed by the book no. and if the book no. has less than 10 digits than it will be prefixed by '0's.	CDACFF0000000123 So "123" is book no.

2.1.4 Features of Tag

- No line of sight needed
- Allows to check-out and check-in several items simultaneously
- Information directly attached to product
- Performing both identification and antitheft in one single operation
- Able to tag almost anything
- Different shape and sizes available
- Fast scanning and identifying

2.1.5 Tag Functionality

There are two basic types of chips available first one is Read-only and second is Read-Write:

- **Read only:** Read only chips are programmed with unique information stored on them during the manufacturing process so the information on read-only chips cannot be changed.
- **Read-write:** In this chip user can add information to the tag or write over existing.

Some vendors offer tags which can only be "written to" once. That is, once the tag is programmed, the information stored in the tag's memory cannot be changed. Alternatively, information stored in the memory of read/write tags can be updated as required.

➢ **Anti-collision**

All RFID vendors in the library market offer a product with anti-collision (the ability to read several tags simultaneously). However, the speed at which this can be performed, and the total number of tags that can be read, will vary. This relates specifically to inventory management with a hand-held reader, and check-in processes.

➢ **EAS** (Electronic Article Surveillance) mechanism

As mentioned above, RFID can be used to prevent theft in the library. This approach varies from vendor to vendor – the security mechanism may be integrated into the chip itself, or security gates may be linked to a separate server which interrogates the database to conclude whether an alarm needs to be triggered.

- **Cost**

- Expect to pay from US$0.85 to over US$1 per tag.
- The price of hardware (per unit) varies extensively from different suppliers. However, the infrastructure requirement also varies.

- **Standards**

The emerging standard for library RFID solutions is to employ a frequency of 13.56MHz. However, no formal standards are currently in place

2.2 Antenna

A conduit between RFID tags and the reader. RFID antennas emit radio waves that activate RFID tags as they pass through the activation field. After a tag is activated, it can send information to or receive information from the reader.

Passive RFID tags utilize an induced antenna coil voltage for operation. This induced AC voltage is rectified to provide a voltage source for the device. As the DC voltage reaches a certain level, the device starts operating. By providing an energizing RF signal, a reader can communicate with a remotely located device that has no external power source such as a battery. Since the energizing and communication between the reader and tag is accomplished through antenna coils, it is important that the device must be equipped with a proper antenna circuit for successful FID applications. An RF signal can be radiated effectively if the linear dimension of the antenna is comparable with the wavelength of the operating frequency. However, the Wavelength at 13.56 MHz is 22.12 meters. Therefore, it is difficult to form a true antenna for most RFID applications. Alternatively, a small loop antenna circuit that is resonating at the frequency is used. A current flowing into the coil radiates a near-field magnetic field that falls off with r-3. This type of antenna is called a magnetic dipole antenna. For 13.56 MHz passive tag applications, a few micro henries of inductance and a few hundred pF of resonant capacitor are typically used. The voltage transfer between the reader and tag coils is accomplished through inductive coupling between the two coils. As in a typical transformer, where a voltage in the primary coil transfers to the secondary coil, the voltage in the reader antenna coil is transferred to the tag antenna coil and vice versa. The efficiency of the voltage transfer can be increased significantly with high circuits. This section is written for RF coil designers and RFID system engineers. It reviews basic electromagnetic theories on antenna coils, a procedure for coil design, calculation and measurement of inductance, an antenna tuning method, and read range in RFID application.

2.3 Reader

RFID reader forms the heart of an RFID system. It is mainly responsible for the functioning and controlling of an RFID system at a particular frequency. It’s a link between RFID tags and the PC

The reader can send information in two directions, It can read information from a tag and send it to the PC (read mode), or it can read information from the PC and send it to an RFID tag (write mode). A typical system includes several different kinds of readers, also known as sensors when

Installed at library exits. These are radio frequency devices designed to detect and read tags to obtain the information stored thereon. 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 decoded by the reader and stored, sent to a server, or communicated to an integrated library system when the RFID system is interfaced with it. When there is no server, most of the software is on the readers.

Long Range Reader

Medium Range Reader

2.4 Host Computer (PC)

This is the link between the reader and your library automation system. A host computer may be configured with an RFID system. It is the communications gateway among the various components. It receives the information from one or more of the readers and checks the information against its own database or exchanges information with the circulation database of the library's integrated library system. The server typically includes a transaction database so that reports can be produced.

3. RFID Technology in Library

The rapid development in information technology has brought out a revelatory change in the field of library systems and services. The new information technology has changed the manual scenario of library to computerized automated library. The RFID technology is a latest technology for automatic identification method.

RFID technology is being implemented in a number of libraries with RFID tags, because of security concerns. A Radio Frequency Identification (RFID) tag is an electronic device that holds data. Typically these tags are attached to an item and contain a serial number or other data associated with that item. An RFID tag is a small, low-cost device that can hold a limited amount of data and report that data when queried over radio by a reader. Several libraries, such as the Santa Clara City Library in California, the University of Nevada, Las Vegas library, and the Eugene, Oregon public library have already tagged every book, tape, CD, or other item in their collections. In an item-level tagging regime, the ability to track tags raises the possibility of surveillance of library patrons and their reading habits. We investigate privacy risks in libraries use of RFID technology and methods for minimizing such risks. FID is a combination of radio-frequency-based technology and microchip technology. At its most basic, RFID systems consist of small transponders, or tags, attached to physical objects. RFID tags may soon become the most pervasive microchip in history. When wirelessly interrogated by RFID transceivers, or readers, tags respond with some identifying information that may be associated with library

data records. Thus, RFID systems are one type of automatic identification system, similar to optical bar codes. The use of RFID in library reduces the amount of time required to perform circulation operations That is due to the fact that the tags can be read regardless of item orientation or alignment (means the technology does not require line-of-sight or a fixed plane to read tags as do older technologies) 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 charged or discharged now appears to be working well. Finally, RFID tags can be read from distances of up to 24 inches—distances far greater than possible with light pens and barcode wands. That is what makes RFID systems not only faster, but able to support electronic inventorying of materials on the shelves with handheld devices. Basic tasks in library management include the planning of acquisitions of materials, arranging the acquired materials according to the library classification, preservation of materials the de accessioning of materials, patron borrowing of materials, and developing and administering library computer systems. Among these, the proposed system will automate the following tasks using RFID technology-

- Accessing number of books at a time
- Searching a particular book to check its presence in the library
- Locating the physical location of the book
- Accounting/Stock verification of the materials

3.1 Components of RFID for Library

Normally a RFID package for library consists of these components:

- **Staff workstation for circulation:** used to charge and discharge library materials,
- **Self check station:** used to check in and out library materials without staff assistance,
- **RFID Security/Sensor Gate for Anti-theft Detection:** 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.

3.1.1 Staff workstation

Counter Station is a staff assisted station on services such as loan, return, tagging, sorting and etc. The programming station is used to program RFID tags affixed to library materials. Using a standard scanner, the barcode is read and its data is automatically programmed in the tag book placed on the programming station. Alternatively the self adhesive RFID tag is pasted on the book and the book is placed on the programming station attached to the PC and the accession number is entered through keyboard and the book data is programmed in the tag in case the book is not

bar-coded. RFID programming station is made up of RFID Reader and an Antenna. It can read information stored in the RFID tag and also update this RFID tag with new information.

It is loaded with arming/disarming module, tagging module and sorting module. Arming/Disarming module allows EAS(Electronic Article Surveillance) bit inside the tag of the library material to be set/reset so as to trigger/not trigger the alarm of the EAS gate. Checking of EAS status of library material is easy. The staff puts the item on the reader and click on the view to display the information stored inside the tag and status of EAS. There are also feature of Auto Arming and Auto Disarm. Auto Arming /Disarming will automatic arm/disarm library material that is within the Reader range.

Figure 3: Staff Circulation station

Self-issue stations come in a wide variety of shapes and size and its work process is;

- Borrowers present their identification to the unit; this might be another RFID enabled card, a barcode or some other technology.
- Depending on library policy they may be required to enter a pin code or password.
- Items placed on the reading table for read and passed for checking to the LMS (Library management system) than LMS return its decision to the self services unit.
- Security data written to the tags to allow or deny them to pass the security gates.

Features of Self check-out station

- Combines check-in, checkout and tag programming in a single station
- Editing and updating of patron's record like add and deleting of patron's record
- Generate loan history for particular patrons

- Managing of fines incurred by the patron
- Arm/Disarm of EAS bit inside the library material
- Program of new library material
- Sort item in accordance to their branch and category number
- Can process both bar-coded and RFID tagged items
- Provide Value Added Customer Service instead of manual daily routine
- Perform media check-in/-out for those patrons who choose not to use the self service system
- Help patron that need assistance from the staff

3.1.2 Self check-out station

The Patron Self Check-out station is basically a computer with a touch screen and a built-in RFID reader, plus special software for personal identification, book and other media handling and circulation. After identifying the patron with a library ID card, a barcode card, or his personal ID number (PIN), the patron is asked to choose the next action, check-out of one or several books. After choosing check-out, the patron puts the books in front of the screen on the RFID reader and the display will show the book title and other information and its ID number which have been checked out. The patron then confirms that he has finished the check-out process and a receipt is printed, showing which books have been borrowed and the return date. The RFID tag in the book is set on quiet as a result no alarm will go off at the EAS gates.

(Print Receipt after transaction)

Figure 4: Self check-out station

Features of Self check-out station

- Speed up book check-in/check out
- Free staff to better service patrons
- Reduces queuing time

- Borrow, return and renewal transaction roll back recovery feature when error occur
- Web based remote monitoring, administration, diagnostic from admin station
- LED status indicator capturing of patron upon transaction
- Easy receipts roll changed multi item borrow, return and renewal, etc

3.1.3 RFID Security/Sensor Gate for Anti-theft Detection

RFID EAS gate is used to detect RFID tags that are equipped with EAS (Electronic Article Surveillance).RFID gates are designed to pick-up active alarms from the RFID tags on the library items such as books, CD/DVD, etc. It is able to detect RFID tags within 1m range without interference from magnetic items. The Library staff will then receive an alarm (light and buzzer), if a library item passes unauthorized. The gates work independently and do not need to communicate with other units in order to identify RFID tags with an active alarm. They can identify EAS or AFI alarms. For the AFI alarm, national settings can be used. The RFID EAS gate comes with a patron counter which counts the number of people passing through as well as alarm counter which register the number of EAS alarms triggered. The gate is also able to capture item IDs of armed items, reducing the hassle of filtering them out from disarmed items.

Figure 5: Exit sensors (Double Aisle)

Features of RFID Gate

- Detects EAS armed RFID tags and triggers audio and visual alarm
- Multi-item and multi-directional and parameter settings
- Records and detects patron count
- Support remote monitoring and parameter settings
- Support read and write of RFID tag data while passing through

3.1.4 Self Return Book-drop and Sorter & conveyor

The book drops can be located anywhere, within or outside the library so book return station can be installed at any convenient location to enable patrons to return their

items anytime. An external book return is a machine with a slot with a chip RFID reader integrated into the wall. The Books may be returned in a similar way to self-issue but in most cases a borrower card is not required for a return. The operation is even simpler than issue. The user will identify him/her if library system required, and the puts the books in to the slot which we can see (figure 6). Once completing the return, the user will receive a receipts showing how many and which books were returned. So the It will automatically check in books, take them off the user's library account, and reactivate the security function. Book drop counter combined with the Sorting units which provide an effective way to

Automatically sort the items that have been returned to the library. The book will be identified at a RFID reader unit, located inside the book returns lot, and then placed in a bin. Two or more bins Can be used for sorting books on hold, media groups etc. In a more sophisticated system, the sorting Can be ex- pended to numerous bins with the appropriate conveying equipment. Basically process is:

- The borrower activates the return function via a touch screen
- Items are passed through a slot (resembling a letter box)
- RFID tags are read and checked to ensure, that it is an item belonging to the library if it is a set, that it is complete
- SIP messages are exchanged with the LMS to determine the delivery location.
- Optionally a receipt is printed.

The system sorts the books using conveyors and bins. Staff may have to be on hand to monitor the system and to cope with any problems but the system should be expected to have the capacity to process all returned items without queues forming. Libraries should do some analysis of their peak volumes and ensure that their RFID solution can cope with these volumes.

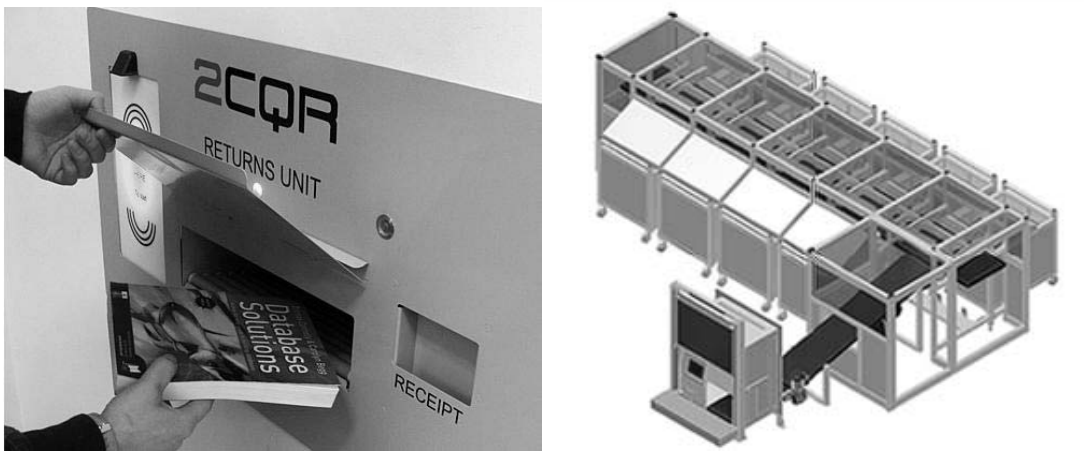


Figure 6: Self Return Book-drop image along with sorter and conveyor

Features of Self Return Book-drop reader

- Patron can return the book during off hours if book dropper installed in outside

the library.

- Loan for the returned items will be immediately cancelled so that user can borrow again other books.
- Library staffs have more time for customer service, as they are from the labor-intensive loan cancellation activity associated with bas-code system.
- Patron can see the return status on display and can get printing receipt
- The design of the book drops is such that cannot be retrieved back once again

3.1.5 Hand-held reader

This device (figure 7) is basically used for various wireless functions like to take inventory, to locate specific types of books or media, and to find misplaced items. The portable handheld reader or inventory wand can be moved along the items on the shelves without touching them. The data goes to a storage unit, which can be downloaded at a server later on, or it can go to a unit, which will transmit it to the server using wireless technology. The inventory want will cover three requirements:

- Screen the complete book collection on the shelves for inventory control
- Search for books, which are miss shelved
- Search for individual book request

Figure 7: Hand-held reader

Features of Hand-held Reader

- Can hold information for more than one million items
- Make shelf-reading, re-shelving, sorting, searching, weeding and finding exceptions much easier and more efficient
- The antenna makes reading items on high or low shelves easier
- The fastest inventory it can ever make 20 books per second

4. Difference between Barcode and RFID System

This section of this chapter on RFID technology focuses on revealing the fact that as compared with the other existing identification and data-carrying technologies like magnetic stripes, barcodes, vision systems and contact memory. RFID has high data

capacity, high robustness and high operating distance. Moreover, specifically, RFID is often positioned as the next generation barcodes or intelligent barcodes due to its real benefits over other existing competent technologies like barcodes.

RFID and barcode are similar in that they are both collection technologies, they automate the process of collecting data. However, they also differ significantly in many areas but some advantages of barcode over RFID, RFID will not completely replace barcode technology. Since the mid 1970s, the retails supply chain and many other areas have used barcodes as the primary form of the auto identification. Barcode is a visual representation of data that is scanned and interpreted for information. Each barcode contains a certain code which works as tracking technology products and is represented in a sequence between parallel lines or other shapes. Barcode are read with an optical reader the read beam form the scanner as it reads the barcode, which convert the bars into a universal product code. This code identifies the product manufacturer and type. Barcodes require direct line of sight. In other words, scanner must see the barcode and at a time scanner can be read only one barcode. On the other hand RFID uses radio waves to transmit data rather than optical recognition. An RFID reader transmits signal radio waves through one or more of its antennas. RFID tags, which hold product identification information electronically on a silicon chip, are inactive until the radio waves sent by the reader electromagnetically charge the tag. The RFID tag then answer the sending the back its information which is captured by one of the reader's antennas.

So they both are carry the information about the product but however there are more difference between both technologies with the advantages and disadvantages

4.1 Difference between with their advantages

4.1.1 Barcode

1. Barcode scanners need a direct line of sight to the barcode to be able to read. In order to read the barcode, the barcode scanner needs to be quite close.
2. Less expensive than RFID as barcode are directly printed onto plastic or paper materials.
3. Much smaller and lighter than RFID tags ant therefore easier to use.
4. Barcodes work with the same accuracy on various materials in which they are placed.
5. In many cases; barcode accuracy has been said to be the same or even better than RFID tags.
6. Today barcodes are found on almost every item and there are no privacy issues involved with its use.
7. Barcodes are a universal technology in that they are the norm for retail products; stores that own a barcode reader can process barcodes from anywhere in the world.

4.1.2 RFID

1. RFID tags don't need to be positioned in a line of sight with the scanner.
2. RFID tags are read/write devices.
3. RFID tags are more reusable and rugged as they are protected by a plastic cover.

Once these are set up it can be run with minimal human participation.

4. Can read RFID tags from a greater distance than barcodes so RFID tags can be read at a faster rate than barcodes; as approximately 40 RFID tags can be read at the same time.
5. RFID tags carry large data capabilities such as product maintenance, shipping histories and expiry dates; which can all be programmed to the tag.
6. RFID contain high levels of security data can be encrypted, password protected or set to include a 'kill' feature to remove data permanently.

4.2 Difference between with their Disadvantages

4.2.1 Barcode

1. Barcodes may be extremely cheap, but their stumbling block is their low storage capacity and the fact that they cannot be reprogrammed.
2. Barcode scanners need a direct line of sight to the barcode to be able to read.
3. Barcodes are more easily damaged; as the line of sight is needed to scan, the printed bar code has to be exposed on the outside of the product. So if a barcode is ripped or damaged there is no way to scan the product.
4. Barcodes have no read/write capabilities they do not contain any added information such as expiry date etc. They only have contained about the book.

4.2.2 RFID

1. RFID involves assembling and inserting a computerized chip which works out to be more expensive.
2. Reader collision can occur where two signals from different readers overlap and the tag is unable to respond to both. And as same Tag collision can occur when numerous tags in the same area respond at the same time.
3. RFID still has two separate chips (read only and readable/writable), which cannot be read by the same machine.

5. Advantages of RFID System

The major advantages of RFID application in libraries can be summarized as :

5.1 Rapid charging/Discharging:

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 charged or discharged now appears to be working well.

5.2 Simplified patron self-charging/discharging:

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.

5.3 High reliability:
The readers are highly reliable. Some RFID systems have an interface between the exit sensors and the circulation system to identify the items moving out of the library. Were a patron to run out of the library and not be intercepted, the library would at least know what had been stolen. If the patron card also has an RFID tag, the library will also be able to determine who removed the items without properly charging them. This is done by designating a bit as the "theft" bit and turning it off at time of charge and on at time of discharge.

5.4 High-speed inventorying:
unique advantage of RFID systems is their ability to scan books on the shelves without tipping them out or removing them. A hand-held inventory reader can be moved rapidly across 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.

5.5 Automated materials handling:
Another application of RFID technology is automated materials handling. This includes conveyor 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. Given the high cost of the equipment, this application has not been widely used.

5.6 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.

5.7 Fast Track Circulation Operation:
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 charged or discharged now appears to be working well.

6. Disadvantages of RFID System

6.1 High cost:
The major disadvantage of RFID technology is its cost. Licensing and maintenance costs for using hardware and software are high and integration option limited.

6.2 Vulnerability to compromise:
It is possible to compromise an RFID system by wrapping the household foil to block the radio signal. It is also possible to compromise an RFID system by placing two items against one another so that one tag overlays another. That may cancel out the signals. This requires knowledge of the technology and careful alignment.

6.3 Removal of exposed tags:
6.4 The RFID Tags cannot be concealed in either spine or gutter of the books and are exposed for removal. If a library wishes, it can insert the RFID tags in the spines of all except thin books; however, not all RFID tags are flexible enough. A library can also imprint the RFID tags with its logo and make them appear to be bookplates, or it can put a printed cover label over each tag.

6.5 Cultural barrier:
Privacy concerns could significantly delay the acceleration of item level tagging in libraries. Though library tags contain limited information like accession number, call number and title holding, but it can track a person easily in exit gates. Therefore, it is essential that all such information should be shared with users in advanced. Another cultural barrier to RFID adoption involves the relationship between retailers and libraries. Thus it is important to monitor legislative activity and prepare to inform legislators about the difference between retail and library application.

6.5 Other barrier:
- Items with odd shapes and metal components, such as CDs, DVDs are stretching the creativity of vendors of RFID systems for libraries.
- As we move to other documents like magazines, pamphlets, sheet music etc that may not have a good location for bulky 2inch tags and tag cost is significant.
- This system alternatively reduces staff and patron interaction, so that proper interaction cannot be maintained among them.

7. Role of Librarian
Now days because of information explosion Librarian has continuously polish his or her own knowledge and skills related to becoming an effective learning facilitator and collaborator. In the current scenario Librarian or library professional have the knowledge of HTML, Networking, scripting languages, the ability to deal with the back-end of the OPAC, the ability to translate library services into the online medium, the ability to troubleshoot basic computer and printer problems. They are always worried for the security of library materials so RFID is the beat security system for them. The technology allows for greatly improved services for patrons especially in the area of self-checkout, it allows for more efficient use of professional staff, and may reduce repetitive stress injuries for library workers. And yet, the technology introduces the threat of hot listing and tracking library patrons. Librarians have taken extra steps to ensure that laws such as the USA PATRIOT Act cannot be used by government entities to invade the privacy of their patrons, and yet many of those same

libraries are placing track able chips on their patron's books. Libraries have traditionally acted to protect and defend the privacy of their patrons and yet some are implementing a technology before proper safeguards have been developed. Library use of RFID technology serves to legitimize the technology in the eyes of the community. Therefore, it is incumbent on the library community to ensure that the technology is developed in concert with established privacy principles and that any library use of RFID follows best practices guidelines consistent with library values.

8. Vendors

There are some venders who provide the RFID .The products of six manufacturers of library RFID systems are available in India through their business associates: Rapid Radio, Bibliotheca, Checkpoint, ID Systems, 3M security, X-indent technology GmbH represented by InfoTech software and systems in India and TAGSYS—the last represented by Tech Logic, Vernon, Lib best, Libsys in India and VTLS Cap Gemini. There are several other companies that provide products that work with RFID, including user self-charging stations and materials handling equipment.

9. Conclusion

This involves affixing a tiny RFID tag onto each book, which allows it to be read by readers stationed across the library. The advantage of this technology over barcodes is that RFID technology does not require a direct line of sight. Thus, multiple books can be detected and checked out simultaneously, instead of having to scan every individual book. In addition, patrons can check their books out themselves, instead of relying on a librarian. This gives the librarian more time to help out other library members, and it lets patrons check their books out faster.

RFID also acts as a security guard on the premises, alerting the guards if a book leaves the library without being checked out. Thus, one single technology, RFID, can replace the existing bar code technology for checkout, as well as the EM technology for theft detection.

RFID also helps in re-shelving, since wrongly shelved books can be instantly identified without needing a line of sight read. Patrons searching for books can also find books much faster using a handheld RFID scanner, instead of having to manually look through the shelves.

Finally, RFID also lets patrons return a book anytime they want. This is because the RFID chip in the book can be identified by the reader in the book drop box, and the returned book can be recorded. A librarian does not need to be physically present to collect the returned book, and so the library effectively stays open 24/7.

Given the many advantages that RFID has over traditional technology that is used in libraries today, many large libraries all over the world such as the Seattle Public Library in America and the Shenzen Library in China have already switched over to RFID.

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