RFID Technology : A Revolution in Library Management

Indira Koneru

Abstract

RFID (Radio Frequency Identification) technology is proven to be a promising alternative in relieving the library staff from time-consuming routines. RFID is an innovative automated library system for automatic identification and tracking of library material. An automated library with the support of RFID technology would be a "Booksmart Library" and a "self service station" that insists least intervention by library personnel. RFID technology is helpful in taking inventory, finding missing items and identifying misfiled items. Tags or transponders, the vital components of RFID, are the electronic chips consisting of an integrated circuit and antenna coil that communicate with a reader by means of a radio frequency signal. Since RFID does not require 'line-of-sight' between the transponder and the reader, it surmounts the limitations of other automatic identification devices, such as bar coding. Smart labels/tags are designed for lasting to lifetime of the item they identify and also perform the EAS (Electronic Article Surveillance) function to detect the thefts.

Keywords : Automatic identification technologies, RFID, radio frequency, smart label, microchip, EAS

0. Introduction

Emerging technologies that relieve the personnel from time-consuming library operations, have always been of interest to libraries. When libraries of all kinds (public, academic, special) are facing budget crunches, considering new technologies as the potential alternatives for cost saving and hassle free management of library operations, is imperative. RFID (Radio Frequency Identification) system is such a promising alternative that aid in the efficient flow of library material.

RFID is an innovative automated library system for automatic identification and tracking of library material. Currently RFID applications range from book tracking and stock management, to theft detection and automatic book sorting. Radio frequency identification (RFID) technology is a dynamic link between people, objects and processes and in the near future it plays a prime role in data collection, identification as well as analysis necessary for specific library operations. An automated library with the support of RFID technology would be a "self service station" that demands least intervention by the library personnel. Efforts are being made to introduce self-service "check-in" and "checkout" that avoid long delay in the delivery of library material and also for achieving better efficiency in operations.

RFID is used in libraries primarily to automate the book handling process including checkout, inventory control, check-in and anti-theft. When combined with Computer Assisted sorting equipment, RFID facilitates and speeds up even book sorting. Automating the library material handling process allows librarians to spend more time with the clientele, thus, increasing the 'user satisfaction'.

1. Origin of RFID

RFID was introduced in the early 1980s for item tracking and access control applications. Tracking of materials is done using radio frequency based technology combined with microchip technology, hence designated as RFID (Radio Frequency Identification). These contact less and wireless automatic

identification data capturing systems are highly effective in hostile environments such as, industry and logistics, textile and libraries, where barcode labels cannot survive and need for inventory control and waste management. Owing to its ability to track moving objects RFID has been established itself in livestock identification and automated vehicle identification systems. In recent times, its use has risen to track books, audio/video tapes and other multimedia collection in a library. After realizing the advantages of RFID technology, libraries are considering it, the more productive tool for flow management sooner than barcodes and other identification technologies.

2.   Challenges Before Libraries

1. Rising labour cost.
2. Inefficient use of trained staff.
3. Increased material handling cost/time.
4. Increased theft.
5. Long queue times.
6. Mis-shelved items.
7. Poor inventory control.
8. Need for improvised and efficient user service.

3.   Benefits of RFID for Libraries

- RFID tags replace both the bar code and traditional security systems and creating a "smart library".
- Check-out stations can be automated with easy, intuitive interfaces, since several items in a pile can be "grabbed" at a time;
- Book returns can be automated with check-in and database updates completed simultaneously in the book return chute.
- Fast and convenient on-the-shelf inventory allows accuracy in collection management;
- Automatic book sorting.

RFID technology uses are limitless, flexible and easier to use than other forms of data collection. RFID is a multi-purpose technology, however, the full potential of RFID technology and some of its unique applications and solutions have yet to come to the information industry. RFID is the new technology that revolutionizes Library Management by increased productivity in deficit budgets. It can be harnessed to:

- Reduce material handling time.
- Do more frequent and accurate inventory to better manage collections.
- Improve ergonomics of the repetitive tasks of librarians.
- Improve customer service.

A big advantage of RFID is that it's not dependent upon the 'line-of-sight', since it uses radio-frequency signals. Since RFID does not require 'line-of-sight' between the transponder and the reader, it surmounts the limitations of other automatic identification devices, such as bar coding. RFID systems work effectively in hostile environments where excessive dirt, dust, moisture and/or poor visibility would normally hinder rapid identification process. One of the most outstanding benefits of RFID is its ability to read through these environments at remarkable speeds — responding in less than 100 milliseconds in most cases.

4.   Advantages over other ID Technologies

Designed specifically for libraries, RF labels offer the following benefits over traditional barcodes:

1. Combining both material identification and security into one single tag or transponder, thus, saving cost and time

2. Multiple items can be read at a time, resulting speedy circulation

3. RFID labels or smart labels can be attached to divergent media, such as CDs, DVDs and other print and non-print media

4. Tags are read/write, providing flexibility in encoding and decoding

5. Durable labels i.e., designed to last lifetime of the item they identify

6. While a laser scanner must read bar codes, RFIDs emit a radio signal that can be picked up from a remote site i.e., 'line-of-sight' that involved in bar codes is not necessary for capturing the item data.

The major disadvantage of RFID technology is its cost and lack of standardization. For a small library with 40,000 items costs around $ 50,000 and a comprehensive RFID system with 100,000 items with a patron self-charging, anti-theft and book drop unit and automatic book sorting system ranges from $.100,000 to $.200,000. Standards will bring interoperability to libraries using RFID. International Standards Organization (ISO) communities have been working on RFID communications protocol standardization for many years and are expected to near its completion of publication under automatic identification and data capture techniques specifications viz., the ISO18000 series of standards.

5.   RFID System Components

An RFID system comprises of a number of components including a range of transponders, handheld or stationary readers, data input units, and system software. The transponders or ID tags are the backbone of the technology and come in all shapes, sizes and read ranges.

A comprehensive RFID system has the following key components:

•   RFID tags that are electronically programmed with unique information.

•   A reader connected to the Library Information System.

•   An antenna connected to the reader.

•   A server to receive and decode the information and to communicate with the automated library system.

Tags also known as transponders are electronic chips consisting of an integrated circuit and antenna coil that communicate with a reader by means of a radio frequency signal. They have an EAS (Electronic Article Surveillance) function to detect thefts. It comes in various shapes and sizes. Tags have three memory components:

1. Item identification i.e., barcode no.
2. Security bit that is turned off and on as items are checked out and checked in
3. Variable memory that is of use in sorting the items.

RFID tags are available as labels with adhesive backings and the ability to reel through a label printer. After sticking RFID label on the book, its information such as Accession Number is registered in the chip of the label. This function allows writing such information on chip either from the Library database or by scanning existing barcode labels, if any. The tags can be purchased blank when retrospective conversion of barcoded collection is to be taken up or pre-programmed, if automation is at initial stage i.e., libraries, which have collection without barcodes.

Reader or interrogator is an electronic device that activates a transponder and retrieve data stored in its IC chip. It is used for communication between RFID tags and a host computer system. A reader generally consists of an RF transmitter and receiver and an antenna for communicating with tags. Communication between the reader and a transponder (tag) via radio waves is a two-step process: in the first step a reader through radio waves activates the transponder and in the second step the transponder responds by returning the data on the IC. Reader may be portable and stationary type and with the aid of a processor it decodes the information.

Server is the focal point of a comprehensive RFID system, which acts as a communication gateway among various components. It receives the data transmitted from the antenna and exchanges the information with the circulation database.

6.   Technical Choice

The choice between low frequency and high frequency depends upon the application. A low-frequency device typically provides slower data transfer and must work at closer distances to an object. Relative speed of the tag moving on a production line past an interrogation unit is approximately 20 miles an hour. On the other hand, high-frequency devices can work at distances up to 250 feet and at relative speeds greater than 150 miles per hour. Barring the high fixed costs, high frequency system is suitable for a 'smart library'. It works when a reader sends a signal to the transponder or ID tag via an antenna. The transponder's electronics return the ID code via a modulated signal being continuously reflected off the transponder's antenna, giving an impressively quick read. On the other hand, low frequency systems are more suitable for tracking, monitoring or controlling the workflow of objects used for manufacturing, production, and processes.

7.   How Does it Work

An RFID system consists of a reader, comprising a transmitter and receiver, together with an antenna and an integrated circuit transponder tag or "smart labels"– microchips attached to the antenna. The transmitter sends out a radio signal on a specific frequency using the antenna. The tag if within the transmitter's reading range recognizes this signal. The tag then responds with a signal that is recognized by the receiver. The significance of recent RFID technology is that most tags are battery-less and receive the energy to power the tag from the transmitter signal. This not only makes the tags low-cost devices but also saves the environment since most of the applications require low-cost and single use throwaway tags.

Smart label or tag (microchip) can be embedded virtually into any object including books and other stock of library individually identifies the book using a unique, unalterable code. The chip communicates with the circulation database of a library so that each item's location, whether on the shelves, checked out or being processed, can be determined. With a hand-held reader the clientele and staff members can scan the shelves to find out the misplaced objects by radio pulse.

Tagging job can be undertaken either by the library or a book jobber or the publisher at the time of publication. However, most libraries prefer to maintain their own tagging and verification station. When

RFID tags are passed in front of a reading station, a radio field charges the chip and lets it transmit its data. Thus, the information contained in the microchips affixed to the library materials is "captured" and retrieved using radio frequency technology regardless of its location.

8.   RFID at Each Step of Material Handling

The RFID tag entrenched into each item (books or other media) of the library brings efficiency at all stages of the library management process. The RFID tags communicate to RFID stations (a combination of the reader and the antenna is an RFID station), which are connected to Integrated Library Software (ILS) and allow instantaneous update of the database.

8.1   Item identification and theft prevention

RFID smart labels or tags reliable and easy to use. Tags are flexible paper-thin with an electronic chip, which are wireless readable and writeable. They can be read using radio frequency technology that operates without contact and line of sight. They are designed for lasting to lifetime of the item they identify and also perform the EAS (Electronic Article Surveillance) function to detect the thefts. Library users leaving the building pass through a four-lane EAS (Electronic Article Surveillance) exit gate, which uses RFID to check articles being carried through. Items not authorized for taking away trigger the security system's alarms.

8.2   Conversion Station and Cataloguing

Conversion from barcode to RFID is a combination of programming and the application of the RFID tag.

8.2.1 Programming

Programming is a single operation that involves scanning of the book ID, encoding of the RFID tag and the activation of the antitheft. The programming of the RFID tag can be done while reading the barcode. A unique number can also be pre-programmed in the RFID tag to link it with the book references.

8.2.2 Application of the RFID tag

Application of RFID tag reduces time and inconvenience of this repetitive task, since only one label can be applied for both the item ID and antitheft function. And for new items or libraries adopting automation for the first time, the process is even easier, since one just has to stick and program one single label.

8.3   Circulation Desk

Circulation desk where librarians do manual checkout and check in of the items, with prolonged queue times is in desperate need of RFID technology, which lessens the cumbersome processes and makes the processes fast and convenient for both patron and the staff.

To borrow items users simply identify themselves at self-service stations and place the items they want to take out on a pad with an antenna. The borrowing station updates the database, assigning the book to the patron and resets the chip to show that the item can be taken from the building. All this is done in one automatic process. Moreover, RFID allows for multiple checks out of books.

And if the library utilizes RFID even for patron cards, then the user identification can also be read with the same reader at the same time, which benefits the library check in process.

8.3.1 Self Check Out

RFID check out system is user friendly, highly intuitive and reduces the queuing times. At this station, the books to be checked out are placed on the deck and both patron card and stack of books can be read simultaneously i.e., recording the patron's ID, the borrowed items and deactivating the antitheft. All this updating of the   library database happens automatically even for multiple items checked out by the same borrower. A receipt confirming the details of borrowed material and due date is printed out.

8.3.2 Check in

Books can be placed on deck station one by one without any intervention by staff. The returned item is instantaneously updated in the ILS and the antitheft is activated. This automated book return gives enhanced benefits to patrons as well as librarians. For patrons it offers great flexibility in returning their material when they want and gives better availability of books as updating the library database is done in real time. Optionally, a receipt is also printed out to confirm the returning of borrowed material.

And for librarians, it saves time by avoiding certain repetitive tasks, since multiple items can be read/write at the same time and at quick pace. It offers reliable book sorting system due to the fact that RFID tags can be read quickly and independent of tag orientation or position.

8.4   Inventory Management

With RFID, inventory management becomes possible, fast and accurate, as it is at least 20 times faster than with barcodes. By carrying a handheld inventory reader along the bookshelves to collect the data and do the inventory. Smart labels inlayed in books can be read in seconds. Up to 64,000 books ID numbers can be stored in the reader memory. It is tremendously time consuming why because instead of handling each book, just walking down a section of a gangway the computer wand reads it, since it's multidirectional. The hand held reader has an audible signal to indicate the misplaced books. This is useful for taking inventory, finding missing items and identifying misfiled items, a common and labor-intensive problem to correct in a library. The collected data is then automatically downloaded to the library database.

8.4.1 Sorting

When book is put on the deck, Integrated Library Software (ILS) harnessing RFID flashes the accession number and shelf number, which facilitate shelving of items. And it provides additional information such as item belonging to other location or if it is a reserved item, etc.

8.4.2 Book Drop

When books are returned through the 'Book Drop' facility of a library, the smart labels are automatically read and both patron record and library database get updated. The theft detection system into the smart labels is simultaneously activated. This Book Drop allows patrons to return items 24 hours a day, 7 days a week. A conveyor sorting system for books that are returned through the Book Drop can be installed.

9.   Conclusion

A library and information system cannot be said fully automated, unless the 'Auto ID technology is not incorporated into the 'Integrated Library System'. One such Auto ID technology is RFID, which proven to bring convenience and efficiency in the item management through the automation of library functions.

Henceforth, many libraries are choosing RFID technology, which significantly improves the customer service and enhances the patron satisfaction.

RFID refers to the process of grabbing and retrieving data from integrated circuits using 'radio frequency' transmission. RFID seen as the next generation of the barcode offers libraries marvelous opportunities by contributing to saving time and manpower and creating cost efficient and total quality services. Embedding books and other library items with radio frequency identification chips, widely known as RFID tags, would improve efficiency by helping staff track materials better, deter theft and allow patrons to check out books faster.

An Integrated Library System harnessing RFID technology, convert a traditional library into a 'Booksmart Library' by reducing queue times at circulation desk, quick inventory control without handling books, trouble-free identification of misplaced books, automatic book sorting and theft prevention and more time for library staff to assist the patrons. However, careful analysis of potential implications relating to "individual privacy" is global imperative, since privacy advocates worry about what happens when the RFIDs leave the library.

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About Author

Mrs. Indira Koneru is Faculty Associate in DLIS at ICFAI University, Hyderabad-500 082, India. Earlier she was Librarian at K.E.S.Polytechnic College, Vijayawada, India.
E-mail: indk68@hotmail.com