

Library Automation Using RFID



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Introduction: RFID is a technology that is sparking interest in the library community because of its applications that promise to increase efficiency, productivity and enhance user satisfaction.

Globally emerging knowledge-based societies of the twenty first century will need information to sustain their growth and prosperity. With intellectual capital as investments, knowledge and information have become wealth generators. In this scenario, who can deny the importance of libraries, which are repositories of reference resources?

A library stacked with books and other information dissemination processes, has a physical presence. A library is an institution of knowledge acquisition and learning; it provides invaluable service to its members, patrons and to a wider local community.

Current library management systems use barcode technology and security strips. Using barcodes, a library management system can keep records of lending, borrowing and shelving status of items such as books, audio or video tapes, CDs, DVDs, etc. Security strips on library items tag their movements.

But barcodes and security strips (electronic article surveillance or EAS) have their limitations. They are slow to read and are prone to sabotaging by thieves. All these lead to irreparable loss to a library and its valuable inventory stock. This is where RFID technology can come to the aid of library managers and users.

Many libraries are switching over to RFID applications, for example, the Vatican Library. With its priceless, ancient collections of 2 million books and manuscripts, the Vatican Library is now using RFID to track, manage and secure its assets. The main problem these ancient libraries face are thefts, non-returns and mis-filed items. It is expected that by adopting an RFID solution the Vatican Library will be able to control misuse of its library and at the same time provide its users the best possible facilities and access to rare manuscripts.

In the ensuing discussions we will see how RFID technology is recommended for library automation. RFID technology is not just there to tag books and other library assets; it will provide a comprehensive route for enhancing all library services and upgrade operations for everyone concerned with the library.

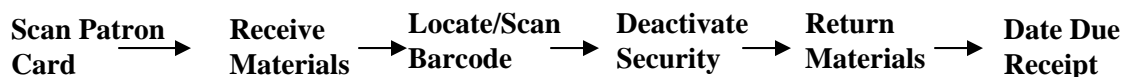
Issues: During a day, library managers have to supervise many activities within their libraries. These activities have to be performed smoothly and simultaneously for the benefit of all persons concerned.

Some of the important functions in a library are:

- check-in/check-out of items
- Shelve items
- Prevent thefts
- Check inventory

If each of these functions is done by conventional methods, they will take time and lead to inefficiencies and unsatisfactory services to the library patrons.

Let us see how check-out of items is done with barcodes and EAS.



It is a six step process. This is tedious and slow. If by using RFID technology this process is made for time-efficient, then it could be recommended.

As far as shelving is concerned, in a conventional library, it is done manually. In most busy libraries, many books, DVDs, audio cassettes and videos must be shelved everyday. This is a time consuming task. Misplacement of items, mis-shelving of books, is quite common. Not only this, repetitive re-shelving task can be health risk to library staff. If automated, all these problems can be avoided.

In each and every activity within a library, RFID technology will provide a greater amount of efficiency and error free functioning. It will ensure that there is:

- Quick check-in/check-out of items for convenience of members
- Quick and correct shelving of items
- Complete prevention of thefts
- Quick inventory check

RFID tags contain a memory chip and RF antenna that can send and receive several bits of data. Such RFID tags are known as smart labels or digital identification tags. These tags provide benefits of electronic article surveillance (EAS) as well as barcodes.

Solution: For a library, smart labels have several added advantages over EAS and barcodes. One of the major benefits of an RFID system in a library is the ease of check-in and check-out of library items. Patrons can self check-in and check-out library items, saving themselves valuable time. To understand this in details, let us see how a smart label on an item communicates.

In a library, an RFID system consists of:

- A smart label
- A reader or a hardware for interrogating the smart label
- A software for controlling the hardware and decoding the responses from smart labels

Since RFID tags do not have line of sight requirements:

- Many items can be read simultaneously even whilst stacked
- Items do not have to be opened and scanned one at a time
- Items in multiple formats like books, CDs, etc. can be read at the same time

Automated counters, which read RFID signals, can help patrons:

- To self check-in/out of items from a height adjustable counter (may be placed anywhere suitable within the library)
- To quickly renew their issued out items
- To obtain a receipt of the transaction

These automated self check-in/out counters are suitable for children and persons with physical disabilities.

After a check-out operation, the same RFID system disables the security requirements so that patrons can take the books, CDs, videos, etc. outside the library.

Many libraries, where RFID technology is operational, have an external chute, mounted on the exterior walls of the library, for returns of books and other borrowed materials. This is operational 24 x 7. (In principle, the return drop boxes may be placed anywhere – at airports, at town centers, at railway stations, etc.) These return chutes have RFID readers installed in them.

The external return chutes can be opened by member's card (secured access). On-board receipt printer can print out the details of the items returned and automatically check items back to the library management system.

Sorting and shelving becomes quick, easy and accurate with RFID technology.

Once items are returned, a digital sort conveyor belt can place them in appropriate bins from where staff can place them in their correct shelves. With hand held mobile digital library assistant and inventory wand, the library staff can obtain data about shelving the item and other information immediately (catalogue number, shelf number, etc.).

Many libraries have found that with RFID technology inventory and scanning of items:

- Take only 10% or less time as compared to conventional systems
- Misplaced books and other materials can be found easily – the reader can hone-in of misplaced or wrongly shelved items quickly
- Find cataloguing errors and replace incorrect spine labels

Besides these incredible technological advantages, an RFID system in a library can offer the following as well:

- RFID tags are safe for magnetic media such as CDs, DVDs, etc.
- Some RFID tags are rewritable. If, for example, a cataloguing error occurs, it can be rectified quickly
- Less manual handling of items hence better preservation
- RFID 'smart' membership cards can give members: access control in certain areas, make payment (fines or fees) easy, lets them use fee-based library facilities such as the photocopier, internet, etc.
- Staff has more time from routine chores and can therefore provide better service to patrons
- Staff schedules can be made flexible
- Tags last longer than barcodes as reading is contact-less

Solution details: With RFID applications in libraries, all the library assets, namely books, manuscripts, CDS, DVDs, videos, audio cassettes, etc. have to be embedded with RFID tags. The RFID readers and antennas are placed conveniently where library users will have maximum access. In addition there has to be computers that are managing and controlling all the library activities.

Thus, in a library, an RFID system consists of:

- A smart label which can be attached to or concealed within a library item – it contains a memory chip and RF antenna to send and receive data and can be programmed
- Hardware for interrogating the smart label
- Software for controlling the hardware, programming the tags and decoding the responses from smart labels in the interrogation zone

The three main system components can be further separated into six more sub-components:

- A smart label or a tag
- A reader
- An encoder or a printer
- A middleware
- An application software
- A host system or a server

Middleware: RFID middleware is a software layer that connects data coming in from tags (on library items such as books, etc.) and readers, to the library management system.

Middleware provides a coherent and stable interface between RFID hardware operations and flow of data elements such as membership number, catalogue number, etc. into the library database. RFID middleware solutions provide messaging, routing, and connectivity features required to integrate RFID data into existing library management system.

Server: A server is the heart of an RFID application system. It is the communications gateway among the various components of the system. It receives the information from one or more of the readers and exchanges information with the library databases.

Application software: The applications software would have the APIs (API: Applications Programming Interface) necessary to interface the RFID system with the server, etc. so as to achieve automated library system.

RFID application software is generally a browser-based management interface for centralized monitoring. The software enables safe, secure and highly efficient movement of library items by asset tracking and prevents loss or tampering.

Tags and readers: The microchips on the RFID tags can be programmed electronically. Similarly a reader (technically known as an interrogator) has to be programmed to send and receive correct information from a tag.

There are three types of tags:

- Read only
- Write once (WORM: Write Once Read Many)
- Full read/write

All of the RFID tags used in libraries are passive types of tags.

Generally data stored on the tags have the following options:

- Item id
- theft bit
- shelving information
- date of circulation

The barcode of an item and its item id are kept identical.

Readers are RF detectors that can read tags to obtain the information stored within them. It has an antenna that sends and receives signals. A reader generates 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 sent to the server.

There is software in each reader to facilitate communication with the server and therefore automate the whole library system.

Today's library RFIDs mainly operate in the high-frequency (HF) 13.56 MHz band, the most widely used of the RFID HF bands because it's the global standard frequency for contact-less smart labels. These tags have a read range of about 3 feet.

Business benefits: A library RFID system consists of several components: tags, tag readers, tag programming stations, sorting equipment, tag inventory wands, etc. A tag microchip is programmed with distinctive information about the item (for example, barcodes) which can be directly imported from an integrated library system (ILS) at the tag programming station. Thus the new technology can be easily merged with the existing ILS.

RFID application in libraries will benefit all persons involved in managing, running and using their facilities.

Let us look at the business benefits that are anticipated with RFID technology.

Benefits to library management:

- Uncompromised security within the library
- Efficient collection management system (can be located suitably and made 24x7)
- Uncompromised collection security
- Flexible staff schedules
- Labor saving methods free the staff to help customers
- Higher customer/patron satisfaction levels
- Improved inter-library cooperation
- Better preservation of inventory because of less handling by staff
- Same security and labeling formats for all items such as books, CDs and DVDs, hence better management of databases

Benefits for library staff:

- Time saving devices free them to help customer better
- Labor saving devices free them from doing repetitive, physically stressful tasks
- Can have flexible working schedules

Benefits for library patrons:

- Self check-in and self check-out facilities
- Check-in and check-out of all types of items (books, audio tapes, video tapes, CDs, DVDs, etc.) at the same locations
- More staff available for assistance
- Quicker service such as payment of fees, fines, etc.
- Better inter-library facilities, more efficient reservation facilities, etc.
- Faster and accurate re-shelving means patrons can find items where they should be, hence quicker and more satisfying service
- Height adjustable self check-in/out tables are liked by children and physically disabled persons who use the library

Possible problems: RFID technology will continuously communicate with the library database, the real danger of merging this technology is in letting secure ILS database be contacted/updated/opened several times and thereby make them prone to hackers.

Some of the technological problems that may occur with RFID applications in libraries are:

- RFID tags are not hidden since these tags are typically affixed to the inside back cover and are exposed to vandalism
- Some interference from metallic material in book covers, CDs and DVDs does occur and tag reading may not be correct
- RFID tags are easy to shield from readers by ordinary aluminum foils and may not serve the purpose of being anti-theft tools
- RFID reading accuracy declines if many items are read simultaneously (although collision avoidance air interface protocol may be used to minimize this effect)
- RFID reader range depends on its power and antenna size

In addition to these technical problems, there may be other difficulties in implementing RFID systems in libraries. Some of these are:

- Privacy issues
- Forward (future) compatibility and inter-library operations due to differences in tags or software
- Limitations in reorganization of library spaces
- Metal shelves may hinder operations of readers and sensors
- Operational difficulties such as installation of return chutes, provision of power supply near the self check-in/check-out desks or chutes
- Budget restrictions for technology upgradation as RFID tags are more expensive than barcodes and security strips

Summary: Today's library RFIDs mainly operate in the high-frequency (HF) 13.56 MHz band and are very suitable for library application since they have longer read ranges, about 3 to 5 feet.

Although RFID technology has matured and offers an ideal solution for libraries to replace their EAS and barcode systems for security and theft prevention, the picture is not all that smooth. There are several concerns and some are about patron privacy violations.

Large numbers of libraries have gone into RFID tagging for their inventory and have put in place best practices to inform their patrons about the use of technology and protection of their privacy.