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# Application of radio frequency identification (RFID) technology in libraries

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**Abstract**
The 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. Due to development of Radio Frequency Identification (RFID) systems is rapidly growing and has the potential to affect many different field and applications. The researcher summarize major RFID applications, and present a primer on RFID fundamental principles. Finally, we discuss several challenges and obstacles to RFID adoption, as well as emerging technologies relevant to RFID. This paper describes the potential of Radio Frequency Identification technology in facilitating efficient library operations and demonstrates that RFID can be used in libraries to ensure security and facilitate innovative services and highlights key issues that need to be addressed in order to achieve successful implementation of RFID in Libraries and also examines key challenges in the deployment of the technology.

**Keywords:** radio frequency identification, rfid, rfid technology, usage of rfid in library

## Introduction
The Radio Frequency Identification was invented in 1969, patented in 1973, first used in Harsh Industrial Environment in 1980s', and standards presented in 2001, is 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 uses wireless radio communications to uniquely identify objects or people, and is one of the fastest growing Automatic Data Collection technologies, which is comprising one or more reader/interrogators and RF transponders in which data transfer is achieved by means of suitably modulated inductive or radiating electro-magnetic carriers. In addition it can be used as a data carrier, with information being written and updated to the tag on the fly. 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.

## Radio Frequency identification (RFID)
The Radio Frequency identification is a technology that uses radio waves to transfer data between a reader and an electronic tag which is attached to a particular object. Typical uses are for object identification and tracking". According to Harrod's Librarians' Glossary and Reference Book, "Radio Frequency Identification, an alternative to the Bar Code that uses tiny microchips in tags to hold and transmit detailed data about the item tagged. RFID has advantages over bar codes such as the ability to hold more data, the ability to change the stored data as processing occurs, it does not require line-of-sight to transfer data and is very effective in harsh environments where bar code labels may not work". The RFID, thus is a generic term for technologies that use radio waves to automatically identify people or objects.

## RFID Tag
An RFID tag is a tiny radio device that is also referred to as transponder, smart tag, smart label, or radio barcode. There are two main components present in the RFID tag. Firstly, a small silicon chip or integrated circuit which contains a unique identification number (ID). Secondly, an antenna that sends and receives radio waves. The antenna consists of a flat, metallic conductive coil and the chip which is less than half a millimeter

## Readers and Antenna
The second component in a basic RFID system is the interrogator or reader. Technically, reader units are transceivers (i.e., a combination of transmitter and receiver) and their usual role is to query a tag and receive data from it. RFID reader converts radio waves from RFID tags into a form that can be passed to middleware software. An RFID tag reader use antennas to communicate with the RFID chip. It can read information stored in the RFID tag and also update RFID tag with the new information. Hence, RFID reader accomplishes two tasks: it receives commands from the application software and communicates with tags.

**Middleware**
The middleware and software applications are required in an RFID environment. Middleware manages the flow of information between the readers and the backend. In addition to extracting data from the RFID tags and managing data flow to the backend, middleware perform functions such as basic filtering and reader integration and control. RFID middleware assist with retrieving data from readers, filtering data feeds to application software, generating inventory movement notifications, monitoring tag and reader network performance, capturing history and analyzing tag-read events for application tuning and optimization.

**Server**
A server may be configured with an RFID system. It is a communication gateway among the various components. It receives the information from one or more readers and checks the information against its own database or exchanges information with the circulation database of the library integrated management system. The server typically includes a transaction database so that the reports can be produced.

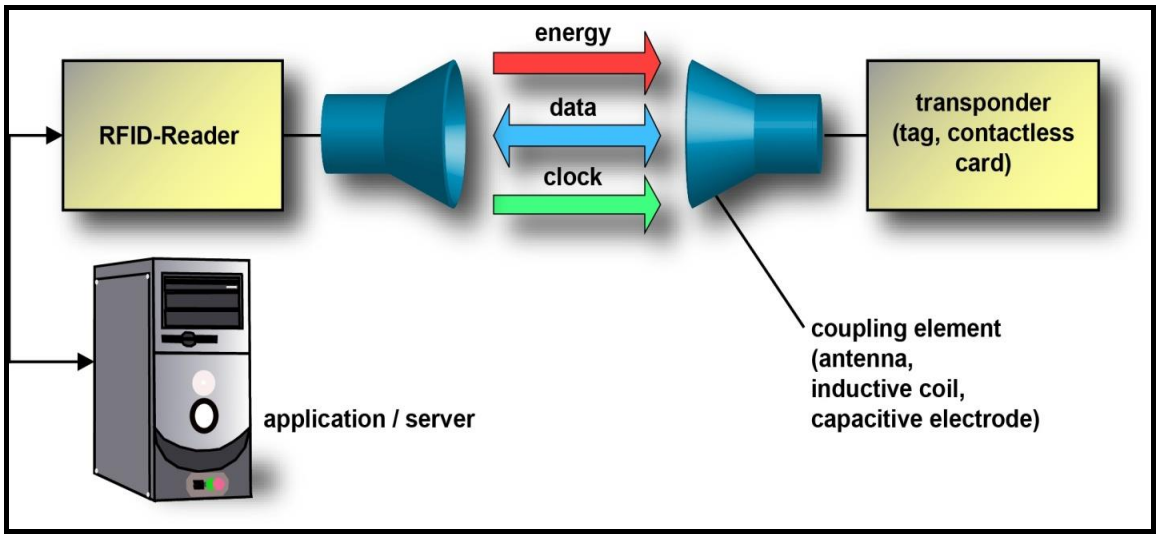


**Fig 1**

**How RFID Works?**
When the power supply is given to the RFID reader, first it will start to emit radio waves continuously. Now, when the RFID tag is brought within the range of the reader, the tag will start to send radio waves back to the reader. The reader then receives the waves and identifies the frequency to generate a unique ID. Reader after decoding the data encoded in the integrated circuit of tags transmits it to the PC for use.

**Application of RFID in Libraries**
Large number of RFID systems installed in warehouses and retail establishments worldwide, these are relatively new in libraries. The use of RFID by libraries since from a decade has grown dramatically. The adoption of RFID technology by libraries promises a solution that could make it possible to inventory hundreds of thousands of items in their collections in days instead of months. In addition, it allow patrons to check out and return library collection automatically at any time of the day. Besides speeding up checkouts, keeping collections in better order and alleviating repetitive strain injuries among librarians, RFID promises to provide a better control on theft, non-returns and misfiling of a library's assets.

**Library RFID Components**
An RFID system for library normally consists of RFID tags, a self-check-out station, a self-return system/ book drop system, a staff work station, a tagging/programming station, security gate/s, a shelf scanner for inventory/digital library assistant, conveyor belts and sorting systems, etc.

**RFID Tag**
The tag is paper thin, flexible and approximately 2"x 2" in size which allows it to be placed inconspicuously on the inside cover of each book in a library's collection. It consists of an attached antenna and a tiny chip which stores vital bibliographic data including a unique ID number to identify each item

**Self-Check-Out Station**
The Self-Check-out station is a computer with a touch screen and a built-in RFID reader, software for personal identification, document handling and circulation. Considering the high levels of circulation per day, the staff is always over burdened with the issue and return of books. With the use of Self Check-out system, the patrons can

check out the documents themselves by following the touch screen menu without taking any assistance from library staff.

**Book-Drop Station**
The book drop system consists of book drop with screen and receipt printer. It allow patrons to automatically return the library documents. A reader installed in a book drop allows reading of the RFID tags as patron drops off the documents. It eliminates the labor-intensive steps of check-in and deactivation of the security protection by the library staff. It automatically checks- in the document, takes them off the patron's library account and reactivates the security function.

**Security Gates**
Security gate is an anti-theft system used by libraries. It plays a crucial role in detecting un-borrowed or improperly checked-out library document. Theft detection is an integral feature of the chip within the RFID tag which performs both the item identification and antitheft function.

**Automated Sorting Station**
Automated sorting station take books from the return station, checks them in, sorts and distributes the books to multiple bins or areas for re-shelving. Books are re-shelved by determining their shelving location in less time with less staff work. Libraries with large circulation eliminates the check-in and sorting of returned library documents by combining a sorter with one or more book drop readers. The sorters include conveyers to move materials from the book returns to the sorter.

**Staff Work Station**
Staff work station is a staff assisted station which is used in a library for charging and discharging documents, programming of new documents, sorting of documents, etc. It consists of a reader and a PC. For doing programming/tagging of a new library document with the help of staff workstation, it is first put on the reader, the accession number of the document is read with the help of barcode scanner and then the data is downloaded from the library management system.

**Inventory Control**
Inventory and shelf reading can be carried out with a portable reader. The reader transmits identification number to the server, which in turn sends it to library management software and response is returned in real time. Alternatively, information may be downloaded with library management software for inventory control. Shelf Management system makes it easier for the library staff to locate and identify the documents on the shelves.16 2.2 How RFID system works in the library The RFID technology works through flexible, paper-thin RFID tags, which can be placed inside the cover of each and every document. Complete information about each document is entered into the Library Management Software. Whenever a user brings a document for issue-return purpose, the RFID reader from the tag reads the information pertaining to that book and transmits the data into the software and document is issued in a few seconds without the assistance of the library staff. As the user takes the document outside the library, the antenna placed at the exit gate automatically reads the information contained on the RFID tag to verify whether the document is properly issued or not. In case, it is not issued to the user as per library norms or it is being stolen from the library, the antenna senses it and gives an instant alert. Thus, it results in successful theft reduction of documents. RFID technology is not only being used for circulation purpose in the libraries, it is also used for stock taking purpose.

**Advantages and Disadvantages of RFID in Library**
Because of low cost of the barcode technology, most of the libraries around the world are using it for circulation management. However, the main constraints related to barcode technology are that it always requires a line-of-sight, does not provide security of library collection, does not offer any benefit for collection management and is becoming very difficult for the libraries to satisfy the increasing demands of the users. Hence, a need was felt to have a better technology that can improve the circulation management, inventory and security of library collections. Some of the advantages of RFID in libraries include issuing multiple books at a time; simplified self-charging/discharging; reduction in queue at circulation desk /counter; more hours of circulation; saving time of the library staff while issue/return of document; allow library staff to provide other users' centric service; reduction of staff at circulation desk; increased issue/return of library documents; security of library collection, etc.

**Advantages of RFID**
- RFID tags can read from a greater distance than barcodes.
- RFID tags don't need to be positioned in a line of sight with the scanner.
- RFID tags can be read at a faster rate than barcodes; as approximately 40 RFID tags can be read at the same time.
- RFID tags can work within much greater distances; information can be read from a tag at up to 300 ft.
- RFID tags are read/write devices.

- RFID contain high levels of security; data can be encrypted, password protected or set.
- To include a 'kill' feature to remove data permanently.
- RFID tags carry large data capabilities such as product maintenance, shipping histories and expiry dates; which can all be programmed to the tag. Once these are set up, it can be run with minimal human participation.
- RFID tags are more reusable and rugged as they are protected by a plastic cover.

**Disadvantages of RFID**

- RFID involves assembling and inserting a computerized chip; which works out to be more expensive.
- RFID readers struggle picking up information when passing through metal or liquid.
- Reader collision can occur where two signals from different readers overlap and the tag is unable to respond to both.
- Tag collision can occur when numerous tags in the same area respond at the same time.
- RFID still has two separate chips (read only and readable/writable), which cannot be read by the same machine.

**Conclusion**

This paper presented about the implementation of RFID technology in a library. RFID technology has a big potential to become ubiquitous in the near future. Today it is already successfully used in libraries for library operation. RFID is a technology that offers many advantages to the library by creating time-saving process management efficiencies, thus enabling staff to provide more value-added services to user. RFID also provides the patron with self-service check-in and checkout options. It is a technology that offers many advantages to the library by creating time-saving process management efficiencies, thus enabling staff to provide more value-added services to patrons. RFID also provides the options of self-service check-in and checkout for patrons.

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