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RFID: The Security for Library

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Radio frequency identification (RFID) technology, a surveillance system promises to relieve repetitive strain injury, and improving safety, security, productivity, accuracy and convenience for communities working in various sectors. This Dedicated short-range communication (DSRC) system has been used in library for multiple purposes; such as automatic identification, tracking and management of material flow. It has also provided an additional advantage to Bar-code technology. In this article authors have presented in details about the genesis, overview and technology associated with implementation of RFID technologies in library application. Also author have discussed major standards and components of RFID system, which introduces the ways for both staffs and user to get advantage of RFID in the sense of cost-effectiveness, safety and security.

1. INTRODUCTION

Radio frequency identification (RFID) a flexible technology has been predicted to be one of the most convenient and well-suited automatic identification surveillance systems since their conception. This system has gained popularity in recent past. The major driving force behind the rapid deployment of RFID technology is its commercial revolution (by increasing the quality of services and improving efficiency of operation), which enables items in transit through production system, warehouse, supply chain, access control, identification, material flow, tracked and so on.

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This new technology is quite inevitable to library, both for financial and human reasons. In this country, library security has always been a key issue; such as material security, personal safety, personals comfort, financial liability, legal issues and problem patrons. The introduction of RFID technology brings notably a solution to minimize such problem at great extend. Thus, this system is claimed to be one of the major time saving automatic identification and data capture (AIDC) tool, which replace barcode and EM system in recent year. So, to a library, RFID is an item tagging technology with profound societal implications that collects, uses, stores and broadcast data for providing a safe hand and cost effective solution to the above-mentioned key issues facing most libraries these days.

2. BRIEF HISTORY

"Many things are hidden in the shrouds of time. The task of tracing history and genealogy is arduous and challenging, but, ultimately, rewarding. Our past can open doors to our future. Whether we realize it or not, RFID is an integral part of our life"[2]. It increases productivity and convenience. One can trace the ancestry of RFID back to the beginning of time, when people were communicated with one another by flashing of sunlight, i.e. (Mirror-Sunlight-Reflection theory). Basic concept behind RFID is same, but only difference; it reflects "radio-wave" instead of light. The roots of this technology and development can be traced year-wise as follow briefly.

- 20th Century: In early 20th century (1922), radar was invented and used in World War II. Based on radar principle RFID invented in 1948, but commercial activities were begun during 1960s. In the 1970s developers, inventors, companies, academic institution and government sectors were actively worked on RFID, and notable advances were being realized from 1980s onwards. The most common application were tracked person and objects, identified goods in supply chain, reusable container, high value tools, security, controlling access to building, networks, payment systems and other assets.

- The 21st Century: Exciting times await of us to gain a lot from RFID. Its impact is lauded regularly in mainstream media, with the use of it, slated to become even more ubiquitous for near future.

3. RFID

RFID is an acronym for radio frequency identification. Briefly the RF stand for "radio-frequency" and ID means "identifier" that allows an item, for instance a library book, to be identified, accessed, stored, reprogrammed and communicated by using radio waves. This technology is similar in concept to a cell-phone or "ATM-card" that is used in transaction of money.

In library context, RFID works by placing a 2"x 2" inch tag (made up of microchip with an antenna) in each library items. These items are needed to personalize through RFID-personalizer and read the tag during circulation process.

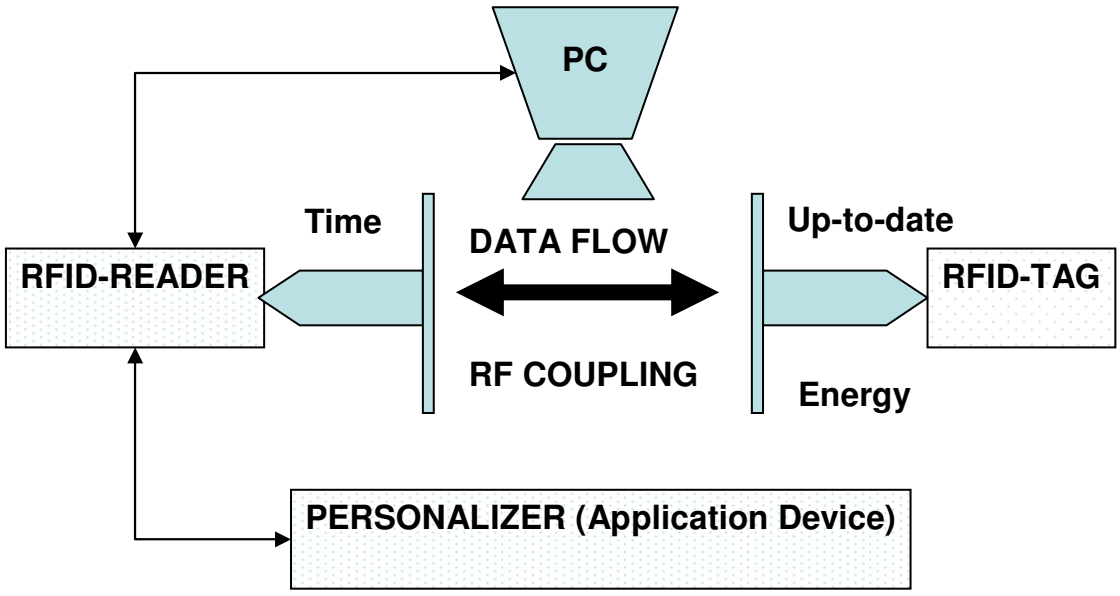

Fig.1. Items personalized model for RFID system

During personalizing the tag-based-items, the system attached with RFID-reader has generated RF (Response/Radio Frequency) wave that help to transfer data from the RFID-tag to the reader and then the application device attached to a system(PC) can manipulate data coming from application device (i.e. personalizer as shown in figure.1). Now the System (PC or Server) having RFID database has generated code for each items which are now being ready for issue and/or return process.

After personalizing each items, when library staff place items to be checked-out or checked-in, again items are placed on RFID-personalizer, which read by identifying tag's antenna. The

antenna enables the chip to transmit the information to the reader, and then the reader convert RF waves reflected back from the RFID tag into digital information. That can be passed onto PC and make use of it. This process is very easy, saving time and energy, and simplifying up-to-date inventory tasks in libraries.

4. RFID AND LIBRARY

Implementation of RFID technology is potentially a lot for all kinds of libraries (public, research, special). The overwhelming reason is its customizable feature that not only save time and energy, also control over economic hardship. So RFID system become a most essential carrier technology for libraries that best fit under the umbrella of automatic identification, management of material flow and streamlines various other library operations. This article highlights few key-feature of RFID that make it, a successor to Barcode and EM-system.

i) RFID versus Barcode

Table.1. RFID Vs Barcode

Barcode	RFID
Barcode readers require a direct line of sight, using laser technology.	Reading is done automatically using RF waves.
Scan and read one tag at a time.	Scan and read multiple tags simultaneously.
Reading by barcode take much more time	Reader can interrogate, or read tags much faster, appx.20tags per second.
Human intervention is required to scan a barcode.	RFID tag can be detected hands-off.
It should be visible on the product for scanning.	Tags can be concealed in any non-metallic items.
The readability of barcode can be impaired by dirt, moisture, abrasion or packaging etc.	RFID tags are not affected by those conditions.
Barcode don't have read/write memory.	RFID tags have read/write memory capability.

Less read range in comparison to RFID	RFID tags have a longer read range.
Technology is old and outdated.	Scope for more advancement.
Less expensive.	More expensive.
Ability hold limited data.	More data can be stored in an RFID tag, also facility for modifying it at later stage.

ii) Inventory management

Libraries spend a lot of money ensuring books are where they needed to be. Books with barcodes require humans to physically remove and handle every item to ensure it's in the correct location. But RFID offers the ability to analyze and make stock rectification without disturbing the day-to-day activities of library with quick succession. So this system greatly improves inventory management and optimizes resources.

iii) Economic facts

RFID technology is still too expensive to be used, because it expects to pay Rs25 per tag, also the cost of software and other equipments. The cost concern is still prohibitive however it possesses some economic facts that help to justify installing RFID system. For example, a lost book typically costs the library around Rs2000 approximately, an average library can have as many as 20million items circulating each year, but through RFID smart labels on item, check-in and check-out save nearly 1.5 minutes per transaction. Besides the unique identification, labels can be programmed, modify and update information, through re-writable facilities. So libraries don't have to replace a book's digital identification tag when updating a book's status. Now libraries are finding new ways to take advantage of RFID, such as minimize work stress of staff, saving time and money and gathering statistics on what items are most often used.

iv) Others aspects

The primary reason behind the introduction of RFID in library is security and improves service to their patrons particularly by having circulated items available when they are needed.

For concerning about the security mechanism it does a lot, it can easily prevent the theft in the library, by triggering the alarm of security-exit gate.

5. ARCHITECTURE OF RFID SYSTEM FOR LIBRARY

As discussed earlier, the implementation of RFID in libraries means automated identification, efficient and economic inventory, security, and circulation operations. So in broader perspective, when we are considering the securities issues in libraries we should have to take into our account the architectural view on infrastructure (of RFID-system) applied for functioning the housekeeping operation and inventory management. A general architecture for RFID system is discussed below.

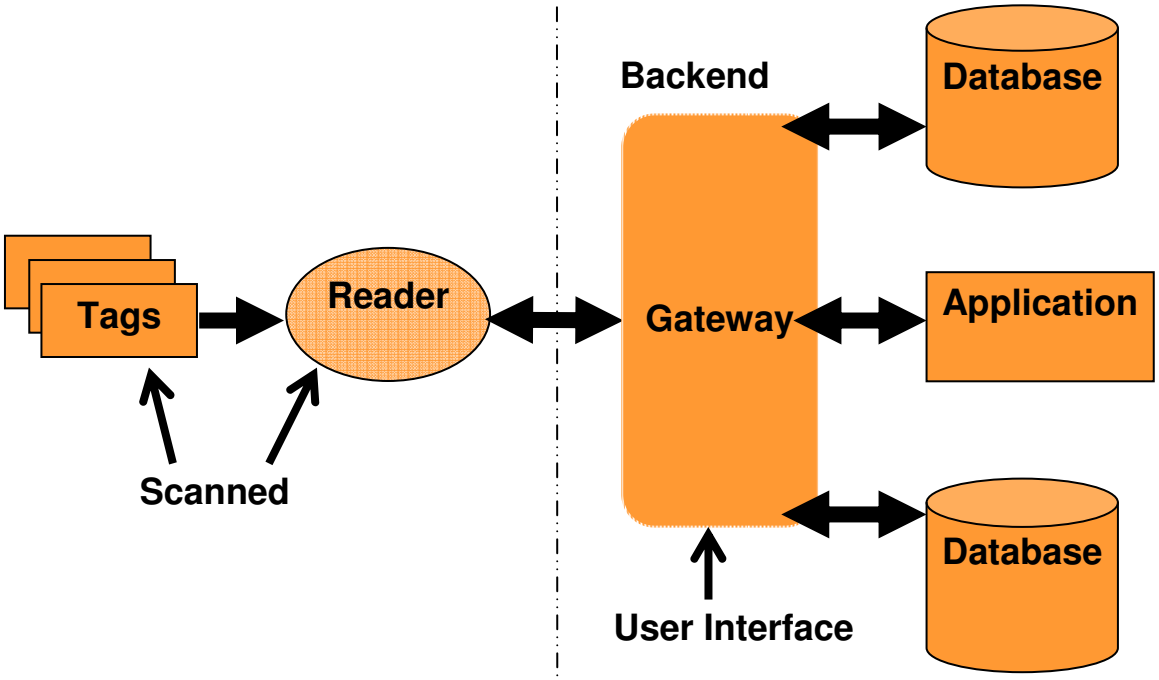

Fig.2. A General Overview of RFID Architecture

As depicted in figure.1 & figure.2, the whole operation are worked under three key phases.

i) Firstly items-tag are scanned by reader;

ii) Secondly in backend transmitted data coming through antenna (RF-wave) are being recognized by RFID-based system PC. It acts as a middleware communication gateway among items, reader and system database;

iii) And at the end it filters out and store data in RFID-databases for checking the data fault and relevant operation.

So it is essential to discuss the factors involved in it for smoothing the operation. Following are the essential components, standard and protocols that can be adopted in library.

I) Components

a. ***Tags (Transponder):*** The tag is paper thin, flexible and approximately 2"x 2" in size which allows inconspicuously on the inside cover of each book in a library's collection. It consists of an etched antenna and a tiny chip read-only or read/writable which having storage capacity of 2KB data that contain 96bits serial number. The chip stores vital bibliographic data including ID number to identify each item. The major function of the tags is hearing the RF wave and merely points to a database with barcode label data, which personalized before through RFID system software. In recent year, tags come in many flavors: passive, battery assisted, active, different frequencies, various anti-collision technologies, printed/wire wounded antenna etc. These day all RFID vendors in the library market offer read/write tags for easy updating, with anti-collision product (that enable to read several tags simultaneously). It has wide application like quick shelving and self check-in/ check-out.

b. ***Antenna:*** The antenna is a conductive element that attached with a tag, enable tag to send and receive data. It works as communicator among tags, reader and system. In general antenna produces radio-signal, that controls the function of data acquisition and communication (both for reading & writing data and activate the tag to work properly).

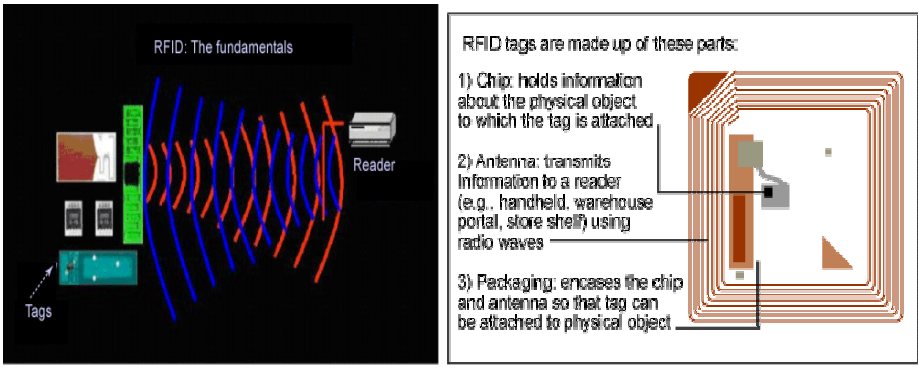

Fig.3 A functional View of RFID tags, antenna & reader.

c. ***Transceiver/Reader:*** The reader so called scanner or interrogator, which holds digital signal that turns the wave into bit of information, usably powers the antenna to generate a RF field. When a tag passes through this RF field, the information stored on the chip is decoded by the reader, and sent to the PC or Central server who in turn, communicates to the library information system.

In the recent year, libraries are using 3M SelfCheckTM system to read the tags, "These are used in the following eight ways" (Boss, 2003);

- Conversion station- Where library data is written to the tags
- Staff workstation at circulation- Used to check-in and checkout materials.
- Patron self check-out/-in station- Used to checkout or check-in book without staff assistance.
- Exit sensors- Verify that all books leaving the library have been checked out.
- Book-drop reader- Checks in books when patrons drop them in book-drop.
- Sorter- Automated system for returning books to proper area of library.
- Portable reader- Hand-held readers for inventorying and verifying that item are shelved correctly [5].

d. ***Computer hardware (such as server/PC, inventory-reader and security gates):***

- Server/PCs are the programming station for transferring necessary data from library database to the tag, and actively participate in the security/ anti-theft functions.
- Inventory- readers are used for stock verification and rectification purposes.
- Security gate placed in the entrance of libraries, it is used to detect whether a book has been properly checked-out or not. Otherwise alarm happens.

e. ***RFID software (such as RFID system controller)****:* So called RFID system administration programs/ inventory software for library. These days so many RFID library system software vendors available in market internationally; such as Bibliotheca, Checkpoint, ID systems, 3M, TAGSYS, Vernon, Libsys and VTLS. In India several other companies like IBM-ISV, Microsoft India developer, Primasoft (Small library organizer pro, V1.5), iMagic etc, are

providing product and material handling equipment that work with RFID. Functionally, Software tells the reader what, when, and for how long to read tags. During personalize the tag, the reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the PC. The application software on the PC processes the data, (often employing PML an extended markup language), and disseminates tag information to be used in advanced data collection library systems.

Besides this, RFID system includes handheld reader, RFID label printer, and external book return like components for betterment of library services.

II) Standard and Protocols

The emerging standard pertinent to library RFID systems is ISO-15693. However, no formal standards are currently in place. A frequency of 13.56MHz is employed worldwide. For better application, SIP2 (session initial protocol), APIs (application programming interface) protocol are playing major role these days. It has made it possible for RFID products and library automation products to exchange information. Given below, The Table-2 showing detail specification of RFID Standard and Its characteristics (physical, environmental, radio wave, communication, power and certification).

Table.2 Specifications of RFID standard

Physical Characteristics	
Dimensions	400 mm x 200 mm x 120 mm
Housing	Metal
Environmental Characteristics	
Operating Temprature	0 to 50 °C
Storage Temperature	–20 °C to 70 °C
Enclosure rating	IP 65
Radio Characteristics	
Frequency	13.56 MHz
Sending Performance	2 x 2 W (at 50 Ohm), splitter configuration

Standard	ISO 15693
Communication Characteristics	
Data interface	RS 232
Data transfer rate	9,600/19,200/38,400/57,600/115,200 Baud
Protocol	STX/ETX
Indicator	Tag Data LED
Power Characteristics	
Power supply voltage	230 V AC 50 Hz
Current consumption	< 1 A
Electrical connections	Terminal strip, BNC connectors (antenna)
Switching inputs	2 x, Vin = 24 V DC, for e.g. triggering via photoelectric switches
Switching outputs	2 x, open collector (Ri = 100 Ohm), VOUTmax = 36 V, IOUTmax = 30 mA
Indicator	Power LED
Certifications	
CE approval	acc. to EN 301489-1, -3/ acc. to EN 60950/ acc.
Radio approval	acc. to EN 300330 (with released antennas), FCC Part 15

6. MERITS

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

a) Increase Security

- Security of material is automatic without staff intervention.
- Automatic items check out/ check in and sorting can be accomplished with LMS circulation software, therefore eliminating extra processing time of staff and make it economically viable.
- The accuracy of detecting a stolen item is very high, and identifies at security gate.

b) High Reliability

- The RFID readers are highly reliable, almost 100% detection rate.
- With the use of advanced anti-collision RFID labels multiple items can be checked out/ checked in at a time.

c) High speed Inventorying

- It is a unique advantage of RFID, through which shelf verification, shelf rectification and circulation processing become easy.
- It eliminates the time consuming process of barcode scanning and reading.
- Make library staff free from the risk of repetitive stress injuries.

d) Rapid charging/ discharging

- The use of RFID reduces the amount of time required to perform circulation operations.
- Self charging and discharging possible.

e) Longevity

- RFID tags last longer than barcodes, because nothing comes into contact with them.

7. DEMERITS

Since increased efficiency and productivity in operation is the key reason for adopting RFID technology in libraries, it is not free of any concerns and criticisms. Some major pitfalls can be underlined as below;

7.1. Technological barrier

- Tags and readers are still too expensive
- Licensing and maintenance costs for using hardware and software are high and integration option limited.
- Reader performance must be improved to increase reader range, read quality (accuracy) and data integrity.
- Lack of proper standards and protocols, it need to be unique and inter-operable.

- Blocking the RF wave is easily done by anybody through ordinary aluminum foil/Mylar, also placing two books against one another so that tags overlays another that may cancel out the signal, need to protect.

7.2. 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 differences between retail and library applications.

7.3. Financial barrier

- The initial investment towards implementation of RFID is very high. Most of the costs are being used for upgrading, integrating and replacing application. So cost factor has discouraged many libraries to adopt this system.

7.4. Other barriers

- 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 can not be maintained among them.

8. CONCLUSION

RFID technology is taking off in libraries at an increasingly rapid pace. Though there are few libraries employing this technology today, but due to its customizable feature and continuing improvement the library communities are beginning to get involved in its development. It is easy to envision that, the RFID tags contents will increase in power, prices are expected to decline and tag will dramatically improve its efficiency, security and accuracy. Also major concerns need to be addressed for successfully implementing this technology. So that it will change our personal and work lives in library and adorns the conventional library management with a new idea and usher for a bright future.

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