Roadmap for RFID Implementation in Central Library, PEC University of Technology

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Abstract

This paper gives brief idea about the emerging Radio Frequency Identification (RFID) technology, its importance in the library management system and its working. It also describes about the basic and optional components required for smooth working of the exercise. The aim is to consider how to extend RFID applications in an academic library keeping in view the scantiness of funds and scarcity of supporting staff. The article also illustrates a vivid picture about how RFID technology is acting as a boon for libraries thereby highlighting the key benefits of RFID like shelf charging-discharging, reliability, high speed inventorying, automated materials handling etc. Besides, it outlines various issues and possible solutions involved in the process of implementing RFID applications in Central Library, PEC University of Technology. It will also provide insight for other academic libraries wishing to implement RFID system.

Keywords: *RFID Technology, Radio Frequency Identification, Library Automation, PEC University of Technology.*

Project Objectives

With this ever changing technological scenario, and with the changing perception about the information and the information system, it is almost obligatory for the libraries to understand current change, accept the current trend and work proactively to handle current situations. The time has come for the traditional libraries to automate their services and try to disseminate the information using new technologies. New technologies have always been of interest to the library professionals both for the potential of increasing the quality of service and for improving the efficiency of operations. Technology which provides the right information to the right user at the right time and in a right personalized way is the need of the hour. Radio Frequency Identification (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 based Library Management system would allow fast transaction flow for the library and will provide immediate and long term benefits to library in traceability and security. This paper gives brief idea about the RFID, its importance in the library system, how it works and describes different components of the RFID technology. The proposed system is based on RFID readers, supported with antennas at gate and transaction sections, and library cards containing RFID-transponders which are able to electronically store information that can be read / written even without the physical contact with the help of radio medium. It also briefs about tentative budget to establish RFID technology in the Central Library, PEC University of Technology (CL PEC) and finally its future in Indian libraries.

The present project is undertaken to accomplish following objectives:

1. To have RFID enabled vigilance system to avoid theft of library documents. For that a RFID tag will be mounted on each document and two EAS Gates at the entrance to check the un-issued document outside the library.

2. To have a RFID enabled Shelf Management reader so as to rectify the arrangement of documents on the shelf and easily find out the misplaced documents.

3. To have a fully automated library having self issue/return counter.

Prologue of Central Library, PEC University of Technology

Punjab Engineering College gained autonomy in 2005 under the Deemed University status given by UGC and switch over to its present name as PEC University of Technology in 2009. CL PEC strives to support the institution's march towards its vision, "to become a centre of excellence in technical education and

research, and occupy a place amongst the most eminent institutions of the nation" by functioning as a centre wherein all relevant information is available for its users. To comply with the vision the library has developed excellent collection of books, print journals, full text online resources and other non-book material (audio tapes, CDs, cassettes, videotapes, and DVDs) in science, engineering, technology, social sciences and management. The library full heartedly endeavors to connect its users to the knowledge and information of their disciplines, thus strengthening the aspirations and expectations of the research and teaching work at PEC.

The CL PEC is housed in a three storied building having an area of about 27000 Sq. Feet and organized into various sections, which are manned by professionally qualified staff. With a collection of about 1,10,000 volumes, it caters to the needs of about 2100 members (both staff and students) imparting/perusing studies in nine different branches of engineering. To keep its readers abreast with the latest developments in engineering & technology, the library is subscribing to 28 foreign and 50 Indian technical journals in the print form. The library is a member of INDEST consortium under the ministry of HRD since 2003. This consortium provides access to electronic resources i.e. IEL (IEEE), ASME & ASCE. However in the year 2009, CL PEC subscribed to four more full text databases which are Science Direct, SpringerLink, ACM and Indian Standards through INDEST consortium. Having centrally air-conditioning facility with 250 seats in two spacious reading halls for reticent reading of its users; the library functions with an open access system to maximize the use of library resources. CL PEC is also having multimedia section to make use of most popular mode of education i.e. electronic media with the help of computers, LCD projector, TVS, VCR, OHP, slide projector. It also has a collection of 450 CDs, 76 floppies and 581 video cassettes on various disciplines of technology. Many knowledge based services like reference, reprographic, CD-ROM databases, Internet Browsing, e-resources are provided by the library for its users.

Present State of the Art
Since automation is emerging as boon for present day libraries; CL PEC changed itself from a traditional library to a modern library with the introduction of different technologies available for library's automation. The library uses LSEase, which is a scaled down version of LibSys software package. It is an integrated multi-user library management system that supports all in-house operations of the Library. It covers all the basic as well as advanced operations and services of the library. Retrospective conversion of bibliographic records has been completed and bibliographic records of all the documents available in the CL PEC can now be accessed through the OPAC. Different databases of circulation section, reference section, Bookbank

and theses section have been prepared. All books have been bar coded and all the members have been given bar coded membership cards. So, a fully bar coded circulation system is in use since July 2008. The database of books available in the Library is being updated on day to day basis with details of recently acquired books.

Present Level of Infrastructure
The library has one server, nine PCs, fully networked and compatible accessories to cater to the needs of library computerization. Each section is equipped with a PC. Two PCs are exclusively earmarked for the users to access OPAC within the library premises.

CL PEC is part of Campus Local Area Network. Library has its own sub LAN with thirteen terminals dedicated for various operations of the library.

Library Management Problems
Basic tasks in library management include the planning of acquisitions of materials, arranging the acquired materials according to the library classification, preservation of materials and developing and administering library computer systems. Management problems being faced by CL PEC include

1. Increasing theft

2. Misplacement of reading material

3. Poor Inventory Accuracy

4. Poor Stock verification Procedure

5. Lack of Security control

Need of RFID Implementation
Due to the low cost of barcodes, this automatic identification system has been extensively applied in the management of library collections. Barcodes simplify the identification of items for library circulation and archives. However, due to low data capacity and the inability to program barcodes, the scope of barcode application is limited to information access of collections and user cards. A better solution for the storage of recognizable information and transactions is to use integrated circuit (IC) memory cards or smart cards to convey data. However, this kind of contact-type IC card must work through a reader contact to have power and to transmit materials. The shortcoming of usage includes lower processing speed and abrasion of an electronic contact. On the other hand, the contact-less IC card technique transmits data between card and reader through radio waves. The power also can be converted from radio waves or built-in batteries in cards. Because of the transport of power and information through radio waves, contact-less auto-IDs are called radio frequency identification (RFID) systems. Technically it is 'a technology that consists of a system and tiny tags, which uses radio waves to automatically identify people or objects'. This wireless automatic identification data capture systems

allow for non-contact reading or writing of data and they are highly effective in manufacturing and other hostile environment where barcode labels cannot survive. It consists of a transponder with antenna and a chip and a reader which attached to a computer to identify the item. The complete set of these items is called a tag or a label. Data or information can be written on the chip (barcode etc.) and stored in the tag or label that is attached to the item to be identified and reader is non-movable (fixed at security gate or so).

RFID plays a vital role in redefining the library process to make everyone's job easier right from the users to library staff. It provides a platform to automate most of the process performed by the library staff like check in-check out, sorting, stock management and inventory control. RFID is an innovative automated library system for automatic identification and tracking of library material. As it is combination of radio-frequency-based technology and microchip technology and can be used to identify, track, sort or detect library holdings. This is an effective way of managing collections of the library and providing enhanced services to the users having following benefits:

1. The RFID tag does not have to be visible for detection. It can be read even when it is embedded in an item, such as in the cardboard cover of a book or in the packaging of a product.

2. Hassle free issue/return of books since several books in a pile can be issued/ returned at a time.

3. Does not need the manual typing so ensuring accuracy in routine works

4. Helpful in identifying misfiled items.

5. Inventory visibility, accuracy and efficiency.

6. Automated Issue/Return

7. No lines or greatly reduced lines at the check out counter.

8.   Increases the security function in library.

9. Instant update of the databases is possible.

10. Improved utilization of resources like manpower, infrastructure etc.

11. Less time consumption as line of sight and manual interaction are not needed for RFID-tag reading.

12. Flexible library timings by use of Books Drop Kiosk for returning library materials.

13. Unique ID of RFID tag prevents counterfeiting.

14. Open access system promotes chances of theft of books, so to secure the valuable resources form anti-social elements.

15. Traditional methods of stock verification are not feasible for libraries having large collections.

16. Automation of repetitive work such as lending or returning of items

Components of an RFID System

A comprehensive RFID system has following components:

1. **RFID tag (or transponder):** These are paper-thin smart labels which are electronically programmed with unique information. These are the electronic chips consisting of an integrated circuit and antenna coil that communicates with a reader by means of a radio frequency signal. These tags are available as labels with adhesive backings and ability to reel though a label printer. After sticking RFID label on the book, its vital bibliographical data including unique 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 and helps to identify each book.

    Two types of RFID tags are available viz. Active or Passive. Passive tags don't have their own power supply so the device is quite small. These have practical read ranges that vary from about 10 mm up to about 5 meters. Active RFID tags, on the other hand, must have a power source and may have longer ranges and larger memories than passive tags as well as the ability to store additional information sent by the transceiver. Active RFID tags can be about the size of a coin and have practical ranges of tens of meters, and a battery life up to several years. Many libraries are making use of passive tags because of their lower cost and appropriate size.

    The tags can be read at a distance of up to two feet by each of two parallel exit sensors. The devices used for circulation are usually called "readers" while the ones used at building exits are usually called "sensors".

2. **RFID reader (or interrogator):** RFID reader consists of a transmitter, receiver, antenna and a decoder. They communicate with RFID tags, identify them and receive data stored on the tag. The read time for a tag is typically < 100 microsecond. Line of sight is not essential for reading the tags with the scanner. It provides a contact less data link which means books can be issued/ retuned without opening. A typical RFID system includes four different kinds of readers, also known as sensors or scanners. These devices are designed to detect and read tags to obtain the information stored thereon.

    (i) ***Staff workstations*** for circulation desk charging and discharging. The equipment can easily be connected to a network or single workstation PC or notebook and the application can begin functioning thereon. It also supports all RFID functions like anti collision feature allowing to

identify multiple labels simultaneously, present in the reader field and full read/write capability. It is used at the issue/return counters at the library and also for label personalization.

(ii) *Self check-in/ check-out stations* for allowing users to borrow books without assistance from the library staff. It is an interactive station/kiosk with touch screen which prompts the user to enter library card. The validity of the library card is checked and user is prompts to place the books on to the deck of the Borrowing Station. The status of each book as checked-out is automatically updated on the Library Management database. The theft detection system of the RFID tag for that book is de-activated to enable smooth passage from the security gate. A receipt may be issued to the user confirming details of borrowed books along with due date.

(iii) *Exit sensors* at exit are of two types; one reads the information on the tag(s) going by and communicates that information to a server. The server, after checking against the circulation database, activates an alarm if the material is not properly checked-out. Another type relies on a "theft" byte in the tag that is turned on or off to show that the item has been charged or not. It is then not necessary to communicate with the circulation database. The security system will work even though the online library server is not working. The gate antennas act a as hardware which issue a warning signal and activate the alarm system if a book or file pasted with a label is leaving the premises or department without an authorized issue/ outward entry into software. Gates are easily mounted and are connected with warning light signals and also sound alarms to inform the security personnel that some mischief has taken place.

(iv) *Portable scanner* or inventory wand, which 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 docking station or a server later on, or it can go to a unit which will transmit it to the server using wireless technology. The shelf scanner allows library staff to take inventory and find wrongly shelved books without having to pull the books off the stacks.

(v) *Bookdrop Kiosk* checks in books when users drop them in the bookdrop. Libraries can offer a distinct service that is very useful for users, such as the ability to return books when the library is closed. An external book return is a machine with a slot with a chip RFID reader integrated into the wall. It works the same way as the self checkout station. The user identifies himself/herself (if required by the library), and then puts the book(s) in to the slot. Upon completing the return, the user will receive a receipt showing how many and which books were returned. . The theft detection system into the smart labels is simultaneously activated. Since the books have already been checked in and RFID tags activated, they can go directly back onto the shelves. The Book Drop allows patrons to return items 24 hours a day.

3. **Application software:** It is used for the reader to transmit or receive data from a tag. Software integrates the reader hardware with the existing Library Automation Software for seamless functioning of Circulation Section. RFID systems can not only heighten information storage, but also provide reprogramming functions not offered by barcodes. The user, book and periodical can all be integrated with RFID systems to extend various applications. Each application must be integrated with the library automation system. Just as general applications are integrated with peripherals, middleware takes charge of the RFID systems and automation systems. Automation systems called application interfaces (API) are provided by middleware to communicate with RFID readers, and then by way of the reader, access information from tags.

4. **Server/Docking Station:** On which the software that interfaces with the integrated library software is loaded. The server is the heart of some comprehensive RFID systems. It is the communication gateway among the various components. It receives the information from one or more of the readers and exchanges information with the circulation database. Its software includes the APIs (Applications Programming Interface) necessary to interface it with the automated library system. The server typically includes a transaction database so that reports can be produced.

How RFID Works

The technology works through flexible, paper-thin smart labels (RFID tags), which allows it to be placed inconspicuously on the inside cover of each and every book in a library's collection and on the other collections like CDs, DVDs etc. Complete information about each document is entered into the software installed in Server or Docking station. Now whenever a user brings the book 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 books is smoothly issued in a few seconds with a minimum of manual intervention. As the user takes the book outside the library, the antenna placed at the exit gate automatically read the information contained on the RFID tag to verify whether the book is properly issued or not. In case the book is not issued to the user as per library norms or it is

being stolen from the library, the antenna senses it and give an instant alert. Thus the technology resulted in successful theft reduction of books. The same RFID technology is also used for stock taking practice. Earlier, manual stocktaking was an exhausting exercise as each and every book's detail had been manually entered into the system or registers. Now with the introduction of new technology it is very easy for the library staff to just place a scanner on the top of the book; the scanner automatically passed on scanned information to the common database or server.

Methodology for CL PEC

RFID is the latest fast growing technology to be used in library for minimizing the theft of documents and as an access control systems. In order to implement the RFID technology, a four member committee consisting of Chairman, Librarian, DDO and technical expert will be formed. The committee will discuss various factors involved such as budget, required hardware and software, cost effectiveness and availability of manpower. After the approval of the committee the work of RFID implementation will be carried out. The methodology for implementation can be divided into many phases taking into consideration of budget provision, the types of document holdings, number of volumes, types of items meant for circulation, and the number and types of user the institution has. Some prerequisites are to be considered before starting the work of RFID implementation like

1. **Procurement of Hardware:** Sourcing for the hardware required need to be done before anything else. Quotations/tenders may be called with detailed specification of each item required so as to compare the rates quoted for different items.

2. **Retrospective conversion** of already existing stack requires a "programmer" or "conversion station." The conversion of existing barcoded items, including affixing the tags to library materials, takes 15-30 seconds per item depending on the amount of information added to the tag and the skill of the person doing the tagging. Pre-programmed tags, which are used for new acquisitions in libraries that want only identification numbers on the tags, take even less time because they do not involve scanning existing barcodes. The speed of conversion can be increased by dividing responsibility for removing and replacing library materials, converting the barcodes, and inserting the tags among at least three people. It is essential that the tasks be rotated so that no one repeats the same motions over an extended period of time. Also, library might consider doing the tagging of new acquisitions at the time of receipt in Acquisition Section itself so as to avoid losses of unprocessed material from other sections of the library.

3. **Tagging Books:** Each document need to be tagged. The fixing of tags to documents can be initially outsourced then in house arrangement can be done after proper training. The tags can be over layered with the self adhesive sticker containing the logo of the library or the institution for longer life. It is also important to select a consistent location for book tags. The inside of the back cover is the recommended location because it is the fastest for right-handed tag installers to reach. One vendor recommends near the spine approximately three inches above the bottom. That avoids possible interference from metal shelves when inventorying. However, a library should consider placing the tags inside the front cover under a bookplate or with a bookplate printed on the tag. That may make the tag less apparent and, therefore, improve security.

4. **Integrating Software:** With the preset Library Management Software. Care should be taken to integrate the library automation package while detailed tender specifications are drawn.

5. **Training of Staff:** Train the staff on various aspects of RFID technology. Since the technology is new to Indian library environment proper demonstration of the system can be arranged and librarian should visit the library where the system is successfully running.

6. **Performing Test Cases:** To check out unit level and system level performance for accuracy.

7. **Process Improvement:** The errors found out from the test cases will be revisited to make the system perform accurately. Until sufficient confidence is gained with the system, old system in practice can be continued.

Vendors of RFID in India

There are many vendors of RFID components all over the world and now a days India is also producing RFID components. Name and address of some vendors are collected so to call a quotation and demonstration of different products, a comparison on that basis will be made to apply RFID technology.

1. 3M Library Systems Division, C-40, Okhla Industrial Area, Phase-2, New Delhi -110020

2. Capgemini India, 455 Anna Salai Teynampet, Chennai - 600018

3. Daphne Systems Private Ltd., 2nd Floor, 459-Functional Industrial Estate (FIE), Patparganj, Delhi -110092

4. Gemini TRAZE RFID Pvt. Ltd. , 1, Dr. Ranga Road, Alwarpet, Chennai - 600 018

5. GreenFuturz Software Solutions, Zams Palm Avenue, #22 6F, 6th Street, Alagiri Nagar, Vadapalani, Chennai - 600 026.

6. IDCUBE Identification Systems Pvt Ltd, B-15, Sec 59, Phase 3, Noida - 201 301

7. LibSys Corporation, 633-A, Phase-V, Udyog Vihar, Gurgaon-120016

8. Modular Technologies India Private Limited, City Tower, 117, Sir Thiagaraya Road, 5th Floor, T. Nagar, Chennai - 600 017

9. netlink information systems limited, 571, phase 5, Udyog Vihar, Haryana 122015.

10. RapidRadio Solutions Pvt. Ltd., B-404, Satyamev I, Opp. Gujarat High Court, Sarkhej Gandhinagar Highway, Ahmedabad - 380 060

11. RFID Infotek, 102 Corporate Avenue, Sonawala Lane, Near to Udyaog Bhuvan, Goregaon (East), Mumbai 400 063

12. VTLS Software Pvt. Ltd., B-219, Sector 26, Noida - 201301

Cost Factor and Time Frame

Smooth implementation of any endeavor required through planning. The work of implementation of RFID in the CL PEC will be carried out in following phases:

Phase I (Planning & Survey) (Financial Year 2009-10)				
Formation of committee consisting of Chairman, Librarian, DDO and technical expert. Committee will discuss various factors involved such as budget, required hardware and software, cost effectiveness and availability of manpower.				
Phase II (RFID for Circulation Section) (Financial Year 2010-11)				
Sr. No.	**Item /Work Description**	**Unit Price**	**Qty.**	**Amount**
1.	Self Adhesive RFID Tags	Rs. 20/-	50,000	10,00,000/-
2.	Exit Gates	4,50,000/-	1	4,50,000/-
3.	Staff Work Station	1,45,000/-	1	1,45,000/-
4.	Installation & Commissioning	90,000/-	1	90,000/-
5.	Application Software	2,50,000/-	1	2,50,000/-
6.	Server/Docking Station	3,50,000/-	1	3,50,000/-
			Total:	**22,85,000/-**
Phase III (Self Issue/Return) (Financial Year 2011-12)				
Sr. No.	**Item /Work Description**	**Unit Price**	**Qty.**	**Amount**
1.	Self Adhesive RFID Tags	Rs. 20/-	60,000	12,00,000/-
2.	Self Check Station	4,75,000/-	1	4,75,000/-
3.	Book-Drop Kiosk	5,75,000/-	1	5,75,000/-
			Total:	**22,50,000/-**
Phase IV (Inventory control) (Financial Year 2012-13)				
Sr. No.	**Item /Work Description**	**Unit Price**	**Qty.**	**Amount**
1.	Portable RFID reader	2,25,000/-	1	2,25,000/-
2.	Portable Computer - Notebook PC or PDA	45,000/-	1	45,000/-
			Total:	**2,70,000/-**

Possible Barriers

1. RFID being new technology lead to a situation of lack of expertise and professional advice as it is not yet implemented in many libraries in India.

2. Transition phase when RFID will take over the Barcode system may lead to a chaos as using both system side by side may cause problem both for staff as well as user.

3. There is a lack of standards for RFID technology.

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

4. The moisture present in the atmosphere, especially on rainy days, affects the RFID tag. A tag, which contains moisture, does not respond to the RFID system.

5. Power failure in a major problem in India. Unless a library has any generator facility or any other

backup system; it is bound to close its circulation operations in case of power failure. This may cause uneven functioning of the RFID system in the library and grounds for inconvenience to user.

Conclusion/Expected Outcome

Although, the RFID technology is quite expensive, still it has yielded excellent results for many libraries throughout the world. It has the capability of making the management processes in the library more convenient. The only barrier in the journey is high cost of it, but every new technology implementation is somewhat dearer. Moreover, RFID applications lead to significant savings in staff costs, enhance service and provide efficient results, which leads to foolproof security and access control. It not only provides a constant update of library collections, proper holding management, but also accomplishes real-time services. The bottom line is that the synergy between the latest technology like RFID and libraries can create wonders resulting in empowerment of both users as well as librarians.

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