



Ramakrishna Mission Vidyamandira
(A Residential Autonomous College Affiliated to University of Calcutta)
P.O. Belur Math, Howrah-711202

PLATINUM JUBILEE COMMEMORATIVE SEMINAR
ON
RFID and Library Services: Use & Concern



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Organized by
Central Library
RAMAKRISHNA MISSION VIDYAMANDIRA

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RFID and Library Services: Use & Concern



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Central Library
Ramakrishna Mission Vidyamandira
Belur Math, Howrah- 711202, West Bengal

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PRINCIPAL'S MESSAGE

Oum Namo Bhagabate Shri Ramakrishnay

RKM Vidyamandira is an autonomous college affiliated to University of Calcutta started its journey in the year 1941. Swami Vivekananda during his last days once mentioned that, there will come up in future an institution of higher learning where the students will be trained in the line of age old Gurukula system perfectly blended with the science and technological innovations time to time. In fact it took more than four decades to translate his vision into reality. On 4th July, 1941 this college began its journey as an intermediate one. In the year 1960 it was upgraded to a college of Undergraduate one. Later in 2006 we started our post-graduate programmes and also later on some research programmes.

Naturally library and learning resources are an integral part of an institute of higher learning may that be a college or a university. As far our history goes we see that right from the 1942-43 the college started to build-up its library. Earlier it was in a hall room at the ground floor of the main building. But as the Institution grew bigger naturally importance of library also drew the attention of the administrators, teachers and the learners.

I am really thankful to the Central Library, especially the Librarian and the library staff. In this year when we are observing the Platinum Jubilee celebration they decided to organize a seminar on library issues targeting to this particular

aspect of technology oriented innovation. When we were thinking how to observe this Platinum Jubilee year, all our teachers from different academic departments told that it would be befitting for an academic institution if we could organize different seminars. Almost all the departments have organized seminars. Perhaps being the mother of all the departments, it is the last one to tell every department what they wanted to do in this platinum jubilee celebration year.

At the same time, I am also really very much grateful to the persons like- Dr. Arun Kumar Chakraborty, Ms. Indrani Bhattacharyya, Dr. Sushanta Banerjee (though unfortunately he is not present) and Dr. Arabinda Maity. It is really a tough task to get them all on a single dais, but it has been possible. This is the holy blessings of Belur Math and this Institute which was once envisioned by Swami Vivekananda who was really a pioneer in the field of enhancing the knowledge. He was always in favour of adding glory to the knowledge. Naturally I hope that the seminar discussion and also all the interaction that will take place with all these eminent people will enrich us and will give us new light in how to use this learning resources in our everyday academic life, in the life which we will face in the coming years.

Hoping this I conclude.

Thank you

Swami Shastrajnananda
Principal

Foreword

On 22nd March, 2017 a Platinum Jubilee Commemorative Seminar on RFID and Library Services: Use & Concern was organized by the Central Library, Ramakrishna Mission Vidyamandira. This book is a compilation of articles submitted by the participants of the seminar.

The authors will be sole responsible for the data, opinion and remarks expressed in the concerned articles.

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Welcome Address

Swarup Ray

Convener, Library Sub-Committee,
Ramakrishna Mission Vidyamandira

Respected speakers, dear colleagues, and students,
Our college, as you perhaps already know, has been celebrating its platinum jubilee through various programmes for the past one year. All the departments of the college have organized a one-day or two-day seminar to commemorate the occasion. Of all the seminars that have been held so far or are scheduled to be held soon, this one is unique. I call it unique because the library – a unit on which all academic departments of an educational institution is very closely dependent – is organizing it. Seldom do we get to hear the library of an undergraduate college organizing a seminar on its own. I think this particular event, more than any other, makes the platinum jubilee celebrations of our college really special and historic. This, of course, would not have been possible without the initiative of our newly appointed, young, and energetic librarian Mr Krishanu De and his equally energetic team. I sincerely thank Mr Dey, Sumanta, Soumya, Haradhan da, and all others in our library for making this event possible, and last but not least our Principal, Swami Shastrajnananda for actively supporting the endeavour.

The British novelist Aidan Chambers once said:

Few pleasures ... rival the pleasure of browsing unhurriedly among books.... Simply to be among books, glancing at one here, reading a page from one over there, enjoying them all as objects to be touched, looked at, even smelt, is a deep satisfaction. And often, very often, while browsing haphazardly, looking for nothing in particular, you pick up a volume that suddenly excites you, and you know that

this one of all the others you must read. Those are great moments – and the books we come across like that are often the most memorable.

Book lovers couldn't agree with Chambers more, though with the arrival of e-books and e-journals, we do not always encounter books in their print form nowadays. But I think even the most tech-savvy book lover or reader would admit that the deepest satisfaction of reading a book comes when we get it in its more corporeal, printed form. Dr S. R. Ranganathan's famous five laws of library science have been revised from time to time to keep pace with changing times, but what he proposed way back in 1931 still remains largely true, I feel.¹ One reason why we, as students, used to flock to the British Council Library or the USIS Library is that they were the only two libraries in the city (perhaps they still are the only two) where we could indulge in the pleasure of browsing bookshelves haphazardly. Besides the Book Fair, these were the only two places where we could actually have a tactile sensation of books. Admittedly, nothing can be more exciting for a reader than "browsing [bookshelves] haphazardly", as Chambers says, but for the library staff, who have to ensure that the books are in their proper place after the readers have left, the experience is not always very exciting.

[¹ 1: Books are for use; 2: Every reader his/her book; 3: Every book its reader; 4: Save the time of the reader; 5: The library is a growing organism.]

I know very little about the Radio Frequency IDentification (RFID) technology to talk about it at any length. However, from the very little that I have come to know about it, I understand that it is essentially an enabling technology that is being profitably used in various sectors nowadays.

As far as its application in a library is concerned, I think the greatest advantage of the RFID system is its ability to scan

books on the shelves without tipping them out or removing them. A hand-held inventory reader can be moved rapidly across a shelf of books to read all of the unique identification information. With this wireless device, it is possible not only to update the inventory, but also to identify items which are out of proper order. I find this prospect very encouraging because it would offer the pleasure of book browsing to users of a college library without taxing the library staff. An RFID library solution, I understand, eliminates or minimizes the requirement of human intervention at certain vital stages of library service. This, I feel, is another great advantage of the RFID system because most of our college and university libraries are not always optimally staffed.

About the health hazards, if any, that the use of the technology may cause, I do not know much. I am sure this issue will be addressed in the academic sessions that follow. However, in course of my reading on the RFID system, I came across two common problems associated with the technology – reader collision and tag collision. Reader collision occurs when signals from two or more readers overlap and interfere and tag collision occurs when many tags are present in a small area. I am sure these collision problems and their solutions will also be addressed in the academic sessions today.

Before I end, let me thank you all once again for being with us here today. I hope our librarian, Mr. Krishanu Dey and his energetic team will organize more library centric events in future. Besides serving important practical purposes, such events, I believe, provide opportunities of an interface between library and academia. The importance of such interface in institutions of higher learning and research cannot be overemphasized.

Thank you.

**Introductory Speech:
A Brief Discussion on the Seminar Theme**

Krishanu Dey

Coordinator & Librarian

Central Library, Ramakrishna Mission Vidyamandira

Radio Frequency Identification (RFID) systems are among the few latest technologies which are facilitating greater productivity along with sheer excellence. Previously the librarians were somehow sceptic regarding the application of RFID in library services but with the passage of time they have started to welcome this technology. The modern libraries are attempting to reap the benefits of RFID technology by employing concerned hardware and software components.

A RFID system consists of a set of technologies which acts in an integrated way to promote tracking and monitoring of any physical object through transmission of invisible radio frequency waves over a distance of hundreds of meters. Now RFID is being used in tracking animals, patients in a hospital, shipping containers, garments, jewellery, airline baggage, etc. RFID has substituted the old barcode technology. While using barcode technology the barcode sticker and the barcode reader must be in a specific angle and there should be no obstacles between them so that the light emitted from the reader may be able to scan the sticker and retrieve the data. In comparison to this shortcoming the radio frequency waves emitted by the RFID reader are able to penetrate any object and activate or deactivate the RFID tags irrespective of line-of-sight relationship.

In mid-1990's, RFID technology was introduced to the sphere of library services. The capability to track items even when they are not in close contact with the readers has advocated the replacement of traditional barcode technology with RFID in library. With RFID it is quite easier to track the books even if the tags are pasted inside the books. Moreover if the RFID tags are attached, the library professionals are not required to take out each and every book from the library stack to manage the inventory. Thus it saves the time of the library staff and they may concentrate on providing quality services to the users.

Besides myriad advantages the library professionals often consider the following elements before implementing the RFID technology in their libraries.

Privacy and Data Security: RFID is a set of different technologies and people often doubt probable adverse use of this technology. People assume as the RFID attached shipping consignments can be tracked from a wide distance, the RFID attached library books or membership cards may also be tracked by any unauthorized user and the information hence gathered can be used adversely. But in most cases these type of apprehensions are misplaced. In most of the cases the libraries use passive tags which reflect the radio frequency waves emitted by the RFID readers. The upper limit of tracking distance depends upon the range of radio frequency waves. For example a tag of 13.56MHz range can be read from a distance of 3.5metre only.

Though the use of RFID in library services has gained prominence in recent decades the standardization of the RFID

implementation is still under process. Seldom has any standard explained the probable arrangement of different bibliographic records in a RFID tag's memory. Therefore the RFID vendors have decided their own formatting patterns and thus the interoperability among the RFID tags of different vendors is yet to be achieved. One of the recent initiative in this regard is the formulation of ISO 28560 standards in March, 2011. There are three parts of this standard. The first part describes the bibliographic data elements which a library may require to record in a tag. Part two encodes these elements in a standardized way but permits the libraries to decide which elements they will record in a tag. According to the standard only one element is mandatory and that is primary item identifier or the Accession number of the book. Part three explains how the encoded elements will be arranged in the tag's memory. This part creates "Block" wise division of the data elements.

The RFID systems operating in High Frequency (HF) range generally works at the spectrum of 13.56MHz. In most of the countries this spectrum range is being followed in industrial, medical and different scientific applications and due to this recognition most of the vendors deals in HF tags. But as the technology evolve the Ultra High Frequency (UHF) tags came into arena of RFID technology. This tags uses 860 and 960MHz frequencies (as per the local rules and regulations) for operations. The spectrum range used by the UHF tags are closer to the one used by the mobile phones. The UHF tags are much cheaper than the HF tags. UHF tags can be read from a greater distance and the chance of frequency collision among the nearby tags is much lesser than the HF tags. But no

standardization has been done in case of UHF tags unlike the HF tags. UHF tags have lesser memory capacity than their HF counterparts. Moreover the UHF technology has some perceived health risks due to their frequency range. The spectrum frequency may create different type of non-ionizing radiation fields and this may affect the health of the library users. Generally the effects of this radiation fields depends upon the frequency and intensity of use. The intensity of radiation is mainly determined by the amount of power used by the RFID reader to track the tags and the distance from the interface of the reader and tags.

Therefore from the trailing discussion it can be concluded that, there are some points of concern related to the RFID technology. Some of these pitfalls are well perceived and some are pre-supposed. But the advantages of implementing RFID technology in library services can not be ignored. When the computer came on the scene there were also a number of doubts and concern regarding its implications. There might be technophobia or ignorance among the traditional library professionals regarding the computerization of library services. But with the passage of time these anxieties have withered away and now computerization in libraries is a basic requirement. Likewise the RFID technology may gain such a popularity in near future due to the constant evolution of its components and the libraries may utilise this technology to meet the demands of the time.

RFID Implementation : a first-hand experience

Indrani Bhattacharyya

Senior Manager, Library and Information Services
British Council, Kolkata

In the late 1990s I had the opportunity of seeing a demo of library RFID (Radio frequency Identification) systems during a visit to our Bangalore office on an annual planning meeting. It was a novelty then .We were still not used to walking into supermarkets or big shopping establishments with RFID gates installed at every exit points, as part of our everyday existence. However things are quite different in 2017. RFID gates are visible in most large shopping outlets in the city and we have consciously or unconsciously adapted to the changes easily in our daily lives. RFID technology has found much popularity in different spheres of our life and as librarians we are witnessing growing interest amongst institutions for embracing this technology in managing day to day library operations.

Reasons for Implementation

Most libraries work with limited budget and it is not always easy to justify a business case for procurement of an expensive system like RFID for managing library operations. British Council introduced RFID system for the first time at the Delhi centre many years back followed by some other centres in the country. In Kolkata the system was installed in our library only last year .

Currently British Council offers a hybrid library service which is a combination of a physical library with a collection of contemporary books, journals and DVDs showcasing the best of UK and an Online library with a wide range of e-books, e-journals, e-movies, online training materials, digital theatre etc. available 24x7 from anywhere in India. Hence preserving and protecting a vast library collection was not a priority for the Kolkata Centre. An academic or public library with a huge physical collection would require adequate systems to track, monitor and maintain the collection properly. Similarly an archival library with rare materials in stock will have to protect and preserve its collection carefully. Our library did not belong to any of these categories. We had already automated our library operations since the late 1990s. Our collection was barcoded, our membership cards were barcoded and we were using scanners at issue return counters, at our processing section and at our membership registration desks. So why did we need RFID. The decision to introduce RFID was based on wider corporate objectives.

Our libraries were evolving. We were moving away from the concept of a library space which had books on shelves and a quiet reading area meant for members only. Our libraries were being transformed into cultural convening centres and we wanted a space which could be used for a variety of purposes. The Cultural Centres had to offer a combination of various things to its clients and customers, books being only one element of essentially a hybrid library offer. The space was meant to be a networking zone for various interest groups, place for holding regular events, running teaching centre classrooms, a café area and also a space where

traditional lending services could be carried out in tandem. In other words we were looking at a multifunctional space. We had open access shelves and we were now looking at flexible boundaries also. Hence we had to put systems in place so that our physical documents were protected and could not move out of the premises without being issued through the LMS.

Secondly we wanted our staff time to be used more productively by reducing repetitive work and doing more customer facing jobs. Moreover new services were being introduced which required added support for members. For example we had introduced our online library a few years back and the collection was being strengthened gradually. This required lot of one to one support for our members who were registering for the digital library services from all parts of the country. The purpose was to use our available staffing resources in an optimum manner.

Thirdly the customer experience was also critical. Our audiences were changing and we were facing a much more technologically savvy group who wanted quick service with minimum intervention.

What changed/improved

Use of Space

Post RFID systems implementation, the library space is now being used for holding a variety of activities and events like book launches, workshops, theatre events , press conferences , panel discussions etc. etc. The RFID gate takes care of the

safety of our collection. We do not have to worry about books being lost or stolen. The issue returns kiosk can be moved conveniently and placed at different points when events are on in the library floor. Members can carry on with their regular transactions and participate at the events simultaneously. Earlier the library area was fixed. But now since the RFID gate is at the security point at the exit, members can even use the extended Café area to sit and read and enjoy their coffee simultaneously.

We could extend our offsite teaching centre services by opening additional classrooms adjacent to the library. Students are able to freely move within the available area beyond library operational hours also. The library resources are available to them at any point of time when they are in the premises to attend classes. We could offer extended hours of service to our students without deploying any additional staffing resources on the floor.

It is no longer mandatory to have the baggage counter at the entry point and the space can be conveniently used for other purposes.

Staff time

Earlier one staff was placed near the library exit point to check the date stamp on labels of books being taken out by members. We no longer require that staff engaged in doing such repetitive work. Instead staff on the floor can easily multi task and deliver lot more. Another staff was stationed full time at the return issue desk to register loans on the system. Staff had to be used at both the counters on a

rotational basis to cover breaks, leaves etc. This meant having adequate resources on payroll to manage these services properly. Both these service points have now become redundant resulting in savings for the organization. Staff on the floor is now helping members to get hands on demo of our online services on a daily basis and through periodic group demos. Events form part of a cultural centre's ethos and organizing events requires lot of staff input. Our mandate is to hold at least 100 events in a year. Thus we were able to redeploy existing staffing resources to help us manage many such new emerging activities.

Customer delight

Library members are generally happy as reflected in our periodic customer effort assessment(CEA) surveys. It takes less time to check in and check out books as multiple items can be issued and returned with a single transaction at the kiosk. Because of fast processing of check in check out transactions, members do not have to wait too long at the kiosk .Members can now use extended areas of the front office including the café area to study or take their library books and have some coffee. They can also carry their personal books inside the library for reference work.

Annual Stock Verification

Annual Stock taking activity can become very fast depending on the system you are using.

Concerns

It is expensive. Research does not indicate and support ROI of RFID implementation in libraries. Hardware is expensive and the costs of RFID tags and cards are high recurrent expenses which need to be planned well in advance.

Return Issue transactions have to be done carefully otherwise there are chances of mismatch and of books getting lost in the process. It is advisable to install printers at check-out kiosks so that members have receipts of transactions instantly. In a recent incident, a member had a book on his account which he claimed he had returned. But the book could not be traced in the library. Fortunately after several weeks the book was returned by another member who had picked it up from the

shelves and then the book was cleared from the original borrower's account. None of the members had checked their records at the check in check out point. Both had assumed that their transaction records were in order. Nor did they find time to login to their account and check their records at a later point of time.

There have been some adverse reactions from some members who still require hand holding to navigate through the new system. There has to be continuous user education in place which could involve considerable staff time in user awareness programmes.

Stock taking exercise can fail sometimes. It was not a very successful exercise in our case. We eventually used the manual process to verify missing items against reports. Since the number of errors was too many we had to do a physical verification of all items in order to get a true picture of the health of the collection.

Stock editing can be quite time consuming. We can no longer track the usage pattern of books by physically examining the books since the date stamps are no longer used. For regular book selection or book weeding activity it is useful to understand which books or subjects are heavily used or less used. With RFID the only way to do it is to scan every title on the system and go through the complete bibliographical details of every title and then locate the title on the shelf to take appropriate action. This is a long drawn process and cannot be done quickly.

There have been cases of tags being damaged or removed from books and DVDs. Tags are expensive specially the DVD tags which cost close to fifty rupees per tag . Sometimes the DVDs are damaged when people try to remove the tags from the discs .In most cases members have been asked to pay for the damage.

Since issue/returns are not monitored, even non-members can use the library unless identified during random checks. There could be security issues since access to internet is also open to users inside the library.

Implementation

Before implementing RFID, it is good to evaluate the needs of your institution. Budget should be planned for future recurrent expenses also, with clear timelines set for the project. Cost is a major factor in influencing decision about RFID implementation. Academic libraries with large collections will have to bear huge financial burden in order to implement RFID. Also if there is an existing LMS system the technology should be able to combine the two. This will reduce cost. We retained our existing KOHA platform with barcoding system. A middleware was utilized to communicate with the existing library management system. The tagging of 35000 books, 3000 DVDs and periodicals took over a month's time. The books on shelves and returned books were handled separately so that there was no confusion. We used the services of the supplier to complete the tagging of all items at the implementation stage. Initially relevant staff members were trained in handling hardware, as well as the processing of books and membership cards. Now our staff members are

doing the tagging job as part of regular processing activity. Investment in staff training and education is very critical to manage a successful transition.

Our experience has been fairly positive till date and the feedback from our members has been encouraging. It has solved our major challenge of working creatively with limited available space and manpower.

Concepts of RFID: some issues

Dr. Arabinda Maity

Professor and Head

Department of Library and Information Science

University of Calcutta

1. Introduction

In the year 1931, the father of Library Science Dr. S.R. Ranganathan formulated the Five Laws of Library Science highlighted the principles of operating a library system. These laws are:

- (i) Books are for use.
- (ii) Every reader his / her book.
- (iii) Every book its reader.
- (iv) Save the time of the reader.
- (v) The library is a growing organism.

Therefore the primary thing is to provide the book or document to the users at the earliest. The users do not bother about the classification scheme the library used for organising the documents in a library or the code followed for preparing the catalogue cards for the documents. They just require their desired documents. If any library is able to provide the required documents immediately, according to users points of view the library is the best one. Whenever we move to any

medicine shop for purchasing the medicine, we never bother about the schemes the medical persons followed for arranging the medicine. If the medical person is able to provide the medicine immediately then we certify that the medicine shop is the best one. That means every time we the people want our required documents immediately. That is also true in case of every library. Whether we make the library a digital one, we make our database in popular Library Management Software, but if we are unable to produce the documents immediately whenever any user demands for that then the main purpose will not be fulfilled. So arrangement of documents is vital one. If the documents are properly arranged then any one can have the documents in any time. But if the arrangement is not in proper way, then RFID will help them for finding the documents in a quicker way.

2. OPAC and Web-OPAC

At present most of the libraries prepare their library database with the help of any LMS and make available in OPAC for access to the users. For the better access of the remote users libraries make the OPAC available in their website which is called web-OPAC. But in all cases, unless and until you have the required document available in the library, the actual purpose will never be fulfilled. Therefore everybody should concentrate on the arrangement of the documents. If it is in closed access, the arrangement may be in proper order. But if it is in open access mode, every time there is a chance to mis-arrangement of the documents. Implementation of RFID is the

correct way in this regard. Most of the libraries in India at present are facing the problem of shortage of staff. Therefore to provide the better service with this shortage of staff, RFID is the only way which can overcome the problem.

3. Implementation of RFID in the Library

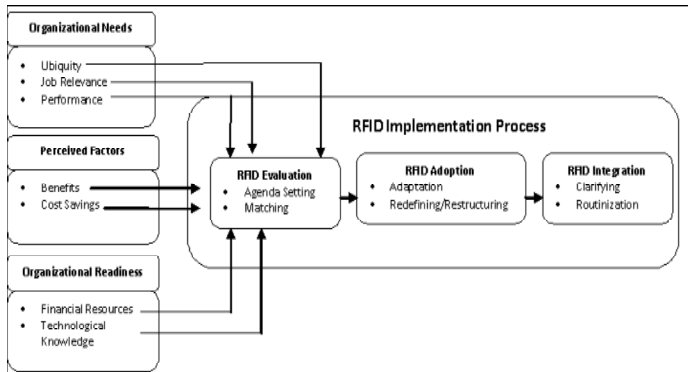
The methodology for implementation can be divided into many phases taking into consideration of budget provision, the types of document holdings, number of volumes, types of items meant for circulation, and the number and types member the institution has.

There are three factors to be taken into considerations before the evaluation, adoption and integration of RFID by any organisations or institutions. Those factors are organizational needs, perceived factors, and organizational readiness.

Stage 1: RFID Evaluation

(a) Need: Ubiquity, job relevance and performance

The perception of an organization or institution on the ability of RFID to provide personalize and uninterrupted connection and communication throughout the organization is called ubiquity. The job relevance is referring to the extent the technology is significant towards the user. It is crucial to adopt and implement RFID as it will significantly increase performance and reduces operating cost of the library.



(b) Perceived factors: Benefits and cost savings

The ability of RFID to provide cost effective communications, information exchanges, and business operations can be considered as cost savings.

(c) Organizational readiness: Financial and technological knowledge

It is crucial for a university to have sufficient budget, and knowledge on the RFID technology before adopting the technology.

Stage 2: RFID Adoption: Adaptation and redefining/restructuring

The RFID technology has to be customized to suit the needs and structures of the library or else, the library has to change in order to adopt the technology requirements and applications.

Stage 3: RFID Integration: Clarifying and routinization

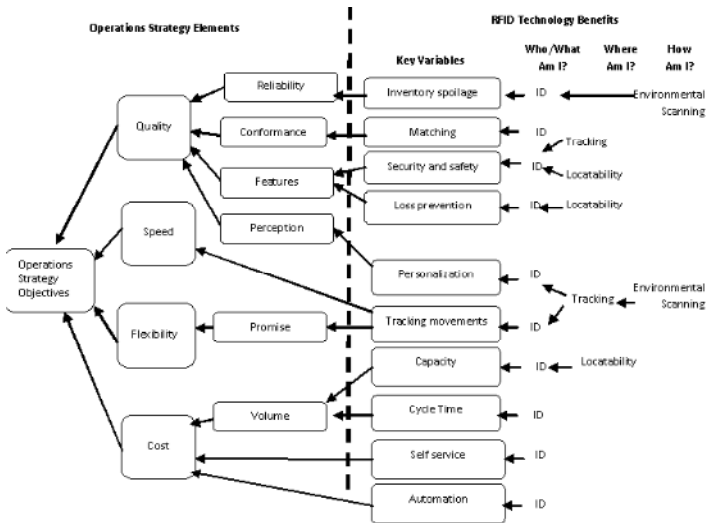
The RFID technology has to be fully integrated and immersed into the library needs, by which all parties able to use the technology easily.

4. Benefits of RFID in the Library

There are four main benefits which are (1) quality (2) speed (3) flexibility and (4) costs.

4.1 Quality

The main function of RFID technology is as security tool whereby the tag is used as a “security bit” that allows switching from “checked-in” to “checked-out”. A library must install an exit gates that will read each tag as the patrons walk through it the alarms will sound if the tag is not in a “checked-out” mode.



4.2 Speed: Tracking movements

RFID will detect the location of a book either on shelf or elsewhere so it is more efficient and faster in tracking book inventories, however it only allows the presence of an object to be detected within an area rather than providing a specific location.

4.3 Flexibility

Promise: Tracking movements

Librarian able to assist patrons in locating the movements of books and documents in the library, as such it increases the efficiency of customer service in the library. Also, the 'checked-out' books and documents information are stored in the computer database that allows the patrons to check the availability of the books online.

4.4 Cost

Self-service and automation

It allows the patrons to check-out all books at once, because the reader can read multiple tags at once in a single transaction. Another investment is automating sorting machine that enable to sort books into bins in accordance to its call number that allows the librarian to do the re-shelving faster. RFID allows the library patrons to do self check out and in for books, thus less time spend to queue and less staff needed at the circulation desk .

Volume: Capacity and cycle time

Although the cost per item for RFID is more, however the libraries items are taken out and returned many times, due to this the RFID tag is re-used many times as such it is more cost efficient and has a longer cycle time.

5. Barcode Vs RFID

- Barcode readers require a direct line of sight to the printed barcode; RFID readers do not require a direct line of sight to either active RFID or Passive RFID tags.
- RFID tags can be read at much greater distances; an RFID reader can pull information from a tag at

distances up to 300 feet. The range to read a barcode is much less, typically no more than fifteen feet.

- RFID readers can interrogate, or read, RFID tags much faster; read rates of forty or more tags per second are possible. Reading barcodes is much more time-consuming; due to the fact that a direct line of sight is required, if the items are not properly oriented to the reader it may take seconds to read an individual tag. Barcode readers usually take a half-second or more to successfully complete a read.
- Line of sight requirements also limit the ruggedness of barcodes as well as the reusability of barcodes. (Since line of sight is required for barcodes, the printed barcode must be exposed on the outside of the product, where it is subject to greater wear and tear.) RFID tags are typically more rugged, since the electronic components are better protected in a plastic cover. RFID tags can also be implanted within the product itself, guaranteeing greater ruggedness and reusability.
- Barcodes have no read/write capability; that is, you cannot add to the information written on a printed barcode. RFID tags, however, can be read/write devices; the RFID reader can communicate with the tag, and alter as much of the information as the tag design will allow.
- RFID tags are typically more expensive than barcodes, in some cases, much more so.

6. Components of RFID

A comprehensive RFID system has three components: (1) RFID tags that are electronically programmed with unique information; (2) readers or sensors to interrogate the tags; and

(3) a server or docking station on which the software that interfaces with the automated library system is loaded.

6.1.1 Classification of RFID tags:

Class 0: Read only – factory programmed. These are simplest type of tags, where the data, which is usually a simple id number is written only once into the tags during manufacture.

Class 1: Write Once Read Many (WORM) - Factory or user programmed. In this case tag is manufactured with no data written in to the memory. Data can then either be written by manufacturer or by the user – one time. Following this no further writes are allowed and the tag can only be read. Tags of this type usually act as simple identifiers.

Class 2: Read-Write – This most flexible type of tag, where users have access to read and write data into the tags memory. They typically used as data loggers, and therefore contain more memory space than what is needed for just a simple id number.

Class 3: Read-Write (with on board sensors) – These tags contain on board sensors for recording parameters like temperature, pressure and motion, which can be recorded by writing into the tags memory. As sensor readings must be taken in the absence of a reader, the tags are either **semi-passive or active**.

Class 4: Read-Write (with Integrated Transmitters) – These are like miniature radio devices which can communicate with other tags and devices without the presence of the reader. This means that they are completely active with their own battery power source.

6.1.2 Active and Passive tags:

First basic choice when considering a tag is either passive or semi-passive or active. Passive tags can be read at a distance of up to 4 – 5 m using UHF frequency band, whilst the other types of tags (semi-passive and active) can achieve much greater distance of up to 100m for semi-passive, and several KM for active.

- **Passive tags** use the reader field as a source of energy for the chip and for the communication from and to the reader. The available power from the reader field, not only reduce very rapidly with distance but is also controlled by the strict regulations, resulting in a limited communication distance of 4 -5 m when using UHF frequency band (860 MHz – 930 MHz) .
- **Semi-passive** (battery assisted back scatter) tags have build in batteries and therefore do not require energy from the reader field to power the chip. This allows them to function with much lower signal power levels, resulting in greater distance of up to 100meters.
- **Active tags** are battery powered devices that have an active transmitter onboard. Unlike passive tags, active tags generate RF energy and apply to the antenna. This autonomy from the reader means that they can communicate at the distance of over several KMs.

6.2 Reader / Sensors:

A typical system includes several different kinds of readers, also known as sensors when installed at library exits. These are radio frequency devices designed to detect and read tags to

obtain the information stored thereon. The reader powers an antenna to generate 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, which, in turn, communicates with the automated library system when the RFID system is interfaced with it.

The types of readers include staff workstations for circulation desk charging and discharging, patron self-charging stations, and longer-range walk-through exit sensors to detect and read an RFID tag passage for purposes of determining whether it is a charged (authorized/no alarm) or discharged (non-authorized/alarm) event. The exit sensors are sometimes called “antennae,” but that is not correct because an antenna is only one component of an exit sensor.

6.3 Server/Docking Station: The server is the heart of some comprehensive RFID systems. It is the communications 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.

7. Advantages of RFID

7.1 Faster Circulation Transactions: The use of RFID definitely reduces the amount of time required to perform circulation operations. The most significant time saving fact is that information can be read from RFID tags much faster than from barcodes and that several items in a stack can be read at the same time.

7.2 The perfect tracker: RFID system that combines RFID security and the tracking of materials throughout the library; or it is a hybrid system that uses EM for security and RFID for tracking

7.3 Simplified self-charging/discharging: For patrons using self-charging, there is a marked improvement because they do not have to carefully place materials within a designated template and they can charge several items at the same time.

7.4 Highly reliable: Several RFID library systems claim an almost 100 percent detection rate using RFID tags and there are very few false alarms than with older technologies once an RFID system is properly tuned. Where a patron to run out of the library and not be intercepted, the library would at least know what had been stolen. If the patron card also has an RFID tag, the library will also be able to determine who removed the items without properly charging them

7.5 High-speed inventorying: A unique advantage of RFID systems is their ability to scan books on the shelves without tipping them out or removing them. A hand-held inventory reader can be moved rapidly across a shelf of books to read all of the unique identification information. Using wireless technology, it is possible not only to update the inventory, but also to identify items, which are out of proper order. This feature of technology is very helpful in stock taking where much time was wasted in manual entries.

7.6 Automated Identification of materials: Another application of RFID technology is automated identification of materials. This includes conveyor and sorting systems that can move library materials and arrange them by category into separate bins or onto separate carts. This significantly reduces

the amount of time required for re-shelving the reading material.

7.7 Better than bar-code: RFID tags are far better than bar codes, as these are not required to be scanned through some reader or recorder, as required in bar-code.

8. Disadvantages of RFID

8.1 High cost: The major disadvantage of RFID technology is its cost. The readers and sensors used to read the information are costing between Rs.100,000/- to Rs.1,50,000/ a server costing as much as Rs.5,00,000/- to 600,000/- and the tags cost Rs.30 to Rs. 45 each.

8.2 Easy to deceive the technology: It is possible to deceive an RFID system by wrapping the protected material in two to three layers of ordinary household foil to block the radio signal. Clearly, bringing household foil into a library using RFID would represent premeditated theft. It is also possible to create a fault in an RFID system by placing two items against one another so that one tag overlays another. That may cancel out the signals.

8.3 Removal of tags: The RFID tags are typically affixed to the inside back cover of the book and are exposed for removal. This is a rare case but that does not mean that there won't be problems when patrons become more familiar with the role of the tags. If a library wishes, it can insert the RFID tags in the spines of all except thin books, however, not all RFID tags are flexible enough. A library can also imprint the RFID tags with its logo and make them appear to be bookplates, or it can put a printed cover label over each tag.

8.4 Exit sensor problems: The performance of the exit sensors is problematic. They must read tags at up to twice the distance of the other readers. If the library install a smaller antenna at checkpoint than there can be problem for sensor to check every patron, because it will not work properly. The performance of exist sensors is better when the antennae on the tags are larger

8.5 Fear to invade Patron Privacy: There is a perception among some that RFID is a threat to patron privacy. That perception is based on two misconceptions: (1) that the tags contain patron information and (2) that they can be read after someone has taken the materials to home or office.

9. Standards of RFID

The relevant RFID standards for libraries are ISO 15693, ISO 18000-3, SIP2, NCIP, and ISO 28560.

9.1 ISO 15693: It is an international standard. It deals with the interface between the tags and the software in the readers. ISO 15693 operates at 13.56 MHz frequency and offers a maximum read distance of 1.5 meters (approximately 59 inches). Almost all RFID products, including all those used for library RFID applications conform to this standard.

9.2 ISO-18000-3, an international standard, means that a read/write passive tag operates at 13.56 MHZ, but limited to a range of 24 inches. All library RFID tags conform to this standard. Each vendor decides on the number and function of the data blocks on its tags. While this facilitates item level tracking, it does not provide interoperability among the tags of different vendors.

9.3 SIP2 (Standard Interchange Protocol) is the de facto standard developed by 3M that makes it possible for a patron

self-charging station or RFID system to communicate with an integrated library system. It makes it possible to verify that patron is a valid borrower and has not exceeded any of the library defined limits on borrowing. The checkout/checkin information is then passed between the RFID and integrated library systems.

9.4 NCIP: SIP2 is gradually being replaced by NCIP, a standard developed by the National Information Standards Organization (NISO Circulation Interchange Protocol Z39.83).

9.5 ISO 28560, a three-part international standard that was published in the second quarter of 2011, is essential to interoperability among RFID systems. The standard spells out the format for library RFID tags. Specifically, Part 1 describes the data models and data elements, while Parts 2 and 3 provide for two options for encoding the data on the tags.

10. Conclusion

Many of the persons highlighted that the RFID technology is used mainly for the theft detecting technology. By the word ‘theft detecting’, generally it means that library professionals are treating the user community (Teachers, scholars and users) as basically as dishonest persons and every moment there is a chance for stealing the documents. Therefore the users should always keep under strong vigilance. Practically it is not the correct one. Basically it is used for saving the valuable time of the bonafide users and helps them to have the facility without intervening the availability of the staff. Even in the whole night, the users can avail the facility of using the resources if only security staff are present at the main gate. The users can issue and return the materials as and when they want.

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Security Concern and RFID Implementation in the University Libraries of West Bengal: A Study

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Abstract: The security has been gradually the prime concern of the university libraries. The paper deals with the security related issues in the university libraries of West Bengal. A survey has been conducted to know the different security related issues and special attention has been given to RFID for securing the collection. It is find out that most of the university libraries have not adopted RFID for security measures but most interestingly they wanted to adopt RFID in order to avoid security related hassle.

Keywords: Library Security, Security Prevention, RFID, University Libraries, West Bengal

1 Introduction

Now-a-days information has been regarded as the valuable resource and the institutions which involved in such affairs are took the lead role in overall development. There are different levels of institutions in our society which collect, store, preserve and disseminate information in different manner using several mechanisms. Libraries are one such organization which involved in the processing and evaluating

information. Libraries are now considered as the store house of information and knowledge in both the print and the non-print format. The function of the libraries is to provide timely information with the available knowledge objects. With these changed patterns, basic infrastructures of the libraries undergo vast changes. Library and information centres are now filled with the various new technological equipments like CDs, DVDs, E-Books, E-Journals, Databases, and Digitised materials. Internet facilities become very common to all kinds of libraries. With all these developments the libraries become more technologically equipped for acquiring different sources and providing services to its clientele.

In this fusion of changing state the library and information centre are in a juncture where the authorities are more concerned about the collection, service, delivery and use of information technologies as they need to combat with the present day and to make the libraries relevant. Thus the library and information centre will sustain in the present time. But there is a need to reassessment the nature of the infrastructure provided within the organisation. The nature of threats brings the new concepts of security management which comparatively new to the field. This paper will try to identify the different areas of threats in the library and information centre.

2 Background

There is limited number of work done in identifying the library hazards and the problems associated with it. There were no standards, definitions and clear concepts in respect to the different facets under the library hazards. Therefore here

the researcher has tried to find out or locate the different kinds of the hazards found in the university libraries. Based on the above mentioned three studies the researcher has been able to identify the concepts of library hazards. The different hazards are represented in the Figure 1.

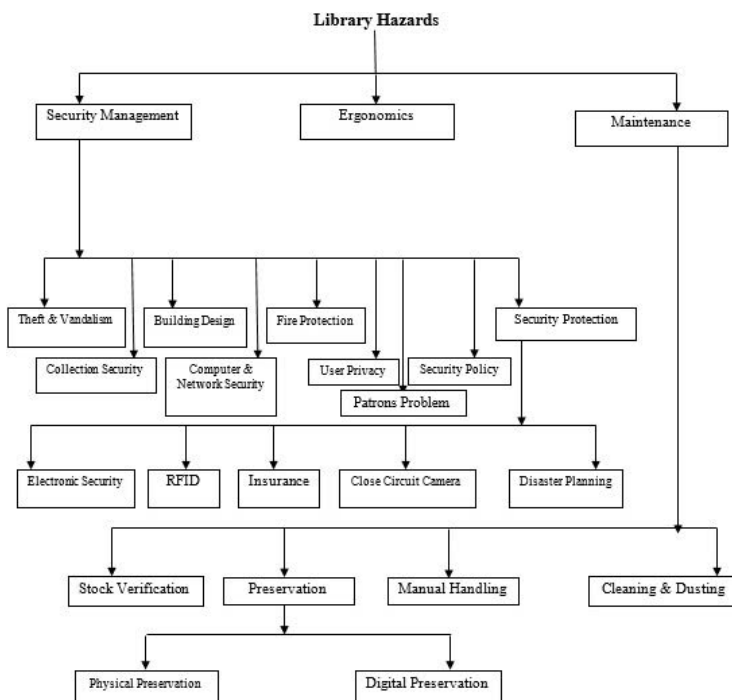


Figure 1. Security management facet representation

The above diagram indicated the structural presentation of different library hazards faced by the libraries. Here the hazards are shown with respect to the three areas. The areas under the security management are Theft and Vandalism, Collection Security, Building Design, Computer and Network

Security, Fire Protection, User Privacy and Security Protection (like Electronic Security, RFID, Insurance, Close Circuit Camera, Disaster Planning). The areas under the ergonomics hazards are Furniture and Lighting. The areas under maintenance are Stock Verification, Preservation (Physical and Digital), Manual Handling and Cleaning & Dusting. The diagram indicated about the presence of different important areas in the form of hazards in respect to the entire library system. Therefore it is the utmost need to understand the different hazards in the library for providing better services to the users.

The above broad categorisation will be based upon the previous focused studies but in several parts different new concepts have been incorporated and the concepts have been extended based on the recent research work of the library security. There is a journal entitled “Library & Archival Security” (1978 - current) by Taylor and Francis which is solely dedicated to different aspects of security issues in Library and Archives which also acts as the important tools for identifying different concepts of library security.

3 Reasons for Need of Library Security

The situation of university libraries gradually changes with the implementation of information and communication technology, virtually almost every aspect of the library and information centre. Now university libraries acquire diverse tools and adopt different new technologies to serve the broader group of users. Professionals have faced many

challenges in maintaining the security condition of the library. The reasons behind this crisis are:

- ❖ **Transformation of traditional university library to hybrid library:** Most of the university libraries now acquire different online and digital documents. Sometimes it is found that the digital and online documents outnumbered the print documents. The university libraries are in a transition phase. With the increasing demand of diverse nature of knowledge objects, libraries are now acquiring both forms of the documents. In this phase, we can term the library as hybrid library. Hybrid libraries are the combination of print material and electronic or digital materials. According to Pinfield and others hybrid library is on the continuum between the conventional and digital library, where electronic and paper-based information sources are used alongside each other. But the major challenge associated with the management of the hybrid library is to encourage end-user in resource discovery and information use in a variety of formats. With the emergence of hybrid libraries the entire situation of library security becomes very gloomy to the professionals as the entire concept is new to us. In most of the university libraries in India least security provision is there which is hybrid in nature. The professionals are not much familiar with the security issues in the digital or hybrid library. Assessment and analysis of security provision in hybrid library is yet to be done.

- ❖ **New tools and techniques used in university libraries:** Libraries are now in a transition phase where different new tools and techniques crept in the library field. Librarians now use software to manage the library services. Using online reference sources, multimedia documents, digital objects, online databases etc. becomes very common to most of the university libraries. With the adaptation of these new tools, libraries are becoming more techno-centric, there is need to put more emphasis on the new resources. But it is found that the safety and security of using such tools and techniques unknown to the most of the university libraries in India. Therefore the situation of the university libraries is quite critical than ever before.

- ❖ **Services of the university library became more technology based:** There has been a clear shift in teaching and learning processes in the universities. As a result the environment of the libraries gradually changes. ICT has been considered as one of the main components of university library system. There have been many difficulties faced by the libraries to provide free flow of services. In order to overcome this, libraries adopt different technological tools and techniques. Most of the scholarly information is now available in digital format. These changes profoundly altered the way of students, faculty and researchers for seeking their information and use it. Few surveys showed that the users prefer more digital information rather than the print mode. All these slowly

revolutionized the service pattern in university libraries. University libraries are now IT based which create further problem to maintain the security condition as this things are very new to the professions. So the true hazards have not yet been realized.

- ❖ **Lack of staff strength in library division of the university system:** University library provides diverse range of services to the users. This is mainly because of the increasing demands of the user community. In this Knowledge Society, access the right information is tedious task for the general people. Users of the university libraries need more attention to find the appropriate information from vast amount of information resources. Thus university library needs more staff to provide the user oriented services. Emphasis of the library shifted towards the service rather than preserving or keeping the documents safe for the users. In university libraries, the staff strength gradually decreasing with the increasing rate of resources. In this situation, more emphasis is to put on the services rather keeping the documents safe. It is not possible with the minimum number of staff to look after both the matters. Thus the security situations have been gradually worsen than before. Sometimes it becomes impossible to look into the security matter with the limited number of staff.

- ❖ **Lack of awareness among staff and administrators:** With the development in the technology and other important areas in library sector, general awareness of staff and administrators has increased a great deal. But the awareness regarding maintaining safety and security hardly found in most of the libraries. Library staff are unaware of the possibilities of security hazards in library and information centre. Administrators also do not feel any need or urge to look after this matter seriously. Thus there is need to awake up the realization among the professionals and administrators. But the utmost needs of maintaining security have been not realized by most of the professionals and administrators. The increasing importance information security is yet to be realized by the professionals employed in university libraries.

- ❖ **Diverse nature of users:** University is considered the hub of the research and development work and library is considered its most important part. The library is used by different groups of people such as teacher, students, researchers, officers and employees. A large number of users from different backgrounds use the university library. They belong to different community and have different habits of information use. Their behavioural pattern is completely different from each other. So there is increasing chance of vandalism in the library. The nature of the users in the library forced the professionals to take serious actions. The different categories of users may create

serious problem for the staff to maintain safety and security within the premises.

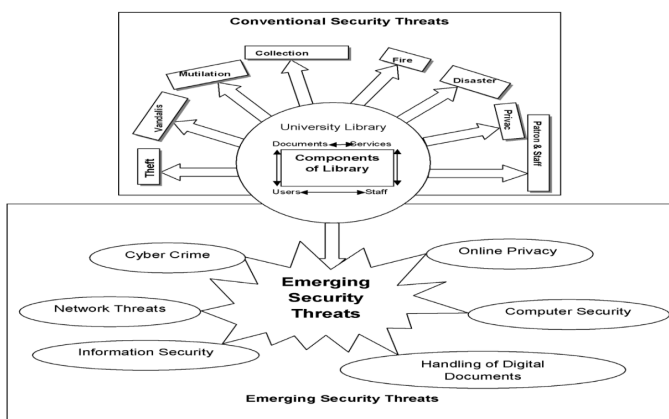
The above reasons are not exclusive in nature. There are many other areas of concern which force the professionals to think on this matter. Above areas surely pose questions to the minds of the professionals. The above mentioned reasons may create serious impetus to the adaptation of safety and security in the library. The library services are now in great transition while the emergence of web put a big threat to the library service provision. Whether there is need to have libraries becomes a questions. To combat with this situation the librarian adopted different tools, techniques and procedures with the help of technology. In such a situation different new problems have been occurred in regard to the security aspects of the library. Transition of the libraries from tradition to hybrid and digital creates problem far more. Thus it is found that the services of the libraries are in great danger and a situation of sustainability occurs greatly.

4 Security Threats in Library and Information Centre of Universities

University library it is the centre of study and research. But with the complex nature and the dimension of change in the service pattern of library and information centre gradually has become area of concern for the stake holders. Thus the security has become major concern for the librarians now-a-days. The growing nature of the vandalism in the different kinds of libraries forced the librarian and administrators to take the matter seriously and initiate proper measures to

control the current situation. The situation become worsens with the implementation of modern technology based services. Following diagram gives a quick glimpse of security threats both traditional and modern form. Chatterjee and Maity (2013) illustrated the following diagram which shows that the university library system consisting of the threats to the library and information systems

Picture 1. Architectural View of Library Safety and Security



Picture 1 shows the architectural view of library safety and security which is the focus points of the paper for providing sustainable library services. The picture represented library system consists of four main interrelated elements i.e. Documents, services, staff and users. These can be considered as pillars of the university library systems and these are related to each other. Change or interruptions in any of these create hindrance in the library system. The university library systems covered by two major type of threats that is Conventional Security Threats and Emerging Security

Threats. These conventional security threats are of 8 types and covered most part of the university system. But the emerging security threats are bigger in scope and size but covered only small part of the university systems. The figure also indicated that the modern ICT based threats may create serious problems to the university library systems and emerged in larger scope than before. The analysis of the figure clearly indicated the presence of threats in the services of the libraries. So to keep uninterrupted and free flow of library services and sustaining the library services we need to think about the security management systems in the library.

5 Security Prevention

Above discussion clearly indicates that the necessity of adopting security measures to the university libraries. There is neither security infrastructure nor security policy is available to the university libraries. But the threats both in traditional and digital form may create huge problems to the service professionals. To prevent all these kinds of security threats we can adopt the following strategies:

5.1. Primary Strategies: This is a basic strategy of making infrastructure and other necessary provisions. Librarians should try to adopt as much as possible of the below mentioned strategies to make the library environment secure for both the users and library staff.

- ❖ **Electronic Security:** Libraries are now using electronic and digital documents to serve their users. All these required proper technology infrastructure. Earlier books were chained to protect the documents

from theft or loss. Now the scenario has been completely changed. Libraries are providing open access system to the users and the chances of document loss, theft or misplace have increased great deal. So, we have to adopt electronic security systems which can assist the libraries to control, minimize or avoid library material theft and unethical losses. Complete electronic security systems are mostly available in advanced countries but developing countries also started to using this kind of security systems in their libraries. There are many electronic security systems in the library. Rajendran and Rathinasabapathy (2007) described following major electronic security systems available for libraries:

- ♣ **Electromagnetic System:** The Electro-magnetic (EM) security system is little bit old technology which was used in libraries for decades. It is dominant in Europe and used by many libraries around the world. In this technology, a magnetic, iron-containing strip with an adhesive layer is attached to the library material. This strip is not removed at checkout; it is simply deactivated by a scanner that uses a specific highly intense magnetic field. One of the advantages of the EM strip is that it can be re-activated and used at a low cost.

- ❖ **RFID:** RFID is one of the advanced technologies widely used by academic libraries to prevent library material theft. But due to high cost it is usually used

in high level academic institutions. RFID-based systems help to track the systems that combine security with more efficient tracking of materials throughout the library, including easier and faster charge and discharge, inventorying, and materials handling. The rapid use of technologies in library arena and increased book theft case forced the libraries to adopt these facilities and to improve the overall security protection. RFID provide cost-effective solutions to many of the problems faced in academic libraries like Annual stock, Rapid checking that the books are shelved in the correct area, Searching for specific items using a scanner, Self check out of items, Self return of items, Security, Library membership cards etc. RFID is a complex system which ultimately helps to increase the security of the library. Kumar(2008) described the five key components of RFID system:

- ♣ **Smart Card:** The term Contact less smart card refers to identification cards that do not need to make contact with the reader to be read. This capability is implemented using a tiny RFID tag in the card; the intention is to provide the user with greater convenience by speeding checkout or authentication processes etc.
- ♣ **RFID Tags:** The RFID tags have been specifically designed to be affixed into library media, including books, CDs, DVDs, and tapes. The RFID tag has three sections: a

lockable section for the item identification, a rewritable section for library specific use and security function for the item antitheft i.e which can be activated and deactivated. The chip also has a multi read functions which means that several tags can be read at once.

- ♣ **Library Programming Station:** This is used to Program the new documents. Programming Station also designed to allow an efficient conversion of the collection from existing barcodes to RFID tags. It enables to program the barcode data into the memory of the tag and to activate its antitheft function at the same time. Small in size and ergonomic, the programming station can be used in any library desktop configuration. The Programming station offers a simple connection to any computer. The Programming station can be used in parallel with any barcode scanner.
- ♣ **Library Circulation Station:** It is made up of Library Reader L-L100 and LI antenna i.e an additional antenna can be added to increase the number of item processed. By using tags the circulation station is able to identify the item and activate/deactivate the tag antitheft function simultaneously. The Circulation station can be placed at anywhere. The circulation station is a staff station enabling library staff to check-out and check-in several times at the same point. It is

possible in a single operation to identify the item while activating/deactivating the antitheft function.

- ♣ **Library Inventory Reader:** This handheld RFID reader consists of a long light weight handle with a flexible end part i.e RFID antenna that rotates to facilitate the identification of items on all shelves especially hard to reach areas. The reader offers optimum reading performance enabling instant data capture when passed alongside the items in a continuance movement. Documents are identified regardless of their thickness and proximity to the shelf's edge. Inventory reader is unique in its shape and its functionality and enabling the Library staff to easily identify the items on the shelves

- ❖ **Insurance:** Several incidents occur in the library that causes significant losses to the library yet the administrators are not quite eager to minimize this loss covering through insurance. The topic of insurance hardly occurs in the written literature of the library. According to McGinty (2008) the fundamentals of risk management consider risk from a sequential perspective:

- ♣ Identify risks to the organization.
- ♣ Evaluate these risks in terms of probability of occurrence and monetary loss.
- ♣ Determine if any risk can be avoided.

- ♣ Control or prevent risks that are part of operations.
- ♣ Insure against risks to avoid financial loss.

This risk management and identifying risk management procedures often been ignored because of the lack of understanding about the risk associated with the regular library operations. But the range of risk inherent in library operations is diverse in scope that is starting from theft or vandalism to computerised file manipulations. In most cases, university libraries may be covered or assumed to be covered under the greater institutional or governmental umbrella policies or through a self-insurance policy for larger organizations or government agencies. The most common way through which this risk can be covered is adopting insurance policy for covering the risks of the organization. Insurance helps the organization to restore its position regarding its financial position. But the basic question arises is the availability of funds to cover all the risks in the library processes.

- ❖ **Close Circuit Camera:** University library is now not an idle place. It remains open in most of the times of the day. It consists of several important components with a larger physical area. In this large physical space it is probably impossible to have strict security vigilance in all the parts of the library. All this creates a need for twenty-four-hour secured access for authorized users without the need for additional

manpower. In this case video camera can work well. The good thing about video camera, it can operate on their own without the help of others. Video cameras can help to monitor the library services and simultaneously help to prevent theft and vandalism in library. Westenkirchner(2008) identified that many libraries use video surveillance, primarily to protect their technology investment and to prevent theft. In the past, the typical technology for video surveillance was closed-circuit television (CCTV) and digital video recorders. Traditionally, libraries operated with CCTV, but many are migrating to integrated Internet protocol (IP) camera surveillance systems. An IP camera is a video camera that attaches to a network. The video it records can be viewed from any computer with Internet access. Thus it can be said that CCTV act as an important tool for maintaining security within library premises. But the problem is huge cost is involved in the installation and maintenance of the system.

- ❖ **Disaster Planning:** A disaster is an unexpected event that may put the organization at risk. It is very much true for the library and archive because most of the libraries posses precious and sizable collection of documents. Disaster planning is thus a basic security requirement for libraries and archives. Now-a-days, it is considered to be an essential part of any preservation programme to be implemented by any kind of library or archives. Disaster planning is one of the ways for the prevention of library materials. It

may be of two parts organizational in which library is part of it and solely for the library itself. University library should have clear and distinct disaster plan which help to protect the organizational treasures. University disaster plan should consist of Prevention, Preparedness, Response and Recovery. Western New York Disaster Preparedness and Recovery Manual for Libraries and Archives (2004) contain 21 worksheets which help to organize emergency information. These are:

- ❖ Emergency Instructions
- ❖ Evacuation Procedures
- ❖ Emergency Telephone List
- ❖ Disaster Team List
- ❖ General Staff List
- ❖ Security Information
- ❖ Fire Detection and Suppression Equipment
- ❖ Emergency Supply Kit Locations and
Emergency Supply Kit Contents
- ❖ In-House Resources
- ❖ Sources for Supplies
- ❖ Sources for Services
- ❖ Collection Priorities
- ❖ Collection Priorities Floor Plan
- ❖ Floor Plans
- ❖ Floor Plan Descriptive List
- ❖ Internal Hazards Survey and External
Hazards Survey
- ❖ Internal and External Hazards Inspection
Checklists
- ❖ Incident Report Worksheets

All these plans help to prevent any kinds of massive disasters in the library which ultimately help to prevent the library from natural disasters.

5.2. Secondary Strategies: This category is consists of different combination of provision except creating infrastructure. These strategies enable the security condition far better than before. Usually these would include creation of rules and other necessary arrangements for the library.

- **Adequate Rules:** Every library must have a clear and adequate rule to control the behaviour of the human element.
- **Awareness:** Security is considered as neglected area in the library. There is need to grow awareness in this regard by organising seminars, workshops etc.
- **Strong Vigilance:** The role of the library staff is not limited to the service provision. The staff members should have the strong vigilance over the activities of the user.
- **Block sites:** The system administrator should block the enlisted unnecessary sites for safety of the network.
- **Firewall:** A firewall is a device or set of devices designed to permit or deny network transmissions based upon a set of rules and is frequently used to protect networks from unauthorized access while permitting legitimate communications to pass. Many

personal computer operating systems include software-based firewalls to protect against threats from the public Internet. Many routers that pass data between networks contain firewall components and, conversely, many firewalls can perform basic routing functions(Wikipedia).

- **Licensed Antivirus:** The computer system must installed licensed antivirus for all the workstation in the library.
- **Use Strong Integrated Library Software:** Use of Integrated Library Software helps to increase the security of the library software.
- **Password Protection in Valuable Records:** Different sets of information may be stored in the computers and access is not given to some selected persons. So, in order to protect the valuable information password features should be used to prevent the records and ensure security.
- **Restricted Access:** There should be restriction of access in some areas of the library and this should be clearly motioned and security staff should be employed in the restricted areas.
- **Regular Maintenance:** Regular cleaning, dusting and checking of documents condition and monthly maintenance systems helps to reduce the mistreatment to books. Regular checking helps to identify the responsible user and staff for the document damages.

- **Proper Supervision:** Along with the staff vigilance there is need to constant supervision over the library service staff and security staff members to watch the staff vigilance. Usually this work is the responsibility of the librarian.
- **Network Administrator:** In large organisation, there should be a permanent network administrator along with support staff should be employed to ensure the library network safety.
- **Orientation Programme:** To prevent the vandalism in the library, library should organise regular orientation programme among the library users.
- **Clear Policy:** Every library should have clear library security policy approved by the administrator. This policy should mention what are the elements to be considered in the policy.
- **Legal Measures:** Serious damages in library arena may force the administrator to initiate legal action to the responsible person. There is provision of punishment in the Indian IT Act 2000 in case of cyber related crime in library also.

6 Objectives of the Study

The basic objectives of the study are as follows:

- To find out the detailed security related problems in the university libraries of West Bengal.

- To trace out the security provisions adopted in the university libraries in regard to RFID.

7 Scope and Coverage

The research work included different security management activities of University Libraries in West Bengal. These Universities are Aliah University (AU), Aligarh Muslim University Campus (AMU), Indian Institute of Engineering Science and Technology (IEST) (formerly Bengal Engineering and Science University (BESU)), Bidhan Chandra Krishi Viswavidyalaya (BCKV), Jadavpur University (JU), Presidency University (PU), Rabindra Bharati University (RBU), Sidhu Kanu Birsa University (SKBU), University of Burdwan (BU), University of Calcutta (CU), University of Gour Banga (UGB), University of Kalyani (KU), University of North Bengal (NBU), Uttar Banga Krishi Viswavidyalaya (UBKV), Vidyasagar University (VU), Visva-Bharati (VB), West Bengal National University of Juridical Sciences (WBNUJS), West Bengal State University (WBSU), West Bengal University of Animal and Fishery Sciences (WBUAFS), West Bengal University of Health Sciences (WBUHS) and West Bengal University of Technologies (WBUT). Netaji Subhas Open University (NSOU) has been excluded from the study as it does not have the proper university library systems. Seven newly formed universities i.e three state universities namely Coochbehar Panchanan Barma University, Diamond Harbour Womens University, Kazi Nazrul University and four private universities namely Techno University, Sonar Bangla University, Seacom Skills University and Adamas University

have not been considered in the study as these universities have not yet able to start the full fledged library system. The institutes of national importance such as IIT, IIM, and ISI situated in West Bengal will be excluded from this research work as these are different from university library system in respect of administration and resource infrastructural facility.

8 Methods Used

The work was based on descriptive survey that consists of the structured questionnaire and observation method. Questionnaire consists of “yes” or “no” type. Questions were grouped under different factors like theft and vandalism, building security, fire protection, network security etc. The questionnaire then distributed to the different university libraries of West Bengal. The researcher in person visited all the university libraries to observe the prevention of library hazards with special reference to security management condition. After collecting the data, different tables have been prepared considering different points of view.

9 Analysis of the Data

Table 1: Distribution of the organizational profile of Central Library of the Universities in West Bengal

Name of the Universities	Name of the libraries	Postal address	Contact number
AMU	Maulana Azad Library	AMU Centre Murshidabad, Vill. & P.O.: Jangipur Barrage, P.S.: Suti, Dist.: Murshidabad, West Bengal-742223	348320-1427, 9564001111

Name of the Universities	Name of the libraries	Postal address	Contact number
AU	Central Library, Aliah University	EN – 69, Sector- V, SaltLake, Kolkata- 700 091	(033) 2357- 1113
BCKV	Central Library, Bidhan Chandra Krishi Viswavidyalaya	P.O: Krishi Viswavidyalaya, Mohanpur, Nadia, Pin – 741252	(033)2587- 7677
BESU	Central Library, Bengal Engineering Science University	Botanical Garden, P.S: Shibpur, Howrah, Pin – 711103	(033) 2668- 4561 (515) (033) 2668- 4561 (284)
BU	Central Library, The University of Burdwan	Golapbag, Burdwan – 713104	(0342)2657104
CU	Central Library, University of Calcutta	87/1, College Street, Kolkata – 700 073	(033) 2241- 0071-74(403)
JU	Central Library, Jadavpur University	188, Raja Subodh Chandra Mallick Road, Jadavpur, Kolkata- 700032	(033) 2414- 6460/6866
KU	Central Library, University of Kalyani	Block C, University of Kalyani, Kalyani, Pin - 741 245	(033) 2582- 0311/ 2582- 0311
NBU	Central Library, University of North Bengal	P.O: North Bengal University, Raja Rammohanpur, Dist: Darjeeling, Pin – 734 031	(0353)2776- 371
PU	Central Library, Presidency University	86/1, College Street, Kolkata – 700 073	(033)2241- 1960 (121,122,151)
RBU	Rabindra Bharati University Library	56A, B. T. Road, Kolkata – 700 050	(033) 2556- 2542
SKBU	Central Library, Sidho Kanho-Birsha University	Vill-Bongabari, P.O- Vivekananda Nagar, Dist-Purulia, West Bengal-723147	032-5224-6050

Name of the Universities	Name of the libraries	Postal address	Contact number
UBKV	Central Library, Uttarbanga Krishi Vidyalaya	Pundibari, West Bengal 736165	03582-270757
UGB	Central Library, University of Gourbanga	P.O: Mokdampur, Dist: Malda, Pin - 732103	03512-22366
VB	Central Library, Visva Bharati	Santiniketan, Birbhum, Pin - 731235	03463-262783
VU	Central Library, Vidyasagr University	P.O: Midnapore, Dist: West Midnapore, Pin: 721102	0322-276556
WBNUJS	Central Library, National University of Juridical Sciences	12, Ambedkar Bhavan, Salt Lake, Block- LB, Sector III, Kolkata –700098	(033) 2569-4700
WBSU	Central Library, West Bengal State University	Berunanpukuria, P.O: Malikapur, North 24 Parganas, Pin – 700126	(033) 2707-9231
WBUAFS	Central Library and Information Network Service	87 & 68, Kshudiram Bose Sarani, Kolkata – 700 037	(033) 2528-0840
WBUHS	Central Library, West Bengal University of Health Sciences	DD 36, Sector I, Salt Lake, Kolkata - 700064	(033) 2334-2008
WBUT	Central Library, West Bengal University of Technology	BF 142, Sector 1, Salt lake, Kolkata - 700064	(033) 2321-1327/0731 (033) 2334-1014/1021

Table 1 shows the distribution of the organizational profile of Central Library of the Universities in West Bengal. The table shows the name of the universities along with their address and phone numbers. It shows from the table that 11 universities were located in the Kolkata or allied areas of

West Bengal and rest of the 10 universities were located in the distant parts of the state. It also shows that there were 1 Central University, 1 IEST, 1 Campus University, 2 Agricultural University, 1 Law University, 1 Animal and Fishery Sciences University, 1 Health Science University, 1 Technological University and 12 State Universities in West Bengal. All the universities across the state were distributed in 10 different districts of West Bengal.

Table 2: Distribution of types of vandalism found in the Central Library of the Universities in West Bengal

Name of the Universities	Theft	Damages to library equipment	Writing on library walls	Nuisance in library premises	Violating library rules	Mis-behaviour with staff
AMU	-	-	-	-	-	-
AU	-	-	-	-	-	-
BCKV	-	-	-	-	√	-
BESU	√	-	-	-	-	-
BU	√	-	-	-	√	-
CU	√	-	-	-	-	-
JU	√	-	-	-	-	√
KU	√	-	-	-	-	-
NBU	√	-	-	-	-	-
PU	√	-	-	-	-	-
RBU	√	-	-	-	-	-
SKBU	-	-	-	-	-	-
UBKV	√	-	-	-	-	-
UGB	√	-	-	-	-	-
VB	√	-	-	√	√	-
VU	√	-	-	-	√	√
WBNUJS	√	-	-	-	-	-
WBSU	-	-	-	-	-	-
WBUAFS	√	-	-	-	-	-
WBUHS	-	-	-	-	-	-
WBUT	√	√	-	-	√	√
Total	15	1	0	1	5	3
Percentage (%)	71.43	4.76	0	4.76	23.81	14.29

Table 2 shows the distribution of types of vandalism found in the Central Library of the Universities in West Bengal. Here the vandalism includes theft, damages to library equipment, writing on library walls, nuisance in library premises, violating library rules and misbehaviour with staff. It also shows that none of the universities reported about the vandalism of writing on library walls.

Table 3: Distribution of RFID security protections in the Central Library of the Universities in West Bengal

Name of the Universities	Having RFID Security	Area of RFID	Future plan of installing RFID security
AMU	No	-	Yes
AU	No	-	No
BCKV	No	-	Yes
BESU	No	-	No
BU	No	-	Yes
CU	No	-	Yes
JU	No	-	Yes
KU	No	-	No
NBU	No	-	No
PU	No	-	Yes
RBU	No	-	No
SKBU	No	-	No
UBKV	No	-	No
UGB	No	-	No
VB	No	-	Yes
VU	No	-	No
WBNUJS	Yes	Books, Bound Journals	Yes
WBSU	No	-	No
WBUAFS	No	-	No
WBUHS	No	-	No
WBUT	No	-	Yes

Table 3 shows the distribution of RFID security protections in the Central Library of the Universities in West Bengal. It shows about three criteria such as availability of RFID security, area of RFID where implemented and future plan of installing RFID security. It shows that 1 university library has the RFID facility and it is on Books and Bound Journals. It also shows that 9 university libraries wanted to adopt the RFID system.

Conclusion

The security has been gradual concern for the university libraries now-a-days. To protect the collection, libraries adopted different mechanism. The main motto here is to prevent the collection from the usual damage. Therefore the university libraries are now thinking towards adopting RFID as one of the most important area of the library security.

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RFID: a Modern Library Management Tool

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Abstract: Information explosion around the world have posed a challenge to the library professionals. The biggest challenge is to render quickest delivery of latest information to the users - in the form they want. RFID, i.e, Radio Frequency Identification is the latest technology in library field. RFID technology based library management system helps library professionals to meet up this challenge. This article highlights on the components of RFID system, implementation of RFID system in libraries, advantages and disadvantages regarding use of RFID technology in libraries, and a few words on real scenario of Indian libraries.

Keywords: RFID, RFID Tags, Antenna, Book-drop, Sensor, Library Management System

1 Introduction: A modern library is a storehouse of enormous quantity of information; courtesy the information explosion around the world, and an unbelievable development of communication technology – which ensures easy availability of information at any corner of the world.

Library professionals are expected to retrieve this enormous quantum of information, organize the same, select the correct or relevant pieces of information, and deliver it to the user within minutes. It is impossible to meet up this challenge without the aid of modern technology. A library, today, thus

needs to be fully equipped, and aided by the technological tools for better management. RFID is one such ‘Library Management Technological Tool’, which is rapidly getting to be useful in libraries.

RFID stands for Radio Frequency Identification. This technology, although in use in industrial and service sectors, is being put to use in the library field recently. RFID is essentially an automatic surveillance system. All library documents, whether paper documents or electronic materials, are fitted with a tag, each of which has a unique identification code. Radio waves are used to identify these items fitted with the tags.

RFID technology can be made useful to library professionals in many ways. Radio waves can be used to identify the document, which a user is looking for, within seconds, and may be handed over to the user much more quickly than before – thus increasing efficiency. It can also be used to prevent unaccounted removal of library documents from the library premises.



Picture 1. RFID based Library Management System

2 Components of RFID system:

- RFID tags / transponders which are electronically programmed with particular unique information.
- Readers or sensors to response the tags.
- Antenna
- Server, on which the RFID software that interfaces with the integrated library software, is loaded.

RFID technology may be used to perform various functions in a library – acquisition, book processing, circulation, stack management etc, and based on the types of functions chosen, other components, i.e., RFID label printer, hand-held reader, self-check unit, external book return, book drop station, staff and conversion station, have to be used with the basic components.

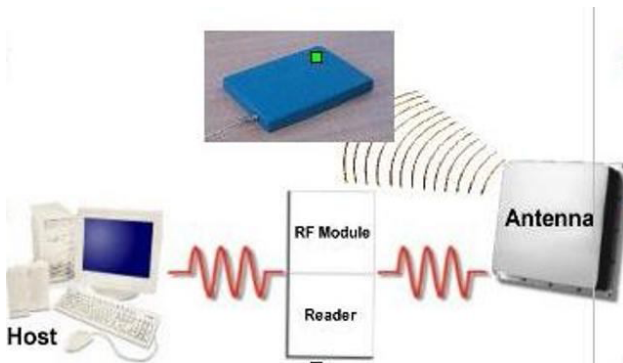
- **RFID Tags** - This tag contains a programmable chip and antenna. Each paper-thin tag contains an engraved antenna and a microchip with a capacity of at least 64 bits. This tag, with a unique code, is attached to each document.

There are three types of tags – ‘Read only’, ‘WORM’ and Read/Write. Tags are ‘Read only’, if the identification is encoded at the time of manufacturing and not rewritable. ‘WORM’ means ‘Write-Once-Read-Many’. These tags are programmed by the using organization, but the facility to rewrite on them does not exist. ‘Read/Write’ tags have the option to change or adding information. Normally, tags are used in libraries, where rewriting is not allowed. That means, in a library, usually, tags which are used, are not rewritable.

- **Readers / Sensors** - RFID readers or receivers are composed of a radio frequency module, a control unit and an antenna to interrogate electronic tags via Radio Frequency (RF) communication. The Reader enables an antenna to generate RF field. When a tag passes through the field, the information stored on the chip in the tag is interpreted by the reader and sent to the server, which, in turn, communicates with the integrated library system, when the RFID system is interfaced with it.

RFID exit gate sensors are basically two types – one type reads the information on the tags going by and communicates that information to a server. Then the server, checks the circulation database that the material is properly checked out or not. If it is not properly checked out, the alarm will be on. Another type relies on a ‘theft’ byte in the tag that is turned on or off to check that the item has been properly checked or not.

- **Antenna** - The antenna generates radio signals to activate the tag to read and write data on it. Antennas can be suitably placed into a doorframe to interface with tag data from the belongings of persons passing through the door and send it to the central server for interpretation.
- **Server** - The server is the brain of the entire system. It receives the information from one or more of the readers and exchange information with the circulation database, to find out whether the object intercepted by the antenna are authorised or not.



Picture 2. Major Components of RFID System

In addition to this, there are some other optional components.

- RFID Printer - RFID printer is used to print the labels with an individual barcode and applied to the documents. The individual barcode contains the unique identification, which the antenna intercepts and the central server interprets.
- Handheld reader - The portable handheld reader 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 server later on.
- Shelf-Check Unit - Users identification is done with an RFID-ID card. Users can put item onto the reader surface in front of the check unit to be registered under particular

user's name. Multiple items can be checked out at the same time.



- External Book Return / Book Drop Station - It is a machine with a chip RFID Reader integrated into a wall. The user can return a document through this without even entering the library, and the central server acknowledges the return.



- Staff and Conversion Station - Staff station consists of antenna, electronic module and power supply.

3 Implementation of RFID system in libraries- RFID i.e., Radio Frequency Identification system plays a major role in Library Management System. This identification system can be created by several methods. Amongst various methods, the most common is to create and store a unique serial number which identifies an object, and perhaps other information, on a microchip, that is attached to an antenna. The objective of RFID system is to carry data in suitable transponder, i.e, tags, to retrieve data, by machine readable means, at a suitable time and place.



Before implementation of RFID technology in libraries, the following points are needed to be considered –

- Proper time to be selected to start implementation process – whether it should be commenced during any vacation or during the normal working days.
- Decision to be taken regarding tagging process, which can be done within the library or outside the library.
- Tagging works to be done by library people or outside agency.
- Proper fragmentation of the whole work.
- Installation of compatible hardware.
- Speedy internet connection.
- Properly trained staff for overall management of this system.

- Timeframe for completion of the whole work and implementation.
- Arrangement of support staff.

In real situation, it is difficult for most of the libraries to implement RFID technology for total library collection at a time. To overcome this problem, decision regarding selection of quantity or volume of collection for implementation is necessary. In that case, a cut-off year regarding selection of documents for tagging process should be decided at the beginning of this work.



4 Benefits of RFID use in libraries- Implementation of RFID technology is bound to be beneficial for library management system. It helps to deliver speedy improvised services to the patrons. In a nutshell, the followings are some advantages, which any library can get through this technology

- RFID improves the library workflow by reducing repetitive regular routine library works.

- Improves staff productivity.
- Improves services to users / patrons.
- Assists inventory check with ease.
- Eases book identification for shelving process.
- Assists traceability of book allocation.
- Enhances book return processes.
- Allows better accuracy in book collection management.
- More than one item can be checked out or checked in at the same time.
- Introduce self-charging and discharging system.
- Easier circulation.
- Automated materials handling.
- Introduce automatic theft control.
- Easy detection of wrongly shelved items.
- Introduce facility of external book return.

5 Disadvantages - In spite of the above mentioned beneficial points, there are some disadvantages as well, in this system. The followings are some of the barriers, which libraries have to face to implement this technology –

- High cost of tags and readers.
- Maintenance cost is also high.
- Probability of lack of integration between hardware and software.
- Lack of standards and protocols.
- Easy blocking of RF wave by anybody.
- Frequency block.
- Tag collision.

- Reader collision.
- User privacy concern.
- Exit gate sensor problems.

6 Conclusion - The conception of RFID technology is new in library community. But, it is obvious that the use of this technology in libraries will become essential in coming years. The major characteristics of RFID technology is to provide high-speed inventory and identify items which are out of proper order. The implementation of this technology can change the whole environment of the library by converting the conventional library management system to a more efficient one. Though there are both advantages and disadvantages involved in this process, but, the beneficial parts override the constraints. This technology saves money in the long run and quickly a good return on investment.

To run RFID technology based system smoothly, library staff and users should be properly trained before implementation. Librarians and information managers are the leaders in protection and managing the intellectual freedom and user privacy, and should take leadership in implementing this technology to strengthen their position.

The overall scenario in India is somewhat different and falls short of expectation at times. In our country, most of the libraries are not fully automated till now. Library automation programme is running 10-12 years behind in comparison to libraries of developed countries. However, now this automation programme is being given due importance in Indian libraries. In addition to this, the libraries suffer from

inadequate financial resources. RFID technology based library environment is, therefore, not implementable in most of the libraries right now.

In spite of these problems, in future, entering into RFID technology based environment is essential for every library. RFID technology helps to upgrade library management system in various forms - it can replace the barcode, and end-user demand can be increased to a large extent.

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RFID in Digital Libraries

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Abstract: RFID is one of the latest technologies to be used in library theft detection system. RFID is the fastest growing and most beneficial technology. RFID is a channel of short range communication which has been used in libraries for multiple purposes. We have given an overview of the technology being implemented in libraries. Due to its advantageous nature above other technology it has been occupying an important place in library management system.

Keywords:

Library Automation, library technology, RFID standards, Information, RFID Tags

A. INTRODUCTION:

Radio Frequency Identification is a generic term for technologies that use radio waves to automatically identify an object. The tags contain electronically stored information. Some tags are powered by a read at short ranges (in metres) via magnetic fields (electromagnetic induction). RFID was used to track objects in industry and academia for increasing efficiency and security, safety, accuracy with convenience. Pharmaceuticals can be traced through warehouse also. Today

RFID is an important and beneficial and one of the most up-to-date technologies used in libraries.

RFID and its uses in libraries- RFID is used library circulation operation system and theft detection system. RFID is a system which combines security with more efficient material throughout the library, making it easier and faster for charging and discharging of materials.

Apart from the use of RFID technology in library services it is also used in various purposes of libraries.

1. **Reduce Staff-** it is a helpful technology and helps librarian reduce valuable staff time spend scanning barcodes during charging and discharging items.

2. **Microchip technology-** RFID is the combination of radio frequency based technology and microchip technology. The information contained on microchips in the tags is read using radio frequency technology regardless of item orientation or alignment.

3. **RFID Gates-** The RFID Gates at the library building can be as wide as 4 feet because the tags can be read at a distance of up to 2 feet by each of the two parallel exit gate sensors.

B. Components of RFID system:

A standard of RFID system has four main parts

1. **RFID Tags-** It is a paper thin smart label and flexible that is applied in library items. In library RFID tag contains a tiny chip which is both readable and writable and it can also store information to identify items in collection.

2. **Reader-** Readers or sensors are used to interrogate the tags. RFID receivers and readers are composed of radio frequency module, a control unite and an antenna to interrogate

electronic tag via radio frequency communication. The reader powers an antenna to generate a radio frequency field. Basically there are 2 types of RFID Exit gate sensors.

a) One type reads the information tag going by and communicates that information to a server after checking the circulation database.

b) Another type is for theft detection. Security gate will sound an alarm if any smart tag is not deactivated and passes through it. Security systems do not require a link to central database.

Readers in RFID:

In the conversion section the library data is also written on to the tag. In circulation section, used to charge and discharge library material under staff workstation. If there is no one available at the circulation counter to issue book material, there can be an optional self-check out station. It is used to check out library material in the absence of staff assistance. When the exit sensor senses theft detection from security gates, security is there to verify that all material leaving the library has been checked out. If the staffs are not available at the circulation counter the book material drops in drop box equipment. The database automatically updates library material. It is an automated system for returning material to proper area of library. The server attached with the scanner can be programme to search for missing books. It is a hand-help reader to be used for verifying the material is shelved correctly or not.

3. **Antenna-** The antenna produced radio signals to activate the tag read and write data to it. Antenna can be fitted in a door to be used by users. Antenna is the communication channels between the tag and the reader. Antenna controls the data and communication.

The antenna can be used for circulation desk check out, it is a checked or unchecked event and also reads a group of items on the shelves for the purpose of locating, missing and misplaced items using a portable device that consist of a hand held scanning gun.

4. **Server-** Server is the important part of comprehensive RFID system. It controls the gateway among various components and receives the information from the antenna and exchange information with circular database. It includes a transaction database so that report can be produced. Server on which the software interface with the integrated library software.

C. Benefits of RFID:

There are several benefits of RFID in libraries and information centres are described as follows:

1. **Charging discharging by self-** Circulation operations can be performed in a much faster manner through the use of RFID. This technology helps librarians eliminate valuable staff time. RFID tags can be read much faster than barcode.
2. **Very Reliable-** Readers are very reliable. Using RFID tags hundred percent detection rate can be obtained.
3. **Very high speed inventorying-** RFID system enable high speed inventorying as they can scan books on the shelves without removing them.
4. **Automatic material handling-** RFID technology enables automatic material handling. It also saves the amount of staff time.

D. Harmful effects:

1. **High Level cost-** RFID technology is highly expensive while the readers and gate sensors used to read the information typically costs around \$2000-\$3500 each and the tag costs \$0.40-\$0.75 each.
2. **Compromise an RFID-** To compromise an RFID system by placing two items against one another so that one tag overlays another. This requires knowledge of the technology and careful alignment.
3. **Removal of exposed tags-** In Indian libraries it is a major challenge to keep the tags intact. RFID tags are affixed to the inside back cover and are exposed for removal. There would be problems when user becomes more familiar.
4. **Reader problems-** The performance of the exit sensor is problematic. They always don't read tags close to the other reader. The same RFID tag used to manage inventory can also be used to protect it from theft. RFID with an EM (electromagnetic) add on for theft.
5. **Privacy of user-** Privacy concern with item label tagging, patron privacy as there is perception based on two conceptions.
 - a) The tags contain patron information.
 - b) They can be read after someone has taken the materials to home and office.
6. **Coverage overlap-** Coverage overlap means the signal from one reader can interfere with the signal from another where the coverage overlaps. It means the readers are instructed to read at different times rather than both trying to read at the same time. So any RFID tag in an area where two readers overlap will be read twice.

7. **Tag collision-** When one chip reflects back a signal at the same time at that time tag clash occurs thereby confusing the readers.

8. **Lack of standard-** RFID vendors sometimes use tags which do not confirm to the standards used.

E. Conclusion:

RFID is important technology advancement for library transaction. For every small action of library the librarian now needs this kind of technological help. Updates are compulsory for all professionals and librarian is not an exception. They need to update their skills in all the sectors so that they can administer the entire library automation function. The main aim for today's libraries in adopting RFID is the need to increase efficiency and reduce cost, can also provide security for the range of different media offered in libraries .This would make it possible to turn it into a debit card with value added upon pre-payment to the library and value subtracted when a user uses a photocopier, printer or other fee based device or wished to pay fines or fees. So RFID technology will make many Indian libraries adopt this in future.

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RFID: A New Era in Library Services

Arpita Roy Chowdhury & Sankha Subhra Das

Abstract: This paper gives an overview of the radio frequency identification (RFID) technology. Aside from a brief introduction to the technology, its components, advantages and disadvantages have also been discussed. Radio frequency identification (RFID) has replaced the barcode system. Mainly it is known as the modern version of barcode. RFID is used for transmitting the identity (in the form of a unique serial number) of an object or person wirelessly. In libraries this technology is used for locating lost items, tracking moving objects and others.

Keywords:

RFID (Radio Frequency Identification), RFID Technology, RFID Tags, RFID Reader, Antenna, Server, Library Circulation, Anti theft Detection.

1) Introduction:

Radio Frequency Identification, well known as RFID, was mainly used in the 1940s for laboratory Research. In the 1980s RFID used to manage commercial items in a business organization. In 1990s commercial applications of RFID entered into main stream. Now RFID technology has received attentions in library services all around the world. It is widely deployed with emergence of standards. Mainly it is a data collection and storage system which provides accurate and exact data without human involvement. It focuses on various benefits in management of circulation system, efficiency and full security of data sharing, inventorying technology.

Basically it is a technology that uses radio-frequency waves to transfer data between a reader and a movable item to identify, categorise and track. All these work is done by tiny tags which consist of a transponder with antenna, chip and reader. The complete set of these items is called a tag or a label. Any Information can be written on the chip/barcode and stored in the tag/label that is attached to the item to identify and an antenna to interrogate electronic tags via radio frequency. This paper is about RFID technology and its application in libraries.

2) Objectives of the study:

- To find the availability of RFID in library services to soothe the acceptability of a new technology.
- Its elaborate its advantage in comparison to other technologies.
- To create a new dimension in library automation.
- To be technologically advanced at par with the current generation.
- To save the time of the user and staff.
- To make circulation system an easy process.
- To improve the staff productivity.
- To improve operational efficiency.
- To exacerbate user satisfaction.

3) What is RFID?

Radio-frequency identification is the wireless non-contact radio-frequency electromagnetic fields to transfer data for the purposes of automatically identifying and tracking the materials in library. The tags contain electronically stored data.

RFID can be used in library circulation and theft detection systems. This technology helps libraries reduce valuable staff time spent scanning barcodes while charging and discharging

the books. RFID is a combination of two types of technology, one is radio-frequency technology and the other is microchip technology. The RFID gates in the library exit can be wide as four feet as the tags can be read at a distance of two feet by each of the two parallel exit gate sensors. This technology is very useful for both the librarian and user to complete the library services within the stipulated time.

4) Components of RFID:

There are basically four parts in RFID system. These are;

a. Tags:

The main parts of RFID system is RFID tag, which can be fixed inside a book's back cover or directly onto CDs and video tapes. These tags consist of microchip and an antenna. Tags are divided into two categories. They are;

- **Passive Tags:** This type of tags do not require power, it has lower storage capacities (1KB) and shorter read ranges (4 inches to 15 ft) use write-once-read-many/read-only tags.
- **Active Tags:** It is mainly battery powered with higher storage capacities (512KB), longer read range (300 ft) and can be re-written.

RFID tag memory is divided into 3 parts;

- **Read-only tag:** Tag ID can never be changed and no additional data can be assigned to the tag.
- **Write once, read many (WORM) tag:** Here data written once and tag is locked once data is written. It is like a CD or DVD.
- **Read or Write tag:** Tag data can be changed over time all of the data section can be locked.



Fig: A Tag with its parts

b. Readers:

RFID readers are composed of a radio frequency module, a control unit and an antenna to interrogate electronic tags via radio frequency communication. The reader powers an antenna to generate the RF field. When a tag passes through the field the information stored on the chip. The reader works as a remotely power tags that establish a bidirectional data link. It can communicate with networked servers and can read 100-300 tags per second.

In any library the radio frequency device is designed to detect or read the tags to take the data stored. RFID sensors read the information on the tag and communicate the information to a server which activates an alarm if the material is not properly checked out.

A book drop reader can discharge library materials automatically. If checked in then it goes back directly to the shelves. Without touching the library material the portable scanner can also move the item to the shelf. This portable reader used for the screening of complete book collection on

the shelves for inventory control, search for books which are misplaced and search for required individual book.

c. Antenna:

Antennas are the channels between the tag and the reader to process identification of the items and activate or deactivate the anti theft tag automatically. Additional antenna can be added to enhance the number of items in large transactions. It produces radio signals to activate the tag and read and write data to it. It is used to receive tag data from people, things passing through the door.

d. Server:

The server is the main part of the RFID system. It accesses the communication gateway by which it receives information from the readers and exchange information with the circulation database. Its software includes SIP/SIP2 (session initiation protocol) require interfacing with the integrated library software. The server includes a transaction database where reports are produced.

5) RFID Use in libraries:

As a part of implementation, a RFID tag needs to be implanted in all the reading material of the library where complete information of the book is to be entered into installed software in the workstation. Now when a member brings the book for issue return purpose, the RFID reader reads the information of that book and transmits the data to the workstation and the book is issued in a fraction of second with minimal intervention. When the member exits the library, the antenna at the exit gate reads the information on the RFID tag for verification purpose. If in case the book is not issued as per library norms or if it happens to be stolen the

antenna senses and gives an alert. Hence this technology results in successful anti-theft detection of books.

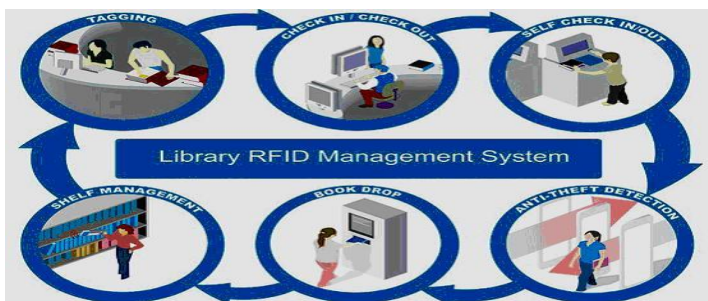


Fig: B Entire process of rfid in a nutshell

6) Advantages:

The aim for today's libraries adopting RFID only needs to increase efficiency. Automation and self-service can help libraries of all sizes to achieve these aims. RFID has the added advantage that can also provide security. RFID can also improve circulation and inventory control which helps librarians to secured their resources without any anxiety. The advantages of RFID are as follows;

- **High speed inventorying and stock verification-** Most important advantage of RFID systems is their ability to scan books on the selves without tipping them out or removing them. By using wireless technology it is update the inventory as well as identify the items which are out of proper order.
- **Reliability-** The readers are totally reliable on RFID. Some RFID systems have an interface between the exit sensors and the circulation software to identify the items going out of the library. If the user card has

also an RFID tag, the library will also be able to know who removed the items without properly charging them.

- **Tag life-** compared to barcodes RFID tags last longer as the technology does not require line-of-sight. Most RFID vendors claim a minimum of 100,000 transactions before a tag may need to be replaced (Boss 2004).
- **Handling of materials automatically-** The automated materials handling includes conveyor and sorting systems that can move library materials and sort them categorically. This reduces the amount of staff time required to ready materials for re-shelving.
- **Charging/discharging-** RFID reduces the time span required for circulation sections. This technology helps to reduce the time span of staff for scanning barcodes while checking out and checking in borrowed books. RFID accelerates the speed of the borrowing and return procedure.
- **Security at gates-** The RFID technology gives library to protect their items by using anti theft detection technology. When an unissued document passes this terminal will sound an alarm in this way technology helps decrease theft.

7) Disadvantages:

Disadvantages of RFID technology are as follows;

- **User safety-** Technology needs High frequency of electrical power source. RFID is such technology that depends on low frequency (125-134 KHz, contact up to 10cm), high frequency (13.56 MHz, contact up to 30 cm) and ultra high frequency (433 MHz and 856-960 MHz) transmission rate

of connection. First of all we have to think about the user of our library. The rate of this RFID frequency more than 13.56 MHz could be harmful to the user.

- **High cost-** One of the disadvantages of RFID is its high costing. It depends on the size and numbers of the books in any library. So it is not possible for the libraries to create RFID facility which have a large number of collections.
- **User privacy concern-** The privacy is another problem of RFID. RFID system is that the tags contain static information that can be easily read by unauthorized tag readers. This allows for privacy issues described as “tracking”.
- **Tag problem-** The problem arises with the tag. When more than one chip produces a signal at the same time, the reader gets confused. Different vendors have developed systems in which the tags respond one at a time (milliseconds).
- **Reader problem-** The signal created from one reader interferes with the signal of another reader and hence overlapping of signal occurs. This can be sorted out whereby readers are instructed to read at different times.
- **Exit gate sensor problems-** The performance of the exit gate centres are problematic. They do not read tags at up to twice the distance of the other readers.
- **Lacks of standards-** Different types of tags have wide range of application with conflicting roles. This can be seen in the

number of standards. The RFID standards are ISO 14223, ISO 14443 and ISO 18000. The recent hype in RFID technology created explosion in patents. Presently there are around 1800 patents related to RFID that are backlogged.

8) Conclusion:

An overview of the RFID technology along with its advantage and disadvantage were discussed relating to its use in libraries. RFID continues to make progress into inventory control systems, and it's only a matter of time for the costs to fall making RFID an effective economic technology. Therefore, engineering efforts are under way to cover technical problems and to make it an accessible and reliable tag reading systems. Though this technology is expensive it improves the library services. Now this technology is becoming popular in India with more implementation. It could be said that it decreases the labour and provides effective results which can lead the entire security and reliability in coming days.

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Use of RFID Technology in the Biju Patnaik Central Library (BPCL) of NIT, Rourkela: a case study

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Introduction

Father of Indian Library Science Dr. S. R. Ranganathan rightly said in his five laws of library science that library is a growing organism. But as library grows in size, the problems associated with the maintenance and security of the documents also grows. Technology helps librarian to solve the problems of arranging documents in order they have given classification schemes, to solve the problems of searching documents according to cataloguing guidelines, to solve the problems of space of library and delay service time over the period of time. By using technology, now librarians can digitize the documents and share it over network. To automate the counter activities librarians generally use bar-code technology. Bar-codes have served the librarians and libraries for a long time, and now it is slowly getting replaced by RFID.

What is RFID Technology?

In 1969, RFID Technology was invented and patented as Mario Cardullo's device in 1973. The RFID stands for Radio Frequency Identification/ Identifier. This technology uses electromagnetic fields to automatically identify and track tags attached to objects. The tag itself consists of a computer chip and an antenna. It contained electronically stored information about that object and often printed on paper or some other flexible medium. Compared to barcode RFID tag does not have to be visible to read. It is an advance

technology that is read with an electromagnetic field rather than by a laser beam. It can be read even when it is fixed in an item, such as in the cardboard cover of a book or the packaging of a product. It can also carry a more complex message than a barcode, which is limited to an identification number. A key fact to understand about RFID is that it is not a solitary technology; there are hundreds of different RFID products on the market today, and new ones appearing constantly. There are the RFID tags that are used for automated toll taking for cars that can be read from many feet away as cars speed along highways. There are those that are in the card keys that many of us use to gain entry to our office buildings or hotel rooms by swiping the card within a few inches of a pad by the entrance door. There are chips that are used to track animals on farms or identify lost pets, and others that help warehouses manage the inventory of pallets of goods. The Food Drug Administration is considering the use of RFID to identify drugs and prevent counterfeiting, and there may be a use for RFID in DVDs to prevent movie piracy (Coyle, 2005) . These are all very different technologies that work on the same principle. What varies is the amount of information the tag carries, the range in which it can be read, the frequency of its radio waves, its physical size, and of course its cost.

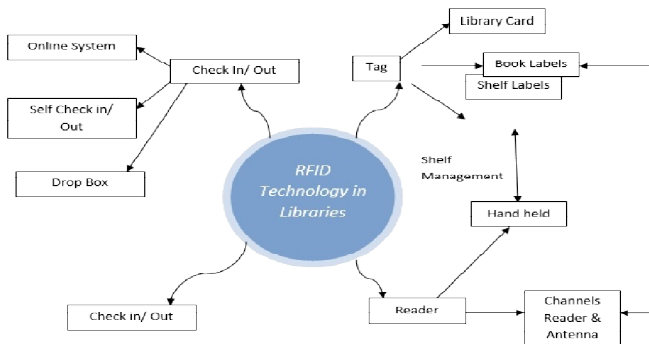
Why RFID Technology in Library?

Libraries use new technologies because the conditions in the general environment that led to the development of the technology are also the conditions in which the library operates. In the case of RFID, anyone managing an inventory of physical objects needs to do item-level functions, such as sales or lending, more efficiently and with less human intervention. RFID is a highly advantageous technology for a wide variety of inventory tracking situations. In a library, RFID is used to identify, track, sort or detect library holdings

at the circulation desk and in the daily stock maintenance apart from theft detection system. RFID-based systems move beyond security to become tracking systems that combine security with more efficient tracking of materials throughout the library, including easier and faster charge and discharge, inventorying, and materials handling (Boss 2004). This technology helps librarians reduce valuable staff time spent scanning barcodes while charging and discharging items. RFID is a combination of radio-frequency-based technology and microchip technology. The information contained on microchips in the tags affixed to library materials is read using radio frequency technology, regardless of item orientation or alignment. The RFID gates at the library exit(s) can be as wide as four feet because the tags can be read at a distance of up to two feet by each of two parallel exit gate sensors.

Components of RFID System in a Library

- RFID tags that are electronically programmed with unique information
- Readers or sensors to query the tags
- Antenna
- Server on which the software that interfaces with the integrated library software is loaded
- RFID Label Printer
- Handheld Reader
- External Book Return
- RFID label Printer



Benefits of RFID Technology in Library

- Self-charging and discharging:* The use of RFID reduces the amount of time required to perform circulation operations. This technology helps librarians eliminate valuable staff time spent scanning barcodes while checking out and checking in borrowed items. For the users, RFID speeds up the borrowing and return procedures. Library employees are released for more productive and interesting duties. Staff are relieved further when readers are installed in book drops.
- Theft detection:* The readers are highly reliable. RFID systems have an interface between the exit sensors and the circulation software to identify the items moving out of the library. If the user card also has an RFID tag, the library will also be able to determine who removed the items without properly charging them.
- Speedy Inventorying:* A unique advantage of RFID systems is their ability to scan books on the shelves without tipping them out or removing them. A hand-held inventory reader can be moved rapidly across a shelf of books to read all

of the unique identification information. Using wireless technology, it is possible not only to update the inventory, but also to identify items, which are out of proper order.

- *Automated material handling:* Another advantage of RFID technology is automated materials handling. This includes conveyor and sorting systems that can move library materials and sort them by category into separate bins or onto separate carts. This significantly reduces the amount of staff time required to ready materials for re-shelving.
- *Longer tag life:* RFID tags last longer than barcodes because the technology does not require line-of-sight.

Biju Patnaik Central Library (BPCL)

Biju Patnaik Central Library is the central library of the National Institute of Technology Rourkela. The Library caters to the educational and research needs of the academic community and its resources are consulted by scholars from all over the country. Biju Patnaik, a great social reformer set up Regional Engineering College, Rourkela. BPCL has started functioning since 1965. The basic aim of Biju Patnaik Central Library is to position itself as one of the leading libraries in the country. The library also aims to provide the NITR academic community with access to rich and relevant information resources to support their research, teaching and learning activities. The objectives of BPCL are –

- To set an environment for more productive teaching-learning process
- To maintain user oriented policies and programmes
- To improve library staff capability and potential to enable them to provide effective, responsive and innovative services

- Using library and information technology innovatively and appropriately
- To provide and deliver information services to the user community
- Support and enhance teaching and learning processes by delivering and promoting the effective use of information resources and services
- Provide an information rich environment that supports and encourages excellence in research in the field of science & technology
- Promote the standing and good reputation of the institute through excellence in library services, collaboration with other organizations and staff contribution to the community.

The Biju Patnaik Central Library has been modernized to provide computerized services to NITR academic community at large. The BPCL is automated with integrated library software package called Libsys – LSmart and modernized with latest Radio Frequency Identification (RFID) based automation system. The library is also using KOHA, Dspace, E-print to build up institutional repository and give access it to whole world. BPCL has developed an Android Application for automatic updates of e-Books and e-Theses which can be installed in any android supported smart phone. The main feature of this application is that it fetches the automatic update of e-Books and e-Theses as soon as any document or content updated to the database.

At present, the library holds about 78,000+ books and 18,000 back volumes of periodicals. Apart from the online journals and standards provided by eShodhSindhu consortium, the

library has purchased license to access more than 2000 online science and technology research journals to support local research activity. Prior to that, the BPCL has many ISI codes, educational video courses & cassettes and CD-ROMS etc.

Use of RFID Technology in BPCL

The Biju Patnaik Central Library uses RFID technology with Libsys that facilitates self-check-in, self-check-out and automatic security system. BPCL introduced RFID in their library system on 2009. This technology offers fastest, easiest, most efficient way to track, locate and manage library materials. The RFID system counts more than 1.2 lakhs transactions (issue, return and renewal) in a year. BPCL is using RFID Technology for –

- Self-check-in
- Self-check-out
- Automatic Security System
- Book drop
- Shelf Arrangement
- Stock Verification

Barriers of using RFID Technology in BPCL

- The major disadvantage of RFID technology is its high cost.
- RFID technology is vendor dependent. The required software to run hardwires supporting RFID technology is not open source software. So, once LMS integrated with RFID it is very difficult to change LMS later.

- It is possible to compromise an RFID system by wrapping the protected material in two to three layers of ordinary household foil to block the radio signal. It is also possible to compromise an RFID system by placing two items against one another so that one tag overlays another. That may cancel out the signals.
- RFID tags are typically affixed to the inside back cover and are exposed for removal. It is a major challenge to keep the tags intact.
- RFID tags pose problems for less strong items like magazines, pamphlets and items with odd shapes and metal components.
- The performance of the exit gate sensors is more problematic.
- Privacy concerns associated with item-level tagging is another significant barrier to library use of RFID tags. The problem with today's library RFID system is that the tags contain static information that can be relatively easily read by unauthorized tag readers.

Conclusion

An RFID system may be a comprehensive system that addresses both the security and materials tracking needs of a library. Though the unique advantages and flexibility of RFID is the good news, the technology is still not yet widely understood or installed in the library environment, and the cost/ROI models far from established. Libraries need tags that are durable, since they are placed on an item that will be used repeatedly. The library function will probably have the longest-lived tags of any other sector, since books can remain on shelves and circulate over decades, while retail products

have a short shelf life and even debit cards rarely are issued for more than four or five years. Libraries may also need tags that, although inexpensive, can be reprogrammed and may even need to have more than one ‘lifetime’. As RFID is a rapidly developing technology, it is not possible to say what capabilities may be available in one, two, or five years, much less further out. There have been significant advancements of this technology in just a few years, with no sign that limits of its potential have been reached.

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Security Concerns of RFID in Library Services

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Abstract: RFID is one of the most common technologies being adopted by both industry and academic world. RFID technology in libraries is mainly used for fast retrieval, theft prevention and stock verification of books. With the help of radio waves it automatically identifies every individual item. A Good Technology always comes for a price, the high cost of implementation and maintenance of RFID system is still a major barrier in the proliferation of such auspicious technology. Apart from that there are many other important concerns related with RFID systems which all librarians and library professionals must know about. In this paper we will explore the various security threats and attacks that RFID systems are prone to, and discuss the probable solutions to these problems

Keywords: RFID, Security Concerns of RFID, Library, Library & Information Science

1. INTRODUCTION

RFID stands for “Radio Frequency Identification”. The RFID technology in libraries is mainly used for fast retrieval, theft prevention and stock verification of books. With the help of radio waves it automatically identifies every individual item. The objective of any RFID system is to carry data in suitable transponders, generally known as tags and to retrieve data, by machine readable means. RFID is one of the most common technologies being adopted by both industry and academic world.

The fifth law of library science states ‘**library is a growing organism**’ which means it grows in terms of library holdings, users and staff. To cope up with this growth, librarians are always found interested in adopting latest technologies to provide better and efficient services to the users. The RFID technology has automated various library related services and made every one’s job easier and efficient, from the patrons to the library professionals.

Good Technology comes for a price, the high cost of implementation and maintenance of RFID system is still a major barrier in the proliferation of such auspicious technology.

The article is written after literature review of many other related articles. Most of the articles written on RFID discusses about it’s uses and implications, while in this article we are about to discuss the possible attacks on RFID systems that a library can face, i.e. the security and reliability aspect of a RFID system.

2. COMPONENTS OF AN RFID SYSTEM

An RFID system basically consists of two components

2.1 The Transponder, which is located on the object to be identified

The **transponder**, which represents the actual data-carrying device of an RFID system, normally consists of a coupling element and an electronic microchip. When the transponder, which does not usually possess its own voltage supply (battery), is not within the interrogation zone of a reader it is totally passive. The transponder is only activated when it is within the interrogation zone of a reader. The power required to activate the transponder is supplied to the transponder

through the coupling unit (contactless), as are the timing pulse and data.

2.2 The Interrogator or Reader, which, depending upon the design and the technology used, may be a read or write/read device.

A **reader or interrogator** typically contains a radio frequency module (transmitter and receiver), a control unit and a coupling element to the transponder. In addition, many readers are fitted with an additional interface (RS 232, RS 485, etc.) to enable them to forward the data received to another system (PC, robot control system, etc.).

3. HOW DOES AN RFID SYSTEM WORK?

An RFID system consists of a tag, which is made up of a microchip with an antenna, and an interrogator or reader. The reader sends out electromagnetic waves. The tag antenna is tuned to receive these waves. A passive RFID tag draws power from field created by the reader and uses it to power the microchip's circuits. The chip then modulates the waves that the tag sends back to the reader and the reader converts the new waves into digital.

4. SECURITY OF RFID SYSTEMS

Like any other telecommunication and information technology system, RFID systems are also not 100% fool proof it faces the potential risk of being spied out or manipulated.

Attacks can be carried out for a variety of reasons. They can be grouped into four attack types:

- **Spying out:** The attacker tries to get unauthorized access to information and data of the active and passive file.
- **Deception:** The attacker tries to feed incorrect information into the RFID system in order to deceive the active party, i.e. the RFID system operator, or the passive party, i.e. the user of the RFID system.
- **Denial of service:** This kind of attack affects the availability of functions of the RFID system.
- **Protection of privacy:** The attacker considers the RFID system to be a threat to her privacy and tries to protect herself with attacks on the RFID system.

4.1 Types of Attack an RFID Equipped Library Can Face

4.1.1 Attacks on the Transponder

Usually the transponder is easily accessible. On goods and tickets it is always available to the attacker, and in most cases even without any time restrictions. Therefore, there is a wide range of attacks with varying degrees of effectiveness.

I. Permanent Destruction of the Transponder

The easiest attack on a RFID system is the mechanical or chemical destruction of the transponder. The antenna can be easily severed or cut off, for instance. The chip can be easily snapped or smashed. A transponder can also be destroyed through exposure to a strong field. Therefore, ISO/IEC 14443 or ISO/IEC 15693 specifies maximum field strength of 12 A/m at a frequency of 13.56 Mhz for inductively coupled transponders. If the transponder is introduced at this frequency into a field with significantly higher field strength, the waste heat produced at the shunt regulator cannot be sufficiently dissipated any longer and the transponder will be

thermally destroyed. If there is no sufficiently strong transmitter available for this frequency range, the transponder can also be put into a microwave oven.

II. Transponder Shielding/Tuning

A very efficient attack is to use metal surfaces in order to shield a transponder from the reader's magnetic or electromagnetic radiation. In the simplest case it is sufficient to wrap a foil around the transponder, e.g. household aluminium foil. For inductively coupled transponders, the antenna resonant circuit can be heavily tuned by using a metal surface in its immediate surroundings. In addition, the reader's magnetic field is dampened due to eddy-current losses in the metal foil. Therefore it is often sufficient to fasten the transponder on one side to a metal surface. It reflects the electromagnetic fields of a UHF backscatter system (e.g. 868 MHz) and efficiently keeps them away from the transponder. In the most favourable case, a passive transponder will not even be supplied with sufficient power to operate the chip. This kind of attack can be used to temporarily disrupt transponder operation. If the shield is removed, the transponder becomes operable again without restrictions. Today, people with limited technological knowledge can use commercial products for shielding transponders (Cloaktec, n.d.).

III. Spoofing and Cloning of Transponders

There are three types of tags 'read only', 'WORM', and 'read/write'. Tags are '**read only**' if the identification is encoded at the time of manufacture and not rewritable. '**WORM**' (write once read many) tags are programmed by the using organization, but without the ability to rewrite them later. '**Read/Write tags**' which are chosen by most libraries, can have information changed or added. In libraries using

RFID is common to have part of the read/write tag secured against rewriting e.g. the identification number of the item.

If a read-only transponder enters the sufficiently strong field of a reader it immediately starts to intermittently transmit its serial number which can be easily read by any suitable reader. The attacker can now use discrete components to build a read-only transponder (transponder clone) and replace the PROM containing the transponder's serial number with a multi-programmable memory (EPROM) or – more basically – with a series of DIP switches. If the attacker then reads out the serial number of a transponder he can program this serial number into the transponder clone. If the transponder clone is introduced into a reader's field it can send the serial number previously read out from the genuine transponder and thus pretend the presence of this genuine transponder to the reader (Westhues, 2005). The reader is not able to determine whether the currently received serial number was sent by a genuine transponder or a transponder clone. The attacker does not have to have physical access to the transponder, but only needs to use a suitable reader in order to enter the read range of the transponder to be cloned, without being detected.

Transponders with writable memories form the next level of functionality constitute the next step. Often, memory sections can be read or written without any restrictions, i.e. without requiring a password or key. Also here, an attacker can easily manipulate stored data for his personal advantage or produce copies of the attacked transponder by reading data and copying them to other transponders. However, the cloning of transponders can be efficiently prevented by using authentication and encrypted data transmission. RFID applications that are easily accessible for attackers, such as entrance systems or ticket systems, should therefore generally avoid read-only transponders or unencrypted access to data.

4.1.2 Attacks on the RF Interface

RFID systems are radio systems and communicate via electromagnetic waves in the near-field and the far-field range. An attacker is therefore likely to try and attack an RFID system via the RF interface. Such an attack is attractive as it does not require any physical access to the reader or transponder, but can be carried out from a distance. Currently, the following attacks are known and have been investigated:

- i. Interception of the communication between reader and transponder (eavesdropping);
- ii. Interruption of the communication between reader and transponder through jamming;
- iii. Extending the read range in order to being able to skim a remote transponder, without being detected;
- iv. Blocking a reader with DOS attacks;
- v. Undetected use of a remote transponder through a relay attack.
- vi. Reverse Engineering

i. The Interception of Communication (eavesdropping)

As RFID systems communicate with electromagnetic waves, systems can be generally intercepted with very basic means. The interception of the communication between reader and transponder is therefore one of the most prominent threats to RFID technology. The ranges given for RFID systems vary between a few centimetres and several metres and apply to the active communication which even requires the transponder to be supplied with power and to generate several volts at the antenna. Radio receivers only need an antenna output voltage that is an order of magnitude lower in order to receive useful signals. This gives reasonable grounds to suspect that

communication can be passively intercepted from a much larger distance.

ii. Jamming

A very simple, but efficient method for interrupting data transmission between transponder and reader is to use jamming in order to send an interfering signal.

iii. Reading with Extended Read Range

Extending the read range of a reader might be an interesting option for an attacker. This way, the attacker may be able to read the transponder from a safe distance, without being detected.

iv. Denial-of-Service Attack through Blocker Tags

The blocker tag, which can be placed over a regular RFID tag, prevents a receiver from scanning information transmitted by a tag by sending the receiver more data than it can read with the purpose of taking down the system or Denial Of Service.

v. Relay attack

Relay attack is a type of man-in-the-middle attack (Kfir & Wool 2005), where the attacker creates a connection between a legitimate reader and the victim's legitimate tag. From the point of view of the RFID system, the communication looks as if the legitimate tag and the reader are close to each other when, in fact, they are communicating through the communication channel, usually wireless, established by the attacker. In this way, the attacker may authenticate himself in an access control system or a payment system. The maximum distance between a legitimate tag and an attacker's reader (called sometimes a "leech") is the same as in the case of rogue scanning, but the distance between a legitimate reader

and an attacker's device which simulates a legitimate tag ("ghost") is much longer – up to 50 m. A successful relay attack against an RFID system complying with the ISO 14443A standard has been proven to be feasible (Hancke 2005).

vi. Reverse Engineering

Like most products, RFID tags and readers can be reverse engineered; however, it would take a lot of knowledge about the protocols and features to be successful. Hackers would take apart the chip in order to find out how it works in order to receive the data from the IC. The main purpose is to steal Information and/or Gain Access

5. OTHER CONCERNS (Lacuna)

5.1 High cost

The major disadvantage of RFID technology is its cost. While the readers and sensors used to read the information are comparable in cost to the components of a typical EM or RF theft detection system, typically \$2,500 to \$3,500 or more each; a server costing as much as \$15,000 may be required and the tags cost \$.60 to \$.85 each. It may be some time before the cost of tags comes down to \$.50 or less.

5.2 Lack of Standard

The tags used by library RFID vendors are not compatible even when they conform to the same standards because the current standards only seek electronic compatibility between tags and readers. The pattern of encoding information and the software that processes the information differs from vendor to vendor, therefore, a change from one vendor's system to the

other would require retagging all items or modifying the software.

5.3 Reader Collision

The signal from one reader interfering with the signal from another where coverage overlaps is reader collision.

5.4 Tag Collision

Another problem readers have is reading a lot of chips in the same field. Tag clash occurs when more than one chip reflects back a signal at the same time, confusing the reader. Different vendors have developed different systems for having the tags respond to the reader one at a time. Since they can be read in milliseconds, it appears that all the tags are being read simultaneously.

5.5 Removal of Tags

RFID tags are typically affixed to the inside back cover and are exposed for removal. This means that there would be problems when users become more familiar with the role of the tags. In Indian libraries, it is a major challenge to keep the tags intact.

5.6 Exit sensor problems

While the short-range readers used for circulation charge and discharge and inventorying appear to read the tags 100 percent of the time, the performance of the exit sensors is more problematic. They must read tags at up to twice the distance of the other readers. The author knows of no library that has done a before and after inventory to determine the loss rate when RFID is used for security. Lacking data, one can only conjecture that the performance of exist sensors is better when the antennae on the tags are larger.

5.7 Perceived Invasion of Patron Privacy

There is a perception among some that RFID is a threat to patron privacy. That perception is based on two misconceptions: (1) that the tags contain patron information and (2) that they can be read after someone has taken the materials to home or office.

The vast majority of the tags installed in library materials contain only the item ID, usually the same number that previously has been stored on a barcode. The link between borrower and the borrowed material is maintained in the circulation module of the automated library system, and is broken when the material is returned. When additional information is stored on the tag, it consists of information about the item, including holding location, call number, and rarely author/title. The RFID tags can only be read from a distance of two feet or less because the tags reflect a signal that comes from a reader or sensor. It is, therefore, not possible for someone to read tags from the street or an office building hallway.

Perceptions, even when mistaken, may have real consequences. It is, therefore, important to educate library staff and patrons about the RFID technology used in libraries before implementing a program. The best way to do that is to emphasize that RFID technology is not one technology, but several. E-Z pass is RFID that is meant to be read from a distance. It would be impractical to affix tags of that size and cost to library materials. The same is true of the tags used on pallets in warehouses.

6. CONCLUSION AND SUGGESTIONS

Current library RFID tags do not prevent unauthorized reading of tag data. Therefore, information such as title,

author, shelf location, patron information, or last check in/checkout time should in no circumstance be stored on library RFID tags. We make the following suggestions to tackle the possible problems that can be faced.

6.1 Suggestions

For centuries myths and fairy tales have sought to find examples of attempts to outsmart security systems. For example, Ali Baba was able to gain access to the supposedly secure hideout of the Forty Thieves by discovering the secret password. Modern authentication protocols also work by checking knowledge of a secret (i.e. a cryptographic key). *However, suitable algorithms can be employed to prevent the secret key being cracked. When selecting a suitable RFID system, consideration should be given to crypto logical functions.* **High-security RFID systems must have a defence against the following individual attacks:**

- Skimming of a data carrier in order to clone and/or modify data;
- Placing a foreign data carrier within the interrogation zone of a reader with the intention of gaining unauthorised access to a building or receiving services without payment;
- Eavesdropping on radio communications and replaying the data, in order to imitate a genuine data carrier ('replay and fraud').

1. Mutual Symmetrical Authentication

Mutual authentication between reader and transponder is based upon the principle of three-pass mutual authentication in accordance with ISO/IEC 9798-2 , in which both participants in the communication check the other party's knowledge of a secret cryptological key. In this procedure, all

the transponders and receivers that form part of an application are in possession of the same secret cryptological key K (\rightarrow symmetrical procedure). When a transponder first enters the interrogation zone of a reader it cannot be assumed that the two participants in the communication belong to the same application. From the point of view of the reader, there is a need to protect the application from manipulation using falsified data. Likewise, on the part of the transponder there is a need to protect the stored data from skimming or overwriting. The mutual authentication procedure begins with the reader sending a GET_CHALLENGE command to the transponder. A random number RA is then generated in the transponder and sent back to the reader (response \rightarrow challenge– response procedure). The reader now generates a random number RB . Using the common secret key K and a common key algorithm e_k , the reader calculates an encrypted data block (token 1), which contains both random numbers and additional control data, and sends this data block to the transponder.

$$\text{Token1} = eK(RB||RA||IDA||\text{Text1})$$

The received token 1 is decrypted in the transponder and the random number $R A$ contained in the plain text is compared with the previously transmitted RA . If the two figures correspond, then the transponder has confirmed that the two common keys correspond. Another random number $RA2$ is generated in the transponder and this is used to calculate an encrypted data block (token 2), which also contains RB and control data. Token 2 is sent from the transponder to the reader.

$$\text{Token2} = eK(RA2||RB||\text{Text2})$$

The reader decrypts token 2 and checks whether RB , which was sent previously, corresponds with $R B$, which has just

been received. If the two figures correspond, then the reader is satisfied that the common key has been proven. Transponder and reader have thus ascertained that they belong to the same system and further communication between the two parties is thus legitimised. To sum up, the mutual authentication procedure has the following advantages:

- ✓ The secret keys are never transmitted over the airwaves, only encrypted random numbers are transmitted.
- ✓ Two random numbers are always encrypted simultaneously. This rules out the possibility of performing an inverse transformation using RA to obtain token 1, with the aim of calculating the secret key.
- ✓ The token can be encrypted using any algorithm.
- ✓ The strict use of random numbers from two independent sources (transponder, reader) means that recording an authentication sequence for playback at a later date (replay attack) would fail.
- ✓ A random key (session key) can be calculated from the random numbers generated, in order to cryptologically secure the subsequent data transmission.

2. Authentication using Derived Keys

A significant improvement on the authentication procedure described can be achieved by securing each transponder with a different cryptological key. To achieve this, the serial number of each transponder is read out during its production. A key KX is calculated (\rightarrow derived) using a cryptological algorithm and a master key KM , and the transponder is thus initialised. Each transponder thus receives a key linked to its own ID number and the master key KM .

The mutual authentication begins by the reader requesting the ID number of the transponder. In a special security module in the reader, the SAM (security authentication module), the transponder's specific key is calculated using the master key KM, so that this can be used to initiate the authentication procedure. The SAM normally takes the form of a smart card with contacts incorporating a cryptoprocessor, which means that the stored master key can never be read.

3. Encrypted Data Transfer

Cryptological procedures are used to protect against both passive and active attacks. To achieve this, the transmitted data (plain text) can be altered (encrypted) prior to transmission so that a potential attacker can no longer draw conclusions about the actual content of the message (plain text). Encrypted data transmission always takes place according to the same pattern. The transmission data (plain text) is transformed into cipher data (cipher text) (→ encryption, ciphering) using a secret key K and a cryptographical algorithm. Without knowing the encryption algorithm and the secret key K a potential attacker is unable to interpret the recorded data. It is not possible to recreate the transmission data from the cipher data.

4. Reader Collision

One way to avoid the problem of Reader Collision is to use a technique called time division multiple access, or TDMA. In simple terms, the readers are instructed to read at different times, rather than both trying to read at the same time. This ensures that they don't interfere with each other. But it means any RFID tag in an area where two readers overlap will be read twice

5. Perceived Invasion of Patron Privacy

To remove this barrier it is important to educate library staff and patrons about the RFID technology used in libraries before implementing a program. The best way to do that is to emphasize that RFID technology is not one technology, but several. E-Z pass is RFID that is meant to be read from a distance. It would be impractical to affix tags of that size and cost to library materials. The same is true of the tags used on pallets in warehouses.

6.2 CONCLUSION

Though the ease of functionality and the advantages of a RFID equipped library clearly outnumber its shortcomings. The possible attacks that can be faced should also be kept in mind while implementing the system. A library may acquire abundant number of rare books, Manuscripts, audio clips and other holdings which might be totally exclusive and not found in any of the other libraries of the world. Such books or library holdings are an asset to our society representing years of hard work and infinite facets of knowledge and it really needs to be preserved and protected.

Current library RFID tags do not prevent unauthorized reading of tag data. However, suitable algorithms can be employed to prevent the secret key being cracked. When selecting a suitable RFID system, consideration should be given to cryptographic functions. The paper provides the means for libraries and their communities to make an informed decision, and the technical options to improve future library RFID systems.

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RFID: an innovative library system for a new look

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1. **Abstract :** A library is a growing organism. As it grows in size the problems associated with the maintenance and security of the documents also grows. To solve the problems of arranging documents for classification scheme, of searching documents for cataloguing guideline and of space and time for digitizing documents through network. Bar-codes have served the librarians and libraries for a long time, and now it is slowly getting replaced by RFID. 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.
2. **Key Words:** Active Tag, Barcode, Passive Tag, RFID
3. **Introduction:**

A library is a collection of information, sources, resources, and services: it is organized for use and maintained by a public body, an institution, or a private individual. In the more traditional sense, a library is a collection of books.

RFID is an electronic identification technology which recognizes data in a microchip embedded in a tag, a label, or a card through remote antennas. It is the fundamental building block of the emerging ubiquitous computing paradigm. In RFID applications, the ID stored in a tag is read through wireless RF communication.

Microchips used for RFID tags are so small that they can be placed in a sheet of paper for practical use. Since the tag price is coming down constantly and the technology is getting more mature, we will see more and more RFID applications in much different area Library is one of the applications.

4. RFID – Meaning:

Radio frequency identification is a relatively new automatic identification system (auto-Id). Auto-Id refers to the methods of recognizing objects, getting information about them, and entering that data or feeding it directly into computer systems without any human involvement. Automatic identification and data capture technologies include barcodes, optic character recognition (OCR), magnetic stripes, smart cards, and biometrics. Typically, RFID systems consist of a microchip with a coiled antenna and a reader. Data and energy are transmitted without any contact between the microchip and the reader. The reader sends out electromagnetic waves that form a magnetic field so that the microchip's circuits are powered. The chip modulates the waves and sends back to the reader. The reader converts the new waves into digital data.

Radio-frequency identification involves the hardware known as *interrogators* (also known as *readers*), and *tags* (also known as *labels*), as well as RFID software or RFID middleware.

5. Types of RFID:

Fixed RFID and Mobile RFID: When the reader reads tags in a stationary position, it is called fixed RFID. When the reader reads tags in mobile it is called mobile RFID. Mobile readers include hand helds, carts and vehicle mounted RFID

readers from manufacturers such as [Motorola](#), [Intermec](#), [Impinj](#), [Sirit](#), etc.

6. Types of RFID tags :

There are primarily two types of RFID tags. One is active and the other is passive. An active tag is powered using internal battery, where a passive tag gets energized using the power from a tag reader. A passive RFID tag will not have a battery or any kind of power source by itself. It extracts the required energy from a reader.

Given below are the primary differences between a Passive and Active RFID tags:

	Passive RFID	Active RFID
Power Source	External (Reader provided)	Internal (Battery)
Tag Readability	Only within the area covered by the reader, typically up to 3 meters.	Can provide signals over an extended range, typically up to 100 meters..
Energization	A passive tag is energized only when there is a reader present.	An active tag is always energized.
Magnetic Field Strength	High, since the tag draws power from the electromagnetic field provided by the reader.	Low, since the tag emits signals using internal battery source.
Shelf Life	Very high, ideally does not expire over a life time.	Limited to about 5 years, the life of a battery.
Data storage	Limited data storage, typically 128 bytes.	Can store larger amounts of data.
Cost	Cheap	Expensive
Size	Smaller	Slightly bulky (due to battery)

7. RFID: Components: There are four basic components to every RFID system:

7.1) **RFID Tags:** For supply chain operations, it is common for the tag identifier to contain the Serialized Global Trading Identification Number (SGTIN) of the item to which it is affixed. This allows differentiation of identical items.

7.2) **Interrogators (or readers) :** A reader basically acts as a sensor because it *senses* what tags are within its range and is designed to interface with an information process system, which we'll explain more about below.

7.3) **Antennas :** One or more antennas are connected to the reader and are required for the radio frequency communications between the tag and the reader. Antennas come in a variety of size and shapes and have a significant impact on read range and performance.

7.4) **RFID Information Processing Systems :** The information processing system provides instructions to the readers, coordinates their operation, collects output data, and most importantly, makes decisions based on business rules about the data it receives.

8. Current uses : At [RFID Journal Live](#) 2010 in Orlando, Airbus detailed 16 active projects, [IBM](#) and—most recently added to the team—[CSC](#). In January 2009 Envego announced a 5.9 cent tag, and in March 2010 a Korean laboratory successfully created a printed chip using [carbon nanotubes](#) that would halve the price of a passive UHF RFID tag to about three cents by late 2011.

9. RFID - Advantages & Disadvantages:

9.1. Advantages of RFID systems:

9.1.1.) Rapid charging/discharging: The most significant time savings are attributable to the facts that information can be read from RFID tags much faster than from barcodes and that several items in a stack can be read at the same time.

9.1.2) Simplified patron self-charging/discharging: Patron self-discharging shifts that work from staff to patrons. Staff is relieved further when readers are installed in book drops.

9.1.3) High reliability: The readers are highly reliable. Some RFID systems have an interface between the exit sensors and the circulation system to identify the items moving out of the library.

9.1.4) High-speed inventorying: A hand-held inventory reader can be moved rapidly across a shelf of books to read all of the unique identification information. Using wireless technology, it is possible not only to update the inventory, but also to identify items which are out of proper order.

9.1.5) Automated materials handling: Another application of RFID technology is automated materials handling. This includes conveyor and sorting systems that can move library materials and sort them by category into separate bins or onto separate carts.

9.1.6) Long tag life: Finally, RFID tags last longer than barcodes because nothing comes into contact with them. Most RFID vendors claim a minimum of 100,000 transactions before a tag may need to be replaced.

9.1.7) Fast Track Circulation Operation: The use of RFID reduces the amount of time required to perform circulation operations.

9.2. Disadvantages of RFID systems: When we get 5-cent tags that is still a significant cost to add to the manufactured

cost of low-cost consumer goods. And even with higher-cost products, or case and pallet level tracking, the benefits of RFID must be greater than this additional cost.

RFID signals may have problems with some materials. Metals and liquids can cause problems when trying to read RFID tags. Since we are unable to read RFID system, we read all tags within its range. RFID smart-labels seem to have some serious quality problems. When compared to bar code technology, where standards have been in place for decades, most bar code scanners are designed to read all standard bar code symbologies.

10. RFID & Barcode:

RFID tags are often a Complement, but not a substitute, for UPC (Universal Product Code) or EAN barcode. They may not ever completely replace barcode, due in part to their higher cost and the advantage of multiple data sources on the same object.

RFID verses Barcode:

RFID	BARCODE
Can be read and write	Read only
No line of sight required	Needs direct visible contact to reader
Multiple items can be read simultaneously (anti-collision)	Single item scan only
Item attendant data (mobile data carrier)	Database look-up always necessary
Guaranteed data retention of at least 10 years	Limited lifetime due to printing
Stock verification made easier as no need of taking the books out from shelf. You can read multiple books from the shelf at a time.	Stock verification takes time because of the fact that each book has to take out from shelf and then scanned with the scanner.

11. RFID: Influences on Library -

The following are the tasks to be performed in the library.

- Circulation
- Collection, development, order materials, maintain materials' budgets.
- Technical Services work behind the scenes

Among these, the proposed system will automate the following tasks using RFID technology,

- Accessing number of books at a time
- Searching a particular book to check its presence in the library
- Locating the physical location of the book
- Accounting/Stock verification of the materials

The following features to the Library using RFID technology to:

- remove manual book keeping of records
- traceability of books and library members as they move
- improved utilization of resources like manpower, infrastructure etc.
- less time consumption as line of sight and manual interaction are not needed for RFID-tag reading.

- provide 2 meters read range antennas
- minimize the manual intervention
- minimize the manual errors
- provide the long lasting labels
- provide fast searching of books

12. RFID Benefits:

There are benefits of RFID which are as follows:

- A) Reduce warehouse and distribution labor costs
- B) Reduce point-of-sale labor costs
- C) Reduce inventory
- D) Improve forecasting and planning
- E) Reduce theft
- F) Reduce out-of stock conditions
- G) Improve customer experience

13. Why RFID in the library :

- A) **Easy Tagging**
- B) **Automated Sorting**
- C) **Managing Collections and Storage**
- D) **Secure and Automated Reservation and Borrowing**
- E) **Interactive Information, Help and Guide**

14. Conclusion:

The advancement of science and technology has made a tremendous improvement and change almost in all walks of life. Especially Radio Frequency Identification (RFID) technology has been chanted in all corners of the global arena. Its image is such which can provoke a significant lime light in the area of information communication technology.

RFID is increasing in popularity among libraries because it makes good economic sense, both for large and small libraries.

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RFID Technology in Libraries: A New Emerging Approach to Circulation, Tracking and Security of Library Materials

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Abstract

RFID stands for radio frequency identification. Now-a-days the library and information professionals have tremendous opportunities due to the development of webs and new information and communication technologies. Libraries and information centres are selecting, sorting, storing and disseminating the information efficiently. RFID technology resembles a traditional barcode system in that it provides a means of assigning an ID to an item and reading that ID to perform circulation process or to take catalogue. A library is able to identify and locate with the help of RFID, even the most remotely out of place item and helps to speed inventory process, and enhances the user experience by enhancing material availability. Radio Frequency Identification technology is the latest technology to make strong security. RFID gives the easier and faster circulation work, security of material, shelf check out and stock verification than Barcode technology. This study provides the basic concept and components of RFID technology. In this paper, the author provide the historical overview, basic structure, basic difference between RFID technology and Barcode, functions,

major standards, advantages & disadvantages of RFID and world & Indian scenario of RFID technology.

Keywords: RFID (Radio Frequency Identification), Automatic Identification Technology, Smart RFID labels, RFID Tag, Theft Deduction, Security System, RFID standards, Barcode v/s RFID Technology, Smart Library.

1. Introduction

In today's information society the librarians have a great responsibility to organize the knowledge centre due to the peak height of information explosion. RFID is a subset of a group of technologies, often referred to as automatic identification, that are used to help machines identify objects, and which include bar codes and smart cards. RFID technology also refers to the subset of automatic identification that uses radio waves to automatically identify bulk or individual items. Libraries are moving towards latest technological environment. RFID is a flexible technology, which was predicted to be one of the most convenient and well-suited automatic identification surveillance systems since 1980s. The library security has always been a key issue such as material security, personal safety, personal comfort, financial liability, legal issues and problem patrons and RFID technology can be a solution to minimize such problems. RFID enables identification from a distance, and unlike earlier barcode technology, it does so without requiring a line of sight. RFID system is claimed to be one of the major time saving automatic identification and data capture technique, which replace barcode and EM system in recent years. In this study, the author introduces the basic principles or ideas of RFID, discusses its main components, primary technologies & advantages and applications in libraries, and reviews the challenges organizations will face in deploying this technology.

2. Definitions of RFID Technology

The RFID joins the technology of the tags and readers with access to global standardized databases, ensuring real time access to up to date information about relevant products at any point in the supply chain.

RFID technologies are grouped under the more generic Automatic Identification (Auto-ID) technologies. RFID is positioned as next generation bar coding because of its obvious advantages over barcodes.

RFID (radio frequency identification) is a technology that incorporates the use of electrostatic coupling in the radio frequency (RF) portion of the electromagnetic spectrum to uniquely identify an object, animal, or person.

Radio Frequency Identification (RFID) is a valuable term for technologies that use wireless communication between an object known as a tag and an interrogating device known as a reader, for the purposes of automatically tracking and identifying of such objects.

3. Historical Development of RFID Technology

Radio Frequency Identification popularly known as RFID is one of the latest technologies invented in 1948 and is being used by various industries including libraries and information hubs. The 1950's were an era of exploration of RFID techniques following technical development in radio and radar in 1930's and 1940's. It was developed during World War II and was the outcome of the radar experiments, but its implementations started in 1970s. The first U.S. patent for an active RFID tag with rewritable memory was obtained by Mario E. Cardullo on January 23, 1973. In 1973 Charles Walton, a Californian industrialist, received a patent for a

passive transponder that was used to unlock a door without a key. Then Walton licensed the technology to a lock making company called Schlage and RFID technology is another form of automated identification system, which is similar to bar codes. RFID in India was developed in the 1940's for defense applications. 1st time it was used for commercial purpose in 1980 for cattle tracking applications. Recent interest is in making RFID technology more ubiquitous in the global value chain. And today, RFID technology is used for lots of application in our day to day life such as reducing theft, automating parking, and automatic handling of traffic. It is highly efficient in hostile environment where barcodes cannot survive. The first library suppliers started to market their systems in the mid 1990's. During the 1990's the proliferation of competing systems and radio frequencies employed created the need for standards and interoperability. Libraries need the higher frequency waves to allow for smaller, less powerful and portable readers.

4. Objectives of the Study

The main objectives of the study are:

- To find out the historical overview of RFID technology for Libraries;
- To find out benefits of RFID for Libraries;
- To find out the advantages and disadvantages of RFID;
- To find out main components and primary technologies used in libraries;
- To find out role of Librarians for adopted RFID in Libraries;
- To find out Impact of RFID technologies on Libraries;
- To chalk out the world and Indian scenario about the RFID Technology;

5. Main Components of RFID system and Their Effects in Libraries

An RFID system for library contain of five components. These eight components are:

a) RFID Tags: Tags is considered to as the heart of RFID system. It is a paper thin electronic device that holds data, which is flexible, cover of each book or directly onto CDs and videos and covered with a property sticker in a library's collection. A paper-thin adhesive label which is available in various shape and sizes as required. It can be applied (attached) to library resources in various ways to improve stock management and security. These tags can store far more information about an item than a barcode, which has been the traditional approach to library automation. RFID tags also allow the use of a single label for both circulation and security. When newly acquired media are entered into the collection. This cuts manual effort per operation in half. RFID tags can be used for status control as well as for security checks. There is no need for an additional security stripe. There are 3 types of tags: Active, Semi Passive and Passive Tags.

- **Active Tag-** Active Tags have their own internal power source which is used to power any ICs that generates the outgoing signals. These are much more readable than passive tags. They don't have any built in power source as the power is provided by the radio frequency wave created by the reader.
- **Semi Passive Tag-** Semi - Passive tags are similar to active tags as they have their own power supply but battery is used just to power the microchip and not broad cast a signal. It uses battery to maintain memory in the tag or power.

- **Passive Tag-** It receives operating power from the reader. The tag shows the radio frequency signal transmitted and adds information by modulating the reflected signal. Passive Tags need no internal power supply. The minute electrical current induced in the antenna by the incoming radio frequency signal provide just enough power for the CMOS integrated circuit in the tag to power up and transmit a response. These tags do not require batteries and have an unlimited life span.

b) Readers or Sensors: Reader is also a component of RFID technology. This system includes different types of reader. Reader works in conversion station where library data is written to the tags. RFID readers or scanners or receivers are composed of radio frequency module, a control unit and an antenna to interrogate electronic tag via radio frequency communication. Reading tags refers to the communication between the tags and the scanner. There are different types of readers like stationary readers, mobile readers, etc. Exit sensors verify that all material leaving the library has been checked out. Sensors at exits are basically two types. Some RFID systems have an interface between the exit sensors and the circulation software to identify the items moving out of the library. Were a library user to leave the library with a stolen book and not be caught, the library would at least know what had been stolen. If the material that has not been properly charged is taken past the exit gate sensors, an immediate alarm is triggered. RFID reader can also be integrated into hand held mobile device. Nokia, a mobile manufacturing company is already offering such kind of RFID reading functionality but in limited models only.

RFID readers are used in the staff workstation of a library in the following manner:

- **Conversion Station-** This is where library data are written to the tags. Using reader and portable cart we can quickly and easily convert library materials from traditional optical barcode technology to RFID technology.

- **Staff Workstation at Circulation-** This workstation is designed especially for library staff to facilitate the smooth handling of books having RFID tags. Checking out, checking in, renewal, monitoring, sorting and admin functions can be done in the station. Checkout station is used to process several items at the same time. A stack of books will instantly read the RFID tag attached to the books while activating or de-activating their antitheft function. Late fine if any can be automatically calculated and updated on the database. Simultaneously, the theft detection system automatically can be activated. Finally, a receipt is also printed out to confirm returning of borrowed material. The validity of the renewals is also checked and accordingly database is updated.
 The most significant time savings are attributable to the facts that information can be read from RFID tags much faster than from barcodes and that several items in a stack can be read at the same time. The RFID system combines barcode scanning and security into one operation, improving workplace efficiency and ergonomics. It processes both barcodes and RFID tags, and can perform smaller scale barcode-to-RFID conversions. For the users, RFID speeds up the borrowing and return procedures.

- **Self Service Units-** Using RFID technology books can be checked out independently by the borrower

without any intervention of library staff. A borrower using self-charging finds it very convenient because he/she does not have to carefully place materials within a designated template and he/she can charge several items at the same time. This is a particular advantage to scientific libraries, where recently published books often experience a high demand.

- **Sorter and Conveyor-** This is an automated system for returning material to proper area of library. The book is identified by a RFID reader unit as it is inserted into the return slot, and then placed into a bin. If this is connected to a multiple sorter in the background, or separated out if they are already marked as being on hold for another user. This significantly reduces the amount of staff time required to ready materials for reshelving and gives an opportunity for users to take a book immediately after being returned by another one.

c) Antenna: The antenna produces radio signals to activate the tag and read and write data to it. Antennas are the channels between the tag and the reader, which controls the system's data. Antennas can be built into a doorframe to receive tag data from person's things passing through the door.

d) Coupler: Coupler the link between RFID tags and the PC, the coupler can send information in two directions; it can send the information from tag and send it to PC or it can read information from the PC and sent it to an RFID Tags.

e) Server: The server is the heart of some comprehensive RFID systems. It receives the information from one or more of the readers and exchanges information with the circulation

database. The server typically includes a transaction database so that reports can be produced within no time. Some system components are based on the server. These are:

- **Sensor Gate-** The sensor gate was designed for the detection and reading of information from RFID labels, which are carried through a door. The gate supplies the media number that shows which books were stolen.
- **Self check Unit-** After the identification of the user, which can be done with an RFID ID Card, a typical bar code library card, magnetic ID Card, or a PIN number, they can put the items (books, cds, videos etc) onto the read surface in front of the self check unit to be registered under their name and programmed to check out. The chip will be set on quiet mode, so as not to alarm at the exit. It is possible to return books at the self check station, but most libraries prefer to have only one function to avoid any user queues. So the return function is an optional function, as is looking up user account status.
- **Staff and conversion station-** To check out/in books at the staff station is a procedure similar to the one at the self check unit. There is additional software windows integrated into the LMS which allow other functions for the staff, such as conversion, the initial programming of the chip, plus some controlling functions. It is connected to a personal computer the antenna will be set beside the pc or underneath the counter. Ergonomics were paramount in the design of the BiblioChip™ staff station and self checkout station.

- **Inventory wand-** This device is basically used for various wireless functions: to take inventory, to locate specific types of books or media, and to find misplaced items. Another function of this device is to feed data into the main system via a wireless LAN (network). Special library specific software programs can be written and utilized with the inventory wand.
- **Books return station-** Many libraries require a separate book return station. The book will be identified at a RFID reader unit, located inside the book return slot, and then placed in a bin. It will automatically check in books, take them off the user's library account, and reactivate the security function. There are three options. The return at a
 - Self check station where the return function is activated (checks out plus returns or return only). This can only be used inside the library
 - Book returns station without sorting, inside the building, in a lobby room or at the outside wall for external access
 - Book returns station with sorting, as above, but with sufficient space for sorting equipment

Two or more bins can be used for sorting books on hold, media groups etc. In a more sophisticated system, the sorting can be expanded to numerous bins with the appropriate conveying equipment.

- **RFID labels-** Apart from the chip, it contains a specially trimmed antenna in order to achieve the highest reading distance. The technology is open and underlies the new standard ISO 15693. This standard guarantees that the chips which are used can be supplied from various sources and are compatible

with each other, meaning that they are non proprietary.

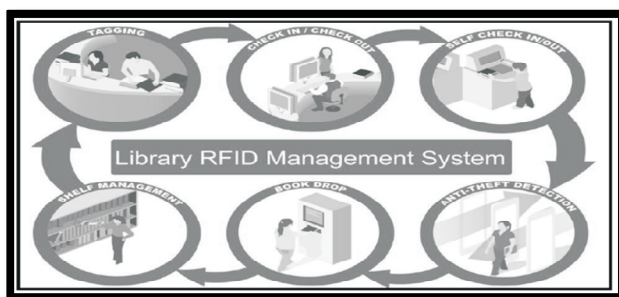
6. RFID Technology in Libraries

Libraries are power house of knowledge where information are stored and accessed in the form of books. In the late 1990's, RFID entered into libraries for its housekeeping operation. RFID tags contain all the bibliographical information of the material (book, periodical, CD, DVD, etc.). Rockefeller University in NewYork is the first academic library to adopt RFID technology throughout USA. In the UK, GlasgowUniversity Library was the first university library to install RFID in 2002 and has been joined subsequentlyby a small number of university libraries including Middlesex and Nottingham Trent University. India isalso not behind. Many IIT's, IISc, NIT's and several universities are using this technology.

This system, consist of smart RFID labels, hardware and software, provides libraries with more effective way of managing their collections while providing greater customer service to their patrons.

The information contained on microchips in the tags affixed to library materials is read using radio frequency technology regardless of item orientation or alignment. It provides a contact less data link, without need for line of sight.

Most RFID tags have no batteries; they use the power from the initial radio.



7. Different Types of RFID Technology

Three basic primary frequency bands are being used for RFID technology. These are:

7.1 **Low Frequency** (30-300 KHz) – Most commonly used for access control, animal tracking and asset tracking.

7.2 **High Frequency** (3-30 MHz) – Most commonly used where medium data rate and read ranges up to about 1.5 meters are acceptable.

7.3 **Ultra High Frequency** (850 to 950 MHz) – offer the longest read ranges of up to approximately 3 meters and high reading speeds.

8. RFID v/s Barcode Technology:

Criteria	RFID	Barcode
Read Rate	High throughput. Multiple tags can be read simultaneously.	Very low throughput. One at a time.
Read Range	Passive UHF RFID: - Up to 40 feet (fixed readers) - Up to 20 feet (handheld readers) Active RFID: - Up to 100's of feet or more	Several inches up to several feet.
Line of Sight	Not required.	Definitely required.

Criteria	RFID	Barcode
Human Capital	Virtually none. System is completely automated.	Large requirements. Staffs must scan each tag.
Read/Write Capability	Ability to read, writes, modify, and update.	Read only.
Durability	High	Low
Security	High	Low
Event Triggering	Capable	Not capable
Automation	Automated	Most barcode scanners require a human to operate.
Technology	RF (Radio Frequency)	Optical (Laser)
Identification	Can uniquely identify each item/asset tagged.	Most barcodes only identify the type of item (UPC Code) but not uniquely.

Radio Frequency Identification (RFID) technology is an investment for libraries. In recent years, many large and small library systems have installed RFID systems. Important five reasons are identified to adopt RFID technology by libraries. These five reasons are:

- Customer satisfaction
- Staff productivity and satisfaction
- Staff health
- Fiscal responsibility
- Save the time of user

9. Role of Librarians Relating to RFID Technology

RFID technology introduces an ethical dilemma for librarians. The technology allows more efficient use of professional staff, and may reduce repetitive stress injuries for library workers. Librarians have taken extra steps to ensure that laws such as the USA PATRIOT Act for betterment of library security.

Libraries have traditionally acted to protect and defend the privacy of their patrons and yet some are implementing a technology before proper safeguards have been developed. Library use of RFID technology serves to legitimize the technology in the eyes of the community.

10. Advantages of RFID Technology for Libraries

Some advantages of RFID technology are:

- i. **Faster Circulation Transactions:** The use of RFID definitely reduces the amount of time required to perform circulation operations.
- ii. **Inventory management:** RFID technology provides a vital advantage in the management of library inventory by its fast and accurate data collection. It also helps in detecting the missing books or books that are not filed in order. It gives an audible signal to indicate the misplaced books. Thus resulting in saving of library staff's time and labour.
- iii. **Better than bar-code:** Barcodes are required to be scanned by some reader individually at the time of issue or return. But in case of RFID technology, many books are issued or returned at a single time with comparatively faster rate than barcode giving an extra lifespan to the tags. Tags can store huge amount of data which have read/write capability but barcode doesn't have. As per the RFID vendors, RFID tags have a lifespan to 100,000 transactions which is far better than barcodes.
- iv. **Automated Identification of materials:** Another application of RFID technology is automated identification of materials. This significantly reduces

the amount of time required for re-shelving the reading material.

- v. **Automated material handling:** Automate material handling is another process of RFID Technology which includes conveyer and sorting system. Here the library materials are moved and sorted as per their categories into separate bins resulting in reduction of time needed by the staffs for sorting purpose.
- vi. **Highly reliable:** RFID technology is a highly reliable one and also claims an almost 100 percent detection rate using RFID tags.
- vii. **The perfect tracker:** An another feature of this technology in time savings and security aspect is that the RFID tags replace both the EM security strips or RF tags of older theft detection systems and the barcodes of the automated library system—i.e., the system is a comprehensive RFID system that combines RFID security and the tracking of materials throughout the library; or it is a hybrid system that uses EM for security and RFID for tracking, but handles both simultaneously with a single piece of equipment.
- viii. **Saving of staff:** RFID technology helps in reducing the work load of staffs. Self service is an important aspect of this technology. So the staffs of circulation can be deployed to some other works of the library.
- ix. **Simplified self-charging/discharging:** For patrons using self-charging, there is a marked improvement because they do not have to carefully place materials

within a designated template and they can charge several items at the same time.

11. Disadvantages of RFID Technology for Libraries

Some disadvantages of RFID technology are:

- i. **Lack of standardization:** A universally accepted and recognized standard should be followed by all the RFID users throughout the world. Standards are essential in the air interface protocol (e.g., radio frequency, data signal strength, communication protocols), tag encoding format (e.g., writing and locking tag data, encryption), and the information service infrastructure (e.g., data structure for supply chain applications).
- ii. **High Cost:** High cost is one of the major disadvantages for RFID technology. The readers, gate sensor and even the tags used in this technology incurred huge sum of money. System costs also include applying tags to items, purchasing and installing readers, system implementing application solutions, redesigning work processes, and staff education and training.
- iii. **Interference:** With the proliferation of wireless devices (cordless and mobile phones, PDAs, consumer electronics devices, etc.), there is the potential for electromagnetic interference with RFID systems. This may be particularly important since RFID does not have its own dedicated frequency band in most jurisdictions, but rather operates in a band that is shared with other users.

- iv. **Removal of tags:** The RFID tags are typically affixed to the inside back cover of the book and are exposed for removal.
- v. **Quick technology obsolescence:** Technology obsolescence is one of the major disadvantages faced by the RFID technology. Everyday new technology with speed, accuracy, user friendly nature is replaced by the existing one.
- vi. **Exit gate sensor (Reader) problems:** The performance of the exit sensors is problematic. They must read tags at up to twice the distance of the other readers. The performance of exit sensors is better when the antennae on the tags are larger.
- vii. **User Privacy Concerns.** Privacy concerns associated with item-level tagging is another significant barrier to library use of RFID tags. The problem with today's library.
- viii. **Orientation:** Before and after adoption of RFID technology, user orientation is a must. As this is a technology, it should be known to each and everyone are connect to it in the form of staff or user.

12. Best Practices for Libraries

Now libraries are implementing RFID system and it is important to develop best practices guidelines to utilize the technology in the best way. The following guideline for library may be concerned:

- The library should be open its use of RFID technology including providing publicity available

documents starting the rationale for using RFID, objectives of its use and associated policies and procedure and who to contact with questions.

- Only authorized personnel should have access to the RFID system.
- No personal information should be stored on the RFID Tag.
- No static information should be contained on the tag that can be read by unauthorized readers.

13. RFID Standard for Library

The international organization for standardization and EPC Global has been very active in developing RFID standards. The AutoID centre and their commercial offshoot EPC Global have also defined specifications and standards. There are two ISO standards pertinent to library RFID systems:

- ISO 15693 Standards.
- ISO 18000-3 Standards.

14. Indian Scenario of RFID Technology

Indian Institute of Management's deployed RFID system in their libraries for automated charging and discharging the books. IIT's implementing RFID technology for library theft detection systems. CSIR Labs and DRDO are using this new technology. ICAR Labs are also equipped with RFID technology. Recently in indigenous bases study (Margam Madhusudhan, 2010) found that after implementation of RFID in Indian Law Institute Library and NASSDOC Library at New Delhi the check-in and use of the libraries has also increased. In both institutions the RFID implementation is integrated with the library management systems, which is the

Indian, developed ILMS, LIBSYS. LIBSYS also supply the RFID system for ILI, but at NASSDOC the RFID vendor was LIBMAN. RFID tags are often seen as a replacement for barcodes, having a number of important advantages over the older barcode technology. NASSDOC had not used any barcode technology before the introduction of RFID whereas ILI had - and it continued their use after RFID implementation for those items that were not yet tagged. The emerging market of an unprecedented growth in RFID technology is likely to provide a fillip to the Indian IT industry. Since the amount of software development required to link RFID networks to enterprise systems is significant, India will be immensely benefited from these new opportunities of RFID. The Wipro technologies are launching an RFID concept store at its corporate campus in Bangalore in hopes of building expertise in the hot supply chain technology. The store will be equipped with RFID technology, including tags, readers, and related software, according to a statement issued by the company during the launching of a radiofrequency ID concept store at its corporate campus in Bangalore in July 2004.

15. World Scenario of RFID Technology

RFID in libraries was first proposed in the late 1990s as a technology. Singapore was certainly one of the first to introduce RFID in libraries and Rockefeller University in New York may have been the first academic library in the United States to utilize this technology. Farmington Community Library in Michigan may have been the first public institution, both of which began using RFID 1999. Approximately 600 contracts had been signed by the middle of 2007. There were approximately 850 facilities using RFID. Most installations are small, primarily in branch libraries. The University of Connecticut Library; University of Nevada/Las Vegas Library, the Vienna Public Library in Austria, the

Catholic University of Leuven in Belgium, and the National University of Singapore Library are among the few sites that appear to have tagged more than 500,000 items each. The most ambitious RFID program is that of the Nederlandse Bibliotheek Dienst (Netherlands Library Service). It envisions implementing RFID in all of the public libraries of the country, with an item able to travel among libraries that are equipped to read the tags of all of the books, not just their own. A pilot system was installed at the public library in the city of Eindhoven in 2002, and the first operational system two years later in the public library in the city of Heimlo. The vendor, Nedap N.V. of the Netherlands, uses Tagsys tags, but the equipment is also able to read the tags produced by Philips and Texas Instruments when the appropriate software is used. The deployment of RFID throughout the country is expected to take a minimum of five years. Major Dutch jobbers are now including RFID tags in all library materials purchased from them.

16. Conclusion

The RFID technology is very new for library community. Use of RFID in libraries is very essential part of upcoming years. RFID technology promises to change our world. However, every new technology comes at a cost. In order to remediate those costs, efforts must be undertaken to guide its development and implementation. As mentioned in the above discussion one can get a clear picture of the operations that are involved in the RFID, one of the best technologies that can be adopted by the libraries for its users and staffs. Despite having numerous limitations, RFID is successful in making its place in the market where tracking or items or books was difficult. It is the responsibility of library community to conduct a comprehensive technology assessment of RFID to make the best possible decisions involving the implementing

this technology. The implementation of this technology will change our personal and work lives in library and decorates the conventional library management with a new idea and usher for a future.

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Application of RFID Technology in Library

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Abstract: Library is an Information centre. To find out the information every library should be open access and to maintain the open access system, library should take the help of modern technologies. RFID helps to manage the inventory, find misplaced books and prevent book lost by detecting theft. RFID tags are the electronic chips consisting of an integrated circuit and antenna coil which respond to a reader by emitting radio frequency waves.

Keywords: RFID, Library security, Information technology, Tag

INTRODUCTION

Radio Frequency Identification (RFID) is an automated data capture technology. The technology may be used to identify, track and store information. Therefore this technology can be well utilised in the libraries. The time for Electro-Mechanical and Radio frequency Systems in libraries has passed away. RFID technology is far more advanced to combine the library security and item tracking systems in a library which helps in easy circulation of books, efficient inventory management and material handling.

COMPONENTS OF RFID SYSTEMS

RFID Tags

RFID tags are small microchips which contains memory and an antenna. The tag is generally thinner than paper and more or less 0.3mm across. RFID tags response to a radio signal emitted by a RFID reader. If a RFID tag receives a signal, it transmits its unique ID code and other data. There are two types of RFID tags—passive and active.

RFID Readers

RFID readers or interrogators contact RFID tags to obtain identification, location, and other data regarding the document the tag is attached to. The RF wave emitted from the reader activates the antenna of the RFID tag and thus turn on the microchip. There are two types of RFID readers:

- RFID read-only readers: These devices can only read information from a nearby RFID tag. These readers are found in fixed, stationery applications as well as portable, handheld varieties.
- RFID read-write readers: These are also known as encoders, these devices can read and write (change) information in an RFID tag. Such RFID encoders may be used to capture information into a "blank" RFID tag. A common application may combine this type of RFID reader with a barcode printer to print "smart labels". Smart labels contain a UPC bar code on the front with an RFID tag embedded on the back.

Antenna

An Antenna is connected to the reader to help to process identification of the items and Activate/deactivate the tag anti-theft function simultaneously. Antennas are the channels between the tag and the reader, which controls the system's data acquisitions and communication so the antenna enables the chip to transmit the identification information to a reader.

Server

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.

RFID IN LIBRARIES

RFID (Radio Frequency Identification) is the latest technology to be used in library theft detection systems. Moreover, human error as well as human resources is reduced to almost null with high accuracy when RFID Systems are used in libraries. Here are the following ways we can use RFID Systems in the libraries:

1. Tagging

Initially, the books are tagged to the server with a unique identification identity. If previously, bar codes were used we can simply keep the database same by updating the unique identities like the same as the previous unique bar codes.

2. Check In/Out Service

Users can take the help of the librarians for the check in or check out service. The previously books tagged are given to the librarian either for check in or check out by the customers. The librarian would then place the books on a reader and the books will be mapped / unmapped to the user on his identity (RFID card for users) in the database and an e-Slip will be generated for the customers where he/she can see in how many days the book has to be returned.

3. Self-check in / check out

Users identification is done with an RFID- ID Card. Users can put item onto the reader surface in front of the shelf check unit to be registered under particular user's name.

4. Anti-Theft Detection

If the user has not registered any books under his/her identification then when he/she is leaving the facility he/she will be scanned by two sensors for his user id and items id and whether they are mapped to each other or not. If they are not mapped to each other then alarm system can be activated as a warning of theft.

5. Book Drop

Libraries can offer a distinct service that is very useful for users, such as the ability to return books when the library is closed. The book drop system can be useful for this activity. In this system user inserts the book/items into the slot. The

RFID reader captures the electronic signature and sends to backend system for loan cancellation. User's record is updated immediately.

6. Shelf Management

Even management of shelves of books can be done with the device. If one book is out of place, the system will be able to tell which book is misplaced/missing and where would it be placed if found in a different place.

AVANTAGES OF RFID

Rapid check-out / check-in

The use of RFID reduces the amount of time required to perform circulation operations. The most significant time savings are attributable to the facts that information can be read from RFID tags much faster than from barcodes and that several items in a stack can be read at the same time. While initially unreliable, the anti-collision algorithm that allows an entire stack to be check-out or check-in now appears to be working well.

The other time savings realized by circulation staff are modest unless the RFID tags replace both the EM security strips or RF tags of older theft detection systems and the barcodes of the library management system - i.e., the system is a comprehensive RFID system that combines RFID security and the tracking of materials throughout the library; or it is a hybrid system that uses EM for security and RFID for tracking, but handles both simultaneously with a single piece of equipment. There can be as much as a 50 percent increase in throughput. The time savings are less for check-out than for

check-in because the time required for check-out usually is extended by social interaction with patrons.

Simplified patron self-check-out / check-in

For patrons using self-check-out, there is a marked improvement because they do not have to carefully place materials within a designated template and they can check out several items at the same time.

Patron self-check-in shifts that work from staff to patrons. Staffs are relieved further when readers are installed in book-drops.

High reliability

1. The readers are highly reliable. RFID library systems claim an almost 100 percent detection rate using RFID tags.
2. There is no false alarm than with older technologies once an RFID system is properly tuned.
3. RFID systems encode the circulation status on the RFID tag. This is done by designating a bit as the "theft" (EAS) bit and turning it off at time of check-out and on at time of check-in. If the material that has not been properly check-out is taken past the exit sensors, an immediate alarm is triggered.

High-speed inventorying

A unique advantage of RFID systems is their ability to scan books on the shelves without tipping them out or removing them. A hand-held inventory reader can be moved rapidly across a shelf of books to read all of the unique identification information. Using wireless technology, it is possible not only to update the inventory, but also to identify items which are out of proper order.

Self-Charging /Discharging

The use of RFID technology in a library decrease the time needed for circulation duties. This technology helps librarians eliminate valuable staff time spent scanning barcodes while checking out and checking in borrowed items. Patrons self-charging/discharging shift that work from staff to patrons.

Automated materials handling

Another application of RFID technology is automated materials handling. This includes conveyer and sorting systems that can move library materials and sort them by category into separate bins or onto separate carts. This significantly reduces the amount of staff time required to ready materials for re-shelving.

Long tag life

Finally, RFID tags last longer than barcodes because nothing comes into contact with them. Most RFID vendors claim a minimum of 100,000 transactions before a tag may need to be replaced.

DISADVANTAGES OF RFID

High Cost

The major disadvantage of RFID technology is its cost. The RFID tags are very costly. Besides tags, the reader exit censor, circulation station, scanner etc. are also quit expensive. These situations discourage many libraries to adopt this technology.

Modification of security tags

In this case, any could use the RFID reader to permanently turn off security by looking the security data. This could also include programming random data, erasing data. Any of these situation cause great difficulty to the library.

Chances of Removal of exposed tags

RFID tags are typically affixed to the inside back cover and are exposed for removal. This means that there would be problems when users become more familiar with the role of the tags.

Tag Collision

Tag collision is also the disadvantages of RFID. Tag collision can occur when numerous tags in the same time confusing the reader.

Reader Collision

Reader Collision can occur where two signals from different reader overlap and the tag is unable to respond to both.

CONCLUSION

RFID technology is not emerging but also more effective, convenient and cost efficient technology in library security. This technology has slowly begun to replace the traditional barcode on library items. RFID is the latest technology to be used in library theft detection system and circulation operations. RFID in libraries saves library staff's time by automatizing their tasks. This technology is quite expensive;

still it has yielded excellent results for all the organization. The decreasing price of tags and other equipments in future will encourage more libraries to adopt this technology for various applications in an effective ways.

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Static Shelf to Smart Shelf: RFID in library resource management

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Abstract *To assure information to the users in time is of immense importance. Unorganized library resource sometime disappoints library users and this is undesirable. Radio Frequency Identification (RFID) technology can solve this problem in an efficient manner. This paper discusses here RFID-enabled smart shelf system, its considerations and multiple benefits. Beside this Real time Location System (RTLS) has also been briefly discussed.*

Keywords: *RFID, Smart Shelf, RTLS, library management, RFID benefits,*

Introduction

The fourth law of the Five Laws of Library Science propounded by S. R. Ranaganathan, is “Save the time of the Reader”. It is a matter of immense importance to each and every library personnel as only timely and accurate information service assures the very potentiality of the library system. But in reality, most of our libraries fail to fulfill this urge of the users’ community as because the library resources are not properly organized and/or misplaced. Either users are to wait for a long to get his/her required information or to leave the library without having the information resources, although the library possessed it. This is why users’ satisfaction level decreases drastically. It’s a great loss no doubt. Here comes the Radio Frequency Identification (RFID) technology which is with a great potentiality to solve the

problem. To track and trace the library items out of a roomful is a task of seconds and in this way RFID has assured the accuracy and timeliness of library service to the users. Smart Shelf techniques have already proven its superiority in tracking the library items with the help of light or sound. But the one of the latest RFID features is Real Time Location Systems with active tags have opened the new arena of library resource management.

Smart Shelf

The Smart-Shelf uses Radio Frequency Identification (RFID) technology to allow tracking of books, publications and folders in libraries and the system is a set of shelves, or some other container that constantly keeps track of the individual items it contains. If an item is removed or added, the shelf immediately updates the inventory. The application can be extended to include searching for relevant items more effectively, thereby minimizing time spent by library staff managing paperwork, conducting searches and checks and reducing human error.

By tying the identity of an item to its attributes, such as name or title, publisher, unique number, publication date or subject, a system using smart shelves can immediately locate all matched items from a certain subject or publisher. An example of a smart shelf system that contains indicators such as horns or lights that warn users if a product has been removed from a certain shelf.

Considerations:

Few considerations to be taken care this type of application are:

Item-level inventory support

The most important consideration in a smart shelf system is the necessity of resolving inconsistencies between existing applications and a system that handles individual inventory.

Hardware and physical equipments

Developing a smart shelf system from readers, antennas, and standard shelving is a daunting task due to the complexity of choosing components, placing antennas, and modeling the possible side effects.

Handling spurious reads

A reader may sometimes fail to recognize a tag. This can be due to interference or absorption of the RF signal. For instance, someone may reach for one item and briefly and block the signal response of several others. Also, passing carts full of items by the reader at once may cause false positives to appear on a shelf.

Benefits of Smart Shelf:

Except the erstwhile feature of theft detecting, RFID technology can help the library in multiple ways which will make this technology an integral part of library resource handling to assured better library service in the coming days, and few of them are as follows ;

- i) Instant inventory checking
- ii) Locating item in real time
- iii) Consumption of least time in delivering library resources to the users
- iv) Misplaced book detection.
- v) Reduction of human error
- vi) Cost effective
- vii) Improved library service quality.

- viii) System will show the book detail according the latest book status which is available and/or borrowed
- ix) Usage information of a particular book or other library item.
- x) More resource utilization.

Real Time Location Systems (RTLS)

A Real-Time Location System is any system using a network of sensors to determine the coordinates of a tag in real-time, anywhere within an instrumented area (ubisense, 2012). Since an active tag is capable of transmitting a relatively strong signal in comparison to the reflected signal of a passive tag, active tags may be used as locator beacons and placed in two- or three-dimensional space using triangulation(Glover and Bhatt, 2010). This means that with only two or three antennas, a reader can determine the location of each tag in a roomful of tags. RTLS systems may perform passive or active (automatic) collection of location information and a system that continuously determines the position of an object in real-time in a given physical space (Claironox, 2009).

Conclusion

RFID system is workable and reliable with its latest features of smart shelf and Real Time Location System in the libraries. RFID active tags are costly still. RFID with its inherent qualities and further research in this area will positively make the library management and service atmosphere in a newer height undoubtedly in coming days. Retrieval of information will be of optimum level with the help of RFID, beside formal library resource arrangement methodology.

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Library Security and Automation Using RFID and SLiMS

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Abstract: A library is a growing organism. As a result the problems arise with the maintenance and security of the documents. Bar-codes have served the libraries for a long time but now it is replaced by RFID (Radio Frequency Identification). Today, more and more libraries are adopting RFID in the area of book issue, book returns, shelf management and other purposes. RFID technology is now widely accepted by various LMS (Library Management Software) software. SLiMS is open source integrated library management software originate in Indonesia.

Keywords:

RFID System, RFID Tag, SLiMS ILMs,

Introduction:

RFID (Radio-Frequency Identification) concept was came in 1969 and get patented in 1973. This technology was first used in harsh industrial environment in 1980s. Finally in 2001 it adopted by many organization. This technologies being adopted by both industry as well as in academic world. Now library management systems use barcode technology. Using barcodes in library, a library management system can keep records of lending, borrowing and shelving such as books, CDs, DVDs, audio or video tapes, etc. RFID library management, using RFID tags in library is easy and secure. A

RFID library management system each books attached with an RFID tag. Anyone can locate books in library with help of the RFID reader.

SLiMS is open source integrated library management software originally developed in Indonesia with a variety of developers from the different parts of the world including Bangladesh. The software was awarded in the category of Open Source by Indonesian ICT Award - 2009. SLiMS can easily implemented in library without any cost. It very simple to install in computer and its structure is very user friendly to use. Since SLiMS is developed based on Unicode, it completely supports Bangla input. On the other hand, it has built-in feature of Digital Library and Institutional Repository feature.

What is RFID?

Radio-Frequency Identification (RFID) is use the radio waves to read information stored on a tag attached to an object. A tag can be read from up to several feet away. It does not need within direct sight line of the reader to be tracked.

RFID Technology in Library:

The concept of RFID can be simplified to that of an electronic tag and can be used to identify, track or detect library holdings at the circulation desk. It helps daily stock maintenance. This system, consist of RFID tag, hardware and software. This technology provides libraries with more effective way of managing their collections.

Types of RFID:

According to Frequency -

Low Frequency (LF) RFID

The LF band covers frequencies from 30 KHz to 300 KHz.

High Frequency (HF) RFID

The HF band ranges from 3 to 30 MHz

Ultra High Frequency (UHF) RFID

The UHF frequency band covers the range from 300 MHz to 3 GHz.

According to Power Source -

Active RFID

In active RFID systems it has a tag for transition and power source. Usually, the power source is a battery. Active tags broadcast their own signal for transition of information stored on their microchips. This RFID systems operate in the ultra-high frequency band and offer a range between 0-100m.

Passive RFID

In passive RFID systems, the reader antenna send a radio signal to the tag. The RFID tag then uses the transmitted signal to power on, to reflect energy back to the reader. Passive RFID systems can operate in the low frequency, high frequency and also in ultra-high frequency radio bands and offer less than 10m. Because passive tags do not require a power source or transmitter, it only requires a tag chip and antenna, so they are cheaper, smaller, and easier to manufacture than active tags.

Battery-Assisted Passive RFID

A Battery-Assisted Passive RFID tag is a type of passive tag which is almost same to active tag feature. While all passive

RFID tags use the energy from the RFID reader's signal to power on the tag's chip to the reader but BAP tags use an integrated power source to power on the chip, so all of the captured energy from the reader can be used for backscatter. But BAP tags do not have their own transmitters.

Components of the RFID System:

RFID system has mainly four components:

1. Tags:

RFID tag is the heart of the system for security, which can be fixed inside a book's back cover or directly onto CDs and videos. All tag is equipped with a programmable chip and an antenna for detecting. Each paper thin tag contains an antenna and a microchip with a capacity of 64 bits. There are three types of tags which are 'read only', 'WORM', and 'read/write'. Tags is encoded with not rewritable 'WORM' (write once read many) tags are programmed by the using organization, but without the ability to rewrite them later 'Read/Write tags' which are chosen by most of the libraries. In libraries who are using RFID is common to have part of the read/write tag secured against rewriting e.g. the identification number of the item.

2. Readers:

A receiver device called as reader who detects the signal as soon as it enters into a radio range and decodes the number for interpretation; Reader interrogates with the tags and offers optimum reading performance enabling instant data capture when passed through the items in a continuous movement. The devices used within the building are called 'readers' while the others used at building are usually called 'sensors'.

3. Antenna:
An antenna is connected to the reader that help to process identification of the items and activate/deactivate the tag antitheft function. Additionally antenna can be added to increase the number of item to process in case of larger transactions.
4. Server:
The server is the heart of whole RFID systems. It is the communication gateway among the various components to receive the information from one or more readers and exchange information with the circulation database of library.
5. RFID Label Printer:
Used to print the labels if necessary.
6. Handheld reader:
It can be moved along with the items on the shelves without touching them. It is used in stock verification, used in search for book-miss helved and it is searched for individual book on request.
7. Shelf Check In Unit:
User's identification is done through a RFID-ID card. Users can put item onto the reader surface in front of the self-check unit to register under particular user's name. Multiple items can be checked out at a time.
8. Shelf Check Out Station:
Libraries can offer a distinct service, to return the books when library is open, as well as closed. It is a machine with a slot and a chip RFID Reader integrated into a wall. User identifies him/her and puts the Books into the Slot. Upon Completion of return, user gets a Receipt which are showing how many and which books are returned.

Advantages of RFID in Libraries:

The use of RFID reduces the time required to perform Circulation operations. The most significant time of saving is that, information can be read from RFID tags faster than barcodes.

- ✓ Self-charging an discharging
- ✓ Reliability
- ✓ Streamlined Inventory Management
- ✓ Tag has a long life
- ✓ Faster Circulation Process
- ✓ Reduction in workplace injuries for saving time
- ✓ Automated documents for handling
- ✓ Easy stock verification process
- ✓ Theft reduction
- ✓ High security level in library
- ✓ Easy miss-shelve identification
- ✓ Improved tracking of high value materials
- ✓ Technology standards which is low cost effective
- ✓ Automated sorting of books on return in the system
- ✓ Increase visibility accuracy and efficiency

Partial use of RFID:

RFID system is a costly one. Many Libraries could not bear so much money to install full RFID system in library. As because the price of full components is very costly.

Rather, RFID system can be use partially in libraries. In Ramakrishna Mission Sikshanamandira (B.ED. College) Belur, I and my Co- authors are working to install the RFID tag in every documents and there will be only one gate from where users can pass through. If anyone going out without issuing the book the

alarm will raise to stop him/her. Here RFID is used only for security purpose. So library who cannot effort full installation of RFID, they can use partial RFID use for their need in library.

SLiMS:

SLiMS is open source integrated library management software originally developed in Indonesia with a variety of developers from the different parts of the world including Bangladesh. The software was awarded in the category of Open Source by Indonesian ICT Award - 2009. SLiMS can easily implemented in library without any cost. It very simple to install in computer and its structure is very user friendly to use. Since SLiMS is developed based on Unicode, it completely supports Bangla input. On the other hand, it has built-in feature of Digital Library and Institutional Repository feature.

The Salient features of SLiMS:

- ✓ A complete library management software
- ✓ Free and open source software licensed under GNU GPL version 3.
- ✓ Integrated Digital Library feature and built-in Institutional Repository functionality
- ✓ Variety of access control over digital contents
- ✓ Z39.50 search retrieval
- ✓ MARC21 and AACR2 compliant
- ✓ Easy to Install
- ✓ Can be install in Windows, Linux, MAC Operating System.
- ✓ Easy to customize to fit with institution
- ✓ RFID integration facility (Enterprise edition)

- ✓ Supports Bangla language and Bangla Searching with Bangla interface (First ever)
- ✓ Barcode and Label printing facility
- ✓ Member Card printing facility

Conclusion:

This paper is intended to give overall view of RFID technology and Slims S/w to library fraternity. Slims is a very effective ILS system with a good quality and presents similar features like commercial systems. The adoption of Slims represents a significant license costs saving and the possibility to adapt the system to the institution needs. With the adoption of RFID for books and user identification it was possible to improve efficiency in circulation and other library works. But RFID is costly implementation plan to a library, again it is technologically advance so a technological library can implement it for security reason and advancement.

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RFID: Its Biological Effects and Associated Health Risks

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Abstract: RFID technology is such a radio frequency modulated technology that reduces human efforts and invokes more convenience to the users. The paper deals with RFID technology in brief and a thorough concept of the different frequencies of electromagnetic spectrum and associated health hazards. The paper also shows the need of Radio Frequency (RF) research in human, animal and social settings. To promote such research needs World Health Organization's (WHO) agendas and guidelines are mentioned. Defining the various terms and the nature of radiations of RFID, the paper addresses some notable researches on the biological effects and exposures of Radio Frequency. Also the related health risks are mention with existing prior studies. Finally, World Health Organization's research agendas of RF and further research questions for conducting proper epidemiologic studies need to be addressed to reach more condensed and evidence based conclusion of RFID associated health hazards in public arenas.

Keywords: RFID, Radio Frequency, EMF, Electromagnetic Spectrum, Non-ionizing Radiation (NIR), Biological Effects, RF Exposures, Reference Level, Epidemiology, World Health Organization.

Introduction

Radio Frequency Identification (RFID) has evolved variedly since its beginning in 1920s with the inception of RADAR system (**R**adio **D**etection **A**nd **R**anging) (Ward & van Kraneburgh, 2006). Such radio frequency detection technology has been used widely since and continuously evolves to the best as it is now in modern times (Ward & van Kraneburgh, 2006). Education, farming, healthcare and pharmaceutical, logistics, retail, manufacturing, aerospace, automobile, transportation, and information technology as well wireless automatic identification technology to streamline enterprise operations – possibly at every production of commodities and services RFID provides a wide range of technological support. Barcodes, QR-codes, magnetic chips and strips, Electromagnetic components day by day enhances the sophistication of RFID as convenience to the customer. But every technology has its own sets of deception points and in case of RFID the concerns are havocs. Potential privacy infringement and identity theft are the main dilemmas of using RFID worldwide. Above all RFID technology is blamed for major health issues for its radiation and electromagnetic regime. The paper deals with the health issues associated with RFID, about Radio Frequency (RF) exposures and World Health Organization's agendas and guidelines for future RF research studies.

RFID Technologies

RFID (Radio Frequency Identification) allows an item, for example a library book, to be tracked and communicated with

by radio waves. There are several methods of identification, but the most common is to store a serial number that identifies a person or object, and perhaps other information, on a microchip that is attached to an antenna. These chips and antennas are called RF TAGS or RFID TAGS. The antenna enables the chip to transmit the identification information to a reader. The reader converts the radio waves reflected back from the RFID tag into digital information that can then be passed on to computers that can make use of it . Active RF tags with batteries radiate higher strength RF signals, which are mainly used in large spaces. Passive RF tags are battery less transponders that operate with RF power transmitted from an RF reader without any contact, for example, gate type RF tags are used for Electronic Article Surveillance (EAS) in retail stores and libraries.

Most of the RFID systems have been operated from 100 KHz to 2.45 GHz frequencies; sometimes at higher than 5.8 GHz frequency level. Different Countries regulates their own sets of RFID spectrum known as ISM (Industrial, Scientific and Medical) so that there may be varying in the use of RFID frequencies by these countries (European Commission, 2006). At per general consideration we can classify these frequencies in four generic categories and where RFID frequencies are used in accordance with the respective bands and respective characteristics (Table 1) (IEE, 2005).

Table: RFID operating frequencies with respective characteristics (IEE, 2005).

Band	LF (Low Frequency)	HF (High Frequency)	UHF (Ultra High Frequency)	MW (Microwaves)
Frequency	30–300kHz	3–30MHz	300 MHz–3GHz	2–30 GHz
Typical RFID Frequencies	125–134 kHz	13.56 MHz	433 MHz or 865–956MHz 2.45 GHz	2.45 GHz
Approximate read range	less than 0.5 metre	Up to 1.5 metres	433 MHz = up to 100 metres 865-956 MHz = 0.5 to 5 metres	Up to 10 metres
Typical data transfer rate	less than 1 kilobit per second (kbit/s)	Approx. 25 kbit/s	433–956 = 30 kbit/s 2.45 =100 kbit/s	Up to 100 kbit/s
Characteristics	Short-range, low data transfer rate, penetrates water but not metal.	Higher ranges, reasonable data rate (similar to GSM phone), penetrates water but not metal.	Long ranges, high data transfer rate, concurrent read of <100 items, cannot penetrate water or metals	Long range, high data transfer rate, Cannot penetrate water or metal
Typical use	Animal ID Car immobiliser	Smart Labels Contact-less travel cards Access & Security	Specialist animal Tracking Logistics	Moving vehicle toll

In terms of using physical properties in different frequencies to establish communication between tags and readers, RFID systems are classified into two categories (Thompson, 2006).

Inductive coupling: It is used at 13.56 MHz or lower frequencies (ICNIRP, 2008). In such '*near field*' communication, The reader creates a magnetic field between the reader and the tag and this induces an electric current in the tag's antenna, which is used to power the integrated circuit and obtain the ID. The ID is communicated back to the reader by varying the load on the antenna's coil which changes the current drawn on the reader's communication coil (Want, 2004)

Propagation coupling: It is used at higher frequencies, especially around 1 GHz and 2.45 GHz (ICNIRP, 2008). Such far field communication system is based on electric radio waves using Ultra High Frequency (UHF) where the reader sends a continuous base signal frequency that is reflected back by the tag's antenna. During the process, the tag encodes the signal to be reflected with the information from the ID tag using a technique called modulation. (Ward & van Kranenburg, 2006)

RFID: A Growing Adverse Concern

As more RFID systems are implemented in various business processes, human exposure to electric and magnetic fields (EMFs) due to RFID will increase significantly. Exposure levels from each device are very small while the number of simultaneous exposures can be very large and the locations of the sources are unknown. This exposure scenario is very different from other RF equipment. Practical methods for

evaluation of human-body exposure to EMFs from RFID devices may therefore be necessary.

CoreRFID Ltd., an expert in the field of RFID research and development and RFID system implement, has raised some questions regarding the health issues caused by the RFID radiations and RFID electromagnetic fields (CoreRFID Ltd, 2010).

- ✓ Is there a risk to users of readers, users of tags or those in the immediate area from the radiation used to exchange data between the tag and the reader?
- ✓ Is there risk associated with humans injecting implantable tags beneath the skin?
- ✓ Is there a risk to patient from using tags in a medical environment for patient identification or other applications?

Unfortunately, there are limited studies regarding these questions and most of the companies follow the guidelines of International Commission on Non-Ionizing Radiation Protection (ICNIRP), the regulatory body which evaluates the risk of public health associated with RFID.

To understand the health issues associated with RFID, there is ample need to understand some more generic terminological definitions which are related with RFID.

Non-ionizing Radiation: Non-ionizing radiation refers to any type of electromagnetic radiation that does not carry enough energy per quantum or photon energy to ionize the atoms – that is to completely remove an electron from an atom (Wikipedia). The electromagnetic spectrum regimes a broad

range of wavelengths; from less than 10^{-10} cm to greater than 10^{10} cm. Cosmic rays, X-rays, Gamma rays etc. generate shorter wavelengths; and microwaves and electrical power generations are associated with longer wavelengths. Now the photon energies of electromagnetic radiations are proportional to radiation frequency and inversely proportional to wavelength. So the higher energies are associated with X ray and Gamma radiation and the lower energies are associated with radio frequency (RF) and microwave radiations (Wilkening, 1973). The photon energy is required to ionize atomic oxygen and hydrogen at 10-12 eV. So the approximately 10 eV is the lower limit in which ionization is produced in biological materials. Those electromagnetic radiations that do not cause ionization in biological system may have photon energies less than 10-12 eV and termed as “non-ionizing” (Wilkening, 1973).

Optical radiations: The optical radiations are associated with visible light especially with higher energies known as UV radiation and that with lower energies as IR radiation. According to K.H. Ng (2003), sources of UV radiation are “the sun, arc welding, oxy-gas welding, sun lamps, lasers (UV), sterilization lamps, low pressure gas discharge lamps, high pressure discharge lamps. Sources of IR radiation are from hot processes such as steelmaking, glassmaking, welding, and also lasers (IR). The application of laser as a coherent light source is increasing rapidly. Medical applications include UV and neonatal phototherapy, surgical and therapy lasers, physiotherapy heat lamps” (Ng, 2003).

Electromagnetic fields: A physical entity carrying or storing energy in empty space and manifesting itself by exerting forces on electric charges. EMF includes static electric and magnetic fields as well as time-varying electric, magnetic and electromagnetic fields with frequencies in the range 0 to 300GHz (World Health Organization, 2006). RF is used in radio communications, visual display units, television sets. Extremely low-frequency (ELF) and, electric and magnetic fields (EMFs) surround electrical machinery, home appliances, electric wiring, and high-voltage electrical transmission lines and transformers. Medical applications include microwave hyperthermia, therapeutic and surgical diathermy, and magnetic resonance imaging (MRI) (Ng, 2003).

Biological Effects of RF as NIR:

In any biological system, radiation affects; not necessarily that suggests a biological hazard or health effect. It only becomes a concern when it causes “detectable impairment of the health of the individual or of his or her offspring” (ICNIRP, 1998). However, biological effects could be physiological changes, biochemical changes and behavioural changes engaged in an organism, tissue and cell (Ng, 2003).

Non-ionizing radiations generally affect with tissues through the generation of heat. Primarily, human tissues are composed of H_2O molecules, which tend to absorb RF energy. The rate of absorption is a dosimetric measure known as the specific absorption rate (SAR) (Arumugam & Engels, 2008). Arumugam and Engels in their renowned research of RF

radiation on human body showed how “to study and quantify the SAR of the human body, more specifically the human head and shoulders for the passive UHF RFID reader environment. UHF RFID reader systems operating under FCC regulations may create RF energy absorption that could represent a significant impact to the human body, when present in high densities and/or close proximities”. The result was obviously a concerned one. Arumugam and Engels (2008) concluded – *“that 2 RFID reader antennas at distances of 10cm from the human head operating additively, will contribute to a SAR in the human head of up to a maximum of 2.02763 W/kg , which is above the limit for safe exposure of RF radiation as allowed by FCC in the US (1.6 W/kg)”*. (Arumugam & Engels, 2008)

C.J. Martin & D.G. Sutton (2002) in their book “Practical Radiation Protection in Health Care” show how biological hazards relies on the penetration of the human body and the absorption characteristics of different tissues. K.H Ng in his research paper published the chart with permission of C.J. Martin & D.G. (Ng, 2003):

Table: Biological Effects of Different NIRs (Martin & Sutton, 2002), (Ng, 2003).

NIR	Wavelength	Biological Effects
UVC	100nm	Skin–Erythema, inc pigmentation
UVB	280 nm	Eye–Photokeratitis (inflammation of cornea)
		Skin–Erythema, inc pigmentation
	315 nm	Skin cancer
UBA		Eye–Photochemical cataract
		Photosensitive skin reactions

NIR	Wavelength	Biological Effects
VISIBLE	400 nm	Skin–Erythema, inc pigmentation Skin photo-ageing, Skin cancer Eye–Photochemical & thermal retinal injury
IRA	780 nm	Eye–Thermal retinal injury Eye–Thermal retinal injury, thermal cataract
IRB	1.4 μm	Skin burn Eye–Corneal burn, cataract
IRC	3 μm 1 mm	Skin burn Eye–Corneal burn, cataract Heating of body surface
Microwave	300 GHz 1 GHz <100 kHz	Heating of body surface Heating with ‘penetration depth’ of 10 mm Raised body temperature Cumulation of charge on body surface Disturbance of nerve & muscle responses
Static	0 Hz	Magnetic field–vertigo/ nausea Electric field–charge on body surface

International Commission on Non-Ionizing Radiation Protection (ICNIRP) in their statement regarding “General Approach to Protection against Non-Ionizing Radiation” (ICNIRP, 2002) has assessed non-ionization radiation, especially RF radiation based health hazards. Through different scientific papers, reports and guidelines, epidemiologic cohort studies and case control studies, ICNIRP has tended to define adverse biological effects and exposures caused by NIR (table 3 and table 4).

Table: Relevant mechanisms of interaction, adverse effects, biologically effective physical quantities and reference levels used in different parts of the optical spectrum (ICNIRP. 2002).

Part of optical spectrum	Relevant mechanisms of interaction	Adverse effect	Biologically effective physical quantity	Exposure and reference level
Ultraviolet radiation UVA, UVB, UVC (180 to 400 nm).	Photochemical alterations of biologically active molecules such as DNA, lipids, and proteins.	Acute erythema, keratitis, conjunctivitis, cataracts, photo-retinitis, accelerated skin aging, skin cancers.	Fluence and action spectrum weighted radiant exposure.	Radiant exposure at skin or cornea.
Visible radiation (380 to 600 nm).	Photochemical alterations of biological molecules in the retina.	Photo-retinitis (“blue-light hazard”).	Retinal radiant exposure weighted by action spectrum.	Radiance and exposure duration.
Visible and near-infrared radiation (IRA) (400 to 1,400 nm).	Thermal activation or inactivation. Photocoagulation.	Thermal injury: skin burns and retinal burns. Thermal denaturation of proteins, tissue coagulation/necrosis.	Irradiance, radiant exposure and absorbing volume (spot size) at tissue site.	Radiance and duration. Exposure.
Middle (IRB) and far-infrared radiation (IRC) (3 pm to 1 mm).	Thermal activation or inactivation. Coagulation.	Thermal injury: skin and corneal burns, cataracts. Thermal denaturation of proteins. Tissue coagulation/necrosis.	Irradiance, radiant exposure and absorbing volume (spot size) at tissue site.	Radiant exposure and irradiance at skin or cornea.

Part of optical spectrum	Relevant mechanisms of interaction	Adverse effect	Biologically effective physical quantity	Exposure and reference level
Laser radiation (180 nm to 1 mm).	Photochemical, photothermal, photoacoustic, exposure duration <100 ps. Photoablative exposure duration < 100 ns. Bubble or plasma formation (change of phase). Non-linear optical effects	Tissue damage. Skin burns. Ocular burns. Tissue vaporization.	Radiant exposure and irradiance.	Radiant exposure and irradiance at skin or cornea; exposure duration.

Table: Relevant mechanisms of interaction, adverse effects, biologically effective physical quantities and reference levels used in different parts of the electromagnetic field spectrum (ICNIRP. 2002).

Part of NIR spectrum	Relevant mechanisms of interaction	Adverse effect	Biologically effective physical quantity	Exposure and reference level
Static electric fields.	Surface electric charges.	Annoyance of surface effects, shock.	External electric field strength.	Electric field strength.
Static magnetic fields.	Induction of electric fields in moving fluids and tissues.	Effects on the cardiovascular and central nervous system.	External magnetic flux density.	Magnetic flux density.

Part of NIR spectrum	Relevant mechanisms of interaction	Adverse effect	Biologically effective physical quantity	Exposure and reference level
Time-varying electric fields (up to 10 MHz).	Surface electric charges.	Annoyance of surface effects, electric shock and burn.	External electric field strength.	Electric field strength.
	Induction of electric fields and currents	Stimulation of nerve and muscle cells; effects on nervous system functions.	Tissue electric field strength or current density.	Electric field strength.
Time-varying magnetic fields (up to 10 MHz).	Induction of electric fields and currents	Stimulation of nerve and muscle cells; effects on nervous system functions.	Tissue electric field strength or current density.	Magnetic flux density.
Electromagnetic fields (100kHz to 300 GHz).	Induction of electric fields and currents; absorption of energy within the body.	Excessive heating, electric shock and burn.	Specific energy absorption rate.	Electric field strength; magnetic field strength; power density.
	> 10 GHz: Surface absorption of energy.	Excessive surface heating.	Power density.	Power density.
	Pulses < 30 ps, 300 MHz to 6 GHz, thermo-acoustic wave propagation.	Annoyance from microwave hearing effect.	Specific energy absorption.	Peak power density.

During 1950s and 1960s attempts were made firsthand for exposure limit for microwaves and RF radiations generated by military radars and other equipments. During 1990s ICNIRP came into the map for protecting NIR based hazards. All the exposure guidelines developed by ICNIRP are manifested to protect against the adverse health effects caused by NIR exposure. We must know that the adverse consequences of NIR exposure can vary across the entire range from trivial to severe (ICNIRP, 2002). These exposure guidelines come into force in terms of two levels of protection—

1. **Basic restrictions** which are based directly on established health effects, and
2. **Reference levels (RLs)** which are derived from measurements or from computed predictions. These RLs “provide for practical exposure assessment to determine whether the basic restrictions are likely to be exceeded” (Ng, 2003).

Health risks associated with RF exposure:

Different epidemiologic researches and cohort studies on health issues caused by RF exposures clearly emphasise that within controlled environment and research set up radiation affects on human tissues and human health. Some common notable health hazards can be identified from such studies.

- ✓ ***Brain tumours and Leukaemia:*** These diseases are the most common occupational exposure of RF radiation found in most of the epidemiologic studies. A study conveyed that there was a risk of “non-lymphocytic leukaemia” in radar exposed navy veterans (Groves et al., 2002). A more popular study

of U.S. embassy staffs in Moscow with possible RF exposure was published (Goldsmith 1995) and a few brain tumours or leukaemia cases were found.

- ✓ **Breast cancer:** Tynes et al. (1996) made a cohort study of fifty radio and telegraph women operators in Norway based merchant ships and found a Relative Risk (RR) of breast cancer of 1.5 ranges. Further an elevated RR through the study revealed endometrial cancer though it was not due to RF exposure (Tynes et al., 1996). Another large case-control study based on job titles from death certificates in the United States found no trend in risk of breast cancer in relation to probability or to level of occupational RF exposure (Cantor et al., 1995). A case-control study in the United States of men with breast cancer found an elevated odds ratio “(OR) of 2.9 (95% CI, 0.8–10)” in radio and communication workers (Demers et al., 1991), based on seven cases in exposed men, and with a low response rate in controls. The available data are insufficient to come to any conclusion on whether RF exposure is related to breast cancer risk (ICNIRP, 2004).
- ✓ **Testicular cancer:** In a case-control study in US related to testicular cancer Hayes, R.B. et al. (1990) showed significant risks on occupational exposure to microwave and radio waves. Another study reported that a cluster of testicular cancer was observed in six police officers in Washington State (USA), who regularly used handheld traffic radar guns (Davis and Mostofi, 1993).

- ✓ **Ocular melanoma:** Stang et al. (2001) found an increased risk of ocular melanoma in subjects with self-reported occupational exposure for at least 6 months and several hours per day to RFs (14% of cases, 10% of controls) and for occupational exposure several hours per day to radio sets (ICNIRP, 2004). Though this study is not sufficient to proclaim that during exposure of RF, the risk increases.
- ✓ **Lung cancer:** Armstrong et al. (1994) found a significant increase in lung cancer in case control study of electrical utility workers in Quebec and France. But there is no evidence that RF exposures cause such lung cancers (Armstrong et al., 1994). ICNIRP concludes that “there is no cancer site for which there is consistent evidence, or even an individual study providing strong evidence, that occupational exposure to RFs affects risk” (ICNIRP, 2004).
- ✓ **Adverse reproductive outcomes:** A number of studies were manifested concerning potential reproductive adversities caused by RF Exposure. But there is no strong suggestions of an association between RF exposure and **delayed conception** (Larsen et al. 1991), **spontaneous abortion** (Ouellet-Hellstrom and Stewart 1993; Taskinen et al. 1990), **stillbirth** (Larsen et al. 1991), **premature birth** after exposure of fathers (Larsen et al. 1991), **birth defects** in aggregate (Larsen 1991), and **increased male to female sex ratio** (Larsen et al. 1991). In most of the cases, either the finding was not corroborated in other studies of

comparable quality, or there are no other studies available.

- ✓ ***Cardiovascular disease:*** A lot of studies regarding RF exposures and consequent cardiovascular diseases have been addressed but no firm reason or evidence is found. In a mail survey of U.S. physical therapists, subjects who were more highly exposed to microwave and shortwave radiation, tended to report a significantly greater prevalence of heart disease, with elevated odd ratios (Ors) of 2–3 (Hamburger et al. 1983).
- ✓ ***Cataracts:*** Laboratory research indicates that the lens of the eye is highly sensitive to heat, and damage can occur from even a single acute exposure. Cleary et al. (1965) made a study on the hospital records of U.S. military veterans and found that subjects who were radar workers, were more prone to cataract problems than that of other medical conditions. In a letter experiment (Cleary and Pasternack, 1966), a tendency toward increased minor lens changes was found among exposed workers, characterized as the equivalent of 5 years of advanced aging in the exposed compared with unexposed workers around 60 years of age (ICNIRP, 2004).

The limitations of all such studies are worth mentioning.

1. Most of the studies are manifested with the quality assessment of RF exposure; more prominently, these studies question whether the RF exposure was present at all. A little has been known about population

exposure from RFs and other RF sources and even less about the relative importance of different sources.

2. Measurement of RF is always a debate as it is laboratory based and no case of direct RF exposure in nature have been studied with better technology.
3. Most of the researches have focused on the on brain tumours and leukaemia and these are of reconceptualised ones. ICNIRP in their 2004 “SCI Reviews” of **Epidemiology of Health Effects of Radiofrequency Exposure** mentions, “... the RF research questions are not driven by a specific biophysical hypothesis but rather by a general concern that there are unknown or misunderstood effects of RFs, studies on other health effects may be equally justified.” (ICNIRP, 2004).
4. A little number of epidemiologic studies have been organised regarding RFID system usage in different setup with different subjects. Proper cohort studies are need for evaluating RFID systems and their subsequent caused health risks.
5. All these researches do not reveal the long term exposure of RF radiation.

WHO’s Agendas for Radio Frequency Studies:

For the purpose of reducing scientific uncertainties through health effects research and responding to public health concern through more valuable and better research of risk communication, World Health Organization (WHO) provides the parameters of research priorities.

1. Create a list of research options, by research domain

In 2009, WHO undertook a survey to compile a list of possible areas of research option to formulate the Research Agendas. Its aim was to ensure the inclusiveness of researches by consulting various stakeholders, including individual researchers, with diverse backgrounds and viewpoints. The pre-defined areas of research option are covering:

- ✓ Epidemiology
- ✓ Human studies
- ✓ Animal studies
- ✓ Cell studies
- ✓ Mechanisms of interaction
- ✓ Dosimetry and exposure assessment
- ✓ Social sciences.

2. Gather technical experts and define the context

To determine the RF research priorities in context of geographical coverage, target population and time period, WHO classified the research activities in two groups:

- ✓ ***high-priority research needs:*** “Studies to fill important gaps in knowledge that are needed to reduce significantly uncertainty in the current scientific information and to improve significantly health risk communication”(WHO, 2010)
- ✓ ***Other research needs:*** “Studies to better assist understanding of how RF, EMF exposure impacts health and public health concern, which would contribute useful

information to health risk assessment and risk communication” (WHO, 2010).

3. Set criteria for priority setting

The priority setting criteria are as follows:

- ✓ Relevance to public health (scientific concern, public concern, exposure relevance)
- ✓ Potential for filling knowledge gap
- ✓ Scientific suitability (study design and method)
- ✓ Feasibility (in terms of cost, ethical issues, timescale).

WHO’s Recommendations for Health Effects Research Needs:

As per the research agendas, World Health Organization recommends different health effect research needs for different research options.

1. Epidemiology:

Table: Health effects research needs for epidemiology (WHO, 2010).

Level of Priority Needs	Particular Priority Needs
High Priority Research Needs	“Prospective cohort studies of children and adolescents with outcomes including behavioural and neurological disorders and cancer.”
High Priority Research Needs	“Monitoring of brain tumour incidence trends through well-established population based cancer registries, if possible combined with population exposure data.”
Other Research Needs	“Case-control studies of neurological diseases provided that objective exposure data and confounder data are available and reasonable participation is achieved.”

2. Human Studies:

Table: Health effects research needs for human studies (WHO, 2010).

Level of Priority Needs	Particular Priority Needs
High Priority Research Needs	“Further RF EMF provocation studies on children of different ages.”
High Priority Research Needs	“Provocation studies to identify neurobiological mechanisms underlying possible effects of RF on brain function, including sleep and resting EEG.”
Other Research Needs	Not identified

3. Animal Studies:

Table: Health effect research needs for animal studies (WHO, 2010).

Level of Priority Needs	Particular Priority Needs
High Priority Research Needs	“Effects of early-life and prenatal RF exposure on development and behaviour.”
High Priority Research Needs	“Effects of RF exposure on ageing and neurodegenerative diseases.”
Other Research Needs	“Effects of RF exposure on reproductive organs.”

4. Cellular Studies:

Table: Health effects research needs for cellular studies (WHO, 2010).

Level of Priority Needs	Particular Priority Needs
High Priority Research Needs	Not identified
Other Research Needs	“Identify optimal sets of experimental tests to detect cellular response after exposure to RF fields used in new technologies and co-exposures of RF EMF with environmental agents.”

Level of Priority Needs	Particular Priority Needs
Other Research Needs	“Further studies on the influence of genetic background and cell type: possible effects of mobile phone type RF exposure on a variety of cell types using newer, more sensitive methods less susceptible to artefact and/or bias.”

5. Mechanism:

Both high priority research needs and other research needs are not identified the WHO Expert Committees to recommend.

6. Dosimetry:

Table: Health effects research needs for dosimetry (WHO, 2010).

Level of Priority Needs	Particular Priority Needs
High Priority Research Needs	“Assess characteristic RF EMF emissions, exposure scenarios and corresponding exposure levels for new and emerging RF technologies; also for changes in the use of established technologies.”
High Priority Research Needs	“Quantify personal exposures from a range of RF sources and identify the determinants of exposure in the general population.”
Other Research Needs	“Monitoring of personal exposure of RF workers.”

WHO’s Recommendations for Social Science Research Needs:

In view of the developments in science and society, the following social science research topics are currently considered important. All the studies described below are needed and there is no specific priority (WHO, 2010).

1. Investigate the determinants and dynamics of RF EMF-related health concerns and perceived health risks.
2. Investigate the effectiveness of different formats for communicating scientific evidence regarding health effects of RF EMF exposure and risk information to the public.
3. Investigate whether and how people's perception of RF EMF health risks can affect their well-being.
4. Investigate how RF EMF technologies have been handled in a larger social context.

Conclusion

Through such thorough knowledge of RF exposures and associated health hazards, we come to the point that special kind of epidemiologic cohort studies are need in different setting so that public health in general can be assessed and can be monitored properly. The gap in present study relies on the fact that no epidemiologic study or cohort study or case control study has been made so far in RFID system implantation in public arenas. As a result, we can suspect that there may be a possible risk of health hazards using RFID systems, tags and readers. But a very few portion of actual evidence can strongly be evoked; the research in epidemiologic scale is rare. Different vendors and RFID providers generally maintain the guidelines of World Health Organization or ICNIRP or any reputed non-ionizing monitoring agency's guidelines. But large scale and geographical deviation based epidemiologic cohort study on using RFID in libraries is yet to be conducted.

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Use of RFID Technology in Library and Role of Librarian: a brief description

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Abstract: RFID stands for Radio Frequency Identification which introduced the new information technology in areas of information industry. The main purpose of RFID technology in library is to identify documents with the help of magnetic security tag. The paper emphasizes on development of RFID, its components, use of RFID in library, advantages and disadvantages. It also describes the role of librarian.

Keyword: RFID technology, Information, Use of RFID, Radio Frequency

Introduction:

The RFID technology is generally used for the identifying the radio signals for the specific objects. It is the wireless non-contact magnetic chip to use for radio frequency magnetic fields to transmitted data for the automatically identifying and capture tags attach to objects. This is modern electro-magnetic sequence of radio frequency based technology and microchip technology. It is one of the most rapidly developing segments of now a day's information era; automatic identification and data capture industries. RFID is the latest development of modern technology to be used in library theft detection systems. It is the complete security protection and inventory management package for modern information centers or libraries. RFID readers can observe and process hundreds of tags within their field and barcode have to be scanned one by one. Librarians using the portable computers with RFID readers to take inventory and find misfield materials simply by walking down and aisle of document

shelves. The RFID readers can recognize the missing documents automatically and get alert the operator.

Objectives:

The objectives of RFID is to get the most tangible benefits with respect to user services, internal operations, security protections, circulations, acquisitions, stock verification and overall maintain of the library.

Development:

The British introduced RFID during the world-war II to identify their aircraft returning from Europe. In 1960s the US government started using the technology to tag and monitor nuclear and other precarious materials. In 1972, the first categorization of UPC, Schlage Electronics developed an RFID card for access control. In the same year, Los Alamos Scientific Laboratories conveyed their technology to the public sector, which encouraged a large number of companies to explore new uses of RFID. The new system first appeared in the early 1980s where it was used in item tracking and access control applications. In 1980s, RFID has established itself in wide range of markets including livestock, retail sales, publishing, wireless transactions etc.

How is RFID different than Barcode?

The significant differences between barcode and RFID to appreciate the benefits RFID can provide. In modern era of information technology they are both identification technologies that hold data that is accessed by some type of reader. Bar code is an optical technology whereas RFID is a radio technology.

As a radio technology, radio frequency identification technology requires no line-of-sight between the reader and

the tag to exchange data. It can automatically recognize and differentiate all the RF tags in their reading fields.

Components:

Generally, a typical RFID system has four different components:-

i. Tags: Tag is the heart of this system. It is generally attached inside a book's back cover or directly onto the CDs or DVDs. It is equipped with two elements- a programmable chip with 64 bits capacity and an antenna. There are three types of tags: "read only", "WORM" (write-once-read-many) and "read/write". In "read only" tags the identification is encoded at the time of manufacture. "WORM" tags can be programmed by the using organization. Both tags are non-rewritable. The only rewritable tags are "read/write", where tags can be chosen by most libraries and can be changed anytime.

ii. Readers: Readers, a radio frequency device which is devised to read tags to obtain the information stored in it. It is composed of three various components: a "radio frequency module", a "control unit" and an "antenna" to interrogate electronic tags via radio frequency communication. A reader powers antenna to generate radio frequency field. When a tag passes through the radio frequency field, information is stored on the chip in this tag which is described by the reader and this information sent to the server.

iii. Antenna: Antenna is the connecting link between the tag and the reader, which controls data acquisition and communication of the RFID system. The signal is created for activating the tag and read and write data to it. The function of this system is to form radio signals which can generate the tag and read and write information into the antenna.

iv. Server: Server is a most important element of modern RFID technology system. It receives information from one or more of the readers and exchange information with the circulation database.

RFID technology applications in library systems:

- i. Accessioning system
- ii. Circulation system
- iii. Shelf verification and shelf rectification
- iv. Library cards
- v. Security protection system

i. Accessioning system: At the time of accessioning the RFID tags to be used in the libraries that is “write one, read many” which can be written at the time of accessioning books with relevant book information and latter read that multiple times which doing other operations.

The tags pasted inside the book, cover page. While the tags are activated the book is kept near the RFID reader and writer and entering.

ii. Circulation system: The circulation system is based on the RFID it comprises of self checkout of the books...

This system follows—

- A. Self searching
- B. Self charging and discharging

iii. Shelf verification and shelf rectification: Shelf verification and rectification typically identifies misplaced

books in the shelves and saves a lot of time by manually inspecting and finding misplaced items. This item is generally found by scanning each shelf identifies some things that's not supposed to be there.

The reader can read one by one each electronic product code tag and transmits same information to the library software.

iv. Library cards: The library smart card that store patron information. The card carry the information that is users address, email id, phone number emergency contact number etc.

v. Security protection system: Security protection systems are normally placed at the exit doors where there exits two large flat RFID readers which read every tag that passes through them. The RFID gates at the library exit can be as wide as four feet because the tags can be read at a distance of up to two feet by each of the two parallel exit gate sensors. The gate detection system is capable of detecting unauthorized tagged items passing through it.

Role of Librarian:

Radio Frequency Identification offers an ethical impasse for librarians. The RFID technology allows for the greatly improving services of the patrons especially in the area of self study and self check out for information seekers. It permits for more and more efficient use of professional staff and decrease repetitive stress injuries for library personnel and workers. This technology introduces the threats of the hot listing and tracking library patrons. The librarians and information officers have taken to extra steps to ensure the law, and many of the same libraries are placing traceable chips on their patron's books.

Advantages:

i. Rapid charging/discharging: The required amount of time is very less in circulation operations system. The most significant advantage that information can be read from radio frequency tags much faster than barcodes.

ii. Self-check in and Self-check out: In RFID help self check in and check out to the user to find out the document or information very firstly and save the time of the users and also save the man power.

iii. High reliability: The RFID system is highly reliable. There is an interface between the exit sensors and the circulation system which can identify the items moving out of the library. If a user escape from the library and not be intercepted, with the help of detection system the library would at least know about the stolen item. If this user has a membership card including RFID tag, the library will also be able to determine not only the removed item but also about this person who removed it without properly charging them.

iv. High- speed inventorying: A typical RFID system is able to scan books on the shelves without removing them. A hand-held inventory reader can be passed through a shelf to read all of the unique identification information about the different documents. It can also identify the documents out of proper order.

v. Tag life: A comparative advantage in case of RFID tags is that it can last longer than barcodes because the technology does not require line-of-sight. Most vendors claim a minimum of 100,000 transactions of a typical RFID tag before it may need to be replaced.

vi. Avoids repetitive stress injuries: It reduces repetitive scanning of individual items during charging and discharging operation in circulation desk and hence avoids repetitive stress injuries.

vii. Flexibility and modularity: It is a flexible and modular technology in which newer products and features can be added easily.

viii. User-friendly: It is a self-check machine which is extremely user-friendly. A large number of items can be checked out at the same time by simply passing it over the scanner.

Disadvantages:

i. Cost: The cost of RFID system is typically high. It may be difficult to afford the initial cost to introduce the system in the library.

ii. Accessibility to compromise: It is possible to compromise the accessibility of documents in this system. If the material is covered with two to three layers of ordinary household foil, it may block the passing radio signal. By facing two items against one another, one tag may overlay another and cancels out the signals. This requires a good knowledge about this technology to get acquainted with this system.

iii. Chances of removal of exposed tags: RFID tags are typically affixed inside the book's back cover and are exposed for removal. This means that there would be problems when users are not aware about the role of this tag. In that case, it will be a major challenge to keep the tags intact.

iv. Exit sensor problems: In case of short-range readers, at charging and discharging system when the inventorying appears to read the tags, the performance of the exit sensors is

more problematic. This system must read tags at up to twice the distance of the other reader; otherwise the detection cannot be made properly.

Conclusion:

The Radio Frequency Identification technology is applied to the variety of activities in the today's libraries, totally automated self check in and checkout, theft detection, stock verification and it comprises many components including RFID tags or labels, security gate, library personnel station or staff station, shelf services units, shelf management, etc. This technology has changed the concept of the security level all over the world by using smart cards for an individual identification. The technology has saved money and fast gives a return on investment.

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RFID Technology Based Library Management System: Application and Limitations

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Abstract: Technology has been of profound an importance since the inception of library automation. Libraries are a fast growing application of RFID, the technology promises speed patron self-checkout, and make possible comprehensive inventory. Library RFID requires item-level tagging, thereby raising immediate patron privacy issues. The digital revolution first instituted the path where information was made accessible seamlessly over the internet and as a consequence most of the libraries went digital which had helped them share not only the digital contents but also other value added services that the patrons were really looking for. Though the digitization added a new dimension to the service there has been a need of reforming existing housekeeping operations with the help of technology and RFID is just about the right set of tools which bring an agile nature to the library operation by incorporating asset identification and tracking by electromagnetic waves. RFID based Library Management system would allow fast transaction flow for the library and will prove immediate and long term benefits to library in traceability and security.

Keyword: Radio Frequency Identification, RFID, Application, Limitations

Introduction:

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.

A library is a collection of information, sources, resources, books, and services, and the structure in which it is housed. Apart from books many libraries are now also repositories and access points for maps, prints, or other documents on various storage media such as microform, audio tapes, CDs, cassettes, videotapes, and DVDs. Libraries have materials arranged in a specified order according to a library classification system, so that items may be located quickly and collections may be browsed efficiently. Reference stacks are different which has only reference books and only for selected members. The RFID Technology will automate tasks, Accession number of books at a time, searching a particular book to check its presence in the library, locating the physical location of the book, Accounting Stock verification of the materials .The RFID based LMS facilitates the fast issuing, reissuing and returning of books with the help of RFID enabled modules. It directly provides the book information and library member information to the library management system and does not need the manual typing. It also provides monitoring and searching system. The monitoring module will continuously monitor the movement of books across the gates, so that the books taken out without prior issuing will be traced out easily and will alarm the librarians. The searching module provides the fast searching of books using RFID handheld reader. The physical location of the books can be easily located using this technology.

Objectives:

The objective of the study is to identify the application of RFID system in different areas of the library any different ways it can influence in today's library perspective. The aim

will be to find the most tangible benefits in regard to user services, stock verification and overall care of the library.

RFID Technology:

An RFID system has two units, a transponder and a reader. The transponder is attached to the object or person to identify, whereas the reader is stationary in most cases. Both units contain an antenna and a computer chip to send and receive radio waves and process the information, which is behind the signals. The reader unit is connected to a computer and power supply.

For libraries the reader can have different designs, for example two stationary antennas with a reading distance of one metre between the sensor gates, or a paper sheet size antenna on a desktop reader with an approximate 300mm reading distance. Another design is a handheld unit or wand with a 150mm reading distance. The readers differ not only in terms of reading distance and size, but also in reading speed and the amount of tags which can be read simultaneously.

Basically, modern RFID systems have the following capabilities

- Signals are sent through non-metal materials. There is no line of sight necessary as with a barcode
- Many transponders can be read at the same time e.g. a stack of books.
- Some specific information can be read from the transponder and also be programmed eg the checked in or checked out status.

Features of RFID Technology:

The following features of RFID technology are as follows:

- To remove manual book keeping of records.

- Traceability of books and library members as they move.
- Improved utilization of resources like manpower, infrastructure etc.
- Less time consumption as line of sight and manual interaction are not needed for RFID-tag reading.
- To minimize the manual errors.
- To provide the long lasting labels.
- To provide fast searching of books.

Advantages:

Most of the libraries around the world are using RFID. Some of the advantages of RFID in libraries include.

- Simplified self charging and discharging.
- Reduction in queue at circulation desk counter.
- More hours of circulation.
- Saving time of the library staff while issue and return of document
- Allow library staff to provide other users' centric service
- Reduction of staff at circulation desk.
- Increased issue and return of library documents.
- Security of library collection.
- Tags can have read and write memory capability, while barcodes do not have the memory.
- An RFID tag can store large amounts of data additionally to a unique identifier.
- Many tags can be read simultaneously, RFID tags can be combined with sensors.
- Automatic reading at several places reduces time lags and inaccuracies in an inventory,
- Tags can locally store additional information; such distributed data storage may increase fault tolerance of the entire system,

- Reduces inventory control and provisioning costs,
- Reduces warranty claim processing costs.

Application:

An RFID system for library normally consists of RFID tags. The RFID tag can be applied in different areas of the library:

- Circulation section
- Shelf Management section
- Book drop section
- Security gates

Circulation section:

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.

Shelf Management section:

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, Shelf Management system makes it easier for the library staff to locate and identify the documents on the shelves.

Drop box section:

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 labour-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:

In the library Security gate is an anti-theft system. It plays a crucial role in detecting unborrowed 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.

Limitations:

Some limitations for implementing the RFID system are below:

Standardization:

Choose of appropriate standards tag is necessary for the amount of information stored in the tag. Currently, two major groups of standards are competing worldwide: one is EPC

created by the Auto-ID Centre and receiving the support of UCC (Uniform Code Council) and EAN (European Article Numbering), the other is the ISO-specified (International Standards Organization) set of standards.

Cost:

For implementing the RFID system in the libraries the cost is very high, Cost depends on their type. Cost is an important reason and that why the libraries cannot able to adopting this technology.

Collision:

Attempting to read several tags at a time may result in signal collision and ultimately to data loss. To prevent this, anti-collision algorithms (most of them are patented or patent pending) can be applied at an extra cost. The development of these methods, aimed at reducing overall read time and maximizing the number of tags simultaneously read, still goes on.

Quick technology obsolescence logy:

One of the common concerns of implementing RFID is today the rapid obsolescence of the technology. Technology is continuously evolving and new protocol standards, faster and more fault-tolerant readers quickly outdate their predecessors.

Security and privacy Issues:

Depending on the field of application it may become necessary to prevent unauthorised persons from reading or writing data stored on or transmitted from tags. To this end, it must be ensured at all interfaces where data could be intercepted or transmitted, such as tag to reader and reader to host communication.

Privacy issues concerning the possibly hidden use of RFID tags has been identified as one of the problems by many experts and from associations are arises.

Possible virus attacks:

RFID software if used together with a backend database it effected buffer overflow, false end of row characters and comments can lead to unverified data being interpreted as SQL commands which can perform malicious operations on the database contents or prompt the system to copy the infected data to further tags.

RFID Tag Selection:

- a. The frequency range.
- b. The memory size of the tags.
- c. Range performance.
- d. Battery life of the tags
- e. Cost of maintenance.
- f. Environmental implications.

Conclusion:

RFID in the library speeds up book borrowing, monitoring, books searching processes, theft detection and thus frees staff to do more user-service tasks. But the performance varies with respect to the vendors of RFID readers and tags. The efficient utilization of the technology also depends upon the information to be written in tag. Though RFID is still a bit expensive for smaller libraries. The technology has the potential to grow further where the tags can connect to the

internet by themselves and become a live node in the internet. The software can then exact the metadata by directly enquiring the book node and there would be no need for the reader. User can self issue their books by this software. This seems not to be far away in the era of internet of everything where everything is supposedly to be tracked for a better management of resources.

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Library security system with RFID

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Abstract: Time is a key factor for every service sector. Information should reach to the user in proper time. It is also played a vital role as a catalyst for library automation management system. This paper provide a clear view about how the document arrangement, circulation work can be managed in a stipulated period with the help of this system. The paper covers the concept of RFID technology and different components of RFID technology. The advantages and disadvantages of this technology are also discussed in this paper.

Keywords: RFID, advantages and disadvantages of RFID technology, use of RFID in college library.

Introduction: Radio frequency identification (RFID) technology is a combination of radio-frequency technology and microchip technology. It is an advanced technology used in highway toll payments, packaging, retail industries and libraries, etc. RFID is a technology used radio waves to automatically identify items.

RFID concept: A RFID system consists of RFID tags, self-check-out station, self-return station, a staff work station, a tagging station, security gate, a shelf scanner, and sorting systems.

RFID Tag: This is a tag like a paper thin and flexible which is placed on the inside cover of each book of a library. It

consists of an antenna and a tiny chip where bibliographic information related to document stores.

Self-check-out station: This is a computer with a RFID reader and software for patron identification, document identification and circulation work.

Self-return Station: It is a check-out station which issue return slip through which user can return their books with their own.

Security gate: This system used as theft detection gate. Security gate is an anti-theft system used by libraries. RFID tag can identify the document and also protect from unauthorised check-out of items.

Sorting system: This system also can help in automated locate the document in shelves.

Staff-work Station: Charging and discharging documents, programming of new documents and sorting of documents works have done in this part of this system.

Technology of RFID and implementation of RFID: The RFID is a flexible, paper-thin RFID tag. It can be placed inside the cover page of a document. Bibliographic data related to each document is encrypted here which is accessible to the library automation software. When a patron holds a document for charging-discharging, the reader from the tag decoding the data related to the document and transmits the data into the management system and document is charged automatically without the assistance of the library staff. The RFID technology is a combination of transmitter and receiver which works through the radio waves transmitted between reader and antenna. RFID reader receives wave information from RFID tags and passes to middleware software which

manages the flow of information between the readers and the server. A server is configured with an RFID system programme. The server communicates the information from reader and checks the data with the database and sent the data into circulation database of the library management system.

Advantage of RFID technology: This technology provides advantages in automated library management systems are the following -

- provides security of library collection;
- automated collection management;
- libraries to satisfy the increasing demands of the users;
- better technology that can improve the circulation management;
- inventory and security of library collections;
- issuing multiple books at a time;
- simplified self-charging/ discharging;
- reduce the queue in front of circulation desk;
- save time of the library staff;
- reduces the amount of time required to perform circulation operations;
- tracking of materials throughout the library;
- users can do self-charging/discharging with their own;

- patron card contained an RFID tag has the ability to determine who removed the items without properly charging them;
- ability to scan books on the shelves without removing them;
- can identify items which are out of proper order;
- reduces the amount of staff time required to ready materials for re-shelving;
- has long durability.

Disadvantage of RFID technology: This technology provides disadvantages in automated library management systems are the following -

- initial implementation cost of this system is very high and it's a major disadvantage of this system;
- possible to compromise with this system by wrapping the protected material in two to three layers of ordinary household foil to block the radio signal;
- possible to compromise an RFID system if two items against one another is placed so that one tag overlays another;
- typically affixed to the inside back cover and are exposed for removal;
- cannot find any evidence of removal of this tag in the libraries;

- can insert the RFID tags in the spines of a book but not in thin books, but another problem is that all RFID tags are not so flexible enough;
- problematic for a small library when circulation charge and discharge and inventorying took place in a small periphery;
- must read tags at up to twice the distance of the other readers;
- can only be read from a distance of two feet or less because the tags reflect a signal that comes from a reader or sensor;
- Impossible for someone to read tags from the street or an office building hallway.

RFID system in college library perspective: The RFID system contain a paper-thin RFID tags, where bibliographic information related to each documents is placed. Library automation software read that information through the reader. In circulation desk where patrons bring the documents, reader reads the information from the tag and passes it to the library management software and document automatically issued. If it is not issued properly of not according to the antenna alert the system automatically. RFID system can also detect the library collection which is useful for library stock verification.

Conclusion: Library is a place where documents containing information is stored for disseminate according to the need of users for current use and also for the future use. Librarians should provide proper service to its users with best way so that it saves the time of its user and proper security for the documents from its unauthorised use. RFID system provides a very effective solution for the library activity with a minimum

staff, minimum time and minimum effort. Though its high installation cost is a factor for library budget allocation but in long term it will provide a very effective tool for library automation management system. It provides an automated charging and discharging system in a minimum time and library staff shortage problem can solve through this technology easily.

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Implications of RFID Technology in Libraries: Merits and Demerits

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Abstract: *With the emergence of technological innovations, libraries are trying to reinvent and repurpose its functioning so as to meet the growing need of the present day users' community. Circulation, one of the key processes to lend out documents to the users, is one such area that is being given special attention by many libraries. Gone were the days where manual circulation processes were in practice and the tedious job involves much of manpower, time and energy. Now-a-days most the libraries have introduced barcode system. However, the introduction of technologies have also made use of bar coding system somewhat outdated in terms of users service is concerned. RFID has thus made its entry to the library and expedited not only the process of circulation but the entire gamut of library activities are streamlined with the help of this new technology. This paper focuses the component, technical features, advantages and disadvantages entailing the application RFID technology in libraries.*

Keyword: *RFID, Library components of RFID, Advantages and Disadvantages and Application of RFID in Libraries.*

Introduction:

With the technological innovations, the library has started embracing tools and techniques to repurpose its service provision. Prompt service received prominence among the users community. Gone were the days where library staff was

engaged in shelving books according to call number and searching the shelves to find a misplaced book. To reduce the burden of circulation staff and to expedite the document/member identification bar code system has already been introduced in many libraries. However, technology demands that a library should move a step forward to streamline its service and improve its collection management with a system more powerful and of course, in tune with the modern society. RFID (Radio Frequency Identification) system has emerged as a fitting solution to it.

Though RFID technology has already made a sharp inroad in libraries of western countries, libraries in India are still far away to adopt this technology because of a lot of factors that would be discussed later. A few libraries in India, and particularly in West Bengal that have implemented RFID, partly or fully, have been able to better manage their physical resources and provide enhanced services to their users. Based on the benefits RFID could provide and the challenges to incorporate RFID in a library, the current study tried to present an overview of its implementation. Here, the paper focuses the component, technical features, advantages and disadvantages entailing the application RFID technology in libraries.

RFID Technology for libraries:

RFID (Radio Frequency Identification) is the latest technology to be used in library theft detection systems. Unlike EM (Electromechanical) and RF (Radio Frequency) systems, which have been used in libraries for decades, RFID-based system moves beyond security to becoming tracking systems that combines security with more efficient tracking of materials throughout the library, including easier and faster charge and discharge, inventorying and materials handlings.

It is a combination of Radio frequency based and microchip based technology. At first the microchip is fitted secretly inside the spine of a reading material. Microchips contain vital bibliographical data, including a unique accession number about the materials. While checking-in and checking-out, the item is scanned for the chip and the details stored in that chip about the item are recorded in the circulation database through library management software.



Library RFID Management System

The advantage of the process is that the material can be used for self-check-in/check-out without the help of library staff. When the book with RFID tag is passed through the exit gate, the sensor at the gate will detect the RFID antenna and alarm for anti-theft detection, if there be any. Hence the process guarantees that the materials are going from outside the library is properly checked out.

When users return those materials, then they easily drop it into the book drop box. After checking-in materials it can be placed at the right shelf with the help of RFID sensors. It is the workflow of RFID system in libraries.

Library RFID Components:-

In a library, commonly the RFID package for library consists of some components. These are:

- **RFID tags:** “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”. [2][Singh,Mahajan,2014]

- **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”. [2][Singh,Mahajan,2014]

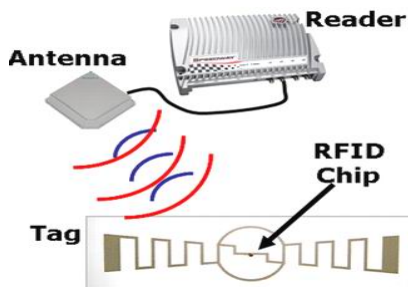
- **Self-return book drop with an automatic check-in feature:** “The book drop system consists of book drop with screen and receipt printer. It allows patrons to automatically return the library documents. A reader installed in a book drop allows reading of the RFID tags as patron drops off the documents. It eliminates the labour-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”. [2][Singh,Mahajan,2014]

- **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”. [2][Singh,Mahajan,2014]

- **Set of security gates:** “Security gate/ EAS (Electronic Article Surveillance) is an anti-theft system used by libraries. It plays a crucial role in detecting unborrowed 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”.
[2][Singh,Mahajan,2014]

- **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”.
[2][Singh,Mahajan,2014]

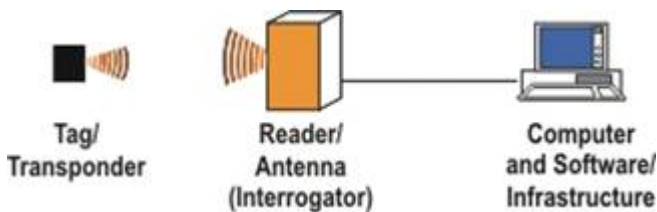
- **Automated sorting station:** “Automated sorting station take books from the return station, checks them in, sorts and distributes the books to multiple bins or areas for re-shelving. Books are re-shelved by determining their shelving location in less time with less staff work. Libraries with large circulation eliminate 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 return(s) to the sorter”.
[2][Singh,Mahajan,2014]



The components of the tag have particular features. Self-checkout station allows patrons to borrow books without assistance from the library staff. The staff checkout station is used when patrons prefer staff assistance. The book drop allows returned books to be processed instantly by updating the database the moment the items pass through the chute. The shelving station speeds the process of sorting the returned books for re-shelving. Also, the shelf scanner helps library staff to take inventory and find wrongly shelved books without pulling of the books from the stacks, as it detects the wrongly placed books automatically.

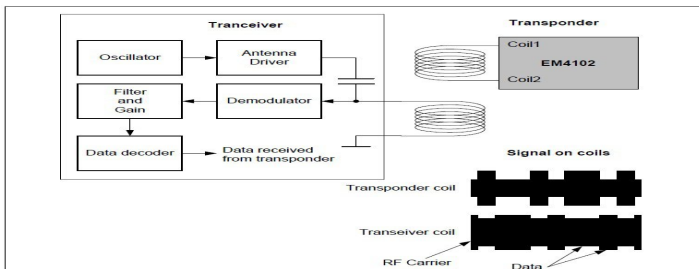
How RFID works:-

RFID uses a wireless radio system to transfer data from a tag attached to an object, such as a book, DVD, CD or magazine, for the purposes of identification and tracking. The tag contains electronically stored information on a microchip which is read by a RFID reader/scanner. The communication process between the reader and the tag is by wireless. The major differences between the different types of waves are the distances covered by one cycle of the wave and the number of waves that pass a certain point during a set time period. The wavelength is the distance covered by one cycle of a wave.

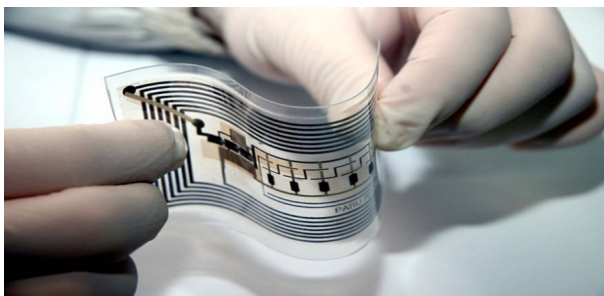


The RFID Reader Module generates and radiates RF Carrier Signals of a particular frequency (say 125 KHz) through its coils. When a RFID Tag which is designed to operate at that frequency (125 KHz) is brought in to this field,

it will energize from it. These tags have internal Rectifier and Filter to convert electromagnetic signals from the RFID Reader Module to DC Power required for its operation. It also gets its master clock from these RF waves. By changing the modulation current, tag will send back the information contained in the factory programmed memory array. [6]



The tag does not need to be within line of sight of the RFID reader. It can be hidden and still be read up to three meters away. RFID tags can be read hundreds at a time, unlike a barcode which can only be read one at a time. Information about the item is encoded on the tag's microchip, which can be read by the RFID reader for circulation, stock take, and collection management purposes. The tag may include the book's title or format of the item, as well as other information.



The information stored on the tag's microchip links to the Integrated Library System (ILS) or Library Management System (LMS). The RFID reader scans the tag and connects the item's details with the information stored in the ILS. RFID tags also include a built-in security feature, which can be used if a library has security gates installed. The security feature is activated or deactivated at the point of issue or return, meaning that a separate magnetic strip is not required in each item. ^[7]

Benefit of RFID use in Library:

According to Pandey and Mahajan the benefits of RFID are as follows: ^[1] [Pandey, Mahajan]

- RFID improve the Library circulation operations.
- Reducing non value added work processes.
- Increase staff productivity.
- Develop customer service.
- Assist inventory check.
- Provide automatic books identification.
- Easy to use books shelving.
- Assist traceability of book partition.
- Automated books return process.
- Allow better accuracy in book collection management.
- More than one item can be checked out or checked in at the same time.
- Ability to locate specific items.

Advantages of RFID in Libraries:

- **Reduction of staff duties:** Use of RFID technology in a library can decrease the manpower in circulation section. Patron check-in/out stations can also free up staff from these

duties. It also reduces the time. By reducing the staff duties in these areas, staff may be used more efficiently in other areas including increased face to face service and increased the number of community programme.

- **Rapid charging/discharging:** “The use of RFID reduces the amount of time to perform circulation operations. RFID tags can be read much faster than barcode. While initially unreliable, the anti-collision algorithm that allows an entire stack to be charged or discharged now appears to be working well”^[5][\[http://www.rfid-library.com/\]](http://www.rfid-library.com/)

- **Simplified patron self-charging/discharging:** “For patrons using self-charging, there is a marked improvement because they do not have to carefully place materials within a designated template and they can charge several items at the same time. Patron self discharging shifts that work from staff to patrons. Staff is relieved further when RFID Readers are installed in book drops”^[4][\[http://www.rfid-library.com/\]](http://www.rfid-library.com/)

- **High reliability:** “The readers are highly reliable. RFID library system required 100% detection rate using RFID tags. RFID systems is properly tuned, there is no false alarm of the prior systems. The systems encode the circulation status on the RFID tags. This is done by designating a bit and tuning it off at time of check-out and on at time of check-in. If the material that has not been properly check-out at the earlier, than the immediate alarm is triggered”^[4][\[http://www.rfid-library.com/\]](http://www.rfid-library.com/)

- **High speed inventory:** “A unique advantage of RFID systems is their ability to scan books on the shelves without tipping them and removing them out. A hand held inventory can be effective that reader use it rapidly across a shelf of books to read all unique identification information. Using wireless technology, it is possible not only to update the inventory, but also to identify items which are out of proper order”^[4][\[http://www.rfid-library.com/\]](http://www.rfid-library.com/)

- **Long tag life:** “Finally, RFID tags last longer than barcodes because nothing comes into contact with them. Most RFID vendors claim a minimum of 100,000 transactions before a tag may need to be replaced”.^[5] [<http://www.rfid-library.com/>]

Disadvantage of RFID in libraries:

- **High cost:** The major disadvantage of RFID system is its cost. The item-wise approximate cost for the installation of RFID systems is cited below:

Item	Cost(approx.)
Security gate	Rs. 6,00,000
Staff work station	Rs. 2,50,000
Installation and commission of RFID system	Rs. 80,000
Application software	Rs. 2,50,000
Server	Rs. 5,00,000
Book drop box	Rs. 4,50,000
Portable RFID reader	Rs. 2,50,000
Tag	Rs. 35 per item

However, most of the libraries have not yet applied this technology due to lack of funds.

- **Remove of tags:** RFID tags are generally fixed inside the spine of the item, which are not usually visible to the patron and are therefore not exposed for removal. However, if the tag is not carefully placed and remain visible then the tag may risk of being exposed to be removed by the user.

- **Less job opportunities:** RFID save the man power of library operations; therefore less staff require into the library. It decreases job opportunities in the library.

- **Exit sensor problems:** “While the short-range readers used for circulation charge and discharge and inventorying may read the tags as much as 100 percent of the time, the performance of the exit sensors is more problematic. They must read tags at up to twice the distance of other readers. The performance of exit sensors is better when the antenna of the tag is larger or when the exit lanes are 36 to 42 inches wide” [2][Singh,Mahajan,2014]

- **Standards:** “There have no standard of RFID in World Wide. Only set frequency bands and some guidelines are available with regards to RFID. Operational standards and regulations are different for each country” [2][Singh,Mahajan,2014]

Conclusion:

The unique advantage of application of RFID technology is that it minimizes the time and labour involves in circulation. It has many other features and functions that help to expedite library’s several operations. In spite of its flexibility, many libraries cannot afford this technology. One of the major causes is cost. In India many libraries do not have enough fund and infrastructure to adopt new technology.

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Application of Radio Frequency Identification (RFID) in libraries: an overview

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Abstract: Mainly libraries are benefited by the application of RFID (quintessential pervasive computing technology) to frugal and quick accessing of books (issuing and reissuing), and eliminating human errors purpose. It may also save some money due to integration of circulation and security with a single vendor in a single system. This paper highlights the features and benefits of RFID technology and present scenario of RFID application in library sector.

Keywords: RFID, Automation, Barcode, RFID tags, RFID reader, RFID antenna, Library security.

Introduction:

Due to the advent of hi -tech, the world has become a small village. Bar code technology is now replaced by RFID technology. Earlier library was just consider as a collection of books, periodicals, journals and other different types of resources, now it has changing its role due to emergence of modern technologies. From ‘traditional type’ libraries to new version as ‘digital library’, ‘virtual library’, ‘online library’ are common in changing library phenomenon . With other

upliftment of digital implementation in house-keeping functions of library, RFID system replaces barcode system to fulfill the general aim of library to provide maximum to its readers for optimum utilization of available resources. This technology is applied for ensuring the quality of providing service and for improving efficiency of operations. RFID based library management system would allow fast transaction flow for the library and will prove immediate and long term benefits in traceability and security.

Although RFID can be used as anti-theft system in library but time frugal, quick accessing of books, eliminating manual errors are also main benefits from this technological use. The library may save some money due to the integration of circulation and security into a single system. The library uses RFID technology because it is fastest, easiest, and most efficiently locates track and manage library materials. Annual stock taking/ verification is one of the laborious works of libraries. In this respect, library can easily work on it, by using RFID. Rapid checking of book is shelved in the correct area possible by using RFID. Check-in/out of items, searching for specific item using a scanner is easily possible. RFID tags can be used for status control as well as security and safety of the document.

In RFID technology, 'subject' means a consumer, customer or any other such individual that comes in contact with a product that has attached to it or contains an RFID tag. 'RFID users' mean the operator such as library. 'Premises' means the library where this technique is used and 'content' means the freely given specific and formed indications of a RFID

subjects wish to have his/her personal information processed by the means of RFID technologies. (Anuragi, 2014)

Initial Stage:

Barcode made inventory tracking easier but they have their disadvantages. At the starting point each barcode need to be read individually by the reader. If an entire stock of information center needed to be check into a computer it would needed several hours of work. One of the disadvantages of barcode is that it just a tag with data printed on it and data are not updated. The RFID system works using 'smart' tags with inbuilt silicon chips that store data. A reader which scan from those tags and the infrastructure to store and analyses the data (Mulla. Chandrasekhara, 2006).

RFID defines as the quintessential pervasive computing technology in the field of Library and Information Science that use radio waves to automatically identify individual items. In the World War II for the identification of their aircrafts, the British Government was the first to pioneer of this technology. But from the year 1960s US government thoroughly follow and using RFID to tag and monitor nuclear and other hazardous materials. In the year of 1972 this special technology used by public of Los Alamos scientific laboratories, encourage a number of companies to explore new uses of RFID tags with rewritable memory. RFID in India was introduced in the 1940s for defense application and first used in commercial purpose in the year of 1980 for cattle tracking applications. Farmington Community Library in Michigan was the first public institution and Rockefeller University in New York was the first academic library

introduces RFID. Today RFID is used for automatic toll collection, access and control security, tracking objects and human in shops, libraries, hospitals, etc.

Basic System Components:

There are some basic components of RFID those are tags, antenna, reader, middle wave.

- Tags consists of a microchip attached to an antenna and is placed in the object to be located. Various types of tags are used like passive, active. It is basically a paper thin, flexible and approximately 2" x 2" in size which allows it to place inconspicuously on the inside lower of each book in a library's collection. RFID system tags are designed to operate at a number of designed frequencies, depending on the application requirements and local radio frequency regulations.
- Reader communicates with the tags through radio waves, staff work stations, hand held readers, self-charging stations, long range exit reader systems.
- It is available in various shapes and sizes to suit respective application within a library, are often integrated into one enclosure for specific library purpose.
- Middle wave converts the data captured by the reader into a format that is perceivable by the application software.

Equipment for action of RFID:

- Antenna



- Staff and conversion station



- RFID Label Printer



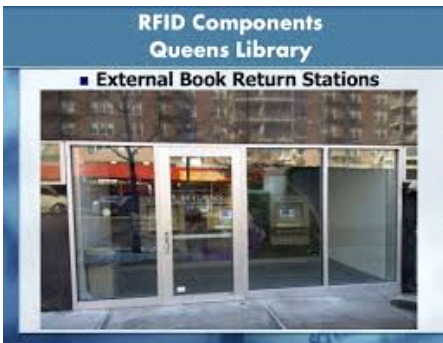
- Self-check-in/check-out station



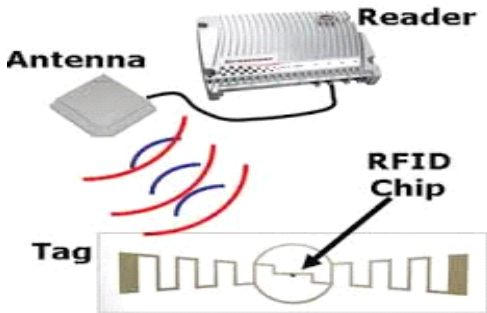
- Hand-held Reader



- External Book Return



- Server on which the software that interfaces with integrated library software is loaded



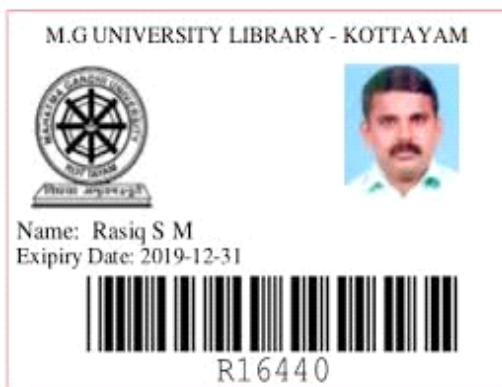
- RFID tags or transponder that are electronically with unique information



- Application software
- Exit sensors



- Patron cards



- Portable scanner



RFID Integration Module:

RFID integration with LMS three modules namely Transaction module, Monitoring module and Searching modules are there. The RFID interface is provided in the transaction forms (like issue, reissue, and return, fine status forms). In this case, manual intervention becomes minimal. The monitoring system will be installed at the entrance of the library to monitor the incoming and outgoing bags continuously and the system alarms the librarians, whenever there is a movement at the gates without prior issue. The books will be searched with the help of RFID readers using any parameter like book number, name of the book, name of the author or publisher's name. Therefore, the main benefit of searching module is that books can be checked quickly using a handheld reader, reducing the stock taking time from weeks to some hour of a day. By using all for those modules, manual errors are also decreased. Library may also save some amount of money due to the integration of circulation and security with a single vendor and a single system. (Dhanalakshmi, Mamata. M, 2009)

Application of RFID throughout the World and in India:

Singapore is probably first nation in the world to have all its public libraries used RFID technology for the circulation and management of library items. This enables them to do a stock take of 100000 items in just four hours. Patrons can issue and return books at any public library. At present, IIM (Shillong, Indore, Lucknow), BCL (Delhi), IGCAR (Kalapakkam), Bank of Baroda, IMSc (Chennai), IIT(Delhi, Roorkee, Madras, Chennai, Kharagpur), NASSDOC (New Delhi), NCL (Pune), NIT (Surat, Rourkela), Parliament library (New Delhi), Panjab University (Chandigarh), University of Pune (Pune), NCBC (Bangalore), Tata Memorial Library, IISc (Bangalore), Biju Patnaik Central

Library, Dayanand Sagar College of Engineering (Bangalore) implemented RFID in their library house-keeping activities.

Role of Librarian:

RFID technology improves library workflow to give great services especially for patrons in the area of self-check-out. As this technology requires more efficient professional staff librarian should look after this area to continue library work smoothly. On the other hand librarian should technically sound because implementation of RFID technology fastens the library works. Initial cost is too heavy of this technology, but proper implementation makes library services rich.

Guidelines for library use RFID:

As libraries are implementing RFID systems, it is important to develop best practices guidelines to utilize the technology in best way and to keep the privacy concern away. The following can demand one of the best practices guidelines for library RFID use:

- The library should be open about its use of RFID technology including providing publicly available documents stating the rational for using RFID, objectives of its use and associated policies and procedure and who to contact with questions.
- Signs should be pasted at all facilities using RFID. The signs should inform the public that RFID technology is in use, the types of usage and a statement of protection of privacy and how this technology differs from other information collection methods.

- Only authorized personnel should have access to the RFID system.
- No personal information should be stored on the RFID tag.
- Information describing the tagged item should be encrypted on the tag even if the data is limited to a serial number.
- No static information should be contained on the tag that can be read by unauthorized readers.
- All communication between tag and reader should be encrypted via a unique encryption key.
- All RFID readers in the library should be clearly marked.
- ISO 18000 mode-2 tags should be used rather than ISO 15693.

Conclusion:

RFID technology implementation means not only theft detection, because generally users used the library documents for reading and research purposes. RFID is more effective, convenient, cost effective technology in library maintenance activities. It gradually replaces the traditional bar-code system in library service. It enhances the work flow, serves users in a better way, and makes automated library works and many more. But on the other hand the cost of the technology is constrained for implementation. Librarian, library staff as well as the users should know the proper usage of this technology. If the volumes of book of Library are huge and financial ability is high, then libraries can easily adopted RFID and enhanced the services and provided better services to their

users. Overall the benefit of using RFID technology is positively emerged in library.

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An Architectural Overview of RFID based Library Information System

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Abstract: RFID is basically a radio-frequency identification technology that helps in automatic identification and tracking of objects in terms of data transfer by wireless radio communication. It started mainly as a military tool for spying, and evolved to serve many fields like automotive, logistics, retail, healthcare and libraries. RFID technology is manifold advantageous over barcode and can provide many additional features. This technology is still relatively new for library applications and needs lots of study and research in this direction as it has the potential to revolutionize many aspects of library service delivery. The present study gives an architectural overview of RFID based Library Information System (RLIS). In this paper, the architectural framework along with the functionalities of its components are discussed.

Keywords: RFID implementation, library information system, architectural framework, design and development

I. Introduction

RFID is basically a radio-frequency identification technology that helps in automatic identification and tracking of objects in terms of data transfer by wireless radio communication. The use of RFID tags is already quite widespread in some elements of the production of cars and electronic goods, but it could also potentially applied in areas

such as healthcare, logistics, waste management, manufacturing, security, postal tracking, road toll management etc [1] .

The popularization of this technology has become beneficial in many ways like increased visibility, security, efficiency, accuracy and most importantly the resource optimization. In the recent few years, it is receiving more and more attention in the field of library science [1].

RFID can bring significant revolution to various aspects of library services. It can easily enhance the functionality of the existing barcode system by providing additional features such as automation in the book issue-return process and thus eliminating the chances of theft. It also reduces the probability of book loss and helps in locating the books on the shelves quickly. Time and patience required for stock verification can be reduced many folds to a simple walk down. The customer-friendly self-service that is combination of features makes possible is at the heart of the attraction of RFID in most of the libraries [1].

Our paper is aimed to discuss the design and development of an RFID based Library Information System (RLIS) comprehensively. The following section deals with the brief introduction of RFID technology and its history. The architectural framework along with the functionalities of its components are introduced in Section III and IV respectively. Finally, Section V presents the conclusion.

II. Overview of RFID Technology and its History

Radio Frequency Identification is basically a wireless sensor technology which can detect electromagnetic signals for tracking individuals and objects to collect information about their behavior. The RFID system consists of three

components: a transponder or a tag, an interrogator and a controller (Figure 1).

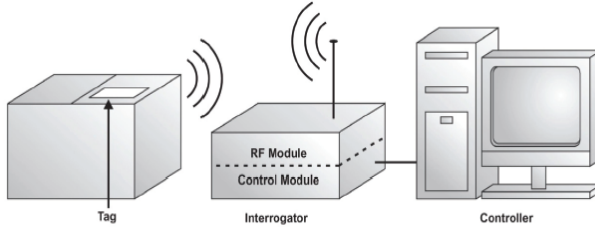


Figure 1. A typical RFID system [3]

The communication medium between the tag and interrogator is radio waves. As soon as a tagged enters into the read zone i.e. the area of coverage of the interrogator, it signals the tag and collects its stored data.

According to the frequency, RFID tags can be classified into low frequency (LF), high frequency (HF), ultrahigh frequency (UHF), and microwave. In case of libraries, the HF passive tags are widely used in various ways such as access control, tracking of books etc. There is also the trend of using of UHF passive tags in some libraries for quicker multiple-item detection, as well as faster inventory checking, as it is advantages over the previous one in reading speed and range [2].

The history of RFID is surprisingly contentious, although there is a general agreement that the basic technology dates back to at least the Second World War. The first use of RFID in commercial sector can be traced back in 1960's in the development of Electronic Article Surveillance (EAS) equipment by the companies like Sensormatic, Checkpoint etc. [4]. It was used to electronic toll management in a wide scale in USA in 1990's. Subsequently, it was

announced by the U.S. Defense department that the RFID technology has the potential to revolutionize "In-Transit-Visibility" and the "Total Asset Visibility" in supply chains, many technology vendors were encouraged to push forward RFID development for commercial purposes [5]. Very soon, it was identified that it also has the potentiality it replace the existing barcode system and the various industrial companies planned its inclusion for improving their business processes and cost saving potentials.

III. Architectural Framework of the RLIS

This section of the article deals with the architectural framework of the RLIS. It comprises five cross-sectional layers as demonstrated in Figure 2. The working principles of each layer are described in the following subsections:-

A. Physical Layer

This layer comprises of UHF RFID tags attached with in different library materials. The high frequency (HF) tags are generally used in libraries but the Ultra-high frequency (UHF) passive tags are capable of communicating with RFID readers through antennas in long distances. The advantage of UHF RFID tags is that it can store a unique identification number which specifies either the book tracking number, library user identification number or shelf identification number and also can contain other bibliographic details such as publisher name, ISBN number etc.

B. Data Capturing Front End

It is the layer of RFID readers. The function of this layer is to provide the accurate real-time data for the system. Handheld terminals as well as readers equipped with fixed antennas are used to communicate with UHF tags. Some

antennas are fixed in entrance of the library, in service desk and in check-in/check-out desks. Basically, a handheld reader is used to scan the tags attached in books and thus it can quickly count the number of books in a particular shelf.

C. Data Capturing Layer

This is also a middleware system that refers broadly to software or devices that connect RFID readers and the data they collect, to enterprise information systems. RFID middleware helps making sense of RFID tag reads, applies filtering, formatting and logic to tag data captured by a reader, and provides this processed data to back-end applications (Burnell, 2008). RFID middleware serves in managing the flow of data between tag readers and enterprise applications, and is responsible for the quality, and therefore usability of the information.

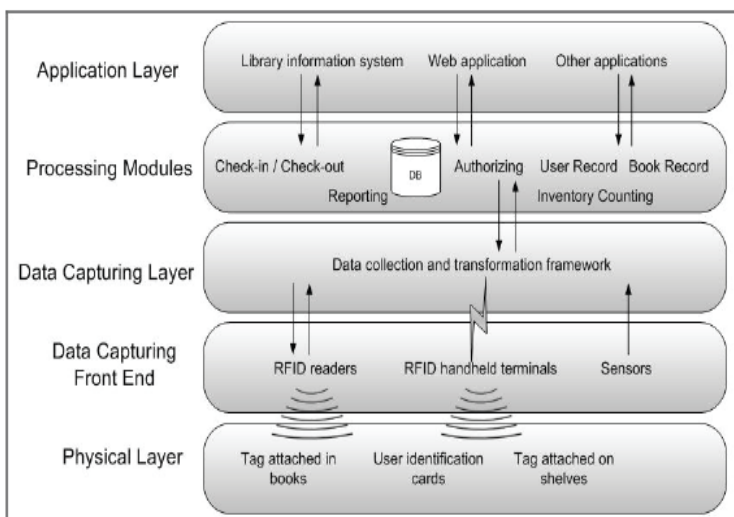


Figure 2. Architectural framework of the RLIS [6]

D. Processing Modules

The processing modules helps in storing the RFID data in a relational database system, it facilitates the accession of the data using Structured Query Language (SQL) and it's processing. The modules are more or less as Check-in/Check-out, Reporting, Authorizing, Inventory Counting, User Record and Book Record. The modules are also capable of interacting with the middleware system.

E. Application Layer

The chief function of this layer is to coordinate and integrate the processing modules and manage data flows within the new library information management system and the existing system applications. The design of this layer is done such a way so that it can provide a user-friendly graphical interfaces for the library staff and also enables them to use other enterprise and web applications for performing their functions effectively [6].

IV. Design and System Analysis of RLIS

This section of this paper is aimed to discuss the current operations libraries that can be done much easily and quickly with RFID. The following system overview deals with the identification of its subsystems along with its control and communication. In addition, the basic functionalities of the components together with the communication interfaces between them are described stepwise. Overall, it is the mapping between the system and business processes.

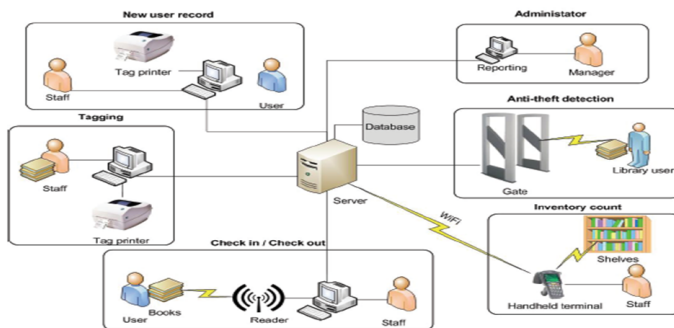


Figure 3. Overview of the RLIS [3]

The general overview of the system is shown in Figure 3. This reveals that an RLIS system consists of six main subsystems: New User Record, Tagging, Check-in/Check-out, Anti-theft Detection, Inventory Control and Administration. All the subsystems are linked up to the main server [7]. The chief subsystems are as below:

A. New User Record. It is required for the library users to carry an RFID attached member identification card. The concerned subsystem is for new user registration that enables the library staffs to print out new UHF tags. This subsystem contains a PC, an RFID reader with antenna and an RFID printer placed at the information desk.

B. Tagging. The chief function of this sub-system is to tag all the library collection with RFID labels. It helps staff to simplify tagging process. This subsystem contains a PC and an RFID printer at the service desk.

C. Check-in/Check-out. The basic function of this sub-system is to enable staffs to perform check-in/check-out operations. This subsystem contains a reader with fixed antenna at the service desk for this operation.

D. Anti-theft Detection. The main function of this sub-system is theft detection. To fulfill this objective, a theft

detection pedestal is installed at the entrance/exit gate of the library. Additional functionalities of this subsystem includes the detection of the person who enters the library without a membership card.

E. *Inventory Control.* This sub-system is responsible for taking stock at every period, which is an important function in the libraries with large collections. RFID also enables staff to perform stock verification quickly by scanning hundreds of documents lying on shelves without even a single book being pulled out.

F. *Administration.* This final subsystem helps the concerned manager to maintain check-in/check-out record, stock verification and tagging process information. It also facilitates the generation of business intelligence reports [7].

V. Conclusion

Since, automation processes are incorporated in the library functions, libraries have been seeking technological aids to improve their customer services. In this context, it can be said that RFID has had a rapid impact on the library world. Automatic identification technology offering potentially a lot more than barcode commonly used in libraries. The major advantage of it over the other technologies used in libraries is usually seen in its ability to combine the barcode and the security tag. In this paper, RFID based library information management system is discussed along with the architectural framework and system analysis of major components.

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Implementation of RFID Technology in West Bengal State Central Library: A Case Study

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Abstract: Radio Frequency Identification is a technology for the wireless transmissions of data via radio frequency. It is an innovative information technology that allows organizations the ability to attain massive amount of data related to products, assemblies, equipments, supplies, inventory, customer services and machinery. it provides a unique identification code that can be read by a scanning device. RFID uses radio waves to communicate with readers also. It plays a vital role for tracking of library materials, person's etc. in this paper we discuss about the implementation of RFID technology in West Bengal State Central Library. This paper also identifies the benefits of the implementation of this technology.

Keywords: RFID Technology in West Bengal, Library Automation

Introduction:

RFID Technology has been available more than fifty years. In 1945, Leon Theremin invented a spying tool for the Soviet Union which retransmitted incident radio waves with the audio information. This device was a covert listening device, not an identification tag, considered to be a predecessor of RFID. The first RFID application was the "Identification Friend or Foe" system (IFF) and it was used by the British in the Second World War. The first commercial RFID application was the "Electronic Article Surveillance" It was

developed in seventies as a theft prevention system. As we approach the end of first decade of the 21st Century research pertaining to Radio Frequency Identification (RFID) has increased. Libraries have implemented RFID to make improvements in their materials management, distribution and transportation process. In Kolkata, State Central Library is the first public library which has implemented this latest technology. In the last year RFID technology was implemented in this library. According to our survey report, the benefits received by the State Central Library due to the implementation of RFID Technology are stated in this paper.

Objectives:

The objectives of our present study are-

- To depict a clear picture of implementation of RFID technology in the West Bengal State Central Library
- To present the benefits of this implementation

Methodology:

We surveyed West Bengal State Central Library, Kankurgachi with questionnaires consisted with two sections: i) General Information, Present Status and personal information are included here and ii) Subjective Information, Implementation of RFID Technology, Benefits, and some technical questions are under this section and interview method also. Not only that we have done some literature study also. Then we arrange the collected data and analysis for showing the clear picture of the RFID implementation.

Scope and Coverage:

The scope of this study is to show the implementation of RFID Technology in the West Bengal State Central Library. This study also covers their benefits after this implementation.

State Central Library, West Bengal:

State Central Library, West Bengal is the zenith of the Library System. It was established in 1956 at Emerald Bower at 56, B.T. Road. It has subsequently been shifted to its present location at Ultadanga, Kolkata in 1936. It is now a six storied building with well organized. It provides Lending service, Reading room facilities, Reference service, Bibliographical service, Career guidance service.

Implementation of RFID in State Central Library, West Bengal:

State Central Library, West Bengal is the one and only public library which is newly implemented RFID Technology on 31st August, 2016. The library authority purchases RFID from vendor Rapid Radio used by tendering method. Koha, library management software is used to operate the RFID technology. The type of the RFID tags is Higher Frequency (HF).

RFID chip used in the tag does have following three sections:

- a) Lockable Sections for identification
- b) Rewritable section for item identification
- c) Security function for item anti-theft

The standard of the RFID tag is ISO 18000-3 and the minimum distance for detection from pedestal is 1.5m. It is also very computable with single side smart card printer. Frequency of this tag is 13.56 MHz

Costing of the implementation of this technology is ten lakhs and twenty lakhs for twenty thousand books is tagging cost.

Analysis:

Library function	Yes /No	Major benefits
1. Self-Checkout	Yes	Staffs are not needed for user check out as if the user checks out with the book, which is not issued; the checkout gate will give the negative signal. Thus staff cost is saved.
2. Reduce the work at circulation Section	Yes	Use of RFID technology in a library can decrease the time of employees in circulation section since more than one tag can be read at a time. Staff may be used more efficiently in other areas including increased face-to-face service and community programs.
3. Re-education in circulation section staff cost	Yes	After using RFID technology in circulation desk, number of staffs is decreased and the staffs who are employed there for supervise, should have technical idea. So staffs of that section are trained and well paid.
4. Return items to shelf more quickly	Yes	RFID technology helps in automated materials handling. This includes conveyor and sorting systems that can move library materials and sort them by category into separate bins or onto separate carts. This significantly reduces the amount of staff time required to ready materials for re-shelving.
5.Reduce Theft	Yes	As state central library is a public library there is a high chance of piracy library materials. So after implementing this theft detection system, RFID technology, library materials specially the rare collections are more secured.

Library function	Yes /No	Major benefits
6.Increased equipment reliability	Yes	RFID Systems have an interface between the exit sensors and the circulation system to identify the items moving out of the library. If a patron to run out of the library and not be intercepted, the library would at least know what had been stolen. The patron card also has an RFID tag; the library will also be able to determine who removed the items without properly charging them. This is done by designating a bit as the “theft” bit and turning it off at time of charge and on at time of discharge.
7.Increase Security	Yes	Correctly operating readers and tags can have near 100% detection rates. Since the tags and sensors communicate with the Integrated Library System (ILS) it is possible to know exactly which items are moving out of the library. So security of library materials is high.
8.Faster Processing of material	Yes	Unique advantage of RFID systems is their ability to scan books on the shelves without tipping them out or removing them. A hand held inventory reader can be moved rapidly across a shelf of books to read all of the unique identification information.
9.Track materials more accurately	Yes	As RFID tags are attached with the library materials, it’s easy for the staffs to track any library material using RFID technology. The sensor gate indicates red light if any library material is crossing wrongly through the gate.

Library function	Yes /No	Major benefits
10.Reduction of overall library staff costs	Yes	Initially the charge for implementing this technology was about 20 lakh. But after implementing, it helps in reduction of staff cost in circulation, check out, lending, and administrative section. So overall a huge amount of staff cost can be reduced by implementing RFID.
11.Patron Satisfaction	Yes	Patrons are satisfied by using this technology as their time is saved in lending and circulation section and can use self-charging and discharging system.
12.Staff Satisfaction	Yes	Staffs are well trained here to use the RFID technology and so they are able to give other important services like face to face service and other technical operations. So all staffs are well paid here and they are satisfied.

Findings:

As per our survey in State central library, what we got that –

- 1) Before implementing RFID technology, library materials specially the rare collections were insecure as people from every cast and creed are allowed here. But now all library materials are highly secured through RFID technology.
- 2) RFID implementation helps the employees to save a lot of time which was spend for scanning barcodes and data entry about book issue. Because now patrons can use self-charging and discharging system.
- 3) According to the employee of State Central Library primarily the implementation may cause of spending a huge amount of money but after implementing, it helps to reduce staff cost in circulation desk, lending, check out, check in section etc. As RFID system helps

in automated material handling and also faster processing.

- 4) State Central Library implemented the RFID technology in the last year, so RFID tags are not attached in all books and other library materials. They are in process of making all materials under RFID system and still the authority of this library is giving training to their staffs for working in and handling the RFID technology.

Suggestions:

- 1) As RFID system is mainly known as theft detector technology all public library should go for implement this technology for the security of library materials.

- 2) In Kolkata State central library is the 1st public library who implements the RFID technology and they should fulfill the other technical criteria so that State Central Library can get top rank among all public libraries of India.

- 3) Not only in public libraries, in all academic and research libraries, RFID technology should be implemented to make the library system and management accurate and technically rich.

Conclusions:

We know that everything has two sides, one is advantages and other one is disadvantages. RFID technology has some limitations. High cost, Collision, Standard, Security, Virus Attack all are the disadvantages of this technology. But it is true that RFID should implement in all type of libraries. It is necessary to implement this technology and pay attention on the advantages of the technology not only theft detection it also helps us to manage the collection development. So we

think that every library should implement this technology for better service or develop its benchmark.

Acknowledgement:

We deeply express and thank to the Central Library Authority, Ramakrishna Mission Vidyamandira for organizing this seminar. Thank to State Central Library for giving attention to our request and proving information and we are thankful to the Department of Library and Information Science, University of Calcutta for helping us in making the paper.

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RFID and its Services

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Abstract: A library is a growing organism. To solve the problems of arranging documents in order there are classification schemes. To solve the problems of searching documents there are cataloguing codes. To solve the problems of space and time librarians have digitized the documents and share it over network. To automate the counter activities bar-codes are there. Bar-codes have served the librarians and libraries for a long time, and now it is slowly getting replaced by RFID. This paper discovers the technology, role of librarian, advantages and disadvantages of RFID in Library.

Keywords: RFID, Tags, Antenna, Self-charging/Discharging, Reliability

1. Introduction

RFID (Radio Frequency Identification) invented in 1969, patented in 1973. RFID uses wireless radio communications to uniquely identify objects or people, and is one of the fastest growing automatic data collection (ADC) technologies. 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.

RFID is a combination of radio-frequency and microchip. **RFID** is the use of radio waves to read and capture information stored on a tag attached to an object. A tag can be read from up to several feet away and does not need to be within direct line-of-sight of the reader to be tracked.

2. Components of an RFID System

A RFID system has four components:

2.1 RFID tags that are electronically programmed with unique information

2.2 Readers or sensors to query the tags

2.3 Antenna

2.4 Server on which the software that interfaces with the integrated library software is loaded.

2.1 Tags

The heart of the system is the RFID tag. The tag is equipped with a programmable chip and an antenna. There are three types of tags: "read only", "WORM," (Write-Once-Read-Many) and "read/write" (Boss 2003). The tag is paper thin, flexible and approximately 2"x 2" in size.

2.2 Readers

RFID readers are composed of a radio frequency module, a control unit and an antenna to interrogate electronic tags via radio frequency (RF) communication (Sarma et al. 2002).

Readers in RFID library are used in the following ways (Boss 2003):

- Conversion station: where library data is written to the tag
- Staff workstation at circulation: used to charge and discharge library materials
- Self check-out station: used to check out library materials without staff assistance

- Self check-in station: used to check in library materials without staff assistance
- Exit sensors: to verify that all material leaving the library has been checked out
- Book-drop reader: used to automatically discharge library materials and reactivate security
- Sorter and conveyor: automated system for returning material to proper area of library
- Hand-held reader: used for inventorying and verifying that material is shelved correctly.

2.3 Antenna

The antenna produces radio signals to activate the tag and read and write data to it. Antennas are the channels between the tag and the reader. Antennas can be built into a doorframe to receive tag data from person's things passing through the door.

2.4 Server

The server is the communications gateway among the various components (Boss, 2004). Its software includes the SIP/SIP2 (Session Initiation Protocol), APIs (Applications programming Interface) NCIP (National Circulation Interchange Protocol) or SLNP.

3. Key Features of RFID in Libraries

The main aim of today's libraries in adopting RFID is the need to increase efficiency and reduce cost. RFID has the advantage that it can provide security for the range of different media offered in libraries. The technology can improve circulation and inventory control, which helps allocate human and financial resources. This means that

libraries can relieve their professional employees of routine work and operational tasks.

A few libraries use "smart" card, which is an RFID card with additional encryption, is an alternative to merely adding an RFID tag on staff and user identification cards (Boss 2004).

3.1 Self-charging/Discharging

The use of RFID helps librarians to eliminate the valuable staff time which is spend in scanning the borrowed items while checking out and checking in. RFID speeds up the borrowing and return procedures.

3.2 Reliability

Several vendors of RFID library systems claim an almost 100 percent detection rate using RFID tags (Boss 2004). If the user card has an RFID tag, the library will also be able to determine who removed the items without properly charging them. If the material that has not been charged is taken past the exit gate sensors, an immediate alarm is triggered.

3.3 Automated Materials Handling

Another advantage of RFID technology is automated materials handling. This significantly reduces the amount of staff time.

3.4 Tag Life

RFID tags last longer than barcodes because the technology does not require line-of-sight. Most RFID vendors claim a

minimum of 100,000 transactions before a tag may need to be replaced (Boss 2004).

4. Best Practices for Libraries

The following may be the best practices guidelines for library RFID use (Berkeley Public Library n.d., Ayre 2004):

- The Library should be open about its use of RFID technology including providing publicly available documents stating the rationale for using RFID, objectives of its use and associated policies and procedure and who to contact with questions.
- Signs should be pasted at all facilities using RFID. The signs should inform the public that RFID technology is in use, the types of usage and a statement of protection of privacy and how this technology differs from other information collection methods.
- Only authorized personnel should have access to the RFID system.
- No personal information should be stored on the RFID tag.
- Information describing the tagged item should be encrypted on the tag even if the data is limited to a serial number
- No static information should be contained on the tag (bar code, manufacturer number) that can be read by unauthorised readers
- All communication between tag and reader should be encrypted via a unique encryption key.
- All RFID readers in the library should be clearly marked.
- ISO 18000 mode-2 tags should be used rather than ISO 15693.

5. RFID for Libraries

RFID can be used in library circulation section and used for theft detection. This technology helps librarians to reduce valuable staff time spent scanning barcodes while charging and discharging items. RFID is a combination of radio - frequency technology and microchip technology. The RFID gates at the library exit(s) can be wide as four feet because the tags can be read at a distance of up to two feet by each of two parallel exit gate sensors.

6. RFID in Indian Libraries

- Library automation in India is 10-12 yrs behind.
- Indian libraries are geared up for Automation with the support from Govt, NKC & Organizations like INFLIBNET, DELNET etc
- Hardly 10%-15% of Indian Libraries are using ILS efficiently.
- Library veterans feel library automation is a must for a knowledge driven.
- ILS automation software's & technologies such as RFID will allow uniform resource.
- Large University libraries should go for automation with RFID.
- Libraries should be promoted as an environment for serious learning.
- A mechanism to rank the libraries on basis of collection, services, use of technology
- Library Automation will help in building a National Union Catalog similar to LOC

7. Advantages of RFID systems:

7.1 Rapid charging/discharging: The use of RFID reduces the time required to perform circulation operations. The most significant time savings are attributable to the facts that information can be read from RFID tags much faster than barcodes and that several items in a stack can be read at the same time.

7.2 Simplified patron self-charging/discharging: There is a marked improvement because they do not have to carefully place materials within a designated template and they can charge several items at the same time. Patron self-discharging shifts that work from staff to patrons.

7.3 High reliability: The readers are highly reliable. Some RFID systems have an interface between the exit sensors and the circulation system to identify the items moving out of the library. If the patron card has an RFID tag, the library will be able to determine who removed the items without properly charging them.

7.4 High-speed inventorying: unique advantage of RFID systems is the ability to scan books on the shelves without tipping them out or removing them. Using wireless technology, it is possible not only to update the inventory, but also to identify items which are out of proper order.

7.5 Automated materials handling: Another application of RFID technology is automated materials handling. This includes conveyor and sorting systems. This significantly reduces the amount of staff time required to ready materials for reshelving.

7.6 Long tag life: RFID tags last longer than barcodes because nothing comes into contact with them. Most RFID vendors claim a minimum of 100,000 transactions before a tag may need to be replaced.

7.7 Fast Track Circulation Operation

The use of RFID reduces the amount of time required to perform circulation operations. The most significant time savings are attributable to the facts that information can be read from RFID tags much faster than from barcodes and that several items in a stack can be read at the same time.

8. Disadvantages of RFID Systems:

8.1 High cost: The major disadvantage of RFID technology is its cost. While the readers and gate sensors used to read the information typically cost around \$2,000 to \$3,500 each; and the tags cost \$.40 to \$.75 each.

8.2 Vulnerability to compromise: It is possible to compromise an RFID system by wrapping the household foil to block the radio signal (Boss 2004). It is also possible to compromise an RFID system by placing two items against one another so that one tag overlays another.

8.3 Chances of Removal of exposed tags: RFID tags are typically affixed to the inside back cover and are exposed for removal. This means that there would be problems when users become more familiar with the role of the tags (Boss 2004). In Indian libraries, it is a major challenge to keep the tags intact.

8.4 Exit gate sensor (Reader) problems: While the short-range readers used for circulation charge and discharge and inventorying appear to read the tags 100 percent of the time (Boss 2004), the performance of the exit gate sensors is more problematic. There is no library that has done a before and after inventory to determine the loss rate when RFID is used for security.

8.5 User Privacy Concerns: Privacy concerns associated with item-level tagging is another significant barrier to library use of RFID tags. The problem with today's library RFID system is that the tags contain static information that can be relatively easily read by unauthorized tag readers. This allows for privacy issues described as "tracking" and "hot listing" (Ayre 2004).

8.6 Reader collision: The signal from one reader can interfere with the signal from another where coverage overlaps. This is called reader collision. The readers are instructed to read at different times, rather than both trying to read at the same time. This ensures that they don't interfere with each other. But it means any RFID tag in an area where two readers overlap will be read twice (FAQ 2004).

8.7 Tag collision: Tag clash occurs when more than one chip reflects back a signal at the same time, confusing the reader. Different vendors have developed different systems for having the tags respond to the reader one at a time. Since they can be read in milliseconds, it appears that all the tags are being read simultaneously (FAQ, 2004).

8.8 Lack of Standard: The tags used by library RFID vendors are not compatible even when they conform to the same standards because the current standards only seek electronic compatibility between tags and readers. The pattern of encoding information and the software that processes the information differs from vendor to vendor, therefore, a change from one vendor's system to the other would require retagging all items or modifying the software (Boss 2004).

9. Role of Librarians:

RFID technology introduces an ethical dilemma for librarians. The technology allows for greatly improved services for

patrons especially in the area of self-checkout. The technology introduces the threat of hot listing and tracking library patrons. Libraries have traditionally acted to protect and defend the privacy of their patrons and yet some are implementing a technology before proper safeguards have been developed. Library use of RFID technology serves to legitimize the technology in the eyes of the community. Therefore, it is incumbent on the library community to ensure that the technology is developed in concert with established privacy principles and that any library use of RFID follows best practices guidelines consistent with library values.

10. Conclusion

RFID technology promises to change our world. It has the capability of making our personal lives and our work lives in the library more convenient. Every new technology comes at a cost. Most of the libraries are not yet implemented RFID systems. RFID would replace the barcode laser scanners now in use. New security gates would alert staff when someone attempted to remove an item from the buildings without first checking it out and would identify the item being removed. Under this system, patrons would be able to check out their own library materials instead of waiting in a check-out line. Libraries should work to ensure that RFID products are manufactured and used according to well-established privacy principles.

Developments in RFID technology continue to yield larger memory capacities, wider reading ranges, and faster processing. The interest in RFID as a solution to optimize further the automation and tracking of documents are gathering momentum at an increasing pace, with more libraries joining the trails. "RFID is increasing in popularity among libraries, as the early adopters of this technology have shown that, it makes good economic sense, both for large and small libraries."

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RFID: Beginning of a New Era in the Field of Library

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&

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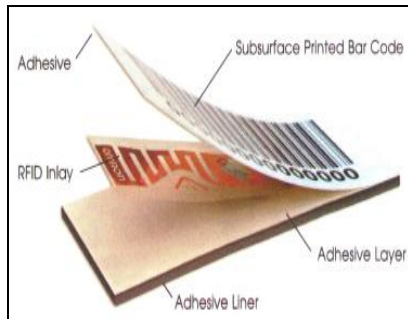
Abstract: RFID (Radio Frequency Identification) is a combination of radio-frequency and microchip that is a wireless data collection technology which uses electronic tags for storing data. Like bar codes, they are used to identify items. This paper introduces the structure and implication of RFID in library. These applications can lead to significant savings in staff costs, enhance service, prevent book theft and easy to stock verification which provide a constant update of library collection, holding management. This paper also discusses the feature of barcode and RFID.

Keyword: Radio Frequency Identification, Library management system, automation, Technology

1 Introduction: Radio Frequency Identification (RFID) technology is a wireless technology mainly used for automatic identification to detect, identify, and thus manage various objects and people. RFID(Radio Frequency Identification) which is a combination of radio-frequency-base technology and microchip technology is being hailed as one of the most important application in every field including highway toll

payments, packaging and handling, and retail industries, libraries etc. The tags contain electronically stored information which can be written and updated. Passive tags collect energy from nearby RFID reader's interrogating radio waves. Active tags have a local power source such as a battery and may operate at hundreds of meters from the RFID reader. The passive RFID tags are used in RFID library management systems.

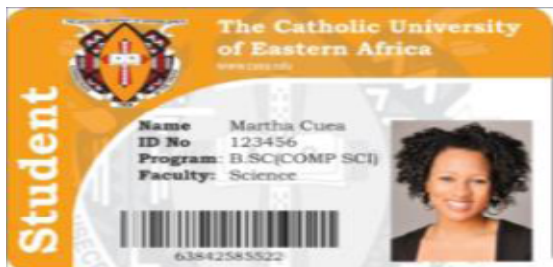
RFID(Radio Frequency Identification) invented in 1969, patented in 1973, first used in harsh Industrial environmental in 1980s', and standards presented in 2001, is the latest addition of technology to be used in the libraries for a combination of automation and security activities in the well maintenance of documents either inside the library or goes out of library. RFID library management, using RFID tags library, is easy and convenient. A RFID library management system consists of books, each attached with an RFID tag, RFID reader, computer network and software. Its basic components include a reader or interrogator, and radio frequency(RF) transponder that transfers data by radiating electro-magnetic carriers(Nayaranan, Singh & Somasekharan,n.d). Library staff handle lending, returning, sorting, tagging etc. of books, using RFID tags in this library system. A person can locate RFID library books marked with a RFID tags ,using the RFID reader which identifies and locates the book. RFID is not only confined in library it also used to identify card to secure the academic children.



RFID Tag



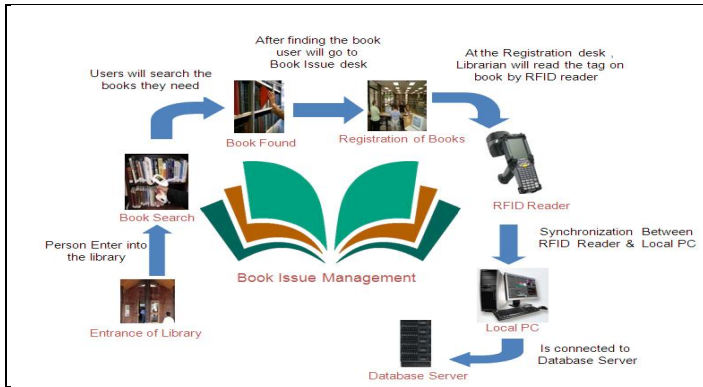
RFID Tagging System



RFID-Patron Card

2 RFID in library management system: RFID (Radio Frequency Identification) is the latest technology to be used in libraries to ensure security and facilitate innovative (Ken, 2004). It is an automatic radio communication (ADC) which functions through wireless radio communication to identify people or items. This means information stored in RFID chips can be read and updated from remote distances. Using RFID in libraries saves library staff's time by automatizing their tasks.

An establishment that uses RFID library management saves a book reader, precious time that he would have been spent, waiting for his turn in a queue for borrowing or returning a book. Taking care of books and making them available to the book readers are important tasks. Most of the library staff's time is spent in recording information of incoming and outgoing books. Borrowing and returning of books can be fully automatized with the help of self-check- in/out systems. This system involves installation of special software. A person using this system to borrow books is presented with options on a computer screen. The person has to identify himself with a code, which is preferably a personal identification number, or any form of unique identity code. Books selected by the person are identified by the system's built-in RFID reader. And, the surveillance bit in the book's tag is deactivated by the system. When a book is returned, the check-in/out system activates the surveillance bit.



2.1 Application of RFID in Library Management System:



1. Book Drops: The Book Drops can be located anywhere, within or outside the library. Possible remote locations outside the library include MRT/train stations, shopping centers, schools etc. This offers unprecedented flexibility and

convenience of returning library items at any time of the day, even when the library is closed. This offers unprecedented flexibility and convenience of returning library items at any time of the day, even when the library is closed.

2. RFID Transponder or Tagging: It is the most important link in any RFID system. It has the ability to store information relating to the specific item to which they are attached, rewrite again without any requirement for contact or line of sight. Data within a tag may provide identification for an item, proof of ownership, original storage location, loan status and history. RFID tags have been specifically designed to be affixed into library media, including books, CDs, DVDs and tapes.

3. Counter Station: It is a staff assisted station on services such as loan, return, tagging, sorting and etc. It is loaded with arming/disarming module, tagging module and sorting module. Arming/Disarming module allows EAS(Electronic Article Surveillance) bit inside the tag of the library material set/reset so as trigger/not trigger the alarm of the EAS gate.

4. The Patron self-check-out station: It is basically a computer with a touch screen and a built-in RFID reader, plus special software for personal identification, book and other media handling and circulation. After identifying the patron with a library ID card, a barcode card, or his personal ID number (PIN), the patron is asked to choose the next action (check-out of one or several books). After choosing check-out , the patron puts the book(s) in front of the screen on the RFID reader and the display will show the book title and its

ID number (other optional information can be shown if desired) which have been checked out.

5. Shelf Management: This solution makes locating and identifying items on the shelves an easy task for librarians. It comprises basically of a portable scanner and a base station.

The solution is designed to cover three main requirements:

- Search for individual books requested Inventory check of the whole library stock
- Search for books which are miss-helved

6. Anti-theft Detection: RFID EAS Gates is the anti-theft part of the Library RFID Management System using the same RFID tags embedded in the library items. Each lane is able to track items of about 1 meter and would trigger the alarm system when an un-borrowed item passed through them. The alarm will sound and lights on the gate will flash as patron passes through with the un-borrowed library material.

Important points based on RFID Library Management System

1. RFID tags replace both the EM security strips and Barcode.
2. Simplify patron self-check-out / check-in.
3. Ability to handle material without exception for video and audio tapes.
4. Radio Frequency anti-theft detection is innovative and safe.
5. High-speed inventory and identify items which are out of proper order.

6. Long-term development guarantee when using Open Standard.

3 Issues related to use of RFID in libraries:

- I. Privacy and RFID: Because of their nature, RFID tags can be vulnerable to unauthorized scanners reading the information stored on the tags. For this reason, most RFID tags used in the libraries contain a minimal amount of information, essentially the same information as stored on the barcode. But even if the tag contains nothing more than a unique identifier (like a bar code), there are privacy concerns. Molner & Wagner (2010) have highlighted the potential threats of implementing RFID to patron privacy include unauthorized tags reading writing, hot listing, eavesdropping and racking. Unauthorized tag reading occurs when the data between the reader and tag is unencrypted. This makes it easier for an unauthorized reader to read the data. Unauthorized tag writing occurs when unauthorized reader inserts data onto the tag during the normal read-write process. For example, the unauthorized reader could illegally reset the security bit, allowing the user the walk out of the library with an unchecked-out book. Hot listing is the process of illegally capturing data from the tag and matching it with specifically targeted item. Eventually the interloper could build up a database of tags code and the title of the item associated with each tag. Tracking is the process of using the tag located in the book to keep track of the movements of an

individual. In order for tracking to be effective, the individual being tracked must carry the tagged books and there must be unauthorized readers wherever the person travels.

II. Cost: While there are many benefits of RFID, the cost of the same is high. For implementing RFID system in Indian libraries, the approximate cost of RFID system includes - RFID tags which varies from Rs.11-22, Security gates which are in the range of Rs.4,00000- 5,00000, Staff Work Station which is in the range of Rs. 1,45,000-2,00000, Installation & Commissioning of RFID system which varies from Rs.50,000- 1,00000, Application Software in the range of Rs.2,00,000- 2,50,000, Server/Docking Station which may cost around Rs.3,00000- Self Check Station in the range of Rs.4,50,000- 5,00000, Book-Drop Kiosk in the range of Rs.5,25,000- 5,75,000, Portable RFID reader (Digital Library Assistant) in the range of Rs. 2,25,000- 2,50,000, etc. The cost is an important reason as to why the libraries are not adopting this technology.

III. Vulnerability to compromise: It is possible to compromise an RFID system by wrapping the protected material in two to three layers of ordinary household foil to block the radio signal. Clearly, bringing household foil into a library using RFID would represent premeditated theft, just as bringing a magnet into a library using EM technology would be. It is possible to compromise an RFID system by

placing two items against one another so that one tag substantially overlays another thereby cancelling the signals. This requires knowledge of the technology and care substantially aligning the tags.

- IV. Removal of exposed tags: RFID tags cannot be concealed and are exposed for removal. If a library wishes, it can insert the RFID tags in the spines of all except thin books. However, not all RFID tags are flexible enough. A library can also imprint the RFID tag with its logo and make them appear to be bookplates, or it can put a printed cover label over each tag.

- V. Exit sensor problems : While the short-range readers used for circulation charge and discharge and inventorying may read the tags as much as 1000 percent of the time, the performance of the exit sensors is more problematic. They must read tags at up to twice the distance of the readers. The performance of exit sensors is better when the antennae on the tags are larger or when the exit lanes are 36 to 42 inches wide.

- VI. Standards: There are no real agreed standards world-wide for RFID. Only set frequency bands and some guidelines are available with regards to RFID. Operational standards and regulations are different for each country.

4 Difference between Barcode and RFID: Barcode and RFID both are two part of technology in digital era. A barcode is a visual representation of data that is scanned and interpreted for information. The barcode technology can be scanned by barcode readers along with newer technology on devices such as smart phones and desktop printers. Barcodes are a universal technology in that they are the authoritative standard for retail products of stores that own a barcode reader can process barcodes from anywhere in the world. In many cases; barcode accuracy has been said to be the same or even better than RFID tags. Today barcodes are found on almost every item and there are no privacy issues involved with its use. On the other hand, Radio Frequency-Identification technology (RFID) involves a tag affixed to a product which identifies and tracks the product via radio waves. RFID contain high levels of security; data can be encrypted, password protected or set to include a ‘kill’ feature to remove data permanently.

- Information can be read from RFID tags much faster than from barcodes
- Several items in a stack/counter can be read at the same time using RFID
- Items do not have to be handled one-by-one nor removed from the shelves
- Inventory-taking is no longer a tedious operation
- RFID can stand more than 10,000 read/write
- RFID can have theft bit which can be in two states “ON/OFF”
- Shelf verification/rectification can be done on daily basis

- More information can be written in the RFID tag on incremental basis
- Need not open/remove books to capture information
- Items are identified on upper and lower shelves more comfortably

Basic technology comparison of RFID vs barcode:



RFID	BARCODE
Can be read and write	Read only
No line of sight required	Needs direct visible contact to reader
Multiple items can be read simultaneously (anti-collision)	Single item scan only
Item attendant data (mobile data-carrier)	Database look-up is always necessary
Guaranteed data retention of at least 10 years	Limited lifetime due to printing
Stock verification made easier as no need of taking the books out from shelf. We can read multiple books from the shelf at a time.	Stock verification takes time because of the fact that each book has to take out from shelf and then scanned with the scanner
RFID tags are more reusable and rugged as they are protected by a plastic cover.	Barcodes are more easily damaged

5 RFID use in Indian libraries: Observing the usefulness and efficiency of RFID, libraries in the developing countries have also started implementing RFID for better circulation. Several libraries in India have implemented technology which include: Dayanand Sagar Collage Engineering(Bangalore), DESIDOC (New Delhi), Gautam Buddha University (Grater Naida), Indian Institute Of Technology (Kharagpur), India Institute of Science (Bangalore), Indian Law University (New Delhi), Indian Institute of Management (Shilong), National Institute of technology (Rourkela) NASSDOC (New Delhi), National Center For Biological Science (Bangalore), National Chemical Laboratory (Pune), National Institute of technology (Surat), Parliament Library (New Delhi), Punjab University(Chandigarh), Punjabi University (Patiala), Ram Manohar Lohiya University (Lucknow), University Of Jammu (Jammu) , University Of Kashmir (Srinagar), University Of Pune (Pune), Jadavpur University (Kolkata) etc. However, most of these libraries are either using some components of the RFID system or are using it only for circulation purpose. Intact, libraries in India are in the initial stages of RFID implementation.

6 Conclusion: Though the unique advantages and flexibility of RFID is the good news, the technology is still not yet widely understood or installed in the library environment, innovation are constantly changing. Its adoption is still relatively new and hence there are many features of the technology that are not well understood by the general populace. Developments in RFID technology continue to yield larger memory capacities, wider reading ranges, and

faster processing. The interest in RFID as a solution to optimize further the automation and tracking of documents are gathering momentum at an increasing pace, with more libraries joining the trails. RFID is increasing in popularity among libraries, as the early adopters of this technology have shown that, it makes good economic sense, both for large and small libraries.

Like any new technology, RFID has erred at times. To summarize, a passive RFID tag does not pose any health risk when carried on your person, as it does not emit any waves when outside of the field of a reader. Readers do emit waves, but they have only a short range. The same goes for active tags, which are relatively rare and similar to sensor networks. The question of privacy is more delicate. Abuses are certainly possible, but use of RFIDs is controlled by laws and regulations.

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Implementation of RFID Technology for Library Security: A proposal for academic libraries using electromagnetic security systems

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Abstract: Library is a growing organism. As it grows in size the problems associated with the maintenance and security of the documents also increases. Proper library security and library maintenance are the probable factors to increase the satisfaction level of the user. This can be greatly influence by regulating the technologies in the library. Libraries has accepted this challenge and started using electromagnetic systems, in spite of all the hindrances at their end. But at the other end, the use of RFID technology for library security of the libraries using electromagnetic security systems would be much effective. The academic libraries would be much efficient in the functions of document identification, self check-in, and check-out, stock verification etc. This paper discusses the use of electromagnetic security systems in academic libraries and the need to shift the security systems to RFID technology.

Keywords: Academic libraries, electromagnetic security systems, RFID technology

Introduction:

RFID technology is gaining momentum and is believed by some to be the most pervasive computing technology in the field the library and information science. In its simplest form RFID is similar concept to bar coding. It is seen as means of

data processes and complementary to existing techniques. It is a technology used since the 1970s.

RFID uses wireless radio communication technology to uniquely identify objects or people, and is one of the fastest growing automatic data collections (ADC) technologies. Library system of management includes areas such as borrowing and returning of books, classification of resources, cataloging. One of the major problem in library is unauthorized taking of books. To curb these problems some of the academic libraries have modified their security system to electromagnetic security system. Electromagnetic security system was developed 30years ago. First it was used as a Radio Tracking of wild and agricultural animals later it was used in many industrial applications today. It is an automatic identification technology, where radio waves are used to identify objects or people.

This electromagnetic security system technology solves the problems of book loss in libraries. Over the past 15 years, academic libraries have developed a holistic change and budgets have also increased.

Objectives:

- To emphasis RFID technology as the best Electromagnetic security system.
- To point out the use of electromagnetic security system in academic libraries.
- To overview the concept of RFID, its issues and concerns
- To figure out the constraints faced by libraries using RFID

Methodology:

The paper work is based on the review and reference of journals and literatures published through online.

Historical development of RFID technology:

1920's foundation established

- Radar was developed as a technology in the U.S in the 1920s
- RFID, a combination or radio broadcast technology and radar, was developed soon after.

1930's progress

- an IFF transponder by Britain was developed.
- Radar is refined.
- “Communication by Means of Reflected Power” was published by Harry Stokman.

1950s Time of Research and development

- RFID technologies were explored in laboratories..
- Designs developed for long-range transponder systems for aircraft.

1960s Applications Abound

- During the 1960s inventors began applying radiofrequency technology to devices aimed at markets beyond the military.
- Companies Sensormatic, Checkpoint and Knogo develop theft prevention production for public consumption using Electronic Article Surveillance

- EAS is an affordable and relatively simple technology. “1-bit tags” meant that systems could only detect the presence of absence of the tag.

1980s commercial expansion

- Full implementation of RFID technology was done.

1990s RFIDs become commonplace

- Standards began to emerge with the widespread use of RFID.
- RFID use was accepted globally by consumers and companies.

2000s RFID enhancements

- Cost of RFID continues to fall.
- Private authentication develops as key concern in library implementation.

Electromagnetic security systems in academic libraries:

Now a day’s academic libraries are automating the library services and functions to fulfill the increase in user demand. EM has been used for decades and is proved to be a highly secure system of detection.

Electromagnetic security system is a flexible technology which is easy to use and well suited for automation in libraries.

Any academic library having an efficient financial budget to implement electromagnetic security system should opt for the RFID security system for the best results.

Why should academic libraries use electromagnetic security system?

- To solve the book loss problem in library.
- To achieve accuracy to remove staff manual process and error
- To save the time of users as well as the staffs.

How the security system works?

Security systems are based on proven technologies. Here a magnetic tape is attached to the document, during check-out, if an item is not deactivated, the security gate at the library detect the unauthorized issue of the document, and sounds an alert. When the document is returned the strip is reactivated, and the process continues.

Components of EM security system:

It consists of 3 components:

- 3M Tattle tape
- 3M book check unit
- Detection System Security Gate

3M tattle tape- it is an ultrathin tape consisting of double sideded strips which are designed to be applied between pages of books and journals.

3M book check unit-it is a flexible, easy to use device which ensures reliable processing and saves time and space.

Detection system security gate-it protects the library assets directly through the single corridor system which is safe from all magnetic media. It has a built-in alarm facility to alert for any unauthorized trespass of library resources.

What is RFID?

“Radio frequency identification an ADC (automatic data collection) technology that uses radio-frequency waves to transfer data between a reader and a movable item to identify, categorize, and track.” (Sidharth Iyer 2005)

Now a day’s RFID is a generic term for technologies used in library systems that use radio waves to automatically identify objects. A typical RFID system will consists of the following elements:

- tags
- antenna
- readers

Tags:

RFID tags contains two parts-

- 1) Integrated circuit- used for storing, processing, modulating and demodulating RF signals.
- 2) Antenna for receiving and transmitting the signal

Each tag consists of an electronic code attached to the object.

Tags may be different types, that of- active tags, passive tags, and semi-passive tags.

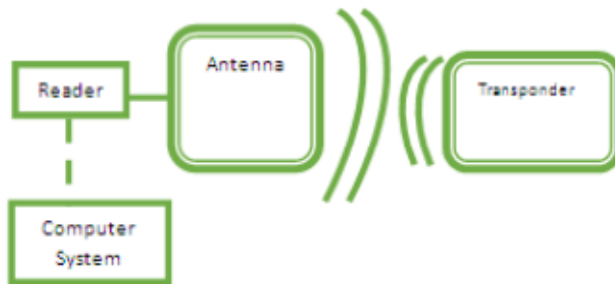
Antenna:

The antenna activates the tag by producing radio signals. It detects the tags within a range of 1m without inference of any magnetic media.

Readers:

Readers are used to retrieve and write the information on RFID tags. Readers can be of several types like tag reads or scanners. The reader generates the electrical impulse which causes the tag to be read. It can be fixed to the book drop section, or the circulation corner. It consists of sensors to check the tag to verify that the item is checked-out. If not, alert is made.

How RFID works?



The tag containing a microchip and an antenna encodes the information. The encoded information is accessed by the reader, which passes data along to the system or the person that needs it. Energy is transferred to the Transponder by emitting electromagnetic waves through the air by the transponder. RF energy is used by the transponder to receive data signals and respond simultaneously. After receiving the transponder response, it is sent to the host (computer).

In practical applications in the use of RFID technology, a tag attached to the object is used to identify the target. The reader builds up the radio signals when the target passes through the area and it builds up the radio signal connections. The tag sends information to the reader in the form of unique codes,

where the data is stored, and the reader decodes. Then it is send to the external link, where the entire processing is done.

Why academic libraries must incorporate to RFID technologies as the electromagnetic security system?

The process of checkouts and check in's in an academic library can be further automated by this technology. This will enhance the concentration of library staffs which will enable better allocation of workforce and funds.

- Though self service check in units can use barcodes but RFID stands better in its functionality.
- RFID readers can recognize several books at once but Barcodes can identify only one at once.
- Installation of sorting machine will make the check-in unit smarter.
- This will save the time by cutting the labor of sorting the books back to the shelf.
- Quick controlling power over the inventory can be done by using the hand-held readers to check the misplacing of any documents.
- When a new books arrives in a library. In a barcode system anew label is to be attached with the electromagnetic tag for anti-theft purposes, whereas in RFID, only a single tag is used for circulation and antitheft management.

This makes the security system stronger and efficient to implement in academic libraries using electromagnetic security systems.

Issues and concerns:

The concept of data security has triggered in the society due to the rise of threats of viruses, hackers, identity theft

etc. keeping data secure is a vital concern for individuals, governments and corporations. It has its broader implications on the business practices and technologies. Increasing adoption RFID technology has opened a frontier for data threats and its security.

- RFID data security is important.
- For data security RFID must meet the user demand.
- Different norms are taken by data security.
- New protocols and new security will be needed by the future deployments.

The RFID controversy and the technology that fuels it:

It is believed by the proponents that the tiny tags of RFID, made of silicon, can stamp out and keep the shelves stocked. Widespread adoption of RFID will cut costs, improve efficiency and offer new dramatic services to the users. But RFID has many critics. The most common are the privacy activists who claim that the technology's unprecedented ability to track the movements of individually serialized items could be turned around and used to track the people with the objects. Many critics argue that RFID is not only a threat to individuals but also to the corporate sectors and governments. Without proper control technology could also facilitate industrial espionage by giving competitors unprecedented access to a company's inventory. (Simson Garfinkel and Beth Rosenberg, 2006)

Implementation of RFID:

The methodology for the implementation of RFID can be divided into following phases taking into consideration of the below mentioned factors.

- Provision of budget
- Types of holdings of documents.
- Number of volumes of documents.
- Types of items for circulation.

Phases:

- ❖ While drawing detailed tender specification to integrate the library automation package, care should be taken.
- ❖ The past experiences of the firm supplying tags, readers, and equipments should be thoroughly investigated.
- ❖ The fixing of tags can be initially done by outsource, then after proper training in house arrangements can be made.
- ❖ The reader should have the ability to read the other manufacturers' RFID tags.
- ❖ The system should have the provision for reading the existing barcodes in the documents, and the required information can be downloaded by interacting with the present database.
- ❖ The tags should have the facility to over layer with the self adhesive sticker containing the logo of the library for longer life. (Sanjay Singh, 2004)

Advantages of using RFID in academic libraries:

- ❖ Rapid and easy check out and check-ins.
- ❖ Simplified form of patron self-check-out check-in
- ❖ High reliability with more authentication
- ❖ High speed inventorying of documents.
- ❖ RFID is automated materials handling.
- ❖ Longer tag life

Constraints faced by academic libraries using RFID:

- ❖ Initial implementation with high cost.
- ❖ Vulnerability to compromise.
- ❖ Since the tags are not concealed, there are possibilities to get removed because of their exposition.
- ❖ It is potentially overwhelming to evaluate competitive offerings of a new technology like RFID.

Suggestions & Conclusion:

With the change in societal priorities, the library environment of an academic library should also change as it stands as the central hub of knowledge for the aspiring generation of our society. Up to datedness of documents as well as its security features play a vital role in the age of information and communication society. A library having medium or large size can apply the RFID technology since bigger the collection, more is the benefit achieved by using RFID technology. For example National Singapore Library, is the one of the earliest users of RFID technology in the world. The changes that the new technology brought were adopted by the library for its continuous running. The expectation from the RFID technology is that in the future days, the technology will be well adopted by the book publishers industry, so that books will be tagged with RFID labels before their entry to the library.

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RFID Technology used for Library Materials is the Method of “Save the Time of the Reader”

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Abstract: Nowadays, library is a suitable protected area of our societal valuable intellectual assets. These valuable assets have to be provided to patrons with care. In present time of information evolution era, various types of valuable information/documents come in library, and such all this documents, for misplace or prevention of theft measures, library has introduced a new technology known as Radio Frequency Identification. The application of RFID technology in library has many features like catch the misplaced of documents, theft detection, sorting of the documents, quick service to patron of the documents etc.

Considering in this paper, how much equality to follow Dr.S.R. Ranganathan’s forth law of the library science that, “*Save the time of the reader* ” with RFID technology use in library materials, has been described.

Introduction:

In library Radio Frequency Identification of documents means identify the library materials by radio waves automatically an individual item. The significance of RFID technology is to receive and carry forward the data in suitable conditions to reader device. Formally known as tags or label to attach the documents for retrieved data by the machine.

Presently, there are various methods for identification of the item but, the most popular is RFID system to store

serial number so as to easily retrieve the documents, and perhaps other information.

Presently, RFID technology challenge to maintain proper library functioning, to control the library management, to manage for library activity and managing various type of huge collection where millions of books advanced; periodicals, CDs, DVDs and other electronic reading materials which comes in library frequently.

RFID tags consist by both chips and antenna that can catch and transmit data to server. RFID tags can be active, semi-active and passive. Active tag is a small device that can store information. Passive tags don't have internal batteries. RFID reader is a device that can receive and transmit a radio signal. It is built to encode data stored in the tag's microprocessor.

RFID tags attached with book can be handle of lending, returning, sorting, tagging etc. A person can locate RFID library books marked with a RFID tags, using the RFID reader which identifies and locates the book.

Key features of RFID system in library application:

There are several features in RFID system:

Help desk- In this section library staff assists patrons in various types like loan service, returning library materials, tagging, sorting etc. Mainly this work is done by machine loaded with various modules like sorting module, charging/ discharging module, tagging module etc. for user satisfaction.

Self-check-out station: RFID system install special software for user identification, circulation of library material, handling of other library materials, mainly have a touch screen computer which is called RFID reader. Firstly user produces

their library card number, barcode number, and personal ID number (PIN), and after being identified by RFID system, machine goes through the next option for check out, then user puts the library material in front of the screen for identifying the item and display the title and ID number for checking whether that information is correct. Besides, other optional information have to be chosen according to need of user. By this system user can access library material easily and quickly.

Book return - One of the most important features of using RFID technology is "book return". Even if the library is closed no patron goes empty hand. A chip with an attached antenna of RFID reader device fixed up in the wall, that any book dropped by a machine with a slot. It works in the same way as the exit section. The user identifies himself/herself if required by the library, and then puts the books into the slot. Upon completing the return, the user will receive a receipt showing how many and which book(s) were returned. Since they have already been checked in, they can go directly back on to the shelves. These units can also be used by sorter and conveyor systems. This offers unprecedented flexibility and convenience of returning library items at any time of the day, even when the library is closed.

Inventory wand - One of the most important features in RFID system for saving time of patron and quick access of the library materials is done by this device. When moving on the shelves in library without touching items by portable handheld reader automatically storing data to the server by wireless facility. Many special library have specific software programmed that can be written and applied with the inventory wand.

This device need under the following requirements to fulfill the functioning:-

- a. Inventory control purpose, display in screen the complete book collection on the shelves in library.
- b. Misplaced library materials easily find out.
- c. Faster search of individual patron's book request.
- d. Security purpose for library materials attached an antenna for functioning additional label.

Theft-detection measures – The main feature of RFID system is the theft detection. When patron takes un-borrowed books and exit through the gates, under the installed of RFID system, at that time signal blink and makes sound several times. RFID tag is embedded in the gates and its each lane is able to track item of about one meter.

RFID tag - One of the most important features in RFID system is tagging. In this technology it has ability to store information relating to the specific item which are attached and rewrite again without any requirement. Existing information can provide identification of an item, ownership, storage location, status of loan and such history to the patron.

Elements of an RFID System

a) **RFID tags** – This is a very small and thin chip-like rice grain to which an antenna is attached and is fixed to a book inside the back cover and this tag is programmable chip. Tags may either be read-only, having a factory assigned serial number that is used as a key into a database, or may be used to read or write, where object specific data can be written into the tag by the system's user. In this field programmable tags may be written once, read multiple times. Empty tags can be written with an electronic product code by the reader. RFID tag is common in libraries to have a part of the read or write

tag secured against rewriting, e.g., the identification number of the item.

b) Reader - Inside the library building, use the device generally called reader, and while this device used at building exit are usually called sensor. Library interpretation purpose uses a reader device to read the received information and as early it input its radio range and decodes the number. When user passes through the item in continuance movement then device asks the tag and offer most favorable reading performances which are enabling instant data capture.

c. Antenna: It is attached to the tag and its plays a vital role in library to help the patron to identify the item. It also identifies the theft detection in library. In case of larger transaction, an additional antenna is attached to increase the number of item(s) processed.

d. Server: It is a communication gateway device. It is heart of the RFID system. All the information from readers is received and provides information to the circulation section.

e. RFID Printer: This device is used for label printing.

f. Handheld Reader: This device is most important role play in library. It can be moved in library on the shelves without touching for item detect. The main function this device for stock taking purpose, finds out the book-misplaced on the shelves, and search for individual patron book on request.

Advantage of RFID system in library:

- a) Easily identify the document.
- b) Quickly locate the library material.
- c) Any un-borrowed library material can be detected quickly.

- d) Without touching the library documents can be detected easily.
- e) Patrons are shelf search the document and find out the closeable item at a glance.
- f) Increasing works flow
- g) Reducing staff time.
- h) Taking stock verification in a limited time.
- i) To find out mis-shelfed item easily.
- j) At the same time multiple items can be processed.
- k) Easy book identification for shelving process.
- l) Book return processes are always open even in library closed day.
- m) Improve customer service.

Barrier of RFID system in library:

Expensive Product: Its major problem for installation this system in library for too much expensive for buying , many rural library not to think to introduce such costly product. However, the reader and gate sensors used to read information are cost around \$2000 to \$3500 each and the tags cost \$.40 to \$.75 each, so that the main barrier to introduce in library.

Tear/ removal the tags: RFID tags with antenna fixed in the back cover page of books. Any mischievous user tear or removal the tag. That for mischievous user can easily access the unborrowed books, because reader or sensor not to detect the library items.

Theft not detected: Ordinary household foil bringing to library used for RFID would represent premeditated theft, just as bringing a magnet into a library using EM technology would be.

Users exit sensor problems: While the short range user used for charge and discharged and inventorying appear to read the tags hundred percent of the time, the performance of the exit sensors is more problematic.

Role of library:

Nowadays, in information evolution era there are various types of information and documents which come in library, but all these information/documents must be kept in library properly. Now RFID system for libraries have a great role to play that the library materials keeping systematically means categories, quickly retrieve according to patron's need the exact document/information, anti-theft detection measures, at any time patron can return book by this system even when library is closed. For that patron as well as library staff can save their valuable time. Before installation of RFID technology, library looks to the patron's privacy and to protect and defend them. In library the security gates act as a collection keeper and they detect the non-deactivated items. When the security is violated, the audible and visual signal runs instantaneously.

Conclusion:

The RFID tags are required for unique identification and there are options for choice to introduce numbering scheme. The data capacity in RFID tags is large and each tag has a unique code. This unique code of RFID tags have great function that document may be tracked to move form location to location and lastly at the end, it would be arrived to patron's hand. RFID tags helps to catch theft and try to minimize product loss. The important feature of RFID tags is that, gets well supported of tracking of products and continue the tag is unique identify and also have a serial number of the object.

RFID technology in the library is the best practices guidelines followed religiously and it's not a threat, this system quickly access to borrowing books and discharge books. RFID technology is not only emerging in library service, but also is more convenient, effective technology in library security. RFID reader can read the information of RFID tags, which contain identifying the book's title or material type, and this information replaces into the standard barcode reader which is found at the library circulation section.

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Implementation of RFID in Library Automation

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Abstract: RFID (Radio Frequency Identification), computing technology has evolved many years ago. At present the library and information professionals have great opportunity to apply these new information technologies. RFID is an automated library system for identification and tracking of library materials. This paper covers the basic components, procedures required for successful implementation of the system. A comparison has been provided between RFID and Barcode system. A brief idea about the emerging radio frequency identification technology, its importance and working in the library system is covered. We have also emphasized on various operations, merits, demerits and budgeting requirements. This paper helps us to enter and better understand the world of RFID Technology.

Keywords: Library automation, barcode system, antenna, server, integrated RFID reader.

I. Introduction:

The concept of RFID (**R**adio **F**requency **I**dentification) technology was developed in 1948, but it took fifty years for large scale implementation. The British were the first to pioneer this technology during World War II for identifying their own aircrafts. Its use further extended in late 1960s when the US govt. began using RFID to tag and monitor nuclear hazardous materials. RFID in India started in the 1940's for

defence applications. It was used on a large scale in 1980 for tracking cattle. In mid 1990's the RFID suppliers first started marketing this system to libraries. With regard to library use Seattle's RFID library project is the largest in the world. Today, RFID is used in various applications such as access control, security, tracking objects, toll collections and in shops, hospitals, etc.

II. What is RFID?

The acronym RFID, Radio Frequency IDentification, employs a number of technologies to identify objects via radio waves. The goal is to carry data on a tag that can be retrieved using readers through wireless connectivity. It uses an amalgamation of radio frequency based technology and microchip technology. The ability to access information through a non line-of-sight storage in a tag can be utilized for the identification of library materials. It is read using radio frequency technology regardless of any alignment and distance from the item. The antenna helps to produce radio signals read and write data on the tags. 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".

III. Components of RFID:

- **RFID Subject:** RFID Subject means a library material such as a book or any individual that comes in contact with the RFID tag.
- **Tag:** Tag contains a microchip that is attached to an antenna and is able to transmit identification information, capable of receiving and transmitting data to a reader.

- **Reader:** Readers or sensors are used to interrogate these tags. Reader is capable of reading data from a tag or transmitting data to RFID tag.
- **Antenna:** The antenna produce radio signals to activate the tag to read and write data to it. Antenna can be fitted to a door. Antennas act as communication channels between the tag and the reader. Antenna controls the entire communication flow.
- **Server:** It controls the gateway among various components and receives the information from the antenna and exchange information with circular database. It has a transaction database where report can be produced.
- **RFID User:** RFID user means an RFID operator, such as a store, hospital, library who employs RFID technology for its use.

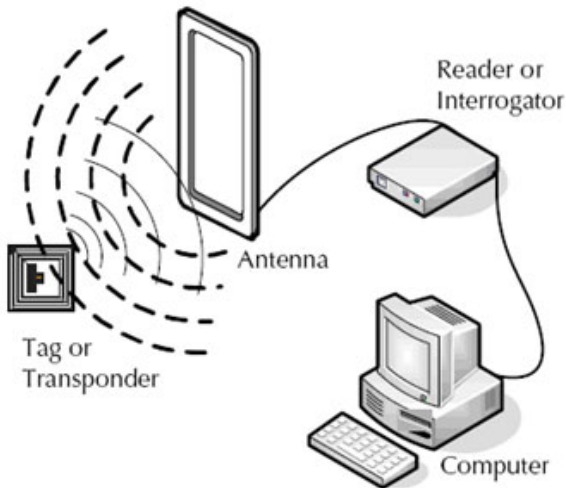


Fig: various components

IV. **RFID vs. Barcode: A comparison**

Many libraries have already inducted barcode systems to identify the books by scanning the barcode, using a barcode scanner.

- RFID tags are used in issuing multiple books simultaneously and can be read without opening them.
- RFID tags are better than bar codes, as there is no requirement of scanning with some reader, as required in bar-code.
- The barcodes use standards that can be read by most scanners. While RFID tags may only be read by a specific reader.
- The barcode data is uni-directional (i.e. you can only read it, not write it). Whereas RFID is used to read and write information to the tag.

V. **Points to be considered before RFID installation:**

In order to determine whether the library is ready for RFID, various basics need to be understood. Once the benefits and limitations of RFID are clear, you will be able to decide if RFID will improve your business.

- An **integrated RFID reader** is a reader with a built-in antenna and usually has another port to support up to one additional antenna. Integrated readers are a great fit if you are only looking for a lower cost solution and only need one or two antennas.
- Choosing the necessary **cable** is important because it must be connected properly to the reader and antenna and minimizing the amount of loss across the length of the cable should also be noted.

- **RFID frequency-** you must be aware of the frequencies that can be implemented but again you must follow the Indian standards prescribed for libraries.

LF (Low Frequency)	HF (High Frequency)	UHF (Ultra-High Frequency)
<p>Frequency: 125 - 134 kHz</p> <p>Typical Use: To identify animals.</p> <p>Range: Contact up to 10 cm.</p>	<p>Frequency: 13.56 MHz</p> <p>Typical Use: smart cards, tickets, libraries.</p> <p>Range: Contact up to 30 cm.</p>	<p>Frequency: 433 MHz & 856 - 960 MHz</p> <p>Typical Use: Used in all types of applications.</p> <p>Range: Contact up to 100+ meters.</p>

- **Rfid standards-** NISO guidelines should be strictly followed that are applicable for libraries.
 - a. In library 13.56 MHz high frequency tags should be used.
 - b. Rfid tags for library purpose should be passive.
 - c. The system will utilize ISO/IEC 18000-3 model 1 tags programmed for identification of items in other libraries.
 - d. Data on rfid tags should be enclosed according to data model recommended in ISO/IEC 15962 for RFID in libraries.

- **Funding-** Last but not the least the problem of sufficient funding must be considered that has been discussed later in this paper.

VI. Rfid in libraries:

The state of art technology for library theft detection is RFID which is now introduced and used by many libraries and information centres. Thus let us elaborate on the benefit aspects. Besides advantage every technology has a loophole where more and more focus should be done.

Merits of RFID	b. Demerits of RFID
<u>Faster Circulation Transactions-</u> The use of RFID reduces the amount of time required for circulation operations.	<u>High initial cost-</u> The major disadvantage is its cost. The readers and sensors cost around Rs1-1.5 lakh, a server cost as much as Rs5-6 lakhs and the tags cost Rs30-Rs45 each.
<u>Automated sorting-</u> This sorting system is automated to move library materials and arrange them categorically.	<u>Easy to deceive-</u> It is possible to deceive this system by wrapping the RFID tags with aluminium foil.
<u>Staff savings-</u> Staff may be redeployed for other activities, such as reader assistance, delivering a better service to the clients.	The <u>impact on employment-</u> should be carefully monitored. It is clear that deployment of RFID technology may result in numerous job losses.
<u>Highly reliable-</u> Several RFID library systems claim an almost 100 percent detection rate using RFID tags.	<u>Fear of Privacy-</u> If not implemented properly, it may create a problem with privacy and information.

VII. Required Budgeting:

A small library consisting of 40,000 books should plan a minimum budget of Rupees 16 lakhs for this RFID system. The shopping list is as follows;

RFID Components	Cost (Rs) approx.
40,000 tags @.Rs.34/-	13,60,000/-
1 programmer rental (3 weeks)	25,000/-
2 staff stations	1,00,000/-
2 exit sensors	3,20,000/-
1 wireless portable scanner	1,80,000/-
1 server	6,00,000/-
222 hours of labour @ Rs. 300	6,66,000/-
Carpentry and electrical	39,000/-

The labour cost depends as conversion rate of three tags a minute. This figure is likely to change depending on the amount of materials to be tagged and hence varies accordingly.

VIII. Future of RFID in India:

The first library suppliers started to market RFID systems in the mid 1990's. So, RFID technology was implemented in

libraries in the late 1990s for varied library operations across the globe. Indian libraries also started using RFID and mostly the academic libraries attached to IITs IISc, Universities are now widely using RFID technology. The only barrier in the journey is high cost of it, but it is expected that in coming days the cost will come down further and very early we will see mass adoption of this technology in various libraries in India. Therefore efforts are going on to get rid of the technical problems and to make it an accessible and reliable technology in reading systems.

IX. Conclusion:

After acquiring a clear concept about the technology to be implemented in libraries. We can say that this technology is quite expensive; still it has yielded great results. The technology is becoming more popular in India with more deployment in days to come in various sectors. It has been proved that this technology reduces the labour, costs and provides efficient results, which
Leads to high security and access control.

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**Problems and prospect of implementing RFID
technology in Indian academic libraries:
A theoretical aspects**

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Abstract: The paper discusses the function of RFID and the role of library in the age of information society. It also emphasizes on the problems and prospects of the technological adaptation in Indian scenario. The Paper also highlighted the problems of libraries and suggested some probable solutions of implementing the RFID system in the libraries. The paper has discussed on the basis of philosophical and theoretical aspect.

Keyword: RFID, Tag, Library security

Introduction:

A library consists full of intellectual assets like book, journal, theses and dissertation etc. According to Ranganathan's five laws of library science, the fifth law is "Library is a growing organism". As it increases in its size the problems regarding security of the documents also increases. RFID is one of the major solution of this problem.

With the changing society and ever changing objectives of library and information center, it is necessary to understand and accept the current trend and need of the users. The time has come to bring the changes in library services from

traditional to automate. To provide fast, accurate and better service, technological adaptation is necessary. RFID is the latest and high quality technology that helps to meet the need of the users as well as staffs. It is for authentication and data transmitting process. It also allows fast and smooth transaction, provides high security and long potentiality. But it is the technology of higher cost, needs trained staffs and high quality integration of hardware and software.

As it is known that, to automate the circulation and other activities of the library the researchers gave us “Barcode” technology. It has served libraries for a long time, now it is being gradually replaced by the RFID technology. So we can say that before introducing RFID technology the libraries were familiar with the barcode system which provides a simple and less expensive technology to transmit the information.

There are some limitations of barcode which encourage the RFID system, as

1. Barcode can read only not write.
2. It is a low security function.
3. In one time it can read only one item.
4. No capability of event triggering.
5. It requires more human intervention.
6. Needs direct contact to the reader.
7. Limited longevity due to printing.

Methodology:

The paper has been prepared on the basis of literature review and from philosophical aspect. So literature review is the key methodology of this paper. After the study about RFID and its function, it has been come to mind that how much it is fit for the developing countries; especially in terms

of India and which kind of problems may be arisen to implement this technology.

About RFID:

The term “RFID” stands for “**R**adio **F**requency **I**dentification”. It is the latest technology which is used by libraries to secure the object and facilitate the library services. RFID is the wireless technology which uses radio waves to detect and identify the object. A tag is attached with the object which consists of information. Its basic four components are:

Tags: It is core of the system, fixed inside the document or book’s back cover. It has programmable chip and antenna. There are three types of RFID tags; those are: a) Read only, b) Write once read many (WORM) and c) Read and write tags. Among those tags “Read and write tags” are more popular just because of it can be modified according to the user’s need.

Readers or sensors: It catches the signal as soon as it enters into its radio range. The devices which are used within the building are usually called as ‘readers’ while it is used at building exits are usually called as ‘sensors’. Readers usually identify the items and activate or deactivate the tag.

Antenna: An antenna is attached to the reader to help the reader to catch the radio frequency. Additional antenna can be attached in case of larger transactions.

Server: Server is the heart of the system. It controls the whole system. It takes information from the reader (it might be one or more than one) and then interchange the information with the circulation database.

The other components of RFID are as follows:

1. **RFID label Printer:** It is used to print the RFID label.

2. **Handheld reader:** It is usually used for stock verification, search the miss helved books or a particular book on user demand.
3. **Self-Check unit:** User will spend less time by self check in and Checkout system instead of long queue. .
4. **External books drop station:** It is the machine which offer an exclusive service such as the capability to return books when the library is closed.

How it works?

A RFID tag is a very tinny electronic device, often the size of piece of paper, which stores data and transmits that data up to several meters. The reading device transmits a query signal. When the RFID tag catches the signal, it transmits the data to reading device. Each RFID tag carries unique identifiers. The tags can be active and passive in nature. In time of charging the tags are in passive or off mode, and in time of discharging it is turned into active mode.

Development of RFID:

During 2nd world war RFID was introduced by British to fetch the tanks and fighter planes. But commercially it was started to use in 1970s. This is the system which is used in industrial as well as academic field. Gradually its users are increasing in every sector especially in industry and academic world.

Benefits of RFID Technology in the libraries:

- It reduces time and labor of users as well as staffs,
- It increases the workflow of the library.
- Motivates user to borrow more books.
- Motivates library to start open access.
- Self help system encourages people.

- Any time any where book dropping system reduces users' time and effort.
- Provides high speed and accurate security.
- Helps in stock verification without pulling the books from shelves.
- Ability to locate a particular item.
- More than one book can be returned or issued at the same time.
- Helps to theft reduction.

Challenges in Indian scenario:

In case of libraries, RFID is the system which depends on the library automation software, collection of library resources, type of tags, and other infrastructure like computer, security gate, and boxes of drop down, member id smart card. But for longer use it needs huge amount of fund.

Now the question is how much it is fit for Indian academic libraries. India is a developing country. Most of the people are still far away from their daily basic livelihood and education. They required more attention. In literacy rate, India holds 168th position out of 234 countries (as per census 2011). The libraries are still facing challenges for surviving, specially public and academic libraries. Sometimes they suffer from low budget which prevents to implement their all services. So it is not possible for every library to implement this kind of high priced technology. Most of the libraries are trying to be converted into digital form. Library services, storage and preservation system, cataloguing all are happening through technological help. The challenges to implement the RFID technology in the Indian academic libraries are as follows:

- **Growing population:** India is the second largest populated country. Poverty, illiteracy, unemployment, below poverty living standard etc. are main problems

of it. India has some social and political obstacles also. All these are the hidden problems behind the main problem.

- **Technology phobia:** Most of the people are still afraid from technological adaptation. They like old manual system.
- **Uninterrupted power supply:** Every technical system required all time flow of electricity which need strong back up. But till now it is one of the major problem in India.
- **Technological literacy:** In India where major portion of the people are still illiterate, how technological adaptation will satisfy them?
- **Status of library professional:** In comparison to developed countries, in many academic libraries' librarians and other staffs are considered as non-academic persons. That's why they are not motivated to implement new technology. Some libraries are managed by non-library professionals, who are not acquainted with the upcoming technology.
- **Human resource:** As we know that India is the second largest populated country and has full of human resources, but they do not have proper employment. This kind of technology may increase unemployment problem.
- **Cost:** RFID system is very costly, every institution cannot afford this system. Special library can bear the cost of the system as its target user is especially professional and comparatively less in number. Research library can afford it easily.
- **Trained staff:** Sometimes there is lack of trained staffs in academic libraries, the system requires trained staff to maintain the system properly which needs money and time.

- **Planning:** Before adopting the system organization needs proper planning, because it is a complicated project and required several activities of procurement of hardware and software, tagging of books, training of the staffs as well as patrons and integration of the whole system.
- **Less resources:** In India, library system is avoided maximum time. Enough resources, internet connection, trained staffs are not present enough. So the question is that is there any need of this kind of technology of higher price.
- **Continuous monitoring:** The system and server requires 24 hour monitoring, which may be problematic.

Suggestions:

So, at the end of our article we want to suggest some ideas, if those are implemented then it might be change the present scenario of Indian academic libraries towards implementation of RFID technology. Some suggestions are as follows:

- At first parental organization and government need to provide all the facilities, fund, training program, and well equipment.
- Before adapting the RFID technology, a proper survey is require to conduct among those institutions who have already adopted it.
- A proper planning is required before adopting RFID.
- Need to assess future and preparation of forecast report.
- It is need to see first that library should have adequate resources for users, if not, then at first library should spend money to buy them, and then remaining money can be used to adopt technology.

- If library wants to adopt automation then, first library management, circulation, cataloguing, OPAC, digital repository can be introduced, then RFID can be adopted.
- Library staffs must be trained properly,
- User education and user orientation is very much required.
- Many computer terminals have to be created.
- Library have to develop collection development policy.
- The scope of human intervention must be opened along with the technological system.
- Regular workshop must be organized for staffs' to serve better.
- Need to be present a technical person all the time.
- A back up must be ready all the time in case of any unwanted situation.
- The condition of library building, electrical system must be monitored regularly.
- Parental organization must understand the importance and necessity of the library.

Conclusion:

In India technological adaptation is still going through many hard situations. Some academic libraries have got the opportunity to increase resources and technical support, but most of the academic libraries are still under privilege. The special libraries are in good condition in compare to them because they have professional and limited user and support of parental organization. It can be hoped that in future Indian libraries will be developed and reached to its ultimate destination.

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Uses of less-wire and wireless innovations in libraries: An SWOC analysis of RFID

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Abstract: Radio frequency identification has become an ever-present infrastructure in current technology. The system eases auto-identification through a mechanism of tags and readers. The present set-up is totally changing for various applications of ICT and the world has been condensed within a very small structure. The paper highlights the applications of RFID in the libraries along with the security and privacy issues. It will also put a light on the advantageous difference between RFID and Barcode system.

Keywords: RFID, Radio waves, Security System, Tag, Theft detection, Wireless.

I. Introduction

RFID or Radio Frequency Identification is a process of identifying unique items using radio waves. Library Professionals have adopted the sort of the technologists to overcome the complexities of in the digital environment. This has enhanced their user service standards. At present the commercial deployment of RFID technology has captured every segment of the market sector as well as dedicated and security related applications.

II. Objectives

- To study the Strengths (S), Weaknesses (W), Opportunities (O), and Challenges (C) of RFID system in libraries
- To identify the advantages of RFID over Barcode system
- To put some light on the professional ethics about the usage of RFID in libraries

III. RFID principles

Several types of RFID exist, but we can divide RFID devices into two division namely active tag and passive tag. Active tags require a power source and are either connected to a powered infrastructure or use energy stored in an integrated battery. But also a tag's lifetime is limited by the stored energy and is balanced against the number of read operations the device must undergo. Passive tag consists of three elements which include an antenna, a semi-conductor chip attached to the antenna. The major concern of a tag reader is communicating with a tag. The transfer process is done by capturing the energy by the tag antenna. The encapsulation maintains the tag's integrity and protects the antenna and chip from harmful environmental conditions or reagents.

Two fundamentally different RFID design approaches are:

- ❖ Magnetic induction.
- ❖ Electromagnetic (EM) wave capture

These two designs are responsible for the EM properties associated with an RF antenna like

- ❖ The near field.
- ❖ The far field.

IV. Components of an RFID system

There are four major components

- RFID tags / transponder that are electronically programmed with unique information
- Readers or Sensors to query the tags.
- Antenna.
- Server and application software
- RFID Label Printer
- Handheld Reader
- Self-Check Unit
- External Book Return
- Staff and Conversion Station

V. Strength (S): How RFID is beneficial to libraries

1. Reduction in workplace injuries

Workplace injuries is caused by the repetitive motions related to flipping books and angling books under barcode readers

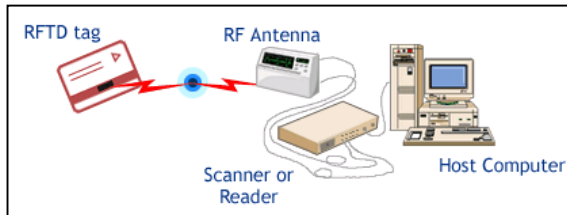


Figure 1: RFID Components

which is expensive for libraries, and, limited physical range, and other problems familiar to a feminized workforce.

2. Facilitating self-check

Users' self-checking out is much easier with RFID system that can move within a range of an RFID reader. Self-check saves money directly whereby reducing labour costs for circulation (check-out) activities.

3. Inventory management

Libraries inventory management is an important part of library activities. Books with conventional barcodes require library staff to handle. RFID system has the ability to analyze and correct library inventories.

4. Efficient processing

The library activity associated with purchasing of books and adding them to the collection—can be streamlined with RFID system.

5. Easy stock verification

Within a short span, verification of the library materials can be easily done with the help of RFID system. A handy inventory reader can easily move across the shelves to read all of the exclusive identification information. Using less-wire technology, it is possible not only to update the inventory as well as to identify items, which are out of proper sequence also.

6. Anti-theft Detection

RFID EAS gate is an anti-theft part of the library RFID management system. Every gate can able to track items and can sound the alarm system when an un-borrowed item will pass through. The alarm will sound as the user passes with the un-borrowed item.

7. Materials Handling

RFID system is also helpful in automated equipment handling, including conveyor and arrangement systems to move library materials and sort them according to category. This reduces the staff-time required to ready materials for re-shelving.

8. RFID improves library workflow

Time Management is a big factor. RFID satisfies the total work of the library in a quicker and easier way.

9. Improves customer service

RFID definitely reduces the amount of time required to perform circulation operations. The most important fact is that information can be read from RFID tags much faster.

10. Multiple items can be checked out or checked in at the same time.

Another important advantage of RFID system is check-in and check-out of more than one item at the same time.

VI. Weaknesses (W): Limitations of RFID

❖ High Cost

The major disadvantage of RFID technology is its cost. The readers and sensors used to read the information are highly expensive.

❖ **Removal of exposed tags exit gate sensor can creates problem**

The exit-sensor can read tags up to double the distance of the other readers. If library can set up a smaller antenna at the check-point then there is a chance of a major difficulty for sensor to check every patron, because it will not work properly.

❖ **Reduction in the number of staffs**

Self-checking systems using RFID have become very popular. Self-check system allows patrons to check-in or check-out books and it also reduces the number of staff required at the circulation section.

❖ **Compromise an RFID system**

It is easier to avoid an RFID system by wrapping the library document in ordinary foil. Also it is possible to avoid an RFID system by placing two items against one another. This requires good know-how of the technology.

❖ **Lack of Standard**

The tags that are used by library RFID vendors are not compatible even when they match to the same standards because at present, the standards only seek electronic compatibility between tags and readers.

❖ **Reader clash**

It may occur when the signals from two or more reader overlap, then the tag is unable to respond to simultaneous queries.

❖ **Tag overlapping**

RFID Tag-clash occurs when tags are present in a small area.

❖ **Disrupted RFID system**

Since RFID system uses the electro-magnetic field, they can easily jam using energy at the right frequency. This problem could be disastrous when RFID is increasingly used.

VII. Opportunities: Merits of RFID system in libraries.

- More than one item can be circulated within the same time.
- Longevity is higher in tag.
- Fast Circulation.
- Self-charging and discharging are easier.
- Quick inventorying.
- Automatic item handling.
- Easy stock verification method.
- Automatic sorting of books on return
- Theft detecting quality.
- Database update is possible instantly

VIII. Challenges: Problems of RFID

➤ **High hidden costs**

Societal and institutional, these are the two sectors where money matters. High hidden cost of RFID in this case is a matter of concern.

➤ **Reduction of staffs in libraries**

Less staff required due to RFID system implementation, which result in unemployment in the profession.

- **Function sneak and surveillance capacity**
Appropriate implementation should be done, failing which create a number of threats to privacy and security problem of the library.
- **User Privacy concern**
User may create problem by tracking of tags.
- **Spy on signals is the blessing for hackers**
An aspect of RFID system is unevenness in signal strength. Here, tags respond by passively modulating a carrier wave broadcast by the reader. It is much easier for hackers to spy on signals from reader to tag than on data from tag to reader.
- **Interoperability**
This technical problem may slower the library workflow as interoperability is a major issue for RFID system.
- **Static information**
The RFID tags contain static information that can easily be read by unauthorized tag readers. This allows for privacy issue which in terms is tracking.
- **Water and metal eruption**
Due to lack of frequency diversity it results in significant performance degradation of tags that are attached to metal surfaces.

IX. Comparative study of RFID over Barcode system

Barcode system	RFID
Barcodes require visibility to work	RFID tags do not require visibility to be read
Barcodes can only be read one at a time	RFID tags can be read almost simultaneously
Physical condition is important	Physical condition is not very important
Barcodes can only identify the type of item	RFID tags can identify specific items.
Barcode information is partially static	RFID information can be updated
Information can be read slower in Barcode	Information can be read much faster in RFID tags
Data stored on paper	Data stored on EEPROM
Less amount of data storage on tag	Data storage capacity is high
No ability to exchange information	Ability to exchange information in two ways
No ability to reprogram tags	Ability to reprogram tags

X. Professional Ethics in addition to Privacy-attack Technologies

It is true fact that privacy is essential to freedom of inquiry. Some ethics must be followed by library professionals to protect the library patron's privacy. In this connection, the following points can be taken into account:

- ✓ To notify users about the use of RFID technology in the libraries
- ✓ To label all RFID tag readers so that users must be aware of their usage

- ✓ To protect the data on RFID tags by using encryption
- ✓ Limitation of the information stored on the RFID tag to a unique identifier
- ✓ Nothing can be stored as personally identifiable information on any of the RFID tag

XI. Conclusion

To conclude, it can be said that, despite of its various challenges, RFID technology is not only very efficient but also suitable technology in terms of library security. This technology has gradually begun to replace the traditional barcode on library items. Technological advancement of RFID in digital libraries will ensure considerable security and ease the librarians to provide more valued services to users-community in digital environment.

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RFID: Application of Library Integrated Sub-system

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Abstract: - This paper gives an idea of the current trends and status of this RFID technology. It also provide huge amount of application of the Library Management System (LMS). Library integrated LMS technology to manipulate of these modules. It has different of benefit. This system will be effective and utilized of the technology. This technology continued to wider reading ranges and faster processing.

Keywords: - RFID system, Library integrated sub system

1. Introduction: - Radio Frequency Identification (RFID) is one of the best wireless transmission identifier. It use to transponder of response to query of tags. It is mostly use in super market, recently it use in Library field. RFID technology is locating exact requirements, tracking moving object. This system is first applied in "Electronic Article Surveillance" (EAS). United State and Norway to starting this technology. It is radio frequency use to transfer data reader to tag item through wide range of application.

Library is a collection oriented repository like Books, Journals, CD, Maps, Sound recoding Video recording, computer file, different dimensional artefacts etc. Lots of collections are there. RFID technology will be could retrieving documents, accessing document, stock verification and location of the physical location of the books.

2. Component of the technology:-

- * Microchips
- * Four Antenna(Thing magic)
- * Case
- * Battery
- * Pro UHF RFID handheld reader(UHF-865-870MHz, MHF902-928MHz)
- * Window embedded CE 5.0 and VGA(full)
- * Day light readable touch screen display
- * Backlit keyboard(full and well backlit)
- * Internet connection
- * Data storage memory(96 bit memory for hexadecimal data storage)

3. RFID tags fall into three regions in respect to frequency:

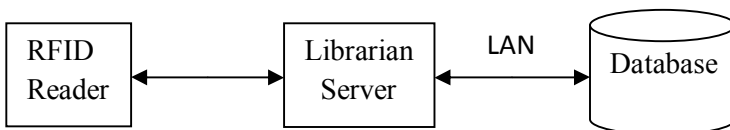
Low frequency (LF, 30 - 500 kHz)

High frequency (HF, 10 - 15MHz)

Ultra high frequency (UHF, 850 - 950MHz, 2.4 - 2.5GHz, 5.8GHz)

4. RFID system:-

- To retrieve the Number
- RFID reader scan barcode
- Tag means chip identifier
- It is shout out properly



5. Tags are two types:-

Active tags: -

Battery power high, score capability is highest, long range reader, RF integrator. High cost

Passive tag:-

Do not require power, Lower range capacity, read only tag, Low cost

6. Technical Range:-

8. Nominal reading range: - It is simplified process.
9. Rogue reading range:- single at higher power machine
10. Tag-to-Reader eavesdropping range:- This single is started
11. Reader-to-Tag eavesdropping range:-High power
12. Detection range:-High power

7. Standardization:-

RFID follows the different standard. These are ISO 11784, ISO 11785, ISO 14223, ISO 10536, ISO 14443, ISO 15693, ISO 18000 etc.

8. Benefit of The system:-

1. Traceability of books and library member to be edit
2. To provide first searching
3. To provide long range capability RFID level
4. To minimize the manual error
5. To identify accurate data

6. Save the time of the staff
7. It access to controlled
8. Identify the tracking activity
9. To maintain security
10. To minimized manual intervention

9.11 RFID library integrated system:-

- Monitoring system:-Monitoring system will be installed at the gate of the library to monitoring inside and outside of the Books racks. The system will be interacting and matching the Library borrower card and document tag through socket using RQL.
- Transaction system:-RFID interface to provide in the transaction to member card ID and Document barcode number ID.
- Searching System: - Physically can be provide to keep sound of matching the particular books. Book will be search as soon as possible.

9.12 Conclusion: -

RFID is a new generation of auto identification and collection development technology which is applied for the library LMS processes. These tags identify the radio waves. RFID based Library management system would allow first transaction flow of the library. When this system started in any library its expenditure is huge. Recently 25% library is starting RFID system in India. When this system will be applied of the library it is reached an automated updated modern integrated library.

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Self Circulation using RFID Technology with KOHA Software at St. Xavier's College, Kolkata

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&

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Abstract: St. Xavier's College Central Library has installed Radio Frequency IDentification (RFID) technology based kiosk for self circulation through open source library management software KOHA. This technology is also improved library annual stock taking, ensure foolproof security and access control i.e. circulation management. This articles briefly describes why our library switch over from barcode based circulation to RFID based circulation, SWOT analysis of RFID technology, self-circulation using RFID technology, types of problem faced during implementation of the new technology and possible remedies. Lastly, the conclusions are drawn based on SWOT analysis.

Keywords: RFID, Barcode, SWOT

1. Introduction:

St. Xavier's College Library was first automated in the year 1992 using the library automation software LibSys. In the year 2004 the software was upgraded to LibSys-4 and barcode technology was also implemented. The barcode technology was integrated with LibSys for circulation of books and stock verification purpose. Due to some limited features the barcode technology and LibSys-4 were replaced with RFID technology and open source library management software koha in the year 2014.

The library currently has about 68,000 books. On an average the number of daily transaction is 750+. RFID tags and stickers with St. Xavier's College logo are affixed in each book both reading and lending books. Details of the book are encoded to the RFID tags through RFID station and library management software koha. An automatic circulation system (Kiosk) has been installed near the circulation counter to facilitate self issue and return of books by the user themselves. Two staff stations have been installed in the lending counter for issue and return books by the library staff members. Another station is installed in book processing section for updating information from koha software and to replace any damaged tags in books. One RFID based hand held reader is also used to identify particular book or locate misplaced books. This facility can be used effectively for stock verification purpose also.

2. Problems faced using traditional barcode based circulation:

The main reason why St. Xavier's College Central Library wants to replace the barcode based circulation system with the new RFID technology is that it significantly increases the efficiency of circulation services and inventory operations. Traditionally, the library staff at the circulation counter would need to use a handheld barcode reader to read the information on the barcode of each borrowed item. The RFID technique simplifies the circulation process. The information related to borrowed items are encoded and stored on RFID tags and the radio frequency can transmit information on the tag instead of just reading the traditional barcode in "Line Sight". The system can identify large quantity of information through built-in chips and the remote sensor can retrieve the information immediately. The problems faced during circulation using barcode technology were:

- Long duration to process the issue and return.
- Poor inventory accuracy of barcode technology
- Lacking in fast and reliable stock verification.
- Lacking in effective control over circulation work flow.
- Inefficient shelf rectification.
- Barcodes are not reusable while RFIDs tags can be reused.

3. Self – Circulation RFID based technology Kiosk:

The kiosk comprises of RFID reader also known as sensors, smart card reader, LCD touch screen monitor, auto cutter thermal slip printer, Orizin RFID software and koha software. Patrons who want to borrow book(s) can themselves issue books using RFID based kiosk [Fig 1.]. Kiosk is an interactive station with touch screen facility. Patrons have to scan his/her library membership card on the card reader after successful authentication the patron will be redirected to select options like issue, return or reissue. Patrons planning to issue items will be required to place the desired items on the RFID reader affixed on the kiosk. Then the patron will be required to select the check-out button on the kiosk console. The check-out process completes after successfully logging out of the system. Similarly patrons who want to return the books have to simply keep the books on the kiosk reader and select the check-in button, the system will automatically record return of books. For every transaction printed receipt are generated and system also sends confirmation mail.

4. Security Gate Antenna:

Security gate [Fig 2.] has been installed near the entrance gate of the library. If any users try to carry a book through the gate without proper transaction, the system will make alert sound and also draws attention to the security staff by blinking red light. These security gates constantly identify

non-deactivated books passing through the gate. If patron brings their own books for reading purpose in the library, they can cross the gate without any hassles but they cannot enter with lending books which one already issued, for reading purpose.

5. Advantages of RFID Technology:

RFID technology is a boon to the librarian as well as its users. It makes the work of librarian much easier, and save the time of the users. It has following advantages:

- As human interference is less it reduces the cost of manpower also.
- Rapid check out / check-in facility.
- Independent self-check-out/check-in by patron through kiosk.
- Minimize the time of the users as well as library staff during circulation.
- Minimize the expenditure incurred on counter and library staff during stock verification.
- Highly reliable than barcode.
- Provides effective and efficient theft detection system.
- RFID tags are reusable comparison to barcode sticker.



Fig:1 Self–Circulation Kiosk



Fig:2 Security Gate Antenna

6. Limitation of RFID Technology:

Though the RFID technology is having enormous advantages it has also many disadvantages as stated below:

- High cost (Cost of each tag around Rs.17)
- Possible to block the radio signal by any metallic content by the users
- Easy to remove the tags from the book
- Exit sensor may create problem during power failure, lightning or if the book passes through the side of the pedestal, which is out of the range of the antenna.

7. Problem faced during installation and possible remedies:

7.1 Online keyboard on touch screen and printer:

Initially online keyboard was installed on touch screen. But it takes more time to enter user ID for authentication of the user and the users are standing in queue. Software can not identify the valid user. To solve this problem a fixed scanner is installed in the kiosk and bar-coded college ID is used for scanning member information. Transaction slips are generated from thermal printer, after 10 to 15 days the slip become useless, nothing readable and very difficult to solve any transaction related problems. Using auto generated e-mail services we can solve the problem. Sometimes user forgot to stamping due date in the books, always one staff require for stamping due date.

7.2 Problem of fixing RFID tag:

During scanning the books using staff station reader, sometimes the information of the book was not capturing due to duplicate barcode found or damaged tags. Distance between staff station and other books are properly maintained and remove the damaged one. During removing damaged tags sometimes new books also damaged. If we re-write tags

sometimes it shows old books information, in that case we remove old books information and reuse the tags.

7.3 Problem of RFID gate:

During testing period, it was found that the gate was unable to identify some books. After checking the system it was found that the frequency of RFID gate was not properly adjusted and distance between two pedestals was not properly maintained. The gate was reinstalled and the distance between two pedestals was adjusted. In our library one gate used for both entry and exist purpose, during rush hour the security gate sometimes are not working properly. Faculty member can borrow eight books at a time, in that case if the gate identifies any non-deactivated books passing through the gate then very difficult to identify particular book.

7.4 Problems of the software:

When the self check-out / check-in was started for all the users it was found that in case of overdue books the system is indicating fine amount but when books are return through kiosk fine amount write / wave off. Finally the software was customized and the system is running in full swing. When items are issued through kiosk sometime other books kept in the shelf also capture, now the kiosk shifted from the shelf area and solve the problem. During issue through kiosk system can not identify the same title also. During return items system cannot identify the damaged return items and users who borrow the books i.e. student can return friends books using his card; hence in our library all the items are return through staff stations only. Sometime users forgot to log out from the current session; in that case next user can borrow books in the name of previous user.

8. SWOT Analysis:

SWOT [Fig 3.] method is used to evaluate and analyse the Strength, Weakness, Opportunities and Threats on RFID based self circulation technology at St. Xavier's College Library.

Strengths:

In barcode based circulation all books scanned individually but RFID technology all books are scanned at a time, it reduces the time. RFID improves the self-circulation efficiency and saves the patron's and staff's time. It fulfils 4th law of library science theory i.e. save the time of the reader proposed by S. R. Ranganathan. Periodically stock taking or locating the miss-shelved books can be a very time consuming and challenging task in barcode based technology. However, the problems can be easily solved by the use of handheld reader. Staff daily routine work and the labour intensity are reduced because more patrons prefer to self-check in/out the books, using RFID based kiosk. RFID is also used in library theft detection purpose also.

Strengths Speedy self-check out/in Improves efficiency Reduces staff daily routine work Theft detection	Weakness No global standard High costs Lightning, metal and water interruption
SWOT	
Opportunities: Developing uniform standard Prospect for development	Threats: Job security Small libraries cannot afford the cost

Fig: 3 SWOT Analysis of RFID Technology

Weakness:

There is no universal standard for this technology and every country can set its own rules. As a result, the library in one country may not share its resources to another library due to its incompatibility. Though the price of RFID tags decrease every year, in general the system equipment, tags price and the maintenance costs are still relatively high for most of the libraries in India. Since the RFID technology is not mature enough, lightning, metal and water can interrupt the frequency of the chips.

Opportunity:

The main opportunity is that many RFID standards are still being developed and constantly being updated. Due to its unique features its application is adopted in various commercial fields also.

Threats:

Since the technology requires minimum human resources, the library staffs may fear about their job security. Small library could not afford the cost of the RFID technology.

9. Conclusion:

Integration of RFID technology with open source library management software Koha has ensured considerable security and it facilitates value added services to the user community of St Xavier's College library. Though it is costly, in the long run RFID applications will lead to significant savings in staff cost as well as enhance the service quality of the library. It will also provide effective results leading to fool proof security and access control. This technology will ensure better stock verification and circulation management which leads to better library services. By implementing RFID technology in the St. Xavier's College library, the patron's self-service

efficiency can be greatly improved and the staff's work load can be effectively reduced.

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Implementing RFID Technology in Libraries: a new approach to Library services

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Abstract: Radio Frequency Identification (RFID) is one kind of computing technology has been implemented by many library and information centers as well as many organizations in India and abroad. It is radio wave that helps to communicate and track items, people and many other objects. There is a serial number that identifies those entities and other information on a microchip that is attached to an antenna. The chip and antenna both are called an RFID tag. The antenna enables the chip and helps to transmit the information to the reader. The reader immediately converts the waves into digital information and passed to the computer. However, the systems of RFID have many advantages including several shortcomings i.e. virus threat. This paper illustrates the emerging challenges associated with RFID technology as well as several technology used in library and information centers, its advantages and disadvantages also.

Keywords: RFID, Library Security, Radio waves, Security System, Tag, Theft detection.

Introduction: Radio Frequency Identification technology is a wireless technology mainly used for automatic identification using radio-waves to detect, track, identify, and thus manage various objects and people that e.g. merchandise (Ayre, 2010; Juels, 2005)¹. RFID (Radio Frequency Identification) is the

latest technology to be used in libraries to ensure security and facilitate innovative services (Kern, 2004)¹.

The great usage of intelligent technologies such as wireless networks and Radio-Frequency Identification (Kourouthanassis and Giaglis, 2005)⁶ has moved during the past decade from labs and niche uses into a broader range of application (Slettemeas, 2009)¹⁵ and derives from the tremendous expansion in computing power and in data captured for decision-making in various domains of retailing, including inventory and supply chain management, category management, dynamic pricing, customer segmentation, market basket analysis, and retail sales forecasting (Ravi et al., 2005)¹⁰. First usage of RFID is known as IFF (Identify Friend or Foe system) (Piramuthu, 2007)⁹. Extant literature shows that the usage of RFID technology is quite a new issue. Nevertheless, today, there are various areas in which RFID technology takes place. In this context, RFID has a wide variety of applications ranging from familiar building access control proximity cards to supply chain tracking, toll collection, parking access control, retail stock management, ski lift access, tracking library books, theft prevention, vehicle immobilizer systems and railway rolling stock identification, and movement tracking (Roberts, 2006)¹¹. Lee & Lee (2010)⁷ explains that RFID technology management is a process of evaluating RFID technology, developing RFID systems, managing RFID systems and RFID infrastructure to achieve business objectives. Hundreds of libraries in UK have implemented RFID mostly for self-service and the vast majority of these libraries are positive about their RFID investment and its benefits. (Edwards and Fortune, 2008)³. Currently, RFID technologies are used to identify, capture and transmit information from tagged objects to enterprise systems (Bhattacharya et. al., 2010:80)². Roh et. al. (2009)¹² studied about RFID adoption in some organization and they explained

RFID usage in libraries with a case study. RFID can provide many benefits for libraries, therefore it becomes an inevitable technology in libraries, both for financial and human-related reasons (Schneider,2003)¹³.

Components of an RFID system:

A comprehensive RFID system has four components:

1. RFID tags which are electronically programmed with unique information.
2. Readers or sensors for reading the tags.
3. Antenna.
4. Server on which the software that interfaces with the integrated library software is loaded.



Source: Wikipedia

RFID systems: In this typical system tags are attached to library material. Each tag has a certain amount of internal memory (EEPROM). In this memory it stores information about the material, such as its unique ID. In some cases details of bibliographic data and product composition are also available. At the time of passing through a Radio Field generated by a reader, the transponder in the tag transmits the

stored information back to the reader, thereby identifying the material.



Source: Wikipedia

Advantages of RFID systems: The advantages of RFID technology have covered many areas in Libraries. These are illustrated as below:

- **Simplified patron self-charging/discharging:** With the implementation of RFID in libraries patrons can avail the process of charging himself/herself. It is a remarkable improvement because they do not have to carefully place materials within a designated template. They can charge several items at the same time. By the same way patron is able complete the process of discharging. This system shifts the duty of staff to patron also and it is helpful at the rush hour in library.
- **High reliability:** The readers are highly reliable. Some RFID systems have an interface between the exit sensors and the circulation system. This system is

for identifying the items moving out of the library without acknowledgement of the authority. If the patron takes library materials in improper way, the library would at least know what had been stolen. If the patron card also has an RFID tag, the library will also be able to determine who removed the items without following the proper way. This is done by designating a bit as the "theft" bit and turning it off at time of charge and on at time of discharge.

- **High-speed inventorying:** Another unique advantage of RFID systems is their ability to scan books on the shelves without tipping them out or removing them. A hand-held inventory reader can be taken to pass through rapidly across a shelf of books to read all of the unique identification information. By using this wireless technology it is possible to update the inventory. It also identifies items which are out of proper order.
- **Automated materials handling:** One of the applications of RFID technology is automated materials handling. It consists of conveyor and sorting systems that can move library materials and sort them by category into separate bins or onto separate carts. This significantly reduces the amount of staff time required to ready materials for re-shelving. As the high price of equipment, this application has not been widely used.
- **Long tag life:** Finally, RFID tags last longer than barcodes because nothing comes into contact with them. Most RFID vendors claim that a minimum of 100,000 transactions before a tag may need to be replaced.
- **Fast Track Circulation Operation:** The use of RFID make the circulation process more swiftly by reducing the time consumption needed for circulation

process. The most significant time savings are attributable to the facts that information can be read from RFID tags much faster than from barcodes and that several items in a stack can be read at the same time. While initially unreliable, the anti-collision algorithm that allows an entire stack to be charged or discharged now appears to be working well.

Disadvantages of RFID Systems:

- **High cost:** The major disadvantage of RFID technology is its cost.
- **Vulnerability to compromise:** It is possible to compromise an RFID system by wrapping the household foil to block the radio signal. It is also possible to compromise an RFID system by placing two items against one another so that one tag overlays another. That may cancel out the signals. This requires knowledge of the technology and careful alignment.
- **Removal of exposed tags:** The RFID Tags cannot be concealed in either spine or gutter of the books and are exposed for removal. If a library wishes, it can insert the RFID tags in the spines of all except thin books; however, not all RFID tags are flexible enough. A library can also imprint the RFID tags with its logo and make them appear to be bookplates, or it can put a printed cover label over each tag.
- **Removal of damaged tags:** The damaged RFID tags are to be removed from the book to replace with a new one. At the time of removing the tag the book may be tempered.
- **Rush hour in library:** At the time of rush hour in library if the patrons pass through the scanner gate in very minimum gap of time the gate may not response properly in case of theft.

Challenges and recommendations on the implementation of RFID technology:

Since the implementation of RFID technology, the library has experienced a number of challenges. First, the cost of maintaining the RFID technology is much higher compared to the more traditional barcodes used earlier. At the beginning RFID tags were removed from library artifacts through vandalism since they are easier to find than electro-magnetic strips. There have been concerns over invasion of personal privacy based on the notion that tags on books contain personal information. The library has also been broadcasting images of visitors to the library and is able to know the kind of materials they read. It is known that RFID tags can be read from a long distance and its contents can be read by anyone with an appropriate scanner because RFID tags cannot tell the difference between one reader and another. While we have no evidence of this, we are vigilant of electronic gadgets that patrons might bring with them to the library. The detection rate of RFID tags by exit gates has been questioned and we are forced to reinforce the RFID exit gates with security personnel to forestall foul play.

Other challenges in the implementation of RFID technology include the following:

- i.** Inadequate expertise and professional advice. RFID is a relatively new technology which has not yet been implemented in many libraries.
- ii.** Lack of standardization for RFID technology. While the prominent standard is to employ a frequency of 13.56MHz, there is yet no formally accepted standard especially in this region.

iii. Unreliable power supply. If the RFID technology is to be used effectively there is need for consistent power supply. Failure to have this will lead to repeated closure of services such as security and circulation services. This may inconvenience library patrons and jeopardize the effectiveness of other library processes.

RFID technology is the latest fast growing technology that promises to improve efficiency in library operations. In order to implement RFID technology successfully it is important to consider factors that may affect the success of the project. These issues include the following

i. RFID Standards and appropriate software and hardware: There exist various vendors of RFID technology spread across the globe. Without widely agreed standards, the integrity of various hardware and software for RFID is a thorny issue that needs to be carefully considered. RFID technology implementation is a costly undertaking and every effort needs to be considered to ensure the library achieves its objectives and return on investment (ROI). Particularly there is need to acquire a stable, integrated library system (ILS) which supports all the functionalities of RFID.

ii. Training of staff: Properly trained staff on various aspects of RFID technology is needed to encourage embracing of the technology and facilitate proper execution of the various aspects of the project.

iii. Process planning: RFID implementation is a complicated project which involves several activities such as procurement of hardware and software, retrospective conversion from existing barcode technology, tagging of books, integration of

software, and training of patrons. It is very important that proper planning should be done.

iv. Privacy concerns of patrons: It is important that patrons fully understand the privacy issues surrounding the use of RFID technology. It is important that they be aware of personal-related data that is being collected by the library through the technology and how it is being addressed. This will minimize mistrust towards the technology.

Conclusion and recommendations: RFID is recognized as the ideal technology for managing libraries in the 21st century to facilitate innovative and efficient services and to enhance accountability of the part of LIS professionals. There are several benefits of RFID i.e. internal security, interaction with patrons, reduced repeatable task and reduced the intensity of labour required at the time of circulation and other library activities. At the same time initially we have experienced negative experiences such as removal of exposed RFID tags from books (vandalism and may be attempted to theft of books from the library) and high cost of maintenance of the RFID technology. However in overall RFID is one of the fastest and most beneficial technologies being adopted by business today and its advantages RFID far outweigh the disadvantages and therefore there are good reasons to implement RFID technology such as management efficiency and customer satisfaction. With careful considerations before investing in RFID technology return on investment can be achieved.

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RFID in Libraries and its other competitive technical developments

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&

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Abstract: Libraries are using leading RFID technology in a feedback control system. Today, more and more libraries are taking up RFID as it modernise workflow in the area of self service, book returns, shelf management and inventory etc. RFID has been executed in different ways by different manufacturers. The automated RFID-based system is a new idea by itself. Owing to the fact that better management of books and materials becomes possible, materials are not lost, theft is avoided, and patrons are served on time and correctly. In spite of all the benefits of RFID, there is always other side of the coin. This paper will try to portray the cons associated with RFID and other competitive technical developments.

Keywords: *RFID, Rubee, Memory Spot, Library security, Digital library, Automated circulation.*

Introduction:

Radio-frequency identification or RFID is an automatic identification method with a feedback control system. RFID uses electronic tags, called RFID tags or transponders for storing and remotely retrieving data. RFID, in general, refers to small electronic devices that consist of a small chip and an antenna. The chip typically is capable of carrying 2,000 bytes

of data or less. RFID device perform almost the same task as a barcode in a book or a magnetic strip on the back of a credit card or ATM card. It provides a unique identifier for that object. The RFID device must be scanned to retrieve the identifying information. Actually, it means, identifying a person or object using a radio frequency transmission, typically approx. 125 kHz (Low Frequency), 13.56 MHz (High Frequency) or 800-900MHz (Ultra High Frequency). RFID is also used in Libraries. Various Libraries has executed this technology for better library management.

RFID System in Libraries:

- Generally, passive RFID tags are in use in the libraries instead of active tags
- These passive tags have a very short read range
- Data stored on the library RFID tag carries information about the particular library material and not any other important information
- Vulnerable library database in a concern in terms of using RFID technology in libraries

Devices associated with RFID:

- ***Application Software***
Application software works to communicate with the RFID system and library back-end database.
- ***Host Computer***
This computer works as a server computer to management the whole procedure.
- ***Reader & Antenna***
RFID reader and antenna delivers high-throughput, high capacity communication, enabling organizations to capture, and manage important data.
- ***Smart Card***

The check-in and check-out function, using this e-card, becomes easy, exact and convenient to the library readers.

- ***RFID Tags***

These tags need not to be visible to be read, so books and other media can be identified quickly through the wireless reader and RFID antenna. It eases and speeds material handling.

- ***Library Programming System***

It is responsible for the conversion of the collection into RFID. Read-write and anti-theft programming is done in a single operation. This can coexist with conventional anti-theft equipments.

- ***Library Circulation System***

The RFID enabled circulation system can process 1 to 15 items simultaneously. The Circulation System can also read RFID reader-cards. The RFID enabled Circulation system can co-exist with any conventional security system.

- ***Library Inventory Reader System***

RFID reader can carry out fast and perfect stock checking and also search particular documents as re-shelving, weeding, and on-hold management.

- ***Library Security Gate or Entry System***

RFID enabled security entry-system allows to perform immediate reading and writing into the chip. At the same time, it also performs simultaneous activation and de-activation of the anti-theft function. RFID Security Gates are ultimately library collection-keeper and it is the most modern detection algorithm that relentlessly detects non de-activated items. When security is violated, an audible and visual signal runs instantaneously.

Benefits for the Libraries:

RFID can be used in the libraries to provide a cost-effective solutions various issues of the libraries.

- ✓ Annual Stock Verification: Using RFID system to verify yearly stock of the library documents at any level becomes very easy and it can be performed in a very short period of time without disturbing any kind of library services.
- ✓ Quick check on book shelving: Using RFID Inventory reader, correct book shelving can be checked in easy and convenient manner.
- ✓ Searching an item using a RFID scanner: Using RFID enabled Inventory Reader, any document in the library, if loosed, misplaced etc., can be searched very easily.
- ✓ Self Check-out: Library users can issue the desired documents using RFID enabled self check-out system without the intervening of Library Staff.
- ✓ Self Check-in: Library users can return any issued library documents using RFID enabled self check-in system without the intervening of Library Staff.
- ✓ Security: RFID tools are most helpful for security reasons in the Library.
- ✓ Library membership cards: Membership cards can be prepared by RFID tagging which can be used for multipurpose functions.

Other side of the Chip:

In spite of all the benefits of RFID, there is always a dark place under the candle. The cons associated with the RDID system are:

- ***High Cost***
The cost is one of the major influencing factors in case of acceptance of RFID. IT-infrastructure cost is another factor for RFID adoption. For many institutions it is the major investment in large scale. Other costs for RFID adoption is also very important, it includes the purchase of initial hardware/software, integrating RF-enabled technology into the library services and activities with the existing management systems. There are also additional maintenance costs for application upgrades, readers and software, and employee training.
- ***Frequency Block***
Blocking frequency is also a major issue for the RFID system in the library. The frequency can be blocked by covering the library material with an aluminum foil, so that the exit-gate sensor cannot recognize the item. Frequency is also a major issue for interoperability. Different frequency bands have been used for RFID tags and readers in different regions of world.
- ***Tag Tampering***
Removal or tampering of exposed tags causes problems with the exit gate sensor.
- ***User Privacy concern***
A big concern is the attack of privacy due to the use of RFID. Some library patrons will oppose to any RFID related system due to the perceived privacy issues surrounding it. All user activities like reading,

browsing, and user behavior will be identified by RFID readers which are installed in libraries.

- ***Reader collision***

This occurs in RFID systems when the coverage area of one RFID reader overlaps with that of another reader. This causes two different problems:

- *Signal interference.* The RF fields of two or more readers may overlap and interfere.
- *Multiple reads of the same tag.* It happens when the same tag is read one time by each of the overlapping readers.

- ***Tag collision***

It occurs when more than one tag or chip reflects back a signal at the same time, confusing the reader.

- ***Interoperability***

Interoperability is an important concept for standardization, including RFID. It is a complicated concern in RFID standardization due to various reasons. There are interoperability conflicts based on frequency allotment of regions. Another multifaceted problem is the issue of existence of two major standards which are ISO and EPC-Global. On the other hand, interoperability between barcode and RFID is also a matter of concern. There is another important issue for RFID interoperability as it is mostly a patent-based technology and it is developed by different companies in various shapes, sizes and designs for tag antennas.

- ***Virus invasion***

Like all other systems, RFID systems are also vulnerable to virus attacks. In most cases, to the virus it is a back-end database or even the library database.

RFID tag virus that can destroy the contents stored in the database, interfere with communication between the reader and the library database. In order to protect the library database, the database must be timely repair vulnerabilities and other risks.

Other Competitive Technological Developments:

➤ ***Ru-Bee by Visible Assets***

Ru-Bee, a two way active protocol is developed by Visible Assets. Visible Assets, a small firm in Miami, developed this packet based wireless technology. The Institute of Electrical and Electronics Engineers (IEEE) has announced that it is making the Ru-Bee protocol a standard. Ru-Bee is magnetic, not based on RF, so it works on steel and also underwater. Ru-Bee tags function at a low frequency (132 kHz), giving them different capabilities compared with RFID tags operating at high and ultrahigh frequencies. Existing LF RFID system have a range of inches. That means, the tags reflect energy back to the reader so the read range is short. Ru-Bee uses a power source to transmit radio-waves and has a much longer read range.

Ru-Bee works more like wireless mesh networks than conventional LF RF systems. Ru-Bee is designed for high security, for high noise harsh environment. Ru-Bee tags needs batteries for function but the battery life is almost 20-25 years.

➤ *Memory Spot by HP Labs*

HP Labs developed Memory Spot, is a kind of RFID system. Actually, it is the mirror opposite of the Electronic Product Code (EPC) concept. The EPC-protocol was developed to create low-cost tags that could be put on packaging that would be thrown away. To keep the cost down, memory on the chip was kept to a minimum. Memory Spot function like a miniature computer than like a passive tag. The chip has a 10mbps data transfer speed and it is almost 10 times faster than wifi speed. It has a short read-range, but can store a lot of information on the chip.

Memory Spot was announced in 2006 and yet to be used commercially. But it is already selected by Scientific American 50, a scientific journal.

Conclusion:

RFID technology is an emerging technology. It is also very effective and convenient technology in case of library security. The traditional technique of barcode on library items are still in use in various libraries but RFID slowly taking its place because of its high security system and anti-theft technology. But, one thing need to keep in mind that same flimsy RFID tags which are used by the retail store cannot be used in the libraries as in retail store the item will not come back to the store but in case of libraries, the users will return their issued items to the library. The recent competitive development of various security tools like Ru-Bee and Memory Spot will also play an important role in the library security and anti-theft system in the near future. The only concern is probably going to be the cost of the technology and its implementation. It is needless to say that, from the

selection to the implementation of the system librarians and other library staffs need to play an important role here as they are the main managers of the library.

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RFID: A new technology in library

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Abstract: This articles discuss about the RFID technology. It is a very new concept. This paper discuss the definition of RFID, its component, merits and demerits, Use of RFID in library. It papers also mention the name of library in India who use the RFID system.

Keywords – RFID, Tags, radio waves, library security. Information

Introduction

Libraries are treated the heart of educational setup and its play a vital and important role in the development of a country. The libraries of today is not only the store house of the books but also the analysis centers of information. Modern academic library is a place where millions of books, periodicals, CD, DVD, and other electronic reading materials are contained. It is a challenge to manage for librarians. RFID technology helps librarian to solve this problem. A library is a growing organism. The state –of- art technology for library theft detection is RFID which is now mostly introduced and used by many libraries and information center.

RFID

RFID is a modern technology it means radio frequency identification. RFID uses radio waves to automatically indentify people or objects RFID is a combination of radio frequency – based technology and microchip technology. RFID system used to carry information on suitable

transponders, on i.e usually called tags RFID transponder's means the micro chip and the antenna. The antenna enables the chip to transmit the identification information to a reader. At a glance, we called RFID is a small device that can store information.

RFID – in library

In the management of library system, RFID used for the library security i.e. library theft detection system. All the document of the library attached with an RFID tag. People can locate the books through the RFID tag. RFID tag can contain identifying information such as book's title or material type. This information is read by the RFID reader. This information is read by the RFID reader. The information can be read from, RFID tags much faster than from barcodes. A librarian can easily identify the books and locate the specific item through the use of RFID. It is also used in the circulation process of library. For this purposes, the system involves installation of special software. A person using this system to borrow books in presented with options on a computer screen. The person has to identify himself with a code, which is preferable a personal identification number, or any form of unique identify code Books selected by the persons are identified by the system's built-in-RFID reader. The surveillance bit in the book's tag is deactivate by the system. When a book is returned, the cheek – in/out system activates the surveillance bit. RFID also used in stock verification of books. RFID system can be done it in hours instead of days with barcode reader system.

Components

RFID based library system have the following components

- 1) RFID Tags that are electronically programmed with unique information (for Books, Journals, magazine, XD's etc.)
- 2) Readers or sensors to query the tags.
- 3) Antenna
- 4) Server on which the software that interfaces with integrated library software is loaded.
- 5) RFID label printer
- 6) Handled Reader
- 7) External Book Return
- 8) Staff Station Reader for circulation Desk.
- 9) RFID out Kiosk.
- 10) RFID Book Drop station.
- 11) Application software

Advantage of RFID in libraries

- 1) Reliability
- 2) High speed Inventorying
- 3) Ability to locate specific item.
- 4) Books are early indentify for shelving process.
- 5) Assist traceability of book allocation.
- 6) Easy Stock-Verification
- 7) Instant update of data base is possible
- 8) Accuracy in book collection management
- 9) More than one item can be checked out.
- 10) Relieve their professional employees of routine work.
- 11) Improve the security function of t he library.

Dis- Advantage of the RFID library

- 1) High cost
- 2) Not compatible
- 3) Reader collision
- 4) Tag collision.
- 5) User privacy concern.
- 6) Exit gate sensor problems.
- 7) Frequency Block.

Role of the librarian

RFID is the new system. So, the librarian should know the RFID system, its capability and uses in the particular library situation. The library should be open about its use of RFID technology. Librarian should follow some rules i.e.

- a) Only authorized personnel should have access to the RFID system,
- b) No personal information should be stored on the RFID tag.
- c) No static information should be contained on tag.
- d) All RFID readers in the library should be early marked. The entire library staff should develop interest in new ideas, acclimatize themselves to changing working conditions and achieve the goal already set forth. The librarian must have the vision, dynamism, determination, persistence and authority to create the essential conditions for the changeover and plan the entire technological set up

Use of RFID in India –

- 1) NASSDIC, New Delhi
- 2) Parliament library , New Delhi
- 3) IIT, New Delhi

- 4) BCL, New Delhi
- 5) ITT, Chennai
- 6) IMSC Chennai
- 7) Anna University, Chennai
- 8) IIM, Shilong
- 9) IIT, Roorkee
- 10) ITT, Kharagpur

Conclusion

RFID is a new technology. It is more effective and cost efficient technology in library security. In India, IIT'S are very successfully implementing RFID technology for library security. But, a library must follow the guidelines to utilize the technology. The efficiencies the technology can bring to libraries are too hard to over look. I hope, in future most of the libraries will be characterized by this technology based information service that extend the traditional mission of libraries in our society.

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RFID: A new concept of a modern libraries

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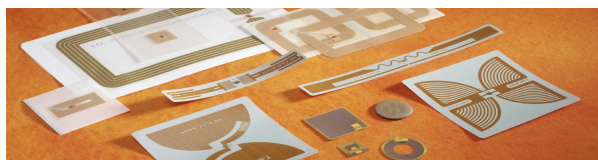
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Abstract: The paper gives an overview of the used of RFID technology in various library, especially academic library. Academic library is a pillar of a society. A brief introduction of RFID definition as well as its advantage, disadvantage and main key features of use are discussed. Radio frequency identification is a generic term that is used to describe a system and used in a security purpose. The main objectives of the security system should be to provide a safe and secure facility for library and resources and equipment and library patrons. Now a days it is an essential equipment for every type of libraries. We are also describes the main importance of library security, this paper emphasis on application of RFID technology in libraries, its component and all activities are describes and also indicate how to reduced theft of library properties. Now also discuss at the last stages where we mention differences between the term RFID and Barcode.

Keywords: RFID-advantages & disadvantages, library security, theft detection, tag, Barcode.

Introduction: RFID is an acronym that means radio frequency identification. It is the wireless non-contact use of radio-frequency electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. Some tags are powered by and read at short

ranges (a few meters) via magnetic fields (electromagnetic induction). Others use a local power source such as a battery, or else have no battery, but collect energy from the interrogating EM field, and then act as a passive transponder to emit microwaves or UHF radio waves (i.e., electromagnetic radiation at high frequencies) radio waves is most essential factor. Battery powered tags may operate at hundreds of meters. Unlike a bar code, the tag does not necessarily need to be within line of sight of the reader, and may be embedded in the tracked object. But RFID and Bar code is not same, this two are different in their work. Let us discuss about this function. RFID is totally new concept in this era. But this term was first use around 1960's and it's officially use in 1980's. Now it's very popular term for library professional.



RFID tags are used in many industries. An RFID tag attached to an automobile during production can be used to track its progress through the assembly line. Pharmaceuticals can be tracked through warehouses. Livestock and pets may have tags injected, allowing positive identification of the animal.

Since RFID tags can be attached to cash, clothing, everyday possessions, or even implanted within people, the possibility of reading personally-linked information without consent has raised serious privacy concerns. In our library RFID is very essential elements. S.R. Ranganathan said that save the time of the reader. When we use RFID technology in

libraries then men power is no needed, but all user required service done quickly and automatically.

The benefits of RFID in libraries:

- Accurate and complete data collection;
- Better utilization of employees' time.
- To saved library property or collection.

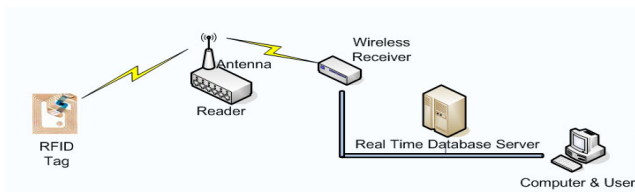
There are five major areas where RFID can better effectively used in a port cargo terminal:

- Access control ;
- Container security;
- Container security;
- Container identification and location;
- Activity tracking;
- Regulatory compliance. [1]

Components of an RFID system:

A comprehensive RFID system has four components:

1. RFID tags that are electronically programmed with unique information.
2. Readers or sensors to query the tags.
3. Antenna.
4. Server on which the software that interfaces with the integrated library software is loaded.



Tags:

RFID tag is the main component of a RFID management system. Which fixed include a book's back cover or directly onto CDs and videos. The tag is connected with a programmable chip and an antenna. Each papers thin tag contains an engraved antenna and a microchip with a capacity of at least 64 bits. These are three types of tags 'read only', 'WORM', and 'read/write'. Tags are read only if the identification is encoded at the time of manufacture and not rewritable. 'WORM' (write once read many) tags are programmed by the using organization, but without the ability to rewrite them later 'Read/write tags.' which are chosen by many libraries, can have information changed or added. In libraries using RFID is common to have part of the read/write tag secured against rewriting e.g. identification number of the item. [6]

Readers:

A receiver device called as reader detects the signal as soon it enters into its radio range decodes the number for interpretation. Reader interrogates the tags and offers optimum reading performance enabling instant data capture when passed alongside the item in a continuance movement. The device used within the building are usually called *readers* while the ones used at building exits are usually called 'sensors'. [6]

The reader powers an antenna to generate an RF field. When a tag passes through the field, the

information stored on the chip in the tag is interpreted by the reader and send to the server, which, in turn, communicates with the integrated library system when the RFID system is interfaced with it (Boss 2004).[3]

RFID exit gate sensors (readers) at exits are basically two types. One type reads the information on the tag(s) going by and communicates that information to a server. The server, after checking the circulation database, turns on 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, making it unnecessary to communicate with the circulation database.

Antenna:

The antenna produces radio signals to activate the tag and read and write data to it. Antennas are the channels between the tag and the reader, which controls the system’s data acquisitions and communication. The electromagnetic field produced by an antenna can be constantly present when multiple tags are expected continually. Antennas can be built into a doorframe to receive tag data from person’s things passing through the door. [6]

Server:

The server is the heart of some comprehensive RFID systems. It is the communications gateway among the various components (Boss, 2004). [3] An antenna is connected to the reader to help to process identification of the items and activate/deactivate the tag antitheft function simultaneously. Additional

antenna can be added to increase the number of item processed in case of larger transactions. [6].

Optional components:

Optional RFID system includes the following three components (Bibliotheca 2003):

1. RFID Label printer
2. Handheld Reader
3. External Book Return

RFID label printer:

An RFID printer is used to print the labels with an individual barcode, library logo etc. when the print is applied, it simultaneously programs the data in to the chip. After this process, the RFID label is taken from the printer and applied to screen the complete book collection on the shelves the book.

Handheld Reader/Inventory Wand:

The portable handheld reader or inventory wand can be moved along the item on the shelves without touching them. The data goes to a storage unit, which can be downloaded at a server later on, or it can go to a unit, which will transmit it to the server using wireless technology. The inventory wand will cover three requirements:

- Screen the complete book collection on the shelves for inventory control
- Search for book, which are misshelved
- Search for individual book requested.

External book return:

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. Since they have already been checked in, they can go directly back onto shelves. These units can also be used with sorter and conveyor system. [4]

Advantages of RFID management system in libraries:

The reliability of the system, its ease of operation, and the flexibility of tagging all kinds of media easily, are important criteria in choosing an RFID system. The main aim for today's libraries in adopting RFID is the need to increase efficiency and reduce cost. Automation and self-services can help libraries of all sizes achieve these aims, and RFID has the added advantage that it can also provide security for the range of different media offered in libraries. The technology can also improve circulation and inventory control, which helps allocate human and financial resources. This means that libraries can relieve their professional employees of routine work and operational tasks.

All of the tags used in RFID technology for libraries are "passive". The power to read the tags comes from the reader or exit sensor (reader), rather than from a battery within the tag. A few libraries use "smart" card which is an RFID card with additional encryption, is an alternative to merely adding to restricted areas or services. This would make it possible to

make it into a “debit” card, with value added upon prepayment to the library and value subtracted when a user used a photocopier, printer, or other fee-based device, or wished to pay fines or fees.

Faster circulation Transactions:

The use of RFID definitely reduces the amount of time required to perform circulation operations. The most significant time saving fact is that information can be read from RFID tags much faster than from barcodes and that several items in a stack can be read at the same time. The time savings are less for charging than for discharging because the time required for charging usually is extended by social interaction with patrons.

The perfect tracker:

Another feature of this technology in time saving and security aspect is that the RFID tags replace both the EM security strips or RF tags of older theft detection systems and the barcodes of the automated library system-i.e., the system is a comprehensive RFID system that combines RFID security and the tracking of materials throughout the library; or it is a hybrid system that uses EM for security and RFID for tracking, but handles both simultaneously with a single piece of equipment.[3M has developed readers that can do both concurrently excepts for videotapes and audiotapes. These have to be desensitized and sensitized in a separate operation]. In either case, there can be as much as a 50 percent increase in throughput.

Simplified self-charging/discharging:

For patrons using self-charging, there is a marked improvement because they do not have to carefully place materials within a designated template and they can charge several items at the same time.



Highly reliable:

The readers are highly reliable. Several vendors of RFID library systems claim an almost

100 percent detection rate using RFID tags (Boss, 2004). Several RFID library systems claim an almost 100 percent detection rate using RFID tags and there are very few false alarms than with older technologies once and RFID system is properly tuned. [3]

Some RFID systems have an interface between the exit sensors and the circulation system to identify the items moving out of the library. Where a person a patron to run out of the library and not be intercepted, the library would at least know what had been stolen. If the patron card also has an RFID tag, the library will also be able to determine who removed the items without properly charging them. However,

author has not been able to identify a library that has implemented this security feature.



High-speed inventorying:

A unique advantage of RFID systems is their ability to scan books on the shelves without tipping them out or moving them. A hand-held inventory reader can be moved rapidly across a shelf of books to read all of the unique identification information. Using wireless technology, it is a possible not only to update the inventory, but also to identify items, which are out of proper order. This feature of technology is very helpful in stocking where much time was wasted in manual entries.

Automated identification of materials:

Another advantage of RFID technology is automated materials handling. This includes conveyor and sorting systems that can move library materials and arrange them by category into separate bins or onto separate carts. This significantly reduces the amount of time required for reshelving the reading material.

Better than bar-code:

RFID tags are far better than bar codes, as these are not required to be scanned through some reader or recorder, as required in bar-code.

Long Tag Life:

Finally, the RFID tags last longer than barcodes, because nothing comes into contact with them. Most RFID vendors claim a minimum of 1,00,000 transactions before a tag may need to be replaced. [9]

This are the advantages of RFID used in libraries. But some disadvantages we are notice in the libraries. These are-

Disadvantages of RFID systems:

High cost:

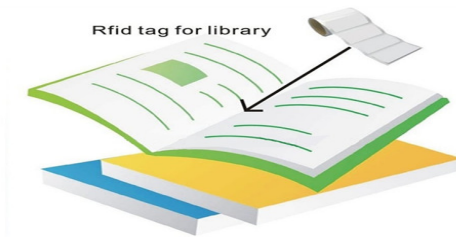
The major disadvantages of RFID technology is its cost. It is very costly chip. Because of these many libraries cannot used this chip. . While the readers and gate sensors used to read the information typically cost around \$2,00 to \$3,500 each: and the tags cost \$.40 to \$.75 each.

Vulnerability to compromise:

It is possible to compromise an RFID system by wrapping the household foil to block the radio signal. It is also possible to compromise an RFID system by placing two items against one another so that one tag overlays another. That may cancel out the signals. This requires knowledge of the technology and careful alignment.

Removal of exposed tags:

The RFID tags cannot be concealed in either spine or gutter of the books and are exposed for removal. If a library wishes, it can insert the RFID tags in the spines of all except thin books, however, not all RFID tags are flexible enough. A library can also imprint the RFID tags with its logo and make them appear to be bookplates, or it can put a printed cover label on each tag. [8]



Accessibility to compromise:

It is possible to compromise an RFID system by wrapping the protected material in two three layers of ordinary household foil to block the radio signal (Boss, 2004). It is also possible to compromise an RFID system by placing two items against one another so that one tag overlays another. That may cancel out the signals. This requires knowledge of the technology and careful alignment.

RFID tags are typically affixed to the inside back cover and are exposed for removal. This means that there would be problems when users become more familiar with the role of the tags (Boss, 2004). In Indian libraries, it is a major challenge to keep the tags intact. [3]

Exit gate sensors (Reader) problems:

While the short-range readers used for circulation charge and discharge and inventorying appear to read the tags 100 percent of the time (Boss, 2004). The performance of the exit gate sensors is more problematic. They always don't read tags at up to twice the distance of the other readers. There is no library that has done a before and after inventory to determine the loss rate when RFID is used for security. [3]



User privacy concerns:

Privacy concerns associated with item-level tagging is another significant barrier to library use of RFID tags. The problem with today's library RFID system is that the tags contain static information that can be relatively easily read by unauthorized tag readers. This allows for privacy issues described as "tracking" and "hotlisting" (Ayre 2004). [2]

Tracking refers to the ability to track the movements of a book (or person carrying the book) by "correlating multiple observations of the book's bar code" (Molnar and wagner2004) numbers (the hotlist) and then using an unauthorized reader to determine who is checking out items in

the hotlist. Or RFID tag. Hotlisting refers to the process of building a database of books and their associated tag.

Reader collision:

The signal from one reader can interfere with the signal from another where coverage overlaps. This is called reader collision. One way to avoid the problem is to use a technique called time division multiple access, or TDMA. In simple terms, the readers are instructed to read at different times, rather than both trying to read at the same time. This ensures that they don't interfere with each other. But it means any RFID tag in an area where two readers overlap will be read twice (FAQ 2004).[5]

Tag collision:

Another problem readers have is reading a lot of chips in the same field. Tag clash occurs when more than one chip reflects back a signal at the same time, confusing the reader. Different vendors have developed different systems for having the tags respond to the reader one at a time. Since they can be read in milliseconds, it appears that all the tags are being read simultaneously (FAQ, 2004).[5]

Lack of standard:

The tags used by library RFID vendors are not compatible even when they conform to the same standards because the current standards only seek electronic compatibility between tags and readers. The pattern of encoding information and the software that processes the information differs from vendor to vendor, therefore, a change from one vendor's system to the other would require retagging all items or modifying the software (Boss, 2004).[3]

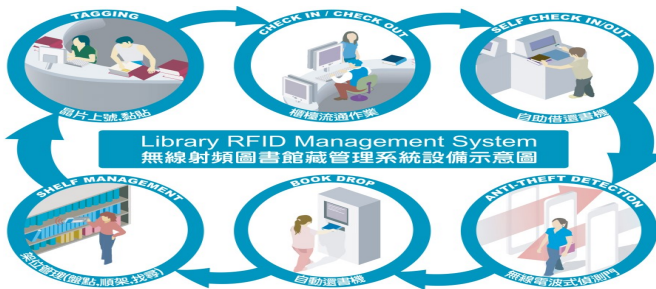
Barcode:

At this point of view we think Barcode and RFID are same thing, but this are not .A Barcode is an optical machine-readable representation of data relating to the object to which it is attached. Originally barcodes systematically represent data by varying the widths and spacings of parallel lines, and may be referred to as linear or one dimensional. Also two dimensional system use a variety of symbols.

The main difference between Barcode and RFID is-

Bar codes	RFID Tags
<ul style="list-style-type: none"> • Bar codes require line of sight to be read 	<ul style="list-style-type: none"> • RFID tags do not require line of sight to be read.
<ul style="list-style-type: none"> • Bar codes can only be read one at a time 	<ul style="list-style-type: none"> • RFID tags can be read virtually simultaneously.
<ul style="list-style-type: none"> • Bar codes cannot be used in dirty environments (physical condition important) 	<ul style="list-style-type: none"> • Here physical condition is not necessary.
<ul style="list-style-type: none"> • Bar code can identify specific types of item. 	<ul style="list-style-type: none"> • RFID tags can identify specific items
<ul style="list-style-type: none"> • Bar code information is static 	<ul style="list-style-type: none"> • RFID information can be updated

Steps to RFID technology works library management system...



Conclusion:

Now RFID is a very popular term. In this paper we discuss a basic knowledge of RFID and its application for libraries. This term is coin probably 1969 and it's applied in libraries in 1980. Now it's familiar of all technical person who involved in libraries. Even though numerous limitations and unresolved issues still hinder the widespread application of RFID. RFID continuous to makes inroads into inventory control system. RFID's potential benefits are large, we are sure to see many novel application in the future. When we used this application we are saved man power, money and time also. The main problem of this application it's highly cost. But we aspect it's cheap in the future and all librarian can apply this application in the libraries and in the case of India we are slowly achieve this concept. Because we have not tremendous money power but we are try to accept this. This is the very helpful chip for any library and we also established Ranganathan's fourth low save the time of the reader and we can also control our library security without depends of any staff or security men.

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RFID and Bar-code Technology

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Abstract: RFID or Radio Frequency Identification is a thorough process where it starts with mounting the RFID readers and cameras. Once the object starts to move, the network starts to track it; there is no need to read all reports and answer the queries at all. This paper highlights that RFID scanning is prone to having a higher frequency of equipment breakages in this particular harsh environment even though it is less sensitive to operator errors compared to barcode. The significant numbers of equipment failures that were observed contributed to a large extent in causing variation in the mean observed scanning cycle time. Resilience to operator errors suggests that RFID might be an easier technology to adopt when we look at it from a workforce-training perspective. Due to this advantage, the attractiveness and cost-effectiveness of RFID might increase provided the training costs are included in adoption costs. However, when it comes to Barcode tags, certain factors on which barcodes can be read such as an adequate print contrast between the light and dark bars and having all bar and space dimensions within the tolerances required for the symbols. The Barcode technologies that are used by each readers differ a bit from each other in case of reading as well as decoding. Once readers understand the basic differences between Radio Frequency Identification and Barcode technology, it will be easier to spot the differences between them and also the implications of them.

Keywords: RFID; Bar code Technology; Implications; Comparison; Radio Frequency Identification; Information and Data; Operation; Function

1. Introduction:

As the RFID system has been getting famous enough, it has grabbed the attention of the UK retailers. Why the system has become so dear to all of them? Actually, it is the planning and review which influence their intelligence to increase their operations and obviously satisfying their customers. Even, it has been assuming that there will be a huge transformation in the supply chain as the process is going to excel its all records. The advance RFID or Radio Frequency Identification technology is able to create a huge collection of information. There are several big brands and famous retailers who are using this technology and grabbing the upfront market with immense popularity. The golden names which are at all praise of this advanced technology are Tesco, Prada, Marks & spencer and obviously the Wall-Mart. Though there are certain organizations which are not still sure about using this technology, you will find the topmost brands and companies who have not only made the technology trustworthy, but also introduced RFID badges on their company badges. It is their belief that these badges can make employee access easier to buildings or areas where security is needed.

2. Objectives:

- a) To find the use of Bar-code and RFID technology;
- b) Comparative study between Bar-code and RFID technology

3. Comparison in Literature Reviews:

Through literature reviews it has been proved that there are not more empirical investigations are conducted to know the advantages of Bar-coding and RFID

technologies. The popularity of RFID has made the companies so overwhelmed that the usefulness of Bar-coding has almost blurred. You will be surprised to know that there are five billion bar codes are scanned around the world every day and those are also implementing in several product ranges and businesses. Initially, maximum literature mainly focus on the cost savings of the organizations by implementing RFID. The cost saving and promoting has become easier as getting appropriate stock information and speedy scanning of inbound product has simpler with this technology.

If you go on comparing the Bar code technology with RFID, you will see that Bar code technology has always been neglected in comparison to RFID. It is true that RFID technology has gained enough success in many of its implementation, but there are certain cases where it failed to serve the appropriate benefits. It is only the present time commentators who have shown some new sides of Bar-code technology that can be used in modern supply chain. It happens that the success of RFID technology is measured in terms of return on investment or cost effectiveness, but if companies start to compare the maturity level of the technologies, Bar code will always come first. Besides this, there are certain accounting methods which restrict the comparison between bar code implementation and RFID with other organisations. There are opinions that when it comes about sturdy technology, RFID will beat bar code technology by providing high speed and accuracy, even within harsh environment. So far, you have seen how difficult it is to compare between two great technologies and this is one of the primary reasons that many organisations have not yet switched to RFID technology so far.

4. Purpose of the study:

You have already gone through a comparative study between the upcoming RFID and the existing bar coding technology. But, it is quite difficult to prove which one is superior as there is no empirical evidence. This paper can be used as references while presenting these two technologies in the literature. The most popular example of using RFID technology along with barcoding is that Motion studies based on time were conducted in a cold warehouse of a distribution company and RFID was already implemented there on refrigerator, but it was the bar coding system that was applied on recyclable food trays. The actual aim behind this operation was to record the number and nature of the mistakes of each technology. After such experiments, it has been proved that when it comes to implementation, though RFID technology can provide better operational performance than age-old Barcode system, it has not been proved enough reliable.

5. Bar-Code:

There are enough differences between Barcode and RFID. Basically, Bar code is an optical machine-readable representation of data relating to the object to which it is attached. Bar code is a traditional method which was used to represent data systematically where the width and space between parallel lines would vary. Thus, the process was described as one-dimensional or linear. With the course of time, the technology advanced a lot and finally takes various shapes- rectangle, hexagons, dots and lots of other two dimensional geometric pattern. The basic 2D systems have lots of symbols and those are also known as bar codes. Initially, the special scanner, used to read bar codes, were known as bar code readers.

The bar codes have four different regions:

- a) **Quiet Zone:** The minimum required space for bar code scan-ability, preceding the Start Character of a bar code symbol. This zone is not applicable for printing and the color of the background and the bar code symbols are similar.
- b) **Start Code:** Indicative of the start of the bar code. Here, you can get specific bar code characters which signify the beginning of the data to scanner and reader. Start characters are normally stripped off and not transmitted to the host.
- c) **Check Digit:** This is the mathematical term which is used to ascertain the accuracy of the other elements on the bar code. As it is an extra digit, added at the end of barcode, this may not be present always. This is done to make sure that the scanner can read the code properly. It is also stripped from the data and not transmitted to the host.
- d) **Stop Code:** This indicates the stopping or end point of the bar code. These characters signify the end of data to the reader or scanner and are stripped-off and not transmitted to the host.

You will be surprised to know that the root of Bar code and RFID technology are same. That is called auto Identification. This is a wide category of technologies which are primarily used to identify animals, objects and also human. There are several other technologies which are connected to Auto-ID as smart cards, optical character recognition system, biometric system, etc. No matter these two technologies have come from same background, but there are lots of differences between them which signify the advantages and disadvantages of both the system.

a) **Bar-code Technology:**

Bar codes are part of every product that we buy and have become the ubiquitous standard for identifying and tracking products. Traditional bar code technology is coupled with the Universal Product Code (UPC) and regularly accounts for billions of scans all over the world. In the year 2006, according to a survey conducted by Zebra Technologies, more than 96% of European companies have given improved efficiency as the main benefit and reason for using bar code technology. Some of the other reasons they listed are- 32 percent of the companies believe that it leads in increasing the accuracy of ordering and invoicing, 26% stated cost reduction as a reason and 16 percent opted for bar code technology as according to them the newer technology isn't ready yet. Within the Auto-ID family, a new two-dimensional system of bar coding has evolved which allows bar codes to hold more data compared to the traditional method. Horizontal and vertical, both methods have been used to encode data. The more data are encoded, the size of the bar code can be increased in both the horizontal as well as vertical directions thereby maintaining a manageable shape for easy scanning and product packaging specifications.



Traditional One-Dimensional Bar Code Two Dimensional Bar Code

The use of the two-dimensional bar codes can be already for concert tickets by sending a bar code to a mobile phone and then scanning the message at the door by a laser gun. Further developments in the lasers used to scan bar codes help improve the efficiency and speed in which bar codes can be scanned.

6. Radio-frequency identification (RFID)

RFID is the use of a wireless non-contact system which uses radio-frequency electromagnetic fields for transferring data from a tag attached to an object, for the purposes of automatic identification and tracking. The basic concept behind RFID systems is that one mark items with specialized RFID systems is that one mark items with tags. These tags contain transponders that are responsible for emitting messages readable by specialized RFID readers. RFID tags can be also contain writable memory, which can store information so that the information can be transferred to various RFID readers in different locations.

RFID tags can be divided into two general categories, active and passive, depending upon their source of electrical power.

- a) **Active Tags:** Because they have their own power source, active tags transmit a stronger signal, and hence can be accessed by the readers from a great distance. Active RFID systems are known to work well on large items that can be tracked over great distances due to the on-board power source. However, the on-board power source is responsible for making them larger and more expensive as well. Active tags that can be categorized as low power are generally larger than a deck of playing cards. Active tags can remain

dormant until they come in range of a receiver or can constantly broadcast a signal.

- b) **Passive Tags:** One the other hand, Passive tags are expensive. They cost as little as 20 cents a piece. The new technologies are constantly trying to make them cheaper so that they can be integrated into common materials and products. In addition to their low cost, passive tags can also be quite small in size. The smallest passive tag is usually reduced about a size of quarter due to the latest antenna technology. The larger the tag, the larger the read range. Currently, passive RFID tags contain about 2 Kbits of memory which is believed to be too small to hold complex information. The technology that is used behind RFID is improving on a constant basis, so the amount of information and capabilities of RFID tags are also believed to increase over time.

7. Bar coding vs. RFID:

Table 1: Difference between RFID and Barcode

BARCODE	RFID
Require the line of sight to be read	Can be read without line of sight
Can only be read individually	Multiple tags can be read simultaneously
Can only identify the type of item	Can identify a specific item
Require a manual tracking and therefore are susceptible to human error	Can be tracked automatically while removing human error
Cannot be read if damaged or dirty	Can sustain in harsh or dirty environments
Cannot be updated	New information can be over-written

It has been observed that RFID tags can be affected adversely by demanding environments. For example, they are acutely affected if they are brought into contact with liquids or metal. The signal frequency that RFID uses is also subject to interference as they are commonly used by other technologies as well. Bar codes, however, can be printed on durable materials and are not affected by substrate materials or electromagnetic emissions either. Hence, these qualities help bar code technology to garner a competitive edge in some industries and also environments. Improvements in how bar codes are printed are evolving all the time as manufacturers are attempting to strengthen the bar code system. When damaged thereby shortening the gap between the two technologies further. Developments in the range at which bar codes can be scanned similarly reduce the apparent performance gap between RFID and bar coding.

8. Conclusion: So, to conclude, with the help of this paper, a comparable analysis of RFID and bar-coding technologies in practice have been represented. It has been observed that the findings support much of the research that has been existed and is indicative of the fact that RFID can deliver more rapid scanning times when compared to barcode scanning. The study suggests this as one of RFID's many benefits as tags can be scanned without being in the user's line of sight. Therefore RFID becomes immediately preferable over barcode technology when it comes to the majority of operational environments where rapid throughout of product is of paramount importance, such as into and out of chilled warehouses. However, the latest developments that happened in two dimensional barcodes and laser scanning equipment, resulted in consumption of time but which will require the scanning equipment, resulted in consumption of time but

which will require the scanning of the barcodes and an empirical analysis of this particular technology.

It has also been noted in this paper that by supporting the very idea and concept of hybrid RFID-barcode systems would employ a particular technology in a specific area to take advantage of its relative cost effectiveness or robustness. Although, the doubts still remain whether the additional complexity of such hybrid systems will lead to an increase in the total system cost which will ultimately lead in exceeding the operational or cost benefits that the individual technologies may deliver.

The study however doesn't provide an account of the cost effectiveness or return on investment of these technologies since individual organizational costing and accounting methods may hide the total costs involved. Lastly, it goes without saying that the rapid advances that are being made in both technologies only suggest that further comparative studies must be made throughout their maturation.

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User satisfaction by using RFID technology at Central library, Sikkim University

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Abstract: Radio frequency identification (RFID) is a rapidly emerging technology which allows detecting, tracking, identifying, and managing various objects in a library. This current technology ensures security and facilitates innovative services in libraries. The article deals with the implementation of RFID technology and its problem and probable aspects in Central library of Sikkim University. Interview and survey method have been followed to accomplish the work. The study has revealed various aspects of this technology and the user satisfaction level of this particular university. During the work it has been observed there are several benefit and weaknesses side by side. Before implementing RFID in other academic institutions the Sikkim University, central library can be a great example before them.

Keyword: RFID, Sikkim University, Library management, patron satisfaction

• **Introduction:**

User satisfaction is the main aim of library management. RFID, **Radio Frequency Identification** technology helps to improve the collection management and self service system. RFID technology works with the help of radio waves. RFID is an emerging technology which still in developing stage. It is a

data collection method between tags and readers to send and receive data by using radio waves.

- **Implementation of RFID:**

The case study is conducted in Central Library of Sikkim University and the information is collected from the users and staff by taking interview. The main purpose of the case study is to gain better understanding of how RFID based library management works and after analysis we get a clear vision of the current situation.

- **Library Background:**

The Central Library of Sikkim University was started in 2008. Collection of the library is 70,000 books, near about 300 encyclopedia and many other documents. Every day near about 200 users use this library but the staff strength is very poor. There is only 14 staff in this library.

RFID technology is included in various components in libraries, such as tagging station to tag the RFID label to each library material, self check-out station to borrow the books using the self service for users; for return the books used book drop station, and anti-theft security gates ensure to detecting that the items are checked-out before leaving the library by the RFID label.

The concept of this central library implies the adoption of RFID technologies gives a better services and user satisfaction. For borrowing or returning the items, automatic lending machines helps the users very much, which require a library card and a password. This password is a general password “Member” which is applicable to all users. With this technology self service becomes much easier.

➤ **Hardware devices are use in Sikkim University:**

- 1) **RFID tags:** An RFID tag consists of a chip and an antenna. It helps to identify and track the library documents. RFID readers access information of documents via radio signal which is stored in RFID tags. RFID tag can be applied in every document.
 - 2) **Staff Station Readers:** The item has already attached with RFID tag or not is check by staff station reader before connecting it to the system. For cataloging module RFID staff station readers are mainly used.
 - 3) **Handheld Readers:** RFID handheld reader is primarily designed for performing activities such as shelf order checking, shelf-reading, searching. RFID handheld reader is mainly used in stock verification of books. High Frequency (13.56 MHZ) hand held reader is used in this library.
 - 4) **RFID Security Gates:** Security gates are placed at entry and exit of the library to keep check on unauthorized books going outside. Gate detection system capable of detecting unauthorized tagged items passing through it. Minimum reading range of this security gates is 36 inches.
- **RFID modules of Sikkim University:**
 - 1) **RFID Tagging Station:** All the materials are affix by tags and then program. All these work are done in tagging station. A tagging station consists of a network PC, reader and antenna. At first every item is attached with RFID tags then item's barcode is scanned by the handheld reader and the system is

connected. After that, information is stored into RFID label using the system. Only one tag is attached with single documents. A label is an item identification chip that contains more advanced technology than conventional bar code data.

2) **Patron Self-Check-out Stations:** Self check out unit save the time of the users. The Patron Self Check-out Station consists of a PC with a touch screen monitor, a RFID reader and with a receipt printer. The use of Self-check-out unit is easy. At first the user chooses his desire language from the touch screen monitor, and then the user is identified by his member card and its password. After identification, the user can place items on the reading table, and then the items status shows on the monitor screen, borrowed or not. The receipt will be printed after the items are successfully borrowed.

- **Strength:**

- RFID technology has been applied in this library system just a few past years, though this technology is not mature but it is in developing stage. The technology originally can only simply use the self check-in and check-out function, but till now, the logistics, effectively inventory and sorting the returned books are to be done. RFID is much better than traditional barcode and magnetic strip. First of all, the speed of self-checkout/in is faster. When identify the object with barcode, its speed is limited because it requires the line of sight and the physical contact. But in case of RFID, doesn't have those requirements and multiple items can be read at a time, which improves the self-check in/out efficiency and saves the time of users.

- Improve the efficiency of the management of collections. Using barcode technology is very time consuming and challenging task to find out the mis-shelved books. However, with the help of RFID technology the problem can be easily solved. RFID technology can locate the book within a short time.
- Though the staff strength is poor in this university library but user service is well because of RFID, more and more users prefer to self-check in/out the books.
- Library theft detection system is used by RFID technology. To active the anti-theft function it requires a separate Electromagnetic alarm strip to be attached to the item.
- Finally, RFID tags have large information storage capacity and long life expectancy.

Unlike barcode, a typical RFID tag can hold 2KB of data, while a typical barcode represents only 10-12 digits. Besides, RFID tags have long life expectancy and they can be rewritten, whereas if the data is change or barcode labels are wear out it must be reprinted each time.

- **Weakness:**

Though RFID technology is in developing stage there are still some problems exist.

- Every country can set its own rules due to lack of global standardization of this technology. Due to its incompatibility, the library in one country may not share its resources to another.
- Cost of RFID products is expensive. Though the price of RFID tags decrease every year, and the maintenance costs are still relatively high.

- As if this technology is not mature so the frequency of the chips can interrupt by metal and water.
- Sometime there may be signal problem when attempting to read several tags at a time.

- **Threats:**

Privacy violation threat is the biggest problem of developing RFID technology. Less staff required if RFID technology is used in a library. Small library could not afford to use the chip technology could go out of business.

Lastly, RFID is a new and immature technology, compared to barcode, though it has lots of advantages. In library field, operation between two of them, only one will survive so RFID facing a great challenge in future.

- **Opportunity:**

RFID technology is continuously improving due to its rapid development and its application is involved in more and more fields. The cost will be accordingly reduced due to the larger amount of RFID tags producing at a time. All those will bring more opportunities to the small investment and make RFID's future in the business more apparent and positive.

- RFID standards are constantly being updated and are still being developed. Unique Standards ensure for interoperate between different entities. This should result in lower prices of RFID products to the users.
- RFID technology is developing rapidly, and due to its unique features its application is accepted in various fields. It will bring the revolutionary change, if the books publishing industry could be adopted this technology in the near future. It will bring total

changes in the whole industry chain such as shipping, publishing cost and library collection management etc. RFID technology is closely cooperating with many library field and more functions are continuously being updated.

- **Analysis of the study:**

User's satisfaction is the main focus of the library service. A small quantitative survey questionnaire has been conducted with 40 respondents, among them 20 users are male and 20 are female. It is really important to design good questionnaire questions because the quality of data is measure by this. First of all, defined the question objectives and the type of answers need to match the goal of the question. Next, it is important to ensure that the respondents know the answer and are able to answer it.

Aiming of improve the self service of the central library of Sikkim University adopts RFID technology. Using automatic lending machines users can borrow and return the items, which require a library card and a password, and the password ("Member"), is common to all users. With the help of new technology as it does not require line of sight and maximum 3 items can be borrowed at a time.

In this part the collected data is presented in tabular format and then interpreted. Among 40 respondents half are male and half are female and they belong to different category of age.

Table 1 The respondents' age in years

Age	Male	Female
Below 20	15%	10%
20-40	55%	50%
40-60	20%	30%
Above 60	10%	10%

Table 1 is representing the age of the respondent and divided them into four categories. Respondents are asked how frequently they visit this library. The response categories are in divided into four scales: daily, weekly, monthly and yearly. Measurement of this data is done in percentage form according to the no of users in both categories already mentioned above.

Table 2 Percentage of visiting the library

	Daily	Weekly	Monthly	Yearly
Male	55%	35%	10%	0%
Female	45%	30%	20%	5%

Table 2 shows the frequency of library visits by presenting the percentage of male and female. From the data we have seen that more than half males come to library daily and near about half females are coming daily basis.

The core of this paper is measuring the user’s satisfaction. Measuring result would be the answer to the following questions.

Question 1: Service provided by this library

Question 2: Ease to use self issue/return machine

Question 3: Ease to find an item with the help of RFID technology

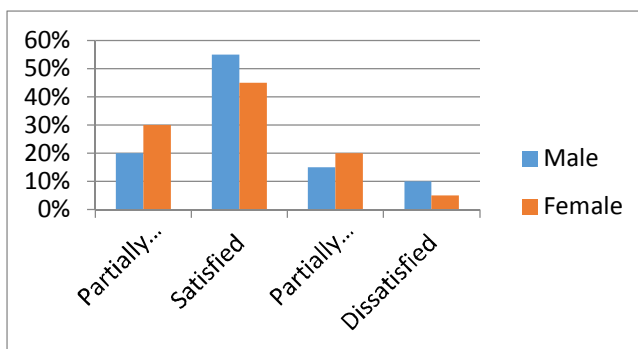
Question 4: Familiar to use with other RFID equipments

Question 5: Ease of use of self-checkout station

Responses of this above questions are divided into four scales: partially satisfied, satisfied, partially dissatisfied, dissatisfied.

Table 3 Measuring Satisfaction

	Partially satisfied	Satisfied	Partially dissatisfied	Dissatisfied
Male	20%	55%	15%	10%
Female	30%	45%	20%	5%



Satisfaction of Serving Quality

As it can be seen from the above figure, male users are more satisfied than female users; whereas male users are less partially satisfied and partially dissatisfied than female users. Due to small sampling size the result does not have much difference.

- **Conclusion and expectation:**

The conclusions are drawn based on the analysis of the survey result and future scope of this technology. In library management as compared to conventional bar codes and magnetic stripes, RFID provides much more advantages. RFID will benefit both the library as well as the patrons if investing in RFID technology should be based on real needs instead of mandatory instructions. Though RFID has the unique advantages and flexibility of RFID, the technology is still not yet widely installed in the library environment and its

total functioning is not familiar with the users. But the good news is its application, standardization, and innovation is constantly changing and tries to reduce its cost. Though the technology still is in developing stage, the rapid improvement will lead to a bright future and RFID will surely play an important role in library management in the future.

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Library Security Measure through RFID Technology

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Abstract: The intellectual capital of any library basically consists of books, scholarly journals, magazines, reports, theses including CD/DVDs etc. For safety and security of these materials, continuous researches are being carried out that can ensure a safe and secure environment for library professionals, library resources and equipments and patrons. One of the latest outcomes of such researches is the Radio Frequency Identification (RFID) Technology. Radio Frequency Identification (RFID) is the most modern fast growing technology that can be used in the modern library environment for minimizing the theft of documents and as an access control system. RFID – based library management systems move beyond security to turn into tracking systems that unite protection with more efficient tracking of materials throughout the library, including smooth & faster circulation, inventorying and materials management. The technology used in the RFID systems perhaps the most advanced and can replace the other theft detection systems. This paper gives general idea about the RFID, its components, benefits and its importance in the library systems. It explores the concept of RFID technology in libraries as the recent application in theft detection system. It also briefs its application in Indian libraries to some extent.

Keywords: RFID, Radio Frequency Identification, Library Security, Theft Detection, Indian Libraries

Introduction

Radio Frequency Identification (RFID) is the technology that uses radio waves to automatically identify individual items.

According to Automatic Identification and Data Capture (AIDC),

“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”The basic purpose of any RFID system is to carry data in suitable transponders, generally known as tags and to retrieve data, by machine readable means, at a appropriate time and place and to satisfy particular application needs.⁹ 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”. RFID, thus is a generic term for technologies that use radio waves to automatically identify people or objects.⁶

RFID is an innovative automated library system for automatic identification and tracking of library materials. RFID technology is helpful in taking inventory, finding missing items and identifying misfiled items .It also describes about the basic and optional components required for smooth working of the exercise. A library is a growing organism. The state –of –art technology for library theft detection is RFID which is now mostly introduced and used by many libraries and information centres .It is a combination of radio-frequency –based technology and microchip technology to be utilized. The efficiencies the technology can bring to libraries are too hard to overlook.

History of RFID technology

The British was the first to pioneer the RFID technology during the World War II for the identification of their own

aircrafts. Its further implementation started in late 1960s when the US government began using RFID to tag and monitor nuclear and other hazardous materials .In 1972, Los Alamos Scientific laboratories transferred its technology to the public sector , which encouraged a number of companies to explore new uses of RFID tag with rewritable memory was obtained by Mario E. Cardullo on January 13,1972. Same year, Charles Walton, a California industrialist, received a patent for a passive transponder that was used to unlock a door without a key. Walton licensed the technology to a lock making company Colled Schlage. RFID in India was developed in the 1940's for defense applications. First time it was used for commercial purpose in 1980 for cattle tracking applications. The first library RFID suppliers started to market their systems in mid 1990's. With regard to library use of RFID, Seattle's RFID library project is the largest in the world, with Shanzhen's in second place .Today, RFID is used for automatic toll collections, access control, security, tracking objects and humans in shops, libraries hospitals, etc.

Objectives of the study

1. To investigate the basic idea about RFID and its components
2. To find out benefits of RFID for Libraries
3. To identify the use of RFID technology for library security

Review of literature

Kumar & Kaur⁴ discussed the advantages, disadvantages, components, and technical features of a RFID library system to provide guidelines for the evaluation of different systems.

Madhusudhan⁵ opined that the RFID technology could be the future of services provided by libraries, but the involvement of high cost in the working and implementation has been encountered as the primary challenge in its proliferation.

Sarasvathy, Jagdish, & Giddaiah¹¹ highlighted the essential role of RFID in the management and security of the pool of resources in a library. Hasan⁴ enumerated merits of RFID over barcode and electromagnetic tapes.

Sinha¹³ opined that although the RFID Technology is quite expensive, but the technology is set to become more popular in India with more deployment in the coming time in different sectors because it has yielded excellent results by reducing the labor, costs and providing better results, which lead to precise security and control on access.

Methodology:

The authors have studied and reviewed various articles from published literature including online journals and observations are undertaken accordingly.

Need for libraries to adopt security measure

The library and information security means provide a safe and secured facility for library employees, library resources, equipments and library patrons especially against their theft and mutilation. In today's environment libraries need to have policies and measures to safeguard their resources effectively and efficiently.

Addressing the dilemma of social inclusion and stock security in today's libraries is not an easily achievable task. The causes of crime are diverse and book theft cannot be totally eliminated. Arguably, imposing security regulations in a library to reduce book theft sits uncomfortably with the philosophy of widening participation but shrinking budgets during the 'credit crunch' require some form of action.

Libraries need to have policies, protection measures and trained staff in place in order to safeguard their investments.

Time line of RFID development ¹²

Decade	Development
1940 – 1950	Radar refined and used major World War II development effort. RFID invented in 1948.
1950 -1960	Early explorations of RFID technology, laboratory experiments.
1960 – 1970	Development of the theory of RFID. Start of applications field trials.
1970 - 1980	Explosion of RFID development. Tests of RFID accelerate. Very early adopter implementations of RFID.
1980 - 1990	Commercial applications of RFID enter mainstream
1990 - 2000	Emergence of standards RFID widely deployed RFID becomes a part of part of everyday life
2000 -	RFID explosions continues

Components of RFID

1. Tags or transponder of RFID are programmed electronically with unique information
2. Readers or Sensors are developed to query the tags.
3. Antenna.
4. Server
5. RFID Label Printer
6. Handheld Reader
7. Self Check Unit
8. External Book Return Station
9. Staff and Conversion Station

1. **Tags:** Tags are the heart of the RFID security management system that can be fixed inside the back cover of the books or directly on CDs and videos. The

tag is equipped with a programmable chip and an antenna.

2. **Readers:** Reader interrogates the tags and offers optimum reading performance enabling instant data capture when passed alongside the items in a continuance movement.
3. **Antenna:** An antenna is connected to the reader to help to process identification of the items and also activate / deactivate the tags antitheft function simultaneously. Additional antenna may be required to increase the number of item processed in case of huge transactions.
4. **Server:** 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 exchange information with the circulation database.
5. **RFID Label Printer:** Used to print the labels
6. **Handheld reader:** It can be used along the items on the shelves without touching them. It may be used in stock verification, used in search for misshelved items and also search for individual book on request.
7. **Shelf Check Unit:** Through this method user identification is done with an RFID-ID card.

8. **External Book Return/book Drop Station:** Libraries can provide a distinct service, such as ability to return the books when library is closed through drop station.

9. **Staff and Conversion Station:** Staff station consists of antenna, electronic module and power supply.⁸

Benefits of RFID use in Library

1. RFID improves library workflow
2. Reduces non-value added work processes
3. Enhances staff productivity
4. Improves customer service
5. Assists inventory check with ease.
6. Provides easy book identification for shelving purpose.
7. Assists traceability of book allocation
8. Enhances book return processes by full automation of check-in, EAS activation and system updates completed simultaneously in the self-return chute
9. More than one item can be checked out or checked in at the same time.
10. Faster inventory process.¹⁴

Importance of RFID in libraries

Library professionals have always tried to use the new technologies that best suits their requirements. The first Library suppliers started to market RFID systems in the mid 1990's. RFID technology was implemented in libraries in the late 1990s for varied library operations across the globe.

RFID has slowly come out to replace the traditional barcodes on library items *viz.*, books, back volumes, CDs, DVDs, etc. The RFID tag can contain identifying information, such as a book's title or material type, without having to be pointed to a separate database. The information is read by an RFID reader, which replaces the standard barcode reader commonly found at a library's circulation desk. It can also act as a security device, taking the place of the more traditional electromagnetic security strip and not only for the books, but also the library membership cards could be fitted with an RFID tag.

It has been investigated that Singapore was one of the first to introduce RFID in libraries and Rockefeller University in New York may have been the first academic library in the United States to utilize this technology, whereas Farmington Community Library in Michigan may have been the first public institution, both of which started using RFID in 1999. The top RFID using countries are USA, UK and Japan.

During 1990s, Indian libraries also started using RFID and mostly the academic libraries attached to IITs, IISc, Universities are now widely using RFID technology. Several libraries have successfully installed the RFID solution in India. Some of them are:

IIM Shilong , Anna University, British Council Library Delhi, IIT Kharagpur , Punjab University, University of Pune, National Centre for Biological Science etc.³

Due to the 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 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, an urgent need was felt to have a better technology that can improve the circulation management, inventory and security of library collections.¹⁰

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.

Library security through RFID technology

An RFID system provides a security mechanism to prevent theft of library resources.² An RFID tag is used as a special "security bit" that can be switched from "checked-in" to "check-out". The exit gates in the library read each tag when the user leaves the library and sounds an alarm if the bit is not "checked out". The function of check-in resets the bit. RFID provides efficient operation processing where each user can simultaneously process check-in/out, verification, and entrance guard control with an RFID reader equipment.¹³ The amount of time required to perform circulation operations can be reduced through RFID.⁷

RFID has high-security technology which can be used in a library as an anti-theft system .² There is greater security of items for loan when using RFID technology. RFID supports theft detection functionality, efficiency in security and effective tracking for library items .⁶ RFID has been used in theft detection and item tracking for over 30 years and was

first used in libraries in the late 1990s .¹ RFID is better for collection management and security . RFID readers are mounted at the exit gates of the library. Sensors are designed to detect and read information from RFID tags. As the user passes through the exit gate, the system reads the tags in the books in the user's arm or bag and cross checks with the library database, ensuring that the items have been checked out .The implementation of RFID technology can help prevent theft during the check-out and after the check-in of items. RFID technology promises to provide better control of theft.

RFID technology is suitable for use in the library because RFID tags can be re-used. The cost of RFID tags can be reduced because library books/items are taken out and returned many times.

Transactions in university libraries have become faster with RFID systems. A few university libraries in Africa such as the University of South Africa and the American University in Egypt reported success in the use of an RFID system. The amount of time required to perform circulation operations for charging and discharging is reduced. In fact, information can be read from RFID tags much faster in comparison to barcodes. Libraries used to scan barcodes one by one which was time-consuming. With an RFID system, users can simultaneously process check-out/in, verification and entrance guard control. An RFID system is able to read several items in a stack at the same time. The check-in and check-out process does not take more than one minute using an RFID system. Self-discharging service saves time for both staff and customers at service points, while increasing satisfaction.

RFID is able to improve security and inventory control in comparison to barcode technology because RFID tags can be read even when they are not directly within the scanner's line

of sight. RFID provides added security and authentication. The rationale for using RFID for security purposes is not because it is particularly strong in this area, but because it is not inferior to other security technologies.

In summary, the benefits of using RFID technology in libraries have been stated from a variety of sources. These benefits actually impact all parties involved in library services.

Conclusion

LIS professionals who are facing a lot of challenges concerned with library security will find RFID system more useful since it offers some great advantages over barcodes. Various benefits of RFID applications have been identified. RFID technology supports tracking of library materials, reduces threats to the library collection, improves accuracy of data collection, and reduces the amount of time required to perform the circulation operations of check-in, check-out, inventory control and shelf-management. Information can be read from RFID tags more quickly than from bar codes and several items in a stack can be read at the same time. RFID systems also have a security function to detect theft. RFID technology is revolutionizing library operations and services.

The library also presents unique challenges for RFID adoption, including technological constraints, cost concerns and privacy concerns. Hence, researchers in different fields should leverage their know-how to concentrate on these challenges, including the high cost of development of an RFID project, market degeneration and unnecessary development, and the development of an international standard.

Privacy is a subject of contention as all activities performed by users can be detected easily by RFID readers. Legal issues concerning users' consent to data tracking also need to be addressed. Libraries would be more inclined to adopt RFID technology if such concerns are addressed through advancements in technology and legislation safeguarding user privacy.

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RFID in Library management services: A quick looks

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Abstracts: Radio frequency identification (RFID) is the modern technology to track & identification of materials i.e. Documents, products, Car, Animals, Health tools, People etc. In Library management, RFID plays an important role for its library staff, library patrons & documents. It plays role of rope which connected these three pillars of a Library. It has advantages and also some disadvantages, but still, using RFID in Library management, helps to improved in modern service.

Keyword: RFID, Library management, Tags, Library services,

Introduction:

RFID or Radio Frequency Identification/ Identification device is a next generation of Auto Identification and Data Collection technology which helps to automation in business processes/ Education field in an Open environment with reliability & security. This automation can provide accurate and timely with securely information without any human intervention. Access or Using to such information where one can individually identify each one of the tagged items individually, which helps in improving your processes and also to make informed decision. RFID (Radio Frequency Identification) invented in 1969, patented in 1973, first used in harsh industrial area in 1980s', and standards presented in 2001, which is the latest addition of technology to be used in 21st century.

Role of RFID in Library management:

Using RFID in libraries like college library, school library or any special library, it saves library staff's time by automatizing their work. An establishment that uses RFID library management saves a book reader's precious time that he/she would have been spent, waiting for his turn in a line for borrowing or renewing or returning a book. Taking care of books and making them available to the book readers are important tasks. Most of the library staff's time is spent in recording information of check in and check out books.

RFID-based systems have been worked for efficient document tracking purpose throughout the libraries that combine, easier and faster charging and discharging of security of materials of documents, inventorying, stock verification and shelf handling. Radio Frequency Identification system's tag's transponder listen for a radio query from the reader and respond by transmitting their unique ID code. The main thing is that most RFID tags which are used in documents, they have no batteries but they use the power from the initial radio signal to transmit their response.

If we look quick main roles of RFID in library, these are-

- i. Self-Issue
- ii. Self-Return
- iii. Combined Issue/Return
- iv. Fine/charge payment
- v. Automatic Sorting
- vi. Security
- vii. Stock management
- viii. Accessioning
- ix. Smart shelves
- x. Intelligent displays.

Differences between Library automation & RFID:

The Library automation is the initial stages of RFID. In Library's work contrast, there is any one of from three ways of Library's daily work can be done.

Only hand written issue/returning/accessioning of Library work in different Library register.

Or

Hand written issue/returning/accessioning of Library work in different Library register

+

Issue/returning/renewing/accessioning of Library's documents in a Library automation software by BARCODE labeling.

Or

Issue/returning/renewing of Library's documents throughout helps of RFID.

In Library automation system, the main role is played by BARCODE. These are two barcodes. One is Barcode of library accession number and another barcode is Student's Id number. The details information of books is stored in Library management software by the unique accession number and student information also stored in LMS by the unique ID number. These two BARCODE are attached with each other by scanning on the barcode with the help of hand scanner.

In RFID, there is no barcode labeling on book or student's card. The main role played by Tag. The whole process is done through radio wave/signal.

Barcode can only read, its needs direct visible contact to reader, only one item can be scanned at one time, database look-up is always importance, barcode validity or life time duration is limited and not only that the stock verification process is turns into hard work.

But in RFID, it can be read and write also, multiple items can be read at one time means there has no anti-collision of individual information, the data retained lifetime if maintained properly, and the most importance is the stock verification is much easier than normal stock verification.

The main difference of RFID with Library Automation (Barcode) systems-

- Several items in a stack/counter can be read at the same time using RFID.
- Items do not have to be handled one-by-one nor removed from the shelves.
- RFID can stand more than 10,000 read/write.
- Inventory-taking is no longer a tedious operation.
- RFID can have theft bit which can be in two states “ON/OFF”.
- Information can be read from RFID tags much faster than from barcodes.
- Shelf verification/rectification can be done on daily basis.
- More information can be written in the RFID tag on incremental basis.
- Items are identified on upper and lower shelves more comfortably
- Need not open/remove books to capture information.

Barrier of Implementing RFID in Indian Libraries

In India, Library profession is always neglected in many state, especially in rural in sector, institute i.e. Government aided or non-government institute. But, still some Government & non-government institutions are trying to develop their library. They trying to move from traditional handling register record to library automation, but developing RFID, is still too far. The main barriers of implementing RFID in Indian libraries are-

- i. Lack of enough fund/money.
- ii. Lack of well trained Library professional who know maintain basic RFID systems.
- iii. Lack of government workshop on RFID systems.
- iv. Less interest of higher authority to develop RFID in libraries in their institute.
- v. Some library professionals are also showing their less courage or interest on RFID due to incensement of work.

Advantage & Disadvantages of RFID:

Advantage —

- i. Reducing repetitive stress/work.
- ii. Efficient inventory management.
- iii. Less time needed in circulation.
- iv. Stock management is easy.
- v. Improved patron services.
- vi. Security/ Controlling on book theft.
- vii. Saving the patron's time.
- viii. Patron can find easily & quickly what they are looking for.
- ix. Self service enhance to patron during staff shortage.
- x. Reliable process.
- xi. Miss-shelves easy identification.

- xii. Maintaining cost is less.
- xiii. Multiple charging, discharging, renewing.
- xiv. Legibility of tag life.
- xv. Work load becomes less.
- xvi. Increased accuracy in work.
- xvii. Library system becomes a standard model.

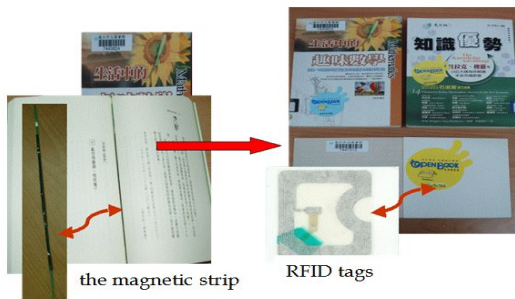
Disadvantages —

- i. Initially high cost.
- ii. Possible to remove exposed tags.
- iii. Frequency block/dependent.

Components of RFID system

RFID system has mainly these components:

RFID tags / transponder that are electronically programmed with unique information-



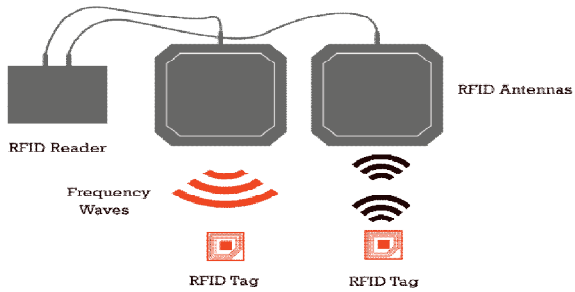
Readers or Sensors to query the tags-



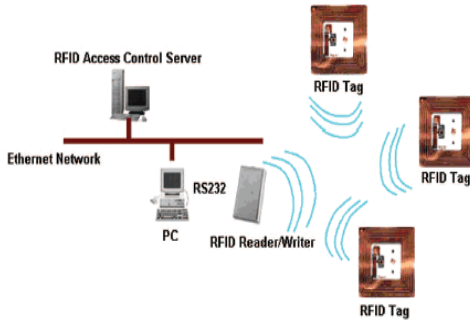
Tags-



Antenna-



Server on which the software that interfaces with the integrated library software is loaded-



RFID Label Printer-



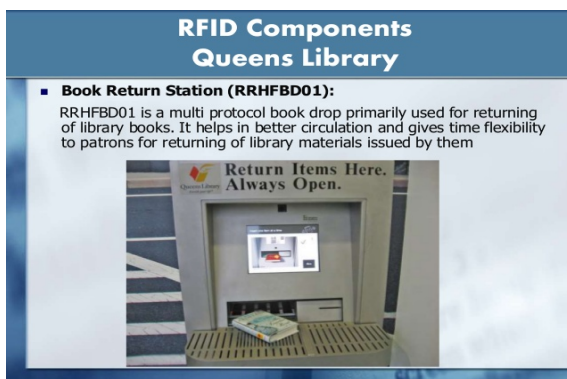
Self Check Unit-



Scanner gate-



Book return kiosk-



Works mapping:



It is quite clear from discussion that, RFID system makes Library a well secure & top class standard

In initial stage, maybe it's a costly matter, but when once setup, it will bring smile to patrons as well as library staffs. In some library of India has already taken step to install RFID

i.e. CIT library, Kokrazhor, Assam., Jammu Kashmir University central library., Indian Law Institute Library and National Social Science Documentation Centre Library, NewDelhi. Some facts should be remembered by library staffs that these are application, standardization and innovation of technology are constantly updating day by day. Not only is that as the Library is a growing organism, so data of library also increasing day by day. Library staff should maintain the situation or updating the RFID system on regular basis with its technology and memory capacity.

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Application of RFID Technology in Libraries: A Strong Security

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Abstract: In the digital environment, we always use smart technology. Now-a-days, we used smart phone for better services in our daily life. It is a challenge towards ICT (Information Communication Technology) that a paradigm shifting from traditional society to modernised society. By the way, libraries should shift its products and services into modernised way and accept the smart technology. One of the best powerful smart technologies is RFID (Radio Frequency Identification) Technology that has been used in libraries as well as in other areas. RFID is a wireless smart technology, non-contact mode, uses the radio waves for transferring data from a tag attachment to an object, for the automatic identification and tracking. There are many prospects that have been extended in implementation of RFID Technology especially in libraries that shows how libraries can perform with physical as well as smart technology to offer better services to its valuable users. This article deals with the concept of RFID Technology towards its design and components. A specific discussion on some prospects and challenges regarding strong securities in libraries has been also highlighted here.

Keywords: *RFID; Components; Prospects; Challenges; Library*

1. Introduction:

The application of computer and its technology has changed our daily life rapidly. With the help of ICT (Information Communication Technology), the concept of

traditional library has been shifted into modernised library where printed version and digital version materials are available and those are easily to accessible, searchable and reusable. The libraries are now upgraded with the help of automation system to meet the various demands of its uses. Thus new concept has given rise to digital library, electronic library, virtual library and hybrid library.

RFID is a wireless technology which uses radio waves for transmit information from a tag attached to an object. It is an automating identifies object. Automatic identification technologies are the border concept that includes RFID, Barcode, Biometric, OCR (Optical Character Reader) etc. If RFID Technology is applied in libraries, a good number of benefits are extended. These are- a) strong library securities; b) reduce manual work; c) save time; d) increase efficiency and e) reduce cost. RFID is a powerful smart technology that can help to provide better services to the users in our digital era. Thus, RFID plays a vital role in modern library services.

2. RFID Technology:

2.1 Historical Background:

RFID is the landmark 1948 paper by Hary Stockman, titled “Communication by means of Reflected power”. Mario Cardullo’s U.S. patent 3,713, 148 in 1973 was the first true ancestor of modern RFID.

The decades of RFID:

- a) 1940-1950-RFID invented in 1948 for Radar refined and used World War-II.
- b) 1950-1960-It was tested early exploration of RFID technology, in laboratory.
- c) 1960-1970-It tried to development of the theory of RFID and applications in field.

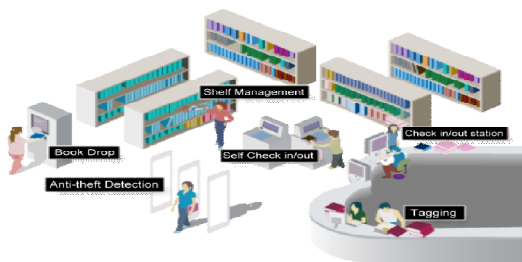
- d) 1970-1980-Explosion of RFID development & test of RFID accelerate.
- e) 1980-1990-It was commercial applications of RFID enter mainstream.
- f) 1990-2000-RFID emergence of standards & becomes a part of everyday life.
- g) 2000-2010-Widely used in European and American continents and entered in Asian continents in the field of library and information science.

2.2 Conceptual Aspect:

According to Wikipedia, **“Radio-Frequency Identification (RFID) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID”**.

Technovelgy.com has defined **“RFID as a small electronic device that consist of a small chip and an antenna”**. The chip typically is capable of carrying 2,000 bytes of data or less.

According to the Harrod’s Librarian’s Glossary and Reference Book, **“RFID is an alternative to Bar code that uses tiny microchip in tags to hold and transmit detailed data about the tagged item”**.



(Image of RFID system in library)

Dictionary for Library and Information Science defines **“RFID as the use of microchips to tag library materials and library card, enabling users to check out items by walking through a self service station equipped with an antenna that emits low frequency radio waves”**.

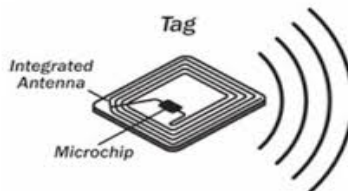
It is a technology where data are gathering without need of touching or viewing the data carrier with the help of radio waves. The data are stored in a microchip attached to an antenna (called as transponder or tag), the latter enabling the chip to transmit information to a reader (or transceiver) with in a specific range, which can forward the information to a host computer.

Thus, RFID is a wireless technology that performs in radio waves platform for transferring data from a tag attached to an object.

2.3 Design and Component of RFID Technology:

2.3.1 Essential Component:

A) Tag: RFID tag is a heart of this system. It is not required electronic power to function. It can be fixed inside a book's back cover or directly on to CDs and DVDs. It is prepared with a programmable chip (with the capacity of at least 64 bits) and an antenna. Three types of tag are available i.e.



(Image of RFID Tag)

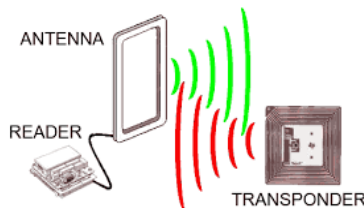
i) Read Only Tags: It is encoded at the time of manufacturing and the information cannot be rewritable.

ii) WORM (write once read more) Tags: These tags are programmed by using organisation, but without the ability to rewrite them later.

iii) Read / write Tags: It is facilitated in which the stored data can be changed / alter or rewrite as required.

B) Reader: It acts as both transmitter and receiver that are used to detect and read information which is stored in the tags. When a tag passes through the radio waves, the information which is stored in the tag, is decoded by the reader and sent to server. It is portable in size and easy to handle to read the tags with in a library which is attached with interrogation zone. It may be used in circulation section for check-in or check-out of library materials, in the self charging section, in the book drop section, in the exits of the library and self rectification and stock verification purpose.

C) Antenna: It is a device that works as a transmitter and receiver through signalling system. It produces radio signals to active the tag and read write data to it. It is a communicative channel between a tag and the reader which control the system data acquisition and communication. The basic antenna is designed at 2.4GHz.



(Image of RFID system)

D) Server: Server is the heart of this system. It is a device to join the reader and the library automation system. It receives the signal from various readers through antenna and transfer into the circulation database. An application programming interface is included which required with the automation system. A transaction database is attached herewith for report generation.

2.3.2 Optional Component:

- a) RFID Label Printer
- b) Handheld Reader
- c) External Book Return / Book Drop Section
- d) Self check-out section
- e) Anti theft Detection Gate

3 Workstation of RFID Technology in Libraries:

a) Circulation Section: With the help of RFID Technology, the circulation section can done various works like check-in; check-out; overdue; reserve etc. The circulation section can perform to identify the items which are active or deactivate with its RFID tags. Simultaneously, it is an antitheft function.

b) Self check-out Section: it is a section just like a bank ATM counter in the libraries where users can issue books from self check-out counter without any help of library staff.

c) Self check-in Section: As usually it is a counter where a book drop box is set up. The users can easily return his / her books into this section with the facilities of 24 hours. It gives more benefits to users as well as library staff in order to save time and flexible in nature.

d) Book Storing Section: After completed the process of check-in system, books are storing in classified order at the

designated bin automatically. Thus, it helps to reduce the staff time required to re-shelving materials.

e) **Inventory:** With the help of RFID Technology, it is useful for scanning the books on the shelves and easily identifies the location of books which are demanded by the users. It also helps to the library to check-out information as well the information regarding books put on the wrong shelf.



(Image of reader)

f) **Sensor Gate:** It is a security gate in the library door for the detection and reading of information from RFID tags. It is an antitheft system. If any tag is not deactivate and passed through this gate, the gate will sound an alarm immediately.



(Image of Sensor Gate)

4. Prospects of RFID in Libraries:

There are huge prospects that are indicating the advantages of RFID in libraries. This are-

- a) It is benefited to extend strong security in libraries.
- b) It reduces the manual workflow in the process of circulation section.
- c) It improves staff productivity and customer services.
- d) It assists to faster inventory process.
- e) It is fully automated process towards self check-in and self check-out and fully reliable.
- f) It is a great flexibility in the process of returning the books.
- g) It is easy to identify the exact location of the books in the particular shelf.
- h) It assists to trace the information regarding overdue, pending, lost etc.
- i) It helps the users as well as library staff for saving time.

5. Limitations of RFID in Libraries:

- a) Established cost and maintenance are more expensive.
- b) Lack of standardisation.
- c) Provisions of removal of exposed tags exit gate sensor problems.
- d) Chances of technical issues i.e. reader collision, tag collision etc.

6. Challenges to LIS professionals:

There are some major challenges towards LIS professionals when RFID is accepted and applied in libraries. This are-

- a) Development to digital preservation is need.
- b) Web based services is required.

- c) Development of information infrastructure.
- d) Sound knowledge and adequate skill is highly needed.
- e) Marketing of LIS product and services is to be followed.
- f) Standardisation and high quality services are needed.
- g) Long term strong security in digital management system is required.

7. Conclusions:

Due to information explosion and variety of demand from the users, traditional library system is shifting to modern e-based library system and the traditional concept is being revised to modern technology where modern technology is accepted and applied in its services. RFID is one of the most popular and powerful technologies that are used in libraries for the benefits of better services to its users. It is a wireless smart technology that performs in radio waves platform for transferring data from a tag attached to an object. Its applications are more effective, reliable and cost efficient process towards library security that highlighted long-term benefits. Thus, it is needless to point out that RFID Technology is a fruitful solution in the modern libraries as strong securities and a great challenge to LIS professionals.

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