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Application of RFID Technology in Libraries

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Abstract: ***Radio Frequency Identification in libraries, describes current deployments, and suggests novel architectures for library. RFID application; the technology promises to relieve repetitive strain injury, speed patron self- checkout, and make possible comprehensive inventory. Unlike supply-chain RFID, library RFID requires item-level tagging, thereby raising immediate patron privacy issues. Current conventional wisdom suggests that privacy risks are negligible unless an adversary has access to library databases. We show this is not the case. In addition, we identify private authentication as a key technical issue: how can a reader and tag that share a secret efficiently authenticate each other without revealing their identities to an adversary? Previous solutions to this problem require reader work linear in the number of tags. We give a general scheme for building private authentication with work logarithmic in the number of tags, given a scheme with linear work as a sub protocol. This scheme may be of independent interest beyond RFID applications. We also give a simple scheme that provides security against a passive eavesdropper using XOR alone, without pseudo-random functions or other heavy crypto op-elations.***

Keywords: RFID, Security, Privacy, Private Authentication.

I. INTRODUCTION

Radio Frequency Identification allows an item to be tracked and communicated with by radio waves. This technology is similar in concept to a cell phone. RFID is a broad term for technologies that use radio waves to automatically identify people or objects. 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 (the chip and the antenna together are called an RFID transponder or an RFID tag). 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.

II. REQUIREMENTS OF RFID IN MODERN LIBRARY

1. Fastest, easiest, most efficient way to track, locate & manage library materials.
2. Efficient Book circulation management.
3. Automatic Check-in and Check-out.
4. Library inventory tracking in minutes instead of hours.
5. Unique ID of the RFID tag prevents counterfeiting.
6. Facilitate inter library & intra- library borrowing.
7. Multiple books can be read simultaneously
8. Automated material handling using conveyor & sorting systems

III. SYSTEM COMPONENTS OF RFID APPLICATION

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.

1. Tags:

The heart of the system is the RFID tag, which can be fixed inside a book's back cover or directly onto CDs and videos. This tag is equipped with a programmable chip and an antenna. Each paper-thin tag contains an engraved antenna and a microchip with a capacity of at least 64 bits. 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

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chosen by most libraries, can have information changed or added. In libraries that use RFID, it is common to have part of the read/write tag secured against rewriting, e.g., the identification number of the item.

2. Readers:

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 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 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 (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.

Readers in RFID library are used in the following ways:

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 inventoring and verifying that material is shelved correctly.

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, 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.

4. Server:

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 SIP/SIP2 (Session Initiation Protocol), APIs (Applications Programming Interface) NCIP (National Circulation Interchange Protocol) or SLNP necessary to interface it with the integrated library software but no library vendor has yet fully implemented NCIP approved by NISO.. The server typically includes a transaction database so that reports can be produced.

IV. OPTIONAL COMPONENTS

Optional RFID system includes the following three components.

1. RFID Label Printer
2. Handheld Reader
3. External Book Return
4. 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 the book.

V. ADVANTAGES OF RFID APPLICATION

1. Libraries Stock management:

Operations such as managing material on the shelves, finding items that are missing and identifying missing & mishelved items are streamlined and taking stocks regularly will be feasible.

- **Improved patron services:** Spending minimal time on circulation operations allows library staff to assist patrons Routine patron services are not disturbed even when libraries are facing staff shortages & budget cuts.

- **Flexibility and modularity:**
  i. Ability to add newer products and features as finances and customer needs dictate.

ii. Expenses of adopting the technology can be managed over a time period.
iii. Allows for phased funding and more effective use of Institutional budgets.

- **Security:** Library item identification & security bit is combined into a single tag, there by eliminating the need to attach an additional security strip, hence minimizing labeling time & its associated cost. Security bit is automatically deactivated & reactivated as materials are checked out and in ; hence no separate security procedures are required.

2. Library Staff:

- **Less time needed for circulation operations**

Implementing RFID will considerably reduce the amount of time required to issue, receive, transport, sort & shelve library materials

Automated check in will reduce staff time required for material handling.

- **Efficient Inventory management**

Inventory management can be done using a handheld reader without closing the library and is at least 20 times faster compared to existing barcode based system.

- **Reducing Repetitive Stress Injuries (RSI)**

RFID based system reduces repetitive scanning of individual items at the circulation desk during check in, check out and hence avoids RSI such as carpal tunnel syndrome

Taking inventory in a rfid based system doesn't require physical deshelving & shelving of library materials.

3. Patrons.

Patrons will spend less time waiting in check-out lines by using Self Check in - Check out systems

Patrons find what they are looking for quickly & easily

Use of book drops & returns chutes for returning library material, allows for flexible timings.

RFID enabled patron cards allows for easy patron identification.

4. Advantage of RFID over Barcode base System:

- Nonline reading of multiple items at a time provides for efficient circulation of library materials.
- Location specific items on shaves are possible using RFID based handled readers.
- RFID based systems can be easily integrated with automated material handling (AHM) unites to read moving items.
- On chip data storage & reprogrammable memory allows rfid tags to record information such as location of books in the library, statistics, etc.
- Auto detection of unauthorized items going out of the library premises using rfid based system.
- RFID based system can be used in harsh environment.

VI. DISADVANTAGES OF RFID

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.
2. **Accessibility 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 . 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.
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 . In Indian libraries, it is a major challenge to keep the tags intact.
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, 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.
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". 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" or RFID tag. Hot listing refers to the process of building a database of books and their associated tag numbers and then using an unauthorized reader to determine who is checking out items in the hot list.

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6. **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.

7. **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.
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

VII. RFID STANDARDS FOR LIBRARY

- RFID hardware products for library are compatible with global protocols such as SIP2 NCIP, ISO 18000-3, ISO 15693, ISO 14443A & ISO 28560 (Part 1,2,&3 to be released)
- Supplied equipment should allow forward compatibility with anticipated new standards.
- Can we purchase tags from others manufactures & still be sure of interoperability with existing hardware in future.
- Will the existing protocols & software work with the new hardware & tags? If not what is required to make them compatible.
- Vendors should make hardware & software upgrades in future to conform to standards.
- Judge Vendors Technology know how for products to be supplied
- Ask for customer's reference & discuss your concerns with the
- Special emphasis on Staff training & Local Support.

VIII. NISO RECOMMENDATIONS FOR USE OF RFID IN LIBRARIES

In Libraries, 13.56 MHz High Frequency tags should be used.

RFID tags for library use should be passive.

The typical read range of tags for library applications should not be increased substantially beyond the present range of 8-20 Inches of smaller tags in substantially.

Only tags including standardized AFI feature should be use in libraries.

The systems will cause no interference with other applications.

The system will utilize ISO/IEC 18000-3 Mode 1 tags programmed so that they should work for identification of items in other libraries.

The system will use tags that will not interfere with the operation of security systems in other libraries.

Security implementations for RFID in libraries should not lock a compliant system into any one security possibility (EAS, AFI, Virtual Deactivation), but rather leave security as a place for differentiation between venders.

RFID tags should be reprogrammable for migration purposes.

Data on RFID tags should be encoded according to the recommended data model, using encoding described in ISO/IEO 15962 & using relative object ID specified in anticipated standard ISO/INP 28560 for RFID in Libraries.

IX. INDIAN SCENARIO

Library automations in India is 10-12 Yrs behind developed nations when we consider current state of our 350 Universities.

Indian libraries are geared up for Automation today with support from Govt. NKC & organizations like Iflibenet, Delnet & Adinet etc.

Hardly 10% -15 % of Indian libraries are using ILS efficiently today and hardly 20 % of this are using library automation technology (huge Opportunity)

Library veterans feel library automation is a must for a knowledge driven economy like India .

ILS automation software's & technologies such as RFID will allow uniform resource sharing amongst University Libraries

Real Potential of RFID as cross- institution platform for identification will be limited by use of proprietary standards and RFID tags should be installed at the earliest point in the life cycle of the book

Large University Libraries (JNU,BHU,MSU…) should go for automation as this will allow efficient circulation of library items to large number of patrons visiting these libraries.

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Libraries should be promoted as an environment for serious learning (Information centers, facilities ambience..)
A mechanism to rank the libraries on basis of collection, services, use of technology
Library Automation will also help in building a National Union Catalog Similar to LOC.

X. CONCLUSIONS

Current library RFID tags do not prevent unauthorized reading of tag data. Therefore, information such as title, author, shelf location, patron information, or last checkin / checkout time should in no circumstance be stored on library RFID tags ..At the same time, both tracking and hotlisting are possible whenever a static identifier is used. Therefore, if a static identifier is in place on the RFID tag, it is imperative to pre-vent unauthorized tag reads. We stress that static identifiers may include collision IDs that are not protected by access control mechanisms intended to protect tag data.

Strengths:-

In todays globlies world indial has been runing fast in trerms of advance technology. RFID is one of those advanved technolgy. In todays world is 'Nanotechnologie', RFID has been made availabel in small size with high mamory capacity, with easy to use.

Weaknesses:-

There are some weaknesses of RFID technology In India many libraries does not make used of advanced applications standard. RFID technology has High cost per unit as well as high RFID system integration costs. People are unaware of benefits of RFID technology they don't have proper market understanding.

Opportunities:-

There are many opportunities in the RFID Technology which can be helpful in Library field. Firstly, it could replace the bar code. Secondly it could increase End –user demand for RFID systems. Thirdly it has huge market potential in Library field. Last but not the least it has many applications in many businesses around the world. In present scenario we should not wait for next generation tags that support cryptography because it has increased cost.

Threats:-RFID technology is filled with Ethical threats concerning privacy life. And highly fragmented competitive environment

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