

A Security Mechanism for library management system using low cost RFID tags

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ABSTRACT

Radio Frequency Identification (RFID) systems will become pervasive in our daily lives due to their low cost and easy to use characteristics[1]. This paper presents a methodology of using low cost RFID tags for a library management system to protect the books from unauthorized capturing and usage. Every object to be identified in the RFID system is physically labeled with a tag. In the proposed method a book or a magazine or a CD is identified with the RFID tag. Whenever a book is issued to any user of the library, the RFID reader will capture the information of that book and compares it with the related information of the book in the Online Public Access Catalogue (OPAC) and issues the book to the user depending on his identity in the database. If any unauthorized person intends to take the book the RFID reader will immediately respond to that and make sure that it was not issued. If any body tries to remove the tag it can be traced with the help of location device.

Keywords: RFID, OPAC, Unauthorized user, tag, Reader.

1. INTRODUCTION

Radio Frequency Identification (RFID) systems are common and useful tools used in manufacturing, supply chain management, and inventory control. Industries as varied as microchip fabrication, automobile manufacturing, and even cattle herding have deployed RFID systems for automatic object identification. For over twenty years, consumer items have been identified with optical barcode. One familiar optical barcode is the Universal Product Code(UPC), designed in 1973[2] and found on many consumer products, More recently, RFID has made inroads into the consumer/object identification

market. Silicon manufacturing advancements are making low-cost RFID, or “smart label” which seems to be an economical replacement for optical barcode.

2. ABOUT RFID TECHNOLOGY

2.1 System Components

An RFID system has three basic components, namely,
1. Radio Frequency (RF) tags or transponders that transmit the data to a reader .
2. RF readers or transceivers, devices which include an antenna to read and/or write data to RFID tags.
3. Communication system, a defined radio frequency and a protocol to transmit and receive data from tags.

Tag readers interrogate tags for their contents by broadcasting an RF signal. Tags respond by transmitting back resident data, typically including a unique serial number. RFID tags have several major advantages over optical barcode systems. Tag data may be read automatically, without line of sight, through non conducting materials such as paper or cardboard, at a rate of several hundred tags per second and from a range of several meters[1]. Since tags typically are silicon based microchips, functionality



Fig. 1. A passive RFID tag, an RFID tag with a printed barcode, and dust-sized RFID microchips.

beyond simple identification may be incorporated into the design. This functionality might range from integrated sensors, to read/write storage, to support

encryption and access control. Three example tags are shown in fig.1.

2.2 Types of RFID Systems

One broad classification of RFID tags is whether they contain a microchip or not. "Chip" tags contain an integrated circuit chip, whereas "chipless" tags are less expensive to make and may store up to 24 bits of information-which provides enough memory for a company's internal use, such as on a ship floor or within a warehouse.

In order for a reader to identify all manufactured items, an RFID tag must have enough memory storage to hold ID number designed to identify a massive number of objects. And the reader must be able to read multiple tags within its range and in close proximity. Chip tag RFID systems enable data, such as a serial number or product code, to be stored and transmitted by portable tags to readers that process the data according to the needs of a particular application. Currently small chips are available which are able to store 96-bits of data – enough to include a manufacturer's name, a product name and one of trillions of unique numbers that can be assigned to products.

There are three types of tags: "read only", "write once read many(WORM)" and "read/write"[3]. They are "read only" if the identification is encoded at the time of manufacturing and not rewritable. "WORM" tags are programmable ones at the user end., but without the ability to rewrite them later while the "Read/write tags," have the ability to modify information .

The working of RFID systems and their features depend on the type of tag the system uses. There are two main types of RFID tags, namely, active or passive, which differ depending on whether they have their own power system.

Active RFID tags have both an on-tag power source and an active transmitter, offer superior performance. Because they are connected to their own battery, they can be read at a much higher range-from several kilometers away. But they are larger and more expensive and hence are suitable for manufacturing, such as tracking components on an assembly line, or for logistics – primarily where the tag device will be reused.

Passive tags have no power source and no on-tag transmitter, which gives them a range of less than 10 meters and make them sensitive to regulatory and environmental constraints. However, they have the

most potential for lowest cost, making them suited for mass single-use applications.

RFID tags are interrogated by readers, which in turn are connected to a host computer. In a passive system the RFID reader transmits an energy field that "wakes up" the tag and powers its chip, enabling it to transmit or store data. Active tags may periodically transmit a signal, much like a lighthouse beacon, so that data may be captured by multiple readers distributed throughout a facility. The reader is equipped with antennas for sending and receiving signals a transceiver and a processor to decode data.

3. PROPOSED SYSTEM

In this paper a secure methodology for library management system using low cost RFID tags is proposed. RFID can be used for library circulation operations and theft detection systems. 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. The information contained on microchips in the tags affixed to library materials is read using radio frequency technology, regardless of item orientation or alignment

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. Our paper emphasises on this privacy concerns and proposes an alternative methodology to overcome the limitations of static information. The tag usage for the library books is shown in figure 2[7]. In the proposed method the information in the tag is dynamic.

3.1 Relevance to library system:



figure 2.

1. The task of identifying misplaced books can be handled using a handheld RFID reader which triggers each book with in a few feet to identify itself via a high frequency signal. A misplaced book sends a

special alert to the reader, with the help of location device prompting the staff to rescue it.

2. RFID reduces stock verification time of the library drastically.

3.2 Components required for the proposed RFID system :

The system has four components:

- 1) RFID tags that are electronically programmed with unique information.
- 2) Readers to query the tags
- 3) Antenna
- 4) Server to load the software that interfaces with the integrated library software.

3.3 Working of the proposed RFID system :

Tags: The RFID tag 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. "Read/write tags," are used in this system .

Readers: 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. RFID gate sensors (readers) at exits 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. Readers in library are used at the following places in the library:

- Processing station: where object data (userid, volume no. etc of the books / magazines /CD's etc) is written to the tag .
- Circulation station : used for the issue and return of books / CDs etc.
- Check-in station: used for checking the books /cDs etc.
- Exit sensors: Used for verification of books/cds leaving the library.

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.

Server: The server 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 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 (Koppel, 2004). The server typically includes a transaction database so that reports can be produced.

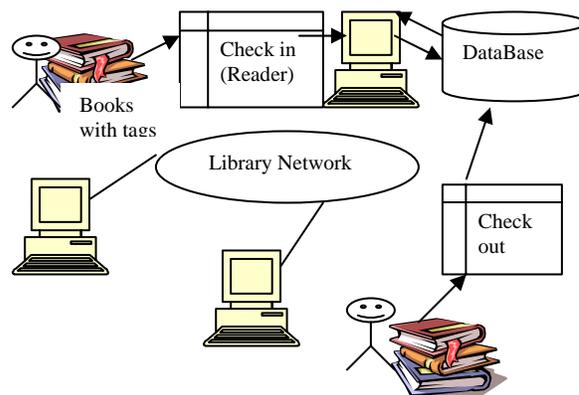


Figure3: A Model for using RFID tags in library

3.4 Security and Privacy:

RFID tags may pose security and privacy risks to both organization and individuals. Unprotected tags may have vulnerabilities to eavesdropping, traffic analysis, denial of service. Unauthorized readers may compromise privacy by accessing tags without adequate access control. Even if tags contents are protected, individuals may be tracked through predictable tag responses, essentially a traffic analysis attack violating location privacy. Another important privacy concern is tracking of individuals by RFID tags. A tag reader at a fixed location could track RFID labeled books carried by people passing by. To address the security risks of low cost RFID tags, passive tags will be used which provide simple identification functionality. Our tags contain a few thousand bits of storage and have an operating range of a few meters. Tag readers are assumed to have a secure connection to a backend database, although readers may only read tags from within the short tag operating range. A misplaced book or a tag sends a special alert to the reader, with the help of location device prompting the staff to rescue it. The tag consists of the following information:

Assuming the tag can store up to a maximum of 256 characters, we divide the available storage of the tag into three parts. The first 8 characters are for identification of library material and the remaining 248 characters are for the material identification.

1.....8 9-----256

MC	Mid
----	-----

MC denotes the material Code while Mid indicates the Material Identification which is a unique code consisting of materialid and userid .

In this system, the material identification consists of two unique id's. One id specifies the material and the other specifies user id which is dynamic. The total length of materialid is 248 bytes among which 216 bytes are for materialid and the remaining 32 bytes are reserved for userid .

9-----224 225----- 256

Materialid	Userid
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3.5 How it works?

After reading the information from the tag, it is sent to the conversion unit where the code is divided into materialid and userid as specified above. Conversion unit is a software which is capable of reading data from the tag through the reader and write the data into the tag from the database OPAC. The userid, which is encrypted form, is read from the tag. Once the conversion unit decrypts the code the information regarding the user and the material will be invoked from OPAC. Depending on the transactions made by the user, the information in the tag will be modified.

Three cases arise, which are dealt as follows:

1. If the material is to be returned to the library information regarding the userid part will be made 0's.
2. If the material is to be retained by the old user, then no change is to be made in the userid part.
3. If the material is to be issued to a new user then the userid should be updated.

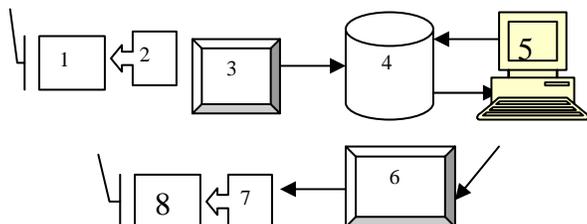


Figure 4: Working of the proposed system

1. RFID Tag , 2. Reader, 3. Decryption
4. Database 5. Work station 6.Encryption
7. Reader 8. RFID Tag

Algorithm :

Step1 : The information in the tag contains Materialid and Userid. Userid which is dynamic is in the encrypted form.

Step2 : Reader reads the information from the tag.

Step 3: Here the user id will be decrypted by using a relevant decryption algorithm.

Step 4: The database checks whether the user is authorized or not with the help of the decrypted userid. If a match occurs with the existing user id then it retrieves the corresponding information .

Step 5 : The corresponding transaction(issue / return/ renewal) will be made.

Step6 : After the transaction is completed the user id is encrypted and is read into the tag.

3.6 Limitations of RFID systems

High cost. The major disadvantage of RFID technology is its cost.

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 .

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.

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 [4].

3.7 Best Practices for Libraries

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 may be 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 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 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.

4. CONCLUSIONS

Radio Frequency Identification (RFID) Systems have been in use in libraries for book identification, for self checkout, for anti-theft control, for inventory control, and for the sorting and conveying of library books and audio visual materials. These applications can lead to significant savings in labor costs, enhance customer service, lower book theft and provide a constant record update of media collections. In this paper, the technical features of a modern RFID system are described to provide a guideline for the evaluation of different systems. The most important result is that non-proprietary systems can be used for libraries today since the new generation of RFID chips with the ISO standard 15693 are available. With this technology, libraries are not dependent on one company for their lifeline.

5. REFERENCES

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