

Implementing RFID Technology for Libraries in the Field of Library Security

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Abstract—I will examine the library security references and opportunities of the most commonly used auto-id system of libraries used for the identification of users and documents. The radio frequency identification and the related areas make new applications and services available for libraries. Using this technology, many current library workflow and user activities will be much easier, faster and safer. I will endeavor to answer the following questions. “What security solutions can be implemented by the currently used RFID systems and what other applications can be used in the field of library security in the future?”

I. INTRODUCTION

Protecting the library's documents, employees, users, reading rooms and workflow are the most important areas of the library security system. The complex library security process can be accomplished by the aligned operation of various interdependent components of the protection system. System components include different forms of mechanical protection, the electronic signaling system and the incident monitoring or responding guard. All those components are supplemented and aligned by preventive measures. In my study I will examine one of the determining elements of an electronic signaling system applied in libraries, the RFID technology.

The development of computer technology has a continual effect on library workflow and new technology tools are constantly becoming integrated into the library systems. This process necessarily characterizes the library's electronic information systems - integrated library systems, bibliographic databases and repositories - but the protection of physical collections are in constant development.

Theft protection of the physical collection has always been a serious challenge for libraries from the very beginnings. Following the appearance of security tools used in trading - with some delay - libraries began to apply these solutions, according to the special requirement.

An important part of the library's document protection system is theft protection. Document protection and protection of the library's collection include safety service and secure long-term preservation of documents, as well as restoration.

The safety of the library's collection is realized in three forms:

Preservation – Making efforts to hold the parts of the library's collection - books, journals and other documents - together in one collection. Prevent their disappearance and destruction.

Preventive protection - This form relates to the situations that may damage the physical collections. Preventive protection can be fulfilled in active and passive ways. The aim is to prevent or minimise the possibility of a document being damaged, or if it has already happened to slow down the speed of the process.

Recovery protection – This form of library security refers to documents that have already been damaged. Recovery protection includes the repair and the restoration processes of the library. [1]

A properly functioning anti-theft system is an important part of every library security's preservation form. The European and American large libraries began to apply theft protection systems shortly after the commercial release of applications. It became common that the anti-theft protection companies - recognizing the new market - began to form the technology used in commerce according to library needs. During this period the libraries installed different electromagnetic systems. Although the RFID (Radio Frequency Identification) technology already existed, it has not been available for commercial use as of yet.

Library theft protection before the implementation of RFID technology

Libraries implemented various systems used in trade. The most common solution was the electromagnetic (EM) security system. The books and the documents must be equipped with thin, plastic-coated labels. These labels or tags can be activated or deactivated, the anti-theft gate will signal an alarm accordingly. Deactivation devices have to be installed at the circulation desk next to each borrowing computer. The books placed on library shelves have activated tags. The librarian deactivates or activates the tags when the borrowing process happens: when a user borrows a book or returns a document. When a user leaves the library and the books "pass through" the gate, the antenna detects whether the tag is activated or deactivated within the scope.

It can be seen that this system is not connected to the integrated library system, it brings a completely independent theft protection into effect. In the integrated library system process the barcode and library system's database ensure the unique identification of books or documents. The use of barcodes is also reasonable in RFID technology based systems, but the borrowing process is also manageable with RFID tags, not only with barcodes.

II. THE USAGE OF RFID TECHNOLOGY IN LIBRARIES

RFID communication is based on the usage of electromagnetic waves. The identification tags

(transponders, RFID tags, RFID labels) contain a microchip and an antenna. The stored data is sent to the controller unit (middleware) by a reader, which unit then processes the received signals. The middleware unit - based on the information sent - communicates with and receives instructions from the library's integrated system.

Communication between devices (readers and writers) and tags in library RFID systems operates on high frequency (HF) at 13.56 megahertz [2].

A. Elements of the system[3]

1. RFID tag

The RFID tag (transponder) stores the most important data needed for document identification. In some cases or in other advanced applications, other identification information can be stored on the tag.

The types of RFID tags are as follows:

Passive tags - This version of RFID tags is used for library materials. These tags do not have their own power source. The necessary energy is derived from the electromagnetic field generated by the reader.

Semi-passive tags - These tags have minimal independent power source. Semi-passive RFID tags only transmit data at the time a response is received. They are most commonly used in trade and logistics.

Active tags - These tags have their own power supply (battery). Active RFID tags are capable of long distance data sending and receiving.

All library users identify themselves with RFID reader cards.

2. RFID readers

Readers are responsible for the identification of RFID tags and cards. The reader devices can store and transmit scanned information. The desktop RFID readers are capable of completing the borrowing transaction quickly and securely. It is easy to find incorrectly classified materials with portable, mobile, handheld RFID readers. These devices can store scanned data directly in their memory units or can send them directly to the system.

Types of RFID reader devices:

Read only readers - These readers can only read and transmit data from the tags that are nearby to the middleware unit. These devices are typically used in the libraries' reading rooms. Self-borrowing and collecting books are realized by read only readers.

Writer/reader devices - These devices can not only read but also modify the data of the RFID tag. Libraries use these RFID applications in several different areas: at the circulation desk when a new patron uses the library card; at the technical service in acquisition work process, and for cataloguing and processing new materials. During this process relevant information needs to be placed on the RFID tag. Minimally the unique identifier used for the library integrated system has to be recorded on the tag. Beyond that any relevant information can be stored on the tags, which is needed for further applications. By way of example tags can store information for a given copy's depositary allocation, so a handheld reader can easily filter out the enumerated document.

Smart/intelligent readers - These devices include a data processing unit. Their Library use is not typical [4].

3. Anti-theft detection gate

The settings of the detection and signal devices placed in entrances are crucial using any kind of theft protection system. In the case of library RFID systems the gate is a reader device, which detects the RFID tags of the documents and transmits the information to the middleware. Then the data communication between the middleware and the integrated library system begins.

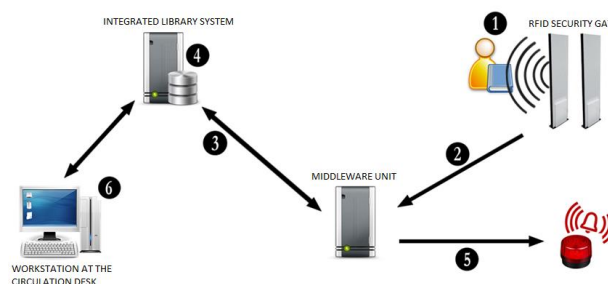


Figure 1. Electronic signaling system in a library using RFID technology

- (1) Library users together with documents/books pass into the reach of the security RFID gate (which is usually the entrance of the library)
- (2) The gate reads the data from the RFID tags (transponder), and then transmits the information to the middleware unit. At this stage the middleware transforms the data for the integrated system of the library for proper usage.
- (3) This unit sends the information to the library's database. The information in this case is mainly the unique identifiers of the items.
- (4) Checking processes of the copy's data terminate at the level of the integrated library system. (copy status and transaction fulfillment) After checking the copies the library database gives instructions to the controller unit.
- (5) In the case a document is taken out of the library without permission, the system generates an alarm. The alarm signal may be sound, light or even the shutdown of a photocell door; it certainly depends on the library's needs and facilities.
- (6) The process can be transmitted to and traced on the library workstations, so the library staff can check the incident immediately.

B. Software background of the system

Data controller unit – middleware software. Middleware is responsible for communication between the physical system, the library database, and the integrated system. The middleware receives complements and processes the information from the RFID readers. Then this unit forwards the data to the appropriate modules of the integrated library systems databases. The library system sends answers to the middleware on the basis of the received data, which transmits the instructions to the devices.

Integrated Library System (ILS). This software is responsible for the automation of the library's work processes, services and related databases. The integrated library system receives information from the controller unit, elevates the necessary decisions up to a certain level

with no human intervention, and then forwards the information to the middleware.

The most important modules and databases of integrated library system related to RFID system:

Items/copies database - This database is a unique registry for the library's specific documents. It includes copy status, interfaces to other databases, transactions history, and authority information...

User/patron database - It contains all the important information about the library's patrons. Each patron and copy has a unique identity number in the integrated library system.

Cataloging module - Cataloguing and bibliographic description. This module classifies indexes, produces metadata and creates the standard description of the library's documents.

Circulation module - In this module all the data from the different modules come in contact with each other: the library basic database, database of books and periodicals, and the patron database. This module also includes the display of the patron information. Not only the raw data of users are displayed in the patron database, but the borrowing "history" of patrons can also be monitored in the system. Additionally, the individual users' or user groups' entitlements can be determined in this database. [5]

C. Optional components of the system[6]

Self borrowing unit

Self borrowing unit, self check in/out - RFID technology based libraries can create self-service borrowing places near the circulation desk. In this case, the patron identifies him/herself with a library card, and then puts the books to be borrowed to the desk. This unit includes a built-in RFID reader. The reader transmits data to the middleware, which - based on the information from the library integrated system - reports the patron about the result of the transaction. With this unit a library can realize fast check-in and check-out processes.

The parts of the unit:

RFID reader built in the desk – This is an automatic identification of the copies of the book and the patrons capturing data from them without any physical contact.

Monitor - either with touch screen solution. The user can monitor the current borrowing transaction coming into existence and the details of the documents to be borrowed. The patron also can obtain additional information - for example, if the borrowing is unsuccessful - the reasons of the cancelled transaction, (wrong permissions, expired library card, cash debt, copy status, etc.)

Printer unit – In the case where all conditions of the transaction are satisfactory, the borrowing data and key information are given to the borrower in a printed form. (user, borrowed document, expiration date, etc.)

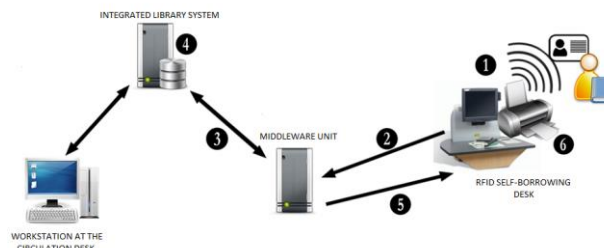


Figure 2. RFID based self borrowing system of the library

- (1) The patron places his library card and the documents to be borrowed on the self borrowing desk.
- (2) This unit transmits the data to the controller unit.
- (3) The middleware sends the unique identifiers of the copies and the patron to the integrated library system in readable form.
- (4) The integrated library system carries out the necessary checks. It examines the patron's authority (valid membership, if there is no money debt and expired borrowing, etc.) as well as the permissions of the copies.
- (5) If all the required conditions are met, the transaction is made. The self borrowing unit receives the exact details of the transaction that the user can see on a monitor panel screen and then the system gives a printed receipt automatically.

Book drop station

Depending on the location of the library this unit can be placed indoors or outdoors (placed in a drop point outside of the library). The advantage of the interior located RFID System is that a simple return transaction does not need any librarian help, and a longer waiting line can be avoided. The station located outside the library is generally placed near the entrance, this way patrons can return books at any time, even beyond the library's opening hours. In both cases it is important to print receipts. When the returning process is finished, the printer as a part of the book drop station creates the receipt for the patron. The unit is also known as "book chute", because behind the door of the station, there is an inclined surface where the books slide down passed the scope of the RFID reader. Here the previously described communication between the reader, the middleware and the integrated system is completed. As the data of the borrowing transaction is stored, there is in addition no need to identify the patron at the station. After identifying the borrowed document the library system returns the copy, and then sends instructions to the printer unit on which following data is included in the report. (patron, returned books, the exact date of the transaction, etc.) [7]

Tasks before the installation

Before the installation of a RFID based self-borrowing desk and book drop station or stations, there are some important tasks to be considered in terms of security:

- Introducing detailed information for the librarians about the operation of the library system. At some level every individual has to be aware of even those parts of the system, which they have no direct work to do with.
- Long-term system test involving the library staff.
- Making explanatory booklets and posters related to the operation.
- Placing short introductions or videos about the usage of the stations at the library portal.
- Detailed logging of operational and safety problems during the testing period, then informing the contractor about the notifications.

The introduction of the system may be implemented with a selected group of patrons as well. Frequent and reliable library users can be easily queried from the library system user database. During the first period it is worth testing and then querying the patrons to share their experiences about the new system.

In the case of self borrowing desk and book drop stations it is important that the camera system installed in the library has a line of sight to these areas. This is vital if the book drop station is located outside of the library. The records of the camera system can give answers in problematic or questionable cases and can gain additional information from them. Undoubtedly, the integrated implementation of the library security system is a precondition for implementing holistic library security.

III. INNOVATIVE POSSIBLE SOLUTIONS FOR THE USAGE OF RFID TECHNOLOGY

A. Controlling and monitoring book traffic

By using sensor gates in the internal environment of the library movement of documents the library's reading areas would become controlled. This could be important especially in the case of special collections and books of higher value. In case of such collections, those books would receive a RFID tag including the location of the document. When the item passes through the gate, the system senses it. In such cases, the system may indicate the incident immediately on the spot, or send a message to the librarian at the circulation desk. In this message - as the library card clearly identifies the patron - the patron's name can be mentioned. The patron management module of the integrated library system may store important data, information, transaction history, and photos about the library user. Thus, the library staff can also get a picture on the screen of who to warn in the reading rooms.

B. Monitoring the entrance of problematic patrons

The system would be able to give signals to the librarian if it detected a patron who had overdue borrowing or money debt. Detecting the library card of the user the middleware transmits the information to the integrated library system patron database. Subsequently,

all data of the patron would be displayed on the screen at the circulation desk, so the library staff could start the routine problem solving or collection procedure.

C. Monitoring environmental effects threatening valuable documents

Libraries physical collections include many historic, valuable and sensitive documents and the protection of these books is first priority. If these books were equipped with semi-passive RFID tags, it would be capable of continuous data collecting, so the system might receive information, which could help to identify the threat. These tags would be appropriate for the collection and the transmission of data about temperature, which can seriously affect the physical condition of the old books. In data receiving and processing software those conditions would be determined and, in case of an identified threat the security system automatically alerts the security employee.

IV. CONCLUSIONS

In this study I have introduced the current RFID library security applications and possibilities inherent in the system. During the implementation of library security and protection undivided attention has to be paid to library work processes and service activities. It has to be kept in mind that a security system should not inhibit the library staff and patrons activities.

In the first part of the study I dealt with the physical protection of the library materials, library stock protection issues and anti-theft protection before the introduction of RFID technology. Then, I turned to RFID technology tools and applications used in library systems. I examined the process of an anti-theft system with a security gate and self-borrowing stations connected to RFID technology. Finally, I presented some possible solutions of RFID technology to increase the efficiency of library security. The results of the constant development of new RFID tools and solutions are not only useful for library security systems, but also in other areas of work process.

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