

Bar Codes and RFID Technology Use to University Library Management

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Abstract— Radio frequency identification (RFID) is a rapidly emerging technology which allows productivity and convenience. 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. This paper proposes RFID Based University Library Management System that would allow fast transaction flow and will make it easy to handle the issue and return of books from the library without much intervention of manual book keeping which benefits by adding properties of traceability and security. The proposed system is based on RFID readers and passive RFID tags that are able to electronically store information that can be read with the help of the RFID reader. This system would be able to issue and return books via RFID tags and also calculates the corresponding fine associated with the time period of the absence of the book from the library database.

Index Terms— RFID, Library Security, Radio waves, Security System, Tag, Theft detection

I. INTRODUCTION

Radio-Frequency Identification (RFID) devices have importance in our daily life and they will become appearing in the near future. There is a tremendous growth in the industry to use RFID technology in the recent years. Research and development in this field has made this technology to be used in supply chain management, attendance management, library management, automated toll collection etc. RFID is an electronic technology whereby digital data encoded in an RFID tag is retrieved utilizing a reader. In contrast to bar code technology, RFID systems do not require line-of-sight access to the tag in order to retrieve the tag's data. Passive RFID is sure to replace bar codes in library applications. The bar-code system used in libraries is very time consuming and labor intensive. 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. The RFID tag can contain identifying information which is unique, such as a book's title or code, 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. One step is to decide on which kind of RFID reader and tag is used for library automation. The importance of reader are what kind of tag it reads, its operating frequency, capability of near reading, writing inside

the tag, connection type with computer. The reader has two main functions: the first is to transmit a carrier signal, and the second is to receive a response from any tags in proximity of the reader. A tag needs to receive the carrier signal, modify it in some way corresponding to the data on the card, and retransmit the modified response back to the reader. Further, tags which are located in book are binding with the specific Id. In modern passive RFID devices; the tag consists of a small integrated circuit and an antenna. The benefit of passive RFID is that it requires no internal power source; the circuit on the tag is actually powered by the carrier signal. Thus, the carrier signal transmitted from the reader must be considerably large so that the response can be read even from the card. In practical applications of using RFID technology, a tag is attached to an object used to identify the target, when the target object pass through the area that the reader can read, the tag and the reader builds up the radio signal connections, the tag sends its information to the reader, such as unique code and other data stored on, the reader receives those information and decodes them, and then sends to a host computer so as to complete the whole information processing.

II. BAR CODE TECHNOLOGY HISTORY

The first barcode was developed by Bernard Silver and Norman Joseph Woodland in the late 1940's and early 1950's. It was a "bull's eye" symbol that consisted of a series of concentric circles. The first commercial use of barcodes was by the RCA/Kroger system installed in Cincinnati on the call of the National Association of Food Chains (NAFC). However it was not widely used until the Universal Product Code (UPC) was introduced into America and adopted by the U.S. Supermarket Ad Hoc Committee. Today's barcodes have two forms: one dimensional (1D) barcode and two dimensional (2D) barcode. The barcodes use bars and gaps to encode identification information such as serial numbers. The 2D barcodes consist of more complicated patterns and may encode up to 4K bytes of data. Figure 1 shows the two types of barcodes. Although 1D is the more prevalent barcode used in daily life, the 2D barcode is becoming increasingly popular since it needs significantly lower surface area to encode the same amount of data as compared to 1D barcodes. Barcodes can be printed from most printers. 1D barcodes usually have coded readable ID printed along with the barcode. Barcodes can be read by barcode scanners which we see at a typical Point of Sale (POS) in retail stores. Bar codes are a very common technology that has been wild implement across various industries for identification. barcode systems consist of a paper tag with black, vertical stripes of different width (the actual bar code) and a scanning device which needs to be connected to a computer system. The transmission of data is initiated by a light signal send from the scanner to the tag. The stripes of the barcode reflect the light in a unique way, which enables the scanner to translate the reflected signal into a

specific binary code that can be interpreted by the computer.



FIG. 1 BASIC BAR COD SYSTEM

Figure 2 illustrates a basic barcode system. Barcodes are read or scanned by a barcode reader and the reader is connected to a computer. The operator has to physically align/point the barcode reader with/to the barcode to read the identification information. The software running on the computer processes the identification information picked up by the scanner. Programmable Logic Controller (PLC) is usually used to control the scanner in more automated process such as production line. The primary scanning technology for barcode is LED (Light-Emitting Diode). More advanced scanning such as CCD (Charge-Coupled Device), Laser, and Imager are used in industry automatic processing

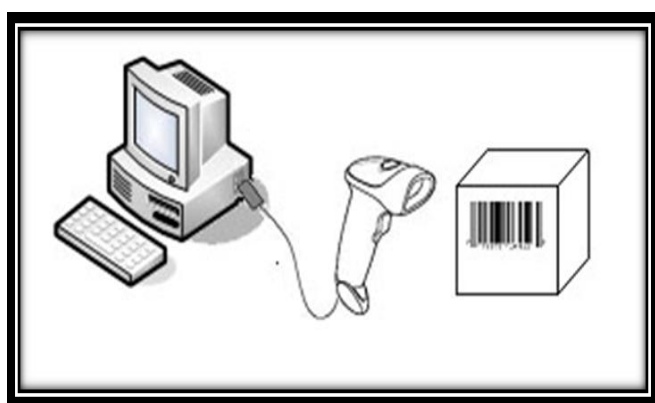


FIG. 2 BASIC BAR COD SYSTEM

WHAT IS RFID

Short for Radio Frequency Identification. The term RFID is used to describe various technologies that use radio waves to automatically identify people or objects. RFID technology is similar to the bar code identification systems we see in retail stores every day; however one big difference between RFID and bar code technology is that RFID does not rely on the line-of-sight reading that bar code scanning requires to work. Basically RFID is a wireless communication system which

use RF signal to establish the communication between two ends. RFID system does this communication by using modulated RF signal which is sent between the two main components in the system; the reader and the tag.



FIG. 3 BASIC RFID SYSTEM

III. ANTI-THEFT SYSTEM HISTORY

In the past, the only anti-theft systems in place at supermarkets and large shopping malls were the CCTV (Closed Circuit TV) cameras and watchful security guards. These were the only known anti-theft systems, which were effective enough in preventing shoplifting. As with any other technology, the same technology was used to prevent shoplifting in a grocery mall as well as a jewelry shop. As expected, the grocery mall’s investment did not pay off much (as the costs of the goods shoplifted were less than the cost of installing and maintaining the expensive security systems). The only place where this system gave a good ROI (Return on Investment) was in the jewelry shops, where each small item (say a diamond ring), is much more expensive than a grocery item.



FIG:4 BASIC RFID SYSTEM

IV. BENEFITS OF RFID FOR LIBRARIES

- RFID tags replace both the bar code and traditional security systems and creating a “smart library”.
- Check-out stations can be automated with easy, intuitive interfaces, since several items in a pile can be “grabbed” at a time;
- Book returns can be automated with check-in and database updates completed simultaneously in the book return chute.
- Fast and convenient on-the-shelf inventory allows accuracy in collection management;
- Automatic book sorting.

RFID technology uses are limitless, flexible and easier to use than other forms of data collection. RFID is a multi-purpose technology, however, the full potential of RFID technology and some of its unique applications and solutions have yet to come to the information industry. RFID is the new technology that revolutionizes Library Management by increased productivity in deficit budgets. It can be harnessed to:

- Reduce material handling time.
- Do more frequent and accurate inventory to better manage .
- Improve ergonomics of the repetitive tasks of librarians.
- Improve customer service.

A big advantage of RFID is that it's not dependent upon the 'line-of-sight', since it uses radio-frequency signals. Since RFID does not require 'line-of-sight' between the transponder and the reader, it surmounts the limitations of other automatic identification devices, such as bar coding. RFID systems work effectively in hostile environments where excessive dirt, dust, moisture and/or poor visibility would normally hinder rapid identification process. One of the most outstanding benefits of RFID is its ability to read through these environments at remarkable speeds — responding in less than 100 Milliseconds in most cases.

V. RFID UNIVERSITY LIBRARY MANAGEMENT SYSTEM

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 checkin/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.

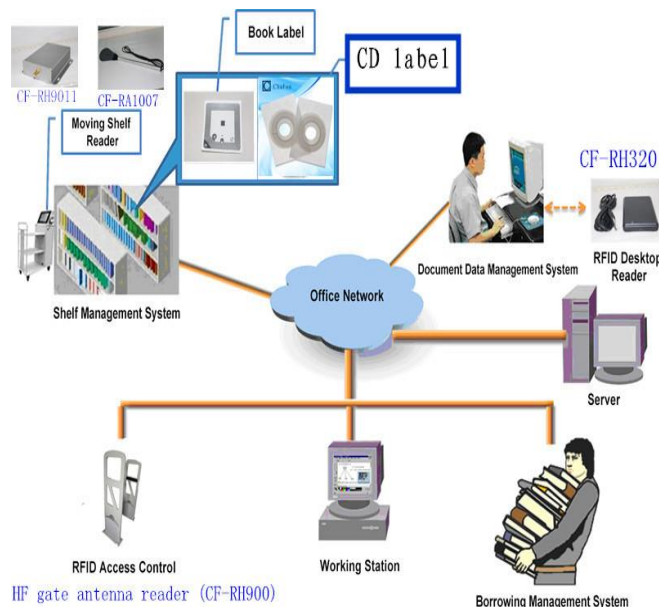


Fig :5 RFID Library Management System

Application in RFID 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 anytime 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: 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 to be set/reset so as to 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 University 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.

VI. BENEFITS OF RFID USE IN LIBRARY

RFID improves library workflow by reducing non-value added work processes Improves staff productivity Improves customer service Assist inventory check with ease. Easy book identification for shelving process Assist traceability of book allocation Enhance book return processes by full automation of check-in, EAS activation and system updates completed simultaneously in the self-return chute Allow better accuracy in book collection management, resulting in reduced book purchase More than one item can be checked out or checked in at the same time. Items can be placed on reader without careful placement that it is required for line of sight system (bar code scanner) Faster inventory process. Ability to locate specific items.

Advantages of RFID in Libraries: The use of RFID reduces the amount of time required to perform Circulation operations. The most significant time saving with bootable to the fact that information can be read from RFID tags much faster than form barcodes and that served items in the stack can be read at the same time.

- Self charging discharging
- Reliability
- Streamlined Inventory Management
- Longevity of Tag life
- Faster Circulation

Reduction in workplace injuries Automated materials handling Easy stock verification Theft reduction High level of security Mis-shelve easy identification External Book Return Improved tracking of high value items Reduce Shrinkage errors Technology standards to drive down cost Reduce materials cost and handling Automated issue/return Automated sorting of books on return Inventory visibility accuracy and efficiency Improved Production planning Ability to manage the expenses over a number of years. RFID tags are very simple to install/inject inside the body of animals, thus helping to keep a track on them. This is useful in animal husbandry and on poultry farms. RFID technology is better than bar codes as it cannot be easily replicated and therefore, it increases the security of the product. Barcode scanners have repeatedly failed in providing security to books

and journals in libraries. But nowadays, RFID tags are placed inside the books and an alarm is installed at the exit doors. The RFID tags can store data up to 2 KB whereas, the bar code has the ability to read just 10-12 digits.

Disadvantages of RFID in Libraries:

- High Cost
- Frequency Block
- Chances of removal of exposed tags exit gate sensor problems
- User Privacy concern
- Reader collision
- Tag collision
- Interoperability

VII. ROLE OF LIBRARIAN

RFID technology introduces an ethical dilemma for librarians. The technology allows for greatly improved services for patrons especially in the area of self check out, it allows for more efficient use of professional staff, and may reduce repetitive stress injuries for library workers. And yet, the technology introduces the threat of hot listing and tracking library patrons. Librarians have taken extra steps to ensure that law such as the USA PATRIOT act cannot be used by government entities to invade the privacy of their patrons, and yet many of those same libraries are placing traceable chips on their patron's books.

Libraries have traditionally acted to protect and defend 5th 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.

VIII. RESEARCH METHODOLOGY

In this paper, the study will analyze the success factors in terms of strategic viewpoints and the RFID implementation level. It is a kind of top-down research structure. Based upon the literature review presented in the previous chapter, it is found that the characteristics of RFID system and its implementation method are different from the well-known bar-code label system. Therefore, the strategic viewpoints will play a critical role in the solution select and reflect the long-term expected return on its investment. In practice, the implementation method will influence its success and efforts taken into its realization in the system.

In terms of external factors and variants outside the enterprises, the RFID industry will be analyzed in the following chapter to present the factor relationship and its impact on the system performance. With the technology evolution and maturity, the impact by external variants will be mitigated through the reference to the successful cases.

IX. CONCLUSION

RFID technology is not only emerging but also more effective, convenient and cost efficient technology in library security. This technology has slowly begun to replace the

traditional bar-code on library items. The RFID tag can contain identifying information such as a book's title or material type, without having to be pointed to a separate. The information is read by an RFID reader, which replaces the standard barcode reader commonly found at a library's circulation desk. The RFID tag found on library materials. It may replace or be added to the barcode, offering a different means of inventory management by the staff and self service by the borrowed. It can also act as a security device, taking the place of the traditional electromagnetic security strip. And not only the books, but also the membership cards could be fitted.

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