

DSS for Library Management System Implementing RFID

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Abstract -- Radio frequency based identification (RFID) based library management using decision support system(DSS) is the most rare and uniquely found integration of two cutting edge technologies that is RFID and DSS, which has led to tremendous increase in the speed, efficiency and accuracy of the library. 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 system is based on UHF RFID readers, supported with antennas at gate and transaction sections, and library cards containing RFID-transponders which are able to electronically store information that can be read / written even without the physical contact with the help of radio medium RFID would allow fast transaction flow for the library and will prove immediate and long term benefits to library in traceability and security. In addition to it, we are providing decision support system for library to make it easier for customer to decide and locate their requirements without manual intervention. DSS is implemented using various data mining techniques for arranging the dispersed information of books, customer, administrators etc in a systematic manner. This unique combination of RFID and DSS is expected to enhance the services offered by the library to a great extent.

Index Terms – Decision Support System (DSS), Radio Frequency Identification (RFID), Data Mining, Library Management System, Barcode.

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1 INTRODUCTION

A library is a huge collection of information, sources, resources, books, and services, and the structure in which it is housed. Due to financial and human constraints for library support, library managers increasingly encounter the need to justify everything they do, for example, the library's operation budget in particular. The most frustrating problem they face is knowing that the information needed is available somewhere in the ocean of data but there is no easy way to obtain it. For example, it is not easy to ascertain whether the materials of a certain subject area, which consumed a lot of financial resources for their acquisition and processing, are either frequently used (i.e., a high rate of circulation), seldom - used or not used at all, or whether they satisfy users' needs.

DSS for library management system implementing RFID is expected to solve such problems faced by the librarian, as well as the library users. The unique feature of this proposed system is the combination of RFID and DSS. Till date, DSS and RFID have been implemented in various libraries, but separately. The proposed system attempts to integrate them, which will prove beneficial to the library. Both these technologies have their own individual benefits. Thus, integration of RFID and DSS will cause combination of features owned by both by technologies imparting it higher level of efficiency.

This library management system replaces the traditional, manual book keeping of records. It intends to replace the barcodes by RFID tags. 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 concept of DSS, which includes Data Mining will help the librarian to provide many services, such as managing the shelf according to the interest of the people. The general description of the technologies our system is based upon is stated as follows:-

1.1 RFID

The "Radio Frequency Identification (RFID) is an automatic identification system. RFID uses RF to identify "tagged" items. This data is then collected and transmitted to a host system using an RF Reader. The data transmitted by the tag may provide identification or location information, or specifics about the product tagged, such as price, colour, date of purchase, etc."

1.1.1 TAGS USED IN RFID

Tags are typically composed of a microchip for storage and computation, and a coupling element, such as an antenna coil for communication. Tags may also contain a contact pad. Tag memory may be read-only, write-once read-many or fully rewritable.

Broadly the tags have been classified in three categories:

- Active Tag: An active RFID tag is equipped with a power source for the tag's circuitry and antenna. The advantages of an active RFID tag includes readability from a distances of one hundred feet or more as well as capability to have other sensors that can use electricity for power. The major disadvantages of an active RFID tag are the limitations on

the lifetime of the tag (5 years). They are more expensive and physically larger and they add to the maintenance cost if the batteries are replaced. Battery outages in an active tag can result in expensive misreads.

- **Passive Tag:** Passive RFID tag does not contain a power source; the power is supplied by the reader. The tag draws power from the inductive coupling with reader antenna. The major disadvantages of a passive tag are that the tag can be read only at very short distances, typically a few feet at most. However there are many advantages. The tag functions without a battery which increases the life time to more than 20 years. The tags are less expensive and much smaller. These tags have almost unlimited applications in consumer goods and other areas.

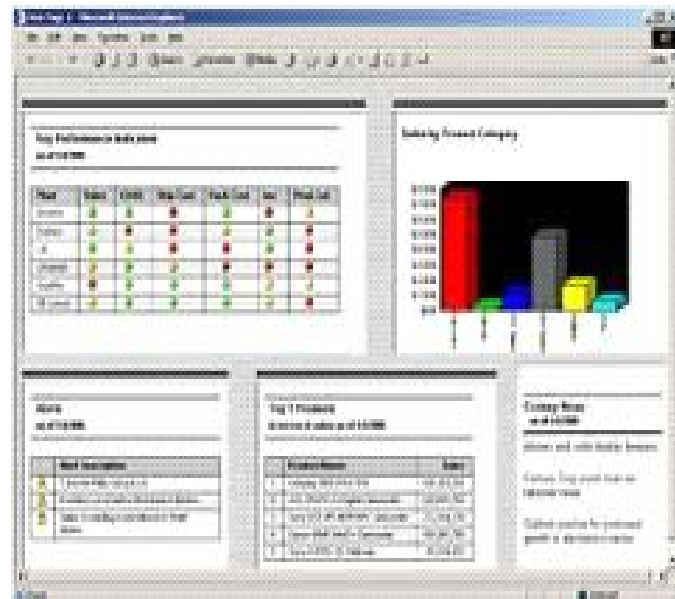
- **Semi-Passive Tag:** Like passive tags, semi-passive tags reflect (rather than transmit) RF energy back to the tag reader to send identification information. However, these tags also contain a battery that powers their ICs. This allows for some interesting applications, such as when a sensor is included in the tag so it can transmit real-time attributes, such as temperature, humidity, and timestamp. By using the battery only to power a simple IC and sensor—and not including a transmitter—the semi-passive tags achieves a compromise between cost, size, and range.

In the proposed system, use of RFID is mainly for identifying books or individual users, administrators using smartcards and tags. Preferably, passive tags will be used here, as tags are required only for reading within short distances or range.

Another most important concept we are going to implement in our system is Decision Support System (DSS).

1.2 DECISION SUPPORT SYSTEM

The best decision support system provides high-level summaries and drilldowns to details. Decision Support Systems (DSS) are a specific class of computerized information system that supports business and organizational decision-making activities. A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions.



Decision support systems could be categorized in terms of the generic operations that can be performed by systems. These generic operations extend along a single dimension, ranging from extremely data-oriented to extremely model-oriented. Alter conducted a field study of 56 DSS that he categorized into seven distinct types of DSS. The seven types include:

- File drawer systems that provide access to data items.
- Data analysis systems that support the manipulation of data by computerized tools tailored to a specific task and setting or by more general tools and operators.
- Analysis information systems that provide access to a series of decision-oriented databases and small models.
- Accounting and financial models that calculate the consequences of possible actions.
- Representational models that estimate the consequences of actions on the basis of simulation models.
- Optimization models that provide guidelines for action by generating an optimal solution consistent with a series of constraints.
- Suggestion models that perform the logical processing leading to a specific suggested decision for a fairly structured or well-understood task.

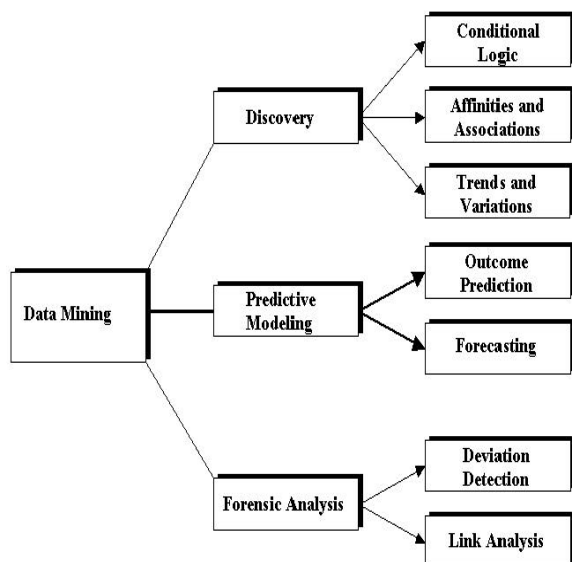
We are going to use DSS for general activities in library such as shelf management, stock management, searching of books.

An important part of DSS is data mining

4 DATA MINING

IBM defines Data Mining as, “the process of extracting previously unknown, valid and actionable information from large databases and then using the information to make crucial business decisions”

4.1 Classes of data mining



First, the information is previously unknown, in that it is not directly derived from the data. Instead, the information takes the form of relationships amongst the database columns where the value in one or more columns predicts the outcome in another – hence the name, predictive model. But predictive models must be valid. Rating a model's predictive power usually involves testing it against another data set. Finally, it goes without saying that the information is actionable. But this does suggest that there should be some goal in mind before putting any effort into data mining.

In our system, data mining will attempt to provide library patrons with more choice, and thus increase user satisfaction.

2 RELATED TECHNOLOGY

2.1 BARCODE USED IN LIBRARY SYSTEM

In this Approach of library Management System, traditional manual method of book keeping is reflected by automated library management system. Application of this concept is Surpass [12]. It's software for libraries which was developed back in 1982 for automated library management system. Surpass is a full-featured suite of applications that smoothly automates all of the day-to-day functions of libraries. Surpass is an effective automation solution for primary and secondary school districts as well as for public, college, corporate, and specialty libraries. Surpass offers a special package for church libraries too. Surpass Hosting Service is offers libraries the ability to put their whole system on-line with no need for in-house servers or IT staff.

- Barcode Scanning

- Catalog Management
- Circulation Management
- Custom User Interface
- Customer Database
- Customizable Fields
- Customizable Functionality
- Customizable Queries
- Customizable Reporting
- Data Import/Export
- Fee Collection
- Kiosk Integration
- OPAC
- Periodicals Management
- Reporting
- Search Functionality
- Self Service Features

Available on the following platforms: Windows, Web Based Support available: Regular Business Hours
Comparing our system with Surpass the one key advantage is replacement of RFID with Barcode.

2.2 RFID VERSUS BARCODE

- 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.

2.3 LIBBEST

LibBest [14], Library RFID Management System. LibBest is the software provider who provides RFID based Library Management System. It provides the following functionalities.

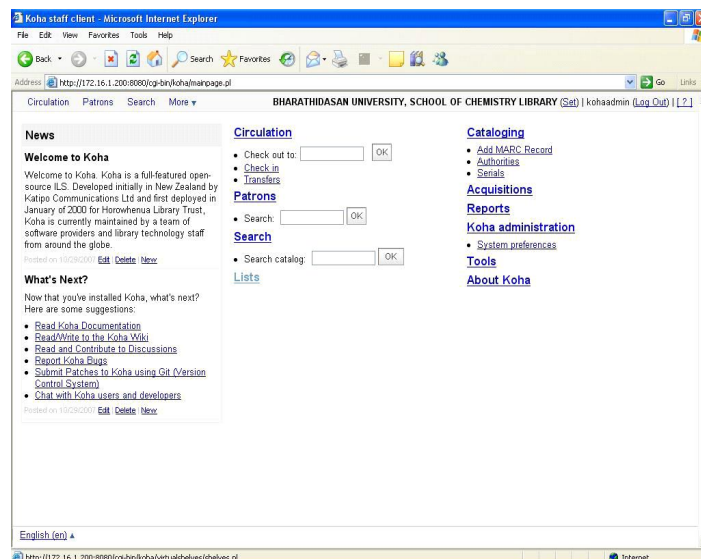
- RFID tags replace both the EM security strips and Barcode.
- Simplify patron self check-out / check-in.
- Ability to handle material without exception for video and audio tapes.
- Radio Frequency anti-theft detection is innovative and safe.
- High-speed inventory and identify items which are out of proper order.
- Long-term development guarantee when using Open Standard.

This system leverages the benefit of RFID for faster processing. Comparing our system with this LibBest system, we are going to provide Decision Support for the user of the system and the administrator in addition to the benefits of the RFID technology.

2.4 EXISTING LIBRARY SYSTEMS

Traditional Library Systems consisted of manual system of managing various activities. The system consisted of large volume of books and can maintain student's data in form of registers that consisted of all details of student members. Issue procedure for the books to issue books allotted to each student. The librarian takes off the book card containing all details of the book that is kept in the book and attaches with the issue card of the student and keeps in record column. Book return is inverse process of issue book when the student returns back the book. Also there was provision of requesting new book for the library by filling the new book request form and deletion of highly used and damaged was done by cancelling the record of the book from all the registers. Fine system required, librarian to calculate the fine for the student which is paid by the student on not returning the book within return date of the book. Also no backup was maintained and duplication of data consumes lot of time.

Here, from the sources [3] we get acquainted that Library automation refers to mechanization of library housekeeping operations predominantly by computerization. Systems have been developed to update the database of Books and other Resources of the university, to implement automated system using respective Library Integrated Open Source Software, to carry out the charging and discharging functions of the circulation section more effectively, to provide various search options, to know the availability of books in the Library, to generate the list of books due by a particular member and also the overdue charges.



The Greenstone Digital Library Software [4] provided a way of building and distributing digital library collections, opening up new possibilities for organizing information and making it available over the Internet or on CD-ROM. Produced by the New Zealand Digital Library project [5], Greenstone was intended to lower the bar for construction of practical digital libraries, yet at the same time leave a great deal of flexibility in the hands of the user.

Greenstone has been used to make many digital library collections. Some were created within the New Zealand Digital Library as demonstration collections. However, the use of Greenstone internationally is growing rapidly, and several web sites show collections created by external users. Most contain unusual and interesting material, presented in novel and imaginative ways. This article [5] briefly reviewed a selection of Greenstone digital library sites to give a feeling for how Greenstone is being used for public digital libraries throughout the world from different countries, from different kinds of library, with different sorts of source material.

The research and surveys [6] also revealed that there was development of online library management projects too. That kept track of issues and submission of books and also created online memberships. It provided better and efficient service to the members and reduced workload of employees with fast retrieval of information about the books and that too with just a click. There were also projects that were offline providing facilities like the books received in the library are entered in Books Entry form and the new student is entered in the student entry form. When the student wants to get the desired book the same is issued on the availability basis to the student. The issuance and due date for the returning of the book is also entered into the Book Issue form under third menu Book Issue. It used Visual Basic which is Graphical Rapid Application Development (RAD) tool that aims at

providing the user with a graphical interface that is intuitive and easy to use.

The research reveals that libraries began using RFID systems to replace the electromagnetic and barcodes in late 1990s. Approximately 130 libraries in library in North America are using RFID but hundreds more started considering it. RFID is a technology that is sparking interest in the library community because of its applications that promise to increase efficiency, productivity and enhance user satisfaction. In each and every activity within a library, RFID technology will provide a greater amount of efficiency and error free functioning. It will ensure that there is:

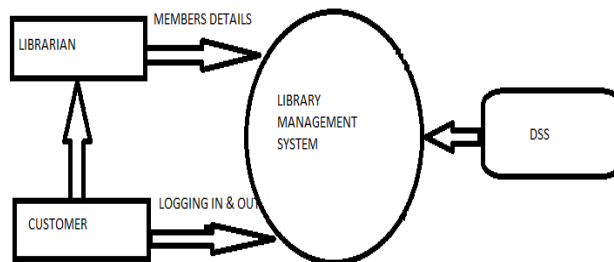
- Quick check-in/check-out of items for convenience of members
- Quick and correct shelving of items
- Complete prevention of thefts
- Quick inventory check

RFID can be used in 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, 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 (i.e., the technology does not require line-of-sight or a fixed plane to read tags as do traditional theft detection systems). 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.

Although employed in business and other industries, it was not much widely used in library. Recent studies [8] revealed that only 14% British libraries and 34 % of American libraries used DSS in library management decisions. Projects using DSS in library include early work by Bommer and Chorba. In 1984 Starlett Reidelbach and Hartse attempted to initiate it at university of Nebraska at Omaha .They reported that the attempt was partially successful. In 1991, Ottensmann and Gleeson developed a decision support system based on circulation of data to assist in public library acquisition budgeting and other library management decisions.

3 PROPOSED SYSTEM: COMBINATION OF RFID AND DSS

RFID and DSS technologies can prove beneficial to the library in their own way. Our System leverages the advantages of both RFID & DSS. We will go through the general working of the System in this section of proposed system. The figure below shows how the general working in the system will take place.



3.1 EXPLANATION

This system will enable the librarians to keep a record of all the books present in the library as well as provide an efficient DSS which will enable the librarian as well as the customers to make certain decisions. It will help the customers for faster access to the library facilities.

However, the customers need to carry RFID smart cards for logging in & out of the system. The books should have RFID tags embedded in them. Also, there will be a facility to send SMS to the customer to inform him/her of the returning date of the issued book.

It provides an easy solution to the librarian as well as the customers to keep track of library books and their respective stocks. This will help the user to search book easily according to their choice.

3.2 THE PROCESS

- Whenever a new book is acquired by the library, an RFID tag is to be attached into the book with the relevant information like, call number, accession number, book number, etc.
- The detailed information regarding the book is also captured in the computer database.
- The computer database also stores all information for individual users (patrons) of the library.
- Each patron will be supplied with a smart card. These smart cards carry identification data for each patron.

- When a patron needs to get a book issued, he can get it done without any manual intervention. As soon as the user will flash his smart card, system will automatically open his login account page.
- He can then place the selected books, one by one on the RFID scanner.
- The computer will automatically record all the data against his name.
- Similarly, when a patron wants to return books, he will simply place the books in the book drop counter near the scanner and the books automatically are adjusted for return against the patron's name. Thus, the library operations will be automated to a great extent. On the other hand, DSS will enable the librarians, as well as the patrons (users) to make decisions helpful to the library management .For instance, library owners can find the how frequently a particular book is issued .The frequently issued books can be ordered in large stocks compared to the other books. Thus, it can also prove beneficial in an economic way.

Data mining, which is a part of DSS, will provide the library users with a large range of choice. Say, if the user, who is logged into the system, enters the name (or a particular set of keywords) of the book of interest, the user will be provided with a list of some of the popular books based on the input entered. Then, he/she can select the book of his/her choice.

3.3 BENEFITS OVER EXISTING SYSTEM

The proposed system is expected to be more efficient compared to the existing system .As it is an integration of the two technologies , RFID and DSS ,their individual benefits will be combined here.

3.4 ADVANTAGES OF RFID

RFID application in libraries will benefit all persons involved in managing, running and using their facilities. One of the major benefits of an RFID system in a library is the ease of check-in and check-out of library items. Patrons can self check-in and check-out library items, saving themselves valuable time.

RFID technology inventory and scanning of items:

- Will take only 10% or less time as compared to conventional systems
- Misplaced books and other materials can be found easily – the reader can hone-in of misplaced or wrongly shelved items quickly. Besides these incredible technological advantages, the RFID system in a library will offer the following as well:
 - RFID tags are safe for magnetic media such as CDs, DVDs, etc.
 - Some RFID tags are rewritable. If, for example, a cataloguing error occurs, it can be rectified quickly.
 - Less manual handling of items hence better preservation.

- Staff has more time from routine chores and can therefore provide better service to patrons
- Tags last longer than barcodes as reading is contact-less
- It will remove manual book keeping of records
- Less time consumption as line of sight and manual interaction are not needed for RFID-tag reading.
- Manual intervention will be minimized
- Manual errors will be minimized
- It will provide the long lasting labels
- It will provide fast searching of books

3.5 ADVANTAGES OF DSS

- DSS for Self Management, which will help the librarian for managing the self according to the interest of the people.
- DSS for Search of the likely Books, this part of the application will help the Member of the library who will search for the book of his interest to get an available choice.
- Data Mining will help the librarian, for searching in the large database of the library which may contain large Database for book information and also Database for Customer Info.
- DSS in Stock Management, it will help for managing the available Stocks for librarians, for ordering the newly launched Books and out dated stock.
- Customers Timeline alert, this will inform both Librarian and Customer about the last date of returning the Book and its penalties if any.

4 CONCLUSION

The striking feature of this paper is the combination of RFID, DSS and data mining in library management. It represents an excellent and unique combination of hardware and software which can be used in library.

RFID is a technology that is sparking interest in the library community. RFID technology is recommended for library automation. It will not only speed up book borrowing, monitoring, books searching processes but also free staff to do more user-service tasks .Mainly, manual intervention will be minimized which in turn, will reduce errors.

DSS on the other hand, can help the librarians to take certain decisions, which can also prove helpful in an economic way. It can also help the library users to select the books of their choice or interest, shelf management. Most libraries exist to serve the information needs of the users. Thus understanding those needs is crucial to library's success. Data mining can help to examine the individual user's behaviour which can aid in understanding that individual .It can also help in examining the behaviour of a large group of users for regular patterns. This can allow the library personnel to have a better idea of the information

needs of the user base, and therefore better customize the library services to meet those needs.

Thus, RFID and DSS can benefit libraries in their own way. But, the proposed system attempts to combine their benefits which promise to increase efficiency, productivity and enhance user satisfaction.

We are looking forward to make this system online to make even more accessible and convenient to the patrons .Also we are trying to introduce sms service to patrons as a part of deadline alert .Provisions can also be provided regarding GPS tracking to ensure stopping theft totally. Research is also being made in the field of decision support system to make the system much more predictable.

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