

RFID LIBRARY MANAGEMENT SYSTEM

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Abstract — Radio frequency identification (RFID) is a term that is used to describe a system that transfers the identity of an object or person wirelessly, using radio waves. It falls under the category of automatic identification technologies. This paper proposes RFID Based Library Management System that would allow fast transaction flow and will make easy to handle the issue and return of books from the library without much intervention of manual book keeping. 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.

Keywords—Radio frequency identification (RFID), RFID tags, Arduino.

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 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. 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. METHODOLOGY

1. Concept

The main purpose of this project is to facilitate librarian works. In this way librarian book searching, finding books which are located in a wrong place has become very simply works. Libraries have very high-level databases that are used for finding location and also information of books. The result of searching book for any user is only text-based information. RFID technology with image-based searching is used to improve this text information. The first step is to decide on which kind of RFID reader and tag will be used for this project. The importance of reader are what kind of tag it reads operating frequency capability of near reading, writing inside the tag, connection type with computer or any mobile devices such as PDA. After lots of researching on net decided to choose this RFID starter kit.

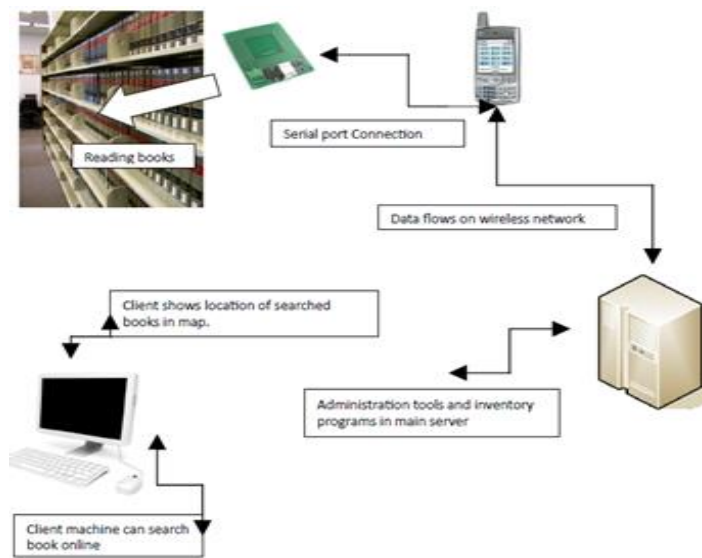


Fig 1: Project Concepts

The main reason of choosing this product is that it is programmable and has standard tag reading features. (Read/write ISO15693 RFID Tags, Read ISO14443A RFID Tags). The second important device to get information from RFID device is PDA which has lots of features with its operating system. Moreover, any PDA device can be used to make bridge between RFID and the main software because all PDA devices which are produced nowadays have JAVA runtime platform support. The only problem is to decide the connection type between PDA and RFID. RFID has serial port connection and lots of PDA devices don't support serial port connection. On the other hand, there is a converting device to resolve this problem which support to conversion between serial port to USB 2.0. The first section of this chapter is about mobile part of the project. Implementation of first part is based on JAVA technology. The reason behind JAVA is that it has lots of ability and simulation models to implementation a mobile software. The next section of the project is only the use of library information system administrator. In second part of project is like a any desktop application. The purpose of this application is letting the administrator creating library layout which can be used after at all operations in library. Searching, checking book locations, making an inventory of books can be done easily after the second part of project is used by administrator. Since this application is depend on the operating system type; programing language for implementing this kind of software must be suitable for all operating systems. JAVA is the best programing language for this kind of software's. This application has the graphical interface and let the user to draw shelf object on uploaded layout image.

2. Components

RFID READER:

It communicates with the tags through an RF channel to obtain identifying information. Depending on the type of tag, this communication may be a simple ping or maybe a more complex multi-round protocol. In environments with many tags, a reader may have to perform an anti-collision protocol to ensure that communication conflicts don't occur. Anti-collision protocols permit readers to rapidly communicate with many tags in serial order.



Fig 2: RFID Reader

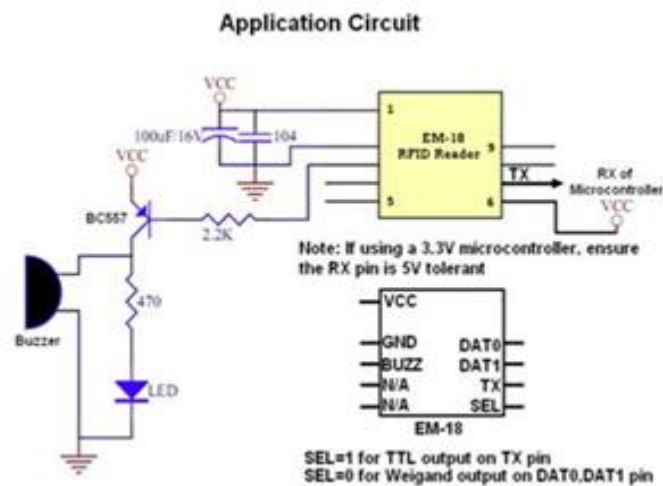


Fig 3: Application Circuit of RFID Reader

RFID TAGS:

These are the tags that have a magnetic coil within them and are used to generate radiofrequency waves. They are passive in nature i.e. they can be read up to a small distance of 10-15 cm, so the system is static. A passive tag is an RFID tag that does not contain a battery; the power is supplied by the reader. When radio waves from the reader are encountered by a passive RFID tag, the coiled antenna within the tag forms a magnetic field. The tag draws power from it, energizing the circuits in the tag. The tag then sends the information encoded in the tag's memory. The tag is typically much less expensive to manufacture. All tags have unique identification number (15 characters long) which is quite useful and these tags can be re-used.

One set of library tags are attached within the Library cards of the books and details of books can be accessed and actions like Issue/Re-Issue can be done in the library interface after the tags are scanned.

Other set of tags are used as Library identity cards of student to get the details of the student.



Fig 4: RFID Tags

ARDUINO UNO:

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo.

Each of the 14 digital pins and 6 Analog pins on the Uno can be used as an input or output, using pin Mode, digital Write, and digital Read functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller. The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values).

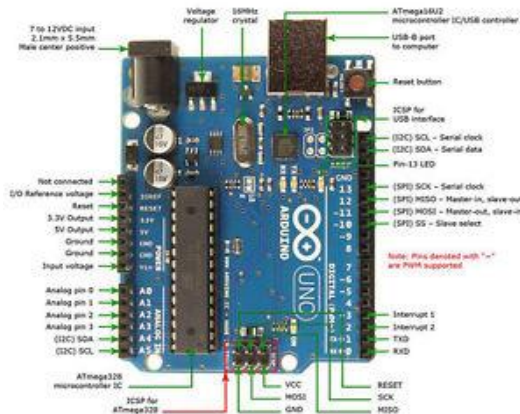


Fig 5: Arduino Uno

III. RFID AND WEB BASED SOFTWARE COMMUNICATION

Libraries have some standardizations on making catalogs of books. LC (Library of Congress) is the most popular classification method. Books have specific ids which is related to shelf id, category id, author id, title and publication date.

PL 248. Y373 I53 1999

PL	Shelf ID
248	Classification ID
Y373	Author Surname + Author ID
I53	Author's book first capital, book ID
1999	Publication Date

Table 1: Library of Congress Classification method

In this project most important part of this classification is shelf id. RFID reader with mobile devices recognizes the first shelf id then starting to read tags in books. This structure has 2 parts; Tags which are located in book are binding with the specific id difference from LC id of book. However, creating specific id for each book is important and costly operation; for security reasons each book must have specific id difference form its own LC id. This binding operation is created in the web part of this project. First of all, with mobile device software shelf id is chosen then all shelf is scanned by device. Then huge data send to the web server via wireless network. During the incoming data transfer of web server, shelf id is the base point of the hole data. Moreover, in administration side, shelf ids are specific properties and relevant to the image pointing based searching mechanism of web part.

1. Drawing a Shelf Using Layout Creation Tool

The main purpose of the second step of the program is to provide administrator an easy way to draw shelf objects using smart user interface similar to any image editing program. At the first step user can create shelf objects on the layout image with the aid of grids.

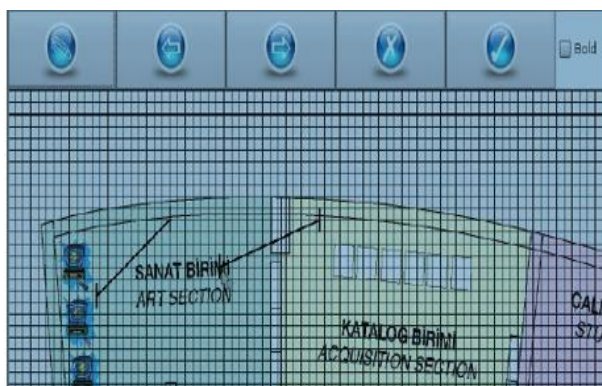


Fig 6: Drawing a shelf object

When mouse released a pop-up, screen is appeared to save information's corresponding shelf objects. System needs two important information from user to make relation with books and shelf objects in search criteria. This input is very important to guessing the books locations that comes from mobile device or from search part of the project.

Fig 7: Pop-Up

Shelf roof number and shelf part number are used to map books position in the shelf. If shelf has 3 part which means shelf consist of 3 blocks. First book in the upper roof at the first blocks in the shelf is the one element and last book in the last block of the shelf is the second element. After calculation of the capacity of the shelf any given book is can be pointed according to getting these two elements.

2. Web Component Part of the Project

The main purpose of creating a web component for this kind of project is that to make use of information's which are collected from mobile device and Layout Creation Tool. Actually, project consist of two main parts as mentoned before, finding incorrectly located books places and resulting the search criteria not only a basic string also answering user with pointing given book on map in the web browser application. The web system provides services for two type of users. First user type is the librarian which can get lots of information about inventory. The other type of user is the students or any user who try to find book location in the library. All librarian has their own accounts and login to the system with using this information.

Fig 8: Login Form

VI. RFID TECHNOLOGY FOR LIBRARIES

RFID (Radio Frequency Identification) is the latest technology to be used in library theft detection systems. Unlike EM (Electro-Mechanical) and RF (Radio Frequency) systems, which have been used in libraries for decades, 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.

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) and distance from the item is not a critical factor except in the case of extra-wide exit gates. The corridors at the building 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 sensors. The targets used in RFID systems can replace both EM or RF theft detection targets and barcodes.

V. AUTOMATED MATERIAL HANDLING

Another application of RFID technology is automated materials handling. This includes conveyer and sorting systems that can move library materials and sort them by category into separate bins or onto separate carts. This significantly reduces the amount of staff time required to ready materials for receiving.

VI. LONG TAG LIFE

Finally, RFID tags last longer than barcodes because nothing comes into contact with them. Most RFID vendors claim a minimum of 100,000 transactions before a tag may need to be replaced.

VII. RESULT

RFID based Library Management System is a unique system to be implemented in libraries to manage the books automatically and efficiently. It will use the RFID reader to identify and manage the books efficiently. Time saving, fast accessing of books and eliminating manual errors is the main benefits of the RFID in Library. The personal transactions can be viewed using various interfaces, either the website or the android app. The data can be managed using the interface created for the librarian. Hence both management and automation have been implemented.

VIII. CONCLUSION

RFID in the library speeds up book borrowing, monitoring, books searching processes and thus frees staff to do more user-service tasks. To yield best performance, RFID readers and RFID tags to be used must be of good quality. The efficient utilization of the technology also depends upon the information to be written in tag. These applications can lead to significant savings in labor costs, enhance customer service, lower book theft and provide a constant record update of new collections of books.

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