

Automation of Library Using RFID and VB.NET

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Abstract

This paper presents the idea about radio frequency identification (RFID) technology in library automation. The use of RFID technology is a major factor to create a move towards self service operations and other aspects of improving efficiency in library. The goal of this paper is to find out whether RFID renders any significant benefits to library management and how these benefits reflect to customer satisfaction. In this paper we are using the RFID technology for identifying the books and persons based on unique Tag number. The Microcontroller 89s52 will process the data and send it to a personal computer data base in which the data base will be maintained about the person.

The database is created using Microsoft Access and the forms are created using VB.NET.

Keywords

RFID, Microsoft Access, VB.NET

I. Introduction

Radio-Frequency Identification (RFID) devices have an important presence in our daily life and will become appearing in the near future. RFID technology is being implemented in a number of industries. Supply chain implementation is one of the most frequently mentioned applications of RFID tags and equipment. The bar-code system used in libraries is very time consuming and labor intensive. In the opposite, the RFID system provides a solution to effectively collect, manage, and distribute items.

The RFID tag does not have to be visible for detection. It can be read even when it is embedded in an item, such as in the cardboard cover of a book or in the packaging of a product. It can also store data such as stack number, accession number, book number, author information etc. but barcode is limited to just an identification number. . RFID significantly reduces the efforts involved in management of records.

The Electronic product code (EPC) is read by Radio frequency technology regardless of item orientation or alignment. The web based software recognizes the unique id and then grants access to one's account. Every individual can check the availability, issue and return the book using his card. RFID tag will also be attached to each and every book to prevent book theft. RFID reader will be placed in the circulation counter, entrance of library and reference section reading table. In this paper we mention about the use of passive rfid tags. 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 object passes 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. The reader receives this information and decodes it, and then sends it to a host computer, so as to complete the whole information

processing. The data from the microcontroller is displayed on the computer using Tera term Hyperterminal. The database is created using Microsoft Access. The database can be updated by entering the data in the forms created using VB.NET. The data from the Microcontroller that is displayed on the LCD gets displayed on the forms as well and gets stored in the database.

A. Hardware Module

1. RFID in Library

A library is a collection of information, sources, resources, books, and services, and the structure in which it is housed. Apart from books many libraries are now also repositories and access points for maps, prints, or other documents on various storage media such as microformes (microfilm/microfiche), audio tapes, CDs, LPs, cassettes, video tapes, and DVDs. Libraries have materials arranged in a specified order according to a library classification system, so that items may be located quickly and collections may be browsed efficiently. Reference stacks are different which has only reference books and only selected members.

The following are the tasks to be performed in the library.

- Circulation: handling user accounts and issuing/returning and shelving of materials.
- Collection, development, order materials, maintain materials budgets.
- Technical Services work behind the scenes cataloguing and processing new materials and De-accessioning weeded materials.

Utmost care has been taken to provide following features to the Library using RFID technology: To remove manual book keeping of records, traceability of books and library members as they move, less time consumption as line of sight and manual interaction are not needed for RFID-tag reading, to provide 2 meters read range antennas, to minimize the manual intervention, to minimize the manual errors, to provide the long lasting labels and to provide fast searching of books.

II. Methodology

RFID is a sensor-based technology consisting of three key elements: RFIDtags (transponders), RFIDreaders(Transceivers) and a data collection, distribution, and management system (middleware) that has the ability to identify or scan information with increased speed and accuracy.



Fig. 1: Smart Library

RFID technology is involved in various modules in libraries, such as Tagging station to tag the RFID label to each library material; patrons self check-out station to borrow the books using the self service; book drop station is used to return the books; and anti-theft security gates ensure the items are checked-out before leaving the library by detecting if the RFID label that are attached in the item is activated; and finally adds to the self management, for example patrons can track the searching items that were miss-shelved by the use of RFID handheld reader.

The Patron Self Check-in station is basically a display with a keypad 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 RFID card, the patron is asked to choose the next action (check-in of one or several books).

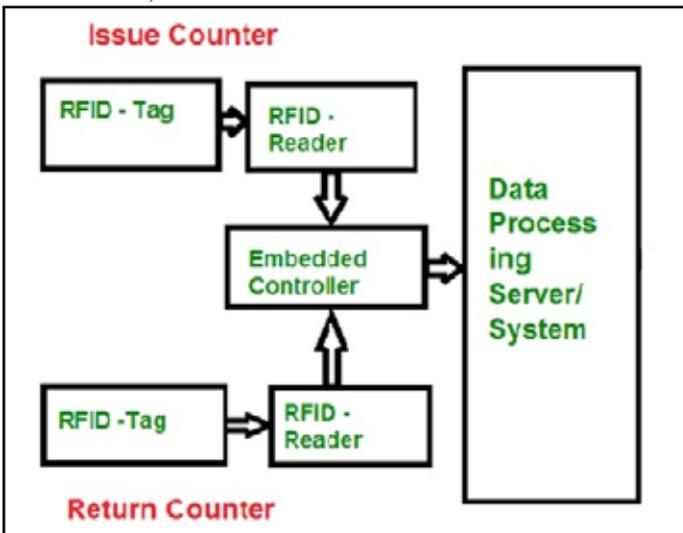


Fig. 2: Block Diagram

After choosing check-in, the patron puts the books 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). Then patron chooses return and then puts one book or a stack of books onto the reader. Patron will receive a confirmation. This flow is illustrated by Fig. 3.

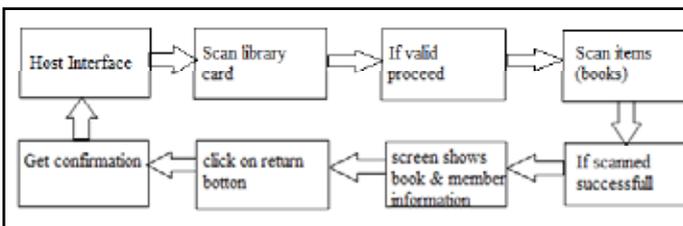


Fig. 3: Flow Diagram of System

The overall system is designed to be Smart thus reducing the efforts of manual intervention to a great extend.

A. Microcontroller

We know that there so many types of micro controller families. Those are 8051, AVR microcontroller, PIC microcontroller, ARM.

We are choosing 89s52 because it is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. It is compatible with the industry-standard 80C51 instruction set and pinout. The on-chip

Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer.

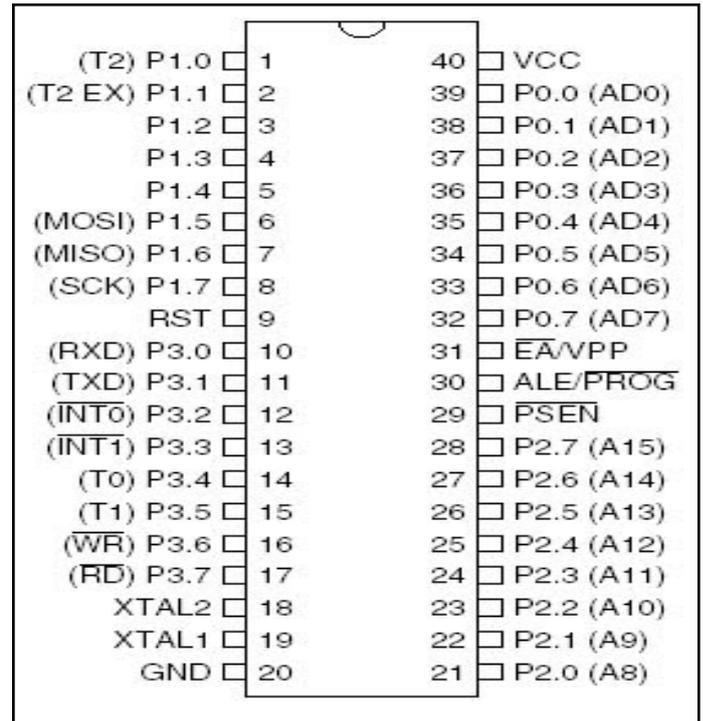


Fig. 4: Microcontroller 89s52

B. RFID Reader

Readers come in many forms, operate on different frequencies, and may offer a wide range of functionality. Readers may have their own processing power and internal storage, and may offer network connectivity.



Fig. 5 RFID Reader

They are electronically programmed with unique information. There are many different types of RFID systems out in the market. They are categorized according to their frequency ranges. Some of the most commonly used RFID kits are as follows:

1. Low-frequency (30 KHz to 500 KHz)
2. Mid-Frequency (900 KHz to 1500MHz)
3. High Frequency (2.4GHz to 2.5GHz)

These frequency ranges mostly tell the RF ranges of the tags from low frequency tag ranging from 3m to 5m, which is the one that we have chosen.

C. LCD

A Liquid Crystal Display (LCD) is a thin, flat panel used for electronically displaying information such as text, images, and moving pictures. LCD (liquid crystal display) projectors usually

contain three separate LCD glass panels, one each for the red, green, and blue components of the video signal being fed into the projector. As light passes through the LCD panels, individual pixels (“picture elements”) can be opened to allow light to pass or closed to block the light, as if each little pixel were fitted with a Venetian blind.

This activity modulates the light and produces the image that is projected onto the screen. We decided to use LCD because of following reasons.

1. The decreasing prices of LCD’s.
2. The ability to display numbers, characters and graphics. LCD displays two lines, 20 characters per line, which is interfaced to the microcontroller.
3. Simplicity of programming for characters and graphics.



Fig. 6: LCD Display

D. RFID Tags

A RFID tag is shown in figure . The antenna is clearly visible. The antenna has the largest impact of the size of the tag. The microchip is visible in the center of the tag, and since this is a passive tag it does not have an internal power source .RFID Tags are attached to books and student identity card. Radio Frequency (RF) tags or transponders transmit the data to a reader. 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 store some sort of identification number .A reader retrieves information about the ID number from a database, and acts upon it accordingly. RFID tags can also contain writable memory, which can store information for transfer to various RFID readers in different locations.

This information can track the movement of the tagged item, making that information available to each reader. RFID tags fall into two general categories, active and passive, depending on their source of electrical power. Active RFID tags contain their own power source, usually an on-board battery (2). Passive tags obtain power from the signal of an external reader

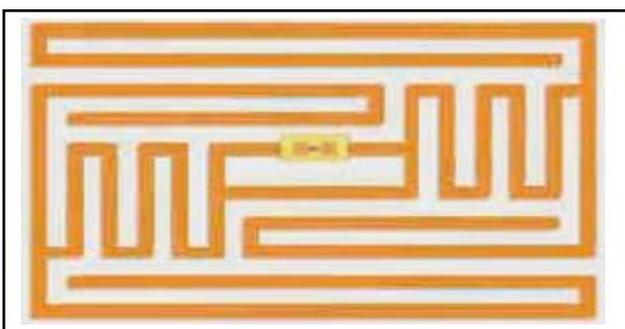
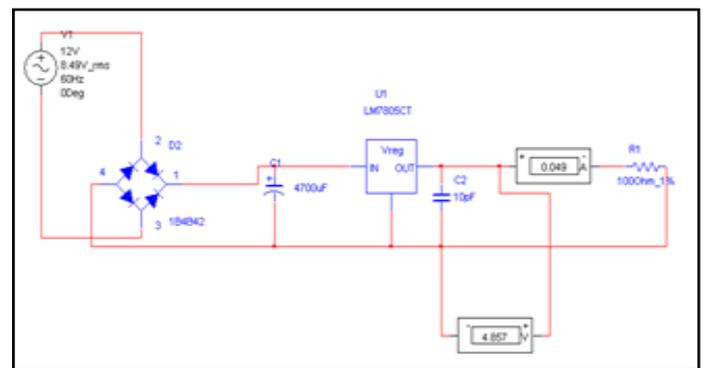


Fig. 7: RFID Tag

E. Power Supply

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others. Here in our application we need a 5v DC power supply for all electronics involved in the project. This requires step down transformer, rectifier, voltage regulator, and filter circuit for generation of 5v DC power.

1. Circuit Diagram of Power Supply



III. Advantages of RFID in Library

A. Rapid Charging/Discharging

The use of RFID reduces the amount of time required to perform circulation operations. The most significant time savings are attributable to the facts that information can be read from RFID tags much faster than from barcodes and that several items in a stack can be read at the same time.

B. Simplified Patron Self-Charging/Discharging

For patrons using self-charging, there is a marked improvement because they do not have to carefully place materials within a designated template and they can charge several items at the same time.

C. High Reliability

The readers are highly reliable. Some RFID systems have an interface between the exit sensors and the circulation system to identify the items moving out of the library. Were a patron to run out of the library and not be intercepted, the library would at least know what had been stolen. If the patron card also has an RFID tag, the library will also be able to determine who removed the items without properly charging them. This is done by designating a bit as the “theft” bit and turning it off at time of charge and on at time of discharge.

D. High-Speed Inventorying

Unique advantage of RFID systems is their ability to scan books on the shelves without tipping them out or removing them. A hand-held inventory reader can be moved rapidly across a shelf of books to read all of the unique identification information. Using wireless technology, it is possible not only to update the inventory, but also to identify items which are out of proper order.

E. Automated Materials Handling

Another application of RFID technology is automated materials handling. This includes conveyor 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 reshelving. Given the high cost of the equipment, this application has not been widely used.

F. Long Tag Life

RFID tags last longer than barcodes because nothing comes into contact with them.

G. Fast Track Circulation Operation

The use of RFID reduces the amount of time required to perform circulation operations. The most significant time savings are attributable to the facts that information can be read from RFID tags much faster than from barcodes.

IV. Disadvantages of RFID in Library

- **High Cost:** The major disadvantage of RFID technology is its cost.
- **Vulnerability to Compromise:** It is possible to compromise an RFID system by wrapping the household foil to block the radio signal. It is also possible to compromise an RFID system by placing two items against one another so that one tag overlays another. That may cancel out the signals. This requires knowledge of the technology and careful alignment.
- **Removal of Exposed Tags:** The RFID Tags cannot be concealed in either spine or gutter of the books and are exposed for removal. If a library wishes, it can insert the RFID tags in the spines of all except thin books; however, not all RFID tags are flexible enough. A library can also imprint the RFID tags with its logo and make them appear to be bookplates, or it can put a printed cover label over each tag.

A. Software Module

1. VB.NET

Visual Studio is a suite of applications created by Microsoft to give developers a compelling development environment for the Windows and .NET platforms. Visual Studio can be used to write Console applications, Windows applications, Windows services, Windows mobile applications, ASP.NET applications and ASP.NET web services, in your choice of C++, C#, VB.NET, J# and more. Visual Studio also includes various additional development tools, such as Visual Source Safe; which tools are included, depends greatly on the edition of visual studio that you are using. We are using Visual Studio 10 windows forms application to create a front end.

Windows form Application: These are Windows desktop applications written using the .NET framework; since they are .NET applications, they require that the .NET framework be on any computer that will run the application.

Advantages of VB.NET:

- Full support for object oriented programming.
- Structured error handling capabilities.
- Access to .NET framework.
- Inherent support for XML and Web services.
- Better windows applications with windows forms.
- New console capabilities of VB.NET.
- New web capabilities with web forms.

- Interoperability with other .NET compiled languages.
- Better database programming approached with ADO.NET.

2. Microsoft Access

MS Access is a database management tool of Microsoft. This is given with MS-Office package. There is need for database management tools like Access for all corporate and private organizations etc., where large amount of data is to be handled. When large amount of data is being saved and processed, the name "Database" is used. Database management is the process of manipulating the stored data to the requirements. Databases are designed to offer an organized mechanism for storing, managing and retrieving information. Basically Database management involves the functions of data storage and retrieval. In some occasions data stored in a database may be edited and manipulated according to the requirements. MS Access is a perfect tool to do all these kinds of functions.

Advantages of Microsoft Access:

- MS Access has easy operating procedure compared to other database management tools that are available.
- It provides excellent graphical user interface (GUI) whereas most database management tools provide console operating interface.
- Table creation for database management is easily done here. That is direct interaction with tables created, and editing is possible.
- There is no need for users to have high programming knowledge for using MS Access.

V. Results and Conclusion of Hardware

The system is successfully implemented where The assembled hardware is shown in the figure below.



RESULTS AND CONCLUSION OF SOFTWARE:

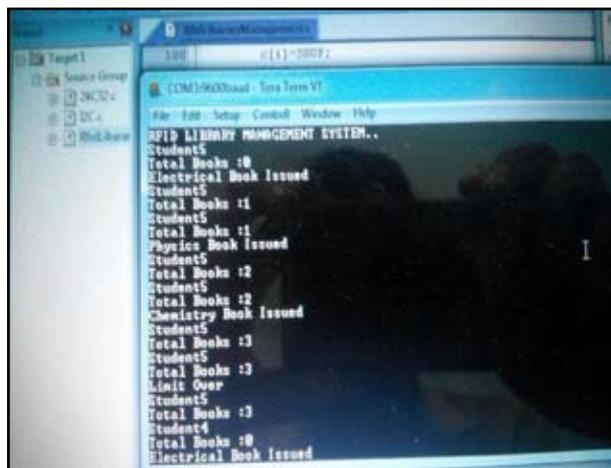


Fig. 8 Output After Interfacing Reader Module & PC

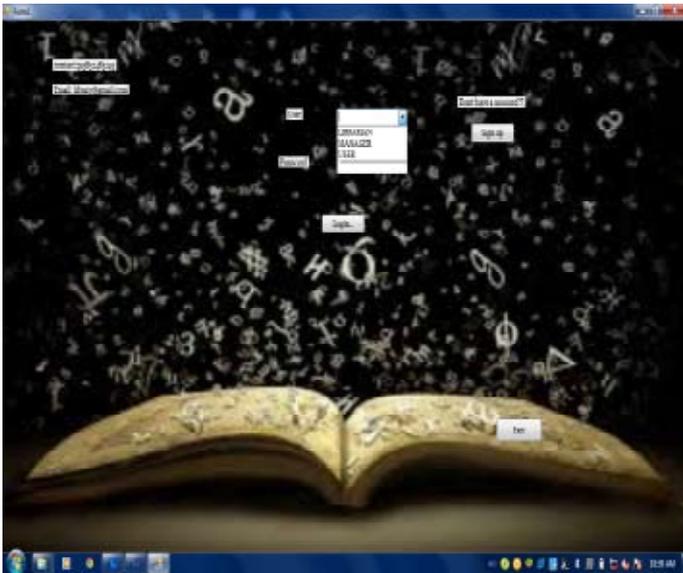


Fig. 9: Login Page

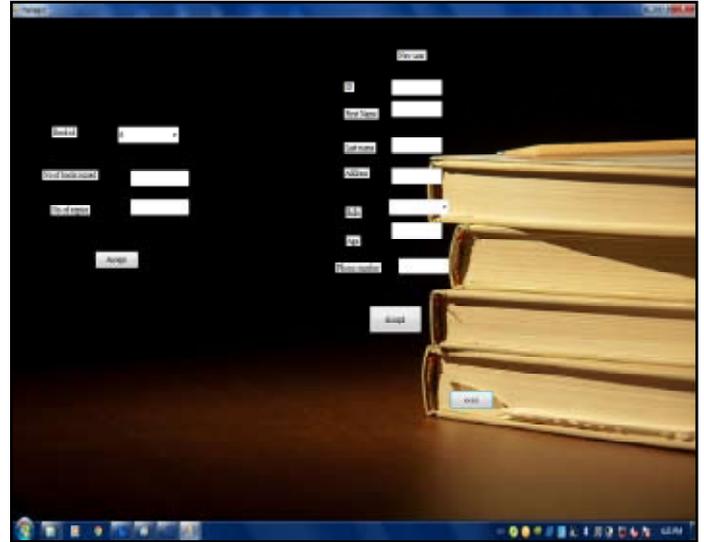


Fig. 12: After Manager Login



Fig. 10: After Librarian Login

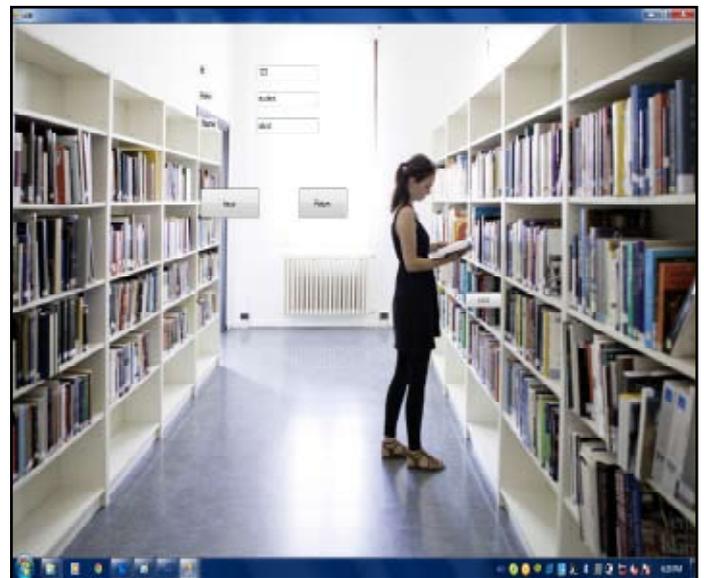


Fig. 13: After User Login

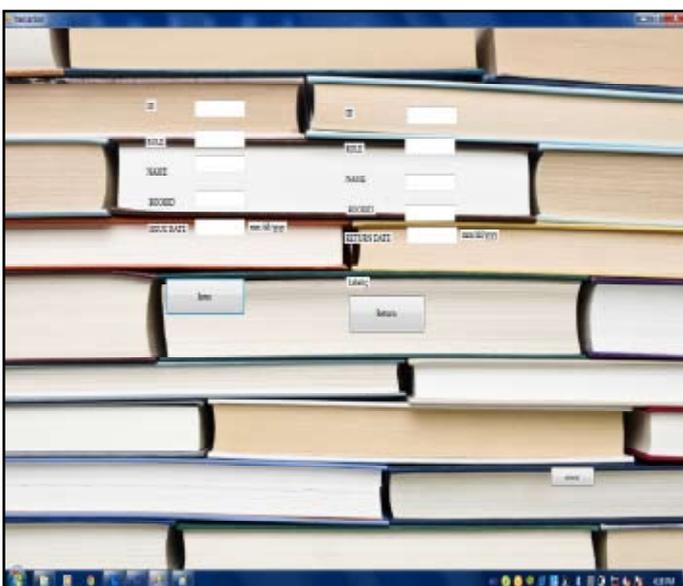


Fig. 11: After Selecting "Transactions" Option

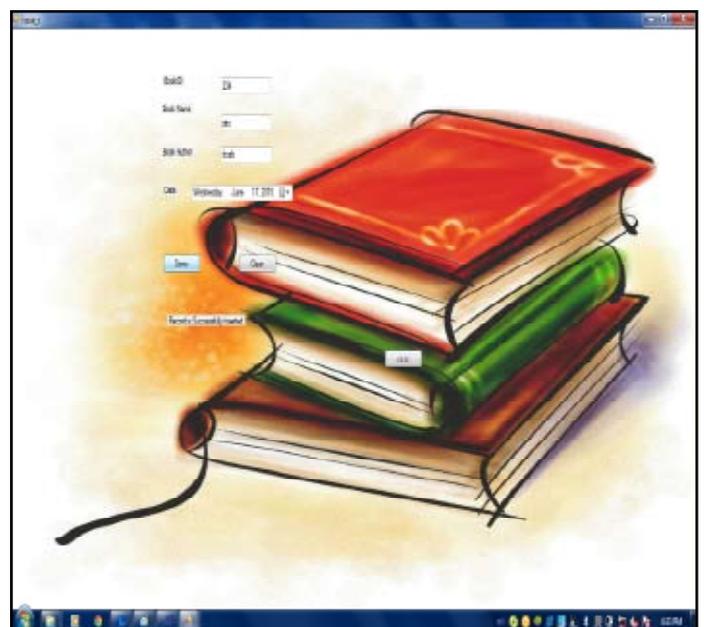


Fig. 14: After selecting "Issue" option

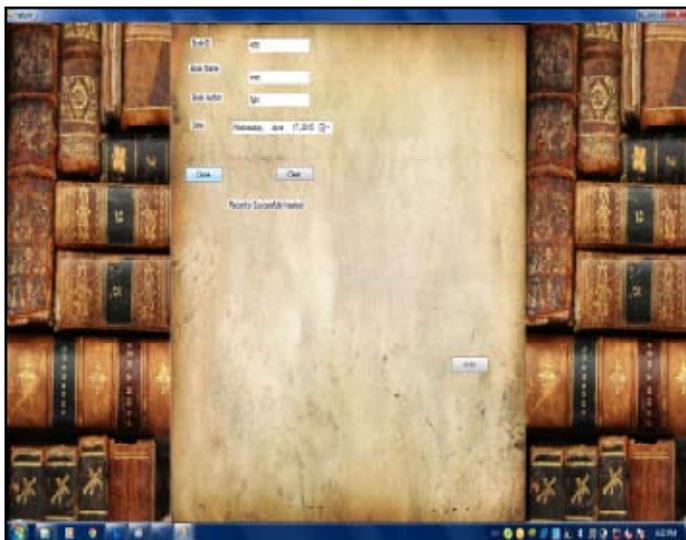


Fig. 15: After Selecting “Return” Option

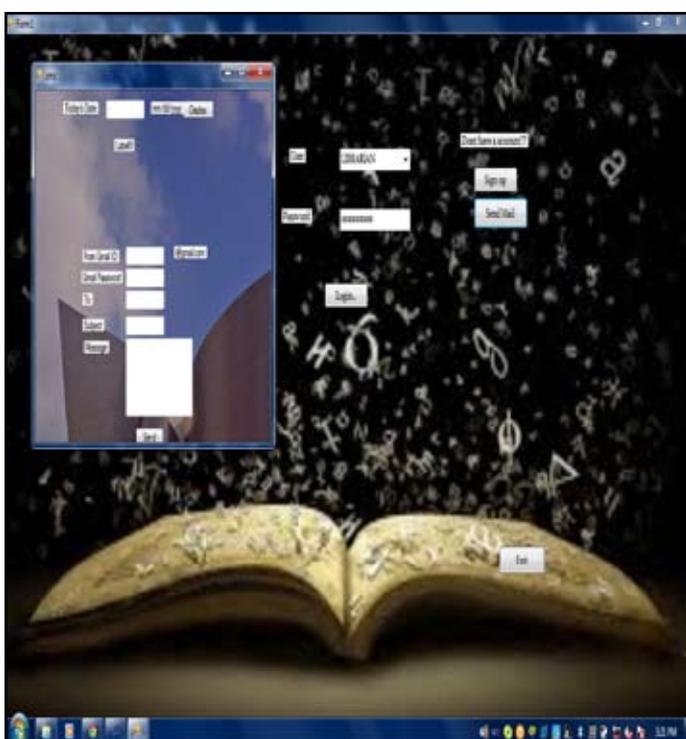


Fig. 16: After Selecting “Send Mail” Option

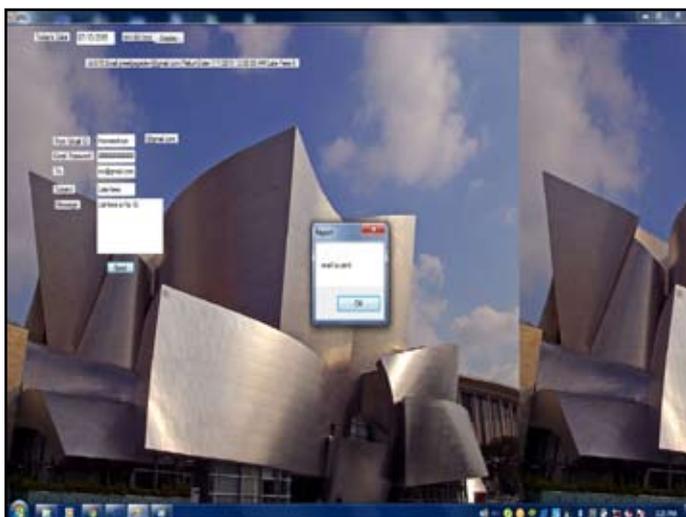


Fig. 17: After Selecting “Send” Option

This paper is intended to give overall view of RFID technology to library fraternity. The information has been gathered and compiled with our inputs for librarians to refer this paper as a base, when planning to go for a RFID solution without getting into technical jargons. It is an attempt to touch base with all the areas relating to use of RFID in Libraries in simple language.

The paper stands as a ready reference for librarians when they commence conversation with vendors for implementation of RFID in their libraries. It mainly focuses on low cost in order to be implemented in libraries all over India on a larger platform.

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