

RFID AUTOMATION SYSTEM

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ABSTRACT

The current library system is a bit outdated. Whenever a student borrows a book the process takes very long especially if lots of books are borrowed. The system aims to fix these drawbacks using RFID.

RFID tags are small programmable chips. The system aims to implement RFID tags to simplify the checkout process. All books are equipped with a RFID chip.

When a student brings the books he wants to borrow to the librarian, the librarian passes the books through the RFID scanner in her desk. The scanner identifies the tags and displays the book information, collected from a database. The student then proceeds to give his ID card that is equipped with an NFC tag. The tag is scanned and student details are retrieved. The books are then lent to the student and the database is automatically updated. Reminders will be sent before the last date to return the book.

Keywords: TAG ,RFID ,DATABASE ,LIBRARY ,MANAGEMENT

1. INTRODUCTION

1.1 Overview

RFID was invented in 1969 and is now being used in numerous applications. When used in industries or retail shops they generally hold the cost of the good. Also in a grocery shop the goods once left have least chances of coming back again. This is not the case when used in a automation, as the books are issued and given a specific period of time within which the book needs to be returned. The same book may be taken again and again depending on the requirement of the users. Also the users are also provided with unique identification codes. The users may use the automation more than once. So the reader will have to read the same tag more than once. RFID is an automatic identification technique used for the fast transaction of books, journals or DVDs using RFID tags and readers. The RFID technology helps in fast issuing, returning, and reissuing of books. The technology helps in direct transaction of information from the tags to the PC of the librarian and in automatic updation of transactions in the users account.

The RFID tags can be programmed with a unique code. This code gets read when passing through the RFID reader. When a tag crosses the reader the reader recognizes the unique code and updates the account of the user. Modern readers have the capability of reading upto 15 tags at a time. The frequency range is upto 13.5 Hz and has a wide read range of about 2 meters. The RFID tags are embedded into the books and are not visible for detection. The readers since they have a wide read range unlike bar code readers have the capability to read the tags even when they are embedded within the books. Special care and attention should be given in programming the tags since they are mostly programmable only once. These tags can store stack number, accession number, book number, author information etc., but the bar code technology is limited to only the identification number.

The programming cost of RFID tags are much costlier than the barcodes but it should be noted that the same tag can be reprogrammed if necessary. Depending on the applications added the cost of tag increases.

The current automation system is a bit outdated. Whenever a student borrows a book the process takes very long especially if lots of books are borrowed. The system aims to fix these drawbacks using RFID. RFID tags are small programmable chips. The system aims to implement RFID tags to simplify the checkout process. All books are equipped with a RFID chip. When a student brings the books he wants to borrow to the librarian, the librarian passes the books through the RFID scanner in her desk. The scanner identifies the tags and displays the book information, collected from a database. The student then proceeds to give his ID card that is equipped with an RFID tag. The tag is scanned and student details are retrieved. The books are then lent to the student and the database is automatically updated. Reminders will be sent before the last date to return the book.

1.2 Problem Statement

The purpose of the management system is mainly to provide automation to the library. The categories of users provided are

Librarian: He can read or write the information about any member and can update, delete or create a membership plan.

Member: He can get a book issued.

The Scope of the application is wide and can be used with any education institute and also can be used in offices with the necessary modifications done. With this application, the manual application is converted into automated online application. For example purposes, customized data is being used for this purpose. The user will not have the privilege to enter the data about the books.

The three major components in the application are

- Login
- Issue/Borrow
- Balance dues

- The solutions provided by the system are:
- Better and efficient service provided
- Faster retrieval of information
- Reduced workload of the automation staff
- All details of the book will be available on a click
- Less paper work and document maintenance

1.3 Objective

The main objective of the RFID Automation management system is to ease the problems that might occur when details regarding books and students are manually entered. Various problems and errors may occur when such details are entered manually. The existing system is also quite tedious. The RFID automation management system also ensures efficient circulation of books among students.

Unlike the previous system, in which the librarian manually entered the details of the students and the books which were borrowed, the current system aims to ensure an efficient process. It also aims to make the process less time consuming. The system ensures that less time is consumed on obtaining the required information for the process such as book borrower details, date of return, book name, book author name etc.

1.4 Organisation of report

The first title gives a brief introduction to RFID technology and its impact in day-to-day processes. It also explains briefly about the existing system and the objectives of the RFID automation management system.

The second title discusses the literature survey which was taken for the implementation of RFID in the automation management process.

The third title discusses the specifications regarding the various hardware and software interfaces which are being implemented in the RFID automation process.

The fourth title provides details regarding the design of the project with various flowcharts and workflow diagrams.

The fifth title provides the details of the various modules present in the system architecture and its working process.

The sixth title provides an insight into the functioning of the project by showing the various operations performed by the RFID automation system.

In seventh title the project is concluded and the future scope of RFID technology is briefly discussed.

LITERATURE SURVEY

2.1 Introduction

RFID technology is the latest upcoming technology which is being used in the modern world. Various online forums have recommended the usage of RFID technology to be used in the day to day functioning of various processes. Radio Frequency Identification (RFID) is the wireless non-contact system that uses radio-frequency waves to transfer data from a tag attached to an object, for the automatic identification and tracking. RFID technology is used to incorporate a concept to create an application for the library management.

2.2-Existing System

Library is a place in which books, manuscripts, recordings, films, or reference material or kept for private or public uses. Generally a automation must be able to handle some housekeeping tasks such as acquisition, interautomating loan ,cataloguing ,circulation, serials management, statistical reports and references. The current system of automation management involves a lot of manual work. In this system ,a student first has to go to the automation where he takes whatever books he requires. The student then submits the books to the librarian. The librarian has to thoroughly check the student's ID for the details .The librarian has to then verify the details of the student, check the details such as register number, date of birth, blood group etc. After verifying if the student is from the university, the librarian then has to type the register number of the student in the computer and then has to enter the book codes of the books the student wishes to take. After entering the above mentioned details, the books are registered to the student. The librarian then has to manually assign the return date. He/she also has to assign the late fees which are to be levied if the books are not returned within the due date.

The current process can take a lot of time to complete. It also requires manpower to check whether the books which have been assigned to the student has been returned to the automation or not. This system could be used by two categories of people mainly administrator\staff category and users. The administrator/librarian could add /remove book and member to the database and fine the user (if any). A automation must be able to handle some housekeeping tasks such as acquisition, interautomation loan, cataloging, circulation, serials management, statistical reports and references. All information of user in that automation is stored in the computer database. Each user is registered and supplied with a user name and password by the librarian as identification data for them. If a user/student wants to borrow a book, he can do it without any manual intervention. He walks to the computer of automation that is connected LAN with the server computer and login with valid user name and password. He can search book with one of these book name, author name, category of book. If the selected book is available computer will show the location of book.

2.3 Issues in existing system

- The current system is a deeply flawed system.
- It requires a lot of manual work and is also very time consuming. Some of the basic problems that occur in the current system of automation management are
- The serial numbers of the books and the student IDs are long and complex.
- There may be manual errors made by the librarian while typing these numbers which results in more time being used
- The existing system requires a lot of manual labour which also increases the time consumed

2.4 Summary of literature survey

An Introduction to RFID Technology

In recent years, radio frequency identification technology has moved from obscurity into mainstream applications that help speed the handling of manufactured goods and materials. RFID enables identification from a distance, and unlike earlier bar-code technology, it does so without requiring a line of sight. In this paper, the author introduces the principles of RFID, discusses its primary technologies and applications, and reviews the challenges organizations will face in deploying this technology.

Implementation of RFID Technology in Automation system

Most educational institutions' administrators are concerned about student irregular attendance. Truancies can affect student overall academic performance. The conventional method of taking attendance by calling names or

signing on paper is very time consuming and insecure, hence inefficient. Radio Frequency Identification (RFID) based attendance system is one of the solutions to address this problem. This system can be used to take attendance for student in school, college, and university. It also can be used to take attendance for workers in

working places. Its ability to uniquely identify each person based on their RFID tag type of ID card make the process of taking the attendance easier, faster and secure as compared to conventional method. Students or workers only need to place their ID card on the reader and their attendance will be taken immediately. With real time clock capability of the system, attendance taken will be more accurate since the time for the attendance taken will be recorded. The system can be connected to the computer through RS232 or Universal Serial Bus (USB) port and store the attendance taken inside database. An alternative way of viewing the recorded attendance is by using HyperTerminal software. A prototype of the system has been successfully fabricated.

3. SPECIFICATION

3.1 Introduction

3.1.1 Purpose

The purpose of the project is to use the RFID stations and equipment provided under this contract to work with Automation Management Software (LMS) provided by other vendor to automate and enhance the automation processes. This allows the user to have a single seat from which to perform daily operation. The proposed system will automate the following tasks using RFID technology

- Accessing number of books at a time
- Searching a particular book to check its presence in the automation
- Accounting/Stock verification of the materials

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 automation member information to the automation management system and does not need the manual typing.

The following are the tasks to be performed in the automation:-

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

Basic tasks in automation management include the planning of acquisitions of materials, arranging the acquired materials according to the automation classification, preservation of materials the de accessioning of materials, patron borrowing of materials, and developing and administering automation computer systems.

3.1.2 Project Scope

RFID technology is being implemented in a number of industries. Supply chain implementation is perhaps one of the most frequently mentioned applications of RFID tags and equipment. Retailers have begun to make it mandatory for their suppliers to tag merchandise destined for their stores. There is, however, a key difference to the automation's inventory as compared to that of a warehouse or a retail outlet. In the warehouse and retail supply chain, goods come in and leave. Only occasionally are they returned. The retail sector is looking at RFID as a "throwaway" technology that hands an item to a customer which gets discarded. Yet the item wise unit cost of including an RFID tag is much more than the cost of printing a barcode on a package. In libraries, items are taken out and returned many times. Thus the same RFID tag is re-used many times.

The libraries across the globe started to use RFID to speed up the self check in/out processes, to control the theft and to ease the inventory control in automation. The barcode technology is slowly getting replaced by the RFID technology. 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. 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 automation member information to the automation management system and does not need the manual typing. It also provides monitoring and searching system. The monitoring module will continuously monitor the movement of books across the gates, so that the books taken out without prior issuing will be traced out easily and will alarm the librarians. The searching module provides the fast searching of books using RFID handheld reader.

The RFID Automation System supplier shall supply, install, test and commission a fully integrated RFID Automation System incorporating RFID tags if any with open communications capabilities as herein specified. The proposed system shall be modular and scalable. It shall be able to interface seamlessly to Automation Management Software (LMS). To accomplish this effectively, system shall be capable of utilizing Standard Interface Protocols version 2 (SIP 2) via existing vendor protocols. System shall be capable of communicating via Ethernet TCP/IP protocol according to IEEE standard. The intent is to use the RFID stations and equipment provided under this contract to work with Automation Management Software (LMS) provided by other vendor to automate and enhance the automation processes. This allows the user to have a single seat from which to perform daily operation. The proposed system shall be strictly based on full RFID technology using 13.56 MHz frequency. Any magnetic technology will not be accepted. All automation items must be secured using the RFID tags.

3.2 Overall Description

3.2.1 Product features

The RFID Automation system is proposed to provide a friendly atmosphere to the librarians in having an efficient automation management in place. The books tagged with RFID labels are used for automated circulation (self check-out and searching of the books. The patron identification and access rights are also controlled by the RFID system. Other features present in the RFID automation management process include

- Fully transparent stock control on all available books in the automation.
- RFID-labels can be identified (read) very easily (without line of sight, over a certain distance, several books simultaneously), the so-called self-check-out system can be used and this will save manpower and increases the attractiveness of the automation.
- Since the RFID-Automation offers a fully controlled and categorized automation stock, the number of similar books can be reduced because the turn-around time of each book can be shortened drastically.
- RFID-label stores data of the book and its system status that gives the possibility to check the book without the database.
- Keeps record of complete information of a book like; Book name, Author name, Publisher's name, Date/ Year of publication etc.
- Easy way to make a check-in and check-out .

Utmost care has been taken to provide following features to the Automation using RFID technology:

- To remove manual book keeping of records
- Improved utilization of resources like manpower, infrastructure etc.
- Less time consumption as manual interaction is 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
- To provide fast searching of books

3.2.2 User classes and characteristics

Book

This class is used to enter the important details of the book such as title of the book, summary of the book, name of the publisher, date of publication of the book, number of pages in the book and the language.

Book Item

This class is used to provide the identification/serial number of the RFID tag which has been placed in the book. With the help of the RFID tag, the database can be accessed by the librarian.

Automation

This class is used to provide the name and address of the borrower to the librarian for his/her personal reference while assigning the books to the borrower.

Author

This class is used to provide the name of the author of the book which has been borrowed by the borrower. It is also used to provide a short biography detailing the past works of the author and his current whereabouts.

Account

This class is used to display the automation account which is used by the borrower. It displays details such as the account number which serves as the automation ID of the borrower, history of the account, date in which the account was opened and the state of the account (whether active or not).

Patron

This class is used to display the details regarding the patrons. Patrons are the people who donated the books to the library. Their details are displayed.

Librarian

This class is used to display the details of the librarian who assigns the books to the borrower. Various details of the librarian such as name, address and position in the automation are displayed.

3.2.3 Operating Environment

Various software and hardware components are used in the implementation of RFID technology in Automation Management system.

Hardware

1. ISO RFID HF Tag
2. Electromagnetic Strip B2 Tattle Tape
3. Mid-Range Reader with

Antenna Software

1. Visual Basic
2. Turbo C

Operating Systems: Windows 7 or higher

A single tag for identification, automation and anti-theft must be read even if not visible and must be read inside the file; temper proof and guarantee for the life of the item on which it is originally affixed. b. The proposed system tags enable the AFI security status to be stored directly on the tag and trigger and immediate alarm if an item not charged is read by the detection system. c. The proposed system tag is guaranteed for the life of the item on which it is originally affixed. Lifetime guarantee assures about the quality of the product offered and future replacement of the RFID tags which are found un-operational without any extra cost.

3.3 External interface requirements**3.3.1 User Interface**

The user requires Microsoft Visual studio for the implementation of the software. Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs for Microsoft Windows super family of operating systems, as well as web sites, web applications and web services. Visual Studio uses Microsoft software development platforms such as Windows API, Windows

Forms applications, Windows Presentation Foundation and Windows Store. This IDE can connect with database by using query language.

3.3.2 Hardware Interface

The hardware requirements for the implementation of RFID technology in the process of automation management are:

1. ISO RFID HF Tag.

- 1.Dimension: RFID Tag size 50 x 50 mm or comparable
- 2.Thickness: 350um Max
- 3.Memory: Not less than 1024 bits
- 4.Data Processing Rate: 26Kbps Minimum
- 5.Frequency: 13.56MHz
- 6.Standard: ISO 15693 and 18000-3
- 7.Type: Read/Write Lockable with unlimited number of Read/Write cycles and must be re-writable
- 8.Distance for Tag Detection: 36" minimum
- 9.Operation Mode: Passive
- 10.Functionality: Both Security & Inventory Control
- 11.Adhesive: Adhesive-backend and one piece (tag and label integrated into one piece) to adhere to file materials without addition of adhesive cover label. The proposed tag uses as low acid or neutral pH adhesive.
- 12.Operating Temperature:25o C to +70o C approximately
- 13.Other Features:
 - a. A single tag for identification, automation and anti-theft must be read even if not visible and must be read inside the file; temper proof and guarantee for the life of the item on which it is originally affixed.
 - b. The proposed system tags enable the AFI security status to be stored directly on the tag and trigger and immediate alarm if an item not charged is read by the detection system.
 - c. The proposed system tag is guaranteed for the life of the item on which it is originally affixed. Lifetime guarantee assures about the quality of the product offered and future replacement of the RFID tags which are found un-operational without any extra cost.

2. Electromagnetic Strip B2 Tattle Tape

- 1.The size of the security strip should be minimum 160mm x 3mm for hardbound books, softbound books and periodicals.
- 2.Strip must be guaranteed to perform for life time of the object in which they are placed.
- 3.Strip once applied on materials should be hidden in nature
- 4.The security strip shall be one-piece, flexible, thin, non-rusting metallic alloy coated with an adhesive film. The film shall not discolour or lose its adhesive or cohesive strength with age. The strip shall require no moisture, heat or additional glue or adhesive for affixing to automation materials.
- 5.The strips shall be virtually unaffected by any shielding devices such as gum, cigarette wrappers, aluminium foils, human body, or by items held back-to-back or cover-to-cover or concealed in briefcase or backpacks
- 6.Manufacturer shall warrant that the strips will be free of defects in materials and manufacture for the lifetime of the strips.

3. Mid-Range Reader with Antenna

1. A desktop based RFID reader which shall be used by staff for item tagging and personalization. This machine will also be used by staff for circulation purpose.
2. This machine may need a separate smart card reader for patron secure identification which has to be provided.
3. Hardware: Mid-Range Reader with Antenna
4. Power Supply: 12-24V DC +/- 15%
5. Power Consumption: Approx. 8VA
6. Operating Frequency: 13.56MHz
7. Reading Distance: Upto 35cm
8. Status Indicator: 3 LEDs
9. Antenna Dimension: 216 x 216mm or comparable
10. Antenna Connection: SMA Plug (50 ohm)
11. Antenna Cable: More than 3.5 meters
12. Supporting Tags: High Frequency ISO 15693 Compliant Transponders
13. Operating Time: < 24ms per one label
14. Nos. of tags at same time: 16 or more
15. Protection Class: IP40

3.3.3 Software requirements

To accomplish the system, the choosing of software is very important. The Microsoft SQL Server 2008 and Microsoft Visual Studio 2008 are used as Integrated Development Environment (IDE). The C# language is also used to implement the system. The C# language is familiar with many users and suitable for GUI design.

A. Microsoft SQL Server Microsoft SQL Server is a relational database management system developed by Microsoft. As a database, it is a software product whose primary function is to store and retrieve data as requested by other software applications, be it those on the same computer or those running on another computer across a network.

Microsoft Visual Studio:

Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs for Microsoft Windows super family of operating systems, as well as web sites, web applications and web services. Visual Studio uses Microsoft software development platforms such as Windows API, Windows Forms applications, Windows Presentation Foundation and Windows Store. This IDE can connect with database by using query language. The C# language is used to write the program.

C# language:

C sharp is a programming language that is designed for building a variety of applications that run on the NET Framework. C# is simple, powerful, type-safe, and object oriented. The many innovations in C# enable rapid application development while retaining the expressiveness and elegance of C-style languages.

3.3.4 Communication Interface

The following network requirements are necessary for the working of RFID automation management process:

- Perfectly working modem with high broadband speed.
- Strong broadband signal

3.4 Other functional requirements

3.4.1 Performance requirements

For the RFID automation management to give a efficient performance, following requirements are necessary:

- An End – User (may be a faculty or student) should be able to login into the system after their registration done by the Automation Administrator.
- After his/ her login is done then user can access their account details like No. of books taken from automation, No. of books returned, Due date for the books . . . etc;
- Accession number, roll number and teacher identification must all be unique as they form the primary keys of the respective tables.
- All new books must be entered in the accession table first, to avoid problems later.
- A book must not be deleted from student profile unless and until she pays the appropriate fine or the same book.
- While inserting values in the database, only valid values must be entered

3.4.2 Security requirements/enhancements

For the safe and proper functioning of RFID automation management system, following security requirements are to be performed:

- The bidders should provide complete technical compliance statement. None compliance to any of the technical parameters will not be considered for further evaluation.
- All the above mentioned items must be from single brand or manufacturers only for seamless integration.
- The vendor must provide MA (Manufacture Authorization Letter) clearly mentioning the hardware warranty of 1 years from the date of successful delivery and installation.
- The vendor must be competent in installation of such Automation System

4. SYSTEM DESIGN

4.1 Introduction

The purpose of the Library Management system is to allow for storing details of a large number of books, magazines, Journals, thesis and allow for add, search, borrow, return facilities separately to administrator/Librarian, staff and students. The traditional services such as maintain the records of all the Books, journal, magazines, newspapers, international papers and students holding membership for that library is implemented by Microsoft Visual Studio and Microsoft SQL Server as IDE. C# language is used to implement this system. The registered member/user of that library must login with the valid name ID and can borrow the books and return books himself easily. The new user and librarian can register as library member under the permission of staff/administrator

The great increase on RFID based implementations provide a great development on the speed of processing and give comfort to the people. For example a simple inventory operation for huge data storage can be done in a few seconds with using RFID technology. RFID based library management system is made to automate this housekeeping information more quickly and efficiently. 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. The aim of this project is implementing new generation of Library Management System. The administrator/librarian can add /remove book and member to the database and fine the user (if any). Whenever a new book is added to the library, an RFID tag is attached into the book and the information of book like, shelf no, author name, categories of book is also captured in the computer database. All information of user in that library is stored in the computer database. Each user is registered by the librarian as identification data for them. If a user/student wants to borrow a book, he can do it without any manual intervention. He walks to the computer of library that is connected LAN with the server computer and login with valid user ID. The administrator/librarian can add /remove book and member to the database and fine the user (if any). Whenever a new book is added to the library, an RFID tag is attached into the book and the information of book like, shelf no, author name, categories of book is also captured in the computer database. The user can search book with one of these book name, author name, category of book.

To finish borrowing, the user goes and takes the book that he searched and waves that book near the reader and the computer will record automatically all the data of that book in the borrow list against his user ID. When user wants to return book, he must login and wave that book on the RFID reader, then the computer automatically deletes the data of that book from the borrow list of the database. This system is good for all users able to search book and self check in/out from any network computer within the library premises.

4.2 System Architecture

4.2.1 Flowcharts Diagram

The below flowchart shows the functioning of the library management system process.

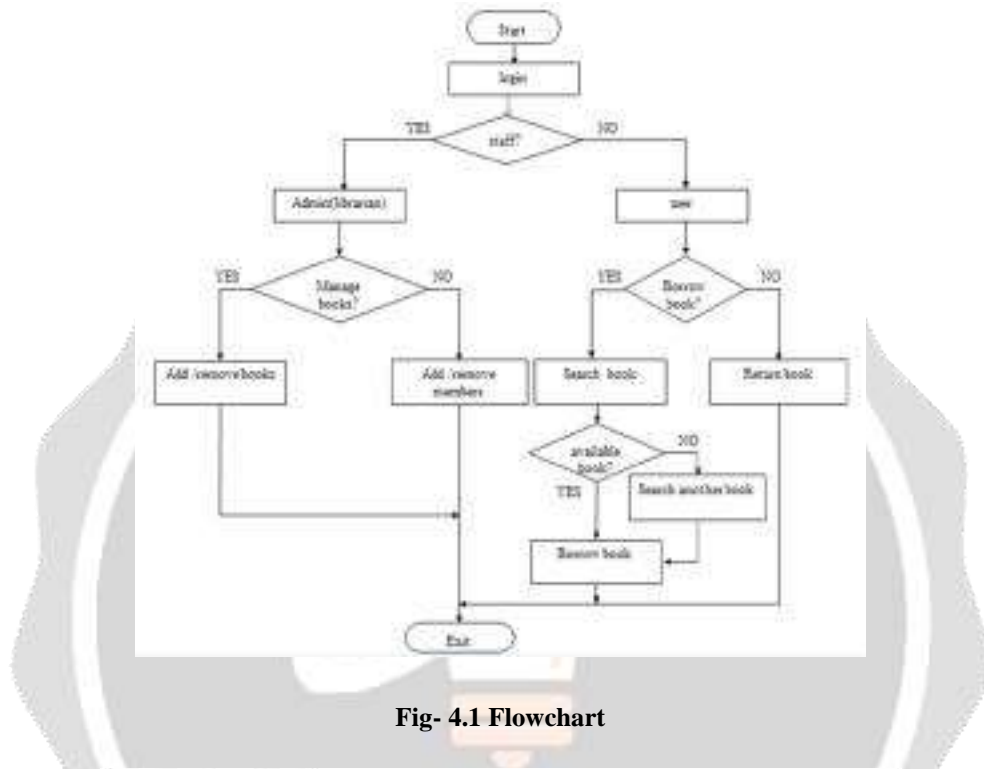


Fig- 4.1 Flowchart

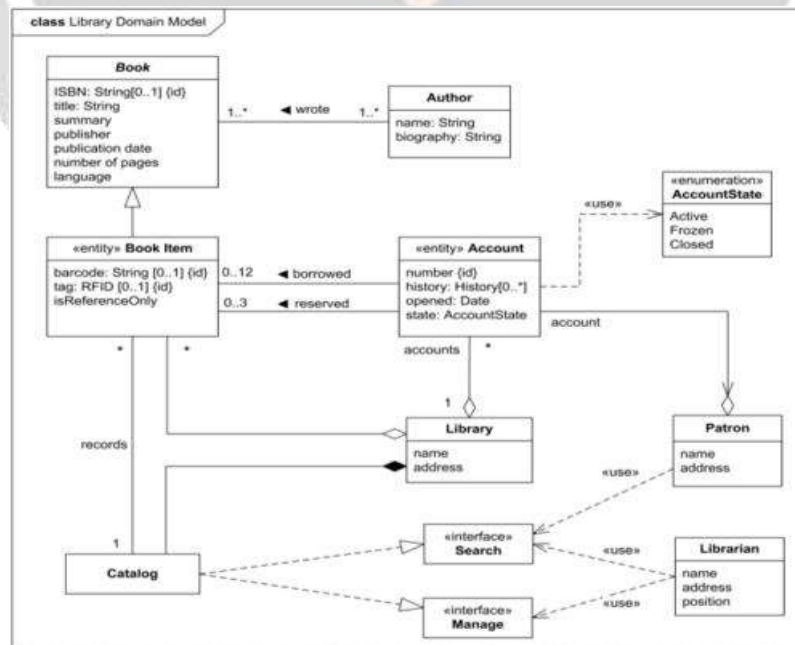


Fig-4.2 Use Case Diagram

4.2.2 Description

The system can be recognized easily by seeing the flow chart of the over all system. This system uses two categories of people mainly administrator/staff category and users. Both of them have to register and login to manage library for staff and borrow books. When the login people is user ,if he wants to return book return it as the library processor and if user wants to borrow books, he can search the book with the title of book, type of book or author of book. If the searching book is available, borrow and take but if searching book is not available search another book or exit.

4.2.3 System Requirements

The main motive of using RFID technology is to decrease the time consumption of every task and to get 100% readability of tags. To achieve this, best tag position has to be identified to make sure that none of the tags gets compromised with reader in terms of getting hidden by the human body while carrying the books. Hence, different tag positions have been taken into consideration and have been checked for its readability. Though there are several options to compromise the reader by hiding the tag deliberately using RF RFID LAN handheld reader (Client s/w) Librarian PC (Server s/w) Wireless /Wired connection Database deliberately using aluminium material or any kind of metals etc.

4.3 System Requirements

The following requirements are necessary for the functioning of the RFID library management process to be smooth and efficient:

- A single tag for identification, automation and anti-theft must be read even if not visible and must be read inside the file.
- temper proof and guarantee for the life of the item on which it is originally affixed.
- The proposed system tags enable the AFI security status to be stored directly on the tag and trigger and immediate alarm if an item not charged is read by the detection system.
- The proposed system tag is guaranteed for the life of the item on which it is originally affixed.
- A desktop based RFID reader which shall be used by staff for item tagging and personalization. This machine will also be used by staff for circulation purpose.
- This machine may need a separate smart card reader for patron secure identification which has to be provided.

Lifetime guarantee assurances about the quality of the product offered and future replacement of the RFID tags which are found un-operational without any extra cost.

4.4 Summary

RFID in the library speeds up book borrowing, monitoring, books searching processes and thus frees staff to do more user-service tasks. But the performance varies with respect to the vendors of RFID readers and tags. The efficient utilization of the technology also depends upon the information to be written in tag. Developments in RFID technology continue to yield larger memory capacities, wider reading ranges, and faster processing.

5. MODULE DESCRIPTION

5.1 Introduction

RFID tags are small programmable chips. The system aims to implement RFID tags to simplify the checkout process. All books are equipped with a RFID chip.

When a student brings the books he wants to borrow to the librarian, the librarian passes the books through the RFID scanner in her desk. The scanner identifies the tags and displays the book information, collected from a database. The student then proceeds to give his ID card that is equipped with an RFID tag. The tag is scanned and student details are retrieved. The books are then lent to the student and the database is automatically updated. Reminders will be sent before the last date to return the book.

The existing system is both tedious and time consuming. In the current system the librarian collects the books from the student and enters the serial numbers of each of the books meant to be borrowed and the student's register number manually. Both the serial numbers of the books and the student IDs are long and complex. There may be

manual errors made by the librarian while typing these numbers which results in more time being used. The existing system requires a lot of manual labour which also increases the time consumed .

When a student brings the books he wants to borrow to the librarian, the librarian passes the books through the RFID scanner in her desk. The scanner identifies the tags and displays the book information, collected from a database. The student then proceeds to give his ID card that is equipped with an RFID tag. The tag is scanned and student details are retrieved. The books are then lent to the student and the database is automatically updated. Reminders will be sent before the last date to return the book. The hardware required for this system are an RFID scanner , RFID chips and a PC running windows operating system. The softwares used in this system are Visual basic 6.0 for the front end , MySQL for the database and Read-a-card for programming the RFID chips. There are four modules in this system. They are :

- Check in and check out
- Submitting the books in the kiosk
- Changes in database

5.2. Check in and check out

5.2.1. Workflow Diagram

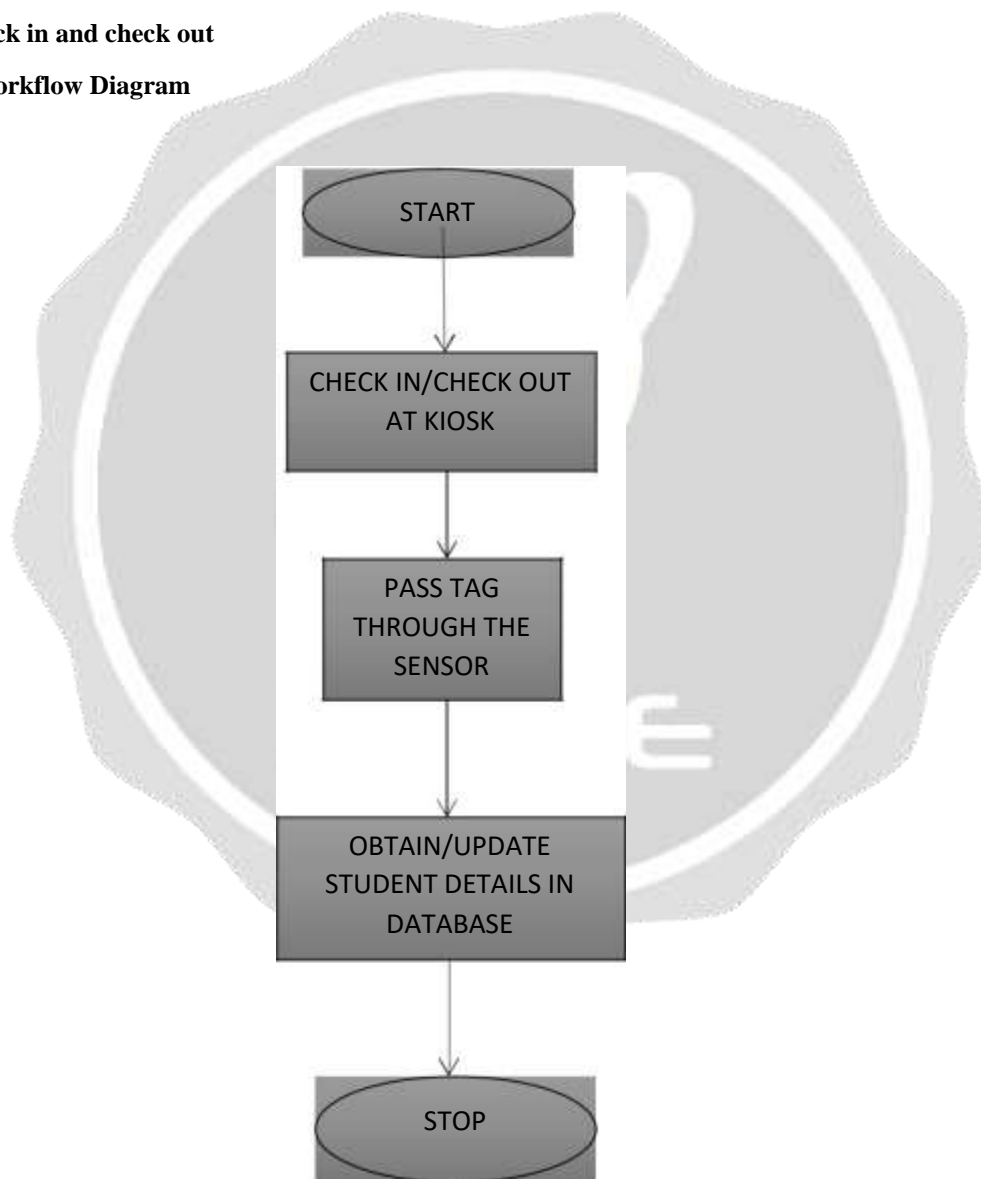


Fig- 5.1 Check in Module

5.2.2. Module Description

- The student ID card is embedded with RFID chips
- The automation has RFID sensors which detect the RFID chips in the students' ID card
- The students have to pass the cards through the sensor in order to enter/exit the automation

5.3 Submitting the book in the kiosk

5.3.1. Workflow Diagram:

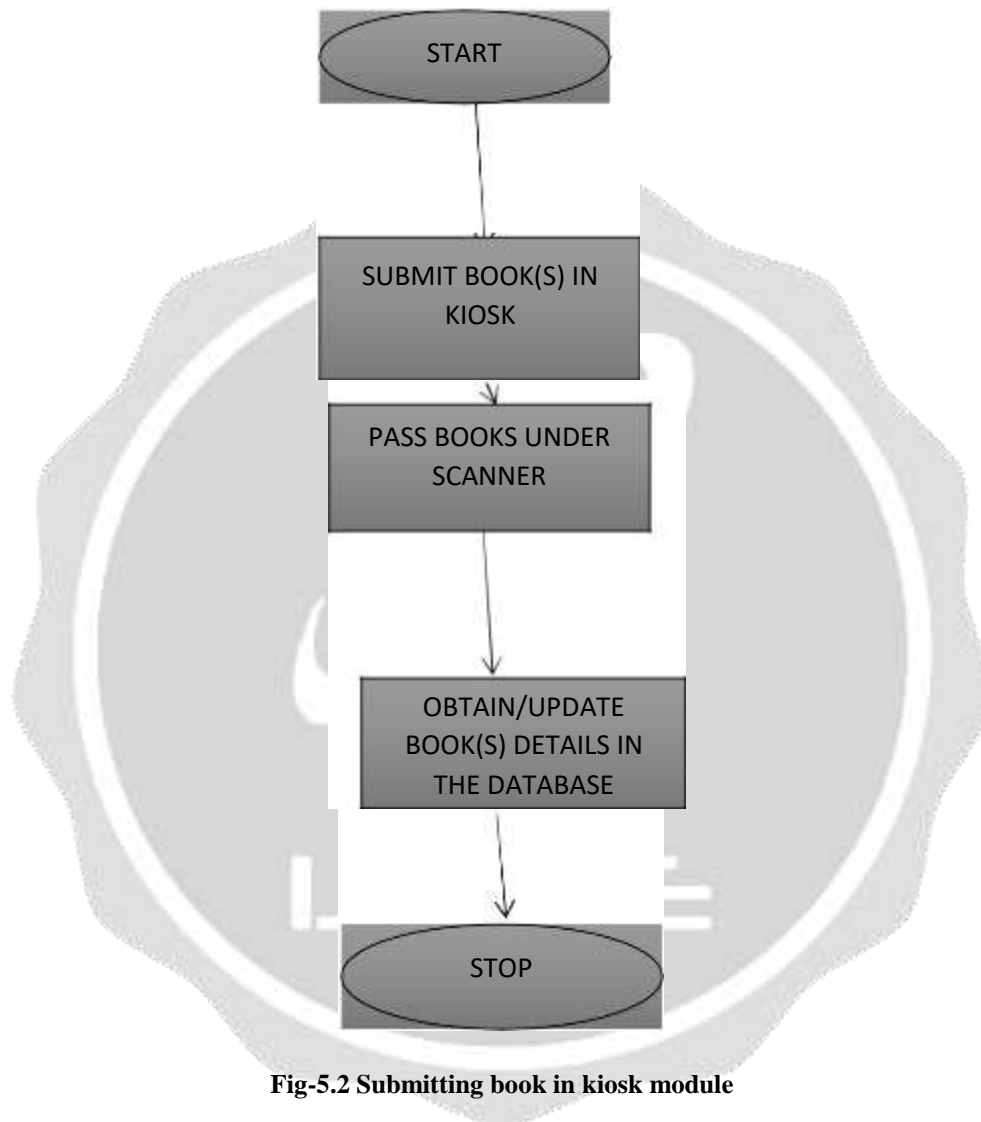


Fig-5.2 Submitting book in kiosk module

5.3.2. Module Description

- The books also contain RFID chips fixed to them
- When they are being taken/returned, they are submitted in the kiosk
- In the kiosk, they are scanned by an RFID scanner
- If the book is being taken/returned the details of the book and the student will be updated in the database

5.4 Changes in the database

5.4.1. Workflow Diagram

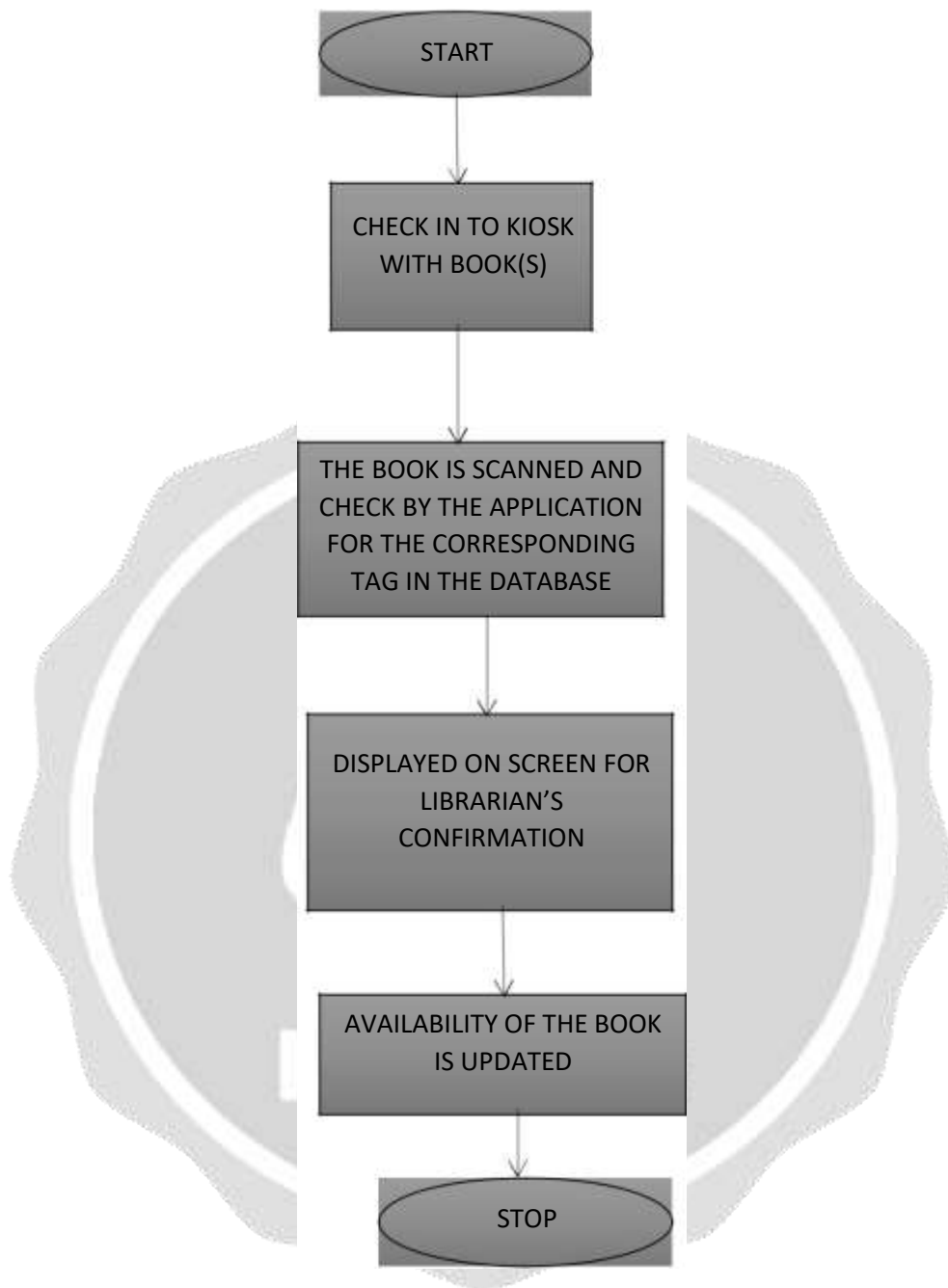


Fig-5.3 Change database Module

5.4.2. Module Description

- The database contains the detail of every student of the institution and every book in the automation.
- The student checks in to the kiosk with his books.
- The book is scanned and the RFID tag-ID gets registered in the application.
- The application then checks the database for the book with the corresponding tag.
- The details of the book are then displayed for visual confirmation by the librarian.
- The availability of the book is then changed in the database.

- This is then repeated for every book he has.

5.5 Alarm if books haven't yet been returned

5.5.1. Workflow Diagram

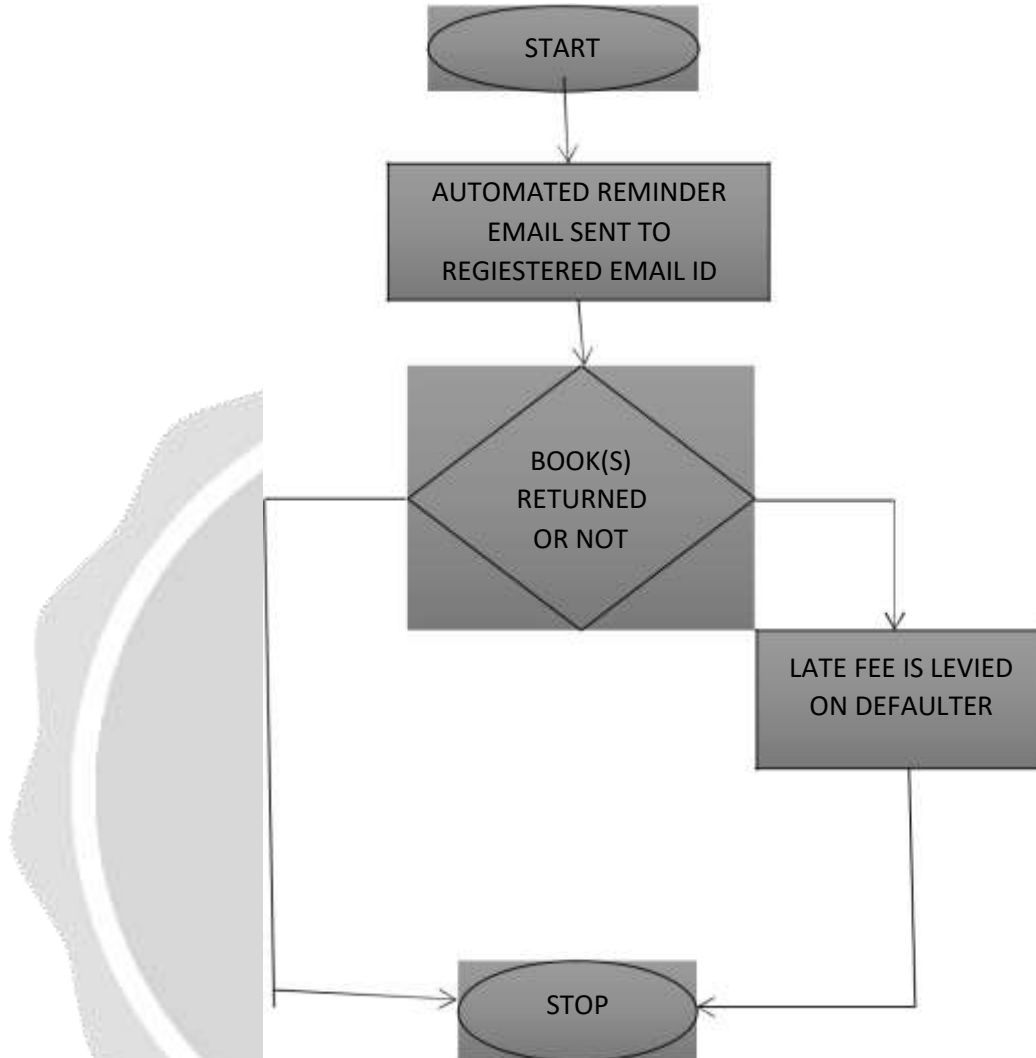


Fig-5.4 Alarm module

5.5.2. Module Description

- A day before the due date, the system sends an automated email to the registered email address
- If the book has not been returned by the due date, then late fees are levied on the defaulter

6. SYSTEM IMPLEMENTATION

6.1 Introduction

Radio frequency identification (RFID) applications that provide batch access, storage mass data and reprogramming are better than barcodes. Applying RFID can promote operational efficiency and precision. The cost is one of the major factors influencing whether or not RFID will be accepted in libraries. Although RFID has improved the efficiency of libraries, the essence of the automation service has not changed. The paper analyses feasibility studies regarding the structure and application of the RFID system. To economize on the expense, the first step to consider is applying RFID to specific collections. Employing RFID systems to supply inventory, entrance guard, and to gather reading statistics is possible. Further extensions to other collections and

all kinds of materials in libraries are likely after the technology develops. The paper provides an evaluation and a model for implementing RFID solutions in libraries. Libraries are a fast growing application of RFID; the technology promises to relieve repetitive strain injury, speed patron self-checkout, and make possible comprehensive inventory. Unlike supply-chain RFID, automation RFID requires item-level tagging, thereby raising immediate patron privacy issues. Current conventional wisdom suggests that privacy risks are negligible unless an adversary has access to automation databases. We show this is not the case. In addition, identification of private authentication is a key technical issue: how can a reader and tag that share a secret efficiently authenticate each other without revealing their identities to an adversary? Previous solutions to this problem require reader work linear in the number of tags. A general scheme is given for building private authentication with work logarithmic in the number of tags, given a scheme with linear work as a sub protocol. This scheme may be of independent interest beyond RFID applications. A simple scheme that provides security is also given.

6.2 Overview of the platform

6.2.1 Microsoft Access

Microsoft Access is a Database Management System (DBMS) from Microsoft that combines the relational Microsoft Jet Database Engine with a graphical user interface and software development tools. It is a member of the Microsoft Office suite of applications, included in the professional and higher editions.

- Microsoft Access is just one part of Microsoft's overall data management product strategy.
- It stores data in its own format based on the Access Jet Database Engine.
- Like relational databases, Microsoft Access also allows you to link related information easily. For example, customer and order data. However, Access 2013 also complements other database products because it has several powerful connectivity features.
- It can also import or link directly to data stored in other applications and databases.
- As its name implies, Access can work directly with data from other sources, including many popular PC database programs, with many SQL (Structured Query Language) databases on the desktop, on servers, on minicomputers, or on mainframes, and with data stored on Internet or intranet web servers.
- Access can also understand and use a wide variety of other data formats, including many other database file structures.
- You can export data to and import data from word processing files, spreadsheets, or database files directly.
- Access can work with most popular databases that support the Open Database Connectivity (ODBC) standard, including SQL Server, Oracle, and DB2.
- Software developers can use Microsoft Access to develop application software.

Microsoft Access stores information which is called a database. To use MS Access, you will need to follow these four steps

- **Database Creation** – Create your Microsoft Access database and specify what kind of data you will be storing.
- **Data Input** – After your database is created, the data of every business day can be entered into the Access database.
- **Query** – This is a fancy term to basically describe the process of retrieving information from the database.
- **Report (optional)** – Information from the database is organized in a nice presentation that can be printed in an Access Report.

Architecture

- Access calls anything that can have a name an object. Within an Access desktop database, the main objects are tables, queries, forms, reports, macros, data macros, and modules.
- If you have worked with other database systems on desktop computers, you might have seen the term database used to refer to only those files in which you store data.
- But, in Access, a desktop database (.acldb) also includes all the major objects related to the stored data, including objects you define to automate the use of your data.

Microsoft Access has the look and feel of other Microsoft Office products as far as its layout and navigational aspects are concerned, but MS Access is a database and, more specifically, a relational database.

- Before MS Access 2007, the file extension was ***.mdb**, but in MS Access 2007 the extension has been changed to ***.acldb** extension.
- Early versions of Access cannot read acldb extensions but MS Access 2007 and later versions can read and change earlier versions of Access.
- An Access desktop database (.acldb or .mdb) is a fully functional RDBMS.
- It provides all the data definition, data manipulation, and data control features that you need to manage large volumes of data.
- You can use an Access desktop database (.acldb or .mdb) either as a standalone RDBMS on a single workstation or in a shared client/server mode across a network.
- A desktop database can also act as the data source for data displayed on webpages on your company intranet.
- When you build an application with an Access desktop database, Access is the RDBMS.

Data Definition

Let us now understand what Data Definition is

- In document or a spreadsheet, you generally have complete freedom to define the contents of the document or each cell in the spreadsheet.
- In a document, you can include paragraphs of text, a table, a chart, or multiple columns of data displayed with multiple fonts.
- In spreadsheet, you can have text data at the top to define a column header for printing or display, and you might have various numeric formats within the same column, depending on the function of the row.

- An RDBMS allows you to define the kind of data you have and how the data should be stored.
- You can also usually define rules that the RDBMS can use to ensure the integrity of your data.
- For example, a validation rule might ensure that the user can't accidentally store alphabetic characters in a field that should contain a number.

Data Manipulation

Working with data in RDBMS is very different from working with data in a word processing or spreadsheet program.

- In a word processing document, you can include tabular data and perform a limited set of functions on the data in the document.
- You can also search for text strings in the original document and, with ActiveX controls, include tables, charts, or pictures from other applications.
- In a spreadsheet, some cells contain functions that determine the result you want, and in other cells, you enter the data that provides the source information for the functions.

An RDBMS provides you many ways to work with your data. For example,

- You can search a single table for information or request a complex search across several related tables.
- You can update a single field or many records with a single command.
- You can write programs that use RDBMS commands to fetch data that you want to display and allow the user to update the data.

Access uses the powerful SQL database language to process data in your tables. Using SQL, you can define the set of information that you need to solve a particular problem, including data from perhaps many tables.

Data Control

Spreadsheets and word processing documents are great for solving single-user problems, but they are difficult to use when more than one person needs to share the data.

- When you need to share your information with others, RDBMS gives you the flexibility to allow multiple users to read or update your data.
- An RDBMS that is designed to allow data sharing also provides features to ensure that no two people can change the same data at the same time.
- The best systems also allow you to group changes (which is also known as transaction) so that either all the changes or none of the changes appear in your data.
- You might also want to be sure that no one else can view any part of the order until you have entered all of it.
- Because you can share your Access data with other users, you might need to set some restrictions on what various users are allowed to see or update.

MS Access uses "objects" to help the user list and organize information, as well as prepare specially designed reports. When you create a database, Access offers you Tables, Queries, Forms, Reports, Macros, and Modules. Databases in Access are composed of many objects but the following are the major objects

- Tables
- Queries
- Forms
- Reports

Together, these objects allow you to enter, store, analyze, and compile your data. Here is a summary of the major objects in an Access database;

Table

Table is an object that is used to define and store data. When you create a new table, Access asks you to define fields which is also known as column headings.

- Each field must have a unique name, and data type.
- Tables contain fields or columns that store different kinds of data, such as a name or an address, and records or rows that collect all the information about a particular instance of the subject, such as all the information about a customer or employee etc.
- You can define a primary key, one or more fields that have a unique value for each record, and one or more indexes on each table to help retrieve your data more quickly.

Query

An object that provides a custom view of data from one or more tables. Queries are a way of searching for and compiling data from one or more tables.

- Running a query is like asking a detailed question of your database.
- When you build a query in Access, you are defining specific search conditions to find exactly the data you want.
- In Access, you can use the graphical query by example facility or you can write Structured Query Language (SQL) statements to create your queries.
- You can define queries to Select, Update, Insert, or Delete data.
- You can also define queries that create new tables from data in one or more existing tables.

Form

Form is an object in a desktop database designed primarily for data input or display or for control of application execution. You use forms to customize the presentation of data that your application extracts from queries or tables.

- Forms are used for entering, modifying, and viewing records.
- The reason forms are used so often is that they are an easy way to guide people toward entering data correctly.
- When you enter information into a form in Access, the data goes exactly where the database designer wants it to go in one or more related tables.

Report

Report is an object in desktop databases designed for formatting, calculating, printing, and summarizing selected data.

- You can view a report on your screen before you print it.
- If forms are for input purposes, then reports are for output.

- Anything you plan to print deserves a report, whether it is a list of names and addresses, a financial summary for a period, or a set of mailing labels.
- Reports are useful because they allow you to present components of your database in an easy-to-read format.
- You can even customize a report's appearance to make it visually appealing.
- Access offers you the ability to create a report from any table or query.

6.2.2 Visual Basic

Visual Basic is a third-generation event-driven programming language and integrated development environment (IDE) from Microsoft for its Component Object Model (COM) programming model first released in 1991 and declared legacy during 2008. Microsoft intended Visual Basic to be relatively easy to learn and use.^{[1][2]} Visual Basic was derived from BASIC, a user-friendly programming language designed for beginners, and it enables the rapid application development (RAD) of graphical user interface (GUI) applications, access to databases using Data Access Objects, Remote Data Objects, or ActiveX Data Objects, and creation of ActiveX controls and objects.

A programmer can create an application using the components provided by the Visual Basic program itself. Over time the community of programmers developed third-party components. Programs written in Visual Basic can also use the Windows API, which requires external function declarations.

The final release was version 6 in 1998 (now known simply as Visual Basic). On April 8, 2008, Microsoft stopped supporting Visual Basic 6.0 IDE. The Microsoft Visual Basic team still maintains compatibility for Visual Basic 6.0 applications on Windows Vista, Windows Server 2008 including R2, Windows 7, Windows 8, Windows 8.1, Windows Server 2012 and Windows 10 through its "It Just Works" program. In 2014, some software developers still preferred Visual Basic 6.0 over its successor, Visual Basic NET. In 2014 some developers lobbied for a new version of Visual Basic 6.0. In 2016, Visual Basic 6.0 won the technical impact award at The 19th Annual D.I.C.E. Awards. A dialect of Visual Basic, Visual Basic for Applications (VBA), is used as a macro or scripting language within several Microsoft applications, including Microsoft Office.

Like the BASIC programming language, Visual Basic was designed to accommodate a steep learning curve. Programmers can create both simple and complex GUI applications. Programming in VB is a combination of visually arranging components or controls on a form, specifying attributes and actions for those components, and writing additional lines of code for more functionality. Since VB defines default attributes and actions for the components, a programmer can develop a simple program without writing much code. Programs built with earlier versions suffered performance problems, but faster computers and native code compilation has made this less of an iss. Though VB programs can be compiled into native code executables from version 5 on, they still require the presence of around 1 MB of runtime libraries. Core runtime libraries are included by default in Windows 2000 and later, but extended runtime components still have to be installed. Earlier versions of Windows (95/98/NT), require that the runtime libraries be distributed with the executable.

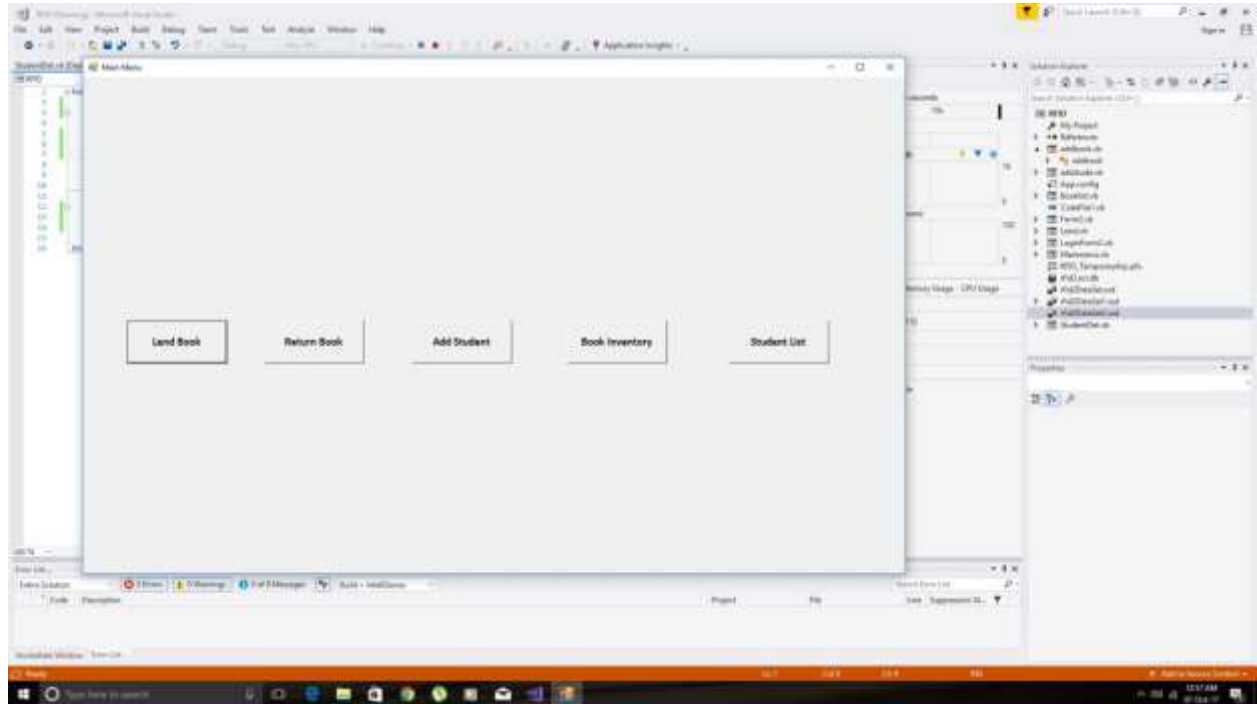
Forms are created using drag-and-drop techniques. A tool is used to place controls (e.g., text boxes, buttons, etc.) on the form (window). Controls have attributes and event handlers associated with them. Default values are provided when the control is created, but may be changed by the programmer. Many attribute values can be modified during run time based on user actions or changes in the environment, providing a dynamic application. For example, code can be inserted into the form resize event handler to reposition a control so that it remains centered on the form, expands to fill up the form, etc. By inserting code into the event handler for a keypress in a text box, the program can automatically translate the case of the text being entered, or even prevent certain characters from being inserted.

Visual Basic can create executables (EXE files), ActiveX controls, or DLL files, but is primarily used to develop Windows applications and to interface database systems. Dialog boxes with less functionality can be used to provide pop-up capabilities. Controls provide the basic functionality of the application, while programmers can insert additional logic within the appropriate event handlers. For example, a drop-down combination box automatically displays a list. When the user selects an element, an event handler is called that executes code that the programmer created to perform the action for that list item. Alternatively, a Visual Basic component can have no user interface, and instead provide ActiveX objects to other programs via Component Object Model (COM). This allows for server-side processing or an add-in module.

The runtime recovers unused memory using reference counting, which depends on variables passing out of scope or being set to Nothing, avoiding the problem of memory leaks common to other languages. There is a large automation of utility objects, and the language provides basic support for object-oriented programming. Unlike many other programming languages, Visual Basic is generally not case-sensitive—though it transforms keywords into a standard case configuration and forces the case of variable names to conform to the case of the entry in the symbol table. String comparisons are case sensitive by default. The Visual Basic compiler is shared with other Visual Studio languages (C, C++). Nevertheless, by default the restrictions in the IDE do not allow creation of some targets (Windows model DLLs) and threading models, but over the years, developers have bypassed these restrictions.

6.3 Implementation Details

6.3.1 Screenshots



Screenshot 1 Main Menu

The above screenshot displays the main menu of the RFID automation management application. There are 4 choices which are given:

Lend Book

This option enables the librarian to lend the book to the borrower.

Return Book

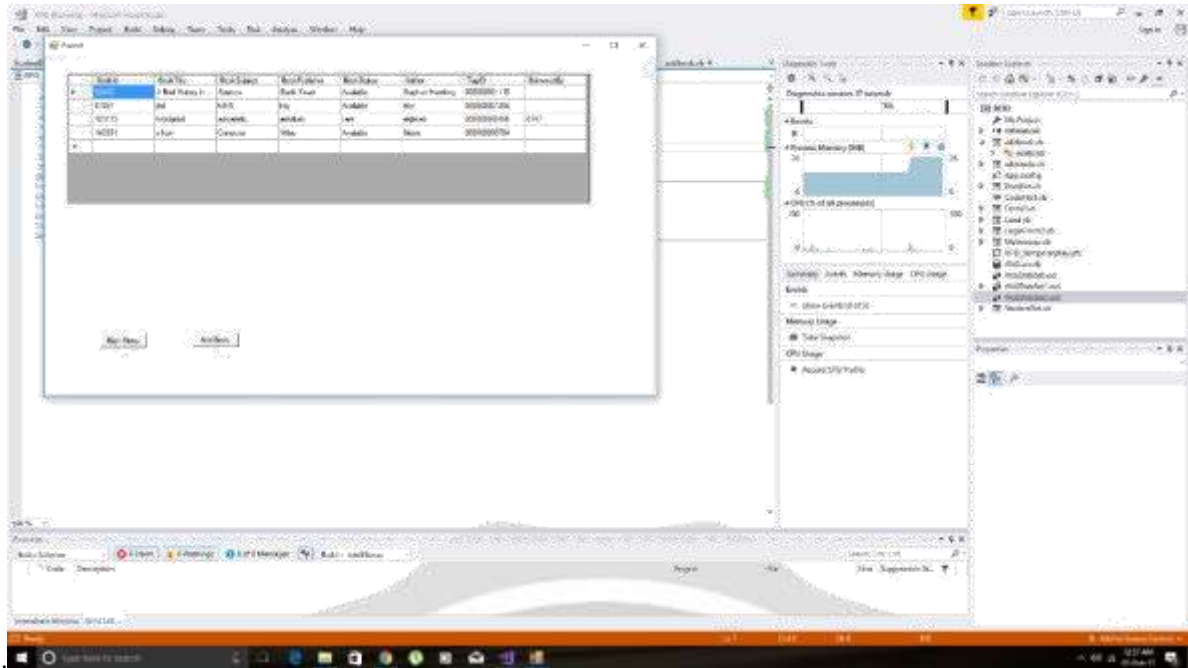
This option enables the borrower to return the books borrowed by him/her back to the automation.

Add Student

This option enables the librarian to add the details of a student such as name, age to the automation database.

Book Inventory

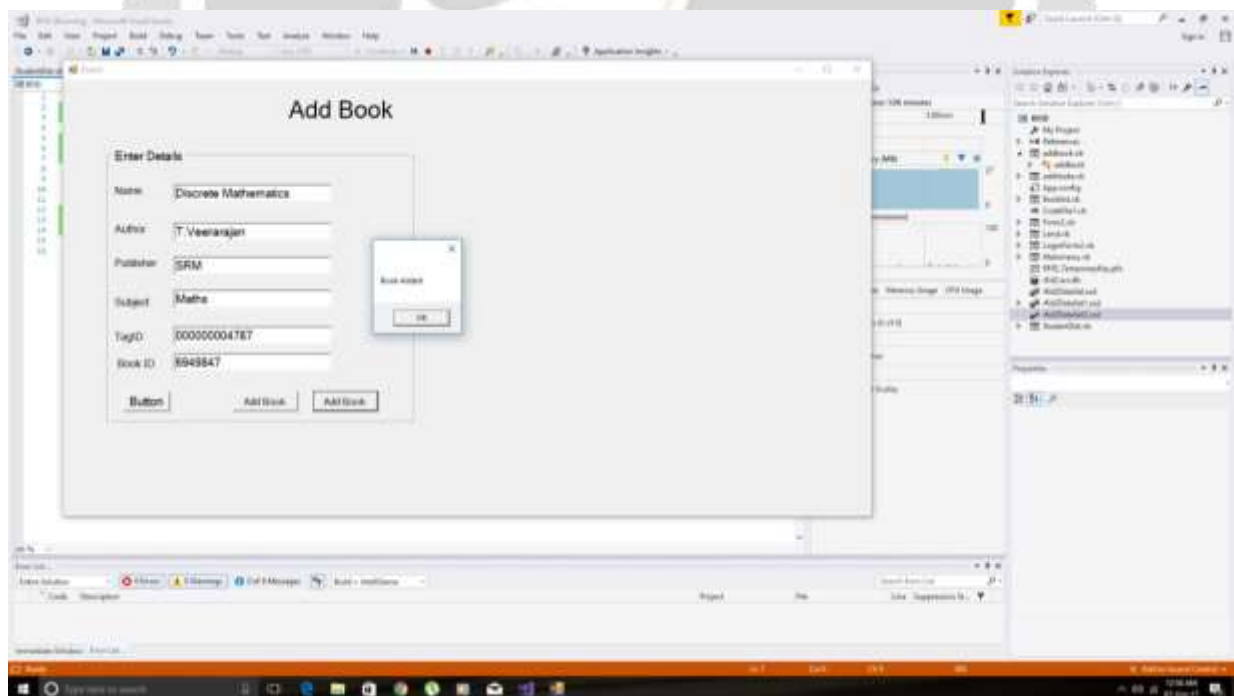
This option enables the librarian to view the existing books in the database and to also add new books to the database



Screenshot 2 Book List

The above image displays the database of the books which are currently stored. The database contains the details of the books such as Book ID, Book Title, Book Subject, Book Publisher, Book Status (Checks the availability of the books), Author of the book, Tag ID (RFID), ID of the student who borrows the books.

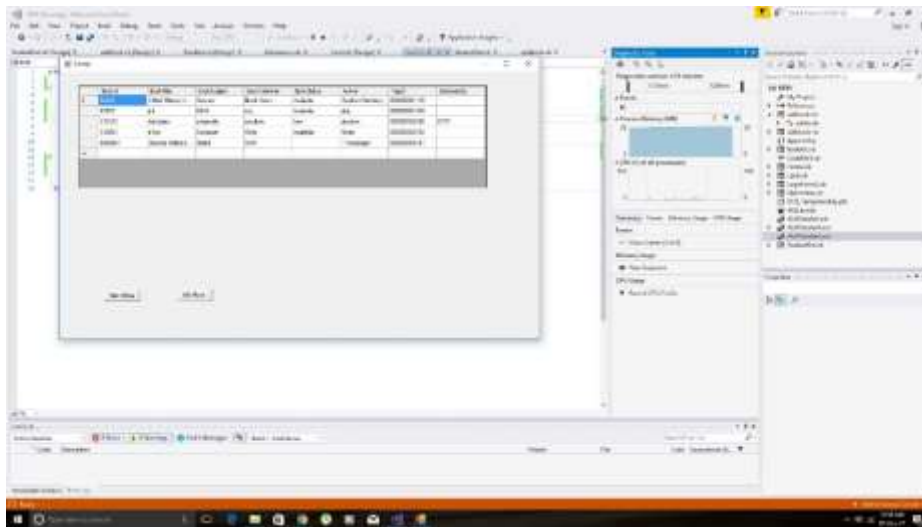
Also, this page has two buttons with the options Main Menu and Add Book. Main Menu option enables the user to go back to the main page which contains various other options. Add Book option enables the user to add the details of a new book such as the Book ID, Author etc. to the database.



Screenshot 3 Add Book

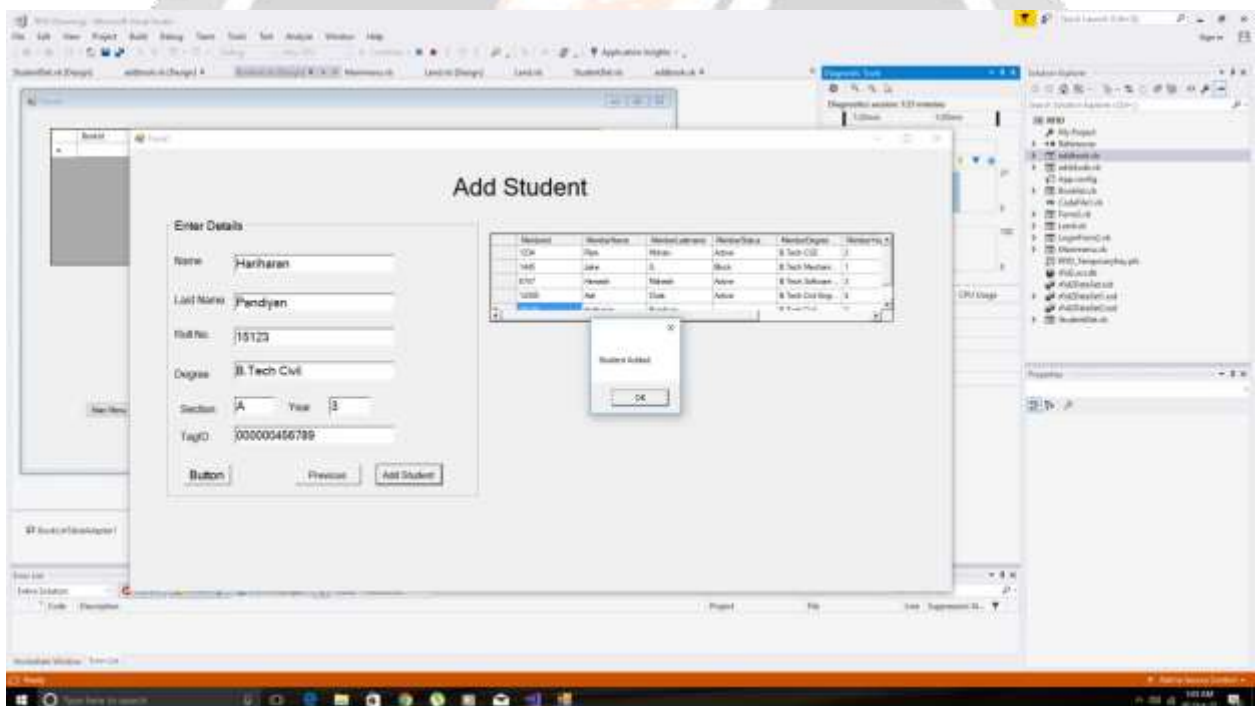
The above image displays the Add Book option. This option can be used to add new books to the database. In order to add new books, various details of the books such as Name, Author, Publisher, Subject and Book ID are

collected. Then a tag ID is assigned for the book. Once ,the Add Book button is clicked ,a window occurs which displays Book Added.



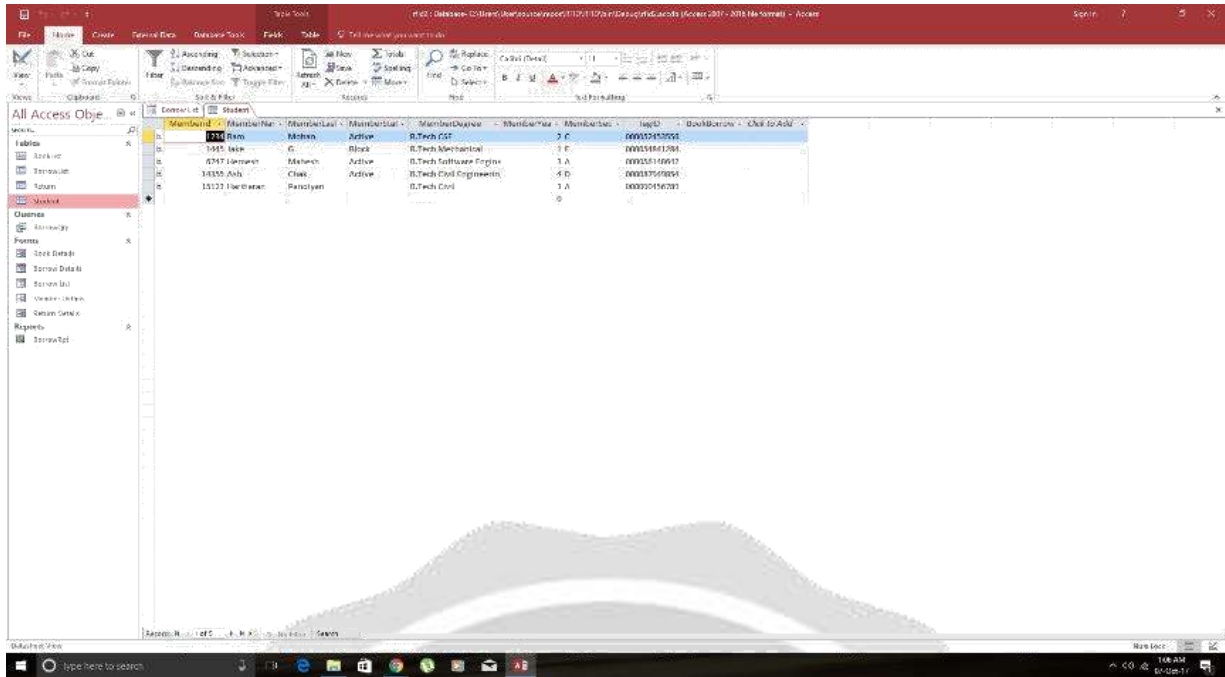
Screenshot 4 Book Database

The above image is of the book inventory after a new book was added.This image shows that a new book has been successfully added to the database.



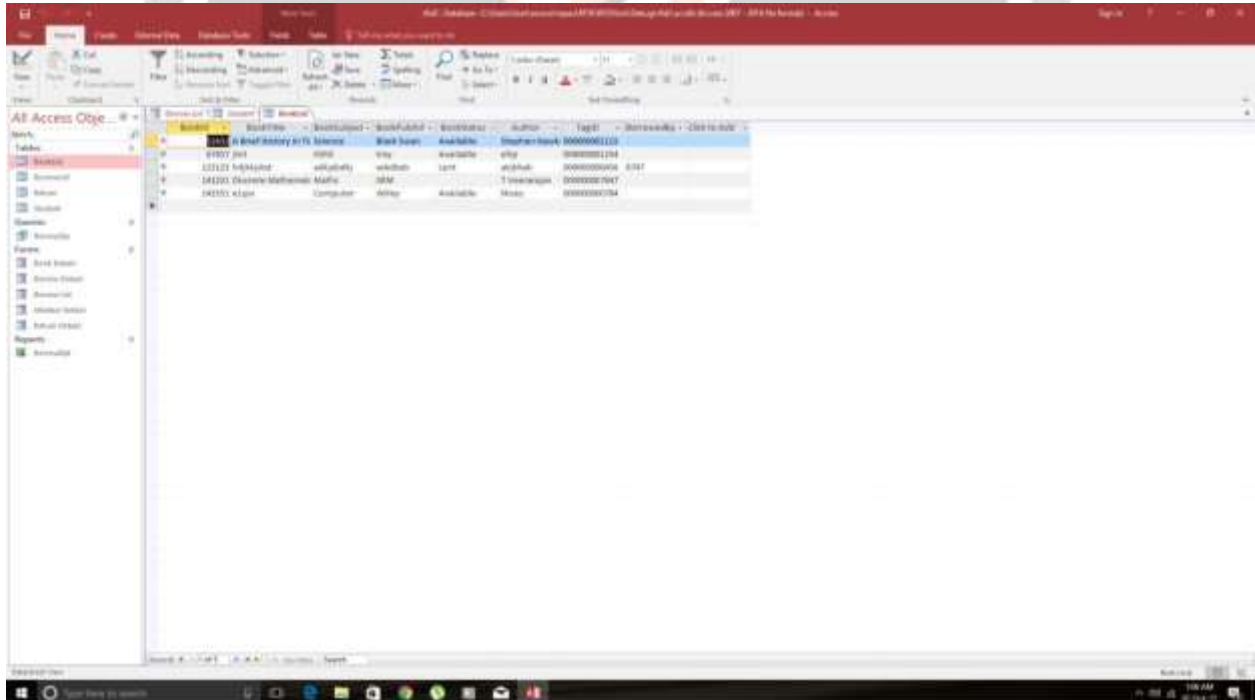
Screenshot 5 Add Student

The above image displays the Add Student option .This option enables the user to add the details of a new student to the database. In order to add a new student, first the details such as First Name, Last Name Roll No.,Degree, Section, Year are collected. Then a tag ID is assigned to the student .Once Add Student is clicked, the student is added to the database.



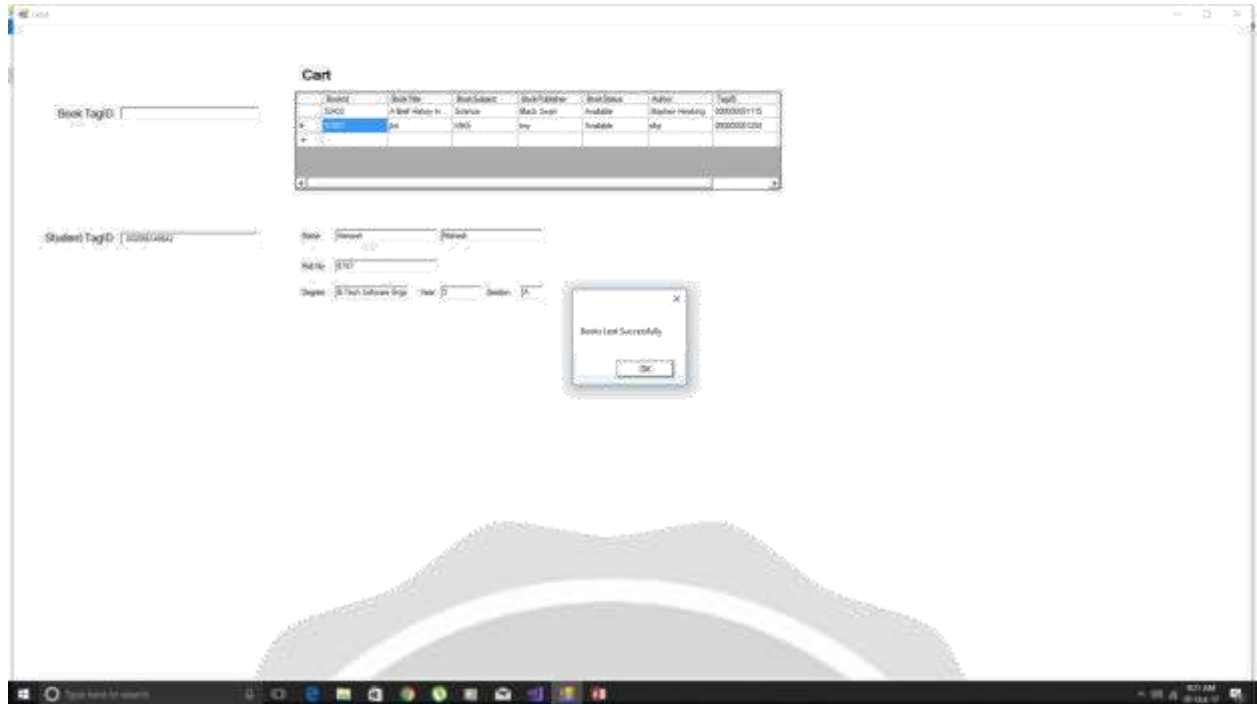
Screenshot 6 Student List

The above image shows the Student List after the new student has been added. Hence, the above image shows that a new student and his details have been successfully added to the database.



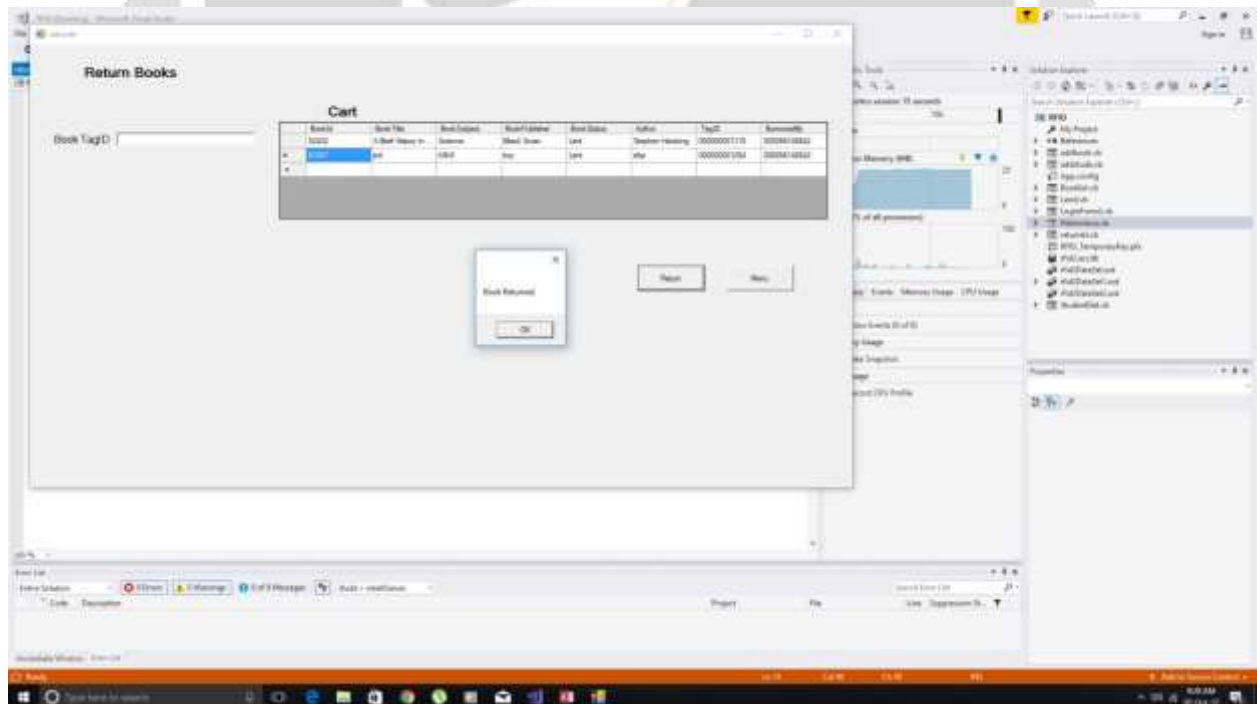
Screenshot 7 Updated Book Database

The above image shows the total number of books which are provided by the automation to the students. It displays the various details of the books such as Book ID etc. Hence, the Borrow List, Student List and Book List have been displayed successfully.



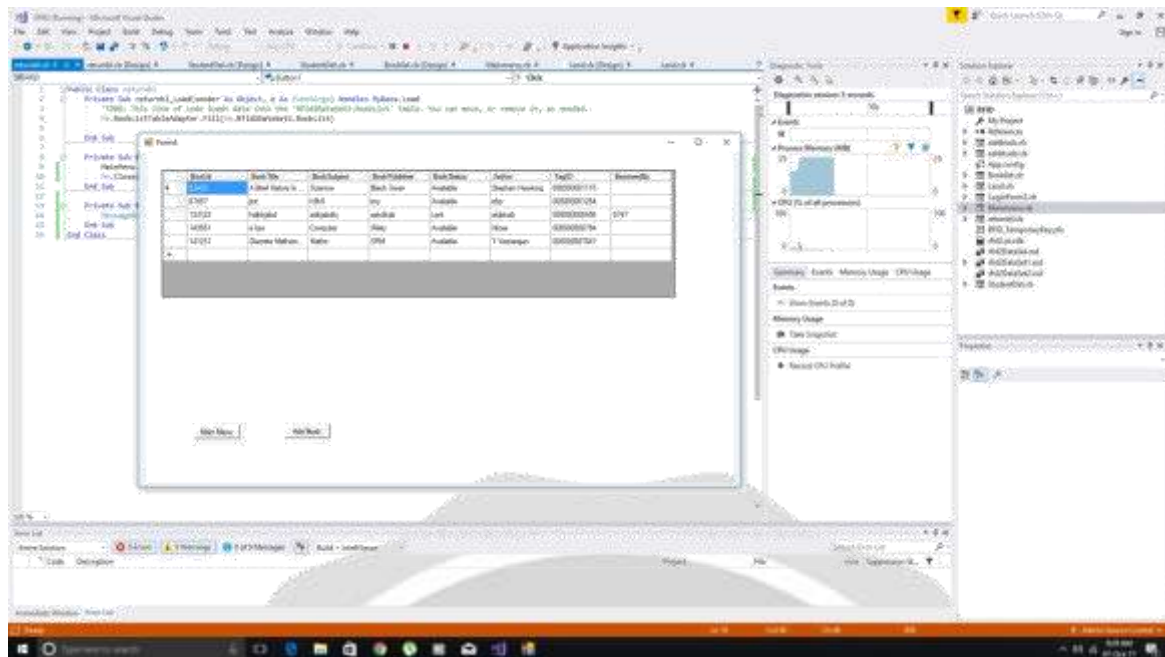
Screenshot 8 Tag Id Database

The above image displays the Student tag ID of the borrower and the Tag id of the books he/she borrowed. It also shows the details of the books which have been lent to the borrower along with his/her details.



Screenshot 9 Return Books

The above image displays the Return Books feature of the system. It displays the tagID of the borrower and the books which he/she has returned.



Screenshot 10 Updated Book Inventory

The above image displays the updated list after the books have been returned. The database is updated once the student has returned the books.

6.4 Summary

Thus, the implementation of the RFID Automation Management system was checked and executed successfully. The various operations in the process such as adding of books, students were performed successfully. RFID Automation Management is a much better enhanced version compared to the current automation management process. The system proposed also showed less constraints in terms of time and manual work. The proposed system was also error free in its functioning. Given more time and money, the above system can be used across larger libraries with a wider range of books and facilities. RFID technology is the latest upcoming technology in the modern world. It is proven to be very efficient and is used across various varieties of systems and in various managements which have been prone to manual errors and time constraints etc.

7. CONCLUSION AND FUTURE WORKS

7.1 Conclusion

RFID based Automation 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 Automation. 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. While creating a system for automation management and automation, the following issues can arise:

1. Getting the adequate hardware, the compatibility between tags and readers is important along with the required frequency and other parameters.
2. Constructing the RFID reader circuit.
3. Sensing/reading the tags via the reader (tedious) and to get output on terminal window.
4. Once we get hold of the data, its manipulation is very important like interfacing it and presenting it to the user as per their requirement (Time consuming).
5. Compacting both hardware and software to get an user friendly and accurate device.

6. Linking the databases to the other interfaces i.e. website and android application.
7. Ensuring there is less of data redundancy in the database, hence the need to properly design it.

RFID in the automation 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.

RFID in the automation speeds up book borrowing, monitoring, books searching processes and thus frees staff to do more user-service tasks. But the performance varies with respect to the vendors of RFID readers and tags. The efficient utilization of the technology also depends upon the information to be written in tag. Developments in RFID technology continue to yield larger memory capacities, wider reading ranges, and faster processing.

7.2 Future works

RFID technology is revolutionizing schools all over the world. Earlier, managing libraries would have been a complex task for you. But with the advent of RFID technology, you would be able to manage libraries better than ever before. Also, the task of school/college librarians becomes much easier and quicker. You can even say that the future of RFID might wipe out the necessity of a full time librarian. The future of RFID in automation depends mainly on rectifying disadvantages and thus giving more focus on the benefits associated with it.

Development of RFID is rapidly going on, which yields larger memory capacities, wider reader ranges and faster processing. Its applications, innovation and standardization are constantly changing. There is no need for separate database as RFID tags contain identifying information such as title of the book, material type, etc. Though benefits and flexibility of RFID technology is widely known, RFID is a better solution for you to further optimize the automation and tracking documents in the automation.

8. REFERENCES

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