A

PROJECT REPORT ON

SMART LIBRARY SYSTEM

SUBMITTED TO SAVITRIBAI PHULE PUNE UNIVERSITY

FOR PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

BACHELOR OF ENGINEERING

In

Electronics and Telecommunication

By

AMEYA BENARE   (B120073016)

PRIYANKA KATKAR   (B120073070)

SHUBHAM PATWA   (B120073097)

Under the Guidance of

Prof. Dr. Mrs. K. J. Kulkarni

DEPT. OF ELECTRONICS AND TELECOMMUNICATION

PUNE VIDYARTHI GRIHA'S COLLEGE OF ENGINEERING AND TECHNOLOGY, PUNE-9

APRIL 2018

Department of Electronics and Telecommunication Engineering

PUNE VIDYARTHI GRIHA'S COLLEGE OF ENGINEERING AND TECHNOLOGY, PUNE 9

CERTIFICATE

This is to certify that the Project Report entitled

SMART LIBRARY SYSTEM

has been successfully completed by

AMEYA BENARE   **(B120073016)**

PRIYANKA KATKAR   **(B120073070)**

SHUBHAM PATWA   **(B120073097)**

towards the partial fulfilment of the degree of **Bachelor of Engineering** in **Electronics and Telecommunication** as awarded by the Savitribai Phule Pune University, at **Pune Vidyarthi Griha's College of Engineering** during the academic year 2017-18.

(Prof. Dr. Mrs. K. J. Kulkarni)   (Dr. Y. P. Nerkar)

Project Guide & Head Of   Principal

Department, E&TC

Place: Pune

Date:

ACKNOWLEDGEMENTS

CONTENTS

ABSTRACT

Current technology used in library is barcode technology for identification. This library is staff intensive and requires large amount of routine procedure. Barcode readers requires a direct line of sight. Human intervention is required to scan a barcode. If any obstacle is present, then barcode cannot be read. Barcode technology is old and out dated. Students find difficult for searching a specific book.

The proposed system is based on the Passive Radio Frequency Identification tags and RFID reader which assign a specific 10 digit tag to both the book and the student's I-card. At the time of entry student scans the I-card and after that the student database is checked enters the library and if there is a pending fine , he/she will be denied access to the library until he/she pays the due to the library. Access is also denied in the case of student having crossed a certain limit of issued books.

The student enters the library using RFID tag on his ID Card, picks at the most 3 books and while leaving, scans his ID card along with the RFID tags of the books he has selected. Theft detection and locating of misplaced books will be implemented for security purpose.

ABBREVIATIONS AND ACRONYMS

Abbreviations/Acronyms	Description
RFID	Radio Frequency Identification
SSL	Secure Socket Layer
USB	Universal serial bus
LF	Low frequency
HF	High frequency
UHF	Ultra high frequency
UART	Universal Asynchronous Receiver Transmitter
UID	Unique Identifier
GUI	Graphical User Interface
CCS	Cascading Style Sheets
IDE	integrated development environment

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Chapter 1

INTRODUCTION

1. INTRODUCTION

Radio Frequency Identification (RFID) enabled automated library is a complete solution for a library that will be useful to track items, bill paid and patrons who have borrowed books. Library management is essential because today library contains thousands of books, pamphlets, journals, periodicals, CDs and others. Library needs a good coordination of information of the entire item above in addition to library management. Library management should be automated otherwise it is very time consuming for all the members of the library to manage all the tasks, resulting in heavy working load for librarians and long waiting queues of book borrowers.

RFID technology is in use since the 1970s. RFID tags can be active, semi-passive and passive. It is a small device that can store information. Passive tags don't have internal batteries. RFID reader is a device that can receive and transmit a radio signal. It is built to encode data stored in the tag's microprocessor. Because of the higher cost, active and semi-passive RFID tags are used for valuable asset tracking. The passive RFID tags are used in RFID library management systems

Our college library system is currently managed using bar code based system. Books' are embedded using bar code sticker. Bar code system doesn't provide any security as such for books' misplacement. So for overcoming this issue we can use RFID such that it will provide security for misplacement as well as while issuing & returning of book.

The existing library management system today uses bar code technology for managing books. This technology was introduced 40 years back and is today becoming obsolete. Moreover, every book needs to be scanned separately using barcode technology which is very time consuming and results in long waiting queues increasing load on librarians. Also there is no facility of theft detection. At the end of the day the librarian needs to put back all the returned books at their proper position which is a very hectic job for him. Drawbacks of Existing System Requires more man power, time consuming. Requires large volume of paper work Need manual calculations No automated notification facility. No automated searching facility. Chance of book theft due to lack of attention. To avoid all these limitations and make the working more accurately the system needs to be improved by using latest RFID technology. Radio Frequency Identification (RFID) is a wireless automatic identification technology that utilizes the Radio

Frequency as the medium of communication. With the capability of carrying and retrieving data, RFID offers a wide application in the automatic identification areas.

Chapter 2

LITERATURE SURVEY

2. LITERATURE SURVEY

2.1: SURVEY

The idea of this project is to implement automated library based on RFID technology. Radio Frequency Identification (RFID) is a wireless automatic identification technology that utilizes the Radio Frequency as the medium of communication. With the capability of carrying and retrieving data, RFID offers a wide application in the automatic identification areas. We are developing this project for integrating the RFID system in the library so to reduce the work load in the library. The scope of work of the project is to develop an automatic library management system to assist the librarians for more efficient management of library by helping to find any misplaced books on the library shelf, books verification, stock management and allowing the students to issue and return books by themselves along with efficient searching facility. The proposed system will also be able to provide security in the library premises by detecting book theft.

➣ **How does RFID work?**

RFID belongs to a group of technologies referred to as Automatic Identification and Data Capture (AIDC). AIDC methods automatically identify objects, collect data about them, and enter those data directly into computer systems with little or no human intervention. RFID methods utilize radio waves to accomplish this. At a simple level, RFID systems consist of three components: an RFID tag or smart label, an RFID reader, and an antenna. RFID tags contain an integrated circuit and an antenna, which are used to transmit data to the RFID reader (also called an interrogator). The reader then converts the radio waves to a more usable form of data. Information collected from the tags is then transferred through a communications interface to a host computer system, where the data can be stored in a database and analysed at a later time.

➣ **RFID Tags**

As stated above, an RFID tag consists of an integrated circuit and an antenna. The tag is also composed of a protective material that holds the pieces together and shields them from various

environmental conditions. The protective material depends on the application RFID tags come in a variety of shapes and sizes and are either passive or active. Passive tags are the most widely used, as they are smaller and less expensive to implement. Passive tags must be "powered up" by the RFID reader before they can transmit data. Unlike passive tags, active RFID tags have an on-board power supply thereby enabling them to transmit data at all times.

DRAWBACKS OF BARCODE TECHNOLOGY

- Barcode readers require a direct line of sight, using laser technology
- Scan and read one tag at a time and also time consuming
- Human intervention is required to scan a barcode
- It should be visible on the product for scanning
- Does not have read/write memory
- The readability of the barcode can be impaired by dirt, moisture, abrasion and packaging etc. Less read range & Holds fixed and Limited data
- Cannot read a bar code if there is any obstacle between the reader and the bar code

BENEFITS OF RFID

- RFID tags can be read at much greater distances;
- RFID readers can interrogate, or read, RFID tags much faster; read rates of forty or more tags per second are possible.
- RFID tags are typically more rugged, since the electronic components are better protected in a plastic cover
- RFID makes the system streamlined and avoids the bottleneck in the process
- RFID tags are more rugged and reusable that Barcodes and hence need to be substituted.
- RFID tags provide more security. Each tag has Unique Identification Number (UIN) which can be factory programmed or manually programmed.

2.2: RFID technology

There are four basic types of RFID technology available today:

1. LF Passive

2. HF Passive

3. UHF Passive

4. UHF Active

Figure 2.1 shows how the four standards relate to each other in terms of radio frequency and read range.

Parameter	Technology			
	LF Passive <135kHz	HF Passive 13.56MHz	UHF Passive 868-950MHz	UHF Active 433-5.8GHz
Read distance	High	low - medium	high	Highest
Data rate	4 kbps to 8 kbps	6.7 kbps to 848 kbps depending on protocol	Freq/1, LF/2, LF/4, LF/8*	Freq/1, LF/2, LF/4, LF/8*
Multi tag reading	10s	100s	1000s	1000s
Form factor flexibility	high	High	medium	Low
Tissue/Water Metal	No absorption controllable	Lim. absorption controllable	Strong absorption reflection	Lim. absorption controllable

Table 2.1 comparison between RFID technology

Passive LF	Passive HF	Passive UHF	Active UHF
(125 – 134 kHz)	13.56 MHz	868 – 950 MHz	433 MHz - 5.8 GHz
Livestock and pets Access control Vehicle immobilizers Waste management	Public transport Smart tickets Books Medical Assets/tools NFC applications Passports	Retail Logistics, roll cages Asset/Inventory management Medical/Health care Air baggage and cargo Access control Waste management	Asset/Inventory management Toll collection Logistics, container tracking Fleet management

**Table 2.2 Application areas of active and passive RFID tag**
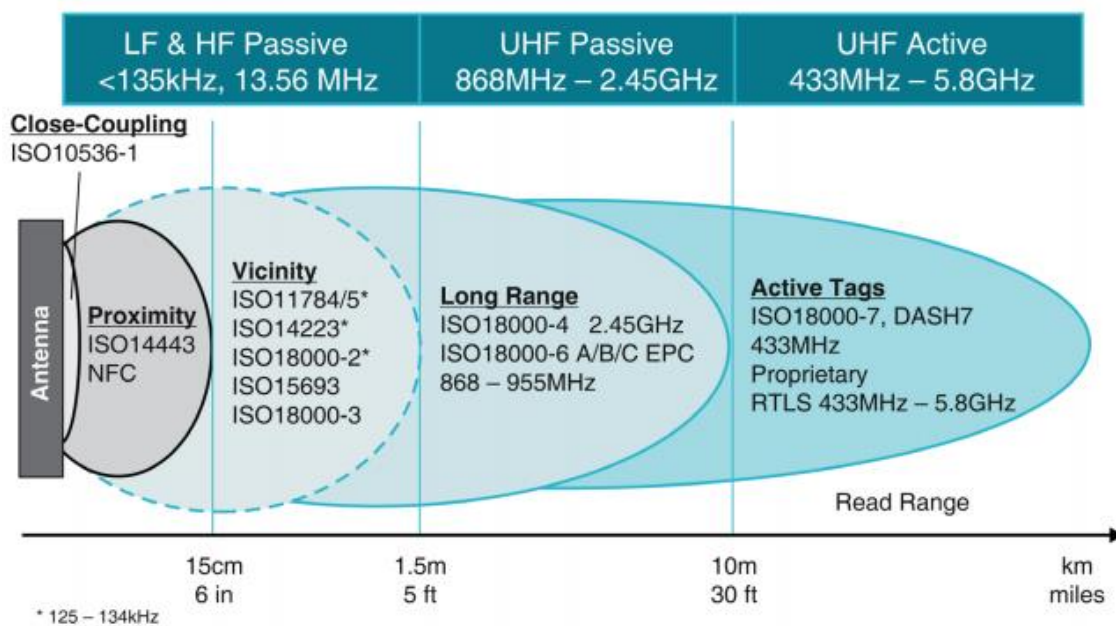
Figure 2.1 RFID technologies

Figure 2.1. The four different types of RFID technology available today are defined by different standards and offer varying read range.

One of the key differences between RFID and other wireless technologies is passive tag reading. Passive tags do not require either batteries or a power source to operate. Rather, when a tag is within range of an RFID reader, either magnetic or e-field coupling provides sufficient power for the tag to transmit its data to the reader. Specifically, power is coupled to the transponder by an AC field produced by the reader via a loop antenna tuned to the center frequency of the field. In contrast, active tags have access to a power source, enabling them to operate over greater distances. Tags can operate in either Full Duplex (FDX, FDX-B) or Half Duplex (HDX) mode. An FDX-based system has data and energy traveling at the same time. This differentiation is valid for technology in the LF 125 kHz to 135 kHz range but not for HF or UHF passive technologies as not used here. Figure 2 shows the reader and tag signals during a transmission. Note that both the reader and tag transmit at the same time. This is because for the tag to be powered so it can transmit data, the reader must be transmitting energy as well.
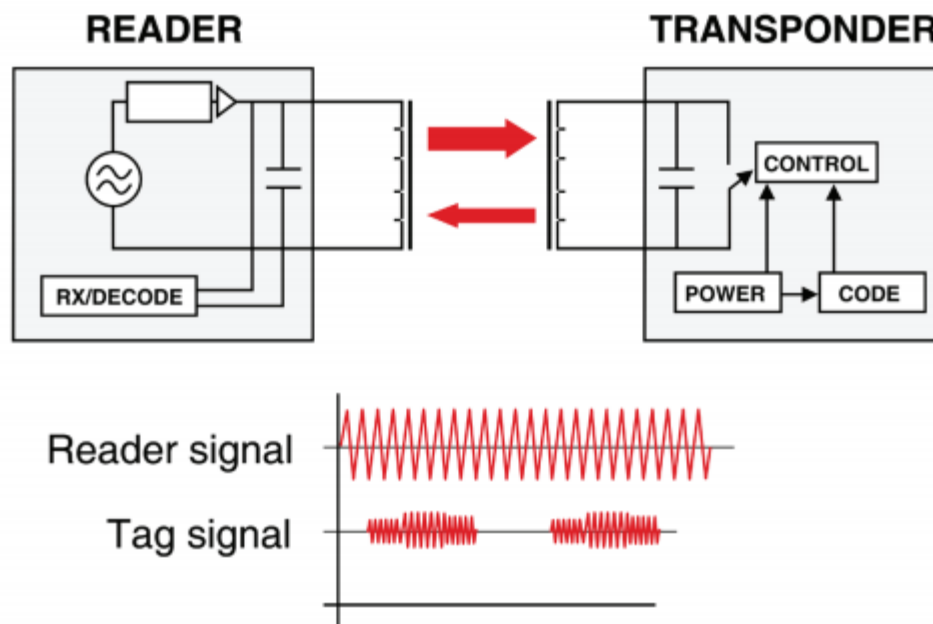
figure 2.2 RFID flow diagram

2.3: Live Example carried out in India:

1. Just Books, a smart library which uses RFID, Sahakarnagar branch in Pune, has fully implemented a library which has RFID embedded books, RFID library card, a kiosk, a central server across all branches. It uses UHF RFIDs for this purpose. Since it was mere branch, it lacked some features. Rest assured, the main branch in Bangalore has all the features mentioned above.

2.British Council Library which is located at Ganeshkhind Road, Shivaji Nagar has developed fully automated library System. This library has a collection of books, magazines, newspaper & DVD. Library also provides online English course. The online catalog will help you to find the book you are looking for, the automated check in and check out facility for the issue and return of books. this library provide feature for user to reserve or renew their books by phone, fax or email.

Chapter 3

SYSTEM ARCHITECTURE

3. SYSTEM ARCHITECTURE

3.1: BLOCK   DIAGRAM
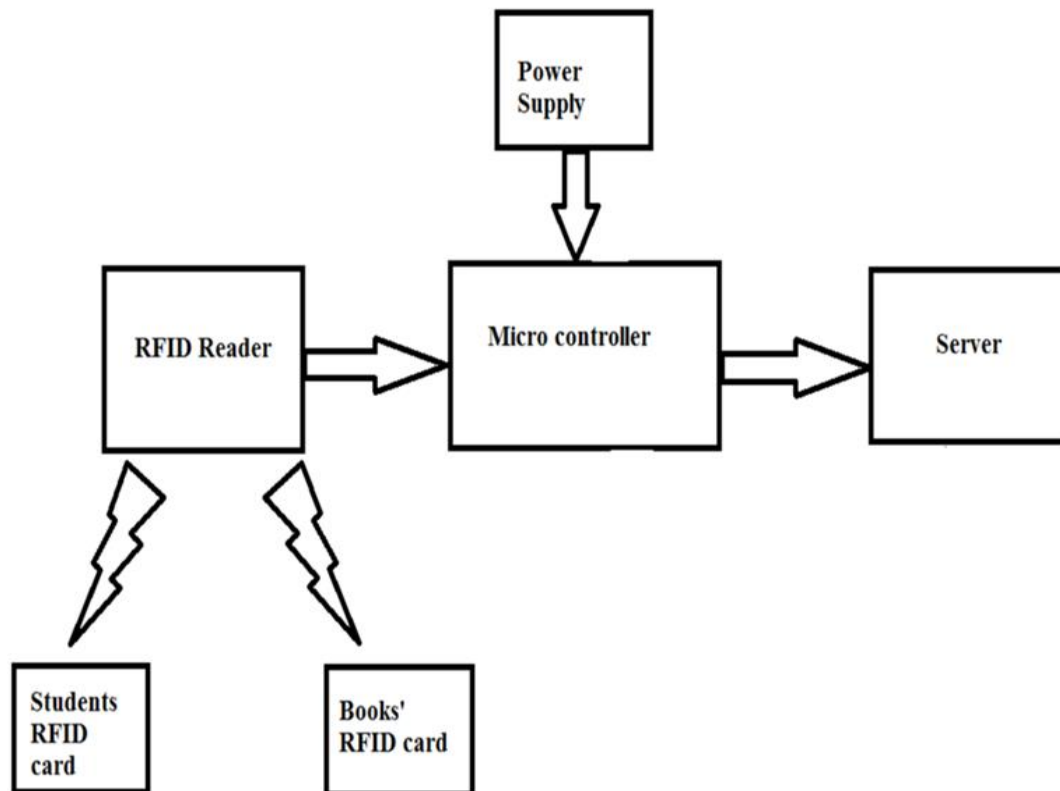
Figure 3.1: Block Diagram

3.2: SYSTEM DESCRIPTION

When the book first comes into the library, it will get a library number and be entered into the library database. The RFID label will also bear the number which is programmed into the chip. The RFID number is then linked to the database. The book will be put on the shelf and will now be active in the circulation system.

The user enters the library through a sensor gate. The user will normally go straight to the bookshelf or the information counter. A book return station is also available. After they have taken the book from the shelf they will go to the self-check station. This contains an RFID reader in the front platen. When the user card is waved on top of the platen, the user is identified and the account is opened. The books are now put onto the platen; the information is read and the chip programmed to a different status, as being checked out. When these books are carried through the sensor gate at the exit there will be no alarm. The book numbers are stored on the account and a receipt is printed. This receipt also contains the date for return, the data for late return, and some additional data e.g. items on hold. For those users who do not want to use the self-check station, they can still go to the circulation desk.

As mentioned above, if the user goes through the sensor gates with books that are checked out, there will be no alarm. In case the item was not checked out, the alarm will sound and then a signal is transmitted to the information counter and/or a turnstile to block the exit. Inventory can be taken by means of a hand-held reader (inventory wand). The user is waved alongside the shelves and picks up all the individual signals from the books. It may also be used to find misplaced books.

Chapter 4

HARDWARE SYSTEM DESIGN

4. Hardware System Design

4.1 Comparison:

Parameter	PIC18f	Atmega328p
CPU	8 bit	8 bit AVR
Flash memory	32Kb	32Kb
SRAM	2Kb	2Kb
EEPROM	256b	1Kb
Pin count	40 pin PDIP	28 pin PDIP
Maximum operating freq.	48 MHz	20 MHz
Operating voltage range	2-5.5 V	1.8-5.5 V

Table 4.1. Comparison between pic and Atmega328p.

4.2. Arduino Uno

The Arduino Uno is a microcontroller board based on ATmega328. It consists of a 16MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Arduino provides open source and extensible hardware and software. The development environment is also very simple, clear yet very flexible.

4.2.1 specification of Arduino Uno

Chipset	Atmega 328p
Physical size	68*52*2
Input voltage	7.0-12.0 V
Clock Speed	16Mhz
Flash Memory	32Kb
SRAM	2kb
EEPROM	1kb

Analog input pins	6
Digital I/O pins	14(6 Provide PWM output)
DC current per I/O pin	14 mA

Table 4.2 Specification of Arduino Uno
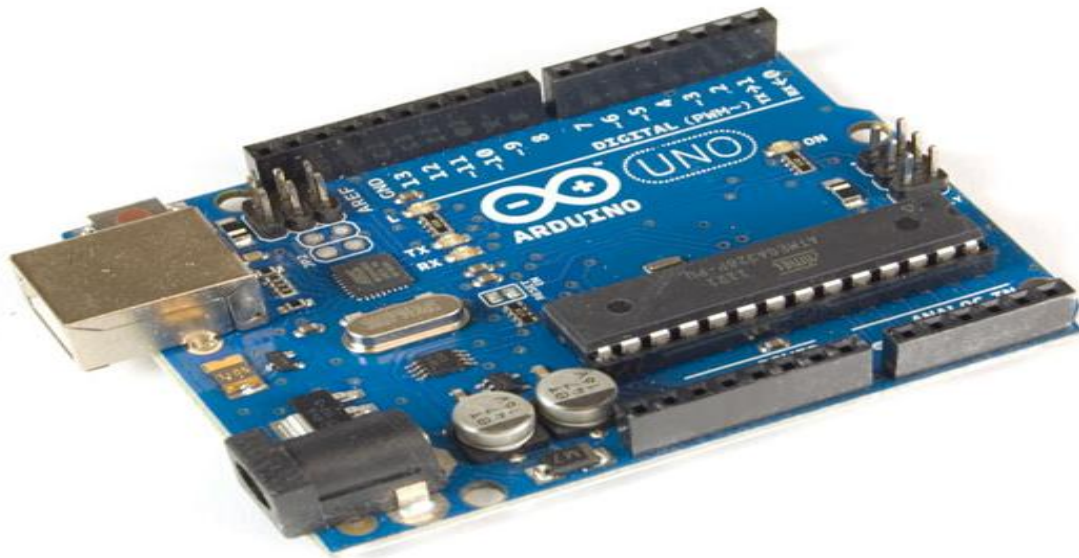
Figure 4.2 Arduino Uno board

4.3 RFID Reader (EM 18)

EM 18 module can be directly interfaced with micro controller using UART communication. The EM-18 RFID Reader module generates and radiates RF carrier signals of frequency 125Khz through its coil .when a 125Khz Passive RFID Tag is brought into this field ,will get energized from it .These RFID Tags are usually made using CMOS.

4.3.1 Specification of EM 18 module

Power Supply	5 volt DC Through USB
Current Capacity	<50mA
Operating Frequency	125khz
Read Distance	10cm
Size of RFID module	32mm(length)*32mm(width)*8mm(height)

Table 4.3 Specification of EM 18 module

Figure 4.3 EM 18 Module

Chapter 5

SOFTWARE SYSTEM DESIGN

5. SOFTWARE SYSTEM DESIGN

5.1 Front End Technologies

5.1.1 GUI Application using Eclipse (IDE):

Eclipse is an integrated development environment (IDE) used in computer programming, and is the most widely used Java IDE.[6] It contains a base workspace and an extensible plug-in system for customizing the environment. Eclipse is written mostly in Java and its primary use is for developing Java applications. The Eclipse software development kit (SDK), which includes the Java development tools, is meant for Java developers. Users can extend its abilities by installing plug-ins written for the Eclipse Platform, such as the Swing plug-in.

Swing class is the component of Java. It helps to create GUI applications easily. Eclipse Window Builder is composed of Eclipse SWT Designer and Eclipse Swing Designer and makes it very easy to create Java GUI applications without spending a lot of time writing code. Use the visual designer and layout tools to create simple forms to complex windows; the Java code will be generated for you. Easily add controls using drag-and-drop, add event handlers to your controls, change various properties of controls using a property editor and much more.

5.1.2 Website:

5.1.2.1 HTML

Hyper Text Markup Language (HTML) is the standard markup language for creating web pages and web applications. With Cascading Style Sheets (CSS), and JavaScript, it forms a triad of cornerstone technologies for the World Wide Web. Web browsers receive HTML documents from a web server or from local storage and render them into multimedia web pages. HTML describes the structure of a web page semantically and originally included cues for the appearance of the document. HTML elements are the building blocks of HTML pages. With HTML constructs, images and other objects, such as interactive forms may be embedded into the rendered page. HTML can embed programs written in a scripting language such as JavaScript which affect the behavior and content of web pages. Inclusion of CSS defines the look and layout of content.

5.1.2.2 CSS

Inclusion of CSS defines the look and layout of content. Cascading Style
Sheets (CSS) is a style sheet language used for describing the presentation of a document
written in a markup language. CSS is designed primarily to enable the separation of
document content from document presentation, including aspects such as the layout,
colors, and fonts. This separation can improve content accessibility, provide more
flexibility and control in the specification of presentation characteristics, enable multiple
HTML pages to share formatting by specifying the relevant CSS in a separate .css file,
and reduce complexity and repetition in the structural content. It can also display the web
page differently depending on the screen size or viewing device. Readers can also specify
a different style sheet, such as a CSS file stored on their own computer, to override the
one the author specified.

5.1.2.3 PHP

PHP: Hypertext Preprocessor (or simply PHP) is a server-side scripting language designed
for web development but also used as a general-purpose programming language. PHP code
may be embedded into HTML code. PHP code is usually processed by a
PHP interpreter implemented as a module in the web server.The web server combines the
results of the interpreted and executed PHP code, which may be any type of data, including
images, with the generated web page.

5.2 Backend Technologies

5.2.1 JAVA

Java is a general-purpose computer programming language that is concurrent, class based,
object-oriented, and specifically designed to have as few implementation
dependencies as possible. The language derives much of its syntax from C and C++, but
it has fewer low-level facilities than either of them.
The One design goal of Java is portability, which means that programs written for the
Java platform must run similarly on any combination of hardware and operating system
with adequate runtime support. This is achieved by compiling the Java language code to
an intermediate representation called Java byte code, instead of directly to architecture
specific.

machine code. Java byte code instructions are analogous to machine code, but they are intended to be executed by a virtual machine (VM) written specifically for the host hardware.

5.2.2 ARDUINO IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

It uses combination of c and c++ languages and makes it easy to write code.

5.3 Server

5.3.1 WAMP SERVER

WampServer refers to a software stack for the Microsoft Windows operating system, consisting of the Apache web server, OpenSSL for SSL support, MySQL database and PHP programming language.

The requirements were of MySQL database for database management and Apache Webserver for going online.

5.3.2 MySQL

MySQL is an open-source relational database management system (RDBMS). MySQL is a central component of the LAMP open-source web application software stack.

phpMyAdmin is a free and open source administration tool for MySQL and MariaDB. As a portable web application written primarily in PHP, it has become one of the most popular MySQL administration tools, especially for web hosting services.

5.3.3 Apache Server

The Apache HTTP Server, colloquially called Apache, is a free and open-source cross-platform web server, released under the terms of Apache License 2.0.Apache Web Server is used to host the website and the database so that it can be accessed remotely.

Chapter 6

ALGORITHMS

6. ALGORITHMS

6.1 Book Issue Algorithm:

- START
- Select the option to issue the book.
- Establish the connection between database and Arduino.
- Ask the student to scan his/her ID card.
- Check in database how many books student had issued.
- If it is equal to 3, ask student to return book before issuing.
- If it is less than 3, ask the student to scan the book to be issued.
- Enter into database, date of issue and date of expected return and increase the count of books issued by the student.
- Close the connection between database and Arduino.
- Display message "Book issued successfully" and expected date to return book.
- STOP

6.2 Book Return Algorithm:

- START
- Select the option to return the book.
- Establish connection between database and Arduino.
- Ask the student to scan the book.
- Retrieve the date of issue from database.
- Compare date of return and date of issue to check whether the book is returned within given days or not.
- If the book is returned within 15 days, display message "Book returned successfully" and decrease the count of book issued in database by the student.
- If book is returned after 15 days, display amount of fine to be paid.
- Then display message "Book returned successfully" and decrease the count of book issued in database.
- Close the connection between database and Arduino.
- STOP

6.3 Storing of log-in/log-out time and book theft detection algorithm:

- START
- Establish connection between database and Arduino.
- Check whether the card is student ID card or book.
- If it is book, then check in database whether the book is issued or not.
- If the book is not issued, ring the buzzer my making Arduino pin high.
- If it is Student ID card, then get todays date and current time.
- Check whether the student is entering or leaving library.
- Accordingly, enter the Log-in or Log-out time into database.
- Close the connection between database and Arduino.
- STOP

6.4 Algorithm for misplaced books:

- Start.
- begin serial connection - Arduino to EM18
- Read the UID Tag.
- If the tag is present in the respective table, then go to step 6, if not, continue.
- Ring the buzzer by making pin 13 high.
- Delay for 20 seconds.
- Stop.

Chapter 7

RESULTS
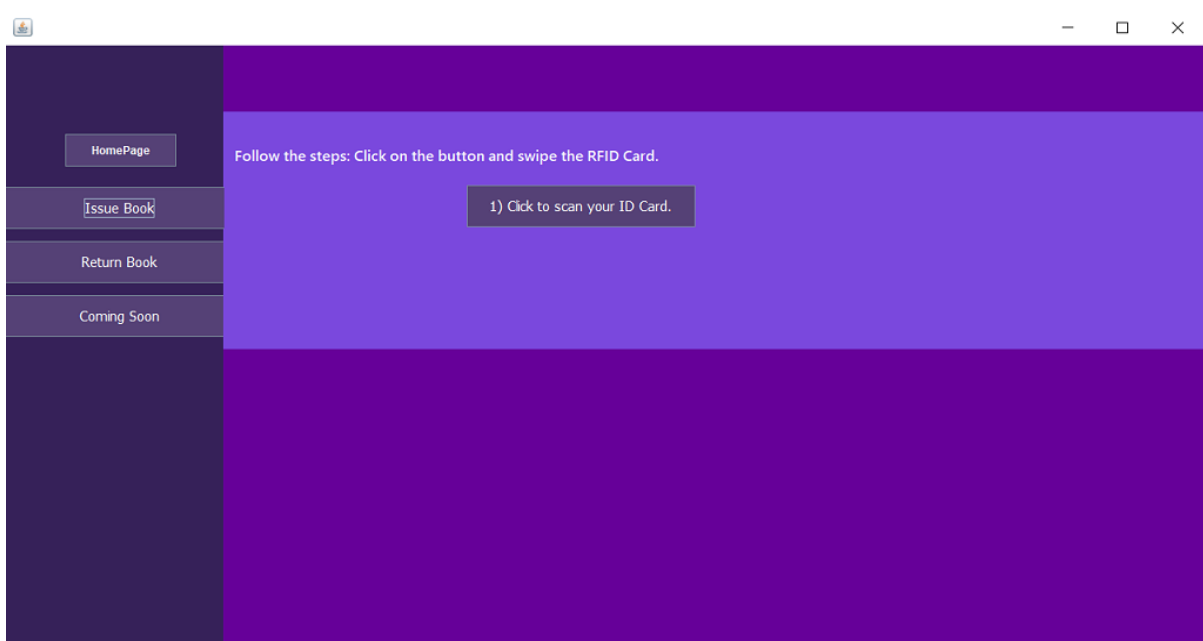
7. RESULTS

7.1: Book-issue

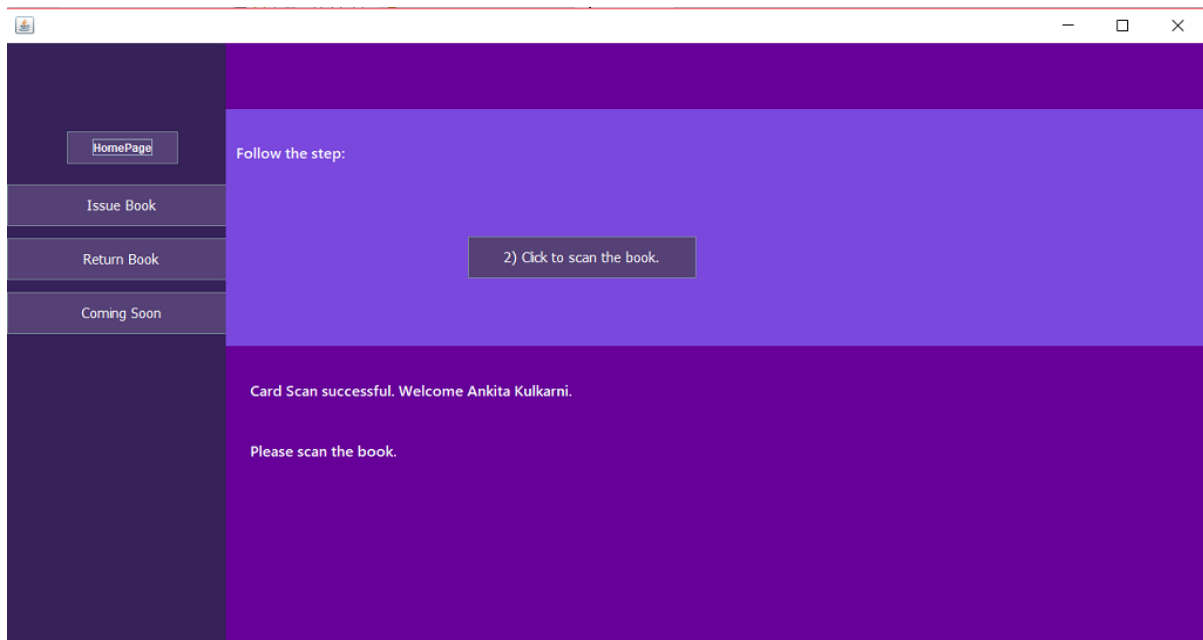Student can easily issue the book in following two steps

1) Scanning his/her library card.
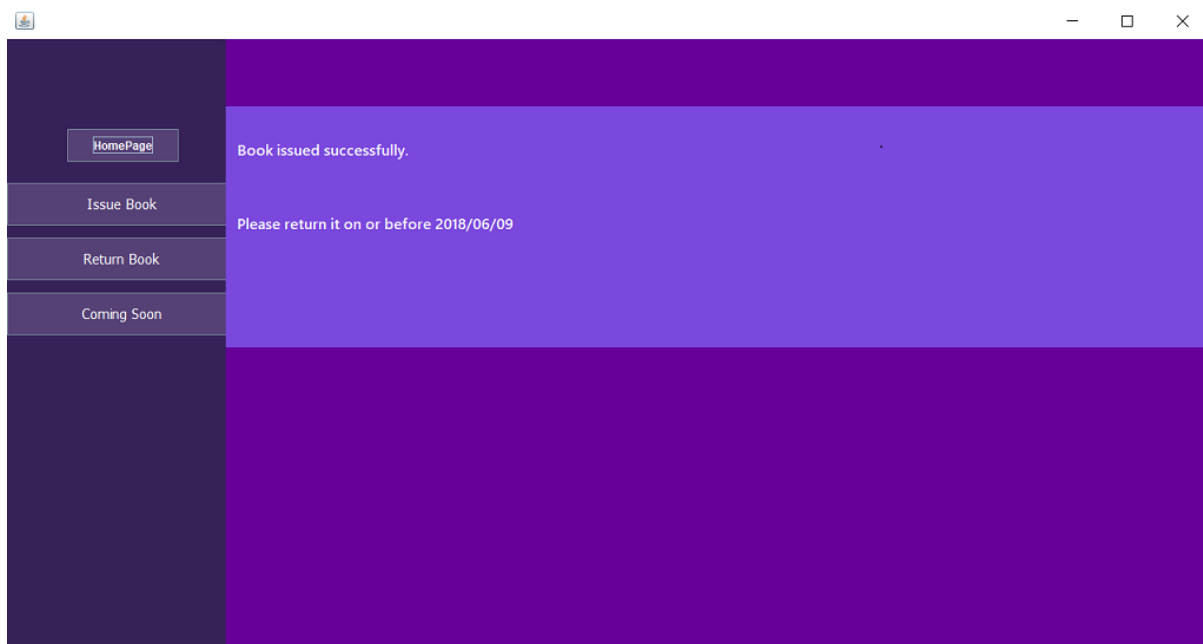2) Scanning the book which is to be issued.

Each student can issue maximum of three books. Error message will be displayed if student tries to issue more books.

**Figure 7.1: Scan your card**

Figure 7.2: Scan the book

Figure 7.3 : Book issued successfully

7.2 Book-Return

Student can easily return the book by simply scanning the book and database will be updated. Student should return the book on or before the expected date of return. If he/she fails then fine will be generated accordind to the delay made by the student to return the book.
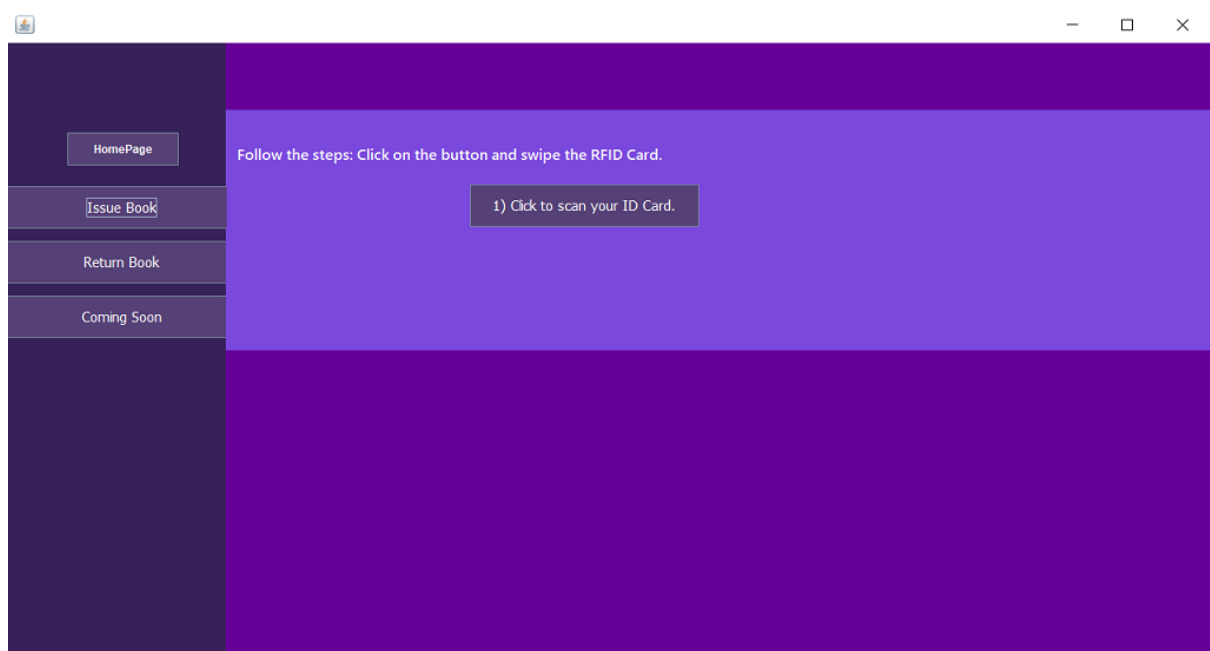
Figure 7.4: Scan the book to return
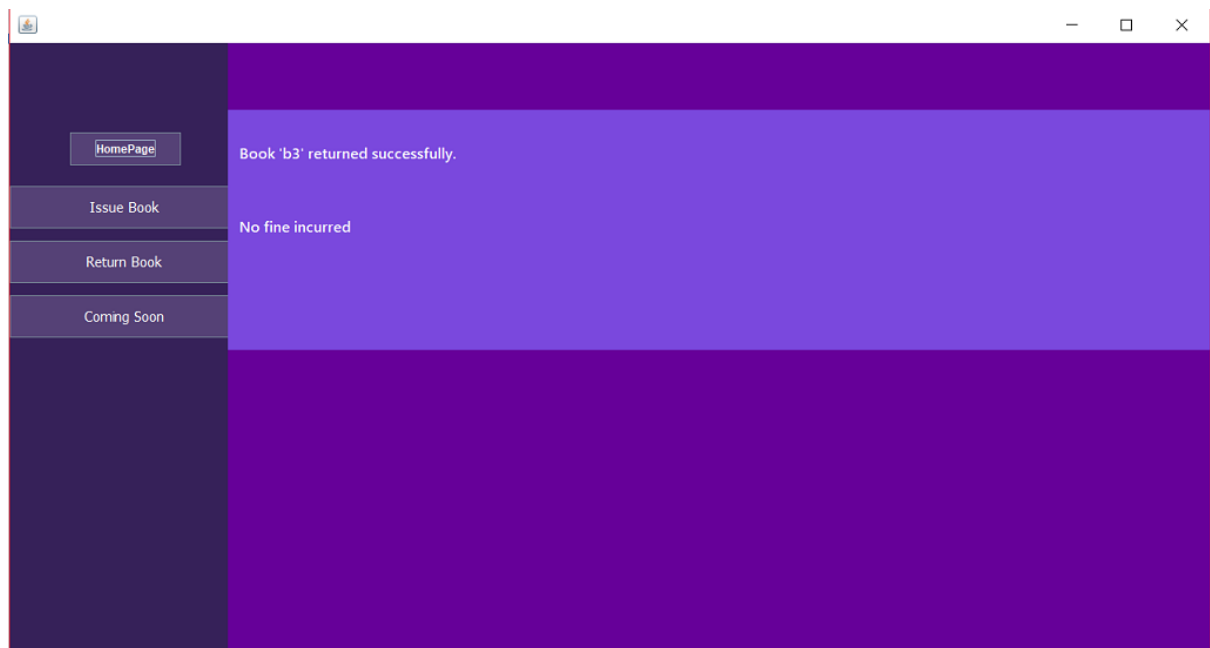
Figure 7.5: Book returned Successfully

7.3: Log in/log out time

When a student enters the library his/her libray card will be scanned and log-in time will be updated in the database. In similar manner log-out will be updated when he/she leaves the library.

Figure 7.6 : Login database

7.4 Misplaced book detection

When a book is placed into the shief, its information will be read by the reader and controller will compute whether or not the book belongs to particular shief. If student knowingly or unnknowingly place in book in wrong shief then alarm will be ring alerting student as well as staff.

7.5 Theft detection

Student should issue the book before taking it out of the library. When students nnear to the exit, reader over there will capture its information and controller will chech whether or not the book the is issued. If book is not issued then alarm will alert staff and theft will be detected.

Chapter 8

CONCLUSION

8. CONCLUSION

We have successfully completed automation of library in which students can easily issue or return the books without any human intervention. Automatic log in-log out along with theft and misplaced book detection are the highlighted features.

Time saving, fast accessing of books and eliminating manual errors are the main benefits of the RFID in Library. However, the range of the RFID reader as deduced from the results is not enough for the practical application. Current RFID reader works at a frequency of 125 kHz having a range of about 10 cm. This range does not satisfy the requirements in practical situations. So, in order to overcome this shortcoming, we will need to replace them with active/UHF RFIDs.

Chapter 9

FUTURE SCOPE

9. FUTURE SCOPE

Nothing can be completed in a single step. As they say, only change is the constant. The project titled 'Smart Library' is modularly designed, so addition of new features can be done without much difficulty.

The various enhancements which could be included in this application are:

- App can be created through which students from home can search and locate particular book in library.
- Student can download a soft copy of any book if available.
- Student can check and pay his fine/dues online.
- To enhance the security, metro gate can be installed at entry and exit points.

Chapter 10

BILL OF MATERIALS

10. BILL OF MATERIALS

SR.NO	COMPONENT	QUANTITY	PRICE
1	Buzzer	1	10
2	Arduino	1	450
3	RFID tag	20	400
4	RFID reader	2	500
5	One to one connector(male)	10	40
6	One to one connector(female)	10	40
	TOTAL	44	1440

Table.10 Bill of material

Chapter 11

REFERENCES

11. REFERENCES

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[2] "An RFID-based System for Library Management and Its Performance Evaluation" by Kiyotaka FUJISAKI at 2015 Ninth International Conference on Complex, Intelligent, and Software Intensive Systems

[3] "An Internet Based RFID Library Management System" by A.Pravin Renold , Joshi Rani at Proceedings of 2013 IEEE Conference on Information and Communication Technologies (ICT 2013)

[4] RFID and Organizational Transformation in the National Library Board of Singapore Paul Raj DEVADOSS

[5] "Design and implementation of library book search and management system using RFID technology" by Haiming CHENG, Linh HUANG at 2016 International Conference on Intelligent Networking and Collaborative Systems

[6]RFID Technology: A Revolution in Library Management, By Dr. Indira Koneru.

[7]Navigating your way through the RFID jungle- Texas Instruments.

Datasheets:

1.Datasheet of Atmega 328p

2.Datasheet of RFID Reader – EM-18