Library Management System Using RFID Technology

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Abstract —**Radio frequency identification (RFID) is a rapidly emerging technology which allows productivity and convenience. Radio Frequency Identification (RFID) is a new generation of Auto Identification and Data collection technology which helps to automate business processes and allows identification of large number of tagged objects like books, using radio waves. This paper proposes RFID Based Library Management System that would allow fast transaction flow and will make it easy to handle the issue and return of books from the library without much intervention of manual book keeping which benefits by adding properties of traceability and security. The proposed system is based on RFID readers and passive RFID tags that are able to electronically store information that can be read with the help of the RFID reader. This system would be able to issue and return books via RFID tags and also calculates the corresponding fine associated with the time period of the absence of the book from the library database.**

Keywords—radio frequency identification(RFID), RFID tags, Matlab , MySQL, Android.

I. INTRODUCTION

Radio-Frequency Identification (RFID) devices have importance in our daily life and they will become appearing in the near future. There is a tremendous growth in the industry to use RFID technology in the recent years. Research and development in this field has made this technology to be used in supply chain management, attendance management, library management, automated toll collection etc. RFID is an electronic technology whereby digital data encoded in an RFID tag is retrieved utilizing a reader. In contrast to bar code technology, RFID systems do not require line-of-sight access to the tag in order to retrieve the tag's data. Passive RFID is sure to replace bar codes in library applications. The bar-code system used in libraries is very time consuming and labor intensive.

The RFID based LMS facilitates the fast issuing, reissuing and returning of books with the help of RFID enabled modules. It directly provides the book information and library member information to the library management system and does not need the manual typing. The RFID tag can contain identifying information which is unique, such as a book's title or code, without having to be pointed to a separate database. The information is read by an RFID reader, which replaces the standard barcode reader commonly found at a library's circulation desk.

One step is to decide on which kind of RFID reader and tag is used for library automation. The importance of reader are what kind of tag it reads, its operating frequency, capability of near reading, writing inside the tag , connection type with computer The reader has two main functions: the first is to transmit a carrier signal, and the second is to receive a response from any tags in proximity of the reader. A tag needs to receive the carrier signal, modify it in some way corresponding to the data on the card, and retransmit the modified response back to the reader.

Further, tags which are located in book are binding with the specific Id. In modern passive RFID devices; the tag consists of a small integrated circuit and an antenna. The benefit of passive RFID is that it requires no internal power source; the circuit on the tag is actually powered by the carrier signal. Thus, the carrier signal transmitted from the reader must be considerably large so that the response can be read even from the card.

In practical applications of using RFID technology, a tag is attached to an object used to identify the target, when the target object pass through the area that the reader can read, the tag and the reader builds up the radio signal connections, the tag sends its information to the reader, such as unique code and other data stored on, the reader receives those information and decodes them, and then sends to a host computer so as to complete the whole information processing.

II. SYSTEM DESIGN

A. Concept

Each book would be uniquely identified via the RFID tags attached to it and communication would be done wirelessly. An RFID sensor would be placed near the library desk wherein one should only place the book near the sensor and it would get reissued/issued/returned depending on the actions required. Moreover information regarding the asset i.e. book can be gained by both the authority and students remotely instead of the traditional way of manually searching the book. This would save a lot of time and enable efficient queue management. As actions on these tagged assets are being recorded, data can be usefully exploited as per librarian's need. Hence, it is tracking books within a limited transmission range.

B. Components

The system consists of following components:

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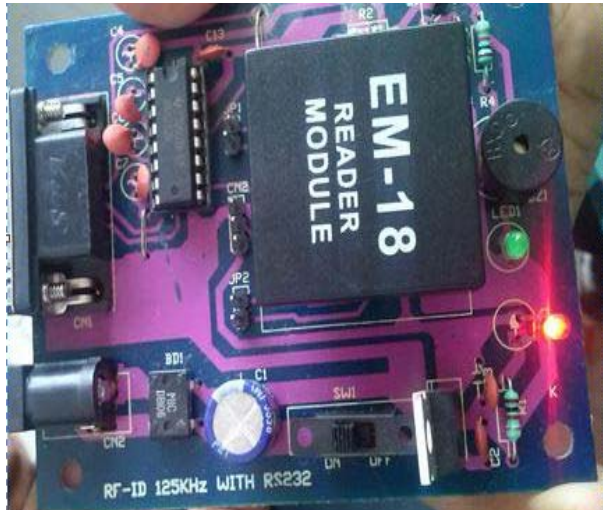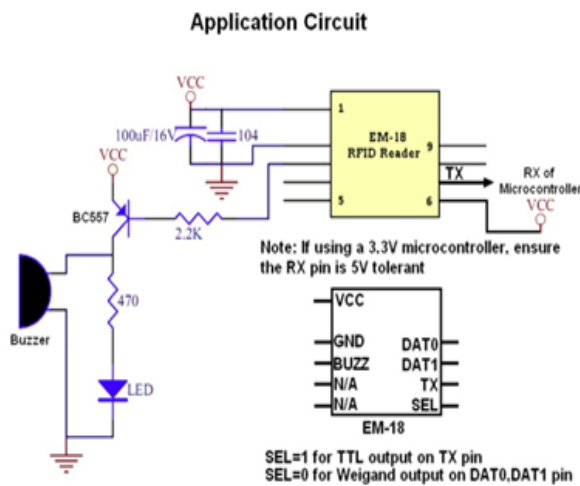

Figure 1: RFID Reader

Application Circuit

Figure 2: Application Circuit of RFID Reader

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

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

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

Figure 3: RFID Tags

Antenna: The antenna resides inside the reader. It generates electromagnetic field. Whenever a tag comes in close proximity of the electromagnetic field it gets activated and it is able to read and write data to the reader by producing radio signals. Antenna behaves like a communication media between the tag and the reader.

C.Implementation

1.SETUP OF THE SYSTEM
Whenever a new book is acquired by the library, an RFID tag is attached into the book with the relevant information like, Book name, Book author, book number, etc. The detailed information regarding the book is captured in the computer database. The computer database also stores all information for individual users of the library. Each user is supplied with registered RFID cards. These cards carry identification data and other associated details like: name, address, roll no., and mobile no. etc. for each user.

2. The Login Process
The librarian has the special privilege of having a unique master password for controlling the GUI of the RFID LMS system. The LOGIN dialogue box appears as soon as he powers on the system. The librarian then enters the corresponding password and enables the system for further usage.

3. Librarian Interface
This is the part of software that has all the operations like issue, reissue, and add data about new user or a

book. Most importantly the database control is given to the librarian so that she can access it. Even then, we have created an option of viewing the transactions that have taken place. The search is made easy by giving him/her to search history according to the member, book or date. Hence manual errors are removed and transactions have been more automated than before. Various actions of the UI like add, delete, issue re-issue and search by name, email-id have been displayed.
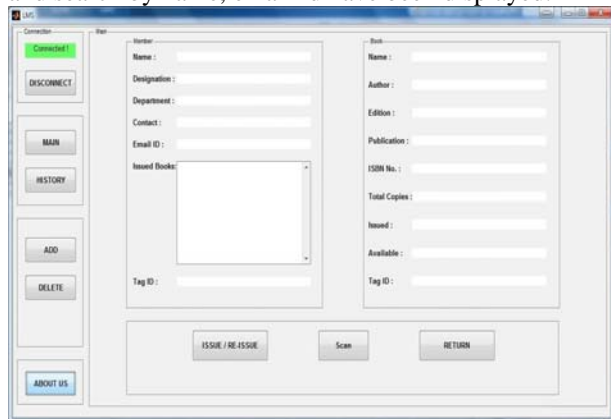

Figure 4: Librarian Interface

4. The user interface

After the student library-id tag and the book tag are scanned it shows the details of the student and book issued by them. It can then perform operations of issue/re-issue and also tell the fine if any.
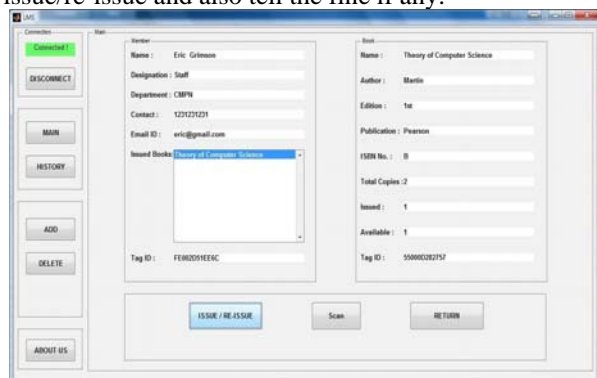

Figure 5: User Interface

5. The Issue Process

When a user needs to get a book issued, he can get it done without any manual intervention. He simply zaps his RFID card in front of the RFID reader and it automatically opens his/her account activity page. He then places the selected books to be issued, one by one in front of the RFID reader. The computer records all these data against his name. Finally a message is displayed informing the user that the ISSUE has been successful. The user takes the books for a specified time from the library after which he has to return the books to the library.

6. The Return Process

When the user wants to return books, he simply flashes the books again in front of the RFID reader and the

books automatically are adjusted for return against the user's name.
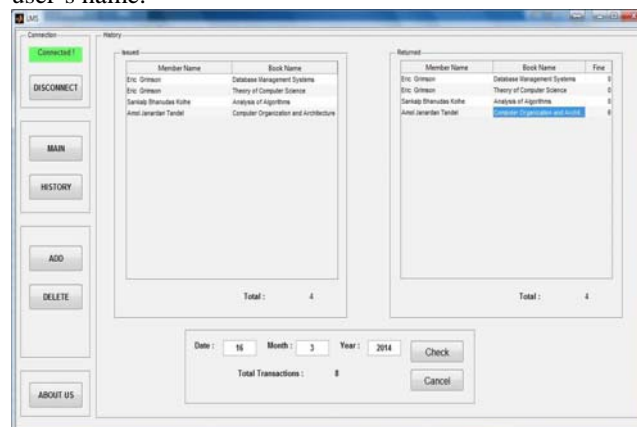

Figure 6: Issue/Return Interface

7 Fine Calculations

The user during the time of returning the book clicks or activates the fine calculation button on the display area or GUI panel. The panel returns the fine.
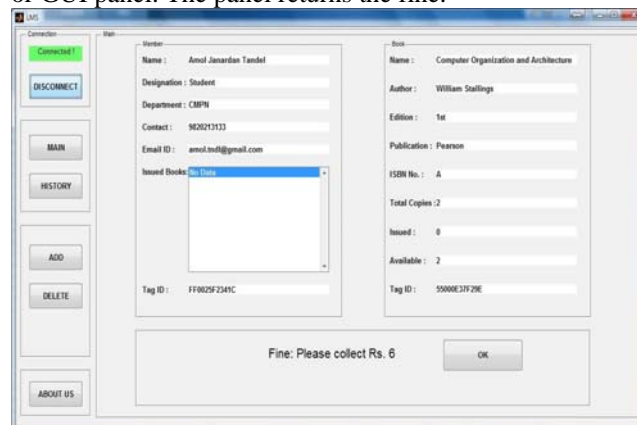

Figure 7: Fine Calculation

8. Website

The library website is developed, where each member of the library can access his/her account and view personal transaction details and know about the book availability. This reduces time taken for transactions and standing in long queue as data is automatically uploaded. As internet is widely available, this can be reached to a large amount of users, irrespective of variation in devices.
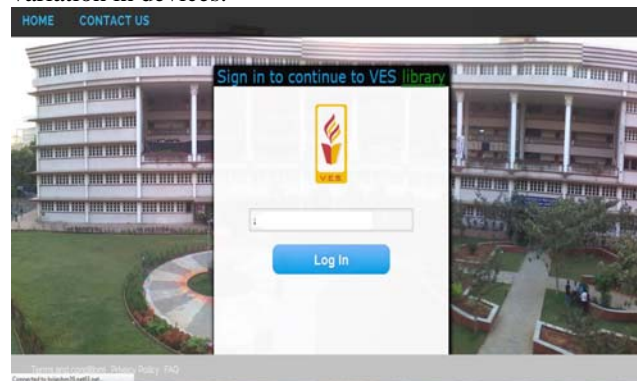

Figure 8: Web interface

9. Android Application

The android app is developed because of its popularity among mobile users and its ease to handle. Here you get to view your personal transaction details; also it gives you a reminder when to return your book. You can also view the book availability.
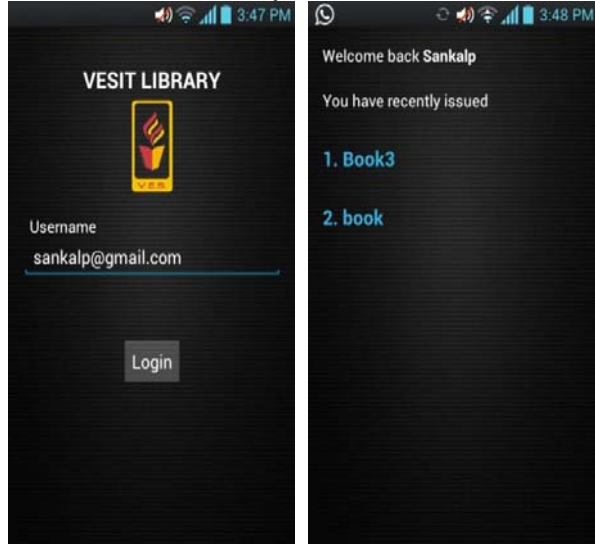

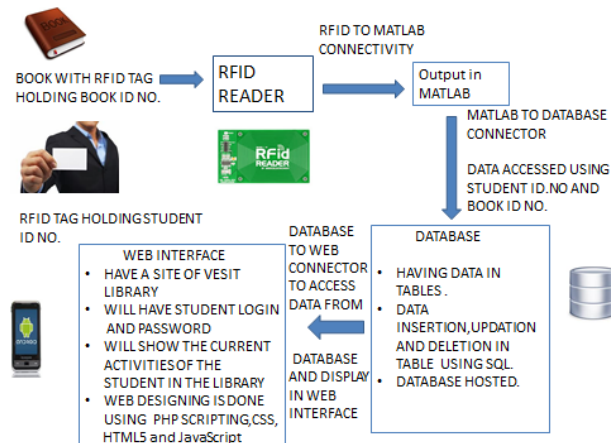Figure 9: Android Application

D.Design Inter-relation

Figure 10: Interrelation between various interfaces

This flowchart depicting the inter relation between the interfaces. A book with RFID tag is scanned by the reader and the input is fed into the librarian interface and the requested query is processed and the following data is extracted from the database. Personal transactions can be seen both on mobile and website as per user convenience.

III. RESULT

RFID based Library Management System is a unique system to be implemented in libraries to manage the books automatically and efficiently. It will use the RFID reader to identify and manage the books efficiently. Time saving, fast

accessing of books and eliminating manual errors is the main benefits of the RFID in Library. The personal transactions can be viewed using various interfaces, either the website or the android app. The data can be managed using the interface created for the librarian. Hence both management and automation have been implemented.

IV. ISSUES AND CHALLENGES

While creating a system for library 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.

V. CONCLUSION

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

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