

DEVELOPMENT AND IMPLEMENTATION OF SMART RFID BASED LIBRARY MANAGEMENT SYSTEM USING RASPBERRY PI AND μ FR NANO WITH ANDROID OS

C. Srujana¹, B. Rama Murthy²

¹Research scholar, Dept. of Electronics, Sri Krishnadevaraya University, Anantapur, India

²Professor, Dept. of Instrumentation, Sri Krishnadevaraya University, Anantapur, India

Abstract - Radio frequency identification (RFID) is a rapidly emerging technology which allows productivity and convenience. Now it is an integral part of our day to day life as they are using in many applications like industrial, shopping malls, traffic and libraries. So far this technology implemented successfully worldwide, but in India it is still in observation state especially in library management at University and Educational Institutions due to lack of awareness and cost. Hence an attempt has few made to develop and implement an RFID based library management system in our university. The proposed system is based on high frequency nfc μ FR NANO RFID Read/Writer having the frequency range of 13.56 MHz's and it can perform perfect Read, Anticoligen Identify/verification, data exchange with contactless transation. The software developed with the environment of ANDROID OS inbuilt local storage database i.e SQLite to improve system performance. The proposed system successfully implemented and tested in our University library and it is satisfactory working.

Keywords: μ FR NANO RFID Read/Writer, μ FR NANO RFID Read/Writer Tags & cards, Android application, SQLite, Rasperry pi 3 B+.

1. INTRODUCTION

In the present scenario the Radio Frequency Identification (RFID) devices are playing vital role in our day to day routine life and an in future becomes most appealing. In the industry there is a tremendous growth in the use of RFID technology in the recent years and it can also be used in Supply chain management, Real time attendance management, Tracking assistance in Transport system and Library Management etc. The RFID is the latest technology to be used in the development of library management system as compared to barcode technology. It is a RF technology based identification system which enables identifying object using tags attached to them, irrespective of the line of sight not being adequate to the reader. However, the system is effected easily by neighbouring environment and the resonant frequency, by which the communication performance is degraded. In the present work we have

used 13.56MHz RFID nfc μ FR Nano system for management of library system with Android OS.

Smart RFID Library Management System is a highly integrated, user-friendly and compatible system for any type of library. It facilitates fast issuing, returning and searching of books and list members with the help of the RFID enabled modules with anti collision [1]. It directly provides the books and members database to the library member and users, so the librarian need not maintain manual records. The RFID tag itself contains Unique ID, with the books information stored in the tag it can never be lost and that information is receptive to UID reading.

Non line of sight AIDC technologies help in identification of objects [2]. The basic system components are tag, reader, middleware. The tag consists of a microchip attached to an antenna and is placed in the object to be located. This depends upon the type of tags that are passive and active. A reader can communicate with the tags through radio waves with-in the work station. The middleware converts the data captured by the reader format that is perceivable by the application [3].

2. HARDWARE OF THE SYSTEM

In the present work the RFID Technology is used with Raspberry pi and Android OS. When the reader is connected through Android OS, a beep sound will be heard which means that the reader is connected and ready to access the tag and if the tag is within the communicating range area, the reader blinks the led within the range non-stopple [4] and block diagram of smart RFID based Library Management System, as shown in figure1. The system consists of fallowing units, they are:

1. RFID Read/writer
2. RFID Tag and cards
3. Rasperry pi 3 B+
4. LCD display unit (Touch screen)
5. Personal computer

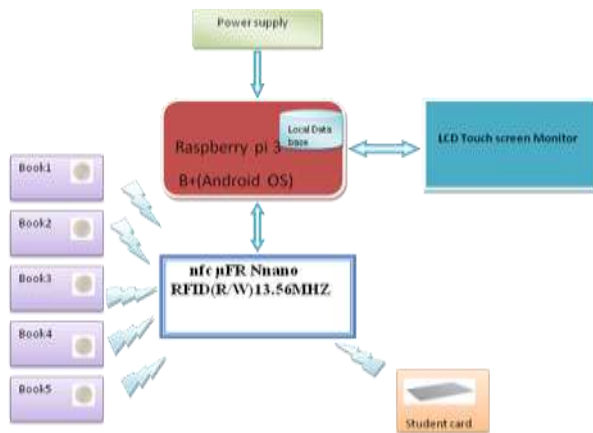


Fig -1: Block diagram of Smart nfc μFR Nano RFID based LMS using Android OS

2.1 RFID READ/WRITER (13.56 MHZ)

A High frequency RFID read/writer of NFC μFR Nano (13.56MHz) is a frequency range communicator and a built-in, well-tuned antenna provides the proximity operating distance up to 80 mm and contactless communication speed at higher baud rates (up to 424 kBd). The device also has a built-in Crypto1® algorithm and non-volatile internal key memory storage for better security [5]. An audible (speaker) and 2 LEDs visible indicators are built-in and are absolutely user controllable by the uFR Nano RFID (R/W). The RFID R/W is shown in figure 2(a).

2.2 RFID Tags

In the present work we used two types of RFID tags, one is meant for member/student card stores the information of student UID and books received and the other the tag is used to store the book information of such as book title, author(s) name, edition, publisher’s name, cost and pages etc.

- The tags are: 1. MIFARE_classic_1K (card)
- 2. NTAG_216 (tag)

2.2.1. MIFARE_classic_1K (card)

The MF1ICS50 is designed for simple integration and user convenience which does allow the complete student ticketing transactions to be handled in less than 100 ms . The operating distance is 100 mm depending on the antenna geometry. This is more securable because of the unique serial number for each card [6]. These cards are used for student identification. The MIFARE_CLASSIC_1K tags are as shown in figure. 2(b).

2.2.2. Ntag-216

The MIFARE MF01CU1 has been developed by NXP semiconductors to be used in contactless smart stickers. The operating range is of 100 mm depending on antenna geometry and reader configuration. It has 7 Bytes of unique serial number, the memory is organized in 16 pages with 4 bytes per page [7], it is used for book identification. The Ntg-216 tag stickers are shown in figure 2(c).



Fig -2(a): RFID (R/W)



Fig -2(b): RFID STUDENT CARD



Fig -2(c): BOOK TAG

2.3 Raspberry pi 3 B+

Raspberry pi 3 B+ is a credit card sized bargain micro Linux machine and 1 GB of RAM, 1200 MHz quad – core ARM Cortex-A53 processor. The important components of the board are CPU, graphics, memory, USB controller and it is compatible for Android OS. In this work we have used Raspberry pi B+ as the Android thing platform [8].

2.4 LCD Touch screen display unit

LCD Touch Screen is a 5 inch resistive touch screen with 800 X 480 resolution, HDMI interface of Raspberry pi 3 B+, its act as by directional communication. A user can communicate with the RFID reader/writer through the LCD touch screen which is a digital key board and acts as an input and output monitor of this system as shown in figure 3. RFID R/W is connected to the Raspberry pi and RFID LMS APP is stored in Raspberry pi and shown all the operations of the LMS using this Touch screen monitor. So this entire system is used to the fixed RFID R/W, as shown in figure. 3.



Fig -3: Raspberry pi 3 B+ with 5inch HDMI LCD

2.5 Personal computer

In the present work, we used Lenovo™ ideapad 320 laptop, window edition is windows 10 Pro and system processor is Intel(R) Core(TM)i5-7200U CPU @ 2.50GHz 2.71GHz,Installed memory 8.00 GB, system type 64-bit Operating System,X64 based processor. To develop the application on Android Studio3.2.1 Build #AI-181.5540.7.32.5056338 built on October 9-2018, to write the user UI designs, database creation and RFID R/W interfacing driver programming and checked all the SQLite database using Android Virtual Device(AVD Manager) this Database of library is the heart of comprehensive RFID systems. RFIDLMS APP develops through Android Studio as presented in figure. 4.



Fig -4: Laptop RFID interface through the Raspberry pi 3 B+

3. SOFTWARE DEVELOPMENT OF THE SYSTEM

Android OS is an open source software stack that includes with operating system, middleware and key applications along with a set of API libraries for writing mobile applications that can shape the look, feel and function of mobile handsets. Small, stylish and versatile, modern mobile phones have become powerful tools that incorporate cameras, media players, GPS systems and touch screens [9]. Android applications are written using Java as a programming language but are executed using accustom virtual machine called Dalvikrather than a traditional Java VM, each Android application runs in a separate process within its own Dalvik instance, relinquishing all responsibility for memory and process management to the Android run time, which stops and kills processes as necessary to manage resources. While a set of APIs provides access to all of the underlying services, features, and hardware [10].

The following application services are the architectural cornerstones of all Android applications providing the framework to be using by developer [11].

Android projects are typically composed of many packages, directories, and files [12].The Android Studio

main window is made up of several logical areas identified as presented when we created project, android studio creates directory structure that contains each and everything which defines our workspace for an android application. As shown in bellow figure 5.

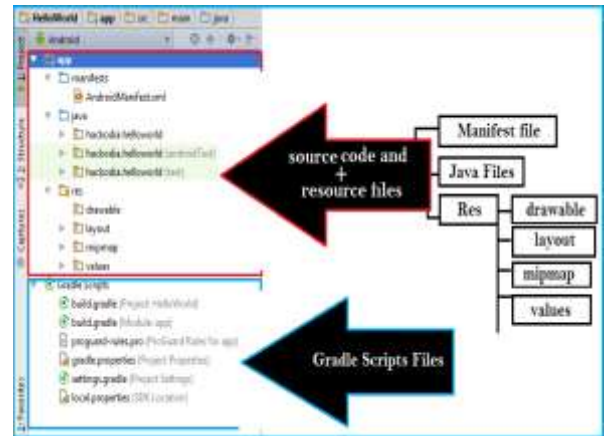


Fig -5: The Android Studio project directory structure.

There are two main steps in creating a GUI viz. One is designing its layout, and the other is writing call back functions that perform the desired operations when the user selects different features.

SQLite database

SQLite is an open-source relational database i.e. used to perform database operations on android devices such as storing, manipulating or retrieving persistent data from the database. It is embedded in android by default. So, there is no need to perform any database setup or administration task. Data is displayed in the Log cat or Table or listview, move to the next page [10]. SQLite Open Helper class provides the functionality to use the SQLite database. SQLite can provide following functions creation of table, insertion of data, upgrade, delete, view etc.

4. IMPLIMENTATION OF SYSTEM

The present work was developed in integrating Smart nfc uFR Nano RFID(R/W) based LMS using Raspberry pi3 B+ to assists the Librarians in the efficient management of books in the library. The user friendly frames are developed using Android Studio (android things platform + SQLite). To stores the detailed information of the book/student or member to the database and subsequently all the information of book and members is loaded in the RFID tag, cards. This covers the database related to books and student based on UID. Following tasks have to be done:

1. Login of the user in the DLMS

2. Registration of book/student information on to the Tag and Card
3. Issuing of Books to the Students
4. Returning of books to the Student
5. Adding new arrival books to the Library/Department
6. Status of books availability in the Library/Department
7. Database management

8. The option of **Books returning**, to return to the books from student for the Student UID read and check the books, return date and charges and add to the department data base and remove to the student data base.
9. The option **search**, in these books and student information search through UID of student and book. According to the student name, student UID and book UID, author(s) name, book title, publisher name.
10. 10. To click on to **Status** option, then enter the **Book UID** and click **Enter**, then the display book information is viewed otherwise **no data** is displayed.
11. To close the application on by clicking **Close** option in the main window.

The processing and implementation of DLMS are discussed with the help of Algorithm and flow chart as presented bellow.

Algorithm of Smart RFID Based Library Management System

1. To switch on the system and open the RFIDLMS App, paste the RFID tag in a proper reading place on the book for effective reading as shown in figure 6.



Fig -6: Tag position in book

2. To Loin in to Application by Librarian and Member. Librarians can access both activities but Members can access User login only
3. To interface the nfcμFR Nano RFID Read/Writer with PC/Tab/RPI through USB to have a serial communication with a baud rate of 115200 PS, 1 second time period.
4. To click the nfcμFR Nano RFID Tag interface, check the RFID Read/Writer is connected properly or not with beep sound, otherwise repeat step 3.
5. To write the data on to the nfcμFR Nano RFID tag, and read the book information using submenu RFID and store in library book database.
6. To register new books using Books ADDING option, to click this options write the information of books like title of the book,author(s) name etc enter the continue button then the book information to the library data base and continue to another book adding.
7. The option of **Book issue**, in this issue the library books for the student using UID of book and student UID, to add the book in to department student database and remove from the Department book database.

MAIN PRGRAM PAGE

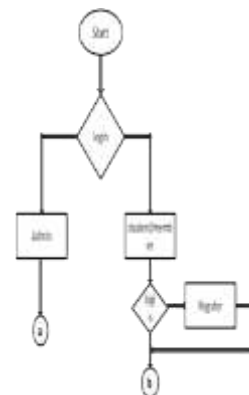


Fig -7(a): Flow chart for the RFID LMS

ADMIN PAGE

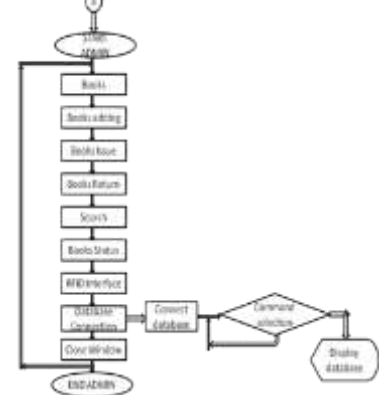


Fig -7(b): Flow chart for admin/user login page Admin page

READING AND WRITING OF RFID R/W

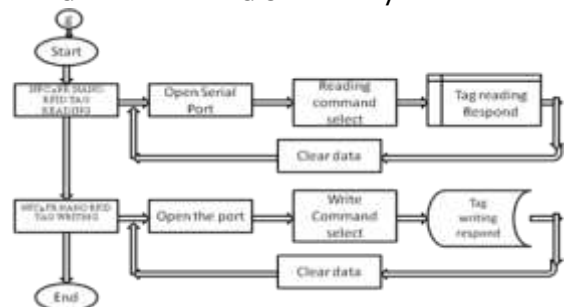


Fig -7(c): Flow chart for interface with Pc/tab/Android thing using Android Studio

Execution and Implementation of RFID LMS

1. To execute the application, click on the RFID LMS App on the desktop screen as shown in

figure 7(a). To open this app chooses the option admin login and user login as show in figure. 8(a) and 8(c).

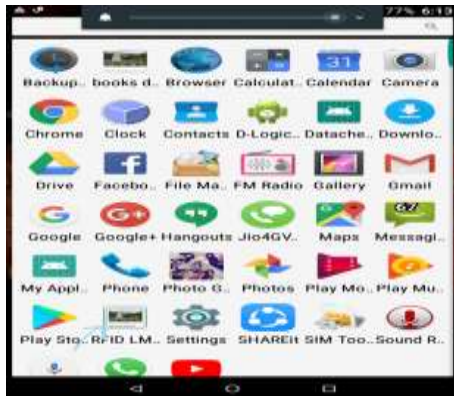


Fig -8(a): RFIDLMS App



Fig -8(b): login page

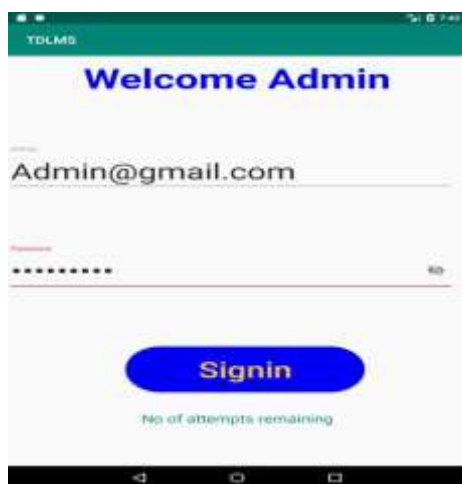


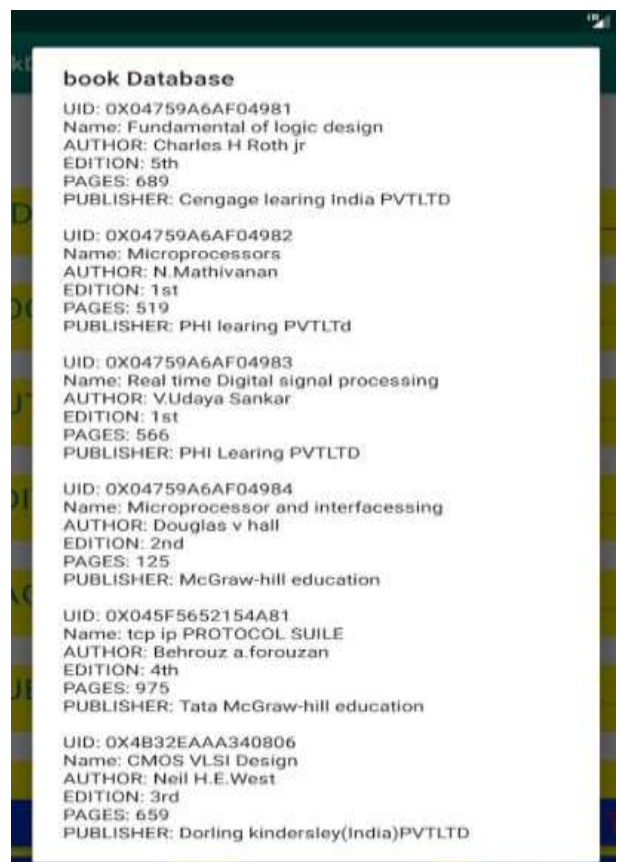
Fig -8(c): User registration page

2. After the Admin selection, appears admin or main window as shown in figure. 8(d).



Fig -8(d): Main window for RFID LMS

3. To view the list of books information available in the department of Electronics and Communication, the window displays the books available in the department and in the same way to show student data base, these two data bases as shown in figure. 8(e).



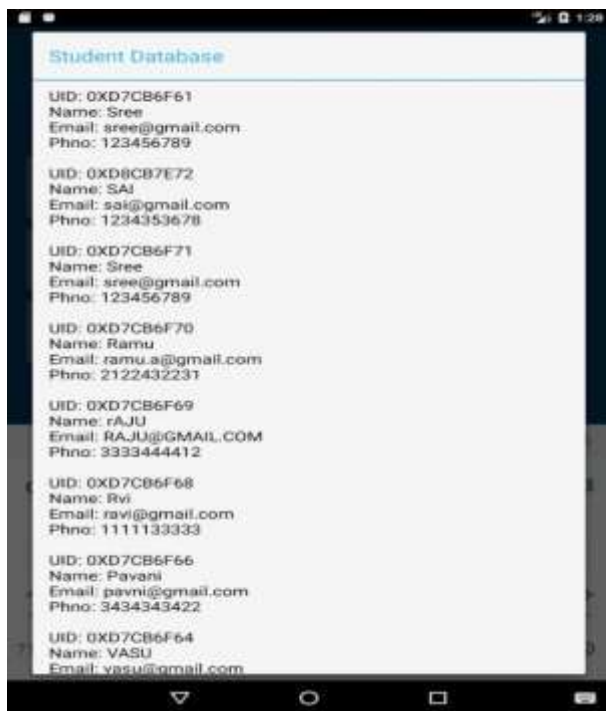


Fig -8(e): Electronics and communication books and student database

- Newly added books are read by the RFID reader and book information stored to the department database and also to the main library database as shown in figure. 8(f).

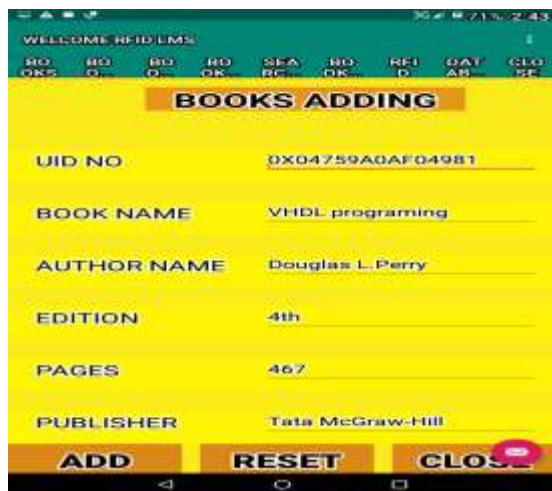


Fig -8(f): Adding of new books to library database.

- To Issue of books to the student, enter the Book UID, Student UID and student Name, Issued and Return date, then click **Add**, adds to the student data base and the book is deleted from the department books database as shown in figure. 8(g).

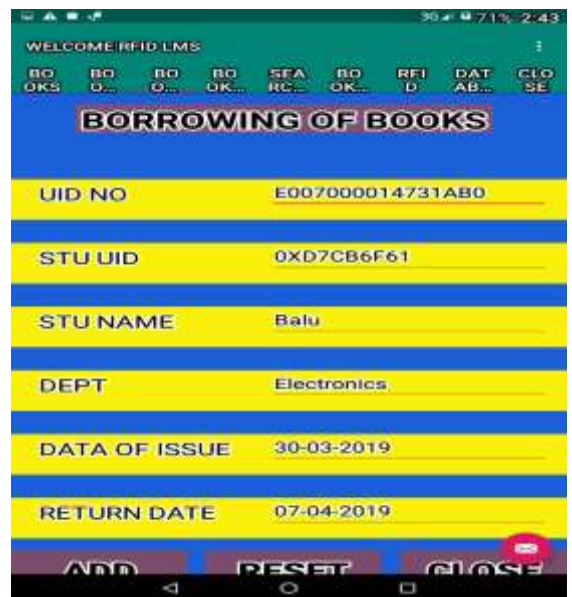


Fig -8(g): Issuing of books

- In Returning of books, enter book UID and student name, return date and due date, then click **Add**, then add the book data to department book database and delete the book from student database shown in figure. 8(h).

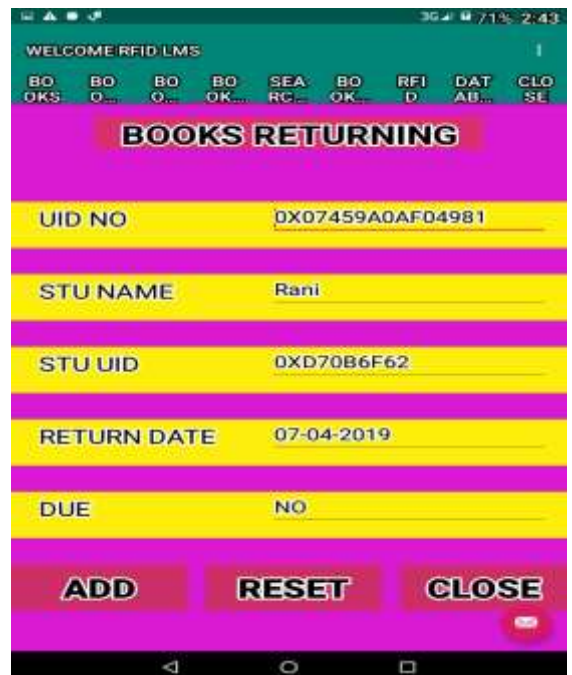


Fig -8(h): Returning of books

- To write and read the information from the tagged book, first write the information of Book Title, Author(s) Name, Edition, ISBN no, Cost etc. then Read the information from the tag with the help of UID as shown in figures. 8(i) and 8(j).



Fig -8(i): Write information on book tag



Fig -8(j): Read information on book tag

5. RESULT AND CONCLUSION

The Developed Smart RFID based Library Management System using Raspberry PI 3 B+ and μ FR Nano with Android OS tested and implemented successfully, as an advanced low cost system which saves lot of efforts and time of the Library persons. In the future development a security may also be inserted by introducing RFID Gate and antitheft system to enter the Library.

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