

# Near Field Communication Enabled Library

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**Abstract**— Near Field Communication enabled library will let user issue as well as return the book in a totally new perspective. This will in turn save the time and unnecessary wastage of paper and most importantly this will digitize the library. The Mifare tag will be deployed by the Library authority by embedding unique identification number (UIN) and user details into the tag. The Mifare tag can be attached to Identity card of user as well as books. Whenever the user will visit library and will chose the book for issuing, ID has to be checked at entrance Reader and same will be sent to server for verification. The server will check user details and if successfully authenticated, user can proceed further. After issuing book(s) and returning, SMS will be sent to user which includes transaction details.

**Index Terms**— Near Field Communication, NFC, Active NFC Tags, NFC-Enabled Library, Library Management using NFC Reader/Writer.



## 1 INTRODUCTION

### 1.1 Manual Library Management System

Manual library management is traditional way for operating the books in libraries. In this system, User gets a library card by which books are issued or returned. Library has to maintain all user records manually in a computer system. Librarian manually inserts the data in the computer system. When a user borrows books, the information of borrower and borrowed book has to be updated in the computer by librarian. This process may take time as the data has to be entered all the time manually [1].

Disadvantages of this system are:

1. Queuing
2. Manually insertion of data
3. Time consuming

### 1.2 Library Management Using Barcodes

A Barcode is a series of parallel altering black and white patterns that represents a sequence of numbers or characters. Barcode is a specially designed font that allows you to specify and generate barcodes on normal text characters. It is extremely easy to use. Through barcode based library management system, manual circulation of resources may completely be avoided.

Every book is pasted with barcode labels. Members are issued with barcode printed membership cards. These membership cards can have necessary details of the user. The barcode reader may be used to scan all the information from barcode label of the book and card. This information is then automatically updated in the library's computer system. Library can take the print out of any of the information any time during the session and any number of times. Although this system minimizes workload of the librarian [2], there are some disadvantages as follows:

1. Queuing.
2. Barcode can be altered.

### 1.3 NFC in Library

Traditional library is managed either by bunch of staff in library (manually) or more advanced, by using barcode scanner. Both of these methods take much of the time for borrowing and returning the books. Considering the current scenario when someone borrows or returns a book, a record has to be maintained in the register and then the book will be issued, so this whole process becomes lengthy and time consuming. Hence there is a need for alternate solution which will be less time consuming and which will reduce the complexity of the current process.

Near Field Communication (NFC) can be used to simplify this time consuming process just by tapping the book or waving it near NFC device [7]. Unlike traditional library system there will not be any need of borrowing book manually just tap the book near device and get the book issued. Similar process is carried out while returning the book.

NFC is a set of standards for smart phones and similar devices to establish radio communication with each other by tapping them or bringing them into proximity, usually its

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range is 4-5 centimeters. The applications which are present and anticipated include contactless transactions, data exchange and setup of more complex communications such as Wi-Fi. Communication is also possible between a NFC device and an unpowered NFC chip, called a "tag".

This system will provide maximum benefits to clients as well as to the Library by allowing them to issue a book by just tapping and processing of data is in the real time to get their validity to notify every user about the submission date of the issued book[8]. This system will be used to get and collaborate end users allowing them to edit their information in the applications and provide more automated details about issued books, submission date etc. This system mainly focuses on following subjects which are required for a NFC-enabled library system in a cooperative and time sharing environment. It is assumed that:

1. Every user has an active tag attached to ID-card with him/her.
2. All users are registered to NFC-enabled Library.
3. NFC reader/writer device is installed in the library which will be connected to the server.

**Contactless Smart Card (Writer):** These are smart cards that employ a radio frequency between card and reader without physical insertion of the card. Instead, the NFC card is passed along the exterior of the reader and read data. Types include proximity NFC cards which are implemented as a read-only technology for building access. The functioning of this card is very limited and they communicate at 125 MHz Another type of limited card is Gen 2 UHF Card that operates at 860 MHz to 960 MHz True read and write contactless cards were first used in transposition applications for quick decrementing and reloading of fare values where their lower security was not a problem. They communicate at a frequency of 13.56 MHz and thus conform to ISO 14443 standard. These cards are often memory types which are protected [9]. They are also gaining popularity in retail stored value since they can speed up transactions without lowering transaction processing revenues (i.e. Visa and MasterCard), unlike traditional smart cards.

Fig 1.1 NFC enabled library

## 2 COMPONENTS OF NFC-ENABLED LIBRARY

### 1. NFC Reader/Writer

This device is used to read and write the information in active tags which are present on books and students [5].

### 2. NFC Active Tags

These are the small cards and stickers on which information is written and read [6].

### 3. Dewey Decimal Classification (DDC)

This is classification system used to classify books. Online Computer Library Center (OCLC) maintains this classification and makes it available online.

These technologies detailed description can be found below.

#### 2.1 NFC Reader/Writer

The ACR122U NFC Reader is a PC-linked contactless smart Card reader/writer developed based on the 13.56 MHz Contactless (RFID) Technology [3]. Compliant with the ISO/IEC18092 standard for Near Field Communication (NFC), it supports not only Mifare and ISO 14443 A and B cards but also all four types of NFC tags. ACR122U NFC reader is compatible with both CCID and PC/SC. Thus, it is a USB device with allows us interoperability with different applications and devices. ACR122U NFC reader can read and write more quickly and efficiently with a full USB speed of up to 12 Mbps and access speed of up to 424 kbps. Approximately, the distance at which ACR122U NFC reader can operate is up to 5 cm, which depends on the type of contactless tag which we use. The security level can be increase when we use integrated ACR122U NFC reader with an ISO 7816-3 SAM slot. The ACR122U is available in module form, permitting easy integration into bigger machines, such as physical access systems, vending machines and POS terminals.

#### 2.2 NFC Active Tags:

NFC tags can be used for applications such as passive devices that can be used to communicate with active NFC de-vice (an active NFC reader/writer) [4].

The NFC tags can be used within applications such as posters, and also for other areas where small amounts of data can be transferred and stored to active NFC devices. Within the poster the live area can be used as a touch point for other NFC device. The stored data in NFC tag contain any data, but commonly it is used for storing URLs from where the NFC device may refer further information. NFC Forum introduced their first standardized technology architecture and standards for NFC devices in June 2007. This standard includes three Record Type Definitions, RTD, NFC Data Exchange Format, and NDEF. These are for Internet resource reading applications and for small poster text. There are four basic tag types of tags and they are given designations 1 to 4, each of these tags has different capacity and format. These NFC tag type formats are based on ISO 14443 three standards (Types A and B which is the international standard for contactless



smartcards) and Sony FeliCa which conforms to ISO 17091, the passive communication mode, standard). The advantage of keeping the NFC tags as simple as possible is that they may be deemed to be disposable in many instances, often these may be embedded in posters that may have a small life, etc.

### 2.3 Dewey Decimal Classification (DDC)

The Dewey Decimal Classification (DDC), or Dewey Decimal System, is a proprietary library classification system first published in the United States by Melvil Dewey in 1876. It has been expanded and revised through 23 major editions; the latest issued in 2011, and has grown from a four-page pamphlet in 1874 with less than 1,000 classes to a four-volume set. It is also available in an abridged version which is suitable for smaller libraries. It is currently maintained and managed by the Online Computer Library Center (OCLC) [16], a library research center. OCLC licenses access to an online version, Web Dewey, for catalogers, and has an experimental linked data version on the Web with open access. The Dewey decimal classification (DDC) introduced the concepts of relative location and relative index which allow new books to be added to a library in their appropriate location based on subject. The classification's notation makes use of three-digit Arabic numerals for main classes, with fractional decimals allowing expansion for further detail [10]. A library assigns a classification number that unambiguously locates a particular volume in a position relative to other books in the library based on its subject matter. This makes it possible to find any particular book using the number, and to return it to its proper place on the library shelves. The classification system is used in 2000,000 libraries in at least 135 countries. The 10 main classes in DDC are as follows:

- 000: General works, Computer science and Information
- 100: Philosophy and psychology
- 200: Religion
- 300: Social sciences
- 400: Language
- 500: Pure Science
- 600: Technology
- 700: Arts and recreation
- 800: Literature
- 900: History and geography

## 3 SYSTEM ARCHITECTURE AND WORKING

Near Field Communication enabled library system allows user to search for a book in Library within a short span of time than the conventional library. As soon as a book gets located, the user has to take it to for checkout at the counter having the facility of reading and writing on a tag.

The book can then be issued after showing a valid Identification. At the counter, these books may be issued by tapping the book in front of the NFC device in order to make entry in the database.

The proposed system uses Dewey Decimal Classification to manage the database [10], [11], [12]. The system uses online

database of Dewey decimal classification for classifying books at locally installed database which is running in parallel to the global database. The system compares ISBN number of book with the ISBN number available in local database. If match is found then the user will be allowed to borrow the book from the library. The Tagging is a process of embedding in the book either on the front or back or at some strategic location within the book. The NFC tag contains information of the respective book along with other related information such as its ISBN number, title of book, author name, DDC number. Books containing these tags may be placed in book shelf. After the installation of these tags, shelf management becomes easier as any operator may just walk in with NFC device which will count the books by reading the tags present on them and update the database accordingly.

### 3.1 Self-Check-in/Checkout

User enters in library with a library card. After identifying the user with a library ID card, the user is asked to choose the next action (check-out of one or several books). After choosing check-out, the user puts the book(s) in front of the screen on the NFC reader and the display will show the book title and its ISBN number (other optional information can be shown if desired) which have been checked out.

This is the process in which user makes an entry in library's computer system manually. The entry is made both the times when user enters and leaves the library.

### 3.2 Shelf Management

Shelf Management is an essential component of NFC enabled library. Shelf Management is the process wherein books embedded with tags are kept in the shelf. This solution makes locating and identifying items on the shelves an easy task for librarians. It comprises basically of a portable scanner and a base station.

### 3.3 Book Drop

The Book Drops can be located anywhere, within or outside the library or at possible remote locations outside the library. This offers unprecedented flexibility and convenience of returning books at anytime of the day, even when the library is closed.

### 3.4 Anti-Theft Detection

RFID Gates is the anti-theft part of the NFC enabled Library Management System using the same NFC tags embedded in the library items. Each lane is able to track items of about 1 meter and would trigger the alarm system when a borrowed item passed through them. The alarm will sound and lights on the gate will flash as user passes through with the un-borrowed library material.

### 3.5 Dewey Decimal Classification

Libraries store and manage thousands of books. These books need to be organized in a manner that allows easiest possible access to the user. Classification Systems are the tools libraries use to organize books and the other library materials. There are different kinds of classification systems but proposed system uses DDC (Dewey Decimal Classification) system which is most widely used classification system, and it is used in small, medium, public and school libraries[13],[14].

The purpose of using DDC in the proposed system is to make system more user-friendly, convenient and efficient. DDC provides different class numbers to each respective class and similarly to sections and divisions. Each given number consists of two parts: a class number (from the Dewey system) and a book number, which avoids confusion in between different books on the same subject. DDC number allows user to choose specific book from its appropriate section. (Here it is assumed that DDC number is known to user).

The Proposed system generates DDC number from Online Computer Library Center i.e. OCLC. OCLC server maintains and manages the Dewey Decimal Classification. Books will be kept in shelf based on DDC standards. Hence when user searches for book, DDC helps to find the respective book quickly without any confusion as there can be different books on the same subject.

### 3.6 SMS Gateway

The System provides a unique feature of sending SMS from a desktop machine using a mobile as a gateway. In this module, a hotspot is created by an android smart phone. Server is connected to the hotspot and then using the hotspot connectivity the server can send message to the users regarding the book he/she has issued. Also After 5 days from issuing the book a message will be sent to user as a reminder of returning of book. In this module for sending message, server utilizes the service given by service provider of SIM card of an android enables phone [17].



### 3.7 Receipt printing

Once user borrow books, a receipt will be generated which will contain transaction details such as transaction id, book title, issued date and return date.

## 4 ADVANTAGES OF RFID SYSTEMS

1. Rapid charging/ discharging
2. Easier self-charging/ discharging

3. High reliability
4. High-speed inventorying
5. Automated materials handling
6. Long tag life
7. Fast Track Circulation Operation

## 5 DISADVANTAGES OF RFID SYSTEMS

1. High cost
2. Vulnerability to compromise
3. Removal of exposed tags

## 6 FUTURE SCOPE

The work may be further expanded by adding a security component into the system. If a malicious reader is reading the information from a tag then system may lose its integrity and will not be secured. Hence a strong security component can be added for authentication of reader as well as tag and if malicious reader and tag are identified them the corrective action can be taken.

## 7 CONCLUSION

The proposed system provides a creative solution to traditional Library Management system. Near Field Communication i.e. NFC being a secured contactless technology has an upper hand over comparable technologies like barcode. With minimum human interference in the system, the operations will be executed in less time and system will be more efficient.

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