Near Field Communication Applications in Modern Library System: A Review

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Abstract - **Near Field Communication is a type of Radio Frequency technology that permits exchange of information over a small distance by versatile phones, computers, labels or other electronics devices. This paper is based on Near Field Communication reviews, features and usefulness of the innovation and summarizes the wide range of its present and expected applications in modern era. The aim of the paper is to explore the impact of NFC technology and its applications on libraries and information centers and proposed system will be helpful in the advancement of traditional Library management system.**
Keywords: **NFC, RFID, NFC Tags, NFC-Enabled Library**

I. INTRODUCTION

Near field communication introduced in the early 1980s within the framework of RFID (radio frequency identification). This advancement enables the client to send radio information to a collector where it was recognized. Near field communication may be a set of communication conventions that empower two electronic equipments, one of which is ordinarily a versatile such as a smart phone or any other to set up communication by bringing them inside 4cm (1.6) of each other. It is evolved from the existing Radio Frequency Identification technology. NFC is extremely short ranged and it is called people-centric. According to The International Standard near field communication - Interface and Convention, ISO/IEC 18092 (NFCIP-1), NFC can work in active or passive mode. In active mode, the gadgets produce their claim electromagnetic field freely, whereas in passive mode as it were one of the gadgets is competent of producing an electromagnetic field and then another one extracts energy from it to function and transmit the desired data (Vazquez-Briseno, 2012).

In 2004, Nokia, Sony, and Philips came together to create the NFC Forum. NFC gadgets are utilized in contactless payment framework such as:

1. similar to those utilized in credit cards
2. and electronic ticket smartcards
3. and permit portable installment to replace/supplement this system

There are three modes of operation that can be supported by NFC-enabled devices: card emulation, peer-to-peer, and reader/writer.

TABLE I MODES OF OPERATIONS IN NFC DEVICES (NFC FORUM, 2018)

Card emulation mode	In this mode, with only a touch NFC enabled devices allows users to perform various transactions such as purchases, ticketing and transit access control
	NFC devices emulating smart cards usually operate in passive NFC mode and the data transfer is secure
	It is compliant with the ISO 14443 and FeliCa schemes
Peer-to-peer mode	Peer-to-peer mode empowers two NFC-enabled gadgets to communicate with each other to trade data and share records, as a result with a touch clients of NFC-enabled gadgets can rapidly share contact information and other related files
	For example, sharing and exchange of information such as virtual business cards or digital photos
	Rapid information exchange compared to other communication modes. Based on the ISO/IEC 18092 standard
Reader/writer mode	This mode enables NFC-enabled devices to reads/writes data to an NFC object
	For illustration, an NFC enabled phone in the nearness of an NFC tag is able to recover a URL and go to the respective website
	It uses NFC Forum-defined message format there is no security of data transfer (ST Microelectronics, 2016)

Nowadays, everyone has mobile phones so integration of NFC technology into mobile phones could be most practical solution for using its application for various services. NFC technology enables communication between an NFC enabled mobile phone at one end, and another NFC enabled mobile phone, an NFC reader or an NFC tag at the other end. NFC technology has much application and it includes e-payment, ticketing, identification, access control, content

distribution, smart advertising, data/money transfer and social services (Ozdenizci, *et al*, 2013). Because of its appropriateness and applicability and the promising value added opportunities, NFC has attracted several academicians, researchers, organizations, and commercial companies as well as libraries and information centers.

II. NFC FUNCTIONALITY

A. NFC Specification and Standards

The first RF NFC standard was ECMA 340, based on the Air Interface of ISO/IEC 14443A and JIS X6319-4. ECMA 340 was adapted as the ISO/IEC standard 18092**.** Simultaneously major credit card companies (Europay, Mastercard, and Visa) have introduced the payment standard EMVCo based on ISO/IEC 14443 A and ISO/IEC 14443 B. Within the NFC Forum both groups harmonized the air interfaces. They are named NFC-A (ISO/IEC 14443

A based), NFC-B (ISO/IEC 14443 B based) and NFC-F (FeliCa based) (Rohde & Schwarz, 2011).

According to NFC Forum there are two major specifications exists for NFC technology:
1. ISO/IEC 14443: Define ID cards used to store information such as that found in NFC tags.
2. ISO/IEC 18000-3: Specifies the RFID communication used by NFC devices. It is an international standard.

1. NFC Forum Tag Types

NFC forum is a type of industry consortium for development and further improvement of NFC technology. On the basis of NFC, five tag types have been defined by NFC Forum, and included in the Forum specifications having designations between 1 and 5 with different format and capacity. NFC Forum has defined following five types of NFC tags:

TABLE II BRIEF DESCRIPTION OF NFC TAGS (NFC FORUM TECHNICAL SPECIFICATIONS, 2017)

S. No.	Tag Type	Standard	Memory	Data rate	Tag Specification
1.	Type 1	ISO/IEC 14443A	96 bytes to 2 Kbytes	106 kbits	Read and write Based on NFC-A technology
2.	Type 2	ISO/IEC 14443A	48 bytes to 2 Kbytes	106 kbit/s	Read and write Based on NFC-A technology
3	Type 3	ISO/IEC 18092 JIS X 6319-4 FELICA	2 Kbytes	212 kbit/s, 424 kbit/s	Read Re-write Read-only Based on NFC-F Technology
4.	Type 4	ISO/IEC 14443A ISO/IEC 14443B	32 Kbytes	106 kbit/s, 212 kbit/s, 424 kbit/s	Read/write memory capacity Based on the ISO Data Exchange Protocol (ISO-DEP) NFC-A or NFC-B based innovation
5.	Type 5	ISO/IEC 15693	64 Kbytes	26.48 kbit/s	Read Re-write Read-only Based on NFC-V Technology

a. *NFC Forum Type 1 Tag Operations Specification:* It is based on ISO /IEC 14443A standard. These NFC Labels are studied and rewrites competent and the client can arrange the tag to end up examined only. Memory accessibility is 96 bytes which is more than adequate to store website URL or little amount of information. In any case, the memory measure is expandable up to 2kbytes. Hence, due to its straightforwardness, this tag is fetched successful and perfect for NFC application.

b. *NFC Forum Type 2 Tag Operations Specification:* The NFC tag 2 type is additionally based on ISO14443A. These NFC labels are read and rewrite competent and the client can arrange the tag to become read as it were. The fundamental memory measure of this tag is 48 bytes and could be extended to 2 Kbyte. The communication speed is 106 Kbyte.

c. *NFC Forum Type 3 Tag Operation Specification:* Sony Felica framework is the basis of this tag. It has 2 Kbyte memory capacities and information communication speed is 212 kbit/ s. The Japanese industrial standard

(JIS) 6319-4, famously known as Felica. Labels are pre-configured at make to be either read or rewritable or read – as it were. Memory accessibility is variable, hypothetical memory restrain is 1MByte per benefit.

d. *NFC Forum Type 4 Tag Operation Specification:* It is profoundly consistent with the ISO/ IEC 14443A and B standard. The NFC tag is pre-configured at manufacture and they can be either read or rewritable or read – as it were. It has memory capacity up to 32 Kbytes and the communication speed is 106 Kbits to 242 Kbit/s.

e. *NFC Forum Type 5 Tag Operation Specification:* It is recently introduced by NFC Forum Specification. It contains more than 64 bytes of memory and based on ISO/IEC 15693 standard. The communication is based on NFC-V Technology.

B. NFC Enabled Devices

First time Nokia 6131 was introduced with near field communication (NFC) with read, write, and peer-to-peer capabilities. As the years passed, more specifications emerged and the technology grew from payment methods to

sharing videos, links, and game invites between electronic devices and other NFC devices. After that in 2010, Android produced its first NFC phone the Samsung Nexus S in 2010. As of now the NFC markets are most predominant in Europe, Asia, and Japan; however the United States is additionally observing fast development in this field ("Near-field Communication", 2017).

1. *Nokia 6131*: The Nokia 6131 was first phone introduced with near field communication (NFC) technology. This phone includes NFC credit card readers and is useful for   Contact less payment and ticketing capabilities.

2. *Google Nexus S*: It was the first Android device which has supported Near Field Communication (NFC) technology in both hardware and software applications.

3. *BlackBerry*: Both the Black Berry 9900 and the BlackBerry 9930 have NFC functionality. They can be used for scanning NFC tags as well as can encode NFC tags too.

4. *Apple iPhone X:* It is NFC enabled device. The phone can only be used to read NFC tags.

5. *Samsung Galaxy S II*: The Samsung Galaxy S II offers NFC services to their users.

6. *Nokia Astound*: The Nokia Astound, also known as the Nokia C7, comes with NFC technology, however it is deactivated as a matter of course and users have to enable it after receiving their smart phones.

7. *Windows Phones*: Windows phone 8 also supports NFC.

III. APPLICATIONS IN LIBRARY SYSTEM

NFC is a new concept in Library management system which can be used to consuming less time and reduces the complexity of the modern Library system. Library professional can use its application to enhance library services and various administrative works in libraries.
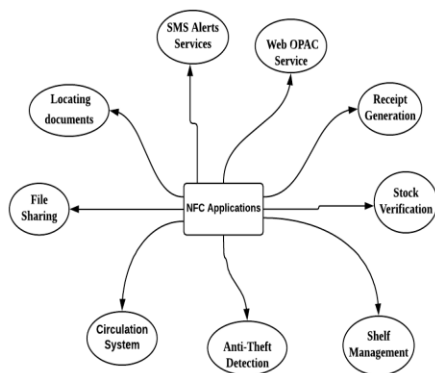
Various applications system of NFC in Libraries

For example, In NFC just waving the book near NFC devices and the book will be issued or returned according to user choice. The processes of NFC are

1. Every user has an active tag attached to ID – card with his / her
2. Every user are registered with NFC- enabled library
3. NFC reader/writer device to install in library which will be connected to the server (Jagtap *et al*, 2015).

1. Circulation: NFC technology is very effective in the circulation process of library. The user shows his NFC ID card to the reader in the library for automatic login and puts the book to be issued on the NFC reader for NFC enabled book issued.

2. Receipt Generation: A receipt can be generated when user lends books with all transaction details. Hence, Receipt generation is another feature of NFC enable library system.

3. SMS Alerts Services: SMS sending facility in an NFC system by using mobile gateway is a unique feature, a reminder of dues of the book are sent to the user.

4. Anti-Theft Detection: The major problem in libraries is theft detection.NFC enabled library management has an anti-theft part in which RFID gates are installed. NFC tag is used which is attached with library items. This system detects the user who enters the library without enrollment or membership card (Yusof *et al*, 2015).

5. Shelf Management: This facility is used for instant searching of the required book in the library. In this, the self-management system consists of mobile NFC reader which is integrated with library software.

6. Stock Verification: Stock verification can be done easily by implementing NFC technology in the Library. The collection accession numbers are transferred to library software and stock verification report will be generated.

7. Web OPAC Service: Library provides web OPAC (online public access catalogue) administrations to a library client for getting data from library collection which they need. Library users can search book and periodicals by watchwords of title, creator, distributor, ISBN, ISSN, Subject etc. at any place of the world through web association and can know about a collection like the status of books (accessible or issued) no. of duplicates and other bibliographical points of interest. Library users get data from his/ her library account like issue/return and due date of the archives etc. and the enlisted user of a library can send a request for the required book by web OPAC.

8. File Sharing: NFC-enabled devices are capable of peer-to-peer data exchange. A file sharing, a feature is a key application for this capability is already available on many NFC-enabled devices. Google's Android operating system is an example of peer-to-peer file sharing via NFC (McHugh & Yarmey, 2014).

IV. ADDITIONAL ADVANTAGES OF NFC

A. Contacts Sharing Facility: NFC enabled mobile phone having the facility of sharing contacts in a very simplest way. By bringing phones together sharing and receiving process can be done easily.

B. App Sharing with NFC: Using NFC facility one can share mobile apps too. Open any app you want to share and bring it near the devices that you are sharing it with then tap the screen. If anyone finds an interesting app on your phone, you can share it with NFC. It will simply open the Play Store and find the app automatically.

C. Images Sharing: It is quite easy to image sharing by using NFC application. The process is simple, user need to bring it near the device he/she want to share.

D. Transfer of Documents or File: Using NFC can be useful when you do not have an Internet connection or you want to share documents or files off line.

E. Location Sharing Facility Using GPS: Sharing the directions is the simplest way when done with NFC because it doesn't need any searches, just tap the phones and another device receives the information. It opens Google Maps and the same screen can be visible on another device to which you have shared it.

V. CONCLUSION

A library is one of a vital field for implementation of NFC applications. This application engages clients as well as library staff to perform different capacities within the library for a case as borrowing, returning, seeing their loaning history and searching etc. NFC innovation has parcels of qualities and openings that can encourage and fulfill the users' experiences in libraries administrations. The NFC technology helps in the library and information center for various activities like performing SDI and CAS through SMS sending facility in an NFC system by using a mobile gateway. The paper emphasizes on the NFC innovation in primary stages for library administration framework which is able to be supportive for the library experts ought to be mindful of a positive and negative effect of NFC innovation in libraries. In modern library system, the use of NFC application will be helpful for users as well as library staff for saving their time and justifies the fourth law of library science i.e. "Save the time of Users."

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