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NFC in Web Application for Data-Entry

Dhanamma Jagli[1], Annora Rodrigues[2]

[1]Assistant Professor, MCA Department, VESIT, Mumbai, Maharashtra, India
[2]III[rd] MCA Student, VESIT, Mumbai, Maharashtra, India

Abstract: ***Near field communication is a set of ideas and technology that enables smartphones and other devices to establish radio communication with each other by touching the devices together or bringing them into proximity to a distance of typically 10 cm (3.9 in) or less. This paper aims at using NFC, as a means of entering data into a configurable web based data entry tool. At present this configurable web based data entry tool can only accept data that is entered into the system through a keyboard. In order to further simplify the data entry process data should be entered in to the system by just tapping the product to the device. This paper proposes ways of entering data into a grid by just tapping any device to a product, whose data otherwise needs to be manually entered into the grid.***

Keywords: NFC, Web Application, Data Entry, NFC Tags

1. Introduction

Near Field Communications (NFC) is a contactless, Wi-Fi-lite style tech that could already be in your smartphone. It's a short-range, low power wireless link evolved from radio-frequency identification (RFID) tech that can transfer small amounts of data between two devices held a few centimeters from each other. Unlike Bluetooth, no pairing code is needed, and because it's very low power, no battery in the device being read is required. By tapping your phone on a contactless payment terminal in a shop, train station or coffee shop is able to identify your account (and even your personal preferences, shopping habits and even your most frequently travelled route) and takes payment through an app on your phone. Passive NFC 'tags' on posters, in shops and on trains could contain a web address, a discount voucher, a map or a bus timetable that passers-by could touch their phones on to receive or to instantly pay for absolutely anything. Communication is possible between the device and the NFC chip, which is named "tag".

2. Theoretical Consideration

2.1 NFC (Near Field Communication)

Let's take an example if you have a laptop and cell phone equipped with NFC, then you can easily download data from Internet into your cell phone by simply touching your cell phone with laptop. Suppose you want to transfer a file from one laptop to another by using technologies, like Bluetooth or Wi-Fi. You need to manually set up the communication link between laptops. But if you are using NFC enabled laptops, then you may transfer the file by just touching both laptops. In another situation you may establish the link using NFC and once communication link is established Bluetooth or Wi-Fi can be used to transfer data. Advantage of using this method is to transfer larger data or continuing the communication session if devices are not in close proximity from each other [1].

NFC enables two way communications between electronic devices. And has the capability to write to the RFID (Radio Frequency Identification) chip. Therefore bidirectional communication between NFC-equipped cell phone and NFC reader can be established. That makes the possibility to develop complex applications like payment, secure exchange of data and identity's authentication [3]. NFC implements touching paradigm. Touching is a famous and interactive method in human lives. This makes NFC technology easy to learn and use. This touching paradigm was initially used in RFID (Radio Frequency Identification) technology. In RFID technology items marked with tags contain transponders which emit messages in the form of signals. RFID readers were used to read those messages. NFC is now integrated with RFID technology. The tags should have 4 to 10 byte unique ID. This unique ID is used for the identification of the tag. There are multiple manufacturers in the industry, so ID's length may vary in size [4]. NFC can read and write data on RFID chip. And RFID (Radio Frequency Identification) Chip can be embedded in everything starting from paper to machinery. RFID is manly used for tracking and identification through radio waves [04]. NFC core applications include connecting electronic devices, Accessing digital contents and making contactless transactions.

2.2 NFC Modes of Communication

Three modes of communication are defined by NFC forum.

- Read/Write mode
- Tag emulation mode
- Peer-to-peer mode

In read/write mode NFC phone can read or write to the tag. For example smart poster.

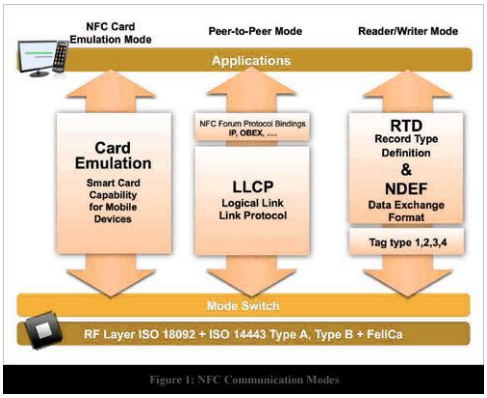

Figure 1: NFC Modes of Communication [14]

Contactless communication supports this mode [5]. While in tag emulation mode NFC phone acts like a smart card. For example, mobile as electronic wallet. Third mode is peer to-peer mode in which link level communication is established between two NFC phones. For example exchanging business cards.

Figure 2: NFC Communication Modes

2.3 NFC Modes of Operation

RF signal transmission between transmitter and receiver creates the main distinction between NFC and other RF wireless communication modes. NFC depends upon straight magnetic/electrostatic coupling between devices instead of freely broadcasting of radio waves, such as in Wi-Fi. NFC devices can operate on low electric or magnetic field strengths due to its short range communication property [6]. NFC system can operate either in active or passive mode depending upon requirements.

ECMA-340 is the standard which defines the modes of operation.

Table 1: ECMA-340 showing Magnetic strength

Field Level	*Field Strength*	*Description*
$H_{threshold}$	0.1875 A/m	Minimum field detection level
H_{min}	1.5 A/m rms	Minimum un-modulated field strength
H_{max}	7.5 A/m rms	Maximum un-modulated field strength

Active Mode

In this mode both devices generate RF (radio frequency) field to transfer data. In this situation any of the devices can be the initiator and other will be the target. While in passive mode, only one device generates the RF field and other uses load modulation to transfer data. In this situation initiator of the communication will generate field and target will use load modulation. During the communication, the initiator starts the communication in a particular mode at a specific speed. Target finds out the current speed and replies back to the initiator. Termination of the communication takes place either when two devices move out of the range or application gives command to terminate it [1].During communication either initiator or target generates RF field of level H min that does not go beyond the field level of H max[8].

Passive Mode

This mode has a key benefit for battery powered devices. For battery powered devices low consumption of battery is the basic priority. Thus NFC allows battery powered devices such as cell phones to operate in passive mode. In this mode RF field is generated on the other side. Thus battery power is saved that was needed to be used for generating RF field. In passive mode target operates continuously between Hmin and Hmax magnetic field strength [8]. NFC protocol is also compatible with connectionless smart card protocols like Felicia and Mifare. NFC device can work with both smart card and smart card reader. Another benefit of NFC device is that it can be used as smart card, as well as smart card reader [1].

Devices cannot change mode of communication (Active/Passive) during single transaction unless target is removed or deactivated. Even transfer speed of target to initiator and vice versa may not affect the change in mode [8].

2.4 NDEF

NDEF is simply the short form for NFC Data Exchange Format. It is a data format classified by the NFC forum in connection with the exchange of information among two devices, i.e. an NFC-enabled device and an NFC tag. NDEF presents rules in relation to the structure of a matching message, without limiting the types of information it contains. This permits the encapsulation of a large amount of varied data, such as images, URLs or XML files [16]. It nonetheless, does not include any NDEF transmission protocol. For this reason, the type of channel for the transmission of messages is also liberally selectable, similar to the sort of information it contains. An NDEF message is made of a series of NDEF records. Accordingly, the actual encapsulation of the data takes place in the individual NDEF records. Defined data formats that are commonly used, e.g. Uniform Resource Identifier (URI), Smart Poster, and Text are standardized by the NFC-Forum as Record Type Definitions (RTD) to allow interoperability of products coming from different vendors [16]. The size and type of data transmitted can be recognized by means of the header. This allows a resourceful analysis of the information enclosed in the records to be carried out. With the help of the NFC Forum, a number of various types of information have been identified.

2.5 NFC Stickers

These stickers are the alternative solution to NFC devices and contactless cards. They are self-adhesive and smaller in size, can fit on any device, like a cell phone. They are simple to use and have potential of gaining significant business benefits. For production and personalization standard they are following A1 credit card format standard.

2.6 How NFC Works

There are four ways how NFC works.

- Phone to phone
- Phone to device
- Phone to tag
- Phone to reader

Phone to Phone

In this category two cell phones equipped with NFC communicate with each other. They can transfer music files or pictures by just touching each other.

Figure 3: Phone to Phone NFC Transaction [8]

Phone to Device

Here NFC equipped cell phone can communicate with any device. For example, by just touching phone with NFC equipped printer can print the pictures stored in cell phone. Or by touching payment device can perform payment transaction.

Figure 4: Phone to Device Transaction [10]

Phone to Tag

Tag contains data. Normally tags are embedded on posters for marketing purpose. Cell phone is touched with tag and data from tag is transferred to cell phone. For example there is a tag on bus terminal which by touching cell phones transfers bus timings and other details.

Figure 5: Phone to Tag Transaction [10]

Phone to Reader

We can purchase and store electronic tickets on our cell phones. Cell phone can communicate with external reader by just touching it with reader. So one can purchase ticket easily instead of standing and waiting in a long queue

Figure 6: Phone to Reader Transaction [8]

2.7 NFC Application

NFC fall under three different categories upon its usage in different fields.

1- Service initiation category
2- Peer-to-Peer category
3- Payment and Ticketing category

Service Initiation

In this scenario functioning of NFC is the same as of RFID. NFC device reads some data from a tag and uses this information in several different ways. In this case tag serves as transponder, it could be a turned off cell phone. NFC device can read the data even if the cell phone is powered off. Example of such scenario can be the advertisement or information poster [12]. In this application NFC tag is fixed near information desk, user touches its NFC device with tag and retrieves the information. Suppose this tag is placed in university for guidance regarding study schedule of students. Whenever student wants to know his course schedule, he brings his NFC device close to NFC course tag and retrieves the information of his course schedule

Peer-to-Peer

In this application direct link between two devices is set up to transfer data. Amount of data may not be too large. If user wants to transfer large amount of data, Wi-Fi or Bluetooth connection can be set up, but that is invisible to user [12].

Figure 7: Peer-to-Peer data transfer [12]

Payment and Ticketing

In this scenario cell phone is used as electronic wallet. Nowadays we are using cards only for payments. But with NFC equipped device multiple functions could be collected under the same platform. Virtual money can be loaded in the cell phone that can be used to pay travelling tickets or parking fee [12].

Figure 8: Presenting e-ticket to machine [14]

3. NFC in Data Entry Tool

3.1 Proposed System

The architecture diagram with necessary components to obtain information of a particular product is shown in figure 9. The detail of how the real-time information from the product is acquired is explained below.

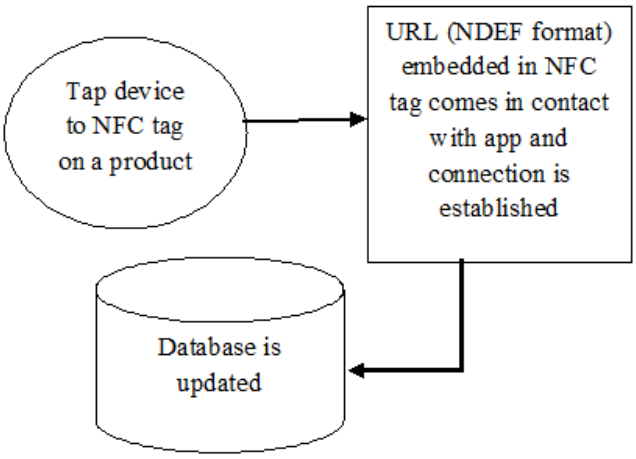

Figure 9: Process Flow

The URL of the user interface is embedded in the NFC tag using the NFC writer, we can use any phone having NFC to write and read the information from the NFC tag. The URL has to be stored in NDEF format to enable data exchange between NFC devices. After the encoding is done, the NFC tag is ready to be embedded to a product.

The data stored in the NFC tag has to be NDEF To encode our URL in to NDEF format and store it in a tag we use the NXP Tag writer android application. NXP Tag writer application fully supports the NFC Forum Type 1 Tag, Type 2 Tag, Type 3 Tag as well as Type 4 Tag portfolio. The application has to be downloaded and installed in the Smartphone. The following steps has to be followed to encode the URL in to the NFC tag

1) Open the NXP Tag writer application on your android device.
2) From the main menu select, create, write and store.
3) Type the URL that has to be stored in the NFC tag and click done button.
4) Select confirm overwrite from the list of options.
5) Just tap the NFC writer on the tag and the information is stored in the passive tag.

Just by doing a simple touch, NFC tag on the Product with the NFC enabled mobile phone, NFC device is initiating the connection with the passive NFC tag and the tag responds with a URL stored on it. This way connection is established. It is very simple, easy and convenient. The NFC enabled device is connected to the user interface and the user interface displays the information of the product

3.2 Advantages & Disadvantages

The implementation of this system would lead to easy data entry of product information into the web application instead of manually entering all the details of a product, it can now be done easily by just tapping a device to a tag.

NFC has several advantages over QR codes because to use a QR code, a business decides what they want the code to link to and uses a computer program to generate the image.

Printing the image onto advertisements or displays makes it available to the public. That's all there is to it. Yet if the business wants to change the link, they must generate and reprint a new QR code. The major advantage of NFC is its flexibility. Storing different types of information and changing it on a whim is possible without every creating a new NFC tag. The owner can simply overwrite the information currently on the tag and create new info. The second major advantage of NFC is its ease of use. With a QR code, the user must open a scanner app on their smartphone, hover over the QR code, and wait for the phone to analyze it and react to the code. With NFC technology, the user waves the phone near the NFC tag area and the information is transferred instantly. No need to open an app or wait for analysis. The tag and reader communicate with each other to complete complex transactions quickly and securely.

Some of the risks involved are Eavesdropping, Data Corruption and Manipulation, Interception Attacks, Theft. These can be reduced by ensuring use of secure channels; devices should be in an active-passive pairing. This means one device receives info and the other sends it instead of both devices receiving and passing information and lastly by installing a password or other type of lock that appears when the smartphone screen is turned on, a thief may not be able to figure out the password and thus cannot access sensitive information on the phone.

4. Conclusion

The paper describes NFC and its functioning in detail and a rough architecture required for enabling data entry into a web portal by just touching a device to a product with NFC tag or sticker on it. NFC compared to QR codes is cheaper and hassle free, because in order to change the content on the NFC tag reprinting of image is not required, a simple overwrite will do the job. Using this method of data entry even an illiterate person can save product information on to the database. A significant advantage of using this technique is the compatibility with existing RFID infrastructures. It would bring benefits to the setup of longer range wireless techniques such as Bluetooth. Though security concerns are present, they can be overcome through the use of various schemes such as setting up a secure channel that can provide confidentiality, integrity and authenticity, or having password based locks on your phone to prevent from thefts.

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Author Profile

Mrs. Dhanamma Jagli is an Assistance professor in V.E.S Institute of Technology, Mumbai, currently Pursuing Ph.D in Computer Science and Engineering and received M.Tech in Information Technology from Jawaharlal Nehru Technological University, Hyderabad and Andhra Pradesh. She has around 9 years teaching experience at the post graduate and under graduate level. She had published and presented papers in referred international journals and conferences. Her areas of research interest are Data Mining, Cloud Computing, Software Engineering, Data base Systems and Embedded Real time systems. She has been associated with Indian Society of Technical Education (ISTE) as a life member.

Ms. Annora Rodrigues is a final year student of Master of Computer Application (M.C.A) from Vivekanand Education Society's Institute of Technology (V.E.S.I.T), Mumbai University, Annora has completed her B.Sc. in Computer-science from SIES college of Arts, Science & Commerce; Mumbai University. She is an ardent programmer with an abiding interest in web application development and programming languages like C++, Java, PHP and .Net technologies.