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HAKI-NFC BASED ANDROID APPLICATION

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Abstract- News forms of interaction should be considered if we want to model intelligent environments. NFC stands for Near Field Communication. NFC is a relatively new wireless technology and is gaining popularity. Its short range is the reason for its success. Operating over only short distance gives a large degree of security. The concept of NFC near field communication is that the technology is able to provide a very easy method of providing connectivity between devices that are a few centimeters apart, and without the need for all the security and set-up procedures that are needed for many other communication technologies. Thus applications using NFC will be really intuitive to use. Mobile devices have started integrating NFC capabilities into them. Nokia 6131 was the first handset to be introduced which included NFC capability. Now with increasing popularity of NFC, Android included its support for NFC with its 2.3.3 version. The major focus of this paper is developing android application(HAKI) based on NFC such as Smartposters, Attendance monitoring and helping visually impaired which targets wide range of audiences.

Keywords - NFC Forum, RF field, Smart Poster, Service Initiation, Tags.

I. INTRODUCTION

One of the advantages of NFC over other wireless technologies is simplicity. Transactions are initialized automatically after touching a reader, another NFC device or an NFC compliant transponder.

NFC is short range wireless technology with range of 10 cm theoretically ,practically being 4cm. NFC standard supports different data transmission rates such as 106kbps, 212 kbps, and 424 kbps. NFC requires no discovery and pairing. Another advantage of installing NFC software in your cell phone is that it consumes less power than Bluetooth. Smart phone users are greatly attracted to NFC technology as they can get another latest application in their NFC Phones that can bring more convenience in the way they operate things.

A. Reasons to choose NFC

- 1) It helps bridging Physical and Virtual worlds together:

With NFC you can bring two devices together and it will trigger a virtual reaction. So for a Physical action we have a virtual reaction. This is kind of new and is not included in any other wireless technology. Unlike Wi-Fi and Bluetooth the user does not have to pair or perform other set-up procedures.

- 2) NFC is somewhat similar to QR codes but the degree of interactivity and speed is high.

It doesn't matter to where you are or what application you are running in your phone, when you tap your phone to the tag it will take you the appropriate application required to run the data stored in the tag. This is what makes NFC better than QR codes.

- 3) Open and standards-based:

The underlying layers of NFC technology follow universally implemented ISO, ECMA, and ETSI standards.

- 4) Inherently secure:

NFC transmissions are short range (from a touch to a few centimeters)

- 5) Interoperable:

NFC works with existing contactless card technologies

B. Key Concept

- 1) Tag

The tag is just a thin device containing antenna and small amount of memory. It is a passive device. Depending on the tag type the memory can be read only, re-writable, and writable once. The NFC tags can be used within applications such as posters, where small amounts of data can be stored and can be sent to NFC devices. The data stored on the NFC tag may contain any form of data such as URL, phone number and text. In fact, any mime data type can be stored in NFC Tags.

- 2) Tag Types

A wide variety of NFC tags exist. However, this is a list of standard specification by the NFC Forum. To be NFC Forum-compliant the tags have to follow these specifications.

NFC Forum Type 1 Tag Operation Specification^[1].
Type 1 tag is based on ISO14443A. Tags are read and

re-write capable; users can configure the tag to become read-only. Memory availability is 96 bytes and expandable to 2 Kbyte; communication speed is 106 Kbit/s.

NFC Forum Type 2 Tag Operation Specification^[2]. Type 2 tag is based on ISO14443A. Tags are read and re-write capable; users can configure the tag to become read-only. Memory availability is 48 bytes and expandable to 2 Kbyte; communication speed is 106 Kbit/s.

NFC Forum Type 3 Tag Operation Specification^[3]. Type 3 tag is based on the Japanese Industrial Standard (JIS) X 6319-4, also known as Felicia. Tags are pre-configured at manufacture to be either read and re-writable, or read-only. Memory availability is variable, theoretical memory limit is 1MByte per service; communication speed is 212 Kbit/s or 424 Kbit/s.

NFC Forum Type 4 Tag Operation Specification^[4]. Type 4 tag is fully compatible with ISO14443A and B standards. Tags are pre-configured at manufacture to be either read and re-writable, or read-only. Memory availability is variable, up to 32 Kbytes per service; communication speed is up to 424 Kbit/s.

C. Tag Shapes

There is variety of shapes of NFC Tags available. They can be rectangular, circle or custom made. Some of the tags are washable also so that they can be attached to clothes. Some of them are in form on cards. Some tags can be used as stickers.

D. NDEF Format

NFC Forum Data Exchange Format is a lightweight binary message format designed to encapsulate one or more application-defined payloads into a single message construct^[5]. Its light weight because it doesn't include significant overhead. An NDEF Message can encapsulate one or more NDEF Record. The size of NDEF record can be of up to $2^{32}-1$ octets in size. NDEF record can be chained together to contain larger payload size. NDEF Records contain three parameters for describing its payload. They are

1. Payload length: It describes the number of octets the payload contains.
2. Payload Type: It indicates the Type of payload encapsulated. NDEF supports URIs, MIME media type constructs, and an NFC-specific type format as type identifiers. Indicating the type of payload helps to dispatch the payload to the appropriate user application.
3. Payload Identifier: It is optional and enables payloads that support URI linking technologies to cross-reference other payloads.

Fig. 1 : NDEF Message Construct

Existing issue :

There are over 5 billion tags deployed which do not contain the NDEF format.

1. Transit
2. Credit cards
3. Passports
4. Physical access cards

So the systems which are to be developed should consider the legacy tags and support them because they are already being deployed. However if you can control the tag which will be developed it will be better use NDEF tags because they are standardized by the NFC Forum.

Moreover the QR codes which involves tedious method to go to a particular website can be easily replaced by Smartposter which will direct user to the site just by touch

E. Reader

The reader is an active device, which generates radio signals to communicate with the tags. The reader powers the passive device in case of passive mode of communication. The reader/writer can be a dedicated NFC reader/writer or NFC enabled phones.

F. Communication modes

NFC devices support two communication modes.

1) Active

In this mode, the target and the initiator devices have power supplies and can communicate with one another by signal transmission.

2) Passive

In this mode, the initiator device generates radio signals and the target device gets powered by this electromagnetic field.

G. Operating modes

NFC devices can operate in three different modes.

1) Read/Write

In this mode, the NFC enabled phone can read or write data to any of the supported tag types in a standard NFC data format.

2) Peer to Peer

In this mode, two NFC-enabled devices can exchange data. For example, you can exchange data such as virtual business cards or digital photos.

3) Card Emulation

In this mode, the phone can act as a tag or contactless card for existing readers. This mode can be used for mobile payments or booking tickets etc.

H. Smart Poster

Smart poster is just like an ordinary poster with some interaction capabilities, where NFC tags are placed in the backside of the poster under each hot spot. Each tag contains a piece of data in the NFC data format known as smart poster.

II. LITERATURE SURVEY

NFC is an emerging technology because of its promising growth and thus has become a topic of interest for academic research. The entire research framework has been divided into four categories^[7].

Fig. 2 : NFC research framework^[7].

A. NFC Theory and development

The most fundamental aspects related with the development of NFC falls under this section. "Overviews, Context and Foundations" deals with general introductions, assessment, reviews and standards etc. "Policy, Legal and Ethical Issues" includes legal requirements, security and privacy issues etc. Such kind of paper focuses on behavioral aspects.

B. NFC Infrastructure

These are intermediate level. "Network and communications" deals with new protocols, data and communication aspects. "Tags, Antennae, Readers and NFC Chip" deals with the hardware aspects. "Security and Privacy" deals with CIA principles, Non Repudiation and other possible vulnerabilities.

C. NFC Application and Services

These include various NFC applications or services that can be developed from NFC infrastructure available. Industry and developers around world focus more on this part. The 3 modes of NFC communication fall under this category. "Read/Write" to read and write data from/to NFC

tags. "Peer-to-peer" mode allows establishing communication link between two active devices. "Card-emulation" mode which makes smart phones behaves like credit cards or smart cards etc.

D. NFC Ecosystem

This is the highest level NFC Research framework. "NFC Economics and Strategy" and "NFC Business Models and Processes" deal with the business requirements and managerial aspects of the NFC Technology. "NFC Stakeholders, Structure and Culture" deals with more of social aspects. They deal with User Acceptance, Reliability and maintainability etc.

III. SCOPE

The main concentration of our project is to build an application with the Read/Write mode of NFC.

IV. PROPOSED SYSTEM

The proposed system will be using the passive communication mode and Read/Write operation modes and will be developing an General Android applications. Our project concentrates on main three applications of NFC as follows:

A. Smartposter

A SmartPoster can be used in many ways. By touching an NFC-enabled mobile phone against the NFC tag embedded in the poster, the user may be directed to a web site for further information or to book tickets without the need to key anything into the phone to open the browser or input the URL. The service initiation use case requires two devices to communicate using NFC, one device is an NFC reader/writer and the other a passive NFC tag. This can be efficiently used for marketing purpose. For e.g. a movie poster can have a NFC sticker stacked on it. This Sticker will contain movies trailers streaming link. All that a user has to do is to tap his phone onto the sticker and will have the trailer playing in his phone. Same can be used with some URL for promoting your organization etc. One can have Contact No. embedded into a NFC can and used it as VCard. So that call to your no will be placed instantly or your contact information will be stored by tapping phone once on the Vcard. HAKI will be providing not only read functionalities but also write ones, so that one can write his own data onto tag and use it as required by him/her.

How it will work?

1) Read

Basically the tags will have some data written onto it (Text, URI, or any other mime type). This data can be written in NDEF Format or any other format. The basic aim is that user shouldn't have to click once or to input anything but he/she should be redirected to

the appropriate application based on the data written. Android's intent filter mechanism will be used for delivering the tags content to appropriate activity. Android provides a special tag dispatch system that analyzes scanned NFC tags, parses them, and tries to locate applications that are interested in the scanned data. It does this by:

- Parsing the NFC tag and figuring out the MIME type or a URI that identifies the data payload in the tag.
- Encapsulating the MIME type or URI and the payload into intent.
- Starts an activity based on the intent.

Fig. 3 : Tag Dispatch System^[8].

Starting an Activity based on Intent

When the tag dispatch system is done creating intent that encapsulates the NFC tag and its identifying information, it sends the intent to an interested application that filters for the intent. If more than one application can handle the intent, the Activity Chooser is presented so the user can select the Activity. The tag dispatch system defines three intents, which are listed in order of highest to lowest priority.

ACTION_NDEF_DISCOVERED intent is used to start an Activity when a tag that contains an NDEF payload is scanned and is of a recognized type. This is the highest priority intent, and the tag dispatch system tries to start an Activity with this intent before any other intent, whenever possible.

ACTION_TECH_DISCOVERED this intent is used if no activities register to handle the **ACTION_NDEF_DISCOVERED** intent, the tag dispatch system tries to start an application with this intent. This intent is also directly started (without starting **ACTION_NDEF_DISCOVERED** first) if the tag that is scanned contains NDEF data that cannot be mapped to a MIME type or URI, or if the tag does not contain NDEF data but is of a known tag technology.

ACTION_TAG_DISCOVERED this intent is started if no activities handle the **ACTION_**

NDEF_DISCOVERED or **ACTION_TECH_DISCOVERED** intents.

In more simple words, the tag dispatch system works is as follows

Try to start an Activity with the intent that was created by the tag dispatch system when parsing the NFC tag (either **ACTION_NDEF_DISCOVERED** or **ACTION_TECH_DISCOVERED**).

If no activities filter for that intent, try to start an Activity with the next lowest priority intent (either **ACTION_TECH_DISCOVERED** or **ACTION_TAG_DISCOVERED**) until an application filters for the intent or until the tag dispatch system tries all possible intents.

If no applications filter for any of the intents, do nothing.

2) Write

Data written onto tag by HAKI is always in NDEF Format. Three Different options will be presented to user for writing contact, URL or plaintext(Fig. 4.2).

Fig 4.1 : Main Menu

Fig. 4.2 Write Menu

Fig. 4.3 : Write Contact

Fig 4.4 : Write Contact to Tag

Fig. 4.5 : Write URL

Fig. 4.6: Write URL to tag

Fig. 4.7 : Write Plaintext

The Basic Principle for Writing to a Tag will be to encapsulate the bytes of data into a NdefRecord first. e.g.

For a record containing text

- (1) `NdefRecord record = new NdefRecord(NdefRecord.TNF_WELL_KNOWN, NdefRecord.RTD_TEXT, new byte[0], data);`
After this the NdefRecords thus created are encapsulated into NdefMessage.
- (2) `NdefMessage textMessage = new NdefMessage(new NdefRecord [] {record});`

This NdefMessage is then written onto tag through radio waves when tag and phone is within a range of 4cm. For information on types of NdefMessage that can be written refer ^[8].

B. Helping Visually Impaired

HAKI will help visually impaired people with an intuitive way to select objects. HAKI will make the retail experience more accessible and simple for blind and partially sighted. Using phones it will help them get product information — including the name of a product, its price and details of what it contains in voice based description form— by reading an NFC

tag. HAKI can also be used at home where NFC stickers can be stacked to medicine, syrups, CD's etc. So that,

How Will It Work?

NFC tag will be containing text information regarding object description.

For example- "Product Name: Music CD

Quantity: 1

Price: 150 Rupees"

"Product Name: HP Laptop

Processor: AMD turion

RAM: 4GB

Price: 40,000 Rupees"

Huge information can be written as the tag memory size is available in different sizes.

server side there is a combination of PHP Script and MySQL.

Fig. 5 : Connecting to Remote Database^[9].

Now with the help of HAKI, when the mobile is brought near the tag, android's tag dispatch system again does it works as discussed above. The activity which is supposed to handle this intent is has its intent filter as shown

```
<intent-filter>
```

```
<action
```

```
android:name="android.nfc.action.NDEF_DISCOVERED"/>
```

```
<data android:mimeType="text/plain" />
```

```
</intent-filter>
```

Mime type specifies the activity to start only if the tag contains text data. How Tag Data is read is already discussed in section 4.1.2. After detecting the tag, instantly the textual information is processed and converted into speech with the help of android text-to-speech engine^[8]. Then the phone will just read out the product description on simply tapping the phone to the tag.

C. Monitoring the attendance of employee

Employees I.D. card will be containing his name and I.D. This information can be used to mark his attendance. All that an employee has to do is to tap his phone (or I.D. Card) on NFC reader. His I.D. will be read and will be used to mark his attendance. Again the principle of reading from tag will be same as section 4.1.2. The attendance database will be stored on a remote server. PHP will be used as middleware. The remote database will be that of MySQL.

Once Name and I.D. is read by using NFC, appropriate Activity will be launched by Android Tag Dispatch System as discussed in section 4.1.2. This Activity will be used for connecting to remote database and updating it. The main reason for taking a scripting language like PHP is because of the interaction with databases it can offer. For making connection to PHP script, we will use HTTP protocol from the android system. If we talk about client-server architecture, client is Android device and in

V. DESIGN

Fig. 6 : Architecture Diagram.

A. NFC Hardware

NFC chips are basically embedded in mobiles which will have an antenna acting as an initiator. NFC chip is mostly supplied by NXP Company to mobile manufacturers such as Samsung. CPU is the processor in the mobile which supports the NFC chip.

B. NFC Software

The android phone should support android 2.3.3 (Gingerbread) operating System. Android 2.3.3 provides improved and extended support for NFC, to allow applications to interact with more types of tags in new ways. A new, comprehensive set of APIs give applications read and write access to a wider range of standard tag technologies. The NFC API is available in the android.nfc and android.nfc.tech packages.

C. NFC Basic Classes

This layer will typically contain basic classes responsible for reading from and writing to NFC Tags.

D. NFC Applications

This will be the applications containing all the Graphical User Interface for Smartposter, Helping Visually Impaired System and Attendance Monitoring system. All the Above blocks will be the base to design the applications.

VI. USE CASE DIAGRAM

Fig. 7 : Use Case Diagram For Entire System.

VII. CONCLUSION

- A. NFC can be used extensively for the betterment and ease of human life.
- B. HAKI can be used as an efficient marketing tool.
- C. HAKI can also be employed effectively for helping the physically challenged.
- D. HAKI is used for Marking attendance..

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