Acta Technica *62* (2017), No. 4A, 785–792

Design of anti-counterfeiting authentication solution based on near field communication technology

Hui Jiang[2]

Abstract. The comparison of the present anti-counterfeiting and authentication methods in the commodity market, based on Near Field Communication (NFC) technology, this author puts forward a relatively complete anti-counterfeiting and authentication system plan, and designs the basic process of anti-counterfeiting and authentication, the key technologies involved in the implementation of the scheme is described. With NFC tag as the information carrier, mobile phone NFC device as a NFC tag reader, together with application system of authentication center, the system can be used as a tool to test the authentication of commodities and may have inspiration and significant reference on commodity anti-counterfeiting and authentication for enterprises.

Key words. Anti-counterfeiting, NFC, electronic tag, near field communication, authentication.

1. Introduction

With the rapid socio-economic progress of China in recent years, the producing, processing and selling of fake and shoddy commodities have emerged in many industries, which leads to increasingly rampant circulation of fake and shoddy commodities on market, severely damages the interest and security of consumers, enterprises and state, causing enormous destruction and threat to the healthy development of socio-economy. Therefore, it has become a urgent task for enterprises and governmental sectors to trace the source of good, certify and distinguish commodities and prevent circulation and sale of fake and shoddy commodities on market using

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[2]Workshop 1 - Department of Computer Science and Technology, Tianjin University Renai College Addresse: Boxueyuan,Tuanbo New City,JinghaiDistrict,Tianjin,China; e-mail: jianghui_nudt@163.com

information technology.

Currently, the frequently used anti-counterfeiting technologies on market include barcode anti-counterfeiting technology, optical anti-counterfeiting technology, biological anti-counterfeiting technology, material anti-counterfeiting technology, printing anti-counterfeiting technology, etc. All these conventional technologies lack of uniqueness and exclusivity and are easily to be mastered and copied, which cannot achieve sound anti-counterfeiting performance in current commodity circulation field[1].

2. Overview of NFC technology

NFC is short for Near Field Communication, which is jointly developed by Philips and SONY. Being developed by integrating RFID (Radio Frequency Identification) and interconnection technique, NFC is a non-contact recognition and interconnection technology, which can be used to realize near field communication among mobile devices, consumer electronics, personal computers and various smart devices. NFC chip integrates inductive card reader, inductive card and point-to-point function, which can realize the function of compatible device recognizing and data interchange processing within short distance.

Three major operation modes of NFC device

(1)Read/write mode: under such mode, it is capable of reading any support tags by opening devices (a mobile phone) with NFC function.

(2)Point-to-point mode: under such mode, data can be exchanged between two NFC devices in a way that is similar to Bluetooth point-to-point data transmission.

(3)Card simulation mode: under such mode, the NFC-supported device (a mobile phone) plays a role of card reader in exchanging information with commodity tag, i.e., allowing the NFC chip of the mobile phone to become any compatible standard card.

3. Demand analysis of anti-counterfeiting and authentication

This paper proposes a NFC-based method to distinguish the authenticity of commodities. NFC tags can store various types of information, therefore the consumers can read and write the information stored in NFC tags using a smart phone with built-in NFC chip. This anti-counterfeiting scheme mainly consists of three parts.

3.1. Initialization of NFC tag information

Each NFC tag has a an exclusive id, the supplier for anti-counterfeiting and authentication service adopts specific encryption algorithm to obtain a key corresponding to each id, and the write such key to NFC tag; meanwhile, the NFC tag id and corresponding key are recorded in the database of authentication center.

3.2. Initialization of commodity information

Commodity producers write commodity information into NFC tags using the app provided by the suppliers of anti-counterfeiting and authentication service. The whole process is to write the information into NFC tags via NFC chip of smart phone, as shown in Fig.2.

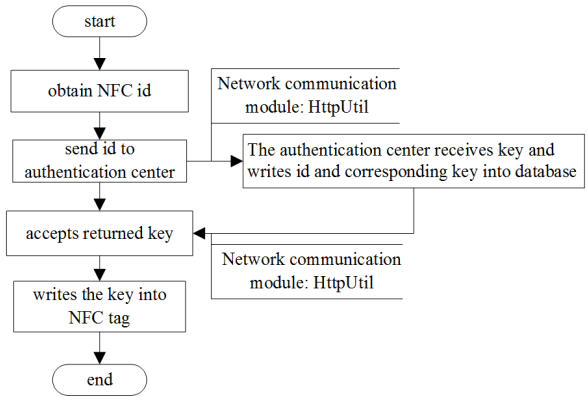

Fig. 1. initialization flow of NFC tag information

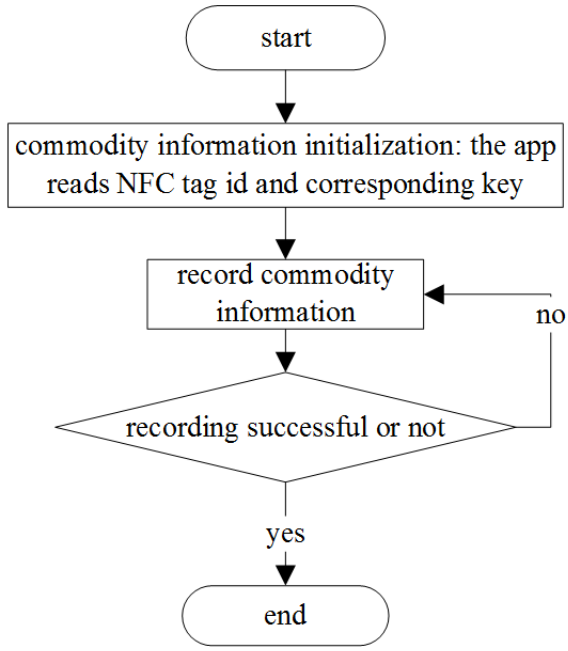

Fig. 2. initialization flow of commodity information

3.3. Anti-counterfeiting and authentication process

The consumers read the information in NFC tag of commodities use anti-counterfeiting and authentication app. Then the data is sent to authentication center via network communication module. Finally, the authentication results are responded to consumers' app end using authentication processing module.

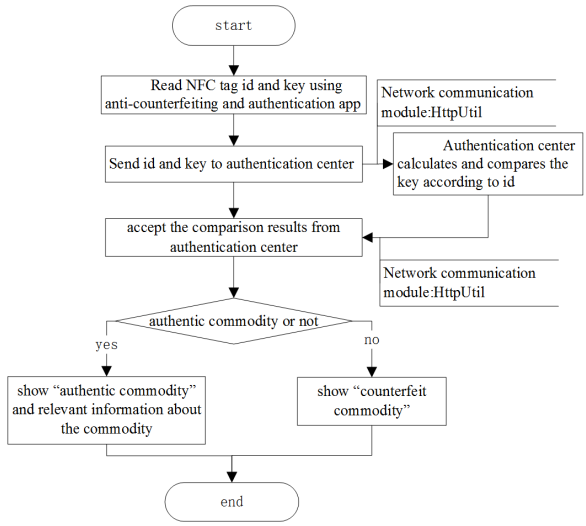

Fig. 3. flow of anti-counterfeiting and authentication process

4. Technical specification for implementation of anti-counterfeiting and authentication scheme

4.1. app design based on Android platform

The API of Android platform provides strong support for NFC technology. The developer can conveniently and freely develop NFC software using these API and install them in Android phone with built-in NFC chip for operational testing. One of main functions of the app is to interact with NFC tag and perform reading and writing of NFC tag information. The descriptions for app to implement key steps are shown as below:

Step1:make declaration to use NFC in the configuration file of the app

```
<uses-feature
android:name="android.hardware.nfc"
android:required="true" />
<uses-permission android:name="android.permission.NFC" />
```

Step 2:make declaration to recognize NFC tag in Activity tag

```
<activity android:name=".Activity.Main.ReadActivity">
<intent-filter>
```

<action android:name="android.nfc.action.TAG_DISCOVERED" />
<category android:name="android.intent.category.DEFAULT" />
<data android:mimeType="*/*" />
</intent-filter>
</activity>

Step 3: acquire tagid[2] (As byte array was directly obtained, for the convenience of text data storage, byte array should be converted into hexadecimal character string)

4.2. Structural design of NFC tag data

To guarantee quick, smooth, orderly and correct RW data and thus realize the whole process of commodity anti-counterfeiting and authentication, reading and writing the data stored in tag are needed. Therefore, the tag data are recommended to be described in XML language in this proposed scheme. XML language is a meta language allowing users to customize the markup language and enjoys sound structure and scalability, which can be used to mark data, define data type and meet the requirement for describing and storing tag data. The structure of xml file storing NFC tag data is shown as below:

<xml version="1.0" encoding="utf-8">
<nfc>
<id>0X53062EF5</id>
<key>0X0001020304050608</key>
<product>
<name>productName</name>
<type>productType</type>
<desc>product_description</desc>
</nfc>

4.3. read-write operation of NFC tag information

NFC tag data are stored in XML file. It is more convenient to describe, store and manage text information using XML fixed tag node. Currently, techniques of analyzing and constructing XML file are well developed, including DOM(Document Object Model)analytic technique and SAX(Simple API for XML)analytic technique[3].

As in the design of this anti-counterfeiting and authentication scheme, small data are stored in NFC tag, the number of nodes is small, and specific nodes of XML file are needed to read and write, DOM technique is more suitable for analysis and construction of NFC tag data.

Table.1 Comparison of DOM and SAX

DOM analytic technique	SAX analytic technique
constructing file tree in internal storage, which is not suitable for processing large xml file	Successively read in file and generate corresponding event, which is suitable for process xml file in all sizes.
freely access to any part of file	being only able to analyzing file once according to certain sequence, not able to freely access to file
freely modify file tree and thus modify xml file structure	only read xml file, not modify xml file
easy to understand and develop	It more difficult to develop, requiring developer to define event processor
file tree is established on the basis of DOM	It is flexible to develop, xml objective model can be established using SAX

The flow path for analyzing XML file using DOM technique is shown as follow:
(1)Invoke newInstance() to construct the factory of DOM resolver
DocumentBuilderFactory factory=
DocumentBuilderFactory.newInstance();
(2)Invoke the newDocumentBuilder()to obtain DOM resolver object??
DocumentBuilder builder =
factory. newDocumentBuilder();
(3)Invoke the parse() method of DOM resolver to analyze XML file, obtaining the Document objective representing the whole file, so as to operate the whole XML file using DOM feature.
Document doc = builder.parse(InputStream is);

4.4. Design of network communication module

The network communication module HttpUtil[4] is mainly responsible for providing the network communication service for app and authentication center, which can be realized by HttpURLConnection and Java I/O technique. Here below are partial reference codes:

```
public String sendRequest(Map<String??String>params, String servlet, String
encode) {
StringBuffer buffer = new StringBuffer();
if (null != params&& !params.isEmpty()) {
for (Map.Entry<String, String>entry:params.entrySet()){
buffer.append(entry.getKey()).append("=").append(URLEncoder.encode(entry.getValue())).ap
}
buffer.deleteCharAt(buffer.length() - 1);}
url = new URL(serverURL + servlet);
HttpURLConnectionconnnection=(HttpURLConnection)url.openConnection();
connection.setRequestMethod("POST");
byte[] data = buffer.toString().getBytes();
OutputStreamoutputStream = connection.getOutputStream();
```

```
outputStream.write(data);
outputStream.close();
if (200 == responseCode)
result = changeInputStream(connection.getInputStream(), encode);
return result;}
private String changeInputStream(InputStreaminputStream, String encode) throws
Exception {
ByteArrayOutputStreamoutputStream = new ByteArrayOutputStream();
byte[] data = new byte[1024];
intlen = 0;
String result = "";
if (null != inputStream) {
try {
while ((len = inputStream.read(data)) != -1) {
outputStream.write(data, 0, len); }
result = new String(outputStream.toByteArray(), encode);
}catch(Exceptione) {throw new Exception(e.getMessage());} }
return result; }
```

4.5. Design of authentication center

The authentication center is the core of the whole system, which concerns the normal operation of whole anti-counterfeiting and authentication process, and affects its accuracy and reliability.

In authentication center, following aspects of work should be fulfilled.

(1)The database and data sheet of authentication center should be designed for storing NFC tag id and corresponding key. When there is a need to authenticate the identity of producer, hardware device and personnel for storing producer information and commodity initialization information are also needed; to enhance NFC tag data reading and quickly finish service logic processing, the commodity information can also be stored in authentication center, to be correlated with tag, as shown in Fig.4.

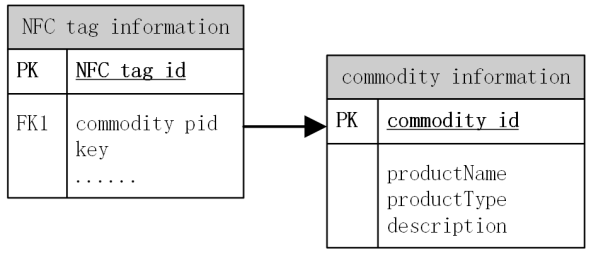

Fig. 4. E-R model for NFC tag information and commodity information

(2)Methods for completing various types of service logic operation

```
public byte[] getKey(final byte[] id) //Retrieve the key according to NFC tag id
publicbooleanaddNFC(final NFC nfc) // add NFC tag information
publicbooleaninitProduct(final Product product) //initialize commodity infor-
```

mation

public String generateKey(final byte[] id) //calculate the key according to NFC tag id

publicbooleanisEquals(final byte[] id, final byte[] key) //judge whether the keys are equal.

5. Conclusion

This paper presents comparative analysis of different conventional anti-counterfeiting and authentication methods, summarizes main features and advantage of NFC technique as well as relevant technical specification. On this basis, this paper proposes a commodity anti-counterfeiting and authentication scheme based on NFC technique, designs complete flow process of anti-counterfeiting and authentication, and gives analysis and description on implementation of such scheme. However, this proposed scheme is still subjected to defects, for example the network communication quality and the anti-decryption of key calculating method should be further improved and researched before achieving the real anti-counterfeiting and authentication function. In addition, the popularization of smart phone with built-in NFC chip and NFC tag cost should be further developed and promoted in China, which requires joint collaboration of commodity producers, smart phone producers, governmental sectors, and consumers.

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Received November 16, 2016