International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 11 | Nov -2016 www.irjet.net p-ISSN: 2395-0072

Design and Implementation of Electronic Pedigree in RFID-Based Anti-Counterfeiting System

Dr.T.Pandikumar[1], YirgalemHailu[2], Mohammed Abderehman[3]

[1]Ph.D. Department of Computer & IT, College of Engineering, Defence University, Ethiopia
[2]M.Tech. Department of Computer & IT, College of Engineering, Defence University, Ethiopia

---

Abstract -Counterfeiting is the illegal production and sale of goods, including packaging, bearing without authorization a trademark which is identical to a valid registered trademark or which cannot be distinguished from such a trademark. Product counterfeiting is an ever increasing problem that affects trademark and brand owners, governments, as well as consumers.RFID, which stands for Radio Frequency Identification, is a term that describes a system of identification. RFID is based on storing and remotely retrieving information or data as it consists of RFID tag, RFID reader and back-end Database.With the growing popularity of Internet connection through phone networks and RFID-enabled cell phones coming into market place, the system allows consumers to check the pedigrees of the products they are purchasing.The anti-counterfeiting mechanism is based on the track-and-trace approach with an extra feature that enables end-consumers to verify the products through their own mobile phones. In this work, android application is used to test the system functionality through which end-users can access e-pedigree from the site.

Key words: Anti-counterfeiting, EPC, e-pedigree, RFID,Tag ID, Android apps.

1. INTRODUCTION

In today's global marketplace there is an increasing threat that physical products are not what consumers and end-users think they are [13].Counterfeiting of branded and trademarked products is an industrial-scale problem that continues to affect industries and societies alike, harming legally run businesses and their clients.

The most serious cases of product counterfeiting are those where a substandard counterfeit product is consumed or used unknowingly by a deceived consumer or end-user. These cases are referred to as deceptive counterfeiting and they can expose the involved consumers and end-users to health, safety, or security risks. Deceptive counterfeiting is especially dangerous when it targets security-relevant products such as car or airplane spare parts, food and beverages, and pharmaceuticals. These products need to conform to adequate quality and safety standards, but counterfeit products do not provide such guarantees. For example, counterfeit drugs might have no active ingredients at all, an insufficient or excessive quantity of the active ingredient, or the wrong active ingredients, and are repeatedly responsible for lost lives, especially in the third world countries [13].

1.1 Statement of the Problem

Product counterfeiting is an ever increasing problem that affects trademark and brand owners, governments, as well as consumers. Counterfeit players work to get a return on investment for their illegal actions. Furthermore, in more dangerous forms of product counterfeiting, the fake products are injected into the licit distribution channel and sold as genuine articles. While potentially risking the health and safety of consumers, in this way the counterfeiters can sell their articles in higher prices for higher profits.

Manufacturing enterprises face tough competition in an increasingly globalized market with increased regulatory scrutiny and requirements in recent years. To survive, they need to deliver safe products with the right parts in the right place at the right time [18].

Tags without a secure authentication mechanism can practically communicate with any readers, regardless of their trustworthiness. Unencrypted communication between tags and readers may also be sniffed by an adversary. Leakage of sensitive information could possibly be used to produce counterfeit tags or readers, although this is considered impractical in the protected supply chain environment because the adversary devices have to be close enough to the genuine readers and tags. Therefore, this is more than a privacy concern to the end-consumers [16].

2. COUNTERFEITING AND ITS EFFECTS

2.1 Definitions and Terminology

Counterfeiting is ultimately an infringement of the legal rights of an owner of intellectual Property. The Agreement on Trade-related Aspects on Intellectual Property Rights (the TAIPRs Agreement) defines counterfeiting and piracy as follows:

2.2 Negative Effects of Product Counterfeiting

The first argument for further research on anti-counterfeiting is that product counterfeiting is all in all a harmful practice. Various reports and scholarly publications discuss the negative effects of product counterfeiting on brand and trademark owners, consumers, and the affected economies as a whole (OECD, 1998; Staake, 2007; OECD, 2007; Harper et al., 2006).

2.3 RFID and How it Works

Radio Frequency Identification technologies provide a wireless means of communication between objects and readers. Radio frequency identification (RFID) involves the use of tags, or transponders, that collect data and manage it in a portable, changeable database. Unlike bar codes, RFID has the ability to identify and track products and equipment in real-time without contact or line-of-sight and the tags can withstand harsh, rugged environments.

The radio frequency identification market is already a multi-million dollar industry and the applications of smart chip technologies are limitless. The transportation, agriculture, and manufacturing industries have all been affectively utilizing radio frequency technology for several years in applications such as toll collection, cattle tracking, and automobile manufacturing, respectively. Presently, retail industries believe they can reduce costs and increase revenues with better supply chain management [11].

Although the foundation of the Radio Frequency Identification (RFID) technology was laid by past generations, only recent advances opened an expanding application range to its practical implementation. RFID is only one of numerous technologies grouped under the term Automatic Identification (Auto ID), such as bar code, magnetic inks, optical character recognition, voice recognition, touch memory, smart cards, biometrics etc. Auto ID technologies are a new way of controlling information and material flow, especially suitable for large production networks [5].

RFID technology can be used for item tagging and identify each individual item. It also allows a unique serial number product authentication to be implemented. For Bluetooth technology, it is used for data transaction purpose. The RFID technology will involve reader, antenna, and tag. The reader will acts like a transmitter and receiver which will communicate with the tag and personal computer. Each tag will carry a unique tracking identifier coding. Thus, with the item tagged with RFID tag and passing through the RFID reader, the specific item will be easily recognized and their location identified [10].

2.3.1 Basic Components of an RFID System

1. The RFID system consists of following five components.
2. Tag (attached to an object, unique identification).
3. Antenna (tag detector, creates magnetic field).
4. Reader (receiver of tag information, manipulator).
5. Communication infrastructure (enable reader/RFID to work through IT infrastructure).
6. Application software (user database/application/ interface).

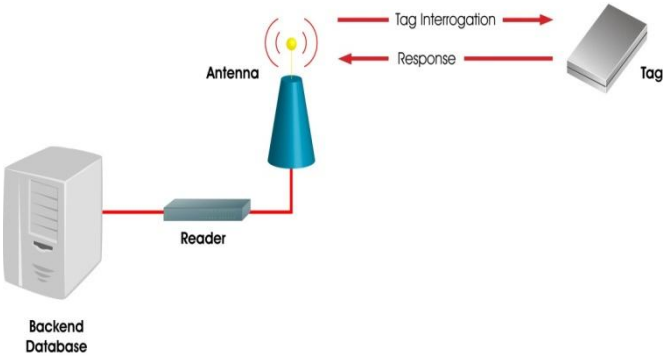

Figure 1: RFID system structure

RFID systems consist of three components in two combinations: a transceiver (transmitter/receiver) and antenna are usually combined as an RFID reader. A transponder (transmitter/responder) and antenna are combined to make an RFID tag. An RFID tag is read when the reader emits a radio signal that activates the transponder, which sends data back to the transceiver.
A basic RFID system consists of three components:

1. An antenna or coil
2. A transceiver (with decoder)
3. A transponder (RF tag) electronically programmed with unique information

2.3.1.1 RFID Tags

There are two types of transponders, which correlate to the two major types of RFID tags.

1. Passive transponders and RFID tags have no energy source of their own, relying on the energy given off by the reader for the power to respond. Cheaper, passive RFID tags are the most likely to be used for consumer goods.
2. An active transponder or tag has an internal power source, which it uses to generate a signal in response to a reader.

They can communicate over miles like ordinary radio communications. They are commonly used in navigation systems for commercial and private aircraft.

2.3.1.2 RFID Readers

Interrogator Depending on the application and technology used, some interrogators not only read, but also remotely write to, the tags. For the majority of low cost tags (tags without batteries), the power to activate the tag microchip is supplied by the reader through the tag antenna when the tag is in the interrogation zone of the reader, as is the timing pulse these are known as passive tags.

Middleware is the interface needed between the interrogator and the existing company databases and information management software.

2.4 Comparison of Barcodes (Popular anti-counterfeit) Vs RFID

As technologies advance and merge, it can be harder to distinguish between seemingly similar types of product identification functions. Take for example **RFID and barcode**labels, which appear to be interchangeable terms in many ways. Not necessarily. Below is a list of differences between RFID and barcode labeling to provide a clearer picture about each process and how they are different even though they both help to track products and shipments [11].

2.4.1 Barcode Labeling

1. Barcode is an older type of technology and is commonly used on items purchased in a retail store. A retailer scans the barcode affixed to an item, which is then recorded as sold and removed from inventory.
2. The information is stored on a piece of paper affixed to the article being scanned.
3. The actual barcode is made from the creation of vertical printed material in a pattern that lets it be read by an optical device.
4. The barcodes can be challenging to read so it sometimes takes longer to complete the scanning and tracking process at point of purchase [11].

2.4.2 RFID Labeling

1. Short for Radio Frequency Identification, RFID is a newer type of product identification and is a bit more advanced in terms of what it can do because it does not rely on manual processes for tracking items.
2. Rather than paper, it uses metallic tags or electronic chips that are read with an RFID reader that uses signals and, therefore, is quicker and more accurate. In fact, it is so quick that it could read a whole group of items in a few seconds that would take significantly longer if the same items utilized barcodes instead.

2.5 Compare and Contrast: RFID and Barcode Technology

- No human capital is required with a RFID system and it is completely automated. On the other hand a dedicated employee is required to scan barcodes of items.Barcodes can only be read while RFID can not only be read but also rewritten and modified depending upon requirements.
- While barcodes can be easily damaged and are difficult to read when greasy or dirty, RFID is rugged and extremely durable.Barcodes can be counterfeited or reproduced whereas this is not possible in the case of RFID tags.While only one item can be read at a time with a barcode scanner, RFID reader can read up to 40 items per second.
- The range of RFID reader is 300 feet. On the other hand barcode scanner can barely read past 15 feet.When comparing RFID and barcode methods, RFID is a more advanced and adaptable process that will surely be utilized more as cost to implement decreases.

Table 1:RFID vs Barcode comparison

Parameters	RFID	BARCODE
Line of sight	Not required	Required
Read Range	Passive UHF: Up to 40 feet (fixed readers) Up to 20 feet (handheld readers) Active UHF - Up to 100's of feet or more	Several inches up to several feet
Read Rate	10's, 100's or 1000's simultaneously	Only one at a time
Identification	Can uniquely identify each item/asset tagged.	Most barcodes only identify the type of item (UPC Code) but not uniquely.
Read/Write	Many RFID tags are Read/Write	Read only
Technology	RF (Radio Frequency)	Optical (Laser)
Interference	Like the TSA (Transportation Security Administration), some RFID frequencies don't like Metal and Liquids. They can interfere with some RF Frequencies.	Obstructed barcodes cannot be read (dirt covering barcode, torn barcode, etc.)
Automation	Most "fixed" readers don't require human involvement to collect data (automated)	Most barcode scanners require a human to operate (labor intensive)

Thus an effective anti-counterfeiting mechanism with the following values is required to benefit all from the manufactures to end-users.

2.6 Pedigree

Pedigree is simply a mechanism to provide information that may be authenticated to help prove the authenticity of a product. Pedigrees may be based on paper or may be

electronic. They may utilize product identifiers or unique item identifiers. And, they may utilize, or not, any of the available automated identification technologies, which is to say that pedigrees are independent of the automated identification technology used to obtain the identifier information.

A pedigree is a certified record that contains information about each distribution of a prescription drug. It records the sale of an item by a pharmaceutical manufacturer, any acquisitions and sales by wholesalers or repackages, and final sale to a pharmacy or other entity administering or dispensing the drug. The pedigree contains product information, transaction information, distributor information, recipient information, and signatures [7].

The strongest pedigrees utilize unique identifiers at the item level. Unique identifiers at the case level will work provided that there is a way to verify the integrity of the case. In this way, ***pedigrees can be maintained on physically encapsulated products;*** thereby, reducing the burden in generating appropriate pedigree documentation.
Once a case is opened, its contents cannot be automatically authenticated unless it has a pedigree. ***Pedigrees must begin at the manufacturer [5].***

2.6.1 Value to Consumer:

Legislative serialization options include the use of 2D Data Matrix or RFID technology. In contrast to an easily duplicated bar code, UHF RFID offers the manufacturer the option of a permanently locked, factory commissioned unique serial number (referred to as the UTID) embedded within the electronic RFID silicon chip.

The unique UTID signature, in addition to an optionally locked drug identification serial number, assigned by the manufacturer, provides the consumer with yet an additional level of authenticity [1].

3. System Design

The system performs anti-counterfeiting by maintaining supply chain integrity in such a way that, the transaction path of a product is clear and its source can be traced accordingly; secondly, product authenticity can be validated.The pedigree of a product is generated by its transaction records along the supply chain, which may be retrieved from the host company server through RFID readers and the Internet.With the growing popularity of Internet connection through phone networks and RFID-enabled cell phones coming into market place, the system allows consumers to check the pedigrees of the products they are purchasing.

The anti-counterfeiting system can be accessed through the Internet. It is divided into three layers – the Application Server layer, the Data Management layer, and the Client layer.

- The Application Server layer provides client access to the business logic and user interfaces.
- The Data Management layer is comprised of the database itself and its database management system.
- The Client layer can be accessed through the Hyper Text Transfer Protocol (http) or through the f (SOAP).

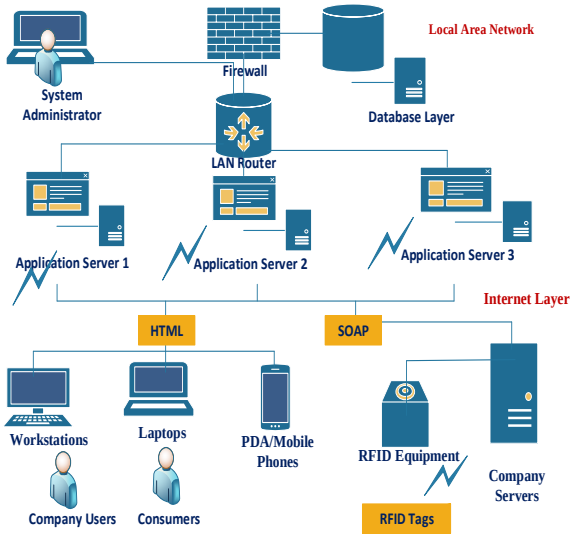

Figure 2: The overall system architecture [21]

This mechanism hinders counterfeiters from cloning the products or the tags because of three reasons:

1. Companies have to pre-register before they can access the host company server to record product transactions, and thus excluding counterfeiters from attempting to do so;
2. Suspicious transactions would be screened out accordingly;
3. Consumers will refuse to purchase products without a plausible history.

3.1 System Architecture

A system structure flow chart of the anti-counterfeiting system is shown in Fig. 3.The system comprises four servers –the Information Server, the Authentication Server, the Pedigree Server, and the Records Server.
The first three servers together form the Application Server layer, while the Records Server itself is the Data Management layer.

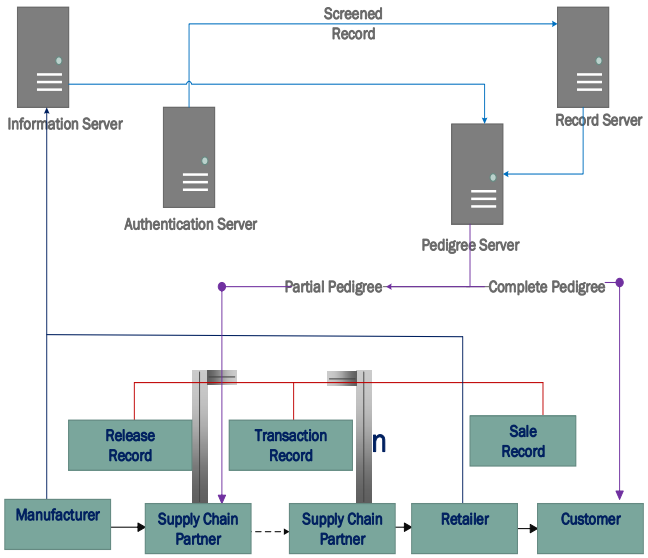

Figure 3: .System structure flowchart

The system servers are divided according to the decision activities described in the business process analysis. The Information Server is responsible for information gathering, the Authentication Server for pedigree building, the Pedigree Server for pedigree retrieval, while the Records Server is responsible the system administration.
The Information Server is responsible for collecting company information from the supply chain partners. The information is crucial for the product pedigrees because they form the geographical picture of the product history; it also forms the basis for tracing problems when suspected counterfeits emerge.As the products move along the supply chain, each supply chain partner should record each transaction accordingly. The products are identified by the embedded RFID tags. Each tag contains a unique tag ID. It can be read by the RFID readers installed at the partners' sites, supposedly connected to the Internet through a Personal Computer (PC).The Pedigree Server is also responsible for generating complete product pedigrees, through the Internet and the mobile phone network, to end-consumers for verification.

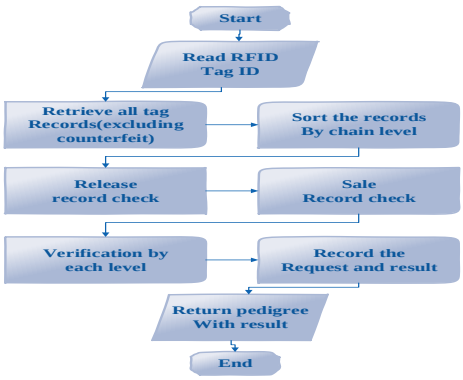

Figure 4: System structure flowchart of the Pedigree

The Pedigree server retrieves all the relevant records of a product item from the database, and then sorts these records by the chain level. The records that are marked as "counterfeit" are excluded from retrieval because they play no part in building up the product pedigree.
If either the product item being handled does not originate from the authentic manufacturer, or it is supposed to have been sold already, the Pedigree Server will mark the pedigree suspicious.

4DEVELOPING A SAMPLE APPLICATION

The web-based system for anti-counterfeiting in RFID application is developed by using web-page development tools like:
When visitor requests a page from our website, our PHP code runs on our web server and outputs the results to the web browser as a web page. PHP can access resources on our Web server, such as databases, specialized software and files.PHP files can contain text, HTML, CSS, JavaScript, and PHP code and PHP code are executed on the server, and the result is returned to the browser as plain HTML.

The reason why PHP is our choice is that:

1. It runs on various platforms (Windows, Linux, Unix, Mac OS X, etc.)
2. PHP is compatible with almost all servers used today (Apache, IIS, etc.)
3. PHP supports a wide range of databases. It is easy to learn and runs efficiently on the server side.

MySQL, developed, distributed, and supported by Oracle Corporation, is named after co-founder Monty Widenius's daughter: My, is the most popular database system used with PHP. It is a database system used on the web and runs on a server. MySQL is ideal for both small and large applications. Is very fast, reliable, and easy to use, supports standard SQL, compiles on a number of platforms.

Databases are useful when storing information categorically. A company may have a database with the following tables: The data in MySQL is stored in tables. A table is a collection of related data, and it consists of columns and rows.One great thing about MySQL is that it can be scaled down to support embedded database applications. Maybe it is because of this many people think that MySQL can only handle small and medium-sized systems.

The truth is that MySQL is the de-facto standard database system for web sites with HUGE volumes of both data and end users (like Friendster, Yahoo, and Google).
JavaScript is a client-side language. Our JavaScript code runs in the Web browser after a Web page is loaded. JavaScript is used for validating form entries and interactive content.

4.1 Android, PHP,MySQL,& JSON

Figure 1.Android, Php, MySQL, & JSON. [25]

Since the thesis work's target is to grantee the end-users by developing application which can be accessed by, here is the detail how the database on MySQL interacts with an android application.The database developed using MySQL on WAMP server are going to be accessed on android, which is different application. Our Android app and a remote MySQL database can't communicate with each other directly without it being an incredibly tedious process. PHP will do all of the talking for us as an interpreter.

In order to do this, we will need to have a server (WAMP), a MySQL database, some basic PHP knowledge, Android studio which is IDE of Eclipse and Android SDK.

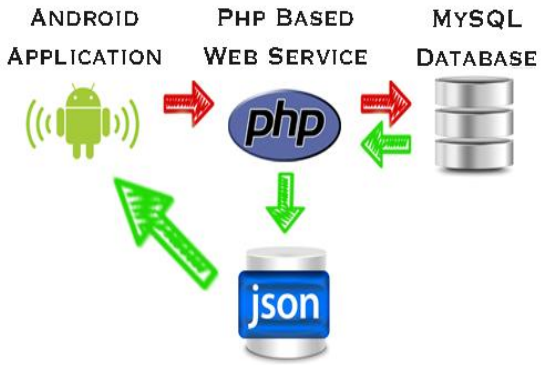

Figure 2 How MySQL Database interact with Android application.[25]

The communication, as stated in the figure above, is controlled by a display of some JSON data that will tell us whether it is successful or not. And our Android device will parse this JSON data and display a "Success" or "Failure" messages [25].

5. TESTING, ANALYSIS AND INTERPRETATION OF THE SYSTEM

In this chapter, the results are discussed based on the design and implementation of the system by the appropriate tools and software.Accordingly, the RFID-based anti-counterfeiting needs additional authentication mechanism where products are expected to be secured in terms of their economic and health risks.

It is electronic pedigree system which is proposed and designed as discussed below:

In this thesis work, three main applications are used to develop the system, which are

1. External database, developed by using MySQL on localhost server;
2. The desired PHP scripts on webserver;
3. The Android application.

MYSQL is used as a database at the webserver and PHP is used to fetch data from the database. Our application will communicate with the PHP page with necessary parameters and PHP will contact MYSQL database and will fetch and return the results.First, the pre-registration of products has to be discussed, and then the connection between the android app and the database.

5.1 Products' Pre-registration

Companies are expected to register their products to their databases with necessary fields like Tag-ID, product name, production and expire dates, and the like.This data is the first to build the electronic-pedigree throughout the transactions.

Figure 3 User interface of webpage developed

This page is the first user interface and users at every level login as permitted by the database administrator, so that partner on 'n' level could not able to modify the partner's record on n-1 as of the electronic pedigree record is built from the original records of partners on every levels.

Figure 8: Information registration pages

Companies have to pre-register before they can access the host company server to record product transactions, and thus excluding counterfeiters from attempting to do so; Suspicious transactions would be screened out accordingly; Consumers will refuse to purchase products without a plausible history.In this page pre-registrations are held by the parts which helps the pedigree report to be generated is the complete one. That is the partners' information from which pedigree is developed should be registered first.The partners are those who are in the supply chain levels including the manufacturer, wholesalers, distributors and retailers where all are developing their own pedigree in addition to the pedigree of the 'previous' partner.

As stated repeatedly pedigree is the electronics information record from where the identification and verification is done on product items whether it is genuine or not!Product information is one of the main building blocks of pedigree which is registered by the manufacturer and passes through the supply chain levels without modification that end-users compares some physical parameters of the product with the pedigree record scanned and generated by RFID reader.

This page is accessed only by the administrator(s) of the manufacturer for secured product registration not to be modified by the partners in the supply chain.

5.2 Transaction Record page

Transaction is the deal between the supply chains and the manufacturer through electronic messages held through secure network for product identification in addition to RFID authentication.

Figure 9: Transaction-record registration page

Transacting parts are those in the chain level made by pre-registration for product exchange and the process is in both directions, means from retailers up to the manufacturer through distributers and wholesalers for product requests, and from manufacturer down to the retailers in the reverse direction for product release with pedigree record down.

5.3 Pedigree Report Generation Page

The pedigree of a product is generated by its transaction records along the supply chain, which may be retrieved from the host company server through RFID readers and the Internet.With the growing popularity of Internet connection through phone networks and RFID-enabled cell phones coming into market place, the system allows consumers to check the pedigrees of the products they are purchasing.

The anti-counterfeiting mechanism is based on the track-and-trace approach with an extra feature that enables end-consumers to verify the products through their own mobile phones.The main target of the system is to grantee the end-users by allowing them to verify the product(s)/items' originality through pedigree report in addition to the unique Tag-ID of the product. The verification is held by scanning the Tag-ID of the item by stand-alone RFID readers or RFID enabled mobile phones. Before generating the report from the website, the Tag-ID has to be scanned and inserted as a key, by which the pedigree is generated throughout the transactions made by the supply chain partners.

Assume Mr. 'X' has RFID enabled mobile phone and he is to by a medicine from XYZ pharmaceuticals.

Figure 7: Tag-ID scanning page and RFID enabled mobile phones

After scanning and accessing the unique Tag-ID of the product, the user has to login to the site of the manufacturer and feed the Tag-ID to the pedigree report page and generate it. If the pedigree generated is reliable, then the retriever should verify the last owner recorded in the pedigree. If they find that the party selling them the product is different from the last owner in the pedigree, the product might also be a counterfeit and should be rejected.

5.4 Connection between Android app and MySQL database using PHP and JSON

We have the external database named "rfid_android"; and table named "pedigree", with the required fields, and the php script named as "pedigree.php", the android app named as "*ELECTRONIC-PEDIGREE-REPORT*"

The connection to be made, it needs three steps:

- Running the app will pass input data from android emulator to a php script hosted in server.
- PHP scripts fetches data from MySQL database and sends to emulator encoding in JSON(JavaScript Object Notation) format.
- Android app grasps these returned encoded data, parse them and display on screen.

Hereurl path will be given in the main class of the android application in the format:
"http://localhost:/filedirectry/phpfilename.php", if using localhost server.
For Android Virtual Device (AVD) 10.0.2.2: is used instead of 127.0.0.1(localhost:)
"http://websitename/username/phpfilename.php", in case of a remote server
The design is made in the layout and the xml code is written in main.xml file.

To connect to the external database internet permission has to be set in the manifest .xml
"<uses-permission android:name="android.permission.INTERNET" />"
The android used is the latest version of android studio 1.0.1, which needs JDK of version 7+ and we have used it as emulator as shown below:

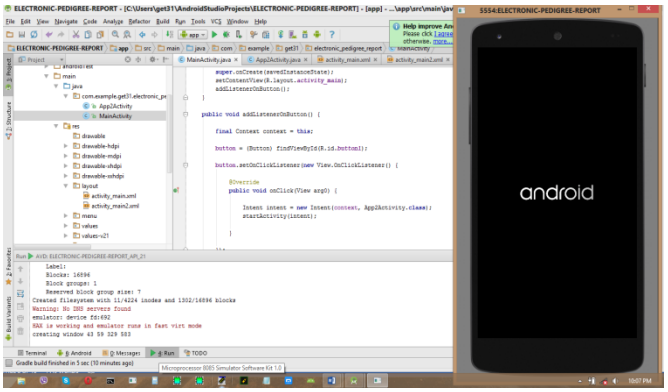

Figure 4: Android emulator when first run

It is when it is checking Hardwar accelerator is working and emulator runs in fast virtmode. The emulator needs to be unlocked to run the application, and the user application will be displayed on the screen of the emulator. In the figure below, two apps are displayed by the name 'DAA' & 'ELECRONIC-PEDIGREE-'

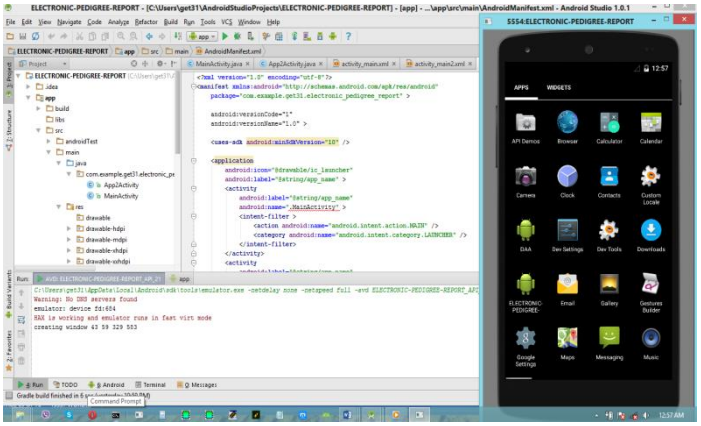

Figure 50: Unlocked emulator waiting for the app to run

When we run the app, connection is made between the android and MySQL database through the http path set on the android main activity class and the button to be clicked will be displayed.

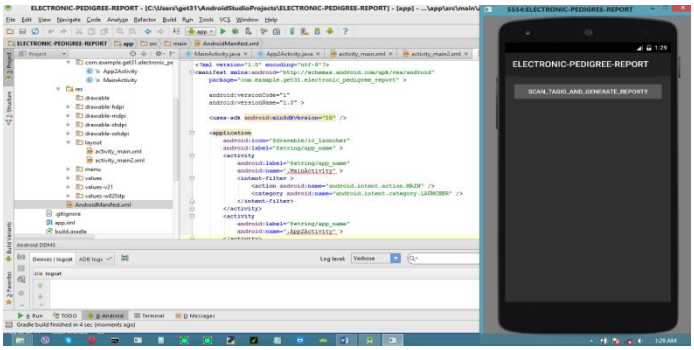

Figure 11: Button-Click display on android emulator

Here we are assuming our smart phone is RFID enabled phone and the product we are purchasing is identified by unique tagid, and we on the RFID reader and scan the id of the product, and TagID of 'E004015017E55CB6' is scanned.The pedigree record of the product say 'AMOXA', displayed on the screen of the emulator, needs to match the value of id as shown in figure 21 below.

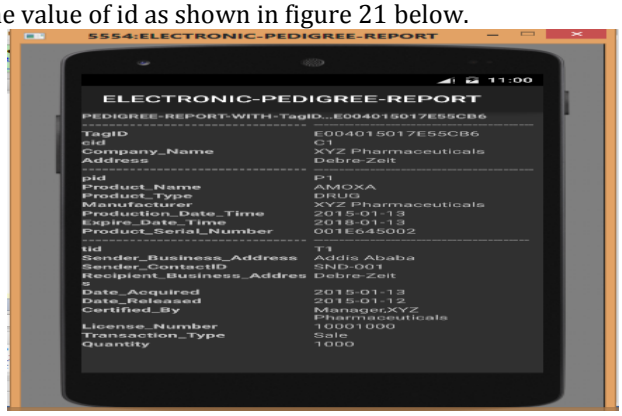

Figure 12: e-pedigree on android emulator identified by Tag-ID

6 CONCLUSIONS

Now a day's anti-Counterfeiting based on RFID is highly attractive options for current growing threats of fake products solution. Unlike other industries, counterfeiting in the foods, pharmaceuticals and aerospace industries may have life and death consequences.Since technology is advancing day-to-day and the threats too, the protection mechanism needs to be advanced accordingly. Hence the electronic pedigree report is added to the system as an additional authentication mechanism.Pedigree is an electronic record on transactions among business partners throughout all stages of distribution. The dictionary meaning of pedigree is the family line or the blood. In this system, the pedigree is the blood of the product. Namely, the pedigree is the business information that includes the manufacturer, the producing area, the producing date, the distributor, the distributing area, the distributing date, the signature, etc.Hence from the proposed system, we can conclude that, the end-user can be granted better about the verification and confirmation of product's originality before purchasing it.

6.1 Recommendations

As discussed throughout the paper, the current product counterfeiting effect will be uncontrollable on the basis of rapid technological advancement; compatible protection mechanism needs to be implemented, so that the proposed system is better based on the following advantages;The system can be updated accordingly, can be implemented in every industries; the product's originality approval can be held by the end-user without interference, and so on.As a result, we recommend that this project should be implemented practically in industries especially in foods, pharmaceuticals and aerospace industries where their counterfeit effects are serious and intolerable!!

6.2 Future work

The proposed system can be extended further, as a future work, we suggest the following:

1. In this work we used software implementation to design and develop the system, one can use preferable RFID simulator.
2. In this paper, due to the luck 0f RFID Reader, we have used Android Virtual Device (AVD) to scan and generate the electronic pedigree report , one can use stand-alone RFID reader or RFID enabled smart phones and verify the TagID if the products are genuine or not.

REFERENCES

[1]ALIEN-RFID in Line Sciences-Significant Pharmaceutical Supply Chain Value Using RFID for e-Pedigree, Patient Safety, and Anti-Counterfeiting.

[2] André-Pascal, France (1998: The Economic Impact of Counterfeiting.

[3] Charles Clift, 2010: Combating Counterfeit, Falsified and Substandard Medicines.

[4] Counterfeit Parts: Increasing Awareness and Developing Countermeasures (March 2011).

[5] Daniel W. Engels, Ph.D. 2006: On Drug Pedigree and RFID in the Pharmaceutical Supply Chains.

[6] Elisabeth ILIE-ZUDOR et al.The RFIDTechnology and its Current Applications.

[7] EPCglobal, January 2007: Pedigree Ratified Standard.

[8] Eustace Asanghanwa, Crypto & RF Memory Applications: Using RFID Technology to Stop Counterfeiting.

[9] http://en.wikipedia.org/wiki/Counterfeit_products. Counterfeit consumer goods.

[10] http://en.wikipedia.org/wiki/Pedigree_analysis.

[11] http://www.griffinrutgers.com/blog/2012/09/rfid-and-barcode-labeling.

[12] Ji-in Eom et al, ***(Gihong Kim, Bonghee Hong and MahbuburRahman)*** Design and Implementation of Pedigree System for Anti-Counterfeit in RFID Application. 2009.

[13] Julian Morris and Philip Stevens, 2006: Counterfeit medicines in less developed countries.

[14] M. B. Roslee and T. W. Lee: Implementation of RFID and Bluetooth Technology for data tagging and transmission to point of sale (2012).

[15] Mike Schneider (April 24, 2003): Radio Frequency Identification (RFID) Technology and its Applications in the Commercial Construction Industry.

[16] MikkoLehtonen et al. (December 2007): (***Jasser Al-Kassab , Florian Michahelles, Oliver Kasten)*** Anti-counterfeiting Business Case Report.

[17] MIKKO OLAVI LEHTONEN (April 2010, Zurich.), How to Secure Supply Chains Against Counterfeit Products Using Low-Cost RFID.

[18] NCPDP-December 2010: Drug Pedigree in the Health Care

[19] OECD ,2007: The Economic Impact of Counterfeiting and Piracy

[20] PimTuyls and LejlaBatina; RFID-Tags for Anti-Counterfeiting.

[21] S.H. Choi and C.H. Poon (February 2008); An RFID-based Anti-counterfeiting System.

[22] S.H. Choi and C.H. Poon (July 2007, London, U.K), An RFID-based Track-and-trace Anti-counterfeiting System.

[23] S.K. Kwok, et al. (***Albert H.C. Tsang, Jacky S.L. Ting, W.B. Lee and Benny C.F. Cheung)***(Seoul, Korea, July 2008). An Intelligent RFID-based Electronic Anti-Counterfeit System (InRECS) for the manufacturing Industry.

[24] STEPHEN B. MILES, SANJAY E. SARMA, JOHN R. WILLIAMS (pages 158, 186): RFID Technology and Applications.

[25] BY TRAV on May 27, 2013: Interacting with a Remote MySQL Database in an Android Application!

[26] WIPOMAGAZINE, September 2010: Dialing for development: How mobile phones are transforming the lives of millions.

[27] Zachary A. Pollinger, Counterfeit Goods and Their Potential Financing of International Terrorism.