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Analysis and Design of "Dates Traceability System"

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Abstract

Food chain traceability verifies the breadth and depth characteristics to meet the production process and to reach desired objectives such as insuring food safety and providing consumers with added confidence in the food authenticity. Information technology is an attractive solution that helps achieve the traceability objectives. This is especially true with the wide spread of the Web technologies. This paper is intended to enable any consumer for tracking dates products from its origin farm all the production stages to its final consumption. The functionalities of this system will include managing dates product data and their related actors, elaborating a way of coding dates product so that we can extract all traceability information using this code, helping/supporting finding anomalies (if any) in the chain of production and improving the dates quality. At any stage of the chain a product can be traced-back and offering services to health and government organizations to get better vision of the date's product history.

Keywords: Traceability; Web Service; FTS Systems; Barcodes; Dates Traceability systems; Food Processing.

1. Introduction

With the growing of food poisoning in the world, Security problems of food got more attention from customers [1] .The traceability of the product is a tool to realize specific goals, like improving food safety or logistic optimization. Therefore, these days many food traceability system (FTS) is produced which is used to registering the path of the food product or the ingredient in the food product . FTS can cover all process of the production from its first supplier through all stages for processing it until it the last consumer gets it [2]. The most important goal of FTS is to allow the food industry promptly to locate and to remove products which are not safe in case of a recall. [2,3].

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In this study [1] the author proposes internet management system as a solution for food security problem. This system is traceability management system allows the customer to trace the product from its source and makes supply chain very clear. The system also allows the enterprises to observe the process of production effectively by identify the cause of the problem and find out the source of the problem at any stage of the supply chain production process.

This paper used RFID technology to design security traceability management system through the Internet. The advantages of using RFID In food traceability are raise the accuracy of the data by increase security and efficiency of the food supply chain and reduce the problem of food corruption which occur from the high temperature degree which affect in some types of food in the food transportation process. RFID technology implements visibility transport to pollution and food borne diseases in the thermal transport conditions.

Yoon-Min and his colleagues in [4] **developed** ginseng traceability System (GTS) based on RFID technique. This study used "as-is analysis" which defined as "A food traceability system is used to prepare for accidents and abnormal situations". The system also provides all information in supply chain to the consumers and the local competent authorities.

GTS production process is based on three stages shows in Figure 1. In production stage, the processors get the ginseng from the growers of various regions. Then they mix and store them together for cleaning and steaming .This process of mixing the inbound ginseng interrupts the flow of traceability information. Therefore, the consumers cannot receive detailed information of their product about the production stage.

Figure 1: GTS timeline.

This research proposed a model for GTS based on adopted sensor network to avoid the loss and mixture of information at the production stage . The proposed traceability system consists of a management system for managing the farming environment, a sensor to capture and collect environment related information to ginseng farming, and a sensor network to collect and record this information.

The growers are boxing the ginsengs and tagging with RFID tag (1) then delivered to distributors. The distributors then immediately inspected and RFID tag (1) is replaced by RFID tag (2). RFID tag (2) is designed with URI-convertible identification number which identifier for trade product and are deployed to look up item information. Then the tag (2) is removed in packaging stage and all product information is kept in an EPCIS. Last replaceable tag is RFID tag (3) which is marked on the surface. Therefore, using this tags complete information about product process including production, inspection, packaging and growing can be retrieved at

any time.

In [5], concentrated on three important topics: goal analysis, design foci, and the FoodPrint approach to make a traceability information model. In a typical FoodPrint project seven phases are mentioned: (1) Business goal analysis, (2) System analysis (3) Bottleneck analysis TO-BE (4) System design (5) System construction (6) Implementation (7) System operation , In the business goal analysis, the aim of the (chain) organization for implementing traceability is linked to the (chain) organization's strategic targets, and translated into tangible design requirements. The Figure 2 shows foodPrint's design foci.

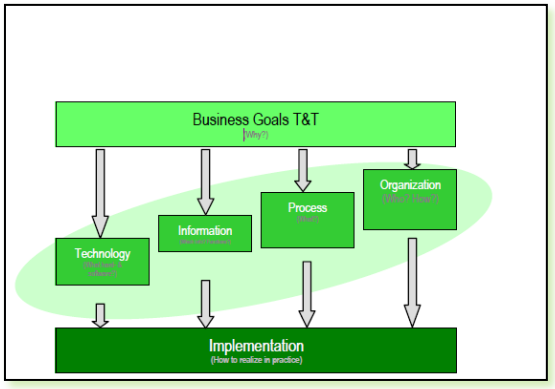

Figure 2: foodPrint's design foci.

As well as in [6], propose a framework of FTS. The framework whole has been divided into presentation layer, business logic layer and data layer. The presentation layer provide the users with interactive components which provide users with the information needed, they are sometimes a group of JSP pages or HTML pages. Business logic layers the core of the application system, is composed by the business logic components which can be Java classes, Java Bean or EJB. Data layer faced to certain database application and completed the interaction of the database.

Huoguo and his colleagues in [7] designed traceability barcode based on the UCC/EAN- 128 encoding scheme. This barcode consists of two parts: the commodity identification barcode and the batch barcode.

The generating process of the total traceability barcode is based on "Guideline for Numbering of Agriculture Products for Tracing". After that the printing process to the tracing barcode on traceability label performs automatically.

The process of cereal production includes: production input, farming ,storage , processing producing, warehousing and transportation.

The first part of their barcode which is the commodity identification barcode consists of: (1) The enterprise identification code, (2)The commodity item code (3) The check code, also it contains the application identifier (01) in the UCC/EAN-128 encoding scheme. The second part is the batch code which refers to the producing batch of the final cereal product. It is made up 8 numbers. It includes of the following information : (1)

Producing date of the final product, with the application identifier (11), (2) or packing date of the final product, with the application identifier (13), (3) and the producing/packing line barcode.

The traceability barcode follows the UCC/EAN-128 scheme. The traceability code has 21 numbers, and consists of the commodity identification code and the batch code.

Huang and his colleagues in [8] used RFID Technology that is a kind of automatic identification technology. This technology has many characteristics are : unique identifier, fast read and write, untouched identification, mobile identification and multi-target recognition . These characteristics is to make it possible to realize efficient traceability for supply chain system. In RFID system, digital memory chips with unique electronic commodity code can be pasted on single agricultural product, and receiving equipment can activate RFID tags, read and change data, and transmit data to host computer for further processing the data.

Dates are a popular fruit are highly nutritious [3]. It is a summer fruit that spread in the Arab world. Now the industry of the date's production becomes one of the main industries in the Kingdom of Saudi Arabia [9,3].

In light of this interest and popular demand for this type of fruit, this paper aims at pursuing the analysis and design of date's traceability system (DTS) together with its associated databases. The system is intended to allow for tracking dates from its origin (farm) all the way to its final consumption (the consumer). Ambitious functionalities of the system will include : (1) Managing Dates product data and their related actors such as the ministry of agricultural, food inspection agency, farmers, transformers, manufacturers, conservers, conditioners (packing operators), transporters, and retailers. (2) Elaborating a way of coding dates product so that we can extract all traceability information using this code. (3) Helping/supporting finding anomalies (if any) in the chain of production and improving the quality of dates. At any part of the chain the product can be traced-back. (4) Offering the services to health and government organizations to get better vision of the date's product history.

The rest of this paper is organized as follows: Section 2 presents DTS services analysis. Section 3 shows DTS design. Section 4 the architecture of DTS. Section 5 describes Barcode design. Section 6 evaluates and Tests the system. Finally conclude the paper and display the results of it.

2. DTS services analysis:

This section will describe DTS services analysis.The figure 3 shows the services analysis for pick and Farmed dates. Note that the final links in these Supply Chains Models i.e. from Processing to Consumer are very common.

In the supply chain for dates pick, it is important to trace the dates and the products made from them all the way through the supply chain from the palm which landed the dates until it reached to the consumer.

Farmed Dates needs also is for traceability backwards in the supply chain to the dates farm. To comply with the Regulation (EC) 2065/2001, it is the requirement that information about the commercial and scientific

names (species), pick area and also the method of production – if it is a farmed or a pick dates, is to be available during the supply chain. This will be done by means of the labeling or the packaging of the product, or by other means such as a commercial document accompanying the goods. Every party in the supply chain should take its individual responsibility to provide the right information and must ensure that it is formatted into the correct bar code, while also ensuring that secure, perfect recording systems for this information can be maintained [10].

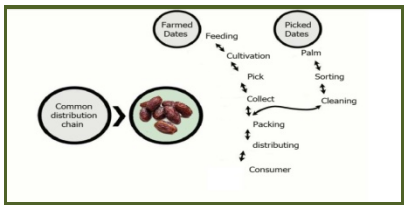

Figure 3: services analysis for pick and Farmed dates.

3. DTS Design

This section describe the several classes that DTS consists of which are showing on the table 1.

Table 1: DTS classes description

	Class	Description
1	Account	This class is used to represent the account information for every user.
2	User	This class is used to represent the users who are responsible for managing the farm or the factory information; it can be either the grower or the packer.
3	Grower	This class is used to represent the grower who is responsible for managing the farm or the initial product information.
4	Packer	This class is used to represent the packer who is responsible for managing the factory or the final product information.
5	Farm	This class is used to represent the farm that produce the initial product.
6	Factory	This class is used to represent the factory that produce and pack the final product .
7	Factory operation	This class is used to represent the operation that take place in the factory like washing, drying, pressuring and packing the product.
8	Initial product	This class is used to represent the initial product that produced from the farm without any packing.
9	Final product	This class is used to represent the final product after packing in the factory.
11	Category	This class is used to represent the different categories for every final product.

The class diagram for DTS is shown in the figure 4.

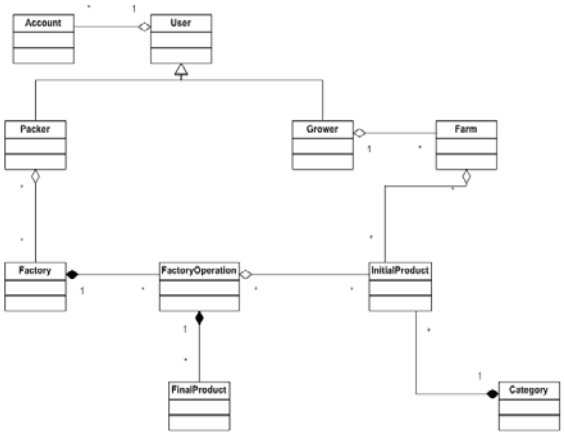

Figure 4: DTS class diagram.

4. System architecture

The aim of DTS is to reach all customers who are in need to trace back through the source of the dates they purchased, if they have laptops, pocket PCs, or smartphones so as to be connected to the Internet. This is also for dates growers, the packers, or the distributors also. For this reason , This project proposed Web-Based, three-Tiers Architecture where the three tiers are database server, webserver and the application .We choose this architecture because web is a powerful and great channel that has the ability to achieve the objectives of this work . The illustration of proposed system architecture is shown in Figure 5.

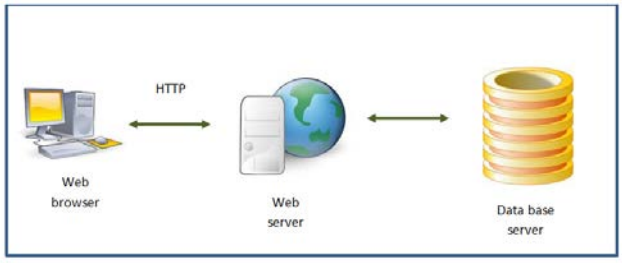

Figure 5: The proposed architectures of DTS.

4.1 Architecture components and subsystems

The proposed architecture consists of five subsystems are : Cultivation , Packing , Code generation Security and Management subsystems .

Security subsystem acts as an interface to the whole system and interactive with the different actors who work with the system. This subsystem is responsible for the access control to the system functions.

Management subsystem is to perform the administrator functions. When the administrator logs in, the security system checks his/her access then directs his/her to the management subsystem.

Cultivation subsystem is to perform the grower functions. When the grower logs in, the security system checks his/her access then directs his/her to the cultivation subsystem.

Packing subsystem is to perform the packer functions. When the packer logs in, the security system checks his/her access then directs his/her to the packing subsystem.

The last subsystem is code generation subsystem which responsible for reading and generating the product barcode. When the grower finished the initial product information in cultivation subsystem, he/she sends the initial product information to barcode generation subsystem, and then this system generates initial barcode and allows the grower to print it in order to attach it with the product. Then the packer received the initial products on the factory, He/she enters the initial barcode to this subsystem which reads the barcode to checks if it is correct then allows the packer to enter the final product information. After the packer completes all information it sends them to this subsystem to generate the final product barcode in order to send it to the distributor.

5. Barcode design

Traceability barcode is for achieve traceability within the system , in this section we explain the detail design of DTS barcode based on the UCC/EAN- 128 encoding scheme and Database design .

This system works with two different barcodes are: initial product barcode and final product barcode.

Initial product barcode is the barcode that send with the initial product from the farm to the factory and used internally by the growers and packers. It consists of: (1) The identification of the farm (3 digits) (2) The identification of the initial product (4 digits) (3) check code (1 digits). It is made up 8 numbers . The figure 6 shows an example of initial product information on DTS.

Figure 6: example of initial product information on DTS.

The concept of initial barcode in shown in the figure 7.

Figure 7: The concept of initial barcode on DTS.

The steps to generating the initial barcode is shown the in figure 8.

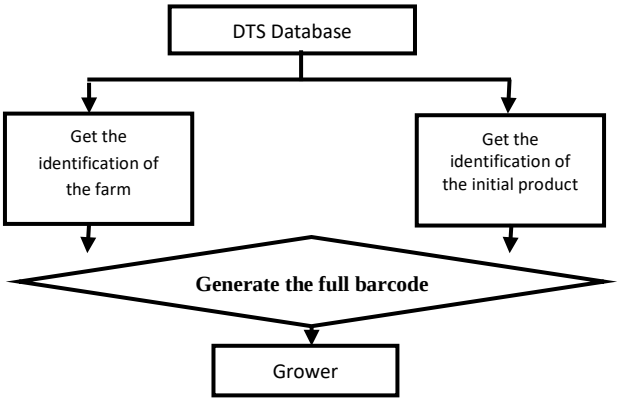

Figure 8: the steps to generating the initial barcode on DTS.

The steps to reading the initial barcode is shown in figure 9.

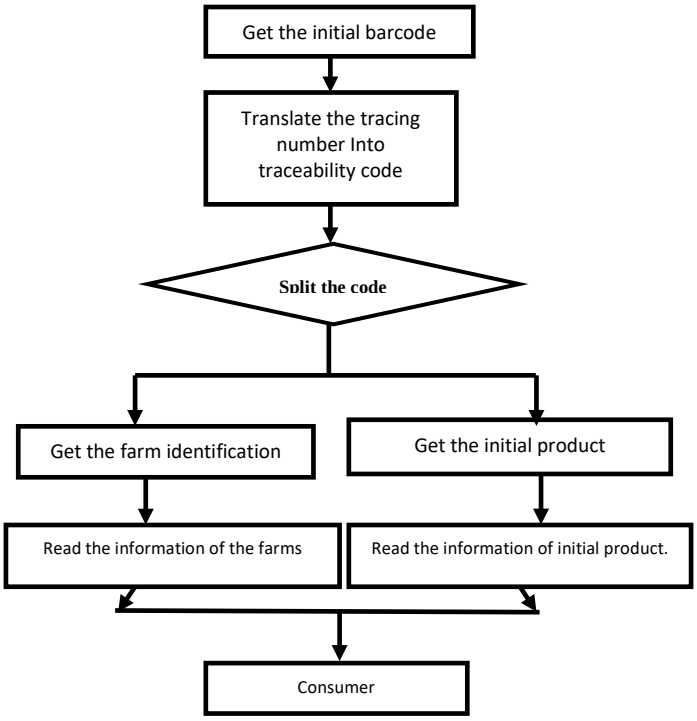

Figure 9: The steps to reading the initial barcode on DTS.

DTS barcode or (final product barcode) is the barcode which send with the final product from the factory to the distributor and use by the final consumer to show all traceability information staring from farm to the final distributor. It consists of two parts: the initial products barcode and the packing barcode.

The first part of the barcode which is the initial products identification barcode consists of: (1) The identification of the operation that includes all initial products code (5digits) , (2) The number of initial products code (1digits), It is made up 6 numbers .The proposed barcode structure is shown in figure 10 .

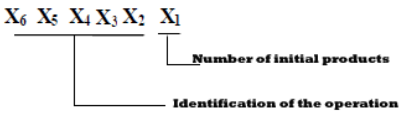

Figure 10: the proposed structure of DTS barcode.

The second part is the packing code which refers to the producing batch of the final dates product. It is made up 15 numbers. It includes of the following information: (1) The code of packing country (3digits), (2) The final product code (6 digits), (3) Factory identification code (3digits), (4) and distributor identification code (3digits).

The packing code structure is shown in figure 11.

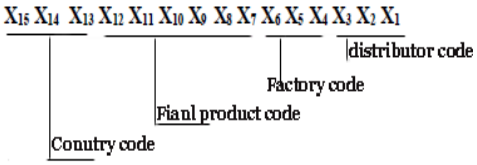

Figure 11: the structure of packing barcode.

The traceability barcode of DTS follows the UCC/EAN-128 scheme. The traceability code has 21 numbers, and consists of the initial products identification code and the packing code.

The structure of the traceability barcode for dates products is shown in figure 12.

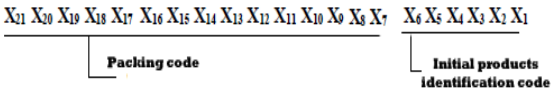

Figure 12: the structure of traceability barcode for DTS.

Also the DTS barcode contains human readable information which is: date of production, expiration date and the price. The figure 13 shows an example of DTS barcode:

Figure 13: example of barcode for DTS.

The concept of final barcode is shown in the figure 14:

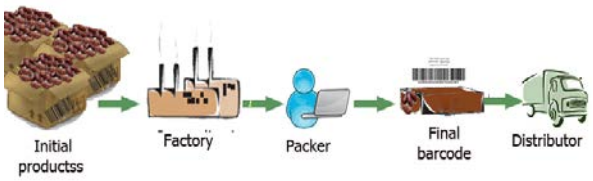

Figure 14: the concept of final barcode for DTS for DTS.

When the consumers want to buy the dates products , they only input the product barcode in the system website on the internet by their smartphones, then the system will read the barcode and display all traceable information about the product on the screen. These steps is shown in figure 15.

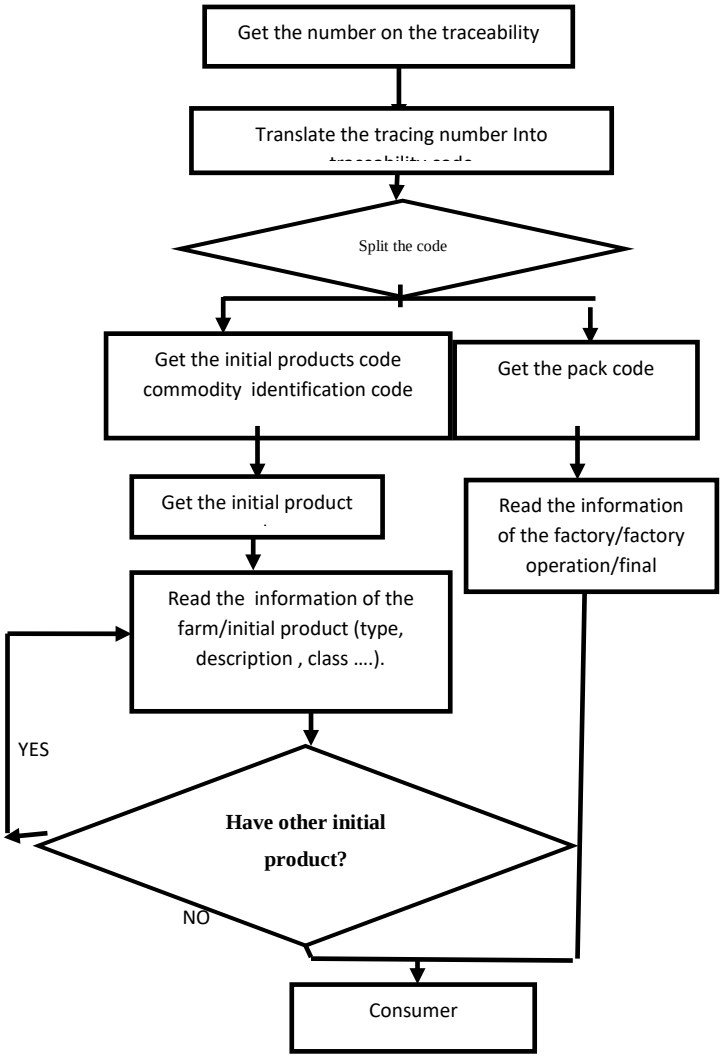

Figure 15: the process of tracing.

The generation steps within the system is shown in the figure 16:

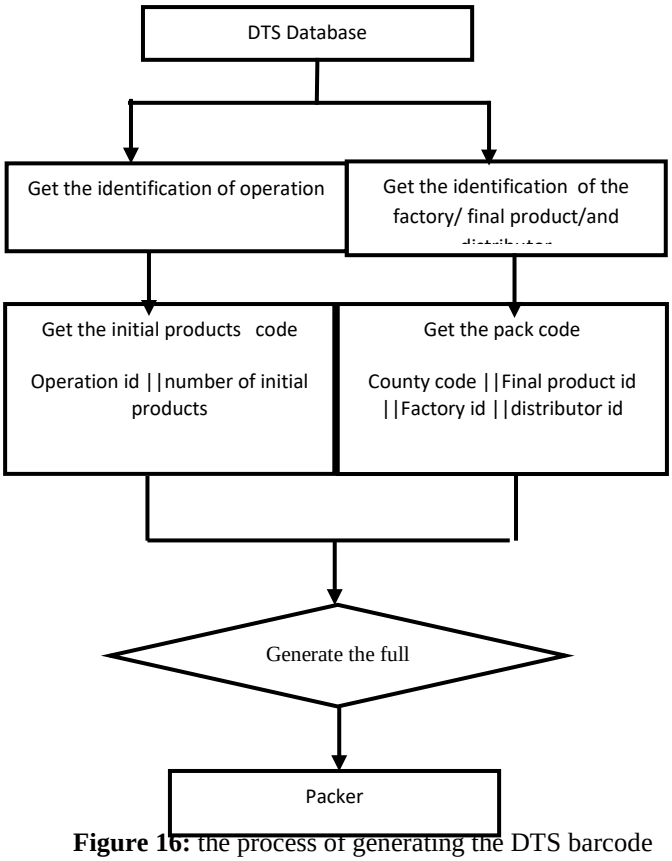

Figure 16: the process of generating the DTS barcode

6. Testing and validation

In this section we've tested and validated our system of the different pages that appears to the users of the system to illustrate the main functionalities and features of the system by represent a small scenario from first step on the farm till the product reach the consumer. The results of these tests show that all tests are successful.

7. Conclusion

In this paper; we tried to apply the concept of the traceability system on dates products that are one of the famous food in the Arabic world.

The main motivation is to proposing the methodology for developing food traceability system. In achieving the objectives of DTS, we choose UCC/EAN-128 scheme for designing traceability barcode that has been successfully applied.

The objective of this work was to outline the architecture for DTS, defining dates barcode to reflect the different product stages according to international standards, designing its underlining database, defining the different services according to the involved actors and extending the designed system to be accessed via the internet.

The future work is to extend this project to discover most of the products in the distributor in order to be a center for traceability information to make it easy for consumers to trace and track all their products in a single web site.

References

[1] Kefei Liu, " Research on the Food Safety Supply Chain Traceability Management System Base on the Internet of Things", International Journal of Hybrid Information Technology, Volume 8, Number 6 , pp.25-34 ,March 2015.

[2] Shengnan Sun and Xiaoqiang Wang , "Food and Rural Initiatives", International Journal of Innovative Computing, Information and Control, Volume 7, Number 5(A), pp. 2201- 2212, May 2011.

[3] Mae Alexander, "Importance of Food Traceability", Available: http:// www.articlesbase. com/industrial- articles/importance-of-food-traceability-5074466.html[Jul 28, 2011].

[4] Yoon-Min. et.al," Developing A RFID-based Food Traceability System in Korea Ginseng Industry: Focused on the Business Process Reengineering", International Journal of Control and Automation, Volume. 8, Number 4, pp. 397-406, Aug 2015.

[5] Floor Verdenius and Nicole Koenderink, "Designing traceability system" , Wageningen University and Research Center, 2009.

[6] Yurong Li and Yi Yu , "The Research and Application of Software component technology In food traceability system" , International Conference on Computer Application and System Modeling (ICCASM), IEEE , PP 387 – 390, 2010.

[7] ZHENG Huoguo . et.al ,"Design and Implementation of Quality Traceability Label for Cereal and Oil" , PP 469 -473,2007.

[8] Lijuan Huang et.al , " Designing and Planning Agricultural Supply Chain Traceability System Based on Modern RFID Technology " , International Conference on Mechatronic Science, Electric Engineering and Computer, , Jilin, China ,PP 2112 – 2118, August 19-22, 2011.

[9] Manitoba Agriculture, "Food and Rural Initiatives",

Available:http://www.gov.mb.ca/agriculture/foodsafety/traceability/cfs07s01.html[2009].

[10] EAN international, " Traceability of fish guidelines " , 7th November 2002 , PP 1-45 .