

NFC based Livestock Traceability Management System

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Abstract. The livestock record tracking system to manage the record of domestic livestock transparently discloses overall distribution process from livestock production to sales. In addition, barcode printed on ear-tag of livestock is used to monitor livestock to prevent false sales such as false labeling of origin. In the case of one-dimension barcode, however, it has the weakness of not being able to store data and restore data upon contamination or damage. As a new technology to substitute such bar code, the attention is paid to NFC, a near field communication device, with the highest potential to replace bar code and RFID. This paper will proposed an information of livestock traceability managing method in the cloud environment using NFC (Near Field Communication). By utilizing smart devices equipped with NFC function, scanning NFC tag, and using wireless connection method such as 3g, LTE, and Wifi, a user can monitor the information as it is synchronized with the history information of cloud server. NFC based livestock history tracking system is divided into raising, butchery, processing, and sale and the information collected in each stage is saved to history cloud. Then, the history management information saved can be monitored through smart devices of user or web portal. Also, XML (eXtensible Markup Language) is used and managed in order to convert livestock information into electronic documents. Based on this, the information being sold is provided to consumers to allow safe purchase and when sanitation and safety issue occurs, it allows swift response such as collecting or discarding beef by tracking livestock record information.

Keywords: NFC; Livestock; Traceability; XML; Mobile device

1 Introduction

A lot of issues are raised in regards to livestock industry recently including the outbreak of livestock diseases such as BSE, foot-and-mouth disease, and others in and outside countries and fraudulent sale of livestock product including false notification of country of origin. Also, in order to resolve tracking problem in distribution process of imported beef which has been a political issue between Korea and United States or prevent safety related accidents caused by contaminated food, production information and distribution path shall be opened to the public. In addition, the tracking of distribution path of food shall be available when the safety accidents occur. Thus, there

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is a necessity to introduce systematic distribution management system for livestock products in relevance to such safety issues[1][2].

For the livestock history tracking management system, an ear tag is attached to the ear of livestock for individual identification. Individual information of livestock can be confirmed through bar code printed to ear tags. However, in case there is no ear tag on the ear of livestock or ear tag has been damaged, it is banned from entering the butchery and it cannot be sold. A bar code printed to the ear tag is one dimensional bar code and it has shortcomings in that data cannot be read when the part of bar code is contaminated or damaged and it cannot be restored[3][4][5].

As a new technology to substitute such bar code, a great attention is paid to RFID and NFC. NFC has been an issue in smart device market together with Cloud and LTE (Long-Term Evolution) and it is a near field communication device with the highest potential to replace RFID. In addition, it can support Card mode, RFID Reader mode for external information acquisition, and P2P mode which can transmit and receive information between devices [6].

The purpose of this study is to propose NFC based livestock history information management system utilizing smart devices equipped with NFC function in order to resolve such problems. NFC based livestock history information management system in proposal saves and manages individual and history information generated from the production to the sale in history cloud. The data saved to history cloud can monitor the information through smart devices and web portal. Individual information of livestock in each stage from production to butchery, processing, and sale, class information based on butchery, and information on processing and sale are input and output by the manager of each stage. The information based on data update can be confirmed through smart devices and web portal.

In case of utilizing smart devices, the information can be monitored by scanning the NFC tag attached to the body of livestock or sold products and searching for individual identification number. Web portal can monitor the information in more detail compared to smart devices by searching individual identification number. Also, the management XML technology is to be utilized for the livestock history information. XML is a technology which supplements the shortcomings of HTML that are the expression of document, structural problem, and others. In addition, it has advantage in that it is easier to produce than HTML and data can be exchanged on the web with the same method. The web document can be monitored by converting and providing individual identification information of livestock from the smart devices with the utilization of XML[7][8].

Through the livestock history management system in proposal, the problems of previous method can be resolved, information from production in livestock farm to sale stage can be provided to the consumers, and the safety and reliability can be assured.

This study is composed as following. Chapter 2 gives an explanation on relevant studies and Chapter 3 presents NFC based livestock history tracking management system in proposal. Chapter 4 illustrates the implementation result of proposed system and Chapter 5 concludes this study by giving a conclusion and contents of follow-up studies.

2 Livestock Traceability Management System

The configuration of livestock history tracking management system proposed in this study is as Fig. 3.

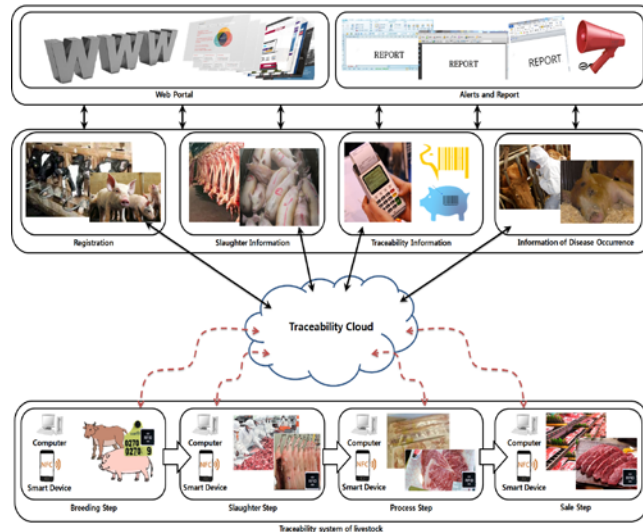


Fig. 3. System conceptual diagram

In production stage, basic information for raising the livestock is managed and the data saved to history cloud is updated with the utilization of smart devices or PC in case of detecting abnormal symptoms in each individual. In butchery stage, the butchery related information for each livestock and hygiene information are handled and information on processing and sale is managed in processing and sale stage.

The information from production to sale stage is saved to history cloud and saved data can be monitored using smart devices and PC of user. The monitoring is available with the utilization of smart devices with NFC function by scanning the tag attached to the body of livestock or tag attached to product label or searching individual identity number by accessing to web portal.

The history information of livestock saved to history cloud is managed as data in XML format and it can be examined by downloading it in document format. Then, it provides alarm accordingly with each individual when abnormal symptoms occur. Also, the infection status and path can be traced by monitoring the history information on individual and information on the disease in case of disease outbreak.

The proposed system operates with processes such as Fig. 4. A user scans RFID scan or input individual identification information by utilizing NFC function of smart devices in order to search individual information of livestock. Then, the manager inputs or revises individual information of livestock through log-in process. The collected data is processed and saved to history cloud. Individual information saved to history cloud is output to smart devices. Also, when abnormal symptoms of each individual occur, the alarm function is performed and history information of each

individual and disease related information are output. Through such livestock history tracking management system, a user can monitor the information collected from production of livestock to sale stage and information related to history tracking for each stage with the utilization of smart phones.

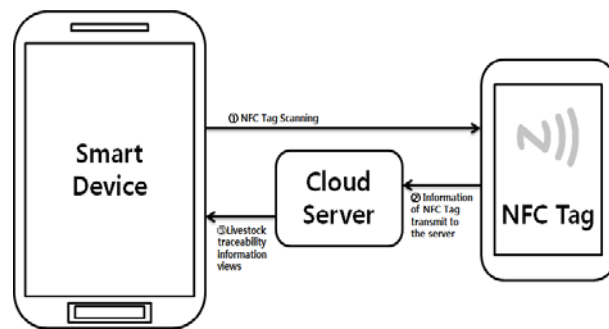


Fig. 4. Process of the system

Elements to convert information related to individual and history of livestock into electronic documents shall be analyzed and electronic document element and XML tag are defined based on it.

Elements to manage the livestock information are divided for each stage from the production to sale. The basic information and information on livestock husbandry is as Table 2.

Table 2. Breeding Step of Livestock

Object	XML tag	Information
Object identification number	<id>	Object identification number
Document name	<title>	Document name
Identification information	<Object>	Identification information of livestock
Kind	<Kind>	Kind of livestock
Sex	<Sex>	Sex of livestock
Date of birth	<Birth>	Date of birth
Origin information	<Breed>	Origin information of livestock
Area of Production	<O_House>	Area of Production
Fodder	<Fodder>	Fodder of livestock
Manager	<O_Manager>	Manager of production
Phone number	<O_Phone>	Phone number of Manager
Transfer	<Transfer>	Transfer of livestock
Car number	<O_Car>	Car number

Basic information of livestock and information generated during the husbandry are managed. Basic information is divided into individual information, livestock species, sex, and date of birth and it can be searched through individual identification number.

The information on the husbandry is divided into place of husbandry, feed, and manager information of each livestock. Also, vehicle information shall be input when it is forwarded from the livestock farm.

Table 3. Slaughter Step of Livestock

Object	XML tag	Information
Information of slaughter	<Slaughter>	Information of slaughter
Slaughter house	<S_House>	Place of Slaughter
Date of slaughter	<S_Date>	Date of slaughter
Sanitary inspection	<Sanitation>	Sanitary inspection
Label print	<S_Label>	Whether to print labels
DNA analysis	<DNA>	Whether to DNA analysis
Class	<Class>	Class of livestock
Car number	<S_Car>	Car number

In order to manage the information of livestock advanced to the butchery process, the object called butchery information was created and the information on butchery is as Table 3.

It confirms the attachment of label containing the information on place and date of butchery, hygiene test of butchery, and livestock information and determines the class of livestock.

Table 4. Process Step of Livestock

Object	XML tag	Information
Information of process	<Process>	Information of Process
Rendering works	<P_House>	Rendering works
Slaughter inspection form	<Application_form>	Slaughter inspection form
Each part number	<Numbers>	Each part number
Parts of packing number	<P_PSN>	Parts of packing number
Whether boxed	<BOX>	Whether boxed
Working days	<P_Date>	Working days
Car number	<P_Car>	Car number

The livestock which went through the butchery process is transferred to processing factory and numbering is conducted for each body part of livestock. It is moved to packaging stage accordingly with the numbers given for each part and it is transferred to the shop after it is put into the boxes.

Table 5. Sale Step of Livestock

Object	XML tag	Information
Information of sale	<Sale>	Information of sale
Information of Shop	<Sale_House>	Information of Shop
Each part number	<S_Number>	Each part number
Whether to print labels	<S_PSA>	Whether to print labels
Manager	<S_Manager>	Manager
Phone number	<S_Phone>	Phone number of Manager

The livestock which went through stages from production to butchery and processing reaches the shop in a package. The shop checks the sale management number and attachment of label for each part of livestock displayed. The manager and phone number of shop are input as well.

Table 6. Disease Step of Livestock

Object	XML tag	Information
Information of Disease	<Disease>	Information of Disease
Name of Disease	<D_Name>	Name of Disease
Cause	<Cause>	Cause of Disease
Symptom	<Symptom>	Symptom of Disease
Treatment	<Treatment>	Treatment of Disease
Shipment	<Shipment>	Shipment of Disease

In addition, the information on the disease which generated in the production process and its treatment shall be checked by handling the disease information of livestock.

In case problem occurs for the meat of relevant livestock, prompt correspondence is available such as collection, disposal, or others by tracing the history information.

Electronic documents using XML are as Fig. 5.

It is output of individual information and history information of livestock on Explorer and XML is divided into total 6 areas. Id of electronic documents for livestock history tracking management is determined accordingly with individual identification number of livestock and it is devised to manage the information for each individual. It manages the individual information of livestock and information from production to butchery, processing, and sale stage. The information input by the manager of each stage and it is output by the device selected by the user. Also, by handling the information related to the disease, the history information of relevant livestock can be traced for countermeasure upon the outbreak of disease.

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<L.T.M. id="002027080289" title="Caw_A001">
  <!-- Livestock Traceability -->
  <Object>
    <Kind>Caw</Kind>
    <Sex>Castration</Sex>
    <Birth>January 1, 2008</Birth>
  </Object>
  <Breed>
    <O_House>85-2 Okdang-ri Munpyeong Naju-si Jeonnam</O_House>
    <Fodder>Hay</Fodder>
    <O_Manager>Gildong Hong</O_Manager>
    <O_Phone>010-5124-5455</O_Phone>
    <Transfer>No</Transfer>
    <O_Car>S8na 4274</O_Car>
  </Breed>
  <Slaughter>
    <S_House>National Agricultural Cooperative Federation in Naju-si</S_House>
    <S_Date>January 11, 2008</S_Date>
    <Sanitation>Yes</Sanitation>
    <S_Label>Yes</S_Label>
    <DNA>Yes</DNA>
    <Class>A</Class>
    <S_Car>S2ga 5644</S_Car>
  </Slaughter>
  <Process>
    <P_House>National Agricultural Cooperative Federation in Naju-si</P_House>
    <Application_Form>Caw_A001</Application_Form>
    <Numbers>A001_01~12</Numbers>
    <P_PSN>NACF_A001_01</P_PSN>
    <BDX>Yes</BDX>
    <P_Date>January 11, 2008</P_Date>
    <P_Car>S9de 3321</P_Car>
  </Process>
  <Sale>
    <Sale_House>318 Naegi-ri Sanpo-myeon Naju-si Jeonnam</Sale_House>
    <S_Numbers>B01_11</S_Numbers>
    <S_PSA>Yes</S_PSA>
    <S_Manager>Gildong Kong</S_Manager>
    <S_Phone>010-5124-5113</S_Phone>
  </Sale>
  <Disease>
    <D_Name>Salmonella</D_Name>
    <Cause>Food</Cause>
    <Symptom>Food poisoning, Gastroenteritis</Symptom>
    <Treatment>Administration of antibiotics</Treatment>
    <Contagion>Yes</Contagion>
  </Disease>
</L.T.M.>

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Fig. 5. Electronic document capitalize on XML

3 Mobile Application Implementation

Mobile application for livestock history tracking management proposed in this study is as Fig. 6.

Initial screen of mobile application for livestock history tracking management is composed of individual identification number and NFC Tag. A user can monitor individual information of livestock through a desirable method. Individual information of livestock is divided into individual identification number, type of livestock, sex, date of birth, owner, place of husbandry, butchery, date of butchery, and processing factory.



Fig. 6. Mobile Application for Livestock Traceability Management System

4 Conclusion

Domestic livestock industry insists the attachment of label which contains the livestock information in order to prevent false notification of livestock distribution market and place of origin.

A NFC based livestock history tracking management system proposed in this study can monitor individual information of livestock with the utilization of NFC tag. Individual information is saved and managed to history cloud with division into production, butchery, processing, and sale stage. The data saved to history cloud can be monitored through smart devices or web portal. Also, the disease related information can be monitored by providing alarm function together with data update when abnormal symptoms occur for each livestock. By supplementing the problem of previous system and monitoring the information on each livestock through proposed system, the information of livestock sold to the consumer can be monitored and it makes consumer feel at ease of purchasing. Also, history information can be traced for countermeasure when hygiene related problems occur.

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