Chicken and Egg Food Traceability System Based on NFC and QR Code Technology

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Abstract. Chicken and egg food traceability system based on NFC and QR code technology was designed. The traceability system registers and uploads the information of raised chickens through the chicken foot ring embedded with NFC tag. The system generates egg QR code according to the registered information and prints it on the eggs corresponding to the raised chickens. It is used for consumer users to scan and query the relevant information of the eggs and the raised chickens, including the breeding address, breeder and breeding record of the raised chickens. The system is designed based on the classic three-layer mode of the Internet of things and the B / S architecture. The system mainly realizes the traceability of chickens through NFC tags and eggs through QR codes. It has high stability and great application and promotion value.

Keywords. NFC, QR code, RFID, IoT

1. Introduction

With the increasing improvement of living standards, people's view of food health has risen to an unprecedented height, and the safety of chicken and egg food has been the concern of the public. At present, there is no complete system and method for the safety traceability system, nor can it run through the whole process from production to consumption. The current traceability system generally uses one-dimensional bar code technology for product identification, and then scans from delivery, storage and transportation to sales to record the circulation process, so as to achieve the purpose of traceability. However, due to the non uniqueness of one-dimensional code and its easy duplication, the traceability does not have real credibility, and the intermediate link is easy to be forged, so consumers can not really rest assured.

Radognat et al. [1] studied the framework for enhancing food safety and traceability, Zhao et al. [2] studied the impact of health risk perception on the purchase willingness of traceable fresh fruits in the Chinese blockchain, and adamashvili et al. [3] studied the wine supply chain based on the blockchain. However, these studies are only aimed at a certain circulation link, which can not be connected before and after, and can not achieve the purpose of real traceability. In addition, the verification and query methods provided by these traceability systems for consumers are generally network query or voice phone query, which greatly increases the possibility of fraud, and the enthusiasm and query convenience of consumers are also poor. Therefore, it is necessary to establish a complete set of chicken and egg food traceability system.

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This paper designs a chicken and egg food traceability system based on NFC and QR code, which includes information input equipment set in 1) breeding, 2) processing, 3) storage, 4) transportation and 5) sales. The input information is respectively connected to the host of each link. In the breeding production link, the NFC tag is used to identify the identity information of livestock and production raw materials. In all links, the CPU card is used to identify the subject identity, legal identity information, transaction records, history records, purchase information and sales information; Wherein, the identity information is scanned and uploaded to the production link host through the information input device, and each link host is wirelessly connected to the management terminal and the market query terminal through the Internet. The system also includes a backup server, a data server, an application processing server and a remote access server that are connected in sequence. The server is wirelessly connected to the management terminal and the market query terminal through the firewall and the Internet, the handheld terminal query machine is wirelessly connected with the application processing server.

The contributions and innovations of this paper are summarized as follows:

1) Designed the food traceability system architecture.
2) NFC and QR code technology are implemented in the system.
3) The service application of system is realized.

The rest of the paper is organized as follows: the second section designs the system architecture, the third section realizes the key technologies of the system, the fourth section realizes the application of system services, the fifth section carries out experiments and compares with manual traceability, and the sixth section summarizes the full text.

2. The System Overall Structure

The system adopts the classic three-layer design mode of the Internet of things, namely, the perception layer, the network layer and the application layer; The system adopts B / S architecture and takes the database as the center to build the system. The system block diagram is shown in Figure 1.

In this system, the perception layer is mainly embodied in the data interaction between smart phones, NFC tag foot rings and egg QR codes. Smart phones with NFC function can contact and scan the foot rings with NFC tag function worn on the chicken feet in the chicken farm to register all chickens in real time; At the same time, the corresponding egg two-dimensional code is generated according to the registered and uploaded data, which is used for printing the two-dimensional code of the egg shell produced by the chicken to realize the correspondence between the egg and the chicken.

The network layer is mainly used to transfer data between the perception layer and the application layer. It is composed of Internet, mobile operator network, network management module, etc. the network layer can realize large-scale and long-distance communication, and is an indispensable part of the whole system [4].

The application layer mainly serves users. In this system, users are mainly divided into two groups: chicken farm management personnel and consumer users. The chicken farm management personnel can realize the chicken registration and information query through the interface information interaction between the smart phone and wechat applet; The chicken farm staff can also view and manage the corresponding data on the

system data service platform. The consumer users can scan the QR code on the eggs through the wechat small program specially released for them to trace the source, so that the consumer users can find it and eat at ease.
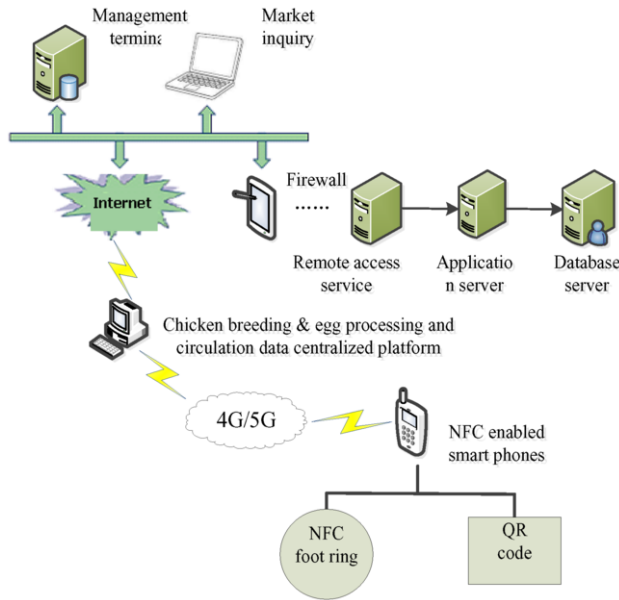

Figure 1. System archetecture diagram

3. System key technology

3.1 Short range wireless communication technology

Near field communication (NFC) is an important part of the sensing layer. NFC technology is evolved from the integration of contactless radio frequency identification (RFID) and interconnection technology. It has the advantages of low power consumption, low cost and high security. At the same time, with the rapid upgrading of smart phones, most of them have NFC reading and writing functions, which is very convenient. NTAG chip is adopted as NTAG216, with a capacity of 888 bytes, which is sufficient to store relevant registration information [5]. The entire NFC tag is embedded in the chicken foot ring. The structure of NTAG216 is shown in Figure 2.
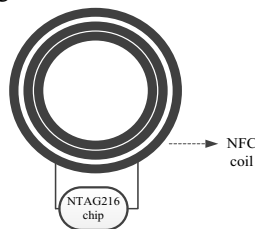

Figure 2. NTAG216 archetecture diagram

When the chicken farm staff reads and writes the chicken ring information, open the smart phone with NFC function and set the phone to NFC card reader mode using app or wechat applet [6]. After the setting is completed, the NFC chicken ring data can be read and written by leaning into the chicken ring. The information is mainly used to identify the identity information of chickens in the process of chicken breeding and production. During the process, various process records can be added, such as breeding address, breeder, breeding record, etc., but they cannot be tampered with by others, thus ensuring the authenticity, reliability and uniqueness of the original source information. Its operation is shown in Figure 3.
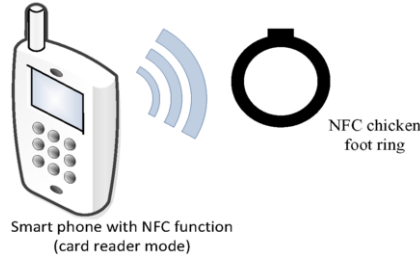
Figure 3. Chicken ring information reading and writing

3.2 QR code technology

Two dimensional code is a product derived from one-dimensional code technology. Compared with the previous one-dimensional code, the two-dimensional code has the advantages of high storage density, error correction capability, wide application in combination with other technologies, and can store various kinds of information such as Chinese characters, letters and numbers [7]. QR code, code 16K and code one are common two-dimensional code formats [8]. In this system, QR code is in the format of QR code.
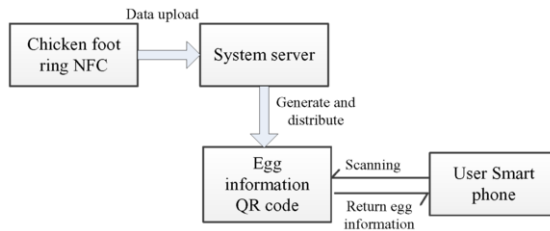
Figure 4. Generation and use of QR code

The QR code label is used for egg identification. That is, during the laying process of the chicken to which the egg belongs, the original NFC tag information plus the egg information (laying time, inspection mark, etc.) are converted into information codes into two-dimensional codes. Each egg has a unique two-dimensional code, which records the identity ID, source, batch, inspection qualification information, subcontracting time, secondary processing industry information, etc. of the food. The two-dimensional code can be used as the traceability code of the product, and it can be scanned and checked in all links. Every time it is transferred and disassembled, a new two-dimensional code will be generated for subsequent traceability until the final consumer. The two-dimensional code is encrypted by the encryption algorithm and

encoded. It can not be copied and reconstructed at will. Consumers can query the source and circulation of the product anytime and anywhere through smart phones, which is very convenient and the system deployment cost is extremely low. The two-dimensional code generation and use process is shown in Figure 4.

4. Application service

The system adopts B/S architecture, and its service architecture is shown in Figure 5. The service part is mainly divided into three modules, namely, the basic module, the application module and the data storage module.

The basic module is the construction foundation of the whole application service, including the function erection of the network service end, the erection of the mqtt service, the erection of the protocol processing service and the establishment of the data storage driver interface.

The function of the application module is: Based on the pure data obtained by the basic module, perform corresponding logic processing according to the required business, and display the data to the user; The application module performs corresponding linkage to the other two modules in the service architecture according to the user's operation at the B-side, that is, the browser side.
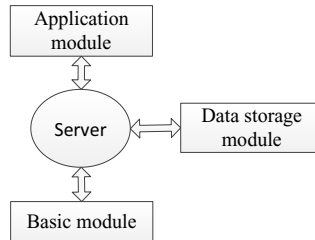
Figure 5. Application service architecture

The data storage module is mainly composed of a database server, which is used to store the information generated in the system, including the user information of the chicken farm management personnel and consumers, the upload registration information of the chicken foot ring collected by the perception layer and the egg two-dimensional code information generated according to the registration information, the process information of the egg from generation to market circulation, the consumer user query related information, the system operation log information and other data. The system itself is the collection of information, and the data storage module provides data support for the whole system, which is the core part of the system. In this system, MySQL database is used. MySQL is a multi-user and multi-threaded database management system. As the current mainstream database, it has the advantages of transaction security, on-demand scalability, high availability, high reliability, fast start and so on.

5. Experimental results and comparison

The main hardware component of the chicken and egg food traceability system based on NFC and QR code is the foot ring. The physical diagram of the foot ring development is shown in

Figure 6, the physical simulation diagram is shown in Figure 6 (a), and the actual diagram of the foot ring is shown in Figure 6 (b).
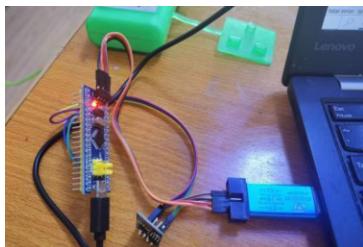
(a) Simulation picture of development board   (b) Actual picture of foot ring

Figure 6. Pictures of foot ring development

Compared with manual source tracing, the system is fast, easy to operate, highly reliable and powerful. It can identify the chicken breeding address, breeder, breeding record and other information, so that users can eat safely.

6. Conclusions

The large-scale application of the system makes the process of chicken and egg production more transparent and open. The management personnel of the chicken farm scan the foot rings on the chicken feet of the chicken farm through the smart phone with NFC function and upload the information of the registered chickens; The system generates the egg QR code according to the uploaded registration information and prints it on the egg. The QR code printed on the egg can allow the consumer to use the smart phone to scan and trace the source, including the chicken breeding address, breeder and breeding record corresponding to the egg. As a passive tag, the NFC tag embedded in the foot ring has the characteristics of short distance, low energy consumption and high bandwidth. Moreover, most smart phones in the market integrate the NFC card reader function, so it is easier, safer and faster to use. The chicken and egg food traceability system based on NFC and QR code technology has high application and promotion value.

Acknowledgement

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