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Research Article

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Beef quality and safety traceability system based on RFID technology

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ABSTRACT

In order to allow consumers to trace to the whole process of beef breeding, production and processing after purchasing beef, to achieve smart, fast and practical goals for quality and safety of beef traceability system, B / S (Browser / Server) mode architecture is used to build quality beef traceability system based on RFID technology in this paper. Through the use of RFID technology, system implements all aspects of information tracking and traceability for each head of beef cattle from breeding, slaughtering and processing, cold chain storage and transportation. And form a quality retrospective file which can be queried on the Internet network for each head of beef cattle. Solve the problem in beef cattle production source take cattle individual as the unit to implementing quality monitoring and implementation of traceability. The system implements safety warning function for cattle breeding epidemic and product quality, so it can ensure the safety of beef products from all aspects of production management.

Key words: RFID technology, beef quality, traceability system, product safety

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INTRODUCTION

With economic globalization, cross-border and inter-regional flow of food more frequently, a variety of food safety incidents and hazards were rapidly expanding and is spreading [1]. How to ensure the safety of meat had been global issues which placed in front of today's government, food manufacturers and food scientists and urgent to be solved [2]. To this end, scholars at home and abroad conduct a lot of research on building safety system framework of the whole process of beef production [3].

In other countries, radio frequency identification (RFID) technology in the field of food quality control has been widely studied [4,5,6]. Australia established a livestock labeling and traceability system, using a unified electronic identification ear tags for cattle management [7]. Japan has established a food card system since 2001, namely agricultural biographical system which is used to implement agricultural production and marketing tracking [8]. SYSCO company, North America's largest food service marketing and distribution organization has showed that the ability of RFID to monitoring temperature, humidity and other environmental parameters during transport is strong, can effectively ensure food quality and quality safety. In domestic food security, RFID technology has gradually become a hot research [9]. At present, the domestic traceability system mostly establish for farms or processing enterprises, often neglected phase of product sales tracking and tracing [10]. The product sales stage is the entrance to fake and shoddy products into the consumer market. If you neglect this stage of the product information monitoring, resulting in counterfeit products into the consumer market, so tracing for farms and processing enterprises upstream would be meaningless. Therefore, in-depth study of beef cattle traceability system to track the product life cycle, to improve the quality and safety of beef in China, increasing consumer confidence in beef consumption has far-reaching social significance.

In this study, the RFID technology is introduced to identify individual and beef cattle, and the collected data of the growth of cattle, beef processing and marketing of various processes is uploaded to network database which is

designed in "PHP + MySQL", the whole process of product quality beef tracking and tracing can be achieved.

SYSTEMS ANALYSIS

Traceability platform system analysis using the Unified Modeling Language (UML) to analyze, describe platform software system and construct the system model. UML-based modeling system follows the core ideology and basic principles of Rational Unified Process (RUP), namely using Use Case driven, system architecture as the core of iterative object-oriented analysis and design process. Here follow the RUP system to model.

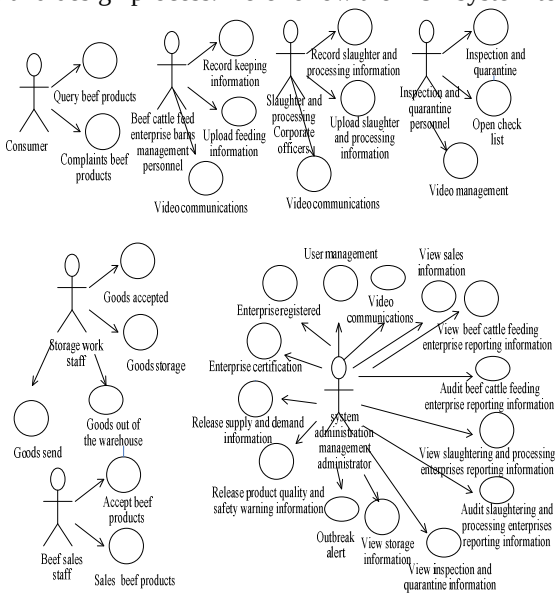

Fig.1: Beef traceability system use case diagram

Identify traceability platform participants: traceability platform participants including consumers, staff who input each barns feeding information, slaughter and processing enterprise administrators, operators, inspection and quarantine personnel, system administration management administrator, storage and transportation business administrator, beef sales enterprise administrator and so on.

Identify use cases, draw a use case diagram, the mainly use cases are shown in figure 1.

Analysis of traceability platform information. Beef production, cattle slaughtering and processing enterprises first applied for certification of production of "pollution-free, green" beef cattle product identification to a third-party beef cattle management system (reporting information including the location, the full name of the applicant, product names, trademarks, annual and other information). Third-party system management department organize personnel to test, publish beef production company directory on the website after testing, and promotion of its products and distribution purchase, sale information.

Beef cattle producers take cattle barns as the unit to record each barns cattle breeding information. After 1.5 to 2 years, the production of beef products is tested and inspected by inspection and quarantine departments, it will be sent to slaughter and processing sectors after passing inspection.

Slaughter and processor record for each batch of beef slaughter and processing information. The products of production beef enter the areas of circulation and sale after inspection and quarantine. People of storage and transportation record reception, storage, warehousing and cargo send a message of transportation links.

Sellers record sales cycle information. Consumers can inquiries all aspects of the sales information from cattle rearing, beef slaughter and processing, storage and transportation to sale through network, SMS, telephone and other media after buying beef products. Founding that product quality problem, they can complain through product traceability codes.

System management department view and audit management, epidemic early warning and beef product quality and safety warnings of information reported by cattle producers and slaughter and processors.

SYSTEM DESIGN

A. TRACEABILITY SYSTEM ARCHITECTURE DESIGN

The system software is designed on the basis of previous studies on the use of PHP + MySQL to develop and design.

Dynamic web is designed by using PHP, the collected cattle rearing and slaughter and processing, and other related information are stored in the network database. Access and share information by using Web dynamic interactive technology and browser / server (B / S) mode to, so all levels producer and consumer can inquiry and trace.

The system consists of a core of enterprise management systems, central database, consumer-oriented retrospective platform. Core system consists of three parts which are client layer, application layer and database layer, shown in figure 2. Client layer uses PHP to design client dynamic page, mainly to complete the interaction between user's front functions and back functions and output final results query; Application layer, which is the core of the system, depending on the different data request realizes the data processing and computing and completes the application logic and functionality of quality traceability system users by returning the need data format through data conversion middleware; Database layer, including all data related to the platform, which include user information, product information, process information, historical information and so on, achieves traceability data information storage and management and provides data support to quality traceability system function. It exchanges data with other enterprise systems on supply through the Web Service, provides to consumers in the form of services and consumers query in network by product number after purchasing products.

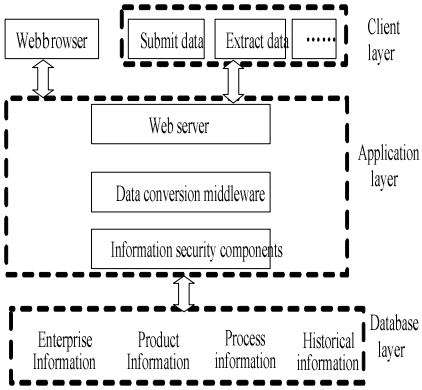

Fig.2: Core system architecture

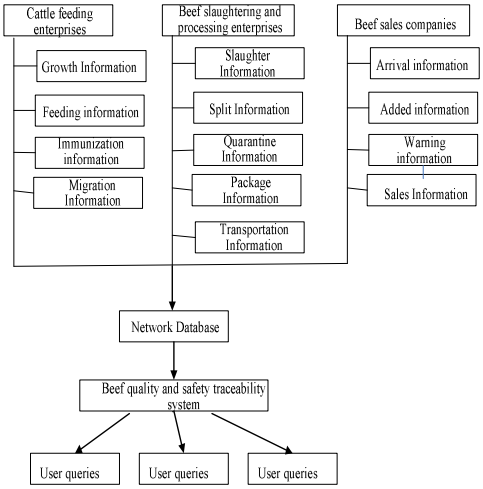

Fig.3: The overall design of the structure diagram of the system

The overall design of the structure diagram of the system is shown in Figure 3, the foreground structure of the system is shown in figure 4 and background function structure of the system is shown in Figure 5.

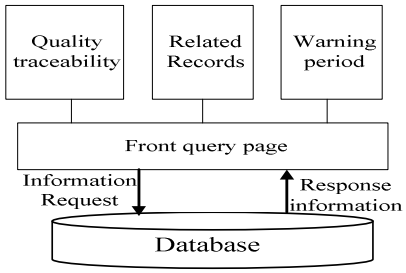

Fig. 4: The foreground structure of the system

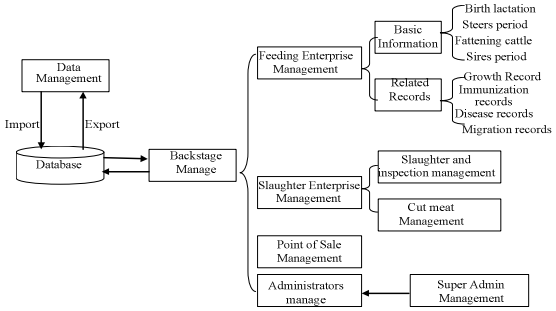

Fig.5: The background function structure of the system

B. SYSTEM FUNCTIONAL DESIGN

(1) Realization of cattle breeding subsystem: Cattle breeding management subsystem which is designed according to cattle breeding process mainly relates to feeding cattle, individual identification, immune disinfection, beef transfer group, feed feeding, treating cattle, beef cattle slaughter, etc. Employees real-time record various information which include all aspects of cattle breeding, feed, medicines out of storage, etc., required to report to system management department. In this process, the system management department will achieve early warning breeding irregularities according to standard library breeding withdrawal period, illicit drugs list, cattle breeding work practices. Consumers can check beef cattle breeding information via the website system, the need to beef slaughter inspection and quarantine before entering the next link. Beef cattle need inspection and quarantine before entering the next link after slaughter.

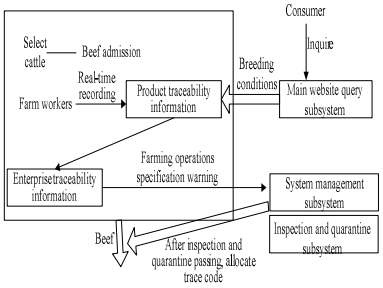

Fig.6: Cattle breeding subsystem frame

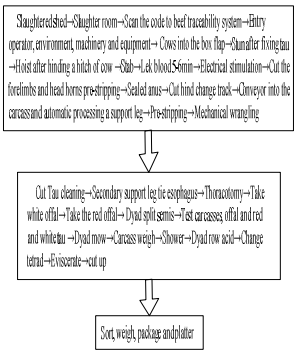

Fig.7: Slaughter flowchart

(2) Realization of slaughter subsystem: Slaughter and processing subsystem records information of slaughter and processing according to standard slaughtering process, shown in figure 7.

(3) Realization of inspection and quarantine subsystem: Inspection and quarantine personnel login in inspection, quarantine subsystem, print inspection and quarantine certificate of cattle breeding systems and slaughter processing subsystem, transportation inspection and quarantine report of beef storage subsystem and market access for inspection and quarantine report of beef sale subsystem. The frame of specific implementation process is shown in figure 8.

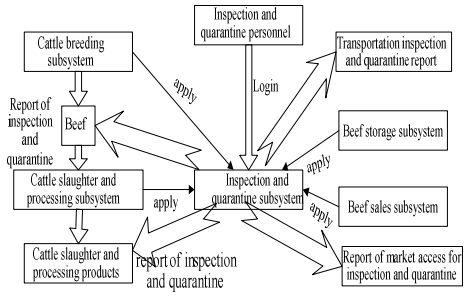

Fig.8: The frame of inspection and quarantine Subsystem

(4) Realization of storage subsystem: Warehouse information (warehouse number, storage charge, temperature of warehouse), delivery information, shipping information (delivery dates, delivery locations, transportation, transportation responsible units and responsible persons), pick-up information (date received, location, transportation responsible units and responsible persons), etc are record.

(5) Realization of sales subsystem: The date of sale, sales locations, sales leaders, sales units, sales and other information are needed to record.

(6) Realization of system management subsystem: System management is a third party of beef industry technology system outside of business and government. System management subsystem is the core of the retroactive platform, whose main responsibilities are: business registration and certification; review and audit all kinds of information reported by all aspects of the beef industry chain; preset warning parameters through breeding operating standards, the number of deaths which are reported by beef cattle in order to achieve breeding irregularities and epidemic early warning; can also timely warn beef product quality by evaluation and complaints by consumers. Implementation framework of early warning functions of system management is shown in figure 9.

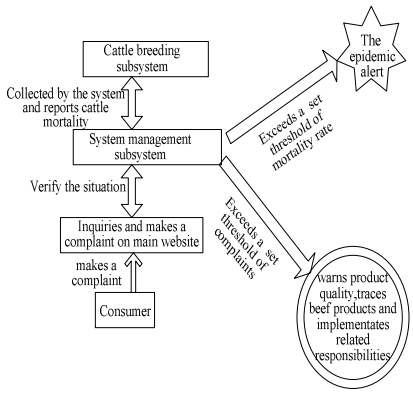

Fig.9: Functional framework diagram of early warning subsystem of system management

The system set up super administrator, farms administrator, slaughter plant administrator, sales administrator, system administrators and ordinary users administrations, which are given different management authority to manage or query the database.

Query: ordinary user opens the Web page. Basic information of the cattle, slaughtering information and storage information, sales information and so on can be queried based on the 14 cattle ear tag or meat division of 17 numbers. Management: Administrators with different permissions can add, modify, or delete data table in different database. Super administrator has the highest privilege and he can do all the operations of the entire site, including adding administrators at all levels, the operation of all database data. Other administrators timing input the business data in detail.

C.DATABASE DESIGN

Some of the database tables which are designed in the system are shown as follow.

Table 1 RFID ear tag table

Field name	Data Types	Constraint
earid(Ear label)	Varchar(30)	Primary Key
weight(Slaughter weight)	Varchar(30)	NULL
munityrecs(Immu-nization records)	Varchar(30)	NULL
treathrecs(Treatme-nt records)	Varchar(30)	NULL
Birthday(Date of birth)	Varchar(30)	NULL
Feeders(Feed)	Varchar(30)	NULL
health(Health Status)	Varchar(30)	NULL

Table 2 feed fed table

Field name	Data Types	Constraint
feedid(Feeding No.)	int	Primary Key,Denity(1,1)
earid(Ear label)	Varchar(30)	Primary Key
feedstiffid(Feed No.)	Varchar(30)	NULL
feedingday(Fee-ding time)	Varchar(30)	NULL
feedstatus(Fed -state)	Varchar(30)	NULL
operator(Breeder)	Varchar(30)	NULL

Table 3 Beef treatment table

Field name	Data Types	Constraint
earid(Ear label)	Varchar(30)	Primary Key
treathid(Treatment No.)	int	Primary Key,Denity(1,1)
cattleid(Kraal No.)	Varchar(30)	NULL
dieeasename(Cattl-e Disease Name)	Varchar(30)	NULL
dieeaseday(Treat-ment Date)	Varchar(30)	NULL
treathmethod(Trea-tment methods)	Varchar(30)	NULL
treater(Veterinary)	Varchar(30)	Varchar(30)

D. SYSTEM IMPLEMENTATION

The system uses the MVC (Model View Controller) design pattern, the system consists of three parts: Model refers to the business data / information processing modules, including access to business data processing, computing and integration, namely the database module, a key part of the program which is executed, is responsible for establishing the connection to the database, create a data table, store data and in response to user queries, etc. in the system; View refers to the user interface which is user-oriented data show, namely the front display module which provides

tracking of each piece of beef traceability information to consumers, the result is to be displayed by the view after the operation of the database module. Controller is used to manage interaction which occurs between user and the view to determine appropriate keyword of the query information, and is responsible for handling Model, manage it in order to satisfy the query of the user interface.

Ordinary users simply log in, the administrator log in which requires a user name and password. Login screen shown in Figure 10. Administrators can query, add, modify, and delete the relevant information, farm administrator to add information page shown in Figure 11. Ordinary users can query information on beef. As shown in Figure 12.

Fig.10: System log

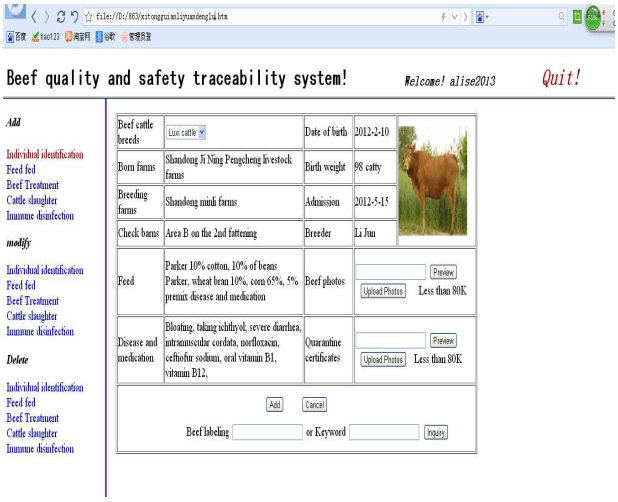

Fig.11: Farm administrator add information

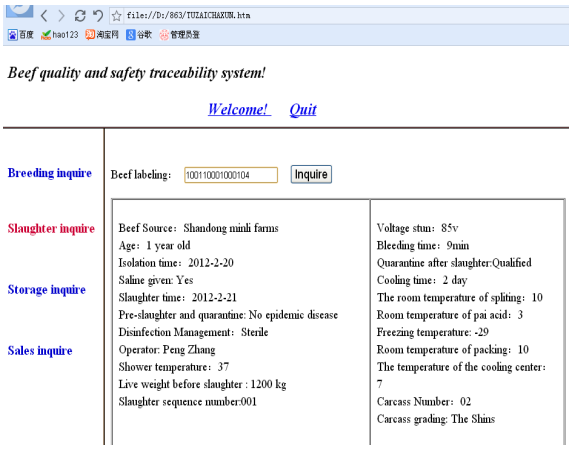

Fig.12: Ordinary user queries interface

CONCLUSION

Quality and safety of beef traceability system based on RFID technology takes into account the interests of producers, regulators and consumers in three aspects: Because this system effectively monitors the farming environment, not only improves the quality of beef cattle which are raised, reduces business risk of farming enterprises due to high rate of Cattle culling rate, but also forms a reliable and accurate traceability of product quality information for every head of cattle. Regulators can timely guidance on beef cattle production, quality safety of beef products is implemented certification, inspection, market access, early warning and confirmation of responsibility in order to achieve effective supervision; Consumers inquiry a variety of information from production to sales of the purchased beef products through a variety of inquiries media, evaluate and complaint to protect their interests.

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