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DATABASE FOR QUALITY CONTROL OF PRODUCTS USING THE INTERNET OF THINGS

Abstract
for a Master's Degree
in the Specialty 1-45 80 01 Infocommunication Systems and Networks

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INTRODUCTION

Research on smart animal husbandry began as early as the 1980s, and the Netherlands began to build digital dairy farms in the 1980s; Israel Afikin Company developed Afi Farm Management System in 1984; Spain Agriee Software Company 1989 Dairy Cow Developed cow management software.

In recent years, with the development and application of Internet communication technology, radio frequency identification technology (RFID), infrared sensors and other technologies, the production model of "Internet of Things + animal husbandry" has begun to attract more and more people's attention, and there are many related The products are designed and used, such as the cow estrus detection system invented by Shanghai Jiaotong University and Wuxi Internet of Things Research and Research, Hebei Agricultural University monitors the health of cows by checking physiological parameters such as body temperature and physical activity of cows through sensors and electronic devices. However, there are still relatively few items on the detection of milk quality.

This master thesis (MT) is devoted to developing IoT milk quality control management database. The MT should achieve the following established tasks:

1 Analyzing the "Internet of Things + Milk Quality Control" system and analyze the parameters of milk quality.

2 Analyzing the structure and function of the database management system and realize the structure design of the milk quality control database.

3 Building the milk quality control database on the cloud server.

4 Simulating data transfer to the database on the cloud server through the mobile phone.

5 Receiving milk information from the cloud database through their mobile phones for subscribers.

6 Designing of the milk quality control database is realized.

The basic information of dairy cows and the quality of milk are stored in the database. By testing the health of milk, it is possible to know in advance which cows are suitable for milk production, and through the detection of milk quality, which cows can be traced There is a health problem. It is very helpful to the development of the milk industry, has high commercial value, and has high research value combined with the currently very popular Internet of Things technology.

GENERAL DESCRIPTION OF WORK

Relevance of the subject

The work corresponds to paragraph 1 «Digital information and communication and interdisciplinary technologies based on them production» of the priority areas of scientific, technical and innovative activities for 2021 - 2025. The work was carried out in the educational institution Belarusian State University of Informatics and Radioelectronics. Dissertation research was carried out within research work SB 21-2033 «Processing, coding and transmission information in network-centric systems».

The aim and tasks of the work

The aim of the work is to design an IoT milk quality control database.

To achieve this goal, the paper addresses the following tasks:

1 Introduce the concept of IoT, related technologies and database analysis.

2 Develop the structure and function of database management system, design the logical and physical structures of milk quality control data.

3 Analyzed the selection of programming tools, the design of the milk quality control database, the simulation of sensors to send data to the database and subscribers to view data through mobile phones.

Personal contribution of the author

The content of the dissertation reflects the personal contribution of the author. It includes the analysis and design of the milk quality management control database, building a cloud database through Google Cloud Platform, simulating sensors to send data to the cloud database and subscribers receiving data from the cloud server through their mobile phones.

Task setting and discussion of the results were carried out together with the supervisor Vishniakou Uladzimir Anatolievich, Doctor of Science, Professor.

Testing and implementation of results

The main provisions and results of the dissertation work were reported and discussed at international conference: Telecommunications: Networks and technologies, algebraic coding and data security (Minsk, November - December 2021); international seminar: Coding and digital processing of signals in infocommunications (Minsk, March - April 2022).

Author’s publications

According to the results of the research presented in the dissertation, 4 author’s works was published, including: 4 articles in international conference and

seminar proceedings.

Structure and size of the work

The dissertation work consists of introduction, general description of the work, three chapters with conclusions for each chapter, conclusion, bibliography.

The total amount of the thesis is 68 pages, of which 45 pages of text, 26 figures on 8 pages, 12 tables on 5 pages, a list of used bibliographic sources (68 titles on 3 pages), a list of the author's publications on the subject of the thesis (4 titles on 1 pages), graphic material on 6 pages.

Plagiarism

An examination of the dissertation « Database for quality control of products using the internet of things» by Zhenghua Liu was carried out for the correctness of the use of borrowed materials using the network resource «Antiplagiat.ru» (access address: https://www.antiplagiat.ru /) in the on-line mode 31.03.2022. As a result of the verification, the correctness of the use of borrowed materials was established (the originality of the thesis is 94,58%).

SUMMARY OF WORK

In the first chapter we introduced the concept of the Internet of Things, then introduced the product quality control of the Internet of Things, and finally introduced several types of databases used on the Internet of Things and some parameters that affect the quality of milk.

In the second chapter we introduced the structure and function of the database management system, then described the structure of the milk quality control database, and finally introduce the structure design of the milk quality management database, and introduced the logical structure of the milk quality management database through the E-R diagram (Entity-Relationship Diagram), By introducing the fields and corresponding attributes of each table, the physical structure of the milk quality management database is introduced.

In the third chapter through the analysis of the advantages and disadvantages of the database, combined with the requirements of this thesis, we chose the MySQL database as the target database, used Android Studio as the development tool, and then introduced how to install the MySQL database on the cloud server, and how to create a database by connecting to the database through the corresponding SQL statement. We gave examples and created corresponding data tables. Then we introduced how to realize database connection through logic code, as well as add and query data, and showed how to realize the jump relationship

between APP interface design interfaces through Android Studio. Showed how to add data to the database through the APP, how to query the data and display it in the user interface.

According to the parameters used in milk quality control, the logical structure of milk quality control database is designed (see figure1).

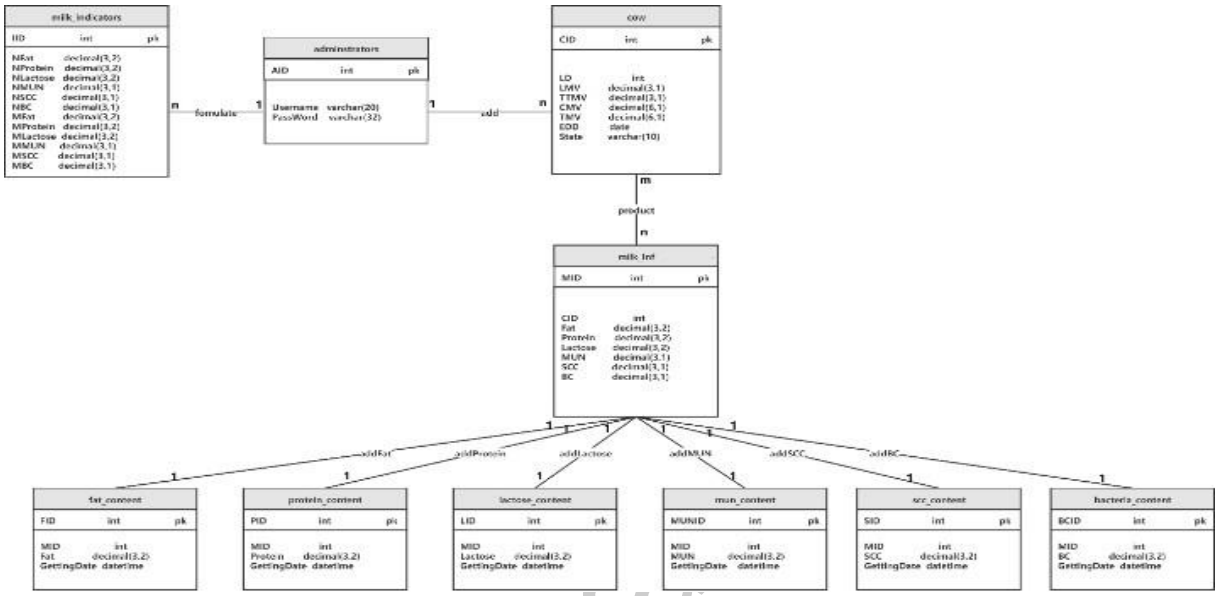

Figure 1 - Milk quality control database model diagram

According to the design of the milk quality database, a MySQL database is built on the Google cloud platform, and the design of the milk quality control database is realized through the corresponding SQL statement, take the milk information table as an example (see figure 2).

```
mysql> CREATE TABLE `milkquality`.`milk_information`  (
    ->   `MID` int(255) ZEROFILL NOT NULL AUTO_INCREMENT,
    ->   `CID` int(255) NOT NULL,
    ->   `Fat` decimal(3, 2) NULL,
    ->   `Protein` decimal(3, 2) NULL,
    ->   `Lactose` decimal(3, 2) NULL,
    ->   `MUN` decimal(3, 1) NULL,
    ->   `SCC` decimal(3, 1) NULL,
    ->   `BC` decimal(3, 1) NULL,
    -> `GettingDate` datetime NULL,
    ->   PRIMARY KEY (`MID`)
    -> );
Query OK, 0 rows affected (0.02 sec)
```

Figure 2- Create table milk_information

Through comparative analysis, this paper uses Android Studio to develop an application for simulating the sensor to transmit data to the cloud database, and for subscribers to view the milk quality data through their mobile phones. The specific user connection interface (see figure 3), and the simulated data transmission is as follows (see figure 4), the user views the milk quality control data (see figure 5).

Figure 3 - Login

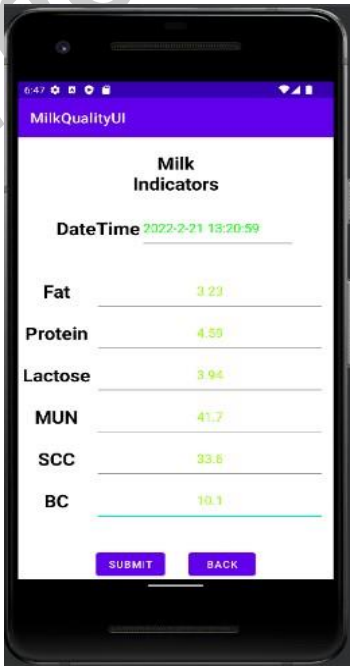

Figure 4 - Submit

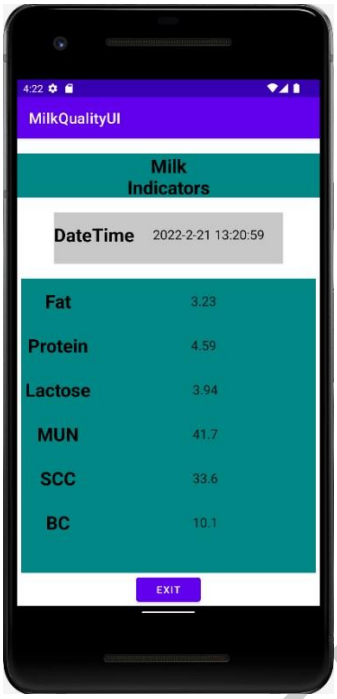

Figure 5 - Show

There are still some deficiencies in this paper. For example, the quality of the milk obtained from the dairy farm is not directly tested, but is realized by simulation, which may have some deviations from the actual situation，but the overall findings are quite satisfactory.

On the other hand, in this thesis, the results of the research and analysis based on the Internet of Things milk quality control database can be extended to the quality control of any Internet-based product, such as the quality control of beef, etc.

CONCLUSION

This thesis discusses the design of the milk quality management database on the Internet of Things system. The architecture of the Internet of Things system is divided into four layers, which are the perception layer responsible for data collection, the network layer responsible for data transmission and network access, responsible for providing the support layer of the application support platform and the application layer used for different scenarios and user interaction. The database belongs to the platform support layer that provides data storage [1-A].

1 In the first chapter, we introduced the concept of the Internet of Things and its architecture, introduced the use of the Internet of Things for product quality control. Then we introduced several types of databases used in IoT systems, including relational databases and ACID principles, non-relational databases, base theory, distributed real-time databases and CAD theory. We introduced the types of

databases, including relational databases, non-relational databases, and distributed databases, and introduces the database design principles followed by these types of databases[3-A].

2 The indicators for milk quality assessment were introduced, including milk fat content, protein content, lactose content, milk urea nitrogen content (MUN), somatic cell count (SCC) and bacterial count (BC).

3 In the second chapter, we introduced the structure and function of the database relational system. DBMS provides the data definition language DDL (Data Definition Language) data manipulation language DML (Data Manipulation Language) function, database operation and management, data Organization, storage and management, database protection, database maintenance, and communication functions.

4 We introduced the structure of milk quality database, which consists of milk information table, cow table, fat content table, protein content table, lactose content table, urea nitrogen content table in milk, mitochondria content table, bacteria content table and so on. The structure design of milk quality database introduces its logical structure design through entity relationship diagram and database model diagram respectively. The physical structure design of milk quality database mainly introduces the field names and field attributes contained in each table[3-A].

5 In the third chapter, through comparative analysis, we chose MySQL database as our target database. In terms of programming tools, we chose Android Studio and database visualization tool Navicat Premium and introduced them respectively. The development environment is based on JDK1.8 and is developed using the Java language [4-A].

6 We installed the MySQL database on the Google Cloud server, design the user interface on Android Studio and implement the connection to the database. Also, we simulated sending the detected data to the database and shown how the data is sent to the subscriber's mobile phone through the database on the cloud server [4-A].

LIST OF AUTHOR'S PUBLICATIONS

1-A. Visniakou U.A. IoT network: models, structure, communications, problems / U.A. Vishnyakou, Hu Zhifeng, Du Zongqi, Liu Zhenhua, Yu Chunyu // Telecommunications: Networks and Technologies, Algebraic Coding and Data Security : материалы междунар. науч.-техн. семинара (Республика Беларусь, Минск, ноябрь – декабрь 2021 г.) / редкол. : М. Н. Бобов [и др.]. – Минск : БГУИР, 2021. – С. 56-61.

2-A. Chuyue Yu. Design of school bell automatic control system based on single-chip microcomputer / Yu Chuyue, Xia Yiwei, Du Zongqi, Liu Zhenghua //

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3-A. Zhenghua Liu. Structural design of the data base on the internet of things for product quality control / Liu Zhenghua // Coding and digital processing of signals in infocommunications: Materials of the International scientific study conf. (Republic of Belarus, Minsk, April 19, 2022) / Redaction. : V.C. Konopelko, V.Y. Tsykkov, L.A. Shicko. - Minsk: BSUIR, 2022. – P. 100-102.

4-A. Zhenghua Liu. Creating database IOT for product quality control / Liu Zhenghua, U.A. Vishniakou // Coding and digital processing of signals in infocommunications: Materials of the International scientific study conf. (Republic of Belarus, Minsk, April 19, 2022) / Redaction. : V.C. Konopelko, V.Y. Tsykkov, L.A. Shicko. - Minsk: BSUIR, 2022. – P. 62-65.