Agricultural Product Quality Traceability System Based on the Hybrid Mode

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Abstract. With the consumer's request to agricultural products is more and more strict, a traceability system of agricultural products quality based on hybrid mode is designed and developed in this paper. The system connects the various links of crop planting, acquisition, processing, distribution and sales, and obtains the real-time information from crop seed cost to agricultural product sales. It can make farmland scientifically be managed according to the information of crop growth environment, improve the use efficiency of agricultural resources, and is conducive to the sustainable development of agriculture. In addition, information processing and transmission, and sales of the crops from the seeding to the harvest and to the agricultural products are recorded in real time in the database so that the consumers can understand real-time information on produce. When unqualified agricultural products are detected, the production process of such products can be immediately controlled from the source, and the circulation of unqualified agricultural products can be more effectively controlled. In this way, the rights in the interest of consumers can be effectively guaranteed.

Keywords: Traceability system · Intelligent agriculture · Quality and safety

1 Introduction

Intelligent agriculture integrated with the IOT technology is a heart-shaped agricultural development model. It appears when Modern Agricultural Technology has grown to a certain phase [1]. Smart agriculture integrates information technologies such as Internet of Things (referred as IOT), Internet and wireless communication. Various sensor nodes are deployed in the detection area, maijorly collect the valuess of air humiture, illumination, soil humiture, and other relevant environmental information parameters of such heavy metals as nitrogen, phosphorus, potassium, cadmium, mercury and other components contained in the soil. At present, in order to promote the sustainable development of agriculture, it is necessary to greatly reduce the cost and corresponding consumption of agriculture. Therefore, it is necessary to adjust the equipment that implements automatic control in a timely manner, such as visual remote monitoring and operation, catastrophic warning, and agricultural precision planting. On this basis, the effective use of agricultural resources can promote the realization of intelligent agriculture [2].

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With the improvement of living standard, people more care about both the safety and the quality of food. Food safety is a significant matter in China, advancing a request to the government to improve the traceability Security System of Agricultural Product Quality. The process from agricultural production to marketing is monitored to ensure that residents get healthy and nutritious agricultural products.

The traceability system related to agricultural product quality has many composite sensors, wireless data transmission, intelligent gateway [3–5], Web Service [6], two-dimensional code (namely, QR code) [7] and mobile terminal technology, collecting the relevant information such as farming of agricultural product, fertilization, irrigation, weeding, pest control, harvesting. In addition, this mixed model also collects and records some environmental information in real time, covering temperature, humidity and light intensity during the growth of crops, as well as soil heavy metal detection, agricultural product processing, transportation and sales. They are included in the database in a timely manner, allowing government quality inspection departments and consumer groups to track the process of crops from growing to final processing as agricultural products without lagging behind. If the crops are determined to be unqualified by the government quality inspection department, the source of the quality problems will be quickly found, so as to effectively respond to such unsafe problems and prevent the circulation of unqualified agricultural products. Consumers can trace quality safety information while purchasing agricultural products in anytime, to safeguard their legal interest.

2 Methodology

The traceability system goes from crop planting to terminal distribution. The agricultural product quality and safety traceability system based on this model involves giving each field a unique ID logo, which involves the whole process of crop cultivation to final distribution. The ID becomes an important indicator for recording the aforementioned actions, such as sowing, fertilizing, crop healing, harvesting, and processing, transportation, as well as the information related to sales of agricultural products. Moreover, consumers can also track the relative information.

3 System Design

The system consists of hardware and software. The former is mainly responsible for collecting the real-time data of agricultural product planting, processing, circulation, distribution and sales, and loading it into the database. The latter is divided into Web services and Android clients, but Android clients cannot directly interact with the database. This article therefore mainly uses Web services to obtain data, and the Android clients implement data acquisition through the SOAP protocol, so that users can check and trace information.

3.1 Design of Hardware Environment

The main component of the hardware is various modules related to power supply, sensor, ZigBee and gateway, among which the power supply module is responsible for the power supply for other modules, sensor modules for the real-time collection of Environmental Data, and then the transfer to the gateway with the help of ZigBee module. The gateway module uploads thereafter the data to the database via a specific serial communication program.

3.2 Software Design

On the basis of the effective content read from the database according to the Web service, the hardware gateway module allows the Android client to complete the acquisition through the SOAP protocol. The end user finally contacts the database through a Web service to implement the software architecture of the data query function shown in Fig. 1.

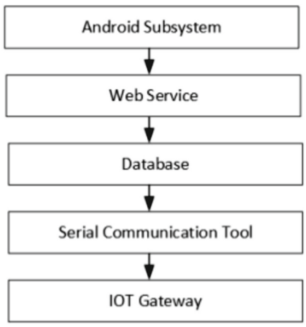

Fig. 1. Software architecture.

4 System Implementation

As mentioned above, the software system includes Web service and Android client. The mobile terminal is the main component of the system with the adoption of Android so that administrators and users can quickly query agricultural product information. While the back-end database selects SQL Server as a tool for managing data. The information completely from the SQL Server database is finally displayed on the Android side. The system uses the Web service as a bridge in the development process to realize the direct transmission of data, and communicates with the Web service through the mobile terminal to ensure indirect communication with the SQLSERVER database.

4.1 Web Service

For the query of the necessary data, the software structure of the Web service can be retrieved from the SQL Server database. Figure 2 exhibits the process of invoking data through Web services, including the information of each link of the crop planting process, as well as other information on pesticide residues, the environment collected by sensors, soil heavy metal detection and agricultural product quality tracking. To obtain the required data, click the corresponding hyperlink. For example, click "selectAllCargoInfor30" to call content related to the quality of agricultural products.

Fig. 2. Web service invocation method.

4.2 Android Client

The Android program includes four modules, which are responsible for farmland cultivation, crop growth, real-time monitoring of the growth environment and quality tracking of agricultural products. For the first two aspects, see Fig. 3.

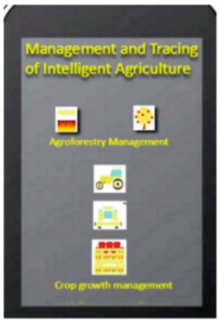

Fig. 3. Real-time mobile monitoring of growth and the traceabilitymodule of agricultural products.

The entire system is composed of three subsystems, namely production management, logistics unit and traceability information query, as detailed below.

Traceability Information Management Centre, as the Core of the System, Manages System Users and Their Permissions. In a shared database, it is mainly used to store index information that can be traced throughout the agricultural product supply chain, as well as related information provided by government regulatory departments and inspection and quarantine departments such as agriculture and quality supervision, and after the information is entered, analyze and output whole system.

The Subsystem of Manufacture and Logistics Parts can not sorely run independently as the identity of the unit's information management system, but obtain access rights after logging in to the system, trace, enter and modify the index information of each link of the agricultural product supply chain.

Traceability Information Query Subsystem allows consumers to trace information through various channels such as trace websites, self-service terminals, Android mobile systems, telephone customer service, etc., and promote, recall and complain about problematic products.

5 Hybrid Traceability Quality and Safety Query for Agricultural Products

Under the background of fast growth of the Internet, acceleration of mobile networks and popularization of smart phones, the system should gradually be widely adapted, mainly including:

PC Web Site Query. You can log in "agricultural product quality safety to trace a system" website, t, carry on the inquiry, and search the traceability information by using any Networked computer.

Self-service Terminal Query. Wholesale centers, supermarkets, and the markets of farm produce set up special business terminals to facilitate consumers to trace agricultural product information.

QR-tag Scanning Query. Scanning of QR codes with smart phones can open the quality traceability website in an automatic way, or directly decode the information traced of the agricultural products.

Android Client Query. Consumers can search source information whenever and wherever through We Chat or brief messages.

In the quality and safety traceability system, these methods are combined with each other to form a mixed query model. This is a typical performance that fully utilizes the mainstream development technology that currently appears in the field of information technology, providing consumers with more convenient methods for querying traceability information as shown in Fig. 4.

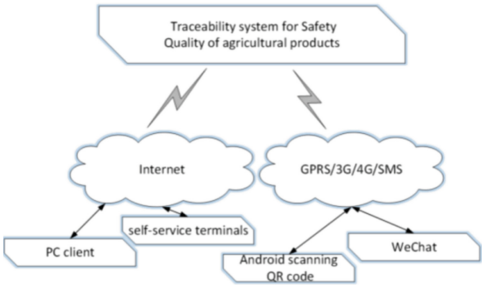

Fig. 4. Hybrid query mode for traceability information.

6 Conclusion

The system successfully links the entire process related to crops, including planting, management, procurement, processing, transportation and distribution. This aspect helps farmers manage agricultural production scientifically based on the external growth environment of crops, and improves the utilization rate of agricultural resources on the basis of improving the transparency of logistics; on the other hand, the detailed content of each link is recorded in the database in real time. In this way, consumers can more easily understand and grasp the traceability information of agricultural products in order to solve any safety management problems that may occur.

References

1. Pivoto, D., Waquil, P.D., Talamini, E., Corte, V.F.D., Mores, G.D.V.: Scientific development of intelligent farming technologies and application in Brazil, Information Processing in Agriculture. J. (2018)
2. Ibrahim, A., Muhammad, R., Alshitawi, M.M.: Intelligent green house application based remote monitoring for precision agricultural strategies: a survey. J. Appl. Sci. **7**, 947–952 (2017)
3. Yang, Y., Wei, K.: The key technology research of quality and safety traceability systems of agricultural products. In: International Conference on Intelligent Transportation, pp. 880–882 (2018)
4. He, C.L., Shen, M.X.: Design and realization of a greenhouse temperature intelligent system based on NB-IoT. J. South Chin. Agric. Univ. **39**(2), 117–124 (2018)
5. Zheng, Q., Peng, L.: The design of remote greenhouse monitoring system based on the embedded web server. J. Agric. Mech. Res. (2013)
6. Chen, N., Zhang, X., Wang, C.: Integrated open geospatial web service enabled cyber-physical information infrastructure for precision agriculture monitoring. Comput. Electron. Agric. **111**, 78–91 (2015)
7. Tarjan, L., Šenk, I., Tegeltija, S., Stankovski, S.: A readability analysis for QR code application in a traceability system. Comput. Electron. Agric. **109**, 1–11 (2016)