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# Using RFID technology to development of agricultural products quality safety traceability system on Internet of things

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**ABSTRACT**

*This paper analyzes the quality and safety of agricultural and sideline products, and agricultural and sideline products contain the emergence. The application of RFID in safety traceability of agricultural and sideline products, must insert RFID tags from its source. This paper presents using RFID technology to development of agricultural products quality safety traceability system on Internet of things. The Internet of things platform includes three parts: service access and deployment, business management, business support platform.*

**Keywords:** RFID; Agricultural product; Internet of things; Traceability system.

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## INTRODUCTION

At present our country food security situation is more serious, all kinds of food safety incidents occurred frequently, causing great harm to people's lives and health and safety [1]. In view of this phenomenon, the government unified arrangements, the implementation of strict market access on meat and meat products, soy products, dairy products, vegetables, fruit and other 6 categories of food. But because of the backward management, effective supervision can not be aspects of food production, circulation, and market access system implementation is severely restricted and influenced. The traditional food quality inspection method has the problem of backward management, low efficiency and high error rate.

The development of modern network technology, makes the establishment of technical means to always go back to ensure food safety, food source as possible. RFID (Radio Frequency Identification, or radio frequency identification technology), is a kind of automatic recognition in twentieth Century 90 time began to rise (Auto Identification, Auto-Id) technology [2]. It is a through space coupling to achieve non-contact signal transmission by radio frequency signal, and achieve the target recognition technology through the signal transmission.

Agricultural products traceability system mainly with the 2D barcode as the carrier, the quality and safety of agricultural products are full traceability. Through application in planting base of portable agricultural information acquisition system, realize the rapid acquisition and real-time upload agricultural history information, can also upload documents to manually scan acquisition.

The RFID radio frequency identification technology, the label card reading and writing data and information functions, RFID tag is different from the bar code label RFID Cary information can be updated in real time function, real-time transmission of information through radio waves, which can be a simple WEB service food safety traceability information to find the corresponding component, the food safety management in the food safety problems of rapid recall harmful food, to prevent the rapid diffusion of products have problems, and through the Internet of things technology to solve food safety problems in life.

**1. Application of Internet of things in agricultural and sideline products quality safety traceability system**

Food quality safety is not only related to the health and safety of the broad masses of the people, but also to the healthy development of the economy and social stability in recent years. Strengthen the quality and safety of agricultural products and promoting the adjustment of agricultural structure, accelerate the development of quality and efficient production of safe agricultural products, an important measure of building a modern agriculture, but also improving the agricultural comprehensive production capacity to enhance the market competitiveness of agricultural products, increase the objective requirements of farmers' income.

This paper analyzes the quality and safety of agricultural and sideline products, and agricultural and sideline products contain the emergence, can be implemented by the administrative department of industry and commerce, can also be through a more effective technical means, to solve the situation between producers and consumers of agricultural and sideline products and information asymmetry, so that consumers can rest assured consumption of agricultural and sideline products, ensure the quality and safety of agricultural products:

Through the application in agricultural production safety management system of production enterprises, implementation of prenatal organic production tips, producing the warning and postpartum detection; the production enterprise data pool to the park administration, construct the back platform database, realize the back online, two-dimensional bar code scanning, SMS and touch screen mode, so as to ensure the quality of agricultural products. So that enterprises can timely, accurately grasp the entire production and supply chain of product flow and change, control the entire production circulation safe and reliable.

Agricultural products traceability system traces the source using the product code information system, the realization of a label corresponding to a product tracing the source, the main production and management to submit the application, through automatic tracing two-dimensional code system, through a special label printer, can realize the production code at any time, at any time to activate the use [3]. No activation of the label is not to view the traceability report, this system to apply labels and activation tagging; users were recorded in detail and entry database, to prevent others from stealing information.

Establishment of traceability system of agricultural products quality and safety in order to give consumers more right to know, as well as the functions of management and control, so as to ensure the quality of agricultural products; at the same time provide the corresponding content producers and regulators, easy to find out which part of a problem, but also for consumers to supervise, from each link intelligent terminal about agricultural products.

Many currently on the market of fake and shoddy products high frequency appeared in public view. Some quality is difficult to identification of the scene, the quality of the products is very important, the service brand effect products has always been illegal enterprises take fake or shoddy. In recent years, with the Internet of things (Internet of thing) and RFID (Radio Frequency Identification) radio frequency technology continues to mature, to establish product traceability system, effective against fake commodities, attention.

When the issue of food safety, the food traceability system can check to the final consumers of food, can also find links appear circulation or production process, forming a unified management, government coordinated, efficient operation of the structure. This is also the development trend of international food safety traceability management mode.

Traceability information system of agricultural and sideline products by the information management center and breeding management subsystem, slaughter and processing management subsystem, the transportation management subsystem, sales management subsystem and consumer information query subsystem is composed of five subsystems, each subsystem, information management center is a data centric storage of animal products from production to the whole process of consumption reporting information. On the one hand, information management center, receiving and reporting stored breeding, slaughter and processing, transportation and marketing of four subsystems of data; on the other hand, information management center provides information about various agricultural and sideline products for the consumer information query subsystem.

Agricultural products traceability system for production of the main agricultural products of agricultural production process record for unified management, including the basic operation, pyrethrum job, fertilization, harvest date and agricultural fertilizer, pesticides and other material usage and dosage of collection and management, agricultural production records for the quality and safety of agricultural products traceability provides important evidence to support.

The agricultural products traceability system is to control the effective means of the quality and safety of agricultural

products. Although the food safety control and effective ISO9000, GMP, SSOP, HACCP and other domestic and foreign management approach is introduced into the management of agricultural production in China, but because of these management approach is mainly aimed at processing link control, lack of connecting the whole supply chain means. Quality traceability system emphasizes the unique identification of the product and the whole process tracking, on each link of the whole supply chain product information for tracking and tracing through various means, once the occurrence of food safety problem, can be traced to the source of food, the timely recall substandard products, the loss to the minimum.

Agricultural and sideline products traceability of Internet of things is based on the Internet, using RFID, wireless data communications technology, to construct a global coverage network [4]. In this network, RFID tags are stored in the specification and interoperability of information, through wireless data communications network to automatically collect to Internet of things platform, realize the goods (goods) recognition, and then through the open computer network to realize information exchange and sharing, the article "transparent" management.

In the production process to create technical barriers to the packaging of goods can not be for other security. In this kind of security technology after a period of time, the technical barriers to production process be overcome or divulge, causes most counterfeiters grasp of such technology, goods will be very easy to take off, even the anti-counterfeiting technology will become the fake goods legal "coat" to enter the market; in addition to large quantities of goods, by comparing the workload a large, low efficiency.

In the source of food production, both feed information animal breeding process to eat, or planting process applied fertilizer information in the plant, all can use the RFID tag storage to food safety production database, as a future food safety traceability of original data [5]. In the food processing process, manufacturers, operators, food processing and time trace information will record into the corresponding fields in the database.

The RFID tag is agricultural and sideline products information accurate, complete, timely and efficient delivery of security, V products suppliers through the RFID tag will transmit the information related to agricultural and sideline products distributor in real time, so that the agricultural products traceability is more rapid, real-time and accurate.

The traceability system is of full back to each product life cycle, the electronic tag (ear) were implanted in each animal's body (ear, fins, foot) animal, write on label in details, name, logistics code, batch, date and other information. Detailed information in animal feeding point out can automatically scan animal, set fixed or portable reader at all levels of distributors, to identify, detect the circulation link. This system can be used for breeding, selective wholesale, retail, transportation, slaughtering, government regulation to consumer inquiries in all business processes and traceability. So that enterprises can timely, accurately grasp the flow and change of logistics, information flow throughout the supply chain, control of the whole circulation safe and reliable.

Agricultural products traceability system for traceability of products provide network port query, consumers through the traceability label two-dimensional scanning is pasted on the mobile phone product code into production traceability of agricultural products traceability information query platform can directly view the report, detailed information about agricultural products into the whole process from breeding market has traceability businesses as well as the base of the subject.

**2. Internet of things based on RFID technology**

The basic structure of RFID: the basic RFID system consists of a label (Tag), reader (Reader), middleware and backend information system etc.. The RFID tag, a coupling antenna and chip, each tag is ROM memory has a unique electronic product code (EPC), and attach label on the object or objects are identified on (Passive Tag, passive tags) in the induction magnetic field, RF signal receiving read write device sends, obtaining energy commodities messages stored in the tag out by induction current [6].

The RFID system work flow is as follows.

(1) The reader through the radio frequency signal transmitting antenna to transmit a certain frequency, when tag into antenna work area induced current, electronic tags obtained from reader automatically removing and activation energy.

(2) Electronic label will be stored in its own memory on the RFID coding information through labels built-in antenna send out.

(3) Receiving antenna for demodulation and decoding of the received signal and then sent to the back of the main system to process, as is shown by equation (1).

$$\begin{cases} \dfrac{dp_0(t)}{dt} = -\lambda p_0(t) + \mu p_1(t), \\ \dfrac{dp_1(t)}{dt} = -\mu p_1(t) + \lambda p_0(t). \end{cases} \quad (1)$$

(4) The main system to judge the integrity, legitimacy of the label encoded according to the logic operation, make appropriate treatment and control according to the different application business logic.

The RFID tag has become the electronic tag, RFID, data information is stored in the RFID radio frequency identification system equipment, composed of a coupling antenna and a control module, a memory chip ROM, each label is determined by the electronic identification only code, and attach the identification information in the object or objects are identified on the marked goods storage.

In this paper, the RFID technology, Internet technology, cloud computing technology integration, building a network of traceability system of a computing technology RFID and cloud based on high-end products, to ensure the safety of agricultural and sideline products technology means, to increase the market share of the products, and to the optimization of the industrial structure in rural areas, increasing farmers and agricultural and sideline products processing personnel's income.

RFID system in general by the electronic tag (Tag), antenna (Antenna), reader (Reader) and the computer system (Computer) is composed of four parts, as shown in figure 1. Label into the field, RF signal reader from, by sending current obtained by the energy out of the product information stored in the chips (passive tags or passive tags), or take the initiative to send signals of a certain frequency (active tags or active tags); the reader reads information and decoded, sent to the computer database system the related data processing [7].

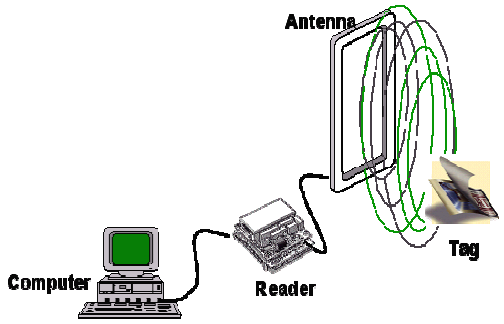


**Fig. 1. The system architecture of RFID**

Reader at least control module and RF module two modules. The RF module is composed of a radio transmitter and receiver, and its main functions include: to generate high frequency power, providing energy for the no label; the transmitted signal modulation and signal demodulation, and tags for data communication. RF Transceiver RF signal and generate energy, activate and provide energy to passive, no label. RF module can be integrated package in the reader; can be both as independent equipment. For example, CC1010, CC1100, NRF9E5 RF module has been widely applied to a variety of RFID system.

The electrical part cards are consisting of only one antenna and the ASIC. Antenna: card antenna is only a few winding coil, easy package to the IS0 card. The ASIC card is composed of a baud rate for the high speed RF interfaces of 106KB, an 8K EEPROM and a control unit. Read write device of electromagnetic wave to the RFID radio frequency card sends a group of fixed frequency, the card has a LC series resonant circuit. The frequency and the reader sends the same frequency, when the electromagnetic wave, the LC resonance circuit resonance phenomenon occurs, the charge capacitor, at the other end of the capacitor is, there is an electronic pump, the one-way conduction.

RFID technology has a large data storage capacity, can read and write, strong penetrating power, reading and writing distance, reading speed, long service life, good environment adaptability, it can only realize the automatic recognition technology of multi target recognition.

The Internet of things platform includes three parts: service access and deployment, business management, business

support platform. Among them, service access and deployment consists of three layers: business engine layer, service adaptation layer, service deployment layer; business management support part comprises five functional modules: authentication charging, user management, SP/CP (service providers, content providers) management, operation, management and maintenance of statistics; business platform portal the platform interface and interface standard for maintenance and service provider.

RFID middleware is a bridge to link the application system and the data acquisition layer, is a message oriented middleware (MOM), information in the form of message, transmitted from one program to another or multiple programs. It is the underlying hardware information acquisition and information processing system and database system are connected by bridges, its main function is to shield the underlying hardware complexity and diversity, provide a variety of reader interface, control the underlying data collection, the collected original data processing (cleaning, compression, count), provides clear semantics report of the incident to the upper application system.

RFID reader in radio frequency identification is the core of the work machine, is connected through the USB-TTL module and the host [8]. RFID reader chip design, and it is composed of a micro processor and corresponding peripheral circuit. The system uses AT89C2051 microcontroller as the core circuit of RFID read write device, configuration chip RF card reader, antenna, antenna coupling circuit, USB-TTL module.

At present, in the process of formulating standard is mainly associated with the RFID tag data acquisition, including reader and tag RFID air interface, reader and computer control terminal interface protocol, data between reader and tag RFID performance test and conformance test specification, and the RFID tag data coding standards, middleware and hardware interface protocols, middleware framework. Background information processing network application system, an official international standard is still not formed, only some part of the standard formulated by the industrial alliance, at present still evolving.

**3. Using RFID technology to development of agricultural products quality safety traceability system on Internet of things**

Storage RFID tags within the ROM has a unique code, is in the production process from entry into, and cannot be changed. Moreover, the RFID tag is an electron carrier, the stored information can be encrypted to protect, and use certain computing power of the reader to realize bidirectional authentication, and the high data security is not easy to be forged or tampered with it [9].

Construction based on the core product traceability system of RFID is the network platform, the ability to network business platform must be able to extract and abstraction layer network. Encapsulating the information related to standard business engine, providing business development environment and convenient to the upper layer application providers, simplify business development difficulty, shorten the business development cycle, reduce the risk of business development, and user management and authentication charging uniform for the end user, to enhance the intelligent application of user experience, at the same time provides the unified management of users and business platform operators, convenient and its safety maintenance.

Electronic code technology of EPC product is developed by research on automatic recognition USA Massachusetts Institute of Technology center, through the Internet platform, the use of radio frequency identification, wireless data communications technology, to construct a global goods real-time sharing of information of the Internet of things. EPC code is a set of digital consists of data header, management code, object classification code, serial number field.

Agricultural and sideline products traceability system for traceability of listed products provide the product brand, product details, size, scale of production, sales region and form, packaging materials and styles, logistics and transport and the honor and the upper and lower time and other information collection and management.

Food safety supervision system is relatively mature, the construction of information system is more perfect, more scientific, comprehensive and systematic study of the agricultural products traceability system. Traceability system mainly includes the following several aspects: labeling system, food quality and safety information collection and distribution, product whole process control, risk assessment. However, research on agricultural products supply chain traceability is still in the initial stage, the integrity of the traceability system of agricultural products is still to be strengthened.

The system uses the RFID passive tag chip each network center of low cost products database record identification code for each product (tag ID number), product name, product category, product price, product specifications, product sales, production, the origin of the environmental information, the use of chemical fertilizer and pesticide,

the feed delivery conditions, production date, date of sale and processing, transit point information etc.. Product search back, RFID card reader read the product ID, and the main modules of the system to identify the corresponding ID code products from the network center database, which reads the products, are all information traceability, as is shown by equation(2).

$$\frac{dY}{dX} = \frac{a_1 X + b_1 Y}{a_2 X + b_2 Y} = g\left(\frac{Y}{X}\right) \tag{2}$$

The application of RFID in safety traceability of agricultural and sideline products, must insert RFID tags from its source, the following specific application of RFID (1): add RFID tags in the agricultural stage, basic information of livestock, such as agricultural and sideline birth records, feed usage, immunization records, inspection records and veterinary records write tag, as the original data for future agricultural and sideline products traceability (2) through the storage, transport links to the slaughter plant, add related information storage, transportation, slaughtering link tag. (3) Regulation will test, quarantine information into the tag. (4) Transport operators will transport links to related information to label. (5) To the sales site, the vendors will be selling links related information into the tag, the last link to achieve traceability.

Agricultural and sideline products traceability management system will use RFID advanced technology and rely on network technology, and database technology, information fusion, query, monitoring, for each stage of production and distribution process to final consumption in the field for each item to provide security, agricultural and sideline products composition and inventory control decision making, to achieve early warning mechanism and safety of agricultural products.

The Internet of things system in general by the perception layer, network layer and application layer, the 3G and other mobile communication cyber source limit, the system design of the sensing layer and application layer two parts. Through radio frequency RFID reader non-contact reading RFID tags in the data information is the perception layer. Through a simple back-end WEB services components to complete the corresponding information on food safety traceability function, as is shown by figure2.

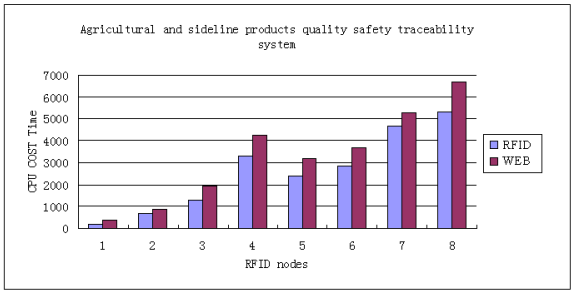


**Fig. 2. Comparison results of agricultural and sideline products quality safety traceability based on RFID with web**

Economic benefit is one of the goals of traceability system. Economic indicators are elements of the standard economic. Evaluation index system of economic efficiency refers to an organic whole formed by a plurality of reflecting economic efficiency indicators linked to the. At present, the traceability system to include the economic benefits of enterprise evaluation index system: the sales profit ratio, return on assets, return on capital, capital appreciation rate etc..

In transport, the door in the reader every few minutes to read the food container RFID tag information, data recording sensor information sent to the food safety traceability management system together, because inside information are basically the same, so the reader rather than on the RFID tag can be integrated sensor greatly reduce the cost of the system. In the transportation of food to the warehouse, RFID reader will read the food information as well as the storage time, and the system automatically assigned area inventory. This paper presents design of agricultural and sideline products quality safety traceability system based on Internet of things RFID technology. Embedded sensor arrangement warehouse in the reader, also according to certain time reads the RFID tag information has environmental information.

## CONCLUSION

E-commerce usually refers to a wide range of business around the world trade activities, the Internet and open

network environment, based on the browser / server mode, both parties not met for various business activities, a new business model realizing consumer's on-line shopping, merchant of online transactions and online payment and a variety of business activities, trading activities, financial activities and related service activities. Traceability of networking and e-commerce are automatic interaction through the network, has great similarity, to achieve seamless traceability of networking and e-commerce trading platform, will greatly expand application value traceability of networking system.

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## REFERENCES

[1]. Yongfeng Wang; Yu Yang; Yongming Gu. *JCIT*, **2012**, 7(1),86-93.
[2]. Sarmas.E.;WeisS.A.; Engels D.W.. RFID Systems And Security And Privacy Implic-ations, In:Proceedings Of The 4th International Workshop On Cryptographic Hard-ware And Embedded Systems, Springer-Verlag Berlin,**2003**;454-469.
[3]. Liu Peng; Liu Wen; Ma Aijin. *JDCTA*, **2012**, 6(23), 172 - 178,.
[4]. Chen H Y. SASI. *IEEE Transactions on Dependable and Secure Computing*, **2007**, 4(4),337-340.
[5]. Avoine G, Oechslin P. A Scalable and Provably Secure Hash Based RFID Protocol,In:Proceeding of the 2nd IEEE International Workshop on Pervasive Computing and Communication Security(PerSec **2005**), Washington DC,USA. **2005**; 125-140.
[6]. Gu, H., & Wang, D. A content-aware fridge based on RFID in smart home for home-healthcare, In Proceedings of 11th international conference on advanced communication technology, **2009**, 4, 987 – 990.
[7]. Wei Jinshi; Lan Hongjie. *AISS*, **2011**, 3(6), 107 - 114.
[8]. Ming-Cheng Lee; Chi-Chung Lee. *JCIT*, **2012**, 7(7), 312 - 322.
[9]. Y.K. Lee; L. Batina. Low-Cost Untraceable Authentication Protocols for RFID, ACM Conference on Wireless Network Security - WiSec ’10 .ACM, New York, NY, USA, **2010**,7,55–64.