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Research Article

Locating Logistics Locations of Suspicious Agricultural Production Food Safety Emergencies

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Abstract: It is difficult to locate the suspicious agricultural products in agricultural product safety emergencies, this study builds an agricultural product logistics system from suppliers to retailers based on RFID technology and designs an agricultural product logistics tracking systems, which collects and integrates underlying data from logistics nodes. Tracking queries get logistics node addresses from the address resolution service system by Internet and obtain and synthesize data from all the underlying data sources to trace agricultural product information for effectively locating locations of suspicious agricultural products. It is very important to prevent more extension for safety emergencies.

Keywords: Agricultural product, emergencies, logistics tracing, RFID

INTRODUCTION

The agricultural product logistics is within a specific range of supply chain, consisting of producers, processing enterprises, distributors, retailers and consumers through transport, storage, packaging, handling, distribution and information processing from production (farmland) to consumption (dinning-table). It plays a very important role for the production of agricultural products in the upstream of the supply chain and the consumption of agricultural products in the downstream of the supply chain. However, the agricultural product safety emergencies are quite conspicuous. The existing agricultural product logistics systems (Wu, 2011; Su and Wu, 2010; Zhao and Xie, 2007; Cheng, 2005) are hard to adapt to the requirements of the safety of agricultural products (Zhao and Yang, 2013). Once the occurrence of agricultural product safety emergencies, The existing agricultural product logistics systems are hard to rapidly and accurately locate locations of others suspicious agricultural products in the circulation and this leads to the further spread for the public health and safety accidents (WHO (World Health Organization), 2011).

Radio Frequency Identification (RFID) (Nath *et al*., 2006) automatic catches the target (such as agricultural products) by radio frequency signal and obtains relevant data. In recent years, RFID applications in Supply Chain Management (SCM) (Ilic *et al*., 2009) are increasing. Networked RFID (Roussos *et al*., 2009) can promote the wholesale tracking of target objects; use the Internet to connect to separate RFID applications, which analyses a large number of events and data by the applications of tracking system. This directly reflect the physical world, which is generated from the RFID equipment deployed on different nodes, so we can find out the current position, historical position or the time interval between different locations for an object. As a result, we can timely intervene the things according to the physical circumstance (such as recalling suspicious products) and can completely change the abilities to our surveillance around the world.

This study will build a logistics tracking system based on RFID, which can effectively locate locations of suspicious agricultural products in the circulation and timely recall them. It provides the prototype software for supporting the RFID application model based on the Internet and can promote the RFID technology playing a key role in logistics tracking. It is very important to improve the safety of agricultural products, to protect the public health and to promote Chinese social stability and economic development.

MATERIALS AND METHODS

Logistics tracking problem: Figure 1 shows the whole process in the supply chain of agricultural products from the manufacturer *S*1 to the consumer *S*7.

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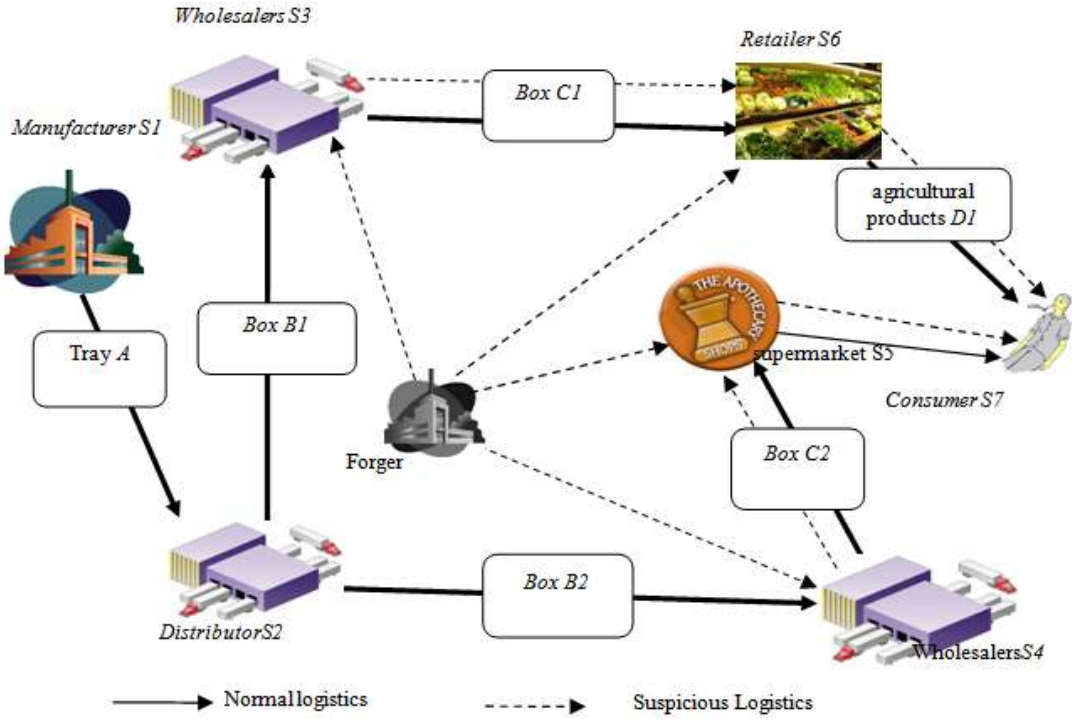

Fig. 1: A agricultural logistics

Manufacturer $S1$ puts on big boxes of $B1$ and $B2$ through the tray A, then they are uninstalled and redistributed in the dealer $S2$ and $S2$ sends big boxes $B1$ and $B2$ to wholesalers $S3$ and $S4$, wholesalers $S4$ takes the small box $C2$ in the big box $B2$ to send to the supermarket $S5$, the wholesaler $S3$ takes the small box $C1$ in the big box $B1$ to send to the retailer $S6$, the retailer $S6$ puts the agricultural product $D1$ in the small box $C1$ to sale to the consumer $S7$. At present, there are some problems as the following.

The forger sends fakes to the supply chain including distributors, wholesalers, supermarkets which will likely lead to inferior agricultural products to be taken by consumers. Once inferior agricultural products quickly and accurately appear and this need to be determined the specific locations of other fake agricultural products.

In addition, if we find that agricultural product $D1$ in a small box $C1$ is polluted, $D1$ cannot to be taken. In the same retailer $S6$, you can quickly find out the other contaminated agricultural products which in the small box $C1$; if we can not sure whether the other small boxes in the big box $B1$ are polluted, or the other big boxes on the tray A are polluted, we need to track locations of other suspicious agricultural products.

The agricultural product logistics system: The RFID system is composed of readers, electronic labels and processing systems. The reader sends a specific radio frequency signal to the electronic tag to obtain data of electronic tags and the reader sequentially receives reading data and transmits them to the processing system to make the appropriate treatment. Applying RFID to the agricultural products logistics tracking, this can monitor the pollution of agricultural products as raw materials, production processing and the agricultural products safety factors in the circulation process, also can provide the transparent safety management in the agricultural products logistics. Once a agricultural product safety problem is discovered, it can quickly and accurately determine the specific locations of the other suspicious agricultural products, so this provides a powerful guarantee for tracking and recalling suspicious agricultural products. There are two kinds of tracing methods to trace and recall the suspicious agricultural products by RFID.

Tracking the supply chain from upstream to downstream, that is from the farm, raw material suppliers, manufacturers, distributors and wholesalers to retailers. Once safety problems of agricultural products arise in the supply chain upstream, we can determine the specific locations of suspicious agricultural products and recall them by tracing.

Tracking the supply chain from downstream to upstream, if safety problems arise consumers purchase agricultural products in retailers, they can be traced back from downstream retailers to upstream in the supply chain and be finally determined the specific locations of agricultural products.

In farms, agricultural raw material suppliers, agricultural production, distributors, wholesalers, retailers and other aspects of transparent tracking,

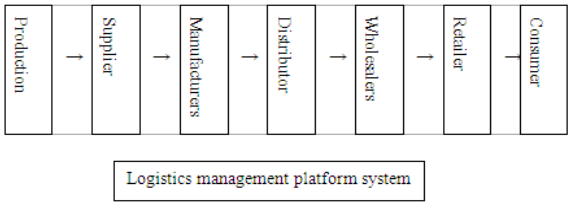

Fig. 2: The agricultural product logistics system

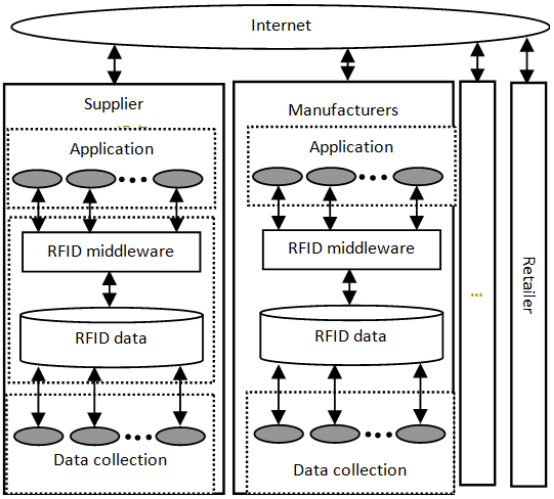

Fig. 3: Tracking system framework

products must be inserted the RFID tags into the source of agricultural production. From the supplier to the retailer, we write information of each layer and realize the whole track for the safety of agricultural products in the whole supply chain.

The system of the agricultural product logistics (Fig. 2) implementation methods are as follows: origin raw materials are sent to the agricultural product raw material suppliers, joined RFID tag, written into basic information of agricultural products (origin, producer, production date and packaging information, etc.); the raw material suppliers are sent to manufacturers, written into the supplier ID, suppliers, supply date, packaging and other information; from the manufacturers arrive in dealerships, written into manufacturers ID, manufacturers, date of production, packaging and other information; the dealers are sent to reach the wholesalers, written into dealers ID, dealers, distribution date, packaging and other information; the retailers are sent to the consumers, written into wholesales ID, wholesales, wholesale date, packaging and other information.

The establishment of agricultural product logistics system structure is based on the RFID technology, the raw material suppliers, distributors, manufacturers, wholesalers and retailers are denoted as the information nodes corresponding to the information system.

The framework and design of system: If the logistics tracking system is responsible for maintaining by one vendor of supply chain, the system is relatively closed, so it is unable to adapt to the current environment flexible application based on internet. Once the safety problems of agricultural products rise, the closed system is hard to quickly track agricultural products. Since various logistics enterprise in the current supply chain has the corresponding information systems, the establishment of the RFID logistics tracking system must be combined with various information systems of current logistics enterprises, so this can be applied to complex logistics environments. The RFID logistics tracking system will be considered the compatibility between the data standard interface and application software of logistics enterprise nodes (Fig. 3).

RESULTS AND DISCUSSION

Applying large amount of RFID tags, we need to use cheap read-only RFID electronic tags. In the whole supply chain, the local application systems of suppliers, manufacturers, distributors, wholesalers and retailers will be a corresponding processing on RFID electronic label information. We track agricultural products or the specific location of other agricultural products in the same packaging in the supply chain sources via the Internet.

This study builds an agricultural product tracking system based on the RFID technology, including RFID data acquisition, function management, address resolution service, tracking query processing and data analysis module (Fig. 4).

Data acquisition: Agricultural products with RFID electronic tags come into the coverage area of RFID reader are activated. The RFID reader reads and decodes the RFID tag data by radio frequency module and compares the decoded data with data in the database. If the decoded data matches the data in the database and the data are stored into the database server, then a time stamp is added into save after received the matched message. If the decoded data does

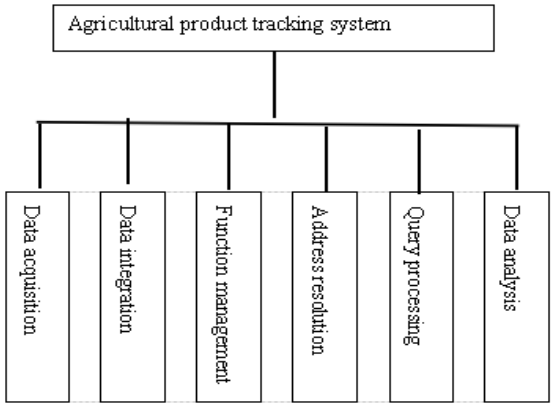

Fig. 4: The tracking system

not match the data in the database, then the error message is transferred to the RFID electronic tag and the system is warned.

Data integration: RFID query processing need to shield the difference of underlying hardware, coordinates each data source of the bottom of data, provides a unified data access interface for upper application logic. Moreover, this hides the underlying data in detail, combines the different sources and different structure data into a whole in the logic synthesis. Thus, the users can be through integrated data source as a whole to carry on data processing, so as to provide a unified data service for each enterprise in supply chain.

Function management: System administrators can enable and disable RFID reader device's managements and configurations. They filter the redundant data which are collected by RFID readers and configure the underlying data source address, user, password, database name etc., (Due to the bottom layer data source of logistics nodes are completely independent, so it is easy to join the new data source and delete the raw data source).

Address resolution: RFID electronic tag information (such as the production date, quality guarantee period etc.) is attached to products by logistics enterprises of agricultural suppliers, manufacturers and other logistics. Moreover, agricultural product information are record in the local information service system, the association is established between the agricultural products and the RFID electronic tag codes and RFID electronic tag information are registered to the Internet address resolution service system. As a result, the information nodes of the supply chain have its own information service system and they are much more dispersed, so they need to be indexed by the address resolution service.

Query processing: Tracking queries issue the query signals to the address resolution service system via the Internet, the dynamic search service returns tracking queries which needs a IP address to track information of agricultural products through the IP address. The tracing queries are decomposed into the underlying databases as executable sub-queries. Query executions of different types of data sources are based on corresponding drivers and they are achieved as query operations in different underlying database. According to users' tracking query requirements, each the underlying data source obtain the data synthesis and it is converted to a final result and the result is return to the user via the Internet interface.

Data analysis: Since the original RFID data collected by RFID readers lacks of practical significance and the data need to be treated to obtain valuable information.

CONCLUSION

It is difficult to locate suspicious products in agricu ltural product safety emergencies. This study builds an agricultural product logistics system from suppliers to retailers based on the RFID technology, which can effectively locate locations of suspicious agricultural products from logistics nodes. We will extend to research functionalities of the prototype system and to apply the prototype system in other industries.

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