
Tobacco Logistics Retroactive System Research Based on RFID Technology

Youyuan Li, Lijuan Xu, Shuang Zhao

School of Information, Beijing Wuzi University, Beijing, China

Email address:

593530703@qq.com (Youyuan Li), 326684463@qq.com (Lijuan Xu), 593530703@qq.com (Shuang Zhao)

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Abstract: With the development of modern logistics industry, traceability logistics of tobacco issues have been taken by the people. However, the traditional way of using ordinary paper bar code to record the information of tobacco products have some shortcomings such as easy to wear, short life, the limitation of usable range. As it can't achieve product traceability of all aspects. In this paper, using RFID technology, and combined with EPC codes to identify the tobacco product with a unique identity from start to finish. Through the establishment of tobacco logistics traceability system, enabling the traceability of tobacco products.

Keywords: Tobacco Logistics, Traceability System, Radio Frequency Identification (RFID) Technology, EPC Codes

1. Introduction

With the development of modern logistics industry and the gradually deepening understanding of the importance of tobacco issues in people's lives, tobacco logistics traceability system plays a more and more useful role in people's daily life. It not only makes more sophisticated management of tobacco business and more transparent of tobacco logistics chain monitoring, but also enables to establish communication bridge between the tobacco companies and consumers to improve the quality of consumer service, enhance consumers' understanding degree on the information of tobacco products.

Domestic tobacco companies mainly using ordinary paper bar code to record tobacco products in the logistics process, since there are many shortcomings in use of paper bar code will bring normal logistics chain some unnecessary trouble in practical applications such as easy to wear, short life, range limitations, etc. So the study of logistics system in this paper is based on the radio frequency identification (RFID) technology, using the EPC tags in all important logistics link. At the same time, associated the logistics unit code with product code to make it clear in the process of checking product information. So as to reduce the complex of repeated stick bar code to various products, but also saves the time of

consulting information.

Therefore, this paper put the process of tobacco products logistics as the main objective. Then, monitoring the whole course of logistics and information flow of each tobacco product, managing and controlling the product information from manufacturers to in-transit logistics until retailers' sales cycle, thus establishing the logistics tracking system to carry out the logistics information traceability in the end.

2. Radio Frequency Identification Technology

2.1. Radio Frequency Identification Technology

Radio Frequency Identification (RFID) is a technology for automatic identification of non-contact [1]. It is using radio frequency signals through space coupling to reach non-contact two-way communication, so as to achieve the automatic identification of the target object [2].

RFID technology is developed on the basis of relevant research on radar. In 1940s, the improving and application of radar has promoted the generation of radio frequency identification technology. In 1948, Harry Stockman published an article which is entitled "Use of the reflected power of communication," the papers, which laid the

theoretical foundation for the development of radio frequency identification technology. After that, the technology from the laboratory research to the application attempts to cross. Until the 1990s, radio frequency identification technology was widely used [3].

As an advanced automatic identification and a represent of data capture techniques, radio frequency identification technology has been successfully applied to manufacturing, logistics management, food traceability, ticket system, automated highway toll collection and other fields of public safety. RFID technology is also considered as one of the important technology which promoted the development of 21st century.

2.2. Radio Frequency Identification System

Radio Frequency Identification (RFID) system generally consists of three parts. Tag: tags consists of coupling element and chips, which is a data carrier of RFID system. It can be pasted on the things to identify objects. The character of it is that each tag uses a unique identifier globally. Reader: the reader can verify the identification code within the tag, read and write within the tag data. Reader transmit information mainly via the antenna and the RFID tag. Antenna: antenna mainly uses for transmitting radio frequency tag reader and communication signal. In the design and production process, the design of shape and the position of the antenna placement may affect the transmission of information [4].

2.3. EPC Codes

EPC stands for Electronic Product Code [5]. Electronic Product Code is a new generation of bar code encoding system launched by international organization. The original product bar code is only the product classification code, EPC code is assigned every single product for a globally unique coding [6]. The vector of EPC is RFID tag, and using the Internet to achieve the transfer of information. EPC aims to establish a global and open identity standards for every single product, and achieve tracking and tracing every single product worldwide to improve supply chain management effectively and reduce logistics costs.

3. The Establishment of Traceability Tobacco Logistics System

3.1. The Flow of Tobacco Logistics Traceability System

Tobacco logistics traceability through retroactive the supply chain from upstream to downstream to determine the origin of the products, it can be better assign responsibilities to the products which is under question of quality and safety. By combining RFID technology and EPC encoding, tobacco products can provide complete and reliable information to consumers, so that consumers have more confidence in the product.

Tobacco logistics traceability system is a large and complex system. Business process of tobacco logistics traceability system is shown in Figure 1.

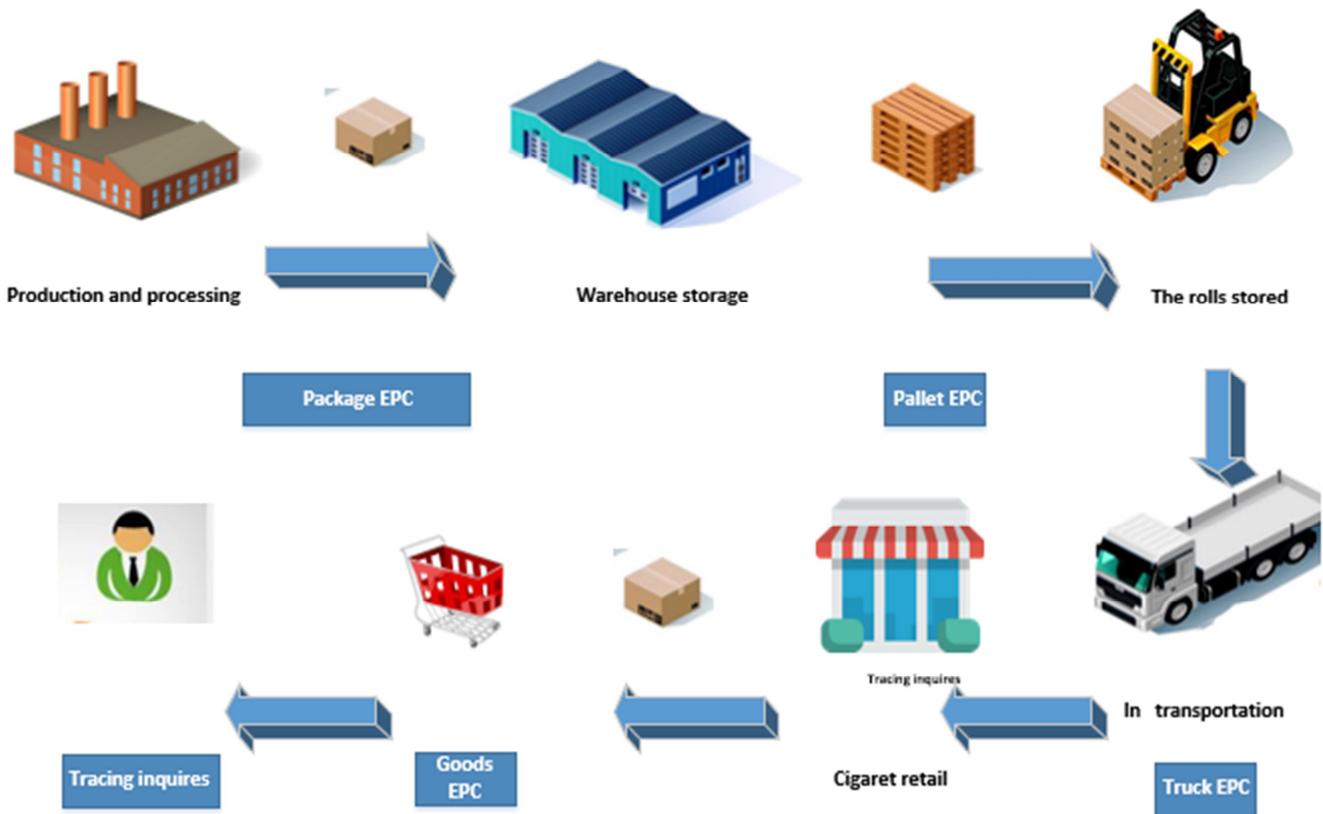


Figure 1. Business process of tobacco logistics traceability system.

3.2. The Prototyping of Tobacco Logistics Traceability System

The study of tobacco logistics traceability system which based on RFID is mainly studied in the framework of the system. System frame is majoring reacted the composition categories and hierarchical relations of this system, and it is the system summary. Through the design of the system framework, we can provide specific direction for the system design from grasping the relationship and interaction between the various components of the overall system and the various parts in total.

3.2.1. The Framework of Tobacco Logistics Traceability System

The framework of tobacco logistics traceability system is

divided into perception layer, network layer, data layer and application layer four levels which is based on RFID / EPC technology. As shown in Figure 2.

The sensing layer is composed of data acquisition and wireless communications component which is at the bottom of the structure [7]. The main purpose of sensing layer is used to identify objects and collecting relevant information and to transfer out information over the wireless network. It is use of RFID technology, RFID tags and readers, as well as cameras, GPS and other devices on the target for information collection. Then using wireless network transmitted the collected information to the internal management system. And then submitted the data to the cloud database through the transferring of network layer, stored and managed them by the database.

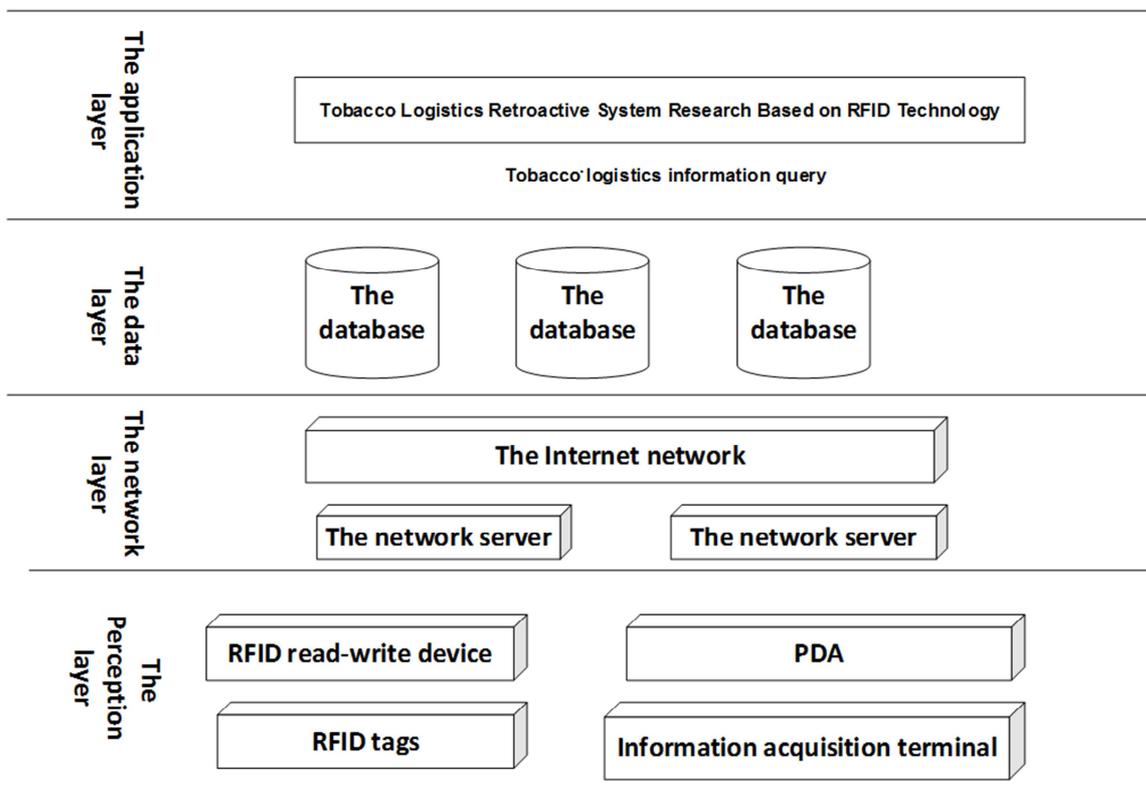


Figure 2. RFID-based tobacco logistics tracking system framework diagram.

The network layer is mainly for the storage and query of information, and achieve management of the network [8]. Tobacco logistics traceability system is based on data-centric. Therefore, it is very important on the management and handling on the perception of data which including data acquisition, processing, mining and the decision which is made by the data.

Data layer is mainly for storing data. It is the core of the entire system which storage and management the data collected by perception layer, transmitted by network layer and needed for application layer [9].

Application layer mainly collecting, processing, sharing, transporting and excavating the information of the objected things, And combined with demand to achieve the intelligent

application [10]. The application layer mainly retrospect the tobacco information in the study of tobacco logistics tracking system. Using Internet to send information requests to the database through different clients' login in the traced platform, database automatically returns the relevant information and ultimately traced query tobacco information.

3.2.2. Prototyping of Tobacco Logistics Traceability System

Manufacturer labeling is the beginning of Tobacco logistics traceability system. After the manufacturer receives the production order from distribution center, production plans are made to begin production, the product with a unique identifier to be transported to the distribution center after processing and labeling commodities is completed.

Distribution center management process including storage of goods, inventory management, library, packing labeling, pallet labeling, ready to transport. When the distribution center according to the order to arrange library table and delivery schedule for shipping out that after receives orders from the supermarket. Goods enters the link of transit shipments, in-transit vehicle sent in-transit information to distribution centers, so as to make the retail and supermarket live view. Goods enter the retail supermarket segment backstage management when arrived at supermarkets which including storage of goods, inventory management, and shelves of goods. When the retail supermarkets background produce the single shippers and cargo-shelves after received foreground replenishment. In the retail supermarkets foreground, consumers is buying goods, the cargo information in the library is real-time updating while the supermarket staff reading commodity EPC code. Warning when the number of goods decreased into a certain value, the management notifications the background replenish based on inventory and sales. In the end, the series of data consisting of tobacco logistics tracking system database. Accessing a variety of logistics information to achieve the purpose of traceability by login into tobacco logistics traceability system platform through Internet.

Specific aspects of retrospective analysis is as follows:

1) Analysis of production chain traceability information

In production, the company developed production plans according to the replenishment information from distribution center for production and processing activities. The production processes including the two links of labeling and processing. Firstly, in the labeling aspect, product affixed RFID tag before processing and adds the product information to the data center, in the processing chain, the reader recorded the start and end time of processing. The main study in this paper is the retrospective of tobacco logistics processing, details of picking and processing of tobacco is not involved.

2) Analysis of storage areas retrospective information

In storage areas, warehouse produced delivery and distribution notes according to supermarkets' orders, distribution note send to the transport sector and delivered note send to the warehouse. After warehouse carried out the products in accordance with the delivery note, the library inventory information updated automatically by the smart shelf.

When it is completed, the goods packing by sorting segments. In the packing part, packed the specified number of finished products into boxes, and affixed RFID tag to every box, the ID tag of the transit box contains information of boxes cigarette.

Case will be managed as a unit in transport links. Transport sector ready for transport after obtaining distribution order, the first thing to do for the distribution note is allocated vehicles, drivers and consummated the information of distribution order. Besides this, loaded the specified number of cargo containers on pallets and pasted RFID electronic signature on each pallet, and the tray ID

associated with the transfer box ID, then loaded the pallets into vehicles. What's more, the transport vehicles ID also must be associated with the pallet ID.

Intelligent warehouse shelves will update inventory information in real-time monitoring, if the inventory information is less than a certain range, distribution center send replenishment to notice the company for production and processing.

Warehouse is using smart shelves which based on RFID technology to achieve intelligent management of normal and abnormal (such as an operating error or theft) out-put and in-put of storage, according the judgment of storage conditions to do a series of normal operations about out-put and in-put of storage and update related database, or give an alarm and locking the implementation of the system, returns to normal operation until the situation is solved. Adopting smart shelves to achieve fast inventory and automatically check, and notified the product information to EPCIS server. The system uses the solution of smart shelf to complete function of intelligent inventory management.

3) Analysis the retrospective information of transport links

In the transport links, after logistics enterprises build or obtain a distribution task and make sure the delivery driver, delivery route, delivery objects, types and quantity of goods information, through RFID technology to complete the identification matching of vehicles and drivers automatically, and start a series of executive vehicle after running, such as open the GPS system automatically and display delivery routes with a task. When an error match is found, such as the driver got the wrong vehicle or others was trying to stand on the bus, etc. The system gives an alarm and lock the vehicle anti-theft system, and reports information such as vehicle location data to central server automatically.

4) Analysis retrospective information of retail supermarket background

The first thing to do is check and put commodities in storage again after retail supermarket backstage receiving order, and in a timely manner in accordance with the library's front desk supermarket sales, while also maintaining the prices and discount promotions of commodities.

5) Analysis retrospective information of retail supermarket shopping in the front

Assistant scans the ID information of goods by reader when consumers is paying a commodity, when the transaction is completed, smart shelves and back-end database update the data synchronized. It will notify the background to replenish automatically if the number of items on the intelligent shelves is under a certain value.

6) Analysis of information query

In the part of information query, the client users are divided into three categories, manufacturers, retailers and consumers. In the process of goods distribution, retailers using customer queries to obtain goods and services current status and displayed it in the client-side, so as to achieve the purpose of query. Consumers log on the client using the query service, the physical client is consumer's mobile terminal or computer terminal, the information returns

contained the current state of cargo information, and customers can view the current status of the goods' text description, or display shipment status more image by map service. Manufacturers are mainly require sales information to adjust the product play of the tobacco market macro-control.

Query system is divided into three kinds of information inquiries, they are product information, distribution of information and sales information.

A. Product Information inquiry

Storage System: Storage system including out-put and in-put of warehouse information queries, inventory information queries and goods allocation usage inquiries and so on.

Delivery System: Delivery System contains distribution area queries, query of distribution task, shipping line inquiries, delivery vehicles inquiry and retailers' statistical inquiry etc.

B. Delivery Information inquiry

Delivery Area information: It can view the planning information of direct distribution area which is including direct distribution area range map, retailer quantity and distribution volume.

Line Information: It is used for query distribution route information which is including circuit diagrams, the retailers' number of lines on distribution, distribution volume and other information.

Retailer Information: It can query the retailers' basic information and the delivery information (the purchased and amount of cigarettes and so on) in specified period they appointed.

C. Sales Information inquiry

Storage systems: The retail supermarket will inquiry the out of the storage information and goods allocation again.

Sales System: Inquiring the added time, sales time, and discounts information of merchandise and price of commodity.

4. The Key of Implemented Tobacco Logistics Tracking System

Data center provided inquiry services to users through WEB services at the all aspects, then enabling the visualization management of the mobile services in whole course, and monitoring the out-put and in-put of warehouse, transportation and sale process of commodity.

4.1. Achieving of Database

The database is a warehouse which is in accordance with the data structure to organize, store and manage data. It is a unit or a general purpose data processing system in application area, the storage is a collection of related data belong to manufacturers and businesses, groups and individuals [11]. Tobacco logistics traceability system through the collected data stored in the database to achieve effective monitoring of the traceability system, it is also facilitated the consumer to query the product traceability

information.

In the RFID-based tobacco logistics tracking system, express as the front, EAN13 code converted to EPC codes of commodity, it is become the major key automatically to generate information table items, as shown in Table 1:

Table 1. Goods Info Table.

Contents	Nature	Remarks
Commodity EPC	INT	major key
Commodity Name	VARCHAR(50)	none
Vendor	VARCHAR(50)	none
Date in Produced	VARCHAR(50)	none
Delivery Time	VARCHAR(50)	none
Commodity Composition	VARCHAR(50)	none
Supplier	VARCHAR(50)	none
Notes	VARCHAR(50)	none

In the process of distribution of commodities, the associated data table of commodity EPC, EPC crates, pallets and vehicle EPC and others will be generated, as shown in Table 2:

Table 2. Commodity distribution info table.

Contents	Nature	Remarks
Commodity EPC	VARCHAR(50)	major key
Product name	VARCHAR(50)	none
Package EPC	VARCHAR(50)	none
Plating EPC	VARCHAR(50)	none
Vehicle EPC	VARCHAR(50)	none
Location	VARCHAR(50)	none
Status	VARCHAR(50)	none
Notes	VARCHAR(50)	none

These data will be stored in the backstage server system, it can realized the goods traceability by querying the related crates, pallets location, vehicle information, as well as goods, status, etc. according to commodity EPC when required.

When goods are sold, the related price and hits shelves time and sells time of the commodity will be integrated into a table, as shown in Table 3:

Table 3. Commodity sales information table.

Contents	Nature	Remarks
Commodity EPC	VARCHAR(50)	major key
Commodity Name	VARCHAR(50)	none
Commodity Price	Int	none
Shelf Time	VARCHAR(50)	none
Sales Time	VARCHAR(50)	none
Goods Discount	Int	none
Supplier	VARCHAR(50)	none
Notes	VARCHAR(50)	none

Thus, merchandise sales information will be recorded. It not only convenient for consumers to query the product information, but also the manufacturers and distributors are based on these data to develop or change their production plans more accurate to make product information feedback from downstream to upstream timely. Database powerful data processing capabilities makes dealers' taped useful information from the vast amounts of data and to do good improvement at the combined sales of goods etc.

4.2. Achievement of Traceability System

Mainly tracked in the RFID-based tracking system in tobacco logistics are consumers, retailers, warehousing and distribution centers, manufacturers of commodities information. They are understanding the different tobacco logistics traceability information from different customer's perspective.

For the consumers, they can view the commodity price and discount information by entering the EPC coding of products. For retailers, they can view the presence merchandise sales information and timely replenishment or update product information as needed by commodity EPC code. For warehousing and distribution centers, the goods or vehicles can be traced back their current status and logistics information for monitoring and management goods in real-time by entering the EPC code. For manufacturers, they can keep abreast of production status. The design of the overall traceability system is written in C# language code, so as to implements a call of product-related information in the existing database.

5. Conclusion

From the logistics point of view, building a prototype system for tobacco logistics traceability through study in the process of tobacco logistics information traceability from manufacturers through distribution sectors to retail and reached the final purchase by the consumer. Besides, introduces the theory of basic technology which tobacco logistics tracking system involved, such as radio frequency identification (RFID) technology, EPC encoding. In the logistics process, there are many logistics unit, business unit and a series of labels. This paper using EPC coding rules and make it associated with the product information. Tobacco logistics traceability system will eventually achieve queries the corresponding product information, distribution and sales information by different user logs on to the system, completed tracing the tobacco products.

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