Design of Agricultural Product Safety Traceability System based on Things EPC Standard

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Abstract

The main purpose of traceability system can be recorded and stored goods in the supply process-related information, when quality problems arise, it is possible to quickly and efficiently traced part of the problem and implement targeted rescue measures, if necessary, product recalls, thus to ensure product quality and safety and consumer's right to know. In this paper, the core technology of agricultural products traceability system conducted in-depth research. This paper shows complete traceability of agricultural EPC standards-based platform for the development of various agricultural products circulation of information transparency display, repeatedly received praise at the exhibition meeting. Platform integration of a number of enterprise product data, meet the supervision of consumers' right to know information on the circulation of agricultural products, businesses and governments to track the quality of agricultural products, but also to promote China to solve the problem of agricultural products provides a new channel.

Keywords: Traceability system; QR codes; RFID; Shaped function transformation; Web Service

1. Introduction

Agricultural Traceability refers to the widespread use of agricultural supply chain information technology, sharing of agricultural information, through the whole process of agricultural supply chain tracking [1]. Once the agricultural supply chain in one part of the problem was found, it can easily useSupply chain traceability bottom, find the source of problems, eliminate safety hazards agricultural fundamentally [2]. Faced with agricultural pollution, poisoning incidents continue to occur, the producers of agricultural products, between operators and consumer information asymmetry situation, in order to protect the quality and safety of agricultural products, to establish a real-time, accurate, efficient and convenient quality safety of agricultural products traceability system is imminent [3, 4]. Guarantee the quality and safety of agricultural products, and promote the standardization of production basket of the project, and to regulate agricultural markets, building a harmonious society is the fundamental requirement [5].

The use of RFID and other advanced identification technologies, and reference architectures EPC traceability of agricultural products is beneficial each enterprise information system compatible interoperability [6-10]. Eventually by third party organization to implement a traceability platform, operation and maintenance of the entire agricultural industry fair fair management and supervision [11]. Meanwhile, consumers can use the Internet at home browser PDA or even mobile phones and other devices, via traceability platform for agricultural products in the various manufacturers of flow of information, production information inquiry, without having to log on from different manufacturers platform as before repeated queries [12]. These are based on the strengths and effectively enhance the EPC architecture of agricultural products traceability system

for traditional traceability system, after a long traceable test and data analysis will also help the country produce things related to the introduction of traceability standards [13-15].

In this paper, governments, businesses, consumers as the center established a safe farm produce traceability traceability system, means the use of information technology to achieve full traceability of agricultural information, in order to strengthen agricultural enterprises focus on quality and safety of agricultural products. Through the establishment of a stable investment guarantee mechanism, and gradually form a standardized production, operation and management system, protect consumers' right to know, and ultimately create a good atmosphere and safety of agricultural production. Based on the characteristics of agricultural product quality traceability system, from the current reality and urgency, taking the basic elements of the safety of agricultural products traceability system as the starting point, combining pilot cases, analyzes and summarizes the current status of agricultural products traceability system and the main problem, and then the causes problems discussed fully draw on the experience and lessons of product traceability, and ultimately made applicable to agricultural traceability solution.

2. Key Technologies

2.1 RFID Identification Process

The basic configuration of the RFID system shown in Figure 1, a basic RFID identification system comprises at least the following three components. (1) The label can be an active or a passive type of identification card, called together by the internal components and related integrated chips that can communicate with the radio frequency antenna, and set itself can be changed. (2) The reader is a control device of the entire RFID system that can read and write operations to the tag wirelessly. (3) The antenna is mainly used in the RFID reader to read, be able to amplify radio frequency signals to pass reader, it is also responsible for receiving RF signals transmitted by the tag to achieve RFID tag reader to read and write operations.
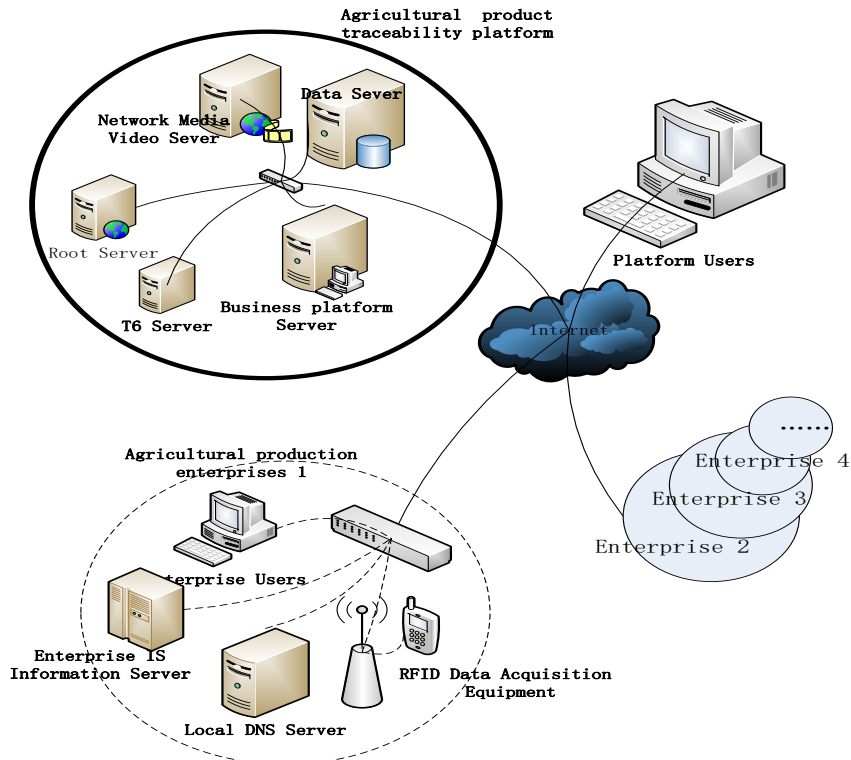
Figure 1. The Basic Configuration of the RFID System

Agricultural products manufacturing and processing sectors, enterprises preclude the use of RFID technology to optimize procurement management of agricultural products, processing and other tasks to do to achieve reach on time execution. Because the use of RFID technology to identify agricultural products can help companies achieve automated assembly line operation, and agricultural products processing and manufacturing of all aspects of the identification and tracking, performed dynamic management of agricultural raw materials.

Agricultural products can be collected at the same time a large number of real-time processing of data, at any time according to the actual get case adjust the production line operation cycle, can reduce manual processing, thus improving efficiency and economic efficiency of enterprises working production line. Especially when preclude the use of JIT (on time) production, raw materials, semi-finished products must arrive on the production station. In addition, preclude the use of RFID technology, companies produce multi-warehouse inventory is also very convenient, just use RFID reader scans or, you can keep the whole situation presented accurate data, deletion of raw agricultural goods at a glance, to accelerate the capture to ensure balanced production line.

2.2 EPC Coding

EPC encoding rules by EAN International (GS1) proposed that the original EAN.UCC global unified coding system is compatible with a new coding system, which is characterized by large capacity, scalability, and high security Features EPC coding system can provide the worldwide unique code identifying the object, namely a EPC codes correspond with a solid object, so that the EPC code can be used as general-purpose commodity worldwide information exchange language, this is also the basis for EPC applications.

EPC code is a set of numbers from the version number of the header, vendor identification code (EPC manager), object classification code, serial number of fields. The specific structure was shown in Figure 2.
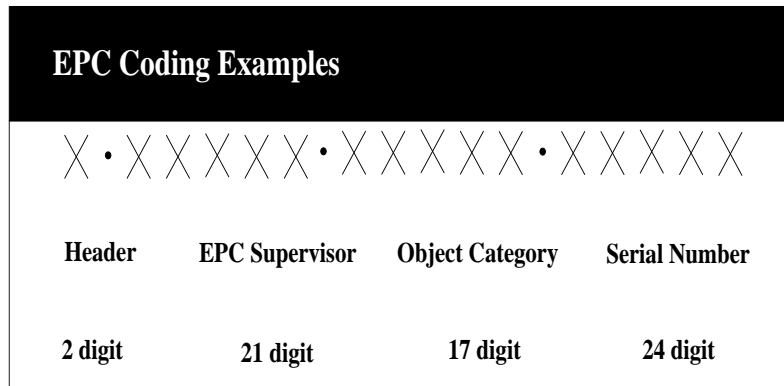

Figure 2. EPC Coding Structure Diagram

EPC code has 64 digits, 96, 256 or even more bits. If we use 96 coding rules, which can provide a unique identification code to 268 million factory, and each manufacturer can have 16 million product codes, each product can be used 68 billion serial number, this design is sufficient to guarantee the future each instance all the world's manufacturers of all types of products distribution EPC encoding. The current serial number does not need so many do, using only 64 EPC, such labeling requirements for storage capacity reduction, reducing costs.

2.3 Database Distributed Storage

Distributed database network technology and computer technology combined with the product, evolved on the basis of a centralized database system on. This type of database system was suitable for use in discrete units between departments, some of the commonly used data stored in the local system use, which can effectively reduce communication costs, improve the response speed of the system.

Global distribution node is the node information between the key information recording databases and stored in a database table, the table is a global database tables. During lookup data, first look through the global database tables to the corresponding node, according to the node directly to the database can locate the desired information. Distributed memory structure shown stored under normal circumstances global table in Figure 3 is divided into two, are as follows.
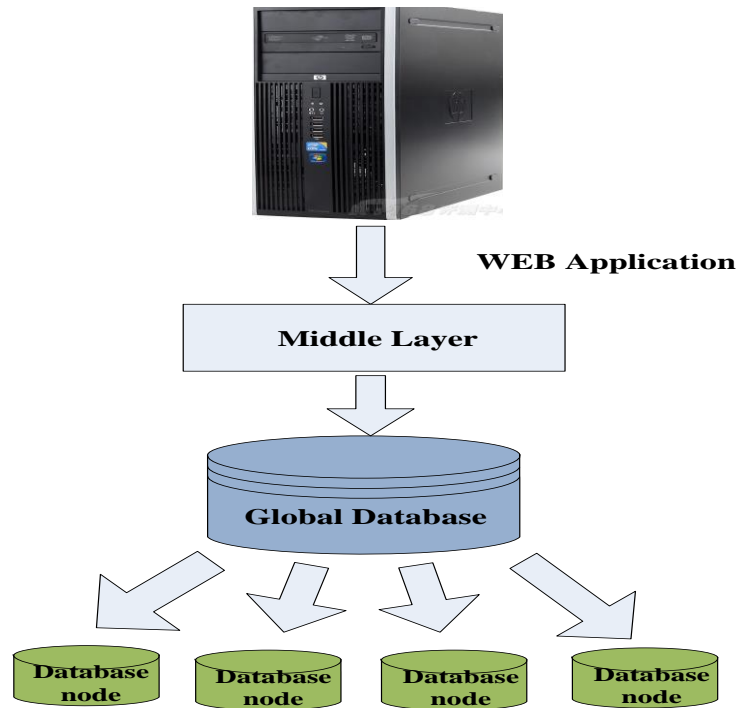
Figure 3. Distributed Storage Chart

Agricultural traceability system generally includes a wide variety of agricultural products, and each product business processes were different, but all aspects of the relatively large amount of information, so the amount of data the system is considerable. Therefore, in order to improve the efficiency of database access, faster access, the paper data storage strategy using traceability information distributed storage of agricultural products.

3. Traceability Platform Analysis and Architecture Design

3.1 QR Code Image Preprocessing and Median Filter

Mobile phones and other smart devices to capture color images through the camera is generally used RGB color mode, and the actual deployment of applied optics RGB is the principle of color, shape features RGB image is difficult to characterize. Since QR code carries information only traceable to characterize black and white, so you need to collect the color image is converted to grayscale and then converted to a binary image processing, which can significantly reduce the complexity of image processing, mobile phones and other smart devices to reduce energy consumption and improve query speed.

Each pixel may respectively direct a byte represents R, G, B three primary colors, if the RGB color space to YUV color space conversion, the Y component is represented exactly as luminance pixels, the gray value as its The conversion formula is as follows:

$$\begin{bmatrix} Y \\ U \\ V \end{bmatrix} = \begin{bmatrix} 0.299 & 0.587 & 0.114 \\ -0.148 & -0.289 & 0.437 \\ 0.615 & -0.515 & -0.100 \end{bmatrix} \bullet \begin{bmatrix} R \\ G \\ B \end{bmatrix} \tag{1}$$

When converting, without calculating the components U and V values, generally in accordance with:

$$Y = 0.299R + 0.587G + 0.114B \tag{2}$$

During bar code capture, will be affected by a number of noise interference, they are mainly two: First, the electronic device in the image when shooting in the imaging process, due to the limitation level imaging technology by the image sensor, circuitry during transmission the impact to the pixel data, resulting in noise; the second is the bar code in the actual use of the process will be subject to a variety of unpredictable noise pollution generated. The latter may be performed by QR code error correction algorithm correction, but because the former are generally impulse noise, Poisson distribution, it is necessary to make the image filtering process.

Median filter can effectively protect the sharp edge of the image, smoothing impulse noise, good results can be obtained. The principle is as follows:

A number of groups x1, x2, x3, ...xn, the number n are arranged in descending order according to the following:

$$x_{i1} \leq x_{i2} \leq \cdots \leq x_{in} \tag{3}$$

$$y = Med\left\{x_1, x_2, \cdots, x_n\right\}$$

$$\begin{cases} x_{i(n+1)/2} & n \text{ is odd} \\ 0.5\left[x_{i(n/2)} + x_{i(n/2+1)}\right] & n \text{ is even} \end{cases} \tag{4}$$

y is the value in the sequence requirements. In practical applications, you can use such as circles, squares and other two-dimensional window style, the image of the QR code median filtering. QR code image of the gray value of each point with $\left\{x_{ij}, (i,j) \in I^2\right\}$ representation is to define a 2D median filtering, the filter window for the A, are defined as follows:

$$y_{ij} = \underset{A}{Med}\left\{x_{ij}\right\} \tag{5}$$

$$Med\{x_{(i+r),(j+s)}(r,s) \in A(i,j) \in I^2\} \tag{6}$$

Binarization key is to select a more appropriate threshold value, type 7 is the gray threshold transformation function:

$$f(x) = \begin{cases} 0 & x < T \\ 255 & x \geq T \end{cases} \tag{7}$$

In practice, the threshold T directly determines the binary image processing effects. Through the actual collection of samples for analysis, the threshold value is set to 145 most of the time be able to achieve the desired effect of the image. QR code image was a median filter after process.

3.2 Traceability Logistics Model

To produce traceability, traceability information you need to record all aspects of the circulation of agricultural products in the supply chain, and then implement the central database integration and traceability platform integration. Which is an important part of the logistics process farm produce traceability throughout the traceability system, since the process of agricultural products due to the location of the mobile, it increases the difficulty to obtain traceability information. Where agricultural logistics chain traceability information needed include the more uncertain sources of agricultural information, transportation carriers, logistics whereabouts and logistics processes. In this paper, tracing

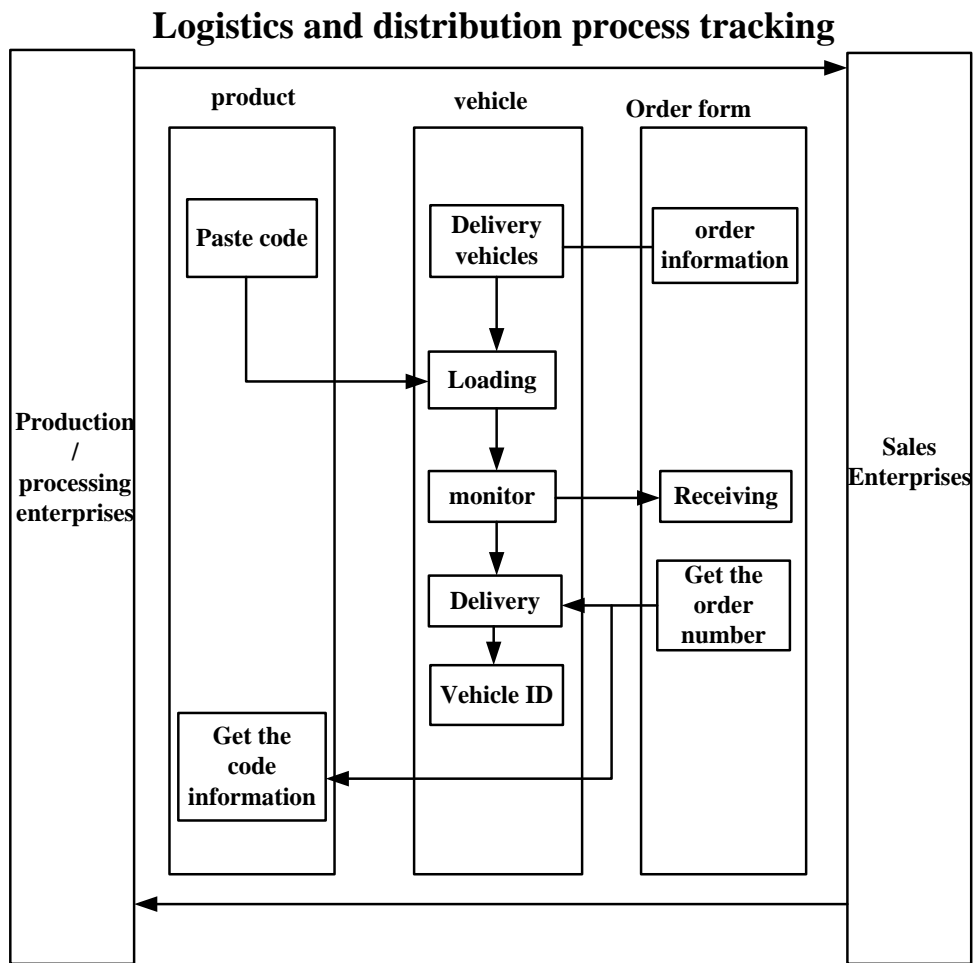agricultural product logistics process modeling, shown in Figure 4.

Figure 4. Retrospective Model Diagram

This model is mainly located in the production, processing and marketing enterprises of logistics information, weakening the main information supply chain, enhance information collection and transmission in the logistics and distribution processes. Logistics and distribution process due west and reverse logistics process traceability are two main lines of the model. Forward logistics distribution process of recording and transmission of information is the basis for tracking, but also for the distribution process reverse data source traceability. The model set out in the logistics process of products, vehicles (transport carrier), intermediate model orders (stream with a single) three closely related. The following summarized the logistics model core processes: First production or processing enterprises according to internal specifications to generate a stream back yards, back yards and the logistics associated with the product information and traceability code affixed to the product surface.

When the vehicle reaches the stream back yards are scanned, automatically understand this product and the target distribution locations, and record information about the distribution of the binding code and the vehicle, while in transit time data for geographic data is continuously updated. When the vehicle reaches the sales companies when selling to scan the stream back yards, you can get the relevant order data, confirm receipt after checking the product information is correct, complete the logistics and traceability code corresponding to the distribution orders. Visible throughout the distribution process is

back yards as the basis of logistics, information is recorded, so you can quickly find the appropriate order information through back yards in the reverse logistics traceability, vehicle transportation information already own information product.

3.3 Platform Network Planning

Traceability platform mainly by ONS root server, DS server, service platform servers, database servers, and extensions servers. Each distribution companies via a handheld RFID device preclude the collection of data and the use of corporate internal wireless LAN messaging, enterprise server and local ONS IS server through the Internet open, accepting traceability platform access, network architecture platform is shown in Figure 5.
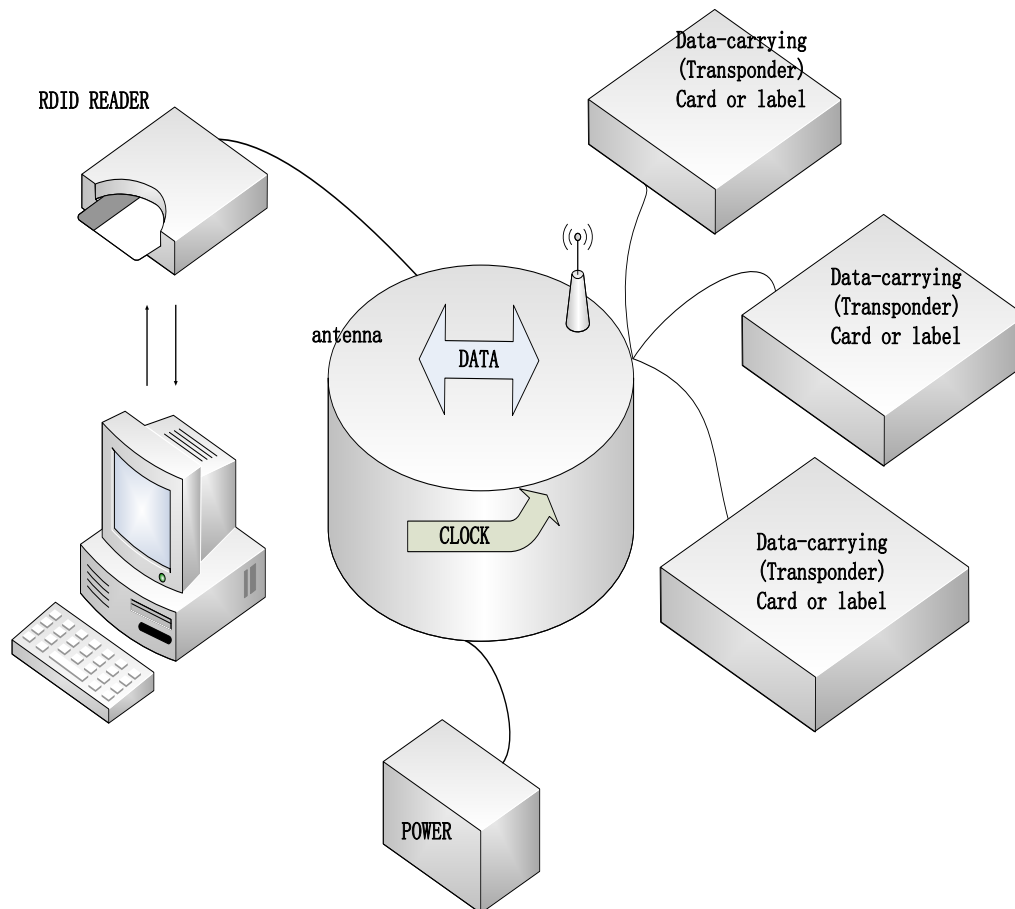

Figure 5. Platform Network Structure

Internal network structure of agricultural products circulation enterprises are basically the same, the choice of traditional LAN layout, which use RFID handheld reader 802.11X wireless network communication in network security, in the RFID device access to the corporate LAN can use the network to do explain restrictions connection, isolated physically connected through the switch. Public network traceability platform relies on Internet, by laying ONS root server, DS server, business server and database servers, providing query server platform users.

4. Results and Discussion

4.1 Overall Business Processes

Traceability systems rely mainly on agricultural products in all aspects of intelligence information among nodes, RFID technology application of wireless sensor technology, GPS positioning technology, Internet technology and database technology, traceability management system, the organic combination of each node. Through wireless sensor networks, 3G networks, wired broadband network with a central database connected to the production, processing, transportation, storage, packaging, testing and health in all aspects of data collection, use QR coding technology to generate QR code, monitoring and traceability through mobile scanning.

In agricultural traceability platform, operating platform through custom code, elements, information elements, links, templates, applications and other information, business users can create, after being authorized on the enterprise self-service platform instance and traceability information can be collected, and ultimately complete traceability applications . Print out the QR barcode contains traceability information posted on the packaging of agricultural product, consumers will be able to easily and quickly query traceability information. The overall system flow was shown in Figure 6:
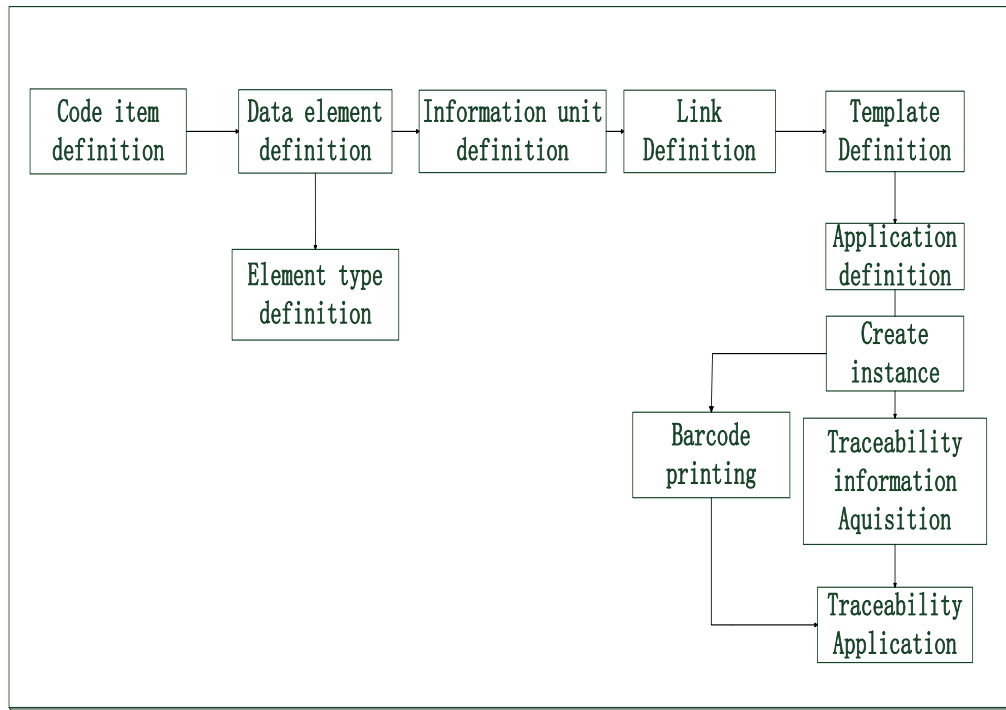

Figure 6. The Overall System Flow

Through the system's performance, functionality and internal modules for analysis and refining, designed the four platforms and two mobile phone terminal systems, are operating platform, the company's business platform, regulatory platform, enterprise self-service platform, client and traceability information collection traceability information query client, and the system in the main business processes are described, for the detailed design of the next agricultural traceability platform and lay the foundation for implementation.

4.2 Web Compatibility Test

Users can access each browser on the PC platform, the platform uses a more sophisticated CSS style sheets and scripts reception JAVAScript platform to showcase as an element of the page. The Web page will look on each browser directly affect the user experience, so we want to agro traceability internet web show compatibility testing, specific test results shown in Table 1.

Table 1. Web Compatibility Test Results

Browser	Test result
Le7	Normal
Le8	Normal
Firefox	Normal
Safari	Normal
Android(Cell phone)	Normal(Users may need to manually zoom)
UCWEB(Cell phone)	Display position has been adjusted, GPS trace is abnormal, basic query function is normal

Test results show that traceability platform to display web to run correctly in a variety of mainstream PC browsers, in line with the compatibility requirements. But now the growing popularity of smart phones, the latter can be displayed on the mobile web to do more work, or the development of smart mobile client to meet consumer use.

5. Conclusions

Agricultural traceability platform has now launched a pilot in some cities, large stores or agricultural products wholesale market for agricultural products traceable development and construction made preliminary studies and pilot, agricultural traceability function and application mode are in the exploratory stage, the existing traceability platform in information access and multi-vendor specification information insufficient degree of integration has not yet spread to people's daily life use. This design of agricultural traceability platform is based on EPC standards, we can meet any vendor, product information and product flow of information access unified management of public demand, which is a universal platform to provide the necessary conditions.

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