Dairy Traceability System Based on Blockchain

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Abstract. With the improvement of living standards and the development of the Internet, while food safety is being paid attention to, big data analysis of customer demand is becoming more and more important. In the past research on dairy traceability systems based on blockchain, people pay more attention to the role of "security traceability". On the basis of the original, this paper implements the traceability system with two functions of "security traceability + precision marketing" in the Hyperleger Fabric platform. On the basis of solving the problem of "security traceability" for consumers, this paper adds the function of big data analysis and precision marketing for sellers. It is hoped to further promote the application of blockchain in daily life.

Keywords: Blockchain; Food safety; Traceability applications; Precision marketing.

1. Introduction

Milk and its dairy products are indispensable things in our life and have high nutritional value. But are the dairy products around us really safe? The Sanlu milk powder incident in 2008 has left a shadow in our hearts. Incidents of foreign bodies in dairy products and expired products are common on major media platforms. In addition, most existing technologies on the market exist in the form of "tracing with code" through "Internet + Internet of Things", and we monitor the whole process by scanning two-dimensional code. However, in the process of tracing the source, the authenticity of the data is questionable. For the sales platform, the public trust in enterprise tracing is not strong enough. Some manufacturers have the behavior of buying and selling source tracing in the process of tracing. By giving the sales platform an empty two-dimensional code, the seller fills in the information, so as to achieve the purpose of deceiving consumers. These problems have led to a crisis of confidence among consumers. Although some ten pieces of safety control technologies have been gradually popularized and applied in the fields of food cultivation and cultivation and production and processing in China, the whole technology to its source is still not perfect. And in an environment where fake and shoddy products emerge one after another, once problems occur, it is difficult for government departments to effectively follow up and trace, control, and recall the problematic products. The previous traceability system may be against the interests of manufacturers and sellers, which leads to their reluctance to apply the blockchain traceability system. However, the new system adds the "marketing" function, which can automatically analyze data for manufacturers and sellers.

This article will mainly be based on the characteristics of distributed, decentralized blockchain, this paper based on the technology of blockchain milk traceability system, establish a Shared database of immutable, solve the problem of consumer trust and government accountability for a difficult problem, at the same time for the vendors provide some dairy audience, customers favorite products marketing data analysis results are accurate.

2. Block chain technology

2.1. Blockchain Definition

Blockchain refers to a mode of implementing and managing transaction processing in the peer-to-peer network (P2P) environment by building non-forgettable, non-tampering and traceable fast data structures through transparent and trusted rules. And it has the characteristics of decentralization, untampering, and distrust. [1] In this paper, the application of the milk traceability system is just based on its non-tampering characteristics.

2.2. The characteristics of blockchain

2.2.1 Decentralized

There is no super management node. Each node is both a server and a client. All nodes jointly maintain resources and services in the network. Blockchain has the advantages of high fault tolerance and intermediate cost saving.

2.2.2 Tamper Proof

The data organization structure of blockchain adopts blockchain data structure, and any data can be verified by tracing the source of the chain structure, ensuring the authenticity, integrity, and security of the data on the chain.

2.2.3 Trustless

The trust mechanism of blockchain is based on asymmetric encryption in cryptography. Any two nodes establish a connection without trusting each other's identity, and the two sides exchange data without trusting each other.

2.3. The blockchain infrastructure

The blockchain system can be divided into the data layer, network layer, consensus layer, incentive layer, contract layer, and application layer, which constitute the basic architecture model as shown in FIG. 1. [2] Among them, the data layer, network layer, and consensus layer are necessary for a blockchain system.

The data layer encapsulates the underlying data blocks, hash functions, time stamps, etc. Miners (accounting nodes) with accounting rights create blocks and link them to the previous block, thus forming the longest main chain, which records the complete history of all data and facilitates our application in traceability. This data layer uses asymmetric encryption to ensure data security and prove ownership of transactions.

The network layer provides a peer-to-peer network environment where each node has the same status and is used to broadcast all valid and legitimate transactions and discard invalid transactions. And the network layer is the foundation of the decentralized storage mode.

The consensus layer encapsulates the consensus mechanism in each node to ensure the consistency of block data among nodes. The consensus algorithm is known as the "blockchain brain", and different systems will adopt different consensus algorithms.

The non-essential layer includes the incentive layer, contract layer, and application layer. The incentive layer is used to "punish evil and promote good", encouraging more benign nodes to participate in the transaction and accounting work in the blockchain, and providing a guarantee for the smooth operation of the blockchain. The contract layer is the basis for the blockchain system to achieve flexible programming and control transactions. Application scenarios and cases of the application layer encapsulating blockchain.

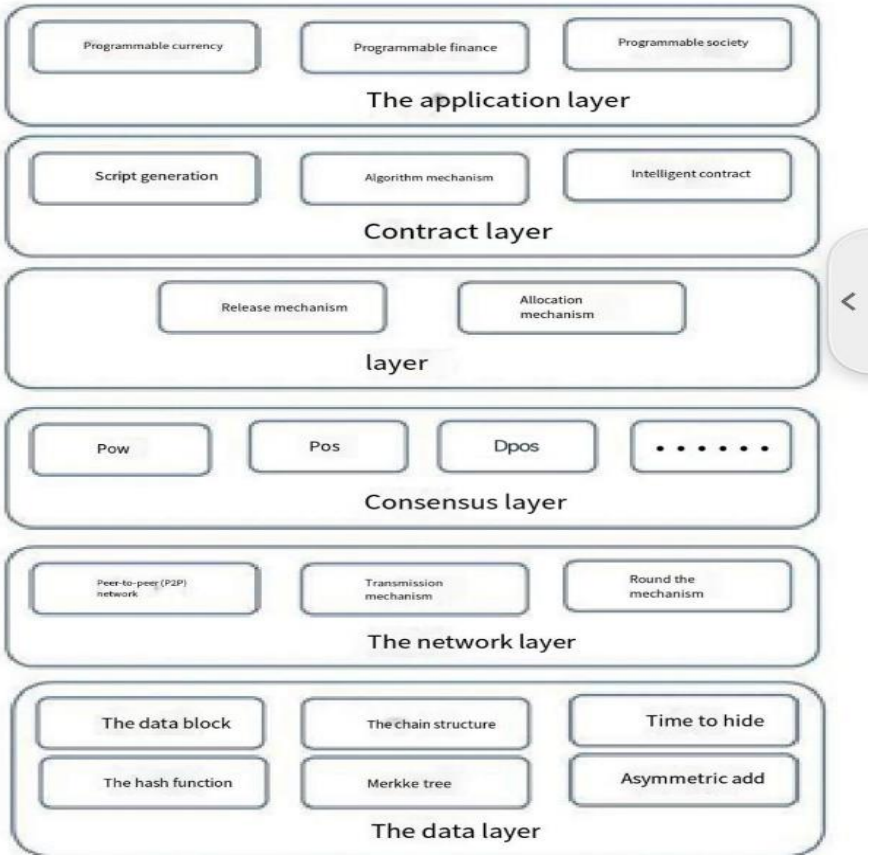


Fig. 1 Block chain Structure

3. Design of dairy traceability system based on blockchain technology

3.1. System design and architecture

The technical architecture of the dairy traceability system is mainly divided into the communication layer, database layer, and application layer (as shown in Figure 2) [3]. Among them, blockchain technology is applied to the database layer and the communication layer.

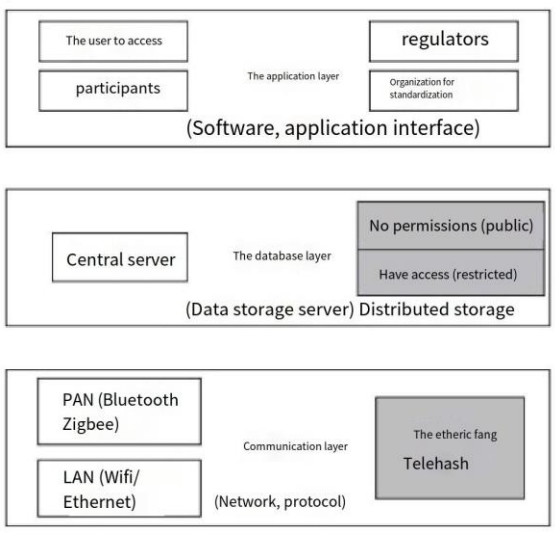


Fig. 2 System design and architecture

Communication layer: mainly provides network services, including network structure and protocol. The technologies of the transport layer of the Internet of Things can be mainly divided into near-field

wireless communication technology and long-distance wireless communication technology according to the distance, including mobile air network, wired transmission, near-field transmission, traditional Internet, and other media [4-6]. The milk traceability system introduced in this paper is based on Hyperleger Fabric open source platform. Hyperleger Fabric is an open-source consortium platform developed by IBM. This platform uses multiple channels to isolate information between different ledgers so that the information does not interfere with each other.

Database layer: This application aims to complete a multi-party co-built distributed storage database. Each piece of data on the link has its own timestamp to facilitate subsequent accountability issues.

Application layer: provides software and application interfaces to connect to specific user roles.

3.2. Application of dairy traceability system

3.2.1. Customer requirement analysis

Generally speaking, customers are divided into two categories: government and enterprise. The local government needs to use the traceability system to drive the local characteristic products and economic development; Government regulators need to emphasize "accountability". In large and medium-sized enterprises, the purpose of using the traceability system is to prevent good channeling and improve the added value of products. The use of a traceability system in small and micro enterprises is to improve the visibility of enterprises, products, and user awareness; The use of the system in the third-party sales platform is to locate the responsible person in a time when there is a security problem and improve user recognition [7-9].

3.2.2. Role analysis

All users of the dairy traceability system need to register and provide their own information, including personal names and companies. At the same time, all users can obtain the public key and private key. The private key is used to verify identity information. The milk traceability system divides all users into producers, transporters, sellers, consumers, and regulators.

3.2.3. Business process and link data

We need to understand the original production, processing, and sales process of local milk, so as to understand the data that consumers want to see and link up these data. Dairy production to sales of the business process: cow feeding, cow disease prevention, milk production, milk quality testing, milk warehousing, processing, packaging, and sales. The dairy traceability system constructed by the application of blockchain technology includes five core nodes: manufacturer node, logistics provider node, seller node, consumer node, and government node. (Figure 3)

The steps of the traceability process are as follows:(Figure 4)

Collect manufacturer node information. After the node obtains the corresponding authority, it carries on the unique tracing source identification after the milk production, collects the pasture environment, cow feed, and other information, and puts the enterprise production license and other subjects on record, production date, transaction date, collection data and tracing source on the chain.

Logistics node for information collection. After obtaining the corresponding authority, the node links up the record of the enterprise subject and transportation information (including the transportation date and method, etc.).

The vendor node collects information. After the node obtains the corresponding authority, the enterprise subject record, transaction information, product quality, storage information, and other data are linked up.

After obtaining the corresponding authority, the consumer node can query the whole transaction process by scanning the source code and putting the feedback information of the commodity on the chain [10].

Regulatory oversight process. The construction of a dairy traceability system is inseparable from the government's supervision and management, and the government node runs through the whole traceability process. The regulatory department needs to carry out qualification certification for

manufacturers, logistics providers, and sellers, join their terminals as nodes in the alliance chain, and put the regulatory information (historical rewards and punishments records, qualification certification information) of the above three companies on the chain.

3.3. Application scenarios

3.3.1. Traceability module

The main application roles are consumers and related departments. When consumers buy milk, they can get precise information about the environment, feed, milk collection time, processing time, transportation time, and the person in charge of each work. Let the user "drink rest assured, buy comfortable". At the same time, once food safety problems occur, relevant departments can obtain a higher level of authority through the private key to determine the source of the problem, so as to carry out an accurate product recall.

3.3.2. The marketing module

The main application roles are manufacturer and seller. Consumers link the feedback information of the goods, and the data link records the final flow direction of the goods. According to the final flow direction of products, we can get two results through data analysis, one is the public's favorite brand and taste preference; The second is a specific user like the brand and taste.

Based on the feedback, the manufacturer can improve the taste of the dairy products, and at the same time, according to the consumer (public) love the degree of processing and selling.

The seller can purchase according to the popular brand, to achieve the purpose of profit; At the same time, in the context of big data, through the analysis of user information and purchasing behavior, consumers are refined and distinguished to understand the consumption trend of consumers and meet their needs. Record the products that a user repeatedly purchases, calculate the purchase time for two times according to the purchase records, and automatically recommend the product and similar products to the user in the next period.

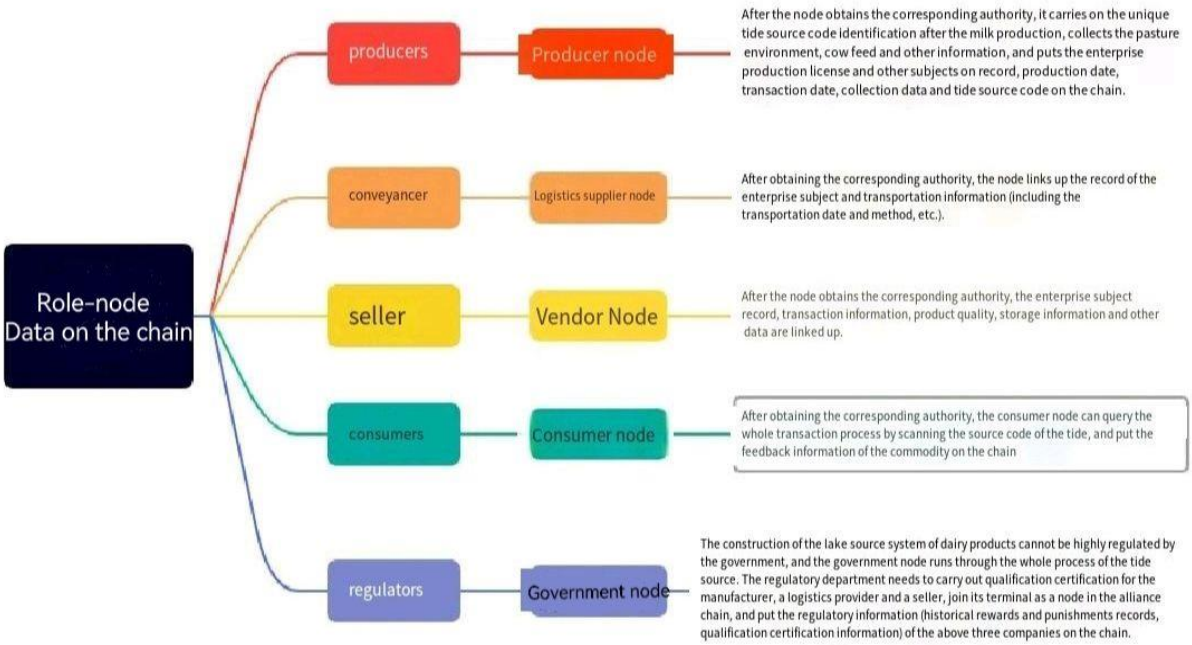


Fig. 3 Role-node-Data on the chain

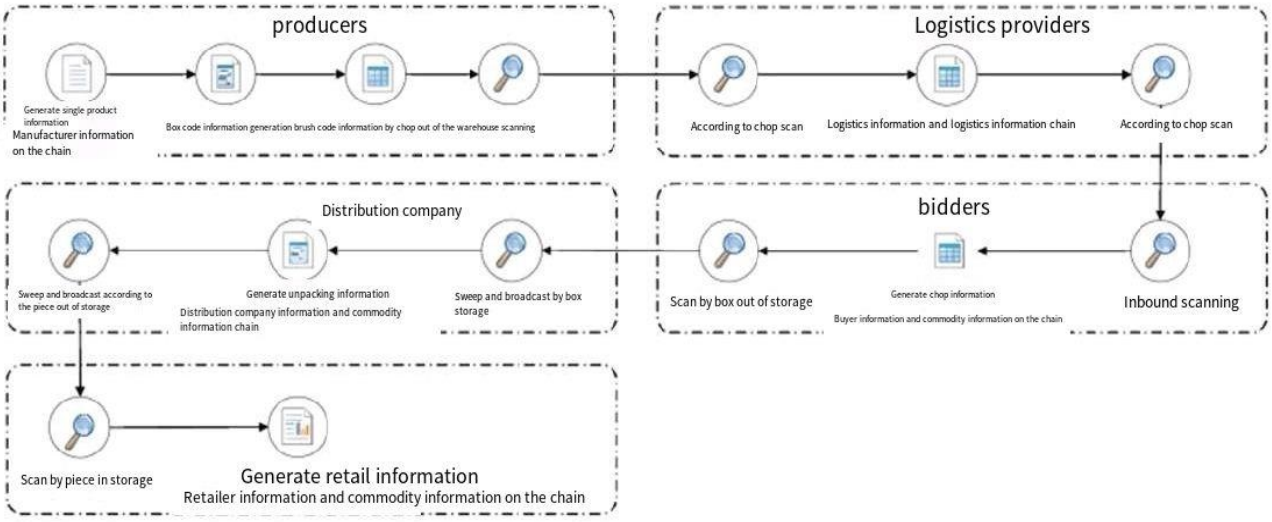


Fig. 4 Traceability process

4. Summary

According to the working principle and characteristics of blockchain, this paper designs a dairy traceability system based on blockchain. Compared with the traditional dairy traceability system, which has a large number of nodes, difficult to realize data interaction, and consumes more resources, the dairy traceability system based on Hyperleger Fabric can directly link the collected data without the central role recognition, which can save more resources and make it more convenient for all parties to conduct big data analysis. The risk of hacking or central database tampering is reduced. The deficiency of this system is that it does not propose specific optimization methods for the supply chain after data analysis. In the future, we hope to establish a more accurate data model, accurately predict the sales quantity of dairy products, and automatically generate orders and send them to manufacturers when the inventory reaches a certain threshold. This paper aims to provide new ideas and methods for the traceability of dairy products, and innovatively put forward the function of "precision marketing" on the basis of the main body of traceability.

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