



Blockchain Traceability Platform Based on Green Agricultural Products

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Abstract. This paper designs and completes a blockchain traceability platform based on green agricultural products. Using item coding technology, cryptography technology, blockchain, big data and other new generation information technologies, green agricultural products (especially Ulanqab potatoes, oats and other geographical indication products) from growth to harvest to circulation throughout the life cycle. The key data can be trusted and stored in the blockchain, providing consumers with real-time agricultural product traceability query services, and providing agricultural and animal husbandry departments with effective agricultural product quality and safety supervision and management mechanisms and means. With the help of QR code as the mobile Internet entrance, link online and offline, design O2O e-commerce transaction system, form a closed loop of planting, traceability and sales, digitally control the quality of authentic agricultural products, and empower the brand value of agricultural products. Realize the whole chain supervision of green products from planting source to circulation through a perfect traceability system, improve product safety and quality, enhance the market's popularity and recognition of agricultural products in the region, form effective protection of agricultural product geographical indication products, and achieve agricultural economic development "Increase quality and efficiency", and then promote the construction of smart agricultural big data projects.

Keywords: BlockChain · Software platform · Big data technology · Smart agriculture

1 Research and Development

This project has designed and completed a blockchain traceability software platform based on green agricultural products. Use big data technology to complete the intelligent collection and convenient sharing of agricultural data in stages, and then promote the construction of smart agricultural data projects. With the help of item coding technology,

each agricultural product is given a unique label to record the key data information about the whole process of green agricultural products from planting, harvesting, processing, packaging, circulation, warehousing and retailing. At the same time, consumers can check and verify products by scanning the code. The whole process of traceability information, a comprehensive understanding of product information, to achieve peace of mind consumption. And the design of the O2O e-commerce transaction system solves the problem of unsalable agricultural products, creates a brand marketing strategy for green agricultural products, and expands marketing channels. Realize digital control of the quality of authentic agricultural products; empower the brand value of agricultural products.

Specifically include the following:

1. Item code management system. Through the code management of people, places and things, the end-to-end one-code communication is realized, and the brand of origin and the reputation of products are escorted.
2. Item traceability management system. Define the key data in the planting and circulation links, and perform trusted storage and query in the blockchain distributed ledger.
3. O2O e-commerce transaction system. Realize the e-commerce transaction of agricultural products and the scanning and tracing of the products by customers. From the in-depth development of "Internet + agriculture", the origin and sales of agricultural products are closely linked, which not only shortens the supply chain and saves the logistics costs of farmers and e-commerce enterprises, but also achieves information sharing, which is beneficial for the people involved in the transaction. Information can be exchanged. As an important entrance to the mobile Internet, QR code links online and offline, which can help the rapid promotion of agricultural products, and a perfect traceability system can realize the whole chain supervision of products from the source of planting to sales, channels, warehousing, logistics, etc., effectively Improve safety and quality. Brand + quality double promotion can better enhance the market's recognition of agricultural products and achieve rapid sales.

2 Technical Route

2.1 Platform Design Ideas

The system adopts a general and mature software framework, has many successful application cases and provides flexible customization functions, which can be set to meet most personalized needs in data management, data analysis, visualization, etc.; the system should also have high The reliability of the system ensures the correctness of the data and the stability of the system operation, without data loss, software errors and system crashes.

The system adopts a micro-service architecture design, which can easily expand and upgrade the system. As long as a simple operation is performed, new functional modules can be easily added to the software interface. When a module has an upgraded version, the module can be replaced by itself. Yes, it does not affect the normal use of other functions.

2.2 Platform Design Principles

Platform Openness and Practicality. In the system construction, the principle of openness should be fully considered, and various corresponding software and hardware interfaces should be supported to make them flexible and extensible. The system should be an open and flexible platform, with various data collection and conversion methods, flexible index analysis model construction, allowing multiple data sources and data sharing and exchange.

The system should strive to meet the actual work needs to the greatest extent, fully consider the practicability of data processing at each business level and each management link, and consider satisfying the user's work and management business as the first element. It enables administrators to maintain some roles and organizations involved in the system, and supports a multi-level administrator management mechanism. Users can regularly and irregularly maintain their passwords. The whole project starts from the practical point of view, provides services according to the actual needs of users, and focuses on the practicality of the business.

On the premise of ensuring the practicability of the system, the security, upgradeability, platform independence and scalability of the system are maximized. The software and hardware systems selected in the project construction can be easily integrated, so that the application system can reduce the difficulty and requirements of system maintenance, and it is also convenient for users to apply and manage in the future.

Functional Scalability and Compatibility. Taking into account the increase of users and business expansion, the expansion of the system scale, the protection of investment and the specific situation of step-by-step implementation, the system design should take into account the use of current existing resources, and consider the subsequent expansion and maintenance requirements. The system can not only meet current needs, but also meet future development.

Adopt systems and products that follow international standards to facilitate interconnection and expansion with third-party systems, and easy migration to future advanced technologies. An advanced and mature big data architecture generally adopts a component-based and object-oriented design, encapsulates each functional module as a service in layers, reflects the characteristics of a loosely coupled architecture, and ensures the expansion and upgrade of the system in the future. Good scalability often adopts a three-tier architecture. With the gradual improvement of the application and the gradual increase in the amount of information, it is continuously expanded, and the entire system can smoothly transition to the new upgraded system to achieve continuous data scale. Accumulation, continuous upgrade of services and continuous expansion of application scale. Compatibility and scalability are mutually reinforcing. For example, for the models and versions of different browsers on the market (including multi-core browsers such as IE kernel, Chrome kernel, Firefox, firefox), as well as projector resolutions as small as 4k screen resolutions, use the window ratio as the unit. The interface layout, when stretching and shrinking, realizes full-scale scaling. This interface-independent technology is an important basis for compatibility and scalability.

System Stability and Security. The software and information resources in the system must meet the reliability design requirements, adopt stable and reliable mature technology, improve the ability of error prevention and error resistance, and ensure that the platform software should have stability, reliability and fault tolerance. The system has a reliable backup and recovery mechanism to ensure rapid recovery of system operation in the event of a system failure.

The security function design adopts hierarchical authorization, data hierarchical and hierarchical management, and pays attention to data security. At the same time, fully consider the security requirements of the network, operating system, database, application, etc. When the system is designed, there are sufficient security measures, such as strict authority management for information access and use, unified identity management, technically providing a login authentication method combined with digital certificates, and supporting the combination with security authentication to ensure the entire system. Safe and reliable. System security is ensured by means of authority classification, SMS verification, and encryption of important information.

User Operability and Maintainability. Ease of operation is reflected in zero requirements for the technical foundation of business personnel. The system has a good man-machine interface, implements the principle of facing the end user, and establishes a friendly user interface. The application interface design on the Web and mobile device App clients conforms to a flat and minimalist style, and the operation is simple, intuitive, flexible, and easy to learn., Easy to use and easy to maintain. The interface style and operation process of all business functions are consistent, in line with business process requirements and usage habits.

Maintainability is reflected in intelligent, visualized, and remote maintenance capabilities. The maintenance terminal has a system configuration interface, which reduces the need to manually modify the code in the background, adopts the technology that can be repaired in time to avoid system restart, uses the system log record to provide effective error reporting and positioning information, supports the addition of new modules during the maintenance period, and provides friendly to other related systems. Interface, etc.

2.3 Development Language Selection

Select Java and Go as the development language, and Node.js as the runtime environment. Java is an object-oriented programming language.

Therefore, the Java language has two characteristics: powerful functions and simplicity and ease of use. Java has the characteristics of simplicity, object orientation, distribution, robustness, security, platform independence and portability, multithreading, and dynamism. Java can write desktop applications, web applications, distributed systems and embedded system applications. Go (also known as Golang) is a statically strongly typed, compiled language developed by Robert Griesemer, Rob Pike, and Ken Thompson of Google.

Go language syntax is similar to C, but the functions include: memory safety, GC (garbage collection), structural form and CSP-style concurrent computing. Node.js is a

JavaScript runtime environment based on the Chrome V8 engine. Node.js uses an event-driven, non-blocking I/O model, making it lightweight and efficient. Npm, the package manager for Node.js, is the world's largest ecosystem of open source libraries.

2.4 Database Selection

This project adopts an application based on the Redis + MySQL + MongoDB storage architecture. The technical architecture of Redis + MySQL + MongoDB fulfills the requirements of big data storage and real-time cloud computing in this project. Using the horizontal dynamic addition of MongoDB slices can ensure the query speed and cloud computing performance after expansion without interrupting the platform business system; index slices according to slice keys, and perform calculations independently in each slice, making real-time analysis under big data a reality. Reality. The data that is frequently accessed is placed in Redis, which reduces disk I/O, makes the business system more agile, and meets the high demand of application services under high concurrency.

2.5 System Functional Structure

The blockchain traceability platform based on green agricultural products includes three subsystems: item coding management system, item traceability management system, and O2O e-commerce transaction system. The functional structure diagram of the system is shown in Fig. 1.

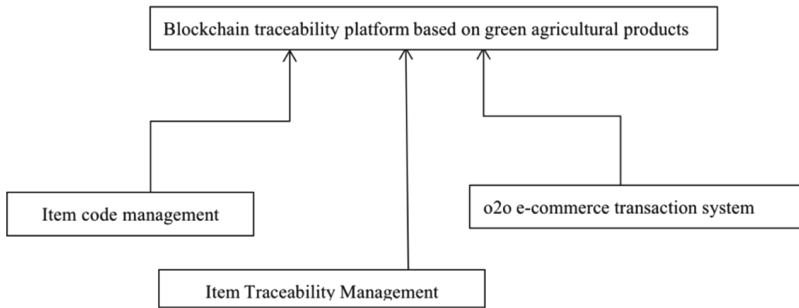


Fig. 1. System main function structure diagram.

Item Code Management System. The functional structure diagram of the item code management system is shown in Fig. 2 and Fig. 3. The item coding management system realizes one item, one code, one person, the code, corresponding to the information collection of the whole process of planting from the sowing period to the fertilization period to the final harvest period of the relevant agricultural products planted by the farmer and the farmer, and realizes the coding of agricultural products. Set up. Set two user roles of administrator and farmer.

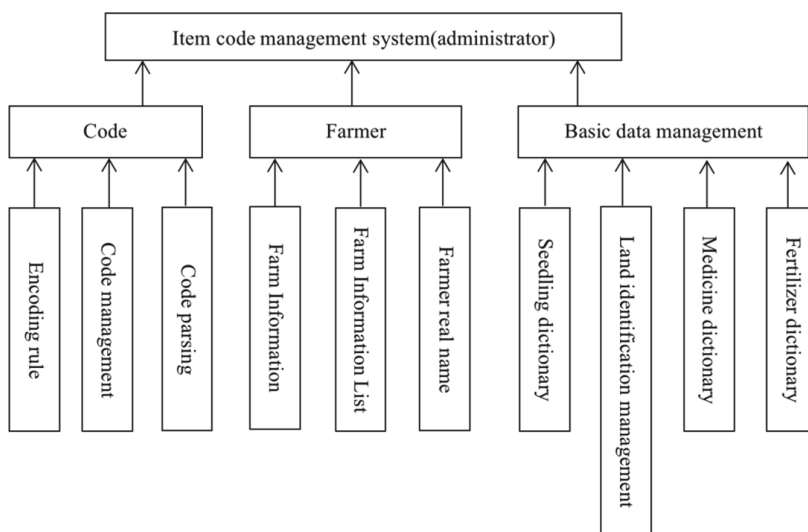


Fig. 2. Functional structure diagram of the item code management subsystem (administrator).

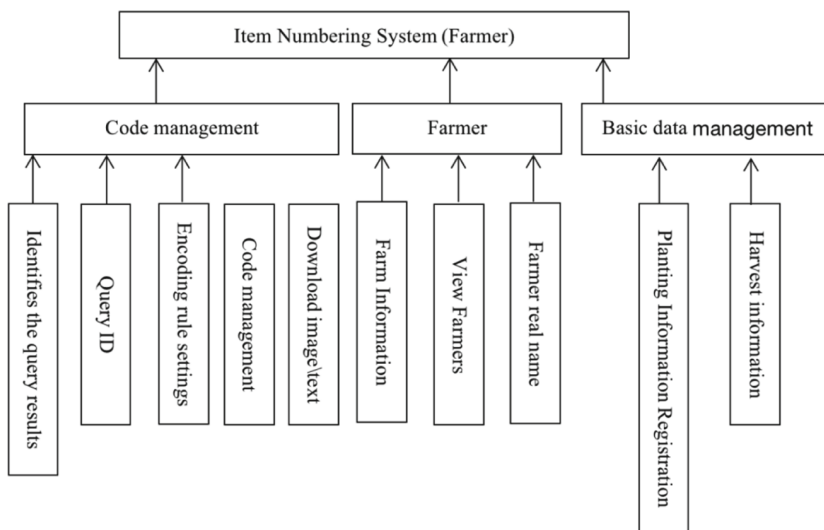


Fig. 3. Functional structure diagram of item code management subsystem (farmer).

Coding management implements coding rule setting, code assignment management and coding analysis management. And realize the identification query display and the download management of the code package.

Farm/owner management realizes the maintenance of farm and farmer information, and realizes the real-name authentication of the farmer. The basic data management function enables administrators to maintain dictionaries such as seeds/seedlings, land

identification, medicines, fertilizers And realize the registration of planting information and harvesting information by farmers. The registration of harvest information means the registration of relevant information on the harvest of agricultural products.

Item Traceability Management System. Item traceability management realizes customer scan code traceability and traceability service management. In this system, a distributed ledger and a blockchain browser are designed to complete the traceability management of items. The implementation of the traditional agricultural product traceability system relies on centralized storage, and the data is opaque and easy to be tampered with. However, the existing blockchain traceability system is segregate with the demand for traceability of agricultural products, and the management and query of large-scale traceability information are relatively low. In this project, the blockchain traceability scheme of agricultural products alliance is based on the Hyperledger Fabric framework, on the basis of ensuring the credibility of traceability, according to the characteristics of agricultural product traceability process and alliance blockchain technology, the system architecture and chain operation method are designed to improve large-scale data. The speed of uploading and querying makes it meet the needs of agricultural product traceability applications.

O2O e-Commerce Transaction System. Design O2O e-commerce transaction function and coding query function. The O2O e-commerce transaction function realizes the function of opening a mall for farmers/farmers or enterprises, can maintain the information of agricultural products, and realize the online and offline of the products, and can realize the management of e-commerce transaction orders and the tracking of warehousing and logistics. Customers can scan the code to trace agricultural products, manage

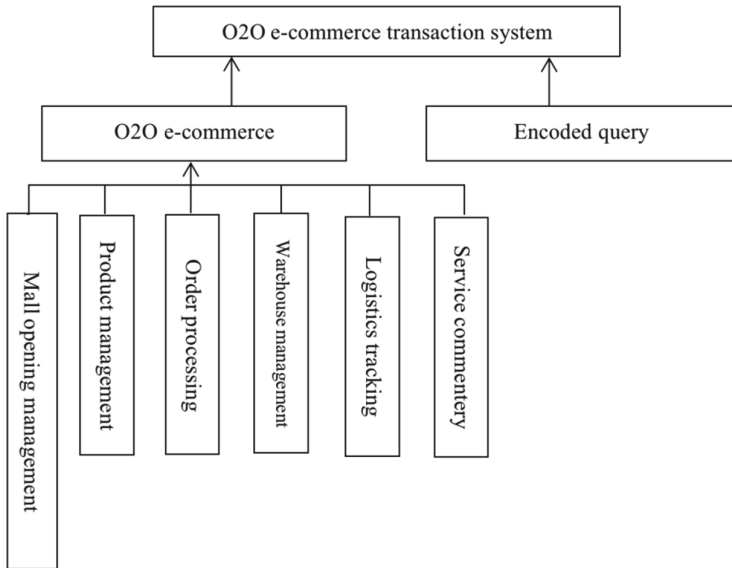


Fig. 4. Functional structure diagram of O2O e-commerce transaction subsystem.

the entire supply chain cycle from sowing to harvesting to warehousing, ordering transactions and logistics tracking. The functional structure diagram of the system is shown in Fig. 4.

3 Key Points and Innovation Points

The blockchain traceability platform based on green agricultural products includes three subsystems: item coding management system, item traceability management system, and O2O e-commerce transaction system, which can help agricultural customers realize the informatization of all aspects of production, sales, management, and government monitoring. Improve management level and improve efficiency.

1. Realize the traceability of agricultural product information. Agricultural product traceability can track agricultural products, from the origin to the consumer, all the way to trace the product life track. Just through a corresponding traceable source code, consumers can take out their mobile phones to scan, and then they can obtain the relevant information about the agricultural products, so that consumers can rest assured.
2. To achieve efficient supply chain management. In the past, circulation of agricultural products, due to the opaqueness of information, inventory often accumulated, which led to quality problems of agricultural products over a long period of time. Through the agricultural product traceability system, we can clearly understand the process of agricultural product circulation, run supply chain management, and avoid the occurrence of agricultural product inventory. Accumulation or deficiency occurs.
3. Use coding technology to achieve end-to-end one-code communication. To solve the identification of “people”, “land” and “things” that cannot be tampered with, the key growth information of crops is collected through two-dimensional codes in the production process, and the credible and stored data are verified through two-dimensional codes in the circulation process.

4 Summarize

This paper uses the following technologies, blockchain technology. The use of blockchain technology stores the data or information in it have the characteristics of “unforgeable”, “full traces”, “traceable”, “open and transparent” and “collective maintenance”. Item code management system. Through the code management of people, places and objects, the end-to-end one-code communication can be realized, and the information collection, upload and query of agricultural products can be realized by scanning. Item traceability management system. The links required for traceability and the level of detail of the information of each link can be defined according to different crop types and the actual needs of local traceability. The key data is stored in the distributed ledger, which can be verified by the transaction hash in the blockchain browser. O2O e-commerce transaction system. It covers e-commerce modules such as agricultural

product category management, commodity management, order management, payment management, and comment management.

Through the demonstration application of this project, agricultural production institutions can create a closed loop of green agricultural products from planting to sales. The key data is stored through the features of blockchain decentralization and non-tampering, so as to reduce the harm caused by fake agricultural products on the market and shoddy products to the planting industry in Ulanqab, and form the protection of geographical indications of agricultural products in the region. Increase economic benefits through direct brand purchases of specific consumer groups on e-commerce platforms.

Use big data technology to complete the intelligent collection and convenient sharing of agricultural data in stages, and then promote the construction of smart agricultural big data projects. Using two-dimensional code technology and blockchain authentication technology, timely collection and upload of agricultural product quality data from growth to sales of agricultural products, providing consumers with timely agricultural product quality and safety traceability query services, and providing agricultural and animal husbandry departments with effective agricultural products Quality and safety supervision and management mechanisms and means. Build an O2O e-commerce transaction system, increase the trading channels of green agricultural products, enhance the market's recognition of agricultural products, realize the rapid sales of the products, and realize digital control of the quality of authentic agricultural products; empower the brand value of the products.

References

1. Christidis, K., Devetsikiotis, M.: Blockchains and smart contracts for the internet of things. *Journal. IEEE Access* **4**, 2292–2303 (2016)
2. Marc, P.: *Blockchain Technology: Principles and Applications*. Journal. Post-Print (2016)
3. Yermack, D.: Corporate Governance and Blockchains. *Journal. Social Science Electronic Publishing* **21**(1), 7–31 (2015)
4. Catalini, C., Gans, J.S.: Some simple economics of the Blockchain. *Journal. SSRN Electronic Journal* (2016)
5. Underwood, S.: Blockchain beyond Bitcoin. *Journal. Communications of the ACM* **59**(11), 15–17 (2016)
6. Cachin, C., Vukoli, M.: *Blockchain Consensus Protocols in the Wild* (Keynote Talk). *Journal.* (2017)
7. Ouaddah, A., et al.: FairAccess: a new Blockchain-based access control framework for the Internet of Things. *Journal. Security and Communication Networks* **9**(18) (2017)
8. Zhu, K.: Assumption of E-commerce Platform of Agricultural Products Based on F2C2B Mode. *Journal.* 2022(4)