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Equipment Supply Support System based on Blockchain and B/S Architechture

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Abstract

The rapid development of computer technology provides a new solution to the problem of equipment support under the new system. Among them, the browser/ server architecture software can ensure that under any network conditions, the terminal can log in to the server to view information at any time. The integrated application of centralized database and distributed database improves the reliability and stability of the system. The emergence of block chain, public key and private key encryption, virtual local area network (VPN) and other computer security technologies make the network security has been unprecedented protection. Therefore, this paper plans to use B / S architecture to write programs to realize the mobilization and management of equipment and equipment network, information. Block chain technology is used to audit the information in the system to ensure the safety, reliability and unforgeability of equipment data.

Keywords

Data storage, Equipment support, B/S architecture blockchain, Ethereum.

1. Introduction

With the rapid development of computer technology, the traditional centralized database is gradually inadequate. New technologies such as blockchain, artificial intelligence and cloud computing make the integration of computer and other fields closer. In 2008, Nakamoto first proposed the concept of bitcoin in his article, and its underlying architecture blockchain was also known for the first time. Bitcoin is called blockchain 1.0. With the introduction of Ethereum, the concept of smart contract makes it possible to combine blockchain with other fields. IBM's super ledger project has realized the application of blockchain in the industrial field for the first time. At present, blockchain technology has been implemented in traceability, logistics, finance and other fields.

In the field of traceability, Alibaba, a Chinese enterprise, has applied blockchain to public credit storage, and its Alibaba forest project has become the first blockchain commercial project in China. It helps to ensure the fairness and transparency of environmental protection donation. The company's later Taobao donation and other projects also used blockchain technology to ensure data security and transparency. In the field of logistics, SF team is exploring the possibility of combining private chain with real-time logistics. The private chain can be quickly generated to facilitate users to query the location of goods in time. Effectively put an end to the false delivery situation. Fresh logistics is another important area. Due to the high demand for the origin of fresh products, in order to improve profits, many vendors choose to use non authentic products as products of origin. The use of blockchain technology can ensure the whole process transportation of fresh products, which helps to eliminate the situation of Midway replacement and fake delivery. Wuliangye Group has also applied blockchain technology to liquor logistics traceability. In the financial field, the digital currency team

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led by the people's Bank of China has proposed a virtual currency based on blockchain technology and will be put into trial operation in the near future. Ping An fimax proposes a high security and high performance blockchain solution, which uses zero knowledge proof algorithm to help build a decentralized business network ecology.

2. Literature References

2.1 Research status

Since the late 1980s, the developed countries' represented by the U.S. began to study the equipment support mode guided by the equipment support demand, and successively put forward "focus logistics", "perception and response logistics", "precise support" and other support theories. In recent years, with the development of Internet of things technology, GPS positioning and navigation technology, satellite communication technology and the application of information equipment, the U.S. has developed global combat support system, full asset visibility system and in transit material visibility system to realize the sharing of equipment and material information and the whole process management and control. Its main research includes:

(1) Construction of accurate support information environment: in the aspect of command support, information collection technology, information transmission technology, information processing technology and information security technology are fully used. In the aspect of support equipment storage and transportation, modern packaging technology, advanced storage technology, automatic identification technology, GPS technology, etc. are applied to provide equipment and information technology support to equipment support institutions rapidly, accurately and efficiently through a series of information technology and information equipment applications. The information superiority is transformed into decision superiority and action superiority, the most appropriate guarantee reality, the most optimized guarantee strength and the most accurate guarantee material are determined, and the precise guarantee is implemented.

(2) Transformation of equipment support mode based on demand traction: from traditional "passive response support" to "high-speed active distribution support". Through the "all asset visual network system", the support organization tracks the consumption and demand of equipment and materials of the front-line troops in real time, distributes and delivers equipment and materials on demand, adopts the supply mode from the starting point to the troops, and actively distributes equipment and materials to the required time and place with a small amount of inventory and flexible means of transportation through flexible dispatching of various support resources Troops. The army can also query and master the whole process of equipment and materials transportation from the rear to the front line in real time through the "whole asset visibility network system", change the transportation route and means in time in case of emergency, and provide real-time, fast and effective accurate support.

2.2 Development trends

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3. Overall functional design

The main functions of this system are unified storage of materials, material transfer under networking, data synchronization under disconnection, warehouse information management, equipment data audit, etc. The overall structure of functional design is shown in Figure 4-1.

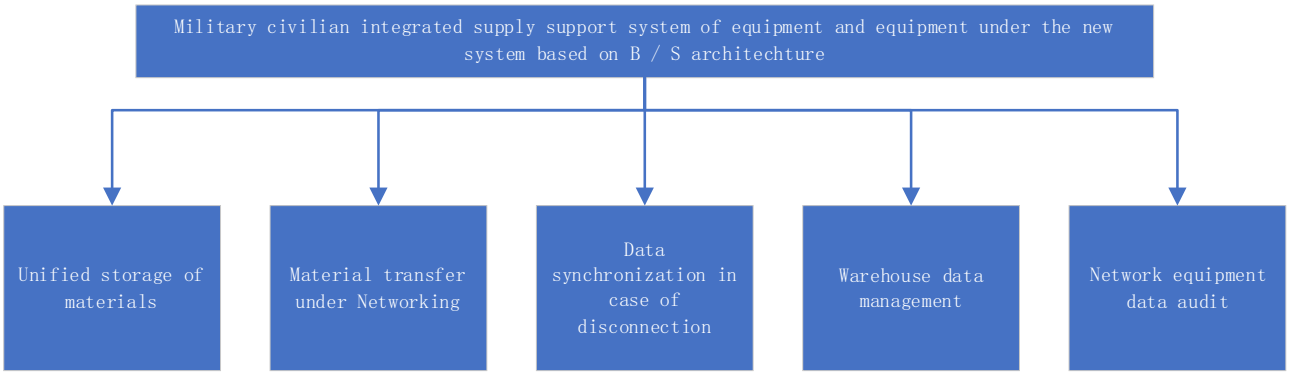

Figure 1. main functions of the system

Unified material storage: all the equipment in the warehouse are numbered uniformly, and the number format is < equipment_id, Storage_id, timeStamp>. Among them, equipment_ ID is the number of the equipment in the warehouse, storage_ ID is the warehouse number. The combination of the two is the unique number of the equipment. Timestamp is the time stamp when equipment is put into storage, which is convenient for sorting, searching and other operations. When the equipment is transferred between different warehouses, the information in this tag needs to be modified. The modification process is carried out by the audit module. And fully stored in the blockchain to ensure the security of data.

Data call in the case of Networking: because each warehouse has its own independent database system, they need to be synchronized in real time in the case of networking. Suppose warehouse a needs to transfer equipment 1 to warehouse B. In warehouse a database, first move out equipment 1 and synchronize to all other databases. Equipment 1 is passed to the transfer library. After receiving equipment 1, warehouse B writes equipment 1 to its own database and synchronizes it to all other databases. The transfer operation is complete. If equipment 1 is consumed in warehouse A (such as shells, bullets, etc.), warehouse a writes equipment 1 into the consumption data table and deletes it from its own database. After synchronizing to all other databases, the data call process is finished.

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Data synchronization in case of disconnection: in case of disconnection, each database cannot synchronize with other databases. Unable to sense the status of other warehouse databases. Therefore, we can only consume our own materials. And record the atomic operation. The database of other warehouses can be synchronized after the network is unblocked. This paper uses the PV operation of deadlock protocol to ensure the normal synchronization of data. Using this protocol can also guarantee the deadlock of equipment due to abnormal synchronization sequence, which makes any warehouse unable to fulfill the requirements. This paper uses the banker algorithm to achieve this requirement.

Warehouse data management: in line with the current management methods. In this paper, the establishment and modification of all warehouses are completed by super administrator. The location information, contact information, account password, IP address and other sensitive data of each warehouse are encrypted by asymmetric encryption algorithm and stored in the database. And use the blockchain technology to write the encrypted information into the blockchain for audit. Each warehouse manager has his own account and password. Forget password needs to be reset by super administrator. All operations on the system are written to the blockchain for storage for audit.

Network equipment data audit: using the audit model based on blockchain proposed in Chapter 3. After each warehouse operation, before the data of the operation is written to the database of the warehouse itself, the digital summary content needs to be encrypted with its own private key and then written to the blockchain. After the blockchain synchronization consensus is passed, the databases of other warehouses can be synchronized. The specific implementation process is shown in Figure 4-2:

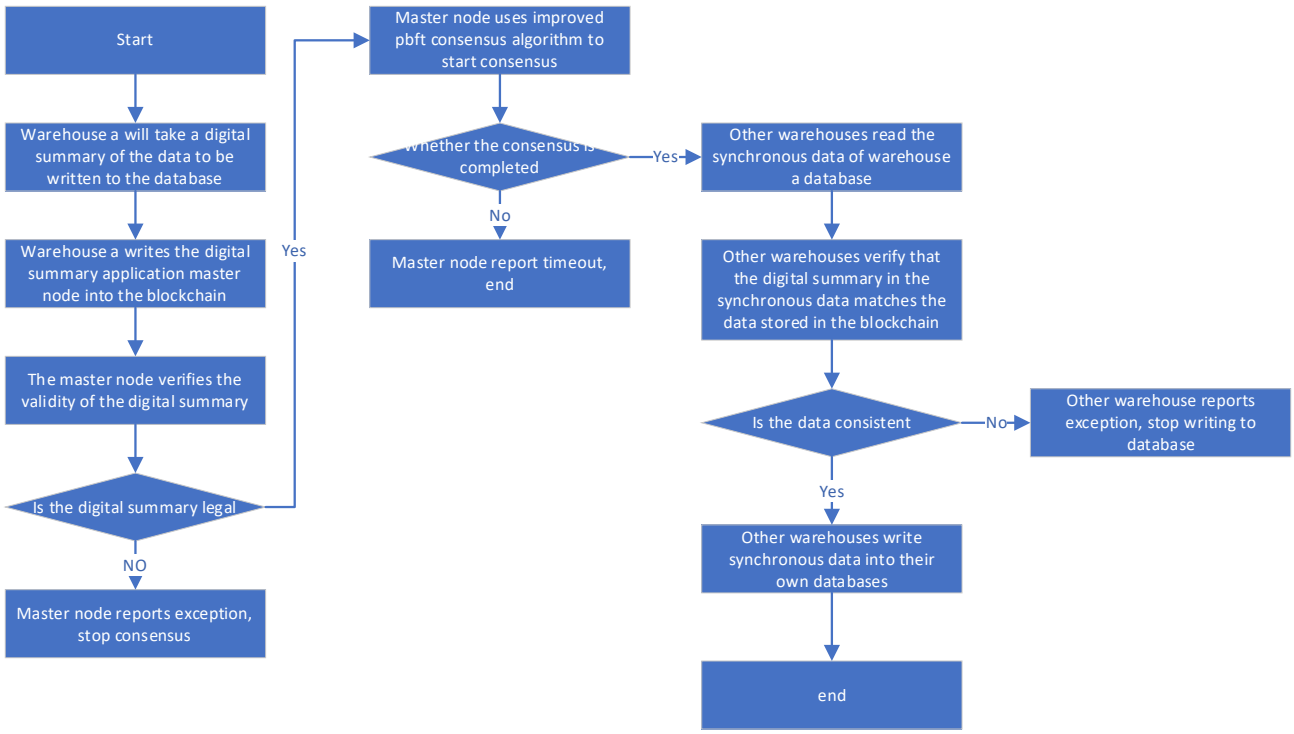

Figure 4-2. Audit process of networked equipment data

After the system starts to run, warehouse a extracts the digital summary of the data to be written, and then sends it to the master node. The master node uses the improved PBFT consensus algorithm for consensus. After the consensus is completed, each warehouse synchronizes the blocks in the blockchain. Then each warehouse receives the equipment change data sent by warehouse A and enters the blockchain to check whether the digital summary is the same. If it is the same, change data will be recorded in its own database. If the digital summary is different, it indicates that the information has been tampered with, discards the information and gives an alarm.

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3.1 Physical architecture design

The physical architecture of the system is shown in Figure3.

Figure 3. Physical architecture of support system

The system ensures the data security of the whole process through data audit and data encryption. Physical layer consists of basic resource layer, data source layer, API interface layer, data resource layer, application support layer, application service layer and access layer. The composition and functions of each layer are described in detail below:

The basic resource layer refers to all the physical resources required for the system operation. Including the Apache server used, the physical disaster recovery layer composed of raid0 disk matrix to prevent sudden damage to the hard disk, the VPN to ensure the safe transmission of data between the internal and external networks, the CA server to ensure the correct authentication of the internal membership of the system, and the use of network monitoring software such as Charles to monitor the operation status of the system.

The data source layer refers to the data sources running in the system. There are three roles in this paper: Super administrator, warehouse administrator and auditor. The super administrator and

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warehouse administrator have independent databases, while the auditor can only audit between different databases. The independent databases are synchronized by PV operation. In the future, banker algorithm can be used to prevent deadlock in the material transfer between warehouses. But it has not been considered in this system.

API interface layer uses API to separate the front and back ends. When the front-end interface is modified, the background code and database do not need to be modified. When the database structure is modified, the foreground interface does not need to be modified as long as the API interface is not moved. The system has better universality and robustness.

The data management layer is mainly responsible for the storage of system data. Data storage operations are mainly completed by databases and blockchain ledgers. Among them, database stores equipment storage, equipment transfer and equipment consumption. Blockchain stores digital summaries of operations in the equipment database to be audited by auditors and other roles when necessary. In order to facilitate the experiment, MySQL database is used to store the relevant information of each warehouse, and Ethereum private chain is used to store the digital signatures.

The application support layer mainly includes unified portal authentication, that is to use a unified authentication server to ensure the normal login of users in various roles. The authentication server is deployed on the super administrator side for external login. If other users want to transmit data online, they must first pass the CA authentication of the server. Single sign on means that each administrator role can only log in on one device. If you log in on two different devices, the latter will squeeze the previous devices out of the line and alarm in the system. Security management is mainly responsible for monitoring the alarm information in the system. If the alarm information is received, the super administrator shall be informed immediately for processing. Message management is mainly responsible for monitoring the message data transmitted in the system, and immediately alarm and freeze the user information if it is found that the data intentionally disturbs the stability. Resource management is responsible for load balancing. When the amount of data sent by a warehouse user is too large, the system resources (such as bandwidth, server throughput, etc.) are inclined to it to ensure the normal data communication. Log management writes the operation information and system operation information of all role users in the system to the log in real time, which is convenient for data recovery and tracking personnel's responsibility in extreme cases. In this paper, the search engine is designed as a separate system, which can realize the search of database information and facilitate the search of equipment data and historical records.

The application service layer mainly realizes various system functions. Such as equipment transfer out record, equipment transfer in record, equipment consumption record, audit database data, audit blockchain data, management warehouse information, management warehouse administrator information, etc. The interface layer is the visible visual operation interface. Use API interface for data interaction with background. This paper uses rest style data interface to ensure the data transmission process is simple and easy to modify.

3.2 System data flow design

The data flow chart of the system is shown in Figure 4:

Among them, there are data sources, data collection, data storage, data analysis, data display and interaction. Under the new system based on B/s, the data source of supply support system for equipment and equipment mainly includes other system API and administrator manual input. Considering the complexity of the system, the amount of data is large. Therefore, the data can be imported in the form of Excel tables, SQL files, etc., and the single equipment data and equipment transfer data can also be added manually by the administrator. After the data source sends the data to the system, the unified data acquisition interface receives the data, converts the input equipment data into a unified format through data conversion, and then loads it into the PDO module, which caches the data, and writes it into the data base or blockchain and other platforms after accumulating a certain amount. The database platform designed in this paper includes centralized database such as Mysql, Oracle and SQL server. The distributed database platforms include mongodb, cockroachdb and

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HBase. Because of the use of object-oriented PDO technology, it is not necessary to modify the code when modifying the storage database, just modify the relevant configuration parameters in the PDO configuration file. In this paper, the audit module is completed by blockchain technology, so the data storage platform of non relational database is also designed. File storage module and blockchain ledger storage mode that can store data including pictures, videos, etc. Data analysis can analyze the data in the database. Through traditional clustering, machine learning, big data and other technologies to analyze the rationality of equipment storage in the warehouse and optimize the equipment storage according to the analysis results. The data sharing service enables a warehouse to transfer its own data to the super administrator or other warehouse administrators under the condition of compliance, so as to realize limited data sharing. The final data interaction and icon presentation are implemented by B / s client. Because the client uses responsive layout, it can also operate and display normally on Android and IOS mobile phones. If you use the August JS tool, you can also package the code into the form of mobile applications to further improve the user experience.

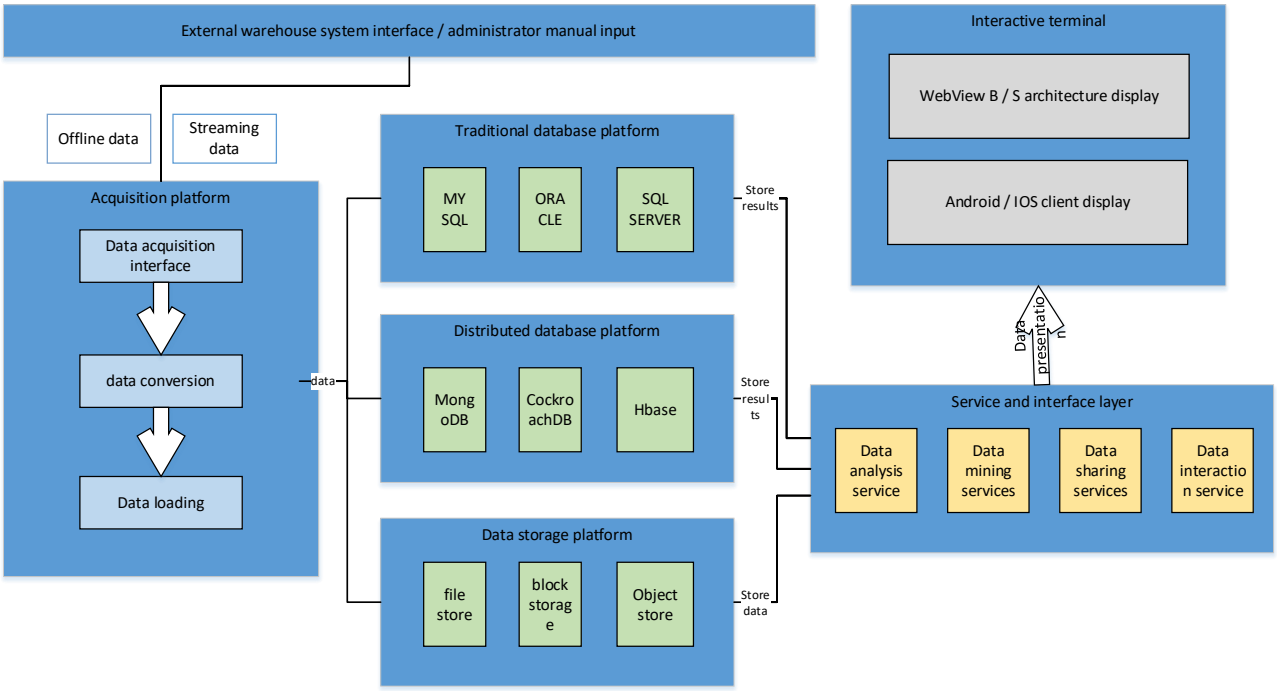

Figure 4-5. Data flow chart of support system

3.3 System technology architecture design

Under the new system based on B/s, the technical framework of the equipment and supply support system described in this paper is mainly described from the data layer, collection layer, storage layer, service layer and display layer. The data layer is the data source step in the data flow chart, the collection layer corresponds to the data collection step in the data flow chart, the storage layer corresponds to the data storage step in the data flow chart, the service layer corresponds to the data analysis step in the data flow chart, and the display layer corresponds to the data display step in the data flow chart. This is discussed in detail below.

In the acquisition layer, this paper uses the combination of long connection technology and B / S architecture. Each warehouse is peer-to-peer on the network. Due to the limited number of warehouses, the use of TCP long connection cancels the connection establishment process when each warehouse communicates, making the overall efficiency more efficient. This paper uses the workerman framework of PHP to realize long connection. In order to ensure the efficiency of communication, this paper does not use the socket long connection commonly used in web development, but uses a lower layer of TCP long connection. Because of the frequent data exchange

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between warehouses, it is unnecessary to use application layer protocol. The workerman framework can guarantee the data receiving and sending of 100000 magnitude per second, which is enough for the scene design requirements of the supply support system of equipment and equipment.

In the storage layer, this paper uses the hybrid storage scheme of MySQL database and blockchain ledger. MySQL is one of the most classic relational databases. Currently hosted by the Apache foundation, it is open source and free. It has high performance and strong cross platform. In this paper, PDO technology is used for database connection. If there is a large amount of data writing requirements in the later stage, MySQL database can be replaced with a large-scale commercial database such as Oracle under the condition of only modifying the configuration file without modifying the code. The blockchain platform selected in this paper is Ethereum. The advantages and disadvantages of Ethereum have been discussed above. In order to make the system have the characteristics of loose coupling, this paper designs a fixed interface between the audit module and other modules to exchange data, as long as the interface does not change the audit module code arbitrarily. Later audit modules can be replaced with commercial alliance chains such as hyperledger.

In the display layer, this paper uses the layui framework to quickly build the interface. The layui framework can quickly and safely build a responsive management platform and encapsulate a large number of JS methods. In this paper, the high chart control is used to display the chart in the interface, so that the warehouse administrator can understand the state of the warehouse and the change of equipment data more intuitively. In this paper, phpexcel framework is used to realize the batch import and batch operation of data. The guzzle framework is used to achieve the goal of front-end and back-end separation. The data interface is used as the link between front-end and back-end, and the front-end interface and back-end code are completely separated.

4. Conclusion

In this paper, a support system based on blockchain is introduced. Its architecture is described in detail, and the implementation process is also very clear. Due to the limitation of time, this paper has some limitations. Next, we will focus on the identification efficiency of blockchain and other details to improve the practicability and performance of the system.

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