

Design of material management system of mining group based on Hadoop

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Abstract. Under the background of persistent slowdown in mining market at present, improving the management level in mining group has become the key link to improve the economic benefit of the mine. According to the practical material management in mining group, three core components of Hadoop are applied: distributed file system HDFS, distributed computing framework Map/Reduce and distributed database HBase. Material management system of mining group based on Hadoop is constructed with the three core components of Hadoop and SSH framework technology. This system was found to strengthen collaboration between mining group and affiliated companies, and then the problems such as inefficient management, server pressure, hardware equipment performance deficiencies that exist in traditional mining material-management system are solved, and then mining group materials management is optimized, the cost of mining management is saved, the enterprise profit is increased.

1. Introduction

At present, with the recessive mining market, mine production cost control is the key to improve the economic benefit of mine, but the material consumption accounts for a large proportion in mine production cost structure, so the material management level directly affects the profit of enterprise size. With the development of informatization and digitalization of mining enterprises, in order to supervise and manage the materials of mining enterprises in a standardized, efficient and scientific way, reduce production costs of mining enterprises, accelerate capital turnover, and increase corporate profits, establishing a material management system for mining enterprises has a great significance.

The majority of mine enterprises have set up traditional mining material management system based on the traditional C/S or B/S, but with the expansion of the scale of mining enterprises production and improvement of mechanization, the material management content is also increasing. Categories of goods procurement are increased, quantity of goods procurement is increased, suppliers involved are increased, inventory management is becoming more complex, which makes the material management system deal with large amount of data, thus many problems are exposed in the traditional material management system, such as supplier information is difficult to update, efficiency is not so high, server pressure is increased, hardware device performance is insufficient, etc. These problems are seriously restricting the level of material management in mining enterprises. In addition, the majority of mine enterprise material management systems are decentralized, and management is relatively independent between the branches and corporation, which is not benefit to comprehensive



management, coordination and optimal allocation of materials in multiple mining subsidiaries, and problems of resources waste and miscellaneous management are easy to cause [1].

As a new technology, cloud computing has great research and application value because of its many good characteristics, such as low cost, high scalability, on-demand service, large amount of data rapid processing, data sharing, etc. As a basic cloud computing platform, Hadoop has the unique advantages for the processing of mass data. A new idea and powerful help can be provided for solving the problem of mining materials management. This paper introduced Hadoop into the mining and materials management, the material management system based on Hadoop mining group is established, the defects of the traditional material management system can be effectively improved, connection between subsidiaries of the mining group is enhanced, and then the material management level of mining group is improve.

2. Overview of the key theories and techniques of the system

2.1. Overview of cloud computing theory

In August 9, 2006, the "Cloud Computing" concept was put forward by Google CEO Eric Schmidt for the first time [2]. Cloud computing is a mode which pays according to application amount, and available, convenient, on-demand network access is provided in the mode. This model uses configurable computing resources shared pool, which including network, servers, storage, applications, services, and these resources can be quickly provided to customers through the platform of cloud computing, just put a few management work, or rarely interact with service providers [3]. The academic community lists cloud computing as the fifth common source besides water, electricity, gas and oil [4].

Cloud computing is the product of the integration of traditional computing technologies, such as grid computing, distributed computing, parallel computing, utility computing, network storage, virtualization, and load balancing [2] [5], and the main technology is to realize the distributed storage and distributed / parallel calculation of mass data. Cloud computing has three service models: IaaS (Infrastructure as a Service), PaaS (Platform as a Service) and SaaS (Software as a Service).

2.2. Hadoop

Hadoop is a Java based distributed computing framework which is developed by Apache foundation, and applications can be run on cluster of many cheap hardware, and a parallel and distributed system with high reliability and good scalability can be built. HDFS (Hadoop Distributed File System) and MapReduce programming model are the core technologies [6] [7].

HDFS is the storage base of distributed computing, and it has high fault tolerance and can be deployed on inexpensive hardware device that is used to store massive data sets. HDFS can provide high throughput access data, and the substance of its work to distribute data to different machines and provide redundant processing [8]. HDFS schematic diagram is shown in Fig. 1.

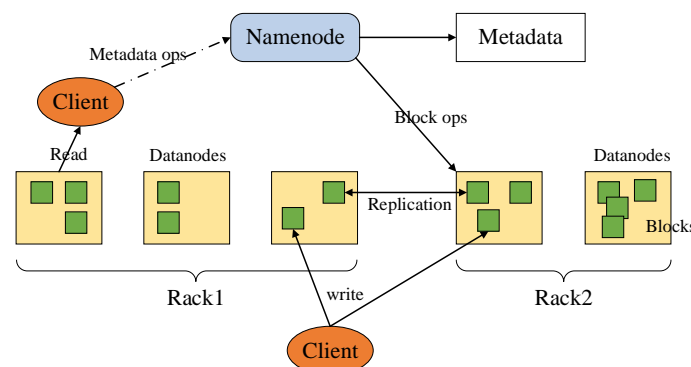


Figure 1. HDFS schematic diagram

MapReduce is a simplified distributed programming and efficient task scheduling model, and the application programmer only needs to focus on the application itself. The idea of the MapReduce pattern has two simple concepts Map and Reduce to constitute the basic computing unit. The data is cut into irrelevant blocks through the Map program at first, and those blocks are allocated to a large number of computers to achieve the effect of distributed computing, and then the results can be compiled and output through the Reduce program. Large amounts of data can be processed in parallel in this process [9] [10].

MapReduce schematic diagram is shown in Fig. 2.

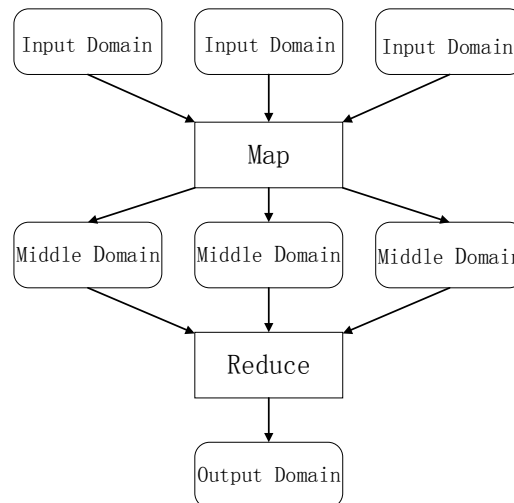


Figure 2. MapReduce schematic diagram

3. Design of system function

According to the actual demand of the material management of mining group, the material management system of mining group based on Hadoop needs to undertake the following tasks [11]:

- (1) To collect and record the raw data of the material management of the mining group, and complete the daily management of collection, delivery, storage and some daily operations;
- (2) To set up safety stock early warning system to avoid production caused by out of stock;
- (3) To establish supplier information database and establish good cooperation relationship with suppliers to ensure the smooth flow of purchasing channels;
- (4) To establish inventory management and control system to ensure that the inventory is in the scientific and reasonable range, to maximize the efficiency of purchasing and inventory management, and to realize the value-added of material management;
- (5) To strengthen the coordination of mining subsidiaries under the mining group and realize the allocation of materials in the case of emergency shortage.

According to the tasks that the material management system of mining group needs to undertake, the following functional modules are designed, as shown in fig. 3. The material management system includes 8 function modules: user management module, project management module, purchasing management module, storage management module, inventory management module, database management module, management module, accounting management module.

User management module: including four functional modules, user information, user changes, user password changes and user rights modification. The main task is to store and modify the information of the personnel using the material management system and set up the personnel access

Program management module: including three functional modules, purchase plan management, purchase plan approval and purchase plan inquiry. The main task is to manage the purchase plan of each branches under the mining group, and set up the necessary approval link in the process of circulation, and all purchase plans can be fully and flexibly viewed.

Purchasing management module: including four functional modules, supplier information management, procurement bidding, quality inspection and contract inquiries. The main task is to carry out the bidding according to the submitted purchase plan, to sign the contract with the successful supplier, and to inspect the quality of the purchased mineral materials, and to return the unqualified materials.

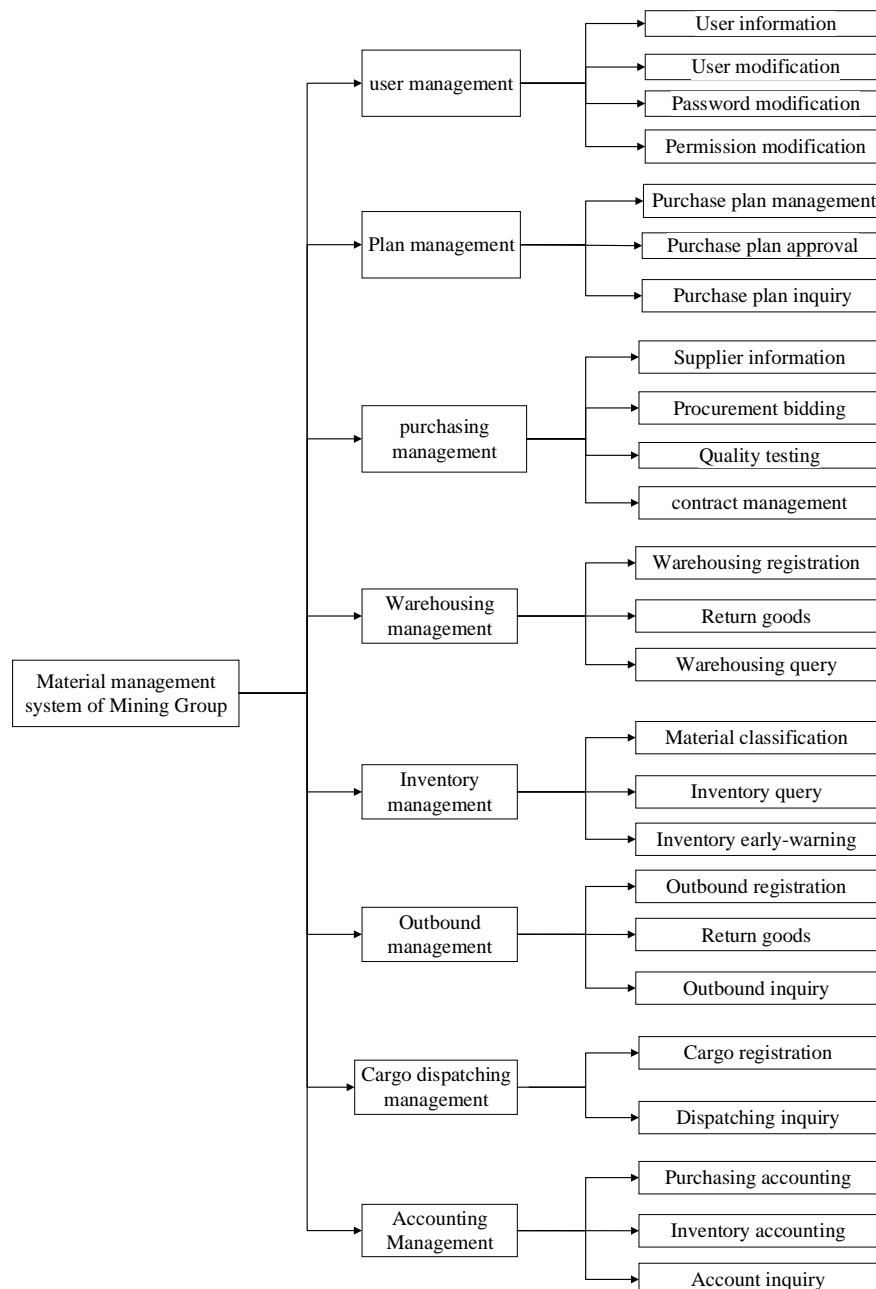


Figure 3. Functional framework of material management system in Mining Group

Warehousing management module: including three functional modules, storage, registration, warehousing, return and storage query. The main task is to register the arrival materials of mineral company, registration materials including suppliers, purchasing, procurement plan number, contract number, delivery time and other information, and registration information can be easily queried.

Inventory management module: including three functional modules, material classification, inventory inquiries and inventory warning. The main task is to classify and code materials stored in the warehouse, the inventory information can be easily queried, inventory can be checked regularly, To establish an inventory warning mechanism and set up the inventory alert range, start the alarm function when inventory exceed the warning range, and reminding the managers to plan the inventory reasonably.

Outbound management module: including three function modules, out of room registration, out of warehouse return and outbound inquiry. The main task is to register the goods out of the warehouse. The contents of the registration include the name of the materials to be used, the units of materials used and other information of the materials, the information of the materials can be easily queried.

Cargo dispatching management module: including two functional modules, cargo registration and transfer goods inquiries. The main task is to deal with the emergency transfer of goods, the goods can be transferred from another mineral company stock when a company mining group needs supplies in an emergency before purchasing, the goods information can be registered, and the information of the materials can be easily queried.

Accounting management module: including three functional modules, procurement accounts, inventory accounts and account inquiries. The main task is to calculate and summarize accounts about purchasing, storage and outbound, the information of the accounting can be easily queried.

4. System key technology implementation

In order to reduce the coupling of the system, enhance the scalability of the system, improve the efficiency of the development, the SSH (struts+spring+hibernate) architecture for hierarchical is applied in the system, material management system in Mining Group will be divided into four layer: the presentation layer, business logic layer, data persistence layer and data layer. The system technical architecture is shown in figure 4.

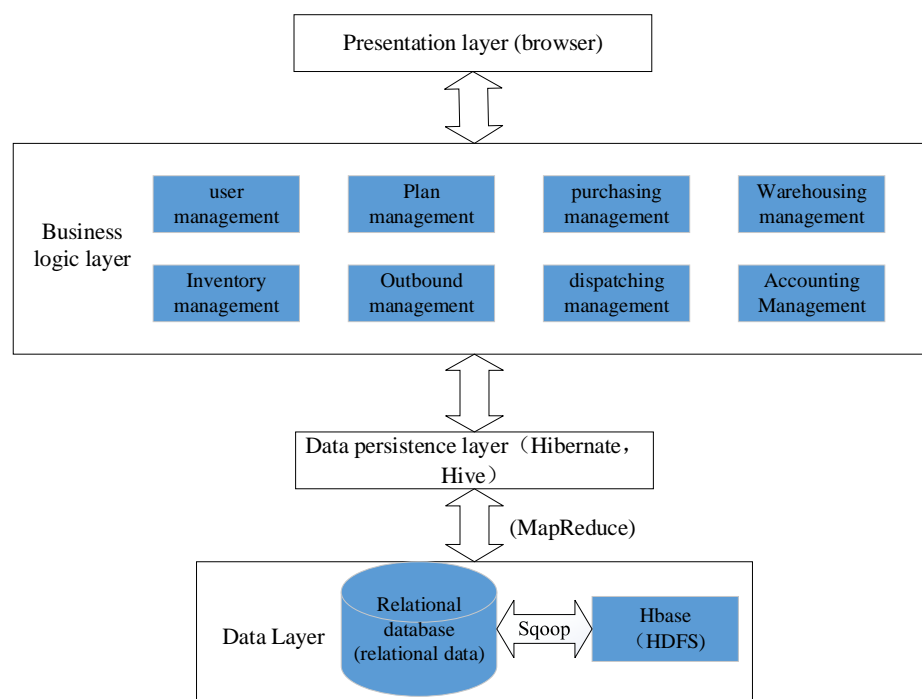


Figure 4. Technical framework of material management system of mining group based on Hadoop

This system uses Struts as the basis of the overall framework to responsible for the separation of the interface, business logic and data model in MVC, control business jump, using Spring to manage

the business logic layer, the Hibernate framework is used as data persistence layer structure. In the presentation layer, interface is achieved through the JSP page at first, which is responsible for receiving requests and transmission responses, then Struts delegates the request received by ActionServlet to the corresponding Action processing. In the business layer, Spring IOC container of management service module involves business model component and cooperative object data processing component (DAO) to complete business logic, it also involves transaction handling component and buffer pool to enhance system performance and ensure data integrity, those components are responsible for providing services to the Action. In the data persistence layer, it relies on the object mapping and database interaction of Hibernate and Hive, processing the data requested by the DAO component, and returning the processing result.

The system makes full use of the cloud computing advantages about storage and computing, it has three Hadoop core components: distributed file system (HDFS), distributed computing framework (Map/Reduce) and distributed database (Hbase) [12]. HBase is an unstructured storage database, which uses HDFS as its file storage system, and uses Map/Reduce to deal with the massive data in HBase. It has many good characteristics: large data storage, fast reading and writing speed. Structured data are usually submitted in daily business, in order to ensure the consistency of the data structure, these data will be stored in a relational database system at first. When the system traffic increases, the data will be synchronized to HBase with Sqoop, Hive defines a simple query language similar to SQL -- HQL, HQL statements can access HBase quickly through simple Map/Reduce statistics, so as to achieve rapid access to mass data.

5. Conclusion

In this paper, Hadoop technology and SSH framework technology are applied to establish the material management system of mining group based on Hadoop, the material management of mining group is optimized and management costs are saved, Thus the economic benefits of mining enterprises are increased. The main conclusions are as follows:

(1) Introducing Hadoop technology into mining material management system, the defects of traditional material management system can be improved, the performance and response speed of the system can be increased;

(2) The mining material management system is established by using the SSH framework, which realizes the separation of the business logic layer and the data persistence layer, the coupling between the system layers can be reduced, and development efficiency can be greatly improved;

(3) The establishment of the material management system based on the mining group can benefit the comprehensive management and coordination among the subsidiaries of the mining group.

References

- [1] Yang Yu. Research on material management information system of Mining Group [D]. Inner Mongolia University of Science and Technology, 2010.
- [2] Li Jianye, Wang An, Li Long, et al. Basic and practical technology of cloud computing [M]. Beijing: Tsinghua University press, 2013.
- [3] NIST Draft. NIST Cloud Computing Program [EB/OL]. <http://www.nist.gov/itl/cloud/>.
- [4] Leavitt, N. Is cloud computing really ready for prime time[J]. IEEE Computer Society Press, 2009.
- [5] Wang Yijie, Sun Weidong. Key technologies of distributed storage in cloud computing [J]. Journal of software engineering, 2012, 23 (4): 962-986.
- [6] Cui Jie, Li Taoshen, Lan Hongxing. Design and development of massive data storage platform based on [J]. Hadoop research and development of computer, 2012, S1:12-18.
- [7] Chen Kang, Zheng Weimin. Cloud Computing: system examples and research status [J]. Journal of software, 2009, 05: 1337-1348.
- [8] Lin Qingying. Modern computer calculation model of [J]. cloud based Hadoop (Professional Edition), 2010, 07:114-116+121.

- [9] Dean J, Ghemawat S. Map Reduce: Simplified data processing on large clusters [J]. Communications of the ACM, 2008, 51(1): 107-113.
- [10] Fang Wei, Pan Wubin, et al. Literature records, Cloud Computing: concepts, techniques and applications of the review [J]. Journal of Nanjing University of Information Science and Technology (NATURAL SCIENCE EDITION), 2012, 04: 351-361.
- [11] Li Sujian, Yu Zhan Qing, Zheng Grote. Logistics theory and case information system [M]. Beijing: Electronic Industry Press, 2004, 6: 252-265.
- [12] Zhai Zhai, Liu Ke. Research and design of electronic procurement system for coal enterprises based on cloud computing [J]. Journal of Xi'an University of Science And Technology, 2012, 02:254-258.