Dietary Nutrition Cloud Platform Technology Based on Big Data

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Abstract: The long-term material shortage is in sharp contrast with the current food surplus. People gradually ignore the excessive food intake, and the accumulation of nutrients in the body is harmful to the body. How to establish a correct understanding of food nutrition, and its scientific and reasonable application in life has become an urgent problem to be solved. The object data processed by dietary nutrition analysis requires high reliability. The massive data processing technology of cloud computing technology meets the requirements, which ensures the accurate and safe access of the underlying user sign data to the system, so as to ensure the accuracy of the processing results. Therefore, based on the application background of big data, this paper discusses the cloud platform technology of dietary nutrition, and designs a simple diet nutrition platform through software and hardware for simulation analysis. The experimental results show that the 20GB file in this paper is composed of 40 512MB small files, and OSS will not perform segmentation operation. Therefore, when OSS is used, the number of maps is 40. HDFS is faster than OSS with the same map number. The BMI value of users with adequate nutrient intake and reasonable dietary structure is relatively standard. Therefore, the amount of nutrient intake can not reflect the quality of physical fitness. Only by taking sufficient nutrients under the premise of reasonable dietary structure can the body shape of users be healthy. The time required by the distributed algorithm increases more slowly, while the time required by the algorithm before the distribution increases faster, which shows that the distributed implementation can improve the speed of clustering immune algorithm to find association rules.

1. Introduction

Before the reform and opening up, China's economic level was poor, the problem of food and clothing could not be guaranteed, the lack of food and a single diet structure caused many people's poor health due to malnutrition. Today, after the economic revolution, rich material conditions and a wide variety of food, on the contrary, cause a high incidence of diseases, people are often confused about this. The development of economy and technology has promoted the improvement of material

life. Food nutrition is gradually known in daily life, but many people's understanding of dietary nutrition is actually one-sided.

Dietary balance is a scientific and reasonable dietary structure. It can provide the human body with sufficient amount and variety of nutrients and the appropriate proportion to maintain the balance of the body and meet the needs of metabolism [1]. Rumen microbial community of sheep has an important impact on animal performance and environment. Few studies have focused on the effects of different nutritional levels on rumen microbial population. Wang used a new generation sequencing strategy and real-time quantitative PCR to study the changes of rumen bacteria with the increase of dietary energy and protein levels. Wang's findings provide the first in-depth insight into rumen microbial composition and targeted improvement of dietary protein and energy utilization efficiency in Tan sheep [2]. Adolescent anemia remains a public health problem in Indonesia. Patimah aims to explore the relationship between balanced diet behavior and microcellular hypochromic anemia in adolescents. Patimah used flow cytometry and SLS hemoglobin method to evaluate anemia, and structured questionnaire was used to collect the data of balanced diet behavior. Patimah's study shows that knowledge and attitude to a balanced diet are not associated with microcytic hypochromic anemia. In contrast, a balanced diet was significantly associated with small cell hypochromic anemia. Patimah suggested that adolescent girls should be given balanced diet education intervention to improve their balanced diet behavior [3]. A balanced diet, a variety of food and adequate nutrition can help children to maintain proper growth and healthy life. Young children come up with a smart board that can easily measure how much food they eat. The smart board has five load cells to measure the weight in five places. With them, food intake can be determined by measuring the weight of food before and after meals. This helps to understand which foods young children like and dislike, and to determine the nutritional deficiencies. In addition, the long-term accumulated data can be used to predict the growth index of young children. Finally, through the analysis of children's undernutrition or excessive nutrition, the children recommend the menu according to the monthly intake of nutrients [4]. A nutrient deficient diet can lead to many different health problems, from fatigue and lack of energy to serious problems with vital organ function and lack of growth and development. The number of calories in a food is a measure of the amount of energy stored in the food. Swetaa investigated the balanced diet and eating habits of college students in order to collect data. Swetaa's study conducted a survey on 110 college students. It was found that although most of them had the awareness of balanced diet, they still took junk food as snacks, accounting for 59.6%, and had unhealthy eating habits. Swetaa thinks they should consult a dietitian so that they can get a balanced diet [5].

With the advent of the era of big data, cloud computing, cloud storage and other information technologies are widely used in various fields [6]. With the development of the Internet, recommendation system plays an increasingly important role in e-commerce and other big data processing fields. Aiming at the problem of big data processing in recommendation system, Zhong proposed a cloud platform collaborative filtering algorithm based on clustering and correlation. The algorithm uses k-medoids clustering and related multi tree data structure to improve the traditional user based collaborative filtering algorithm. Zhong's research results show that Zhong's collaborative filtering algorithm has better recommendability and is more effective in processing big data [7]. Customizing cloud support for each autonomous driving application requires maintaining multiple infrastructures, which can lead to low resource utilization, low performance, and high management overhead. To solve this problem, Liu proposed a unified cloud infrastructure, in which spark is used for distributed computing, alluxio is used for distributed storage, and OpenCL is used for developing heterogeneous computing resources to improve performance and energy efficiency [8]. Reforgiato introduces an open, interoperable and cloud computing based citizen participation platform, which is used for the management of public administration

management process and improves citizen participation. The goal of the project is to create a new digital ecosystem model that supports and implements new approaches to interaction between public administration, citizens, companies and other urban stakeholders. The full adoption of the platform is spreading rapidly throughout the region, so that Sicily and other Italian provinces are generally interested in its use [9]. In recent years, cultural tourism has become a new trend of tourism consumption market and has great development potential. Liu analyzed the market potential evaluation model of cultural tourism resources based on cloud platform. The index design in the matrix model not only considers the generality and particularity of cultural tourism resources, but also considers the market demand of tourism development. Liu's evaluation index system meets the requirements of market segmentation and takes various factors affecting market development as evaluation indexes, which provides a reliable basis for resource development [10].

This paper first introduces the background of intelligent nutrition cloud and related research at home and abroad, focusing on the research of association rule mining of eating habits and physical condition in intelligent nutrition cloud, and analyzes the advantages and disadvantages of previous literature and some traditional algorithms. On this basis, this paper proposes an intelligent nutrition cloud association rule mining algorithm based on immune clustering, and carries out the related algorithm In depth research and improvement, and according to the actual problems of the algorithm for distributed optimization.

2. Big Data and Diet Nutrition Cloud Platform Technology

2.1 Dietary Nutrition

The nutritional structure of diet is the quantity of various nutrients in the diet and their proportion in the diet. Therefore, the dietary nutrition structure is not static, and people can make full use of various nutrients in food by balancing the ratio of various foods [11]. To achieve a balanced diet, and to promote its healthy direction. Physique is formed by individual congenital genetic factors and acquired by postnatal, and the body has inherent and relatively stable characteristics in morphology and function. A person's physical condition is affected by heredity, eating habits and other factors. Constitution is the ability of human body to resist diseases and physical activities [12].

Reasonable diet is not only the material basis of reasonable nutrition intake, but also an effective way to achieve scientific and reasonable nutrition. Reasonable nutrition is not only convenient to meet the needs of human health, but also convenient for digestion, absorption and utilization of various nutrients through reasonable dietary collocation. It is also necessary to consider reasonable dietary collocation and cooking methods, so as to avoid the destruction of nutrients or the formation of harmful substances in the process of unscientific cooking. Dietary balance should be composed of multiple diets to provide enough heat and nutrients for the human body to meet the normal physiological needs, and to maintain the quantity balance of various nutrients. It can not only meet the nutritional needs of human body, but also prevent and control various diseases. Dietary balance can be divided into four categories, mainly refers to the balance of amino acids, composition of caloric nutrients, acid-base balance and nutrient intake. The composition balance of caloric nutrients mainly refers to the proper proportion of fat, carbohydrate and protein intake, which promote and restrict each other's protective effect on human body. The three nutrients restrict and influence each other. Only when the proportion of total calorie intake and distribution is balanced can health be ensured. Long term imbalance in intake will affect and weaken the role of other nutrients, thus causing hidden diseases.

2.2 Big Data

HBase is a set of column storage system built on HDFS. It is developed according to Google's BigTable concept. It can be used for large-scale structured data storage. It supports horizontal expansion and can achieve the purpose of large-scale storage by adding a large number of cheap commercial machines. MapReduce is a big data computing engine such as Hadoop and spark, which provides computing power for big data processing. It also uses divide and conquer method to divide large-scale data into small data sets and hand them over to multiple nodes for processing. Finally, the intermediate results are summarized to output the final results. Because Hadoop programming is expensive for data engineers who are not familiar with Hadoop, it is relatively easy to master SQL statements. Hive and other big data query tools similar to SQL have been developed. Data engineers only need to write hive SQL to query the information they need. Hive will compile the SQL statement and convert it into MapReduce program for processing. The purpose of sqoop is to convert data tables into data files. Due to the limitations of the first generation Hadoop architecture, performance bottleneck will appear when the cluster scale is expanded to 5000 nodes. And Hadoop's first generation design can only run MapReduce programming model, which is not friendly to other programming models. In order to be compatible with other programming models, the community developed the resource scheduler yarn. As a basic component of Hadoop, yarn solves the problems of the first generation Hadoop architecture, and plays an important role in resource scheduling. Zookeeper is a coordinator in the big data ecosystem. It is mainly used to solve the problems of unified naming service, state synchronization service and distributed cluster management.

YARN is a general resource manager. Its basic idea is to divide the work of JobTracker to resource manager and application master for processing. The resource manager is responsible for the resource allocation and management of the entire big data system. The node manager is responsible for the resource management of each node. It will periodically send the resource usage status of the node and the running status of the container to the resource manager, and the resource manager also receives status information such as the start and stop of the container. This container is an abstract description of resources on YARN. When the client submits a task, the application master will apply for the resource from the resource manager, and the resource returned by the resource manager is represented by the container. The application master is used to apply for resources from the resource manager, communicate with the node manager to start and stop tasks, monitor the running status of the task, and reapply for resources when the task fails.Spark is an important computing engine in the big data ecosystem. Spark has several different modes of operation: local mode, Standalone mode, Mesos mode and YARN mode. Local mode is a mode of running Spark tasks on a local machine, and is generally used for development and testing. Standalone mode is an independent cluster operation mode that uses a master-slave architecture. This operation mode uses Spark's own resource scheduling framework and ensures the high availability of the master node through Zookeeper. Mesos mode is an operation mode that uses Mesos scheduler as cluster resource scheduler. The Spark client will connect to Mesos, and users do not need to build a Spark cluster by themselves. The YARN mode is similar to the Mesos mode. The Spark client can work by connecting to the YARN scheduler, without the need to build an additional cluster.

HDFS is the most popular distributed file system in the field of big data. It has high fault tolerance and is suitable for deployment on a large number of cheap machines. HDFS adopts master-slave architecture, which is composed of the following parts: name node, data node, second name node and client. The name node is responsible for managing the file metadata information, which is stored in the disk through HDFS metadata image and HDFS file change log. The metadata image and file change log are constructed when HDFS restarts. When HDFS reads a file, it needs to find the data node location of the file block through the name node, and then read the file on the

corresponding data node. When HDFS writes a file, it needs to check whether the file exists through the name node, and then segment the file, and then upload the file block to the data node. In addition, the name node will monitor the health status of the data node. Once a data node goes down, it will be removed from the HDFS system and the file will be backed up. Second, the role of the name node is to merge the metadata image and the file change log regularly to the name node, so as to reduce the pressure of the name node. Data node is used to store data, it will periodically transmit data information to the name node. The data stored on the data node exists in the form of file blocks. When uploading a large file, the data will be segmented according to the size of the file block, and then the file blocks will be stored on different data nodes. The client is the system interface used by users, which can access HDFS through name node and data node.

2.3 Cloud Platform

Based on the technical framework and general tools of the general platform, the basic framework of knowledge service system integrating the collection, processing, analysis and mining and comprehensive application of nutrition and health knowledge resources was preliminarily designed and constructed. To establish the standard of nutrition and health knowledge resources integration, and carry out continuous data collection and integration to form the basic resource layer of knowledge service. Knowledge service support layer is an important part of nutrition and health knowledge service system. The system will rely on advanced information processing and processing technology, based on the unified data processing specification, integrate and process various related professional knowledge resources. Knowledge service portal layer is an important portal for users to acquire knowledge services. The system will be based on the portal system and application service framework of the general platform, and will be constructed with modular ideas. Combined with the typical common needs of knowledge service in the field of nutrition and health, the design and development of characteristic application module (s) were focused. In terms of portal system construction, it will be based on the portal framework of the general platform, focusing on the framework deployment and other aspects of testing and debugging and technical transformation. At the same time, carry out the user interface design to ensure that the user interface design meets the requirements of the central UI interface, and ensure that users can access knowledge services conveniently and quickly. Based on the needs of system management and follow-up service promotion, the system operation and maintenance monitoring management module is constructed. Test and use the existing user registration and unified authentication management, user behavior analysis and other general functions of the general platform. At the same time, the design of management function is carried out according to the needs of sub center service. Resource processing tool layer, based on the classification of resource construction from four dimensions of self built resources, network resources, alliance resources and purchased resources, various tools are developed to collect data, and support the construction of resource warehouse layer and the whole system.

The service types of cloud computing can divide cloud into three layers: infrastructure as a service (IAAs), platform as a service (PAAS) and software as a service (SaaS). Different cloud layers provide different services. IAAs infrastructure services: in this layer, based on virtualization technology, dynamic allocation and elastic expansion of resources will be used to realize the corresponding nutrition services in the upper layer. Through the dynamic configuration of virtual machine resources, CPU, memory, network and other resources can be concentrated on the business with high load, so as to realize the full utilization of infrastructure and reduce energy consumption. PAAS service: the cloud computing platform, database platform, Internet of things platform and other common system software development platforms will be built by using distributed storage and

other technologies. SaaS service: it is divided into three sub layers: the first is the data layer, which establishes the data structure, defines the data mode and obtains various types of data; the second is the general software service layer, which abstracts the common business logic in the "diet nutrition cloud" service, and creates business component services. This makes the platform more universal, more open, and can be easily used by third-party developers, The third is the typical application demonstration layer. It develops the catering and nutrition cloud services for different groups of people and different needs. The service is implanted into the platform in the form of plug-ins, which has high independence. Moreover, each sub layer is deployed in strict accordance with industry standards, and has a strong information security system.

In order to achieve reasonable dietary recommendation, intelligent nutrition cloud platform not only depends on the manual provision of dietary solutions, but also needs to learn and calculate the existing data through the platform to achieve automatic and real-time recommendation. One of the most important is to find the relationship between nutrition intake and chronic diseases. The intelligent nutrition cloud platform calculates the constantly updated database according to a certain frequency, and constantly updates the intelligent nutrition cloud association rules, and caches these results. When a user uses the dietary recommendation function in the system and sends out a request for dietary guidance. The intelligent nutrition cloud platform will first find the matching dietary scheme in the cache, and if there is, it will directly return it to the user. Otherwise, the intelligent nutrition cloud platform will use the existing data of the user's physical condition and nutritional intake to calculate the intelligent nutrition cloud association rules, and then recommend the dietary scheme corresponding to the association rules to the users.

3. Implementation and Testing of Diet Nutrition Cloud Platform

3.1 Cloud Platform Implementation

This paper uses a Ubuntu host to install the virtualenv virtual environment package and create the virtual environment directory. After entering the virtual environment directory, deploy Python 2.7 language environment, install git version management tools, and deploy development projects. Install and configure SQL Server database after using pip to install flash, pymssql, Jieba and other packages needed in the development process, and open port 1533. Install and configure the web crawler tool pyspider, and test whether the 6000 port is occupied. If so, select another port to start pyspider. After that, install and configure the spark cluster and start spark.

Design the data table structure, import the data into the database, and use kettle tool to synchronize the data regularly. The API interface of PAAS service module and SaaS service module is written by using pychar development tool and a new flag project. The interface is composed of URL and function. Flash automatically associates the URL and function through Python decorator. When the client makes a request, flag will find the URL of the request, call the specific function to process the request, and finally return the result to the front-end display.

3.2 System Testing

This paper uses Apache JMeter, a data interface testing tool, to test the interface of the system development, download and install the test tool, start the test tool, configure the thread group and concurrency number, and add HTTP requests and request parameters.

4. Technical Analysis of Diet Nutrition Cloud Platform Based on Big Data

4.1 Comparative Analysis of HDFS and OSS

In the start-up phase of wordcount, the time gap between HDFS and OSS is small, and the time gap between task cleaning phase and stage1 is also small. The main time gap is reflected in stage 0. The execution time of each phase of wordcount running 40Gb task is shown in Table 1.

Table 1. The execution time of each stage of WordCount running 40GB task

Stages of the mission	HDFS execution time (s)	OSS execution time (s)
Startup phase	26	28
Stage 0	135	2007
Stage 1	25	26
Cleanup phase	111	115

The work of wordcount load in stage 0 is to read OSS files, generate elastic distributed data sets, and then map the data sets into key value pairs for data shuffling. In this process, due to the physical distance between the OSS and the constructed node, there will be network transmission delay when I / O requests and pull data from OSS. But when using HDFS, the data is saved in the local cluster, which avoids a lot of network transmission overhead. The wordcount experimental results after modifying the file block size are shown in Figure 1.

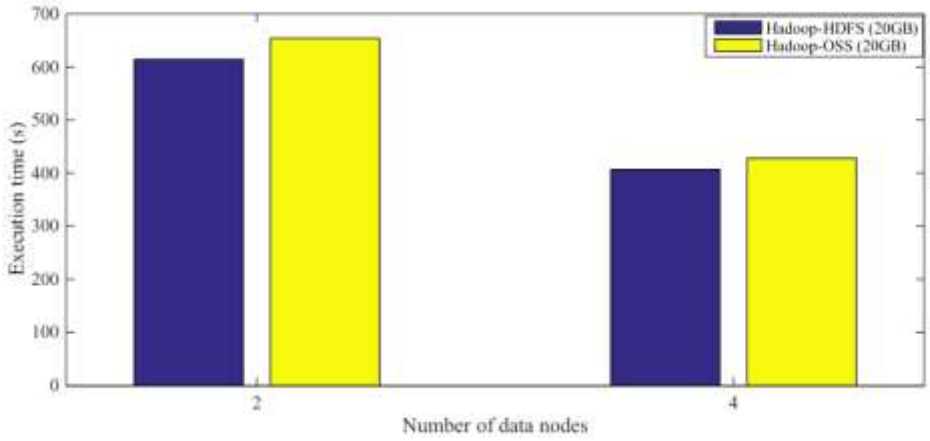

Figure 1. WordCount experiment results after modifying the file block size

The sorting results of sort need to be uploaded to the remote storage service OSS. This process is affected by network delay, and the OSS performance is worse than HDFS. When Hadoop uses OSS to perform tasks, the final stage of reduce also needs to write the calculated temporary files to OSS, but when using HDFS, the calculation results are written to the local file system, and there is no network transmission. Moreover, due to the OSS storage protection mechanism, the bandwidth provided is small, resulting in a further decline in the execution speed. Due to the protection mechanism of network transmission and OSS itself, OSS takes more execution time than HDFS. The 20GB file in this paper is composed of 40 512MB small files. OSS will not perform fragmentation operation. Therefore, when OSS is used, the number of maps is 40. In order to verify that the number of maps will affect the speed of task execution, after changing the size of file block to 512MB and restarting all components, this paper conducts two groups of experiments. It is found that HDFS is faster than OSS when the number of maps is the same.

4.2 Comparative Analysis of Algorithms

In this paper, 10 fold cross validation method is used to divide the data into 10 parts, 8 copies are used as training set, 2 copies are used as verification set, and 10 training sets and 10 verification sets can be obtained by one hot method. In this way, the LSTM model is trained and verified. Three

algorithms, logical regression, random forest and AdaBoost, are selected as comparison algorithms. The experimental results of one hot processing are shown in Table 2.

Table 2. one-hot processing experiment results

Model	ROC-AUC	PR-AUC	FI score
LSTM	0.6528	0.2386	0.2785
Logistic Regression	0.5428	0.1482	0.0021
Random Forest	0.5482	0.1538	0.0032
AdaBoost	0.5928	0.1748	0.0438

After 10-fold cross validation, the average values of LSTM and other three algorithms under ROC-AUC, pr-auc and f1score are obtained. The results show that the accuracy of LSTM in disease prediction is higher than that of logistic regression, random forest and AdaBoost algorithm, which indicates that LSTM model has better performance and pass to pair ratio detection, the performance of LSTM model with user diagnostic events embedded in vectors is better than that of one hot. The experimental results of word embedding vector processing are shown in Figure 2.

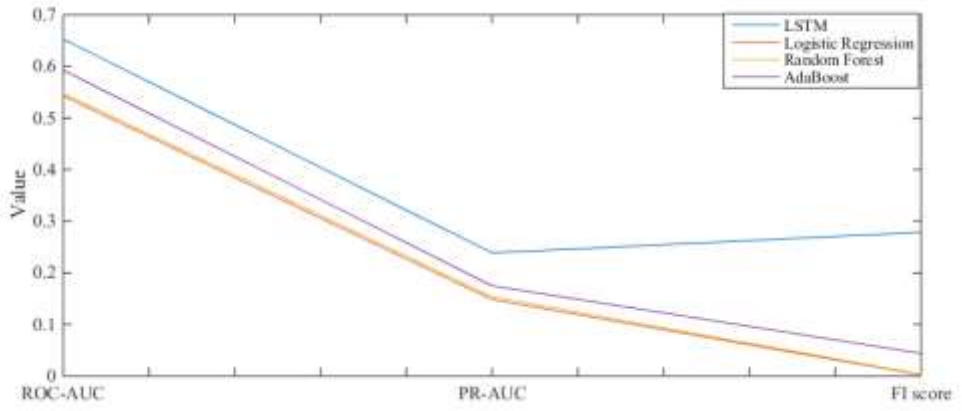

Figure 2. Word embedding vector processing experimental results

The input of LSTM model is the user's diagnostic event sequence. In fact, the semantics of "microphone" and "microphone" are the same, but the one hot expression can not reflect the similarity between the two words. The other method is word vector model, which provides a method for directly calculating the similarity between two words. The basic idea of the model is: through the learning of a large number of corpora, each word is mapped into a vector of fixed length. Generally, the length of the vector is much smaller than that of the dictionary in the language, usually between tens and hundreds of dimensions, All vectors form a word vector space, and each vector represents a point in the space. In this way, similarity is measured by the distance between points. The experimental results show that the accuracy of LSTM model is higher than that of traditional algorithm.

4.3 Correlation Analysis of Dietary Mutrition Structure and Physical Ftness Index

By analyzing the correlation between the acquisition of nutrients and physical fitness indicators in physical health, the correlation between food nutrition structure and physical fitness indicators is shown in Figure 3.

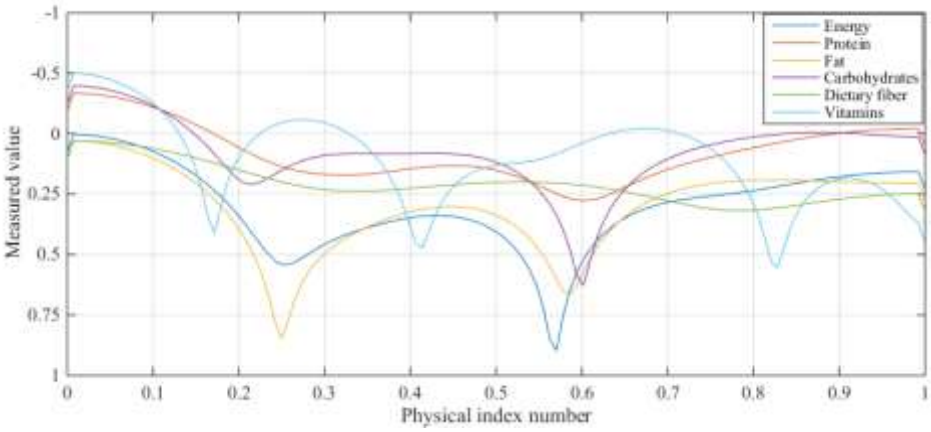

Figure 3. Correlation between dietary nutrition structure and physical fitness index

From the analysis of the correlation between dietary nutrition structure and physical fitness of users, some nutrients are indeed related to the results of physical fitness test, and even the more intakes, the better the score. However, it is not the more single intake of a certain nutrient, the better the score is. It is the result of the comprehensive effect of the whole body in front of the improvement of morphological health. Overweight or obese students' intake of some or more nutrients exceeds or seriously exceeds the recommended intake, and their physical fitness test results are not ideal. However, those users who have adequate nutrient intake and reasonable dietary structure have relatively standard BMI value, body shape index and physical fitness index tend to be optimal, and their physical fitness measurement results are relatively good. Therefore, the amount of nutrients intake cannot reflect the quality of physical fitness, only in the premise of reasonable dietary structure, intake of adequate nutrients, make the user's body shape healthy, and then achieve the health of physical function and physical exercise ability, can we improve the physical health level of users as a whole.

4.4 Experimental Analysis on Distributed Mining of Dietary Nutrition Cloud Platform

In this paper, the speed of traditional and distributed two cases are compared. The results of distributed comparison of dietary nutrition cloud platform are shown in Figure 4.

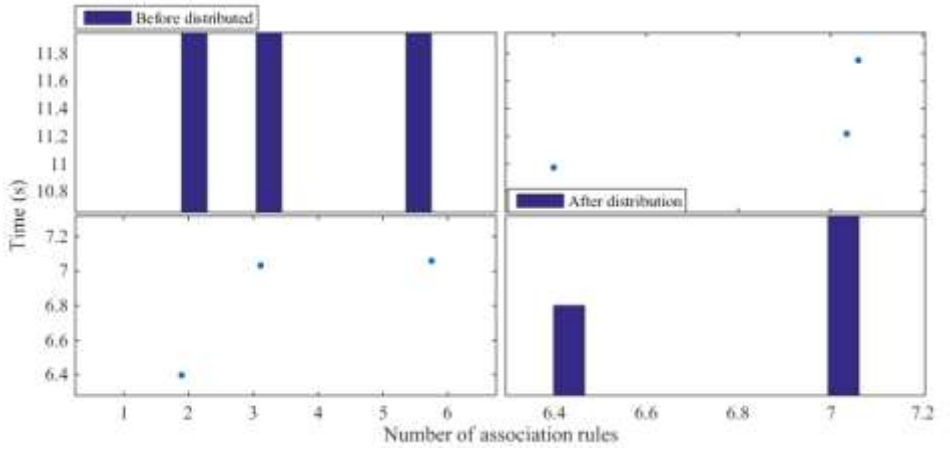

Figure 4. Distributed comparison results of diet nutrition cloud platform

A large amount of data is needed for dietary recommendation in the dietary nutrition cloud

platform, and a large amount of data is applied in the process of finding intelligent nutrition cloud association rules. Due to the characteristics of a large number of data, in order to ensure the speed of data processing, it is necessary to use non-relational database and unstructured data. In the use and processing of data, it also needs to adapt to this kind of data. Intelligent nutrition cloud platform needs the feature of real-time recommendation. Users may use the platform at any time and upload their diet records and other information. It can be seen from the figure that when the number of association rule items is set to different values, the time required for the calculation results before and after the distribution will increase to varying degrees, but it can be seen that the time required by the distributed algorithm increases more slowly, while the time required by the algorithm before the distribution increases faster, which shows that the distributed implementation can improve the clustering immune algorithm to find association rules Then the speed of.

5. Conclusions

This paper analyzes the characteristics of food nutrition cloud platform and disease and nutrition intake in detail and puts forward the shortcomings of traditional association rule algorithm in dietary nutrition cloud platform, and proposes an improved immune algorithm based on clustering to find the association between nutrition intake and disease. The algorithm can improve the searching speed of association rules, and can directly find the specified number of frequent itemsets.

Due to the limited time and ability, there are still some problems in the experimental design. The algorithm of association rules mining based on immune clustering in cloud platform of dietary nutrition has certain randomness, and individual solutions will be missed in some cases. In the following work, the accuracy of the algorithm needs to be further improved.

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