Application of Cloud Computing Technology in Information System Construction

Renxian Zeng*
School of Information Engineering, Nanchang Institute of Technology, Nanchang 330099, China

*Corresponding author e-mail: zengrx@ncpu.edu.cn

Abstract. With the rapid development and improvement of information technology, information system construction has new requirements and goals. Cloud computing technology is an inevitable choice in the construction of information system. By taking cloud computing technology as the basic structure framework, the phenomenon of data information island can be broken. The purpose of this paper is to study the application of cloud computing in the construction of information system. Taking the management mode of university campus as an example, based on the research of cloud computing technology, virtual machine technology and Internet of things technology, this paper discusses the data resource management algorithm of smart campus. Aiming at the scheduling model, strategy and research objectives of cloud computing resources in data center, this paper proposes a method of initial allocation and adaptive dynamic scheduling of virtual machine resources. According to the multi-dimensional vector characteristics of virtual machine, this paper proposes a resource allocation algorithm based on multi-objective evolution, and gives four important strategies. The experimental results show that the four advantages and strategies can effectively reduce the number of virtual machine migration and reduce the adverse impact on the overall performance of cloud computing core network.

Keywords: Cloud Computing, Information System, Smart Campus, Virtual Machine Resources

1. Introduction
Information management system is a kind of management information system, which is a very important part for enterprises. It can help enterprises to organize and extract resources more efficiently, thus reducing labor cost [1-2]. In recent years, the rapid development of information technology makes the enterprise more and more dependent on the network. As the core area of enterprise information construction, data center runs many hardware equipment [3-4]. The existing personalized information service is more from the perspective of the service subject itself to organize resources and information services, and the service content and mode are relatively single. However, users need to obtain services according to their professional background, research topics and hobbies, or provide
corresponding situation information services at the right time and place. Therefore, we must change the current information service mode single, service efficiency is low [5-6].

Cloud computing technology can greatly improve the ability of computer to process data. Cloud computing is being used in various information management in recent years. Many scholars in China have developed mature theories and methods for this research [7-8]. For example, a professor of a university in China analyzes the application of information technology in archives information management, and improves the traditional manual form of archives management [9]. Another scholar analyzed the significance of computer technology in information management, and proposed a management system which can effectively improve the awareness of information management [10].

This paper selects the information management system of digital campus as an example to carry out the related research work [11]. The first chapter is the introduction, which analyzes the research status of the integrated cloud computing and information management system at home and abroad; The second chapter is the introduction of related technologies and algorithms, and analyzes the core technologies of cloud computing; The third chapter is the design and analysis of the smart campus, and constructs the overall scheme model of the intelligent campus design; Chapter four is the research on the cloud computing resource scheduling algorithm of campus data center; Finally, the paper summarizes the research results in the intelligent campus information system, and points out the shortcomings [12].

2. Related Technologies and Algorithms

2.1 Cloud Computing Technology
The concept of cloud computing is based on the Internet and computer technology to further develop, virtualization is also his more important feature, the concept of cloud computing is more emphasis on the use of resources on demand, on-demand distribution. The main technologies of cloud computing in virtualization include computing virtualization, storage virtualization, network virtualization and so on.

2.2 Internet of Things Technology
The application scope of Internet of things has developed from intelligent transportation system and other fields, and gradually extended to medical, logistics, community governance and other industries. Although it is still in the initial stage, it must be designed in a way of global coverage in the future, and it has been integrated into life. In this paper, we think that the mobile medical information sensing layer designed by us should be supported by the Internet of things technology, especially the sensor network technology and information perception recognition technology.

2.3 Cloud Computing Resource Algorithm of Smart Campus Data Center

2.3.1 Cloud Computing Virtual Machine Allocation Algorithm Based on Multi-Objective Evolutionary Algorithm. Cloud computing virtual machine regards the allocation of multi-objective virtual machine as a multi-dimensional cluster problem. The available resource of each virtual node is a C-dimensional vector, and each dimension represents a certain resource.

Where, represents the number of virtual nodes occupied, and represents cluster load balancing variance.

Where n refers to the number of virtual machine nodes, is the average value of the i-th dimension performance characteristic in all virtual nodes, and the performance characteristic is the normalized value, which is equal to the residual allocation of the i-th dimension resources in the virtual node divided by the total i-dimension resources.

2.3.2 Dynamic Scheduling Algorithm of Cloud Computing Virtual Machine. Based on the traditional technology of virtual resource allocation algorithm, we need a dynamic scheduling method of cloud
computing resources, so as to ensure that the virtual resource management platform can adjust the allocation mode of virtual resources according to the specific operation requirements of virtualization application services, so as to optimize the distribution of cloud computing resources. The efficient utilization of cloud computing resources and the dynamic and scalability of virtualization application services are fully met.

The dynamic scheduling algorithm of virtual machine based on cloud computing core technology is summarized as follows: performance-based overall load capacity evaluation strategy; location strategy based on dynamic cost; trigger migration mechanism based on memory data; and target mechanism selection strategy based on optimal matching.

2.3.3 GK fuzzy clustering algorithm. GK algorithm is a fuzzy clustering algorithm based on objective function, which can be well consistent with the data characteristics of campus construction informatization. He has a distinct feature: for strange or special data types, such as elliptic sphere, data boundary is not very obvious data type, GK algorithm can be fuzzy clustering through corresponding calculation.

GK fuzzy clustering algorithm can adapt the distance standard and detect different geometric shapes in the cluster.

2.4 Application of GK Clustering Algorithm in Smart Campus Construction Information Platform

2.4.1 Data Types in the Construction of Information Platform. In the construction of university digital campus, there are many data that need to be processed, such as: personal basic information of college students, personal performance information of college students, personal daily activities information of college students. In the design of various functional requirements, each functional module will contain a lot of test data collected by measurement and analysis. In real projects, data objects can contain many fields with attributes. These attributes of data are the expression of a feature in data. The common attributes of data objects mainly include standard attributes, binary attributes, and numerical attributes.

2.4.2 GK Algorithm Application Simulation of Building Information Cloud Platform Data. First of all, we use GK clustering simulation to collect personal data and information data of college students. Then the data of teachers are collected and clustered. From the simulation of GK clustering algorithm for the personal information of teachers and students in the construction of campus network platform, we can clearly see that GK algorithm can achieve accurate classification for various types of data, and can separate different types of data. Therefore, GK clustering algorithm can build an information cloud platform for digital campus, which can effectively manage massive data resources and help other fields.

3. Virtual Machine Algorithm Experiment

3.1 Experiment of Virtual Machine Allocation Algorithm

3.1.1 Experimental Method. To verify the performance of the improved algorithm, this paper uses the traditional priority matching structure algorithm, the simple genetic algorithm with the number of nodes as the goal and the improved multi-objective evolutionary algorithm to carry out simulation experiments.

3.1.2 Experimental Platform. In this paper, cloudsim, a cloud computing simulation software proposed by gridbus project in the Network Laboratory of the University of Melbourne, and MyEclipse 6.5 are used for simulation.
3.2 Virtual Machine Dynamic Scheduling Algorithm Experiment

3.2.1 Experimental Method. In order to verify the performance of CVDs, this paper uses cloudsim's no migration strategy, dynamic voltage and frequency scaling strategy, and CVDs algorithm for experimental simulation.

3.2.2 Experimental Platform. Cloudsim, the simulation software of cloud computing, is still used in the experiment.

4. Experimental Results and Analysis

4.1 Analysis of Experimental Results of Virtual Machine Allocation Algorithm

The number of virtual servers in cloudsim simulation data center is 20, and the number of virtual machines deployed is 10, 20, 30, 40, 50 and 60 respectively; the experimental parameters are shown in Table 1.

| Table 1. Simulation experiment parameters of virtual machine allocation algorithm |
|---------------------------------|---------------------------------|---------------------------------|
| Number of virtual nodes | Number of virtual machines | Virtual machine allocation algorithm |
| 20 | 10 | PMH, CGA, IEMOA |
| 20 | 20 | PMH, CGA, IEMOA |
| 20 | 30 | PMH, CGA, IEMOA |
| 20 | 40 | PMH, CGA, IEMOA |
| 20 | 50 | PMH, CGA, IEMOA |
| 20 | 60 | PMH, CGA, IEMOA |

According to the simulation experiment parameters, we can know the number of enabled virtual nodes and cluster load variance diagram, as shown in Figure 1 and Figure 2 respectively.

Figure 1. The number of start virtual machine nodes
Figure 2. Cluster load variance diagram

From Figure 1 and Figure 2, it can be seen that in terms of enabling the number of virtual nodes performance, the number of virtual nodes based on CGA and iemoa is almost the same, and the number of virtual nodes based on PMH is less, which indicates that the energy consumption of the algorithm is proportional to the number of virtual machine occupied. In terms of load performance structure of cluster, the load variance is inversely proportional to the server load balance. However, the total load variance of CGA based virtual machine deployment algorithm in the figure is larger than that of iemoa, showing that the load balancing of virtual machine deployment algorithm based on iemoa is better. Through the above analysis, we can get the virtual machine deployment algorithm based on iemoa, which can greatly reduce the number of virtual servers.

4.2 Experimental Results and Analysis of Virtual Machine Dynamic Scheduling Algorithm

In CloudSim, in order to simulate the load of the cloud computing center, you need to modify the datacenter broker class. You can generate rand ()\% 5 + 2 tasks by writing data with an interval of 10s, and then add them to the loading method of the virtual machine. This can make the task allocation and the number of tasks are random, so that different virtual machines and servers generate different loads at the same time. In this way, we can simulate the dynamic scheduling algorithm of virtual machine to realize the load experiment of cloud computing data center. When all tasks are simulated, the number of transfers, the average error rate of SLA and the number of virtual nodes enabled at different times are output. The diagram of migration times is shown in Table 2.

| Migration times   |   |
|------------------|---|
| CVDS             | 109|
| No migration     | 1287|
| DVCFS            | 0  |
As can be seen from Figure 3, among the three types of virtual servers with different performance, the DVFS strategy of cloudsim is much larger than CVDs. The more times the virtual machine migrates, the greater the impact on cloud computing performance and the worse the performance stability. There is a little difference in the average error rate of SLA among the three types of virtual servers with different performance. The lower the average error rate in SLA, the smaller the impact on the performance of application service layer. CVDs is less than no migration and DVFS scheduling strategy in the number of virtual nodes enabled at the same time in different times for three types of virtual servers with different performance. The less virtual nodes enabled, the better the energy-saving effect. In conclusion, CVDs can significantly reduce the number of virtual machine migration and reduce the impact of virtual machine migration on the overall performance structure of cloud computing data center on the basis of ensuring the application layer service performance structure.

5. Conclusion
This paper focuses on the data center algorithm of cloud computing technology in smart campus. Firstly, the paper analyzes the current development status of cloud computing and intelligent campus and the main research contents of the paper. Then, it discusses the related technologies of cloud computing in the intelligent campus information system based on cloud computing, including the core technology, service mode and the application of cloud computing in smart campus. Then, the design and analysis of the intelligent campus are given, including the design principles, the user management and role management in the system. Based on the above content, on the basis of selecting the cloud platform of campus information system and formulating information standards and databases, a unified data center platform, identity authentication platform and information entry platform are formed to realize information sharing, exchange and integration of intelligent campus information. Finally, a new virtual machine allocation algorithm based on multi-objective evolution algorithm is proposed.

References
[1] Ye Liangyan, Li Jing, Zhang Xuedong, et al. Research on personalized virtual training room of cloud computing technology and application specialty. Journal of Anhui Institute of electronic information technology, 2019, 018 (003): 21-23
[2] Zheng X. Energy management platform construction and reliability analysis based on cloud computing technology. Revista de la Facultad de Ingenieria, 2017, 32(14):728-732.
[3] Alnawaiseh A. Article ID: IJARET_11_09_062, A Proposed Model Based on Cloud Computing Technology to Improve Higher Education Institutions Performance. INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN ENGINEERING & TECHNOLOGY,
[4] Riana E. Implementasi Cloud Computing Technology dan Dampaknya Terhadap Kelangsungan Bisnis Perusahaan Dengan Menggunakan Metode Agile dan Studi Literatur. JURIKOM (Jurnal Riset Komputer), 2020, 7(3):439.

[5] Adeleke I A, Muraina I O, KKAdegbuyi. Adoption of Cloud Computing Technology for Effective University Administration in Nigeria. Current Journal of Applied Science and Technology, 2020:1-8.

[6] Bommala H, Kiran S. CLOUD COMPUTING TECHNOLOGY FOR DIGITAL ECONOMY. i-manager’s Journal on Cloud Computing, 2020, 7(1):1.

[7] Suroso A, Astuti E S, Utami H N, et al. THE EFFECT OF INFORMATION SYSTEM ON ACHIEVEMENT OF CONSTRUCTION PROJECT IN JABODETABEK REGION. SINERGI, 2020, 24(1):65.

[8] Shi, Y., and J. Xu. "BIM-based information system for econo-enviro-friendly end-of-life disposal of construction and demolition waste." Automation in Construction 125.1(2021):103611.

[9] Dong Qingchao, Chen Qinghua, Qiao Yongjun, et al. Construction of actual combat teaching environment with multi specialties based on command information system. Experimental technology and management, 2017, 034 (0z1): 49-52

[10] Zhang W Y, Xu Q, Liu S N, et al. Construction and application of immunization information system based on children cases collected by vaccination clinic clients in Shandong Province, China. Zhonghua yu fang yi xue za zhi [Chinese journal of preventive medicine], 2019, 53(9):951-954.

[11] Zhang Yan, Wang Meiyuan, Yang Dan, et al. Construction and practice of laboratories for information management and information system. Laboratory research and exploration, 2017, 036 (005): 250-255

[12] Construction exploration of Chongqing Environmental Supervision Information System under the vertical reform of environmental protection. Environment and ecology of Three Gorges, 2018, 040 (001): 63-66,88