Design of cloud computing-based foreign language teaching management system based on parallel computing

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Abstract: In view of the long response time of the traditional foreign language teaching management system and the inability to guide students to improve their learning interest, a foreign language teaching management system based on parallel computing is proposed. In this method, the cloud architecture of the foreign language teaching system is given under the cloud computing environment, on which the parallel computing method is adopted to design the foreign language teaching management system hardware, which is scalable and flexible. The parallel algorithm is designed and the communication between the modules of the system is implemented with C# language. The experimental results show that response time for each of the four scores of 'Zhang' is 1s in reference (Huang, 2017), the response time for each of them is only 0.6 s in this paper. The system can shorten the response time for query and improve the development speed of web-based foreign language teaching, effectively promotes the development of web-based foreign language teaching and students' interests in foreign language learning.

Keywords: parallel computing; cloud environment; foreign language teaching; management system.

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1 Introduction

Foreign language is an essential lesson in education and an important way to implement quality education. Existing foreign language teaching is mainly carried out through face-to-face instructor lead and end-of-term assessment (Li, 2016). In Liu (2015), a plan of adopting cloud computing platform and speech recognition technology to improve college students' English listening and speaking levels is proposed. However, this

method has high technical requirements and poor operability. In Huang (2017), it is proposed to incorporate advanced educational concepts into new technologies such as internet of things and cloud computing, making mobile learning be an active and constructive learning process, which satisfies the needs of students. However, the promotion of this method is difficult and it requires a long time. In Pan and Zhao (2016), a mobile platform accessible to teaching and managing university information at anytime and anywhere with mobile intelligent terminals is designed and achieved through the secondary development of the WeChat public platform and the use of mobile smart terminals as a visiting access, which improves the efficiency of management, learning and communication between teachers and students. However, with this method, students are easy to be disturbed by the outside world and cannot concentrate on learning. In Zhang (2017), the SERVQUAL model is introduced into the teaching quality evaluation system for basic instrument analysis course of biochemistry major, which emphasises the students' satisfaction with the quality of course teaching. However, the awareness of this method is low. In Kong and Zhao (2016), a higher teaching management system based on RFID-SIM technology is designed. With high reliability, this system can be applied to classroom teaching management, laboratory teaching management and staff attendance management, and so on, but there are limitations in it for its scope. This kind of traditional mode is often disturbed by irrelevant variables such as lecture time and instructional environment. It is not only too monotonous in teaching content, but also lacks new ideas, which makes students be in a passive position, resulting in gradual loss of students' interest in foreign language learning.

To solve the above problems, a design of a foreign language teaching management system based on parallel computing is proposed in this paper. Under the continuous development of network technology, web-based foreign language teaching has been developed to a certain scale. This new teaching method will fundamentally improve students' interest in learning and provide a driving force for the reform of teaching methods. The experimental results show that the proposed cloud computing-based foreign language teaching management system based on parallel computing does have a significant improvement in the level of foreign language teaching, and at the same time, it effectively enhances students' interest in foreign language learning.

2 Design of cloud computing-based foreign language teaching management system

Microsoft XML web services operating system is adopted as a data communication and sharing platform in Cloud computing network technology. Parallel computing is relative to serial computing (Chu, 2017), which is an algorithm able to execute multiple instructions at a time. Its purpose is to increase the speed of calculation and solve large and complex computational problems by expanding the problem solving scale (Sun, 2017). In the foreign language teaching management system, the parallel relationship between different management modules is realised through the parallel computing environment, which not only greatly reduces the probability of confusion between various parts of the system, but also effectively improves the system's operating efficiency. Based on parallel computing theory, a foreign language teaching management system is established to reduce the operation difficulty of interactive teaching websites. On the basis of the original Web operation platform, the high degree of unity of the

foreign language teaching management system is emphasised. The block diagram of the overall system scheme is shown in Figure 1.

Figure 1 Block diagram of the overall system scheme

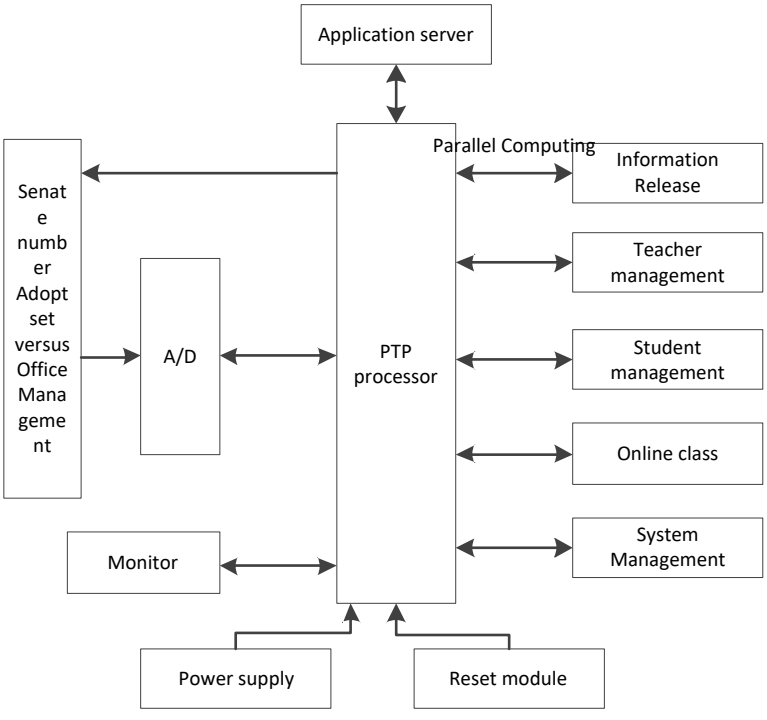


Figure 1 shows that PTP processor is adopted to link different modules to construct a parallel computing environment between different modules. The main modules include information release module, teacher management module, student management module, online topic module, system module and so on.

3 Design of hardware of parallel computing-based foreign language teaching system

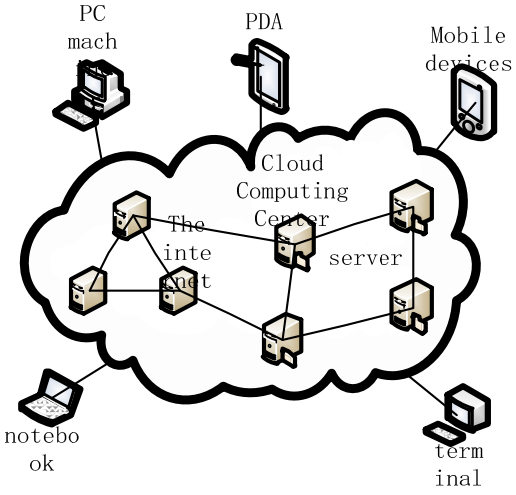
The hardware part of the parallel computing-based foreign language teaching management system is supported by functional architecture and functional modules, which is scalable and flexible. The specific construction process is as follows.

3.1 Cloud computing teaching management frame composition

In preliminary network design of foreign language teaching management system, the cloud computing architecture can be adopted to clarify the network relationship of the system, clear the network structure, and facilitate the follow-up design of the overall system (Li, 2017). In addition to implementing cloud transmission and cloud storage of teaching systems, the cloud computing architecture can also effectively increase the use

of teaching resources, maximise the value of its use, and realise the 'client + internet + cloud centre' teaching resource network management frame composition as shown in Figure 2.

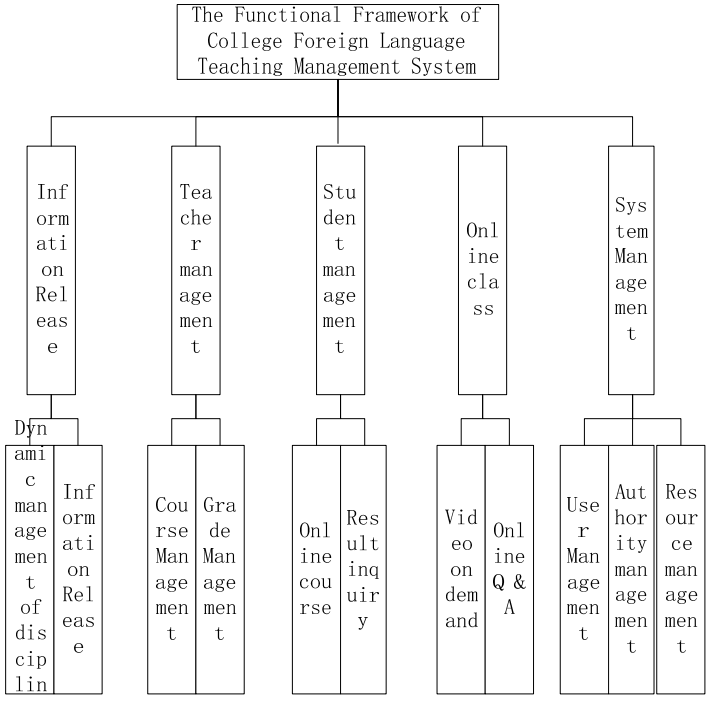
Figure 2 Cloud frame composition of teaching system (see online version for colours)



3.2 Design of systematic hardware platform based on parallel computing

The network function platform under parallel computing consists of five parts: windows operating system, cloud computing server, studio network, web control, and framework. Among them, framework is the core part of the entire cloud computing network platform, which not only provides the service agreement required for platform operation, but also facilitates the operation of the services required by the application. When the cloud computing server and web control are purchased, the traditional method is rejected to choose the more expensive hardware purchase method directly. By synthesising the performance indexes of the system, the hardware with high performance and price ratio can be purchased without affecting the running quality of the system. The platform adopts the network computer mode and solves the problem about loosely coupled distributed computing through XML, SOAP and other protocols. The application of parallel computing platform to build a foreign language teaching management system avoids writing functional code frequently used by applications, and saves the time required to construct hardware systems (Li et al., 2015). Based on in-depth understanding of the features of the parallel computing functional platform and the business needs of foreign language teaching management system, different functional frameworks are designed as shown in Figure 3.

Figure 3 Design of different functional architectures



The design of system functional architectures shows that the hardware part of the parallel computing-based foreign language teaching management system is composed of information release module, teacher management module, student management module, online classroom module, and system management module (Wang, 2014; Qiu and Miu, 2015). The specific function description of each module is shown in Table 1.

Table 1 Functional description table of five major function modules

Module name	*English name*	*Meaning*
Information release	Info-release-class	Information publishing
	Info-release-interface-class	Information publishing interface
Teacher management	Teacher-manage-class	Teacher management
	Teacher-manage-interface-class	Teacher management interface
Student management	Student-management-class	Student management
	Select	Select
Online class	Online-classroom-class	Online class
	Online-classroom-interface-class	Online classroom interface
System management	System-manage-class	System management
	System-manage-interface-class	System management interface class

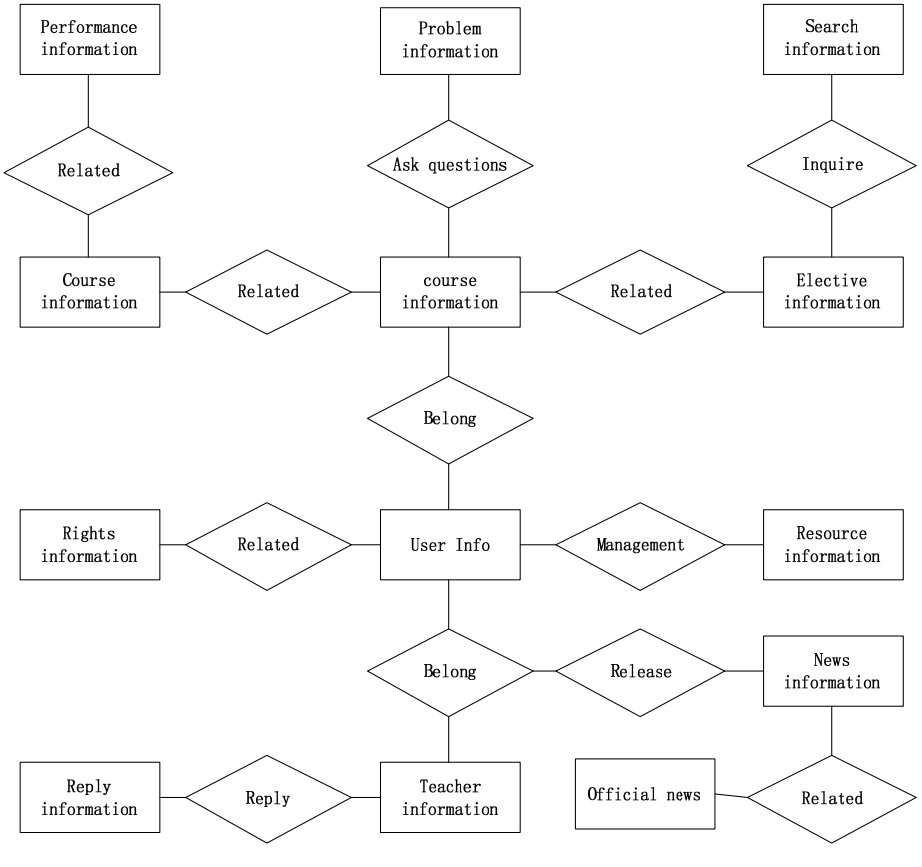
4 Design and implementation of teaching management system software

With the above-mentioned process, the foreign language teaching management system hardware is completed based on parallel computing. In order to build a complete system, it is necessary to build the system software module according to the following steps.

4.1 Design of database of foreign language teaching management system

Database design is the most important part of the software module of parallel computing-based foreign language teaching management system. The database mainly stores information related to the system. When the computer system issues a reference command, the database will automatically select information meeting the requirements and return the information to the computer system (Zhang and Xie, 2015). The system database design shows the relationship between each data table through the E-R model. All the information that needs to be stored in the database becomes an entity. For example, score information, question information, and query information can all be used as one entity. In the database E-R diagram, the entities are represented by rectangles, and the connections between the entities are represented by connecting lines, whose specific structure is shown in Figure 4.

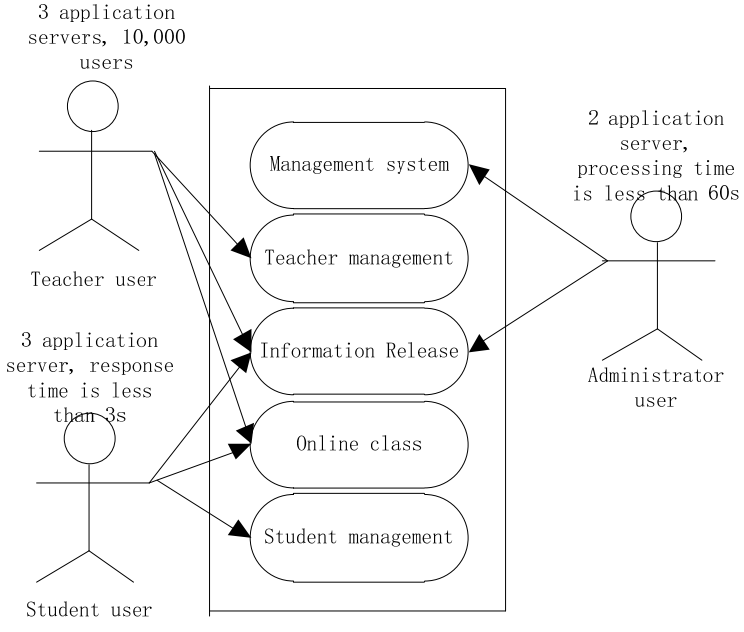
Figure 4 E-R diagram of system database



4.2 Software development environment and performance requirement

In order to ensure that the parallel computing-based foreign language teaching management system can maintain a good running speed in the actual operation process, C# language is adopted for communication among various modules of the system. The system is directly connected to the router, and the other end of the router is connected to the Internet to obtain network resources directly and conveniently. The external network users at all levels are connected in parallel, which not only achieves individual connections of users, but also meets common online requirements (Liu et al., 2015). Internal users, as direct users of the system, can connect directly to the firewall to facilitate quicker access to foreign language instructional management commands issued by web servers (Zhang, 2015). Teacher users, student users, and administrator users, as the three major users of the foreign language teaching management system, have different development environment and performance requirements. The specific development environment and performance requirements of them are shown in Figure 5.

Figure 5 Detailed drawing of development environment and performance requirements



4.3 Parallel computing scheduling strategy based on parallel algorithm

In a large-scale cloud computing system, parallel computing allocates mutually independent work requirements requiring to be executed cyclically in the system to virtual machines that can complete tasks at the same time to ensure that the tasks requiring to be completed in the system are completed in the shortest time and the load balance.

Assuming that there are μ virtual machines participating in scheduling of the system scheduling tasks and there are ω tasks under execution requiring to be completed in the system, if the constraint condition of the objective function is the minimum system compliance and the shortest execution time, when requirements are met, the parallel computing scheduling method is a suitable method. The specific process is as follows:

1 After the constraint conditions are determined, priority needs to be assigned to tasks. Joint calculation is performed according to the constraint conditions and the priority level of the tasks to obtain the task priority under the constraint conditions, on which the algorithm is designed.

Assuming that the system is in cloud computing and the constraint condition of result quantity of parallel computing scheduling task is k, $k \in [0, 1]$, when the quality is satisfying, set $k = 1$; when the quality is dissatisfying, set $k = 0$ and the customers' expectation value for service quality is z, and then:

$$k = i(z) \tag{1}$$

Based on the above analysis, a constraint relationship model on computational quality under constraint conditions can be established.

Assuming that the set of virtual machines participating in system scheduling is $\mu = \{u_1, u_2, L, u_q\}$ and μ_k is the number of the k^{th} virtual machine involved in the task calculation in the system; assuming that $w = \{y_1w_1, y_2w_2, y_pw_p\}$, and w_k is the requirement for the virtual machine T by the k^{th} computation task and U_k, $w_k \in [0, 1]$, y_k represents the priority level of tasks required to be scheduled in the system and $y_k \in [0, 1]$, relevant task scheduling processes are completed.

2 Actual load level of virtual machine. Because the system completes work in the cloud computing environment, different virtual machines have different ability of participating in computing under different cloud computing environments. Therefore, the virtual machine allocation capacity is always limited, and parameters can be adopted to describe the actual use of virtual machines, so as to make the next decision:

$$h(u_1, u_2, \cdots, u_p) = 1 \tag{2}$$

3 Selection of constraint conditions. Constraint conditions are necessary conditions and metrics in completion of task execution, which provides necessary constraint conditions for the scheduling model. The measurement and constraint of the task can be completed by mathematical modelling under a certain constraint condition:

$$\begin{aligned} f &= |u - w| = \sqrt{(u_1 - y_1w_1)^2 + (u_2 - y_2w_2)^2 + \cdots + (u_q - y_qw_q)^2} \\ &= \sqrt{\sum_{k=1}^{q} (u_k - y_kw_k)^2} \end{aligned} \tag{3}$$

where f is the satisfaction degree obtained after the system completes task execution. The greater the distance between μ and w is, the higher the customer satisfaction with the parallel computing scheduling task is.

4 Scheduling algorithm. Based on the customer satisfaction obtained, a parallel computing scheduling model is established to complete task scheduling (Yuan and Shi, 2015; Cao and Zeng, 2015). The following formula can be adopted to describe the parallel computing scheduling model in the cloud computing environment:

$$\min f = \sqrt{\sum_{k=1}^{q} \left(u_k - y_k w_k\right)^2}$$

$$s.t.h\left(u_1, u_2, \cdots, u_q\right) = 0 \tag{4}$$

where $u_k, w_k, y_k \in [0, 1]$, $k = 1, 2, \ldots, q$.

According to the method described above, the mapping relationship between parallel computing service quality and customer evaluation is established. The customer satisfaction is regarded as the goal of the parallel computing scheduling task, and the model of the parallel computing scheduling task is established, and finally a parallel calculation scheduling strategy under reasonable parallel computing environment is obtained. Based on the parallel computing environment, the parallel relationship between different management models is realised, which not only greatly reduces the probability of confusion between parts of the system, but also effectively improves the operating efficiency of the system.

4.4 Summary of system testing

With the above process, the parallel computing-based foreign language teaching management system is designed. In order to ensure the normal operation of the system, it is necessary to conduct encoding tests on each module before it is officially used (Wang et al., 2015). For user login module, the purpose of testing the module is to detect whether the user can successfully enter the system operation interface after entering correct user name and password. If a user can enter the system operation interface successfully after entering the user name and password correctly, the test result is consistent with expectations, which represents that the module can run normally. Specific test methods for other modules are shown in Table 2.

Table 2 Function test method of each module of the system

Module name	*Test operation*	*Expected outcome*	*Test results*
Online Q&A	Enter the question and click submit	Display related reply statements	Normal
Course management	Add course he	Display 'add success'	Normal
Upload results	Determine student class, name, input grade	Display 'successfully uploaded results'	Normal
Data management	Input data	Read correctly	Normal
	Input needs to modify the data	Can be modified	Normal
	Retrieving system visualisation data	Successfully displayed data retrieved	Normal

5 Experimental result and analysis

Experimental scheme:

1 experimental motivation

2 experimental parameter setting

3 comparison in response time and students' interest in foreign language learning

4 experimental results.

In order to prove the timeliness of the designed parallel computing-based foreign language teaching management system, based on the development of web-based foreign language teaching, the experiment is designed with MATLAB in a computer lab room in December 2017, and the system is implemented with C# language, and LSM303DLH.is adopted for experimental parameter collection, such as HDS, PTP, SEM, MMR, MCF, DTP, etc. A comparative experiment is designed according to the steps below. Prior to the start of the experiment, relevant experimental parameters are set.

5.1 Setting of experimental parameter

The parameter name items in Table 3 are, from top to bottom, hard disk space, processor model, software environment, memory, maximum compatibility factor, and database type. In order to ensure the authenticity of the experiment, three computers are selected as experimental objects in this experiment. Under the premise of ensuring that the three computer parameters are set to the same, the experiment is started at the same time.

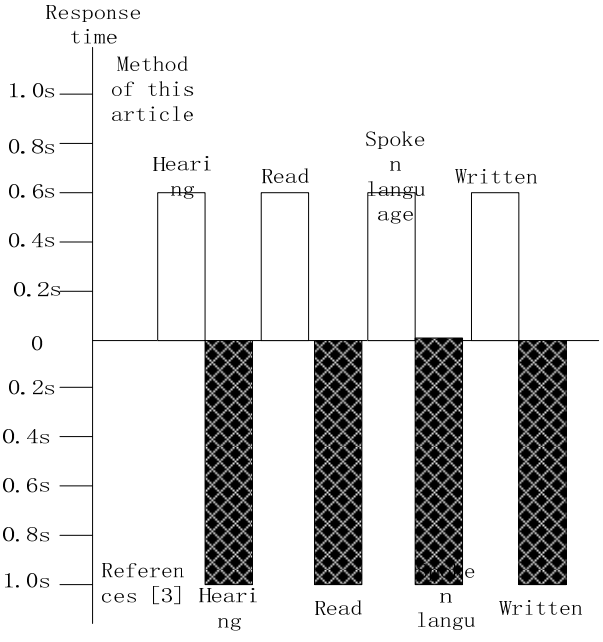
Table 3 Table of setting of experimental parameter

Parameter name	*1*	*2*	*3*
HDS/GB	2.00+	2.00+	2.00+
PTP	I5	I5	I5
SEM	Windows 7	Windows 7	Windows 7
MMR/GB	16.00	16.00	16.00
MCF	2.64×10^{-6}	2.64×10^{-6}	2.64×10^{-6}
DTP	SQL Server 2000	SQL Server 2000	SQL Server 2000

5.2 Comparison in response time

When a student's name is entered in the system, the system will judge the name, and give the student's foreign language score according to the judgment result. The time required for this process is response time. In general, the response time is inversely proportional to the development of foreign language system. The shorter the response time is, the faster the representative system develops. In this experiment, the four goals of listening, reading, speaking, and writing of student 'Zhang' are taken as query aims. In three computers, when the name of 'Zhang' is entered at the same time, the response time required for completing the four results query is calculated with the method proposed in Huang (2017) and the method proposed in this paper respectively. The experimental results are as follows.

Figure 6 Response time contrast diagram



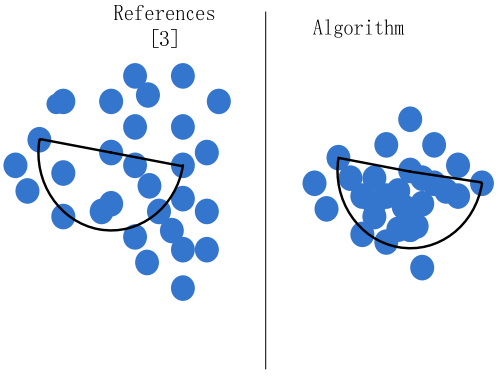
Analysis of Figure 6 shows that with the method proposed in Huang (2017), response time for each of the four scores of 'Zhang' is 1s; and with the parallel computing-based foreign language teaching management system proposed in this paper, the response time for each of them is only 0.6s. Therefore, it can be proved that the application of the parallel computing-based foreign language teaching management system can shorten the response time for query and improve the development speed of web-based foreign language teaching.

5.3 Comparison of students' interest in foreign language learning

Students' interest in foreign language learning is directly proportional to the students' knowledge of foreign languages searched in network by students each time. The more foreign language knowledge searched each time, the higher students' interest in foreign language learning, vice versa. With the method proposed in Huang (2017), let a student randomly search for 'jump' in 50 foreign language-related keywords, and then with the parallel computing-based foreign language teaching management system proposed in this paper, let a student search for 'jump' in same 50 foreign language-related keywords, the search results before and after the application of the system are recorded as follows.

The small dots in Figure 7 represent 50 foreign language-related keywords, and the semicircle represents search results. Analysis of Figure 7 shows that the search results of 'jump' with the method proposed in Huang (2017) are significantly smaller than that with the parallel computing–based foreign language teaching management system proposed in this paper. Therefore, it can be proved that the application of the parallel computing-based foreign language teaching management system can significantly enhance students' interests in foreign language learning.

Figure 7 Comparison diagram of network search results of foreign language-related keywords (see online version for colours)



6 Conclusions

1 The application of the parallel computing–based foreign language teaching management system can significantly increase students' interest in foreign language learning, shorten the response time for score query, and promote the development of web-based foreign language teaching.

2 In the foreign language teaching management system, the parallel relationship between different management modules is realised through the parallel computing environment, which not only greatly reduces the probability of confusion between various parts of the system, but also effectively improves the operating efficiency of the system. It provides a scientific basis for the diversified development of foreign language teaching.

3 However, there are still many shortcomings and problems to be further studied. In parallel computing system scheduling, the load balance in the shortest time can be achieved only under the condition of idealisation. It is necessary to further optimise the network load balance, which is more in line with the practical application.

References

Cao, J. and Zeng, G.S. (2015) 'Dual fault-tolerant scheduling algorithm of periodic and aperiodic hybrid real-time tasks in cloud environment', *Journal of Computer Applications*, Vol. 35, No. 3, pp.648–653.

Chu, W.J. (2017) 'Design and implementation of school network teaching management system', *Computer Programming Skills & Maintenance*, Vol. 15, pp.11–12.

Huang, Z.Q. (2017) 'Research on foreign language mobile learning intelligence platform in cloud computing environment', *Electronic Test*, Vol. 18, pp.35–39.

Kong, Y.H. and Zhao, Y. (2016) 'Design and implementation of university teaching management system based on RFID-SIM technology', *Laboratory Science*, Vol. 19, No. 5, pp.44–48.

Li, C. (2017) 'Research on optimization and simulation of teaching resources equilibrium assignment in mobile network', *Computer Simulation*, Vol. 34, No. 2, pp.238–241.

Li, Y. (2016) 'The application of cloud computing in English teaching', *Overseas English*, Vol. 22, pp.71–72.

Li, Z.J., Wu, X.J., Ren, Z.P. and Qu, X.B. (2015) 'Research on genetic programming algorithm based on distributed coarse-grained parallel computing', *Application Research of Computers*, Vol. 32, No. 1, pp.48–50.

Liu, J.K. (2015) 'Application of cloud computing and speech recognition technology in college English teaching', *Information & Communications*, Vol. 7, pp.139–139.

Liu, Y., Cheng, J.X. and Lin, J. (2015) 'Research on artificial firefly algorithm based on gaussian variation in cloud virtual machine scheduling', *Computer Applications and Software*, Vol. 32, No. 3, pp.834–837.

Pan, Z.J. and Zhao, L.F. (2016) 'Design and implementation of university teaching management system based on WeChat public platform', *Computer Knowledge and Technology*, Vol. 12, No. 12, pp.41–44.

Qiu, H. and Miu, Q.R. (2015) 'A lord access optimisation method of cloud computing database on ICFV', *Computer Applications and Software*, Vol. 32, No. 2, pp.41–44.

Sun, S.Y. (2017) 'Design of network teaching management system based on B/S three-tier architecture', *Electronic Technology and Software Engineering*, Vol. 5, pp.197–197.

Wang, N.N. (2014) 'On sensor network database design and application of parallel computing', *Computer Development & Applications*, Vol. 27, No. 12, pp.39–42.

Wang, S.N., Gao, S.X. and Yang, W.G. (2015) 'Overview of data scheduling in P2P media streaming system', *Computer Simulation*, Vol. 32, No. 1, pp.5–9.

Yuan, X.L. and Shi, H.J. (2015) 'Cloud virtual machine scheduling model based on simulated annealing algorithm', *Software Guide*, Vol. 14, No. 2, pp.68–70.

Zhang, A.K. and Xie, C.L. (2015) 'Cloud computing task scheduling algorithm based on fairness and load balancing', *Computer Applications and Software*, Vol. 32, No. 2, pp.268–271.

Zhang, H.Y. (2017) 'The application of SERVQUAL model in the evaluation of higher vocational classroom teaching quality', *Science Bulletin*, Vol. 5, pp.240–243.

Zhang, Q.M. (2015) 'Task scheduling of cloud computing based on improved ant colony algorithm', *Application of Electronic Technique*, Vol. 41, No. 2, pp.120–122.