

A Platform for Remote Computer Education based on Cloud Computing

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Abstract — With the development of remote education, a platform as its main support environment exposes increasingly more problems, such as independent platform construction, learning resources, hardware facilities difficult to share, and so on. Aiming at these disadvantages, this paper discusses cloud computing technology to provide the hardware infrastructure, mass storage and service characteristics. Remote education platform based on cloud computing is put forward in order to develop a unified, open remote education system. The proposed remote education platform can change the waste of manpower and material resources which exists in distributed education information development mode. It also can optimize allocation of regional education resources and effectively eliminate the information island phenomenon between remote education platforms.

Keywords -- computer remote education platform; cloud computing; server cluster

I. INTRODUCTION

Remote education means teaching and learning activities through the Internet on the basis of network technology and multimedia technology[1,2]. It makes full use of modern information technology, which provides fast and convenient communication mechanism and the rich resources of learning environment for the learners of the information age. This learning model has changed the traditional teaching of teachers facing to students uniformly. It has the characteristics of network, personalization and traceability. Remote education is a kind of learning method through remote education platform for learners[3,4]. It implements the demands that learners can accept education at any time and place and breaks the limit of time and space in traditional teaching. With the deep population of the remote learning style, its main support environment gradually exposes some problem, such as uniform education information resources distribution, information islands and other issues. The emergence of cloud computing provides a possible way to solve these problems effectively[5-7].

Remote education system is supporting platform of remote learning. However, current remote education environment of each unit is developed individually. Configured hardware facilities related to each site generally only satisfy a certain number of users access. When a large number of users access to the site at the same time, the system is easy to crack. And as the increasing of learning resources, storage space is too tight. Although some units upgrade hardware facilities to deal with this kind of situation, in most cases, these hardware resources seem to be wasteful to some extent[8-12].

Cloud computing is composed of a large number of computer communities, and software and hardware resources are virtualized into a unified resource pool through the distributed computing and virtualization technologies, which provides customers with computation, storage and other services[13-14]. At present, more mature cloud computing

platform has server cluster composed of millions of servers, which can provide powerful computing capacity and huge amounts of storage space[15]. Combined with characteristics of cloud computing service, we set up computer remote learning platform based on cloud computing.

In remote education model based on cloud computing, various education units no longer needs independent development of learning system, and they can access cloud services platform through the Internet. They can realize uninterrupted access any time anywhere using the cloud service platform, at the same time they also can share bandwidth and computing resources with other users within the platform. Remote education platform based on cloud computing platform has the incomparable advantages.

(1) Cloud platform provides infrastructure services, including storage, servers and network devices, which is able to manage IT Infrastructure uniformly and provide a powerful computing capacity, mass data storage space and network communication and other resources.

(2) Cloud platform has the ability of mass storage, and it integrates a lot of learning resources into the cloud, solving the independence of the resources. A user can access all the learning resources stored in the cloud through a uniform interface.

(3) Application environment provided by the cloud platform calls for the API to build an remote education system. The system is deployed on the cloud platform, and each end user carries out remote education through a unified user interface. Various education unit will no longer need to focus on how to obtain and manage data information, storage and management of all data information is performed by the cloud service platform.

(4) The resource is stored in the cloud, the cloud computing platform provider is responsible for resource security and education site no longer care work of server.

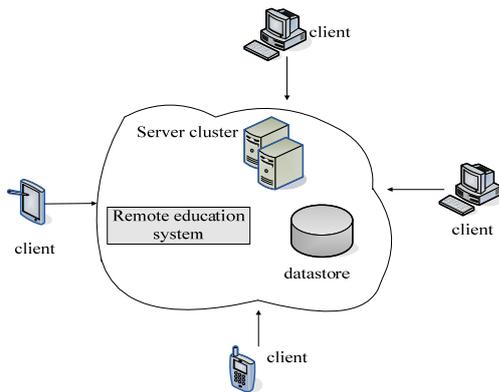


Fig. (1). Computer remote education system structure based on cloud computing

(5) The traditional remote education platform generally is supported by only one or two terminal servers. The cloud computing model is made up of server cluster including millions of servers, which has very strong computing power and network throughput.

In the next section, structure design of remote education platform based on cloud computing is given. In Section 3, system requirements analysis and system design is worked out. In section 4, system business logic implementation and system security is worked out. At last, some conclusions are given.

II. STRUCTURE DESIGN OF REMOTE EDUCATION PLATFORM BASED ON CLOUD COMPUTING

Operation of a complete remote education platform needs learning resources, storage, computing resources, application system and interface, etc. According to the characteristics of cloud computing technology, computer remote education platform structure based on cloud computing is shown in figure 1. Among them, the user terminal (the user + client) is the consumer in the whole cloud computing system, application layer, management platform layer, data layer and infrastructure layer are supporters and service providers of the whole cloud computing system. Layout of computer remote education platform based on cloud computing is shown in figure 2.

Users of remote education platform can be divided into three types: students, teachers and administrators. After login into the remote education platform, students can learning online course, download courseware, practice and other learning materials or through BBS communicate with teachers or students to exchange the problems in learning, etc. The teachers guide students to learn through remote learning platform, assign online homework and communicate with students, etc. While the system administrator is responsible for user information management in the learning platform, curriculum information management, BBS management and other related work.

As the communication network technology and the continuous development of wireless mobile communication

equipment, the mentioned client here refers to the personal computer, smart phones, PDA and other mobile support equipments. The client is interaction media between the user and the system, which is responsible to present system content to the user, the system will provide a different interface and function according to the type of devices hold by user.

In the cloud platform architecture, the application layer is used to provide a wide range of applications related to education teaching, which provides education oriented SaaS. This layer consists of a remote education network platform, and the network platform is the support of the whole system, which doesn't carry specific data content. The users login into the website homepage, they can call related services provided by cloud computing platform through interfaces. In this paper, remote education network platform mainly includes the user management module, public information module, resource management module and interactive module.

Management platform layer plays a central role in the whole remote education cloud platform architecture, which provides the running environment for remote education system in the application layer and is application platform for the various application software.

Google App Engine (GAE) is PaaS cloud computing platform service designed for software developers and its massive computing power and storage space is managed by Google, which allows users to deploy and run the application directly on the Google powerful infrastructure. This article uses PaaS system proposed by the Google cloud computing. Google App Engine is the third party application platform deployed in Google's unified infrastructure, so users do not need to worry about platform reliability, performance and security. The operation of the platform is monitored and maintained by the service provider uniformly, without user involvement. GAE implements load balancing mechanism, which can automatically distribute a lot of requests into free application server for processing. GAE provides various services for user applications, data persistence mechanism and the necessary management and control function, which is implemented mainly by the application programming interface (API). User and resource in the remote education is sent to DataStore components in the data layer to manage through the GAE provided interfaces (based on Java JDO/JPA interface).

The data layer is the core of the whole architecture, which is responsible for the various types of data storage. For remote education system, the construction of learning resources is the core and foundation of remote education. Today's various remote education platforms are difficult to fully use, data storage services through the cloud computing integrates resources to build a unified public resource pool for users to share, which is a focal point of this problem. The cloud data storage is provided by millions of servers, which does not need to worry about the size of the storage space and can be extended according to need dynamically. Learning resource is stored in the cloud, which doesn't need to consider learning material loss problem caused by

damaged terminal equipment. Large capacity of the cloud storage makes different schools, education institutions and individual learners and other users upload learning resources to the cloud for unified management, so learning resources are integrated to a great extent, which certainly will eliminate the phenomenon of information islands and achieve the goal of resource sharing. And in the process of resource integration, various data resources storage is a key problem.

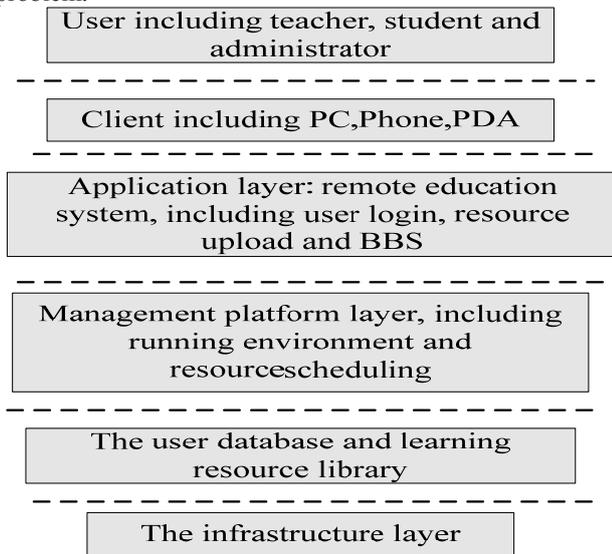


Fig. (2). Layout of computer remote education platform based on cloud computing

In the face of huge amounts of heterogeneous data resources, data stored in the data layer is mainly divided into two kinds, structured data and unstructured data, such as students and teachers user information belongs to structured data, which can be expressed in two-dimensional table structure and usually is stored in a relational database. And relative to the structured data, those which are not convenient to be represented using the database two-dimensional logical table is called unstructured data, including all formats of text documents, pictures, sound, graphics, images and video information, etc. When storing this kind of data, on the one hand, they can be stored in a file system in the form of text, and then in the database the file path is saved. On the other hand, these unstructured data is saved directly in the large objects field of the database, which is convenient for unified management.

Infrastructure layer is the base layer of the architecture, and the infrastructure corresponding to cloud computing service level is infrastructure as a service-IaaS, which determines service scope and service ability of the remote education platform. The infrastructure layer provides customers with server, storage, network equipment and other hardware resources, but these hardware resources are not the real physical devices and virtualization technology makes the server virtualization, storage virtualization and network virtualization. It is thus able to generate multiple virtual machines on a physical server and can achieve full

isolation between the virtual machines. Virtual storage resources are virtualized into a pool, integrating many scattered storage resources and improving the overall efficiency. Then through the computer cluster technology, it realizes unified dispatching management and a unified virtual cloud computing service platform is generated. Powerful computing capacity and huge amounts of storage space meets growing remote education users, increasing huge demand and hardware resource sharing. Through the use of infrastructure provided by cloud computing, education units do not have to consider the problem such as servers and storage space, they should just concentrate on learning resources integration and the other is solved by cloud platform.

III. SYSTEM REQUIREMENTS ANALYSIS AND DESIGN

The existence of computer remote education system breaks the limitations of traditional face-to-face education, and makes the student not restricted by learning time and place. Students can master learning according to their interests, so as to realize autonomous learning. Traditional remote education system development paid more attention to the improvement of the system function. In this paper, the remote education system in addition to meet the requirements of this nature, more important is to build this system based on the cloud computing infrastructure, which makes the system not only can provide more comprehensive services, but also can use the advantages of cloud computing to construct remote education system more efficient and more practical. This article analyzes the functional requirements of the whole remote education system from the angle of different users. The system user includes students, teachers and administrators.

A. The first is students function requirement analysis.

After students login into system, they carries out related functions of remote education. Detailed introduction is as follows. remote education: The students can choose courses according to their own learning progress, browse courseware content, learn new knowledge and review the old knowledge. Announcement browsing: Student users can browse the announcement, news posted on the site. Students can download their learning materials, such as curriculum related software, learning video, PPT and testing, etc. Students can regularly check their knowledge level through online testing, submitted to the system mainly in the form of examination papers. The system will automatically mark and will feedback the test scores to the students. File upload: Users can also upload finishing materials or job files to the server. Learning interaction: Students can communicate with others through email, BBS or instant messaging tool. Personal information maintenance: Students have permissions to modify their personal information

B. The second is teachers function requirement analysis

Online classroom: The teacher is responsible for updating courseware content on the learning site, allowing students to learn new knowledge and review the old content. Teachers can also download the course materials, software,

video, etc. Online testing means that the teacher is in charge of design and upload of the examination paper and they can browse the students' test scores. File upload means that teacher can upload courseware, teaching outline data to the site. The teacher can interact with the students and answer questions through email, BBS, or instant messaging tool. Personal information maintenance means that teachers have permissions to modify personal information.

C. *The third is administrator function requirement analysis.*

System administrators can manage other user's information, course information, interactive information, permissions and configuration, etc. Through the concrete analysis of remote education platform system, this article divides the platform into user management module, learning resource management module, testing module and interactive module. The user management module is used to ensure the legitimacy of the users accessing to the whole remote education system, which mainly includes user registration, examination management, and user permission setting. Users fill the registration list and submit personal information to wait for system administrator to review. When the request is taken as legitimate user, the administrator approves registration and assigns role according to the user's identity. After the success of the user registration, the system administrator allocates corresponding roles to the user. After user owning its role, the user enjoys the corresponding rights to use service provided by the system. The registered users can login into the system through their own user name and password. According to login information, determine the user identity to enter into different user interface. When a user input error occurs, the system will prompt error message.

Public information module includes three kinds of information releasing, which is website profile, news centres and announcement. Website introduces information of learning website, including web services and web dynamically, etc. News centre is used for releasing of academic hotspot or current news, etc. The announcement is released teaching information facing to students, teachers, or administrators. Different user identities have different operating authority. Students only have permissions to view the content of information, and the teacher can browse, release and delete information. Administrators not only have all of the above operation rights, they can also maintain the information classification. Resource management module mainly includes two modules of the curriculum management and learning resource management. Course management system mainly includes adding and deleting of learning resource. Learning resource management system is the management of learning resources associated with the course. Through the function and service provided by the system, all kinds of teaching resources are added into system resource library in accordance with the respective course. The development and integration of learning resources is the key to realize the user sharing. Students, teachers and administrators have permissions to upload and download resources.

Examination module design is mainly used to meet the students to look up knowledge as well as the requirements of teachers to check students' knowledge level, which mainly includes the adding, deleting and modification of testing questions as well as the result of evaluation. Interactive module makes communication between students and students, between students and teachers as well as the communication between the teacher and the teacher timely. Email and instant messaging uses Google third party service Gmail and Google Talk. The two existing applications are integrated into remote education platform, which can save cost. Network BBS provides a piece of public electronic whiteboard and each user can write on it, including the contents of study to question or their understanding of certain knowledge and so on. Different types of users carry out different operations to BBS. Students and teachers can browse the posts as well as publish posts and reply to the posts. The administrator can remove bad or outdated posts. In the traditional design of database, we usually set up data model using the data table structure. GAE does not support the traditional data storage method, which is relational database storage. The data table is transplanted into data model information that GAE can identify.

IV SYSTEM BUSINESS LOGIC IMPLEMENTATION AND SYSTEM SECURITY

GAE cloud computing platform provides SDK of programming language Java and Python for users to download. Java SDK includes all API provided by Google application service engine, function libraries and a web server application. We can simulate all cloud computing software services provided by GAE using local computer, so the download SDK installed on the local computer, you can carry out cloud computing application design. This system uses Java as development language and Edipse3.6 as integrated development environment.

Google App Engine provides many useful services in the SDK. One of them is the user system service and the service can make us integrate Google's user account system conveniently. So users don't need to register a separate account and they can log in using the Google account directly. As long as passing the authorization of the administrator, you can directly use public information and resources. But the user's system provided by GAE is too simple, so the system uses Java web programming technology to implement its own user management subsystem independently. User management is mainly used to ensure legitimacy of the user, in order to achieve management of different operating permissions, we need to set up a user login module. By setting a user login area, we complete the user login and authentication function.

Because GAE for Java SDK does not support file system yet, for a variety of learning resources storage, here we use the method of large object storage field to store data, which uses big data type blob to store binary files. For distributed database Datastore, App Engine Java SDK contains two kinds of standard data access interface implementation: Java persistent API(JPA) and Java data objects(JDO). The two

interfaces are used to describe data object structure through the concept of Java classes. This system adopt the JDO to define data classes in the remote education system and the data class is mapped into data storage area and PersistenceManager class of JDO is used to operate data. Involved entity classes in this system mainly include user, role, learning resource and so on. When defining there entity classes, Java annotation is used to tell JDO how to store and create entity classes. Interaction between application and data is implemented by the PersistenceManager class of JDO. Each PersistenceManager is responsible for the control of a group of persistent objects and it can also create new persistent objects or delete existing persistent objects. It could obtain an instance of this class by PersistenceManagerFactory. Due to the PersistenceManager instantiation is time-consuming, so this paper makes an application share a single instance.

This application belongs to multi-user system, in order to guarantee the security of the system, when the user requests service, we will need to authenticate user's identity to ensure the legitimacy of the user operation. This paper uses servlet filter to pre-process each page request, making different users can only access different pages under different folders. Servlet filter is a kind of program class realizing java. servlet. Filter interface, which supports the basic request processing function of servlet and JSP page. But these requests run on the server, which mainly used to check whether servlet or JSP page request is legal and stop illegal request. Servlet filter usually realizes authentication using the session object. When accessing the Web application, the system will generate a separate session object for each user to store state information of the user. The corresponding session disappears until the user leaves the Web site. Using the characteristics of the session object, servlet filter obtains user information from user session sending the request, so as to determine whether the requested action is allowed.

Because GAE application environment does not support the session mechanism, so the system authentication filter uses Google Memcache service. Calling interface of Memcache service, generated cache object produced by CacheManager can store user data in the session period, the effect of which is equivalent to the session. So using cache object to replace session to realize filter is a feasible solution.

Using Memcache service, the user ID and the character Role is stored in the cache object. By means of judging cache sign, we can realize authentication when writing filter class program, making users of different permissions can only access the files under different folders.

V. CONCLUSIONS

Network popularization and the rapid development of information technology makes more and more people choose remote learning. Cloud computing with high stability, strong computing power and the advantages of the mass storage used in the construction of remote education platform is the trend of times. In this paper, the advantages of cloud computing is used in the building of remote

education platform, Remote education platform based on cloud computing is investigated including design idea, overall structure, function design and implementation details in depth, Specific work done in this paper can be summarized as the following aspects.

The cloud computing platform is analysed, including connotation, characteristics and advantages of cloud computing and the key technologies to implement cloud computing. Google's cloud computing application development platform-Google App Engine is introduced. We set up Google App Engine development environment under the Windows XP operating system, so as to deepen the understanding of Google cloud computing platform. In view of the insufficiency in the current remote education platform, with the consideration of the characteristics of cloud computing service and remote education system based on cloud computing is proposed.

Architecture of remote education platform based on cloud computing is discussed, and combined with three layers of cloud computing service, responsibility of each layer is analyzed one by one. Combined with requirements of current remote education systems, data model and business process of each functional module is analyzed and designed in detail. Google App Engine development platform, Eclipse integrated environment and Java web technology is used to develop remote education system, including user management, learning resource management and interactive module. System interface, business logic and data persistence and system security is analyzed and designed in detail.

Under the background of cloud computing, developers can build a remote education system of lower cost and higher efficiency. Learners only need to use the terminal device can access the cloud platform through the browser to independently choose rich learning content and complete real-time interactive learning.

Web application information based on this platform is too little, to strengthen the stability of the system and make the computer remote education system based on cloud computing is more perfect, exploring work has to be continued.

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