

Design and Implement of a Distance Education System Based on Mobile Agent and Cloud Computing

Qianli Shen ^{1, 2, a}, Jiye Wu ²

¹Business and Management School, Donghua University, Shanghai 200051, China;

²Institute of E-business and Network Economy, Hangzhou Normal University, Hangzhou 311121, China.

^agalen@21cn.com

Abstract

The various kinds of distance educational resources are highly distributed and with huge amount of information. According to the special features of these kinds of resources and the constructive need of the next distance educational information system based on educational resources. After the introduction of key technology such as mobile agent and cloud computing, the design and implement problem of a distance education system based on mobile agent and cloud computing was discussed.

Keywords

Cloud computing; mobile agent; distance education; architecture.

1. Introduction

With the development of modern communication and Internet technology, distance education overcomes the shortcoming of traditional education that being conditioned by space-time with information technology. Based on distance education resource, new generation distance education information system provides all teachers and students an autonomous, individual, open distance education software environment. Distance education resource is featured by huge amount of information (such as material database, courseware database, test database, simulation experiment database, typical case database and etc), multiple media categories (image, text, audio, video), scattered storage, various manifestations, sustained dynamic growth and so on. Existing education resource often is stored concentratively in a specific pattern, which is inconvenient for dynamic update and autonomous acquisition, affects the construction efficiency and usage cost.

Due to cloud computing's distributing, dynamic, diversity, multiplicity of management and Mobile Agent's intelligence, autonomy, mobility and other characteristics, we may introduce Mobile Agent technology into distance education cloud architecture aiming at the features of new generation distance education information system to achieve the communication among layers and management of middleware construction, making the system have characteristics of single mapping space, node autonomy, unified education resource management and etc to realize the construction and sharing of heterogeneous distance education resource in different region, improving users' efficiency in organizing specific teaching contents. Based on this idea, this paper proposes a design and implementation scheme of distance education system on the basis of Cloud computing and Mobile Agent, so as to implement the extraction and reconstruction of resource components in heterogeneous, distributed large distance education resource library.

2. Introduction of Key Technology

2.1 Cloud Computing Overview

Cloud computing is a style of computing in which dynamically scalable and often virtualized resources are provided as a service over the Internet, it integrated the whole Internet into a supercomputer, realizing the full sharing of computing resource, storage resource, data resource, information resource, knowledge resource, experts resource and other various resources. The idea of cloud computing derived from power network. Based on the power supply needs of users, power network coordinates several electric power suppliers, while consumers do not need to construct their own electrical power supply system, just purchase electric energy from power network without caring about its source. The basic idea of cloud computing is that cloud computing suppliers provide high-performance computing environment for users, no expensive computing device is needed to be bought for the running of information system, users only need to obtain the computing capacity they need from cloud computing. The implementation mode of cloud computing is to interconnect various kinds of computing resources which are distributed geographically with Internet or private network widely, including supercomputer, computer cluster, large database, valuable instruments, sensing equipment, broadband backbone, software and other parts.

Cloud computing can satisfy all kinds of application requirements in various ways, it has many advantages such as powerful computing capability, sharing and management of information resource, unified management and scheduling of resource, interoperability, convenient and efficient in information resource utilization, expansibility and adaptability, reliable security assurance and so on. The fundamental characteristic of cloud computing is the sharing of resources and services, and intelligent information processing, rather than huge scale, we can build distance education cloud, campus cloud, home cloud even personal cloud as needed, therefore, the application prospect of cloud computing is very wide.

2.2 Agent and Mobile Agent Technology

Agent is the program which can simulate human behaviour and relations with some intelligence to run and provide corresponding services autonomously. The generation and development of software Agent is the combination of artificial intelligence and Internet technology. From the 1960s, traditional artificial intelligence technology started working on the researches on knowledge representation, intelligent reasoning and other fields, the application of these research results in computer software makes software be initiative in a sense, also have certain intelligence in autonomous judgment and behaviour choice.

Compared with the popular software entities now (such as object, component), Agent has larger granularity and higher autonomy. Agent has the responsibility, autonomy and initiative to environment, it has reasoning, learning, adaptive ability and the ability to maintain communication, cooperation and coordination with other members in Agent group. Agent technology is applied to many fields, different specialized people will have different understanding about it, Figure 1 is the complete description of software Agent.

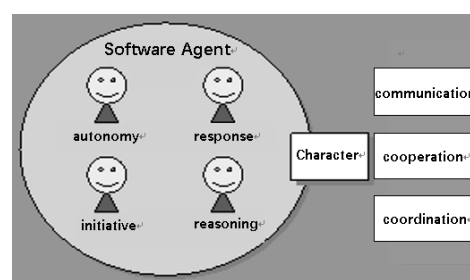


Fig.1 Software agent

Of which, autonomy is the essential feature to distinguish the software Agent from other general software programs. The intelligent reasoning of software Agent should be accomplished with three main components, they are internal knowledge base, adaptive ability and reasoning ability based on knowledge base. Character means that software Agent needs to take security, risk, faith and other factors into consideration in social activities. Communication, cooperation and coordination are the social attributes what the software Agent group should possess.

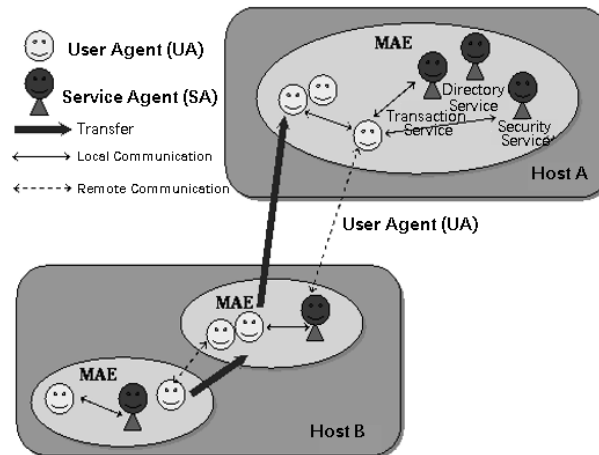


Fig.2 Mobile agent system architecture

Mobile Agent is a kind of special Agent, except for autonomy, responsibility, initiative, reasoning and other essential qualities of Agent, it also has mobility that it can move from one host to another host computer autonomously to perform the assigned tasks on behalf of users. Because Mobile Agent can move in the heterogeneous software, hardware network environment freely, this new computing mode can reduce the network load in distributed computing effectively, improve communication efficiency, dynamically adapt to the changed network environment, owning good security and fault tolerance.

Figure 2 is the architecture of Mobile Agent, including Mobile Agent (MA for short) and Mobile Agent service facility (MAE for short). MAE is responsible to build safe and correct operating environment for MA, provide the most basic service for MA (including create, transmission and execution), implement the restraint mechanism, fault-tolerance strategy, security control and communication mechanism aiming at specific MA. The mobility and problem solving ability of MA greatly depend on the service provided by MAE, generally speaking, MAE should include transaction service, event service, directory service, security service, application service and other basic services at least.

Mobile Agent has the advantages of saving network bandwidth, asynchronous calculation execution, providing real-time remote interaction, easy to distribute and maintain service distribution, easy to customize personalized service and so on.

3. Architecture of Distant Education Cloud System Based on Mobile Agent

The main purpose of distance education cloud is to build a distributed mass distance education resource library, provide a set of efficient resource sharing and storage management mechanism, users can have network information access conveniently and quickly anywhere, anytime. The system structure of distance education cloud is as shown in Figure 3, the education resource servers distributed in different places continually input information to distance education cloud, including online courseware, video on demand, remote virtual experimental platform and so on, users can log in distance education cloud to acquire information or store information for other users to use, the geographical position and topological structure of whole cloud are fully transparent to users, which also can make dynamic scheduling according to subscriber number.

In distance education cloud we can define learning object registry, learning object storage, learning object retrieval and query and other cloud computing services. Distance education cloud architecture

can be divided into five layers generally: Fabric Layer, Connectivity Layer, Resource Layer, Collective Layer and Application Layer, the function description of each layer is as follows:

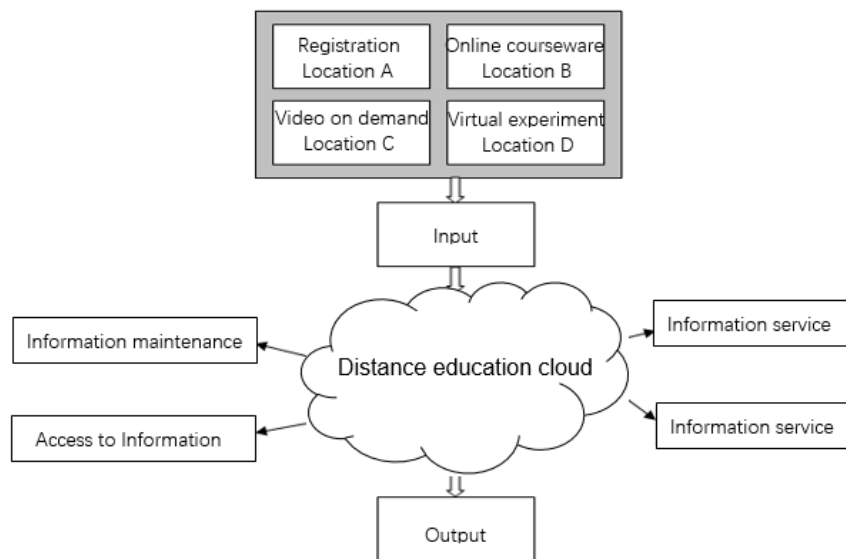


Fig.3 Distance education cloud system structure

- Fabric Layer: the function of this layer is to control local resource, provide resource access interface. It is composed of the external feature descriptions (such as resource identifier, provider, subsidiary disciplines, resource category, language, resource interface or knowledge points association and so on) of various education resource components and entity object. The external features and interface information of distance education resource are described with XML and built on this layer.
- Connectivity Layer: this layer defines the communication and authentication protocol what core network transaction processing needs, communication protocol allows the data exchanges among resources in Fabric Layer, authentication protocol provides encrypted security mechanism for user identification and resource identification.
- Resource Layer: this layer is based on the communication and authentication protocol of Connectivity Layer, sharing the single resource. The protocol implementation of this layer calls the functions of Fabric Layer to access and control local resources, and only consider the single-class local resource to form users' specific requirements. Resource Layer contains two important protocol families: information protocol and management protocol. Information protocol is used to get the structure and state of information, management protocol is used to coordinate the access to shared resources, point out resource demands and the impending operation.
- Collective Layer: this layer coordinates various kinds of resources, the functions offered include directory service, co-allocation, scheduling and agent service, monitoring and diagnostic services, job load management and collaboration framework, software discovery service, public stats and payment services and so on.
- Application Layer: this layer is in the virtual organizations environment, and the application is constructed according to the defined service of any layer. Every layer defines protocol to provide access to related services, including resources management, data access, resource discovery and so on. API can be implemented with SDK, using the interaction between cloud computing protocol and web service to provide services for final users.

As Mobile Agent technology has a definite advantage in the aspects of network information issue and information query, this paper proposes the distance education cloud architecture based on Mobile Agent and cloud computing middleware, of which structure is as shown in Figure 4. The middleware consists of directory service manager, explorer and Agent server. Of which Agent serve forms the basis of Agent to support environment, the main function is to shield the differences in heterogeneous platform, support the running of Agent. Agent server contains Agent life cycle module, Agent security

module, Agent communication module, Agent migration module and so on, the basic instruction set of Agent running and other computation model also are considered. Directory service manager is similar to the MDS in Globus metacomputing toolkit, record the dynamic and static informations relative to the status of every component (such as network, education resources distributed node, storage system, instruments and so on). Source manager is similar to GRAM in Globus metacomputing toolkit, which processes the request of remote applied education resource, allocates the resources required, manages activities job, as well as updates the service condition and availability status of resources to directory service manager.

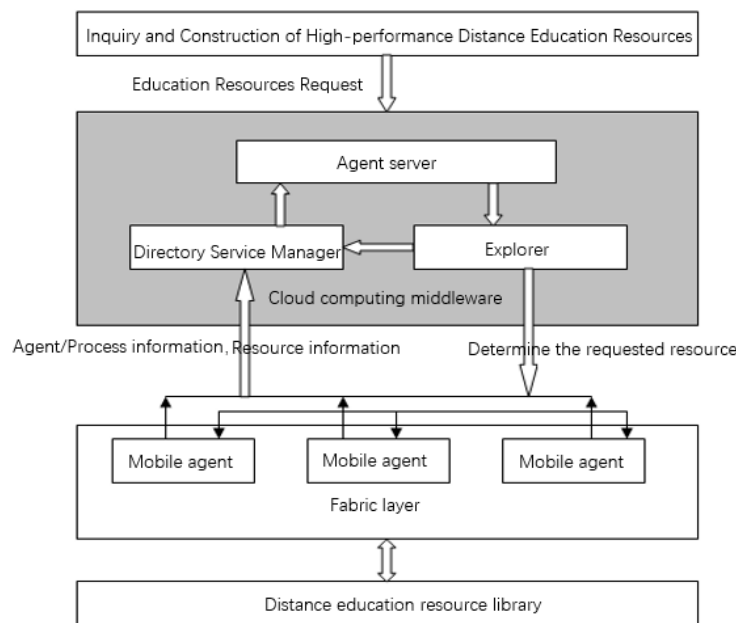


Fig.4 Distance education cloud system structure based on mobile agent

Agent server generates some Mobile Agents which will perform tasks according to computing tasks model, allocate resources through explorer and assign these Mobile Agents to specified compute node. Mobile Agent may determine whether to start a task based on computing resource and data resource, if there is no data resource, we can inquire data sources nodes and collaborate the transmission of data resources with Mobile Agent distributed in this node.

Before Mobile Agent decides to move to some node to perform operation, it is need to query the resource and load condition of every node automatically to choose the proper node. Mobile Agent can bring its own computing resource, or get computing resource from the Mobile Agents distributed on other nodes. Once Mobile Agent implements a phase of tasks, submit the resource information Agent called, status of Agent and Agent ID to Agent server through directory service manager, Agent server collects the calculation result of this phase and reassign the resources through explorer to implement the tasks of next phase.

4. Design and Implementation of Distant Education System Based on Cloud and Mobile Agent

4.1 System Design

Distant education system usually consists of student Agent, teacher Agent and collaboration server. System Agent model should embody the autonomy of Agent, student Agent can search appropriate teacher Agent for students. Even if students do not specify destination, system also can assist them in searching teacher Agent effectively.

(1) Student Agent

Student Agent is used to help students for studying, it is composed of subscriber interface module, learning module, self-test module, control module, communication module and knowledge. When students login the distance education system, the system will generate a student Agent automatically which is controlled by teacher Agent.

(2) Teacher Agent

Teacher Agent is used to help teachers to manage and control teaching, it is composed of subscriber interface module, monitoring module, evaluation module, study guide module, control module, communication module and knowledge base.

(3) Collaboration Server

Collaboration Server is used to support the cooperating of several Agents, it is composed of communication control Agent, collaboration management Agent and collaboration application Agent. Of which, communication control Agent implements the exchanges among Agents, between teacher Agent or student Agent and collaboration server, it supports HTTP, FTP, TCP/IP, UDP and other various communication protocols, also responsible for message routing, quality of service (QOS) management, bandwidth allocation, store-and-forward and so on.

Collaboration management Agent is the organizer of group collaborative learning, which is the monitor program of the whole system and used to implement the registration (such as sign, identity and activities engaged in) of coordination member, account and rights management, dynamic joining and evacuation management of member, grouping management, information management of collaborative task, issue of shared cooperative information, access and query service of shared information.

Collaboration application Agent implements application shared service, chat service, electronic whiteboard service, video conference, multimedia interactive service and so on. In order to maintain the fundamental features of these conventional educations in network teaching process, that is interactions between teachers and students, students and students, this Agent generally needs to provide the following six collaboration tools: ① Courseware Browsing Tool; ② Applications Sharing Tool; ③ Electronic Whiteboard Tool; ④ Virtual Class Synchronous Text Communication Tool; ⑤ Questioning Answering Tool; ⑥ Synchronous Voice/Video Transmission Tool.

4.2 Implementation of System

This system implement the separate of three layers of B/S application architectures: presentation layer, service layer and database access layer. The development of application adopts component -based development management, which is easy to manage, develop and maintain.

- Presentation Layer: that is the user interface based on web browser, client uses operating system's own browser.
- Service layer: consists of traditional Web server, management information base and application gateway. The intermediate layer almost can be supported by any server platform. As an application server of intermediate layer, it packs the service logic.
- Data Layer: are the Oracle, SQL Server, DB2, Sybase and other heterogeneous databases to which can be accessed by the intermediate layer application server, including all the data and knowledge bases system used.

The intermediate layer application server provides the transparency to geographic position, programming language, communication protocol and operating system for application, which can solve the communication problems of Mobile Agent in heterogeneous distance education network effectively. Using Cloud computing technology to integrate the education resources under every kind of systems into a large-scale system, this feature just satisfies the needs of distance education construction. In addition, it can implement the interaction between objects on different network platforms easily.

5. Conclusion

Modern distance education is a kind of education model integrating with computer network technology, mobile satellite communication and multimedia technology, digital personalized service will be the new mode and development direction of Internet services, introducing the concept of personalized service into modern distance education system will be a hot spot of modern distance education development. The new generation distance education system this paper proposed and designed based on distance education cloud and Mobile Agent technology can solve some problems existing in current distance education system, improve the load capacity, flexibility and intelligence of system so as to satisfy the demands of modern distance education. Of course, in order to implement the collaboration and interoperability among systems, further improvement is needed in some aspects, such as the security problems of system, standard problems of system architecture. We need to make further in-depth study combing with working practice closely.

References

- [1] Wang Suzhen, Du Zhijuan. Construction method of mobile cloud computing system based on mobile Agent [J]. Journal of Computer Applications, 2013, 33(5): 1276-1280.
- [2] YANG Na-na, WANG Yang, CHEN Fu-long, HUANG Ya-kun, DENG Kun. Research on cloud computing security authentication mechanism based on mobile agent [J]. Application Research of Computers, 2012 29(10): 3812-3814.
- [3] Liu Mengjuan. Research on Distance Education Platform Based on Cloud Computing Technology [J]. Automation & Instrumentation, 2015 (09): 107-109.
- [4] Ji Min. Application of Cloud Computing Technology in Distance Education [J]. Wireless Internet Technology, 2016 (19): 147-148.
- [5] Li Yi-qi, Wu Jia-li. The distance education system design based on cloud computing [J]. Journal of Northwest University (Natural Science Edition), 2012, 4(1).