Online Cooperation Learning Environment

A thesis presented
In partial fulfillment of the requirements
For the degree of

Master of Science
in
Computer Science

At Massey University, Albany,
New Zealand

Jun Shang

2005

ABSTRACT

This project aims to create an online cooperation learning environment for students who study the same paper. Firstly, the whole class will be divided into several tutorial peer groups. One tutorial group includes five to seven students. The students can discuss with each other in the same study group, which is assigned by the lecturer. This is achieved via an online cooperation learning environment application (OCLE), which consists of a web based J2EE application and a peer to peer (P2P) java application, cooperative learning tool (CLT). It can reduce web server traffic significantly during online tutorial discussion time.

ACKNOWLEDGEMENTS

I would like to thank my supervisor, Dr. Chris Messom, for his guidance, patience and support during the period of this research project. Also, I would like to thank Dr. Abdolhossein Sarrafzadeh, for his guidance and support.

Finally, I would like to thank my wife Julia, for her endless support and encouragement.

TABLE AND CONTENTS

1 INTRODUCTION

Becoming better at learning is one of the most important goal for anyone participating in education or training programs. Cooperative learning is one of the solutions to help people to archive this goal. Bouton and Garth stated that learning is a group process: the learner actively constructs knowledge by formulating ideas into words and then the ideas/concepts are built upon through reaction and responses of others [22]. The cooperative learning occurs when a small group of students work together to maximize their learning capacity under the lecturer's instruction [2]. It is useful to help student to reappraise, if necessary, their thinking about how they learn best, so that they can take control of their learning processes consciously and develop them systematically. Cooperative learning has proven to be a successful method in traditional classroom settings [23].

Online Cooperation Learning Environment (OCLE) is an application that provides tool and solution for the cooperative learning by using Internet and the World Wide Web as a framework. Using such software, the learners can discuss and share files within their own group.

E-learning has become more and more popular in educational institutions. The E-learning means that learning is facilitated and supported through the use of information and communications technology; E-learning is to learn entirely online, from supported learning to blended learning [1]. E-learning presents a host of new opportunities for institutions to cost-effectively expand access to education and improve educational outcomes. The learner can get learning material and contact with another learner freely without any timing and location's limitation.

The existing commercial products of the Online Cooperation Learning Environment are part of an E-learning system. Also, there are many research projects, which implement the OCLE. The weaknesses of the existing OCLE application are either the feature of study group was vaguer or the client-server module was adopted.

In the past decade, the population of accessing internet was growing fast. People use internet to get information and communicate with each other. The communication tool, which based on internet, has been developed and proven successfully, such as Windows Live Messenger, ICQ and AOL Instant Messenger. Those applications are named as the instant messaging (IM). The instant messaging is a form of real-time communication between two or more people based on typed text. The text is conveyed via computers connected over a network such as the Internet. The framework of the IM makes the peer-peer computer based Cooperative learning possible.

1.1 Aim of my research

The aim of this research is to investigate and test the technologies by creating an online cooperative learning environment (OCLE) application. This application will conquer the shortcoming of server-client module by combining the P2P network and the web service. Also it tries to conquer the P2P module's shortcoming, which is loss of centralize control in order to meet cooperative learning's aims.

To achieve this goal, the whole application is divided into two components: OCLE controlling component, which uses JBOSS [7] application server to build a J2EE application and a cooperative learning tool component (CLT), which uses the P2P JXTA [6] network.

The OCLE controlling component, which is the J2EE application controls the group forming and monitors the group's performance. The lecturer inputs the group information and assigns student into a group.

The OCLE cooperative learning tool component is a windows application, which uses P2P JXTA network. Students can use this tool to chat and to share files within a study group. The cooperative learning tool will get group information

from the web service of OCLE controlling component in order to form a study group and upload group status to the web service of the OCLE controlling component.

The open source framework is adopted wildly in this application, such as the JBOSS application server and the P2P JXTA network. The open source framework is published and made available to the public which enables anyone to copy, modify and redistribute the source code without paying royalties or fees. The advantages of using open source framework are low cost and easily adjusting the framework by changing the framework's source code. After these frameworks have been changed, the OCLE cooperative leaning tool component and the OCLE controlling component can connect seamless.

1.2 Thesis Outline

This thesis is organized into the following 8 chapters:

Chapter 2 gives an overview of existing commercial applications and research projects as thesis background.

Chapter 3 gives an overview of the technology, which uses in this application and educational theory for Cooperative learning. The technologies include J2EE architecture, JBOSS application server, web service, and JXTA P2P network.

Chapter 4 gives an overview of the Online Corporation Learning Environment (OCLE) application and the two components' functionaries.

Chapter 5 gives the implementation details of the J2EE application and the P2P application.

Chapter 6 gives detailed testing procedures for the P2P application and the testing result.

Chapter 7 and 8 cover the shortcoming of this application and future analysis.

2 RESEARCH BACKGROUND

The concept of cooperative learning has been accepted by more educators. When the educator uses this concept in the traditional class setting, there are some limitations. For example, a physic location and a meeting time must be selected for a group of student and the lecturer must go around those groups in order to monitor the performance of the cooperative leaning. Recently, the internet technology has been selected by many educators to conquer these limitations. There are two types of internet products in cooperative leaning area: research projects and commercial products.

2.1 Existing Research Projects

2.1.1 First User Group of Cooperative Work

As early as 1980s, the first online user group of cooperative work appeared at the University of Essex [25]. It was created by the Richard Bartle and Roy Trubshaw and was named as the Multi-User Domain (MUD). It was initially confined to campus's student and then was extended to global user via modems. This was achieved by connecting the Essex University to the American ArpaNet, the precursor of the Internet.

The group of student used the MUDs to work together along with the FTP and email. The MUDs became popular with college students. By 1984, there were more than 100 active MUDs and variants all around the world.

The MUDs is pioneers of new forms of human interaction via the internet. On late time, many researchers and programmers of cooperative work get the idea from the MUDs and develop a new framework and application.

2.1.2 Teach++ project

Teach++ project [26] was created by the Di Salerno University in Italy. The Teach++ project is a cooperative environment, which specializes for the distance learning. Using Teach++ project, the teacher can give students tutorial online, assign the working group and upload the study material; the student can collaborately work on any project development online within a working group and retrieve the study material.

2.1.2.1 Architecture of Teach++

The client-server architecture and Java language are adopted by the Teach++ project. A Multi-Applet Server (MAS) is used to collaborate in the distributed computation on server's side. The MAS keeps the connection for any applet of a single client and manages communications among clients. The Java applet on the client establishes an independent connection with MAS.

The ClientChat and ClientTeach components operate on Client of the Teach++. These components are implemented by Java applets embedded in a multi-frame HTML page. The ClientChat component provides a synchronous communication channel among group members. The teacher and the student can use the ClientChat to send message to each other.

2.1.2.2 Teach++ Appraisal

In order to provide rich user interface, the applet is adopted by Teach++ project. The limitation of the applet, which they cannot perform connections to other hosts but the one they were downloaded from [27], forces the Teach++ project to adopt the server-client architecture. Every message, which the client is sending, must go through the server. The high performance server machine must be installed for the Teach++ application and the network traffic will be increased.

The Java applet was concerned by the OCLE application as the client interface for student, but it was abandoned later due to the disadvantage of server-client communication module. In order to conquer those disadvantages, the P2P communication module was adopted by my project.

2.1.3 WebDAV-Based Collaborative Distance Learning (CDL) Environment

The WebDAV-Based Collaborative Distance Learning Environment [28] is a web based application, which supports collaborative learning among a small group of learners amongst distance learners in a virtual university.

2.1.3.1 CDL Architecture

In order to directly address the complex computing requirements, Java 2 Platform Enterprise Edition (J2EE) is adopted as the foundation of the CDL environment. The EJBs, servlet and jsp technology are used to implement the CDL application. The CDL application uses the IBM HTTP Server 1.3.6.2 as a web server and the WAS AE as the EJB container.

The collaboration-friendly internet communication protocol: Web-based Distributed Authoring and Versioning (WebDAV) [29] are used by the CDL environment as the communication protocol rather than using HyperText Transfer Protocol (HTTP) protocol. The WebDAV is a groupware protocol, which extends the HTTP/1.1, provides a coherent set of new methods, headers, XML- based request and response entity body formats to directly support collaborative work on the web.

The IBM DAV4J 1.0.34, which consists of a client-side API and a server-side servlet to provide full support for class-2 WebDAV, implements the WebDAV's functionality. The application server and WebDAV framework, which are used in the CDL environment, are commercial products.

2.1.3.2 CDL environment Appraisal

In order to support web based collaboration, the CDL environments combines the J2EE platefrom and the WebDAV protocol together. Using the J2EE platform, the complex, trivial and repeated low-level development work are avoided. The collaboration-friendly WebDAV protocol provides full support to web based collaboration activities. This approach is adopted by the OCLE application. In OCLE application, the J2EE platform is adopted. Instead of using the WebDAV protocol, the OCLE application uses the JXTA framework to support cooperative work.

Apart from shortcoming of the server-client architecture, the commercial products are used in CDL environment, which includes the IBM J2EE application server and the IBM's WebDAV implementation. The commercial products provide stable implementation and support, but the developing cost has been increased significantly. Because the developing cost is important factor for the most research project, instead of using commercial product, the open source product is adopted by the OCLE application.

2.1.4 Rowan Virtual Meeting (RVM) System

The Rowan Virtual Meeting System [30] is a synchronous, on line web audio/video conferencing application, which has been developed by the RVM project team of the Rowan University. Using the RVM system, the student can collaborate online with students and lecturers in real time, between either individuals or large groups—with just a PC and an Internet connection.

In order to implement virtual meeting in real time, the Flash is adopted as a basic media type and the Macromedia Flash Communications Server is used as the server side framework, which manages the Flash communication and provides

access control. The Flash Player software is needed on the client computer to run Flash communications application.

The Flash is good media type for real time audio/video meeting because the size of the flash file is much smaller than the traditional media type. The communication of the RVM still sticks on the server – client which leads to the high network traffic.

The online web audio/video conference and the Flash communication can be combined into the OCLE application in the further. The communication model should be changed into P2P JXTA in order to reduce the network traffic.

2.2 Existing Commercial E-learning Systems

The existing commercial products of Online Cooperation Learning Environment are part of an E-learning system. Existing products, which contain OCLE, include WebCT [3] and LAMS [4].

2.2.1 WebCT

WebCT, Inc provides the most popular E-learning System in the world. Thousands of institutions in more than 70 countries are using this System. WebCT Campus Edition 6 is the newest version of WebCT 's E-learning System. It provides easy course preparation, efficient course management, and innovative teaching and learning tools. The WebCT Campus Edition 6 has Who's Online tool [5] for Cooperation Learning Environment (OCLE). Figure 2.2.1 shows the user interface for Who's Online tool.

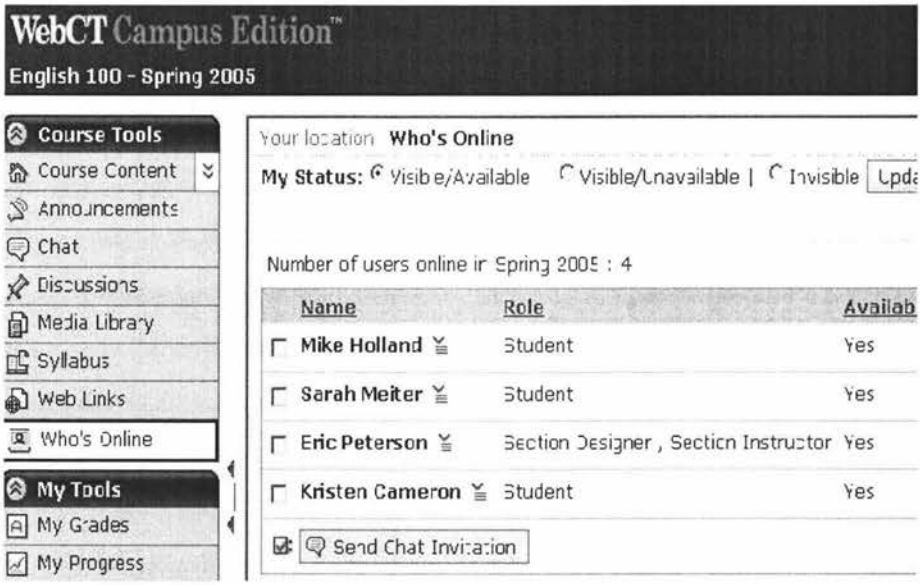

Figure 2.2.1 WebCT Campus Edition 6 -Who's Online tool

According to the paper and which student has been enrolled, the student can access learning material, which the lecturer distributed, and the student also can use the who's online tool to find and chat to another student who is studying the same paper.

However, there are no file sharing and peer group functionality in the who's online tool. The lecturer has the ability to mute or deny access to manage participation. Strictly speaking, the who's online tool of the WebCT is not an application of OCLE.

The who's online tool is a client-server network application. There is a chat server module hosting in WebCT application server to handle all conversations between learners.

2.2.2 LAMS

Learning Activity Management System (LAMS) is a revolutionary tool for designing, managing and delivering online collaborative learning activities [4].

LAMS tool focuses on sequencing leaning activities. Using LAMS, the educator assigns a task to a group of students. The group of students is predetermined by the educator. Students within the same group can do their task cooperatively by using the chat and sharing tool. Figure 2.2.2 shows the interface, in which the educator can edit learning content and group members.

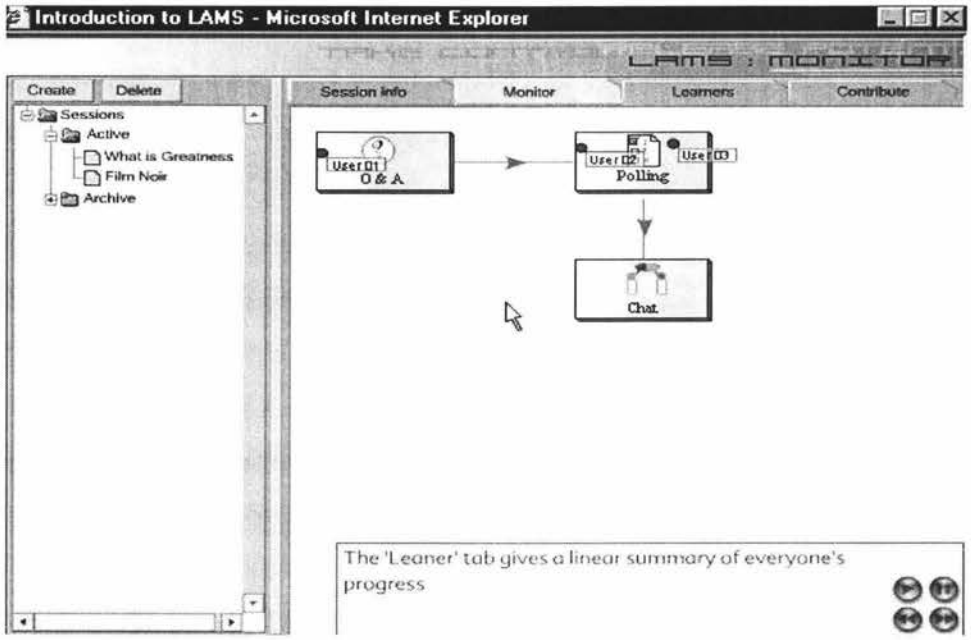

Figure 2.2.2 LAMS's learning content editor for lecture

LAMS is based on the java programming language and it allows the application to have a clean separation of presentation, logic and workflow. The LAMS server handles chat session between users.

2.2.3 Existing Commercial System Appraisal

Both of LAMS and WebCT are client-service applications. Client-server OCLE applications have some advantages; centralization efficiently handles participant coordination, since all names and IP addresses are kept in the main server; using user friendly web browser ' user interface which doesn't need to be installed; As part of the application, it can combine application server likes JBOSS and

Weblogic [21] etc easily. Despite its advantages, centralized OCLE applications need to use a high quality web server and large bandwidth to handle network traffic, since every message or file, which the learner sends to each other must go through the web server. The problem will become more serious, when multimedia is more popular during online discuss sessions.

The existing commercial OCLE products are expansive. The Educator that plan on having a subscription to use the full version of the WebCT campus edition can expect to make an annual payment upwards of $15000 or more, based on the number of students enrolled at the college [31]. This is big disadvantage for the most educators.

2.3 Valuable Insight

Both commercial and research products have a common shortcoming, which is using client – server architecture. This shortcoming can be addressed by building the application using peer-to-peer concepts. Any two computers directly exchanging resources have a peer-to-peer connection. The essence of peer-to-peer is that resources and services are in every node of the network and not to gather in servers. This model has gained popularity during the last few years because of an increase in computing power, computer storage space, and network bandwidth. In order to implement P2P communication in this project, the JXTA P2P framework was adopted as the basic communication's architecture.

Concerning cost efficiency, there are not any commercial framework and application server used in this project. All framework and application server are open source products, which mean you can free use those products and edit the source code easily. It reduces developing cost significantly.

The OCLE application adopted the CDL environment's architecture, which uses the J2EE as foundation and use third party framework as protocol of client's communication.

In order to provide a rich client interface, the Java applet technology is still used as the interface for teacher's administrator tool of the OCLE application. Instead of using the method, which the applet connects to the MAS server in the Teach++ project, the applet connects to the servlet container of the J2EE application server in my project.