

On the Continuous Service of Distributed e-Learning System

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Abstract—In this paper, backup and recovery technique for Peer to Peer applications, such as a distributed asynchronous Web-Based Training system that we have previously proposed. In order to improve the scalability and robustness of this system, all contents and function are realized on mobile agents. These agents are distributed to computers, and they can obtain using a Peer to Peer network that modified Content-Addressable Network. In the proposed system, although entire services do not become impossible even if some computers break down, the problem that contents disappear occurs with an agent's disappearance. As a solution for this issue, backups of agents are distributed to computers. If a failure of a computer is detected, other computers will continue service using backups of the agents belonged to the computer.

Keywords—Distributed Multimedia Systems, e-Learning, P2P, Mobile Agent

I. INTRODUCTION

Nowadays, e-Learning systems, especially asynchronous Web-Based Training systems (hereafter we abbreviate as WBT) are very popular. A WBT allows a learner to complete the WBT on his own time and schedule, without live interaction with the instructor. Although a large number of studies have been made on asynchronous WBT [1] [2] [3], all of them are based on the client/server model. The features of the client/server model are that all are to execute management and to offer the exercise by the server machine. Although the client/server model have an advantage of easy construction and maintenance, however, the client/server systems generally lack scalability and robustness. There is Peer to Peer (hereafter we abbreviate as P2P) model to supplement the disadvantage of client/server model. The feature in the system is based on P2P model that each computer works as a client or a server. The feature can distribute the load to a node. The function of the entire system doesn't stop even if some nodes break down.

We have proposed and implemented a distributed e-Learning system based on P2P architecture [4] [5]. The proposed e-Learning system has two distinguishing features. Firstly, it is based on P2P architecture to improve the scalability and robustness of the system. In the proposed e-Learning system, every user's computer plays the role of a client and a server. While a user uses the system, his/her computer (hereafter we refer to such a computer as a node) is a part of the system. The node receives some number of contents from another node when it joins the system, and has responsibility to send appropriate contents to the requesting nodes. In addition to the above

advantages of using P2P architecture, the proposed e-Learning system can be constructed at low cost because the system need no server computers. Secondly, each exercise in the system is not only data but also an agent which has functions, such as scoring user's answers, telling the correct answers, and showing some related information without human instruction.

In the proposed system, exercises and functions are distributed among all node. If a node failure occurs, another node of the system will continue service. However, when a node failure increases, the exercises in the node are lost and cannot be studied by anyone afterward.

As a solution for this issue, we propose an e-Learning system that backups of agents are distributed to nodes. In this system, if a node failure occurs, another node will continue service using backup of the agent which belongs to the failure node.

This paper is organized in 5 sections. The proposed e-Learning system is described in Section 2. We describe the design overviews of the proposed system in Section 3 and the experimental result in Section 4. Finally, some concluding remarks are drawn in Section 5.

II. PROPOSED E-LEARNING SYSTEM

A. Overview

All exercises in the proposed system are classified into categories, such as "Math/Statistic", "English/Grammar", etc. A user can obtain exercises one after another through specified categories of the required exercises. While a user uses the proposed e-Learning system, his/her node is to be a part of the system. The node receives some number of categories and exercises from another node when it joins the system and has responsibility to send appropriate exercises to requesting nodes.

The important point to note is that the categories a node has are independent of the categories in which the node's user is interested, as shown in Figure 1. Figure 1 illustrates that user A's request is forwarded first to the neighbor node, and the request is forwarded to the node which has the requested category.

B. P2P Network

When the proposed system bootstraps, one initial node has all categories in the system. When another node joins the system, it receives certain number of categories from the initial node. The categories are distributed among all nodes in the system according as nodes join the system or leave the system.

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