Mobile Agent Assisted E–Learning System

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BACKGROUND OF ORGANIZATION

In the past decades, the Internet has evolved so rapidly that it makes the information-technology industry grow extremely fast. Internet-based applications such as e-commerce, e-payment, e-billing, e-learning, and so forth have tremendous influence on society: There is a trend that our society will be reshaped by the Internet. Among these applications, e-learning is one of the killer applications.

Currently, the traditional education system faces some challenges that arose from the development of the knowledge-based economy. School enrollment increases with the population growth, education levels also increase for the new economy, and the cost of higher education escalates. On the other hand, in the workforce-training market, as the information economy develops, the demand for skilled workers increases. As the technology keeps changing, the workforce needs continuous training to maintain its productivity level. Hence, both formal school-based education and continuous workforce training have become big business now, and they will be even bigger in the future (Kerrey & Isakson, 2000). A more sophisticated education model is required to take this challenge, and so e-learning came into being.

Compared to traditional classroom teaching, e-learning provides one major advantage: It makes the access of information much easier and more convenient. Hence, it makes learning of all kinds, at all levels, anytime, anyplace, at any pace a practical reality (Kolar, 2001). E-learning also gives tremendous cost savings for both instructors and learners; the learning model is shifted from instructor centered to learner centered, which focuses primarily on the needs of learners. The updating of online material is also much easier. Many e-learning systems can develop personalized and interactive applications that allow users to customize their e-learning models to their own pace, and they can truly engage the user in that they involve the simulation of real-world events and sophisticated collaboration with other learners and instructors (Quah & Chen, 2002). In our e-learning system, we incorporated mobile-agent technology to enhance the response time of information retrieval. The purpose of this incorporation is to overcome the bottleneck problem faced by many pure client-server-based systems. Since mobile agents are able to traverse from one information server to another autonomously to search for relevant documents for users, only relevant articles are sent back. This saves bandwidth and enhances the efficiency of the e-learning system. As a result, the turnaround time for user queries or information searches reduces, and the feedback from the user community is positive as the response time is shorter and users find it easier to maintain their trains of thought in their study.

DESCRIPTION OF MOBILE AGENT ASSISTED E-LEARNING SYSTEM

Mobile Agent

The server-client paradigm is popularly used in current e-learning applications. Mobile agents are an emerging technology; they make the design, implementation, and maintenance of distributed systems much easier, so they attract a great deal of interest from both industry and academia. In particular, the mobile-agent paradigm has been used to design applications ranging from distributed information retrieval to network management.

A mobile agent is an autonomous, intelligent program that can migrate from machine to machine in heterogeneous networks, searching for and interacting with services on the user's behalf. Typically, agents possess such characteristics as being autonomous, adaptive, goal oriented, collaborative, flexible, active, proactive, and so forth (Smith & Paranjape, 2000). The mobile-agent paradigm is used in distributed computing as it improves performance upon the conventional client-server paradigm.

Under the mobile-agent paradigm, any host in the network is allowed a high degree of flexibility to possess any mixture of service codes, resources, and CPU (i.e., processor) time. Its processing capabilities can be combined with local resources; the service code is not tied to a single host but rather is available throughout the network (Gray & Kotz, 2001).

Information Push and Pull Based on Mobile Agents

With the above features, the mobile-agent paradigm is suitable for distributed information retrieval and e-commerce applications.

The rapid evolution of Internet-based services causes information overloading on the Web. It has been estimated that the amount of information stored on the Internet doubles every 18 months, and the number of home pages doubles every 6 months or sooner (Yang, Yen, & Chen, 1998). Therefore, it becomes difficult for the user to find the required information or services on the Internet in the huge amount of information.

Information push and pull technologies make the delivery of information from service providers to users easier. Push technology is the process of service provision by the provider in anticipation of its use, and pull technology is the process of searching for information in the network (Quah & Lim, 2003).

Ahmad and Mori (2000) from the Tokyo Institute of Technology proposed the faded information field (FIF) architecture based on mobile-agent technology to cope with fast-changing information sources and reduce the information access time of the user. In FIF, each component such as the user, provider, and node is considered an autonomous entity. The information is distributed on these nodes, and the amount of information decreases away from the service provider as shown in Figure 1. The nodes near the service center are allocated a larger volume of information, and those farther from the central nodes are allocated a smaller volume of information.

In FIF, service providers generate push mobile agents to push information in the neighbouring nodes in faded patterns. These agents negotiate with neighbouring nodes and allocate information according to the situation and the importance level of the information. The important information is stored at more nodes, and less important information is stored in less nodes. The user looks for information with pull agents, and the pull agents navigate through the distributed nodes in FIF autonomously to find the appropriate information.

The algorithm for designing autonomous information fading takes consideration of the popularity, size, and lifetime of the information. A parameter access effort $E_g(i)$ is defined to assign the fading level to each piece of information as

$$E_g(i) = \frac{N_i \ln(d_i + 1)}{\ln(S_i + 1)},$$ (Equation 1)

where N_i, d_i, and S_i denote the number of accesses, the lifetime, and the size of the information unit, respectively. The information having high access effort is assigned high priority and is stored on all nodes.

Through the cooperation of push agents and pull agents in FIF, the access time for the user to get the needed information is reduced since the user need not reach the service provider and can get the required information from the closer nodes. The service provider can avoid the congestion of the access, and the levels of reliability are improved.

IMPACT OF THE MOBILE AGENT ASSISTED E-LEARNING SYSTEM ON THE ORGANIZATION

We use a system architecture based on mobile agents to improve the performance of current systems. In our system, the university centers preinstalled a certain mobile-

Figure 1. Faded information field
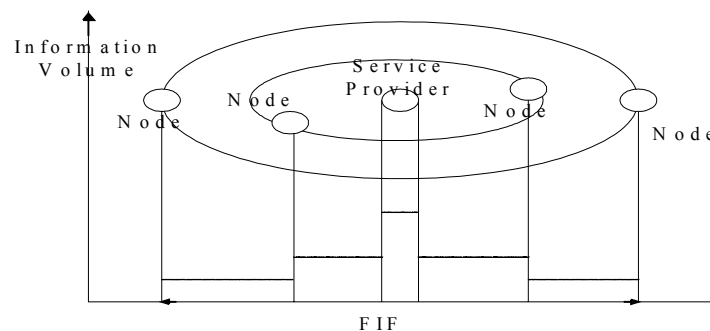
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