Chapter XIV

An Architecture for Developing Multiagent Educational Applications for the Web

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ABSTRACT

New applications in training and education are emerging daily trying to meet the requirements of distance learners. Network-based or World Wide Web (WWW)-based intelligent tutoring systems (ITSs) are expected to meet most of these requirements. In this context, software agents seem to be a promising distributed software technology that can be used to implement WWW ITSs. In this chapter, we present a multiagent approach for constructing an educational application for distance learning. The proposed architecture exploits the assumption that each teaching subject can be regarded as the synthesis of elementary pieces of knowledge, each of which can be presented by an independent expert. Moreover, in order to better support individualized learning, a mobile agent is placed at the disposal of each distance learner.

INTRODUCTION

The increasing Internet penetration rate and the potential of World Wide Web (WWW) could be used as an enabling technological framework for the development of courseware applications, which could meet the requirements of distance learners. Currently, popular Web-based courseware applications provide location independent learning; however, they exploit disadvantages such as (a) nonrenewable educational material without the interfering of the trainer, (b) nonadaptable to the different levels of trainees’ needs, and (c) nonuse of existing information on the WWW.
Most of these shortcomings are not new; they had already been encountered again in the past and led to the development of intelligent tutoring systems (ITSs) (Sherman, Singley, & Fairweather, 1999). On the contrary, network-based or WWW-based ITSs are expected to meet most of the requirements of the distance learners, allowing the emulation of a human tutor in the sense that an “intelligent” tutor can know what to teach, how to teach it, and are able to find out certain teaching-related information about the learner being taught. Most of the network-based ITSs provide server-based access to the courseware. Such an approach, although having benefits in terms of development, maintenance, and access control, is lacking in flexibility and scalability.

In the light of these, an approach based on agent technology seems to be a promising distributed software technology that can be used to implement flexible, truly distributed WWW ITSs. In this chapter, an agent is considered as a resource-bounded autonomous software entity, which is capable of collaborating with peers and of exhibiting reactive and proactive behaviour (Jennings & Wooldridge, 1998). Then, a multiagent system (MAS) is considered as a loosely coupled network of communicating and cooperating agents possibly situated on distributed machines, which provide complementary services (Sycara, 1998).

In brief, the main features of the proposed architecture are the possible distribution of teaching knowledge among different network nodes and the support of end-user mobility. The proposed architecture uses a network of communicating agents and exploits the assumption that each teaching subject can be regarded as the synthesis of elementary pieces (or aspects) of knowledge, each of which can be presented by an independent expert. Moreover, in order to better support individualized learning, a mobile agent is placed at the disposal of each distance learner.

A brief survey of WWW ITS architectures and agent-based systems on the Web is presented in section 3. Then, in section 4, this chapter proposes a new software architecture for distributed courseware applications, which is based on the multiagent paradigm. Two applications of the proposed architecture are described in section 5, while some implementation issues are described in section 6. The advantages of the proposed architecture as well as future work are discussed in the last section of the chapter.

**ISSUES RELATED TO DISTANCE-LEARNING COURSEWARE**

When designing a courseware to be used by distance or network-based learners, designers should take into account issues related to technology and to the special learning situations.

Technology-related issues include the following:

- **Availability of training service**: In contrast to stand-alone learners, network-based learners may suffer from network unavailability or breakdown.
- **Robustness**: The software should guarantee a minimum level of educational services available under all conditions.
- **Quality of service (QoS)**: This issue is, in fact, a complex one and can be analyzed in constituent issues, such as
  - **Accessibility**: Which may depend on whether the learner logs via a LAN or WAN (Internet), or uses a dial-up connection to the educational service provider. Different educational software designs need to be developed for different platforms of learner access.
  - **Performance**: This may prove of paramount importance if large files of dynamic data have to be transferred across the network. Again, modularity of content and stream-based transmission may improve the situation.