Chapter VIII

An Agent-Based Architecture for Virtual Environments for Training

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Abstract

This chapter proposes an architecture for the development of intelligent virtual environments for training (IVETs) which is based on a collection of cooperative software agents. The first level of the architecture is defined as an extension of the classical intelligent tutoring system architecture that adds a new world module. Several software agents are then identified within each module. They communicate among them directly via messages...
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and indirectly via a common data structure that is used for the collaborative development of plans. Some details are provided about the most remarkable interactions that will be established among agents during the system’s execution. The proposed architecture, and its realization in a platform of generic and configurable agents, will facilitate the design and implementation of new IVETs, maximizing the reuse of existing components and the extensibility of the system to add new functionalities.

Introduction

Computer-based training is a promising application area of three-dimensional virtual environments (VEs). These environments allow the students to navigate through and interact with a virtual representation of a real environment in which they have to learn to carry out a certain task. They are especially useful in situations where the real environment is not available for training, or it is very costly or risky. A good example is training of nuclear power plant operators. A multi-user virtual environment also allows for team training. An intelligent virtual environment for training (IVET) results from the combination of a virtual environment and an intelligent tutoring system (ITS). IVETs are able to supervise the actions of the students and provide tutoring feedback. The intelligent tutoring component of an IVET usually adopts a virtual representation (a pedagogical virtual agent) that inhabits the environment together with the virtual representations of the students (avatars).

The development of three-dimensional virtual environments has a quite short history, dating from the beginning of the ‘90s. The youth of the field, together with the complexity and variety of the technologies involved, have led to a situation in which neither the software architectures nor the development processes have been standardized yet. Therefore, almost every new system is developed from scratch, in an ad-hoc way, with very particular solutions and monolithic architectures, and in many cases forgetting the principles and techniques of the software engineering discipline (Munro, Surmon, Johnson, Pizzini, & Walker, 1999). Some of the proposed architectures deal only partially with the problem, since they are centered on a specific aspect like the visualization of the VE (Alpdemir & Zobel, 1998; Demyunck, Broeckhove, & Arickx, 1999) or the interaction devices and hardware (Darken, Tonessen, Passarella, & Jones, 1995).

As a result, current VEs lack many of the desirable quality attributes of any software system, such as flexibility, reusability, maintainability, or interoperability. The size and complexity of VEs will continue to increase in the future, making this situation even worse. Many researchers and developers of VEs are starting
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