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.
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 architec-
tures, 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; Demyunk, 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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