Chapter XVIII

RiskMan: A Multi-Agent System for Risk Management

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ABSTRACT

The purpose of this chapter is to discuss the use of multi-agent systems to develop virtual reality training systems. We first review these systems and then investigate the architectures used. We demonstrate an example of our own (RiskMan) and then discuss the advantages and drawbacks of using multi-agent agent approaches in the development of virtual reality training systems. The chapter describes the system architecture of a multi-agent system for risk management (RiskMan) to help train police officers to handle high-risk situations. RiskMan has been developed using a high-level scripting language of a game engine, Unreal Tournament 2004. The major modules are a scenario-based expert system, a narrative engine, a game engine, and a graphics engine. The system integrates a simulation agent, trainee agent, communication agent, interface agent, and scripted agents communicating using games technology.

INTRODUCTION

The purpose of this chapter is to discuss the use of multi-agent systems in the development of virtual reality training systems. We first review these systems overall and then investigate the architectures used. We demonstrate an example of a multi-agent virtual reality training system.
RiskMan components of a multi-agent system for risk management. RiskMan is an ARC Discovery project carried out by Macquarie University (Barles, Dras, Kavakli, Richards, & Tychsen, 2005, Dras, Kavakli, & Richards, 2005). The project’s goal is to train emergency police and defense personnel to handle high-risk situations that can be costly and even dangerous. RiskMan has been developed using a high-level scripting language of a game engine, Unreal Tournament 2004.

RiskMan links three research projects carried out by the department of computing, Macquarie University, and sponsored by the Australian Research Council (ARC):

• ARC Discovery Grant (DP0558852 titled “Risk Management Using Agent Based Virtual Environments”) to Richards, Kavakli, and Dras,
• ARC Linkage International Grant (LX0560117 titled “An Interactive Drama Engine in Virtual Reality”) to Kavakli, Pelachaud, and Szilas, and
• ARC Linkage Grant (LP0216837 titled “Cognitive Modelling of Computer Game Pidgins”) to Kavakli, Bossomaier, and Cooper.

RiskMan comprises these three projects in a unique system architecture integrating risk management, desktop and immersive virtual reality, and agent-based natural language systems, using game engineering. In the following section, we will review these systems.

A multi-agent simulation consists of intelligent agents competing or co-operating with each other, with a view to achieving system objectives (Rzevski, 2003). There are a number of multi-agent architectures designed for interactive learning. Some of these work on a generic platform of agents (Capuano, Marsella, & Salerno, 2000; Silveira & Vicari, 2002). Some address the use of pedagogical agents (Johnson, Rickel, & Lester, 2000) and learning companion agents (Chan, 1996), socially intelligent agents (Conati & Klauwe, 2000), and tutor agents (Ritter & Kodinger, 1996). Some explore software engineering techniques based on the multi-agent-oriented analysis for agent, environment, interactions, and organizations (Petsy & Webber, 2004) proposing that the educational function of a system will be an emerging property of the interactions organized between agents and humans.

In this chapter, we investigate agents as a paradigm for software engineering and discuss how a virtual reality training system, which draws on research in the areas of computer games (Kavakli et al., 2004; Kavakli & Thorne, 2002), knowledge acquisition (Kavakli & Thorne, 2003; Richards & Busch, 2003), agent technology (Pelachaud & Poggi, 2001; Richards & Busch, 2003) and natural language processing (Dras, 1998; Rudra, Kavakli, & Bossomaier, 2003), can provide a safe learning experience to assist knowledge acquisition. Tacit knowledge is practical know-how as defined by Wagner and Sternberg (1991). Tacit knowledge cannot be read from a procedures manual in a training simulation. Tacit knowledge can be acquired through interacting with the world and objects. We call this process interactive learning.

Interaction is probably the most important single characteristic of complex software (Wooldridge, 2002). As a complex system, we will explore the interrelationships between the components of a multi-agent system for risk management. RiskMan is an ARC Discovery project carried out by Macquarie University (Barles, Dras, Kavakli, Richards, & Tychsen, 2005, Dras, Kavakli, & Richards, 2005). The project’s goal is to train emergency police and defense personnel to handle high-risk situations that can be costly and even dangerous. RiskMan has been developed using a high-level scripting language of a game engine, Unreal Tournament 2004.

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Virtual reality training simulations for risk management: The satisfactory management of risk situations (Decker, 2001) involves risk identification, the development of risk handling strategies and plans (Kavakli & Gao, 2005; Kavakli, Kavakli, & Gao, 2004c; McCamley, 2000), and the conduct and monitoring of those plans. Risk management requires the use of both codified and tacit knowledge. Recognizing the importance
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