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Hybrid Teams in Virtual Environments: Samurai Joins the Training Team

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Abstract. This paper demonstrates a virtual environment where mixed human-agent teams are used for team-skills training.

Keywords: Human-Agent Teams, Team Training, Cognitive Modeling

1. Introduction

Training team skills forms an essential part of the education of many professions which demand a tight collaboration, such as medical, military, or fire fighting. Usually, this is done by team training drills with a (potentially large) number of participants, each playing a dedicated role in a given scenario.

The demonstrator described in this paper intends to provide a different approach. We have developed a game-based platform in which some team-members are played by humans, and some team-members are played by software agents. In this way, team training can be made less costly, as not all roles have to be fulfilled by humans anymore. Furthermore, it can be better tailored to the specific learning objectives of a specific individual, as we can more precisely control the team behavior of artificial team members than that of human team members (which may be trainees themselves).

We use the game SABRE [3], which is a Virtual Environment (VE) based on the commercial game Never Winter Nights, which has been developed by NATO for training military team skills. Normally, SABRE is played by a group of humans which collaboratively explore a village to find weapons hidden by terrorists. In this project, we implemented a software agent, called *Samurai*, and allowed it to participate in a team of human SABRE-players as an equal team-member.

Samurai is based on the agent programming language 3APL [3], where agents are defined in terms of cognitive concepts such as goals, plans and beliefs. To endow an agent with the desired team characteristics, we also added organizational notions to the framework, such as roles, workflows, and team goals.

[1] The first two authors are listed alphabetically and should be regarded as having made an equal contribution.

The next section describes Samurai's different types of team behavior. Section 3 describes the implemented prototype. Section 4 concludes the paper.

2. Teaming up with Samurai

Most simply, a team is a group of people working together to achieve a common goal. This requires team members to maintain *common ground*, to be *mutually predictable*, and to be *mutually directable* [2]. Related literature reports different ways in which these properties can be implemented in artificial team members, with different levels of sophistication. In an elementary way, we have implemented them in Samurai as follows. Samurai maintains common ground with the other team members by actively sharing relevant pieces of information with them. Mutual predictability is achieved by applying an organizational structure to the team, which is commonly known by all participants, and provides a shared basic understanding of how the different participants are performing their share of teamwork. Mutual directability is implemented by a *request* protocol, which allows one agent to ask another agent to perform an action.

Whereas we believe these properties to be essential for team membership, *how* these properties reveal themselves in behavior may vary. By explicitly modeling such differences in artificial team members we can expose trainees to different types of team behavior. For all three aspects discussed above, we can configure Samurai in either *provocative* mode or *unprovocative* mode. When Samurai maintains common ground in a provocative way, it sometimes refrains from sharing relevant information. This invites the trainee to learn to actively collect relevant information. When mutual predictability is implemented in a provocative way, Samurai is not (fully) organization aware. This invites the trainee to improve the collaboration with Samurai by communicating his or her own roles. Provocative mutual directability means that Samurai will not blindly follow up a request from the trainee. Instead, the trainee should convince Samurai that that the requested action is in its own interest too, or in the team's interest.

3. Team Training Environment

We assume that an agent's behavior can be modeled by specifying *beliefs*, *goals* and *plans*. Following the agent programming language 3APL [1], we assume that the relation between these three notions is specified by practical reasoning rules (or *PR-Rules*). When an agent enacts a role in the organization, it adopts the corresponding PR-rules, which is then known by all other agents in the organization. These other agents can decide which information qualifies as relevant to an agent, by inspecting its organizational PR-Rules. Because also human behavior is specified in this way, Samurai can decide which information is relevant to a human trainee, and subsequently share it with the trainee.

The coupling between the agent (Samurai) and the virtual environment (SABRE) is depicted in Figure 1. A screenshot of the application is depicted in Figure 2.

The Samurai and SABRE processes run in parallel. At the Samurai side, the process starts when new information is obtained from SABRE. This may be about actions being finished or new observations. This information may be exchanged with others, and may lead to new actions. Actions are executed at the SABRE side by calling game scripts. In this way, the higher level planning of actions is implemented in the agent, while the lower level implementation of these actions is implemented in the VE.

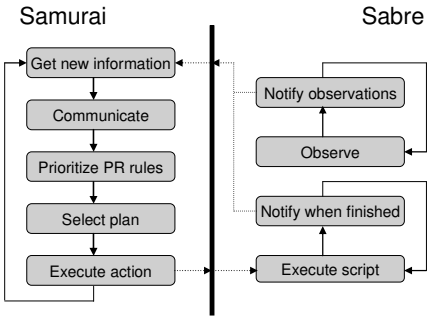

Figure 1: Agent-VE coupling

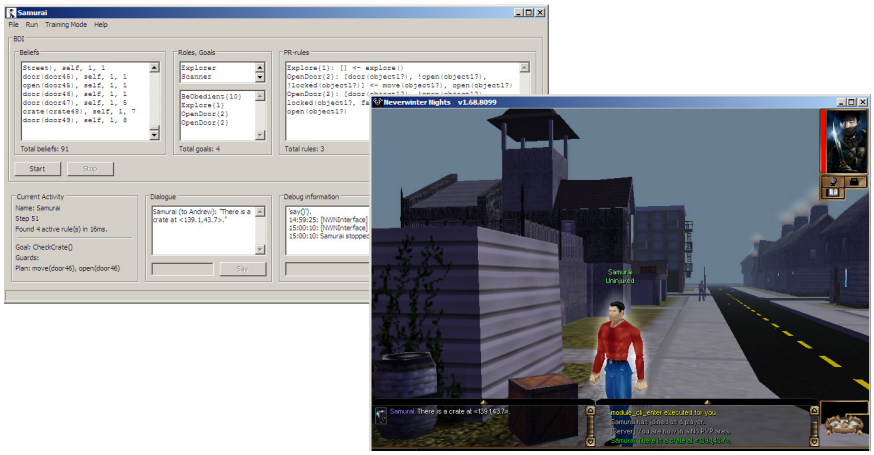

Figure 2: Samurai's internal workings (left); Samurai in the VE (Right)

4. Conclusion

This demonstration paper describes our approach to applying virtual team members in training scenarios. Samurai can be configured to exhibit different types of team behavior which may be more or less challenging to the trainee. In the future, we plan to perform experiments to test the effectiveness of our hybrid training environment on human learning.

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