Jacob: An Educational Agent in a Virtual Environment

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Abstract

The Jacob Project involves the construction of a virtual environment where an animated human-like agent called Jacob gives instruction to the user. The project focuses on three issues: the software engineering aspects of building a virtual reality system, the integration of natural language interaction and other interaction modalities, and the use of agent technology. Jacob has been given a task model and an instruction model in order to teach a particular task. The results of the project can be generalized so that the agent can be used to instruct other tasks in other virtual environments.

1. Introduction

The Jacob project involves the design and construction of an animated agent. The agent is called Jacob and provides instruction for tasks the user has to learn to perform in a virtual environment. The user interacts with Jacob by performing actions as well as by using natural language (NL). The use of a lifelike agent in an interactive learning environment has a strong positive impact on students [1]. The project involves an integration of knowledge from different disciplines: tutoring systems, agent technology, NL processing, and agent visualisation and animation. It is a pilot project of the VR-Valley Twente Foundation, which aims at establishing a knowledge centre on VR. In the future, Jacob is supposed to play a role in other pilot projects and it will be integrated in the Virtual Music Centre, one of our ongoing projects [2].

A prototype is being developed that has to meet a number of requirements. First, the interaction between the user and Jacob should be multimodal, requiring both verbal and nonverbal interaction. Second, Jacob should behave in an intelligent way. He should help the user in a proactive way and he should learn from the interaction. Third, visualisation plays an important role. This includes animation of the body. Fourth, both the user and Jacob should be able to manipulate objects. We have chosen to give instruction for tasks that consist of manipulating objects.

2. Approach

Software engineering plays a prominent role in the project. We apply OO techniques, design patterns, and software architecture knowledge. We address questions of how to design and build a VR system in a maintainable and adaptable way, whether VR

introduces new software engineering problems, and whether existing techniques and methods can be used. We have applied the following technology: the environment and the agent have been defined using VRML. The 'intelligent' part of the system has been written using Java. The Java part is linked to VRML through the external authoring interface. In this way, the system is highly portable.

Figure 1: Screenshot of Jacob agent

3. Current State of the Project

In the current prototype, Jacob assists and instructs the user in learning the Towers of Hanoi. We have applied a layered architecture to separate the concerns of the 3D visualisation from basic functionality of the system. The *concrete* 3D world layer consists of a structure of VRML nodes, like transformation nodes, geometry nodes, and sensor nodes. The *abstract* 3D world contains objects representing e.g. blocks, pegs, and Jacob's physical manifestation. This abstract 3D world layer also provides simulation of physical properties (collision avoidance and a simple gravity variant). The task model and instruction model form Jacob's mind. These two models form a control system together with the abstract 3D world: the task and instruction act as controllers that observe the world and try to reach specific educational objectives by manipulating Jacob's body. The body has been created to comply with the H-Anim standard. Simple animations like walking, jumping and grasping have been defined. Fig. 1 shows Jacob moving a block.

4. Future research

We are currently working on the NL interaction part. The intention is to add speech (recognition and synthesis) later on. NL interaction involves parsing and interpretation of the utterances using an appropriate representation of the virtual environment. Jacob responds by producing utterances or performing actions. For generation of utterances, annotated templates will be used. When NL interaction will have been implemented, the instruction model will have to be integrated with the dialogue management component.

References

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