A Platform for the Generation of Virtual Environments Inhabited by Intelligent Virtual Humans

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ABSTRACT
We describe a platform to build virtual environments inhabited by autonomous virtual humans. We propose an architecture comprising several software components assembled to define a platform. The architecture includes a 3D-modelling software, a rendering engine, a library for simulating rigid body dynamics and an agent development framework.

Categories and Subject Descriptors
I.3.7 [**Computer Graphics**]: Three-Dimensional Graphics and Realism – *animation, virtual reality.*

General Terms
Design, Experimentation.

Keywords
Virtual environments, autonomous virtual humans.

The construction of 3D Virtual Environments populated by Intelligent Virtual Humans is a research area with interest to build applications and user interfaces in areas such as education and entertainment. Human movements and facial expressions are the result of actions driven mechanically by muscles and bones under the control of believes and intentions. Due to the complexity of simulating all these operations together, achieving a realistic behavior of a virtual human in a virtual environment is a highly demanding task. A main issue is to conceive a synthetic representation of the virtual human with human-like appearance and capable of conveying emotion and personality through the combination of face and body expressions. This synthetic representation must be assembled with a virtual brain in order to give a simulated life to the virtual human.

We propose an architecture comprising several software components assembled to define the platform that will support the development of virtual worlds populated by virtual humans. The architecture has two layers: the Graphical Processing Layer (GPL) and the Artificial Intelligence Layer (AIL). The GPL is responsible for the modeling and animation of both the virtual environment and the virtual human body. The AIL simulates the "brain" of the virtual human, being responsible for the intelligent behavior of the agent that is behind the virtual human. Since several graphical processing tools and suitable agent development frameworks are already available, we have decided to select and assemble some of these tools. For the GPL we need 3D-modeling and rendering capabilities and the ability to simulate rigid body dynamics. Unlike other approaches [1,2], we adopted the following tools: Blender (http://www.blender3d.org/) to perform 3D modeling, OGRE (http://www.ogre3d.org/) as the rendering engine and the ODE library (http://ODE.org/) to simulate rigid body dynamics. To build the AIL the agent development framework JADE (http://jade.tilab.com/) was chosen.

As the GPL components are developed in C++ and JADE is developed in Java, the GPL was developed using C++ and the AIL using Java. The two layers were connected using sockets. The modularity of the architecture is an essential feature to support its future evolution. Another important feature is the capability to be executed in a distributed environment provided by the socket connection between the GPL and the AIL.

With the platform we produced a demo that simulates a visit to a virtual museum. It illustrates the capabilities of the architecture to couple the graphical and the AI components. It also explores the integration of new modules to accomplish specific tasks, stressing the modularity of the architecture. Our main goal when developing the platform was to obtain an environment to be used in research projects that involve, mainly, graduate students. As a result of these research activities enhancements to the platform can be expected.

REFERENCES
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