Extensible Behavior Simulation with Motion Archive

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1. Introduction

Humanoid animations in Web3D are largely created for entertainment uses such as role-playing games, but they are seldom used as tools for evaluating working environments [Badler et al. 2002]. Such tools have been implemented as plug-ins of expensive industrial CAD systems, and they often require elaborate manipulations in creating realistic human movements with kinematics-based controls. On the other hand, use of motion capture data becomes a major tool for designing realistic movements with intelligent editing [Gleicher 2001] and transition [Lee et al. 2002] methods. Integration of such data-oriented tools with behavior modeling ones can enhance the quality of simulations. We therefore developed an environment that can simulate realistic human behaviors with an archive of motion capture data. A motion archive has been constructed by measuring 12 persons' movements as they transfer and manipulate objects, whose total playback time reaches 6 hours. Our simulation middleware intelligently manages the motion data and displays them with X3D humanoid animations through gl4Java. Our system can be flexibly extended on the basis of XML-based behavior specification, by which any type of environments can be evaluated.

2. System architecture

Our system consists of three layers of a MVC (Model, View, and Control) architecture. The model layer supplies an XML archive involving motion and skeleton information, extracted from BVH, and behavioral and environmental data for customizing simulations. The control layer generates motions through the conversion of the motion data from behavior rules with extensible transformation tools, and also supplies a dynamical analyzer for evaluating the resulting motions. The view layer manages the X3D data of virtual humans and task environments, and supplies an information visualization tool using Java2D for efficiently searching for motion segments from the archive.

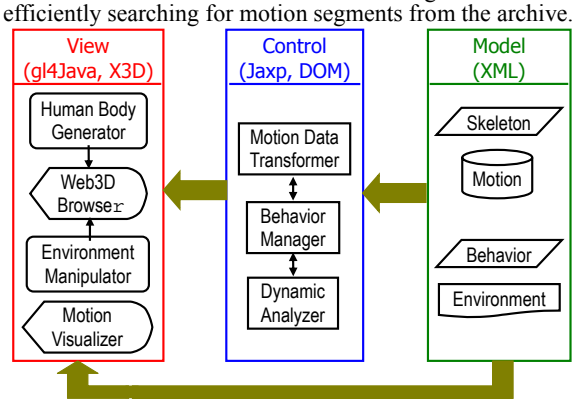

Figure1. MVC layer of system architecture

3. Behavior description

Behavioral rules of the simulation are described as an XML-tag set that consists of the following elements:

- *Resource*: specifies motion data files and their associated frame bounds.
- *Human*: specifies the skeleton data file, type of geometric embodiment, and initial location and behavior.
- *Sensor*: specifies the class that manages sensory information for an environment and targeting objects.
- *Manipulator*: specifies the class that reactively manipulates objects and utilized sensors.
- *Behavior*: specifies a sequence of playback motions.
- *Motion*: specifies the resource name and frame bounds for playback and controllers by which the movements are automatically transformed.
- *Controller*: specifies the class that transforms motion data with constraints given from sensors.

This system supplies base classes of a Java library for creating or extending sensors, manipulators, and controllers in order to be adapted to an environment of simulation. Figure 2 shows the snapshots of a simulation of assembling in an automobile plant.

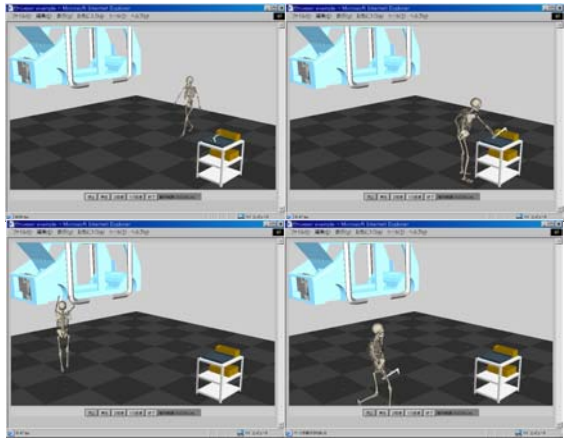

Figure 2: Assembling simulation in automobile plant

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