Applied Mechanics and Materials Vol 442 (2014) pp 588-592 *Online: 2013-10-31*
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doi:10.4028/www.scientific.net/AMM.442.588

Designing Interactive Virtual Products using VRML and Java

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Keywords: VRML, Java, Product, Interactive, EAI, Script.

Abstract. This paper exploits the combination of VRML (Virtual Reality Modeling Language) and Java for the construction of highly interactive products. The products are modeled in vrml, which allows the definition of a Java program to process and generate events that determine the interactive of the product. An application for the generation of Java graphical interfaces was developed, aiming to establish the communication between the user and the vrml product, sending parameters to the program that controls the product.

Introduction

VRML (Virtual Reality Modeling language) is an international standard on which the 3D models can be distributed and users can browse the models with common web browser with plugin for vrml. Though it lacks immersion, with the advantage of easy realization, fast transmission on net, vrml has become a popular solution of web based interactive 3D visualization application. The field of vrml applications is increasingly emphasized along with the widened bandwidth and promotion of computer hardware ability[1].

Now, most of the product design is used software (3dmax, photoshop, etc) to complete the design of products and processes which includes parts drawing, parts assembling drawing, general assembly drawing and so on. These designs are two-dimensional design can only present the drawing. Vrml-based product design for a new product development model through virtual design can complete numerous physical prototype could not (because of the cost and time does not permit) accomplish virtual experiment. So there is no need make a physical prototype to obtain the optimized design scheme.

The advent of the Virtual Reality Modeling Language(VRML) as a portable file format for describing three dimensional(3-D) scenes has enabled researchers, educators,and students to share anatomical models on the WorldWideWeb.This paper exploits the combination of vrml (Virtual Reality Modeling Language) and Java for the construction of highly interactive products[2]. The products are modeled in vrml, which allows the definition of a Java program to process and generate events that determine the interactive of the product.

Product Modeling Design

We present the virtual product by VRML. VRML describes 3D models in the form of nestable "nodes". Nodes generally define 3D physical descriptions that may be made up of 3D primitives, such as spheres, cuboids, cones and cylinders, or of complex polyhedra made up of polygon facets. In addition to these form descriptions, nodes can also define materials, colors, texture maps, lighting, shape transformations and viewing criteria. These nodes support linkable anchors, so that clicking on a 3D object will bring up another 3D model or any other URL.

Creating VRML Models.VRML2.0 consists of a bunch of objects. While we could type in the vrml code for every object, and many people have, we save time and effort when we will use a tool, called a world builder or modeler, to generate and position the objects in your world [3].

W can actually create VRML in a text editor like notepad or vi just like HTML.we can use VRML builder to help us. A VRML builder is a piece of software that allows the user to build interactive 3D objects or environments for the internet in a visual manner through the use of a user friendly interface.

As the user creates objects or environments, the software writes the necessary code behind the scenes. Any VRML file may be viewed and edited in a VRML builder. All the basic functions required in constructing an interactive VRML object or environment can be achieved as well as many of the more complex features [4]. Very complex attributes will require the use of the VRML scripting language such as giving an object an intelligent and organic behaviour. VRML builders will provide tools to add scripts to objects so really anything is possible within the limitations of telecommunication technology, computer processing power and the users imagination.

So,creating VRML worlds is more complex than authoring an HTML document, and invariably requires the acquisition of suitable software. Integrated VRML modeling environments that let we build, place, light, color, and animate your objects. Programs designed for other purposes, such as CAD, raytracing, game development, or 3D film animation that you can use to do most of our jobs. Programs that do only one thing, but try to do it very, very well. We can use these programs for part of your world building in combination with other tools, or to supplement the features of another modeler[5].

Integrated Modelers.An integrated modeler will let us do at least some of the following:

- Import vrml objects and objects in other 3D file formats
- Position those objects anywhere in the scene
- Scale the objects (including stretching and squashing on various axes)
- Delete, copy, and paste objects or parts of objects
- Group objects together and ungroup them
- Color the object, a part of the object, or an individual face or vertex
- Set transparency and shininess for an object
- Put an image texture on an object
- Change the position of individual faces and vertices
- Create new objects, either from primitives or from 2D objects you can extrude, loft, or lathe
- Perform Boolean operations, like cutting a window out of a wall.
- Create and position lights and viewpoints
- Animate objects and debug your animations
- Develop, debug, and attach scripts
- Create and texture terrain
- Syntax check your world and help you improve its download and rendering time

Efficient VRML Models.A major key to building useful Interactive Virtual Products is to keep them efficient. This speeds up download times and improves navigation performance. This limitation is necessary since detailed models such as those produced by CAD software produce files too large for rapid transmission over the Internet.

Size is a critical factor. we can reduce size by using primitives when possible, instead of complex shapes. Using transforms allows us to mold primitives into a number of useful shapes.

Eliminate extraneous objects. This is especially true of models that come from CAD systems. CAD models tend to have a lot of shapes inside of others, or minute objects that might critical in engineering design -- but much of this is irrelevant in a presentation model.

Re-use objects. The vrml DEF and USE nodes allow us to define a complex shape once, and re-use it in other parts of the vrml model. These re-used parts can be modified in size, proportions and color, using transforms and other modifiers[6].

Implementation of Interactive function of Virtualized Objects

For Virtual product, even though it is vivid to use animation effect, viewers take in message passively. It would be better for viewers being able to control the product. As a programming language characterized by hardware and software being unrelated, Java complemented VRML. The former is for programmer designing in internet environment whereas the latter is for building virtualized product. As VRML is not strong in its interactivity, Java complemented VRML by way of using Script node which connects VRML with Java within virtual product[7].

There are two popular approaches to using Java to extend VRML virtual product: one is internal Java Script Authoring Interface (JSAI) and the other is External Authoring Interface (EAI).

Java Script Authoring Interface. A vrmled product consists of nodes that mimic real world objects and concepts such as various geometries and material descriptions etc. Script nodes defined within the VRML file are used to program more complex behaviors for a VRML product. A node can signify or receive events from the user or other nodes from the scene and effect changes in the scene by using ROUTE to send events. The script is the way VRML communicates with outside world, encapsulating the Java code and providing naming conventions for interconnecting Java variables with field values in the scene. Program scripts are miniature applications that contain the logic and interfaced Java classes import the rml.*; vrml.field.* and vrml.node.* class libraries to provide type conversion between Java and VRML. In this way, we can establish a link between a VRML scene and a Java application by making a handle to a Java.class file in a script node[8].

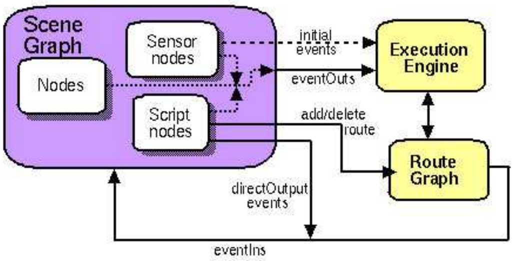

Fig.1 .Events routing in an object with the Script node.

In spite of its strengths, JSAI is unable to link with external data because it runs entirely within its plug-ins environment.it needs EAI(External Authoring Interface). The EAI is a set of language-independent bindings that provides a conceptual interface between VRML scenes and an external environment. The EAI not only allows manipulation all of the entities that internal scripts can modify. By using EAI to bind the data in the Java applet to the VRML world, developers are able to create a compelling cost efficient, cross-platform solution. EAI firstly creates an object reference to the browser, using the methods of that object to locate various nodes which are named using a VRML statement DEF within a scene, once the pointer to a node is obtained. It then creates objects that encapsulate the EventIn and EventOut constructs of that node. Once that is accomplished, manipulating values within a VRML world is accomplished in the same way as SAI. Another feature of EAI is being notified when events are sent from eventOuts of nodes inside the scene. In this case the applet must subclass the EventOutObserver class, and implement the callback() method. The advice() method of EventOut is then passed the EventOutObserver. It permits handling of events from multiple sources, the source being distinguished just according to this value. Thus the applet can be notified once something has happened in the VRML world[9].

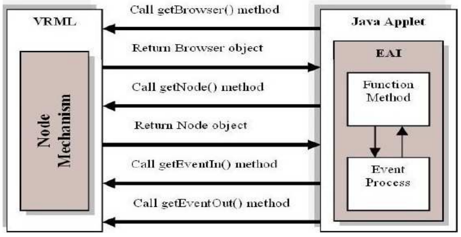

Fig.2 . EAI event transmit mechanism

To enable the Java Applet to interact with a VRML scene through EAI, it is necessary to pre-code all the DEFed nodes and related events in the Java file in advance. This approach results in data redundancy and it is also impossible to include all the DEFed nodes in a single file. We then use X3D DOM Handler to extract and store the DEFed names as a tree structure in memory to enable the EAI Handler to access and send or receive events to/from them[10].

The combination of VRML and Java is a very powerfultool for the control of virtual products. Interactive products that have their behavior defined by user actions can be modeled with VRML using a Script node and its associated program, which is capable of receiving parameters from another Java application, responsible for the user interface.

Compilation and Example

JavaSoft's JDK 1.3.1 has been used to compile the Java classes. The EAI is using blaxxunClientSDK which is provided by Blaxxun, Inc. For the natural language part, we used NLS API which was developed by the National Library of Medicine. This implementation has been tested on a Windows 98/2000 platform using Internet Explorer 5.0 and 6.0; Netscape 4.75, 6.0.

We present here a interactive camera. This vritual product employs virtual Modeling Language (VRML) to form a virtual camera. Users control the three-dimensional virtual camera movements (top, bottom, left, right, front, behind) by mouse. The user can easily identify the key control elements of the camera and study the most important functionality. With this interactive camera designer can form the camera they desire by choosing the size, type, color and get both a detailed description and 3D model of the camera. Each model can be viewed either separately or installed on a camera. Designers can find out every spare part through the model themselves or by clicking on individual spare part they wish to explore.

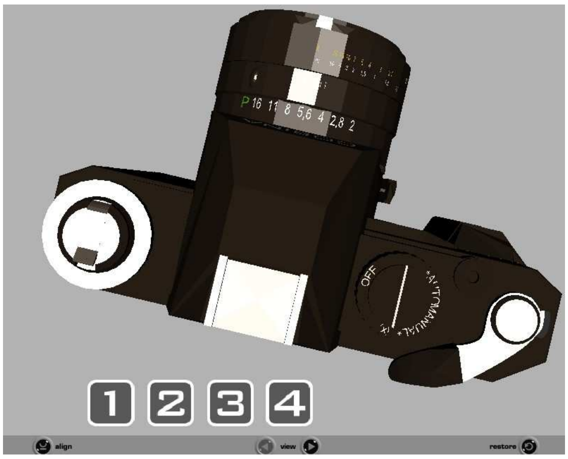

Fig.3. 3D product generated from sentences

Conclusion

In this paper, we explained and discussed the different approach of using VRML and Java technologies to generate an interactive product. The EAI fills in the gaps between the built-in functionality of a VRML world and the programmability of Java through the use of an embedded Applet on an HTML Web page. VRML turns the internet to be a real broad virtual product with its strong capability to construct 3D models and its interactivity. In spite of its limitation, VRML keeps developing by involving technologies of Java3D and XML in the new product of X3D, which backs up the latest streaming and rendering technology. Therefore, VRML and Java has become the mainstream of Interactive virtual products and shows great prospects of further application.

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Materials Engineering and Mechanical Automation
10.4028/www.scientific.net/AMM.442

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