Interactive Walkthrough of the Virtual Campus Based on VRML

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Abstract

An interactive walkthrough system is designed based on Virtual Reality. The techniques of Virtual Reality Model Language(VRML) and Java are combined in this system, and the virtual scenes and Human-Computer Interaction have been realized. In order to increase the speed of browsing the scenes, some optimal methods have been used in dealing with the model files.

Keywords: Virtual Reality, Web 3D, Walkthrough, VRML, Virtual Campus.

1. Introduction

During the past decade we have witnessed significant evolution in the computer industry mainly due to the introduction of multimedia and the World Wide Web. Virtual Reality technology, has introduced a new spatial metaphor with very interesting applications on Intelligent Navigation, social behavior over virtual worlds, full body interaction, virtual studios, etc[1].

The Virtual Reality Modeling Language (VRML) has emerged as the de facto standard for describing 3-D systems on the World Wide Web. It is platform-independent, easy to use, and gives Web authors the possibility to embed virtual worlds inside their pages. While Java has dramatically altered the way applications are created and distributed, VRML's impact goes beyond, changing the nature of the applications themselves while enriching and deepening the meaning of the data it encapsulates[2][3].

An interesting application would be the creation of worlds that represent real places or buildings, where the user can be able to access various kinds of information interacting with objects or avatars and travel at the same time in the virtual space. Such applications would require the development of overlying modules which would be capable of communicating with the VRML browsers, providing special control on certain virtual entities, maintaining Information Databases, Interacting with the user, etc. In this system, we have implemented a virtual environment based on the campus of Guangxi University of Technology.

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2. Background

The Web is being extended to three spatial dimensions thanks to VRML, a dynamic 3D scene description language that can include embedded behaviors and camera animation. A rich set of graphics primitives provides a common-denominator file format which can be used to describe a wide variety of 3D scenes and objects. The VRML specification is now an International Standards Organization (ISO) specification (VRML 97). Java adds complete programming capabilities plus network access, making VRML fully functional and portable. This is a powerful new combination, especially as ongoing research shows that VRML plus Java provide extensive support for building large-scale virtual environments

2.1 Overview of VRML

The Virtual Reality Modeling Language (VRML) is a powerful tool for the description of virtual worlds in the World Wide Web. VRML is capable of representing static and animated dynamic 3D and multimedia objects with hyperlinks to other media such as text, sound, video, and image, while VRML browsers, as well as authoring tools for the creation of VRML files, are widely available for many different platforms. VRML includes a few 3D graphics nodes such as: Shape, Geometry, Appearance, etc[4].

The scene topologies in VRML are grouping and child nodes. VRML syntax and node typing also helps enforce a strict hierarchical structure of parent-child relationships, so that browsers can perform efficient rendering and computational optimizations. Grouping nodes are used to describe relationships between Shapes and other child nodes. Moreover, the semantics of a scene graph carefully constrain the ways that nodes can be organized together. Child nodes come under grouping nodes to comply with the scene graph hierarchy inherent in any author's VRML scene. In addition to Shapes, child nodes describe lighting, sound, viewing, action sensors and animation interpolators.

2.2 Interfaces between VRML and Java

Interfaces between VRML and Java are effected through Script nodes, an event engine, DEF/USE naming conventions, and ROUTEs connecting various nodes and fields in the VRML scene. VRML provides the 3D scene graph, Script nodes encapsulate Java functionality, and ROUTEs provide the wiring that connects computation to rendering[5].

Java via VRML's Script node is well specified and multiple compliant browsers exist. Other interfaces are also on the horizon which can further extend Java-VRML functionality. Rather than provide Java connectivity from "inside" the VRML scene via the Script node, the External Authoring Interface (EAI) defines a Java or Javascript interface for external applets which communicate from an "external" HTML web browser. EAI applets can pass messages to and from VRML scenes embedded in an HTML page. Much of the browser interface is similar but somewhat different semantics and syntax are necessary.

3. An architecture for the development of Virtual Campus

The system consists of several different parts that communicate with each other according to the user's requests:

- **The User Interface:** It consists of two frames. The first one displays the virtual world that shows the 3-D content, and the second one is the Information Panel with a few command buttons and a container, where the settings of the system are defined and the texts are loaded (see figure 1).

Figure1. The main screenshot of the system

- **The VRML models:** They are the static models that represent the main building of the Guangxi University of Technology.
- **The Information Database:** It contains information about departments and other entities of the university. HTML pages that are displayed in the Information Panel and contain text, image and sound.
- **The navigation Graph:** A graph containing location information about the general layout of the campus to help the user's navigation. It can be switched by one command button on the Information Panel. In the graph, a red flag indicates the current position in the campus (see figure 2-3).

Figure 2. The navigation graph of the system

Figure 3. A screenshot with the navigation graph

The system has two patterns of walkthrough, one is manual mode which the VRML plug-in offers, the other is automatic mode which a fixed path throughout the campus has been initialized in the system.

The whole architecture of the system can be displayed in the following diagram:

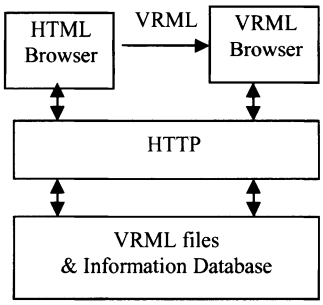

Figure 4. The diagram of the system

4. Implementation

Various approaches and technologies for the implementation of a virtual campus application can be

adopted. One possible approach to implement the system described above is using Java for the interface, VRML for the 3D scripting and visualization, and HTML for all other multimedia pages (2D visualization) and the integration of the system.

3D models created by well-known software such as 3DS MAX can be exported to VRML files and become available to the Web users, providing that they have a VRML2.0 plug-in installed in their Web browser with Java capabilities.

A web browser with a VRML2.0 plug-in is intended to provide an interactive 3D environment to the user. If the browser is executed on a high-end graphics workstation, it can maintain the detailed and fully texture-mapped building models on screen at all times. However, in order for a browser to maintain its interactive response and a reasonable frame rate when rendering a complex scene on a client with lesser capabilities, it must render the image with less computationally demanding techniques. For example, to reduce the number of polygons in the VRML world, in most cases we substituted the texture mapping for the polygons. Moreover, we can use the JPEG compression of the texture maps and gzip compression of the ASCII VRML file to hide the latency and download time.

5. Conclusions

In this paper we have seen that virtual walkthrough system can be an interesting application of Virtual Reality. We presented the architecture and implementation of a virtual campus, and demonstrated our own example.

The performance of the 3D engine that we used (VRML) is client dependent, and therefore does not impose any burden on the part of the server. There are, however, some requirements for the client system, as the Java / VRML combination produces results that depend much on the amount and complexity of the 3D models used, and a complex virtual world would require high-end equipment to have an acceptable performance. So, one difficulty that we encountered was to maintain a balance between quality and performance, providing that our application is Web based and platform-independent. Another important point that should be mentioned is the difficulty of navigating in three dimensional environments using 2D devices (like keyboard, mouse or joystick), a fact that can cause a lot of confusion to the non -experienced user. Nevertheless, we believe that today's expensive 3D input and output devices (e.g. head mounted displays, haptic devices, etc.) will be tomorrow's standard features of an average home computer.

Furthermore, we are currently working on extending the system's interactive capabilities and making it more attractive to the common users. Another possibility for future work is the use of Java3D class libraries for 3D modeling.

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