

Simplified Authoring of 3D Haptic Content for the World Wide Web

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Abstract

As haptic technology becomes more developed, the potential applications for three-dimensional haptic content online become more and more numerous. However, the proliferation of such content has been restricted by the fact that it requires considerable effort to create. In this paper, we present a system for allowing this content to be more easily authored and displayed. In our system, three-dimensional content created with a simple modeling language is displayed haptically by the internet browser. Thus, three-dimensional haptic scenes for the web can be written in this simple language, allowing the webpage author to circumvent the more complex scripting and/or programming which is currently necessary. Such a system should facilitate the creation of three-dimensional haptic content for the web.

1 Introduction

The World Wide Web is rich with sound, picture, and animation, but haptic interaction online is still a rarity. Immersion has taken the first steps towards widespread haptic content on the web with the development of their FEELtheWEB software [1], which allows authoring of web content that can be felt using a force-feedback mouse such as the Logitech iFeel mouse. However, such content is two-dimensional and is severely limited by the capabilities of the device. Many applications have been generated for web pages containing three-dimensional haptic content, such as a haptic museum which would allow interaction with museum artifacts online [2] and a home-based rehabilitation system for stroke patients [3]. However, few instances of such content actually exist. The effort involved in creating such simulations has slowed their proliferation.

1.1 Current Methods

Current haptic applications require programming, either with C, C++, Java, or a similar language, in order to incorporate haptic feedback in an environment. While this is a feasible approach, it does not lend itself to easy authoring and embedding of haptically-enabled worlds in webpages. In general, to implement haptic feedback on a given piece of hardware, the user must:

- Learn the application's interface, which is unique
- Hand-code a special application in C/C++/Java
- Download the application to a local machine



Fig. 1 User interacting with a webpage in which a haptic sphere has been embedded.

1.2 Plug-in System

In this paper, we present a system for allowing three-dimensional haptic content to become part of the World Wide Web. This system makes use of an existing modeling language called Virtual Reality Modeling Language (VRML) for the authoring of three-dimensional content. VRML is a simple and versatile language which facilitates creation of 3D worlds. As such, it is already established as the Web3D Consortium standard for three-dimensional graphic content online. The benefit of the system described in this paper is that a user can now create content using VRML, a scripting language. Our system allows such content to be displayed and navigated haptically through the use of an Internet browser plug-in, thereby transforming this simple modeling language into a powerful tool for three-dimensional haptic world creation.

Additionally, the haptic navigation interface of the plug-in provides a more natural way of navigating three-dimensional scenes than current VRML navigation interfaces, which require many controls in order to allow navigation in three dimensions. Thus, our system also builds on previous work seeking to improve quality of user interaction with existing graphics-oriented VRML content on the web through the addition of force feedback [4].

2 Methods

2.1 Implementation of the plug-in

The haptic VRML browser was implemented as a plug-in for Netscape Navigator using the Netscape Plug-in SDK.

However, this implementation is also compatible with Microsoft Internet Explorer. For parsing of the input VRML, the plug-in makes use of the VRML file reader included in the GHOST SDK for the PHANTOM Desktop. This file reader is capable of processing the basic elements of the VRML 2.0 specification, such as primitive shapes, meshes, and transform nodes, into a scene graph for a haptic scene. However, this file reader does not yet handle more complicated VRML constructs such as definitions, ROUTES, extrusions, and appearance nodes. The haptic scene graph thus obtained is displayed haptically using the GHOST SDK and graphically using the OpenGL libraries.

2.2 Installation and operation of the plug-in

Like all Netscape plug-ins, the haptic web browser is installed by compiling the code into a DLL which is then placed in Netscape's plug-ins folder on the computer. The current system has only been implemented on a Microsoft Windows 2000 operating system.

The plug-in has two modes: an exploration mode and a navigation mode. In exploration mode, the user may interact haptically with the VRML scene just as he would any other haptic scene. Graphics for the scene are embedded within the webpage window, with the location and size as specified in the page's HTML source. In navigation mode, force-feedback, as well as the versatility provided by the PHANTOM's many degrees of freedom, is used to provide a more intuitive way of navigating the scene. First, a constraint effect is introduced around the user's current position, pushing the user towards this original position. Pushing in any direction against this effect moves the user's camera position in that direction. The greater the pushing force generated by the user against the position constraint, the faster the user moves in the direction of the push. The three degrees of rotational freedom associated with the PHANTOM stylus are used to allow the user to adjust yaw, pitch, and roll of the camera (in essence, turning your head to view the extents of the scene). Thus, the user can navigate the VRML world using only the PHANTOM, providing a more easy-to-use interface with the three-dimensional content than that provided by ordinary VRML browsers, which are limited to keyboard and mouse for navigation. On a 6DOF PHANTOM, it would be possible to employ the same sort of control scheme in the rotation degrees of freedom as we implemented with the translation degrees of freedom. It should be noted that the haptic scene stays fixed when the subject uses the navigation mode.

2.3. Authoring of haptic web content

Three-dimensional content to be viewed was written in VRML 2.0 according to the standard published by the Web3D Consortium. Such VRML was further constrained to contain only nodes of three major types: appearance, geometry, and transform/grouping. Once written, the VRML was embedded in html documents using the EMBED tag, which is also used to embed sound, animations, and other content generally processed by internet browser plug-ins.

3 Conclusions

In contrast to existing methods, our plug-in involves:

- Learning a single standard interface for any web page
- Specifying the geometry in a W3C-sanctioned scripting language (VRML)
- Downloading the plug-in only once, regardless of the number of website visits

In addition, this plug-in:

- Adds haptic capabilities to *any* VRML web page, so long as it only uses the VRML features supported by the plug-in
- Could be used simply to navigate a VRML page, if one weren't interested in haptics

The work presented in this paper provides an improved system for authoring three-dimensional haptic content for the World Wide Web. Using VRML provides an easier way to create three-dimensional haptic content while embedding the finished content in a webpage is as easy as embedding an image. Subjectively, the haptic navigation interface permitted more fluid navigation than the traditional mouse/keyboard VRML interfaces available in other VRML browsers.

4 Future Work

The basic browser given here can be extended to allow for a richer haptic display of VRML. For example, a more extensive VRML file reader could be developed in order to allow for parsing of the entire VRML 2.0 standard. These ideas are congruent with current efforts by Phantom users to establish a standard representation for haptic data, a Haptics Interchange File Format, as discussed at the two most recent Phantom Users Group (PUG) Workshops.

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6 References

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