3.5 ADVANCED MULTIMEDIA FOR EDUCATION ON THE INTERNET

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1. INTRODUCTION

Research in the education field has supported a shift toward learning in a constructivist setting, i.e., one in which the user actively learns about a topic through inquiry and exploration rather than passively receiving information [Ramamurthy 1999]. At the same time, the rapid increase in desktop computer capabilities coupled with a decrease in hardware cost has made possible the delivery and viewing of more advanced forms of multimedia content to the typical Internet user. Web developers and content providers have a variety of options available to add this content to their sites.

These faster computers and new multimedia formats allow access to animation, video, and interactive diagrams that can give the student a much more intuitive feel for scientific concepts than traditional text and static 2-dimensional diagrams.

2. TECHNOLOGY

The Java programming language from Sun Microsystems provides one method of including the non-trivial, interactive content necessary to engage the user. As a full-featured programming language yielding executables that can be embedded in a web page, Java can be used to provide a nearly endless variety of customized software. Examples of this are the Weather Visualizer Java prototypes [Plutchak 1998], which allow user interaction with meteorological image data, and the University of Washington's buoy data display applets [Denbo 1997]. Unfortunately, the development time and effort can be significant for such applications.

There are a variety of other means to create interactive web documents that don't require special programming skills. One such option is the Virtual Reality Modeling Language (VRML). With VRML, three-dimensional objects, or scene elements, define a world. VRML 1.0 only permitted changing viewpoints into an otherwise static world. By contrast, the VRML 97 standard has added the ability for 3-D objects themselves to interact, and for the user to interact with each individual object. Using these advanced scene elements, interactive 3-D diagrams can be created which demonstrate key meteorological concepts. For example 3-D data from a model of thunderstorm formation can be animated and viewed from a variety of perspectives. Interaction can be added by allowing custom or preset "fly-throughs" of the model data from the point of view of a particle released into the data stream. Ultimately, control of the parameters that define the model may be given to the user, allowing instant interactive visualization in a web document.

Streaming video can also be used to add active educational content. The most significant advantage to streaming video over other types of animation or video is that it is displayed as it is being transmitted, rather than downloaded all at once before being played. This allows much longer (temporally) and larger (spatially) video segments to be viewed without long delays. Another advantage is that the video can be delivered at a speed and resolution that is automatically configured on the fly depending on the bandwidth and processor speed available to the individual user.

Although in its most basic form streaming video is simply video embedded in a web document, extensions to streaming video allow for more useful functions such as hyperlinking from areas within the video frames. This allows, for example, integrated access to explanatory documents, related video clips or frames, or even to VRML scenes focusing on a specific aspect or segment of the video.

There are also a handful of proprietary multimedia formats available. For example, Macromedia Corporation provides the Shockwave format, which allows the creation and display of vector graphics, animation, and sound without

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programming. Recent versions of Shockwave allow the content to be streamed. QuickTime, from Apple Corporation, is another proprietary format. It allows animation, 3-D graphics, video, and sound, along with a limited virtual reality capability. However, it is unclear how widespread the use of these proprietary formats will become, so we are investigating these options cautiously.

3. INTEGRATION

Our current efforts combine conventional HTML educational modules in our WW2010 framework [Bramer 1999] with the previously mentioned multimedia elements. The basis of the first such module is a set of HTML documents covering various aspects on the subject of hurricanes, from general definitions through specifics on the stages of development, etc.

Amidst the text, still images, and short animated diagrams are enhanced video clips, VRML scenes, interactive Shockwave movies with JavaScript interfaces, and small Java programs which augment the presentation. Links between the advanced multimedia elements provide a further dimension to the experience. For example, key frames within a video clip are linked to a VRML scene, which the user can interact with using a Java or JavaScript graphical user interface.

One such example consists of a set of web documents describing the developmental stages of a hurricane. A time-ordered sequence of GOES images covering the life cycle of a specific hurricane is presented as a streaming video. Clicking on the video at any point brings up a separate window containing a VRML scene consisting of hurricane model data depicting the state of various meteorological parameters at the appropriate stage of development. The user can then explore these parameters interactively.

4. CONCLUSION

Our experiences with this combination of WWW and multimedia elements, with meaningful cross-linking between the various individual elements, have shown the potential to provide a rich, engaging environment for learning. As the technology continues to mature, we expect to further develop interactive, multimedia educational modules using available technology.

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