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The bioMovies Project: Interactive Panoramic Movies to Provide Virtual Field Trips and Studies of Microscopic Life

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Introduction

Over several decades, we have noted changes in students' aptitudes and attitudes in university classrooms that have prompted us to seek ways of adapting modern technology to enhance learning. Specifically, we have noted an increasing reliance upon visual imagery coupled with a more limited vocabulary and less comprehension in reading. Others have also noted that today's students exhibit a greater reliance on visual imagery and on participating actively in the learning process, probably stemming from experience with electronic media during their formative years (Brown, 1997; Brumfield, 2005; Oblinger & Oblinger, 1997). Thus, we now emphasize teaching techniques that employ graphics and endeavor to include interactive features that provide students with control of the unfolding imagery. The burgeoning of new technology has allowed us to utilize multimedia in creating learning objects that accomplish these goals.

As biologists constructing learning objects, we have used photographs and video whenever possible, as opposed to diagrams and animations. Whether the course covers "whole animal" topics or deals with organs and tissues, we prefer that students see the real thing. However, we do use some diagrams and audio narration to enhance understanding of the imagery, to illustrate abstract concepts, or to draw attention to specific details of the learning objects. In the past, we have created a variety of visually based learning objects in the form of QuickTime™ movies with interactive features such as moving arrows, pop-up labels, accompanying text, and links to related materials. We have recently added a new technique that provides a 360° panoramic view of selected habitats, with "hotspots" linked to close-ups of animals within the habitat. This article describes a panoramic movie of the forest floor, the resources required to construct it, and the potential uses of such a learning object.

Procedures

Before a multimedia learning object can be created, the media must be obtained and decisions made concerning its mode of presentation. Making a panoramic movie requires a 360° view of an area that can be displayed to allow the user to move through the circular image by dragging the mouse over it. Since we wished to provide panoramas of environments under study in our courses, it was necessary to create the panoramic photographs and accompanying media ourselves. We chose QuickTimeVR™ technology to display the resulting panoramic movies because the free QuickTime™ player works on both PC and Mac platforms, and software is available to add interactive features to a QuickTime™ panorama.

The first step in constructing a panorama is obtaining the 360° image. One way of doing this is to take digital pictures that overlap by using a tripod with a rotating head. The images can then be merged into a 360° image using appropriate software. However, a much easier way utilizes a camera equipped with a parabolic mirror to produce a single image (Table 1). The parabolic mirror is mounted atop the lens of an appropriate digital camera so that the lens points up. The image produced is doughnut-shaped with the “hole” being the location of the camera. To eliminate the photographer from the picture, the camera can be mounted on a pole with the photographer beneath the camera. Alternatively, the photographer can set the camera timer to allow time to hide or can activate the camera by remote control from a hidden position. The resulting image is processed by software (Table 1) that “unwraps” the doughnut into a linear view, then exports it as a 360° panoramic movie. At the linear stage, the image can be edited in the same manner as other digital images to eliminate artifacts or enhance selected features.

Table 1. Tools for creating panoramic movies.

Application or Equipment	Operating system	Comments	URL
QuickTime Pro™	Mac OS, Windows	Simple editing and conversion tools for Quicktime™ movies	http://www.apple.com/quicktime/whyqt/
VR ToolWorx™	Mac OS, Windows	VR multinode creation tool for panoramic movies	http://www.vrtoolbox.com/vrthome.html
0-360 Unwrapper™	Mac OS, Windows	Free VR export tool for 0-360 optics in panoramic movies	http://www.0-360.com/software.asp
Cannon Powershot G5 Digital Camera	NA	High quality, 5 mega-pixel camera for taking panoramic pictures	http://consumer.usa.canon.com/ir/controller?act=CamProductCatIndexAct&fcateoryid=101
0-360 panoramic optic	NA	Parabolic mirror attachment for camera to take panoramic pictures	http://www.0-360.com/

To add content to the panorama and to make the movie an interactive learning experience, links can be added from within the panoramic movie. Since our panorama of the forest floor was designed to illustrate the types of plants and animals living there, we first videographed selected areas of the forest floor at close range using a high quality digital camcorder and linked the resulting video clips to the panorama. The latter step can be done quite easily using the application VR Worx™ to designate “hotspots” at appropriate locations within the panoramic movie. To each video clip, audio, supporting text or additional interactive features can be added. We chose to add audio narration that describes the selected habitat and any large organisms present. To facilitate navigation, we embedded the panoramic movie and video clips on separate web pages, and then added a button below each video clip to return the user to the panorama. At this point, one would have a useful learning object. For the forest panorama, however, we wished add a second level of linked videos to include small organisms living in the forest environment. To do this, we collected samples of soil, leaf litter, rotten logs, moss, and tree-hole water and utilized video-microscopy to capture close-up video of tiny animals. We used html links from the initial video pages to access the second level of video clips.

This type of learning object contains many individual elements and can require a large amount of storage space. Although our initial forest panorama (frame size 640 x 520 pixels) was only 3.1 MB in size, addition of 9 video close-ups and 15 videos at the microscopic level increased the learning object to almost 200 MB. While all elements of the forest panorama play smoothly from a CD or computer hard drive, it should be noted that panoramic learning objects with video links cannot be played from the Internet without severely compromising video quality.

Results

A portion of the “forest panorama” learning object is illustrated in Figure 1. The panoramic movie is shown in the center, turned to face a fallen log. In this view, the user has selected “show hot spots” from the play bar, so all hot spots are indicated by rectangles. If this command is not selected, the mouse arrow turns into a pointing finger when moved over the hot spot. Thus, the user can choose to explore the scene, searching for links. Clicking on a hot spot replaces the panorama with a narrated videographic close-up of the area, in this case the surface of the log with rotting bark and a salamander. The names of additional animals found under the bark are listed beneath the video. Clicking on a name causes a new window to slide on to the screen and play a video of that animal. The user can close the new window and return to the panorama by clicking on the “back to panorama” button. The panorama of Figure 1 also shows a second hot spot leading to a patch of moss. Videos of microscopic animals in the moss include a rotifer, tardigrade, tiny spider, and insect (species remain to be identified). As the user rotates the panorama, additional hot spots appear until all major habitats on the forest floor have been examined.

There is no limit to the number of plants and animals one can add to this type of learning object, and we are still producing videos to expand the forest floor. An even more complex panorama could be created by linking hotspots to additional panoramic movies, allowing the user to take a “virtual walk” through the environment with complete 360° panoramas at each stop. From the pedagogical viewpoint, one must decide whether to make the learning experience modular (a panorama with limited material that can be assimilated at one sitting) or more integrative (a very large panorama that might require days

to work through). In either case, the panoramic learning object serves to put information in a contextual setting, showing where animals live within a given environment. It provides more of a global than a sequential learning experience, as defined by Felder and Soloman (1999), since students can explore regions of the 360° environment in any order and observe the many animals present as they are discovered. Eventually, the learning experience should congeal into a unified view of how (and why) animals live in different niches within a given environment.

There are several ways in which a panoramic learning object might be used. We plan to use the forest panorama in an Internet distance education course in Animal Diversity. It could also be used as a study aid in a lecture-based course or as a laboratory exercise when the environment to be studied is inaccessible for students due to time or distance constraints. We have created the forest panorama as part of a grant-funded *bioMovies* project to develop interactive movies for use in education (Feaver, et. al., 2004). The panorama will be available for download at the *bioMovies* web site <http://ncsu.edu/biomovies/> by January 2006.

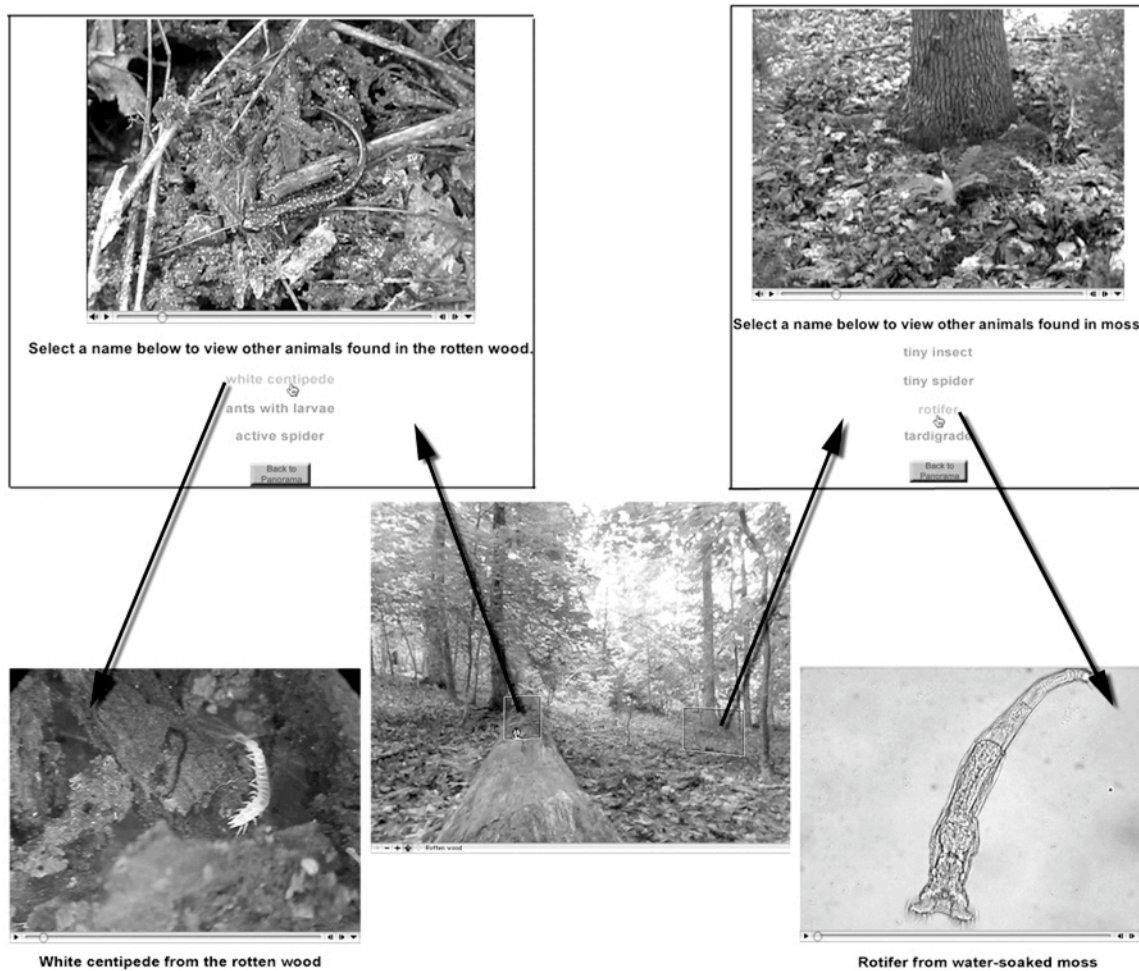


Figure 1. Panoramic QuickTime VR™ movie with embedded links to illustrate life on the forest floor.

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