

Low-bandwidth, multi-media tools for web-based lecture publishing

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Abstract

This paper describes some multi-media tools, which have been developed for recording audio-graphic presentation material for publication in an html reference environment, i.e. "on the web". The tools comprise two Macintosh applications and two Netscape plug-ins. The presentation model, which is used as a basis for the recorded lectures, closely follows the model of delivery used in a lecture theatre itself. The presenter arrives with a set of pre-prepared slides and has a device for displaying those slides and a means for annotating them with hand drawn text and diagrams. In addition voice is used to reinforce the slides and animations presented. The paper describes the applications, the technology used to provide low-bandwidth streaming and the likely applications. One of those applications, the recording of university lectures, has been evaluated in a trial of the prototype for the tools presented here.

1.0 Introduction

Multi-media has been used as a teaching aid for a number of years but it was not until the advent of the world-wide web that its use has mushroomed for both distance and local teaching and training needs. Effective tools are now required which are both easy to use and which integrate well into this burgeoning technology. More recently there has been a large interest, in the university sector, in the establishment of Virtual Universities¹ whose students study at a distance using the Internet and various forms of multi-media teaching delivery. There is a potential mismatch here, however, as multimedia usually demands a large amount of bandwidth and most potential "virtual" students do not sit on an intranet but are at the end of a possibly quite slow modem line. Those tools therefore must take account of this problem. This paper describes work on the Aidiograph project, which addresses both of these problems. It describes multi-media tools, which have been developed for recording audio-graphic presentation material for publication in an html reference environment, i.e. "on the web". The tools comprise two Macintosh applications and two Netscape plug-ins. The applications are a multi-media authoring tool for recording lectures for publication

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on the web and a previewing tool, which allows playback of the recorded material without having to publish it on a web server. The plug-ins support playback of the recorded material from within Netscape's web browsers. Plug-ins have been developed for both Macintosh and Windows 95/NT PC platforms.

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The paper describes the lecture recording application and players, the technology used for the graphics and to ensure a low-bandwidth streaming of data, and the likely applications areas. One of those applications, the recording of university lectures, has been evaluated² in a trial at the University of Surrey, where a prototype of the AudioGraph lecture recorder was first developed^{3,4}.

2.0 The AudioGraph lecture recorder and player

As indicated in the introduction, the AudioGraph lecture recorder models the presentation style adopted by most lecturers and trainers over the last couple of decades. It therefore presents a shallow learning curve to the potential multi-media author. This is important if the package is to be used by non-experts; the package must be as easy to use as a wordprocessor ... or even easier!

In this model the slides are prepared before the lecture is given (or recorded), usually using a presentation graphics package such as Microsoft Powerpoint. These are then printed or used live using the presentation facilities provided by the presentation graphics application. The AudioGraph lecture recorder, which records a presentation for subsequent playback on the web, also allows the use of Powerpoint presentation graphics as a starting point. Alternatively the slides can be a graphical object cut from any application running under MacOS or "printed" from any application using the Macintosh Print-2-PICT printer driver. The PICT image format is the standard format used on the Macintosh and is used by the AudioGraph, the clipboard and many other graphical utilities. Whereas the OHP or computer projector is used to display these slides in a lecture theatre, they are displayed on the presenter's screen in the AudioGraph package. In the lecture theatre the presenter will have a number of tools available for highlighting or annotating the presentation material. These may include a laser or similar pointing device, coloured transparent pens for marking the slides and possibly drawing aids such as templates, erasers etc. The analogues of these tools in most presentation packages are rather limited. In the AudioGraph lecture recorder however, a complete set of pointing and drawing tools are provided for annotating the slides and for drawing attention to components of the slide being presented. The final and most important component of the presentation is the speaker's voice. The ability to record voice annotations on the slide and to sequence voice and other annotations.

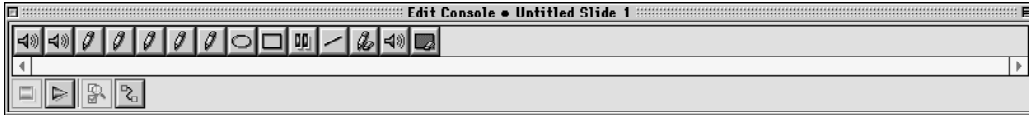


Figure 1. Edit console for the AudioGraph lecture recorder showing a sequence of recorded

additions to existing applications, examples of which are the presentation or HTML export facilities of applications such as Powerpoint. These are usually simple but very limited in what they can accomplish. On the other hand we have professional multi-media authoring systems which provide unlimited flexibility in their output and which are typically used for glossy, promotional CDs. It is accepted that the latter require many hours of expert authoring time to produce a few minutes of presentation material. Neither is ideal for the non-expert presenter. The former needs a great deal of expertise in gluing the various components of a presentation together while the latter is definitely expert territory.

Using the simple model above the AudioGraph provides a niche in this middle-ground. The two extremes above also represent the two extremes of directing. The first provides no time-line within a presentation, except perhaps for the sequencing of the slides themselves. The second provides multiple time lines and introduces the problem of synchronisation. The AudioGraph provides a single time-line with each presentation graphic and this time-line is linear. It can be likened to a tape on which a sequence of events is recorded. Some of those events are real time events and others have no temporal information associated with them. The first real-time, AudioGraph event is the voice patch, which has a fixed duration and which is played back over exactly this same duration. The other real-time event is a pause, which is used to provide timing control over all other events. The remaining events are graphical events, which draw or erase items from the presentation screen. This sequence is emphasised by the control window from the AudioGraph, which is illustrated in figure 1. The control window is used for playback and editing functions. Each icon in this window represents a single event. Playback can begin from any selected event and the normal cut, copy and paste operations are implemented on events or groups of selected events. I will not provide detailed instruction here on the use of the tool as this is not the primary purpose of this paper and details can be found at the AudioGraph home page⁵. However, figure 2 shows a complete screen shot of the application during the recording of a presentation graphic.

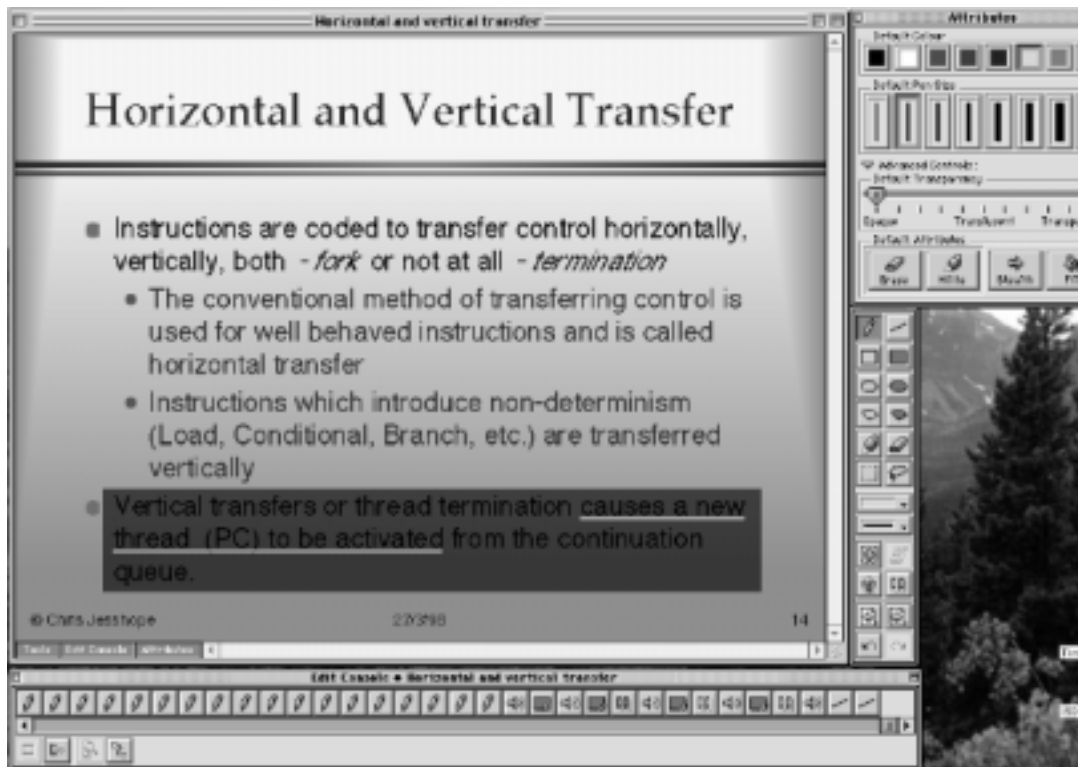
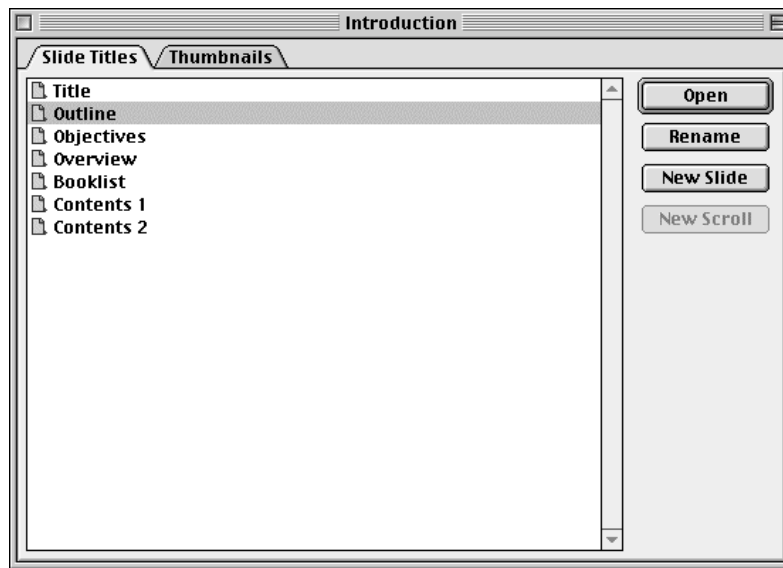


Figure 2. A screen shot of the AudioGraph application, showing the presentation window, the attributes and tools windows (right) and the control window, already described.

The easiest way in which to use the recorder for preparing a web-presentation is to export a set of slides generated from Microsoft's Powerpoint as a Scrapbook file, this file format holds any Macintosh resource and in this case it hold one PICT image per slide. Such a file can be opened directly by the AudioGraph, and when saved it stores the slides and any annotations in the Macintosh AudioGraph format. Figure 3 shows the lecture window, which provides an overview of the slides in the presentation. As can be seen, each slide may be named and displayed by either name or thumbnail. Slides are then opened, giving the display in figure 2, and can then be annotated with voice and graphics. When the presentation is complete, it can be exported for publishing on the web. This process converts the slide and annotation data to a cross-platform file format (*.aep) which is embedded in an html file (also output). The browser, using either the file extension, file type or mime type, if the data is served across the network, can then select the AudioGraph player plug-in for playback. The presentation can either be output as a single html file with associated aep file, in which case the presentation sequences through each slide and its annotations when played back. Alternatively, each slide can be output as a separate html file with associated aep file, which when played, displays just that



single slide and its annotations. If the latter case is selected for export, then an index file is generated which has a link to each slide, creating a simple two-level web site.

The controls on the AudioGraph Player (in stand-alone or plug-in format) are very simple and are shown in figure 4. Clicking on the presentation screen starts and stops the playback (the state is shown by the play/pause button in the lower left corner). The slider at the bottom of the presentation window can be used to position playback at any point in the presentation when the playback is paused. Similarly the jog buttons on the lower right of the window can be used for stepping forward and back by a single annotation.

3.0 Technology used

3.1 Graphical objects

The AudioGraph presentation format uses two levels of graphics. The background, which displays the presentation slide, and the foreground, which displays the graphical annotations. The background images are stored in PNG format⁶, which is a compressed image, similar to a GIF, but which uses a royalty free algorithm. This has the added advantage that transparency is supported by the use of an alpha channel, which can provide an eight-bit value for each pixel, which determines the transparency of that pixel. Thus images may be superimposed with appropriate use of this facility. The aep file format also supports transparency of foreground graphics, using a single byte per object to specify the transparency. This is in addition to colour, line width and other attributes. If, for a given coordinate, the foreground colour is specified by f and the background colour by b , then for a transparency value of α the resulting colour is given by:

$$\alpha * b + (1 - \alpha) * f$$

Erasing actions are drawn objects, which have an erase attribute set. The erase attribute modifies the drawing algorithm for an object such that if it is fully opaque ($\alpha = 0$) it completely negates the foreground colours that it intersects. However, when an object has an erase attribute set and is transparent ($\alpha > 0$) the result is a partial erasure. The algorithm for erasure effects only the transparency of the foreground. The colour in the record is irrelevant. It does this by modifying the transparency of the foreground with which it intersects. The new transparency is calculated as follows:

$$\text{Alpha-new} = 1 - \gamma * (1 - \alpha)$$

where α -new is the new transparency, α is the old transparency, and γ is the transparency value specified in the delete record. It should be noted that erasure is cumulative, such that two intersecting objects, which have the erase attribute set, will at

