Radiology Teaching File Cases on the World Wide Web

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The presentation of a radiographic teaching file on the World Wide Web can be enhanced by attending to principles of web design. Chief among these are appropriate control of page layout, minimization of the time required to download a page from the remote server, and provision for navigation within and among the web pages that constitute the site. Page layout is easily accomplished by the use of tables; column widths can be fixed to maintain an acceptable line length for text. Downloading time is minimized by rigorous editing and by optimal compression of image files; beyond this, techniques like preloading of images and specification of image width and height are also helpful. Navigation controls should be clear, consistent, and readily available.

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THE WORLD WIDE WEB (WWW) may become a valuable supplement to the conventional residency program.¹ Already many departments of radiology display instructive cases on the WWW so that residents, medical students, and other interested parties have ready access to them. The presentation at these sites generally follows the model of the print medium with a description of the case in text and in-line placement of the relevant images. Browser software retrieves the text and images from the remote teaching file and displays it in a window on the user's computer monitor. At some sites, the initial images that are loaded into the browser are reduced-size ("thumbnail") images that serve as hyperlinks for a magnified or higher resolution version.

Although the content at these sites is generally of good quality, it is often possible to improve on the presentation of the content by applying principles of web design. In this report, I will emphasize control of layout, reduction of waiting time, and ease of navigation as keys to the success of a web site, using the latest version of our own WWW teaching file as an example.

Design Considerations: The WWW Teaching File at the SUNY Health Science Center at Syracuse.

Mission. We set out to provide an online teaching file as a resource to residents, medical students, and radiologists that excels in both content and usability. High-quality content is the top priority. We select only cases that have an established

diagnosis. The case record is edited for clarity and brevity. The most informative images are selected for display.

The user begins at an orientation page where the interface is described. This page allows the user to choose a case based on topic (radiologic subspecialty).

Layout. We use a simple three-column grid. The left and right columns are reserved for navigation controls. The largest column, in the center, contains left-aligned text. Line length is maintained between 200 and 450 pixels for readability.² Table width is set at 470 pixels so that the user is not obligated to resize the default browser window (Table 1). The column widths are also specified. To assure that they remain at their maximum width, a transparent Graphic Interchange Format (GIF) image that is one pixel high and has a width equal to the desired column width is placed at the top of each column. The width of the center column, dedicated to text, is in the 200 to 450 pixel range. The table as a whole is centered in the browser window so that if a user has a window width greater than 470 pixels, the table floats to the center. This allows the first and third columns to widen, but holds constant the width of the text.

We follow a consistent format for case presentation: (1) header—summary of the patient's age, gender, and presenting complaint; (2) body—history, physical findings, laboratory data, and imaging studies; (3) diagnosis, including the method used to establish the diagnosis; (4) comment on the imaging findings, the differential diagnosis, the disease process, and follow-up information; (5) suggested reading.

Minimization of waiting time. Text pages download quickly. It is the images that require the most optimization.

All browsers recognize images in Joint Photographic Experts Group (JPEG) and GIF formats. The JPEG format is preferred for radiographs and

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Table 1. Default Dimensions of the Netscape Browser Window for Various Screen Resolutions

Screen resolution (pixels)	Height (pixels)	Width (pixels)
480x640	300	470 Mac, 580 PC
600x800	430	470 Mac, 580 PC
768x1024	600	470 Mac, 580 PC

This takes into account toolbars and status bar.

photographs because they contain continuous gradations of value; the GIF format is best for line drawings and images that have large areas of solid color. The JPEG format incorporates a lossy compression scheme, and the compression ratio can be controlled. We provide a selection of images based on different tradeoffs between file size and preservation of image quality. We also indicate the file size with each link so that the user can estimate downloading time based on the bandwidth of the connection.

Image elements that are used repetitively, like the transparent GIF images referred to above, are preloaded by the orientation page of the teaching file. This reduces waiting time for loading the subsequent pages because the images are stored in, and reloaded from, the local disk cache; they do not need to be retrieved again across the Internet. Preloading is rendered inconspicuous by forcing a single pixel representation of each image on the orientation page.

Navigation within a case. We provide links to locations within the page (the top, the bottom and the diagnosis section), and outside to the orientation page. There are also links to the images for the particular case. The navigation elements are labeled clearly and adhere to the same format in every case. Inter- and intrapage links are located in the left column of the page, and links to images appear in the right column.

DISCUSSION

Overview of principles of interface design. The greater the use of advanced features (advanced and browser-specific Hypertext Markup Language [HTML], and plug-ins like Shockwave and viewers for proprietary image formats), the more limited will be the audience; on the other hand, we can assume that those who will make serious use of a teaching file will have certain characteristics (browsing with graphics “on,” better than minimum screen resolution of at least 600×800 pixels, at least 8 bit per pixel of “color” depth). Although the essential elements of our on-line teaching file are

accessible to nearly anybody who has a popular browser, we design for and test on Netscape Navigator and Microsoft Internet Explorer browsers, both Macintosh and PC versions.

Rationale for layout. Designers strongly advocate consistency of user interface.^{3,4} We follow this principle by employing a consistent format for all case presentations. In particular, line length is maintained between 200 and 450 pixels for readability.²

The simplicity of our layout has a number of benefits: absence of distractions, ease of maintenance and ease of use—“successful interface metaphors . . . do not require the user to learn and remember many rules and procedures.”³

Rationale for minimized waiting time. The desirability of faster downloading is self-evident. We keep the size and number of text and graphics files to a minimum. Where graphics are used, there are methods to reduce loading time even further. First, repetitive image elements can be preloaded. An initial page downloads image files to be used on subsequent pages; this reduces waiting time for those pages because the images are stored in and reloaded from the local disk cache; they do not need to be retrieved again across the Internet. Second, image width and height can be specified in the HTML code, allowing the browser to lay out the page and place the text before the images load, and reduce overall download time.

Rationale for navigation. Navigation controls are essential to the user’s control of his own learning experience. Every case in our teaching file provides a direct path back to the orientation page from which cases are selected. Navigation aids also allow the user to move back and forth within a case, in addition to the availability of scrolling, because the text column can be lengthy. They also indicate images available for the user’s inspection.

We elected to use a second window for image viewing to make the most efficient use of limited screen area. With this benefit come two drawbacks: multiple running instances of the browser may slow the user’s system, and the second window may be positioned directly over the first. The latter may lead to confusion that we attempt to avert by asking users to close the active instance of the browser when they are finished looking at the image.

On to the third generation. If one refers to WWW teaching files that include content with little or no acknowledgment of design as “first genera-

tion" efforts, then the "second generation" may be defined as preservation of the quality of content while adhering to principles of good design. The next step, or "third generation" of WWW teaching file will maintain content and design, and add interactivity—taking advantage of the capabilities of the Internet to go beyond the model of the printed page.

Examples of interactivity include the ability of the user to control the contrast and brightness settings of images to match the local monitor and lighting conditions. Other types of image manipulation may be desirable as well. There is no way to implement these capabilities in HTML, but it is possible through the use of programming languages such as Java.

The ability of the user to search the teaching file for particular keywords is another desirable form of interactivity. If there were interest and agreement on standards for content and design, a multicenter

distributed teaching file could be developed; implementation of a search engine with links to all available cases would be mandatory.

A third form of interactivity would permit user self-assessment. The user may be presented with "unknowns" on a specific topic or from the teaching file in general. A collection of different presentations of the same pathologic entity could be assembled. Questions could be included with cases and could be submitted by form, with correct answers given in reply.

The opportunities for supplementing education by means of the WWW have been recognized for some time. The success of these growing efforts depends on quality of content and the usability of the interface. Interactivity will become increasingly important as well. This presentation has focused on principles for the user interface that are recognized by web designers but not commonly appreciated among radiologists.

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