Interactive Web-Based Radiology Teaching File

Mark Zaidel, Kenneth Hopper, and Tunc Iyriboz

This multimedia radiology teaching file was developed for medical students, residents, physicians, and researchers to present teaching components related to clinical studies. Patient studies are used to create teaching cases, user can also create lecture series and custom presentations (catalogs) by linking related text and images. The user is able to make and preserve his/her own notes related to reviewed information. From the computer workstation, the user can perform search our case library by American College of Radiology (ACR) codes, keywords, modalities, or text. Results are presented in custom pages and include text lists, thumbnails lists, rescaled images, and full-size images. Text can be easily printed in custom format or exported to an ASCII file. To preserve the privacy of the student, access to our database is granted to the web browser by log-in panel. Image and text can be imported from Digital Imaging and Communications in Medicine (DICOM)-compatible devices or entered by using web forms. In conclusion, we developed a multifunctional interactive teaching environment accessible for multiplatform internet users.

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T HIS MULTIMEDIA RADIOLOGY teaching file was developed for medical students, residents, physicians, and researchers to present teaching components related to clinical studies. It contains more than 1,500 pathology-oriented patient studies of all imaging modalities stored on an internet server. Patient studies are used to create teaching cases, lecture series, and quizzes. The user can also create individualized catalogs by linking related text and images. All information can be linked to pertinent literature references. The user is able to make and preserve their own notes related to reviewed material. Via the internet, the user can search the case and image libraries by American College of Radiology (ACR) codes, keywords, modalities, or text. Results are presented in dynamically generated graphic pages, including text lists, image thumbnails, rescaled images, and full-size images. Privacy of the viewer is secured by a password control. Image and text can be imported from Digital Imaging and Communications in Medicine (DICOM) compatible devices or a film digitizer, or entered using Web forms. Content can be easily printed or exported to an ASCII file.

The exhibit demonstrates an interactive relational database allowing complete integration of radiologic and pathologic images with text for

teaching and research purposes. The implementation of a standard web interface provides high portability of the archived data, allowing access to the system from any graphic workstation independently of hardware platform. The system can acquire images by using network connections to other systems and client workstations. The web server can run on Windows/Intel or Macintosh computers, limited only by storage capacity. Text from external resources can be easily linked to patient studies, increasing the effectiveness of teaching.

The system has six major modules: Data Entry, Teaching Case, Image Library, Lectures and Tutorials, a user-defined Catalog of images or studies, and an Interactive Quiz Module. In addition to the web interface, the system allows multiuser connections from Windows (Microsoft, Redmond, CA) and Macintosh (Apple, Cupertino, CA) computers using client-server architecture. Both interfaces support medical keywords and ACR codes to identify images, and the system has extensive query and sorting capabilities. The teaching function is designed on a case basis, with demonstrative images and teaching data originated from clinical studies. In addition, the system offers radiology educators the opportunity of creating lectures and presentations inside the system as a combination of images, patient studies, and hypertext. These multi-element teaching modules allow the user to develop disease-oriented presentations by grouping similar clinical studies. The system creates automatically intelligent links from cases to books and paper references corresponding to presented material. Links between images, studies, teaching cases, user's catalogs, keyword and references are flexible and dynamic, easily modified by the user. By using the Quiz Module, radiology cases can be presented as unknown. This module also demonstrates how

From the Department of Radiology, Pennsylvania State University, Hershey, PA.

Address reprint requests to Mark Zaidel, PhD, Department of Radiology, Pennsylvania State University, 500 University Dr, Hershey, PA 17033-1850.

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interactive radiology images and multimedia can be used to enhance teaching value of presented material.

For example, the regions of interest can be identified directly from internet browser by pointing or mouse click. All material is displayed in a consistent way by the internet browser, making the system very easy to use. For non-English-speaking users, we implemented the multilingual interface allowing the display of database content in the user's native language. The Java Script technology is widely used to enhance user interactions with the system.

The Internet-Based Radiology Teaching File is accessible from any graphic computer connected to the internet. Database program controls system access, and individual user accounts are protected by log-in passwords. After log-in all session documents are created in advance by the background

processes on the server. Using this technology combined with Joint Photographic Experts Group (JPEG) image compression, there are near instantaneous responses from the web server. Images can be loaded to the system using DICOM connections from digital modalities like computed tomography and magnetic resonance imaging scanners. Plain films may be transferred using a DICOM compliant film digitizer. Received images can be archived in a distributed manner on various storage devices, including network volumes, disk arrays, or CD changers.

The presented system gives physicians, educators, and students the opportunity to access their teaching files from any computer with internet access. The Interactive Web-Based Radiology Teaching File created by Penn State University offers a unique, significant advance in radiologic education.