A Java Viewer to Publish Digital Imaging and Communications in Medicine (DICOM) Radiologic Images on the World Wide Web

E. Setti and R. Musumeci

The world wide web is an exciting service that allows one to publish electronic documents made of text and images on the internet. Client software called a web browser can access these documents, and display and print them. The most popular browsers are currently Microsoft Internet Explorer (Microsoft, Redmond, WA) and Netscape Communicator (Netscape Communications, Mountain View, CA). These browsers can display text in hypertext markup language (HTML) format and images in Joint Photographic Expert Group (JPEG) and Graphic Interchange Format (GIF). Currently, neither browser can display radiologic images in native Digital Imaging and Communications in Medicine (DICOM) format. With the aim to publish radiologic images on the internet, we wrote a dedicated Java applet. Our software can display radiologic and histologic images in DICOM, JPEG, and GIF formats, and provides a number of functions like windowing and magnification lens. The applet is compatible with some web browsers, even the older versions. The software is free and available from the author.

Copyright © 2001 by W.B. Saunders Company

THE NEED TO PUBLISH, for both documentation and teaching purposes, radiologic images on the internet requires a conversion of the images to Joint Photographic Expert Group (JPEG) or Graphic Interchange Format (GIF).¹ It is in fact impossible to publish radiologic images in the native Digital Imaging and Communications in Medicine (DICOM) format,² which is not recognized by the most commonly employed web browsers. To obviate this problem, we developed a Java applet with the ability to display DICOM, GIF, and JPEG radiologic images.

MATERIALS AND METHODS

The viewer is written in Java 1.0 (Sun Microsystems, Palo Alto, CA) for the greatest compatibility with all web browsers.³ The tool offers the capability to modify brightness and contrast (windowing, Fig 1) and to magnify the picture (magnification lens, Fig 2). Only for DICOM images, the viewer can display all of the information embedded in the image.

RESULTS

The viewer has been tested with many different DICOM files generated by our picture archiving and communication system (PACS; Siemens [Munich, Germany] Sienet) or downloaded from the

internet. The tool works well with the DICOM 3.0 file format, even if for previous release of the standard the correct functioning is not assured. The software is compatible with the most popular and the web browsers, Microsoft Internet Explorer 3.0 (Microsoft, Redmond, WA) and Netscape Navigator 4.5 (Netscape Communications, Mountain View, CA), as well as the newest, such as Sun HotJava (Sun Microsystems), and works well in Windows, Sun Solaris, and Macintosh (Apple, Cupertino, CA).

A 512-kb image (a standard magnetic resonance image) requires about 5 seconds to be shown on an Intel (Santa Clara, CA) Pentium II with 32 Mbyte of RAM connected on a 10 Mbit/s ethernet network. About 3 seconds are needed to download the file and about 2 seconds to display the image. Windowing and zooming are quick enough for clinical use.

CONCLUSIONS

The applet allows DICOM medical images to be published directly on the world wide web, without converting them to another graphical format. Moreover, it supplies some image processing tools common in the radiologic environment. The viewer characteristics make it suitable for preparing educational web radiology sites or for clinical files on the web.

The DICOM Viewers are being used in some electronic medical sheets, like that of the Italian Rare Tumours Network (<http://www.istitutotumori.mi.it/rtr.htm>). The Rare Tumours Network is a permanent joint collaboration of many Italian Oncological Centres, with the aim to increase the quality of care for patients with rare tumors. An internet database is used to share clinical and follow-up data from the Network members. The

Department of Images for Diagnosis and Therapy, Radiodiagnostic Unit A, National Cancer Institute, Milan, Italy.

Address reprint requests to Ernesto Setti, MSEE, Unità Operativa, Radiodiagnostica A, Istituto Nazionale Tumori, via Venezian 1, 20133 Milano, Italy. E-mail: setti@istitutotumori.mi.it.

Copyright © 2001 by W.B. Saunders Company

0897-1889/01/1402-1067\$35.00/0

doi:10.1053/jdim.2001.23887