

concerns documents that include raster images that are referenced but not stored therewithin.

[0093] Storage of references to raster images rather than the images themselves within a document achieves two advantages. The first advantage is that it significantly reduces the size of the document, since raster images tend to be large data structures. This makes it possible for a user to quickly download all or parts of the document without the images. The user can interact with the document, such as by advancing pages or clicking on links, before the image data is downloaded.

[0094] The second advantage of storing references rather than raster images is that it provides for scalability; i.e. it provides an efficient way to automatically scale the raster image according to a desired display or print resolution. Considering the abovementioned example of a document containing an image that was scanned at 3,600×4,800 pixel dimensions, the original image is stored on an image server as an approximately 5 MB file, and not within the document. The document references the original image by means of a link.

[0095] If a user interactively displays the document on a video monitor, he cannot typically display the image contained therewithin at the full 3,600×4,800 pixel dimensions, as video monitors do not support pixel arrays this large. The display resolution depends on the resolution of the video monitor, the portion of the image being viewed and the portion of the video monitor on which the image is being viewed. For example, if the user is currently viewing the top left quadrant of the image in a viewing window of 240×320 pixel dimensions, and if the original image was scanned at 600 dpi, as above, then the current view corresponds to a display resolution of 160 dpi, only 26.7% of the original resolution.

[0096] Moreover a viewing window of 240×320 only requires 230.4 KB of uncompressed image data (at a color depth of three bytes per pixel), which is approximately 23 KB of compressed image data, using the 10:1 ratio for high quality compression recited above. Using the present invention, only the 23 KB of image data necessary to render the desired display is downloaded. Moreover, as described hereinbelow, once this data is downloaded it is cached for subsequent use, so that whenever the same data is required again, it is not necessary to download it from the image server.

[0097] Reference is now made to FIG. 3 which is a simplified illustration of an Internet publishing system of the present invention for publishing images over the Internet or any other suitable computer network in accordance with a preferred embodiment of the present invention. An electronic document management system 310 contains several documents 320. Documents 320 are image-less documents, obtained by removing some or all of the images within an original document, and substituting references therefor.

[0098] In accordance with a preferred embodiment of the present invention, the images selected to be removed from an original document are those images contained within the original document that are larger than a prescribed size. Each document typically contains text characters, page layout information, font references and references to raster images 330 in the form of links. Image-less document #1

contains links to image #2 and image #3. Image-less document #2 contains links to image #1 and image #4. The raster images 330 are stored on one or more image servers 340. A document viewer 350 accesses image-less document #1 via an Internet connection. Document viewer 350 may be part of a web browser or, alternatively, it may be auxiliary client software.

[0099] When document viewer 350 initially accesses a requested document, document manager 310 transmits image-less document #1. Document viewer 350 initially requests from image server 340 screen resolution versions of each image that is missing from image-less document #1, by means of an IIP request, generates an initial default page of the requested document with screen resolution images embedded therewithin, and displays the initial default page. Alternatively, document viewer 350 may initially request from image server 340 screen resolution versions of only those images that actually appear within the initial page that is displayed, and may request additional images as they are needed to satisfy subsequent user requests. Document viewer uses the references embedded within document #1 to identify the IP address of the appropriate image server and the path and file name for the files containing the appropriate image data. The images referenced in document #1 may reside on a single image server, or alternatively, some of the images may reside on different image servers than others of the images.

[0100] The IIP request used to request image data may include a server-side processing command, such as a CVT command. Alternatively, it may include a client-side processing command, such as the TIL command. In the latter case, document viewer 350 combines the image tiles it receives into a single display.

[0101] A user interactively views the requested document by advancing back and forth through pages, by zooming in and out of a page, and by navigating within the page. Each interactive user request for viewing the requested document initiates corresponding IIP requests for specific images or image portions that is transmitted from document viewer 350 to image server 340. Image server 340 transmits the requested image data to document viewer 350. Document viewer 350 then embeds the image data into image-less document #1 and displays the requested page or portion of a page with images embedded therewithin.

[0102] Reference is now made to FIGS. 4A-4C which are simplified illustrations of a page containing text and images from a scalable document as seen at various display resolutions, in accordance with a preferred embodiment of the present invention. A scalable document 410 is accessed by a client and displayed using an initial default view, as shown in FIG. 4A. The page contains font text data 420 and a raster image 430.

[0103] A user interactively views scalable document 410 and may zoom in on a portion of the page. The scalable document is automatically re-scaled so that both the text 440 and the image 450 are enlarged, as shown in FIG. 4B. The user may further zoom in on a portion of the page, and the scalable document is automatically re-scaled again so that both the text 460 and the image 470 are further enlarged, as shown in FIG. 4C. In an alternative embodiment of the present invention, the image can be opened in a separate window in the viewer, and interactively viewed within the separate window.