

**204.** FIG. 2b illustrates this exemplary web page after lower right area **204** has changed in response to an activation of navigation buttons **206** in top area **200**. While top area **200** and lower left area **202** stay the same, new textual content **212** is displayed in lower right area **204**.

[0038] Web pages, such as the exemplary one, are requested from Web server **104**, which sends the web page data to intermediary **112**. FIG. 3a diagrammatically illustrates the steps performed by intermediary **112** after receiving web page data. Intermediary **112** first stores the received web page data in an intermediary cache. Next, intermediary **112** determines the distinct areas of content in the page layout and their spatial relationship. For each distinct area, intermediary **112** then determines meta-information of the content in the area. The meta-information provides a higher-level view of the content contained within the areas of the web page by indicating the characteristics, structure and/or composition of the content. The following is exemplary meta-information:

[0039] area (frame) was updated.

[0040] area contains specific items the user has designated to be of interest, e.g. specific keywords contained in the content.

[0041] what kind of content is within the area, e.g. text, form, table cell, header, image?

[0042] whether the area is scrollable or visible in its entirety.

[0043] number of hyperlinks contained in an area.

[0044] percentage/number of hyperlinks linked to information "outside" of the website.

[0045] area contains content in a visually impaired user inaccessible form (e.g., java applet, image without ALT tag) or, alternatively, area contains content in a visually impaired user accessible form.

[0046] From the area and meta-information determinations, intermediary **112** generates a non-visual, abstract representation of the web page. This non-visual, abstract representation comprises borders of vibratory feedback between the distinct areas and auditory feedback associated with each area, which is representative of the meta-information of the respective area.

[0047] The auditory feedback representative of the meta-information utilized is, preferably, earcons or auditory icons. Auditory icons are naturalistic sounds representing a real world equivalent. An example of an auditory icon is the sound of knocking on a door to indicate that somebody is joining an online conversation. Earcons, on the other hand, are abstract sounds that do not always have a real world equivalent. For example a three tone chord in major key indicates a successful save file operation, whereas a three tone chord in a minor key indicates the save operation was not successful. The following articles provide further descriptions of auditory icons and earcons: Blattner, M. M., Sumikawa, D. A., et al. (1989). "Earcons and Icons: Their Structure and Common Design Principles." *Human-Computer Interaction* 4(1): 11-44; Bussemakers, M. P. & deHaan, A. (2000). "When it Sounds like a Duck and it Looks like a Dog . . . Auditory icons vs. Earcons in Multimedia Environments." *Proceedings of the Interna-*

*tional Conference on Auditory Displays '2000*, Atlanta, Ga., ICAD, pp. 184-189; Gaver, W. W. (1989). "The SonicFinder: An Interface That Uses Auditory Icons." *Human-Computer Interaction* 4(1): 67-94.

[0048] As an example of the generated representation, FIG. 3b illustrates a non-visual, abstract representation of the web page shown in FIGS. 2a and 2b. Intermediary **112** generates nonvisual, abstract representation **300** by generating data indicating the non-visual feedback associated with coordinates, to which the coordinates of a user's finger on a touch surface of touch pad **108** will be mapped (described below). As shown, a non-visual, abstract representation of the web site of FIG. 2a is generated by associating auditory feedback indicating a "form" with the area bound by x coordinates 0-50 and y coordinates 0-75. This corresponds to lower left area **202**. To represent lower right area **204**, auditory feedback indicating "text" is associated with the area bound by x coordinates 51-125 and y coordinates 0-75. For the top area **200**, auditory feedback indicating "navigation buttons" is associated with the area bound by x coordinates 0-125 and y coordinates 76-100. Also, the boundaries of these areas are delineated by associating vibratory feedback with the areas bound by x coordinates 50-51 and y coordinates 0-75, in addition to x coordinates 0-125 and y coordinates 75-76. All of these coordinates are preferably chosen to represent the general spatial layout and the respective boundary and content area's proportions of the entire web page. Also as illustrated, after lower right area **204** changes, a non-visual, abstract representation is generated similar to before, however, auditory feedback indicating lower right area **204** has new content, i.e. it has changed, is also associated with the area bound by x coordinates 51-125 and y coordinates 0-75.

[0049] After the non-visual, abstract representation is generated, it is sent to interface component **116**. In addition, the unmodified web page data to web browser **114**, for display to a visually capable user. Via touch pad **108**, interface component **116** provides a non-visual display of the web page to a user based upon the representation and the coordinates of the user's finger on the touch surface of touch pad **108**. In addition, interface component **116** performs actions in response to inputs from the user to provide interaction with the non-visually represented web page.

[0050] FIG. 4 diagrammatically illustrates the steps performed by interface component **116** for non-visual display and to provide user interaction with the web page. After receiving the non-visual, abstract representation, interface component **116** receives data representative of a user's actions upon touch pad **108**. When a user slides their finger **400** across the surface of touch pad **108**, interface component **116** provides the non-visual, abstract display of the web page. To provide this display, when the user's finger is slid across touch pad **108**, interface component **116** maps the coordinates of the user's finger **402** on touch pad **108** to the coordinates of the non-visual, abstract representation. Interface component **116** then determines the non-visual feedback associated with the coordinates **404** and generates the feedback **406**. Thus, when a user's finger crosses a boundary of a content area, interface component **116** causes touch pad **108** to generate vibratory feedback, while, when the user's finger is touching an area, interface component **116** cause an auditory output device to generate auditory feedback corresponding to the meta-information of the area.