Hierarchical Atomic Navigation for Small Display Devices

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ABSTRACT
We present a new transcoding technique for WWW navigation on small display devices: hierarchical atomic navigation (HANd). Unlike previous techniques, HANd shows all original information in a comprehensible way, without imposing the use of a specific browser. A *navigator* page is used to represent original contents in a symbolic way. Unreadable elements are replaced by icons. These icons are linked to actual individual contents, as a set of *atomic* pages. HANd pages use standard formats that are supported by any PDA browser.

Keywords
WWW navigation, PDA, mobile communications.

1. INTRODUCTION
In the near future, many WWW services will be accessed from small display devices. By 2005, there will be one billion broadband cell phones and PDAs [1].

However, there is an important problem to be solved: mobile terminals must have small displays, and most WWW pages are not designed for them [2]. A trivial (and undesirable) solution is limiting mobile WWW services to specialized ones like stock quotes, weather forecasts and sports scores.

This paper presents a new philosophy to improve WWW navigation on small displays. Our system is based on the HANd concept: Original elements embedded in a WWW page are identified by means of a reduced page preview, the *navigator page*, which is generated automatically. Unreadable elements are replaced by icons. These icons are linked to actual individual contents, as a set of *atomic* pages.

2. RELATED WORK
2.1 Clipping
Web clipping [3] replaces the original page by a "clipped" version for small display devices. First, a page fragmentation process is carried out. Then, a human or an automated process sets an importance value for every page fragment. Low importance fragments are ignored when display space is limited. As a consequence, this technique produces information loss.

2.2 Handy-Fit-to-Screen
Microsoft Pocket Internet Explorer includes the Handy-Fit-to-Screen feature [4], which resizes WWW pages to fit into small displays. Obviously, many page elements are not properly displayed. To cope with this drawback, Pocket Internet Explorer includes a zoom menu option that displays text in several sizes. This technique avoids information loss. However, it does not work properly on complex pages, and it is only supported by Microsoft Pocket Internet Explorer.

3. HANd
3.1 Overview
HANd divides the original page into zones. These zones are groups of elements included in the original page (e.g. images, text paragraphs, headers, hyperlinks, Java applets, forms, etc.). The user may select any zone to be displayed at original scale.

The main *navigator page* is a reduced overview of the original page. The navigator page is always displayed on a side frame or pop-up window. It provides access to different atomic readable elements (i.e. elements of the original page), using links to auxiliary or *atomic* pages (on a second side frame or pop-up window). There are two possible representations in the navigator page for a given element in the original WWW page: (i) a reduced version of the element, if still readable, or (ii) a representative icon, if it is decided that the reduced element is unreadable.

A key issue is element dependence. All original elements are ordered in a tree hierarchy, and any element is considered unreadable if all its descendants are unreadable. In the navigator page, the representative icon of an ancestor hides all its descendants, but, if that icon is selected, all descendants are shown on the atomic page.

Note that HANd can be considered a sort of *visual clipping*, which provides a high readability. Nevertheless, unlike web clipping techniques, every single information item is kept and the end user is free to decide which elements are shown. Also, HANd can be used on any PDA, regardless of the OS and browser used, since both navigator and atomic pages use standard formats.

3.2 Implementation
The HANd generator receives documents written in any language, and processes them in two stages:

- *Preprocessing stage.* Non-XML documents (HTML, TEX,...) are converted into XML. All non-XSLT tasks are performed at this stage (e.g. computing original image sizes).
- *Conversion stage.* This stage uses a XSLT [5] interpreter and XSLT templates to generate the navigator page and its atomic pages, using the output of the previous stage. For each page, the conversion kernel decides which XSLT templates are used. Both the page and its XSLT templates are processed by the XSLT interpreter.

For non-XML contents, the preprocessing stage generates the input of the conversion stage. However, note that this conversion does not impose constraints on original WWW contents (this is not the case of WML or c-HTML).

3.3 Transformation rules

The following rules are applied to associate original page elements to their representatives in the navigator page. The XML tree associated to the original page is followed in increasing hierarchical order, ending at the root node. A quantitative analysis determines if an original element is unreadable on a small display, and the corresponding leaf node is marked accordingly. For the sake of clarity, transformation rules can be simplified as follows:

- A node is unreadable if all its descendants are unreadable.
- Unreadable nodes are replaced by representative icons.

Figure 1: Original page

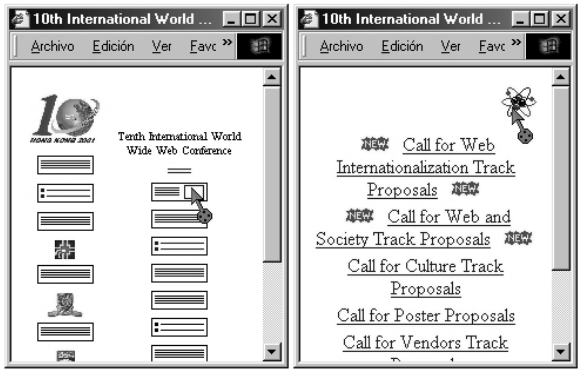

Figure 2: Navigator page and associated atomic page

- Adjacent icons are substituted by a single icon.

3.4 Example

Figure 1 shows the original WWW10 conference page as displayed on a PDA screen. Figure 2 shows the corresponding navigator page and one of its atomic pages.

4. REFERENCES

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