SemantiLynx: Using Context Based Icons for Web Navigation and Directed Search Tasks

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ABSTRACT
Typical web navigation techniques tend to support undirected web browsing, which is a depth-first search of information pages in hyperspace. This search strategy often results in the unintentional and often undesirable behavior of ‘web surfing’, where a user starts in search of some information, but is sidetracked by tangential links. A mobile user in particular would prefer to extract the desired information quickly and with minimal mental effort. In this work, we introduce the concept of ‘SemantiLynx’ to visually augment hyperlinks on web pages for better supporting the task of directed searches on both desktop and mobile platforms.

Introduction and Motivation
The fastest growing community of World Wide Web users is made up of people who use mobile devices to access the Internet. As the amount of information available on the mobile Internet continues to grow, it is essential to prevent users from wading through a morass of irrelevant content to find a single piece of relevant information. Most people use the mobile Internet for directed searches, where the goal is to find information about a predetermined topic of interest [6]. Despite the modifications and features introduced by web browsers, the primary method of web navigation is via hyperlinks. Current web navigation techniques are suited for depth-first traversal where a user first selects a link on the current page, which in turn loads a new page. The user repeats the process till he finds the needed information or the current search path is abandoned returning the user to the initial search. This process can be referred to as a hub-and-spoke strategy where the user follows a path from the start page or hub ending at a spoke, and then returning to the hub to start another spoke [2]. Backtracking often becomes difficult as the context of the search is forgotten. This loss of context serves as a cognitive overload due to the fact that both the search task and navigation trail must be held in short term memory. Users inadvertently create secondary hubs while they traverse the search space. These secondary hubs may drift away from the original search topic defeating the purpose of a directed search and leaving the user frustrated. Thus, the primary contribution of this work is creating a navigational mechanism eliminating the need for the user to constantly revisit the hub.

Related Work
Standard web design practices that aid in user’s navigation include bread crumbs and sitemaps. While these design metaphors provide a user with a sense of where they are within a website, such metaphors do not provide a sense of where the user may want to go. Several websites (e.g. http://www.ask.com) have binoculars preview icons preceding some of the URLs on the search space. However, the preview is only a scaled down version of the target page containing significant amount of unnecessary information further obfuscating the information.

Previous work has used a number of graphics techniques for various types of content search tasks. For file based search systems, several visual file icon representations exist to help make the task of finding a target file easier [9]. In the mo-
bile domain, there have been attempts to adapt content for web browsing [1]. Summary thumbnails help users identify viewed material and distinguish between visually similar areas [7]. While these papers deal with the adaptation of web content prior to loading, they do not address the issue of directed search tasks and may still lead to cognitive overload.

The SemantiLynx System
The SemantiLynx software system automatically generates icons revealing the information content of a web page pointed by a hyperlink. Due to the bandwidth and power constraints on the mobile device in particular, we off-load majority of the processing to a remote server. As the mobile phone receives HTTP responses, the data is scanned for html tags. Once it has been identified as a web page, the hyperlinks, identified by the anchor tags, are surrounded by javascript to cause a "pop-up" effect showing an image on the mobile web browser. When the server receives an HTTP request for an image, it checks its database to see if such an image is already cached or computes the icon before sending the image to the mobile device. We briefly describe the SemantiLynx icon generation process below:

Image Retrieval: To generate the icons used for the hyperlinks, we leverage the images present in the target web page that the hyperlink points to. The importance of images are based on various parameters such as relative sizes and placement. In cases where images are not present on the target page, we use standard information retrieval techniques like TF-IDF [8] to extract the keywords from the target page. The output after applying the TF-IDF weighting results in a scored set of terms based on relevance. In practice, we have found that the top 5 highest scored terms are sufficient enough for retrieving images to composite into a SemantiLynx icon. These keywords are used to query a stock image database to retrieve relevant images for compositing the icon.

Saliency Based Image Simplification: To make the images as simple and recognizable as possible, we remove unimportant visual information particularly large backgrounds. We use a simple region extraction method based on image segmentation and image saliency. To determine the salient regions, the image is broken down into three separate components (intensity, color and edge orientation) to create a bottom up model of visual saliency as described in [5]. These components are normalized based on the global maximum and combined to create a representative saliency image. In parallel, the image is run through a segmentation algorithm [3]. The importance of the segments are based on their corresponding saliency values. The more salient regions are retained to composit the final image.

Image Composition: Due to the limited real-estate of the icon, we only consider 2-3 images at a time for compositing into the final icon. A good visual composition for conveying the right information often relies on placing important elements, i.e the focal point of the design, within the visual center of a piece [4]. The graphics design rules to achieve this goal include the rule of thirds, dominance and proportion. We implement these rules in our automatic compositing technique by initially placing the highest scoring image as large as possible on the icon canvas, and iteratively adding the other images in decreasing order of importance by using a combination of resizing, blending and alpha manipulations to produce the final SemantiLynx icons. Our system can generate multiple SemantiLynx for the same hyperlink, and of which one of them is randomly associated with the hyperlink. A web designer could also decide to explicitly choose one of the SemantiLynx to be associated with a hyperlink at the design phase.

Conclusion
The outcome of the work reported here is an automatic visual technique to improve directed searching using hyperlink navigation. The system is general enough for both desktop and mobile web designers. Our initial studies show between a 10% and 13% improvement in timing when compared to using web pages without the icons. To a computer scientist long used to Moore’s law, this can seem trivial. However, one must note that this is not an improvement in machine performance, but rather an improvement in human performance, which is much harder to come by. Moreover, in areas where screen real-estate is limited, SemantiLynx provides an increase more than proportionate to the space it takes. The real strength of our approach lies in leveraging the information available on the web to automatically compute visualizations that improve human performance.

REFERENCES