The Real-World Wide Web Browser: An Interface for a Continuously Available, General Purpose, Spatialized Information Space

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Abstract

In this paper we describe an augmented reality (AR) system that acts as continuously available interface to a spatialized information space based on the World Wide Web. We call such an information space the Real-World Wide Web (RWWW). We present the assumptions we make about the characteristics of such a system, discuss the implications of those assumptions for an AR interface, and describe a RWWW browser we are building.

Keywords: augmented reality, human-computer interaction, adaptive interfaces, mobile computing, wearable computing.

1 Introduction

In our previous work, we have focused on task-specific AR systems (e.g., [1]). Recently, we have begun exploring how to create AR interfaces for general-purpose 3D information spaces, as suggested by [4]. In our current research, we are investigating the use of 3D augmented reality (AR) to envelop mobile users in contextually-relevant, spatially-registered information spaces. We envision an enhanced version of the World Wide Web, where each information object (i.e., "web page", containing 2D and 3D visual and auditory information) may have contextual meta-data associated with it, such as a location, person, or activity. This meta-data would be used to decide when and where to present the information objects to users. We refer to such a space as the *Real*-World Wide Web (RWWW), and interfaces to it as RWWW Browsers. In a RWWW Browser, web pages would be registered with real-world locations and presented to the user at the appropriate place and time.

We are particularly interested in RWWW Browsers that can be worn *continuously*, providing users with constant awareness of the information spaces they move through in their daily lives. We are interested in presenting the user not only with information that is relevant to their current location (i.e. restaurants or people near by) but any information that might be pertinent to their context (i.e. to-do items's, calendar entries, messages from friends) [3, 5]. Unlike most research in continuously-worn wearable computing, where researchers use 2D heads-up-displays (e.g., [2, 5]), the ability to place information in 3D around the user raises new opportunities and challenges. In particular, the interface design must balance the conflicting requirements of minimizing the volume of information displayed (to avoid distracting the user and cluttering their visual field) with the need to provide rich context (to capitalize on the users ability to rapidly scan and synthesize data).

2 The Initial prototype RWWW Browser

The main design goal of the interface to our prototype RWWW Browser (Figure 1) is *continuous access to, and awareness of, the RWWW.* We assume that the character of the RWWW is similar to that of the WWW; namely, it is collaboratively authored and distributed on servers throughout the world. Therefore, the content, spatial accuracy, availability, access speed and trustworthiness of RWWW content will be *heterogeneous*. We believe that information services, portals and indices (such as Fodors Restaurant Guide, Yahoo and Google, respectively) will acquire new importance in the RWWW; as the user's context changes, such services will be automatically searched by a user's Browser for information relevant to their new context. Since context is continuously changing, the set of relevant data will also *change continuously.*

Since the system is continuously worn, as in [5], but is placing information in 3D around the user, unlike [5], we have different design priorities. Our design focuses on *safety* (e.g., by not directly displaying untrusted information), *minimizing interaction* (e.g., by using context to suggest interactions, and control how

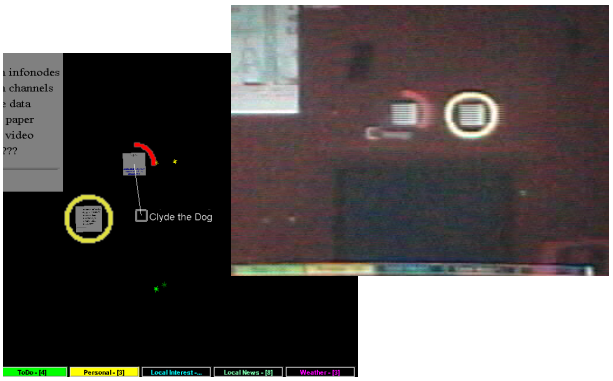

Figure 1 The prototype RWWW browser. For clarity, a screen-capture from the HMD is displayed on the left, in addition to an image taken through the HMD on the right. The link closest to the center has a text description displayed. After a short gaze, a link changes to a small thumbnail (10cm in world coordinates, with a yellow circle around it) to provide the user with more information about its content, and stays that way until a new link is gaze-selected. The current selected page is visible in the upper left corner of the display.

information is displayed), and *minimizing distraction* (e.g., by keeping the display uncluttered and minimizing unexpected changes).

Based on these assumptions and design priorities, we have developed an initial interface for our browser that focuses on providing an awareness of the amount of information available, with a coarse indication of the information content. First, web pages are organized by grouping them into related information channels (following [4]). The user can control which channels are displayed, giving them fast (but coarse) control of the amount of information in their visual space. Second, unlike previous work where detailed information such as labels are placed in the world (e.g., [1]), web pages are displayed using spatially-located anchors (currently, small "twinkling stars" that are colored to indicate which channel they belong to). This approach gives the user an indication of the amount, location and kind of information available, while minimizing visual clutter. Information that does not have detailed spatial location information, such as a page associated with a time or activity, is automatically positioned in space at a reasonable location by the Browser.

Additional information about an anchor is obtained using a simple form of two-level gaze selection, extending the approach we developed in [1] (i.e., the object closest to the center of the screen is selected). The first level (*glance*) immediately displays the title of the selected anchor near the center of the screen. The second level (*gaze*) is activated by gazing at the same anchor for a few seconds. Gazing causes the anchor to be replaced with a thumbnail rendering of the web page, and a larger rendering to be placed in a fixed location in the upper left corner of the screen. This approach allows an area to be scanned quickly to obtain more detailed information. Detailed information is always placed at a fixed location (the upper left corner of the display in Figure 1) so that users can predict where information will appear, and therefore locate it or work around it when necessary.

The system alerts the user of significant changes to the set of "relevant information" by flashing the channel indicator along the bottom of the display, but new channels are not displayed without an explicit user action. Currently, our Browser can handle any traditional 2D web page that can be rendered by the Java HTML renderer.

3 Discussion and Future Work

We have created a browser for the RWWW designed to provide continuous access to a general-purpose 3D information space while minimizing distraction and visual clutter. The design is based both on the requirements of continuous availability, and the distribution and authoring characteristics we expect the RWWW to have. While coarse organization into channels is one useful organizational technique, we are continuing to experiment with different ways of visualizing this large information space. We are also creating a simplified RWWW infrastructure that supports contextual meta-data and provides the Browser with models of the user's physical environment, to support more controlled spatialized display.

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