The BubbleFish: Digital Documents Available On Hand

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Abstract: The BubbleFish uses Augmented Reality to let its users maintain digital documents spatially in the physical environment as an alternative to the currently dominating file/folder approach in desktop based computer systems. The style of interaction provided by the document manager follows the principles of direct manipulation, but takes the issue of directness at the interface further by providing an interaction space that blends the virtual and the physical world.

Keywords: BubbleFish, Document Management, Augmented Reality, Physical/Virtual Blend

1 Introduction

One of the everyday concerns of computer use is how to store, retrieve and maintain digital documents. In today's desktop-centric computer systems, they are stored as files within folder hierarchies. Yet we often find it intricate to organize documents using this approach, because it is difficult to correctly classify documents into specific folders as some documents may belong to two or more categories or insufficiently match a user's subjective folder system (Rekimoto, 1999). For the same reasons, finding a document is also a difficult task, which is especially true for digitized data such as images, audio and video where there is currently no straightforward means to search on content.

Two explanations to the perceived problems have been explored in related work: that spatial organization is poorly supported and that the issue of time is not properly conveyed. To overcome these issues, a 3D-based spatial information retrieval system has been proposed (Card et al, 1996), as well as a one-dimensional system where documents are ordered by time (Freeman et al, 1996). These two approaches have also been considered as complementary, e.g. in *TimeScape* which combines a spatial desktop metaphor with chronological navigation in time (Rekimoto, 1999).

The work reported here recognizes and draws on these efforts, but also intends to establish a third explanation: the separation of physical and virtual spaces. Currently, the user has to organize digital documents into hierarchical folders, while at the same time manage physical documents such as papers, books, print-outs and Post-IT notes, which are often spatially organized (Malone, 1983). In today's offices, these are two very separate activities that require different approaches. The BubbleFish gives physical shape and location in the room to digital documents, e.g. pictures and word processing files, which allow the users to organize them using the same method as physical documents are maintained.

2 Managing Digital Documents

By use of Augmented Reality, the BubbleFish lets its users manipulate and move virtual representations of digital documents in and out of a computer space—the virtual stage—where they are manipulated by applications, and allows them to be placed somewhere in the room. In the current prototype a computer screen represents the stage, but through AR it could also be entirely virtually defined.

Representations of digital documents appear as bubbles, and are positioned spatially by the user in 3D somewhere in the room surrounding the virtual stage, on the user's desk, on a shelf, beneath the ceiling, to the left of the desk light, on top of a pile of other bubbles etc. The user is able to directly manipulate bubbles in the physical space, and to arrange them according to own preference in a way similar to how the user would handle physical documents, for instance according to document category, active tasks and frequency of use. The act of dragging a document out of the virtual stage by hand and placing it in the room equals the save

command. When the user wishes to put a stored document to use, to open the document, the corresponding bubble is grabbed from somewhere in the room, moved and released in front of the virtual stage.

3.1 Defined Spaces

Users of the BubbleFish may also configure *defined spaces* in the room for special purposes. For instance, a physical trashcan may also be used to obliterate bubbles, and a printer the defined space to place documents to be printed. The office window could be defined as a shared space, to share bubbles with other users.

3.2 Different Views

Making virtual objects appear physical, rather than actually being physical, easily allows for different *views* on the stored documents. In the aquarium view, the default mode, the spatial location of the bubbles is completely controlled by the user. While the current prototype does not support additional views, future versions of the BubbleFish would benefit from e.g. a search view, in which the bubbles may be reconfigured by the system according to search results and visualized in different ways. The user should also be able to define task views, in which certain bubbles are reconfigured according to the needs of a specific task. The time view would reconfigure the bubbles in terms of their age.

4 Current Status

The BubbleFish document manager is consistent with the design principles of direct manipulation (see Shneiderman, 1983). However, the BubbleFish holds a substantial amount of directness at the interface not generally found in other systems that rely on direct manipulation. Here, the users do not merely control representations of themselves in a virtual space, e.g. through a mouse pointer. Rather, the BubbleFish provides representations of itself outside its realms, and lets the user manipulate these directly in the physical world. Hence, a blended space of the physical and the virtual is provided in which both the user and representations of digital information subsist and interaction takes place.

The current implementation uses the ARToolkit developed by the HIT Lab at University of Washington, Sony Glasstron personal display glasses and a head-mounted camera. The ARToolkit's approach to vision based AR has several limitations that constrain further development of the BubbleFish. The key concern is that it requires physical representations in terms of a printed pattern for each bubble, which in practice impedes free positioning of the bubbles in the 3D space. To resolve these issues, a more advanced prototype is in development that will be based on tracking of the user's head and hands.

We also plan to add sensors for the physical environment, so that the user can keep certain bubbles in a drawer or a cupboard, which only become visible when open.

Albeit preliminary in-house tests have been promising, a substantial amount of usability evaluation will have to be carried out in order to state to what extent the BubbleFish document manager is feasible in real-life situations.

5 Conclusion

The BubbleFish document manager uses AR to allow representations of digital documents, bubbles, to be placed freely in the room by a user. The user saves a document by physically moving it out of a virtual stage into the room, and opens it by moving it back into the stage. Defined spaces are provided to give physical objects and places in the room virtual functionality, and views that allow bubbles to be repositioned according to searches, tasks and time. Hence, the BubbleFish provides an interaction space that is a blend of the physical and the virtual.

References

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