Design for Collaboration on a Table-top Display in the Home

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ABSTRACT
In this paper we discuss design issues for a domestic table-top display application supporting co-located collaboration. We present an application scenario dealing with manipulation of picture collections and illustrate some preliminary ideas.

Keywords

Ubiquitous computing, interaction techniques, table-top displays, collaboration.

1. INTRODUCTION
The pervasive introduction of display capabilities into our environments promises to effect the way in which we interact with digital information, physical information, and with each-other. The FLUIDUM project [1] investigates interaction techniques for instrumented environments, i.e. environments where computing and displaying capabilities are embedded in the space, in ubiquitous computing scenarios of different scales. Everyday life environments are investigated, which do not necessarily include just the working domain. The current position paper focuses on the design issues for table-top displays for domestic environments and proposes some preliminary solutions which we would like to discuss during the workshop.

2. PROBLEM STATEMENT: A TABLE-TOP DISPLAY FOR THE HOME
The distribution of large displays and their impact on collaboration and social patterns has mostly been investigated in the working domain. Vertical large displays provide affordances for shared visualization and do not cause orientation conflicts, but hinder active multi user simultaneous interaction. The physical affordances of the table seem to provide social affordances [5] suitable for co-located collaboration: in particular, it seems that the horizontal orientation of the display is raising more discussion, which is the parameter mostly adopted to assess co-located collaboration.

When trying to envision the impact of display technology and possibilities in domestic environments it makes sense to look at scenarios of social interaction and collaboration within the households, and to look at activities that typically involve more people and take place around the table. Browsing, filtering, and sharing of physical picture collections are some of those. Families have often gathered together to browse through the pictures kept in old shoe boxes, look at travel slide shows, select the pictures to compose and possibly annotate a photo album, or to frame them and hang them as decoration. The rapid shift of photography from analogue to digital has enhanced the sharability of pictures over distance and time, and their fast inexpensive copying and editing in size, resolution, colors, etc.: on the other hand the display of a personal computer does not provide social affordances suitable for co-located sharability within the household, thus hindering discussion and sociability.

Besides the screen size, a main limit is the single-user manipulation of the media collection, which does not allow, for example, to create collections collaboratively and to search for pictures with different criteria by different users. In this sense our design of an interface for a table-top display aims to accomplish the goal to share the visualization and manipulation of digital picture collections among different users, preserving and augmenting the social collaborative aspect.

3. DESIGN ISSUES
Defining the design space asks for taking into account the following issues:

- **design of a new interaction style**: interaction with mouse and keyboard proper of the WIMP paradigm do not provide the social affordances suitable for the collaborative scenario. Alternative interaction styles should allow for multi-user simultaneous input. Further more the physical affordances of the table support objects, and people naturally put both their hands and elbows on the table, thus suggesting the appropriateness of bimanual interaction;
- **visualization:** sharing an information landscape requires people to share a spatial arrangement of information in order to have references. On the other hand people have different perspectives and can look for information with different criteria. In this sense the visualization should accomplish both general contextual view and allow for personal focused visualization and interaction area. Maintaining visibility of other users' personal actions and visualizations supports reciprocal awareness and discussion. In addition, control areas should be independent from the display real estate geometry. As a consequence, a linked-views display, proper of existing softwares such as Photofinder [2], would not be appropriate, as the interaction would be possible only in fixed portions of the table surface. In order to support the casual arrangement of users around the table, users should be able to define their personal interface and interaction area, according to their location and area of reach.

- **application design:** softwares such as Photofinder [2] and Picasa [4] allow for browsing, filtering, annotating media collections. Picasa also allows for basic editing of the picture data. None of them though supports multi-user interaction, as the specification of filtering and sorting criteria automatically reconfigure the visualization of the information landscape. When specifying the features of our application we focus on collaboration: in this sense we aim to a casual way of browsing, filtering, selecting, based on gestures which are compliant with direct manipulation, thus avoiding detailed editing operations. The latter seem to be more suitable for individual interaction, in which keyboard input does not conflict with the collaborative setting.

4. FIRST SOLUTIONS

In order to cope with the issues above, we have been working on possible solutions, illustrated in the mock-up presented in the annexed page. In the envisioned scenario two users collaboratively search for pictures (see Figure 1) across multiple collections of digital pictures in order to compose a shared collection: this could then be displayed somewhere else in the environment, for example as decorative wallpaper on a vertical domestic display.

Each collection is visualized as a pile of pictures chronologically sorted, in analogy to the visualization suggested in [3]: the picture in the foreground is the most recent one of that collection, while the others in the background appear as slightly rotated on the perpendicular axis driving through the center of the foreground picture (see Figure 2). As the pile lets visible small portions of the pictures underneath, people can more easily recognize what is possibly piled in the collection.

Each user has a small physical input device that can be placed on the table (Figure 3), thus triggering the visualization of an overlapping graphical interface. With such device the user defines and moves his/her personal interface: as working with a transparent lens, the user can move the device on the different collections (Figure 4). When overlapping such lens on a pile (i.e. a picture collection), the latter unfolds in thumbnails visualization (Figure 5). Only the pictures that correspond to the filters specialized in the left region of the movable personal interface are visualized. This allows users to browse through the collections applying personal searching criteria, which can be different among users, as it actually happens in real life.

The affordances of the input device, working on the familiar mechanism of the bike chain, or of the scissors for example, support the intuitive reduction and increment of the distance between the fingers: this movement is mapped to the zooming of the visualization (Figure 6). When the fingers get closer and the angle of the input tool gets smaller, the pictures are zoomed in.

The interaction technique supports bi-manual interaction. When manipulating physical objects our hands cooperatively work: typically the non-dominant hand defines the interaction space on a macro metric level, while the dominant hand works on detail, on a micro metric level. As one hand is locating the lens on the surface and arranging the zooming factor, the other hand can manipulate the pictures in the visualization. With the right hand users can select pictures and drag them in the lower opaque portion of the personal interface: in such a way temporary collections of pictures can be created, such as in a tray, and the user can proceed selecting and collecting pictures across different collections (Figure 7). This aspect is relevant in terms of collaboration as it allows users to share pictures and create new combined collections in a second step.

On the left opaque portion users can define and apply filters. In order to define filters they can write in the scribbling area on the top of the list and add a tag (Figure 8), which will be listed in the filters column. Further more they can directly tag pictures by dragging the tag on the picture, in analogy to the direct manipulation enabled by Photofinder [6]. This implies that if another user is applying the same filter when browsing through the same collection, such picture will be visualized in the lens. Thus, tagging pictures has also a collaborative value and contributes to raise discussion.

5. DISCUSSION

The work we presented is at an early stage: several technical and design issues remain open, which we would like to discuss during the workshop. The accurate interpretation of the position and of the opening angle of the input device, together with the detection of multiple simultaneous input, are still unsolved.

On a design point of view, additional considerations need to be taken. The ergonomy of the whole collections arrangement plays a decisive role to make sure that the arrangement of numerous collections on the table allows the users to reach and interact with each of them, without triggering a Midas golden touch effect.

Furthermore the design of the personal interface needs to accomplish different visualizations and provide affordances for bimanual interaction. The collaborative setting also implies to design solutions enabling the handing over of pictures to other users and the creation of new co-created collections.

6. ACKNOWLEDGMENTS

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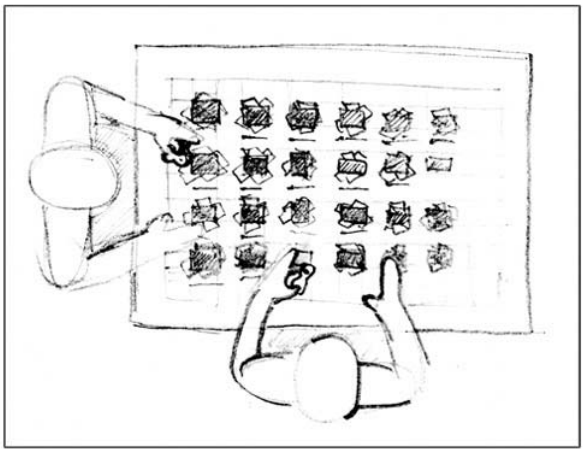

Figure 1

Figure 2

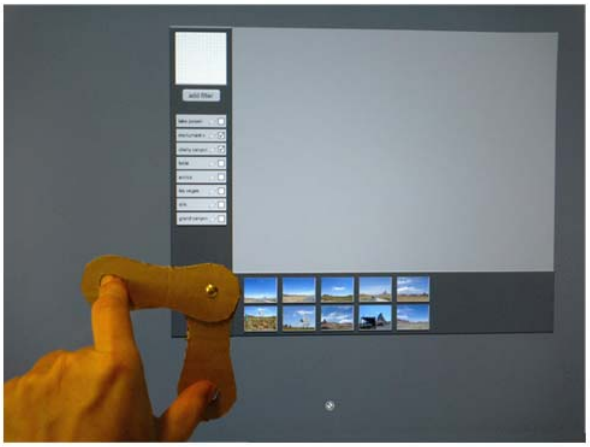

Figure 3

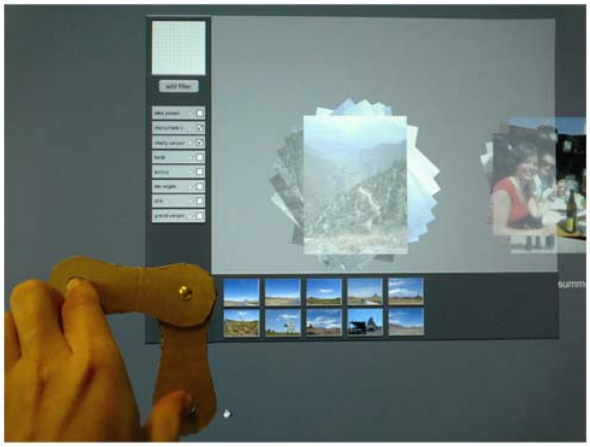

Figure 4

Figure 5

Figure 6

Figure 7

Figure 8