A Visual Interface for Multi-person Exploration of Personal Databases

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Abstract

The Personal Digital Historian (PDH) is an ongoing research project aimed at allowing groups of people to casually browse, embellish, and explore large collections of their personal data, such as pictures, video, or more business-related items such as spreadsheets or PowerPoint slides. Our initial prototype system is designed for a tabletop display and to be used while people are talking to each other. In this paper, we focus exclusively on describing those aspects of our project which provide a visual interface to support exploration of a database of personal data. The interface allows people to organize their images along the four questions essential to storytelling: who?, when?, where?, and what? Users are provided with a wide variety of flexible interaction methods, including region of interest query specification with in-place freeform stroke input, image-based book marking, suggestion generation via automatic query relaxation, and output summarization. With this interface, the users can enjoy their conversation while having the photos at their finger tips, rather than being distracted by the effort of formulating queries.

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ABSTRACT

The Personal Digital Historian (PDH) is an ongoing research project aimed at allowing groups of people to casually browse, embellish, and explore large collections of their personal data, such as pictures, video, or more business-related items such as spreadsheets or PowerPoint slides. Our initial prototype system is designed for a tabletop display and to be used while people are talking to each other. In this paper, we focus exclusively on describing those aspects of our project which provide a visual interface to support exploration of a database of personal data. The interface allows people to organize their images along the four questions essential to storytelling: who?, when?, where?, and what? Users are provided with a wide variety of flexible interaction methods, including region of interest query specification with in-place freeform stroke input, image-based book marking, suggestion generation via automatic query relaxation, and output summarization. With this interface, the users can enjoy their conversation while having the photos at their finger tips, rather than being distracted by the effort of formulating queries.

Keywords

Multi-person interactive visual interface, table top display, visual navigation, personal databases.

1   INTRODUCTION

One of the best parts of life is sharing experiences with others, whether it be with family over dinner, friends we see occasionally, relatives who live far away or colleagues whom we work with. People often use records of their past, such as photographs, videos and electronic documents, to help tell their stories. Recent advances in technology have made it possible, and perhaps soon nearly unavoidable in many parts of the world, to amass large collections of digital recordings of our personal lives. The overall goal of our ongoing PDH project is to help people effectively and intuitively organize, navigate, browse, present and visualize this data in an interactive multi-person conversational setting.

In this paper, we focus on aspects of the PDH project that provide a visual interface to personal databases. Other research topics within the PDH project, including how to orient, layout and visualize information on a shared display, how to annotate the data, how to provide rich support for storytelling, and how to compose and maintain personal histories of individuals or groups, are beyond the scope of this paper.

In general, almost all research in how to support experience sharing with digital data suffers from the limitations of current display technology. Indeed, while digital photographs are easier to share remotely than physical photographs, they are much more difficult to use in face-to-face conversational settings. Desktop computers force people to face the direction of the screen, which often is not natural in a conversational setting. Handheld devices can only support the simultaneous viewing of the same photo by at most two people comfortably side-by-side, and the size of the screen only allows a few images to be clearly viewable at once. Motivated by these considerations, our decision is to use a tabletop display. Figure 1 is an artistic rendering of our envisioned system with a circular display area. The document orientation, visualization and layout issues brought about by such a circular display surface have been discussed in [19].

Figure 1: **The PDH table.**

1.1   4 W's: The Organization Principle

Given the envisioned interactive and exploratory applications, our primary method of photo database indexing, organization and navigation is derived from the four questions essential to storytelling: who?, when?, where?, and what? Control panels located on the perimeter of the user interface contain 4 buttons corresponding to these alternatives for organizing information.

Who and *What*

People often remember and recall their experiences by the person(s) or events in them. When a user presses the "Who" button, PDH displays a view of the people who appear in the photos in the database. For each person, PDH displays a portrait of that person (specified by the user, or chosen automatically). The view initially displays all portraits in black and white. The users can form queries by selecting or deselecting people's images. Selected portraits are shown in full color. The Who button on the control panel also lists the names of the people that have been selected as shown in Figure 2. This both reminds users of what the current selections are, and allows them to easily retract these selections by touching the names on the button.

Of course, all the people in the database might not fit on the screen at once. We allow users to hierarchically group images. A user might, for example, put all their work colleagues in a single group, or further subdivide that group into smaller groups. We describe our techniques for managing the structure and layout of the hierarchy in [19].

The What view closely resembles the Who view, but allows users to organize and query their photos based on the objects and events recorded in those pictures, rather than the people who appear in them. The users can chose an image to represent the object or event, and can select and

deselect the events and objects in the same manner as selecting or deselecting people in the Who view.
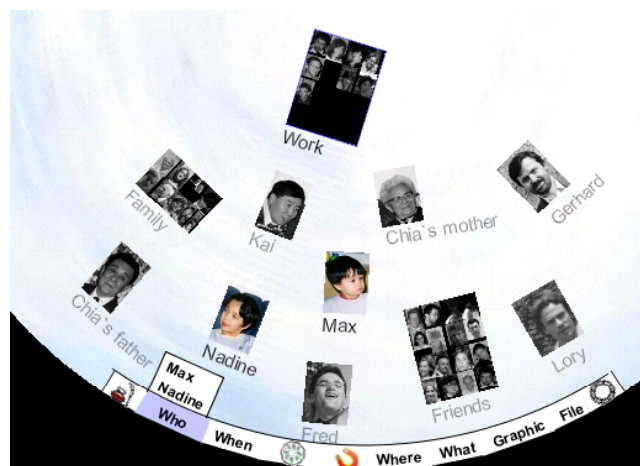

Figure 2: A close-up view of the **Who** view.

Where

It is a pleasure to be able to visualize where one has traveled or lived, or who we have traveled with or moved with, through the years. When a user presses the "Where" button, PDH displays a map of the world. Every picture in the database that is annotated with a location will appear as small thumbnail at its location as shown in Figure 3. The user can pan and zoom in on the map to a region of interest, which increases the size of the thumbnails. The user can also select regions of interest. By touching an icon on the control panel, a user essentially turns their finger into a "freeform stroke" tool, which can then be used to identify a region on the map. The user can disable this request by pressing on the name describing the selected region, which appears on the Where button.
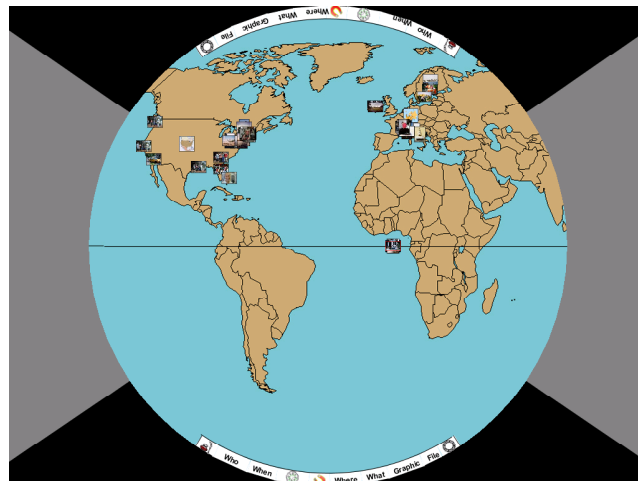
Figure 3: The **Where** view with geographic registration of photos.

When

Time passage is one of the most memorable and noticeable aspects of people's lives. By pressing on the When button, the user can indicate to the system to retrieve the pictures to be viewed by the time they were taken along a linear timeline as shown in Figure 4. A user can press on any photo in the calendar view to enlarge that photo. In the When view, users can pan and zoom into region of interest they select. This is needed for the case in which the entire calendar contains too many years to be simultaneously viewed on the display.

Figure 4: The **When** view with in-place freeform stroke input to mark region of interest**.**

Implicit Query Formulation

The 4 W's described above are navigation views, selections made in each of these views are easily combined automatically by the PDH system to form richer Boolean queries.

More precisely, the selections made in any of the four views will result in a subset of the images to be highlighted and prominently displayed in other views. The semantics of selecting people, for example, is to tell PDH to highlight only those images containing at least one of the selected people. For example, if a user selects two friends in the Who view, and then switches to the Where view, then they would see where they have traveled with either of these friends by observing where the highlighted pictures appear on the map. If the users select several people in the Who

view, and several objects in the What view, then PDH will highlight only pictures that contain at least one of the selected people *and* at least one of the objects. We found this AND/OR semantics to be the most natural way to quickly form queries. Similarly, the users can select regions of interest in time or space with the When or Where views.

1.2 The "Free Space" View

There is a fifth view available to users in which photos are not organized by any particular dimension. Pressing the "Show" button on the control panel tells PDH to retrieve and display the photos in the user's collection that match all the constraints the users have specified by selecting items or regions of interest in the four W views described above. An example of this view is in Figure 7. Thus, if a user wants to see all and only pictures of her grandmother taken in Paris in 1995, then she can specify those constraints in the Who, Where, and When views, and then press the Show button. PDH will then switch to the "Free Space" view and display the relevant pictures. Our research in PDH has generated some initial visualization and layout techniques for documents and images for this Free Space view. They are reported in [13, 19].

2 TRANSITIONAL STRATEGIES AMONG NAVIGATIONAL VIEWS AND DOCUMENT VISUALIZATION

The overall goal of PDH is to enable casual usage of computers as an intermediary in conversational settings. Smooth transition among navigation, browsing, retrieval and viewing activities in the user interface is the key. Our PDH design objective was aimed at supporting interactive conversation, whether it be social or professional in nature, without distracting the users with interface operational mechanics. Conversation flows and wanders and often follows several interleaved threads. It also is easily disrupted. We now describe several aspects of PDH intended to minimize the distraction of the users, encourage conversational wandering, and support smooth transitions to new topics as well as the return to previous ones.

2.1 Freeform Stroke as Region of Interest Input Method

Freeform stroke is a natural and intuitive way for users to select regions of interest. Certain data and information lend themselves very well to *in-place* freeform stroke as input method for specifying range queries. In PDH, this applies to all the 4 W views. In the following, we briefly describe how

this input method is applied to the When and Who views as examples.

For the When calendar view as shown in Figure 4, we translate the points along the path of a freeform stroke into min/max points on the linear calendar (i.e., on the time axis). For grouping of hierarchies in the Who view as Figure 5 shows, the polar coordinates of every photo currently displayed on the table is transformed to find the center of each image in the Cartesian screen coordinate system. Then it can be determined whether an image is inside or outside the freeform stroke drawn. The system automatically completes the unfinished open strokes drawn by users. However, because such actions are often discussed between users around the table, the produced stroke must be understood by both the computer and the other users. It is interesting to notice that naturally all the persons who tried the system (even the implementers) produce circles or ovals.

Figure 5: The Who view with in-place freeform stroke input for grouping contents.

2.2 Association Generation Using Query Relaxation

Association is used as unobtrusive reminders of related events to the users. Our system will optionally project a slowly moving stream of pictures along the unused portions of the perimeter of the table. These pictures are one way in which computers can add value to experience sharing by suggesting related information, either from the users personal information or from more public sources (e.g., the web), that might be related to the context and content that are specifically requested by the user. A simple form of this can simply be to randomly show photos that were taken at similar locations or times as the other photos that are being displayed. As another example, when looking at a picture of one's grandparents, the PDH might bring out images and

passages that related to historical events around the time the pictures were taken.

Figure 6: Free Space display with Association generation.

In the current system, we present a static association ring according to the set of pictures on the table as shown in Figure 7. It corresponds to the result of a disjunctive variation of the query which was used to retrieve the images on the table. By replacing the AND constraint with an OR constraint, we obtain related images in the resulting relaxed query. Since the images are often grouped by events and/or time which does not provide the diversity of data we would like to see in the association ring, we need to post process the set of resulting images. First we remove the images already on the table from the relaxed query results. The second process randomly permutes the order of elements to present a representative set of images instead of just displaying the first N images returned by the database.

2.3 Image-based Visual Book-Marking

During a conversation, people often branch out to different topics and threads, and then come back to some previous discussion point. Current user interface technology typically keeps a linear history of some sort with text-based book marking, and/or a *back* button. We propose an image-based book marking function which records both the contents retrieved from the database plus the visual layout as individual objects for later recall.

Here we allow the user to choose an item on the viewing display as a landmark (e.g., an image or a document), which will be used as an entry in the PDH bookmark method, and can then be memorized by the user for easy re-use. The advantage of this image-based bookmark technique is analogous to how people remember places where they have traveled to by noticing landmarks. We

have chosen to not use a thumbnail screenshot of the entire display as the bookmark because, when zoomed out, all the displays look the same visually as a colored blob. What is really important in a bookmark is the differentiation of the individual memorable entries.

We provide a drag&drop operation of any document to the bookmark area. Although the main PDH content display area is circular, we actually use a rectangular table top since most of the tables in our daily environment are rectangular. We use the rest of the rectangular area outside the circular interface (the black and gray area in Figures 2 – 8) as *private* space for users. Figure 8 shows an example of this image-based book-marking function. The photo with the large Swedish horse is moved to the private space as the bookmark by the user.

We are currently also working on a new non-menu driven query metaphor in PDH. It is invoked when the user presses and holds down a particular image in the Free Space. The system then offers the user the ability to show photos taken at a similar time, a similar place, or with the same people, or at the same event, or some other similarity metrics as the selected picture. Thus, in this feature, any photo of present focus can be used as a "retrieval key".

Finally, we are also working on is a facility to allow users to pre-author stories as part of ongoing browsing activities. This feature will be constructed by creating editing and start&stop capabilities for a combination of the image-based bookmark function and automatic user event record&replay function.

Figure 7: Image-based book marking**.**

Figure 9: PDH Table prototype**.**

3 CONCLUSION AND FUTURE WORK

We are in the process of constructing the initial PDH prototype. Except for Figure 1, all figures in this paper are actual screen shots of our current working prototype. The PDH prototype user interface is being implemented using Java on Windows 2000. The digital photo library is based on Microsoft Access™ Database. The PDH interface translates user's visual requests into SQL commands. A tabletop display with top projection onto a sturdy standard whiteboard as shown in Figure 9 is currently used as the physical PDH table.

In this paper, we have assumed that digital photos have been automatically annotated with the time when they are taken and the location by GPS where they are taken. Given the advance in digital camera technology, this is a realistic

Figure 8: Popup keyboard for group naming.

assumption. We also assume that the photos in the database are partially annotated with the name of the people in the photo and the occasion/events the photos are about, e.g., trips, birthdays, and holidays. As part of the PDH project, we are also carrying out studies on user annotation of their data.

We have collected substantial database contents for both group histories and personal recordings so far. Since the PDH system is designed for people to share stories, meaningful contents are those that a user owns and cares most about. Our first large-scale evaluation of PDH will be to use it create a group history of our research lab. Over the past few months, we have conducted interviews, made audio recordings, and gathered photos and electronic technical documents. We have also collected historical data to supply background and context for our group history. In the next few month we will carry out user studies in which, for example, people who have been at the lab for a longer time will use PDH to tell newer members of the lab about its history, followed by the newer members relating the stories they have heard to other people. Additionally, many of the researchers working on PDH are also collecting and annotating their own digital collections.

4 Acknowledgement

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