PhotoArcs: A Tool for Creating and Sharing Photo-Narratives

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Project Goals

The goal of the PhotoArcs project is to enable photographers to add narratives to their online photograph collections in a way that closely mimics face-to-face sharing patterns. Using PhotoArcs, users can organize their pictures into linear arcs connected by textual narratives. Users can also view the ways in which their narratives intersect with others' narratives, create and view multiple versions of a particular narrative for different audiences, comment on others' narratives, and more. These interactions introduce a nonlinear element by providing jumping-off points or tangents from their own narratives.

The project is heavily influenced by our ongoing investigations into the social uses of photographs [22, 23]. We have found that one of the primary uses of photographs is for sharing, where sharers construct narratives around the photographs they show which then reinforce relationships and group identity [1, 8, 19]. One of the advantages of face-to-face photo-sharing is the narrative flexibility the sharer (and recipient) has: the sharer can change the narrative depending on the recipient's interests and reactions, and the recipient can chime in with comments or additional stories. Existing digital photo-sharing mechanisms do not enable this kind of flexibility, interaction, and play. Our goal is to extend the flexibility of online sharing into a digital medium.

This project is also inspired in part by Geoffrey Bowker's talk on September 28, 2005, as part of the SIMS Distinguished Lecture Series. Bowker posited that the concept of Perfect Memory is rare and often difficult to achieve, particularly in digital media where end products, not narratives, are often stored, and the process of creation is lost. Our project attempts to visualize and save some of the usually-ephemeral narratives created during photo-sharing.

Finally, the PhotoArcs project is inspired by other examples of "ludic technologies" [12] – technologies that are designed to invite playfulness and exploration. In particular, Gaver et al. explains that storytelling itself is a "ludic" activity [13]; thus, the PhotoArcs interface should support the playfulness of narrative creation.

Our interface will support the following tasks:

- Construction and modification of photo-narratives using interactions that are as intuitive as possible, such as drag-and-drop of photos and input of text on the line between them;

- Views of other related photo-narratives that use photos one has also used in one's own narrative (in other words, other PhotoArcs that intersect one's own);

- Multiple views of photo-narratives, including an overview of all arcs and a photo-level detail view; and

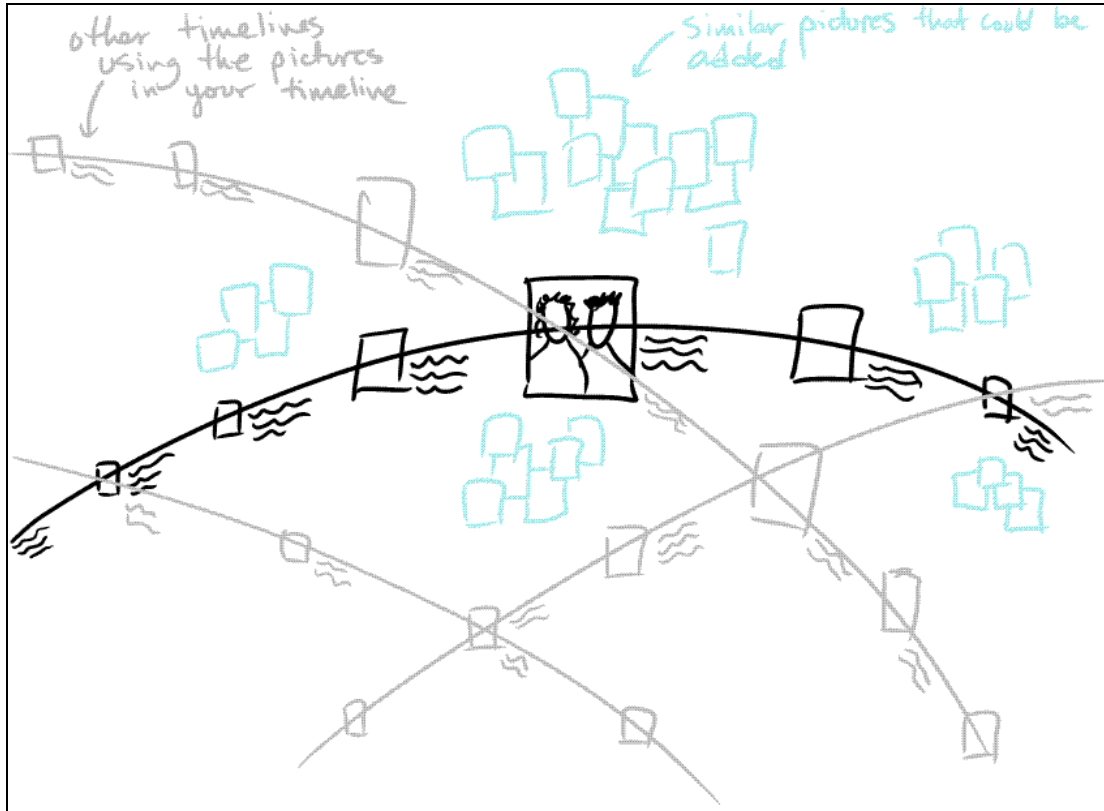- The ability to comment on others' PhotoArcs to provide feedback and co-construct narratives.

Figure 1. A screenshot from a preliminary brainstorm for the PhotoArcs interface

Related Work

The human-computer interaction community has long been working together to tackle the problem of digital photograph storage and sharing, though few interfaces have focused specifically on narrative-creation for sharing. In addition, researchers in sociology, anthropology, visual studies, and cultural studies have explored personal photography and narrative creation (especially for prints in albums), many elaborating on the ways in which it contributes to identity creation, communication, or other social actions. In this section, we will first discuss the research on photography that has been done in human-computer interaction, particularly the research on photo-sharing applications and timeline applications. We will also discuss several popular online photo-sharing methods for purposes of illustration. Finally, we will summarize the research in social science that relates to photo-sharing and narratives.

Digital Photography

Many tools exist to help people organize and retrieve their digital photographs, though few explicitly help in sharing and only one explicitly supports the creation of narratives for sharing purposes. Bederson's PhotoMesa interface provides a unique photo visualization using quantum treemap organization and "focus+context" interaction (Figure 2a) [6]. PhotoTOC [20] and Timequilt (Figure 2b) [17] use representative thumbnails to provide an overview of pictures and organize them by date. Harada et al. also provide a timeline interface and an event-based interface for interacting with photos on PDAs [15]. Photofinder (Figure 2c) enables annotation of parts of a picture for searching and "storytelling" purposes. MediaBrowser (Figure 2d) integrates many of the above ideas and provides many views, including a time-based view, and many interaction mechanisms, including a two-level fisheye and easy selection by group or keywords [10]. Fotofile (Figure 2e) incorporates narrative-making, as well as bulk annotation, a hyperbolic tree view, and some automatic feature extraction, into a digital album-making system, but for the purposes of archiving rather than sharing [18].

Some tools exist to assist in the creation of narratives. CounterPoint is a zooming presentation tool that allows users to define multiple narratives through slide-based presentations [14]. Balabanovic et al. created a tool explicitly for narratives and sharing digital photos (Figure 2f) [5]. Audio can be recorded over a photostream to create a multimedia narrative. These images and audio files can be sent to distant others, though the interface is best with copresent others (particularly because recording audio without an audience synchronously listening is awkward and reviewing audio is cumbersome).

Picasa [4] and other commercial photograph organizers also provide some of this functionality. Picasa in particular gives a timeline view of all photos, similar to the preliminary sketch of our interface above (see Figure 3a).

Several of these interfaces – particularly the tool developed by Balabanovic et al – address the issues of narrative formation and photo-sharing. The PhotoArc interface is unique, however, in providing an intuitive timeline view of the narrative, enabling the creation and viewing of multiple overlapping narratives, focusing on photo-sharing, and allowing flexibility in narration and response. The other photo-organization techniques summarized here could provide a framework for navigating among photographs in the PhotoArc system that are not currently on PhotoArcs.
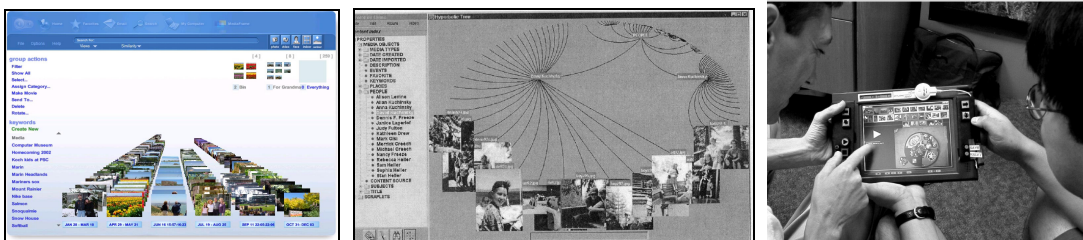

Figure 2. a) PhotoMesa, b) TimeQuilt, c) PhotoFinder, d) MediaBrowser, e) Fotofile, f) Balabanovic et al's photo-narratives interface

Timeline Interfaces

As mentioned above, Picasa provides a photograph timeline view in its interface (Figure 3a), and many photo systems organize photographs chronologically. Flickr's "Organizr" interface provides a clickable summary timeline with sliders along the bottom of the screen (Figure 3d). Closer to home, the MMM2 developers created a timeline view of MMM2 photographs to use in photo-elicitation interviews with MMM2 users last summer [21]. Beyond the photographic realm, the filesystem Lifestreams is built on a chronological storage and retrieval model [11], and now Nokia provides a similar system in its LifeBlog software (Figure 3c), which automatically captures SMS and cameraphone pictures and organizes them chronologically.

Because most people organize their photographs chronologically and because photographic storytelling progresses in a linear fashion – even though the course of progression may change from one telling to another – we chose to use the timeline metaphor for our PhotoArcs interface.
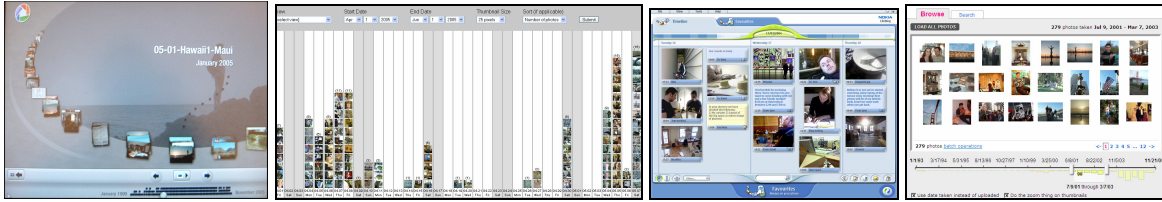
Figure 3. Examples of timeline interfaces: a) Picasa, b) MMM2, c) LifeBlog, d) Flickr

Photo-Sharing Media in Use

Many sites are dedicated to photo-hosting and photo-sharing. We will not attempt to be exhaustive in our descriptions since the number of photo-sharing sites and applications is very large. Instead, we will discuss two particular examples – Flickr [3] and narrative photoblogs – that are similar to many of the others and also call attention to who of the most common modes of online photo-presentation, one with a focus on photos and the other with a focus on stories.

Flickr and other sites geared specifically to photo-sharing allow the user to upload and annotate individual photos, to sort them into sets, and to annotate the sets themselves. However, users generally cannot create a narrative unit out of a set of photos that can be viewed all on one page. For example, consider a series of photos on Flickr titled "The Adventures of Bat Barbie" (Figure 4). Each photo has a description of what the fictitious character is doing, but there is no mechanism for encouraging users to tell a story from one photograph to another, and no way for viewers to get an overview of this narrative.
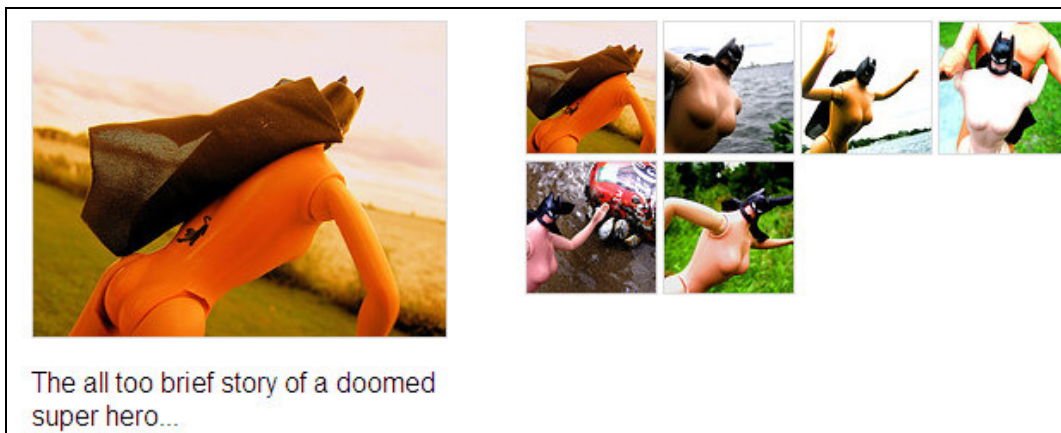

Figure 4. An online photo-narrative that could benefit from PhotoArcs: "The Adventures of Bat Barbie" (http://www.flickr.com/photos/lemonhound/sets/1372462/)

Many tech-savvy photo-sharers are getting around the limitations of online photo-sharing sites by creating photoblogs. While some photoblogs consist entirely of photographs that have no narrative or an implicit narrative told through the sequence and subject matter of the photographs themselves, others combine the narrative potential of blogging with photo-sharing to create rich online photo-narratives (Figure 5). Narrative photoblogs in particular are the most similar to the interface we are proposing, and such narratives could potentially be automatically converted into PhotoArcs. However, the general model for blogging is that there is only one author for a particular narrative, comments appear at the bottom rather than interspersed throughout the narrative as they would be in face-to-face sharing, and most bloggers don't alter their original story based on the comments they receive. The PhotoArcs system is intended to be easier to use and to enable a higher degree of interactivity between the storyteller and the listeners (or co-storytellers).
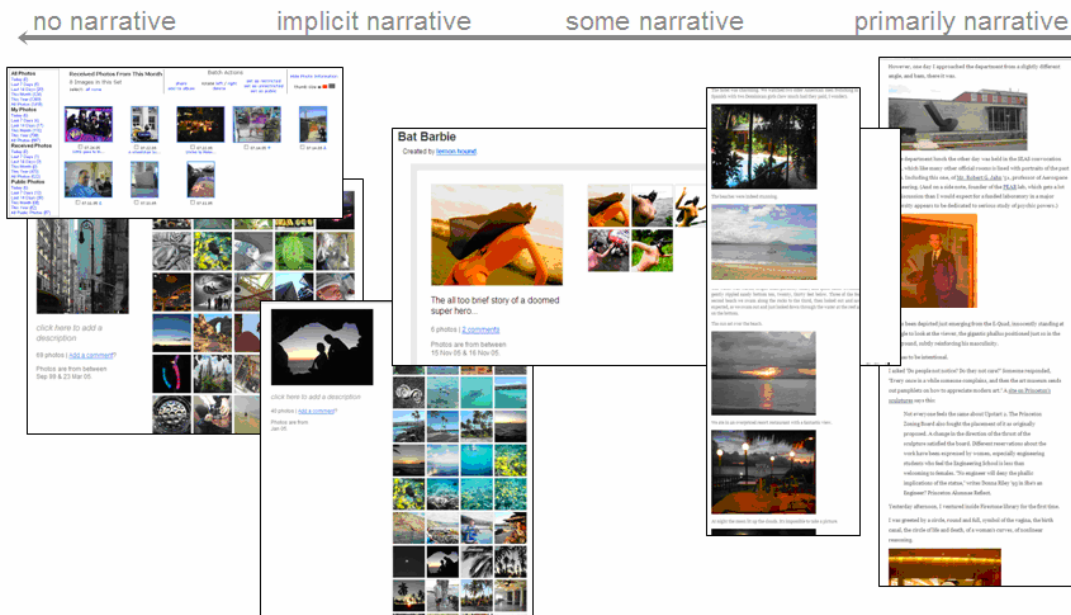
Figure 5. Examples of online photo-albums and narrative photoblogs, ranging from having no narrative to being primarily narrative

Research in the Social Sciences on Photographs and Narratives

In addition to this work in HCI, research in areas such as sociology, anthropology, visual studies, and cultural studies address photography and photo-sharing as a social activity. Chalfen [8] and Musello [19] both conducted ethnographies of family photography, focusing on interviews and family albums. Chalfen found that "snapshots" served three roles: artifacts of social communication, vehicles for constructing memories, and signs of cultural membership (by establishing and reinforcing what is considered "photo-worthy"). Musello found that the narratives created around family photographs and photo-albums played an important role in a family's ongoing narrative and its group identity. Both Chalfen and Musello found that people shared pictures face-to-face, through albums or slideshows. In corroboration, Bruner [7] discusses the role of narratives in identity formation, reinforcement, and performance:

> Even our own homely accounts of happenings in our own lives are eventually converted into more or less coherent autobiographies centered around a Self acting more or less purposefully in a social world. Families similarly create a corpus of connected and shared tales … Institutions, too … 'invent' traditions out of previously ordinary happenings and then endow them with privileged status.

In 1995, just as digital photography adoption started to take off, cultural theorist Don Slater predicted more communicative uses of images and expressed a "utopian hope" that in the future people would be able to tell their own stories photographically [1]. In our recent research, we found that cameraphones connected to internet-based sharing led to exactly these outcomes, as people sent one another images as messages and posted them online [21]. The most common audience for photo-sharing is others who were at the same event or those that "should have been there" (as one interviewee stated) – people who know those who were at the event and have an interest in finding out the details of what happened. Another common audience is distant family and friends who may not have as much invested in learning all about a particular event as just "keeping tabs" on each other through more general stories and images. Finally, some present their photographs to strangers.

Despite this rise in internet-based sharing, we have found that people value prints more than digital photos and prefer an element of human interaction and feedback in their photo-sharing – the best being

face-to-face, but also over the phone or through email or instant messaging [23]. As more people adopt digital cameras and start wanting to share photographs with distant friends and family, the need for easy-to-use photo-narrative tools such as PhotoArcs that combine the advantages of face-to-face sharing and online dissemination becomes ever-greater.

The PhotoArcs Visualization

Description

The PhotoArcs visualization aims to leverage the convenience, flexibility, and fun of face-to-face sharing along with the persistence and easy remote sharing of online interfaces to encourage users to create digital photo-narratives. These photo-narratives take the form of timelines or "arcs" to take advantage of the strong chronology of photographs and further encourage narrative creation and interaction on a photo-by-photo and story-by-story basis, similar to the interactions in face-to-face sharing. Photos that are re-used in different narratives appear at the intersections of the respective arcs in the interface (Figure 6), allowing the storyteller or the listener to follow tangents of the main story and thus introducing a nonlinear element into the narratives.
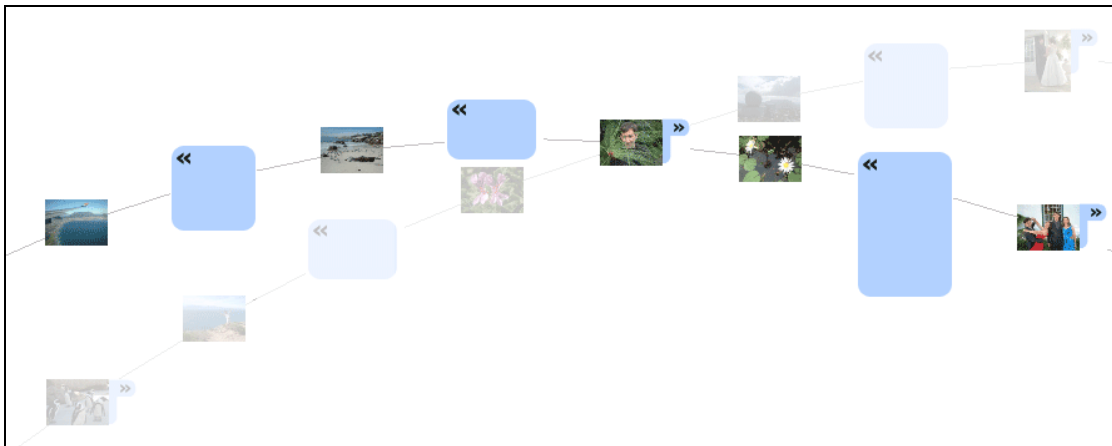

Figure 6. Two intersecting photo-arcs with some expanded and some collapsed textboxes

Much of the PhotoArcs interaction is drag-and-drop. Users can click and drag photos around the screen, drop photos on an arc, "tear" photos from an arc (Figure 7), and rearrange photos. Dragging a photo to an arc automatically pops up a text box, into which the user can type. These text boxes by default expand to fit all of their text, but can be resized by dragging their corners or collapsed by clicking on their associated chevrons (« or »; see Figure 6). This allows viewers to peruse just the images in a PhotoArc if they wish. These interaction styles encourage direct manipulation of the narratives and minimize dialogs and other indirect input in order to support more "playful" interaction.
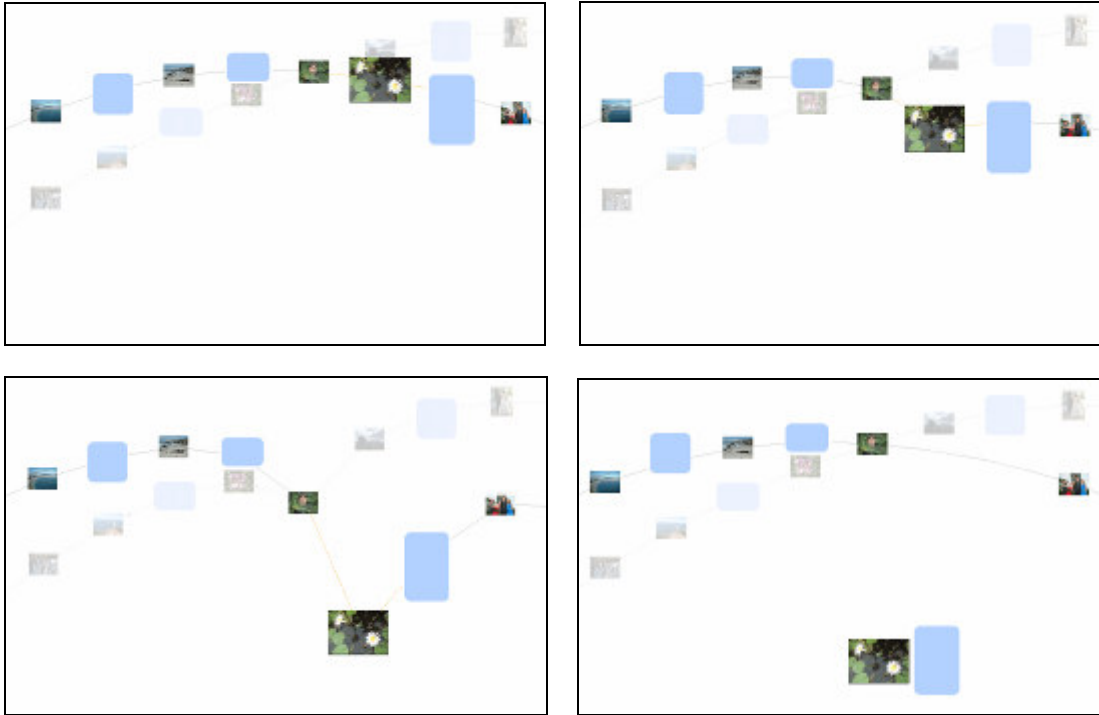
Figure 7. Mock-ups of selecting and removing a photo and its associated text box by dragging

We considered several options for PhotoArcs with so many photos that they cannot fit legibly on the screen, including a telescoping arc, an arc that curls at the ends, and a scrolling arc. Based on feedback from our usability studies, we decided that the best option was an arc that scrolls off the screen and re-centers on a clicked photo.

We also decided to provide several overviews of all arcs to help different navigation styles. Intersecting or related arcs are shown on the screen with the primary arc (Figure 6). A box in the upper-right corner provides an overview of all arcs that a particular user has created (Figure 10). Finally, arcs are loosely arranged according to the time the photographs on them were taken, and the user can zoom out to see all arcs arranged on a scrollable timeline view (Figure 8). In this view, the active arc is still highlighted in the same ways shown above. Hovering over an arc shows the arc's name and any other metadata the system has stored about the arc.
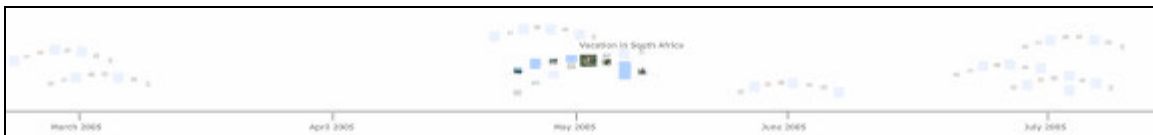

Figure 8. Timeline overview of PhotoArcs (the mouse is hovering over the active arc, bringing up its name)

In addition to this summary view, a detailed view featuring just one photograph is provided when users double-click a picture (Figure 9).
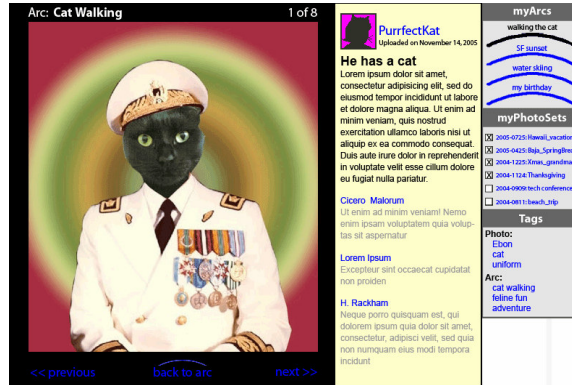
Figure 9. Detail view of one photograph

Though initially we also wanted to implement a photo-organization tool to help users browse through photographs that are currently not on arcs, we observed that such an effort would, at best, duplicate many other photo-organization research studies such as the information visualization project Amp. Ideally, we would integrate a photo-organization tool such as Amp into the background of the PhotoArcs interface to allow for easy image browsing and selection. For the purposes of this project, though, we decided to focus on the visualization and interaction techniques involving the PhotoArcs themselves, and leave the integration of non-arc photo-browsing to future work. Some screenshots below show clusters of photographs in the background, but we do not discuss the visual properties or implementation of these clusters.

Target Audience

The target audience for PhotoArcs is anyone interested in sharing digital photographs. The best existing fit for this are people who currently take a lot of digital photographs, including photobloggers, family photographers, and other life-chroniclers. In turn, *their* audience would be their existing audiences for photographs: others at the same event, friends who "should have been there," distant friends and family, and even strangers.

Implementation

Our initial prototypes consisted of sketches (Figure 1) and low-fidelity prototypes (Figure 12). We used the latter in our user studies, described below. We mocked up additional prototypes using Adobe Photoshop and Adobe Illustrator [2]. We began implementing our interface in Java using the prefuse package [16], particularly experimenting with the force-directed layout functions. Though we did not progress as far in our implementation as we would have liked, we were able to get a sense of the interactions that are feasible to implement and hope to continue the implementation in the future. (Figures 6, 7, and 8 are augmented screenshots from our Java implementation.)

Data Used

Our data consisted of our personal collection of photographs plus those volunteered by the five people who volunteered for our usability studies. We used thumbnails of these photos for the usability studies and for our prototype.

Visual Properties

We leveraged the following visual properties in our visualization to facilitate the user's creation of online narratives with photos.
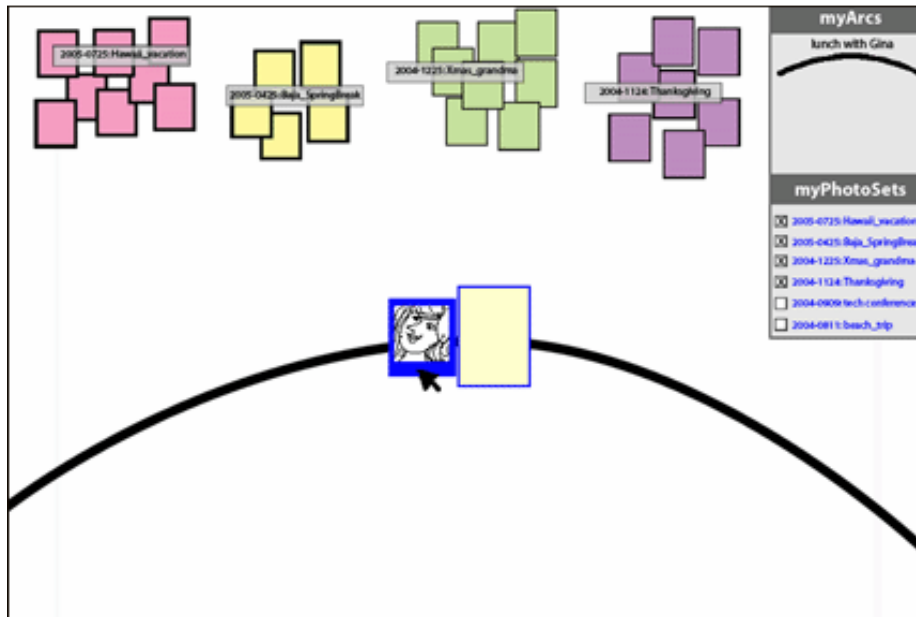
Retinal visual properties

Figure 10. An illustration of some of the retinal visual properties employed by PhotoArcs

Color

- An active arc is black while inactive arcs are gray.
- The border and edges of selected photographs or text boxes is a bright color (blue above) to draw the eye to it and reinforce that it has been selected.

Position

- The active arc is positioned in the center of the screen, horizontally aligned and symmetrical.
- Asymmetrical arcs are inactive ones that intersect or relate to the current arc.

Length, Width, and Size

- PhotoArcs extend across the screen. Photos on the arc are then spaced evenly across the arc, regardless of the number of photos. This design was chosen to provide a fluid, uncluttered visualization that evokes flowing story lines.
- Selected photographs are double the size of unselected photographs, reinforcing what is currently active or selected in the interface (see Figure 7).
- An active arc is rendered with a thicker width to denote proximity.

Intersection

- PhotoArcs intersect at the points where the same photo exists on both arcs.
- Used to denote intersecting stories, shared moments, or objects in common.

Direction of motion (for adding or removing pictures)

- Moving a picture over an arc will automatically add it.
- Moving a picture off of the arc (e.g. above or below) will pull the photo off of the arc.

Animation

- When a picture is dragged, the animated motion is displayed as a smooth transition that directly corresponds to the mouse motion.
- PhotoArc connectors behave like springs, stretching when pulled and snapping back when photos are "torn" off (see Figure 7).
- Selecting an arc in the background makes it change color and move into the center of the screen, pushing the arc previously in the foreground to the background.
- Thumbnails re-space automatically of when a photo is added or deleted to an arc.
- Textboxes scroll open when clicked (see Figure 6).
- When photos are added to more than one arc, the arcs automatically align themselves so that they intersect without overlapping any of their other elements.

Gestalt Properties

We also used the following Gestalt properties in the PhotoArcs interface.
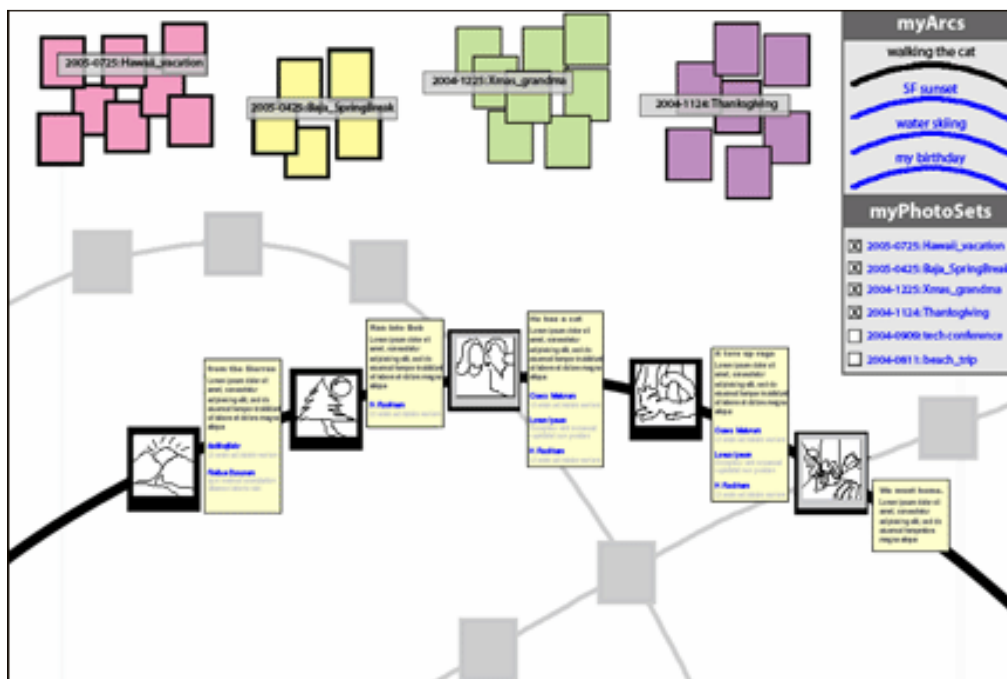

Figure 11. An illustration of the Gestalt properties employed by PhotoArcs

Proximity

- The active arc is placed in the foreground; inactive arcs are grayed out to appear farther away from the user.
- Photos on an arc are displayed with equal spacing.

Similarity

- The active PhotoArc is displayed with a different appearance than 'inactive' arcs: it is rendered in black, with a thicker line, and full-color photos and textboxes.
- Inactive PhotoArcs in the background are all rendered similarly, with thinner lines in gray and washed-out thumbnails and textboxes (see Figures 6, 11).

Connectedness

- Thumbnails on an arc are connected with black or grey lines to aid in the creation of a linear narrative.
- Arcs that share a photograph intersect, representing to the user the possibility to go off on a related tangent.

Grouping

- Photos on the same arc are grouped as a narrative.
- In the MyArcs dialog box, saved PhotoArcs are displayed as a group of arc icons in the same window.
- In the timeline overview (Figure 8), arcs are organized by the time the pictures in them were taken, and multiple arcs taken around the same time are stacked to show their similarity.

Symmetry

- The active arc is symmetrical and it is centered on the screen, and displays equally-spaced thumbnails.

Usability Studies

Participants

Five participants responded to an email solicitation to test a low-fidelity prototype of the PhotoArcs interface. Two participants are female and three male; four are MIMS students (three in the class of 2006, one in the class of 2007) and the fifth has a PhD in computer science. All are digital photograph enthusiasts, taking many digital photographs on trips, at special events, and (for some) even day-to-day, which matched our target audience very well. Participants were asked to provide digital copies of between 20 and 30 of their own images for the study, preferably from one event or two related events. Participants were not compensated for the study.

Method

We chose to conduct our usability studies with a low-fidelity prototype of our interface in order to allow a richer set of interactions than those implemented in our coded prototype. Our low-fidelity prototype consisted of a foam-core board, strips of yarn and ribbons of fabric in various colors, squares of paper in various sizes, and print-outs of the digital images that the participant provided before the study. We also had scissors, tape, pens, and push-pins on hand and invited the participant to use them if they wished.

Figure 12. Our low-fidelity prototyping materials, put to use in a pilot study/brainstorming session

Because we believe that our interface should support *intuitive* interaction, we wanted to conduct our tests so that we could observe the ways in which participants intuitively interacted with their PhotoArcs. To do this, we let participants manipulate the interface components directly, only intervening when participants got stuck or veered far from our goal of supporting photo-narratives. In contrast, in standard low-fidelity testing, participants illustrate what they want to do to the study facilitators, and then the study facilitators perform those actions themselves [9]. We felt that our method would also allow us to observe what interactions the participants felt *were* most intuitive, rather than simply how they reacted to the interactions we had decided on. Though this technique did introduce a degree of uncertainty and variation, as described below in the results section, it did indeed provide us with valuable information on how accurate we were in our design ideas for supporting intuitive interaction.

We developed a script for our interface evaluations which we followed loosely during the usability studies. While we made sure to cover all of our questions, we were flexible about the testing process, inquiring about and documenting the spontaneous interactions chosen by the participant. The tasks we asked our participants to execute were:

1. Upload pictures into the system
2. Create a new arc
3. Add a photo to an arc
4. Add text to an arc
5. Remove a photo from one arc
6. Delete a photo from the system
7. Change the order of photos
8. Read and comment on a friend's arc
9. Look at a photo's details
10. View all arcs (imagining that the participant has many)

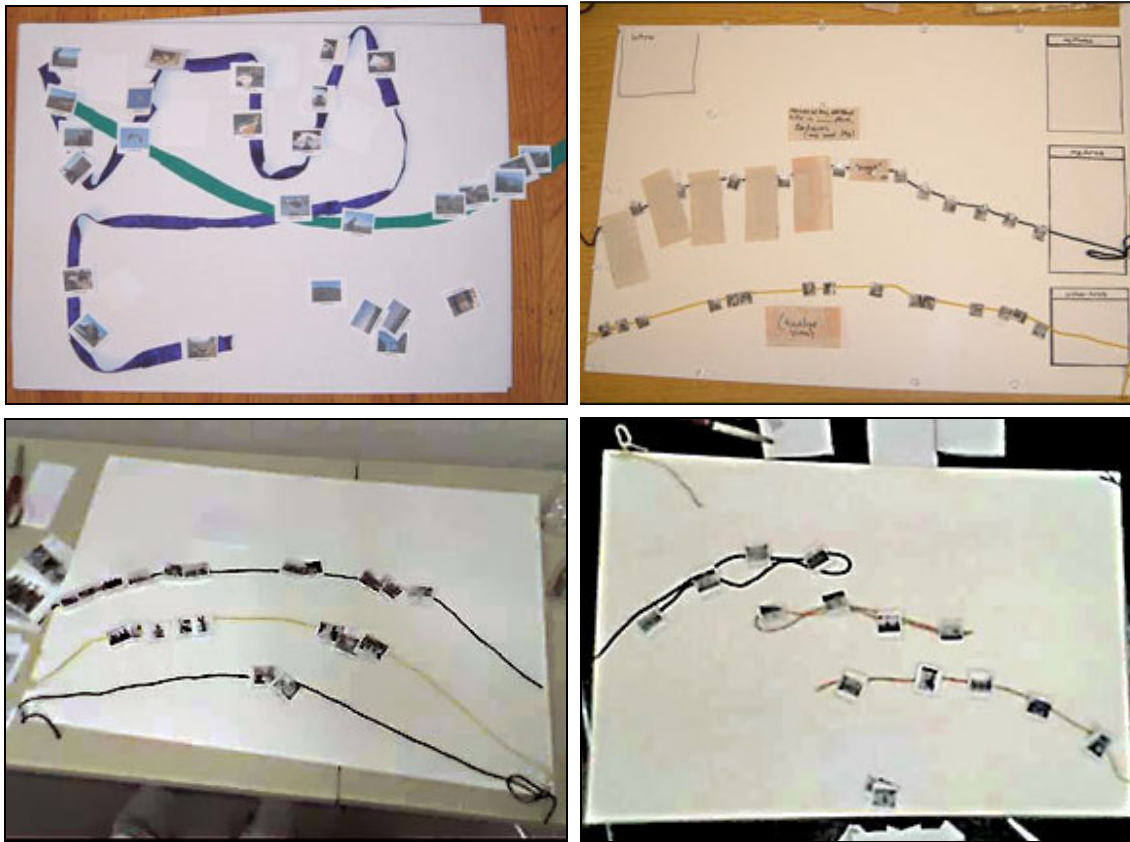*Participant Responses and Alternate Interface Ideas*

Figure 13. PhotoArcs created by four of our five participants:
a) top left, b) top right, c) bottom left, d) bottom right.

Since PhotoArcs presents a novel way to create and organize photo narratives, we kept our interface testing very open and flexible, allowing the participant to direct their interactions and play with the metaphor of the arc. We also focused exclusively on getting qualitative feedback from participants, since quantitative information such as the amount of time a task took was neither as relevant for this interface as it is for others (as long as the times are not exorbitant) or possible to test using a low-fidelity prototype. We also took pictures of the participants' arcs as they created them (see Figure 13 for examples).

Overall, user response was positive. All participants said that they would like to use the PhotoArcs system and, assuming that interaction was as seamless as they expected it to be in the low-fidelity prototype, they preferred it to current methods of online sharing. The tasks we asked participants to complete were designed to answer the following questions about our visualization:

Do users want to the ability to create a linear narrative with their photo collections?

Overall, the five users we tested liked the idea of being able to create linear stories of events. One participant mentioned that he would love to use PhotoArcs to store and share his son's soccer games, while another stated that she would use it to chronicle her many hiking ventures. Another stated her "initial model was that others could add photos and captions to the same arc."

Is the metaphor of an arc for photo narratives intuitive?

All participants liked the idea of an arc to represent a narrative. They easily manipulated the arcs of yarn during lo-fidelity usability testing, as they arranged photocopies of their thumbnails to tell their stories. Other desktop metaphors interacted well with the arcs. Three participants suggested a scissor tool to cut a PhotoArc into two, and four wanted to delete photos from a PhotoArc by dragging it to a trash can icon.

Do participants want uploaded photos to be automatically organized into PhotoArcs? If not, what behavior would they desire upon upload?

Three participants liked that uploaded photographs were automatically put on an arc. Two said they would prefer to have a bin or workspace for uploading and the ability to drag photos onto arcs (where a copy of the photo would remain in the bin, but marked as having been used on an arc). All participants wanted the chronological order of their photos to be preserved when the photos are uploaded, and several wanted filtering to get rid of undesired pictures.

Do participants want intersecting arcs to represent intersecting narratives?

One participants latched onto the idea of PhotoArcs intersecting each other at different points where they have photos in common (Figure 13a), which is the interface design we imagined. However, the other four participants thought intersecting arcs were confusing (Figure 14). Instead, they preferred parallel arcs with photos that line up according to time (Figure 13b). Thus, they suggested that spacing between photos be determined by when they occur, resulting in clusters of photos on different arcs spaced according to time intervals. One participant suggested organizing and displaying the PhotoArcs by month, which we have integrated into our timeline overview (Figure 8).
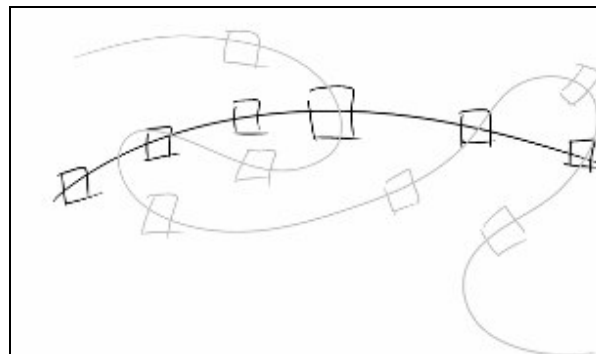

Figure 14: an example of how intersecting PhotoArcs could be particularly confusing

How do participants want to add text?

Participants gave varied responses regarding how they would like to add a captionor annotation. Two mentioned wanting to right-click on a photo. One of these two said they would then want the text box to open in the center of screen so he could type the text, then attach itself to the selected photo when he was done. The second person said the textbox should open next to the photo so she could type her text and then close it.

Two participants said they would prefer an annotation tool to create captions. All said they would like to treat text boxes as independent from their photos. One participant suggested a group and ungroup tool that would allow her to move clusters of photos, and color-code boxes for categorizing.

All participants wanted to add a title and a short description to an arc. One said she would like to display a "summary nugget" but hide the rest of the text, and another suggested incorporating the functionality of a Word document that automatically generates the summary of a PhotoArc for you.

Do participants want the ability to add comments to friends' narratives?

All participants agreed that comments are useful for commenting on narrative. One participant independently said that it would enable interactive storytelling.

Do participants want different levels of privacy for sharing PhotoArcs to their bosses vs. their friends?

Some participants wanted different filters for different audiences, but other said they would simply send different PhotoArcs to different people.

Do participants want the capability to add metadata to PhotoArcs, to individual photos, and to text boxes?

All participants said they would like to be able to add metadata to facilitate searching and organization. One participant wanted the ability to create new arcs from a tag and to tag all at once.

Other Findings and Comments

- All participants wanted an overview view of a PhotoArc that provided a summarized version of the photos and captions. One participant said that he would like a "zoom out view" to see pictures of his son's entire fall soccer season. He also wanted see light grid determining time in the background, with the option to turn the grid on and off.

- One participant had the novel idea of shaping PhotoArcs in the form of a dramatic arc that features a starting point, conflict, climax, etc. For example, a PhotoArc could display a high point like a vacation as a peak, and a low point such as a bad family gathering as a dip in the arc.

- Another participant suggested having a ratings system. People could rate their favorite arcs or have people vote for their favorite photo in the arc.

- One participant wanted to be able to create arcs by drawing a line intersecting photos. He also wanted to be able to arrange arcs into distinctively-shaped "glyphs" that could help him identify arcs when zoomed out. He suggested having a view where miniature glyphs are displayed on a linear timeline.

- Some participants wanted information on the number of times a photo or arc has been viewed, similar to the statistics that Flickr keeps. One suggested an information pane in the interface that displays metadata when a caption or group of photos is selected, along with comments and number of times shared.

- One entrepreneurial participant said he would commercialize PhotoArcs in the following manner: let users do some cropping and optimization (would like ability to edit photos, but nothing fancy), add text to each photo and a title (or overarching description to arc), and send URLs to friends and family for $20/year.

Future Directions

The first task for future work on this project would be to implement and test a working prototype of the PhotoArcs system, incorporating what we learned from the low-fidelity usability studies and integrating a standard photograph visualization in the background to assist users in adding photographs to arcs. After that, the PhotoArcs project could potentially go in many directions. Below we will outline the directions that most interest us.

- Privacy filters: let users create an arc specifically for one person and send it to them.

- Audio clips and/or integration of synchronous audio communication with recording

- HistoryArcs can show one's browsing path through others' PhotoArcs or a photo site such as Flickr

- Interactive, multi-author PhotoArcs

- Automatic conversion to and from other photo-sharing formats such as photoblogs and online albums, and easy ways to switch between the various views

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