

Cherish: Smart Digital Photo Frames

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Abstract

The introduction and rapid acceptance of digital cameras has fundamentally changed the way people take and share images. When displaying and interacting with images in the home, people still print out the photos as if they had been taken on a film camera. Although sharing occurs on computer monitors or even on TV, the digital photo hasn't made complete circle in being represented digitally in a home environment. This research explores the display and social interaction with digital photos in the home.

To find design opportunities we used a User-Centered Design approach and studied how people currently display and interact with photos at home. Observed needs were used to generate concept scenarios that were validated with representative users during a concept validation session. Out of this has emerged the design of Cherish, a system for accessing and displaying photos in the home using digital photo frames.

Key words: Interaction Design, User-Centered Design, Interface Design, Digital Photo Frames, Digital Photo Display, Story Telling, Co-experience, Family, Home

1. Introduction

People preserve experiences through many forms. Spoken, written and drawn forms of experiences have long been used to record our legacies, narratives and experiences. With the invention of the camera, our thousand words were captured in one photographic image. Through the photographic image, our traditions and history became visible through time. The story of our lives no longer relied just on words but was accompanied by photographic images of events that supported the stories. These experiences were shared with vivid accuracy, as a viewer who didn't experience the event first hand imagined themselves in those photographic images, among family and friends.

Photo making has become an integral part of how families, with the use of film-based cameras, preserved their legacy and shared narratives of events and experiences with each other. Printed photos decorated homes in photo frames on fireplace mantles, bookshelves or coffee tables. A denser collection of photos can be found in family albums, or stored in multiple shoeboxes. People would give gifts of photo images on mugs or shirts as well as collages or duplicate photos. They could be seen adding messages to the photos in albums or even on the photos themselves as they shared and recorded their thoughts. Ultimately, people display photos in their homes to share narratives and stimulate social interactions.

Advancing technology continued to support families and their endeavors to use photography as a means to support social interactions. Of the many technological contributions to photography, the introduction and rapid acceptance of digital cameras created a paradigm shift in the way people recorded and reviewed images of everyday life. From the invention of the camera obscura [1] to the modern day film-based cameras, cameras allowed people to more easily capture, reproduce, and share visual narratives. However, the time and the money needed to process the film and print the pictures strongly influenced people's behavior. Digital cameras invoked a change by allowing instant review of photos taken, easier duplication and sharing, while still supporting the overall need to capture and share visual narratives.

People's reasons for recording images have not changed. However, technology has changed to support and enhance their experiences in making photos. As film-based cameras became more robust, easier to use and cheaper, people expanded the role of photos from capturing

special events to capturing everyday moments in life. People shared photos by sending them through the mail, constructing albums, and displaying them in photo frames in their homes and offices. While digital photography has changed the capture and electronic sharing of photos, the construction of albums and the display of photos in the home have not been greatly affected.

The home computer has become a digital archive, taking on storage, retrieval and display duties; however, its location in the home and its aesthetic appearance limit the type of sharing and social interactions that happen. For presentation most people still print out physical photos for display and interaction in the home. People do not often change the photos because of the effort involved. Somehow, the digital photos haven't made the full transition to support existing behaviors of people when sharing the photos. Furthermore, current digital photo frames have not yet addressed these needs in the home. The increase in the number of digital photos people are acquiring makes digital display in the home desirable.

2. Aim/Purpose

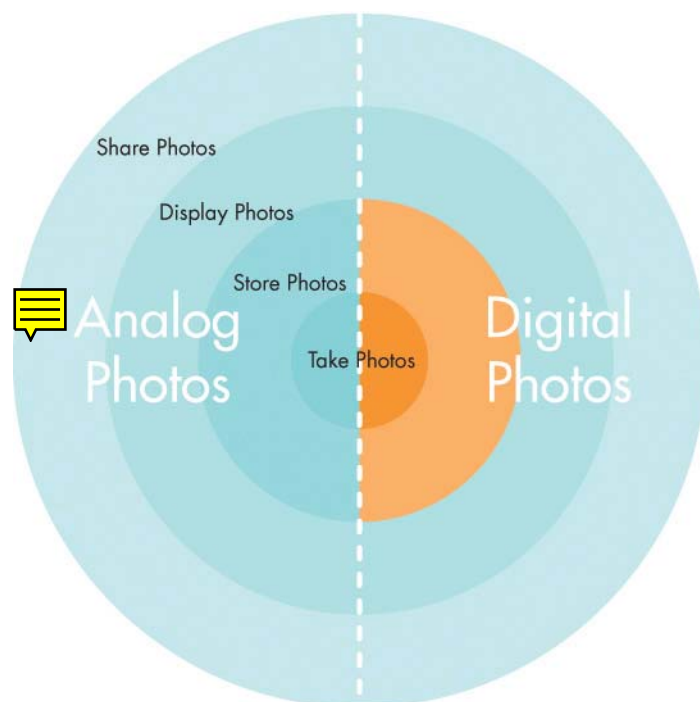


Figure 1. Design opportunity; complete the digital transition so digital photos can be displayed and shared at home

Smart digital photo frames can provide great opportunities for increasing social interactions in the home that will improve the experience of people's lives by supporting and increasing the emotional connections among them. This is the opportunity Cherish seeks to explore and, ultimately, complete the transition of accessing and displaying digital photos at homes by using a system of smart digital photo frames. As traditionally printed photos supported rich social interactions, this project hopes to support these rich social interactions and co-experience [9] through mediating digital photos displayed electronically.

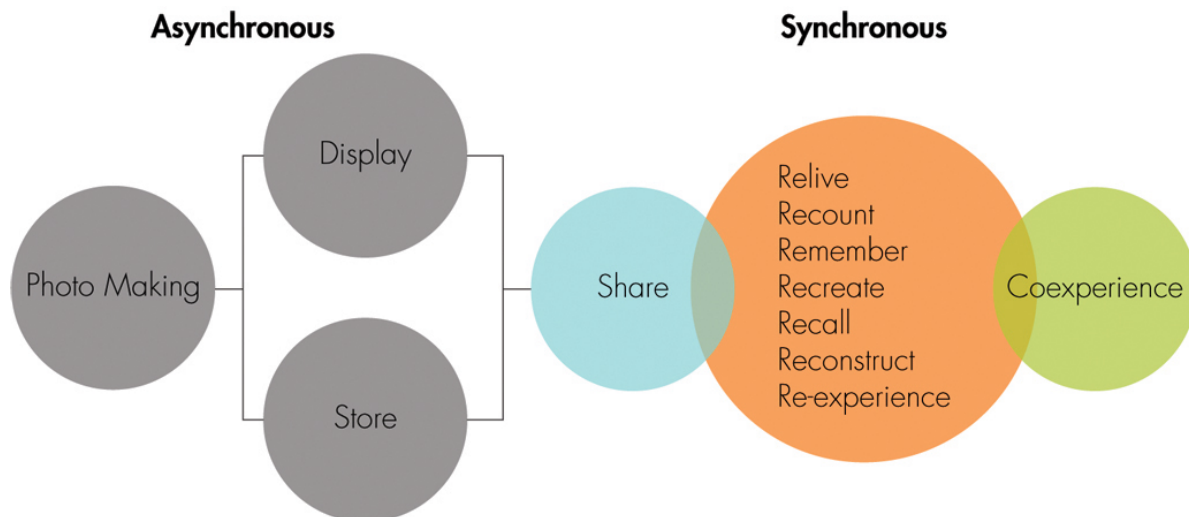


Figure 2. Asynchronous part of the photo making comes alive when people start sharing, making it a synchronous

The project follows a User-Centered Design process and demonstrates three methods in which the digital photo frame can support social interactions: ability to rapidly display photos of people in the home to increasing social interactions, automated updating of photos in the home to make the photos more present and to stimulate reminiscing of the recent and the distant past, and ability to spontaneously share photos and memories of photos with those at a distance directly from the digital photo frame. To support existing user behavior of sharing social narratives at home, the digital photos will have to be displayed in the context of how photos are already viewed at homes using albums and photo frames. Using digital photos to display in the home allows for rich interaction possibilities such as ease of selecting and displaying, annotation and sharing. Furthermore, the digital photos can be organized in the context of social roles of the family (i.e. father, mother, son, grandmother) in addition to time, event and location. Accessing, organizing and sharing digital photos support today's families who are already engaged in activities with traditionally printed photos. The design opportunities come from addressing those interactions with digital photos for the home.

This paper provides findings from the User-Centered Design process in designing Cherish: related works that established grounding for accessing and organizing digital photos, competitive analysis, contextual interviews, concept validation session, scenario based experiential and paper/digital prototyping, and iterative refinements of the interface on the Cherish Frame.

3. Related Work

Related work falls into three categories: research conducted on interfaces for photo retrieval and annotation, commercial products that focus on providing new ways for people to share their photos, and digital photo frames for the home.

Significant contributions have been made for browsing, organizing and retrieving digital photo collections at home. Examples are Requirements for Photoware, PhotoMesa: Zoomable Image Browser, Living Memory Box, MyPhotos, smartAlbum, and FotoFiler [2,3,4,5,6,7]. These applications, in one way or another, allow people to access their collection visually using thumbnails, categorize photos and organize them using folder metaphors.

However, this work has generally ignored issues of display and social interactions around the digital photos in the home. Another area for consideration has to do with finding what meta data would be needed to make retrieval work for display of digital photos. EXIF tags in digital photos give raw information about the digital photo, but lacks descriptions defining relationships among the people in the digital photos.

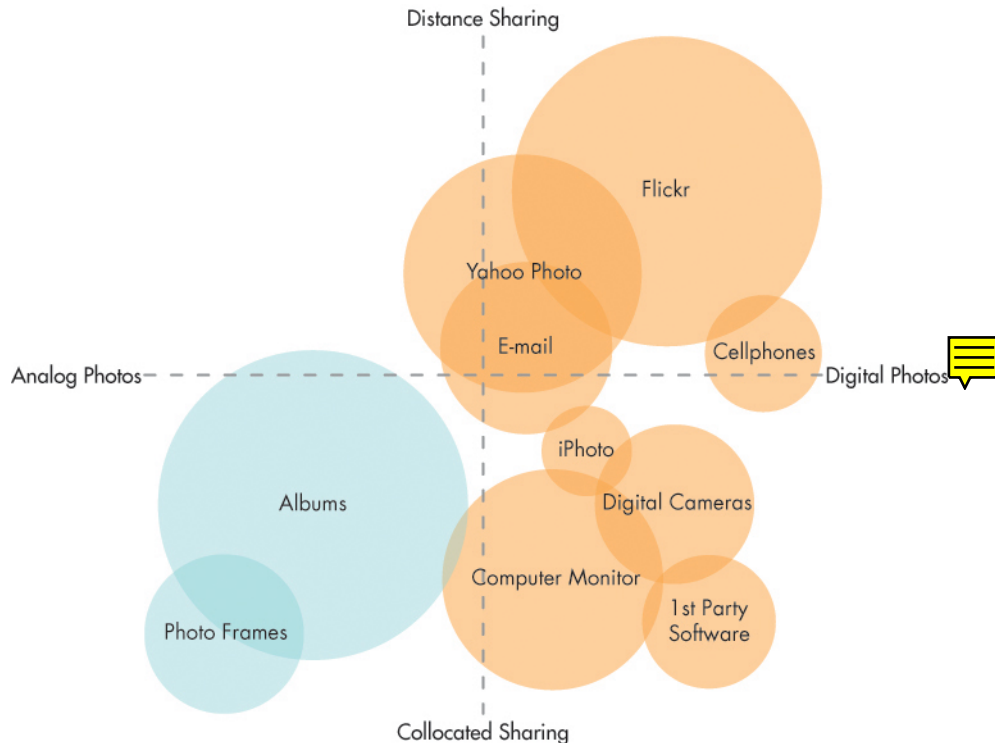


Figure 3. We want the orange circles to go to the blue circles where it supports people and their photo viewing behavior at home

Services for sharing digital photos are plentiful. From e-mail to Flickr [11], people have many opportunities to enhance their sharing experience with people at a distance. However, there are few services for people to share digital photos within their home unless they print the digital photos on paper and use albums or photo frames. Products such as iPhoto [12] and other first party software from camera manufacturers support users ability to print individual photos or make albums through a service. They also support sharing digital photos using the Internet for distance sharing. These products deal with presentation of digital photos but these photos need to be printed, or the user must use a computer or a television with a DVD player to display the digital photos. Although displaying digital photos using television is the modern equivalent of the slide show, it is done infrequently. The use of applications and services is evidence that people want to share their digital photos, and that they want to engage people in social interaction through digital photos, but these social interactions occur at a distance, asynchronously.

Manufacturers such as Wallflower Systems, digi-Frame, Ceiva, Pacific Digital, Westinghouse, and Philips [13,14,15] all have digital photo frames for consumers. All feature fixed or removable media to store and display digital photos and photos are displayed in “slide show” mode with preferences set by the user. With the exception for Wallflower Systems, none of them have wireless connectivity. These digital photo frames focus on the display of digital photos but does not address issues of access and sharing digital photos from an archive, which is most likely to be the user’s computer. Also current digital photo frames are focused on other people loading digital photos or on single frame displays, not a digital photo frame system for whole home.

4. Development Process

4.1. User Research

4.1.1. Method: Contextual Interviews

Using User-Centered Design methods we conducted user research to explore opportunities to increase social interaction around display of digital photos. We conducted ethnographic research in the home exploring how families display and have social interaction around photos. Concepts were generated and validated through a focus group session, exploring possible context of use for a digital photo frame that addressed accessing, displaying and sharing roles of digital photographs.



Figure 4. Photos taken during contextual interviews

During our user research we conducted contextual interviews and observed the activities of eight families to find out how they displayed and interacted with photos in their homes. Of the eight families, six families had one child or more. They were working professionals from the greater Pittsburgh area, who used film-based cameras and moved onto using digital cameras. During the interviews, families were asked to show where they kept and displayed photos and to share stories about social interactions they had in the home in which the images played a role. All the families had traditional film based cameras but found themselves using the digital camera more for its convenience; i.e., digital cameras allowed them to view their photos instantly. During the interviews digital photos were taken to map out where the photos were

displayed in the home. After the interviews, maps were made to reflect where the families had photos displayed or stored, and what kind of photos they had for display.

4.1.2. Findings

These maps revealed families have formal and informal spaces for displaying photos. Formal spaces were living rooms, entry ways, and bathrooms. Photos displayed in this space were posed, taken professionally, or taken by a family member and followed a theme. Informal spaces were bedrooms, family rooms, and the kitchen. Here, photos were candid, personal, and captured the moment. Photos in formal spaces are more up-to-date than photos in informal spaces, with the exception of the kitchen. The kitchen, especially the refrigerator, was a focal point for most current photos formal and informal, updated and most accessed by family members.



When relatives and guests came for visits, photos in formal spaces were often used to start conversations. Family members do not always organize their photos since they are aware of the context. Instead they label them by time because that specific information can be forgotten.

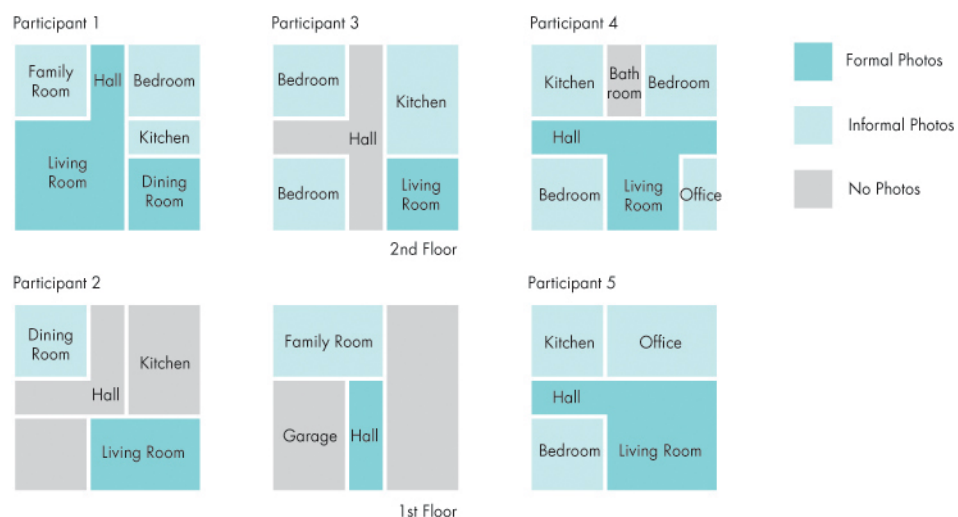


Figure 5. Map of where families displayed their photos

When families shared stories about the photos on display, they always started by who was in the photo—the social connection among themselves or with the

person they are engaging with—and what the event was. This supported the idea of how people organized and recalled photos [6,8]. Photos in formal spaces and majority of informal spaces were in photo frames while some empty frames were hung, waiting to be filled.

Women were the primary organizers of photos for storage and display in the home. Males shared in taking photos with women, but after the photo was taken, women spent more time preparing and sharing photos with friends and families.

4.2. Concept Generation

5.2.1. Method: Concept Validations

We developed fifty concepts based on the synthesis of our user needs. These addressed our observed needs for people to access, share, and display photos at home. These concepts imagined a future smart house full of digital frames as well as technology for recognizing persons in the home. We reduced this set to twenty-two concepts by focusing on specific user needs. Following the concept generation we conducted a concept validation session where we shared the concepts with a group consisting of one member from seven different families. We presented the concepts, using them to further explore the user needs, looking specifically for overlaps between the needs we had observed and the needs the participants perceived in themselves and their families.

4.2.2. Findings

Participants provided rich feedback on the concepts and below we detail some highlights from this session. The concept of using digital photo frames as an interface to access the photo collection was well received. This allowed people to view digital photos away from desks where computers are and in a place in the home where photos are traditionally viewed.

Access Point

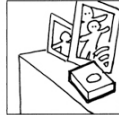
Is there a better way than to connect your camera via wire to download in front of the computer?



Bill just got back from the family trip to Maui and has tons of pictures.



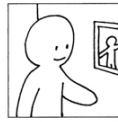
Lora needs to check her email and everyone else in the family is anxious to see the photos from the trip.



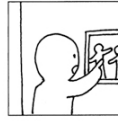
Bill puts the camera near a DPF in the family room, and the DPF downloads the photos and displays them in the rest of the DPFs.

Voice Annotation

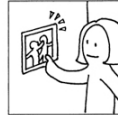
Have you ever wanted to share your thoughts about a photo you saw? Is there a quicker way than sitting on a computer to do it?



Larry sees a picture of Susie in a line dance photo displayed in the family room DPF.



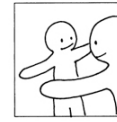
He touches the DPF to record his thoughts about how much denim she wore that night.



Later that evening, Susie notices there is a new voice annotation from Larry and listens.

I know You

Ever wanted to have some photos displayed for relatives who were about to visit your home?



Uncle Ben was about to arrive from Italy.



Jimmy wanted to make uncle Ben welcome, so he has his living room DPF to show pictures of him with uncle Ben from his last visit.



Uncle Ben arrives and laughs as he sees himself wearing the same shirt he wore during his last visit.

Figure 6. Three of twenty-two concepts evaluated

Editing and annotating as people viewed digital photos from the digital photo frame was a novel way to interact with their collection. This allowed the users to respond as they view the digital photos rather than having them return to the computer to perform these actions.

Issues of sincerity and appropriateness were discovered as the system or the user changed digital photos for display. If a person does not have a relative's photo displayed regularly, but changes only when the relative visits, it seemed to make the user insincere. This also suggests that people view the digital photos as less permanent and less of a "shrine" in the home.

5. Design: Cherish

Preserving legacy, sharing narratives of events and experiences are the key motivations for families to make photos and display them at home. Accessing, displaying and sharing are interactions supporting their needs using traditional photographs but not fully realized with digital photography. The Cherish System aims to support existing interactions using a system of digital photo frames to display digital photos at home. The Cherish System can be used in a ubicomp home, making system based decisions for which digital photographs to display depending on who is at home or what time of the year it is. The Cherish System will mediate digital photos to Cherish Frames (thin client) using a wireless network throughout the home.

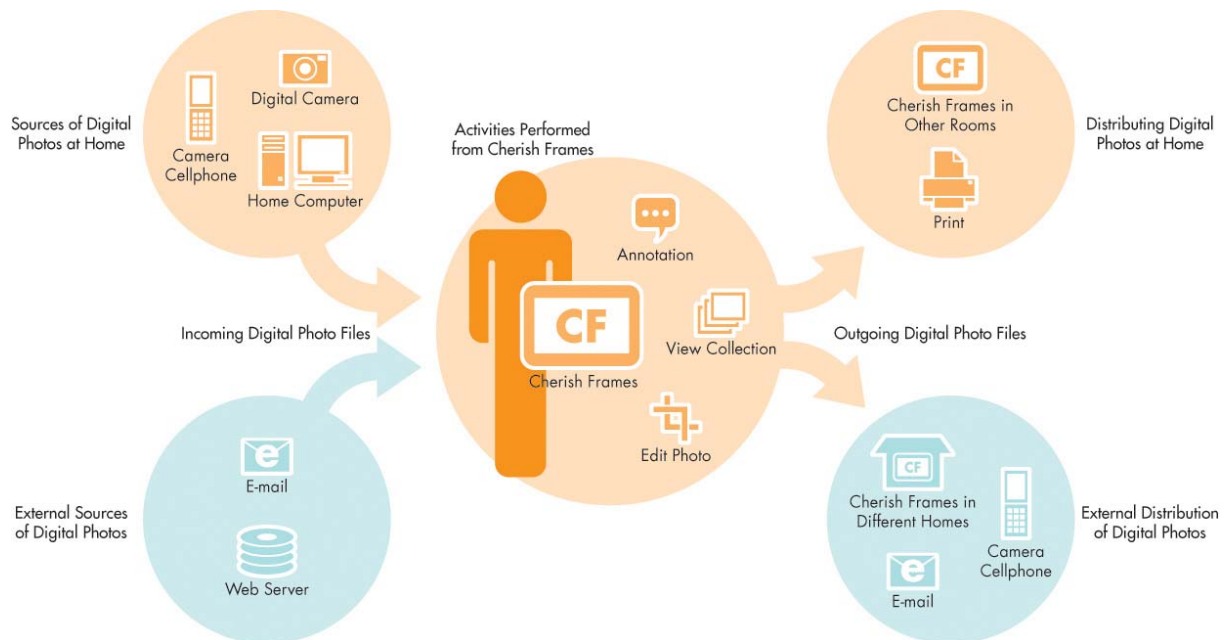


Figure 7. Cherish Frame positioned to support existing context of use

For the purpose of this research, we've focused on interactions supporting the Cherish Frame. Three applications were developed and evaluated. These applications address the need for accessing, displaying and sharing digital photographs. The first application People Present, allows users to rapidly change frames to display people who are present in the home. The second application, Event Display, automatically updates frames based on events users have specified such as seasons, holidays, birthdays, etc. The third application, Opportunistic Sharing, allows users to share images and messages with people at a distance while in front of the frame.

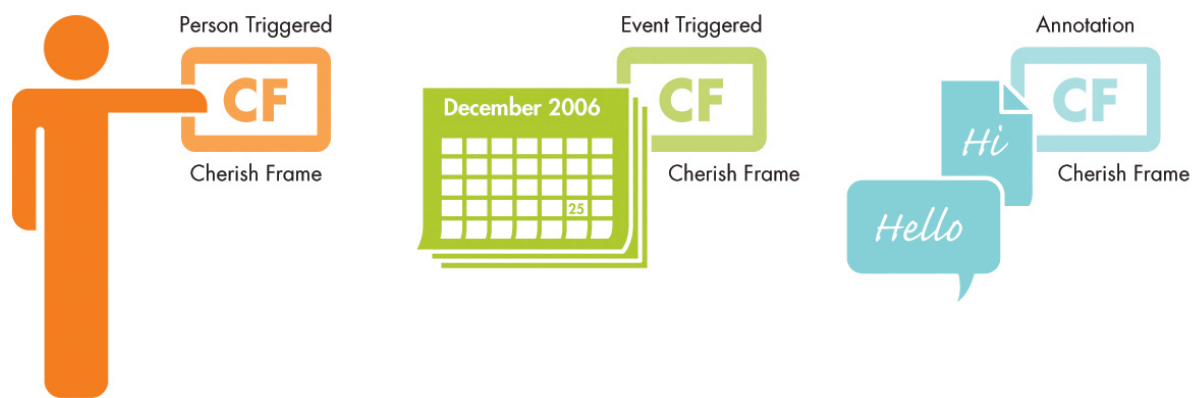


Figure 8. Three applications for the Cherish Frame

5.1. Design Validations

6.1.1. Method: Experiential Prototyping

We used two methods with seven participants for evaluating the interaction of the Cherish Frame: experiential prototyping [16] and paper prototyping.

During each session with the participants, they were asked to do a Think Aloud. Experiential prototyping was used to see how users might react to the Cherish Frame in context of their every day environment: living rooms, office space, etc. Two scenarios were used to evaluate the Cherish Frame based on Event Triggers. The first scenario was based on how the Cherish Frame first displayed one event and change the display to a holiday related digital photos.

In this case a group of family picnic digital photos were displayed on the office Cherish Frames but was later changed to past Halloween digital photos. The second scenario was based on how the Cherish System in an ubicomp home noticed the visitor and changed a Cherish Frame to display a digital photo of the visitor. In this case a group of Cherish Frames in the living room displayed photos of a family picnic, but one of the frame changes its display to a photo of the visiting friend who was ringing the doorbell.



Figure 9. Six participants during the experiential prototyping

5.1.2. Findings

The feedback participants said the experience overall was emotionally satisfying. They responded favorably to the first scenario where they felt being able to change digital photos depending on events or holidays supported what they currently do with their photos at home. This interaction would allow them to create and continue to share narratives with family members or visiting relatives and friends. The second scenario raised some questions regarding the Cherish System's ability to gauge what kind of relationship a visiting relative or friend might have with the participant at home. They felt changing digital photos to make it so that everyone visiting has a space on their coffee table seemed not genuine, and participants would adjust the setting to only allow for certain visitor's digital photos to be displayed.

5.1.3. Method: Paper Prototyping

Paper prototyping was used to design and refine the interface and to define the meta data was needed for users to access and share digital photos through the Cherish Frame. For evaluation, seven participants evaluated the third version of the paper prototype. Paper prototype was made with wire frames. Two additional scenarios were used based on Person Triggers and Annotations. The third scenario was based on the participant changing what is currently displayed on one Cherish Frame to another digital photo. In this situation, the user's grandmother was coming for a visit, so he/she decides to change one of the family picnic digital photos displayed in the family room Cherish Frame to a digital photo of his/her mother and their son together. The fourth scenario is

based on how Cherish Frames could be used to annotate a digital photo and share it with other people. In this situation the user finds a digital photo and reflects upon the experience shared with a friend. Then the user decided to send a copy of the digital photo with a voice annotation to his/her friend's cell phone.

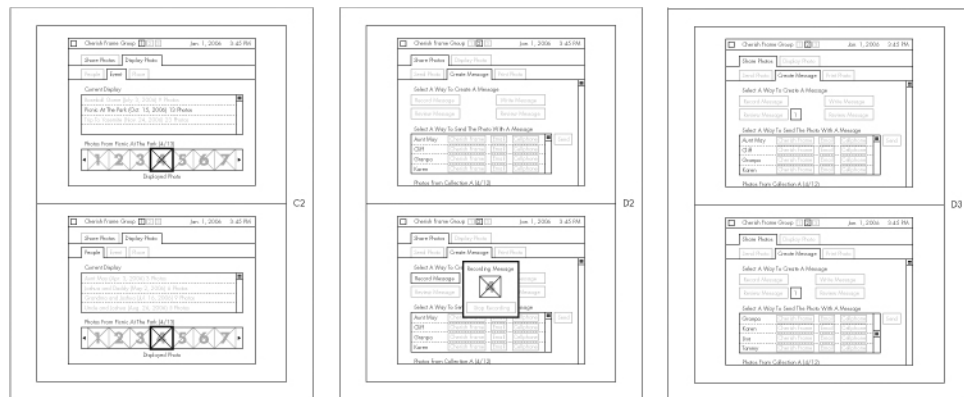


Figure 10. Wire frames for paper prototype evaluations, version 3

5.1.4. Findings

Participants found the general interaction with the Cherish Frame easy to use and the language used on the interface to be informative as they engaged the interface for the first time. Comparisons of formal software interface languages to conversational languages were made using Microsoft Word and Flickr as examples. Lack of icons brought about discussions of interfaces that either have too many or too little icons. There were some issues as to how to navigate a selection of thumbnails using a fixed highlight or scrolling window. Also, most participants found using a stylus onto a LCD touch screen favorable compared to using a finger to interact with the Cherish Frame.

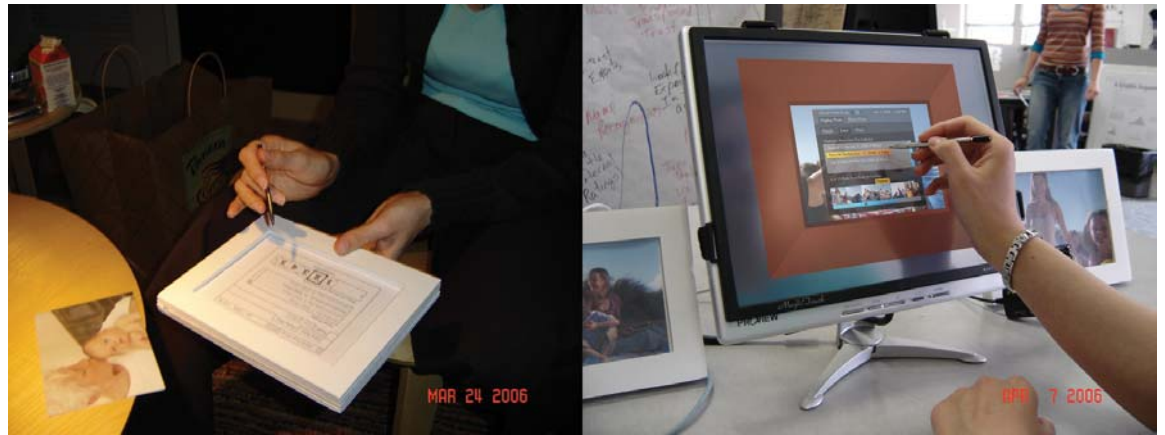


Figure 11. Six and eight people participated in the paper and digital prototype evaluations

5.1.5. Method: Digital Prototyping

The following iteration was on a digital prototype, and a visual design language for the interface was developed in conjunction with the feedback the participants gave from the previous paper prototype session. Also a touch screen adapter was used on a LCD monitor to simulate participants using a LCD touch screen. They had options either to use their finger or a stylus to interact with the Cherish Frame. Same scenarios were used to evaluate the refined digital prototype and the interaction using the interface.

5.1.6. Findings

Further suggestions for refinements were made as eight participants did a Think Aloud using the interface. Clarification as to how the interface appears and closed was suggested. Participants thought the translucent interface allowed them to see changes occur on the Cherish frame directly without being distracting. Two participants used their fingers to navigate the interface and suggested areas for clicking to be larger. Overall, the digital prototype for the Cherish Frame met their expectations as their interaction using the interface allowed them to access, display and share digital photos.

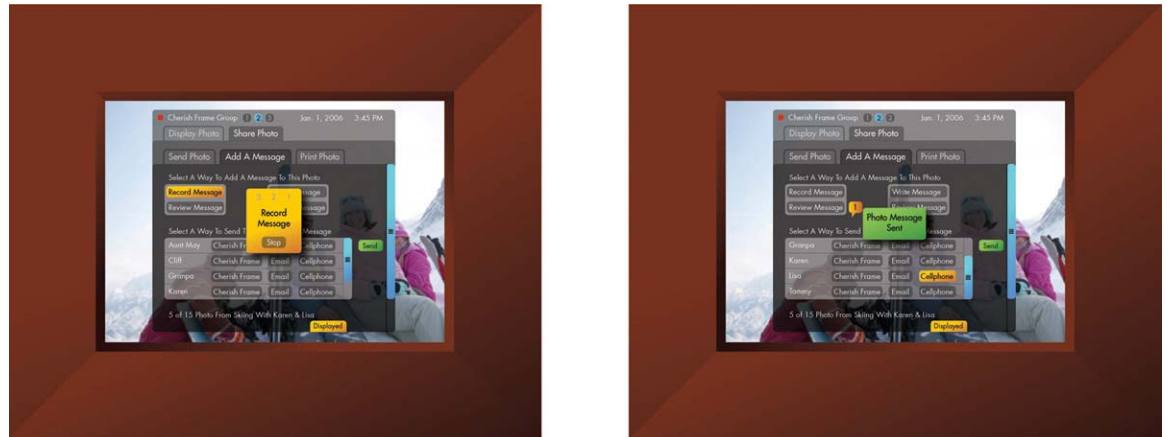


Figure 12. Digital prototype evaluations using LCD touch screen, version 4

Through developing a group of scenarios exploring the context of use for the Cherish Frames, we were able to iteratively test possible interactions the Cherish Frame could support. Users of the Cherish Frames could access and change the digital photos being displayed, share their digital photo collections with added annotations and have the Cherish Frames display seasonal or event based digital photos reflecting the time of the year.

5.2. Design Demo: Video Sketch

Using the feedback from prototype evaluations and extending ideas from the concept validations, a video sketch was developed to demonstrate the interactions of Cherish smart digital photo frames. The video sketch illustrates the three applications developed for the Cherish Frames: People Present, Event Display and Opportunistic Sharing. The first scenario shows the owner of the Cherish Frame change the displayed photo on a group of Cherish Frames to welcome a visiting relative. The second scenario shows how the Cherish Frames show an upcoming event, a birthday, and how family members respond. Lastly, the third scenario illustrates how people viewing photos from the Cherish Frame can continue to share in context of viewing the photo.

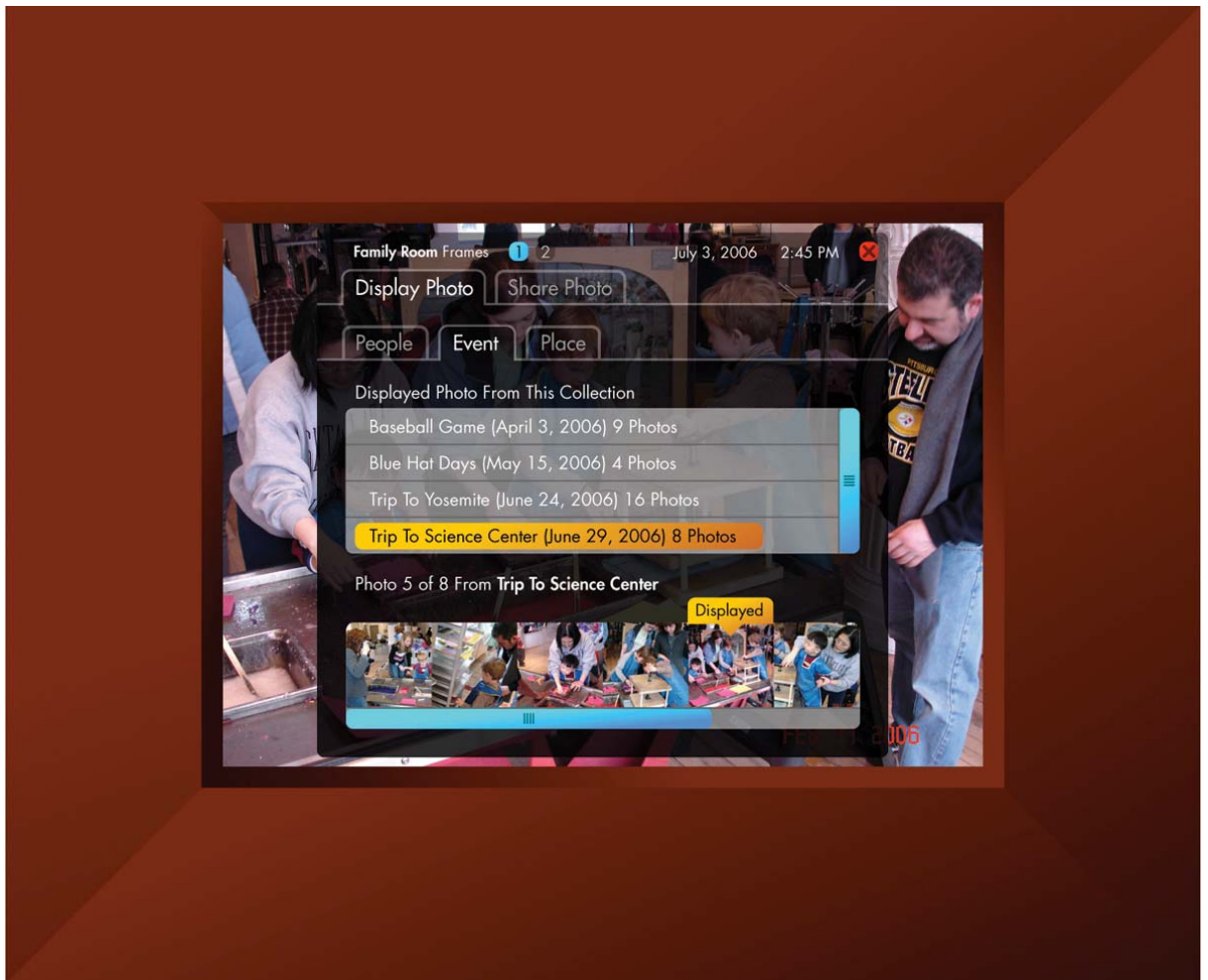


Figure 13. Final Cherish Smart Digital Photo Frame interface, default screen

In support of the interactions people can have with the Cherish Frames at home, a product demo of the Cherish Frames was made to specifically show a person using the interface. This shows how the Cherish frame interface supports the interaction for the user. These interactions shown in the video sketch and in the product demo were made in addressing people's needs to display, access and share their digital photos to continue their social narratives at home.

6. Conclusion

Cherish

People want to add meaning to their lives and be able create meanings into coherent and significant narratives in the process [2]. Storytelling and reminiscing using photographs are one way of keeping and sharing memories [10] and building the family legacy. Being able to display digital photos in a social context helps users continue their narratives, continue to recollect experiences past and hopefully look forward to creating new memories to be shared. Allowing for better opportunities to access their digital photos helps users to spend more time reliving past experiences and less time searching or organizing. Designing for digital photos to be distributed in the home environment allows for co-experience among family members and visitors, continuing their storytelling without the time delay of traditional methods of displaying photos.

As many possible solutions were generated to address the opportunities, there were two areas of focus: how digital photos should be organized and how digital photos should be displayed. When considering organizing a photo collection, Cherish System can learn to recognize people in digital photos to have relationships with the people they are being photographed with (i.e. family, father, mother, son, daughter, cat, dog, grandpa, grandma). Cherish System will mediate digital photos to be displayed using social relationships as labels, and the user can direct which photos should be displayed in formal and informal spaces in the home. The home uses wireless digital photo frames to receive distributed image content from user's computer. Using sensors from the ubicomp home, when relatives or friends visit, Cherish can display photos of visitor and the family in the formal/informal space.

The goal for Cherish digital photo frame system is to create an opportunity for enriching the social interaction and co-experience [9] among family members and visitors to the home through mediating digital images displayed electronically. Digitally represented photos no longer need to be formatted like traditional photos. Series of digital photos being actively displayed can create an opportunity for a continued narrative in the home for families and guests.

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I express my gratitude to the families and friends who helped me during the project. Without their help, defining this project using User-Centered Design methods would have been impossible.

During my first year at CMU, I was apart from my family. Esther and Joshua were in California, and Esther uploaded hundreds of digital photos of her and Joshua for me to see. Through this I experienced first hand how powerful digital photos can be. My two years at CMU were only possible with Esther's loving support. I've spent many nights looking at photos of her and Joshua to remind myself why I was here. I am thankful for her prayers, our late night conversations and her friendship. Esther and Joshua became my inspiration.

Soli Deo Gloria.

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