MemoryNet Viewer: Connecting People with Media

Rakhi Rajani, Alex Vorbau
Mobile and Media Systems Laboratory
HP Laboratories Palo Alto
HPL-2003-219
October 23rd , 2003*

E-mail: {rarajani, alexv}@hpl.hp.com

awareness, personal networks, media sharing

We describe a peer to peer (p2p) system, which we call the MemoryNet, for sharing and annotating media objects among people in our personal networks. Recognizing that people naturally associate their own media with that of their friends, we developed a prototype (the MemoryNet Viewer) to investigate how these connections might be reflected in a software infrastructure. It was also a stepping stone to further research that looks at how people share stories and maintain an awareness of the lives of their family and friends. We present the results of a small study that tested the concept of the MemoryNet Viewer (MNV). We conclude with details of how this work is progressing based on our initial observations, and detail future research and deployments.

* Internal Accession Date Only
Approved for External Publication

MemoryNet Viewer: Connecting People with Media

Rakhi Rajani, Alex Vorbau
Mobile and Media System Lab
Hewlett Packard Laboratories
1501 Page Mill Road, Palo Alto, CA, 94304
{rarajani,alexv}@hpl.hp.com

ABSTRACT
We describe a peer to peer (p2p) system, which we call the MemoryNet, for sharing and annotating media objects among people in our personal networks. Recognizing that people naturally associate their own media with that of their friends, we developed a prototype (the MemoryNet Viewer) to investigate how these connections might be reflected in a software infrastructure. It was also a stepping stone to further research that looks at how people share stories and maintain an awareness of the lives of their family and friends. We present the results of a small study that tested the concept of the MemoryNet Viewer (MNV). We conclude with details of how this work is progressing based on our initial observations, and detail future research and deployments.

Author Keywords
Social computing and social navigation (primary keyword) video content/communications, home, user studies, user experience design/experience design

ACM Classification Keywords
H5.2 User Interfaces

INTRODUCTION

Digital capture is here to stay. The technology has predictably become smaller, cheaper and better. Digital still cameras can be slipped into pockets and camcorders rest easily in the palm of one's hand. People can now enjoy shooting photos and short videos of the most trivial events, enjoying the freedom from the feeling that they are 'wasting' film. Camcorders record in computer-friendly formats and new software makes it easy to edit footage into nicely produced home videos. We have no shortage of personal media.

Unfortunately there still exists a divide between the capture/authoring stage and sharing/discussion stages of the personal media lifecycle. We capture moments on disk with the desire to relive or share the experience with loved ones. We share our digital media with the hope that others will give us feedback or express interest, and we add captions and comments to frame the media in some context that we don't want to forget in order to build collections of memories.

Despite the advances in capture technology, the sharing scenario is usually reduced to two options: email or upload to a photo service on the web. Email works well for sending a few photos or a very low bandwidth video. Uploading involves a number of steps and we are always using an 'in-between' to share and talk about our media. Organization, metadata tagging and annotation are still more cumbersome and these tasks are often left to be done 'later' [6, 11]. Unfortunately 'later' often turns into 'never' and stories are lost, memories fade and as a result we capture events that are seldom relived, commented on, described, or narrated. We also often don't get a response when we share this media within our personal networks.

In this paper we describe a software infrastructure called the MemoryNet. We also describe a prototype called the MemoryNet Viewer (MNV) that was built to probe the issues described above.

The difference between what we describe, and prior art is that we are implementing a p2p system for sharing media and annotations that eliminates the need for active uploading to a web based service. We also introduce the concept of *authoring by playing* which keeps the media object alive so that the annotation process can be weaved into the viewing experience over time, thus reducing the burden of narration on the user.

BACKGROUND

Personal Networks

Social networks exist in many different forms and we bond at different levels with different people based on factors including work, race, religion, hobbies etc [15]. We define personal networks as a subset of these social networks that are comprised of a close network of friends and family with whom we share information, tell stories about our lives and find support on a regular basis. The conversations we have with them are rich interactive experiences [17] that

comprise of gestures, sights and sounds. When our networks are separated by distance and time we maintain our networks with the use of communication tools such as email, phone etc that do not necessarily convey these interactive elements. With the media we can now generate, we can capture the sights and sounds of the experiences we share together or encounter apart, but how do we effortlessly integrate that media with our interactions and share those sights and sounds?

In the past, as families and communities were co-located, proximity fostered awareness of the small details of the lives of those close to one another. These small details are important in maintaining rich personal relationships [15]. As we dispersed over time and distance we developed tools such as mail, the telephone, the internet and email etc to support our awareness even when we were no longer co-located. However, these tools, and the media transmitted do not necessarily support the sense of awareness that exists in co-located memories.

We capture our experiences with media tools, and we author stories associated with them at a later date; we share our media with others over email etc and we discuss them at a later date. But there is a disconnect between these processes that require concentrated time and effort to convey the stories we want to tell [6]. As users, we want to enhance meaning, provide better recall and richer memories by attaching stories to our media [1, 4, 6 11, 18] but the authoring process is laborious. Nevertheless we still share to sustain the connections in our networks. The sharing process involves uploading images to a web site, zipping them up and transferring them over email or creating a CD. With these methods, the discussion process is limited and we might get a few comments back, but people forget, and stories don't evolve.

Even though our memories are connected via the stories we tell and the events that we participate in, our media associated with such activities are not connected because we author *and then* share, the *creation* of media is the endpoint and *ownership* of media is mostly defined by who possesses it even if the strongest emotional connection to it is held by someone else. These closed artifacts don't allow for the same social connections that are made in more face to face situations where we can experience and judge reactions and be a part of the emotional responses to our memories as represented by the media.

Content creation has crossed the threshold of simplicity, but how do we move on from manufacturing closed artifacts to something that more closely resembles natural reactions and interactions?

Moving forward

We are developing tools that allow us to see more media that we care about and that allow us to participate in the telling of the stories that mean something to us. We want to get to a point where sharing *is* authoring and have developed the notion of *authoring by playing* which considers how the process of playing media can also be the process by which we author our media, add meaning to it, and build its value over time and through the thoughts of a number of people in our network. By integrating annotations and metadata collection in with the viewing experience, we have developed a less burdensome method for recording the emotional connections between our media and that of others. We hope this will allow for stories to be collected and built upon over generations.

Media Sharing and Awareness

The issue of sharing digital images as media for communicating life events has been addressed in the literature from the point of view of many disciplines for some time. Anthropologists like Chalfen [2] and Myerhoff [14] note how photos are statements that people make about themselves. With the ability to record segments and passages of their lives [19] people find ways to record these moments for posterity, to share important moments with friends and family and document events that contain meaning for them. When the cost of taking and processing photographs was high, people took images sparingly, spending time and effort to create elaborate albums of multiple images that told a story [19]. As we were able to 'point and shoot' and process at lower cost, we started to take more images and then have trouble knowing what to do with them. We hear countless stories about shoeboxes full of images we haven't had the time to organize [6,16]. Many [3, 5, 6, 7, 18, 19] note how much people want to be able to use their images to share and document their lives, creating lasting memories, but as the format of media changes, so too does the way in which we achieve this.

Much of the focus so far has been on preserving memories, but Makela et al [12] note how photographs are also used (by kids in this case) as "tools for creating playful stories, expressing affection and creating art" [12, pp 554]. These activities assist with staying in touch and digital media, especially photographs and video, provide a means by which to share the sights and sounds of our lives with others.

Liechti & Ichikawa [11] note how photographs have important social roles in supporting communication and "affective awareness", providing benefits for both the "Photographer" and the "Watcher". In this model however, the boundaries are clear. The owner of the media is the photographer and the person receiving it is the watcher. The vision behind the MemoryNet is to blur these lines of ownership allowing media to proliferate the network and stories and reactions to emerge over generations by connecting media objects. Nevertheless, their concept of lightweight media through which people share experiences, is one we resonate with strongly in trying to achieve levels of awareness of everyday lives.

Photographs contain details that are not immediately apparent from the image and often people want to add rich

data to their photographic memories. Attaching audio to photos [5] is a compelling way to add richer detail, but how do you do this with ease? It's possible to add audio at the time of capture to relate the events the photographer wants to tell but later on, how do you capture the audio detail and context that an animated conversation would bring? How do you pick up the details that get added to media over time? The MNV seeks to address some of these concerns by allowing for media to be annotated over time.

Although digital solutions to media management and narration have been explored successfully [7], there still remains an issue of how this can be done seamlessly and in a fashion that does not dictate a task based [12] effort to sit down to provide long commentary to ones media. Asynchronous and ad-hoc ease of use with narrating such media is still low. With the proliferation of technology into the home space, how do we provide an easy, intuitive and valuable way to connect ourselves through our media and to allow our media to carry our stories? The domestic space is used for social interaction [8] and we also use it to 'display' our personal tastes, habits and interactions through the pictures we put on view. These pictures however become 'stale' after a while and we sometimes stop noticing them. They may be replaced by something new, but our informal interviews with people noted how, other than the "obligatory old family photos" they were there just to take up some space, with "important" photographs now being stored on a computer in digital form. Most people wanted a way to bring those out, display them, and use them.

Some of the larger research efforts in this area are in projects such as the Interliving project [10] HomeNet (which considers the use of the internet in the home) [9] and the Aware Home [18] that looked at a number of technologies including those that help people stay in touch and locate, enrich and store their memories. The Interliving project in particular has been looking at how to place devices and applications in a home setting to connect families. The VideoProbe [10] is a more lightweight method of capturing the activities of those in home settings and the MessageProbe [10] is a more focused way of sending messages to other households. By connecting households they connect daily lives. These probes have proved successful in identifying technologies and activities to support both inter- and intra-family awareness and communication of events that are currently taking place in their lives.

In the majority of the projects described here, the goal is to *connect people* allowing them to share their media and tell stories. Although we also have this goal, we want to approach the issue by trying to find ways to *connect the media* that people possess and connect people through commonalities represented in these media objects. Opportunities for memories and insights into personal, and other significant events arise when we bump into media representations that hold meaning for us and that provide us with more pieces to our life puzzles than we were previously aware of. If we can connect these pieces and find ways for media to find us through the metadata we attach to it and the networks we create, then what other rich opportunities for memories and information can we begin to develop?

Our primary setting for such technologies is the home. Many commercial products including the Ceiva picture frame have entered the home space as a way to give people our digital images and allow them to be displayed with ease. These have been popular in providing a way to share photos with mum and grandma for instance. However, with such devices the picture frame often gets lost in a sea of other frames and the images again become stale if they are not updated. We acknowledge that this is a problem that will persist and if people do not add new media, over time, systems will continue to fade out of use. Although we do not propose heavy interaction models, we have found that by providing opportunities to interact with the media, for example in the form of simple annotations, people are willing to put in some effort because they see an increase in value over time.

MEMORYNET

The MemoryNet is our vision for an open system of interconnected personal media that can be used to facilitate relationships in personal networks.

In our minds our media is connected. We capture photos and video at the same event. We have friends in common and thus each have photos of the same people. In your collection, you have photos of me and my family and vice versa and it may be the case that you 'own' something that I have a stronger connection to.

As an anecdotal example, one of the authors recalls a story of a woman returning to her hometown in Ohio and visiting the local Ford dealership that had been in the same family for a century and that is currently owned by a childhood friend. The woman and the owner swapped stories in the office of the dealership, catching up on the past 20 years of their lives. In the office the woman spotted a black and white photograph on the wall that showed a jazz band. She is surprised to see that one of the members of the band is her father holding a trombone. She had never before seen the photo and was thrilled to see her dad while her friend had no idea who the men in the picture were. As a result he took the photo from the wall and handed it to her saying "take it, it belongs to you more than me".

This example is illustrative of a number of points:

1. *The meaning behind media, and the display of media, get lost over time and generations*. In the above example, the photo was probably on the wall because it meant something to the present owners' father/grandfather. It remained there but its significance was lost.

2. *Ownership of media is NOT defined by who possesses it.* In the above example, it made sense for the woman to own the photo as she had a stronger emotional connection to it. So what happens when we blur the lines of ownership?
3. *We bump into relevant and significant artifacts that we were not aware of.* In the above example, a piece of history was found by chance, but what would it be like if media found us through the media connections that evolve within our personal connections, and how would we present that information? [13]

The broader vision for MemoryNet is a social community where these connections are realized in a software system. Establishing these connections among the media objects in people's collections would form a mesh of interconnected personal media that is navigable, dynamic, and could be the foundation for any number of interesting "MemoryNet" applications, operating within the scope of a personal network (See Figure 1). We believe that this MemoryNet would facilitate the discovery, narration, and preservation of memories, increasing awareness and strengthening relationships. It would help to redraw the boundaries between what's yours and mine and change the way in which we preserve the past.

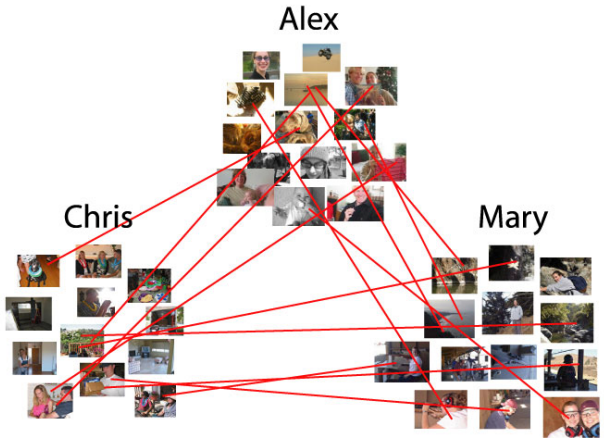

Figure 1: A Mesh of Interconnected personal Media

This vision presents us with a number of interesting challenges. For example, how do we form these connections, especially early on. Some connections can be deduced from metadata like time and location. If two photos were taken within a certain radius distance or within a certain period of time, they could be considered related. However, many important connections can only be expressed by humans. So how do we encourage users to express these connections? Can an application be built that can offer sufficient value back to the user such that they are motivated to express their thoughts about the media? In our prototype, we experimented with notions such as opportune annotation and trolling for metadata to avoid overwhelming the user with metadata tagging. Also, should or how should links be broken or moved? Will media be able to find me, instead of vice versa? Many more questions have yet to be asked, probes deployed, and ideas prototyped.

THE MEMORYNET VIEWER

As a first step toward bridging the divide between capture/author and share/discuss, we developed an application that explores our idea of *authoring by playing*. We recognize that people want sharing to be easier and that they are not motivated to add metadata to their media in large batches [6, 18]. We have also seen a general acceptance of the p2p model in the form of file-sharing software and instant messaging. Although we consider all types of media to be relevant and important, for the purposes of this prototype we focused on digital images and video. Most of these were personal photos and video.

With these observations in mind, we built an experimental prototype called the MemoryNet Viewer. The MNV retrieves media from the collections of the users on the system and the people on the user's buddy list and displays the photos and videos in the form of a continuous slideshow. It displays the objects in random order, choosing equal numbers of objects from each person's collection.

While we acknowledge similar applications (such as Instapix, Ceiva etc) we added functionality to capture the comments and reactions from friends and family in the form of both audio and text annotations. These annotations result in threads of conversations and gut reactions to the media being shown, and as a result, stories begin to emerge 'naturally'.

The MNV prototype application was written in C# using the MS .NET Windows programming tools. We use the MS .NET remoting functionality for exchanging metadata and a separate, lightweight embedded web server for transferring media files back and forth. All communication is made over HTTP. The SOAP protocol was considered but would have required the user to install a heavy-weight IIS web server. Metadata for the media is stored in an MS Access .mdb database file using the MS Jet interface. This enabled us to store data with the flexibility of an SQL database without having the large install of an SQL server. Media files are stored in a temporary cache after being downloaded to reduce network bandwidth.

The Interface

The interface to the MNV was kept deliberately simple (See Figure 2). The screen is similar to that of an Instant Messaging application with a buddy list to the left. The media display window is to the right of the buddy list and along the bottom are 6 buttons, one to stop and start the random display of images, two to move back and forward, one to make a text annotation, one to save buffered audio annotations and finally one to access settings. The Speech bubbles to the right of the screenshot in Figure 1 demonstrate how annotations are represented. With text

annotations, the text is displayed and with audio annotations, a speech bubble with a 'play' button is displayed.

Figure 2: The MemoryNet Viewer

Annotations

The user adds a text annotation to a photo or video by clicking the appropriate button (similar to Liechti et al's model [11]) while the object is being displayed. Comments are then keyed into the dialog box. The next time that media object is displayed the text annotation will appear on the right side of the screen. Audio commentaries can also be added to media using one of two methods. In the first, the user can hit a button to begin recording and one to stop. This method was somewhat intrusive and people didn't think to hit the button. Also, initial reactions to media were not captured and the annotations seemed 'fake'.

The second method, which fits well with the way audio annotations were found to be significant and effective, involved buffering audio while the image was being displayed. Whilst images were being shown, people often stopped to view the display and comments were shouted out, laughter was heard and stories were told. The comments and stories were spontaneous and the annotator often didn't think to hit a button to record until he/she was too far into the story to start over. To address this we added a passive recording option that, by default, recorded from the moment the media object was first displayed to when it transitions to the next object. If the user clicks the 'save audio' button during the story, the annotation is saved, otherwise the recording is discarded.

Recognizing that people occasionally regret what they say, or that questions and comments get 'old', annotations are physically stored on the users' computer. The annotation must be requested from the user each time it is displayed on another machine and if it has been deleted, will not be played.

This prototype was built to probe the possibilities of media sharing and linking and that of annotating media. It is not a technology probe as described by Hutchinson et al [10] but sits somewhere between their definition of a technology probe and a prototype. Developed to elicit information from people about their photo sharing and storytelling habits and requirements, the MNV has limited functionality and interface components.

In building the prototype our goals were to:

1. Investigate how a lightweight method for showing media might encourage sharing
2. Investigate how stories might evolve over time and be told as part of the process of 'playing' related media
3. How we might create connections between media objects
4. Find a relatively effortless way to associate metadata with media over time

THE STUDY

We ran a small, informal study with colleagues to evaluate the concept of the viewer as a method for sharing digital media and to gain some initial feedback on personal value in supporting personal yet social connections. The study consisted of a semi-structured interview with the users also giving demo's of how they used the system.

The prototype application was in use by 7 people for at least 2 weeks prior to the interviews. The constraints of the study were that the system was being used in a work environment. Although this inhibited some of the social uses we had envisioned, it still provided valuable data and actually changed the social atmosphere of the work environment too.

Results

General Perceptions

The overall response to the MNV was positive. The simple interface and interaction model were compelling. The most encouraging comment from users was that 'it just made sense' as a way to share and distribute digital media, to keep family friends abreast of events in your life. Frohlich et al [6] ask the question "What do users want to do differently with photos once they have captured them in the digital realm?" Although we don't claim to have the answers, the initial response to the MNV was that this was something they wanted to do differently with their photos once they had captured them in the digital realm. They didn't want to print them and make albums, they didn't want to write long stories about them and they didn't want to have to think about ways to author a media disk. They wanted to "dump them somewhere" and have them be accessible. Although we don't yet provide the ability to search on images using metadata, this is something that is under development and a feature that many suggested as being a useful addition.

On an average day, users spent approximately 10-15 minutes actively interacting with the viewer. This involved concentrated viewing of the media, reading/adding annotations and uploading more media. Although this may not seem like a considerable amount of time, it is in fact in line with what we had hoped for. We wanted the viewer to be fairly passive, something that did not require large amounts of interaction time on the part of the user to reap any benefit. Although it is in fact possible to spend hours viewing media, creating stories and interacting with the Viewer, it is also possible to benefit from its presence without actively interacting with it. Users commented upon how the media (usually photographs) caught their attention at moments and they could pay attention to it, or not. But the presence of the images was somehow satisfying or pleasing in that they felt they had some connection to the other people on the network.

Annotations

The annotation facility gave users the ability to add short comments to the media being displayed. The text annotation feature was used more commonly in this environment as people were a little more wary of what they were saying and how they were commenting upon other peoples' media. In the work environment and with work colleagues, users commented upon how they were more conservative in the comments they offered. As a result, people were more calculated in the wording of their comments and were keen to not offend out of ignorance of details. All users mentioned that auto capturing of the 'aha' experience from distant family members would be something that they would look forward to playing.

The most common reasons for adding annotations included:

1. when the 'owner' wants to give a story or some background
2. to make a funny comment
3. as a response to someone else's annotations
4. adding some knowledge (either to your own or someone else's images
5. to ask questions about content/context

When people were alone they usually added text annotations rather than audio annotations to the media, mainly because they felt 'stupid' talking to their computer. In social situations however when a number of people were present in a room and paying attention to the viewer, more buffered audio annotations were saved, These often involved laughter and a social response to the media being displayed.

In a home setting people mentioned how voice would be more lively and provide extra value if receiving annotations from family and friends as these are familiar people and you want to hear their reactions to your photos and the events in your life and maybe even what you just bought etc – there is a large amount of value in getting feedback from those close to you in voice form than there is in text form. Nevertheless there were issues with audio annotations in that you didn't have any way of knowing what might be contained in them. With text, you can glance at the words and get a flavor for what is there but with audio this was not possible. Users wanted to navigate the audio to get to the bits that were interesting or skip the long pause at the beginning of some audio annotations. Although the value of audio was clear, the method of implementing both capture and playback was viewed to need work.

Unlike the annotation facility provided by Liechti & Ichikawa's [11] model, the annotations here were implemented to explore ways in which to capture actual instant emotions, the views of a wider audience and familiar responses from friends and family.

Conversations

The majority of people commented upon how the application had led to in person conversations. This was most enjoyable for people when they were co-located, for instance in our lab and a photo sparked a conversation. But, people also reported the application sparking other conversation too, away from the viewer itself. The majority of people mentioned how they had seen something that they later either asked the owner of the photo about or commented on it to the owner or even someone else. The moments were common and people mentioned how they liked the fact that it sparked new and interesting conversations. Users also mentioned how they had been approached by people to enquire about photos.

Feeling more connected & Discovering new links

Almost everyone mentioned how they had learned something about someone that they hadn't known before. It led them to change their opinions of people and their interests. It helped them learn about peoples families, 'meet' their spouses, the kids, see their houses etc – it essentially gave people a window to a less formal part of peoples' lives and the majority of people valued that immensely. As people put vacation photos up, more stories were told. A lot of people mentioned joy or happiness as an emotion sparked by the photos – "it made me smile" was a commonly used phrase. The annotations also sparked emotions and overall people mentioned feeling more 'intimate' with people, their interests etc. There was also an element of feeling commonality with people as you realize you have similar interests, and also some envy at how much other people travel! There was also curiosity, poignancy and the sparking of personal memories.

Wanting More

The interviews highlighted the good and the bad both in terms of functionality and the interface. The interaction model was compelling in its simplicity, yet people wanted more. We deliberately began with little functionality and

the 'more' came from the users and not from the developers. People wanted:

1. The ability to use one piece of media to link to other pieces of media in their own collections or those of others. This launching pad would give them access to a greater selection of media objects of interest to them based on their contextual clues of the moment.
2. The ability to have live conversations with people with the media objects being present.
3. The ability to control the media they see by person, by theme etc
4. The ability to navigate audio annotations
5. The ability to create groups of people based upon interest, commonalities etc

The Value

The value for people was in sharing their everyday lives with their close friends and family and in providing a constant connection to people, being able to access other people's archives of photos and just having a window into the world of others.

FUTURE WORK

From a technical standpoint, we are working to grow MemoryNet into an infrastructure that supports the management of links between media such that we create a system that strengthens personal networks and improves the preservation of memories by representing these emotional connections in software. We see home archival appliances that store and manage the connections among our media. We are developing user interfaces that display dynamic clusters of media based not just on time but on a phrase, a name, or spoken word and we are developing physical interfaces and interaction models to navigate and annotate the media.

We also recognize that as technology progresses, we retire old machines yet we want to keep the annotations associated with the media that we store because the stories told and comments made are more valuable over time. This is an issue that we still need to address.

For the purposes of this implementation, we have ignored the process of capture but acknowledge the importance of this in the sharing process also. With camera phones becoming more pervasive we are leveraging the capabilities that these devices provide. The increasing popularity of photo-blogging web sites (moblogs) that are used to display images of trivial daily events [3] is further evidence of the willingness and want of people to be able to share and document these moments fleetingly and with ease.

We are in the process of developing the infrastructure and appliances for deployments with networks of friends and family. One likely future deployment will include connecting family members with elderly relatives in care facilities. We will use these deployments to investigate how connected media in personal networks might augment personal connections. We will also further investigate perceptions associated with blurring the lines of ownership so that those who have a stronger emotional connection to media also have possession.

Finally, one of our goals is to research interaction models that promote the ability to express an emotional connection to media by facilitating effortless annotation and storytelling.

CONCLUSIONS

The MemoryNet Viewer was built as a prototype used to investigate how we might share our connected experiences and moments from not only significant events but also our everyday lives. In maintaining a sense of awareness about those to whom we are close but often separated from, we believe we can influence the personal networks that currently exist and augment them with the sights and sounds that our media now allows us to capture and share.

The MemoryNet Viewer provided some positive evidence of our desire to find simple and intuitive ways to share our media to influence our memories and to change the way we attach stories to our media. It was a valuable first step toward developing the concept of *authoring by playing* and realizing the vision of a network of interconnected personal media.

Our future work will further investigate these issues and develop new prototypes to add to our research in this space, focusing on not only the software infrastructure needed to support these models but the user interface and interaction models that will drive use and influence the way we converse in our personal networks.

ACKNOWLEDGMENTS

The authors wish to thank Gene Becker and all members of the Contextual Media Systems Group for comments and contributions to the work.

REFERENCES

1. Balabanovic,M., Chu,L.L., Wolff,G.J., (2000), Storytelling with Digital Photographs, In the Proceedings of CHI'00, pp564-571, ACM Press
2. Chalfen,R., (1987), Snapshot Versions of Life, Bowling Green State University Popular Press, Bowling Green, Ohio
3. Daisuku,O., Ito,M., (2003), Camera Phones Changing the Definition of Picture-Worthy, Japan Media Review, http://www.ojr.org/japan/wireless/1062208524.php
4. Frohlich,D., Murphy,R., (2000), The Memory Box, HP Tech Report, HPL-2000-95
5. Frohlich,D.., Tallyn.E., (2000), Augmenting Photographs with Audio, HP Tech Report, HPL-2000-15

6. Frohlich,D., Kuchinsky,A., Pering,C., Don,D., Ariss,S., (2002), Requirements for Photoware, In the Proceedings of CSCW'02
7. Frohlich.M., Pilu,M., (2002), PicShare, Online at http://www-uk.hpl.hp.com/people/mp/research/picshare/
8. Frohlich,D.M., Kraut,R., (2003), The social context of home computing, In Harper,R. (Ed), Inside the smart home, Springer Verlag, London, pp127-162
9. HomeNet trial, Carnegie Mellon University, http://homenet.hcii.cs.cmu.edu/progress/
10. Hutchinson,H., Mackay,W., Westerlund,B., Bederson,B., Druin,A., Plaisant,C., Beaudouin-Lafon,M., Conversy,S., Evans,H., Hansen,H., Roussel,N., Eiderbäck,B., Lindquist,S., Sundblad,Y., (2003), Technology probes: Inspiring design for and with families. In the Proceedings of CHI'03, pp 17-24, ACM Press
11. Liechti,O., Ichikawa,T., (1999), A Digital Photography Framework Supporting Social Interaction and Affective Awareness, In the Proceedings HUC'99
12. Makela,A., Giller,V., Tscheligi,M., Sefelin,R., (2000), Joking, Storytelling, Artsharing, Expressing Affection: A Field Trial of how Children and their Social Network Communicate with Digital Images in Leisure Time, In the Proceedings of CHI'00, pp548-555, ACM Press
13. Meadows,M.S., (2002), Pause & Effect: The Art of Interactive Narrative, New Riders, Indianapolis
14. Myerhoff,B., (1978), Number our Days, Simon & Schuster, New York
15. Putnam,R.D., (2001), Bowling Alone: The Collapse and Revival of the American Community, Simon & Schuster
16. Rodden,K., Wood,K.R., (2003), How Do People Manage Their Digital Photographs?, In the Proceedings of CHI'03, pp409-416, ACM Press
17. Shedroff,N., (2001), Experience Design 1, New Riders, Indianapolis
18. Stevens,M., Abowd,G.D., Truong,K.N., Vollmer,F., (2003), Getting into the Living Memory Box: Family archives and holistic design, In the Proceedings of the 1st Internatonal Conference on Appliance Design (1AD).
19. Walker,A.L., Moulton,R.K., (1989), Photo Albums: Images of Time and Reflections of Self, In Qualitative Sociology, Vol 12, No 2, pp155-182