User-Centered Design of a Mobile Application for Sharing Life Memories

Thomas Olsson[1], Marika Lehtonen[1], Dana Pavel[2], Kaisa Väänänen-Vainio-Mattila[1]

[1] Institute of Human-Centered Technology,
Tampere University of Technology
P.O Box 599, 33101 Tampere, Finland
{thomas.olsson, marika.lehtonen,
kaisa.vaananen-vainio-mattila}@tut.fi

[2] Nokia Research Center, Helsinki
Itämerenkatu 11-13
00120 Helsinki, Finland
dana.pavel@nokia.com

ABSTRACT
People have an inherent need to capture and collect life memories such as moments with children or special events with friends. Capturing life memories is either spontaneous or planned. Memories are stored and frequently shared with other people. New internet services allow online sharing of photographs but they bypass the mobile aspect in capturing and sharing multimedia. In this paper, we present a concept mobile application for capturing and sharing memories while mobile and the user research studies that supported its design. Our aim was to design a prototype application that would enable mobile users to capture and share precious moments. Various categorizations of user behaviors related to personal media management emerged out of our user needs studies. We then followed a user-centered design process according to Contextual Design. The user evaluation of the resulted paper prototype showed that users appreciate the event based, instant sharing within particular groups of people.

Categories and Subject Descriptors
H.3.5 Online Information Services: Data sharing. H.5.2 User Interfaces: Prototyping, User-Centered Design. H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Human Factors, Design

Keywords
Life memories, mobile application, personal content management, Contextual Design, user-centered design

1. INTRODUCTION
People have an inherent need to capture and collect memories throughout their life span. Life memories can be seen as both people's internal memories, but also as physical and digital artifacts relating to meaningful events. Memory artifacts have traditionally been captured by taking photographs and storing them into photo albums, perhaps with some textual information attached. In addition, letters and mementos from special events such as family gatherings, concerts, meetings can be stored for later viewing. Personal life memories are traditionally shared to a limited extent, mostly by viewing the artifacts together or by sending them to friends via email or MMS. More recently, internet services, such as Flickr or Picasa, have enabled people to share photographs online. These and other similar applications enable new forms of user-generated content management.

Mobile technology is suitable mostly for capturing the media – useful mobile sharing tools have not emerged at the same pace. However, mobile phone is a versatile platform in personal content creation and management since capturing, managing and sharing the data can be done instantly and using only one device. In addition, mobile phones offer natural opportunities for collecting instant digital pictures and videos because of their immediate availability to users. Easy access to data on the phone or around it enables easy metadata annotation of captured content, which can greatly improve the management of the personal content [2].

Our research work is part of the SharMe exploration activities from Nokia Research Center. The focus of our research was on finding solutions for how mobile phones could enable people to easier capture and share precious memories so that they can focus more on living the moment than caring about technical problems. We started out from Vannevar Bush's vision of continuous capturing [3] and tried to identify – through interviews, observations and interactions with users – what kind of situations, interaction and application paradigms people would find acceptable and desirable to be captured.

As extensive previous work shows (e.g., [4][5]), any type of media capturing with mobile phones that involves other people's presence or future sharing is extremely sensitive. In our work, we conducted in-depth user needs research with different user groups. Existing applications involving mobile phone-based capturing have been evaluated. Usage of existing applications has been observed. All these eventually lead to the creation of a concept prototype that has been further designed and tested with users.

The design of the concept utilized the Contextual Design method [1] to ensure the user-centeredness of the developed concept

Mobility'07, September 10 -12, 2007, Singapore, Singapore.

prototype. The challenge was in designing a visionary concept prototype when no existing, similar task processes for mobile memory sharing could be observed. Instead, existing sub-processes of photograph capture and sharing were used as a basis for Contextual Design.

Section 2 describes related work on personal content management on mobile devices. Following that, Section 3 describes the user-centered design process. Section 4 presents a selection of user needs research findings. The resulting concept prototype and user evaluation results are presented in Section 5. Section 6 discusses the findings from the prototype acceptability and design process perspectives. Finally, Section 7 presents a summary and conclusions regarding the research and design work.

2. RELATED WORK

This research involves several intriguing aspects to be taken into account, for example mobile capturing and sharing, metadata annotations, context awareness and continuous capturing.

Previous studies have shown that users' needs for capturing, managing and sharing memories are universal but the users' habits seem very diverse. The photos and other media are captured for both personal use and for sharing them with others. Users share their recordings to maintain the social relationships, for self-expression and to construct personal and group memory. Mobile sharing is usually instant and for very small group of recipients. Sharing on PC and using web sharing tools is more public. PC sharing is addressed to smaller groups by using e-mail or peer-to-peer networks. [6][7]

The idea of continuously recording one's life memories has been around for quite some time. The initial vision was developed by Vannevar Bush [1]. Notable research activities have been going on since then in various groups, e.g. [7][9]. While the topic still generates various controversies either due to gadgets that need to be worn or due to ethical and legal issues involved, recording the most precious, but usually missed moments, interests users [4][5]. While continuous capturing has certain advantages, allowing people to focus on experiencing the moment with little or no interaction with the capturing device, the opinions are split when it comes to losing privacy and control over what and when is recorded. While certain individuals are more willing to give up this control [10], most of the people are not, as also shown in our studies.

Personal media annotation has recently been extended to mobile phones [2], due to their capacity to collect various internal and external data. The amount and type of metadata that can be attached to digital media is very diverse, including context data [11][12], user-set tags, descriptions of the media content, etc. The annotations can be either automatic or user input. Recent mobile phone applications and platforms (e.g. ContextPhone, Meaning and Jaiku) have been taking advantage of the availability of this data in phones. One of the most important context information, location, is already being used both in prototype systems [13][14] and in commercial phone-based navigation software (e.g. Nokia's Smart2go).

Context awareness has for long been a rising topic in mobile computing research [11][12]. The possibilities of mobile device to automatically capture various context data have affected on emerging of context aware mobile applications, such as Jaiku and Context watcher. In personal content management, adding context information to recorded media makes it easier for the user to remember the real life event more evocatively [15]. It can also enable easier management and search of personal content.

Experimental mobile applications such as Mobile Media Metadata (MMM2) [16] and Meaning have enabled new forms of mobile instant sharing. MMM2 introduces a method for predicting the recipients of a to-be-shared photo by identifying the near-by Bluetooth devices at the time of photo capture. Meaning supports using an external GPS device for locating. The location information can be added to the captured photo as raw location coordinates or as semantic location tags (e.g. home, work, downtown). Using a web-based portal to browse and post process the uploaded data utilizes the benefits of the PC user interface and provides good accessibility to the memories.

In the field of web-based personal content management applications the growth has been remarkable for the last few years. Web2.0 applications, such as Flickr, Picasa and YouTube, have offered services for organizing and sharing personal media files. In the research presented in this paper, the aim was to develop – based on the user needs – a set of versatile features for mobile memory capture and sharing.

3. USER-CENTERED DESIGN PROCESS

As the memory sharing is a very sensitive area of user activity, we first conducted an in-depth user needs research study. Our user-centered design (UCD) and research process then involved a slightly modified version of Contextual Design method (CD) [1]. The main challenge in applying CD was the fact that mobile memory management and sharing contains tasks that do not exist in mobile applications currently. Thus, related sub-tasks of mobile photography were taken as a basis for design.

3.1 Study Goals

The main objective of the research was to bring the end-users' perspective to the development of the SharMe concept of life memory management. A wide scale of user-centered design and research methods was used during the project. Users were involved in all phases of the design: user needs research, contextual inquiries, paper prototype tests in two rounds and acceptability tests for the designed prototype system.

Contextual inquiries aimed at revealing the selected target users' current behaviour with mobile photography. Contextual inquiries would result models of the current behaviour, comprehension about the division of tasks between mobile and PC usage and users' opinions (benefits and flaws) about the currently used capturing and sharing applications. A list of both universal and case-specific design drivers was to be generated by interpreting the inquiries' results. These results would then be used to design a skeleton of the concept prototype. The user needs results should also reveal issues that could be utilised in the creation of further memory management applications.

The most concrete goal was to develop a prototype of the SharMe concept according to the user studies. Paper prototype testing was aimed at iterating the first versions of the prototype and its UI towards a more usable direction. Additionally, paper prototyping was used to gather users' opinions regarding the acceptability of the current prototype. Finally, an important goal was to evaluate the resulting concept prototype with the target users.

3.2 User Needs Research

The aim of the user needs research was to tackle wide range of questions dealing with user values, expectations and emerging needs in relation to the overall SharMe concept and in specific to the processes of capturing, retrieving and sharing life memories. Interviews and scenarios were chosen as the research methods to elicit insightful discussion with the potential target users.

Specific challenges in planning the interviews dealt with the decisions between potential target groups and themes of the interviews. Difficulties were due to wide-ranging SharMe concept and unclearness of the target group of such a novel concept. Also, planning the usage scenarios to be used in the interviews was demanding, since there is no current system which could have been used as a starting point in the scenarios.

The findings of the interviews and scenarios were used as a background for user-centered design. Interviews were carried out in two consecutive rounds with partly different sets of interview questions and variety of target groups. Altogether 54 persons participated in the interviews.

In the first interview round, qualitative thematic interview was selected as a suitable research method. Two of the nine interviews were focus group interviews and the rest were individual or couple interviews. To get an overall viewpoint of potential users' opinions to life memory management, participants were selected to represent three user groups: 1) Young families with babies or young children, 2) Young people familiar with on-line communities and 3) People living away from their relatives (in another country).

In the second interview round the methodology included evaluation of the usage scenarios. Based on the findings from the first round, 11 scenarios were written to describe different types of use situations and aspects of SharMe (see Figure 1 for an example). There were no pictures or other illustrations in these textual scenarios. Second round was composed of five focus group interviews with the following user groups: 1) the parents, 2) the elderly, 3) the travelers, 4) the enthusiasts (car tuners) and 5) the athletes. Overall, this broad selection of potential user groups gave a useful overview of different needs and expectations towards SharMe concept.

Vera has just settled comfortably on the hotel room bed in Barcelona and **browses with her mobile device through all memories saved during the day**. Especially the visit to the church "La Sagrada Familia" was really exciting and there is a lot of good material on that. Also, the **automatically saved official presentations** of the city seem to be useful. It's easier to **tell** about the holiday for your friends when there are so much valuable **details** saved in the system. Vera decides to **authorize sharing these memories only for her friends**, although there is nothing secret here. Perhaps she is just **concerned about anonymous troublemakers** who want to play jokes on the internet. She notices that Erika is already **adding some comments** on the files. [...]

Figure 1. Excerpt of an example usage scenario used in user needs research (central topics bolded for emphasis)

3.3 Contextual Design

After the user needs study the Contextual Design phase followed. The target group of research at this stage was chosen to be youngish people who already use some mobile devices and applications for personal content management. This user group was chosen as the target group for the design phase, because they were assumed to be able to give insightful comments about the novel ideas of SharMe. They were also assumed to be the first real consumer groups of such service. Altogether 10 contextual inquiries were carried out. Eight people of this group were male, two female, and the ages varied from 25 to 35. The study had two sub user groups: Flickr users and users of modern camera phones. As there are no corresponding applications to the SharMe concept, profound interpretation was needed for the inquiry results. The inquiries took place at the user's normal usage environment in order to maximize the naturalness of the usage situation.

The contextual inquiries focused on finding out the usage patterns and sequences of SharMe concept. The specific focus was on revealing when, where, with whom, in what kind of situations and how users capture or share recordings. The contexts of use and usage of contextual information were other important focus areas. While the focus was on mobile use, the study also aimed at finding what features that are currently in the PC UI would be needed in the mobile UI. Furthermore, the wide range of functions in personal content management related to creating, browsing and sharing the memory objects was observed and discussed with the study participants.

After inquiries the interpreted data was reclassified on an affinity wall and consolidated sequence and interaction models were drawn. However, the cohesion between inquiries and user needs interviews had to be confirmed. An integrated affinity wall was built to show the consolidated research material, not just the contextual inquiries. The notes were broadly at same level of abstraction and they represented user needs, habits or opinions of the participants. The resulted integrated affinity was used to create design drivers to steer the prototype design.

The resulted affinity wall along with the interpreted models let us form design drivers to steer the prototype design. Totally 17 drivers with various focus areas were written. The drivers served as an idea source when designing the prototype outline and as a check list during the design iteration of the prototype. Figure 2 shows examples of the design drivers.

1) Provide features for creating collages from several users' recordings.

2) Provide easy ways to organize and browse the material according to *time*, *event* and *place*.

3) Let user control what kind of metadata is added and shared.

4) Provide features for browsing the most recent captures.

Figure 2. Examples of design drivers created based on the affinity wall

3.4 Paper Prototype Testing and Prototype Acceptability

Based on the Contextual Design results, a paper prototype of the central functions of the SharMe service was created. The prototype is presented in Section 5, Resulting Prototype. Paper prototype testing was carried out in two rounds, the first round with seven participants and the second round with five. The first round of prototyping aimed at getting user's opinions on the general idea of the system, and specific parts of the user interface design. This revealed the biggest flaws and produced improvements on the prototype user interface.

The design process was very iterative: after every test the most obvious flaws in the UI were identified and the related screens were redesigned. However, altering any fundamental part of the prototype was changed only based on input from several users. When designing a new prototype of a futuristic concept it proved to be useful to perform paper prototype tests that allowed frequent iteration. Most of the unwanted or unclear design solutions were discovered at an early stage and the main functionalities and screen layout were redesigned immediately.

The second round of paper prototype tests was done with much more detailed mock-up screen and menu images. The mock-up images were represented with example use cases. In this round the focus was also on preliminary user acceptance of both the prototype in general and certain parts of it. In this phase, some new and interesting design features were still invented. Users offered us valuable insight on what they regard as troublesome in current mobile user interfaces. These facts proved the significance of paper prototype testing in our study.

4. USER NEEDS FOR LIFE MEMORY MANAGEMENT

Extensive user needs studies were carried out in order to find out users' expectations and needs in relation to SharMe system. Attention was also paid to those factors which might act as obstacles for usage of such system.

4.1 Needs for Saving Memories

Users have generally positive outlook of the overall concept of SharMe. It is important for the users that SharMe can be used with a mobile device, while in certain situations other devices would be used as well when, for instance, larger screen is considered necessary. It is definite that users have a need for versatile memory saving devices, the kind that will make it easy to collect life mementos, manage them and share them with others.

Based on the interviews, it was found out that needs for saving can be divided in three separate categories on the basis of the type of collected memory data (see Table 1). In addition, each category represents either long term or short term memory. This division makes visible the users' needs for saving memories either for good or at least for a long period of time or for shorter time corresponding to such memory tools as calendar, note book or PDA.

Table 1. General needs for saving memory items

Types of memories users want to save	**Examples of memories**
1. Happy moments (related to long term memory)	Family and friends, nice events (birthdays, weddings etc.), related context information etc.
2. Life history (long term memory)	Important events of personal life, travel mementos, development steps of children, related context information etc.
3. Details to facilitate daily errands (short term memory)	Calendar information, checklists, medical history etc.

To sum up, users are interested in saving data which captures moments of some significance. However, needs for saving does not rise only from users' personal interest. For instance, elderly people could see the value of the savings from the perspective of future generations. Also parents wanted to save memories of their children to be shared with them when they grow up. Thus, needs for saving are often interconnected with the idea of *sharing* and persistence of the memory data.

Users also emphasized that they would like to capture life moments which usually pass by so quickly that nobody is able to save them.

4.2 Levels of Sharing Memories

The idea of sharing memory data with others is very appealing for users who have realized that currently the technology in use restricts sharing in many occasions. For instance, large amounts of data cannot be sent via e-mail. Moreover, using web-based platforms for sharing is not always easy or suitable for given situation. Yet, users are interested in sharing visual and audio presentations of their memories. Simultaneously, communication culture is becoming increasingly visual by its nature, which emphasizes the importance of making it easier to share visual materials.

Even though sharing of memories was considered to be very positive by participants of the interviews, this does not mean that everybody wants to share all their memory data with anybody. Instead users want to be in control over granting the rights for viewing or otherwise utilize their saved materials. Thus, granting the rights for others must be carried into effect very easily.

Table 2 presents an interpretation of the categories of sharing based on the interviews. As seen from the table, the idea of sharing divides the users. While some are ready to share all or at least a lot of their memory data, others create memory materials mainly for their personal use. It seems, however, that majority of users are in between of these two extremes. But without statistical study this cannot be stated with certainty. Nevertheless, based on our qualitative interviews and analysis, it is obvious that the context of sharing and content of the memory data are the defining factors, when users consider with whom to share their data. Generally speaking users are more interested in sharing happy memories, while mementos of negative life events are more often considered to be private.

When sharing their memory items users are often interested in having comments from others. They want to hear other people's opinions on their saved materials or to have other participants to add their own perception of the event. This collectiveness in commenting others data shows us that memories are often created together. It can be done through discussion on past events, but nowadays reminiscing can also be carried out virtually, via an internet or GSM application.

Table 2. Three levels of sharing memories

Willingness to share	Perception of memories	Explanation of ways of action	Motivation for sharing/ not sharing
1) No sharing at all *"Private memories"*	Memories are private. Others are probably not even interested in them. Sharing them might give others an opportunity to harm me.	I save memories mainly for personal use. Saved items provide means to recollect, contemplate and develop myself.	I enjoy recollecting happy moments, but I can also relieve unpleasant moments of my life through memory data.
2) Sharing only with my family, closest friends or people presenting the event *"Sharing creates intimacy"*	I share my saved memories with the people I can trust. Other people might do me harm, if they had access to my memories.	Sharing strengthens our relationships with each other. It creates feeling of community and belonging.	I like to make others happy by showing them pleasant things. I enjoy sharing positive memories.
3) Sharing with anyone *"Creating new communities and shared memories"*	I have nothing to hide.	Free sharing of all the savings is a must in Internet age. It is a part of new culture.	I like to get comments from others about my saved memories and myself. I enjoy getting attention.

4.3 Timing of Sharing

One of the interesting themes is the timing of sharing. When sharing is carried out via mobile phone, e-mail or other internet applications, it does not always happen in real time, which means that receiver does not necessary view materials immediately after having received them. However, users are quite interested in instant sharing in order to be able to give instantly additional information on the data, if necessary. They would also be eager to have receiver's comments on the data right away after the mementos have been sent. Obviously there are situations when real time sharing is not required or even possible, but when it is, it creates a feeling of intimacy and closeness between users of the system. Of the different user groups especially travelers and people living away from their relatives (in different countries) found real time sharing adding something new to their way of communicating with the people close to them.

4.4 Event-based Management

Both interview rounds pointed out that users want to record especially happy moments, trips, parties and other interesting events. In social gatherings the conversation easily drifts to reminiscing the past together experienced events. In other words, users reminisce about the memories as entities. This is particularly emphasized in long-term memories.

As studying the users' habits in the contextual inquiries it came out, that users tend to organize their media files according to real life events' occurrence time. Users often capture photos in bursts. The ordinary everyday life is little recorded but when the users are involved in something interesting, abundant recordings are taken. Therefore, it is natural to organize the recordings in entities according to real life events. One burst of recordings can easily be identified as one event.

An interesting event is usually something done with a group of other people (e.g. hobbies, family vacations or public events). The recordings are meant to be shared with that group or even publicly. Inquiries showed that groups with close relationships, such as family or a group of friends, have need for gathering collective events. The group usually participates together in an event, and the recordings from different devices are then wished to be accessible for the whole group. Secondly, if only few members participate in an event, the rest of the group wants to view the recordings.

The group members' personal recordings from the same event might differ a lot from each other. Thus, the collective memory becomes a dynamic collage of different private memories. Even small pieces of personal recordings shared to others might change others' mental impression of the event. Users manifested also that it is interesting to keep both the private and the collective version of the event. This way it is possible to reminisce the event from only personal point of view or by using all the collective data. This makes the concept of collective memory so intriguing.

5. RESULTING PROTOTYPE

The results of the UCD process yielded a prototype of the SharMe concept. The prototype's outline is first described briefly. Then, we describe the two most interesting features in the prototype, which are also thought to be the most novel.

5.1 Prototype Outline

The resulted prototype is an application for capturing memories, sharing them, and automatically organizing them with both mobile phone and PC. The designed part of the system is to be used with a mobile phone. The designed prototype could be thought as a replacement of modern mobile phone's camera and gallery softwares. Figure 3 describes the prototype's main functionalities as a whole system.

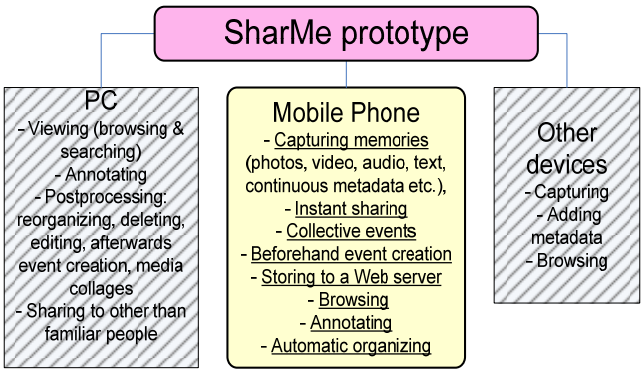

Figure 3. The prototype outline. The prototype focused on the Mobile Phone user interface.

As in most related systems, the media content is stored in the Internet, accessible via both mobile and PC UIs of the prototype. Collective use of the media content is thus emphasized. User can easily share content by forming events of the media and sharing the event to certain user or groups of users. Event creation and its effects on application's other functionalities is more exactly described in Section 5.2. Capturing the media includes also other features, like context data added to the memories. Attaching other than mere visual or audio data makes the memory more alive. Moreover, users may add their own tags to the memory items and annotate them in order to enrich the shared memory. Browsing the recordings is more versatile: user can browse the media by different browsing rules and view only part of the viewable media by filtering the content. Adding various types of metadata enables versatile search features. In the contextual inquiries users emphasized the need for quickly viewing the most recent captures. This was taken into account by offering a quick route to the gallery of the most recent captures.

5.2 Collective Events for Instant Sharing

The results of the user needs research and contextual inquiries lead us into creating an event-based capturing feature. The event is thought to contain all the material relevant to the memory of the corresponding real-life event. As the modern mobile phones are capable of capturing diverse metadata and PC platform is excellent for creating versatile data types, creating events to integrate all the data is rather straightforward. This idea of event-based content management is a fundamental thought in the design. Using it affects rather much of the functionality of the rest of the prototype.

As the event can be thought as a certain period of the user's time that has common characteristic, various settings can be given to the event. A user can create an event before the actual capturing event takes place, during it or even afterwards. The recordings captured during the duration of the event are automatically organized under the event. Several options to define the duration of the event are provided in order to support flexible management of the events (see Figure 4).

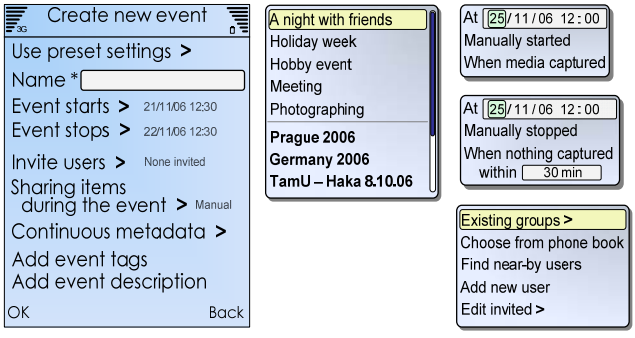

Figure 4. Left: the event creation wizard, Middle: the submenu under *Use preset settings,* Right: the submenus under *Event starts,* *Event* ***stops* and *Invite users*.**

Creating events makes it easier to share captured media to different groups. User can form a group of users to be invited to the event. Every invited user is allowed to view others' recordings and share their own. Moreover, different users' memories from the same real-life event can be merged as collective events. During the event, sharing is either automatic by sharing all the recorded material or manual, in which case the user chooses the sharable recordings any time after capturing. As the recorded memories are usually for collective use, group control, commenting and discussing features are provided. This helps collecting all the event data into one collective memory and annotating it. This feature was designed for close groups that have mutual trust. Thus, only 2 different access right levels are needed (the event's creator and the invited users). Tools for public sharing exist already (e.g. Flickr) and they can be utilized in the prototype's PC user interface.

Event-based automatic organizing makes it easier to browse media in natural entities. It is vital to support browsing the media from different viewing levels, because browsing can be done either for close viewing the recordings or quick searching for a certain recording. The filtering options ease finding desired recordings. Sorting options provide alternatives how to sort the content (e.g. time, name). Furthermore, according to contextual inquiries organizing content based on user set tags, time or place is most natural for users. In the prototype the user may add own tags to single recordings or to all the recordings in the event. Event tags added after the moment of capturing can however be added to previous recordings in the event, too.

Event based thinking in the paper prototype tests elicited an idea of sub events. Users agreed that one sub level under each event would be sufficient. For example, a weeklong vacation could include several lesser events that should be located under the vacation event and, still, form an event of its own with individual settings. The sub events' size would be more suitable for one-time sharing, because users do not want to view too much at one time. Finally, the feature of sub events was designed to be based on user set continuous tags.

5.3 Sharing through Continuous Capturing

Continuous capturing was one of the features explored in our concept. The aim was to design a system that can minimize the lost important moments and that allows users to focus on experiencing the moment rather than dealing with a device. This drove us into designing features that will allow for user-controlled continuous recording.

The capturing solution presented in Section 5.3.1 was designed first. Iterative paper prototype tests, however, brought out very diverse aspects on how the continuous capturing could be implemented. The solution of continuous context data (5.3.2) is a part of the resulting prototype and was tested with users in the second user evaluation round (see Section 6).

The media captured continuously is video, audio or merely context data. Truly continuous video recording is limited by the fact that the camera is not wearable or convenient to be aimed at the target all the time [4], but this shortcoming could easily be addressed by using a wearable camera.

5.3.1 User Initiated Buffering

Here, buffering is a capture mode where the user can set the device to record video or audio into a buffer of selected length. When something interesting occurs the user may save the media in the buffer – or a part of it – and continue the recording in video mode after that. Figure 5 demonstrates the buffering user interface.

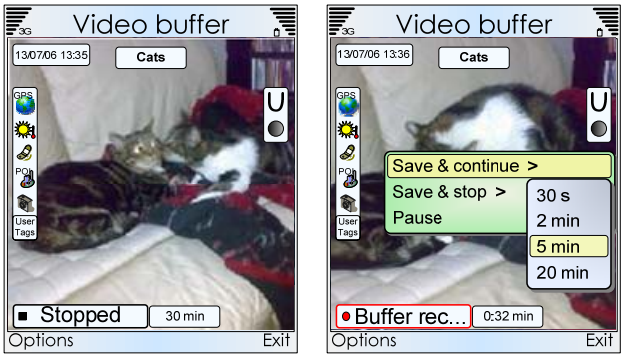

Figure 5. Left: the user initiated buffering in stopped mode. Right: buffering running and the quick menu options

The length of the buffer defines how much of the past can be saved permanently. If the buffered material is not saved, it will be overwritten as the buffering goes along. This solution is most suitable for predetermined situations where only part of the recording is important, but unforeseen (e.g. a sports event). Users thought this model to be the lightest and most ethical, but at the same time inefficient for saving the usually missed moments. The system would greatly benefit from having hard buttons on the device that would allow the user to easily save, start and stop any recording.

5.3.2 Continuous Context Data

One way to record data continuously and more ethically is to record mere context data without any audio or visual media.

In the prototype, recording context data (e.g. location, weather, near-by devices) during the event can be either truly continuous throughout the whole event or the context data can be attached to a single memory item at the capturing moment. This continuous and semi-continuous metadata can be presented in graphs over time or other visualization methods, and may serve as search keys. The included context data types were chosen after paper prototype tests. To keep the sharing of recordings simple the objective was to choose such context data types that users are willing not just to capture but to share, too.

5.3.3 Sharing of Continuous Data

From the sharing perspective, continuous capturing is promising, since the missed moments are usually the basis of the precious memories that would have been shared. The continuously captured context data enriches the life memories for collective use. Users can then further annotate the memory item in order to make it as vivid and personal as desired.

6. PROTOTYPE ACCEPTABILITY

The whole SharMe concept design process was based on user needs research and prototype iteration with users. The second round of paper prototype tests were executed with well specified mock-up pictures. Thus we were also able to gather acceptability feedback about the prototype. Acceptability testing aimed at gathering feedback for the overall concept and a few selected features: event-based sharing and continuous capturing. The tests were carried out in a laboratory. Five users of the chosen target group (young people who are experienced with technology) tested the prototype by carrying out three prepared test tasks. We asked the test users to evaluate the usefulness of each feature while testing it.

Generally, the prototype received good acceptance feedback from all the five test users. Users liked the idea of creating the event and setting parameters for it already before the actual event. Preset settings for events and group inviting features were highly appreciated. Instant sharing to the group of invited users suited the users' usage habits well. Users thought that the event settings should be changeable anytime because the time and invited group of the event might change even during it. Moreover, creating the events afterwards should be supported. Certain features, such as reorganizing events, managing the overlapping and tagging the events' recordings were regarded as PC UI's features.

The idea of capturing continuous metadata during the event received a warm welcome. However, the comments on different metadata types were conflicting. Not surprisingly, location and near-by resources (devices, services) interested most. Capturing user's bio-signals interested a few of the users but few needs for continuous capturing or personal use cases were identified. Weather data, user or device activity history and news feeds received only little interest. Users manifested the need for testing the data types in a functional prototype before being able to express the final opinions. They emphasized the role of semantic meanings when representing any of the captured metadata.

Continuous capturing as presented in Section 5.3.1 polarized users. Most users doubted the need for truly continuous capturing, and liked the idea of user-initiated buffering. On the other hand, some users expressed the desire for truly continuous capturing. Some of the test users presented innovative ideas, for example, they brought in ideas inspired by the buffering features in modern digital TV set top boxes and bookmarking of streamed data. Bookmarking the continuous data was liked as it enables easy finding of the interesting part in a long recording and sharing data in real time. The specific implementation has to be well designed, since truly continuous capturing raised suspicion and ethical questions within both the user needs research and contextual inquiries.

Generally, users thought that the event-based capturing and sharing would raise their use of camera phone and sharing of the recordings. They stated that many awkward phases are improved in this prototype, for example, manual sharing and organizing the recordings. The idea of capturing the usually missed moments is appealing, but the implementation needs further design. Users stated that the control in both capturing and sharing has to stay in users' hands. Since our study group included also very technology-oriented users, the current technology's restrictions in prototype's feasibility slightly diluted the reception. Knowing the current technology limited some users' future-geared thinking. The biggest suspicions were related to the cost of using the service and how the current technology would serve the implementation.

7. CONCLUSIONS AND FUTURE WORK

The research revealed interesting aspects about capturing and sharing life memories. Users want to share different kinds of memories but the extent of sharing – with whom and what data – varies between users and situations. One precondition on sharing a memory is its interestingness. Hence, a system that allows users to capture the most interesting moments that usually are missed,

fascinates users. People tend to capture memories in different events. As the events are usually experienced with a group of close people, it is natural to base the sharing of memories around events and the related group. Test users agreed on the basic ideology of the developed SharMe concept.

Continuous capturing turned to be a central feature in this study. However, it requires further design to ensure its suitability with users' needs. Continuous capturing generates new problems with the amount of recorded material. Proper collages and browsing features become essential when using the vast amount of recorded data. Truly continuous capturing ("24/7") is challenging to implement but it would offer users extensive possibilities to capture the important life events.

Context data and its usage as metadata or triggers for adaptable user interfaces need further extensive studies. The visualization paradigms and use cases for each context data type should be developed. A proper context-aware system with ability to adapt itself to the current conditions and easy ways to mark the interesting parts of the stream are desired. Automatic user- or environment-originated triggers, such as high pulse rate or high noise, should be studied.

As the total concept of SharMe is rather extensive, further research in several fields is required. This study focused on capturing and sharing the memories. Regarding sharing, we have planned a future research for further studying the concept of collective memory and its utilization possibilities. To be able to study and evaluate the use in a more realistic setting, a (semi)functional version of the prototype is required. A functional prototype that users are able to interact with in real contexts of use can bring out further problems in the usage.

Upcoming acceptability tests will be more interactive with a real user interface (on a mobile phone), and with a pairs or group tests. Prepared use cases and scenarios will be created to show how the usage could proceed in certain situations. Cases will include, for example, capturing the recordings and metadata using events, and sharing and browsing of memories with the mobile device. Assigning test users with different roles within the test group makes it possible to observe the collective usage of memories.

It is challenging to apply user-centered design process when designing applications with no existing comparison systems. In the contextual inquiries we had to choose a focus from existing sub-task of mobile photography. Even though this worked out well – we got very relevant data from the inquiries – it would be useful to combine user-centered design with other methods. One interesting approach is "user innovation" [17] which could be combined with the user-centered data gathering and analysis in supporting designers' innovativeness.

8. ACKNOWLEDGEMENTS

This article was part of the SharMe project led by Nokia Research Center (NRC) in cooperation with Tampere University of Technology, Institute of Human-Centered Technology (IHTE). We want to express our gratitude for NRC's Salla Myllylä, Markku Laitkorpi, Pertti Huuskonen, and IHTE's Minna Wäljas and Hannu Soronen. Moreover, we wish to thank all our user representatives in the research and user-centered design process.

9. REFERENCES

[1] Beyer, H., Holtzblatt, K. 1997. Contextual Design: Defining Customer-Centered Systems. Morgan Kaufmann Publishers Inc. San Francisco, CA, USA.

[2] Davis, M. et al. 2004. From Context to Content: Leveraging Context to Infer Media Metadata. In proceedings of 12th Annual ACM International Conference on Multimedia.

[3] Vannevar B. 1945. As We May Think. The Atlantic Monthly, July 1945.

[4] Gemmel, J. et al. 2004. Passive Capture and Ensuing Issues for a Personal Lifetime Store. 2004. CARPE '04. New York.

[5] Hayes, G. et al. 2004. The Personal Audio Loop: Designing a Ubiquitous Audio-Based Memory Aid. MobileHCI 2004. Glasgow, Scotland.

[6] Van House et al. 2005. The Uses of Personal Networked Digital Imaging: An Empirical Study of Cameraphone Photos and Sharing, CHI '05. Portland, Oregon, USA.

[7] Okabe, D., Ito, M. Everyday Contexts of Camera Phone Use: Steps Towards Technosocial Ethnographic Frameworks. In Höflich, Joachim & Hartmann, Maren Eds. Mobile Communication in Everyday Life: An Ethnographic View. Berlin: Frank & Timme, 79-102.

[8] Gemmell, J. et al. 2002. MyLifeBits: Fulfilling the Memex Vision. ACM Multimedia, pp. 235-238. ACM Multimedia '02. Juan Les Pins, France.

[9] Hewlett Packard: Photographic memories. http://www.hpl.hp.com/news/2004/jan-mar/casualcapture.html. Viewed: 1/2007.

[10] Millican, T. iam: Experiences with Persistent Video Recording. 2005. Publishing and Sharing, CARPE'05, Singapore.

[11] Dey, A., Abowd, G., Wood, A. 1999. CyberDesk: A Framework for Providing Self-Integrating Context-Aware Services. Knowledge-Based Systems, 11. pp. 3-13.

[12] Schilit, B., Adams, N. Want, R. 1994. Context-Aware Computing Applications. 1st International Workshop on Mobile Computing Systems and Applications. pp. 85-90.

[13] Kaasinen, E. 2003. User Needs for Mobile-Aware Location Services, J of Personal and Ubiquitous Computing (6). pp. 70-79. Springer-Verlag, London.

[14] Häkkilä, J. 2006. Usability with Context-aware Mobile Applications – Case Studies and Design Guidelines. Doctoral Dissertation. Acta Universitatis Ouluensis, Finland.

[15] Sarvas, R. 2006. Designing User-Centric Metadata for Digital Snapshot Photography. Doctoral Dissertation. Helsinki Institute of Information Technology, Finland.

[16] Davis, M. et al. 2005. MMM2: Mobile Media Metadata for Media Sharing. Conference on Human Factors in Computing Systems, CHI '05. Portland, Oregon, USA.

[17] Kanstrup, A.M. & Christiansen, E. 2006. Selecting and Evoking Innovators: Combining Democracy and Creativity. Proceedings of the fourth Nordic Conference on Human-Computer Interaction (NordiCHI), Oslo, Norway.