The Design of an Intergenerational Lifelog Browser to Support Sharing within Family Groups

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Declaration

I hereby certify that this material, which I now submit for assessment on the programme of study leading to the award of PhD is entirely my own work, that I have exercised reasonable care to ensure that the work is original, and does not to the best of my knowledge breach any law of copyright, and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

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Chapter 1

Introduction

1.1 Motivation

What if you had an application on your computer that would allow you to access your parents' or even your grandparents' lives? Imagine being able to listen to every story your late grandmother ever told or watch her making your favourite brown bread. We are now in the age of lifelogging where this scenario is being made possible. We are already allowing our mobile phones to automatically monitor our movements, our conversations, and our web browsing, so why not archive this information for future generations?

People have always collected artefacts and mementos to remind them of special moments, such as holidays they went on or relationships they had. Diaries and photographs in particular build a rich narrative of an individual's life. Older people tend to use these mementos to support reminiscence. Psychologist Robert Butler first conceptualised 'life review' in 1963 as a process that all individuals experience as they age or approach death (as cited in Haber, 2006). This theory suggests that in the last

years of a person's life they develop a need to construct their life story and to reminisce over experiences and unresolved conflicts. The practice of lifelogging would lend itself nicely to this theory. Lifelogging is the digital capture of life experiences typically through mobile sensors or devices. Lifelogging is a relatively new concept with early pioneers such as Steve Mann (2012) concentrating on making wearable devices smaller and smaller. One wearable lifelogging device, the SenseCam, automatically captures images every 30 seconds, resulting in thousands of recorded images per day. It is a small box-like device, worn around the wearer's neck and sitting at chest level. The SenseCam has received much attention with scientific researchers, following a study carried out by Microsoft Research and Addenbrooke's Hospital, led by Dr. Emma Berry (2009). This clinical trial explored the effect of reviewing SenseCam images over a period of many months with a patient with severe memory impairment, following a brain infection. The results were very promising, with the patient recalling events that had occurred weeks and months earlier, where before she would have had no recollection. Not only do lifelogging technologies archive information about life experiences, but they may also support our memory, a cognitive process that is affected with normal ageing.

Digitally archiving into old age would mean that we could review a lifetime of events, from everyday routine activities to significant occasions. Life review can be therapeutic for an individual but it also allows an older person to leave a legacy for their family to remember them by, and to remember the generations before them. As part of this thesis I interviewed a 61-year-old woman and asked her why she collected certain items throughout her life. She responded by saying that she was keeping them for her children: *"I'd like them to see me not as their mother but as a person who was young like they are, and who was going through all the things they went through".* But what if she had kept a lifelog of her day-to-day routines? Imagine if her children could see a day in her life as she went to college, having fun with her friends or the moment she met their father. It is now possible to record thousands of photographs per day, videos, dietary logs, emails, music preferences and so on. We are moving ever closer to the day

when lifelogging will be automatic and unobtrusive, recorded by discrete wearable or mobile sensors without manual intervention, and wirelessly transferred to a digital storage facility in the cloud.

Some people might be appalled at the notion of recording every moment. One problem that is continuously being raised is in relation to privacy. Although some people are happy to publish intimate details of their lives on the Internet (Mann, 2012), there are those that cringe at the very thought. Lifelogging could be thought of in the same terms. Some may want to exhibit their experiences to the world while others might lifelog for their own personal reasons. In a world where CCTV cameras are omnipresent and marketing companies seem to know our most intimate details, the meaning of privacy is becoming diluted. Retaining our rights to privacy is particularly crucial when it comes to lifelogging due to the quantity and level of detail that we can capture (Allen, 2008; Massimi et al., 2010; Nguyen et al., 2009; O'Hara, Tuffield, & Shadbolt, 2009). Therefore we will continue to raise the issue of privacy and oblige developers of lifelogging applications to consider the security and privacy rights for the user.

Archives tell us about the people and places that went before us and add depth to our historical knowledge. With advancing digital and sensor technologies, soon there might not be a moment that we can't retrieve and relive. Lifelogging is a new concept, therefore we have not yet seen what a complete lifelog would look like from birth to death. But lifelogging is not just for the young. It is possible that the benefit of lifelog archives increases as we grow older and begin to contemplate our life and legacy, and this is perhaps where the most fascinating research opportunities lie. This thesis aims to explore intergenerational lifelogging with the goal of designing a lifelogging browser that families can use to archive and share their life moments.

1.2 Problem Definition

As mentioned in the previous section, the term lifelogging is an unfamiliar one to the general public. Modern technologies enable large scale data capture, however often the benefit of this data is unclear. With the introduction of the SenseCam, researchers have begun to explore how large scale image sets could support people with memory impairments, including older adults with dementia. Past research has shown, however, that older adults are significantly more likely to accept new technologies when the older person is of high-cognitive functioning (Mayhorn, Stronge, McLaughlin, & Rogers, 2004). The willingness of older adults to adopt technology is also dependent on numerous factors, including relevance to their lifestyle and interest. Based on this research, it is my belief that to successfully introduce lifelogging technologies, we need to consider the needs and preferences of high-cognitive functioning older adults, and how lifelogging would fit into their lifestyle and interests. The problem therefore is to determine how lifelogging could be incorporated into the daily life of older adults.

1.3 Research Questions

With the problem definition in mind, I can now define specific research questions. A distinguishing goal of this research is to design a lifelogging application that older people are motivated to use. Exploring these motivations is central to this thesis. My first research question focuses on older people's use and attitudes towards technology and how these compare to younger adults. I then need to determine what motivations drive current life-long collections in the home and how these motivations can be applied to lifelogging. These issues are addressed in the second and third research questions. Finally, I need to design a lifelogging application that supports these motivations, in addition to the cognitive, sensory and physical abilities of older users. This issue is the subject of the final research question.

Technology Use

Research Question 1 *What are older people's experiences with technology in terms of:*

- *their lifestyle and everyday activities,*
- *their attitudes and preferences for technology devices,*
- *how these factors compare to younger age groups?*

As part of the requirements gathering processes, I begin by setting out to understand older people's experiences with technology and how these technologies are incorporated into their lifestyle. The purpose of this is to learn what factors motivate people, both older and younger, to use or want to learn to use technology. By comparing different age groups we see more clearly what issues are common to all age groups and those that are specific to the older population. The requirement gathering findings are outlined in Chapter 4.

Life-long Collections

Research Question 2 *What are the motivations for current life-long practices in terms of:*

- *the types of items people currently collect,*
- *the reasons for or against collecting these items,*
- *the triggers for reviewing these collections?*

Lifelogging can automatically record everyday experiences, however people have always collected items throughout their lifetime. We need to determine why people collect these artefacts and how the motivations can be applied to the act of lifelogging. Other issues include, the motivations for deleting or throwing away collections, and also

why people return to their life-long collections to review them. I investigate this research question through an interview study which I present in Chapter 5.

Lifelogging Motivations

Research Question 3 *Are older adults motivated to lifelog when it is incorporated into their lifestyle and interests?*

Having determined the motivations for life-long collections, we then need to determine whether these can be applied to the act of lifelogging. To examine lifelogging behaviour in a naturalistic setting I conduct a field experiment, providing younger and older participants with a SenseCam for a two week period. I focus on whether people would be more likely to lifelog when the motivations, determined by Research Question 2, are incorporated into the act of lifelogging. These questions are addressed in Chapter 6.

Application Design

Research Question 4 *How should a lifelogging application be designed to support intergenerational interaction?*

There are several factors that influence older user's acceptance of technology. Having identified the relevance of lifelogging to everyday lifestyle and interest, I now focus on the ease of use of the system in relation to the system structure and interface. Accessible interfaces should have inclusive usability, or in the context of the current research, intergenerational usability. There are numerous methods to examine usability. In this thesis I include older and younger participants in the design process, followed by a field evaluation of a family lifelogging system. The answers to Research Question 4 are discussed throughout Chapters 7 and 8.

1.4 Research Contributions

On a high level, the thesis contribution is in designing an intergenerational lifelogging system that supports both short-term and long-term sharing within family groups. This browser was designed to support shared family reminiscence using lifelog images captured by the SenseCam. As shared family reminiscence is an intergenerational activity, it was necessary for the lifelogging browser to support both older and younger users sharing their activities and experiences. To-date, lifelogging applications have not focused on intergenerational interaction or sharing.

This work also provides a new understanding of lifelogging. Previous works in this area identified how lifelogs can be used to support the individual but until now there has been a lack of understanding into how group of individuals, such as families, browse and share lifelog images. Informed by people's current motivations for using technology and collecting items throughout their lives, a novel way to experience lifelogging has been proposed, focusing on the needs of the individual as well as the family group.

In detail, the contributions of the thesis are:

- Based on existing literature, I designed a questionnaire study exploring older and younger people's experiences with, and attitudes towards technology, in everyday living. The findings highlight the importance of technology to support **social connectedness**, the interest of older adults in **learning** to use computers, and the **perceived difficulty** of household devices. This research study offers new information in relation to what types of technology older adults want to use but currently do not. It also contributes to a general understanding of the devices that people use to support daily tasks and the frequency of use. This information offers a guide to future research studies investigating why certain devices are used or not used and how to improve the usability of those that are rejected.

- I specify the **motivations** of older and younger people for collecting items throughout their lifetime, as well as the triggers for reviewing them. This is a significant contribution in the domain of digital archiving and lifelogging. Where past studies have concentrated on investigating current artefacts in the home, the findings from the interview study provide insight into why people collected items throughout their entire life, either in the past or present. It also highlights the motivations for not saving collections, which is particularly relevant for designing a lifelog application, towards understanding how people manage large collections, what makes it important or worth sharing, and also what makes it private.

- I show that **family** and **sharing** are important factors to motivate lifelogging in both older and younger people and that lifelog images support family interaction for reminiscence and reflection of experiences. These findings highlighted the importance of displaying lifelogs in a meaningful way, to allow users to easily find events of interest from their past, to browse or share. It also contributes to an understanding of the potential problems associated with wearing a lifelogging device, such as the look, the comfort and privacy issues.

- I implement the themes and findings from the research methods into the design of a family lifelog system called **Family Capsule**. This design concept offers novel visualisation techniques to support the management of lifelogs for both short-term and long-term use. The interface of the mock-up browser presented in this thesis is designed specifically to accommodate older user's needs and preferences. This is related to both, their social needs and their technology needs. The design concept, including the recommended approaches to manage visual data sets which are already in development, offers a significant contribution to this area. The design considerations which are presented at the end of the thesis can be used to inform future developments in the domain shared family lifelogging.

- I **evaluate** a prototype of the lifelog system in a real-world family setting. In this study, it is the functionality of the system that is examined and how family members interact with the system in their home. This study highlighted the importance of firstly designing for the individual user, and their needs, and secondly designing for the family group. This study contributes to an initial understanding of family lifelogging and sharing.

1.5 Thesis Organisation

This thesis is presented in 8 parts including this Introduction chapter. The outline of the thesis is as follows:

Chapter 2 describes the domain of the research through a review of the literature. I begin with a brief history of lifelogging and the SenseCam. Following this I discuss theories of ageing, reminiscence and life review. I then provide an overview of systems supporting reminiscence and family archiving. Finally, I consider the issues influencing older adults' acceptance of lifelog technologies.

Chapter 3 presents the methodology for this research, outlining the design model, and the methods used for sampling, data gathering and analysis.

Chapter 4 focuses on the technology experience of different age groups. I conduct a questionnaire study with 237 participants to explore their experience, attitudes and perceived difficulty of technology in everyday life.

Chapter 5 explores through an interview study the motivations for and against life-long collections, and the triggers for reviewing these collections.

Chapter 6 describes a field experiment with older and younger family members and examines whether sharing is a motivation for lifelogging. I also describe a follow-on study, at least 6 months after data capture, which involved observing participants sharing their lifelog images.

Chapter 7 then discusses the design process for Family Capsule, an intergenerational browser. I include personas, wireframes, user participation and finally a description of the final concept.

Chapter 8 outlines a field evaluation study of a family using a prototype of Family Capsule. For this evaluation study I was interested in user feedback in relation to the use and usability of the system.

Finally, **Chapter 9** provides a summary of the research and discusses the conclusions derived throughout the research process.

Chapter 2

Literature Review

In this chapter I provide an overview of existing literature relevant to my research, in relation to lifelogging, reminiscence and older adults. I begin with a brief history of lifelogging and lifelog research. I then follow this with a discussion on older adults' motivations to life review and reminisce in later life, and outline studies that have investigated family archiving and reminiscence technologies. Finally, I look at older adults' experience with technology, and make a case for touch-screen devices for older users.

2.1 Lifelogging

"In the future, devices that capture our lifelong memories, and share them in real-time, will be commonplace and worn continuously, and perhaps even permanently implanted" (Mann, 2012).

The history of wearable computing and lifelogging can be fundamentally attributed to visionary computer scientist Steve Mann, a professor in the University of Toronto. It is Mann's belief that in the future, people will not only interact with computers, but that computers will become part of the person. Since the 1990s, much of

his research has concentrated on miniaturising visual lifelog capture devices. He is currently developing a skull cap with implantable and surface electrodes to aid the blind to see, as well as an artificial eye implant, with a built in digital camera (Mann, 2012). It was after an experiment, conducted between 1994 and 1996, in which Mann streamed live video from a wearable camera to and from the Web, that the concept 'lifelogging' was born. In contrast to 'surveillance' technologies, which refer to visual monitoring from above, Mann coined the term 'sousveillance', to describe the recording of activity from the perspective of the participant, typically by way of small wearable or portable devices. Lifelogging is one form of sousveillance. Privacy issues around sousveillance have been explored by the experts in these fields (Allen, 2008; Nguyen et al., 2009; O'Hara et al., 2009). Massimi et al. (2010) found that most people expect and tolerate being recorded by surveillance devices in public places, however consent is expected in private settings. Mann (2012) acknowledges that privacy concerns and regulations related to sousveillance, being a new concept, have yet to be worked out. He argues that it would be impractical to obtain consent from every individual one passes when life recording, and instead suggests pointing concerned participants towards a Request for Deletion (RFD) form (Mann, 2009). This topic deserves further study in terms of lifelogging technology. It is currently unclear within lifelogging research what it appropriate conduct, for example, allowing people who participate in lifelog studies to use their own judgement, determining whether they have a right to record in public places and also whether it is necessary to obtain consent from people who they interact with. Pointing people towards a RFD form, as Mann suggests, most likely would not be received positively by the person demanding the deletion of images. However, until a clear set of guidelines is established, it is necessary that lifeloggers use their own judgement in relation to third party concerns.

Mann's life streaming project inspired people to 'lifecast', recording their lives through fixed and/or portable cameras and making the footage available to the public through the Internet, such as Justin.tv. Social networking site Facebook has recently acknowledged the value of their users' content by introducing a timeline layout, created

from user's postings, videos and photos (https://www.facebook.com/about/timeline). FaceBook's Timeline was created by manual lifelogger, Nick Felton, who spent years reporting and charting his personal activities (Bilton, 2010). In contrast to lifecasting, lifelogging is considered to be the capture of personal experiences for personal use. The technologies to capture a visual narrative of one's life have so far been the primary focus of lifelogging research (Bell & Gemmell, 2009). Researchers in Microsoft Research decided to go beyond the capture of visual data, by exploring extreme lifelogging, or in other words, recording everything an individual experiences. Inspired by Vannevar Bush's hypothetical Memex device (1945, as cited in Gemmell, Bell, & Lueder, 2006), computer scientist Gordon Bell endeavoured to collect a lifetime of personal content, which included documents, email, photos, music, conversations, and Web sites visited. The project, entitled MyLifeBits, aimed to develop searchable and secure personal archive software.

One of the devices that Gordon Bell used to record his experiences was the SenseCam, developed by Microsoft Research in Cambridge, U.K (Hodges et al., 2006). The SenseCam is a small digital camera that is designed to automatically take photographs without any user intervention. It is worn around the user's neck via a lanyard, sitting at chest level. The camera automatically captures images on average every 30 seconds. Additionally, embedded sensors monitor changes in the user's environment such as movement, light, body heat, and temperature, and changes in these sensor readings can be used to automatically trigger image capture. The SenseCam has an advantage over other devices investigated for the purpose of visual lifelogging, such as mobile phones, due to the longevity of battery life (approximately 24 hours). It also holds advantages over video recorders, as the device only takes images on average 2 times per minute, which means that storage requirements are reduced, and privacy concerns are not as strong, as the camera takes snapshots as opposed to continuous footage. In 2009 the device was commercialised and is now available as a product rebranded as Vicon Revue. The SenseCam is now used by not only lifelogging research

groups, but also by research groups in other fields, as it presently offers the most usable and accessible wearable camera solution (see Figure 2.1 for example images).

Figure 2.1 Example images captured using a SenseCam device.

The benefit of the SenseCam to support autobiographical memory was quickly realised. Berry et al. (2007) paved the way for lifelogging and memory research in her pioneering study investigating whether reviewing SenseCam images improved autobiographical memory in a patient with severe memory impairment. Comparing the SenseCam recordings of experienced events to a written diary and baseline condition, Berry found that reviewing SenseCam images significantly improved recall compared to the other conditions. Even three months after viewing the SenseCam images, the patient could recall over 70% of the experienced events, whereas events recorded using the written diary elicited no recall. Furthermore, an fMRI study showed that successful recognition of the images in the SenseCam condition was associated with activation of brain regions associated with normal episodic memory (Berry et al., 2009). Similar findings were found in a subsequent study which showed the benefit of rehearsal to support the formation of personal semantic (knowledge-based) memory in children who have distinct memory difficulties (Pauly-Takacs, Moulin, & Estlin, 2011).

Older adults with degenerative memory difficulties could also benefit from lifelogging technologies. For example, Lee and Dey (2008) designed a lifelogging system, MemeXerciser, to support people with early-stage Alzheimer's disease and their caregivers. The system captures both audio and visual content, using a SenseCam, voice recorder and GPS logger. The system then automatically chooses salient memory cues to present to the user, based on people, place, action and object-based experiences. Lifelog applications also have the potential to support the reminiscence practices of older people with mild dementia (Kikhia, Hallberg, Bengtsson, Sävenstedt, & Synnes, 2010). Although reviewing SenseCam images may help people to cope with memory impairment, there is no evidence that it leads to recovery (see Harrell, 2010).

A broad range of lifelog applications have emerged from this growing body of research. For example, the SenseCam was used to investigate active and sedentary travel behaviour (Kelly et al., 2011) and Doherty et al. (2011) use the visual images from SenseCam recordings to automatically detect the lifestyle traits of its users. Lifelog collections can also be used as digital biographies, incorporating email archives (Hangal, Lam, & Heer, 2011), or for creating stories from multimodal content, such as photos, email, and documents (Byrne & Jones, 2009). The DietSense project in UCLA makes use of a mobile phone, hung via a lanyard around the neck, to capture pictures of meals automatically for documentation and dietary analysis (Reddy et al., 2007). Another area of interest is market research, where lifelogging devices are used to observe what products and stimili potential customers are exposed to, with a view to relating this to the effectiveness of a marketing campaign (Hughes et al., 2012).

Due to the vast quantity of data that can be recorded by lifelogging devices, such as SenseCam, managing collections in a way that users can quickly and easily retrieve events is challenging. Several approaches have been developed to organise this data. For example, the software in the MyLifeBits project (Gemmell et al., 2006) uses a database to support the management of its numerous data sets through hyperlinks, annotations, reports, saved queries, pivoting, clustering, and search. Doherty and

Smeaton (2008) utilised sensor readings embedded in the SenseCam to automatically segment large streams of lifelog data into meaningful events, where an event constitutes an activity such as having lunch, talking to a neighbour or watching television etc. Kalnikaite et al. (2010) maintain that both image and locational data is needed to provide context when reviewing lifelogs.

Several design principles have been proposed to guide researchers when creating lifelogging systems. Sellen and Whittaker (2010) put forward principles with a focus on supporting human memory. These include; 1) Rather than logging everything, efforts should be directed at the kinds of data people find most valuable, and the issues they find most problematic, such as absentmindedness and remembering to do future tasks. 2) Collections can serve as cues to trigger memory, but are not memories themselves; therefore the focus should be on designing effective retrieval cues. 3) There are different types of memory, including recollection, retrieval, reminiscence, reflection, and remembering intentions, and systems should be designed to support each type appropriately. 4) Lifelogging systems should work in synergy with human memory rather than replace it.

Identifying the kinds of data that people find most valuable is certainly important. However, one could argue that it is only by logging everything, or as much as possible, that the value can be identified. For example, later in this thesis (Chapter 5) it is shown that often the value of items are not clear until time has passed. For example, letters or emails sent home whilst away travelling at the time of sending serve as a communication aid, however as time passes these become a record of events to which the sender can refer back to and reminiscence upon.

As mentioned, Sellen and Whittaker (2010) state that lifelogging systems should work in synergy with human memory rather than replace it. Many studies have found that younger as well as older adults benefit from the use of artefacts as external aids, and also that individuals are more likely to use external rather than internal strategies to support memory (Einstein & McDaniel, 1990; Kapur et al., 2002). I believe that lifelogs

would be used in the same way, supporting memory, and that there should not be a concern regarding memory replacement for healthy individuals.

Whittaker et al. (2012) further points out that users are reluctant to delete information, and therefore access to data should be simplified by making important items more prominent. This is a relevant statement, as visual lifelogs can accumulate rapidly and efficient browsing, searching and retrieval techniques are needed. These developments are already underway (Doherty et al., 2012). They also maintain that digital mementos need to be integrated into the everyday lives of people so that they are not overlooked and "invisible" compared to physical mementos. In keeping with their earlier article lead by Sellen and Whittaker (2010), Whittaker et al. stresses that digital tools should be used to provide support to unaided memory rather than used exclusively, and that lifelog collections should be used to support more than just recall of simple facts, but also reconstructive processes, such as reflection and reminiscence. Examples were given previously within this section, demonstrating the wide range of uses being explored for lifelogging technologies, (Doherty et al., 2011; Hughes et al., 2012; Kelly et al., 2011; Reddy et al., 2007). Therefore, although it is true that digital tools should support more than just recall of simple facts, there is a wealth of research in the area of lifelogging that explores other benefits.

I am interested in identifying the benefits (if any) for healthy older adults using lifelogging devices such as the SenseCam. One possible motivation which I will discuss in the next section is shared family reminiscence and life review.

2.2 Ageing, Reminiscence and Life Review

2.2.1 Defining the 'older adult'

Age classification is not a straightforward process as many variables impact the rate at which a person ages. Chronological age markers are the most common measurement used, for example, determining the age of retirement. However, this does

not take into account biological, psychological and social factors. Newell (2008) groups older people into three broad categories; 1) Fit older people, who do not appear or consider themselves disabled, but whose functionality, needs and wants are different to those they had when they were younger, 2) Frail older people, who would be considered to have a "disability", and in addition have a general reduction in many other functionalities, and 3) Disabled people who grow older, whose long-term disabilities may have affected the ageing process, and whose ability to function can be critically dependent on the other faculties, which will also be in decline. Fisk et al. (2009) state that, although individual differences exist, generally older adults have common biological, psychological and social characteristics. They suggest grouping older adults into two groupings; 1) The younger-old, ranging in age from 60-75; and 2) The older-old, for individuals over the age of 75 years. However, Morris, Goodman and Brading (2007) point out that age-related changes in sensory and motion capabilities, and reductions in technology use, begin before the age of 60 years, and that by including a pre-retirement age group in samples, from the age of 50 years, we can gain a more comprehensive view of the older population. Morris et al. acknowledge that there is significant diversity within this wide population range, and like Fisk et al. and Newell, they recommend grouping the older population into subgroups to compare 'younger old' and 'older old' age populations.

2.2.2 Reminiscence and life review

The study of the human developmental process has drawn interest from a variety of disciplines and because of this, theories of ageing and human development range from biological and psychological to sociological. Influenced by Sigmund Freud's psychoanalytic theory of human developement, Erik Erikson's psychosocial theory was the first to address development across the entire life span (first described in 1950, as cited in Salkind, 2004). In contrast to Freud, Erikson's theory takes account of the whole patten of a person's life experience, including the influence of family, friends and acquaintences, and the part played by society (Stevens, 2008). Erikson's theory was

based on the principle that development takes place through the resolution of crises at successive developmental stages, of which there are eight. The first five stages are concerned with childhood and adolescence, working towards trust (birth to 1 year), autonomy (2 to 3 years), initiative (4 to 5 years), industiousness (6 to 11 years) and identity (12 to 18 years). According to Erikson, people begin to develop relationships in young adulthood. The focus is no longer on the individual, but on the invididual's relationships with others. This stage is also linked with adolescence where role confusion can result in a poor sense of identity, which in turn can lead to unsuccessful relationships in young adulthood. As we progress into adulthood, the seventh stage of Erikson's lifecycle, individuals develop 'generativity'. Erikson coined the term generativity for this stage to refer to a concern for establishing and guiding the next generation. The term implies a capacity to give without expectation of return, such as parenting or volunteering with charities (Stevens, 2008). Those who do not develop past this stage can experience stagnation and boring preoccupation with self. Finally, the eighth stage is maturity where individuals experience conflicts between ego integrity and despair, the outcome of which is wisdom. Erikson maintains that the healthy individual at this stage is able to look back on past years and feel satisfied that their life was meaningful. This awareness develops ego integrity and helps the individual prepare for death. King and Wynne (2004) proposed that older adults also strive for 'family integrity', developing a sense of meaning, connection and continuitity within their multigenerational family. Erikson's theory was important in the context of this thesis as it helped to shape the findings gathered from the exploratory studies, and to also understand why participants of different ages varied in terms of the things they did, who they did them with and why.

Reminiscence is the process of recalling personally experienced events from one's past (Webster & McCall, 1999). It is perhaps due to Erik Erikson's (1963, as cited in Stevens, 2008) theory of development that reminiscence is associated with old age. However reminiscence is not limited to older adults (Havighurst & Glasser, 1972; Bryant, Smart, & King, 2005). As Havighurst and Glasser (1972) wrote; *"Reminiscence*

is not simply a phenomenon of old age… a 10-year-old child reminisces" (pp. 245). Webster and colleagues found that younger adults reminisce just as frequently as older adults, however reminiscing purposes tend to differ with age (Webster & McCall, 1999; Webster, Bohlmeijer, & Westerhof, 2010). Webster and McCall (1999) identified eight functions of reminiscence including; boredom reduction, death preparation, identity, problem-solving, conversation, intimacy maintenance, bitterness revival and teach/inform. According to Webster, shared family reminiscence can serve many of these functions. Shared family reminiscence involves people sharing common experiences from their past, or sharing personal experiences with other people in their family. Taking from Webster's example, a simple experience such as sharing memories of a holiday spent with grandparents, can keep alive memories of past relatives (i.e. intimacy maintenance); create emotional bonds between family members (i.e. conversation); pass along a moral lesson (i.e. teach/inform); and clarify dimensions of your own personality (i.e. identity). Rosenblatt and Elde (1990) found that shared reminiscence had particular significance between siblings as part of the grieving process following a parent's death, having a role in building relationships between family members and helping them to identify a shared reality. Rosenblatt and Elde stated that *"in the process of sharing reminiscences, people came to know one another better, increased their common experiences and memories, made peace about past differences and conflicts"* (pp 208).

Reminiscence is also part of everyday social interactions within the family household (Fivush, 2008). Bohanek, Marin and Fivush (2008) showed that emotional expression and explanation of shared family reminiscence by mothers with their children contributed to the development of positive self-esteem and adjustment. However, Webster et al. (2010) asserted that even with the family unit, family collusion, power plays, and implicit rules can influence what memories are shared and the versions that are told.

Erikson believed that integrating memories into a meaningful whole through the process of 'life review' can help create acceptance, without regret over one's life. In turn, Erikson's theory of human development has had a significant influence on life review research (Haber, 2006). Even more influential for life review research have been the insights of psychiatrist Robert Butler, who argued that reminiscence and life review were normal and essential processes, which all people go through as they age and approach death (Coleman, 2005; Haber, 2006). Prior to this, reminiscence and life review were discouraged in the elderly, and associated with age-related diseases such as demenita. According to Butler, as individuals age or approach death they begin to examine the life they lived, their successes and their failures (Woolf, 1998). In contrast to reminiscence, which tends to be more descriptive, life review is more likely to be an evaluative process, in that participants examine how their memories contribute to the meaning of their life, and they may work at coming to terms with more difficult memories (Haber, 2006; Webster et al., 2010). Life review and reminiscence therapy has proved to be a successful method to improve the mood of older people, including those with dementia (Haber, 2006; Woods, Spector, Jones, Orrell, & Davies, 2005). According to Birren and Cochran (2001) there are six reasons to encourage people to record their life story. These motivations include: 1) to leave a legacy for family members, 2) to facilitate life transitions, 3) to enhance personal growth and development, 4) to build a sense of community, 5) to contribute to history, and 6) to enjoy the thrill of self-discovery. Artefacts such as diaries, photographs and mementos can play an important role to facilitate this process, acting as a visual and tangible representation of one's life. Artefacts acquired over a lifetime can support reminiscence, reflection and identity preservation (Unruh, 1983). Furthermore, reminiscence therapy interventions encourage people to use memory prompts, such as photographs, to support the recounting of their life stories (Coleman, 2005).

2.3 Supporting Reminiscence and Reflection

With the digitisation of mementos such as photographs and videos, researchers have begun to realise the benefit of this media for reminiscence. Digital reminiscence systems have been developed to support conversation in people with dementia (Astell et al., 2010) using a combination of text, photographs, video and music from the past. Online tools such as YouTube have also been shown to support reminiscence in people with dementia, increasing well-being, mood and engagement in the activity compared to traditionally used methods (O'Rourke et al., 2011). Although older adults are less likely to use technology compared to younger individuals (Czaja et al., 2006), Mulvenna and colleagues (2011) found that older users had no significant issues when interacting with photographs on a device, compared to card-based photographs. One method of increasing older user acceptance of interactive reminiscence systems is to combine features from traditional objects, such as a music reel tape recorder, into an interface representation (Astell et al., 2009); a technique referred to as skeuomorphic design. Similarly, digital artefacts such as FMRadio (Petrelli, Villar, Kalnikaite, Dib, & Whittaker, 2010), the Living Memory Box (Stevens, Abowd, Truong, & Vollmer, 2003), Family Archive (Kirk et al., 2010) and Lovers' Box (Thieme et al., 2011) integrate both digital and physical components to support family reminiscence by creating an interactive experience.

Lifelog collections, such as emails, photographs, and context data (e.g. GPS) also have the potential to support reminiscence (Cosley et al., 2012; Kikhia et al., 2010; Kalnikate & Whittaker, 2011) and story-telling (Byrne & Jones, 2009). Taking the idea that the home is central to a memento collection, Kalnikate and Whittaker (2011) developed a lifelog application, MemoryLane, which depicts different spaces in the home for digital collections through the interface design. Another system, Pensieve (Cosley et al., 2012), supports reminiscence through memory triggers, sent by email containing content from personal social media services. The idea behind Pensieve was to support spontaneous reminiscence and reflection through digital memory prompts.

Similarly, Hangal, Lam and Heer (2011) developed Muse, a system to support the browsing of emails, by analysing content and generating a set of cues. In a study of six users browsing through five years worth of emails, they found that the users spent more time looking through email exchanges with family compared to any other group. Lifelogging devices also support reflection and story-telling within family groups. Lindley et al. (2009) examined the use of the SenseCam with seven households over the course of a week. The SenseCam automatically captures approximately 5,000 images per day, which is significantly more than a person would take manually. However, one of the findings that emerged from Lindley's study was that the family narratives when reviewing the SenseCam images were similar to those expected when reviewing typical photographs. Following on from the initial study, Lindley et al. (2011) explored how revisiting these images might foster reflection 18 months after capture. Reviewing the SenseCam images allowed the participants to gain insight into their family life, routines and behaviours, prompting reflection on past activities and how life might be improved.

2.3.1 Personal and shared family archives

Similar to shared reminiscence, artefacts and archives can represent both individual and shared experiences. For example, a person can share photographs from a school trip with their family, telling stories of events that happened and the people they met at the time. This same person could then share the photographs with a schoolmate who was also on the trip. This shared reminiscence will be very different from the first scenario, as the school mate will also remember the school trip, and can have an active input. Categorising archives into personal or shared is not always straightforward. In this example, if the individual is a young child, then the mother in the family would probably consider the photographs to belong to the family collection. However, if the individual is an adult showing images from their childhood, then the collection might be considered personal. The meaning or value that we place on archives can evolve over time, or have different values for different people in a family. Sellen (2011) identifies six different values that people place on home archives including: defining the self;

honouring those we care about; connecting with the past; framing the family; fulfilling a duty; and purposeful forgetting (i.e. archiving items that may have significance but are painful at the time of archiving). Odom, Pierce, Stolterman, and Blevis (2009) also explored the attachment that people place on possessions, placing emphasis on the role of the object itself. They found that the reasons why people hold onto objects are related to (1) the extent to which the owner engages with the object, (2) the extent to which they preserve personal histories and memories, (3) the extent to which an object has been reused, renewed or modified, symbolising the owner's resourcefulness, and (4) the perceived durability of the object. Kroger and Adair (2008) interviewed a sample of older adults about their valued personal objects and found that their cherished possessions were important for identity maintenance, creating a link to cherished relationships, family across generations, and past events among others. Similar results were previously found by Cram and Paton (1993) when exploring the relationship between personal possessions and self-identity for elderly women. These studies focus on the possessions and artefacts that people currently possess, but they do not explore what types of objects that people had collected in the past or the types of objects that they do not have but would like, for example, artefacts that did not seem important at the time but later on gained significance. These subjects deserve careful consideration to inform the design of lifelog/archive systems.

Family archives are often governed by one person in the family, who manages and preserves collections for all individuals (Durrant, Frohlich, Sellen, & Lyons, 2009; Lindley, 2012). Kirk and Sellen (2010) found that it was typically the mother who made decisions about holding onto family artefacts, such as baby toys and clothes in households with young children. Lindley (2012) carried out an interview study with eight adults over the age of 50 years who were currently involved in family archiving. She found that there are generally two types of family archives; those that are inherited and those that are created. In Lindley's study the participants were the 'gatekeepers' of inherited family archives, taking responsibility to ensure that artefacts were not lost or damaged, were accessible and meaningful to younger generations using the information

to make new discoveries about the family history. Inherited family archives were not considered to be owned by any one individual, and therefore family members were consulted before any alterations were made, such as adding onto the family tree. In contrast, records that were created from memory, such as memoirs, were considered to be personal, even when the purpose of creating the archive was to share with family. Creating personal archives allowed the participants to include information relevant to their own experiences, or from their perspective.

Several devices have been designed and developed to support family archiving (see Figure 2.2). TimeCard, developed by Richard Banks and colleagues (cited in Sellen, 2011), is an interactive digital photo frame which allows a user to browse through a person's photographs organised on a timeline. The purpose of this is to allow households to honour and reflect on someone's life. Stevens et al. (2003) proposed the concept of the Living Memory Box to assist people in preserving a digital representation of physical artefacts and creating a narrative about them. The conceptual device is composed of 'the box', recording devices and an interface display. The intended use of the system is to allow families to bring together artefacts, placing them temporarily in the box and recording photos, video and audio related to the item. The Family Archive (Kirk et al., 2010) is a bespoke tabletop where family members could upload digital photographs, and also capture an image of physical objects using an overhead camera. The purpose of the device was to encourage family interaction. Kirk et al. found that although the design of the system encouraged playful interaction with children and older "tech-shy" individuals, this interaction made it difficult for more conscientious users to manage and organise the archives. Finally, where the previous examples focused on digitising physical objects, the FM Radio (Petrelli et al., 2010) was designed as a digitally enhanced object to support family reflections on audio recordings. This approach was used to make digital mementos more visible and accessible to families.

Figure 2.2 Four examples of digital family archives. TimeCard (top-left; Richard Banks, cited in Sellen, 2011), Living Memory Box (top-right; Stevens et al., 2003), Family Archive (bottom-left; Kirk et al., 2010), and FM Radio (bottom-right; Petrelli et al., 2010).

Anita Allen (2008) questions whether the continuous preservation of experiences is a good thing. One of the concerns that Allen raises in relation to personal digital archiving is privacy. She states that privacy concerns arise because by their nature digital archives, or lifelogs, are collected for interaction, which enables destructive reminding and remembrance. Some of the problems that Allen predicts include "*unwanted data collection, retention, and disclosures that may be considered tortious or otherwise unlawful under existing privacy law"* (pp. 63). She also claims that

lifelogging is a form of spying and interferes with the personal privacy that individuals expect others to respect. O'Hara and colleagues (2009) acknowledge that these concerns are real, however they are based on existing literature, which most often portrays extreme lifelogging, such as the MyLifeBits project (Gemmell et al., 2006) which, as a research project, is concerned with collecting data from everything experienced, rather than the trajectory of lifelogging practice that is likely to evolve in full cognizance of such issues. The studies that are discussed in this thesis support O'Hara's prediction. For example, in the field study presented in Chapter 6, participants were provided with a lifelogging device, the SenseCam over a two week period. As expected, the participants used their own judgement concerning social expectations of when it was appropriate or not appropriate to capture data. It is however my belief that a clear set of guidelines is needed with regard to lifelogging, not only to protect the privacy of third parties who may be captured in the images, but also the privacy of the lifelogger themselves.

Lifelogging is the practice of automatically recording information from our daily life. This means that an individual does not intentionally record each and every image, or sound or message. All data is recorded. This can mean that a person can forget they are wearing a logging device when they go to use the bathroom, or they may not take the device off as they bathe their children. An individual may not even know what has been recorded until they later review their data. It is mainly for this reason that lifelog collections are considered to be extremely personal and private.

Preserving privacy for personal collections may prove to be a challenge for digital archiving, particularly when several family members are using the same PC in the home. The level of privacy that we expect for our collections is easily established through physical artefacts by the way they look, or where they are stored. Personal artefacts are usually stored in locations in the home, where other people are not likely to be, such as the bedroom, whereas family artefacts such as children's drawings or holiday mementos might be displayed in rooms such as the kitchen or living room, where the family spend most of their time (Petrelli, Whittaker, & Brockmeier, 2008). Similarly, a

physical diary can be easily identified as a private and personal item to anyone who comes across it, but this distinction is not as easy to identify for digital collections. Massimi and Baecker (2010) explored how people inherit, use and reflect upon digital technology following the death of a family member. They found that PCs and TV/VCR devices were the most likely type of technology to be inherited. Most often these devices were shared between family members in the home, however the bereaved reported having to face ethical dilemmas when trying to organise the deceased's digital remains, for example, trying to determine what information was private and discovering information about the deceased that was previously hidden. However, it is often such private collections that give us the greatest insight into a person's life and into the culture at that time. Probably one of the most famous examples is 'The Diary of a Young Girl' (1994, reprint), a diary by thirteen year old Anne Frank written as the family was in hiding during the Nazi occupation of the Netherlands. Similarly, insight into the life of "recluse" J.D. Salinger, author of The Catcher in the Rye, was revealed through a series of personal letters that he had written to a friend in the UK (Sharp, 2011). In Lindley's (2012) interview study of family archiving practices, participants considered personal items belonging to deceased parents, such as love letters, to be inherited by the family as a whole, and that implied consent was given by their parents by the very act of saving the items when alive. Personal artefacts, such as letters or emails, are more likely to offer insight into an individual's experiences and personality, information which is cherished by bereaved family members (Massimi & Baecker, 2010; Lindley, 2012).

2.4 Issues for the Adoption of a New Lifelog Device

In today's society, technology takes an integral role in recording people's experiences throughout their lifetime, and as part of the life review process, technology can be used to record life stories, which can then be passed on to younger generations. From the literature outlined above, we know that digital artefacts can support reminiscence and life story, and also that they play an important role in self-identity,

identity preservation and family interaction. However, using technology, such as lifelogging devices, creates a certain burden on the user; to wear the device, to connect it to a computer, and to use the associated software to review their data.

Despite significant progress in recent years, the necessary hardware & software integrated framework for lifelogging is not yet available for deployment. This is with exception to very limited deployments with expert users, normally the researchers developing the technology. As we learnt from the MyLifeBits project mentioned previously which was concerned with recording all activities through numerous devices (Gemmel & Bell, 2009), it is not just automatic capture devices such as the SenseCam that can be used in lifelogging. For example, mobile phones, computers and tablet PC's, can be used to record an extensive range of data including location, email, appointments, photographs, audio, video and so on. As smart phones are currently so ubiquitous, several projects are underway to increase the battery life of these devices to support lifelogging, allowing automatic capture of events throughout a whole day (De Jager et al., 2011; Qiu, Gurrin, Doherty, & Smeaton, 2012). However, according to a PEW Research Centre report, only 34% of people aged 50-64, and 13% of 65 years and older own a smart phone, compared to 66% of people aged 18-29, and 59% aged 30-49 years (Smith, 2012). From a usability perspective, the SenseCam has an advantage as a lifelogging device being small, compact and more or less unobtrusive, in that once it is switched on the user does not have to interact with it. Whilst not capturing the content of everything you do, it captures *images* of everything you do. At the moment, we believe that the SenseCam is the only viable option to be used as a lifelog device with older users. This will no doubt change in the future with forthcoming devices such as the Autographer (www.autographer.com) and Memoto (memoto.com) competing with the SenseCam on wearability, range of capture, and image quality. In the meantime the limited functions of the SenseCam make the device ideal for people who have limited or no technology experience. As I mentioned earlier however, the wearer also has to upload these images to a browser. A SenseCam browser has previously been designed for older users to manage their data, which has shown to support ease of use (Caprani et

al., 2010), however there are numerous factors that influence older adults' acceptance of new technologies. Understanding older adults' use of technology may help guide us towards an understanding of how to increase acceptance of lifelogging devices and software.

2.4.1 Older adults use of technology

Although older adults are currently the fastest growing group of Internet users (Wagner, Hassanein, & Head, 2010), they are less likely to use technology compared to younger groups (Czaja & Lee, 2007; Morris et al., 2007). Older people generally have a positive attitude towards technology and will use a product if they have a need for it (Fisk et al., 2009). Positive attitudes are also more likely to be expressed towards everyday devices in the home, such as the television, microwave and house alarm (Coleman, Gibson, Hanson, Bobrowicz, & McKay, 2010). Although modern versions of these devices are digital, older users are familiar and comfortable with them. Czaja et al. (2006) proposed that the factors predicting older adults' use of computers are age, education, fluid intelligence (abstract problem solving ability), crystallised intelligence (cultural knowledge), computer efficacy (belief about ability), computer anxiety and prior technology experience.

Morris et al. (2007) investigated older adults' use of computers and the Internet. In total, 473 older adults participated in this survey. The responses showed that word processing and keeping in contact with others (e.g. email) were the most frequently used computer and Internet features. This finding was supported by previous research carried out by Selwyn (2004). Of the Internet users in Morris's survey, 64% stated that it had a positive impact on their lives. The most common reason for not wanting to learn to use a computer or the Internet was that they were simply "not interested". Other reasons given were feeling too old to learn, believing it to be too difficult, and not having access to a computer. Selwyn found that as circumstances change, so do people's interest or lack of interest in technology. For example, an older person may become interested in

using email after their grandchild emigrates abroad, and another older person who used a computer as part of their profession may choose a computer free life after retirement.

So why are older adults less interested in using computers compared to their younger counterparts? As mentioned in the paragraph above, those older individuals who are using computers believe that the technology enhances their lives (Morris et al., 2007) and previous use of technology has an influence on the acceptance of new technologies (Czaja et al., 2006). Similarly, Jay and Willis (1992) tested the attitudes of 101 older adults before and after a two week computer training program. It was found that direct computer experience can significantly modify attitudes, particularly in relation to computer efficacy and comfort. However in Morris et al.'s study, when non-Internet users were asked if there were any factors that would encourage them to learn in the future, the majority (60%) said there was nothing that would influence them. As well as attitude and age-related changes to perceptual, cognitive, and physical abilities acting as barriers for older adults learning new technologies, there are the issues older people have in relation to their privacy, particularly regarding monitoring technologies (Charness & Boot, 2009). Bouwhuis (2003) maintains that the interaction with technology in younger years when learning and cognitive functioning is at its peak, allows the user in later years to transfer the existing knowledge to new technologies. Similarly, Mayhorn and colleagues (2004) believe that acceptance of a device can be achieved by introducing the technology into the older adult's home when they have high cognitive functioning, increasing the level of technological support as motor control, perceptual and cognitive abilities decline. This is a key motivation for the current research study. Where the current research focuses on the benefits of reviewing visual lifelogs to support cognitively impaired people, such as older adults with dementia, following Mayhorn and Bouwhuis' claims it is crucial to introduce older adults to lifelogging practices before cognitive functioning declines. Therefore, it is necessary to explore other motivations for lifelogging. This is the premise for the current thesis.

2.4.2 Touch-screens for older users

In lifelogging, as well as interacting with wearable devices, a person must interact with the computer system that stores the data. One solution to enhance the usability experience for older adults is using touch-screen interfaces. It is largely due to the release of the Apple iPhone and iPad, quickly followed by similar offerings from competitors, that we have recently seen a touch-screen revolution. Today, touch-screen devices are easily available, portable and relatively inexpensive. Furthermore, commercial touch-screen technology offers a balance between accessible interaction and aesthetics. This is welcome news for the older user. Some of the factors that impact the experience for touch-screen users are the size of the screen, the precision needed to select a target and the design of the screen elements (colour and grouping etc.). With large screens, designers can afford to offer large input and output features. Users should easily see menus and content on one screen. Larger features such as big buttons benefit users with vision problems, but they also support accurate target selection. Providing large targets is particularly important for older users. Fezzani and colleagues (2010) looked at the effect of target size on performance for younger and older individuals. The study showed that reducing the target size resulted in difficulties with pointing accuracy, increased the time per task, and increased the mental cost associated with performance. For the older users, the impact of motor difficulty on performance was considerable.

Shneiderman (1991) points out the advantages and disadvantages of touch-screens over other input devices. The advantages include:

- Touching a visual display of choices requires little thought and is a form of direct manipulation that is easy to learn.
- Touch-screens are the fastest pointing device.
- Touch-screens facilitate easier hand-eye coordination than mice or keyboards.
- No extra workspace is required as with other pointing devices.
- Touch-screens are durable in public access and in high-volume usage.

The disadvantages include:

- Users' hands may obscure the screen.
- Screens need to be installed at a lower position and tilted to reduce arm fatigue.
- Some reduction in image brightness may occur.
- They cost more than alternative devices.

Although Shneiderman made these claims 20 years previously, they still apply to today's touch-screen technology, and the views are more recently echoed by Bhalla and Bhalla (2010). According to research, however, these advantages outweigh the disadvantages for older users. For example, in a study comparing input devices for numeric entry tasks it was found that both younger and older participants preferred using the touch-screen compared to a physical keypad (Chung et al., 2010). Similarly, Umemuro (2004) showed that anxiety towards computers was reduced significantly for elderly users trained with a touch-screen terminal, whereas there was no significant decline in anxiety for those using a keyboard based terminal. In comparison to a computer mouse, using a touch-screen can significantly reduce the age effects for the time it takes to carry out pointing tasks (Iwase & Murata, 2002). Ease of use and reduced anxiety towards technology follow well designed systems and interfaces. It is because of these advantages that touch-screen technology is so frequently used for general public use.

2.5 Conclusion

Although digital archiving and lifelogging are relatively new practices, only coming into the public domain in the past few decades, there has already been a substantial amount of research carried out investigating this area. As it has been discussed here, the benefit of digital artefacts is considerable in terms of supporting processes such as recall, memory and reminiscence. However, previous research has not dealt with how to display large quantities of visual data sets to users in a meaningful

way. Furthermore, it has not yet been considered how to include older adults in lifelogging practices. These are subjects that will be explored throughout this thesis.

This review of the relevant literature, culminating in the considerations outlined above leads to the first study in the thesis, which seeks to further understand the use of technology in everyday life for people of different ages. While the studies described above have identified important factors that contribute to technology acceptance and attitudes of people towards different types of technology, this first study also explores the types of technology that people would like to use. The findings obtained using this approach sets the stage for deeper exploration of lifelogging in a social context in the remainder of this thesis.

Chapter 3

Methodology

One of the main objectives of this thesis is to design a lifelog browser that would encourage older users to lifelog, which is a challenge because the abilities, needs and preferences of users can vary dramatically across age groups (Fisk et al., 2009). Therefore, in the design processes it is important to identify who the users are, what they want and how a system can fulfil these needs. These criteria are central to user-centred design. Gould and Lewis (1985) recommended three principles that they believed would assist in the development of useful and easy to use computer systems. The first principle recommends an *early focus on users and tasks*. This means first understanding who the users will be, understanding the user's abilities and behaviours, and the nature of the tasks needed to be accomplished with the system. The second principle focuses on *empirical measurement* which emphasises the importance of involving the user in the design of the system, observing their reactions and performance to printed scenarios and later examining their interaction with prototypes of the system. Finally, the third principle is *iterative design*, making changes to the system when errors are observed and retesting it again. Although these three principles were laid down almost twenty years

ago, which is a long time in the age of computing, they are still accepted as the basis for a user-centred approach (Sharp, Rogers, & Preece, 2007). Alternative design approaches include Activity-Centred Design, which focuses on the tasks and activities that need to be accomplished; Systems Design, which focuses on the components of a system; and Genius Design, which relies on the skill and wisdom of the designers used to make the products (cited by Saffer, 2007). However, because of the universality of acceptance of the user-centred design, in this thesis I apply a user-centred approach, actively involving users in early exploratory studies, the design, implementation and evaluation of the proposed system, ultimately designing a lifelog browser that is relevant to older user's lifestyle, needs and preferences.

In this chapter I begin with an overview of the user-centred approach to design that was adopted. In the sections following I then outline the methods that were used to gather information from participants and the methods that were used to analyse these findings. I end the chapter with a brief summary of the topics discussed.

3.1 Design Model

Throughout this thesis there is a shift in the research focus, beginning with exploratory studies to understand the user, and then moving to the design concept and users interaction, followed by studies examining the functionality of a prototype system. Houde and Hill (1997) proposed a model for understanding the purpose of prototypes. They argue that by focusing on the purpose of the prototype we can make better decisions about what kinds of prototypes to build. There are three dimensions to this model: (1) Role, (2) Look and Feel, and (3) Implementation. As Houde and Hill state, each dimension corresponds to a class of questions which are salient to the design of interactive systems. '*Role'* refers to questions about the function that a system serves in a user's life and how it is useful to them. '*Look and Feel'* refers to questions about what the user looks at, feels and hears while using the system. '*Implementation'* refers to

questions about the techniques and components through which the system performs its function. The model shown in Figure 3.1 displays a triangle representing a three-dimensional space. Because prototyping can explore several issues, the position of a

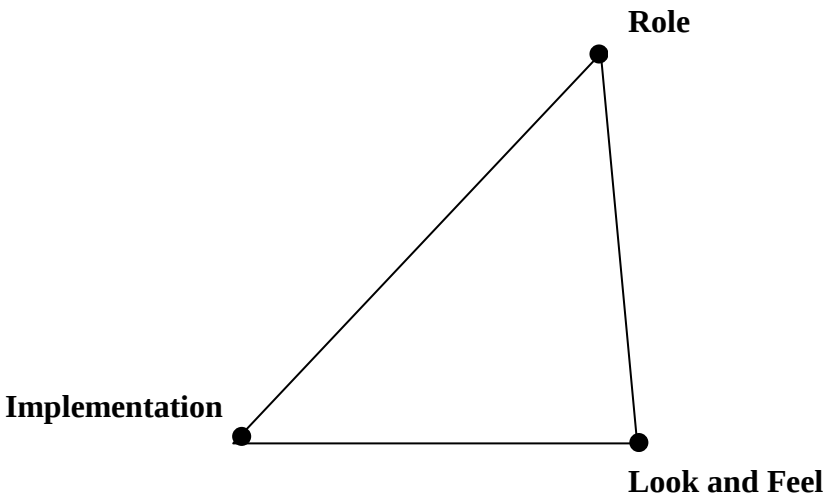


Figure 3.1 A model of what prototypes prototype (Houde & Hill, 1997)

prototype within this space is dependent on the questions that are being explored. Houde and Hill explain that the triangle is purposively drawn askew to emphasise that no one dimension is more important than the other.

In this thesis I adopt a user-centred approach to the prototype design, actively involving users in the process to examine the role, look and feel, and implementation of a lifelog browser. In the following sections I explain this process further with regard to each of these dimensions.

3.1.1 Role

I begin the design process by asking questions about the role of technology in people's lives. These questions are answered through a questionnaire study, where it is asked what types of technology people use in their daily lives, their attitude towards computers and the perceived difficulty of everyday household devices. I have marked this study as (1) on the model shown in Figure 3.2. This study is placed closest to the

Role dimension because at this stage of the research I am not yet concerned with the look and feel of technology or any specific functions. The purpose of the study is to obtain an overall understanding of the functions that technology serves in daily life.

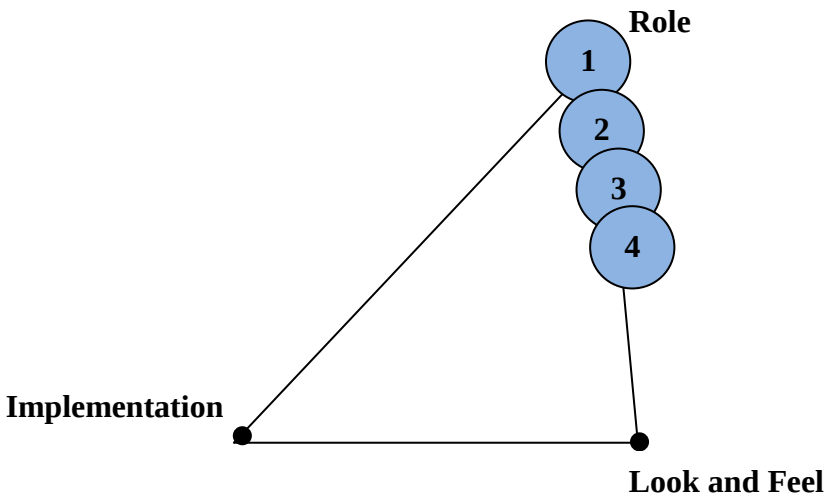


Figure 3.2 Relationship of four exploratory methods to the model

The next stage of the research examines the role of life-long collections in people's lives. This subject is explored through a series of interviews with a group of older and a group of younger individuals. In Figure 3.2 this method is marked by the circle containing the number 2. The purpose of the interviews was to obtain an understanding of the functions that life-long collections serve in the lives of these participants. Examples of life-long collections are photographs, diaries or concert tickets. The aim of the study was to explore whether the motivations for collecting these artefacts could be similarly applied to visual lifelogs. In the figure above, the number 2, representing this interview study is placed in the space denoting the Role of an interactive system. It is moving slighting towards the Look and Feel dimension as these sensory aspects (e.g. the smell and feel of a book) of current life-long collections are discussed by some of the interview participants.

The final exploratory study that is carried out contains two parts: a field study (number 3 on Figure 3.2) and an observation study (4). These studies were conducted to

understand the role of lifelogging, and browsing and sharing visual lifelogs have in the lives of older and younger family members. In the figure above, these studies are again moving closer to the Look and Feel dimension as I begin to look at how people feel about wearing the SenseCam lifelogging device, and also how people interact with visual lifelogs when sharing them with a family member.

3.1.2 Look and Feel

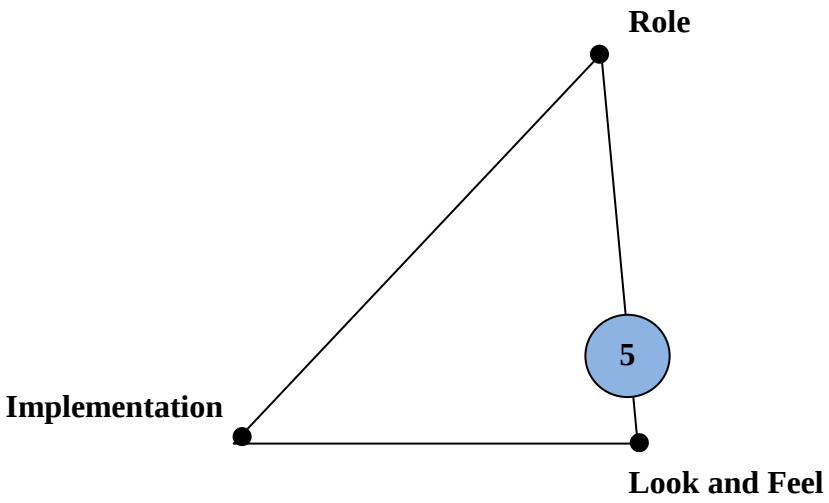


Figure 3.3 Relationship of user participation study to the model

With an understanding of the role of technology, life-long collections and visual lifelogs in people's lives, I now turn the focus on how a user would experience interacting with a lifelog application. The findings from the previous studies inform the design of this browser. Other techniques are implemented to support the design, such as creating personas (fictional users to represent the target group), a task analysis (focusing on the tasks to be completed with the proposed system) and the creation of wireframes (focusing on the structure and layout of the interface). Mock-up screens were designed demonstrating the look of the proposed lifelog browser and how a user would interact with it. These mock-up screens were then used in four user participation sessions, were family pairs were shown the screens and asked to provide feedback in relation to how the proposed system looks and how it should be used. These participation sessions are

marked in Figure 3.3 as the number 5. The study is placed in the Look and Feel dimension, but slightly moving towards Role, as the participants also discuss the projected role that a family lifelog browser would have in their lives.

3.1.3 Implementation

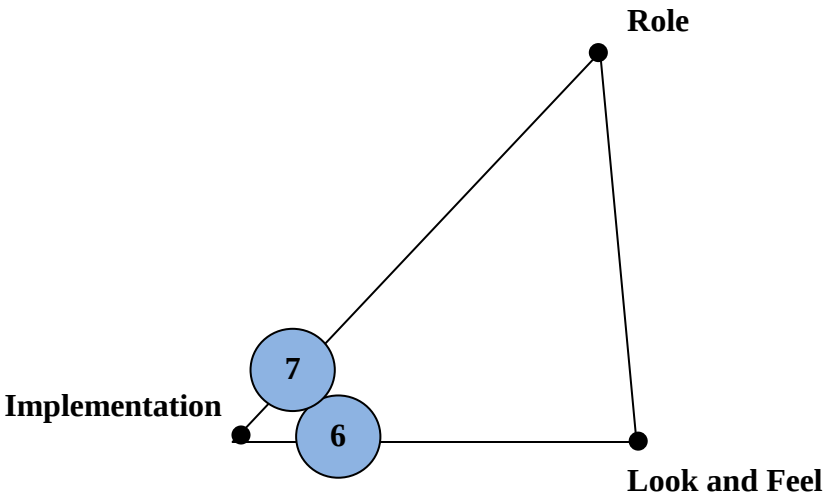


Figure 3.4 Relationship of two user evaluation studies to the model

The final dimension in Houde and Hill's (1997) prototype model is Implementation, focusing questions on the functionality of a system, the techniques and components though which the system performs its function. In this thesis the functionality of the lifelog browser prototype is investigated through a user study (marked 6 on Figure 3.4) and a field study (marked 7 on Figure 3.4). The purpose of the user study was to examine the tasks that a user would carry out to complete tasks, such as sharing images, and to identify and fix any usability errors. I have placed this study in the Implementation dimension of the model above, but also along the same section of the triangle as Look and Feel, as participants were invited to comment on interface features, such as the size of text and images, colour and speed of slideshow.

The final study was an evaluation of the prototype in a family home. Again the main concern of this study was on the functionality of the system, understanding how

users would interact with the prototype and whether it supported these interactions. Although similar to the look and feel of the mock-up prototype, some of the user interface features were different. However, this was considered acceptable as the focus of this prototype and its test was on functionalities. In the model above, I have placed the number 7, representing this study, between the dimensions Implementation and Role, as although the focus of the field study was testing the functionality, I was also interested in the role of the prototype in the household.

3.2 Sampling

To actively involve the user in the design process we need to recruit a sample from the population. In the following chapters I state that participants were recruited through snowball sampling (Chapter 4) or through association (Chapter 5). We used snowball sampling for the questionnaire study where we wanted to obtain a large number of respondents. Snowball sampling is a method where participants refer another person to take part in the study. The advantages of this method are that it includes members of the population that are hard to reach. For example, questionnaires were distributed to older people who were members of a social club. These participants can then nominate a person that they know, but who we as researchers would not have been able to reach. The disadvantage of this sampling technique is that there is no way of knowing whether the sample is representative of the population (Black, 1999).

The second sampling technique that I employed was volunteer based, or by association. Advertisements were sent by email within Dublin City University and to people known in the local area, such as neighbours. Participants were recruited this way for the interview study (Chapter 5), and then the same participants took part in further studies, such as the field and observation study in Chapter 6. This involved a high level of commitment for the participants therefore I considered this to be the most appropriate sampling method.

3.3 Research Methods

The overall philosophy of user-centred design is to place the user at the heart of the design process through the use of rigorous methods. In this research I used a wide range of methods to understand who the users are, want they want and how they interact with visual lifelogs. I summarise these methods in Table 3.1 outlining what the method is, the purpose for using the method including advantages and disadvantages, and the research focus of the method in relation to the design model adopted (Houde & Hill, 1997).

Table 3.1 Summary of methods used in my thesis design process, their purpose (Sharp et al., 2007), and the research focus with relation to prototype design model (Hounde & Hill., 1997).

Method	**Purpose**	**Stage of Design Process**
Questionnaire	Answering specific questions: user lifestyle, activities and attitudes to technology *Advantages* are that you can reach many people with low resource. *Disadvantages* are that the design is crucial. Response rate may be low. Responses may not be what you want.	Role
Interview	Exploring issues: current practices *Advantages* are that the interviewer can guide interviewee if necessary. Encourages contact between designer/developer and users. *Disadvantages* are that it can be time-consuming. Artificial environment may intimidate interviewee. To accommodate for this I have conducted interviews in the participants' home.	Role
Field Study - (in-direct observation (computer logs) & questionnaires on experience)	Exploring user lifelog activity; data captured automatically (e.g. browsing logs) and by participants (questionnaire). *Advantages* are that users don't get distracted by the data gathering. *Disadvantages* are that participants' memories may exaggerate (e.g. experience questionnaires)	Role

Observation	Understanding context of user activity when sharing images. *Advantages* are that observing participants gives insight that other techniques can't give. *Disadvantages* are that it can be time consuming and observer's presence may influence behaviour.	Role
User Participation (mock-up screens)	Explores questions about the concrete sensory experience of using an artefact. *Advantages* are that you can identify what the user looks at and identify ambiguous features or terms. *Disadvantage* is that users can not interact with the mock-up system.	Look and Feel
User Testing (working prototype)	Evaluation approach testing users on system tasks. *Advantages* are that usability problems can be identified and fixed. *Disadvantage* is that testing focuses on a specific set of tasks and may miss problems in areas.	Implementation
Field Evaluation (working prototype)	Evaluating the techniques and components through which a system performs its function. Finding out how it is adopted by participants in their environment. *Advantages* are that the system is tested in the environment it will be used. Participants use the system as they wish, rather than given tasks. *Disadvantages* are that it can be time-consuming. Relies on participant's accounts of how they used system.	Implementation

3.4 Analysis

Quantitative data is data that is in the form of numbers and within this thesis we derived quantitative data from the questionnaire study outlined in Chapter 4, and the field study in Chapter 6.

The questionnaires that we distributed in Chapter 4 asked respondents to rate their answers on a Likert scale, a response scale used to obtain degree of agreement with a statement. The responses in a Likert scale are treated as ordinal data because we cannot assume that respondents perceive the difference between adjacent levels to be equal. For example, there participants may view the difference between '*agree*' and *'strongly'* agree to be different from *'agree'* and '*neutral'*. For this reason we applied non-parametric tests to analyse for differences between groups. As the respondents were divided into four different age groups, we applied the Kruskal-Wallis test (Green & Salkind, 2008).

In Chapter 6, data was obtained from the field study in relation to the time participants spent browsing images, the time wearing the SenseCam and the number of images captured by the participants. For this study we wanted explore where there were any differences in these data sets between (1) age group, and (2) week type. One sample of participants were used in two conditions; a sharing week and a non-sharing week. A repeated-measures analysis of variance was conducted to test for these differences.

Qualitative data is data that is difficult to measure, count or express in numerical terms. In this thesis qualitative data was derived from the interview study (Chapter 5) and the observation study (Chapter 6), for example. This data was in the form of interview transcripts, transcribed verbatim from audio recordings, and field notes. To analyse this data I applied an inductive thematic method of analysis. An inductive approach concentrates on identifying themes that are linked to the data themselves (Braun & Clarke, 2006). The inductive approach begins with the

transcription of the raw data and multiple readings of the text. This is followed by coding, which involves putting a label to units of interest in the text (words or phrases) and interpreting meaning about the unit of text. These segments are put into appropriate categories and a memo is written about the category. This approach allows for patterns to emerge and links to be made, identifying themes and making conclusions about the findings.

In qualitative research and analysis there is the potential for interpretative bias, because the researcher is instrumental in both data collection and data interpretation. A method that was used in this thesis to reinforce the objectivity and validity of the findings was to include multiple coders and cross-checking. These coders included myself and a second PhD research student.

3.5 Summary

In this chapter I provide an overview of the user-centred design approach applied to the design of the proposed intergenerational lifelog browser. Each stage of the design process focused on answering questions in relation to the role of the browser, the user experience and the functionality of the system. These questions are answered through rigorous methods, such as questionnaires, interviews and evaluations. The following chapter begins the process, exploring the role of technology in people's lives through a questionnaire study.

Chapter 4

Exploring Older and Younger People's Technology Experience in Everyday Life

4.1 Introduction

There has been a simultaneous development in society between the growth of older populations and the prevalence of technology (Bouma, Fozard, Bouwhuis, & Taipale, 2007). It is a natural progression that technology is proposed as a potential solution to tackle issues concerned with a rapidly ageing population. Assistive technologies and information communication technologies (ICTs), that address the physical, cognitive and social aspects of ageing, have the potential to enable older adults to live independently as they age, increasing their quality of life and reducing healthcare costs.

Society is becoming increasingly reliant on technology and the necessity of using ICT to access certain services is increasing. This reason, coupled with the potential of independent living technologies, means it is crucial to ensure these systems are designed in such a way as to be intuitive and thus approachable for older people. However, potential barriers to technology use by older adults, such as physical, cognitive and sensory problems, can result in increased complexity in designing technologies that they can and will use.

The main purpose of the research presented in this chapter is to understand peoples' lifestyles, how people of different ages use the technology in their lives, and as a consequence, better understand how we can design new technology that is accessible to and acceptable for older adults. I present findings from the requirements gathering process - a questionnaire study which was conducted in the year 2009. The goal of which was to gauge peoples' experience, subjective confidence, and attitudes towards technology. This questionnaire helped to answer my first research question, focusing on what technologies older people are currently using for their daily activities compared to their younger and middle-aged counterparts. It is also concerned with ascertaining where technology is used, how frequently it is used, as well as lifestyle factors that affect access to technology and technology use or non-use.

4.2 Method

The study used a questionnaire method to gather information across four different age groups (to view the questionnaire see Appendix B). The questionnaire was divided into two sections. The first section was concerned with the participants' experience with technology and the types of technology they use to complete everyday tasks, such as shopping or communication. The second section related to the attitude of the participants towards computers. Some of the questions included were influenced by the technology and computer experience questionnaire developed by the CREATE Center (Czaja et al., 2006) and the Computer Anxiety Questionnaire (CAQ; Heinssen,

Glass, & Knight, 1987). The questions taken from Czaja et al. (2006) related to devices used to support activities (questions 6-17; Appendix B). These questions were updated and adjusted to suit an Irish population (e.g, changing cell phone to mobile phone). The questions taken from the CAQ can be found in Appendix B, question 18. Responses were structured on a Likert scaling system and analysed using non-parametric tests. As there were more than two age groups, Kruskal-Wallis tests were used to explore whether there were significant differences between variables (discussed in Chapter 3).

The participants were recruited through an advertisement sent to universities, community centres and various organisations in cities around Ireland involved with older adults. Snowball sampling was used whereby participants were asked to send the questionnaire to one other person. This method provided access to participants who were not a member of these community centres or organisations. Although the sample may not be truly representative of the population, which may be obtained through random sampling, this method was suitable for this study to provide a general understanding of people's use of technology. This is method is also discussed in Chapter 3. In total 237 people responded to the questionnaire (male n = 83, female n = 154). The participants were divided into four age groups; 18-29 years (n = 63), 30-49 years (n = 65), 50-64 years (n = 61) and over 65 years (n = 48). As these sample number varied, the findings represent a percentage of the total of each age group, rather than the overall sample.

Participants were offered the choice of completing the questionnaire online or in printed form. As the questionnaire took approximately 20-30 minutes to complete, the printed form was offered for those who could not commit this time in one sitting, and the printed form also accommodated to people who did not have access to a computer. Accessibility issues for the questionnaire design were considered in terms of the text size, the spacing between questions and responses, and the length of the individual questions.

4.3 Results

In this section I present my results focusing on (1) Internet, ICT and mobile phone experience; (2) Anxiety towards computers and (3) Use and attitudes towards everyday technologies.

4.3.1 Internet, ICT and mobile phone experience

4.3.1.1 Internet and ICT experience

To investigate the level of Internet experience between the four age groups I asked the participants to report whether they had used or would like to use different Internet features, such as email, online banking or voice calling (e.g. Skype). The most popular Internet features used by all age groups were email and Internet search applications, followed by photographic applications (see Figure 4.1). Very few older adults (65+ years) said that they stored music on a computer, and only 1% of this age group said that they would want to. It was found Internet voice calling was the most popular of the Internet features that participants said they would like to use. Non-parametric tests showed that there were significant age-related differences for all currently used Internet features ($p<0.05$). There were fewer differences between the younger age groups (18-29 and 30-49 years) except for Skype use.

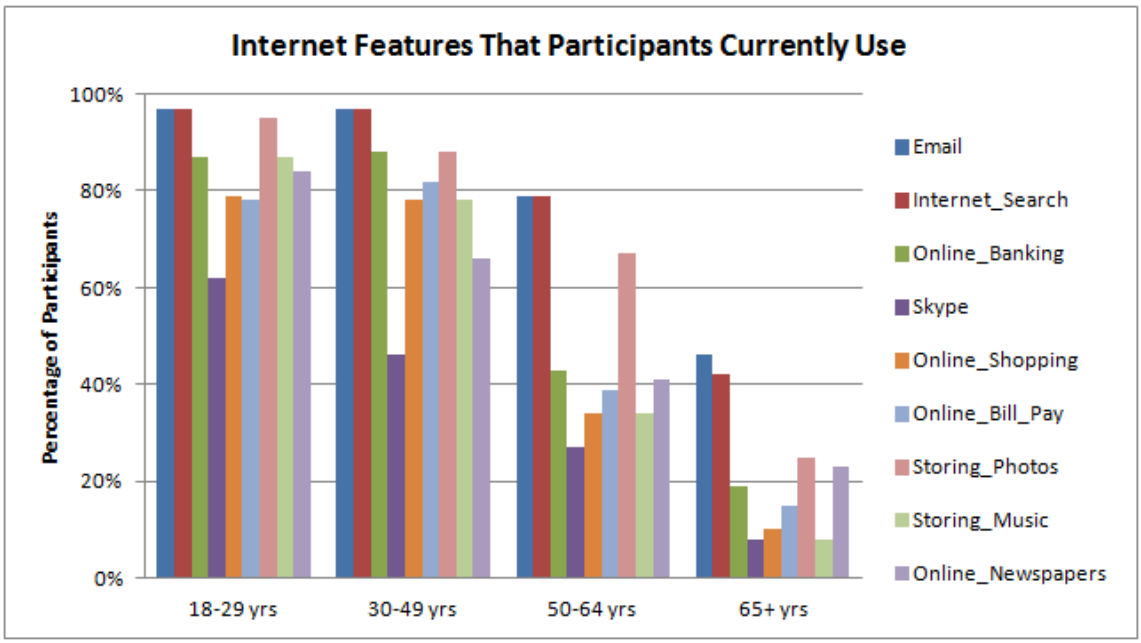


Figure 4.1 Internet features that participants currently use (non-normalised data).

Although older adults typically have less experience using the Internet and ICT, this does not imply that they do not own a computer or that they are not willing to learn how to use them. Therefore, I was interested in learning whether people owned their own computer, or if not whether they used one in another location and what level of training, if any, they would like in order to learn how to use computers. When asked whether they owned a computer in their home, 95% of people aged 18-29, 98% aged 30-49, 80% aged 50-64, and 50% 65+ years and over said that they did own a computer. Unexpectedly, the over 65 age group were the only age group to show an interest in owning a computer if they did not already have one. Half of this age group did not own a computer but 23% said they would like to own one.

With regard to training, nearly three quarters (72%) of all participants said that they would like some level of training. More people in the older groups said that they would like a higher level of training compared to the younger age groups. This is very

encouraging feedback as, although individuals in the older groups are less exposed to computer use, they expressed a keen interest in learning and developing their ICT skills.

4.3.1.2 Mobile phone experience

Research has shown that older adults are less likely to use mobile phones than younger adults (Cullen, Dolphin, Delaney, & Fitzpatrick, 2008). With a multitude of mobile phone features currently available I was interested in knowing to what extent people are using various features on their mobile phones. Participants were asked to rate whether they had ever or would like to use various mobile phone features including; the call function, text messaging, camera, picture messaging, radio, Internet, Bluetooth and music functions. The participants' responses showed that the call function and text messaging were the most frequently used functions for all age groups (see Figure 4.2).

The 50-64 age group used less functions than their younger counterparts, however the utility of the camera function and picture messaging was relatively high. A further drop could be seen for the oldest age group. Only 20% of the over 65 age group said that they used the camera function on their phone compared to 70% in the 50-64 age group, 91% in the 30-49 age group and 82% in the 18-29 age group. These results are consistent with previous research studies that found that older adults' use of mobile phones is limited to basic functions such as making calls and sending text messages (Kurniawan, 2008). A limitation of this study however is that the participants were not asked whether these features were available on their phone. For example, the older adults who did not use the camera function may have had an older version mobile phone that did not offer this feature.

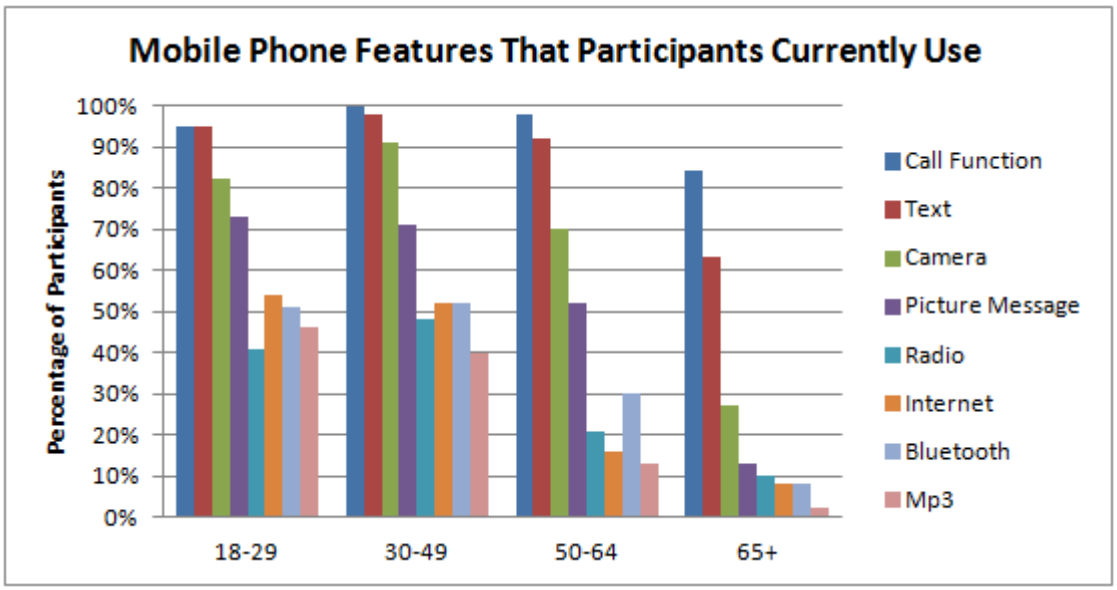


Figure 4.2 Mobile phone features that participants currently use (non-normalised data).

4.3.2 Anxiety towards computers

It is often cited that anxiety and unfamiliarity are two common factors of non-use of technology amongst older people. For example, Jay and Willis (1992) examined older peoples' attitudes toward computers before and after computer training, and they found that experience modified attitude. However, previous studies have shown that older adults are more likely to report feelings of anxiety toward computers compared to younger people (Bjorklund & Bee, 2008). Similar results were found in the current study of anxiety toward computers which included questions taken from the Computer Anxiety Questionnaire (Heinssen, Glass, & Knight, 1987). Participants who had access to a computer responded positively to the statements in the questionnaire, however there were no differences between positive and negative responses for participants who did not have access to a computer. For example, in Figure 4.3 it can be seen for the statement *"I fear making mistakes that I cannot correct"* there is a progressive increase in the percentage of participants who owned a computer providing a positive response whereas there is not obvious pattern for those who did not own a computer.

Figure 4.3 Computer Anxiety Questionnaire responses to the statement, "I fear making mistakes that I cannot correct".

Non-parametric tests showed that there were significant age-related differences for; not being confident of being able to learn computer skills, feeling apprehensive, a fear of making mistakes, a feeling of not needing to use computers, and being unsure how computers would benefit them (where $p < 0.05$). These results were derived from all samples, those who had access to a computer and those that didn't. In general, the older group felt confident that they could learn how to use a computer. For example, 59% felt they were confident in learning computer skills while only 12% felt they would not understand computer terms and jargon. Only 14% were afraid of becoming dependent on computers whereas 80% felt that anyone could learn to use a computer if patient and motivated. These results were derived from all samples, those who had access to a computer and those that didn't have access.

4.3.3 Use and attitude towards everyday technologies

4.3.3.1 Technology use for everyday tasks

It was of interest to understand how people use technology to support everyday tasks, such as conducting financial transactions, communicating with people, and shopping. The responses received showed that more than half (55%) of the participants said that they conducted financial transactions on a weekly basis. There was an age-related decline for participants who reported daily financial transactions. Looking more closely at the methods it could be seen that younger participants (18-29 and 30-49 age groups) were most likely to use Internet banking, whereas older participants (50-64 and more so 65+ age groups) preferred conducting financial transactions face-to-face with a banking employee. Automated teller machines were popular with all age groups however the frequency of use declined with age.

The majority of participants (84%) said that they communicated with other people on a daily basis, with a slight age-related decline (25% age 18-29; 23% age 30-49; 20% age 50-64 and 16% age 65+). Younger participants (18-29 and 30-49 age groups) most frequently used mobile phone and email to support communication. Participants in the 50-64 group favoured mobile phones, followed by the landline telephone and email, whereas participants aged 65+ used the house telephone more often than their mobile phone, while only a small proportion frequently used email.

The majority of participants said that they shopped on a weekly basis. Older adults were the least likely to use technology to support shopping activities, with 60% of those aged 65 and over never use online shopping and 45% of this age group never using a supermarket self-checkout. Although the younger age groups reported using these technologies they did not use them frequently.

A moderate 47% of participants said that they carry out a hobby based activity on a daily basis and 38% said they do so on a weekly basis. The participants were asked if

they had ever used devices to support these activities and if so how frequently. Again, older adults were the least likely to have ever used technology to support their hobbies. The most popular devices used by all age groups were recording and playback devices (mp3, CD, or DVD player). A digital camera was the second most popular device used and was used most often by younger age groups. A small proportion of older adults said they played video games (23%), used a digital camera (32%), fitness device (19%), or a computer for hobby specific use (31%) either sometimes or often.

There are many technological options for people travelling from place to place. 70% of the participants owned their own vehicle and mostly drove on a daily basis. There was no age-related difference. The youngest age group used public transport the most frequently and were the most likely to use technology such as Internet travel schedules, self purchase ticket stations and airport check-ins. Parking self-payment was regularly used by all age groups.

4.3.3.2 Attitudes towards everyday technologies

To understand how people of different ages perceive the difficulty of ICT and household technologies, the participants were asked to rate on a 5-point scale whether they found items very easy or very difficult to use. These items included a computer, Internet, email, mobile phone text and call, microwave, digital camera, radio, house alarm, television and DVD/VCR player. A similar trend was seen for all age groups, with more participants finding the technologies easy or very easy to use than those who found them difficult (see Figure 4.4 - 4.7). It was found, however, that as age increased there was a higher number of respondents who perceived the technologies to be difficult to use. Surprisingly, one type of technology which seemed to cause considerable difficulty for the participants was a DVD/VCR player, despite this being the most popular entertainment device used by all age groups. Although the participants find it difficult to use, the device is used frequently. Perhaps it is because of the popularity in sales, that the usability of these devices has been ignored by manufacturers. Radio and televisions were rated as the easiest technologies to use. Respondents aged 65+ found

the radio, television, microwave and the call function on a mobile phone to be very easy to use.

Non-parametric tests were carried out to explore whether there were significant differences for the perceived difficulty of devices in the home in relation to age. The results show a significant increase in perceived level of difficulty with age for computers, Internet and email use, mobile phone texting and calling, digital cameras and DVD or VCR player ($p < 0.05$). There was no age difference for the perceived difficulty of the radio, house alarm, television or microwave ($p > 0.05$). There were no differences between the 18-29 and 30-49 age groups and very little differences were found between the 50-64 and 65+ age groups. However there were significant differences between the 18-29 and 30-49 age groups with the 50-54 and 65+ age groups.

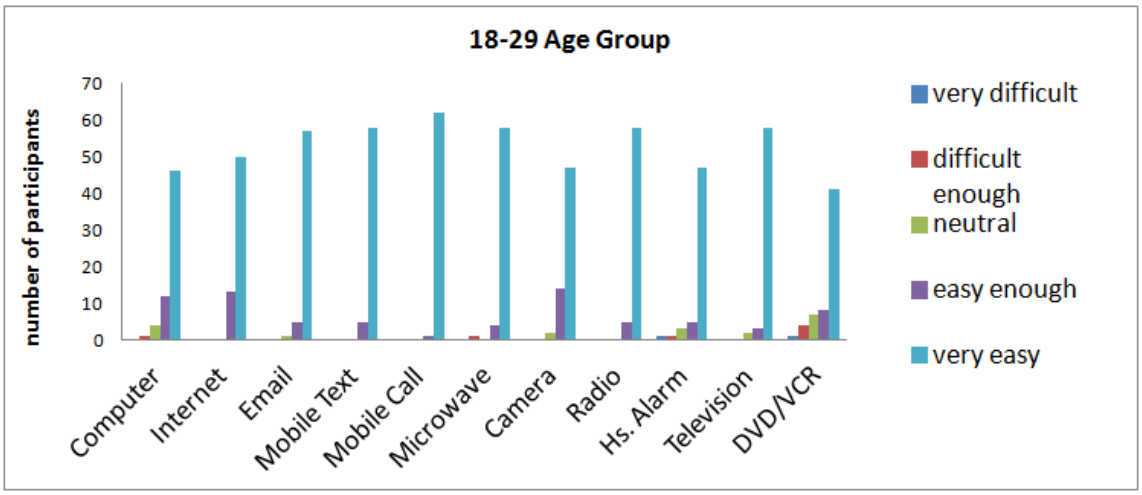


Figure 4.4 **Perceived difficulty of household devices for the 18-29 age group. In this graph we can see that the majority of respondents found these devices very easy to use.**

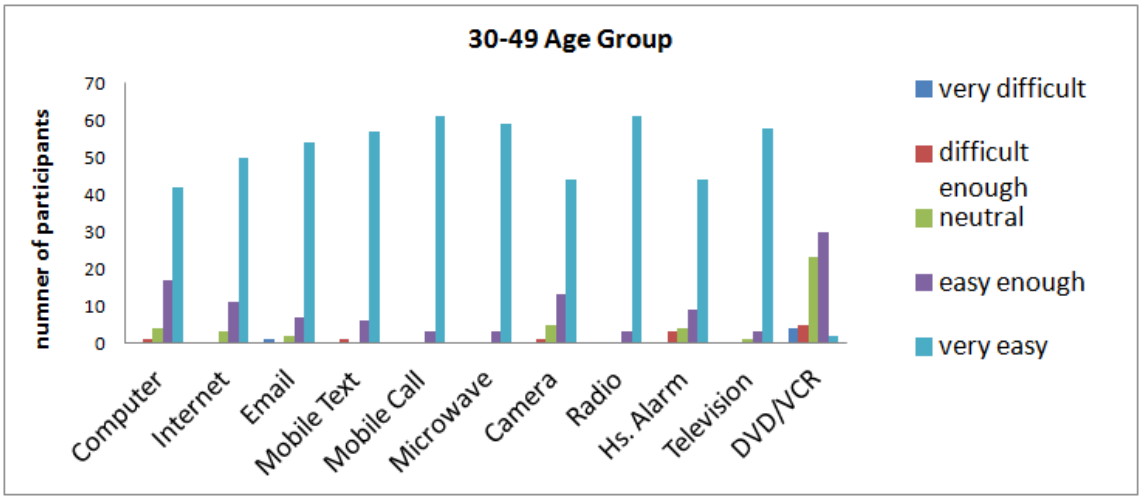


Figure 4.5 **Perceived difficulty of household devices for the 30-49 age group. This graphs shows a slight increase in the perceived difficulty of household devices, in particular the DVD/VCR player.**

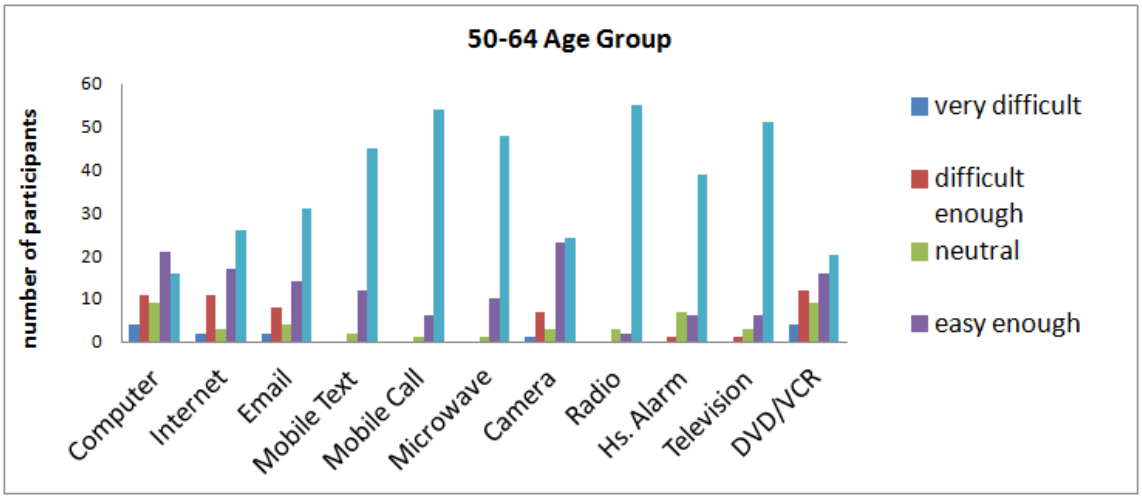


Figure 4.6 **Perceived difficulty of household devices for the 50-64 age group. Again there is an increase in perceived difficulty compared to younger age groups. The computer, Internet, cameras and DVD/VCR player show higher levels of difficulty.**

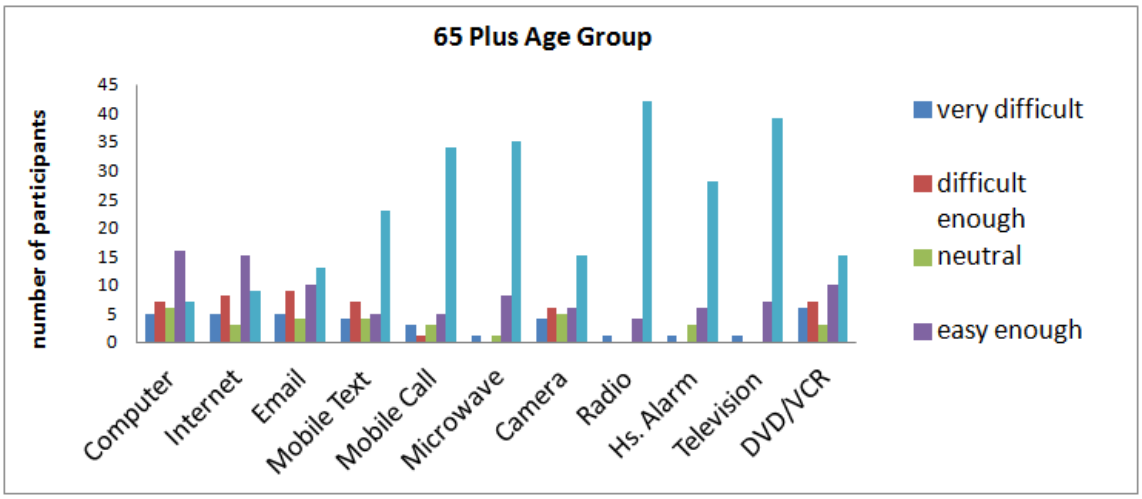


Figure 4.7 **Perceived difficulty of household devices of the 65 plus age group. There is an increase in perceived difficulty for all devices compared to younger age groups.**

4.4 Discussion

In this thesis, understanding older adults' lifestyles and how technology fits into their everyday experiences is fundamental for guiding the design of new types of technology, such as lifelog devices. The goal of my questionnaire study was to explore the use and acceptance of everyday technologies across different age groups, and to consider how the findings can be implemented into the design of a lifelog application. The factors that exhibited most prominence from the results of the questionnaire were:

- A large majority of the older adults either own a computer or would like to own one,
- The findings emphasised not only the awareness of older adults of the different types of technologies, but also a willingness to learn how to use them given the opportunity,
- There was a focus on social interaction for the older age group in relation to the methods that they used to carry out everyday tasks and the technology features that they were most interested in learning,
- Although there is an age-related increase in perceived difficulty of some types of technologies, many household technologies maintain intergenerational usability.

I now discuss these findings and their implications for future technology design in the domain of lifelogging.

4.4.1 Technology experience and acceptance

Overall the findings from the questionnaire study showed that a higher number of younger adults are using more types of devices compared to older adults. However, there was a lot of variance for technology experience and attitude within the older age groups. A large number of the older respondents said that they were confident in their abilities to learn computer skills and the majority believed that anyone could learn

provided they had the time and patience. This response is very encouraging as it shows that older adults do not feel defeated by the rapid evolution and ubiquitous nature of technology. The issues that did concern the older group were how computers could be of benefit to them and not feeling that there was a need to use them. Technology companies tend to target their products, such as mobile phones or computers at younger generations emphasising a multitude of functions for entertainment or business purposes. It is not surprising therefore that older adults are not aware of how they can benefit from commercially available devices. Since conducting this questionnaire study there has been significant developments for the accessibility and use of touch-screen devices, such as touch-screen mobile phones and tablet computers. Recent studies have shown that in the United States tablet computer ownership rose from 3% in early 2010 to 19% in January 2012 (Rainie, 2012). The percentage of older adults (age 65+) who purchased a tablet computer increased from 2% to 7% during this time. I outlined some of the benefits of touch-screen interaction for older users in Chapter 2, Section 2.4.2. One of the benefits noted was a reduction in anxiety for older users compared to interaction with a physical keyboard (Umemuro, 2004). In the current questionnaire study, there were age-related differences reported for feeling apprehensive using computer technology and being afraid to make mistakes. Providing better support for training such as documentation or visual demonstrations on screen displays could also support this need. Providing adequate training is a key factor for successful adoption (Charness & Jastrzembski, 2009).

4.4.2 Technology to support social interaction

Throughout the analysis of this questionnaire a common thread was the importance of social connectedness and an interest to learn to use communication applications, such as mobile phones and Internet voice calling (e.g. Skype). The benefits of communication devices are that they can fulfil a number of roles, including a sense of security and peace of mind, connectedness to the outside world and enjoyment. Although many older adults wish to live independently in their homes (Charness &

Jastrzembski, 2009), social interaction remains an important factor for everyday well-being. The results of this study suggest that the key to a successful technology design for older adults is to integrate technology that will support the user through social connectedness. The nature of lifelog data means that the images recorded are extremely personal. However, by providing the user with control over their lifelogs it may be possible to support social connectedness through lifelogging.

From the current study I have discovered that older adults are aware of modern technologies, and many are already using them. It was found that Internet voice calling and video conferencing emerged as the two most popular features people would like to use, across all age groups. These findings further highlight that older adults perceive communication technologies as worth learning.

Mobile phones are another example of the popularity of communication devices. With regard to mobile phone experience, calls and texts are the most used functions by older participants, with all other features rarely used. Again, this highlights the importance of communication. A study conducted by Mallenius et al. (2007) found that older adults used mobile phones for increased feelings of security and to be reachable. They also found that perceived benefit was the largest contributing factor to usage of a mobile phone by this age group.

Services such as shopping, making reservations and performing financial transactions are becoming more accessible through online or interactive kiosk methods. In fact some banks now only work with online banking transactions. Some of the benefits of these digital services are that they can be carried out in your own time, you can quickly shop around different stores for comparisons, products can be delivered to the door and people with mobility difficulties can conduct their business from their home. From the study it was found that younger adults (18-29 and 30-49 years) were the most likely to use technology to support everyday tasks. The 65+ age group were the least likely, favouring face-to-face transactions. Again, this highlights older adults' preference for social interaction and connectedness. In terms of lifelogging, these

findings suggest that older adults may capture a more diverse range of images compared to their younger counterparts, as they do not conduct all of their transactions through the computer, preferring human interaction.

The evidence associating social interaction with various health metrics (physical, mental, mortality rates) has been well documented over many years. This association occurs across the entire age spectrum, but is particularly prevalent in older adults where there is evidence linking meaningful and sustained social interaction to reduced risk of diseases and conditions such as dementia (Wang, Karp, Winblad, & Fratiglioni, 2002) and coronary disease (Rosengren, 2004). Despite this, few people realise the health risks associated with social isolation. Communication technologies are a way of maintaining existing social connections as well as facilitating the creation of new ones. Such technologies have huge potential to increase the wellbeing of older people, without being perceived as medically necessary or 'assistive'. This lack of associated stigmatisation, coupled with the fact that survey respondents in the older age groups expressed an interest in communication technologies, increases the likelihood that technologies, such as the SenseCam, will be both accepted and adopted.

4.4.3 Intergenerational usability of household technologies

Considering the needs of older adults when designing technology increases the accessibility and ease of use for all users. Hanson (2010) on the other hand believes that understanding the strengths of the older age group, rather than focusing on weaknesses and disabilities, should be the way forward in technology design for older people. For example, it was found that older adults had little or no difficulty using household technologies such as the radio, house alarm, microwave or television. Using these technologies to support assistive applications is a potential method to increase usability. A first step to utilising these household technologies as platforms for other applications has already been made. For example, Carmichael et al. (2010) investigated the use and acceptance of a physical exercise application on a digital television platform for older users. Although there was no significant health benefit found from using the application

there was a positive impact on mood and well-being. The CASALA centre in Dundalk, Ireland is also currently exploring how to use interactive television to increase the accessibility of the Internet for older adults. The use of touch-screen tablet computers is becoming commonplace in households. Researchers at the CASALA centre have observed positive results from older adult iPad training classes in relation to older adult's interest and ease of use, influencing the use of these devices in their independent living smart homes (CASALA, 2012).

Usability is not always a predictor of frequency of use. Interestingly it was found that although DVD/VCR players were the most frequently used device for entertainment/hobby purposes (when compared with computers, video games, digital cameras or fitness devices), according to the respondents they are not necessarily easy to use. All age groups reported having difficulty using this device. This finding suggests that even poorly designed technology will be used if the functionality is found to be useful. However, with good design and training documentation, technology in the home should be accessible to all users.

4.5 Conclusion

By identifying current practices, problems and preferences for everyday tasks we can design technologies that can offer support to people within their lifestyles. The aim of this questionnaire study was to gain an understanding of what technologies people are using or not using, and what factors influence their experience; thus addressing Research Question 1. A significant amount of information was gathered in relation to these factors, however there were three prominent findings that influence the direction of this research. I have focused these findings on the older sample of respondents as they were the least likely to use technology and the most likely to have difficulty using everyday devices.

Firstly, we learned that there was a strong motivation to either learn or to continue learning to use computers by the older group. This finding is encouraging for my research as it suggests that older people may not be adverse to new technologies, such as lifelogging devices. It was also found that social connectedness influenced how the older group used or would like to use technology, with applications such as Skype being of great interest to the older sample. Furthermore it was shown that systems which eliminated the need for social interaction, such as self-checkouts, were not used by many older respondents. This finding suggests that older people would be more interested in learning to use new technologies that supported social interaction and well-being. This is important when considering lifelogging devices and applications as lifelogging may be considered a private and personal activity. Finally, the questionnaire results revealed that many household technologies, such as microwaves and televisions, maintained their usability across all age groups. Having an understanding of older adults' capabilities can help us to understand how devices should be designed to maintain intergenerational use. I will discuss this further in Chapter 7.

These results inform us of the feasibility of introducing new technology to older users. In this thesis I explore the use of lifelogging technologies for older users. The results have also suggested that focusing on the social aspects of a lifelogging system would increase older user interest and acceptance. In the next chapter I explore current practices for life-long collections. I investigate the motivations behind collecting different items and the social aspects behind the activity.

Chapter 5

Identifying Motivations for Life-long Collections

5.1 Introduction

In the previous Chapter I investigated older and younger people's use of technology. It was found that although younger people were more likely to use different types of technology, older people showed a significant interest in learning how to use them, particularly those that supported social connectedness. To explore how we could support social connectedness through lifelogging we need to learn more about people's current practices for life-long collections and to what extent social factors are involved.

Creating and gathering artefacts over our lifetime is a typical human trait and family homes are central for storing these collections. Petrelli and colleagues classified mementos found in the home into three groups; public, family and personal (2008). Public mementos are those that are displayed in public rooms where visitors are

welcomed and are usually displayed due to aesthetic quality. Family mementos on the other hand are displayed in rooms where the family spends time together and represent the relationship between family members (e.g. children's artwork). Finally, personal mementos are items that are meaningful to the self or to long past events, such as trophies for sports achievements. As Petrelli et al. points out, mementos, particularly digital mementos, can be hidden in folders or boxes and are not initially valued as highly as those on display. Often childhood mementos are boxed and put into the attic so that they can be rediscovered at a later stage either by the person who collected them or their family. Other 'hidden' items might include old calendars and diaries, scrapbooks, receipts and medical certificates that build a rich narrative of a person's life and lifestyle. It is interesting to consider these everyday mundane items that people choose to collect and keep. Although these items may not be on display in the home, they hold significance either to the past or to the future. Clearly, in the context of this thesis, it behooves us to identify the types of items that people collect, or have collected in the past, and then explore the reasons for collecting them.

In a field study exploring physical and digital household objects Kirk and Sellen (2010) identified six values that people in a household place on their archived objects. These were: 1) defining the self, 2) honouring those we care about, 3) connecting with the past, 4) framing the family, 5) fulfilling duty, and 6) forgetting. These values explain the importance that people place on items and the reason why they keep them. The value of objects often changes over time, increasing or decreasing their importance to the owner. Understanding the motivations for why people collect or throw away their collections may further inform us of the changing value placed on items. To better understand the motivations behind life-long collections several factors need to be considered. For example:

- What are the reasons for or against collecting items over a lifetime?
- What are the triggers for reviewing these collections?

- Understanding this, how could a lifelog application be designed to accommodate older and younger family members?

These questions combined form Research Question 2. To address these questions, I carried out an interview study with both older and younger participants. I was interested in what life-long collections the older and younger participants possessed and how they used or intended to use these collections. I was interested in interviewing both age groups to understand whether any age differences exist, and if so, whether these differences relate to the type of object collected, the motivations for collecting or discarding them, or the triggers for reviewing them.

5.2 Method

5.2.1 The study

To explore people's motivations for collecting or keeping items throughout their lives I conducted semi-structured interviews with two groups of participants; older adults and their adult children. In retrospect, it was irrelevant to the study that these participants were family members as the questions were not directed towards family issues. The participants were asked questions about themselves, their motivations and their practices.

The interviews were carried out individually in the participants' home. This was to ensure that the participants were comfortable throughout the interview and also to allow the home environment to act as a memory support to help answer questions regarding their collections. The interviews normally lasted 45 minutes and all interviews were audio recorded. The participants were asked a specific set of questions, however, if a participant mentioned a new topic then this subject was further explored (to view the interview script see Appendix C). Examples of the types of questions that the participants were asked included: *Is there anything that you keep or collect either now or in the past? What are your reasons for keeping these items? Where do you keep*

them? Do you ever take these items out to look at them, and if so why? Do you ever show these items to other people and if so how? What would you like to happen to these items after you pass away?

5.2.2 Participants

In the previous chapter I studied four different age groups, 18-29, 30-49, 50-65 and 65 plus years. It was found from the results of the questionnaire study that the main differences were between the two younger age groups and the two older age groups. Therefore, to simplify the research process, from this point the participants are divided into two age groups, 18-49 years and 50 plus years.

Table 5.1 Participant demographics including gender, age, mobile phone, computer and Internet use, and computer experience.

	Younger	**Older**
Gender	Female(n = 6), Male (n = 4)	Female(n = 6), Male (n = 4)
Age (average)	29 years	62 years
Mobile phone	Yes (n = 10)	Yes (n = 10)
Computer	Yes (n = 10)	Yes (n = 9), No (n = 1)
Internet	Yes (n = 10)	Yes (n = 9), No (n = 1)
Computer Experience (average on Likert scale 1-5)	4 (very familiar)	3 (familiar enough)

n = number of participants;

Likert scale 1-5 where 1 = Never used Computer and 5 = Expert Computer User

A total of twenty people participated in the interview study. This included ten older adults (4 male and 6 female; age 51-75) and ten younger adults (4 male and 6 female; age 20-35). The participants were recruited through acquaintance. Each older participant was a parent of one of the younger participants. Three of the younger participants were living in the family home with their parent at the time of the study.

Two of the younger participants had children of their own. All of the participants owned a mobile phone, and all but one (older participant) owned a computer and used the Internet. On average the younger participants felt that they were very familiar with computers and the older participants felt they were familiar enough (see Table 5.1).

5.2.3 Data analysis

Audio recordings of the interviews were transcribed and analysed. I used the qualitative research approach of inductive thematic analysis to examine this data (discussed in Chapter 3). Thematic analyses focus on identifying and describing both implicit and explicit themes within the data (Guest, MacQueen, & Namey, 2011). A large number of codes were generated from the interview data. Initial coding was carried out by separately by a PhD researcer as well as myself. The relevance of these codes were then discussed and agreement on the final coding structure was met. These codes were then compared for frequency, and co-occurrence. Memos were written for each code and the relationships between codes were visually organised using affinity diagramming (Holtzblatt, Wendell, & Wood, 2005; see Figure 5.1). I identified several themes, each containing subthemes to help understand motivations for life-long collections. The results are presented in three parts: the motivations for collecting items; motivations against life-long collections; and finally the triggers for revisiting collections.

Figure 5.1 Affinity diagram of themes and subthemes using yellow sticky-notes.

5.3 Interview Findings

The results presented in this chapter highlight the reasons why people collect items throughout their lives, and also the relationship they have with these items. The level of attachment that people place on items is interesting in the context of lifelogging. For example, some collections represent a time in a person's life (childhood, university etc.) and are important because of this association. Collections can also be associated with a single experience, such as a first date. Other collections are functional, reminding people or stored just in case it is needed. These findings have significant value towards informing why visual lifelogs might be stored. Another aspect is how people manage their collections. The findings outlined in the following sections show how people deal with space limitations, both physical and digital, filtering, deleting and discarding information that does not have significant value to them. In terms of lifelogging,, the management and display of images is complex due to the large quantity that can be recorded by a wearable device. The results below go some way towards understanding how this can be achieved.

5.3.1 What were the motivations for collecting?

5.3.1.1 Overview

The focus of this study was to understand what motivated people to collect particular items throughout their lives. I was interested in why the participants collected artefacts, what they did with them and what they intend to do with them in the future. Analysis of the participants' responses resulted in five main groups of motivations: memory support, sharing, precaution, sentiment and family background. Table 5.2 outlines these groups and divides them into subgroups with a brief description. I now discuss these groups in more detail.

Table 5.2 Themes, subthemes and description of motivations for life-long collections.

Motivations	Subthemes	Description
Memory Support	Reference	Collecting information to refer back to. Expected to be used (e.g. the cost of monthly bill)
	Remind	Making a record of past or future events to remind themselves of it
	Reminisce	Items that support individual or social reminiscing on past events
	Reflect	Items that support reflection on the individual's experiences
Share	Inheritance	Items that have been passed down from deceased family members or that are collected by individual to pass to others
	People	People with whom collections are shared (e.g. family, public)
	Third party	Items that may have more significance to third party (e.g. old photograph of cousin as a baby)
	Privacy	Preferences for items to remain private and personal
Precaution	Personal	Collections to have just in case someone wants information related to item or the person/place/event it relates to
	Official	Official documents collected just in case they are needed again (e.g. divorce documentation)
Sentiment	Significance	Importance of collection to the person
	Attachment	Emotional attachment that exists between person and collection
	Relationships	The people that are linked to particular collections and the relationships they have with the individual. Could be person from the past that they do not have contact with

		(e.g. ex-partner)
	Identity	The representation of the individual's identity at a particular time in their lives
Family Background	History	Information gathered concerning the history of the family
	Accuracy	Authenticity of the information gathered
	Contribution	Level of contribution from family members
	Published documents	Published books, newspaper articles etc. related to the family history

5.3.1.2 Motivations for collecting

Memory support

Memory was a key motivation for life-long collections for all of the participants. This was not surprising as research has shown that mementos such as photographs are successful aids for both retrospective and prospective memory. The participants described the way in which their collections supported memory through referencing, reminding, reminiscing and reflection. For the participants, referencing was used to find and verify information from the past. Some of this information was for practical purposes. For example in one case the participant wrote down the days he took as holiday leave from his job and another participant collected her household bills so that she could compare them from one year to the next. Participants also commented more generally on how experiences can be forgotten without having a record to refer back to:

> *"Such a large portion of your life is gone and otherwise it might as well not have happened". (part.14, male, age 35)*

Collections such as souvenirs and photographs acted as reminders for past events whereas appointment diaries and calendars for example, reminded participants of future

events. People who shared the same experiences could also support each other's memory by talking about the event:

> *"You'd remind each other [siblings] of things that happened in the past and the way people reacted, you know. The things could be funny or sad". (part.20, male, age 54)*

Reminiscing is a purposeful form of remembering experiences in the past and can be personal or shared. From the current interviews it was found that shared reminiscence was most common between family members to compare their experiences, compared with other social groups such as friends or colleagues. For example one of the participants said:

> *"I would reminisce with my sisters and especially my brother. I suppose because his impressions would be different because he was the only boy and they would be different". (part.2, female, age 68)*

Artefacts such as photographs support reminiscence by triggering a memory and stimulating conversation. The artefact itself may not have a direct relationship with the past but it is what the artefact represents to the owner that is meaningful. For example, one of the participants told of a painting he bought of a canal because it reminded him of his childhood. He remembered his mother warning him to stay away from the canal but it was the first place he went every day after school. Similarly, collections can support reflection on one's life, experiences and identity by allowing the owner to reflect on how they have changed in their appearance, their thoughts and the people that have come and gone throughout their lives. For example, one of the older participants said:

> *"Sometimes it's nice... even sort of....it helps you remember how you felt at that time and how you were, and like you know, maybe as well how young you were. I suppose you see all the stages of your life through the things you keep". (part.8, female, age 61)*

Share

Collecting items to share with other people was also a motivation for participants. Inheritance, or passing items down through a family, was one form of sharing. Some of the participants had inherited items from family members that had passed away. These artefacts were meaningful to them because of the relationship with the items previous owners. Other participants collected items with the intention of passing them on to their children in the future:

> *"I started to collect things more so since I had my family. I would be much better at keeping things, you know, for them down the road". (part.8, female, age 61)*

The act of passing important and meaningful artefacts to another person highlights the closeness of the relationship, the trust and responsibility of taking care of something that was cherished by another person.

The relationships that people had with others determined the types of items they shared. Family sharing was the most common and significant for all of the participants. Items such as photographs and videos that illustrated experiences, events or young children were most frequently shared within family groups. Groups that people shared their collections or lifelogs (travel blogs, Twitter feeds etc.) with also included friends, work colleagues, online social network friends and public Internet users. Items that were shared with friends were personal and most often related to a shared interest or experience. Items shared with work colleagues, social networks and public were less personal, but also related to shared interests and experiences.

Third party involvement was a topic that many participants brought up. This was in relation to other people capturing a record of events that involved the participant or an item that the participant had that was a record of a third party. For example, one of the older participants told about a family gathering she had recently attended where they met

with family they had not seen since childhood who had photographs from this time that the participant did not know about:

> *"We had a family gathering a few weeks ago and it was brilliant...that people brought things that you wouldn't have seen". (part.11, female, age 56)*

Privacy was also a common theme when the participants were asked about sharing, particularly for collections which contained past opinions and thoughts such as a diary. None of the younger participants who had written a diary wanted future generations to read it. The participants said that when they wrote their diary they had never intended other people to read it and would still never want anyone to read it in the future:

> *"If I die they can be burnt to smithereens". (part.3, female, age 28)*

Although the participants' own diaries were private, both older and younger participants showed an interest in reading their parents diaries. For example, one participant said:

> *"I just think if it was me, if I found my Mam's diary I would like to go through...like not to read her personal in-depth life stories but you know it would be nice to have a record of what she did this day or that". (part.5, age 28)*

Appointment diaries were considered to be less private however and were often shared with friends and family. This was mainly for ease of organising events and activities between people. These shared appointments were recorded either using wall calendars or appointment notebooks made available in the home, or through shared online calendars.

Precaution

Documentation was another form of collection that emerged with both groups. Apart from the youngest participant (aged 20), all of the participants kept official

documents. The length of time that the documents were kept depended on their importance or the likelihood that they would be needed as a reference in the future. For example, for one of the younger participants it was a medical condition that motivated him to collect his hospital records:

> *"I keep all my medical information because I got epilepsy a year or so ago. So everything from the epilepsy is all in a folder and filed away". (part.12, male, age 25)*

The primary purpose of collecting documentation is to act as a record for an official process, such as getting a mortgage, a legal claim, or purchasing merchandise in a shop. It was found from talking to the participants that in some situations the significance of the documents change over time from being a simple record to becoming a significant memento. For example, in the current study some of the participants saved receipt items that were related to happy events, such as the bill for a wedding, or a receipt from a sky dive. One of the most common reasons given for keeping these items was as a precaution, in case it was needed in the future. This was more often for official items such as medical, legal or financial documents, but personal collections were also kept should anyone ask for them in the future. One of the participants explained that she was advised to hold on to her legal documentation after she was separated from her husband in case she ever needed to return to it:

> *"I would have kept a lot of things from the time I was separated; again I have all...bills and all from the time. And again somebody once said to me to just keep them, you know, sort of in case you ever need them." (part.8, female, age 61)*

Sentiment

Written mementos were classified to include any form of message that has personal meaning to the participants, either physical or digital. Physical mementos included those that were sent from another person such as letters or postcards. These

often had sentimental attachments if they were from loved ones, particular those that were now deceased. Many of the participants, both younger and older mentioned letters, cards or postcards that they have saved because the person who gave them was important to them and had passed away since. One of the younger participants, for example told of her written mementos from a loved one:

> *"I have some postcards that do mean a lot to me. My uncle who passed away when I was about ten, I have a postcard from him and he wrote a big long message on it". (part.17, male, age 29)*

The handwriting of the sender was a particularly important component of these messages. Other written mementos included diaries, either personal diaries where the participant expressed their feelings, or diaries where the person wrote down activities they engaged in and the places they went. Digital messages were also considered to be meaningful to participants. This included emails or text messages that were sent to the participant particularly if the subject matter related to a happy event or if the message was from a person who rarely sent them. For the participants who had sent letters or emails home when they were abroad for a long period of time, they found on their return that when the messages were combined they created a log of their experiences that they wanted to keep for themselves. Although the intention of the letters were to communicate with their family at home and keep them updated on activities, after time the meaning of the letters altered, motivating the participants to reclaim them as records of their own experiences. Lifelogging, in the same way could support communication and sharing of experiences between family members for short-term use, while at the same time acting as a record of events which people can return to at a later stage in their life.

People were motivated to collect and keep items because of the meaning attached to them. Collections were deemed significant because they represented memories for the owner where other people would not see value:

"They're your treasure, they're yours. They're everything to you". (part.15, female, age 51)

Attachment to items was often strengthened with time or because of the event or person to which they relate. One of the participants told that he kept his wedding bill and over time the attachment to this item became stronger because of the event that it represented:

"We've still got the one of our wedding, the bill we got for our wedding. It's just something we have...we never really thought about throwing away. The longer you keep it the more you sort of become attached to it". (part.13, male, age 64)

Relationships were represented through collections such as scrapbooks or items given as gifts between people. They also represented the individual's identity, the person they were in the past and the person they are now. Collections were used, particularly by participants that were parents, as a catalyst or aid to tell their children about their younger selves:

"I'd like them to see me not as their mother but as a person who was young like they are and was going through all the things they went through". (part.8, female, age 61)

Family background

Throughout the interviews I asked participants to talk about any collections they had that related to their family history. Photographs were frequently mentioned by all the participants as recorded items and verbal family stories for non-recorded information. Verbal story-telling was the most common method and included participants telling stories to younger generations or participants telling friends stories about their family:

> *"I'd talk about any stories I have for them [children] and when I was a child. Always, and always did. You know they loved to hear what you did when you were small. What you played when you were small. What trouble you got into". (part. 11, female, age 56)*

In some cases family stories were recorded through diaries, as part of writing courses or to intentionally pass onto children or grandchildren.

Each of the family groups had access to a family tree that was either created by them or by another family member. The level of information varied greatly between participants with some only having names and dates and others including photographs, birth/death certificates, newspaper clippings etc. The type of medium also varied between paper and digital versions. The older participants had more interest in their family tree compared to the younger group. This may be because they feel a responsibility to their children to pass on this information, an interest in the family history for themselves or as a way to record the life of loved ones that have passed. For example, one of the younger participants talked about his observations of his parents' experiences with the death of family members:

> *"I see that with my parents with my grandparents passing...I've been to three funerals now over the last four or five years of parents of my parents...and you see that they become very very conscious of...being aware of...publicising and evaluating the legacy that those people left behind". (part.17, male, age 29)*

Motivations for developing the tree varied whereby some participants continued on from a tree that was already created and others started one, acting on an interest they had in their family background. One participant's interest was sparked when she was asked to begin an online family tree as part of a computer class. There was also a strong motivation to pass on this information to children and to preserve the family history, as one participant said:

"I think it's important to collect these things and whatever way they're collected, to share with other people. Because I think it's important that people know where they have come from, you know what I mean? And I think that's all part of the family history and the extended family history. Where we've come from, where the family has come from". (part.20, male, age 54)

An issue that concerned the participants about their family tree or family background was the accuracy of the information. Access to family backgrounds were obtained from older generations, published material, public records such as census data, or online information. Problems that people experienced were not having older family members to ask to obtain this information, not trusting the person to tell the family history accurately or not trusting online resources because the content appeared outlandish:

"I mean I have looked up my father's side and that was quite interesting. There again I got some of the stuff and I just thought it can't be right. I looked it up online". (part.13, male, 64)

There were various factors that influenced the level of contribution by the participants towards gathering a family tree and background information. One of these was the access to information, where the participant did not feel competent to carry out the research by themselves. One of the older participants said how she did not use the Internet so she felt she could not look up information without help from others:

"I would be interested in a family tree but I'd need someone in the family to kind of do the research, probably on the Internet or that that I don't use". (part.10, female, age 75)

Another reason that participants gave was because another family member had or is currently working on a family tree:

"I would eventually be interested in working on a family tree but now that I have Dad working on it I don't see the need to duplicate any effort". (part.17, male, age 29)

From the interviews it was found that often one person in a family conducted the background research and other family members contributed to this effort with any items or information they had available.

Public material concerning family background was a source of interest and pride for the participants. Documents that were published on paper or online, or television clips were important additions to family collections. For example, newspaper clippings, dedications to a family member in another person's book, and even a recording of a play telling the story of the participant's childhood;

"They did a play on my childhood there two years ago. I was doing drama class and they asked me where I lived and they just decided to put a play together. So I told them about my childhood and the whole family came to see it. I have it on DVD". (part.15, female, age 51)

It was noted that when the participants talked about these types of items they talked about experiencing or reviewing them collectively with family;

"My father wrote a book or started to write a book, and I think that was mainly about his war time. The thing was he did do a diary on that which we were only looking at the other day". (part.13, male, age 64)

The above themes show how varied motivations can be for both older and younger people to collect items throughout their lifetime. Often the motivation for keeping a collection is different from the reasons why they were initially collected. Next I look at the emergent themes from the interviews that related to deleting or discarding collections.

5.3.2 What were motivations against collecting?

5.3.2.1 Overview

The reasons why people don't keep or collect life-long items were also of interest to this study. This section explores why collections are discarded or lost and also why they are not collected in the first place. The aim was to understand how the collection and deletion of items can be supported. The themes, subthemes and a brief description of each are outlined in Table 5.3.

Table 5.3 Themes, subthemes and description of motivations against life-long collections.

Motivations against	Subthemes	Description
Loss and Deletion	Death	Information that is lost when older generations pass away
	Damage	Collections that are damaged physically or digitally
	Space	Collections that are deleted or thrown away to make space
Effort	Control	The control individual has over what is collected or not in the home
	Future Intention	The intention of the individual to collect items in the future
	Technology	Changing technology formats
Identity	Self-Confidence	Avoidance of being in photographs or videos. Not wanting to see themselves captured at that time in their lives

5.3.2.2 Motivations against collecting

Loss and deletion

The reasons for the loss or deletion of collections varied greatly and ranged from purposeful disposal to unavoidable loss. Death was a reoccurring theme for the older participants where information about the family was lost after the older generation passed away. The problem that people experienced was that once the older family members were gone, they had no one to ask for information:

> *"We can't ask questions now because there's nobody to ask". (part.6, female, age 64)*

As people become interested in life review and family history when they grow older, it is almost inevitable that the previous generation will be elderly or deceased. Unless this information is documented in some way it would most likely be lost. The loss of family mementos was also an occurrence following the death of a family member where items were dispersed among surviving relatives and could no longer be traced.

The loss of collections was also put down to damage or theft of items. Some items such as photographs faded naturally with time. However, participants also talked about unfortunate incidents that happened in their home that caused their collections to become damaged. For example, one participant said that all her letters from her husband were singed when their house went on fire. Another participant told of her jewellery that was stolen. Not all damage to collections was accidental however. One of the older participants expressed her regret over the damage inflicted on family photographs when she was a child:

> *"I love photographs. I have some old ones from when I was younger but there were eleven of us. But being kids we tore some of them and everything....I'd love to have them now". (part 6, female, age 64)*

Most of the participants deleted or threw out collections because they took up too much space, both physical and digital. This was most common with official documents where there was no emotional attachment:

"I'd pay the bills and then that's the end of them". (part.10, female, age 75)

The participants spoke about their emotional responses to the loss of collections. Regret was a strong theme when it came to missed opportunities for recording life-long collections, particularly following the death of older family members:

"You sort of regret after they go that I should have asked them this or I should have asked them that. Because my aunty who died it must have been about 18 months ago. She said to me "invite me round one night to yours and I'll go through all the family history with you". Because she was one of those who if you picked up the phone to her you knew you were there for an hour. You wouldn't get off. So we never invited her round. You know, and we should have done". (part. 13, male, age 64)

Today, video and audio recordings of deceased older generations are rare as people did not have the access to technology in the past as they do now. Having a recording of loved ones when they were alive and well was something that the participants felt they missed out on:

"To hear my Mam and Dad's voice...I'd love that. I'd love to have captured that". (part.11, female, age 56)

However, one participant spoke of the negative attachment that can result from holding onto items connected to deceased loved ones:

"A friend of mine died and I kept a text message on my phone from her. But then my phone was robbed. It was the best thing that happened because I wouldn't have ever been able to delete it. Because I don't know whether it

would be guilt or sadness, I'd have never felt...just when the phone was gone I kind of got closure on it as well. It's very hard to delete everything". (part.15, female, age 51)

In this circumstance the participant experienced a feeling of relief when the control and responsibility over the meaningful text message was taken away from her. This feeling of responsibility and attachment was common when collections had links to relationships with others:

"I don't want to disregard them by throwing them away". (part.18, male, age 57)

Effort

Motivations for and against life-long collections was determined by who in a household took control over the collections. It was found that one partner often took control over particular collections for the household:

"I really don't [keep official documents] because my wife does. But if she wasn't there I would keep them. I'd ask her if I needed them". (part.4, male, age 65)

For both the younger and older parents in the sample it was the mothers who took control over collecting the children's mementos:

"We definitely have some things from when the kids where young but I think that's more down to my wife than to me". (part.18, male, age 57)

In many cases the participants also had no control over the disposal of collections:

"I would throw out half of the stuff in our attic. But I'm not allowed". (part.20, male, age 54)

Although some types of items were not currently being collected a reoccurring theme of intention to record in the future was found. The participants claimed that they would like to or feel they should make a record of instances in their lives. The reasons given for why they do not currently record these items included not having the time, not being experienced with computers, and forgetting. The development of technology has meant that older versions of recording and viewing equipment are no longer used, making old recordings redundant. For example, home movies that were once recorded using a super 8 camera would have once been transferred to a VHS cassette, and then VHS to DVD and now many home movies are in file format. Transferring to modern equivalents can take up time and money:

> *"I plan to organise the photos and I went as far as buying a scanner to do so until I realised this takes an awful long time". (part.18, male, age 57)*

For some participants the avoidance of making a record of life events was influenced by their self-identity at a particular time in their lives. For example, some participants did not take photographs because they did not want to see any images of themselves:

> *"I never take photos. I hate being in them". (part.9, female, age 34)*

> *"I had a pretty poor self image growing up. I never had an interest in seeing myself young". (part.17, male, age 29)*

One participant spoke of a significant event that happened in her life that prevented her from taking photographs:

> *"I did take photographs to a point until my father died and I stopped taking them for a while and then I went back to it. I just kind of...I don't know whether it was just where I was in my life, I can't explain. Then I just stopped. I didn't even want to be in photographs. And then I went back again and started again". (part.15, female, age 51)*

Again it may be that the participant simply did not want to remember or reflect on this time in her life.

The motivations against life-long collections were dependent on numerous variables within a person's life, such as the amount of space they had in their home, the people they lived with or unexpected events that affected their collection, such as theft or house fire. In the next section I return to the collections that were saved by the participants and examine the types of triggers that prompt people to review their collections.

5.3.3 What were the triggers for reviewing?

5.3.3.1 Overview

In the previous section I have discussed why people collect various items over their lifetime. This section will outline the reasons participants gave for reviewing their collections. From the interviews four main triggers emerged: discovery, third party, intention and death (see Table 5.4).

Table 5.4 Themes, subthemes and description of triggers for reviewing life-long collections.

Triggers	Subthemes	Description
Discovery	Accidental	Come across collections that are put away and had been forgotten
	Environment	Something in the environment that reminds an individual of particular collections
Third Party	Sharing	Other people asking to see or sharing their own collections
Intention	Boredom	Reviewing collections to fill time

	Memory	Reviewing collections to remember particular events
Death	Legacy	Reviewing or reminiscing after a person has died to remember their life and share with others the individual's legacy

5.3.3.2 Triggers for reviewing

Discovery

The most common trigger that the participants gave for reviewing their collections was that they "came across" it. In most cases this was accidental, where the person was looking for something else and then became distracted by these life-long collections. Often these collections would be stored away in locations such as the attic or wardrobe where they would not be easily found:

> *"If I came across a box or something in the attic I would look through it and I would be amazed again at the bits of things that would be in it". (part.2, female, age 68)*

Environmental triggers, such as something on the television, also encouraged people to review their collections or stimulated conversations between people about events in the past. For example, one of the older participants said that the simplest things, like a cookery program could remind her of her mother's cooking and would prompt her to tell her daughter about the meals she had as a child.

Third party

Another reason given for why collections are taken out from storage is when third party persons are interested in reviewing them. In the example below, it is the participant's son who requests her to look through her collections:

"I have all the kids collections put away in case any of them want it, any of them for any reason. Like Donal last week said to me, 'Do you have photographs of us in the tennis club when we were small'? I said I have a few. So he wants me to dig them out". (part.10, female, age 75)

In this situation the participant would have to review her collection of photographs in order to find the relevant ones for her son.

Intention

With the previous two triggers, 'discovery' and 'third party', the participants did not deliberately think to review their collections. However, the interview findings suggested that some triggers are intentional and can be motivated by boredom, for example. One of the participants said how they take out video recordings of their grandchildren if there is nothing on television. Others told how they spontaneously review accessible items, such as photographs on their phone when they are bored:

"I'd take out the family photos and have a quick gander through them if I was bored". (part.12, male, age 25)

Intention to review collections was also triggered by the desire to remember events and to reminisce with other people:

"We'd have a laugh with my Mam and Dad over the photos, a good laugh" (part.12, male, age 25).

However, collections could be reviewed intentionally to support any factor of memory, such as remembering the name of a person or the location of a good hotel. Many of the participants particularly liked to review photographs to compare how they and other people looked at different stages throughout their lives. For example, one of the younger participants, a mother of two children, said she frequently looks through her photographs to see how her children have changed:

"I love looking at the kids at the different stages". (part.3, female, age 35)

Death

The final trigger for reviewing life-long collections that participants experience is death. The participants who had experienced the death of a loved one told how the practice of organising the deceased person's legacy, and discovering their collections, inevitably resulted in reviewing these items and reminiscing over past experiences, either alone or with others:

> *"We would have I suppose around the time when Mam and Dad died, we would have maybe then got out the albums and looked through them. And you know I suppose when we were tidying through things. And again like that the next thing you're sitting down for hours looking through them" (part.8, female, age 61).*

Webster (1999) showed that intimacy maintenance (e.g. keeping alive memories of deceased persons) is an important part of shared family reminiscence. Webster also maintains that older adults are more likely than younger adults to reminisce and 'life review' due to the proximity of impending death. This may not be limited to the individuals own death but could also be triggered by the impending death of family members. For example, one of the participants spoke of how he reminisces over his life with his aged mother:

> *"I like looking at photographs of when my mother was small and her wedding photographs and the people who were around then, putting names on people. Because we're not too far away unfortunately from the time when she won't be around". (part.20, male, age 54)*

5.4 Discussion

5.4.1 Changing motivations over time

The changing values and motivations that the interview participants attached to their life-long collections could be attributed to the changes in their lives as they age and develop. In Chapter 2 I discussed Erikson's theory of the human lifecycle where people pass through eight stages of development (Stevens, 2008). Erikson believed that development involves the interaction of biological needs with societal demands. In my research I focus on adulthood for which Erikson attributed three stages; young adulthood; maturity and old age. These stages were evident in the interview findings:

Young adulthood is associated with forming relationships with other people through friendships or romantic partnership. Erikson believed that these relationships test the firmness of our identity. The motivations for collecting in young adulthood had strong relations to identity. This was true for the younger adults and the older adults talking about this time of their life. The participants collected items that related to them and their experiences. For example, all of the participants said that they took photographs at this time. Although the participants said that they shared these photographs with others, the primary reason for taking them was to have the collection for their own purposes. In other words, the collections acted as a record of what they did, who they were friends with and how they looked. Two of the younger participants reported that they did not like being in photographs because they had a poor self image. In contrast to the other participants, these people did not want to be reminded about who they were at this time of their lives. Other collections that the participants were motivated to collect in young adulthood were items such as letters from friends or partners, scrapbooks (again related to friends or partners), and artefacts relating to or inherited from grandparents for example. As one of the participants said, these items remind you of who you were at this time and that people liked you.

As well as forming relationships at this stage, the participants were beginning their careers, opening up bank accounts, buying a car or house and getting married. With these life events come large quantities of documentation. In young adulthood, the participants' motivation for keeping these items was mainly as a precaution should they be needed in the future.

Maturity, according to Erikson, is "the concern in establishing and guiding the next generation" (Erikson as cited by Stevens, 2008). One of the most prominent motivations for parents in this stage of the development life cycle was keeping a record of their children and keeping artefacts for their children to have when they are older. In contrast to young adulthood, the participants at this stage were not primarily collecting items for themselves. For example, although the participants said that they captured photographs and loved to look through them, they wanted these collections for their children to have and to see their childhood. Cards were kept from grandparents that parents thought would have significance to their children in later years. Similarly, the participants said that photographs they had taken, when travelling for example, were initially captured for themselves but now they keep them so that their children can see the person they were and the things they did. However, it was not just parents who kept items for their children, some of the younger adults also kept items, such as the participant who kept some of her clothes so that her future children could play dress up like she did when she was a child.

At the maturity stage, the reasons against collecting images increased. For example, the participants would have moved out of their family home, taking their childhood collections and then gathering new collections. One of the problems that the participants faced was having enough space to store these collections. This was true also with digital collections, as the participants did not only have to consider their own collections but also those of their family. The time and effort to collect artefacts was also an issue, particularly for those who were working full time or had children to mind. Many of the participants intended to make records, such as creating a personal album for

their children, but these plans were pushed back until they had more time, after retirement for example.

Old age is the final stage in the development lifecycle when a person strives for wisdom, "the detached and yet active concern with life itself in the face of death itself" (Erikson as cited by Stevens, 2008). The participants in the study were, for the most part, only at the beginning of this stage. Over half of the older participants were grandparents, half were retired and the other half worked part-time. In the previous stages, I mentioned that people tend to initially collect items for themselves, and then go through a stage of collecting them for their children. In old age however the participants were motivated to collect items more generally, for their children, their grandchildren and future generations. Death was a significant contributing factor for the older adults to collect or save items. This contribution was threefold. Firstly, the participants collected items, such as heirlooms or photographs from past generations. These were often treasured items such as a watch or wedding band passed on from grandparents or parents. The older participants expressed regret that they had not recorded more from the lives of their parents, such as recording their voices. Secondly, the participants gave or gathered information to create a family tree. All of the older participants had a keen interest in their family history and felt that it was important for future generations to be aware of their family lifeline. Death motivated the participants to gather artefacts relating to their family history but with death there was a loss of information. The participants reported that although family stories were commonly told, at the time they were not interested in documenting them. It was only after the older generations had passed away that it was realised that these stories were buried with them. Another problem the participants faced was being able to trust the authenticity of the information obtained, particularly those found through Internet sources.

Lastly, the older participants talked about the importance of documenting life in some way. This was seen through motivations to update old media to digital format, saving newspaper clippings about important world events that happened or collecting

personal documentation to convey a story of the person's life, for example. The older participants talked about how collections that they saved in younger years, such as the bill from their wedding, gained significance throughout the years. Over time these documents made a transition from formal paper work to a record of significant events. It is through these collections that we can see the person that they were and as well as the person they became. In the same way, I believe that lifelogs would increase in significance over a person's lifetime, particularly at a time in their lives when they begin to review their life, conflicts and accomplishments (Birrin & Cochran, 2001).

5.4.2 Collections within family groups

It was clear from the interview findings that family was at the core of life-long collections, particularly for the older participants and the younger participants with children of their own. However, for all of the participants, sharing and story-telling within the family group contributed to reminiscence, conversations and fun. It should be clarified here again that although each older participant was a parent of a younger participant, the questions were not focused towards family. The participants were asked generally what they collect, what they share and who they share with, for example.

It was found that parents, particularly mothers, paid great attention to collecting items for their children so that they would have mementos from when they were a baby, or in school. Children were a significant motivation for collecting behaviour. Photographs or videos of children were shared with grandparents and siblings. Our participants said that they frequently send or receive photographs from family through mobile phones, online photograph software or printed copies. These examples show how involved a family network can be in capturing and reviewing collections. Sharing between families is intergenerational, with each generation sharing information from their own experiences.

The triggers for reviewing collections were common to the younger and older participants in the interview study. The one trigger that stood out was reviewing

collections following a *death* in the family. It was because of the age of the older adults that they were more likely to have experienced the bereavement of a parent, sibling or friend. It is after such events that people must organise the belongings of the deceased, which in turn prompts story-telling and reminiscence. So here we have two extreme motivations for collecting, reviewing and sharing family artefacts: life and death.

The main aim of my research is to design a lifelogging browser that would be relevant to older adults and one that they would be interested in using. Our questionnaire and interview findings point towards a system that incorporates social connectedness, family and sharing. In the next section I discuss some of the implications for the design of such system.

5.4.3 Implications for design

Participant motivations for collecting life-long items can help guide the design of a lifelog system. These motivations tell us why people collect or keep different items and what they do with them. For example, a person might keep a photograph because of the sentiment attached to it. They may want to share this photograph with others or reflect on the past when they see it. There may be many motivations attached to a single item. Therefore a digital lifelog should support all of these motivations.

In all of the family groups interviewed there was a person who was creating or at least interested in creating the family tree. In some cases these family trees were passed down and developed through the generations. Although the younger participants were less interested, they did believe that interest would come as they got older. A potential structure for organising family member's lifelogs is with a family tree where family members contribute to their own lifelogs. The family tree would then be further developed by future generations contributing their lifelogs.

Although the participants were enthusiastic about sharing their collections with family, there were also items that were considered to be distinctly personal. Therefore a

user of a family lifelog would have to have access to their own private accounts from which they can add certain items to a shared family account. The interview findings showed that collections shared with family members were most likely related to other family members or events. Another factor that needs to be considered is who the user wants to share information with. For example, a user might want to share photographs of their children with the whole family, but they might want to share images of a romantic dinner only with their spouse. Therefore, the user should be able to control who sees what information.

The problems that the participants experience with their collection, such as accidental loss or limited space can be both physical and digital issues. Storing collections using a secure cloud based application may resolve some of these issues and would allow information to be shared or remain private to the user. The issue of control is more complex. In the participants' situations one spouse usually had a method for finding and retrieving items that only they understood. One option would be to create equal access for inputting and finding this shared information.

As can be seen, the issues associated with shared family-based lifelogging are numerous and varied. All of these issues are kept in mind throughout the design process.

5.5 Conclusion

It is clear from the findings that life-long collections play a significant role in both older and younger people's lives. One common topic was that the value of items and the motivation for keeping them can change over time. For example, many participants collected souvenirs or photographs for themselves to enjoy, however as time passed they held onto the collections not for themselves but for their children and grandchildren to experience. Although the younger participants were at different stages in their lives, with some still living in the family home and others having left with

children of their own, their motivations for life-long collections did not vary greatly from their older counterparts. The main age-related difference was that the older group had more experience with the death of family members. Perhaps because of this, the older group were more motivated to gather together their family collections and to research their family history so that there would be a legacy to pass on through subsequent generations. These findings are interesting as they suggest that the value of collections gradually evolve over a person's life, often collected for personal use, then shared with others and eventually recorded with the intention to pass down to future generations. It is possible that lifelog data could be collected and used in the same way. Collecting a lifelog over many years and into old age would mean that individuals would potentially be able to pass on a rich narrative of their lives and perhaps the lives of family members before them. However, we first need to understand whether an individual would want to lifelog. In the next chapter of this thesis I aim to identify whether older and younger adults are motivated to lifelog for either their own personal use, or to share with others.

Chapter 6

Sharing versus Personal: Investigating Older and Younger Peoples' Motivations for Lifelogging with SenseCam

6.1 Introduction

In the previous chapter I identified through in-depth interviews with older and younger adults the types of life-long collections people have, their motivations for collecting and discarding them, and the triggers for reviewing these collections. It was identified that some age-related differences existed for the type of collection, particularly between physical and digital collections, with the younger participants storing more items digitally compared to the older participants. Differences for motivations to collect items were influenced by experiences throughout the person's life, such as the birth of a child, buying a new house, or the death of a parent. All of the older participants had experienced the death of family members, triggering a review of the person's life and also the family's legacy. In this chapter I begin to consider my third research question

which asks whether older adults are motivated to lifelog when it is incorporated into their lifestyle and interests, and also how reminiscence and story-telling can be supported by lifelogging.

As explained in Chapter 2, reminiscence, the process of looking back over our lives, is typically associated with old age (Havighurst & Glasser, 1972), and reminiscence therapy has been shown to improve the mood of older people (Woods et al., 2005). Reminiscence and story-telling are often triggered by mementos and collections in the home. Digital lifelog collections also have the potential to support story-telling. Byrne and Jones (2009) investigated the narrative presentation of lifelog data through card-sorting tasks. Participants who were avid lifeloggers were asked to choose (from their multiple media collections) types of 'artefacts' that represented specific stories from their life. The study showed that participants used photographs (in this case SenseCam images) 50% of the time to support the narration of their experience. When questioned as to why this was the preferred method the participants reported that the SenseCam images captured spontaneous moments in a life-like manner, which would not be typically taken with manual digital cameras. Another study (Doherty et al., 2011) looked at the types of images SenseCam wearer's perceive to be most significant to them. They found that photographs portraying social moments were ranked very highly, *"Time spent with friends and family. It would be something that I would want to look back, months or years later"*.

These studies highlight the importance of reminiscing for people of all ages and suggest that sharing lifelogs could support reminiscence and story-telling. Some of the questions that I aim to address in this chapter of the thesis are:

(1) Does sharing motivate lifelog behaviour?

(2) Does sharing influence browsing lifelog images?

(3) In what manner does sharing lifelog images influence browsing?

These questions are answered in two phases. Phase 1 focuses on the first two questions, which I investigate through a long-term field study. Phase 2 involves a follow-up observation study and aims to understand how sharing influences browsing. The focus of these studies is to understand the *Role* that lifelogging and a lifelog browser would have in an individual's life.

6.2 Phase 1: Field Study

6.2.1 Method

The main goal for this study was to determine whether sharing was a motivating factor for older adult's lifelogging behaviour. To do this I looked at both older and younger people's lifelogging behaviour under sharing and non-sharing conditions. In this section I describe the tools used in the experiment, the participant profiles and the study procedure.

6.2.1.1 Lifelogging tools

SenseCam: The lifelog data was recorded by the participants wearing a SenseCam (Figure 6.1). The SenseCam is worn around the wearer's neck via a lanyard and sits around the chest area. The SenseCam's image capture is triggered by changes in the wearer's environment through embedded sensors monitoring light-intensity and light-colour, temperature, movement and passive infrared. In addition, an internal timer automatically triggers image capture every 30 seconds. A fish-eye lens maximizes the field of view so that images display almost everything within the wearer's field of vision.

The device itself is black in colour with dimensions of 6.5cm (w) x 7.0cm (h) x 1.7cm (d). There are three buttons which include a power button, a privacy button (which temporarily stops image capture), and an image capture button (which either disables the privacy button or forces an image to be recorded). There are three small

lights at the top of the device; a green light to indicate the device is switched on, an orange light to indicate sensor readings, and a red light to indicate that the privacy function has been activated (for participant user guide see Appendix D.1).

Touch-screen browser: Each partipcant was given a touch-screen computer to allow them to upload the images from the SenseCam to custom browser software designed (personal contribution) and developed within the resarch team (Caprani et al., 2010; see Appendix D.3 for details of this design). To manage the high quantity of images that the SenseCam captures the browser automatically segments the images into 'events'. An example event might be eating breakfast or driving a car. These events are represented by a key-frame image, an image taken from the middle of each event[1]. The browser interface was designed to accomodate older users with limited computer experience (Figure 6.1 and 6.2).

Figure 6.1 The SenseCam wearable camera and browser on touch-screen PC (Caprani et al., 2010).

[1] For more information see: http://sensecambrowser.codeplex.com/

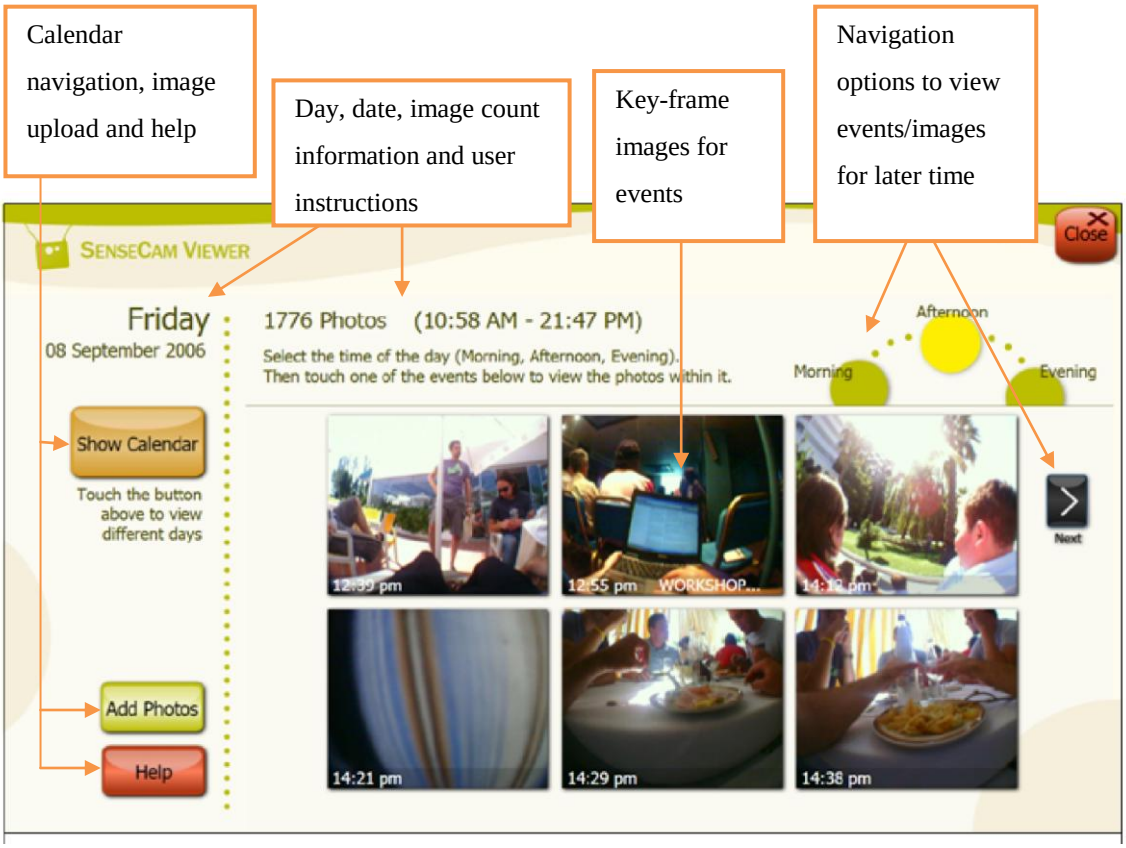


Figure 6.2 The main screen of SenseCam browser used in field study

The browser allows users to upload images from a SenseCam connected to the computer, view a slideshow of images within an event, and navigate to different days using a calendar function. The main content area of the interface displays the key-frame images for a day, which a user can select to view more images within an event. The uploaded images are stored locally on the touch-screen computer, and once uploaded, automatically deleted from the SenseCam. The browser does not support online sharing, therefore 'sharing' for this study related to individuals viewing images from the same touch-screen system. The image count and frequency of user interaction with the browser was automatically recorded using time and date-stamps. The user was also given documentation on how to use the browser should they need it (see Appendix D.2).

Questionnaire: The participants were asked to complete a questionnaire at the end of each week. The questionnaire was identical for both sharing and non-sharing weeks and consisted of two parts. Section one contained 23 items and related to the participant's experience of wearing the SenseCam. This included how they felt about the appearance of the device, the use of it and how comfortable they felt wearing it. Section two contained 15 items and related to the participant's experience in viewing and sharing their lifelog images. This included how frequently they viewed or shared images, their enjoyment and factors that influenced their enjoyment (see Appendix D.4 for questionnaire).

6.2.1.2 Participants

The focus of the study was on family sharing therefore the participants were recruited as intergenerational family pairs. Ten family pairs participated in the study, 20 people in total with 10 older and 10 younger participants. Each older participant was a parent of one of the younger participants. Seventeen of the participants had taken part in the previous interview study on life-long collections and agreed at that time to participate in the present study. Five of the younger adults were living in the family home with their parent. Overall the participants were familiar with technology, with all of the participants owning a mobile phone and having access to a computer or Internet (see Table 6.1).

Table 6.1 Participant age, gender and access to technology.

	Gender	Average Age	Mobile	Computer	Internet	Familiar w/ Comp.
Younger	F (6), M (4)	28	Yes (10)	Yes (10)	Yes (10)	4.4
Older	F (5), M (5)	58.8	Yes (10)	Yes (10)	Yes (10)	3.4

F = female, M = male; Familiarity rated on a 5-point Likert scale where 1 = Never used a computer and 5 = Expert.

6.2.1.3 Procedure

The participants were paired together with their family member so that there were 10 pairs of participants with each pair containing an older and younger participant. The study was conducted over a two week period during which they were asked to wear the SenseCam and upload their images to the touch-screen browser. Prior to the study period the participants were introduced to the technology devices and given time to familiarise themselves with it. The commitment involved in wearing the SenseCam, and uploading the images, alongside the limited number of devices available for the study meant that two weeks was the longest feasible timeframe to conduct the study. Ideally, a lifelogging study would be conducted over a long-term study (months or years) to obtain a full understanding of lifelogging motivations and sharing. However, for this study it was not a reasonable option.

The purpose of the study was to examine whether sharing lifelog data had an effect on data capture. Therefore I divided the experiment into two separate weeks; one sharing and one non-sharing week. The order of these weeks was alternated for each group. For the 'sharing week' the participants were asked to wear the SenseCam for at least two days (this was to ensure that there was data to analyse); however they could wear the SenseCam intermittently and as frequently as they wanted. I wanted the participants to use the SenseCam according to their own preferences. When wearing the SenseCam they were asked to undertake a common activity, such as going out for a coffee, with their paired participant (i.e. parent/child). This was to ensure that there were images captured of a common event for both participants.

Participants were advised that they could share their lifelog data with other people, either their paired partner or anyone with whom they felt comfortable sharing. They could also choose not to share their images if they did not want to. At the end of the week the participants were asked to complete a questionnaire relating to how they felt about wearing the SenseCam and their experience sharing or not sharing their photographs with others. The procedure for the 'non-sharing week' was identical to the

sharing week however the participants were advised to collect the SenseCam data for their own personal viewing.

6.2.2 Results

The results of the Phase 1 study are presented detailing participant interaction with the SenseCam and browser and supported with the questionnaire findings.

6.2.2.1 Interaction findings

As mentioned in Section 6.2.1.1, the image count and frequency of user interaction with the browser was automatically recorded using time and date-stamps. This data was used to compare older and younger participant interaction for both sharing and non-sharing weeks in relation to the number of days the SenseCam was worn, the number of images captured, the time spent using the browser and the time spent logging. An increase in the time spent wearing the SenseCam results in an increase in image quantity. Therefore, motivation was measured by an increase in recorded data for the dependent variables (days worn, time browsing, images captured and time logging) between the sharing and non-sharing weeks. Recorded data was subjected to a two-way repeated measures analysis of variance having two levels of age (older and younger) and two levels of week type (sharing and non-sharing). All effects were statistically significant at the .05 significance level. The results were as follows:

Days worn: There was a slight increase in the number of days that the SenseCam was worn during the sharing week for both the older and younger group. For the younger participants the average number of days was **4.4** (*SD* = 1.57, *min* = 2, *max* = 7) for the sharing week and **3.5** (*SD* = 1.58, *min* = 1, *max* = 7 days) for the non-sharing week. Older participants wore the SenseCam on average **4.2** days (*SD* = 1.62, *min* = 2, *max* = 7) for the sharing week and **4.1** days (*SD* = 1.45, *min* = 2, *max* = 6) for the non-sharing week. Test of within-subjects effects revealed a significant main effect for week type, [$F(1, 9) = 5.625$, $p = .042$]. However there was no statistically significant

interaction effects between week type and age group, [$F(1, 9) = 2.929$, $p > .05$]. Figure 6.3 (top, left) displays these effects. A follow up set of paired t-tests were conducted to compare the means for week-type. A significant difference was found for the younger sample between the sharing and non-sharing weeks [$t(9) = 2.586$, $p = .029$] whereas no significant difference was found for the older sample [$t(9) = .361$, $p > .05$].

Time browsing: The time spent browsing SenseCam images decreased during the non-sharing week, particularly for the younger adults. For the younger participants the average time spent browsing was **65.7** minutes (*SD* = 91.21, *min* = 6, *max* = 244) for the sharing week and **34.8** minutes (*SD* = 26.79, *min* = 5, *max* = 94) for the non-sharing week. For the older participants the average time was **65.8** minutes (*SD* = 76.3, *min* = 8, *max* = 268) for the sharing week and **55.8** minutes (*SD* = 52.3, *min* = 5, *max* = 169) for the non sharing week. Test of within-subjects effects revealed no statistically significant main effect for week type, [$F(1, 9) = 1.298$, $p > .05$], interaction effects between week type and age group, [$F(1, 20) = .865$, $p > .05$]. Figure 6.3(top, right) displays these effects.

Images captured: A total of 242,679 images were captured during this study with little variation between the two weeks (127,475 = sharing week, 115,204 = non-sharing week). However there was variation in the number of images captured between the older and younger participants with older participants collecting a greater number than the younger group. The average number of images captured by the younger participants was **5336.5** images (*SD* = 4104.403, *min* = 524, *max* = 13717) for the sharing week and **4958.4** (*SD* = 3801.1, *min* = 793, *max* = 13519) for the non-sharing week. Whereas the average number of images captured for the older participants was **7411** (*SD* = 5105.6, *min* = 2347, *max* = 18163) for the sharing week and **6562** images (*SD* = 3343.97, *min* = 2234, *max* = 10870) for the non-sharing week. Test of within-subjects effects revealed no statistically significant main effect for week type, [$F(1, 9) = .492$, $p > .05$], interaction effects between week type and age group, [$F(1, 9) = .663$, $p > .05$]. Figure 6.3 (bottom, left) displays these effects.

Time logging: As the embedded sensors within the SenseCam can influence the frequency of image capture I also looked at the number of minutes that the participants wore the SenseCam. The participants wore the SenseCam for a total of 64,794 minutes over the two weeks. The average time wearing the SenseCam by the younger participants was **1302.1** minutes (*SD* = 1113.9, *min* = 188, *max* = 3915) for the sharing week and **1291.8** minutes (*SD* = 904.95, *min* = 213, *max* = 3183) for the non-sharing week. Whereas the average time the older participants wore the SenseCam was **2076.7** minutes (*SD* = 1352.47, *min* = 624, *max* = 4971) for the sharing week and **1808.8** minutes (*SD* = 1217.8, *min* = 528, *max* = 4047) for the non-sharing week. Test of within-subjects effects revealed no statistically significant main effect for week type, [$F(1, 9) = .104$, $p > .05$], interaction effects between week type and age group, [$F(1, 9) = .527$, $p > .05$]. Figure 6.3 (bottom, right) displays these effects.

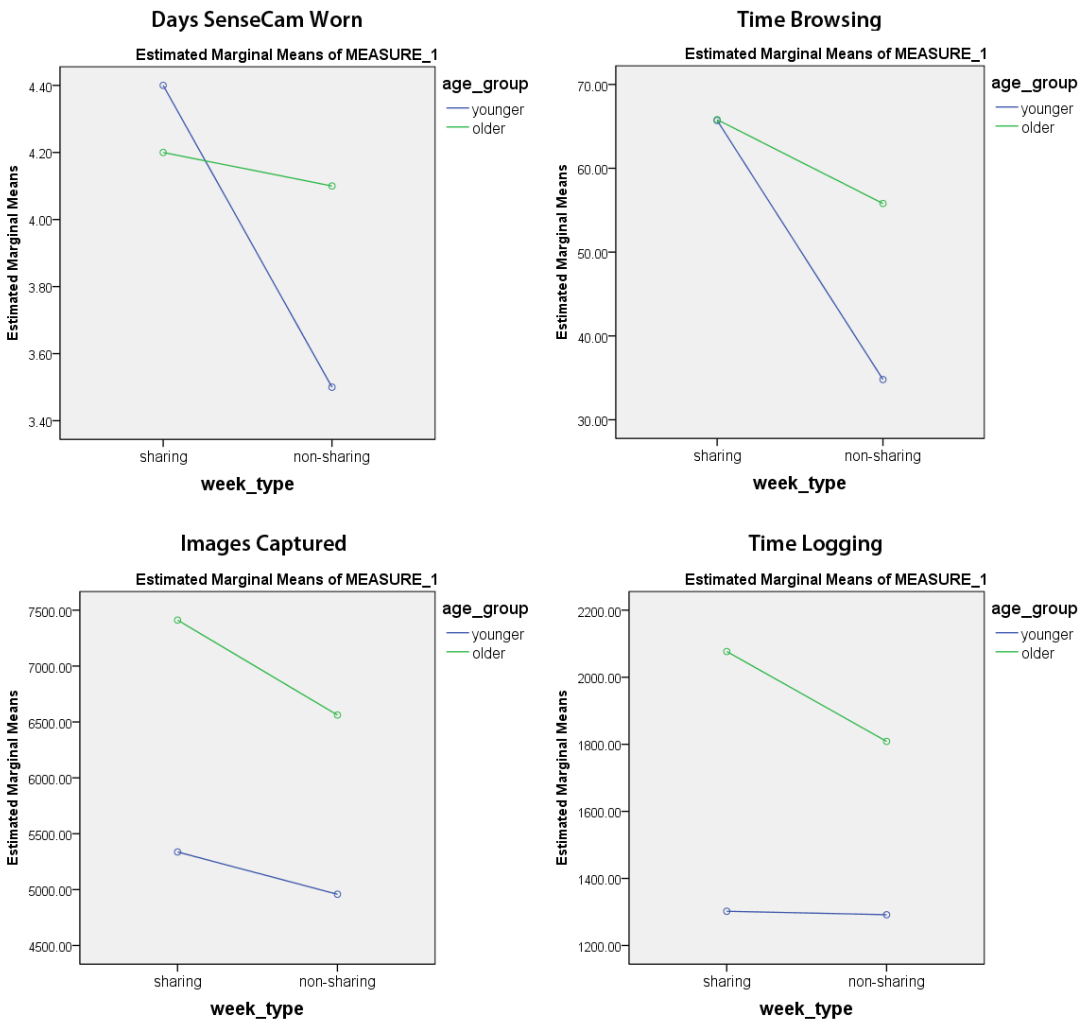


Figure 6.3 Plots representing the relationship between the week type and age-group for days worn, time browsing and number of images captured.

6.2.2.2 Questionnaire findings

I outline the results of the questionnaire in relation to participants' responses for wearing the SenseCam and their responses for viewing and sharing the lifelog images. The comments included in this section are taken from the participants' questionnaire reports.

Wearing SenseCam

The purpose of the first section of the questionnaire was to discover whether the participants' experience of wearing the SenseCam impacted their lifelogging behaviour and whether there were any evident differences between age group and week type. The areas that were covered included the appearance of the lifelogging device, the usability and the comfort of the wearer.

Appearance: Participants were asked to rate on a five point Likert scale their level of preference in relation to the size, shape and colour of the SenseCam (where 1 = really disliked and 5 = really liked). There was little variation between older and younger participant responses in both sharing and non-sharing weeks for all three factors. The participants gave an average rating of 3.27 for the size and 3.45 for the shape of the device suggesting that they neither liked nor disliked these aspects (Figure 6.4). Some of the comments made about the appearance contrasted greatly where some people thought it *"large and clunky"* (female, age 29) and others "*discrete"* (female, age 35). The colour of the device was rated slightly higher with a mean on 3.76. This rating was supported by the participants' comments:

> *"It was able to be worn with lots of things and didn't really stand out too much" (male, age 26).*

However, some of the problems that were noted included the device moving too much when worn around the neck and being conspicuous:

> *"I wouldn't want to wear it all the time, I'd expect something slicker. Having young kids, it kept bouncing when I was bending down to them so I'd have to hold it" (female, age 36).*

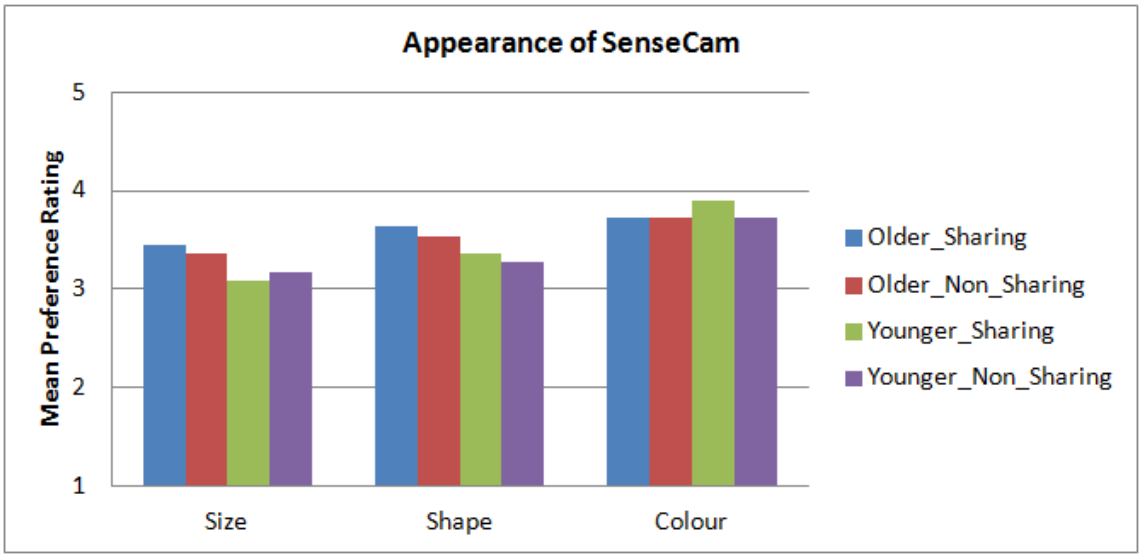


Figure 6.4 Participant preferences rating for the appearance of SenseCam (size, shape and colour; where 1 = really disliked and 5 = really liked).

Usability: Participants were asked to rate the level of difficulty in relation to wearing the SenseCam, the lights, powering on/off, buttons, charging, remembering to wear and locating the SenseCam when it is not being worn (where 1 = really difficult and 5 = really easy). Again, there was little variation between older and younger participant responses in both sharing and non-sharing weeks. Overall, the participants found the SenseCam easy to use (Figure 6.5). Wearing the device (M = 4), powering it on and off (M = 4.1), charging (M = 4.3) and locating (M = 4.5) the SenseCam were on average rated as "easy":

"I found it relatively easy to use, it was similar to a phone" (female, age 36).

Understanding the lights on the SenseCam (*M* = 3.7), the buttons (*M* = 3.4) and remembering to wear the device (*M* = 3.3) were rated on average as being "neither" easy nor difficult:

"Using SenseCam was fine. Remembering to put it on after coming home from work was an issue for me so I missed out on lots of activities" (female, age 56);

"The buttons on the side were too similar and are confusing when you try to remember them on the spot" (female, age 29).

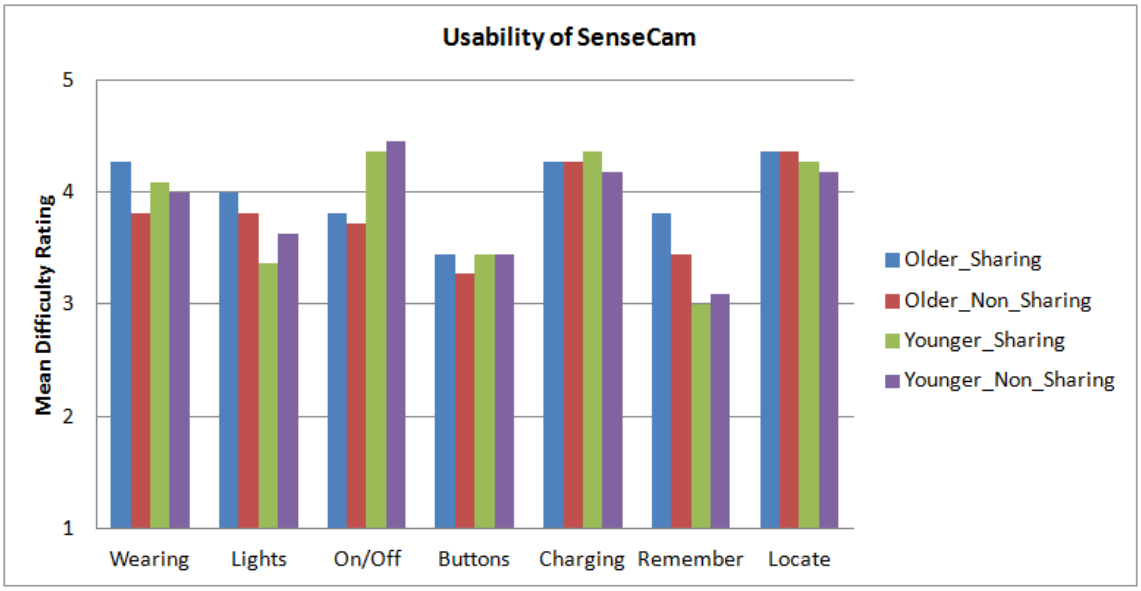


Figure 6.5 Participant difficulty ratings for the usability of SenseCam (wearing, lights, powering on/off, buttons, charging, remembering to wear and locating; where 1 = really difficult and 5 = really easy).

Comfort: Participants were asked to rate their level of comfort in relation to wearing the SenseCam around friends, strangers, at home, in public and other peoples' comfort towards SenseCam (where 1 = really uncomfortable and 5 = really comfortable). In relation the how comfortable the participants felt when wearing the SenseCam there was a similar trend for the older and younger participants during both weeks (Figure 6.6).

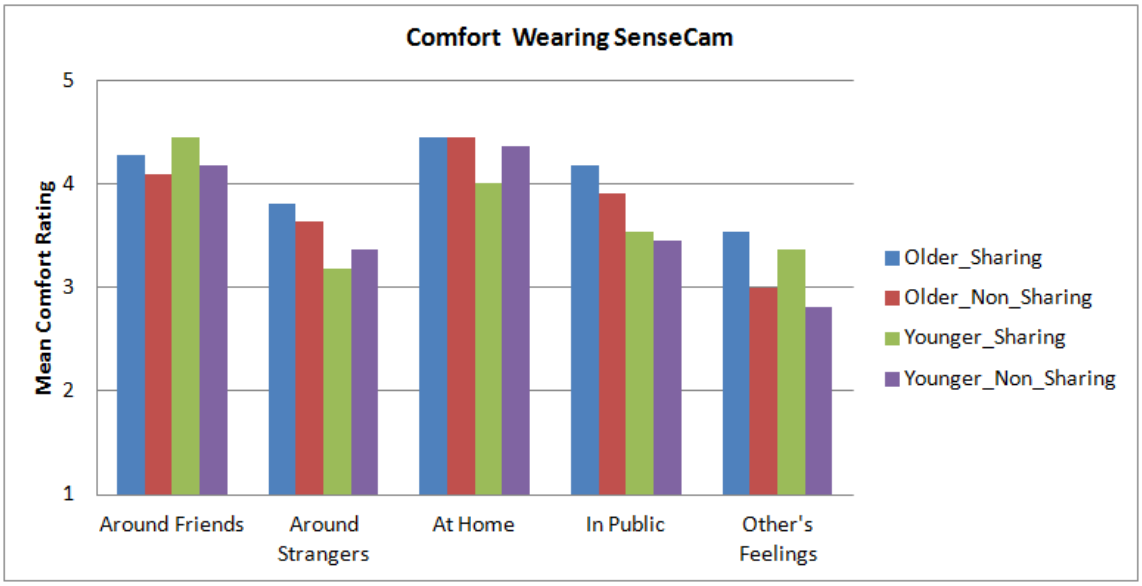


Figure 6.6 Participant comfort rating for wearing the SenseCam (around friends, strangers, at home, in public, and other's feelings; where 1 = really uncomfortable and 5 = really comfortable).

Participants were most comfortable wearing the SenseCam around friends (M = 4.2) and at home (M = 4.3). The participants gave a slightly lower rating for their comfort around strangers (M = 3.4) and in public (M = 3.7):

> *"I felt a little odd wearing it and I kept expecting people to ask about it. I was a bit concerned about invading people's privacy but no-one seemed to notice it" (female, age 35).*

The above comment suggests that the participant was uncomfortable wearing the SenseCam when around people, without asking for their consent. Unlike a manual camera, where it is more obvious when someone is taking a photograph, the automatic capture facility of the SenseCam means that it is less clear that images are recorded. It is expected that as lifelogging devices become more prevalent, social, if not legal, guidelines will emerge.

The lowest average comfort rating was for other people's comfort towards the SenseCam when the participants were wearing the device (M = 3.1):

> *"Some strangers felt anxious until offered an adequate explanation" (male, age 30).*

When the participants were asked who asked them about the SenseCam, friends were the group type most frequently rated (37% of those who asked) with strangers accounting for only 2.5%.

The findings of this first section of the questionnaire have shown that the participants' experiences and opinions of the SenseCam device did not vary significantly between the sharing and non-sharing weeks. This suggests that the activity of wearing the device had no influence on the frequency the SenseCam was worn or browser interaction between the test weeks.

Viewing and Sharing Images

The second section of the questionnaire was included to collect information regarding participants' enjoyment of viewing and sharing their images. Two of the participants shared their images during the non-sharing week. The reasons given for this were; (1) the participant was asked by their spouse to see a particular event and (2) the images they captured on a particular day were interesting and they wanted to share them. However, I have only taken into account participant sharing preferences during the sharing week.

Viewing lifelog images*:* Although the participants were advised that one week of the study was for viewing their own personal images without sharing them, the participants viewed their own images throughout the two weeks of the study. The participants were asked to rate how often they viewed their images each week. From the responses it was found that the most common frequency for viewing images was between two to three times per week. Overall the participants said that they enjoyed viewing their own images (M = 4 on 5 point Likert scale). This was consistent for both older and younger participants across the sharing and non-sharing weeks. Some of the reasons given for enjoying browsing through the images were because it was a fun new experience; they liked seeing pictures of themselves (in mirrors) and their family; and seeing how they spend their time. One of the participants said that they couldn't believe how much time they spent cleaning the house and another participant said *"it was interesting to see how repetitive days are"* (female, age 56). This feeling of routine and repetitive activities, broken up by unusual or significant events, was a common theme throughout the participants' reports.

Sharing lifelog images: The participants were advised that they could share their images during one of the test weeks. The items pertaining to the sharing week in the questionnaire covered: the frequency with which participants shared their images, who they shared with and what types of images they shared.

In terms of frequency of sharing, the majority of the participants reported sharing their lifelog images between two to three times per week; 6 of the younger and 4 of the older participants, with only a few (only 1 younger and 2 older) participants sharing their images more frequently than this. The participants were also asked to rate on a 5 point Likert scale their enjoyment sharing and looking at other people's lifelog images during the sharing week. The mean rating was 3.89 for sharing and 4.15 for looking at other people's images showing that the participants enjoyed these activities. Again there were similar ratings between the two age groups (younger ratings – M = 3.66 for sharing, M=4.12 for others; older ratings – M = 4.14 for sharing and M = 4.16 for others). The

participants responded positively to viewing their parent or child's SenseCam images, some even saying they were more interesting than their own. For example, one participant said they liked looking at them because they *"didn't know what the other person normally does in a day"* (male, age 26).

Factors influencing sharing: To understand participants' sharing activities I questioned the types of images shared, the people they were shared with and also what factors would have influenced further sharing. In terms of the types of images shared, younger participants mostly shared images that featured family members. Additionally, images of children, friends, images of the participant themselves, and "funny" images were also favoured types for sharing. Similarly, the older participants were most likely to share images featuring family members, followed by images of themselves and scenic images. For example, one older participant said:

> *"It was funny to see some previous unknown traits of certain people" (female, age 61).*

When the participant was asked what she meant by this she said that both herself and her daughter (also a participant of the study) had been looking at SenseCam photographs of when they were watching the television with their feet up on the coffee table. Both participants had photographs of the same event. She explained that her daughter was making fun of her because in her photographs you could see her wriggling her toes continuously. When they then looked at the daughters images she too was wriggling her toes and in her pictures you could see the two pairs of feet which they found funny to look at in the image slideshow. This example highlights how viewing images of everyday activities such as watching the television can have humorous revelations.

Also of interest was who the participants shared their images with. It was found that younger participants were most likely to share with their study partner (i.e. parent taking part in the study); however images were also shared with their spouse, siblings and friends. Older participants were most likely to share their images with their spouse.

A high proportion of the older adults also shared the SenseCam images with their children, of which included their study partner (i.e. child taking part in study). The participants said that they would have shared their lifelog images more if they had captured better photos (in terms of both content and image quality), or if there had been an interested person present:

> *"A lot of the photos were the same and nothing interesting was happening in my life" (female, age 24).*

The younger group also said they would have shared more if online sharing was available. I discuss the reasons why online sharing was not available to the participants in this study in Section 6.2.3.1.

Lifelog activities: The participants were asked to rate what lifelogging activities they liked the best and what factors they liked the least throughout the two week test period. There is a similar trend between the older and younger participants for the activities that they liked best. Looking at the lifelog photos was by far the favoured activity. The remaining activities such as wearing the device, showing photos to others and looking at other people's lifelog images were moderately liked. The majority (n = 16) of the participants said that they would like to keep their recorded images. Some of the reasons for wanting to keep them were to look back on them at a time in the future, to share with family members or to pass on to future generations as a record of a 'day in the life':

> *"I'd like to keep them to look back on or even send some to the children's grandparents" (female, age 36);*

> *"I'd like them so that I can look back anytime to see them and also so that someday my grandchildren can see a day in my life" (female, age 52).*

However, a few (n = 4) of the participants said that they would prefer to edit their collection to keep only the events they considered important.

One interesting finding was how the older participants showed a higher level of preference for transferring the images from the SenseCam to the touch-screen computer compared to the younger group. Comments that were included explained this difference:

> *"It was a big thing for me to be able to take the photos and put them on the computer. I liked doing it" (male, age 66).*

In this case the participant was not very familiar with computers so successfully uploading images was an achievement. This highlights the importance of applications being easy to use and learn so that a wide range of users can avail of the service.

There was some variation between the older and younger participants' responses in relation to the activities rated as least favoured. Over half (n = 6) of the older participants said that there were no activities they disliked. Of those activities that were rated, wearing the SenseCam was the most disliked however this only accounted for 2 of the older group. Wearing the SenseCam was disliked by 6 of the younger participants. Some of the reasons given for not wearing or taking the SenseCam off were: the participants could not wear it in work or at meetings, they forgot to wear it even when they intended to, they were doing things they considered too boring to record, when playing sport or meeting friends where they anticipated questions about the device. It was also seen from the responses relating to the appearance of the lifelogging device that participants did not particularly like or dislike the SenseCam however many suggested that a smaller, more appealing device that was securely fastened to clothing would be more suitable for everyday wear.

6.2.3 Discussion of Phase 1

Ideally lifelogging would be a completely automatic activity without any user input. To some extent this is possible, for example the SenseCam's automatic image capture functionality. Research effort is currently being invested into improving lifelog

methods, such as wirelessly transferring lifelog data from wearable or mobile devices to a server (De Jager et al., 2011; Qiu et al., 2012). These technologies are not yet widely available, therefore, for the current study the participants played an active role in wearing the SenseCam, transferring images from the SenseCam to a computer and browsing through the images; activities that involve effort. I was interested in determining what would motivate both older and younger individuals to invest this lifelogging effort, and also whether these groups would be more likely to lifelog for sharing purposes or for their own personal viewing.

6.2.3.1 Sharing versus personal lifelogs

Overall the participants wore the SenseCam and browsed through their images more frequently during the week they were asked to share their images with other people compared to the week dedicated to personal viewing. During the sharing week the participants could share their images with anyone that they felt comfortable sharing with, e.g. friends, family, neighbours. In terms of who the participants were most likely to share their images with, it was found that family members, including spouse, children and siblings were shared with most often. Furthermore, the type of images that were shared most often by both the younger and older participants featured family members. The participants rated their enjoyment for sharing the SenseCam images as highly as their enjoyment for viewing the images alone. For example, one of the participants said that her husband asked to see her images and they looked through them together, laughing at the funny moments the SenseCam captured. The participants who were grandparents said that they particularly enjoyed sharing the images of their grandchildren. One particular participant shared his images with his spouse, his daughter and his grandchildren, which indicates lifelogging to be an intergenerational activity. The majority of the participants also said that they would like to keep their lifelogs to review in the future, to share with family or to pass on to their grandchildren. The motivations for holding onto these lifelogs echo the reasons given for collecting and saving physical mementos in Chapter 5. These findings are very interesting as it shows

that sharing motivates lifelogging and suggests that lifelogs could support shared family reminiscence.

Not all of the participants shared their images during the sharing week. From the questionnaire responses it was clear that some of the participants considered their images to be uninteresting. Images taken from activities such as driving, working at a computer or watching the television were considered to be particularly "boring". If the study had been carried out over a longer period it is probable that certain activities would stand out as being interesting and therefore worth sharing. A potential benefit of capturing lifestyle patterns is the possibility to reflect on the time spent on certain activities, perhaps influencing positive lifestyle change. Another problem that a few of the participants faced during the sharing week was finding a person who was interested in looking at the SenseCam images. For example one of the participants said that there were images that they had taken of their friend that they wanted to share. However they were not in contact with the person again during the sharing week so they were unable to show them. Again, in a more realistic situation the participant could share these images the next time they saw their friend, which might be weeks or months after the event.

Other issues that influenced whether people shared their images were more technical and included the poor quality of the images and re-locating images to share. Images recorded with the SenseCam are affected by motion blur and low level natural light and therefore when hundreds of images are taken during an activity that causes this problem it can become frustrating to a user browsing through the collection. Ideally, very low quality or dark images would automatically be hidden or deleted depending on the user's preferences. Similarly, the large number of images means that when a user returns to their collection to find a particular image it can be very difficult. Although the SenseCam browser automatically groups SenseCam collections by date, time and event, the user is still required to remember these details. Naaman et al. (2004) recommend the use of context-based features, such as location, for photo management. The current

version of the SenseCam does not capture location based information however other image capture devices, such as mobile phones, already have GPS integration.

It should be noted again that the participants could only share their images in person through the touch-screen browser and could not communicate any images via the Internet. The reason for this was twofold. Firstly, none of the participants had ever used a SenseCam before or created a lifelog, therefore it was important to avoid any concerns about what would happen to their images if they were shared online. Secondly, the older participants were less experienced with computers and online sharing so we felt that standardizing the level of sharing for this study would be appropriate.

The participants were asked to capture SenseCam images for their own personal viewing for one of the weeks during the two week study. The participants viewed their own images during both weeks however. The majority of the participants stated that they enjoyed viewing their images, even being surprised at how much they enjoyed it. Some of the reasons given for this included liking being able to see lifestyle patterns developing, being able to remember activities they did, looking back on a typical day and seeing a summary of their activities. Images portraying time spent with family and friends or activities that were "memorable" or out of the ordinary were particularly enjoyed. Some of the participants reported that they would have more interest in viewing their images at a date in the future when the events were less clear in their mind.

6.2.3.2 Age differences

Some age-related differences emerged from the study that could impact the future design of an intergenerational lifelog application. One of the main findings from the results was that the older participants lifelogged considerably more frequently than the younger participants. The reasons behind this became obvious when we looked at the participants reports on why they did not wear the SenseCam at certain times. For example, most of the older participants were retired so they could choose to wear the SenseCam whenever they liked. In contrast, many of the younger participants said that

they could not wear the SenseCam in the workplace or at meetings. Furthermore, remembering to put on the SenseCam in the evening after work proved to be a challenge, for both the older and younger participants who were working. In terms of the future of visual lifelogging and identifying activities throughout one's day, year, or life, there will be a significant gap during the times when a person in at the workplace, assuming that certain workplaces prohibit photography recording. Other forms of lifelogging, through GPS or Bluetooth sensors communicating with other devices, for example, could provide the individual with a significant amount of detail concerning their activities.

Another age-related difference that was found from the results was how the younger participants included friends more in their lifelog experiences. The younger participants reported friends featuring in their SenseCam images twice as often as the older group. The younger group also shared their images with friends whereas the older group only shared with family. This finding is not so surprising considering the different group's life stages. Referring again to Erik Erikson (1963, as cited in Stevens, 2008), development during young adulthood (19-40 years) involves creating and maintaining relationships with friends, work colleagues and partners, whereas as during middle adulthood (40-65 years) people develop themselves by raising a family and contributing to their community. Aside from this, the younger participants were also more experienced with technology. Although the number of older Internet users (aged 50 years and over) is fast growing, younger people are still the largest user group (Zickuhr, 2010). This is also true for social networking sites, such as Facebook and Twitter, set up for sharing information and photographs, so it is likely that the younger participants would have more experience sharing through social networking sites than the older participants.

6.2.3.3 Lifelogging experience

Using the SenseCam device was a new experience for the participants in this study. The questionnaire provided at the end of each test week gave some insight into

their perception of the device's appearance, usability and comfort. It was observed from the results that there was a similar trend for both older and younger participants, and also that opinion did not change between the sharing and non-sharing weeks. The experiences of the participants when lifelogging support those found in Lindley et al.'s (2009) study of SenseCam use. In Lindley's work the experiences of seven households, five of whom had young children, centred on routine, playfulness and sense of family. As shown in Section 6.2.2.2, the participants observed the repetitiveness of their activities from day-to-day and the time that they spend on particular activities that they don't enjoy. Unusual events were highlighted in the participant's mind because they occurred outside of this routine, such as viewing a house for sale and witnessing a car crash.

In the current study, playfulness was not as evident, however the participants did comment on how they found it fun wearing the SenseCam and looking through their images. Some of the participants also said that they placed the SenseCam in different areas of the home to capture their household activities from a different perspective. Overall, it was found that over the course of the study the participants adopted the SenseCam into their daily routine, not paying any particular attention to it as they carried out their day-to-day activities. Sense of family was again echoed by the study in that the participants' images mostly featured family, they showed a preference for sharing their images with family members and they showed an interest in keeping their images to share or pass down to family members.

Shared reminiscence is the process of sharing past experiences, therefore it was felt that a suitable period of time was needed between image capture and an exploration of reminiscence through lifelogs. I examine shared family reminiscence further in Phase 2 of this study, which I discuss in the following section.

6.3 Phase 2: Follow-Up Observation

6.3.1 Overview

In Phase 1 I looked at whether older and younger family members would be more motivated to lifelog for sharing or personal browsing purposes. It was found that although the participants wore the SenseCam more frequently during the sharing week, certain factors inhibited sharing between participants, such as lack of access to the family member's images. Another issue that was raised was that the participants did not find their images worth sharing because the activities were so recent. Therefore to further investigate family sharing Phase 2 was set up; a follow-up observation study of participant families browsing through and sharing their SenseCam collection six months after data capture. The purpose of this observation study was to explore whether reminiscence and story-telling is supported by lifelog sharing. This study was influenced by Lindley et al.'s (2011) research, which involved observing young householders reflecting on their SenseCam images 18 months after data capture.

6.3.2 Method

6.3.2.1 Participants

Eight of the participants who had taken part in the field study were available to participate in the follow-up study. For ease of discussion these families will be referred to as Fam1 to Fam4. A short description of these families is outlined below:

- Fam1 is comprised of a *father* (Fam1-f) aged 66 years old and his *daughter* (Fam1-d) aged 36. The father lives with his wife and minds his grandchildren during the week when his daughter is working in a school. The daughter is married and living with her husband with two children.

- Fam2 is comprised of a *father* (Fam2-f) aged 64 and his *daughter* (Fam2-d) aged 29. The father is widowed, living with his son and retired. The daughter is living with her partner and working in a web-design company.

- Fam3 is comprised of a *mother* (Fam3-m) aged 62 and her *daughter* (Fam3-d) aged 29. The mother is divorced, living with her second daughter and working part-time in a hospital. The daughter is living with friends and working in an insurance company.

- Fam4 is comprised of a *father* (Fam4-f) aged 58 and his *son* (Fam4-s) aged 30. The father lives with his wife and is semi-retired. The son was married, living with his wife and working in a university.

6.3.2.2 Procedure

The observation method was used in the follow-up study to explore participants reviewing their SenseCam images together at least 6 months after capture (the interval varied by 2-3 weeks between the groups). Observations were conducted in the home of the older participant of each family. The participants were given the choice of setting so that they would feel comfortable reviewing the images and to encourage natural behaviour.

Before the observation study began the participants were shown the touch-screen computer that they had used in the Phase 1 field study, and were reminded how to use the SenseCam browser. At this stage the participants were offered the opportunity to browse through their images privately to ensure they were happy to share their images. None of the participants chose to partake in private browsing.

The participants were then asked to browse through the images together. They were told that they could choose who would go first. They were advised that they did not have to look through all of the images if they did not want to. The participants were also advised that either family member could control the interactions with the browser.

The participants were reminded that the researcher was only there to passively observe and that they should behave as naturally as possible.

Field notes were taken to record the participants interactions. An audio recording was also taken to support the field notes. The observations mainly focused on the dialogue between the participants when browsing the images however body language was also noted. I analysed the field notes using inductive thematic analysis. The data was coded, memos written, and patterns identified. On the basis of this I derived the findings.

6.3.3 Observation findings

The purpose of the observation study was to determine whether browsing and sharing lifelog images supported shared family reminiscence. Reminiscence was indeed observed throughout this session. However, in addition to reminiscence narration, story-telling, reflection, and interaction between the family members was observed. I will now discuss these observations in more detail.

6.3.3.1 Narration, reminiscence and story-telling

Narration is commentary delivered to accompany a visual display, such as a video, play or in the current context an image slideshow. Narration was the method of interaction that dominated the observed browsing sessions. This was particularly evident at the beginning of an event or set of images being looked at. The process of narration was usually a step-by-step dialogue of observed actions, such as: *"there I am washing up.... back in the garage...feeding the dogs" (Fam1-f).* It was observed that the person who interacted with the browser led this narration, regardless of whether they owned the images or not. If the narrator was not familiar with the other person's location or actions within the lifelog, they would stop to ask questions, *"you're in the garage, what were you getting?*" *(Fam1-d).* These narrations provided the basis for

family interaction and it was from this that reminiscence, story-telling and reflection intermittently occurred.

Reminiscence was observed in two forms; cued reminiscence and spontaneous reminiscence. Cued reminiscence was most prevalent, where the lifelog images themselves triggered memories of a past event. This was particularly evident where the participant's circumstances had changed since the images were first captured. For example, both participants in Fam3 had captured images of the daughter preparing to move out of the family home. The whole family was involved in helping to pack up boxes, move them out and set her up in her new home. Browsing through these images encouraged the parent and child to reminisce about this time, the struggles and the fun they had.

Like the previous example, shared family reminiscence most often occurred when family activities were captured. These were often amusing memories, for example, when Fam1 were browsing through images of a family dinner in a restaurant, the daughter made the following remark:

> *"The pasta looks good with your mussels. Then you brought the shells home and put them in my garden". (Fam1-d)*

The participant later explained that her young daughter had a nature section in the garden where she liked to collect shells, branches and flowers. Although the participants were informed that I, as the observer, would not have any interaction during the observation study, it is believed that the best approach when included by the participant is to react naturally, as to ignore any attempt of interaction may encourage unnatural behaviour (Hayes, 2000).

It was not just shared experiences that prompted reminiscence. The lifelogs also triggered memories of funny things people said or did. For example, the participant Fam2-d came upon images of when she went to the cinema with a child she was

minding; *"Oh, we went to the cinema to see The Lion King. And Laura shouted out "this is the bit where the daddy dies", haha".* Other reminiscences occurred from browsing images of unusual events, such as meeting a colleague for the first time. The facial expressions and behaviours of the new colleague reminded the participant (Fam4-s) of how nervous the person was and what they talked about. Meeting a person for the first time was a significant memory for the participants who captured this experience.

Spontaneous reminiscence, although not as frequent, was also observed when a participant remembered an event in the past that was not directly related to the images they were looking at. For example, one of the older participants saw his granddaughter in his lifelog images which prompted him to remember something that happened in the more recent past; *"look at that beautiful girl. Do you know what she said to me the other day...?" (Fam1-f).*

Not all of the memories that were evoked from the SenseCam images were positive, however. On one occasion a participant said that they did not want to be reminded of a specific experience he had. The image reminded him of how frustrated and annoyed he was at the time. This observation indicates the importance of providing the user with control over their lifelogs, so that images can be deleted if the memory if upsetting.

Story-telling occurred when the participants came upon images of an event that they particularly liked, or an event that was important to them at the time. The images were used to support story-telling. For example, at the time of data capture one of the older participants, Fam2-f, was getting his house renovated and had visited different show houses to get ideas. He had given his daughter a verbal account of these after his visits, however when they were browsing through his lifelog they came across images of this event and he became animated, saying to his daughter, *"slow it down, this is the house I wanted you to see"*. This led to an elaborate story about his experience in the house, the design features, the people who were there, and how the house contrasted to their now renovated home.

It was common for a set of images to trigger stories about the event that was taking place. Story-telling was used to provide an explanation of why the participant was doing specific activities, filling in the details that the SenseCam did not capture, such as the conversations that were occurring, or the mood in the room. In the browsing session with Fam4, the son was sharing his images with his father. He noticed that in the images he was cooking for an unusually long time. After looking at the date he remembered that it was Valentine's Day, and that he was preparing a three course meal for his wife. He expanded by telling his father what he was cooking, how he found the recipes and where his wife was at the time he was cooking. This event had occurred six months previously and even though it was a significant memory for the younger participant (from the observed enthusiasm in his story-telling); he had not shared this story with his father before the browsing session.

The observations show how narration, reminiscence and story-telling can enhance lifelog browsing and in turn, how lifelogs support these processes.

6.3.3.2 Reflecting on activities and behaviours

As mentioned in Section 6.3.1, Lindley et al. (2011) previously explored householder's reflections on SenseCam data 18 months after data capture. In comparison to the current study, Lindley's participants were either young couples or families with young children. However, the results obtained from Lindley's research mirrors the observations found in the current study, particularly in relation to reflections on routine, reflections on behaviours, and the changing value of the SenseCam images over time.

When the participants reviewed their images it was the activities of the wearer and those around them that were of most interest. Some images did not immediately trigger a memory of the event. When reviewing these events, the participants were determined to figure out what they were doing, where and why, using clues in the images and the time it was taken to help them reach a conclusion. Talking to the

participants after the browsing session, it was found that they preferred reviewing the lifelogs images with their family because they enjoyed trying to figure out these forgotten activities. The daughter in Fam2 for example, could not understand why everyone in her images was eating cake during the day. After looking at the date on the browser she realised that it was her brother's birthday; *"We're eating cake...Oh its John's birthday, November. No wonder he's being sociable"*.

Time was a significant component for reflecting on activities. This included references to the time that the images were recorded (time of day, month etc.) and the time taken to complete tasks. It was observed that the participants continuously made a note of the time, especially when trying to determine what activities they might be doing in the images; *"It's seven o'clock, I must be on my way to the club"*. The participants also made use of time to report how long the SenseCam wearer or other people in the images had taken to complete their tasks. There were numerous examples of this. The daughter in Fam1observed how long it took for her father to pack everything into his van when he was going camping, and Fam4-s used the images to show how long he was left waiting on a family outing while everyone went shopping. Similarly, the daughter in Fam3 came across images of her brother putting together a bedroom cabinet for her. The mother and daughter joked that he spent ten hours putting it together. However, when they were looking through the images they realised that he only took two hours and the rest of the family had stood around watching him. The participants reflected that maybe they should not have teased him so much about it.

Although the participants' lifelogs were made up of irregular events, such as renovating a house, moving out of the family home, dinners and nights out with friends and family, the participants were surprised at the predictability and sameness of their lifestyle. They voiced their observations concerning patterns and behaviours; *"Get up, have breakfast, go out. Every day is the same" (Fam1-f).* Routine was even observed in the types of food they ate; "*I'm mixing up tuna and pitta again. We went through a phase of eating that" (Fam1-d).* The younger participants were surprised that their own

lifelogs depicted routine and sameness more so than their parents'. They had not expected their parent to be more social and active than they were; "*my day isn't as exciting as yours*" *(Fam3-d).* After reviewing the images, the participants observed activities that they believed they spent too much time doing, such as household chores, watching TV and sitting at a computer. One participant reflected that although she spends many hours doing housework, this was not likely to change; *"I do a lot of clothes and mundane jobs. That's not going to change though" (Fam1-d).*

Personal behaviours and habits were also observed and commented upon throughout the browsing session. This was in relation to the participant's own behaviours, those of their parent/child, or other people captured in the images. The images either reaffirmed the participants' beliefs or produced previously unknown behaviours. For the most part these observations were commented on in jest; *"look at you, you do a lot of hand movements when you're on the phone don't you?" (Fam2-d).* Other behaviours that the participants pointed out were texting in the car, playing with a pen in meetings, or sitting tensely. For example, the father and daughter in Fam2 were browsing through the father's images, which showed him watching TV when the daughter commented on them:

Fam2-d – That's a very tense way to sit. You shouldn't be sitting like that.

Fam2-f – Oh, it's a match.

Fam2-d – Oh, rugby.

Fam2-f – That's what it was, it was a rugby match.

Fam2-d – All you can see is the hands like this (shows hands clenched together) in front of the SenseCam.

In this scenario, it was only after the participants browsed through the event that they saw the rugby match on the television and realised that this was why the father was sitting so tensely.

6.3.3.3 Family interactions

It was observed that narration and reflection on activities came about with or without family interaction. That is, one person could give an account of their activities without any participation from their parent/child. Reminiscence and story-telling in contrast transpired through family interaction, enhanced by a teasing rapport between the family members. In other words, the participants were encouraged to share their memories and experiences by their family member, through questions or teasing them about activities or behaviours. Having a shared interest also encouraged this interaction. This could have been having images of the same event, seeing themselves in the other person's images, or seeing images of family or shared acquaintances:

Fam2-d - Ah Pauline! Look she's chatting away.

Fam2-f - There she is peering in the windows.

Fam2-d - You can nearly hear her.

Fam2-f - All the pointing she's doing.

Fam2-d - It looks like you locked her in the shed. You see her in the shed and then you see you closing the lock.

The participants' body language was noted, particularly when viewing the other person's images. Interest in the other person's lifelog was observed through behaviours such as asking questions, leaning forward towards the computer, making sounds of surprise and asking to slow down the slideshow. Boredom was also observed however, when a participant would be looking at their family member's lifelog. Signs of boredom included yawning, the participant sitting back on the chair, staying quiet for a long time, and asking their parent/child to speed up or skip through images. The types of images that seemed to evoke boredom were those that had repetitive images such as driving, at the workplace, at a computer, or shopping.

After the browsing sessions I briefly discussed with the participants their opinions of looking through their images after the 6 month interval and also their experience sharing with their family member. All but one of the participants said that they found their lifelogs more interesting to browse after this interval. The reason given was that at the time of data capture they knew what to expect in their images, however when they were looking at them 6 months later they had forgotten all their activities and could re-experience them. One older participant disagreed and said he preferred looking through his lifelog at the time of capture, because it was his belief that once you did things they were in the past and you then moved on.

The participants were also asked to report whether they enjoyed sharing their images together or whether they would have preferred to share them remotely or not at all. Six of the eight participants said that they considerably favoured browsing through the images together; *"together definitely, you can ask questions and have a bit of fun" (Fam1-f)*. For these participants teasing and poking fun was prominent throughout their interactions; "*your hand looks old like mine, old and wrinkly" (Fam3-m)*. In contrast, the remaining two participants said that they would feel more comfortable sharing their images remotely, i.e. not in person, so that their family could look through them in their own time and of their own accord. This finding suggests that a family browser should support both types of sharing; in person and remote sharing. There was also some variation in responses for sharing lifelogs. Most of the participants said they would prefer to choose events to share rather than allowing their family to have open access. Even the participants who said they would not mind their immediate family having access were wary against extended family or in-laws having or asking for access. Finally, although the participants said they would love to have a lifelog from their deceased parents or grandparents, they said that they would only want to leave behind lifelogs that they had chosen to share when living.

6.4 Summary and Conclusion

In this two-part field study I investigated whether sharing would motivate lifelogging behaviour and whether there would be any age-related differences in lifelogging behaviour. It was found that sharing did motivate people to wear the lifelogging device more often when they thought they would be sharing their captured images. Both older and younger participants browsed their lifelog images more frequently during this week also. However, there were factors that impeded sharing such as the perception of the images being boring or low quality and not having an interested party to view the images. As the participants could only share the images displayed on the touch-screen computer they were most likely to share their images with their spouse or partner living with them. However, from the comments made by the participants it was shown that the family pairs were interested in viewing each other's images but may not have had access to them during the sharing week.

To further investigate this, I set up a follow-up study six months after data capture to allow the participants to share their images with each other. The purpose of this observation study was to determine whether shared reminiscence would occur through lifelog browsing. It was found that although the participants did reminiscence at times, this came about alongside narration, story-telling, reflection and general family interactions.

In conclusion, I have addressed my third research question and determined through the field experiment and observation study that sharing is a motivating factor for lifelogging and that family-based sharing supports family interaction through reminiscence, narration, story-telling and reflection. Through the questionnaires, interviews and the current study, we now have a rich understanding of older users' preferences and motivations for lifelogging; specifically family and sharing. I use these findings to inform the design of an intergenerational family lifelog browser. In the next chapter I consider these design requirements.

Chapter 7

Considerations for the Design of an Intergenerational Family Lifelog Browser

7.1 Introduction

The purpose of this thesis is to investigate the design considerations for a lifelogging browser for the older user. In the previous chapters the goal was to understand what would motivate an older person to want to lifelog. As the research progressed it emerged that although older and younger peoples' motivations for collecting and sharing varied somewhat, 'family' was a significant component to both older and younger peoples' collecting/lifelogging behaviour. These findings have been incorporated into a lifelog browser design, focusing on intergenerational use between family members to allow them to view and share lifelogs.

In this chapter I put the findings into practice, utilising human-computer interaction techniques in the design process. I begin the chapter with a brief outline of ageing and the effects of perceptual, cognitive and physical ageing in relation to

computer use. I then introduce my design concept, Family Capsule, an intergenerational family lifelog browser. The interface for this browser is designed to support both personal and shared family browsing. In Chapter 6 it was found that sharing lifelogs encouraged family interaction, including shared reminiscence and story-telling. Therefore, the design concept aims to support group sharing, through mobile tablet touch-screen interaction. The development of this concept is shown through a series of HCI techniques, such as wireframing, user participation, personas, and task analysis. In the last section of this chapter I present the final design concept, discussing the browser features and addressing usability considerations for older users.

7.2 Designing for Older Adults

According to Fisk et al. (2009) good design for older adults is generally good design for everyone. Understanding or, at the very least, being aware of the capabilities and limitations of older users can help us to create more useable technologies. As we grow older we change and develop, increasing some skills, losing others and learning to compensate for those in decline (for a useful review see Bosman & Charness, 1996). Some of these changes have more implications on how we interact with technology (e.g., vision problems) compared to others (e.g., greying hair). The characteristics that we as designers are concerned with include perceptual, cognitive and physical changes. Perceptual abilities, most commonly for vision and hearing, generally begin to show signs of decline from a relatively young age. Approximately half of all men over the age of 65 and 30% of women suffer hearing loss, and most people notice visual problems around the age of 40 (Fisk et al., 2009). These figures highlight the importance for interfaces to provide clear adjustable output from devices (Charness & Jastrzembski, 2009). We can accommodate for this by displaying appropriately sized text and design features, using high contrast colours and including adjustable audio output at low frequencies (Fisk et al., 2009; Hawthorn, 2000).

Cognitive changes also have a significant influence for older users. Age-related differences in cognitive functioning can be seen to stem from the reduction of cognitive resources available, impairing older adults' ability to carry out cognitively demanding processes (Kester, Benjamin, Castel, & Craik, 2002). For example, working memory, the ability to store and retrieve new information, along with declining information processing speed, affects how older adults learn and interact with new devices. Many systems rely on a person's ability to keep information active, however this is unrealistic for older users unless they are proficient users. Therefore we need to make use of appropriate feedback to the user informing them where they are in the system and where they have been. Simple use of text, colour and icons can significantly reduce confusion and increase ease of use.

Older adults show changes in their physical abilities, due to loss of muscle mass and flexibility. Physical problems can also occur as a result of accidents and falls (common with frailer older adults) and age-related conditions such as arthritis and stroke. In computer use this can result in difficulties grasping a mouse, and positioning and controlling the curser (Hawthorn, 2000). To reduce these problems, it is recommended to implement large targets for accurate cursor positioning, reduce scrolling when possible and allow for slower response times. Touch-screen interfaces are more frequently being used to assist the technology experience of older adults as they require direct input, require large button targets and eliminate the need for multi-components (e.g., a desktop uses a mouse, keyboard and monitor) (Jin, Plocher, & Kiff, 2007).

Designing an accessible lifelogging browser that older people would be motivated to use is central to the research. Being aware of older peoples' perceptual, cognitive and physical abilities and taking these into consideration when designing a system can lead to a more accessible system for a wide range of users, not just older users. I discuss these design features in Section 7.7 where I describe the proposed Family Capsule interface.

7.3 Concept Development

7.3.1 Overview

Through questionnaires, interviews and field studies I have gained significant insight into older and younger people's motivations for life-long and lifelog collections. The findings from these studies helped to shape ideas for an intergenerational lifelog browser. I believe that a system that supports family-based interaction must display a user's personal collection, enhanced by the family's lifelog collections. Applying the findings from the previous research studies I identify three approaches that I believe achieve this. These are: 1) highlighting events and activities; 2) combining lifelogs; and 3) family lifelog. I explain these approaches in the following section.

Table 7.1 presents a summary of the findings and their implications for the proposed design. To consider how these solutions can be incorporated into an interface visualisation, I develop the concept through wireframing, a low-fidelity visual representation of the application's interface. Wireframes allow the initial focus of the design to be on the basic layout, structure and navigational scheme of the interface. I then use these wireframes as a reference to describe the main functionality of the proposed browser.

Table 7.1 Summary of findings throughout this thesis and their application to a family lifelog browser

	Issues Identified	**Application to family browser**
Questionnaire Study (Chapter 4)	The majority of older adults either own a computer or would like to own one. Also, older adults are aware and willing to learn new technologies if given the opportunity.	Lifelogging requires users to adopt new wearable devices (e.g. SenseCam) and interact with computer technology to view their data. The findings show that older adults are willing to learn to use new technology, therefore, provided with opportunity and motivation it is believed that older adults would accept lifelogging technology.
	Both older and younger adults are interested in technology to support social connectedness.	Our intergenerational browser supports social connectedness through sharing lifelogs within family groups. Sharing is supported remotely, with shared events sent to the family account or a specific user's account. Sharing can also occur in person. A touch-screen tablet computer would be ideal to support mobile, person-to-person sharing.
	Some household devices maintain intergenerational usability.	Although there was an age-related increase in difficulty for household tasks, some devices were found to be easy to use by all age groups. I suggest using a touch-screen device to support intergenerational use. Touch-screens have been shown to support older users through direct finger touch input, and large screen features. The sensitive screen buttons also do not require physical strength which would accommodate frail older users, and have also been shown to support people with visual and motor disabilities (Caprani, O'Connor, Gurrin, 2012)
Interview Study (Chapter 5)	Changing motivations over time.	As people age their motivations for collecting adapts to their lifestyle. With the family lifelog browser, young adult users can lifelog to capture their experiences, see lifestyle patterns and share with family. Users with young children can capture lifelogs of activities with their children to share with grandparents, spouse or siblings. Finally older users might choose to lifelog to capture and share experiences with family and create a legacy to pass

		on. The aim is to support these changes through short term sharing (sharing updates, combining lifelogs) and long term sharing (retrieval of lifelogs through search, highlighting traits and activities, older generation lifelogs).
	Collections within family groups.	Older participants were interested in creating a family tree, to document information so that it will be passed down to younger generations. I recommend a family tree visualisation, where each family member can update their own lifelogs and have access to shared family lifelogs across generations.
Field Study (Chapter 6)	Finding interesting events easily to view and share.	I propose to incorporate methods for lifestyle trait detection and search into the design to support potential users finding interesting events.
	Interest in events that include family members and lifelogs of the same event.	I recommend a method for augmenting lifelogs, using pattern recognition and comparison of image features. The participants in the study were particularly interested in viewing an event from multiple people's collections.
	Interest in lifelogs changed over time.	In the short term, users found their family members' lifelogs more interesting than their own. After a 6 month interval personal lifelogs became more meaningful. I identified shared reminiscence, story-telling, narration and reflection through family sharing. I provide a visualisation to allow the user to see changes in their lifestyle, their family network and shared memories over time.

7.3.2 Recommended approaches

In this section I introduce novel approaches that I believe would augment family group lifelogging. As mentioned in the previous section, we want to design a lifelog browser that supports personal lifelogging enhanced by family sharing. Therefore, techniques should be addressed for group sharing, as well as a password protected account. With the large number of images captured by a SenseCam device it also needs to be considered how to organise the data. The SenseCam browser that we used in the field study automatically segments lifelog data into events, as mentioned in Chapter 6, Section 6.2.1. Each event is represented by a key-frame image, which is the middle image of an image set. Organising visual lifelogs in this way facilitates the user to quickly see events that might be interesting to them, whilst ignoring events that they find boring, such as images of driving or watching television. Event segmentation is adopted as the basis for the conceptual design of Family Capsule, enhanced by techniques to highlight activities, combine events and display a family network. The approaches to share lifelogs, provide password protection and event segmentation are currently feasible for implementation, due to previous development and/or low complexity. However, the recommendations for highlighting activities, combining events and displaying a family network are at the conceptual level. Before implementation, these approaches would require further investigation and development. I discuss the meaning of these in the next section. Table 7.2 outlines the feasibility of implementing all techniques.

Table 7.2 Recommended approaches for family lifelog browser and their feasibility for implementation.

Approach	Description	Feasibility for implementing into system prototype
Group Sharing	Providing access for family members to view images and events from personal collections	✓
Personal Account	Providing users with a password protected account from which they can manage their lifelog collection	✓
Segmenting Events	Automatic segmentation of image collection into separate image sets by processing SenseCam sensor readings to obtain event boundaries	✓
Highlighting Events	Providing an option to mark events as 'favourite' to support the retrieval of images for reviewing or sharing	✓
Highlighting Activities	Automatic detection of activities and lifestyle traits	**X.** Algorithms in development. Extremely promising research results to date (Doherty et al., 2011)
Search	Access to search for *who, what, when, where* within a collection	**X.** Dependent on activity detection, face recognition and GPS, not currently available with the SenseCam device but the subject of ongoing research within the field e.g. Qiu, Doherty, Gurrin and Smeaton (2011)
Combining Events	Automatically recognising and combining similar events from different lifelogs	**X.** Algorithms in development. High-level of difficulty for implementation using only visual feature input available with SenseCam but preliminary research is very encouraging (Alexiadis et al., 2011)
Family Network	Displaying an interactive network to display family relationships and a summary of lifelog activity over time	**X.** Not in development to-date.

7.3.2.1 Highlighting events and activities

The activities in which the participants in the field study were involved influenced their interest in viewing and sharing lifelogs. Events that involved other people or unusual activities were of interest, whereas other inactive events such as sitting in front of a computer or driving were considered boring. However, some activities that were initially described as boring were later discovered to be interesting (e.g. mother and daughter watching television) and revealed to the participants how much time they spend on various activities (e.g. cleaning).

Highlighting events and activities would allow users to quickly find interesting images, or share images that they think would interest others. This could be automatically achieved in three ways;

1) **Highlighting important events –** One of the problems reported by the participants who used the SenseCam browser throughout the field study was that they had difficulty re-finding images to share, amongst the large quantity of images captured. An easy solution for this is to provide users with the option to highlight images or events that they want to retrieve again, such as marking an event as 'favourite'. This would duplicate the favoured images from the main data set, copying it (or a symbolic link to it) into a separate folder to which the user has direct access. In a large data set collected over months or years, images/events marked as 'favourite' may be difficult to retrieve. Therefore, within this *favourite* data set, search and retrieval techniques should support users to quickly and easily find desired images or events.

2) **Recognise event activity** (Doherty et al., 2011) – Lifelogs provide users with a detailed representation of their everyday activities. Doherty et al. developed a technique for automatically eliciting these activities, or lifestyle traits, from visual lifelogs. This is achieved through the extraction of image features, which are analysed for pattern recognition, and then used to classify lifestyle traits, such as reading, walking, eating, or being with other people. This allows users to easily find events that may be of

interest to them, such as meeting friends or having dinner in a restaurant. Although this approach is under development, for applications in the domain of health and lifestyle, implementation into a lifelog browser to be deployed with non-expert users is not yet possible due to the current performance of such techniques.

3) **Search based** (Doherty et al., 2012) – Additionally, Doherty et al. recommends providing search functionality for *'who, what, when and where'* to enhance the lifelog browsing experience. Image retrieval through search can be text-based, through manual tagging or using the information obtained from image features. To improve search functionality with SenseCam, Qiu and colleagues (2011) have explored the use of accelerometer data to provide the context of a user's activities. Additional functions, such as GPS and Bluetooth for example, can significantly enhance search performance; however these sensors are not yet incorporated within the SenseCam although early stage research and development effort is looking at alternatives that do incorporate these sensors (Qiu, Gurrin, Doherty, & Smeaton, 2012).

7.3.2.2 Combining lifelogs

It was found from the results of the previous research studies that given the opportunity, the participants enjoyed viewing their younger/older family member's SenseCam images. Viewing these images allowed them to see what the other person did throughout a normal day. It also allowed them to see events from a perspective other than their own. Images that the participants also enjoyed viewing were those featuring family members. To support these preferences I recommend that a family lifelog browser allow users to combine their lifelogs. For example, if a user has images of an event, say their birthday party, and other family members shared their images of the same event, then the user could combine these images enhancing their own image set. Automatically identifying similar events from family members' lifelogs could be implemented using Doherty et al.'s event association approach (Doherty et al., 2012). Automatic event association is achieved by firstly identifying an image's traits, linking the images by time in a first step and then by visual features, typically colour, edge and

texture properties, in addition to a number of other traits. These representative vectors are then compared against each other to determine the similarity between events. Doherty and Smeaton (2010) showed how lifelogs can be augmented by combining external sources from the Web and integrating them into one's own lifelog. The same principle could be applied for combining family events, albeit perhaps requiring more sophisticated object/scene/person matching. This opens up a whole new research question which future studies should clearly investigate further.

7.3.2.3 Family network

To support family-based lifelogging we not only have to think about the user and their lifelog but also the family as a whole. Shared family reminiscence helps to create bonds between family members and maintain memories of past loved ones. The idea behind the family lifelog is to include, through a family tree like structure, the lifelogs of all family members, past and present. A user would only see the lifelog images that a family member has shared. Based on my findings I believe it is necessary to allow users to have the option to share with the whole family network, specific family groups or individual people. Similar to the user's personal lifelog, the family lifelog would integrate event importance and event association methods to allow the user to identify events of interest in their family lifelog. A user could see activities in which their grandparents had participated and perhaps share these images with their own children. Considerations would also have to take into account user preferences for lifelog remains, namely who would have access to the lifelogs and the level of privacy expected.

In the following section I propose visualisations for these approaches, using wireframe diagrams to illustrate the layout and functionality.

7.4 Wireframe Visualisations

7.4.1 Highlighting activities and important events

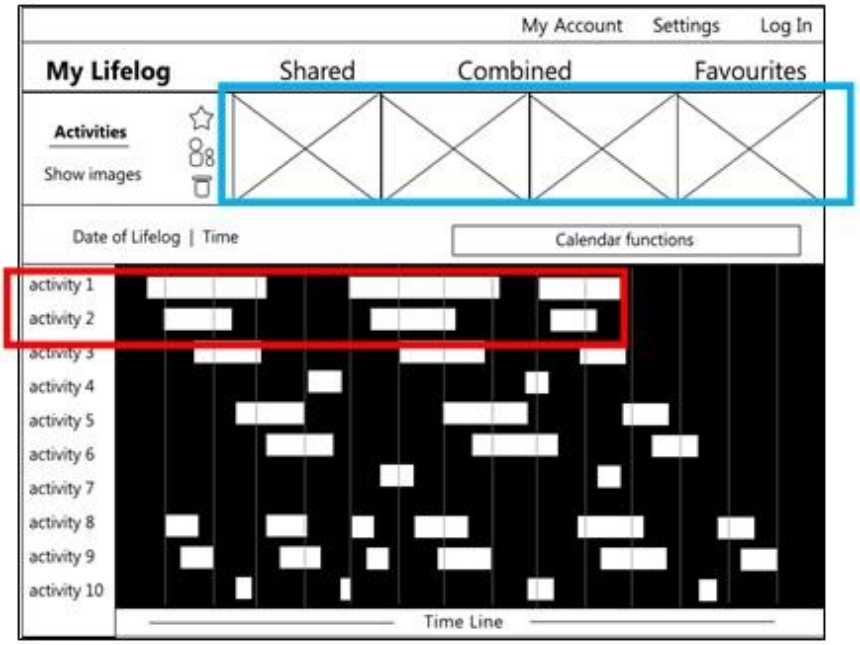


Figure 7.1 Wireframe diagram to display activity visualisation.

Highlighting activities and important events would allow users to search and retrieve images of interest from their lifelog, for example, finding images of a friend's dinner party. Using this approach, images of activities such as eating and drinking are identified and displayed over a timeline. In Figure 7.1 I show how this could be visualised. I begin with the bottom half of the screen. On the left hand panel we list activities that are automatically identified when images are uploaded (such as eating, drinking, reading etc.). The interface shows a day (24 hours) as the default unit of time. The amount of time spent on each activity is represented by a horizontal bar in-line with the activity. In the wireframe diagram we have highlighted the top two activities with a red rectangle. These activities could be eating and drinking. Looking at the bars to the right of the activities, and comparing them to the time the images were taken (approximately morning, afternoon and evening), it could be concluded that these

images were taken when the user was having breakfast, lunch and dinner. Selecting one of these bars would result in the images displayed above (highlighted by the blue rectangle), which the user can navigate through or select to bring up a slideshow.

A ‘favourites’ option has also been included for users to mark events, or images that they particularly like; allowing them to be easily retrieved amongst their vast data collection. The user can mark an event as favourite by selecting the star to the left of the image display, and view these images by navigating to the Favourites menu option.

7.4.2 Combining lifelogs

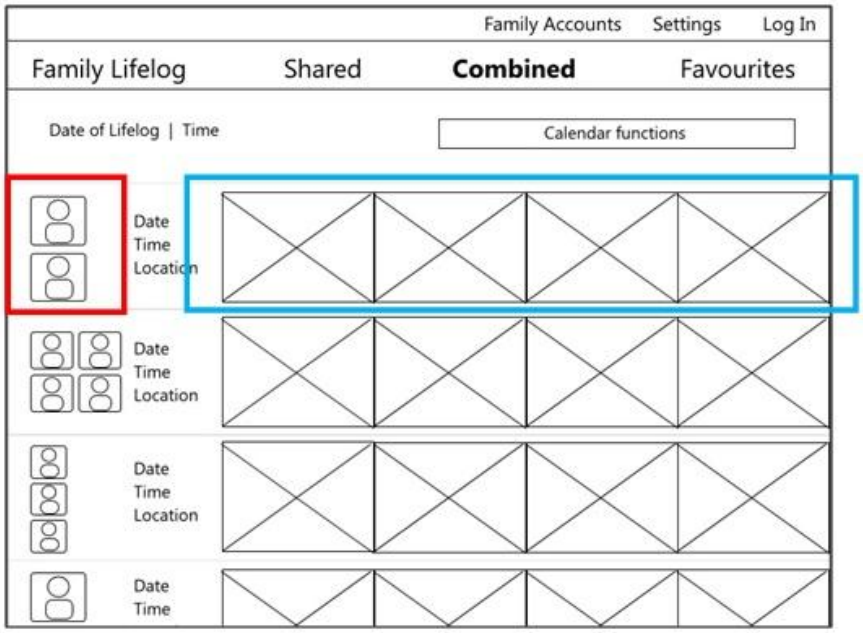


Figure 7.2 Wireframe diagram to display combining events visualisation.

In the field study and observation it was discovered that both older and younger individuals were interested in browsing images that they featured in and also in comparing images of an event that was captured by more than one person’s SenseCam. I propose implementing an approach to combine multiple users’ events. A wireframe visualisation of this approach can be seen in Figure 7.2. When a user uploads images of

an event, such as a family day out, which a family member has already shared, the system will ask the user if they would like to combine their images with the other user's images. In the wireframe diagram a visual representation of these combined events is displayed. Each horizontal panel shows a different event. In the first panel, I have highlighted in red the section to display the family members who have contributed the images of the event. To the right of this, images of the event are displayed. The user can then select these images to view a slideshow.

7.4.3 Family network

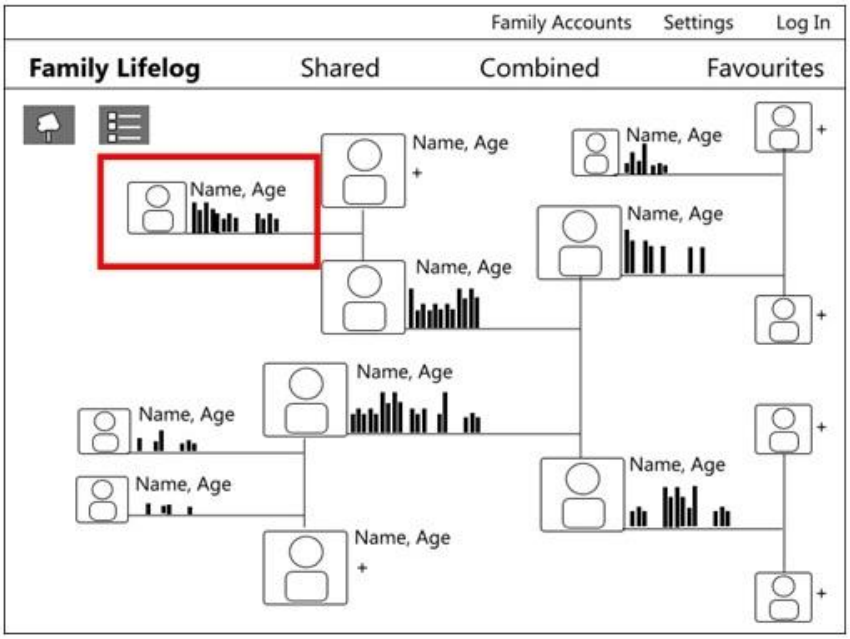


Figure 7.3 Wireframe diagram to display family network visualisation.

Although motivations change over time, sharing collections with family was common for both older and younger participants in my studies. Older participants were particularly interested in documenting their family history as they were aware of how information could be easily lost through the death of older generations. I propose a visualisation to depict the family network alongside lifelog activity. The wireframe in Figure 7.3 displays this proposed interface. In this it can be seen that family members

are connected to each other, creating a network. In the wireframe diagram I have highlighted one user in red which shows a profile image of the user. The visualisation lays out the family tree horizontally, from left-to-right with youngest family members on the left. I have incorporated a node-link diagram to visualise the family network as it is the most common representation for hierarchical relationships (Ward, Grinstein, & Keim, 2010). This visualisation is most often used in genealogy software as users can clearly identify marital relationships and descendents (see Figure 7.4). Similar to the diagrams used by www.familytreemaker.com I propose to incorporate a horizontal family tree visualisation. The purpose of this is twofold: 1) the lifespan of each person can be represented by the length of the line linking them to their parent(s); 2) we can use this line to display the user's lifelog activity throughout their lifespan. This activity is represented by a series of vertical lines of varying heights and above this the name and age of the user is displayed.

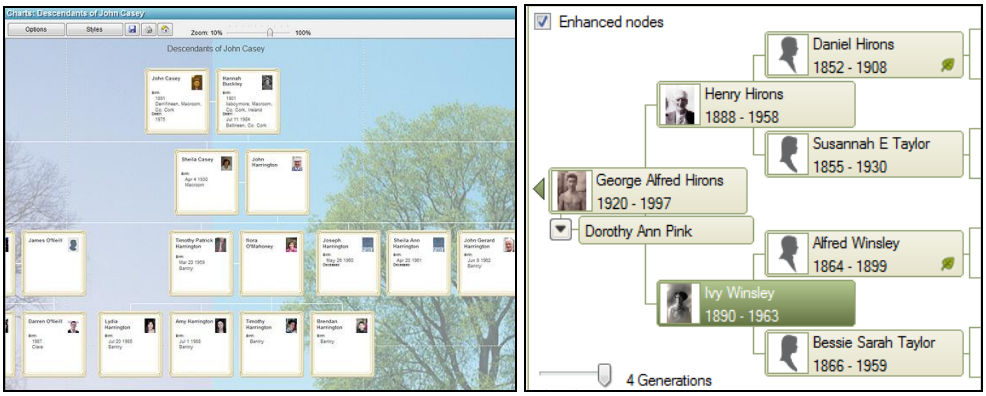


Figure 7.4 Vertical (www.myheritage.com) and horizontal (www.familytreemaker.com) node-link diagrams to represent hierarchical relationships.

Kim, Card and Heer (2010) designed a visualisation technique for genealogical data which prioritises temporal relationships, using lines to represent family members and the convergence and divergence of these lines to represent marriages, divorces and death. This is a useful technique to visualise large and complex family groups. Incorporating such a technique could be considered for viewing the whole family tree

structure with multiple connecting families across generations. Similarly, when a user zooms out from the family network and each user's profile is no longer clearly visible, the visualisation could be adjusted so that each person is represented by a line, such as the TimeNets example below (see Figure 7.5).

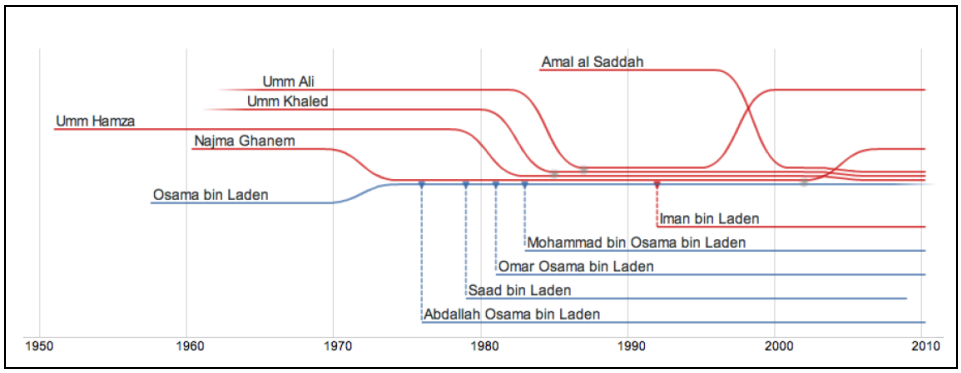


Figure 7.5 TimeNets family tree visualisation (Kim et al., 2010).

The wireframe diagrams described above portray how the research findings have been incorporated into the design of a family lifelog browser. Exploratory findings have also helped to gain an understanding of who the target users are, their lifestyle and goals. I use this information to develop personas in the following section.

7.5 Personas

Personas are fictitious representations of target users which are based on research studies of real people through the design process (Adlin & Pruitt, 2007). The persona is representative of a group of target users and the purpose of creating a persona is to put a face on 'the user', to allow designers to focus on their behavioural patterns, goals and motivations. Personas provide us with a precise way of thinking and communicating about how users behave, how they think, what they wish to accomplish, and why (Cooper, Reimann, & Cronin, 2007).

The research focused on two age groups; younger adults and older adults. The findings from this research were used to develop personae to represent target users of a family lifelogging browser. I created Ann Fields to represent older users, while Jane Mathews represents young adult users.

7.5.1 Persona 1 – Older user

Ann Fields

Part-time special needs teacher

Age: 58

"I think it's important to collect things and whatever way they're collected, to share with other people"

Ann thought that as she became older she would have less to do, however she feels she has never been busier. She spends half her week working in the local school as a special needs teacher and the other half running around after her very energetic grandchildren that she minds for her daughter. Ann's daughter Judith works in a bank and doesn't get home until dinner time. Whenever Ann is minding the kids she tries to take short videos and photographs of them on her phone, having breakfast, on their bikes or getting messy painting. She doesn't want her daughter to miss out on these moments, however when minding two young children, Ann doesn't always have her hands free to put on her spectacles and take out her phone in time to capture the moment.

Recently Ann's father died and all the family came together to help sort out his belongings. As the family went through all the photographs and mementos stored away in her father's home they talked about their father, stories from their childhood and the stories that their father had told them about himself. Ann realised that there were very few photographs from when her father was young and most of these were quite formal. She couldn't find any that told her about his day-to-day life

and she never thought to ask him about it. It was because of this event that Ann decided to try lifelogging. She had read about lifelogging in an article and it sounded like it could be fun. Although Ann isn't the best on computers, it is something she is willing to learn. She figured that she would wear the camera on the days when she minded her grandkids. That way, she could share the pictures with Judith who could see all the things her children got up to. Ann's going to get a wearable camera for her husband and Judith for Christmas so they can lifelog too. It's too late to collect a lifelog of her father's life but Ann could make a start on her own lifelog, so that her children and grand-children would know her better and the part that they had in her life.

7.5.2 Persona 2 – Younger user

Jane Mathews

Chartered accountant

Age: 31

"If it's collectable I probably collected it"

Jane has been collecting things all her life. When she was younger she wrote a diary every day. Although she doesn't write about her feelings anymore, Jane still enters her day-to-day activities into her digital calendar, and keeps a scrapbook full of notes of countries she visits, people she meets and restaurants she goes to. Jane started making these scrapbooks for her own amusement but now she keeps them in her sitting room so that her friends, nieces and nephews can look through them.

Jane is living in the city centre and walks in and out of work each day. She doesn't plan to live in the city forever and therefore wants to document her current lifestyle in some way. Last year Jane decided to take a photograph with her phone everyday for a month whilst walking to work. The first week was fine but Jane soon

realised that if she was checking her text messages or emails on her phone or in a rush because she was late, she usually forgot to take the photograph.

Jane is always looking for new ways to document her life. She tried to write a blog but didn't feel comfortable telling a faceless anonymous world about her life. She decided to use Family Capsule after she saw her cousin wearing a camera to lifelog. Now Jane's whole family lifelog; her parents, her brothers and their wives and kids. Like her scrapbooks, Jane leaves her Tablet PC with the Family Capsule available in her living room so that when the family is over they can browse through the photographs together. Usually this time is spent reminiscing over their frequent family day trips and looking in wonder at how sunny the days were in the lifelogs when it always seems to rain in Ireland.

7.6 User Participation

These personae helped to focus the design of Family Capsule on the user. Including potential users in the design process also helps to put the needs and preferences of the user into focus. Therefore, 4 younger and 4 older adults were recruited to participate in participatory design sessions to obtain feedback on a series of low-fidelity prototype screens. The prototype was a mock-up system using Microsoft PowerPoint (see Appendix F). The intention of this study was to identify usability problems, including ambiguous labelling or functionality, and also user feedback on how to visualise information, methods of sharing and privacy concerns. The focus of this study was to explore the *Look and Feel* of the system, as described in Chapter 3 (Houde & Hill, 1997).

7.6.1 Procedure

The study was carried out in the participant's home. The participants were given a demonstration on how the system would work and how a user would interact with it. There were 26 mock-up screens in total. At the end of the demonstration the researcher returned to the first screen and asked the participant: 1) what they thought the screen was displaying, 2) was there anything that they were unsure of, 3) how would they expect it to be. This was repeated for each screen that contained new elements.

The participants were provided with blank paper sheets to encourage them to sketch their recommendations. Only one participant felt confident enough to do this, with the remaining participants preferring to describe their ideas for the researcher to sketch out.

7.6.2 Problems and solutions identified

Overall the participants were very enthusiastic about the design. Some participants thought that the system would be good for extended family, or family abroad to share their day-to-day experiences. Another participant said that they would use it only with close family members, but would not have any limitations on sharing with them. Yet another participant said that he would mainly want to use the system to see his own activities and lifestyle patterns. These comments show how a system cannot be designed to suit one type of person, but must accommodate many needs and preferences. The problems that the participants identified were as follows:

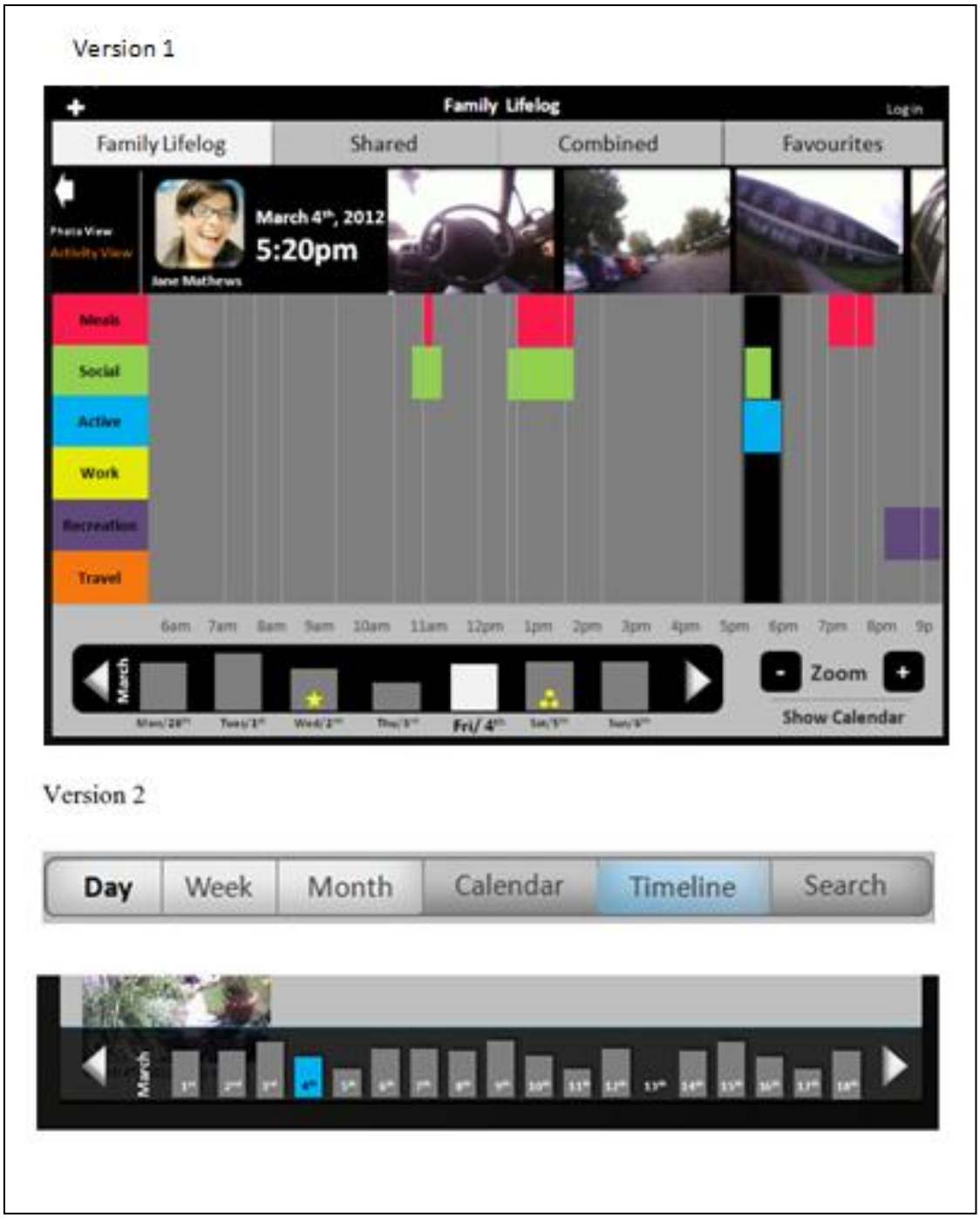


Figure 7.6 Version 1 and 2 for navigating the timeline.

Usability

Although the participants did not interact with the prototype useful feedback was gathered regarding the usability of the system. The users were all happy with the size of the text (minimum 12pt), image size and the colour contrast. One area that confused the participants was with the timeline (Figure 7.6). The timeline was initially designed to view high level information, such as a whole week. The user could click one of the days in this week to see the day in detail as the screen main content. Using the zoom buttons, the user could change the timeline, zooming out to see a higher level (e.g. month/year), and zooming in to see low-level (e.g. day). Firstly, the participants said that they were not sure what the plus and minis zoom buttons meant, and did not associate it with the timeline. Also, the participants said that in theory they understood that on the timeline they could see a week and then select a day to view on the main content but in practice it just confused them. They expected the timeline to show a summary of what they would see as the main content.

The design was adjusted based on this feedback. Instead of using a zoom function to change the depth of time, I introduced Day/Week/Month options. On this menu bar I also included time navigation options with a calendar and timeline button (Figure 7.6, middle image). When the Timeline button is selected, a timeline would appear at the bottom of the screen, from which the user can select different days to view (Figure 7.6, lower image).

Family network visualisation

Overall, the participants commented positively towards the family network visualisation. They liked that they could interact with their family members' lifelogs on a day-to-day basis while also being able to access lifelogs shared by deceased parents or grandparents. One of the older participants said about it; *"I love the family tree and genealogy is really popular now. I think the family tree will really capture people's attention"*.

It was intended that on opening the browser, the first screen displayed would be the family network. However, one issue that was raised was that the network was static. Although the graphs displaying the users' quantity of logging would gradually change over time, this change would not be noticeable for frequent users. It was decided that a better solution would be to initially display a screen showing the family's most recent interaction with the browser. This would be similar to the News Feed on Facebook that is constantly updating. With Family Capsule, updates would appear when family members share, combine or mark shared images as favourite.

Sharing and privacy

Visual lifelogs can of course be extremely personal and for this reason the browser is designed so that users will have a password protected account to manage their lifelog. Although the purpose of the browser is to maintain family lifelogs within the family group, there is also extended family to consider, e.g. in-laws, cousins etc. The participants said that although they would want to share some events with everyone, other events might be more suited to sharing with just one person, or group of people, such as grandparents. This is similar to Google+ where the user can place different people into circles, or groups to make sharing easier. For example, the persona Ann Fields only wanted to share images of the time spent with her grandchildren to her daughter Judith, as these images would only be meaningful to her. I recommend incorporating a similar feature to Google circles within family groups, where the user can have predefined groups from which they select to share their images. It is the user who controls whom they share their personal lifelogs with. To accommodate accidental sharing, users should be able to retrieve their images back at any time – unshare. This facility may be important should family relationships breakdown and users so not wish for others to have access to their collections. Changing family dynamics may be a significant issue in relation to family lifelogging. In the concluding chapter, it is suggested that further exploration into lifelogging and sharing across family households and regions is needed.

The Sharing section of the low fidelity prototype was designed so that the user could see events that they had shared with their family. A Family menu option was also included where events that the family shared with the user would be displayed. Through discussions with participants it was decided that the user's shared images and the images shared by the family with the user should be displayed on the one screen. In Figure 7.7 version 1 and 2 of the browser can be seen. In version 2 I have removed the Family menu option and within the Shared section I have included a slider to allow a user to change the display from showing only their own shared images to viewing all shared images.

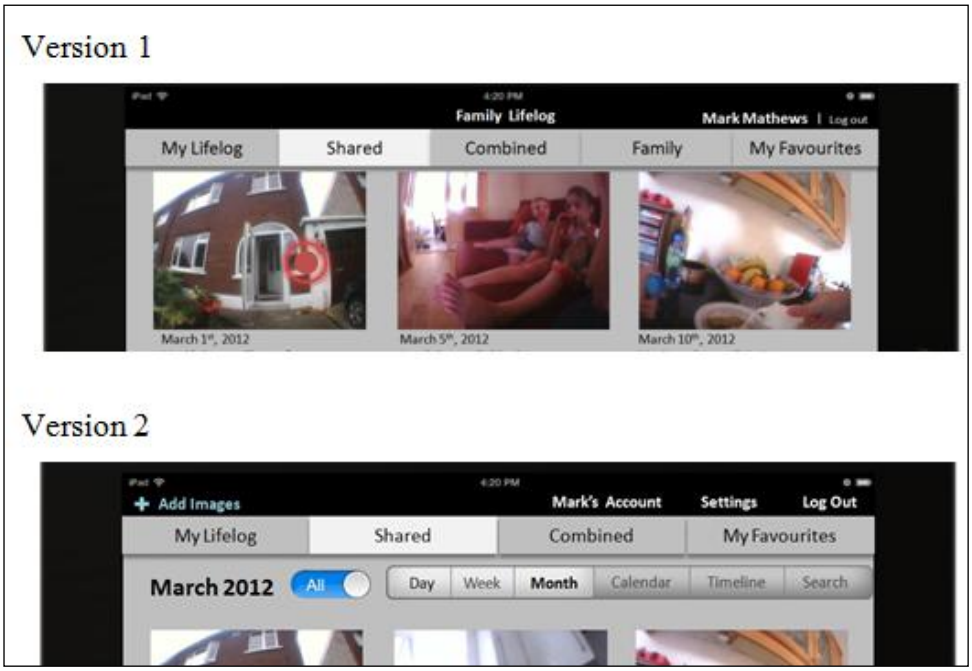


Figure 7.7 Version 1 and 2 for displaying shared images within a personal user account.

Figure 7.8 Version 1: Visualisation for family member's activities. This display was considered to be too personal for family members to have access to.

The participants were informed when they were shown the prototype that only images and events that were shared by a user would be visible to other family members. I included in the prototype a series of screens; when a user selects a family member from the family network visualisation they are brought to a screen where they can look through this person's shared images or alternatively, a visualisation of their activities (see Figure 7.8). It was expected that the participants would like this visualisation as they had reacted positively to the display for their own personal activities. However, this visualisation was considered to be too personal, even when the images it represented were already shared with family. The participants thought that it could be used in a negative way, for example, they did not want their partner to be able to check how long they had spent watching the television or how little time they spend doing chores.

The feedback that was gathered from the participants during this prototype study was used to improve the design of the family lifelogging browser. I describe the design concept in full in the following section.

7.7 Proposed Design Interface: Family Capsule

7.7.1 Touch-screen interaction

To accommodate both older users and multi-person interaction in the home, I have designed the lifelog browser to be used on a touch-screen tablet computer, such as the Apple iPad. Touch-screen technology can accommodate some of the age-related considerations outlined in Section 7.2. The technology itself requires that the screen size, even on mobile devices, is larger than non-touch devices. In addition, touch-screen interfaces are designed to incorporate virtual buttons that are large enough for a finger to press accurately. These features mean that items are larger on the screen, making them (a) easier to see and (b) easier to select accurately. Furthermore, the use of virtual buttons on the screen means that older users do not require as much strength to select a target, and they also do not have to divide their attention between the keypad and the screen. As well as accommodating older user interaction, a touch-screen tablet would support family sharing, allowing users to view lifelog images together and pass the system from person to person.

7.7.2 Task analysis

Task analysis is the process of analysing the way people perform tasks. The process looks at the steps taken by a user to achieve their goals. Each step is broken down into sub-tasks, or plans. A task flow diagram illustrates these actions and allows us to think through the system's structure before any development takes place. With the Family Capsule I consider user interaction with the system and also potential interaction with other family members, where browsing through lifelogs may prompt shared reminiscence and storytelling. There are several possible tasks which a user could

perform using the proposed lifelog browser. As sharing is the primary purpose of the browser, I have included a task flow diagram demonstrating the actions a user would take to perform this task. This task flow diagram can be seen in Figure 7.9.

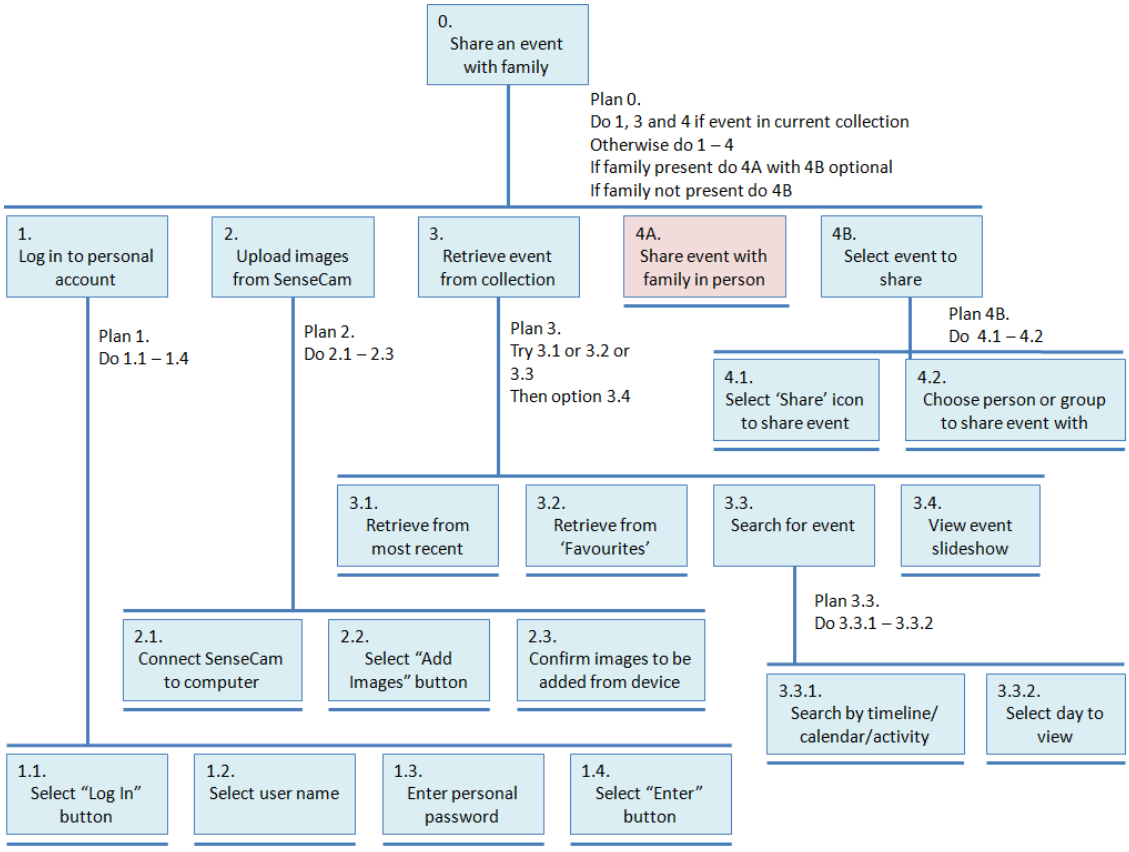


Figure 7.9 Task flow diagram for sharing an event with family using the proposed Family Capsule lifelog browser.

7.7.3 Interface design

Creating personas, including target users in the design process and developing a task analysis, facilitate in focusing the design on who the users will be and what tasks they will perform. In relation to the usability of the proposed system for intergenerational use, I outline considerations with respect to the Family Capsule interface, put forward by Fisk et al. (2009), in Table 7.3. The integration of these design considerations can be viewed in the following section as I describe the Family Capsule system and include screen shots of the proposed interface.

Table 7.3 Interface considerations for intergenerational use.

Design Guideline	Considerations for Family Capsule
Physical characteristics	Visual information will be spaced so that users can easily view and select targets.
	Users will be able to adjust the size of the display using multi-touch gestures to zoom in and out (place index finger and thumb on screen and widen to zoom). An option to adapt font size and colour contrast would also be offered within 'Settings' menu option.
	The users will not have any time constraints for inputting or viewing data.
	Labels, icons, images and targets will be large enough for touch interaction, also ensuring clear visibility and access.
Navigation	Scroll bars will be avoided. Users can navigate using next/previous buttons as well as multi-gesture touch-screen interaction, e.g. swiping across the screen to scroll.
	Previously viewed events will be highlighted to allow the user to see where they have visited.
	The users will know their current status through highlighted menu options and text information.
	Main navigation options will be present on the screen at all times.
Information organisation	With a touch-screen application, a broad and shallow menu structure will be most appropriate. This is to ensure that the user does not get lost in complicated menu systems.

	Frequent and important actions, such as, viewing family lifelogs, adding images and sharing will be prominently positioned.
Conceptual	Each screen will have a standardised format, including layout of menus, images and colour.
	The interface will be designed to be compatible with user expectations. Participant feedback will be taken on board to ensure compatibility for interface features such as targets and label options.
	The users will be made aware of the options that are available for the screen they are currently viewing through textual information and highlighting available options.
	Feedback messages will be displayed so that the user will know when images have been added, shared, combined, marked favourite or deleted.
	To enable easy error correction, the user will be provided with options to undo or edit any actions, such as editing family member details, or undoing share, combine, favourite or delete actions

7.7.3.1 System interface and functionality

Opening Family Capsule

On opening the Family Capsule lifelog browser the user will view the home screen, which displays the most recent actions taken by the family group. This screen can be seen in Figure 7.10. The main menu, displayed at the top of the screen includes the sections; Family Lifelog, Shared, Combined, and Favourites. Within the Family Lifelog section the user can toggle between the family's recent updates and the family network screen using the buttons shown in Figure 7.11 directly under the Family Lifelog menu option.

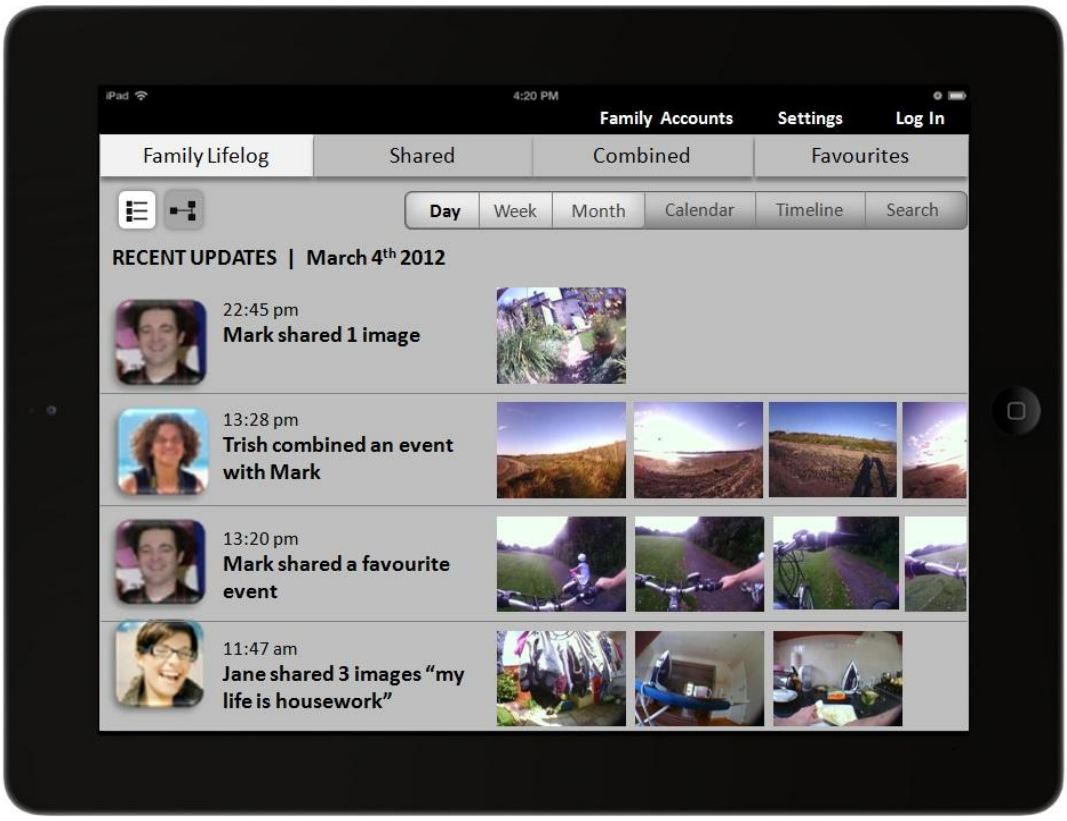


Figure 7.10 Mock-up home screen of Family Capsule displaying recent updates of family members' actions.

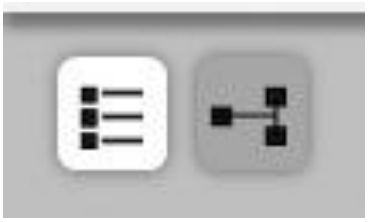


Figure 7.11 Buttons to allow users to toggle between most recent updates and family network visualisation.

The purpose of displaying recent updates is to allow family group users to quickly and easily see if there is any new information for them to view within their family members' lifelogs. I have included a user profile picture, the time of the action taken, a description of the action taken and also the images that were involved. Under the main menu I have included the menu bar described in Section 7.6.2. This allows the user to choose whether they want to see updates from the day, the week, or the month. The user can also search for actions taken at a different time using the calendar, timeline or search options.

By selecting the network icon (Figure 7.11) the user can navigate to the family network screen. I described the functionality of this visualisation previously using a wireframe diagram. This display allows the user to view their family connections and also see the lifelog activity for each family member. A mock family network is displayed in Figure 7.12. Not only lifelogging would be included within this network. Information from deceased family members, and names of family who do not currently contribute to the family lifelog could also be added to the network. This is to ensure that future generations will have an accurate account of their family tree.

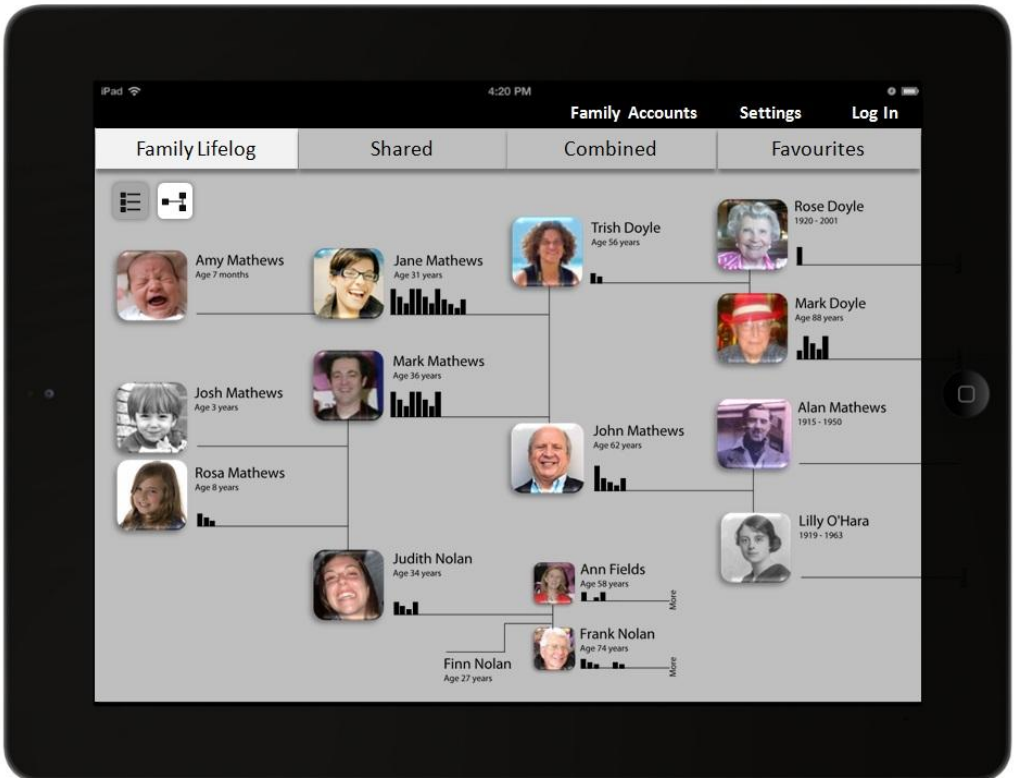


Figure 7.12 Family network mock-up interface displaying active and in-active family members.

Viewing family lifelogs

To view a family member's lifelog, a user can select them from the family network display. Alternative methods could be to use the search function, or if the user had chosen to view an event created by another user, they can navigate through all the events shared by this person. A user can only see images or events belonging to other family members that have been shared for family viewing. A user would have to log-in to their personal account to view their whole lifelog collection.

Family relationships are constantly changing, through the birth of children, death, or divorce for example. Odom et al. (2011) claims that characterising and understanding family life is complex, however families work at adapting to these structure shifts and technology is becoming a common part of this process. Odom suggests that more research is needed to fully understand the role of digital possessions following family loss or marital breakdown. This would also be relevant to lifelog contents shared within families.

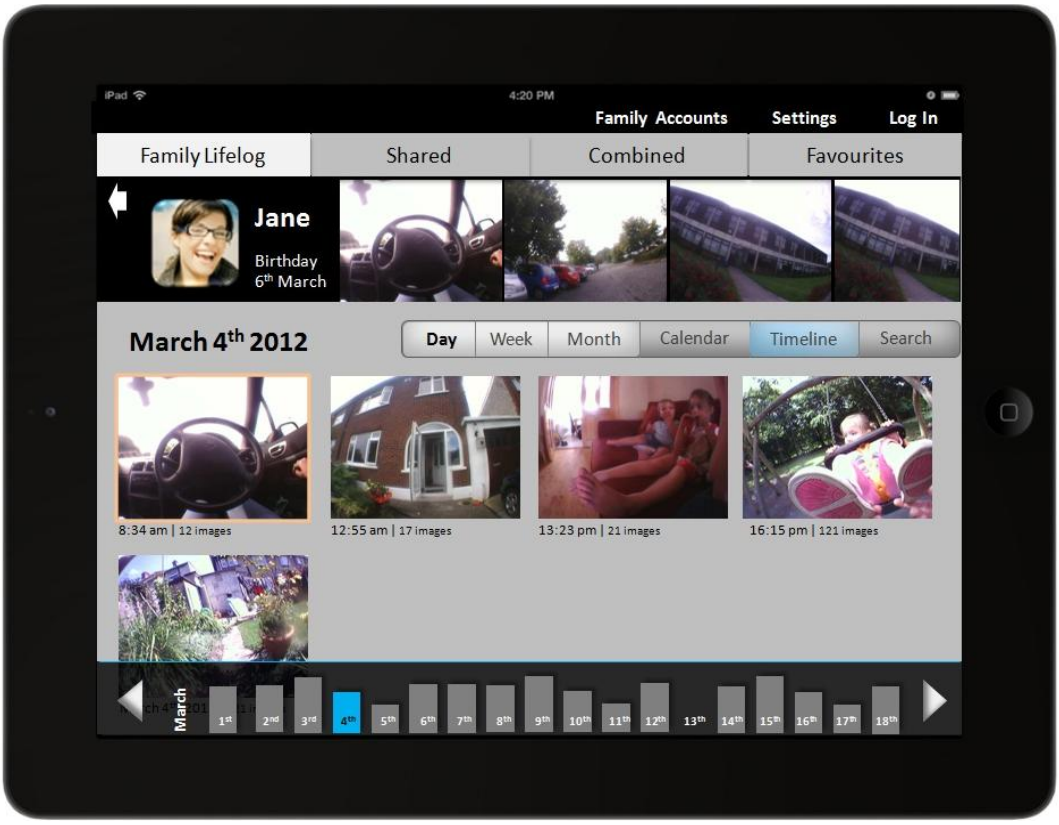


Figure 7.13 Family member's shared lifelog mock-up screen.

If a family member's profile is selected, the user would see a screen similar to Figure 7.13. In the top panel the user can see a profile picture of their family member alongside their name and birth date. To the right of this is a series of images corresponding to the currently selected event. The main content displays these events, represented by a key-frame image. Under each event is the time the images were captured and the number of images in the event. The family member's most recent lifelog will be displayed, from which the user can navigate to previous days. The user can see a slideshow of an event by double tapping on the event group. The first tap will show the image series in the top panel of the screen and the second tap will show the slideshow in full screen view.

7.7.3.2 Browsing different days

In Figure 7.13 I have also included an example of the timeline displayed when a user selects the 'Timeline' target option. This timeline enters from the bottom of the screen, overlaid on top of the content. The timeline displays a series of vertical bars, each representing a different day of the month. The height of the bar corresponds to the quantity of images captured (and shared in the case of viewing family member's images) on that day. This is so that the user can easily see what days might be of interest to them. The day that the user is currently viewing is highlighted in blue and the user can navigate to previous or future dates using the arrow navigational buttons to the side of the timeline. If a user is interested in viewing lifelogs on a specific day, they can alternatively use the calendar option.

7.7.3.3 Searching for an event

Providing users with the ability to search for an event would facilitate users to find images from the past more easily. As mentioned in Chapter 6, search functionality is enhanced when people can choose *who* they want to search for, *what* activities they are interested in, *when* and *where* the event took place. Our proposed visual display for this search functionality can be seen in Figure 7.14.

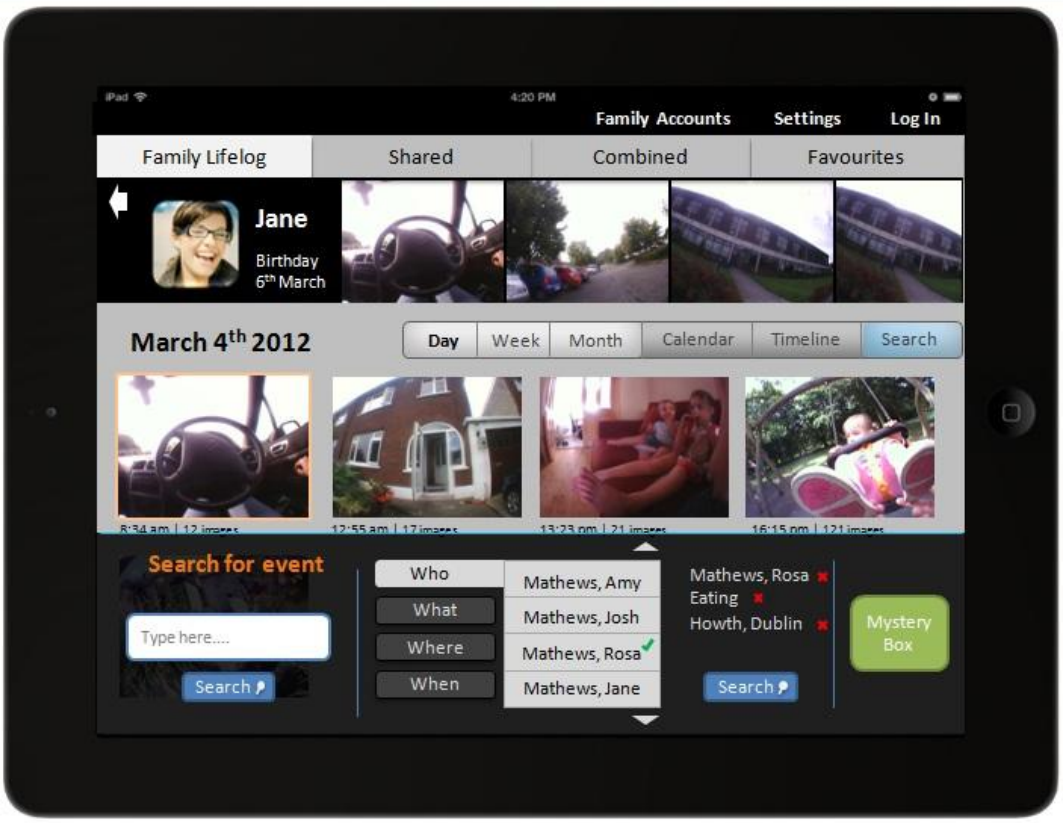


Figure 7.14 Search functionality, displayed when a user selects the 'Search' option.

Within this section I have also included a search box, where a user can type a query, a 'Mystery Box' button is also included, the intention of which is to present the user with random lifelogs from the family member's collection. From the interview studies it was found that people were often motivated to review their past collections by chance, where they stumbled upon them when looking for something else. I included the Mystery Box function into the design concept to replicate these instances of random discovery.

7.7.3.4 Viewing shared, combined and favourite lifelogs

As well as the Family Lifelog, the browser's main menu allows users to view Shared, Combined, and Favourite lifelogs. Unless a user is logged in, these lifelogs will belong to all family members who have made events visible to the family group. The layout of the Shared and Favourite section would be identical, each displaying events that have been shared/favourite, with a profile image of the contributing user below, alongside the event date or time (depending on whether the user selects the

day/week/month option) and the number of images in the event. An example of the shared screen can be seen as Figure 7.15. Again, a user can select the event to see a slideshow in full screen view.

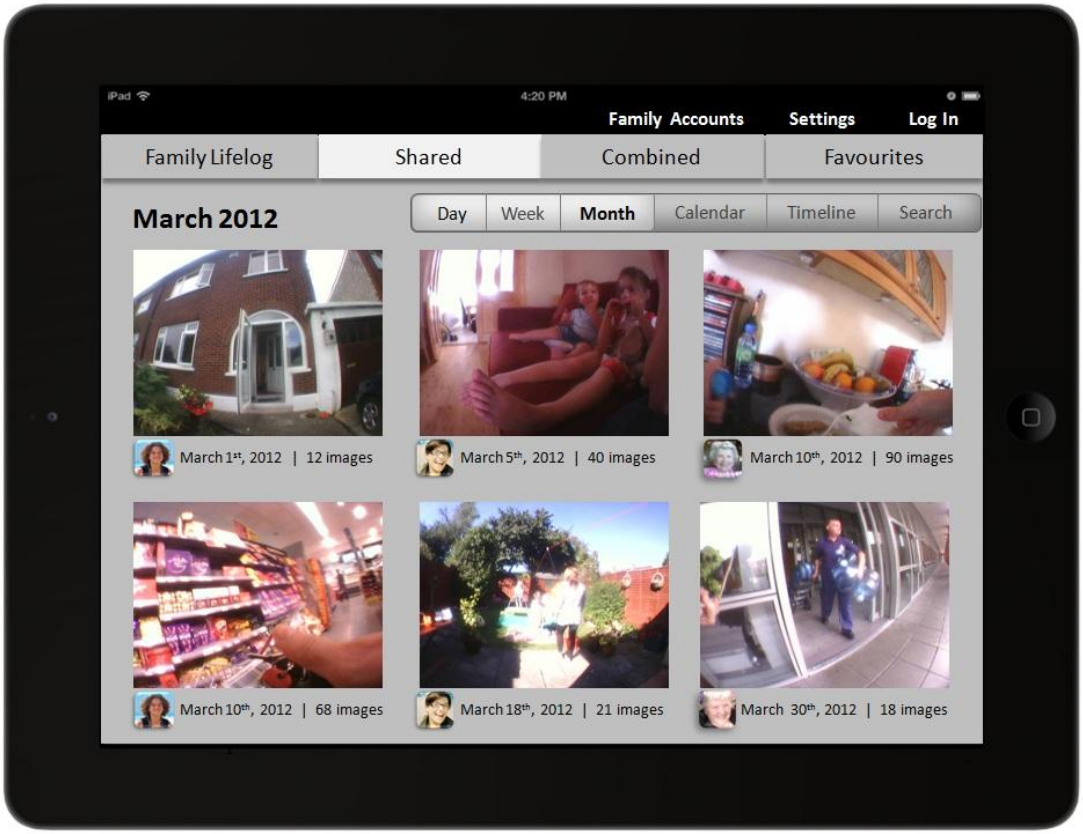


Figure 7.15 Shared events for all family members.

The Combined section of the browser is slightly different. The content for this screen is made up of combined events from different users. If a user uploads images from their SenseCam and the system detects that another family member has shared images from the same event, the browser will alert the user of this and ask them if they would like to combine the events. Once combined, the events will be displayed as in Figure 7.16. The users who contributed to the event will be displayed, alongside event information and to the right of this a series of images from this event. A user can select a family member's profile pictures to see what images they contributed. A slideshow of the event can also be viewed by selecting one of the images in the series.

Figure 7.16 Combined events for all family members.

7.7.3.5 Personal lifelog account

The previous descriptions have concentrated on the interface screens that are visible to all users within a family group. To manage personal collections, a user would have to log into their account using a private username and password. When logged in, their most recent lifelogs will be displayed. It is within the personal account that users can add, share, combine, mark as favourite or delete their images.

Once logged in the main menu options change slightly with Family Lifelog converting to My Lifelog. When in the My Lifelog section, a user can view their lifelogs through a 'Photo View' which displays the events represented by a key-frame image, or the user can view a visualisation of their activities, as seen in Figure 7.17.

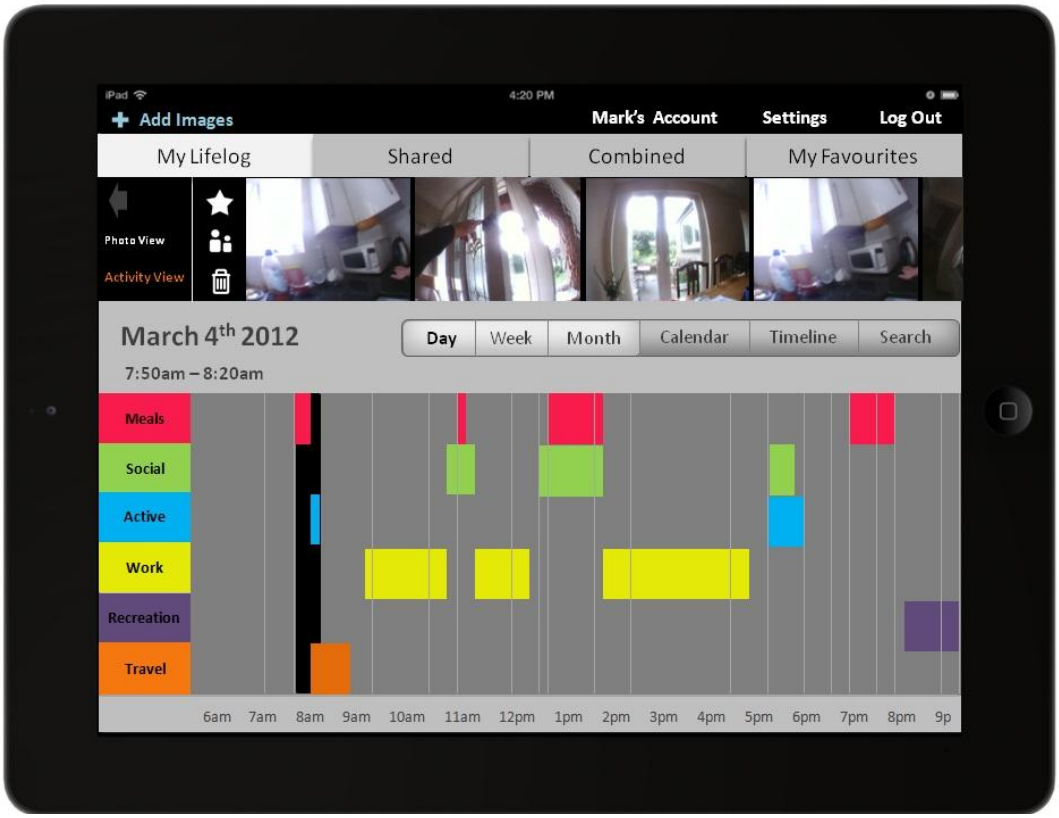


Figure 7.17 Personal lifelog interface. The user can view their lifelog by activity or by photo view.

The above figure shows a visualisation of a user's activities, as described in the wireframe diagram in Section 7.3.2. Images imported from a SenseCam device are automatically segmented into different activities, such as meals (eating, drinking, cooking), social (people, telephone) and so on. Using this visualisation a user can see how much time they spent on these activities. By selecting an activity from the list, a sub-menu would open up, where the general activity is broken down. For example, in the figure above a user can see how much time they spent on meals. By selecting the meals button, they can see activities relating to this, such as how much time they spend eating, drinking, preparing and cooking. This would be useful to participants who are interested in their health and lifestyle activities over time (Kelly et al., 2011). This is displayed in Figure 7.18.

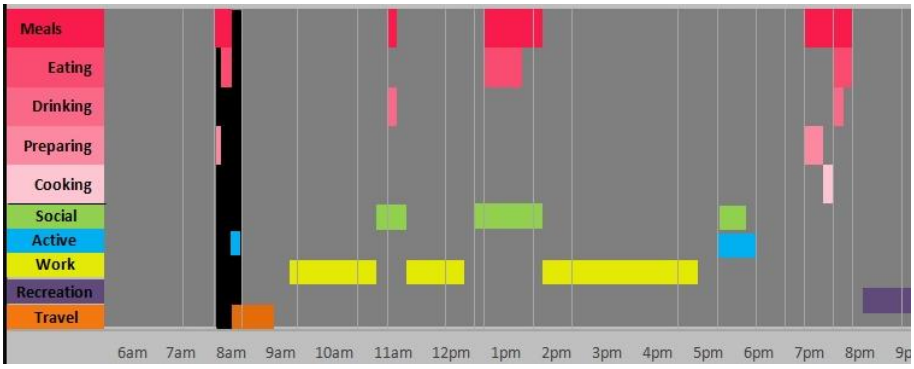


Figure 7.18 Visualisation for viewing sub-activities.

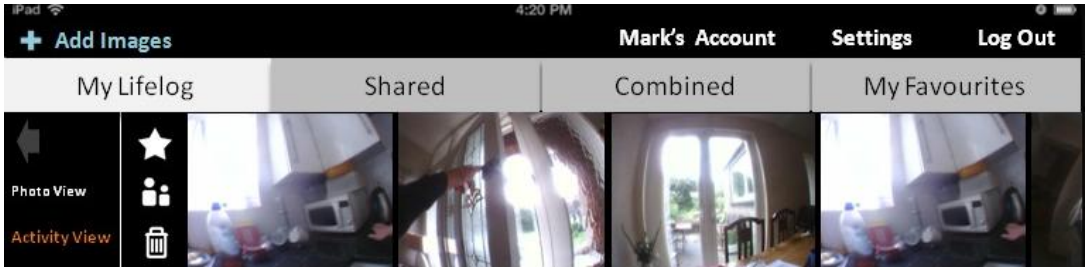


Figure 7.19 Layout for displaying event images and favourite/share/delete options.

Images within an event can be viewed on the top panel of the screen when a user selects specific sections from the main content. A slideshow of this event can be viewed by the user selecting the event from the main content again, or by selecting an image from the top panel. Within the top panel, there are also icons that the user can select to mark an event as favourite, share or delete (Figure 7.19). A user is also offered this option within the slideshow view, seen in Figure 7.20.

The slideshow view automatically displays a series of images within an event. On the top of the screen the user can view event information such as the time the image was captured, the date and the image number in relation to the event. A user can also manually navigate through the event using the next and previous buttons. Once a user reaches the end of an event, they will have the option to view the next event in the sequence.

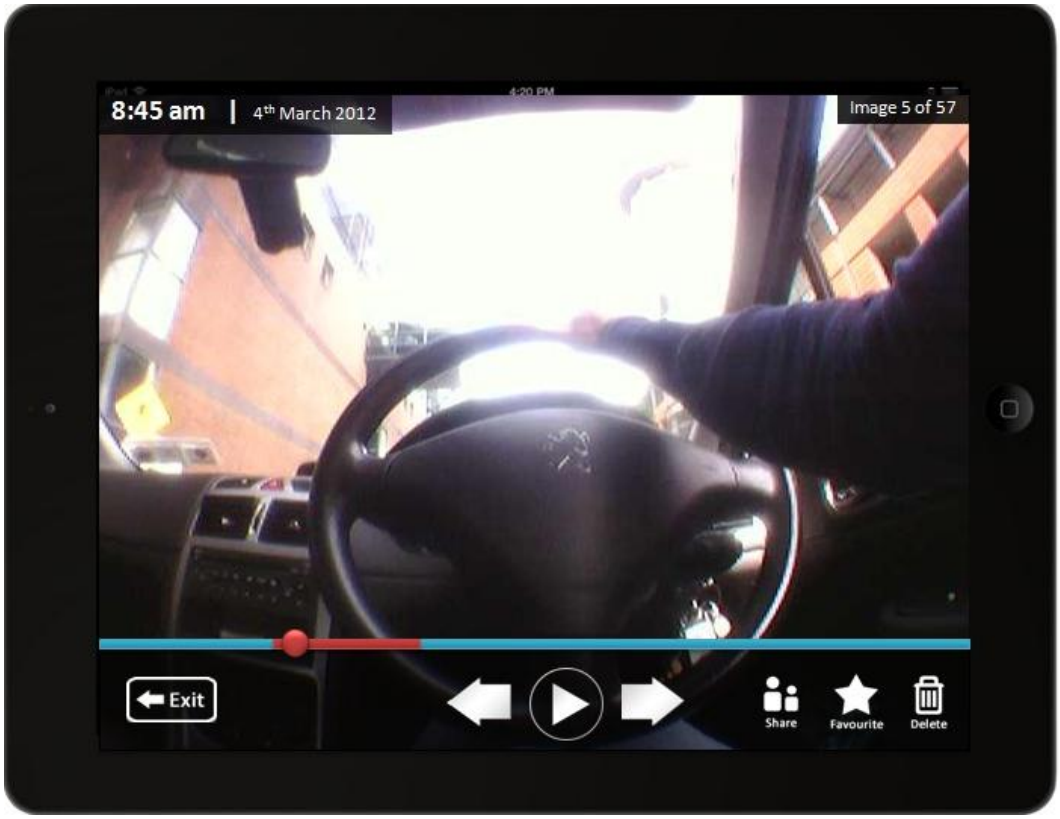


Figure 7.20 Slideshow interface for viewing images within an event.

7.7.3.6 Viewing shared, combined and favourite lifelogs

I have described the interface a user would see, when they are not logged into a personal account, within the Family Lifelog for shared, combine and favourite lifelogs. As found from the exploratory research, people sometimes do not want to share with everyone in a group and may choose to share with specific people. When a user is logged in to their personal account, they can view events or images that have been shared with them, but may not be shared with other family members. A user can also choose to view only events that they have shared, combined or marked as favourite (see Figure 7.21 for example).

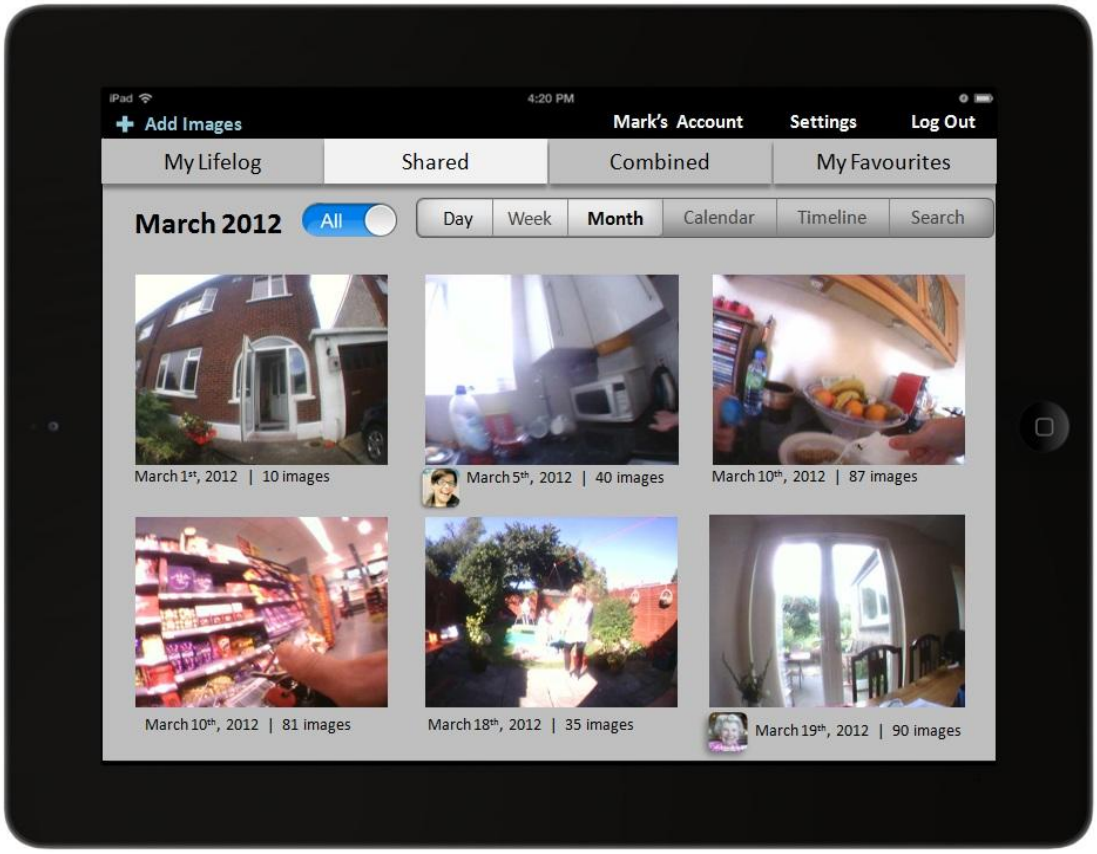


Figure 7.21 Interface for events shared by other family members with the user. A user can also view the events they shared themselves by using the slider option.

7.8 Conclusion

In this chapter I addressed my fourth research question which focused on how a lifelogging application should be designed to support intergenerational interaction. I presented the design concept for Family Capsule; the end product of a combination of influencing factors, which include findings from my previous research studies, existing guidelines for designing for older users and well known state-of-the-art HCI techniques used throughout the design process. I believe that the resulting design would support family group lifelogging and sharing.

In the next chapter I continue to address Research Question 4 when I examine the usage and usability of a family lifelog browser in a prototype field evaluation study.

Chapter 8

Evaluation of Family Capsule in a Home Environment

8.1 Introduction

In the previous chapter I introduced the design of Family Capsule. This design is somewhat aspirational in that some of the technologies underpinning the functionalities that I recommend for a family lifelog browser have not yet been developed for implementation, and are still the subject of ongoing research in content analysis. Nevertheless, in preparation for future developments, we need to evaluate the use and usability of an, albeit simplified, intergenerational lifelog browser in a home environment. The intent of this chapter is to present the evaluation study.

Evaluation is needed to ensure that users can use a product or system and that they like it (Sharp et al., 2007). As well as being useable, the system should be engaging and provide an enjoyable experience. There are three main approaches to evaluation: usability testing, field study and analytical evaluation. Usability testing is an approach that involves measuring users' performance on tasks such as speed and accuracy, and measuring their satisfaction. This is usually conducted in a controlled environment, such as a laboratory. Field study is a method of evaluation which involves users interacting with the system in their natural environment, such as at

home or work, as opposed to a laboratory. Finally, analytical evaluation is an approach that does not involve end-users directly, instead involving experts to predict user performance, often guided by heuristic guidelines and standards. These methods can be applied individually, or all three can be applied to the evaluation of a system. The focus of this study was to evaluate a new design concept, to investigate the functionality of the system by a family in a home environment. Therefore, it was decided that usability testing and a field study should be conducted.

In the first section of this chapter I discuss the development of the Family Capsule prototype. This section includes a usability study where users were asked to perform tasks in order to identify and fix any problems before beginning the evaluation study. The second section then describes the field evaluation. This study involved the placement of a working prototype into a family household, consisting of older and younger adults. Finally, I make some conclusions of how the system can be improved based on the feedback obtained.

8.2 Prototype Development

A prototype of the Family Capsule was built for evaluation by L. Zhou, a software developer within the research team (Zhou, Caprani, Gurrin, & O'Connor, 2013). The system was designed (personal contribution) and implemented based on cross-platform techniques, *flex* for interface design and *Sqlite* for data storage. Images are captured by family members using a lifelog device such as the SenseCam. These images are uploaded to the browser, segmented into events and stored in a database (see use case diagram, Figure 8.1). For the purpose of the evaluation, prototype functionality is focused on:

- uploading SenseCam images to a private user account,
- segmenting images into events,
- browsing images through a slideshow,
- sharing images to a family account,
- marking images as favourite for personal or sharing purposes.

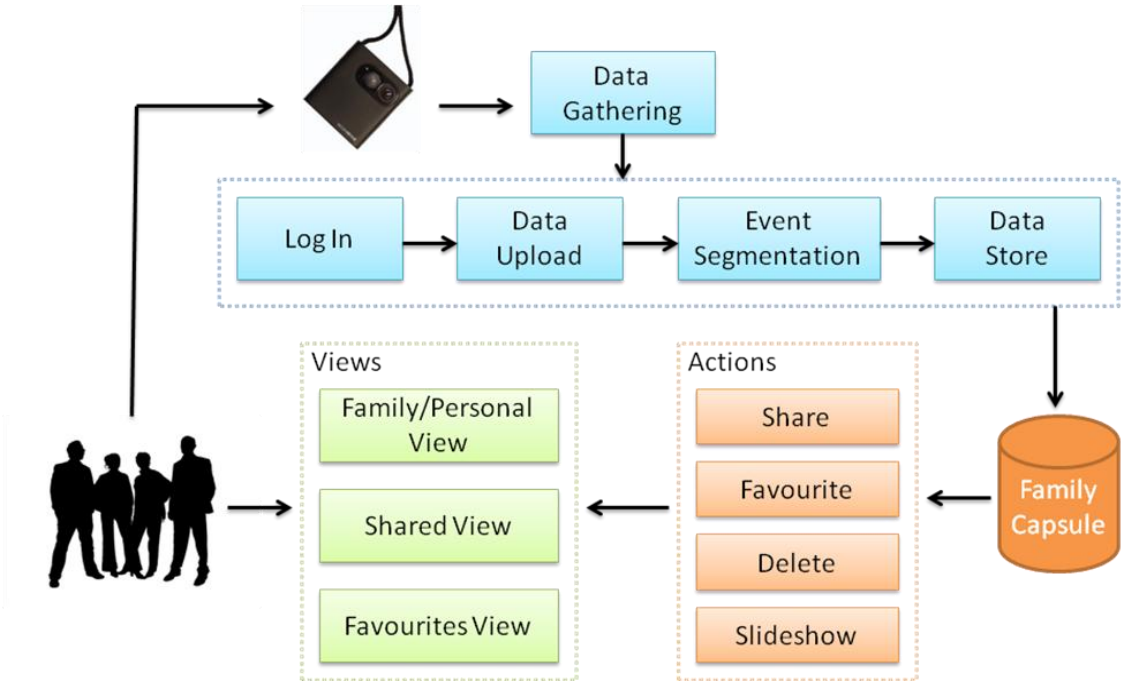


Figure 8.1 Lifelogging and family browser use case diagram.

The prototype system was developed to be used on a touch-screen computer. The current storage capacity required for an extensive lifelog collection meant that the system could not be evaluated using a tablet PC. I believe that this storage problem will become less pertinent with the growing access to cloud computing services. For the current evaluation the browser was run on an ASUS EEE Touch-Screen PC. A screenshot of the prototype can be seen in Figure 8.2.

This prototype system is a simplified version of the proposed intergenerational browser. The purpose of the evaluation was to examine the functionality of the system, and how these functions would be used. This was previously discussed in Chapter 3, where Houde and Hill's (1997) model was outlined. In the previous chapter it was the *Look and Feel* of the lifelog browser that was of interest, whereas in this chapter it is the *Implementation* that is of interest.

Similar to the design concept described in Chapter 7, a user can upload their images to a personal account from which they can browse through their lifelog, share, delete or mark as favourite. In the family view section, all users can view the events that have been shared by their family members, and also the shared favourite

events. In Chapter 7, Table 7.2, a description was given of the approaches recommend to be incorporated into a family lifelog browser and the current feasibility for implementation when using a SenseCam. The feasible techniques were implemented into the prototype. These are group sharing, a personal account, segmenting events, and highlighting events. The remaining approaches, which include highlighting activities, search, combining events and family network, are not yet ready for deployment.

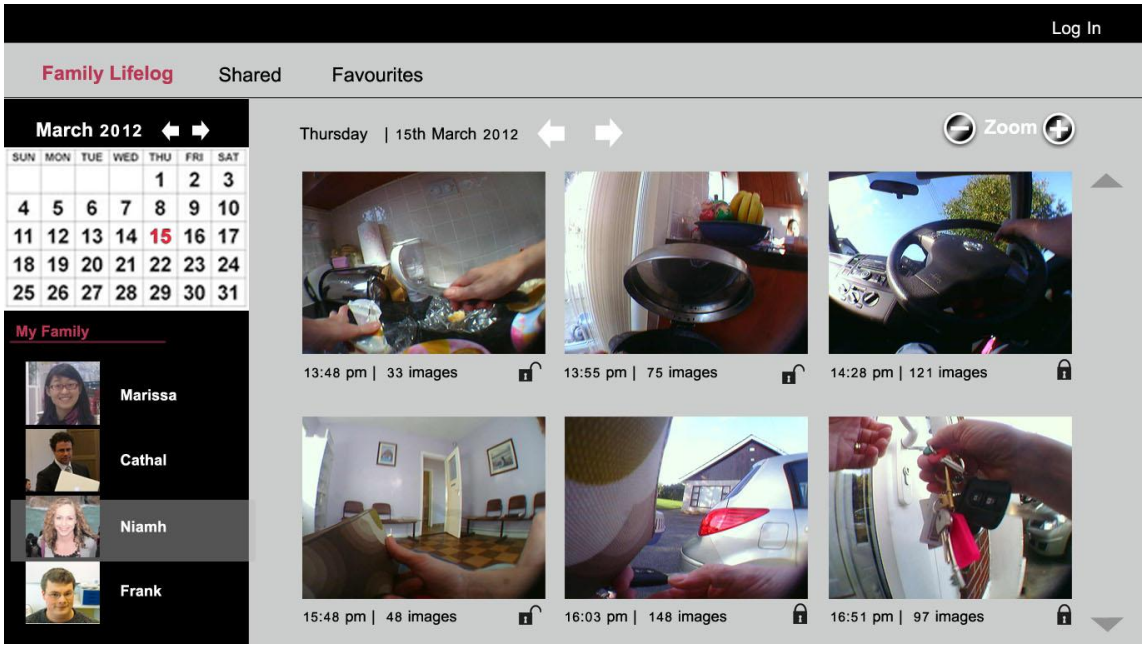


Figure 8.2 Interface design of the Family Capsule high-fidelity prototype.

One finding from my research that I decided to explore during prototype development was that people did not like to force their collections on others, preferring to share them if the other person asked or showed an interest. A strategy that I wanted to explore to create a balance between protecting the user's privacy and triggering an interest from family members was to implement a 'lock system'. For each event a user uploads, which may contain 100 images, only the key-frame image representing the event will be visible to the family. The event will be locked and will display a closed lock underneath the image. Events that are shared by a user will

display an open lock, and will be fully accessible to the family to select and view. I discussed this strategy with the participants following the evaluation study.

8.3 Preliminary User Testing

8.3.1 Overview

Before beginning the evaluation study preliminary user testing was conducted. This was informal user testing conducted in the participant's home. The goal of the testing was to highlight any problems or difficulties the participants had using the system so that they could be corrected before the evaluation study began.

The user testing involved five participants, two older (mean age = 65 years) and three younger (mean age = 33 years). The 'think aloud protocol' was adopted for the user testing, whereby the participants were encouraged to talk through their actions while performing specific tasks. Any difficulties, hesitations or confusion that the users encountered were noted down. After testing, the participants were asked to explain in more detail why they encountered these problems and a potential solution was identified.

The participants were given an introduction to the prototype system and allowed five minutes to freely explore the system. The participants were then asked to complete five tasks. If the user became stuck at any stage during testing, the observer firstly repeated the task instruction. If the user continued to struggle with the task, the observer pointed out the next appropriate action. The participants were given a sheet of instructions to complete the following tasks:

- uploading a set of images from the SenseCam to the browser (user will need to log into an account and select 'add images' option),
- sharing an event (user can either select the share icon under the event image or select the share icon from the slideshow),
- view shared events (the user will select the "shared" option on the main menu),

- finding images to browse on a specified date (the user can use the calendar option or the arrow buttons beside the date label),
- viewing a slideshow of another person's images from the family account (the user will log out of their personal account and select the name of the person whose images they wish to view).

8.3.2 Problems identified

Table 8.1 Problems identified and fixed from user testing

Problems Identified	Problems Fixed
Incorrect images displayed	✓
Event slideshow returning to start	✓
Image count display	✓
Time format display throughout system	✓
Double touch to select event	**Not changed for current evaluation**
Navigation issue	**Not changed for current evaluation**

There were several problems that were identified throughout the user testing which were consistent across all the test users. Some of these problems were due to bugs and inconsistencies (for overview see Table 8.1). For example, when a user was looking at a slideshow of an event it was discovered that the images displayed in the event were not correct. This was due to a problem with the database not refreshing after each slideshow and displaying previously viewed images. Another problem identified was that when the slideshow reached the end of an event, the event refreshed to the start, presenting the first image again. This confused the users who were then not sure if they had viewed all of the images in the event. Solutions to these problems were found and implemented by the software developer. Other minor issues included updating the image count after an image was deleted, and having a consistent time format.

Throughout the system the interaction is set for one touch (similar to single click with a mouse) to select a target. A problem that the developer found was that when selecting the share/favourite/delete option which is presented under the key-frame image, the action triggered the slideshow screen to open. This was occurring even though no contact was being made with the key-frame image. Due to the sensitivity of the touch-screen it was decided that a temporary solution would be to use a double-touch to open the slideshow. This was not ideal however the users did not find any difficulties with it once they were informed.

Other problems were design related. When the user was asked to log into their private account the older users initially tried to select their user name on the left hand panel. This panel was intended for users to navigate to each family member's lifelogs. The Log In button was quickly found after this, therefore it was decided to keep the layout as it was designed.

8.4 Field Study

The approach that I chose to evaluate the prototype system was a field study in a family home. The purpose of the evaluation was to investigate how easy or difficult the system was to use, how a shared lifelog system would be used in a home environment and whether intergenerational interaction would occur.

The family group consisted of two generations of adults living together, two parents and three children. The parents in this family were at the early stage of 'older adulthood'. As well as the three children living with them, they had a son, married and living abroad with their two year old grandchild.

The participants had all worn a SenseCam one year previously. Two of these participants were involved in the previous research studies. The remaining three participants had collected data out of their own interest. The number of days the participants wore the device ranged from 3 days to 8 days. Based on participant feedback from the Phase 2 observation study discussed in Chapter 6, it was felt that these past lifelogs would be more meaningful and more likely to inspire shared

family reminiscence compared to images captured during the evaluation period. Therefore, it was decided to use this data rather than collecting new data, and the image collections that were obtained from the previous year were uploaded to the browser (for image count, see Table 8.2).

Table 8.2 Number of images in each participant's collection uploaded to the prototype system.

Participant (gender, age)	**No. images captured one year previously**
FK (male, 56)	4618
CK (female, 58)	11071
DK (male, 28)	3249
SK (male, 23)	2443
RK (female, 21)	1554

As only one family was used in this study, I acknowledge that the results cannot be generalised to other family groups, which vary in age, dynamics, and living conditions. This evaluation study is to gain some initial feedback on how a family lifelog system might be accepted into a family home.

8.4.1 Materials

A questionnaire was given to the participants following a week-long evaluation period. The questionnaire focussed on the general usability of the system asking participants to rate the use in terms of: ease of use, learnability, efficiency, usefulness, aesthetics, fun and interest, satisfaction, and whether it was emotionally fulfilling. The participants were also asked to rate the usefulness of each feature or function of the browser, such as group sharing, password protection, favourites, image and event deletion etc. According to Fisk et al. (2009), determining the usefulness of a product is the first decision point to acceptance.

The users' interactions were automatically recorded with the system, including when they logged into the account, and when they used the share and

favourite options. After examining the data obtained from the interaction logs it became clear that conclusions could not be made about the participant's activities from this data alone. Activity was only recorded if a user was logged into a particular user account and not when browsing through the shared images, therefore these recordings were discarded. A post-evaluation discussion was conducted with the family group to ask them how they typically used the system and why they used it in the way they did. For example, with the interaction logs, it could be seen that the system was being used but this did not tell us whether there were two or more participants reviewing the images at the one time. Also, if the participants chose not to share their images using the share function, this does not mean that they did not share their images in person. The discussion session was used to explore these possibilities. The questionnaire and interview questions are included as Appendix E.

8.4.2 Procedure

As mentioned above, the participants had collected images using a SenseCam one year previously. These images were uploaded to the Family Capsule prototype system. The touch-screen computer was placed in the participants' home, situated in a communal room where the browser could be easily accessed. The participants were given a demonstration of how to use the browser and were then each given time to interact with it and to ask questions related to its use. Documentation was also provided should the participants need any support.

The participants were informed that the purpose of the evaluation was to explore the usability and use of the system. They were asked to use the system when and how they wished throughout the evaluation period. The system was placed in the family home for one week. During this time, the family was contacted on two occasions. The first was to ensure that the family did not experience any major technical problems with the system and the second was to remind the participants to fill out the post-evaluation questionnaire. After this week, the family were re-visited to discuss their experiences using the system and to gauge their opinions on a family lifelog browser.

8.5 Findings

Our findings from this evaluation study are divided into (1) the usability of the system, (2) the use of the system, and (3) family experience. The participants' feedback from both the questionnaire and the discussion session is included in these sections. Some of the limitations of the study are also highlighted so that future iterations of the system can learn and progress from them.

8.5.1 Usability of system

As part of this study participants were asked to rate their agreement on usability statements such as "the system is easy to use" and "the system is easy to learn". The responses from this section are displayed in Figure 8.3. In this figure it can be seen that overall the participants had a positive user experience. All members of the family found the system easy to use, easy to learn, an efficient way to access information, useful, fun and interesting. Some of the statements that the participants rated slightly lower included the aesthetics, finding the system satisfying, and emotionally fulfilling. As the system was a prototype, there was not a significant amount of time invested on the aesthetics, although we do believe it is a very important aspect. The design described in Chapter 7 represents the projected interface design. There were mixed opinions concerning whether the system was satisfying to use and emotionally fulfilling. This is not all that surprising. As the system is intended for long-term, as well as short-term use, with a family collecting and sharing data over many years, through many generations, I anticipate that any attachment to lifelogs would develop over time.

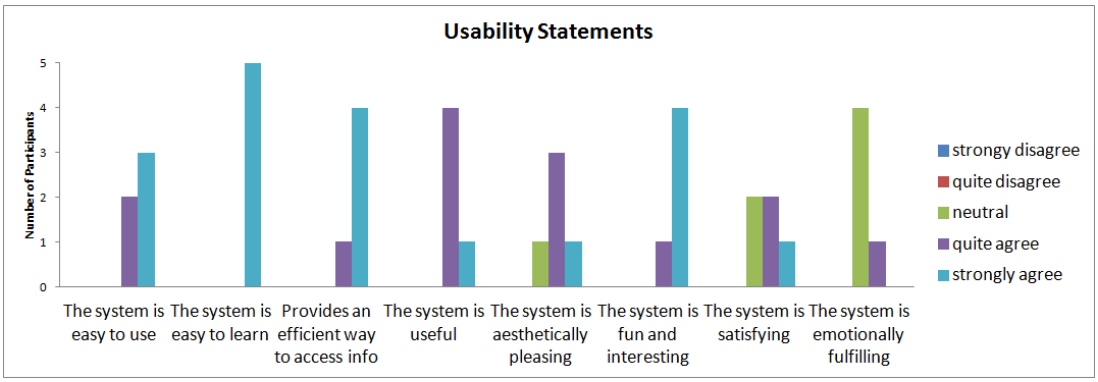


Figure 8.3 Participants' rate of agreement for usability statements.

During the post-evaluation discussion the participants raised some issues that they had when they were using the system. RK, one of the younger participants said that she would have preferred to have more than one key-frame image to represent an event. She suggested showing four smaller images so that a user would have a better idea about their activities before they committed themselves to selecting the event to view as a slideshow.

> *"I would have liked to see a block, maybe four, so you can see what's going on" (RK, age 21).*

The other members in the family agreed that this would have been useful. However, CK, the mother in the family said:

> *"Yeah, I can see why that would be good but I'd have to make sure I'd have my glasses on" (CK, age 56).*

This initial prototype was built to include only the basic elements of the proposed family lifelog browser, with the intention of integrating the design more fully in future iterations. Some of the issues that arose throughout the evaluation are considered in the design outlined in the previous chapter. For example, in this design when a user selects an event they can see the event series on the top of the screen, without having to compromise the size of the key-frame image.

Another issue that was discussed was having the option to share, favourite and delete individual images, rather than the whole event. It was intended to allow

the users to carry out these actions however this problem needed further analysis of the database structure than the development time allowed.

During my time in the participants' home, one of the participants FK, the father in the family, wanted to look through some images he had taken but did not get a chance to look through during the course of the week. As he began to browse through these images CK, his wife looked at the images over his shoulder. Similar to the participants in the observation study, FK and CK pointed out the places that they were at this time, and the people they were with. This also led to stories about the people in the images. However, a problem with the system did arise when the slideshow would not play the images in one of the events.

8.5.2 Usefulness of system

The questionnaire that was given to the participants also asked them to rate their agreement on the usefulness of the system features. As well as rating the usefulness, the participants commented on why they gave this rating. The opinions were further explained during the discussion session. The ratings can be seen in Figure 8.4.

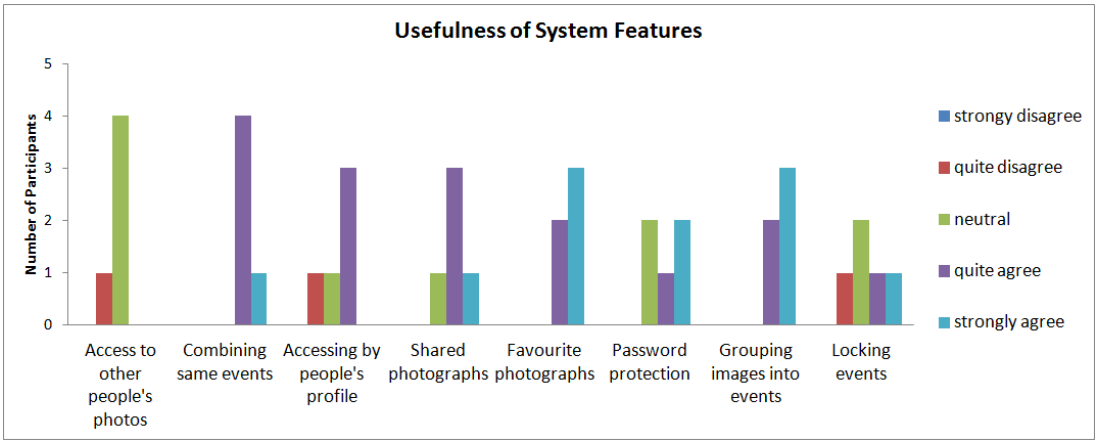


Figure 8.4 Participants' agreement rating for the usefulness of system features.

There was a difference in opinions between the family members particularly in relation to privacy and access to family lifelogs. Only one of the family members, SK, did not share his images with the family, although he did share them with friends

when they visited the house. This was mainly because he was wearing the SenseCam when he was out with his friends. It was this participant who was concerned about the privacy of his collections, rating negatively for aspects of the system relating to access to other people's images, and accessing images for specific people. The reason that SK gave for this was that he did not want to look through people's lifelogs without permission and he would not like anyone looking though his. In contrast, the other family members were very open to sharing; they gave a neutral rating for accessing other people's images because they shared their images together at the same time anyway. Similarly, they believed it was not necessary to lock an event from family access as they would allow free access to their family. The older adults also thought it was not necessary to have a password to log into their account: *"I couldn't think of a picture that I didn't want to share"* (FK, age 56). In the discussion however the family noted that although they are happy to share images with each other, they would not want a neighbour or family friend to have access to their lifelogs if visiting. In this case, they said that they would want to lock their activities. From this discussion it was decided that providing an image of a 'locked' event is not a suitable strategy. It is too intrusive for people who want to keep their lifelogs private, and it is too limiting for those who wish to provide unrestricted access to family. I will maintain the practice of allowing the user to choose when and what to share with their family. It is also worth considering providing a group log-in facility, to ensure that visitors do not have access to the family system without permission.

Although only one of the participants (DK) marked their images as 'favourite', all of the participants said it is an option they would want. The main reason for wanting this feature was that it would allow them to find images they enjoyed easily. However the participants said that during the evaluation period they did not mark their images as 'favourite' because they shared the ones that they liked best. Similarly, although the family rated the share function as mostly positive, they said that they did not use it because they viewed the images in person together. The participants believed that these features would be more useful over long-term use, when they would want to retrieve an event from the past. On this topic, FK said that

he would ‘favourite’ images that he intended to print out as printed photographs are more meaningful to him. Providing an easy method for users to print individual images, or a sequence of images is also something that should be considered for future designs.

The users’ images were automatically grouped into events when uploaded to the system. In the family lifelog section, events that were recorded at the same time by different people were presented side by side. Overall the participants were happy with the way the images were organised, saying that it allowed them to see different people’s view of an activity and allowed them to see things in other people’s images that might have been missed in their own. All of the participants rated organising the images into events and combining family events as being useful.

8.5.3 Family experience

In general the participants used the lifelog system in slightly different ways. As mentioned before, SK only shared his images with his friends. CK said she viewed the images on her own before inviting her family to view them, whereas FK, DK and RK viewed their images for the first time with their family. Among four of the participants there was a definite sense of comfort with sharing their lifelogs.

> *“We all looked at everybody’s. Except SK, because he’s never here most of the time” (FK, age 56).*

DK explained that the system was positioned beside the table where the family have their dinner so it was easy for them to gather around together and look through them. CK and FK said that when they visit their grandchild abroad they always take videos and show them to the rest of the family, so gathering around the Family Capsule added to this family activity. For this family, looking at the SenseCam images together was an important part of viewing them.

> *“I prefer looking at pictures with everyone around rather than sitting there on my own looking at things. It’s more sociable when you have people there and you can remember things with them” (DK, age 28).*

All of the participants commented that DK had the best images. When asked why, they said that it was because DK was wearing his camera when they were on a camping holiday, walking though a forest and on the beach. Because a lot of these images were outdoors with natural light, the images were also brighter and better quality. CK said that she realised when she was looking through her own that she was wearing the SenseCam too high, so that the camera did not capture what she was doing properly. Only when she was sitting down could she see the context of her activities better. Although the family viewed all her images, these were the only images she shared using the system's share function. CK remembered that she wore the SenseCam with the necklace at this particular length to stop it from swinging when she was walking.

Similar to the interactions in the observation study, during the discussion the participants teased each other good naturedly about their images. The family said that they only looked at someone's images if they were there at the time so that they could ask questions and tease them about what they were doing. For example, CK was saying how she was glad to share her images to show all the time she spends doing jobs such as cooking the family's dinner, making bread, and driving to the supermarket. DK joined in to add that the images also showed all the time she spends texting when driving. CK replied that she was parked at the time and then reflected that maybe she should not have shared all her images.

Overall the participants said that they felt the lifelog system fitted in well with their normal family activities. Each person took control of the browser to share their own SenseCam collection and did not have any difficulties with its use. Nearly all of the participants believed that they had worn the SenseCam more often than they had and lamented that they had not captured more images. Apart from SK, the participants wore the device when they were doing family activities, for example, at FK and CK's granddaughter's first birthday party. It was natural then, for these participants to gather together to look through their SenseCam collections. For this particular family, the system supported intergenerational use.

"I think it's a good family activity. I think it fits in well with family life. I think it's a good activity for family periodically to get together and look at photographs in some fashion" (FK, age 56).

FK went on to say that he had an elderly mother in her nineties who he believed would also benefit from wearing a device like the SenseCam. Although his mother lives with FK's sister, she is usually alone during the day while his sister is out at work. CK continued that the elderly woman often has visitors whom she lets into the house. Although there are signs that someone has visited, she cannot remember who it was or even that someone was there. CK said that she would love to be able to go through her mother-in-laws SenseCam recordings with her when these situations occurred so that they could be sure she was not letting strangers into the home. This example demonstrates how lifelog collections could facilitate family life in many ways, depending on family circumstances which vary considerably.

8.5.4 Limitations of study

The evaluation study was concerned with examining the use of a working prototype. This allows me to use the findings to improve the design of the system, but also to learn from the issues relating to the evaluation study itself.

It had been initially considered conducting an evaluation over a month-long period with participants using the SenseCam to record their activities and using the system to upload and view their images. It was believed that this would provide insight into the overall use of the system, such as that shown in Figure 8.1. However there were two reasons why the evaluation structure described abovewas chosen. Firstly, the cost of the SenseCam device (£299) meant that it was difficult to obtain a large supply for an extended length of time. And secondly, it was learnt from the field study described in Chapter 6, that participants attach less meaning to images captured a few days ago compared to images depicting forgotten activities taken months previously.

Another limitation of the study was that it involved only one family group. The reason for this was that in my previous studies, only two members of a family

captured data and many of these had reviewed their images in the follow-up observation study. The family members involved in the current study had all gathered images one year previously making them ideal candidates for participation. However as this is only one family's experience the findings from the study are used to highlight the potential of a family lifelog system, rather than making concrete judgements.

The family consisted of two generations with the parents in their late 50's and the children ranging from early to late 20's. The abilities and experiences of individuals vary greatly, particularly within the older population. The older participants were in the early stages of older adulthood and therefore cannot represent older adults as a whole. A future evaluation would benefit from a larger sample of family groups, of varying in age. This would also necessitate providing all members of participating families with a lifelogging device to collect their data for a reasonable period prior to the evaluation.

8.6 Summary and Conclusion

The purpose of this evaluation study was to gather some feedback from a family using the Family Capsule in their home. Although this was with a simplified version of the proposed system, some level of insight has been obtained into how a family lifelogging system can be integrated into the home and also the problems that have to be worked on.

I began with a user study, asking people to explore and carry out tasks with the system. I identified various problems whilst observing the users carrying out these tasks. Some of these issues were minor and were fixed prior to the field evaluation. Other issues were more complicated. For example, incorporating double-touch interaction to select an event, due to the sensitivity of the touch-screen. From the post-evaluation discussion we also found that the participants felt there needed to be an easier way to navigate from event to event without feeling they have committed themselves by selecting an event to view. These are challenges that will have to be examined further.

The field evaluation highlighted areas where the system could be improved. Some of these issues were considered in the conceptual design but have not yet been implemented into the working prototype. As noted, the participants said they would have liked to see more information about an event before they selected it. They also wanted the option to share/favourite/delete single images. This is certainly possible; however it would have taken more development time to implement than was available for this study. Related to this, the participants suggested providing an option to print out favourite images to share.

It was found that providing the family with one image to represent an unshared event from a family member's lifelog was not appropriate. It was thought that it would create a balance between preserving the user's privacy and allowing family members to see a glimpse into their lives, encouraging an interest in viewing and sharing lifelogs. This was not the case however, as found from the discussion session with one participant feeling it invaded people's privacy and the other participants feeling that it was not necessary as they would allow free access to their lifelogs. Perhaps, as with social networking sites such as Facebook, the user should be allowed to choose their preferred level of security. Also, providing a group log-in would ensure that curious visitors would not have access to the family's shared lifelogs.

Overall, the family gave positive feedback in relation to the usability of the system and their experience interacting with it. Within this family different ways were identified in which the system was used; viewing the SenseCam images on their own, sharing with friends and sharing with family. The method of sharing experiences by sending data such as photographs or text from one person's phone/computer to another person's device is widespread. There is no doubt that sharing in this way facilitates people who are separated by distance. The findings from the study have shown that group sharing, in-person, is also an important part of family life. Although further developments are needed, I believe that an intergenerational lifelog browser, such as Family Capsule, can be integrated into family life, adding to and enhancing traditional methods of life capture.

Chapter 9

Conclusions

In this thesis, three studies were carried out in order to establish and explore the motivations, needs and preferences of older adults in terms of lifelogging. The first study, examining peoples' use of technology in everyday life, showed that although younger people were more likely to use different types of technology, older people showed a significant interest in learning how to use them, particularly those that supported social connectedness. In study two I explored how lifelogging could support social connectedness by examining current practices for life-long collections. From this I established that the motivations for collecting items change throughout a lifetime, however family was at the core of life-long collections. The third study, which was composed of two phases, demonstrated how both older and younger people were more motivated to lifelog when they could share their images, and that through sharing images family interaction, reminiscence and story-telling transpired. The findings from these studies were then applied to the design of a lifelog browser, together with established guidelines of design for older users. I also recommended visualisation techniques to enhance the browsing experience, such as highlighting events and activities, combining events and a family network displaying lifelog activity. I developed a prototype of a family lifelog browser for evaluation. This evaluation, although small, showed that the system successfully supported family members' sharing their SenseCam images with each other, while at the same time providing users with control over their lifelogs.

In this concluding chapter I present my reflections on the research and family lifelogging. I then provide a summary of each of the chapters of this thesis. This is followed by a section dedicated to a set of design considerations for family lifelog systems that capture major lessons learned from my earlier work. Finally, I reflect on some avenues of future research to further develop lifelogging technologies for family groups, following the outcomes of my exploratory and design studies.

9.1 Reflecting on Family Lifelogging

Steve Mann predicted that devices that capture our lifelong memories will soon become commonplace and worn continuously (Mann, 2012). However, Anita Allen (2008) questioned whether the "availability of lifelogging technology might lead individuals to overvalue the otherwise transient details of their lives" (pp.52). In this thesis I explored peoples' current practices for life-long collections, as well as their lifelogging practices. It was learned that although everyone collects items throughout their life, the effort put into collecting and the meaning placed on items varies from person to person. I envisage a similar fate for lifelogging in that some people will choose to wear lifelogging devices continuously, whereas other people might lifelog sporadically. It was found from the field experiment that it is often an individual's lifestyle that dictates when and where they can wear visual recording devices. For example, many of the participants could not wear the SenseCam in their workplace. In contrast to Allen's concern of people overvaluing details of their life, I found that people placed the most value on images that captured the details of their life that were already important to them, such as lifelog images taken when moving house or on a family holiday. Similar to stored text messages, photographs and emails, I believe that people would browse through their lifelogs when they are triggered to do so by an external source.

The exploratory studies indicated that older adults would be motivated to use a lifelog device if it supported family connectedness. Previous studies have highlighted the potential of digital family archives to bring family members together, sharing and reflecting on the recorded data (Kirk et al., 2010; Lindley et al., 2011;

Petrelli et al., 2010). Similarly, I have shown that visual lifelogs support family interaction between older parents and adult children, encouraging reminiscence, story-telling and reflection. Through the discussions with participants throughout the design process, and the feedback from the evaluation study, I am confident that lifelogging will find a place in the family household. I predict that these lifelogs will be shared between older and younger family members, creating bonds through the sharing of experiences, as a reminder of deceased loved ones, learning of past ways of life, and reflecting on one's own life.

9.2 Summary

In the introductory chapter I highlighted the potential of lifelogs to support older people, facilitating shared family reminiscence and life review. I outlined how digital archives can be used to inform us about the lives and activities of generations that have gone before us, not just factual information but intimate details about their everyday life. Previous research has shown that reviewing these lifelog images can have positive results in relation to recall and reminiscence, particularly for people with severe memory problems. However, older adults are more likely to adopt new technology when they retain high-cognitive functioning. With this in mind, I proposed that older adults would be more likely to accept and adopt lifelogging technologies if they were motivated to use them when cognitively healthy. I also proposed that older adults could be motivated to lifelog if a system was designed to fit in with their lifestyle and interests.

In Chapter 2 I provided an overview of what lifelogging is and the evolution of lifelogging. I described how the concept of lifelogging was first established from Steve Mann's live streaming project, and how it has developed into a practice for personal collections. I then gave an outline of Erikson's theory of human development and how it has influenced the research into reminiscence and life review. The literature has also shown that shared reminiscence is an important process for families to learn from older generations, create bonds and to keep alive memories of past relations. However, the use of lifelogging technologies places

certain demands on a user, such as learning how to use the lifelogging device itself, and also the software to view the recorded data. I outlined the problems that may challenge older people being introduced to lifelogging and how the SenseCam may offer an easy-to-use solution.

Chapter 3 outlined the methodology, presenting an overview of the user-centred approach which was applied to the design process. This process was influenced by Houde and Hill's (1997) model on what prototypes prototype, focusing on the role, the look and feel and the implementation of the system. Data gathering techniques were implemented to explore each of these dimensions, actively involving users at each stage. This chapter also presents an overview of the sampling, data gathering, and analysis methods used throughout the research project.

In Chapter 4 I explored my first research question to investigate older adults' current experience of technology in comparison to younger age groups. To understand how to successfully integrate lifelogging technologies into people's daily lives, the questionnaire study focused on the use and preferences of everyday technologies, attitudes towards computers and peoples' perceived difficulty using household devices. Similar to previous research, the findings from the questionnaire study highlighted the awareness and interest that many older people have in technology and a willingness to learn if given the opportunity. I also found that older adults are highly motivated by social interaction, in that they avoid using technology that negates human interaction, but are interested in technology that supports social connectedness, such as mobile phones or video chat. Lastly, the findings from the study highlighted the importance of designing for inclusive use, as the older age groups indicated most difficulties using household devices.

In Chapter 5 I decided to further explore the concept of social connectedness in relation to life-long collections. For this chapter I considered my second research question which was to identify the current motivations of people to collect life-long items. I carried out an interview study with older and younger family members asking them to tell us why they collect things throughout their life, what motivates them to review them and also why they do not collect or keep particular items.

Overall, I found that there were numerous reasons why people collect items, including as a memory support, to share, as a precaution, out of sentiment or as a record of the family background. Patterns emerged which suggested that as people go through different life stages, their motivations for collecting changed. This was also true for why people chose to throw out collections, for example when they move out of their family home and do not have the same amount of storage space. Family was a strong motivation for collection and review, particularly when triggered by the birth of a new baby or the death of a family member. This led me to consider further how lifelogging could be integrated into a family household.

This study contributes to the field of lifelogging as the findings can be used to inform how people store and manage large collections. For example, people stored childhood items in the attic and large collections such as children's drawing were filtered. Although event segmentation goes some way towards lifelog management, searching for and retrieving visual lifelogs is not supported. The findings from this interview study demonstrate why people collect, review and discard images and these findings should inform the way in which lifelogs should be managed.

In Chapter 6 I presented my work in relation to research question three, which focused on whether sharing was a motivation for older and younger people to lifelog compared to personal lifelogging. This study was composed of two parts. In the first part I described a field study in which older and younger family members were given a SenseCam and browser for two weeks. The participants were asked to wear the SenseCam for as many days as they wanted over these two weeks. For one of the weeks they were allowed to share their images, and for the other they were asked to browse through the images on their own. Although the findings did not show statistically significant results, I did find that both older and younger people wore the SenseCam more often during the sharing week and the older participants collected a larger number of images compared to the younger age group. Although the participants could have shared their images with anyone they wanted, they were most likely to share with family, particularly spouse or partner. In the second part of the study I returned to the participants after a six month interval and observed them as

they reviewed their images. I presented the findings from these observations which showed that sharing lifelogs encourages reminiscence, story-telling and reflection.

My final research question was the focus of Chapter 7, in which I considered how a family lifelog should be designed to support intergenerational use. I outlined the characteristics of older users and the suggested guidelines to accommodate for age-related changes. Using wireframe diagrams I recommended visualisation techniques which I believe would support family lifelogging. Following this I developed personae to represent older and younger users based on the lifestyle and motivations identified in my early research studies. Finally, I outlined the conceptual design giving detail of the interface and functionality of the proposed family lifelog browser which I named Family Capsule.

The design concept proposed contributes to an understanding of how extremely large data sets should be presented to users to allow them to browse, find and share interesting images. It was learnt from the interview studies that people discard items if they take up too much space or if too many items accumulate. In a lifetime, a person would accumulate millions of images therefore, the way in which this data is presented is very important. The interface design and visualisation techniques presented here, which are supported by the empirical research studies, offer a solution to the problems associated with the display of large lifelog data sets.

In Chapter 8 I evaluated a prototype version of the family lifelog browser. This browser did not contain all of the functionality proposed in Chapter 7, the reason being that several of the recommended approaches (although showing promising results) are still at a research stage and not yet ready for integration into such a browser. I described the evaluation study which involved placing the touch-screen prototype in the home of a family for one week. The family was composed of two parents and their three adult children. Images collected by the family one year previously were stored on the browser and the family were asked to use the browser over the week. I wanted to explore how the family would use the browser in their home, whether it would fit in with everyday family life and whether the family would engage in intergenerational use. Overall, it was found that the browser did become

part of the family's normal activities. The participants browsed through their images when they were all together, usually following a family meal. As the participants viewed the images together they did not tend to use the share or favourite function within the browser, however as I found from the earlier studies, different people have different sharing preferences. This evaluation highlighted some areas where the browser could be improved. I suggest further evaluation following these modifications and the subsequent implementation of the techniques recommended in Chapter 7.

9.3 Design Considerations

People naturally share their experiences and collections with others, particularly family as it is often family who are an integral part of our experiences. Collections can hold different meanings to us, ranging from personal collections which we tend to keep in a private place, to those we display on walls or mantelpieces in our home. This distinction is not so clear with visual lifelog collections, as the images recorded can quickly change from a shared experience (dinner with family) to a private one (going to the bathroom). I have explored how family members might record and share this information, their preferences and their needs, and from this I have learned some valuable lessons concerning the design of family lifelog technologies. In this section I present considerations which may guide future developments.

- *Design for changing motivations*. People of different ages and at different stages of their life have different motivations for collecting. The meaning of collections can also change over time. We form a stronger attachment to them or they become important for different reasons than those when they were originally captured. To accommodate family members of different ages using a lifelog browser we need to provide support for these changes. I believe that this can be done by supporting both the short-term and long-term use of a lifelog system. Short-term everyday use can be supported by providing recent updates on family members' activities (such as updating when an event can been shared), facilitating users to

combine images from a shared event, and highlighting events and activities for a user to browse through. Long-term use can be supported through summarising lifelog activity, building a family network and allowing users to search through past lifelogs.

- *Design for intergenerational use*. We learn about our past from the stories that our parents and grandparents tell us. Having a visual artefact, such as a photograph, can significantly enhance story-telling and shared family reminiscence. SenseCam images can tell us even more about the past as they capture large quantities of images from everyday activities. These images could be of our past, our parents' or grandparents' past, or the lives of family members that have gone before us. This would give younger family members a unique opportunity to question older generations about captured events, or if they did not know or remember an event, then deciphering the activities together. By focusing the design on both older and younger users, we can support family interaction and intergenerational use. This includes designing interfaces that accommodate older users' capabilities and utilising technology, such as touch-screen devices, with which both older and younger people can easily interact.

- *Making use of individual contributions*. As people age they tend to develop an interest in their family history. This is often triggered by the death of older generations and the realisation that as people die, stories and information about their past often goes with them. Gathering information about family history can be overwhelming. People put off creating a family tree because they don't have the time, they're not sure where to look, or they do not trust the accuracy of the information they find. Creating a visual lifelog is way of preserving a record of events, and in a family lifelog if all family members created their own record, any shared information can then be used to create a family network, or family tree. This family network could evolve through the generations, keeping an ongoing record of people, their birth, their activities (those they chose to share) and finally their death.

- *Support image sharing*. Sharing is one of the main motivations for collecting items throughout one's life. The way in which people share their lifelog images can vary depending on the relationship they have with other people, whether people are

present at the time of browsing, or the level of interest in the images themselves. To accommodate for this it is important to support in-person group sharing as well as remote sharing. Technology, such as touch-screen tablet PCs with a large screen, can support sharing in a family group as more than one person can view and interact with it at any one time. Providing users with an option to share with their family group or specific people, and to combine their events with other people, can support remote sharing, allowing people to view each other's images in their own time or in another location.

- *Give control to the user*. SenseCam images are inherently private and personal collections due to the nature in which they are recorded. Browsing through lifelog collections can reveal traits about ourselves that we may not have been aware of and may not want to share with others. For this reason it is necessary to ensure that lifelog collections are secure and that only chosen images and events are shared. This sense of privacy encompasses lifelog remains, where users should have control over what they want to pass onto their family after death.

- *Support browsing and retrieval*. Thousands of images can be captured in one day with a lifelogging device. Collections stored over many years would result in millions of images. Finding a specific image could be like finding a needle in a haystack. I presented some techniques to support everyday browsing and the retrieval of images from a lifelog collection, which included search, automatically detecting activities and highlighting important events. Time is also an important part of the browsing experience, allowing users to place where they were at any given time and for how long. Checking the date an image is taken can also inform users as to when and why they are doing certain activities. Presenting information over a timeline, alongside images, can support this.

9.4 Future Work

This thesis presented exploratory studies to inform the design of a lifelog browser for older adults. I proposed that the browser Family Capsule would be used by both younger and older family members so that they could collect and share

everyday lifelog data, and at the same time build a family archive that can be shared with future generations. In this section I outline potential studies to be conducted that would be logical extensions of the work presented here.

9.4.1 Implementation of visualisation approaches

In Chapter 7 I suggested visualisation techniques that would enhance a family lifelog browser influenced by the findings from the exploratory studies. Currently the work investigating the development of these techniques, such as automatically extracting lifestyle traits from SenseCam images, has shown promising results (Doherty et al., 2011). Doherty and colleagues suggested some areas in which this technique could be applied, including analysis of health and well being, improving personal efficiency, and automatically creating labelled personal diaries of past activities and interests. I believe this last application would enhance a family lifelog browser, not only by automatically labelling activities, but also to allow a user to find, browse and share events that are of interest to them and their family. Similarly, providing users with the ability to automatically combine shared events with their family members would enhance family lifelogging, as people are interested in viewing images from events that they were part of and also viewing events from a different perspective than their own. Some work has been carried out to investigate how lifelogs can be augmented using visual features and matching them to images from external sources, such as images from web sites. Combining lifelog images from two separate collections would be a more complicated process, however I believe it would be a very interesting challenge for future studies.

Node-link diagrams are common representations for hierarchical information and it is the method most often used by genealogical applications to display family trees. My visualisation extended the common family tree by utilising the lines linking family members. The length of these lines represented temporally the life of a person beginning with their birth and ending at their current age or death. Using the lines as a platform I suggested displaying the lifelog activity of the person, with vertical lines representing one year and the height of the line representing the quantity of images captured during this year. As far as I am aware, such a

visualisation does not exist. This could be a potential avenue for future research and development in the lifelogging domain, not just for family lifelogging but possibly in areas such as social networks where the activity of groups over time is of interest.

Currently, in my opinion the SenseCam is the most useable lifelogging device for older adults, however new devices such as the Autographer[2] and other devices investigated for the purpose of visual lifelogging, such as mobile phones, may prove to be more successful in the future. Certainly, context aware sensors integrated into these devices, such as GPS and Bluetooth (communicating with other devices to identify other people present), would significantly improve the search and retrieval of images and events.

9.4.2 Extending family lifelogging across households

Throughout these studies the sharing of lifelog images has been limited to a local computer within a household. One of the reasons for this was because the participants were new to lifelogging and the SenseCam, and therefore may not understand at first the level of detail that the camera can capture. I wanted to avoid any concerns that people may have about uploading and sharing their images online. It is my conjecture that in time people will become as comfortable sharing their lifelogs as they are sending text messages and emails to people. In preparation for this, lifelog research could investigate sharing lifelog images across households.

Many of the older participants in my studies had children and grandchildren living abroad with whom they share photographs and videos. Sharing lifelogs could extend current family practices by allowing families to share their daily experiences and routines. In the interview study some of the older participants said that they frequently view videos of their grandchildren because they cannot often see them in person. Future research could examine whether sharing lifelogs between family members living in different regions supports connectedness, and also how a family

[2] http://www.autographer.com/

lifelog browser would be used by multiple generations of family; children, parents and grandparents. My research did not directly examine the involvement of children lifelogging or browsing family lifelogs, however I believe it would be a topic worthy of further exploration.

One issue that should also be considered for personal lifelog information within a family lifelog application is 'lifelog remains'. In other words, what happens to the data when the user is deceased; is it automatically deleted, do family members inherit it, or should the user have a digital will of some sort? Previous research has shown that in the absence of explicit instructions, family members of deceased individuals use their own discretion over what they think their family member would consider private within their digital collections (Massimi & Baecker, 2010). Privacy in digital collections is more ambiguous compared to physical items such as a diary or personal letters. The participants in my studies indicated that they would want only the images they chose to share while living to be passed on to future generations, however they also said that they would like to have had their parent's or grandparent's lifelogs. This topic could be explored in more detail with a specific emphasis on visual lifelogs.

9.4.3 Supporting life review

As technology has advanced, wearable computing has become easier to wear. The devices are smaller, the battery life is longer, and the storage potential has increased. It has only been due to these developments that lifelogging is now a realistic endeavour. With the commercialisation of the SenseCam and Autographer we may see a new generation of lifeloggers. As this trend increases, in time it will become possible to explore whether lifelogs would support people as they grow older and begin to review their life. In this thesis I have observed the positive effects of sharing lifelogs, in terms of reminiscence and story-telling, however it would only be possible to examine life review after years or even a lifetime of data collection.

9.5 Conclusion

Taken as a whole, this thesis calls attention to the potential of lifelogging technologies within a family group, and provides an early exploration into this space through a series of questionnaires, interviews and field studies. These studies informed the design of a lifelog browser to support older and younger generations of families to connect and share their experiences. This has also opened the door to further opportunities for the exploration of family lifelog systems and their potential to support shared family reminiscence and life review.

Appendices

Appendix A: Author Publications

I have published a number of works which have directly contributed to this thesis. These are as follows:

A.1 Papers

Zhou, L., **Caprani, N**., Gurrin, C., O'Connor, N.E. (2013). ShareDay: A New LifeLogging Brower System for Group Sharing. Proc of MMM 2013, China.

Caprani, N., Doyle, J., O'Grady, M., Gurrin, C., O' Connor, N.E., Caulfield, B., O'Hare, G. (2012). Technology use in everyday life: Implications for designing for older users. *iHCI 2012: 6th Annual Irish Human Computer Interaction (HCI) Conference*, Galway, Ireland , 20-21 June 2012.

Caprani, N., O' Connor, N.E. & Gurrin, C. (2012). Touch screens for the older user. In *Assistive Technologies*. InTech Open Access Publisher, ISBN: 978-953-51-0348-6.

Doherty, A.R., Pauly-Takacs, K., **Caprani, N**., Gurrin, C., Moulin, C. J.A., O'Connor, N.E., & Smeaton, A.F. (2012). Experiences of aiding autobiographical memory using the SenseCam. *Human Computer Interaction*. 27 (1-2), 151-174.

Caprani, N., O'Connor, N.E., & Gurrin, C. (2011). Motivating lifelogging practices through shared family reminiscence. *Proceedings CHI 2011 Workshop: Bridging Practices, Theories, and Technologies to Support Reminiscence*, Vancouver: ACM.

Caprani, N., O'Connor, N.E., & Gurrin, C. (2011). Considerations for a touch-screen visual lifelog. *ICMR - ACM International Conference on Multimedia Retrieval*, Trento, Italy: ACM.

Doherty, A.R., **Caprani, N**., Ó Conaire, C., Kalnikaite, V., Gurrin, C., Smeaton, A.F., & O'Connor, N.E. (2011). Passively recognising human activities through lifelogging, *Computers in Human Behavior, 27*(5), 1948-1958.

Caprani, N., Gurrin, C. & O'Connor, N.E. (2010). I like to log: A questionnaire study towards accessible lifelogging for older users. *ASSETS 2010: The 12th International ACM SIGACCESS Conference on Computers and Accessibility*, Orlando: ACM.

Caprani, N., Doherty, A.R., Lee, H., Smeaton, A.F., O'Connor, N.E., & Gurrin, C. (2010). Designing a touch-screen SenseCam browser to support an ageing population. *Proceedings of CHI 2010*, Atlanta: ACM.

A.2 Presentations

Caprani, N., O'Connor, N.E., & Gurrin, C. (2012). Sharing as a motivation for lifelogging. *SenseCam 2012*, Oxford, UK.

Caprani, N., Doherty, A.R., Lee, H., Smeaton, A.F., & O'Connor, N.E. (2009). Utilising the simplicity of touch to enable older people review their SenseCam images independently. *SenseCam 2009.* Chicago, Ill., USA.

Appendix B: Study 1 Materials

Experience with Technology Questionnaire

You are invited to participate in this survey, carried out by the CLARITY centre, involving researchers from University College Dublin, Dublin City University and the Tyndall Institute, Cork.

The purpose of the survey is to gain an understanding of the technology experience of older people in Ireland and to compare this with the experiences of those under 60. Therefore, if you are 18 years or older, you are eligible to take part.

The survey should take approximately 20 - 30 minutes to complete. You do not have to complete the questionnaire all at once – you may start one day, and finish it the next, for example. However, please try to answer all questions.

Your decision to participate in this study is entirely voluntary and you may decide at any time to withdraw. The responses of all participants will be completely confidential. Only the researchers working on this project will have access to the information provided. Any information that is published or used publicly will maintain participant anonymity.

Once complete you can return it to the address below, or you can return it to the person who gave you the survey and they will return it to us.

Dr. Julie Doyle and Niamh Caprani

Main CLARITY Office
Science North
University College Dublin
Belfield, Dublin 4

B.1 Demographic Questions

Question 1. Gender: Male ☐ Female ☐

Question 2. What **age** group are you in?

- ☐ 18 – 29
- ☐ 30 – 49
- ☐ 50 – 64
- ☐ 65 – 79
- ☐ 80 +

Question 3. What is your current marital status? Check **one**.

- ☐ Single
- ☐ Married
- ☐ Separated
- ☐ Divorced
- ☐ Widowed
- ☐ Other (please specify)

_____

Question 4. What is your primary mode of transport? Check **one**.

- ☐ I drive my own vehicle
- ☐ A friend or family member takes me to places I need to go
- ☐ Transportation service provided by where I live
- ☐ I use public transport

Question 5. How often do you use public transportation (e.g., train, bus, luas)?

- ☐ Daily
- ☐ Weekly
- ☐ Monthly
- ☐ Yearly
- ☐ Never

Question 6. How often do you drive? Check **one**.

- ☐ Daily
- ☐ Weekly
- ☐ Monthly
- ☐ Yearly
- ☐ Never

Question 7. On average, how many hours **per day** do you spend at home, **including** sleeping hours?

- ☐ Less than 8 hours
- ☐ 8-11 hours
- ☐ 12-15 hours
- ☐ 16-19 hours
- ☐ 20-24 hours

Question 8. What is your primary occupational status? Check **one**.

- ☐ Student
- ☐ Work full-time
- ☐ Work part-time
- ☐ Homemaker
- ☐ Family carer
- ☐ Retired
- ☐ Volunteer worker
- ☐ Seeking employment
- ☐ Other (please specify)

_____

B.2 Technology Experience Questions

Question 1. Do you own a Personal Computer (laptop or desktop computer)?

- ☐ Yes
- ☐ No
- ☐ No, but would like to

Question 2. If you answered **no** to the above question, do you currently use a computer somewhere else?

- ☐ No
- ☐ Yes, at work
- ☐ Yes, at a family member's house
- ☐ Yes, at a friend's house
- ☐ Yes, at a public place (e.g. library)
- ☐ Yes, other (please specify)

_____

Question 3. Which of the following activities have you either used before **on a computer**, currently use **on a computer** or would like to use **on a computer**?

	I have never used	**I have used before**	**I currently use**	**I would like to use**
Email				
Looking for information on the internet				
Online banking				
Skype (calling another computer)				
Skype with video (webcam)				
Online Shopping				
Paying bills				
Storing and looking at photographs				
Storing and playing music				
Reading a newspaper online				

Question 4. How much more training would you like to have in the use of technology?

- ☐ None
- ☐ A little
- ☐ Moderate training
- ☐ A lot

Question 5. What features on a **mobile phone** have you either used before, currently use or would like to use?

	I have never used	**I have used before**	**I currently use**	**I would like to use**
Making a call				
Text messaging				
Camera				
Picture messaging				
Radio				
Internet				
Bluetooth				
Mp3 Player				

Question 6. Within the last year, which of the following methods have you **used for communication**? (Note: check the box under "Not sure what it is" if you have never heard of it).

	Not sure what it is	**Never**	**Seldom**	**Sometimes**	**Often**	**Almost Always**
Answering machine						
Mobile phone						
Fax machine						
Internet - email						
Internet – Skype (calling someone using the internet)						
Telephone						

Question 7. How often do you **communicate**, through any of the above methods, with **any** other people (e.g., family members, friends, doctors etc.)?

- ☐ Daily
- ☐ Weekly
- ☐ Monthly
- ☐ Yearly
- ☐ Never

Question 8. Within the last year, which of the following have you **used for shopping**?

	Not sure what it is	**Never**	**Seldom**	**Sometimes**	**Often**	**Almost Always**
Credit/Laser Card						
Supermarket self-checkout						
Internet (e.g., online shopping)						
Person on the telephone						

Question 9. How often do you go **shopping**?

- □ Daily
- □ Weekly
- □ Monthly
- □ Yearly
- □ Never

Question 10. Within the last year, which of the following have you **used for financial transactions** (e.g., bill paying, banking, tax preparation)?

	Not sure what it is	**Never**	**Seldom**	**Sometimes**	**Often**	**Almost Always**
Dealing with a person face to face (e.g., going to post office						
Automated teller machine (ATM)						
Internet (e.g., online banking, online bill paying)						
Person on the telephone						
Software (e.g., Microsoft Excel, for your accounts)						

Question 11. How often do you make **financial transactions**?

- ☐ Daily
- ☐ Weekly
- ☐ Monthly
- ☐ Yearly
- ☐ Never

Question 12. Within the last year, which of the following **healthcare devices have you used** in your home?

	Not sure what it is	**Never**	**Seldom**	**Sometimes**	**Often**	**Almost Always**
Blood pressure measurement						
Digital thermometer						
Emergency call system						
Infusion pump						
Monitoring device (e.g., glucose, heart monitor)						
Nebulizers						
Oxygen equipment						

Question 13. How often do you use **healthcare devices** at home for yourself or others (this **does not** include medication)?

- ☐ Daily
- ☐ Weekly
- ☐ Monthly
- ☐ Yearly
- ☐ Never

Question 14. Within the last year, which of the following **transportation-related systems** have you **used?**

	Not sure what it is	**Never**	**Seldom**	**Sometimes**	**Often**	**Almost Always**
Airport self check-in kiosk						
Parking self-payment station						
Self- purchase ticket station (e.g., luas, DART ticket machines)						
In-car navigation system (e.g., GPS, TomTom)						
Internet travel schedule (e.g. bus timetable)						
Person on the phone						
Internet maps or directions (AA route planner, Google maps)						

Question 15. Within the last year, which of the following **leisure/hobby/entertainment-related** systems have you **used**?

	Not sure what it is	**Never**	**Seldom**	**Sometimes**	**Often**	**Almost Always**
Computer/Video Game/Wii						
Digital photography						
Fitness device (e.g., pedometer, treadmill)						
Hobby specific computer usage (e.g., internet, sports, recipes)						
Online support group (e.g., chat room, discussion forum)						
Recording and playback device (e.g., CD, DVD, VCR)						

Question 16. How often do you engage in leisure/hobby/entertainment-related activities?

- □ Daily
- □ Weekly
- □ Monthly
- □ Yearly
- □ Never

Question 17. Within the last year, which of the following **home-based** systems have you **used**?

	Not sure what it is	**Never**	**Seldom**	**Sometimes**	**Often**	**Almost Always**
Microwave oven						
Home security system (e.g., house alarm, gate access)						
Personal computer						
Programmable device (e.g., lights, thermostat, sprinkler)						

Question 18. For each of the following statements, please **circle** a number along the scale, where 1 means you strongly disagree with the statement and 5 means you strongly agree.

	Strongly Disagree	**Disagree**	**Neither Agree not Disagree**	**Agree**	**Strongly Agree**
1) If given the opportunity, I would like to learn about and use computers	1	2	3	4	5
2) I do not think I would be able to learn the computer terms and jargon	1	2	3	4	5
3) I am confident that I can learn computer skills	1	2	3	4	5
4) Anyone can learn to use a computer if they are patient and motivated	1	2	3	4	5
5) I am afraid that if I begin to use computers I will become dependent upon them and lose some of my reasoning skills	1	2	3	4	5

Question 18 Continued

	Strongly Disagree	Disagree	Neither Agree not Disagree	Agree	Strongly Agree
6) I feel apprehensive about using computers	1	2	3	4	5
7) I hesitate to use a computer for fear of making mistakes that I cannot correct	1	2	3	4	5
8) I avoid using computers because I don't need to use them	1	2	3	4	5
9) I am interested in learning to use a computer but I am not sure how it would benefit me	1	2	3	4	5

Question 19. For each of the following statements, please circle a number along the scale, where 1 means you find the activity very difficult and 5 means you find it very easy.

	Very Difficult	Difficult Enough	Neutral	Easy Enough	Very Easy	Not Applicable
1) A computer	1	2	3	4	5	N/A
2) Internet	1	2	3	4	5	N/A
3) Email	1	2	3	4	5	N/A
4) Texting with a mobile phone	1	2	3	4	5	N/A
5) Making calls with a mobile phone	1	2	3	4	5	N/A
6) Microwave oven	1	2	3	4	5	N/A
7) Digital camera	1	2	3	4	5	N/A
8) Radio	1	2	3	4	5	N/A
9) Home alarm system	1	2	3	4	5	N/A
10) Television	1	2	3	4	5	N/A
11) Programming a DVD or VCR	1	2	3	4	5	N/A

Appendix C: Study 2 Materials

Interviews on Life-long Collections

C.1 Demographic Information

1. Your Gender: **Male** / **Female**

2. Your Age: [ ]

3. Do you own a mobile phone? **Yes** / **No**

4. Do you have computer access in your home: **Yes** / **No**

5. Do you have Internet access in your home: **Yes** / **No**

6. Familiarity with Computers

Never Used a Computer	Not Very Familiar	Familiar Enough	Very Familiar	Expert
1	**2**	**3**	**4**	**5**

C.2 Interview Schedule

1. Is there anything that you collect or keep a record of, either now or in the past?
2. Where do you store these collections?
3. What are the reasons for collecting them?
4. How often would you take them out to look at?
5. For what reasons would you look through them?
6. Can you tell me if you use any devices to collect items, such as a mobile phone? What types of things do you record with it (messages, emails, appointments)?
7. Do you keep these and if so have you ever looked back at them?
8. Do you ever show your collections to friends or people in your family? Where or how would you share them?
9. Do people share their collections with you? Where or how would they share them with you?
10. Do you think you record these events for yourself or to share with other people?
11. Can you tell me if you have kept anything related to your family background?
12. What do you think are the positive and negative aspects of collecting these items?
13. What do you think will happen to these collections after you are gone?
14. Do you think you would like to save these collections on a computer? What are your reasons for this?

Appendix D: Study 3 Materials

Field Study

D.1 Guide for Using the SenseCam

Using the SenseCam

Turning on/off – you can turn the SenseCam on or off by pressing the button in the top of the device for a few seconds. When it is turning on it will make a beep sound at an orange light will appear beside the button.

Turn the SenseCam off when you are not wearing it to save the battery. You will most likely only need to turn it off when you are going to bed or if you decide you do not want it to record anything for an extended period.

Privacy button – press this button to temporarily stop the device from taking pictures. It will reactivate automatically after 7 minutes.

Activate button – this button allows you to take a picture manually or to re-activate the device if you had previously pressed the privacy button.

Status lights – an orange flashing light will indicate every time an image is captured. A red light indicates that the privacy button has been pressed and the device is not taking any images at this time.

Charging

You will be given a charger lead with a plug on one end and a small square plug on the other end. It is recommended that you charge SenseCam at night when you are sleeping so that the battery will be full for the next day.

To charge the SenseCam, put the small end of the charger into the SenseCam in the slot on its side (see picture below) and plug the other end into your domestic plug socket.

D.2 How to Use the SenseCam Browser

STEP 1: Turn on computer

- Press the power button on the computer (bottom right hand corner)
- Wait a few moments for the computer to warm up
- Touch the picture of the orange SenseCam twice in quick succession
- This will open up the SenseCam photo browser

STEP 2: Add your photos from SenseCam to Computer

- When you wear the SenseCam it takes photos. To see these photos you will need to add the photos from the SenseCam to the computer. To do this:
- Plug your SenseCam into the computer
- Touch the green **"Add"** button on the left hand side, it is above the help button.
- A new purple screen will appear. Touch the **"Start"** button. This will load the photos. When the photos are added the main screen will reappear with your photos displayed.
- While plugged in there should be a red light at the top of the SenseCam. Do not unplug the camera when there is a red light. This means that the SenseCam is transferring photos to the computer.

STEP 3: Look at Your Photos

- The photos are grouped into events. So each picture you see on the main screen represents a set of photos, such as you driving or eating.
- You can touch one of the event photos to see the photos within it. This will bring up a blue coloured screen.

- Your photos should play automatically through the event. You can press the "**Pause"** button to stop it and you can press the "**Next"** and "**Previous"** buttons to look through them one at a time. If you want it to play automatically press the Play button.
- Press "**Close"** at the right hand side to close this screen and go back to the main screen
- You can touch another event photo to look through a different event

To Look at Photos from Previous Days

If you want to look at yesterday's photos or photos you added from a previous day…touch the orange **"Show Calendar"** button on the left side of the screen. This will bring up your calendar. If you have photos on a day it will show up red. Today's photos may not be in red however.

To Delete a Photo

If there is a photo you want to delete…from the main screen touch the event photo where the photo you want to delete is. This will bring up the blue screen. You can press the **"Previous"** and **"Next"** buttons to look through the images until you come across the photo you want to delete. When you find it touch the **"Delete"** button. If there is more than one photo touch "**Delete"** for each one. If there is a whole day you want to delete you can contact the researcher.

To Add a Label to a set of Photos

You may want to add a label to a set of images if you want to remember it or if you think you may want to look at it again. Adding the label will help you to find it again easier.

When you touch a photo for the important event from the main screen it will bring up the blue screen. On the left hand side is an **"Add Label**" button. Touch this. This will bring up a keyboard. Touch the letters to type out your label. If you make a mistake you can press **"BackSpace**" or "**Clear Label".** When you are happy with the label touch the yellow **"Save Label"** button.

STEP 4: Turn off computer

- You can close the SenseCam photo browser by pressing the red "Close" button at the top right side of the screen. If a message comes up asking you to wait a few moments it means that the SenseCam has not finished deleting the photos from it. It is best to leave the computer and come back to it after 10 minutes or so.
- When you press the "Close" button the computer's green "desktop" screen will show. At the bottom left is a **"Start"** button. Press this. This will pop up a blue section. At the bottom is a red **"Turn off Computer"** button. Press this. You will then be asked to press the red **"Turn off"** button again.

D.3 Designing a Touch-Screen SenseCam Browser to Support an Ageing Population

Section taken from - Caprani, N., Doherty, A. R., Lee, H., Smeaton, A. F., O'Connor, N. E. & Gurrin, C. (2010). Designing a touch-screen SenseCam browser to support an ageing population. *CHI 2010 - 28th Conference on Human Factors in Computing Systems*, 10-15 April 2010, Atlanta, Georgia, USA.

The Development of the SenseCam Browser

Purpose of study

The purpose of this study was to design a browser using novel technologies to facilitate older people, who had never used a computer, to easily review their SenseCam images. The proposed SenseCam browser was developed through three stages:

1. An evaluation of two existing SenseCam browsers
2. The design of a new SenseCam browser
3. The evaluation of the new SenseCam browser through a longitudinal field study with older users

Evaluating existing SenseCam browsers

As part of our work we initially asked three older adults between the ages of 62 and 79 years to assess two SenseCam image browsers currently being used by neuropsychological researchers, (1) DCU event segmentation browser and (2) Microsoft SenseCam browser.

The participants wore the SenseCam over a 2 day period and then reviewed the images using both aforementioned browsing applications, one after the other in alternating sequence. Questions were put to the participants regarding the physical characteristics of the browsers (screen characters, icons and text), navigation (how to view next/previous images, different days), organisation of information (natural grouping of information, consistency), and conceptual (feedback to user, system status, possibility for error making). Some of the common problems that were identified from these browsers were as follows:

- Image thumbnail size too small to identify context
- Speed of image presentation too fast to process
- Text size and colour contrast not appropriate
- Scrolling caused difficulties
- Computer terms were not easily understood
- Event information was not clear (time and date)
- No help option available
- Difficulty navigating to different days or time of day
- Require experience using desktop computer

Suggested Design

The issues that emerged from this exploratory study were used to guide the design of a new SenseCam image browser for older adults. Throughout the design process, low fidelity prototypes were shown to older individuals to obtain continuous feedback and to keep the design focus on older users. The factors implemented into the design were as follows:

Physical characteristics

- The application was designed for touch-screen use to encourage novice computer usage
- On the main screen, event key-frame images are displayed large enough to recognise context
- Target buttons are designed to be large to encourage usability and interaction
- Text size is set at a minimum of 14 pt to accommodate visionary difficulties
- There is a focus on high colour contrast between the text and background colour
- The image size was set so that the content and context can be easily recognised by users

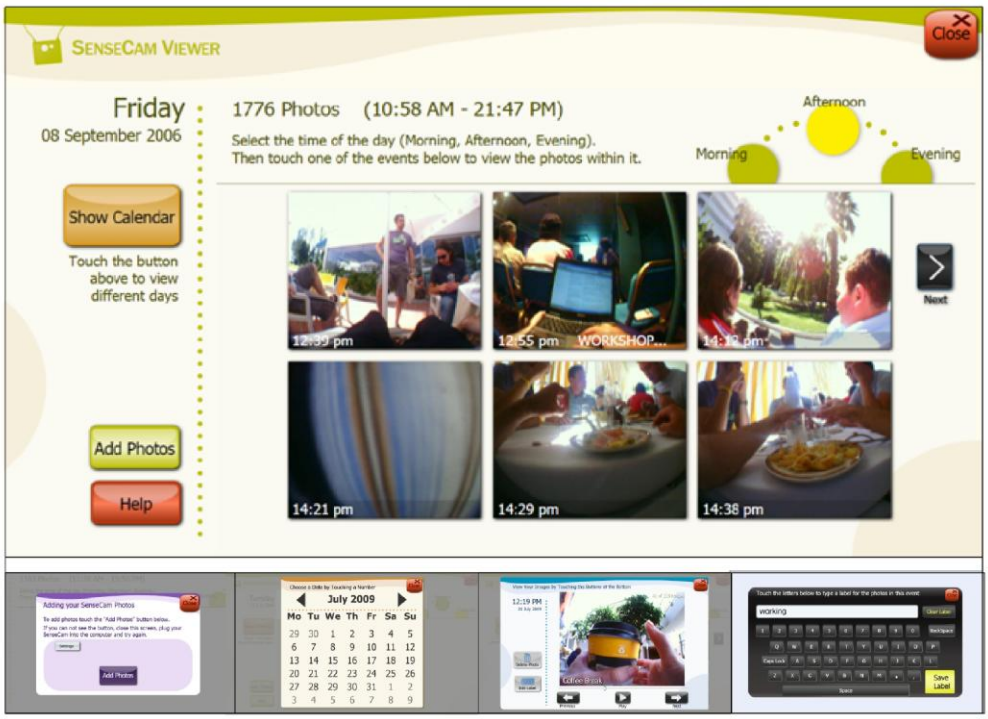
Navigation

- There is no scrolling required throughout the application, instead previous/next buttons are used
- Items are positioned so that they can be easily seen and accessed
- Instructions are provided on each page to guide the user through any action
- Images can be viewed as a continuous slideshow at moderate speed or by looking through them one by one
- Information organisation

- The design and layout of each page is standard
- Users have the option to add a label to their event
- Users can readily see information about the images
- Help option highlighted in red to ensure visibility

Conceptual

- Immediate feedback is offered through highlighting and a low frequency beep tone on target selection
- Users are provided with delete and undo delete functionality to improve user control over the content
- The language used is generalized to be understood by novice computer users



User Trial and Evaluation

To evaluate whether the design of the SenseCam browser is appropriate for older adults we placed a touch-screen computer with the installed application in the homes of three older participants (different to the original three participants) for a two week period. The participants were between the ages of 64 and 79 years. None of the participants had ever used a computer. The participants were asked to wear the SenseCam everyday and to upload their images using the SenseCam browser. As the participants had never used a computer, written instructions were provided to guide them through turning on and off computer. The participants were also given an introduction and demonstration of the browser and directed to the help section should they need it. The participants were visited 3-4 times during the trial period.

Data Gathering Methods

1. A pre-trial questionnaire was supplied to gather some demographic information
2. The participants were asked to keep a diary
3. The participants' use of the browser was recorded; including time interacting with it, buttons pressed etc.
4. A post-trial questionnaire was administered

Findings

The findings from the evaluation were taken from the post-trial questionnaire and the automatically recorded interactions. Although the participants were encouraged to write down any problems or thoughts into the diary provided, none of the participants used it. During the trial period some technical issues arose for two of the participants. Only one week of one of the participant's recorded interactions could be used.

The findings show that the participants accessed the SenseCam browser at least once a day throughout the trial period and spent between 15 minutes to 1 hour interacting with it. There were no set times of the day that the participants used the browser. Access to the system was dependant on when the user was in the home and had some free time. In all, our participants collected five week's worth of SenseCam data, corresponding to 27,212 images which were automatically segmented into 308 events. SenseCam data was gathered at regular intervals and our participants interacted with the browser just as frequently.

Novel activity of reviewing the day

Considering the fact that reviewing one's day with passively-captured photos is quite a novel activity that none of our participants has done (or was aware of) before, a number of novel experiences were reported, discussed, and their value was mentioned. For example, one user remarked on how he had taken some good photos of his grandchild at the beach. This example highlights how valuable the SenseCam is for capturing typical day-to-day activities that would not normally be recorded.

Developing personal pattern of use

From the usage data we collected it was revealed that certain features such as the delete and label function, while rarely used by our participants, were perceived as highly useful. Other features such as the buttons to view the different times of day, and the play/pause button were frequently used by our participants as they produce an immediate and obvious output to the user. This highlights how certain features could be perceived more or less important depending on the duration of expected usage, and a longitudinal study such as this should take this into account.

Ease of use

The users commented that they found the photos to be easy to view and find, and that the browser helped them to remember what they did on different days. All three of the participants said that they would use the browser again and that they would recommend it to a friend. In particular, the users rated the browser highly for its ease of use, efficiency in accessing information and as an aesthetically pleasing interface. Our participants found no problems reading the text on the screen and frequently referred to the date of the images being reviewed. The participants also noted that the image size of the thumbnails on the main screen was a good size for them.

Increasing user confidence in technology

The participants' confidence in using the touch-screen computer and interacting with the browser gradually increased throughout the trial period. They also found it satisfying to use and felt it gave a sense of future technology. At the beginning of the trial the participants did not know how to turn on or off the computer or how to select an item on the screen. A combination of face to face guidance, paper instructions of how to access the computer and browser and the help section within the browser assisted in building up the users' comfort and confidence with the technology. After the trial, all of the participants were accessing and interacting with the system without any input from the researcher: "It took me a while to get used to it as first as I had never used a computer but I soon got in on it".

Conclusions

We have experienced and discovered numerous issues in introducing lifelogging technologies to elderly non-technical participants, whom we believe are representative of a set of users who may find memory aids such as the SenseCam to be of great benefit to their quality of life. There are a number of challenges moving into the future. As

images are captured on an external device (to the PC), it is a little daunting for non-technical users to download images from the camera, and we believe that this process must be simplified even further in future. However, we received very positive feedback from our non-technical older participants, who repeatedly commented that they felt they were satisfied with using our browser, and that it gave them a sense of future technology. It was very pleasing to see these participants independently browse their own SenseCam images, and mostly to see their increased sense of confidence in computing technology.

D.4 Field Study Post Week Questionnaire

Section 1: Wearing the SenseCam

Please answer these questions only in relation to the previous week

Question 1. How many days did you wear SenseCam for this week?

Question 2. Were there times when you did not wear it? Why?

Question 3. How did you feel about the **size** of SenseCam?

Really Disliked	Disliked	Neither	Liked	Really Liked
1	2	3	4	5

Question 4. How did you feel about the **shape** of SenseCam?

Really Disliked	Disliked	Neither	Liked	Really Liked
1	2	3	4	5

Question 5. How did you feel about the **colour** of SenseCam?

Really Disliked	Disliked	Neither	Liked	Really Liked
1	2	3	4	5

Question 6. Do you have any **comments** about the **appearance or feel** of the SenseCam?

Question 7. How did you find wearing the SenseCam **around your neck**?

Really Difficult	Difficult	Neither	Easy	Really Easy
1	2	3	4	5

Question 8. How easy or difficult did you find the **lights** on the SenseCam to understand?

Really Difficult	Difficult	Neither	Easy	Really Easy
1	2	3	4	5

Question 9. Do you have any further **comments** on how easy or difficult you found the SenseCam to **wear**?

Question 10. How easy or difficult did you find **turning on and turning off** the SenseCam?

Really Difficult	Difficult	Neither	Easy	Really Easy
1	2	3	4	5

Question 11. How easy or difficult did you find the **buttons on the side** of the SenseCam to use for privacy or to manually take a picture?

Really Difficult	Difficult	Neither	Easy	Really Easy
1	2	3	4	5

Question 12. How easy or difficult did you find **charging** the SenseCam?

Really Difficult	Difficult	Neither	Easy	Really Easy
1	2	3	4	5

Question 13. How easy or difficult did you find **remembering to wear** the SenseCam?

Really Difficult	Difficult	Neither	Easy	Really Easy
1	2	3	4	5

Question 14. How easy or difficult did you find remembering **where you put** the SenseCam?

Really Difficult	Difficult	Neither	Easy	Really Easy
1	2	3	4	5

Question 15. Do you have any further **comments** about how easy or difficult you found **using** the SenseCam?

Question 16. How comfortable did you feel wearing the SenseCam when around **friends or family**?

Really Uncomfortable	Uncomfortable	Neither	Comfortable	Really Comfortable
1	2	3	4	5

Question 17. How comfortable did you feel wearing the SenseCam around **strangers**?

Really Uncomfortable	Uncomfortable	Neither	Comfortable	Really Comfortable
1	2	3	4	5

Question 18. How comfortable did you feel wearing the SenseCam **in your home**?

Really Uncomfortable	Uncomfortable	Neither	Comfortable	Really Comfortable
1	2	3	4	5

Question 19. How comfortable did you feel wearing the SenseCam **in public**?

Really Uncomfortable	Uncomfortable	Neither	Comfortable	Really Comfortable
1	2	3	4	5

Question 20. Did any of the following people ask you about the SenseCam? You may tick more than one.

- ☐ Spouse
- ☐ Sibling
- ☐ Parent
- ☐ Grandparent
- ☐ Children
- ☐ Grandchildren
- ☐ Friends
- ☐ Neighbours
- ☐ Strangers in the street
- ☐ Shop assistants
- ☐ Other

Please Specify_____

Question 21. How often did people ask you about the SenseCam?

Never	Seldom	Sometimes	Often	Very Frequently
1	2	3	4	5

Question 22. How comfortable did **other people feel** when you wore the SenseCam?

Really Uncomfortable	Uncomfortable	Neither	Comfortable	Really Comfortable
1	2	3	4	5

Question 23. Do you have any **comments** about wearing the SenseCam at **home or in public**?

Section 2: Sharing SenseCam Photographs

Please answer these questions only in relation to the previous week

Question 1. Please rate how often you **looked** at your own SenseCam photos for the previous week only.

- □ Never
- □ Once this week
- □ Between 2 and 3 times this week
- □ Between 4 and 6 times this week
- □ More than 7 times this week but not every day
- □ Once a day
- □ More than once a day

Question 2. Please rate your enjoyment for **looking at your own** SenseCam photos for the previous week only.

Really Disliked	Somewhat Disliked	Neither	Somewhat Liked	Really Liked
1	2	3	4	5

Question 3. Why did you choose this answer?

Question 4. Please rate how often you **shared** your SenseCam photos with other people for this week.

- ☐ Never
- ☐ Once this week
- ☐ Between 2 and 3 times this week
- ☐ Between 4 and 6 times this week
- ☐ More than 7 times this week but not every day
- ☐ Once a day
- ☐ More than once a day

Question 5. What type of SenseCam photographs did you mostly **share** with others? *You can choose more than one option. Leave blank if you did not share.*

- □ Photos with family in them
- □ Photos with children in them
- □ Photos with friends in them
- □ Funny photographs
- □ Myself doing activities. *Please Specify*

_____

- □ Scenic photos
- □ Photos with animals in them
- □ Unusual photos
- □ No particular type
- □ Other. *Please Specify*

_____

Question 6. Who did you **share** your SenseCam photos with for the previous week only? *You can choose more than one option. Leave blank if you did not share.*

- □ Parent/Child taking part in study
- □ Spouse
- □ Children
- □ Grandchildren
- □ Sibling
- □ Friends
- □ Other People. Please Specify_____

Question 7. Please rate your enjoyment for **sharing** your photos for the previous week only. Leave blank if you did not share.

Really Disliked	Somewhat Disliked	Neither	Somewhat Liked	Really Liked
1	2	3	4	5

Question 8. Why did you choose this answer?

Question 9. Would you have shared your SenseCam photos more if you:
(choose more than one if appropriate)

- ☐ Captured different or better photos
- ☐ Seen a person who would be interested in looking
- ☐ Able to send them to person through computer
- ☐ Able to easily find particular photos again
- ☐ Other (please specify)

Question 10. Please rate how often you **were shown other people's** SenseCam photos for the previous week only.

- ☐ Never
- ☐ Once this week
- ☐ Between 2 and 3 times this week
- ☐ Between 4 and 6 times this week
- ☐ More than 7 times this week but not every day
- ☐ Once a day
- ☐ More than once a day

Question 11. Please rate your enjoyment **looking at other people's** SenseCam photos. *Leave blank if you were not shown any.*

Really Disliked	Somewhat Disliked	Neither	Somewhat Liked	Really Liked
1	2	3	4	5

Question 12. Why did you choose this answer?

_____

_____

_____

_____

Question 13. What did you **like best** about recording the SenseCam photographs? *You can choose more than one option.*

- □ Wearing the SenseCam
- □ Putting photos onto the computer
- □ Looking at my photographs
- □ Showing my photographs to other people
- □ Looking at other peoples photographs
- □ None of these
- □ Other. *Please specify*

_____

Question 14. What did you **like least** about recording these photographs? *You can choose more than one option.*

- □ Wearing the SenseCam
- □ Putting the photos onto the computer
- □ Looking at my photographs
- □ Showing my photographs to other people
- □ Looking at other peoples photographs
- □ None of these
- □ Other. *Please specify*

_____

Question 15. Would you like to keep your SenseCam photographs?

- □ Yes
- □ No

Please explain your answer.....

End of Questionnaire

Appendix E: Prototype Evaluation

E.1 Post-trial Questionnaire (Condensed Version)

- **How frequently did you access the system?**

  - ☐ Less than once a week
  - ☐ Once a week
  - ☐ A few times a week
  - ☐ Once a day
  - ☐ A few times a day

- **What was your preferred way to use the Family Lifelog system?**

  - ☐ Looking through my photographs ***on my own***
  - ☐ Looking through my family members photographs ***on my own***
  - ☐ Looking through my photographs ***with my family***
  - ☐ Looking though my family members photographs ***with my family***
  - ☐ Other _____

- **Please rate (i.e., tick an appropriate box) agreement or disagreement with the following sentences:**

	Strongly agree	Quite agree	Neutral	Quite disagree	Strongly disagree
The system is easy to use					
The system is easy to learn how to use					
The system provides an efficient way to access information					
The system is overall useful					
The systems interface is aesthetically pleasing					
The system is fun and interesting to use					
The system is satisfying to use					
The system is emotionally fulfilling					

- **Please rate (i.e., tick an appropriate box) agreement or disagreement with the following sentences:**

	Strongly agree	Quite agree	Neutral	Quite disagree	Strongly disagree
Having access to everyone's photographs is useful					

Reason for this rating if any:

	Strongly agree	Quite agree	Neutral	Quite disagree	Strongly disagree
Combining same events from different people is useful					

Reason for this rating if any:

	Strongly agree	Quite agree	Neutral	Quite disagree	Strongly disagree
 Accessing photographs by the family member profile is useful					

Reason for this rating if any:

	Strongly agree	Quite agree	Neutral	Quite disagree	Strongly disagree
Accessing shared photographs is useful 					

Reason for this rating if any:

	Strongly agree	Quite agree	Neutral	Quite disagree	Strongly disagree
Accessing favourite photographs is useful 					

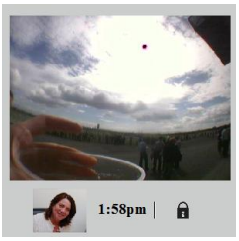
Reason for this rating if any:

	Strongly agree	Quite agree	Neutral	Quite disagree	Strongly disagree
The login in and password feature is useful 					

Reason for this rating if any:

	Strongly agree	Quite agree	Neutral	Quite disagree	Strongly disagree
Grouping photos into events/activities is useful 					

Reason for this rating if any:

	Strongly agree	Quite agree	Neutral	Quite disagree	Strongly disagree
Seeing one image from group of locked events is useful 					

Reason for this rating if any:

- **Were there features within the system that you didn't understand?**
- **What are the good things about the system? And why?**
- **What are the bad things about the system? And why?**
- **Are there any new features you would like to see in the system, or any existing features that could be improved? What are those and why?**

E.2 Post-Evaluation Discussion Questions

1. Tell me how you typically used the system. (For example, when I use it I look though my family's photos, then log into my own, browse through those and mark some for sharing).

2. Tell me how did you typically shared your photos? (Did you mark them as shared on the system or look through them with other people?)

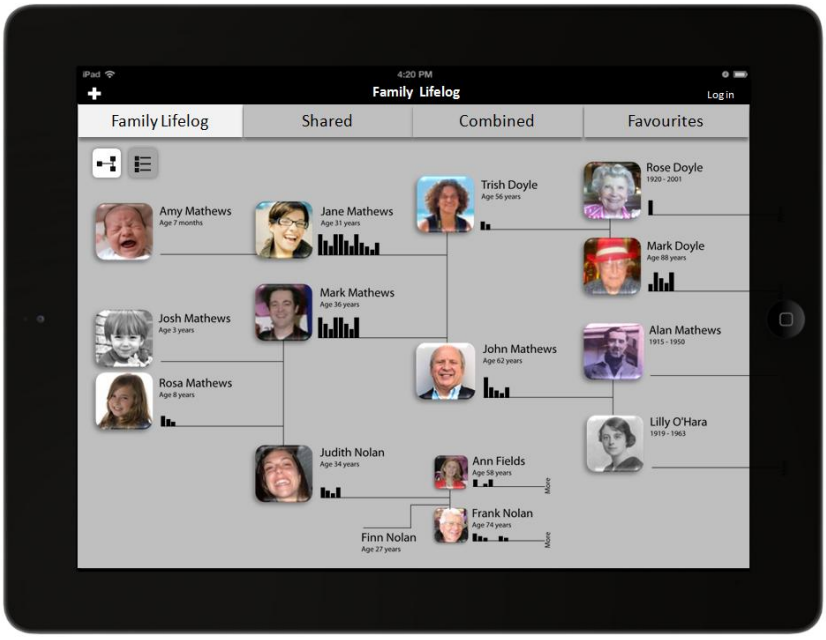
3. How did you look through other people's photos? (Did you do it when you were on your own or if they wanted to show you?)

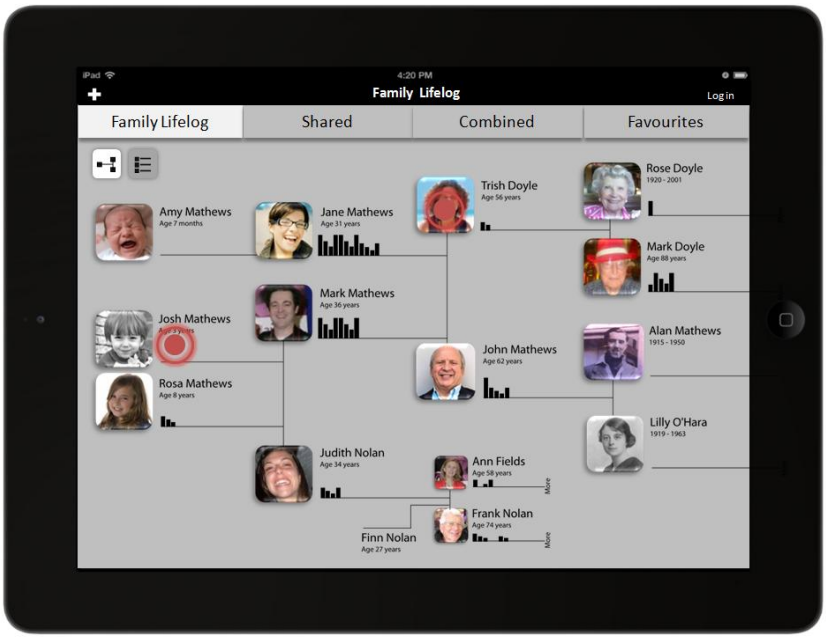
4. Did any particular person take control over using the system?

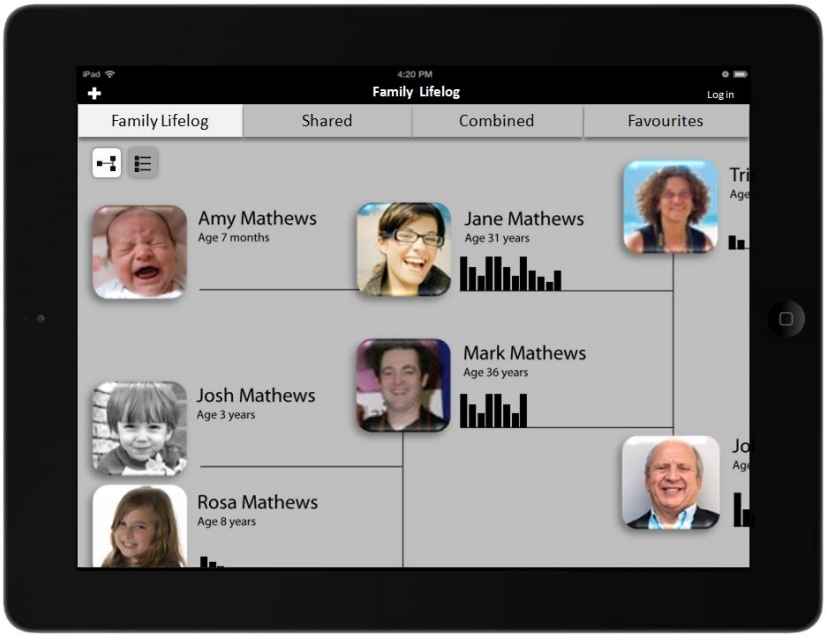
5. What were your thoughts on allowing family to see one picture of an event that you have not shared?

6. How do you think the system fits in with family life?

Appendix F: Prototype Screens



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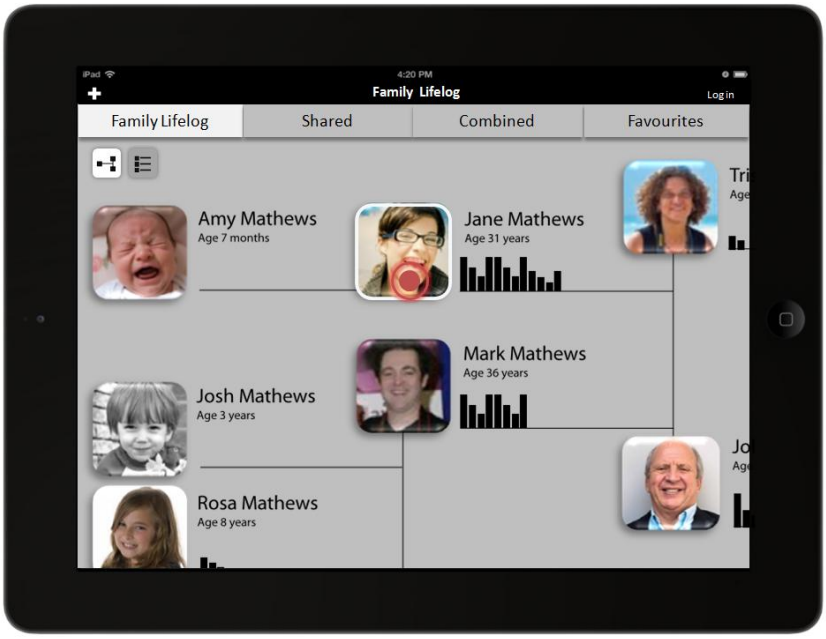
Family Lifelog
Log in
Family Lifelog
Shared
Combined
Favourites
Amy Mathews
Age 7 months
Jane Mathews
Age 31 years
Mark Mathews
Age 36 years
Josh Mathews
Age 3 years
Rosa Mathews
Age 8 years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4:20 PM
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Log in
Family Lifelog
Shared
Combined
Favourites
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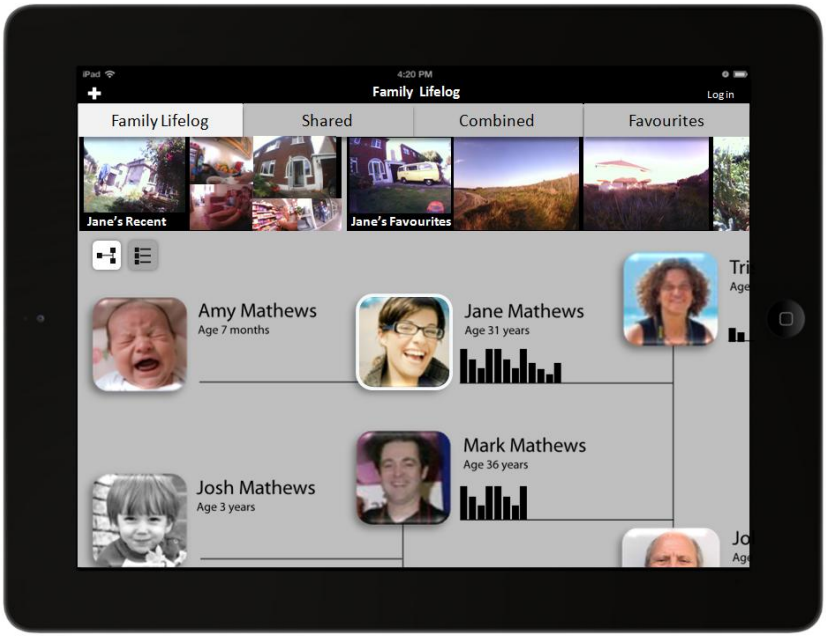
Age 7 months
Jane Mathews
Age 31 years
Mark Mathews
Age 36 years
Josh Mathews
Age 3 years
Rosa Mathews
Age 8 years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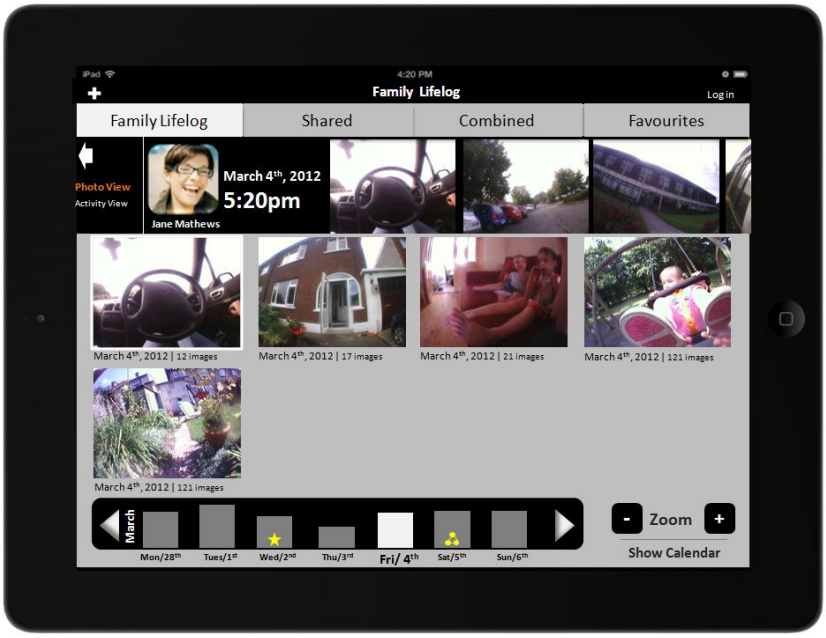
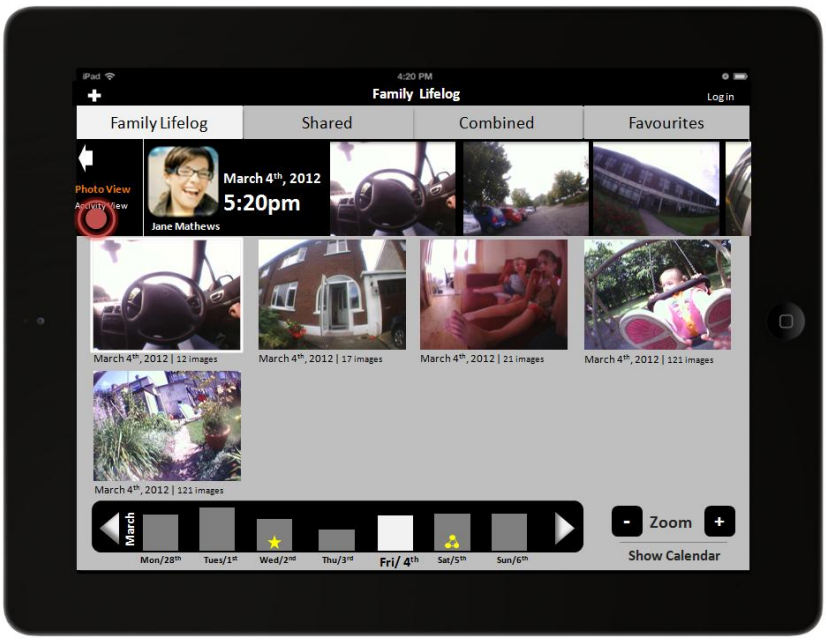
Family Lifelog
Log in
Family Lifelog
Shared
Combined
Favourites
Jane's Recent
Jane's Favourites
Amy Mathews
Age 7 months
Jane Mathews
Age 31 years
Mark Mathews
Age 36 years
Josh Mathews
Age 3 years


iPad
4:20 PM
Family Lifelog
Log in
Family Lifelog
Shared
Combined
Favourites
Jane's Recent
Jane's Favourites
Amy Mathews
Age 7 months
Jane Mathews
Age 31 years
Mark Mathews
Age 36 years
Josh Mathews
Age 3 years


iPad
4:20 PM
Family Lifelog
Log in
Family Lifelog
Shared
Combined
Favourites
Photo View
Activity View
March 4th, 2012
5:20pm
Jane Mathews
March 4th, 2012 | 12 images
March 4th, 2012 | 17 images
March 4th, 2012 | 21 images
March 4th, 2012 | 121 images
March 4th, 2012 | 121 images
March
Mon/28th
Tues/1st
Wed/2nd
Thu/3rd
Fri/ 4th
Sat/5th
Sun/6th
Zoom
Show Calendar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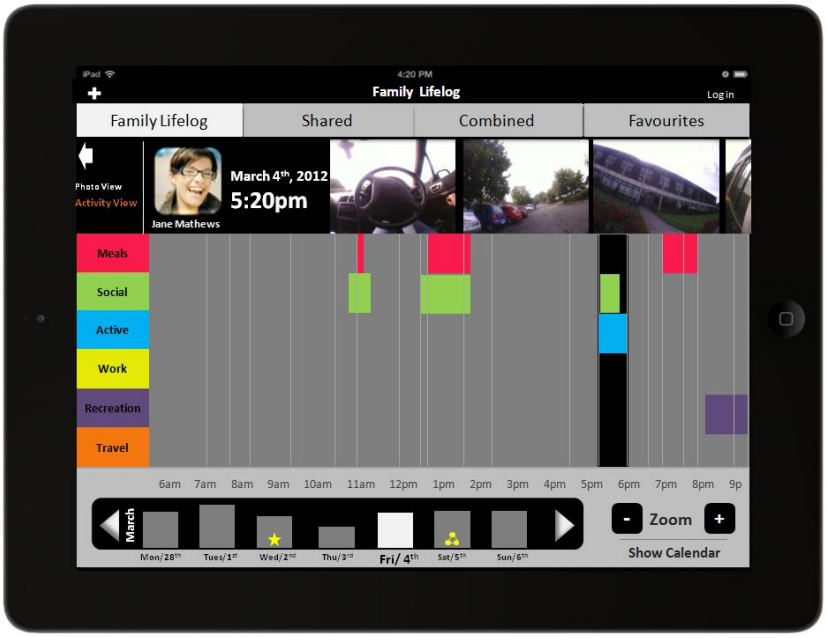
Family Lifelog
Log in
Family Lifelog
Shared
Combined
Favourites
Photo View
March 4th, 2012
5:20pm
Jane Mathews
March 4th, 2012 | 12 images
March 4th, 2012 | 17 images
March 4th, 2012 | 21 images
March 4th, 2012 | 121 images
March 4th, 2012 | 121 images
March
Mon/28th
Tues/1st
Wed/2nd
Thu/3rd
Fri/ 4th
Sat/5th
Sun/6th
Zoom
Show Calendar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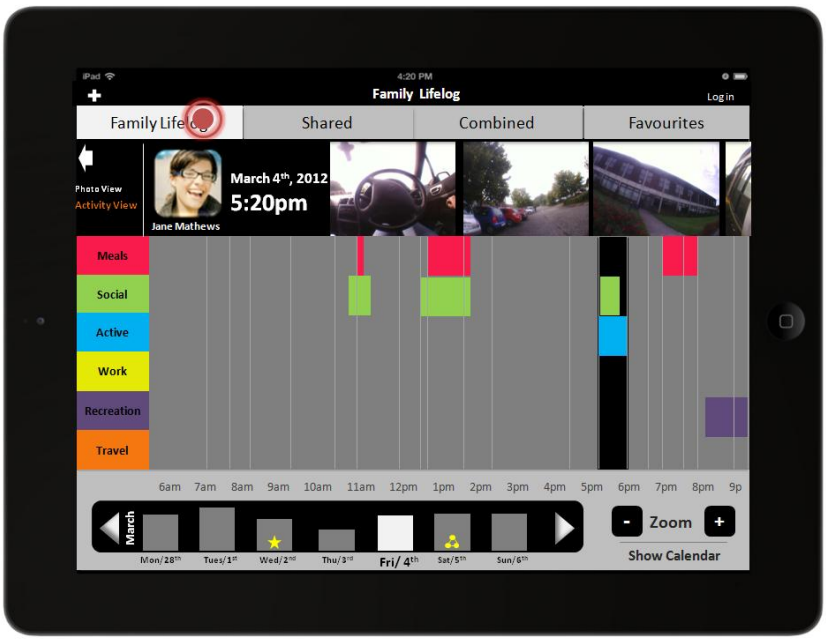
Log in
Family Lifelog
Shared
Combined
Favourites
Photo View
Activity View
March 4th, 2012
5:20pm
Jane Mathews
Meals
Social
Active
Work
Recreation
Travel
6am 7am 8am 9am 10am 11am 12pm 1pm 2pm 3pm 4pm 5pm 6pm 7pm 8pm 9p
March
Mon/28th
Tues/1st
Wed/2nd
Thu/3rd
Fri/ 4th
Sat/5th
Sun/6th
Zoom
Show Calendar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Log in
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Combined
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Activity View
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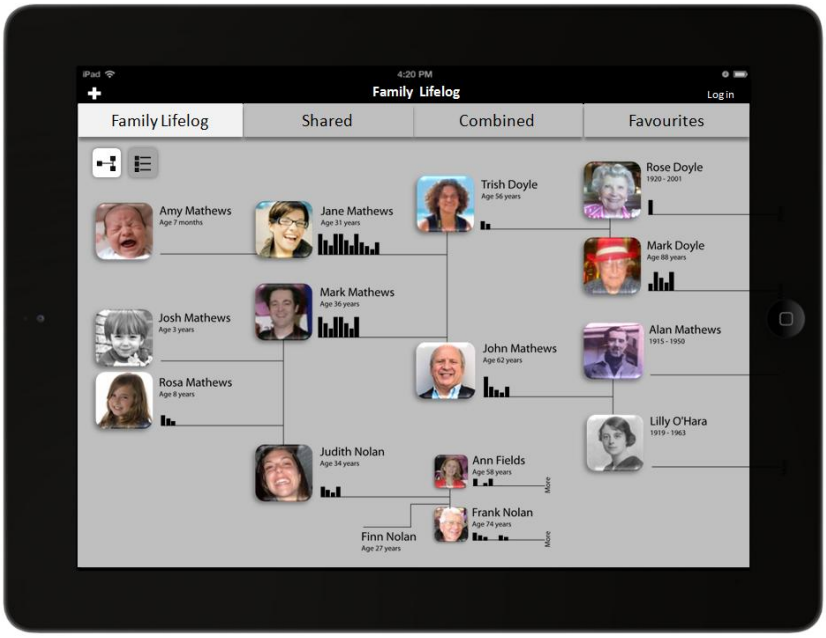
5:20pm
Jane Mathews
Meals
Social
Active
Work
Recreation
Travel
6am 7am 8am 9am 10am 11am 12pm 1pm 2pm 3pm 4pm 5pm 6pm 7pm 8pm 9p
March
Mon/28th
Tues/1st
Wed/2nd
Thu/3rd
Fri/ 4th
Sat/5th
Sun/6th
Zoom
Show Calendar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Log in
Family Lifelog
Shared
Combined
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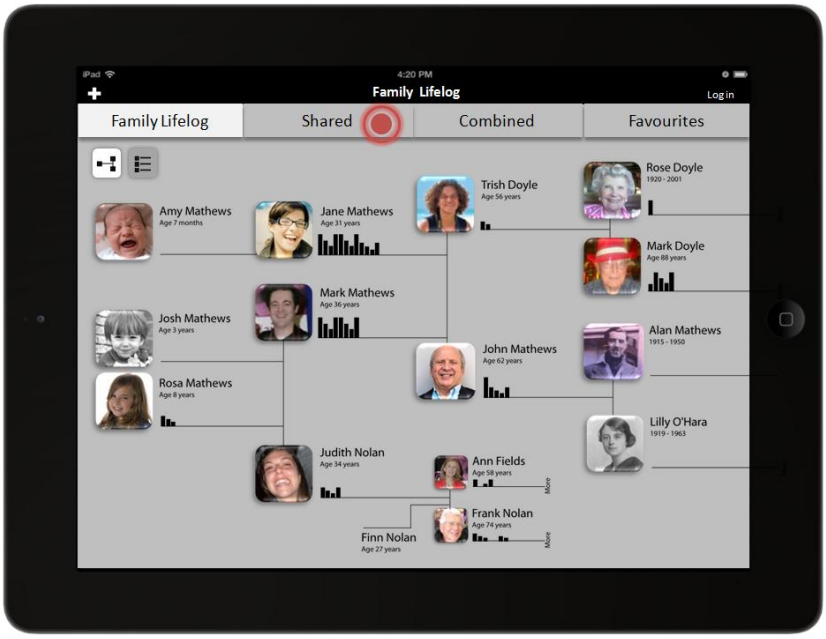
Amy Mathews
Age 7 months
Jane Mathews
Age 31 years
Trish Doyle
Age 56 years
Rose Doyle
1920 - 2001
Mark Doyle
Age 88 years
Mark Mathews
Age 36 years
Josh Mathews
Age 3 years
John Mathews
Age 62 years
Alan Mathews
1915 - 1950
Rosa Mathews
Age 8 years
Lilly O'Hara
1919 - 1963
Judith Nolan
Age 34 years
Ann Fields
Age 58 years
More
Frank Nolan
Age 74 years
More
Finn Nolan
Age 27 years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Log in
Family Lifelog
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Combined
Favourites
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Age 7 months
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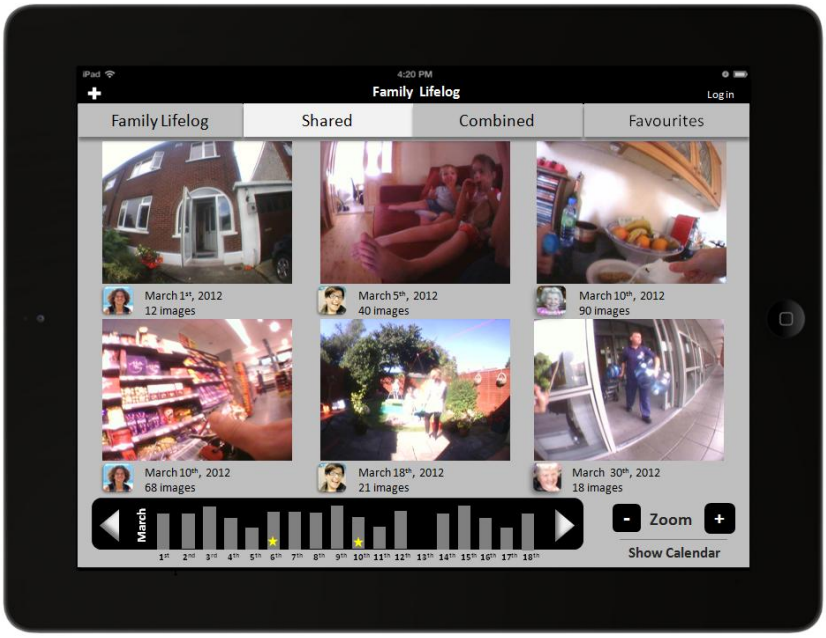
Age 31 years
Trish Doyle
Age 56 years
Rose Doyle
1920 - 2001
Mark Doyle
Age 88 years
Mark Mathews
Age 36 years
Josh Mathews
Age 3 years
John Mathews
Age 62 years
Alan Mathews
1915 - 1950
Rosa Mathews
Age 8 years
Lilly O'Hara
1919 - 1963
Judith Nolan
Age 34 years
Ann Fields
Age 58 years
More
Frank Nolan
Age 74 years
More
Finn Nolan
Age 27 years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90 images
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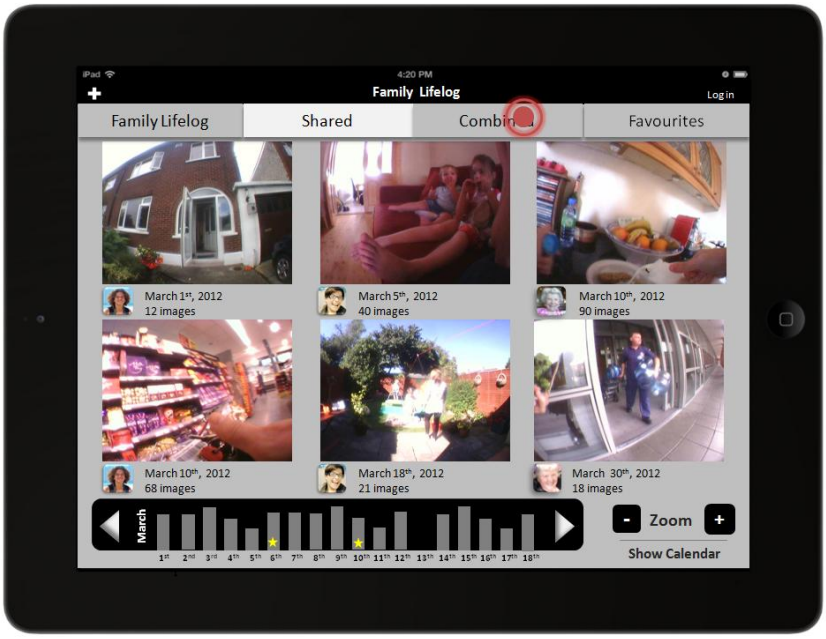
68 images
March 18th, 2012
21 images
March 30th, 2012
18 images
March
Zoom
Show Calendar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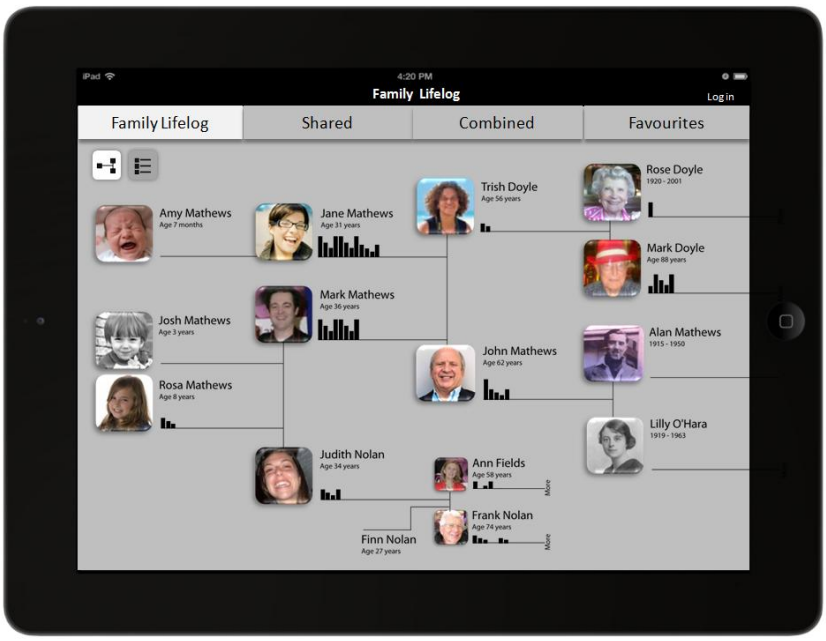
90 images
March 10th, 2012
68 images
March 18th, 2012
21 images
March 30th, 2012
18 images
March
Zoom
Show Calendar


iPad
4:20 PM
Family Lifelog
Log in
Family Lifelog
Shared
Combined
Favourites
March 5th
7pm– 9pm
Redwall Beach
March 28th
3pm- 5:14pm
Mathews Home
March 31st
12pm– 12.35pm
St. Annes Park
March
Zoom
Show Calendar


iPad
4:20 PM
Family Lifelog
Log in
Family Lifelog
Shared
Combined
Favourites
March 5th
7pm– 9pm
Redwall Beach
March 28th
3pm- 5:14pm
Mathews Home
March 31st
12pm– 12.35pm
St. Annes Park
March
Zoom
Show Calendar


iPad
4:20 PM
Family Lifelog
Log in
Family Lifelog
Shared
Combined
Favourites
March 5th
7pm – 9pm
Redwall Beach
March 28th
3pm - 5:14pm
Mathews Home
March 31st
12pm – 12.35pm
St. Annes Park
March
1st 2nd 3rd 4th 5th 6th 7th 8th 9th 10th 11th 12th 13th 14th 15th 16th 17th 18th
Zoom
Show Calendar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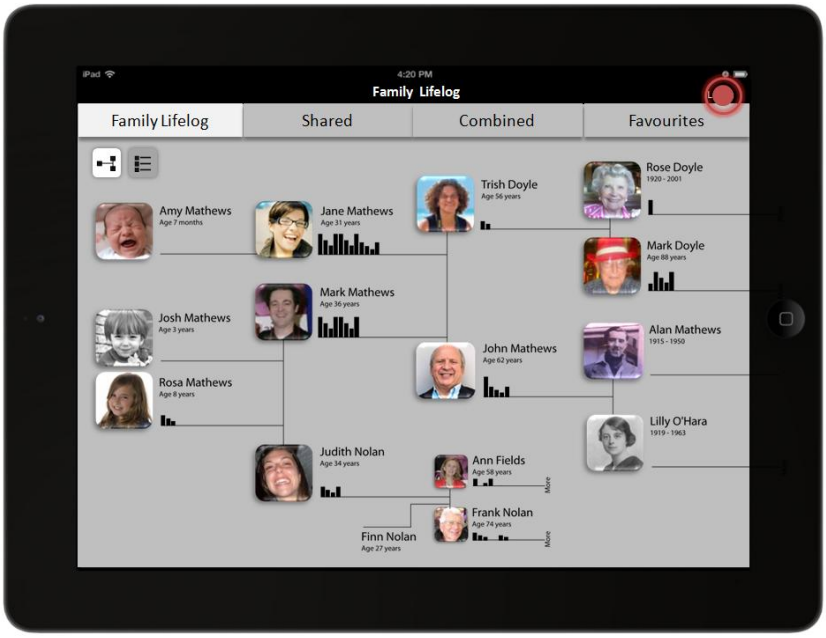
Age 7 months
Jane Mathews
Age 31 years
Trish Doyle
Age 56 years
Rose Doyle
1920 - 2001
Mark Doyle
Age 88 years
Mark Mathews
Age 36 years
Josh Mathews
Age 3 years
Rosa Mathews
Age 8 years
John Mathews
Age 62 years
Alan Mathews
1915 - 1950
Lilly O'Hara
1919 - 1963
Judith Nolan
Age 34 years
Ann Fields
Age 58 years
Frank Nolan
Age 74 years
Finn Nolan
Age 27 years
More
More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Family Lifelog
Shared
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Age 7 months
Jane Mathews
Age 31 years
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Age 56 years
Rose Doyle
1920 - 2001
Mark Doyle
Age 88 years
Mark Mathews
Age 36 years
Josh Mathews
Age 3 years
Rosa Mathews
Age 8 years
John Mathews
Age 62 years
Alan Mathews
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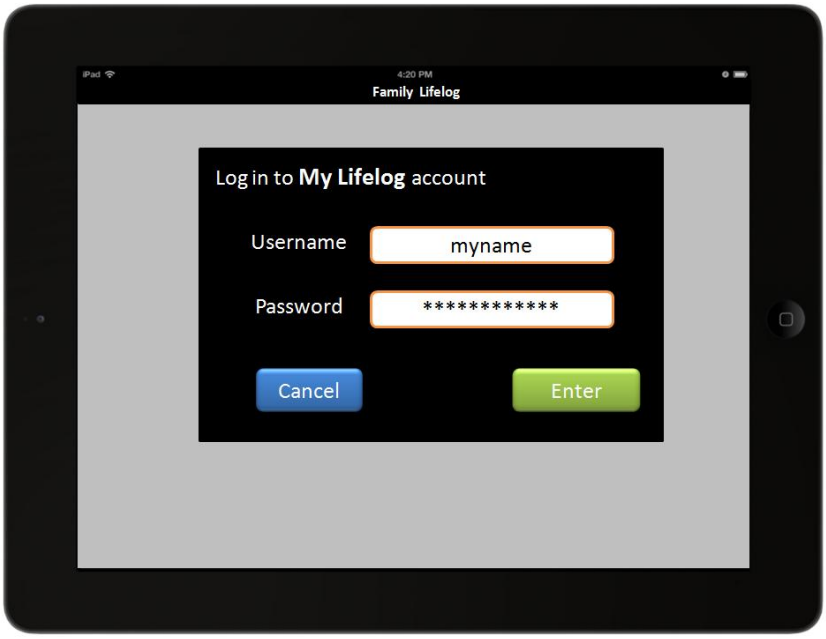
1919 - 1963
Judith Nolan
Age 34 years
Ann Fields
Age 58 years
Frank Nolan
Age 74 years
Finn Nolan
Age 27 years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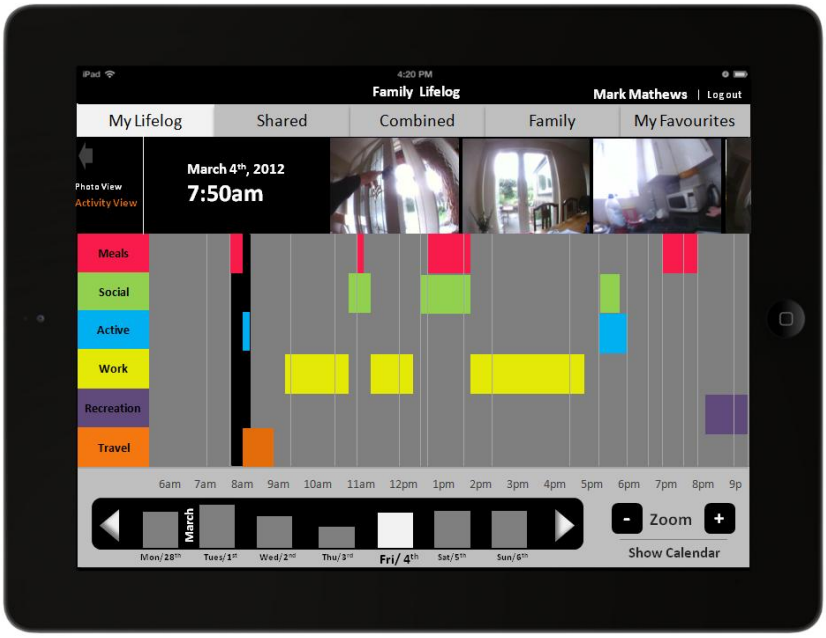
Username
myname
Password
****
Cancel
Enter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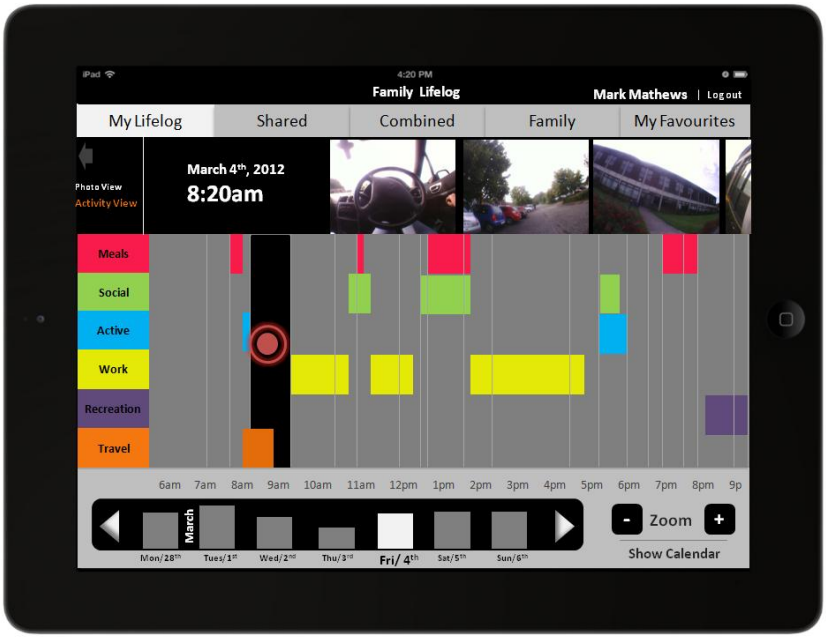
4:20 PM
Family Lifelog
Mark Mathews | Log out
My Lifelog
Shared
Combined
Family
My Favourites
Photo View
Activity View
March 4th, 2012
7:50am
Meals
Social
Active
Work
Recreation
Travel
6am 7am 8am 9am 10am 11am 12pm 1pm 2pm 3pm 4pm 5pm 6pm 7pm 8pm 9p
March
Mon/28th Tues/1st Wed/2nd Thu/3rd Fri/ 4th Sat/5th Sun/6th
Zoom
Show Calendar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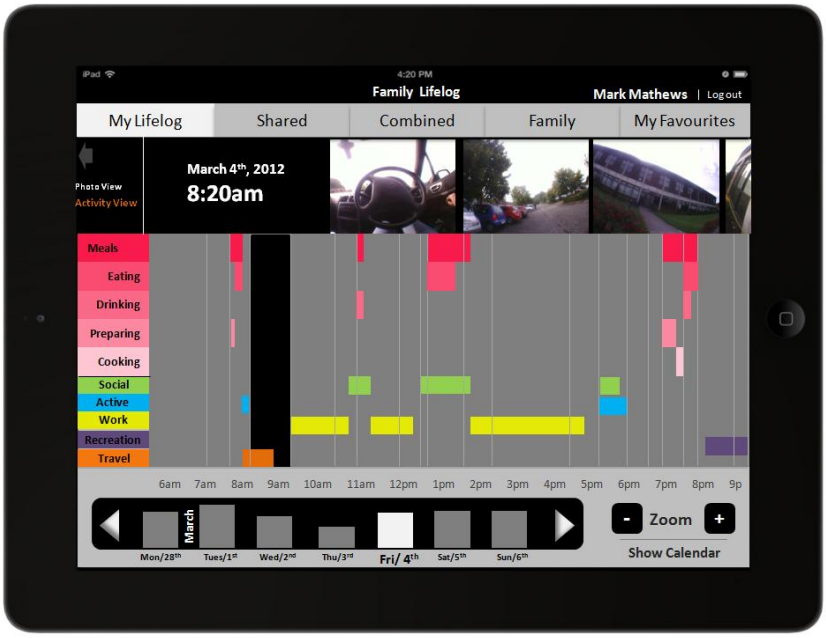
Family Lifelog
Mark Mathews | Log out
My Lifelog
Shared
Combined
Family
My Favourites
Photo View
Activity View
March 4th, 2012
8:20am
Meals
Social
Active
Work
Recreation
Travel
6am 7am 8am 9am 10am 11am 12pm 1pm 2pm 3pm 4pm 5pm 6pm 7pm 8pm 9p
March
Mon/28th Tues/1st Wed/2nd Thu/3rd Fri/ 4th Sat/5th Sun/6th
Zoom
Show Calendar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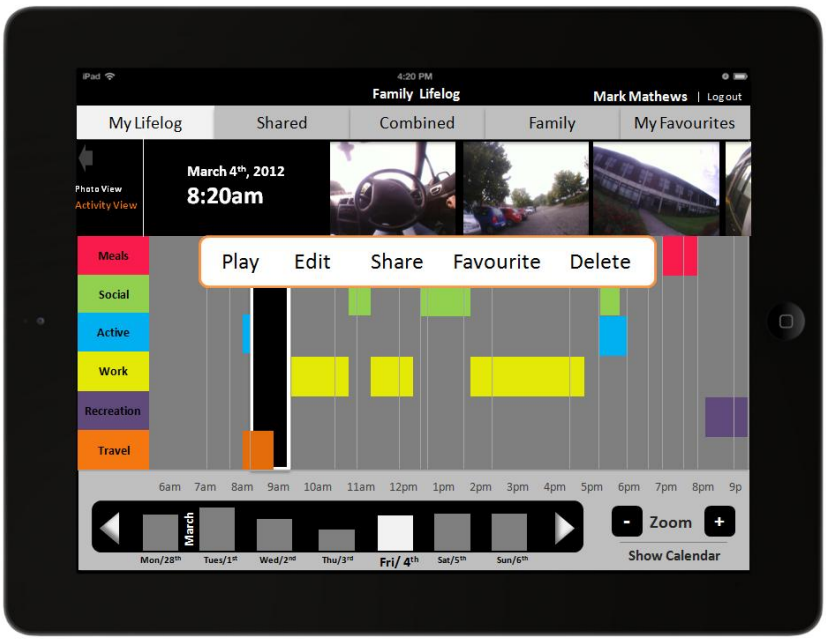
Family Lifelog
Mark Mathews | Logout
My Lifelog
Shared
Combined
Family
My Favourites
Photo View
Activity View
March 4th, 2012
8:20am
Meals
Eating
Drinking
Preparing
Cooking
Social
Active
Work
Recreation
Travel
6am 7am 8am 9am 10am 11am 12pm 1pm 2pm 3pm 4pm 5pm 6pm 7pm 8pm 9p
March
Mon/28th Tues/1st Wed/2nd Thu/3rd Fri/ 4th Sat/5th Sun/6th
Zoom
Show Calendar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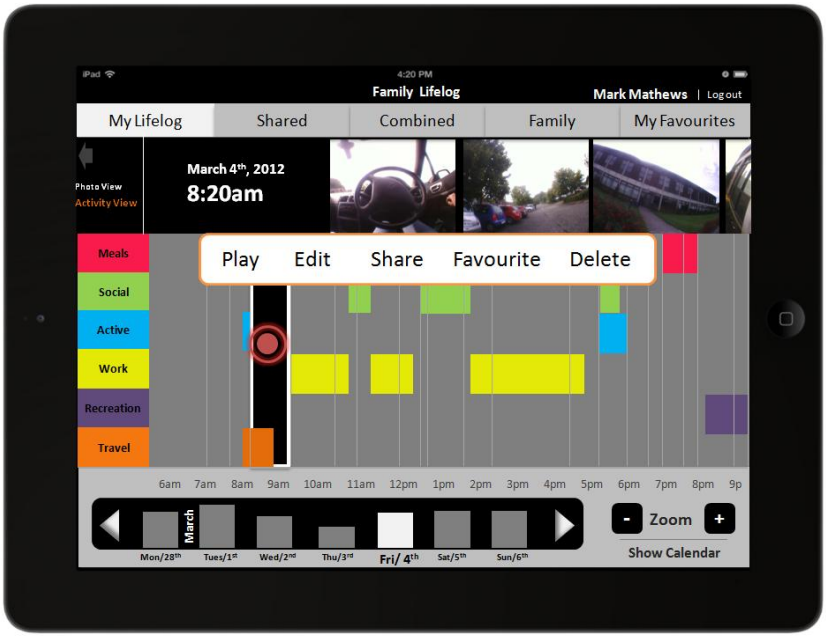
Family Lifelog
Mark Mathews | Logout
My Lifelog
Shared
Combined
Family
My Favourites
Photo View
Activity View
March 4th, 2012
8:20am
Play
Edit
Share
Favourite
Delete
Meals
Social
Active
Work
Recreation
Travel
6am 7am 8am 9am 10am 11am 12pm 1pm 2pm 3pm 4pm 5pm 6pm 7pm 8pm 9p
March
Mon/28th Tues/1st Wed/2nd Thu/3rd Fri/ 4th Sat/5th Sun/6th
Zoom
Show Calendar


iPad
4:20 PM
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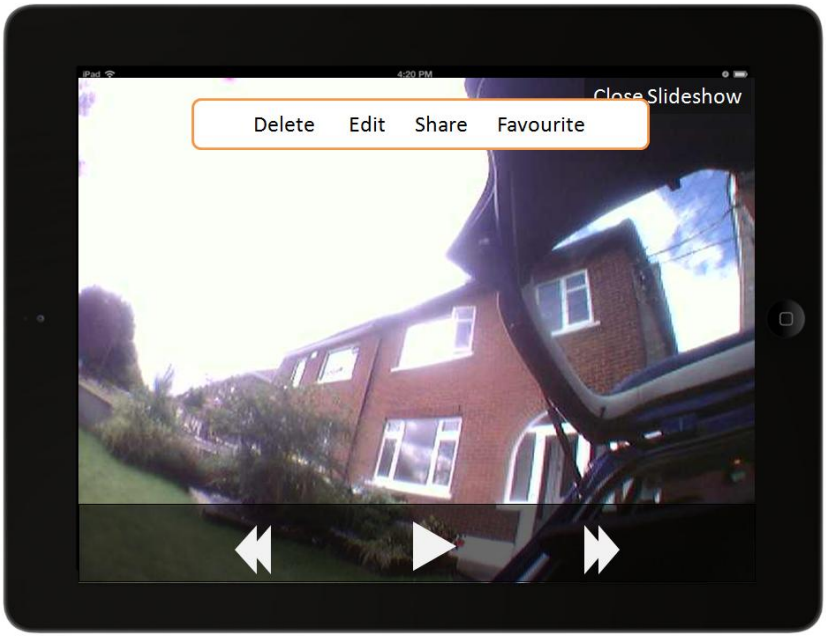
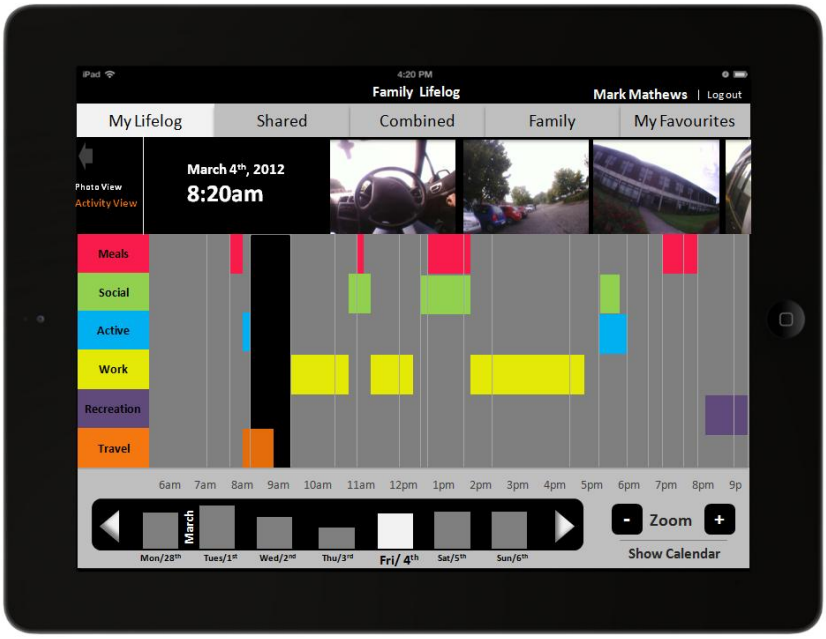
Mark Mathews | Logout
My Lifelog
Shared
Combined
Family
My Favourites
Photo View
Activity View
March 4th, 2012
8:20am
Play
Edit
Share
Favourite
Delete
Meals
Social
Active
Work
Recreation
Travel
6am 7am 8am 9am 10am 11am 12pm 1pm 2pm 3pm 4pm 5pm 6pm 7pm 8pm 9p
March
Mon/28th
Tues/1st
Wed/2nd
Thu/3rd
Fri/ 4th
Sat/5th
Sun/6th
Zoom
Show Calendar


iPad
4:20 PM
Close Slideshow


Delete
Edit
Share
Favourite
Close Slideshow


Family Lifelog
Mark Mathews | Logout
My Lifelog
Shared
Combined
Family
My Favourites
Photo View
Activity View
March 4th, 2012
8:20am
Meals
Social
Active
Work
Recreation
Travel
6am 7am 8am 9am 10am 11am 12pm 1pm 2pm 3pm 4pm 5pm 6pm 7pm 8pm 9p
March
Mon/28th Tues/1st Wed/2nd Thu/3rd Fri/ 4th Sat/5th Sun/6th
Zoom
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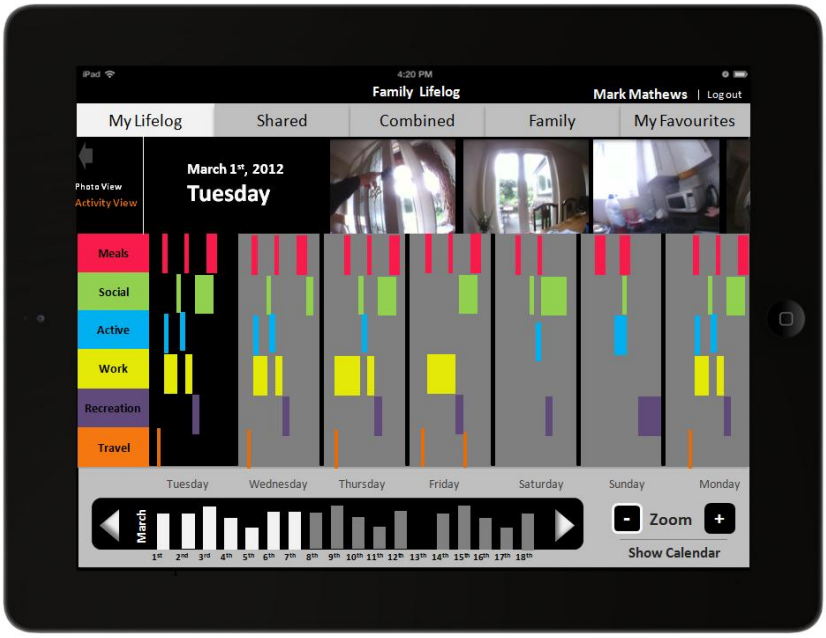
iPad
4:20 PM
Family Lifelog
Mark Mathews | Logout
My Lifelog
Shared
Combined
Family
My Favourites
Photo View
Activity View
March 1st, 2012
Tuesday
Meals
Social
Active
Work
Recreation
Travel
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Monday
March
Zoom
Show Calendar


iPad
4:20 PM
Family Lifelog
Mark Mathews | Logout
My Lifelog
Shared
Combined
Family
My Favourites
March 1st, 2012
Mark's home, Clontarf
March 5th, 2012
Jane's home, Baldoyle
March 10th, 2012
Mathews home, Fairview
March 10th, 2012
Dublin City Centre
March 18th, 2012
Jane's home, Baldoyle
March 30th, 2012
Dublin City University
March
Zoom
Show Calendar


iPad
4:20 PM
Family Lifelog
Mark Mathews | Logout
My Lifelog
Shared
Combined
Family
My Favourites
Edit
Delete
Share
Combine*
Date: Tuesday, March 1st, 2012
Location: Home, Clontarf, Dublin
People: Molly
Activities: Eating, talking, television
March 1st, 2012
Mark's home, Clontarf
March 5th, 2012
Jane's home, Baldoyle
March 10th, 2012
Mathews home, Fairview
March 10th, 2012
Dublin City Centre
March 18th, 2012
Jane's home, Baldoyle
March 30th, 2012
Dublin City University
March
Zoom
Show Calendar


iPad
4:20 PM
Family Lifelog
Mark Mathews | Logout
My Lifelog
Shared
Combined
Family
My Favourites
Edit
Delete
Share
Combine*
Date: Tuesday, March 1st, 2012
Location: Home, Clontarf, Dublin
People: Molly
Activities: Eating, talking, television
March 1st, 2012
Mark's home, Clontarf
Jane shared images of same event
Cancel
Combine
March 10th, 2012
Dublin City Centre
March 18th, 2012
Jane's home, Baldoyle
March 30th, 2012
Dublin City University
March
Zoom
Show Calendar


iPad
4:20 PM
Family Lifelog
Mark Mathews | Logout
My Lifelog
Shared
Combined
Family
My Favourites
Edit
Delete
Share
Combine*
Date: Tuesday, March 1st, 2012
Location: Home, Clontarf, Dublin
People: Molly
Activities: Eating, talking, television
March 1st, 2012
Mark's home, Clontarf
March 5th, 2012
Jane's home, Baldoyle
Jane shared images of same event
Cancel
Combine
March 10th, 2012
Dublin City Centre
March 18th, 2012
Jane's home, Baldoyle
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