Reminiscence Processes Using Life-Log Entities for Persons with Mild Dementia

Josef Hallberg
Luleå University of Technology
SE-971 87 Luleå
+46 920 491 000
josef.hallberg@ltu.se

Basel Kikhia
Luleå University of Technology
SE-971 87 Luleå
+46 920 491 000
basel.kikhia@ltu.se

Johan E. Bengtsson
InterNIT
Parkvägen 2, SE-972 53 Luleå
+46 70 173 1000
johan@internit.se

Stefan Sävenstedt
Luleå University of Technology
SE-971 87 Luleå
+46 920 491 000
stefan.savenstedt@ltu.se

Kåre Synnes
Luleå University of Technology
SE-971 87 Luleå
+46 920 491 000
kare.synnes@ltu.se

ABSTRACT

In this paper we present the reminiscence process in a prototype memory support tool for persons with mild dementia. The purpose is to promote autonomy for persons with mild dementia by supporting actualization and maintenance of episodic memories, and real-time access to a context-annotated life log.

The main research challenges are defined with a user scenario, Suitable reminiscence methods and memory entitities to reperesent life logs are described, and a preliminary architecture is presented. Finally an early design of a concrete *ReviewClient* is shown, to solicit feedback on the reminiscence methods, entitites chosen, architecture and the usability of the proposed interface.

Categories and Subject Descriptors

J.3 [**Computer Applications**]: Life and Medical Sciences – *health, medical information systems.*

General Terms

Management, Human Factors

Keywords

Reminiscence Process, Life-Logging, Context-awareness

1. INTRODUCTION

In our ageing population the number of persons suffering from chronic diseases is increasing [24]. Persons suffering from dementia may lose the ability to recall names, past activities, and objects [19]. This affects not only the persons with dementia but also their families, friends, and carers. Furthermore, frequently forgetting things induces frustration, risks of losing social

contacts, and reduces the ability to maintain an independent living in the home.

There exists many assistive devices for persons with dementia that are usable and possible to learn in early stages of the disease, and it is generally agreed that those devices address important needs in everyday life. Example assistive devices include simplified calendars, active reminders, item finders, picture dialing phones, and kitchen appliance safeguards. For those still living at home, a relative or carer often visit on a daily basis to assist with chores and the activities of the day. While these supporting solutions assist with the most important needs [10][26] for remembering, keeping social contacts, feeling safe and performing daily activities, they do not help persons with dementia to build and maintain memories.

This paper aims to show the viability of a semi-automated tool for supporting reminiscence and at the same time building up a media-rich life-log, as a useful basis for integrated services for persons with dementia. It presents and discusses a reminiscence process which aim to build and maintain episodic memories of everyday life. The reminiscence process utilizes life-logging entities, namely time, place, persons, and automatically recorded media, all aggregated into activities. This reminiscence process is part of a larger system, called *MemoryLane*, which will also provide real time support based on this life-log, using context reasoning and context correlation.

The main research challenges in creating a memory support system using reminiscence are:

1. What life-log entities are significant for supporting reminiscence and later recall of past activities?

2. How can a reminiscence process support actualization and maintenance of episodic memories?

3. How should a memory support system be designed to promote autonomy and independent living for persons suffering from dementia?

To answer these questions this paper presents an architecture, and a process for capturing context and content data, filtering and

aggregation it, then storing and presenting it for review. Furthermore, a *Review Client* is presented, which is a tool for this reminiscence process that allows activities in the near past to be reviewed.

The rest of this article is organized as follows: In Section 2 some background and related work is presented, giving examples of early life-logging systems, and referencing studies on how reminiscence can help build durable episodic memories. Section 3 presents and reviews state-of-the-art reminiscence methods, laying the foundation for how the *Review Client* should operate. Section 4 presents our working hypothesis for what life-log entities are significant in describing the daily life. Section 5 presents the MemoryLane system architecture, explaining how collected sensor data is aggregated, filtered and analyzed into context and content databases. Section 6 describes an early design of the user interface of the Review Client. In Section 7, privacy and integrity issues are discussed, and conclusions are drawn about the relevance and viability of the *MemoryLane Review Client*.

1.1 User Scenario

This section describes a scenario featuring Lisa who is a woman suffering from mild dementia. She has been provided with the *MemoryLane* system to support her. The scenario describes how the *MemoryLane* system can help her throughout the day, and how she and her husband can review the images from the day, to build lasting episodic memories.

- Lisa is on her way to the medical centre for her medical check-up. Today she is meeting with Dr. Stefan, and as she sits down in the waiting room she is reminded of his name by the mobile device that has detected the doctor's presence. While she is waiting she takes the opportunity to recall and review past activities where Dr. Stefan has been present. Lisa's automatic camera attached to her chest transparently records images of her surroundings. Dr. Stefan asks Lisa if she is going to turn off the recording of images during the visit. - "Of course Stefan", Lisa says, while pushing the big red button on the camera .

- At the end of the day, when Lisa is back in her home, she and her husband sit down to review the activities of the day. Collected data from her camera and mobile phone is automatically uploaded to the home station and they start reviewing the suggested set of activities for the day (some were taken directly from her electronic calendar). Together they select representative images for each of the different activities: a few images from the clinic, an image from the laundry room, and images from the dinner that Lisa had with her friends that day. Lisa watches the screen the entire time, and sometimes asks to move back to repeat the names.

- Known persons which were present and known places are already indicated by the Review Client, and Lisa's husband helps her add information and auto-detection for two of her friends. Once they are done with the review process, Lisa's husband helps her add "Going to the day centre tomorrow 10:00-14:00". They also add "Day Centre" as a new Place. Even though it would be possible to add the exact location of this Place, Lisa's husband decides that it is not necessary, since he will be accompanying her on this first visit, and the MemoryLane system will figure out the exact location during the activity. - I hope the others at the day care centre will not be too curious about Lisa's memory

support tool, he thinks and rejoices at the thought of not having to worry about Lisa when she goes to and spends time at the day centre in the coming months.

The scenario above describes how the *MemoryLane Mobile Client* provides Lisa with real-time support, reminding her about her doctor's name and past activities with him. The scenario also describes the review process where Lisa can recall and learn by rehearsing her activities during the day. In the reviewing process, she is assisted by her husband that helps in naming activities and in adding details which are not automatically detected by the system. Reviewing activities in this way can help in building lasting episodic memories [1], and it makes possible to recall past activities at a later time. Finally, the scenario shows that future activities can be added to the system and that the system could fill in significant life-log data and auto-recorded media at the time of the activity.

2. BACKGROUND

Many studies have been done on how to best aid persons in storytelling and reminiscence processes. The Memex vision is one of the earlier visions in this area and was described as "a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility" [3]. This vision has already been realized, by for instance the MyLifeBits project [11]. However, advances in technology have pushed the borders of what is possible for reminiscence. Aggregation of audiovisual media, and sensor data such as location and temperature, makes it possible to create an overview of the activities of a day. This goes beyond the Memex vision and has inspired several projects aiming at providing memory aid using life-logging and reminiscence methods.

The Context-Coded Memories project [2] aims at providing technological support for episodic memory to aid persons in storytelling and reminiscence activities by utilizing aggregated data from a GPS logger and a digital camera. PENSIEVE [15] is a project which utilizes life-logging to help persons remember key facts of their life. It features a personal memory organizer which uses images, sounds, and recorded text, to help recall names, faces, conversations and other important information. Studies have also been done to explore the feasibility of using images from the innovative SenseCam device [13][27] in conjunction with sensor data as a life-logging approach which can support building artificial memories of the past [27] [28] [23].

The typical approach for reminiscence processes in the studies mentioned above, is to use wearable devices which can capture and collect data during the day of a person (mobile device, camera, GPS logger, etc). The data is then typically transferred to a local storage where it is aggregated and analyzed to form a life log. This data is then used in reminiscence at a later time. Our approach is similar, but we also introduce a review client which, in addition to recalling past activities and adding future activities, can be used to learn by rehearsing.

Aiding persons with dementia generates more challenges for reminiscence processes since they often find technology difficult to understand and use. Some studies are targeting life-logging aspect for the elderly, such as the HERMES project [16]. The aim of HERMES is to develop a user-friendly system that will support elderly persons when their memories fail. The key services are

reminding the user of what happened in the recent past, helping users to manage their daily schedule, and offering a series of exercises to strengthen the user's memory [14]. This project has similar values to *MemoryLane* in targeting persons with mild or severe memory problems. The HERMES project aims to boost existing memories, while *MemoryLane* proposes a solution for building lasting episodic memories, and to recall past activities for maintaining those memories.

3. REMINISCENCE METHODS

The Concept of Reminiscence has been defined by different authors; for instance, "dwelling on the past and as retrospection, both purposive and spontaneous" [13], "the act or process of recalling the past" [4], and "the remembered past" [20]. Many researchers are trying to address this concept by logging the life of a person, recording daily activities and making them available in reminiscence processes later on.

Reminiscence methods were introduced in dementia care over 20 years ago and has taken a variety of forms. *Reminiscence Therapy (RT)* involves the discussion of past activities and events with other persons, usually with the aid of tangible prompts such as photographs, daily life items, music and archived sound recordings. RT is one of the most popular psychosocial interventions in dementia care, and is highly rated by staff and participants [30]. *Life Review* is another method for use in reminiscence processes that typically involves individual sessions, in which the participants are guided chronologically through life experiences, encouraged to evaluate them, and possibly to produce a life story book [30]. *Life Story Work (LSW)* is another method used in reminiscence processes, which is a biographical approach in health and social care that give persons the opportunity to talk about their life experiences [21]. The Cochrane review [30] concluded that there are many promising indications of the effect of reminiscence work on quality of life and reduced depression, but due the small size and relatively low quality of the few studies done, it is difficult to make a robust conclusion yet.

Many studies on reminiscence interventions focus on persons in advanced stages of dementia and living in nursing home settings. However, there are also studies positively evaluating reminiscence work among persons with mild dementia [7]. Several studies describe the use of LSW with an overarching aim to help uncover or preserve the identity or personhood of the person with dementia. Other described aims are to improve quality of life through the impact of being listened to, and to help staff better understand the person and to improve the provision of care [21], Assessment of the significance of life story work from the perspective of the person with dementia and family members indicates appreciation for being in focus and valued as a person [9] and that it can provide a significant improvement of psychosocial well-being [18]. There is no evidence that LSW or other cognitive training methods can improve cognition and behaviour [25][8].

The reminiscence interventions described in literature varies in content and are often described as using personal photos, visual and verbal prompts, collection of verbal life stories, use of music, movements, and role plays [22]. A study by Bassett and Graham [1] emphasizes that the persistence of self across time can be maintained, despite the cognition and memory problems in dementia, through cognitive socialization. That study emphasizes the importance for the person with dementia to do reminiscence work together with others. There is a social influence on memory in temporal and contextual dimensions [1]. The creation of a life story and stories of selected events, are important for maintenance of self for persons with dementia [29].

4. LIFE-LOGGING ENTITIES

Life-logging entities are memory concepts with which persons with dementia need support. Preliminary definitions of those entities were made based on the works of other authors. It is mentioned in [19] that persons with mild dementia have difficulties in remembering the details of their daily activities, remembering names, objects, faces, and so on. Information about these entities can be used to provide memory support for a person with mild dementia. An *Activity* entity is a period of time with a specific purpose in daily life (shopping, going to medical centre, etc). Known present *Persons* and their relation to the person with dementia are significant as this provides contextual links to semantic memory. Furthermore, persons with dementia may get lost, even in their own neighbourhood. They may forget how they got to a certain place or how to get back home [6]. The *Place* entity provides contextual links to other activities at the same location, and has annotations about the exact location and the significance of the Place to the user. The Places in a day is also helpful in partitioning the day into distinct activities based on the visited places. The idea is to actualize episodic memory by visualizing explicit links to related entities in the semantic memory of the person with dementia. Each entity will also be associated to relevant recorded media, such as images and audio, which will help train the episodic memory of a person with mild dementia. Our hypothesis is thus that the main significant conceptual entities for forming a life-log are

- Places visited
- Persons met
- Personal Items brought along
- Recorded media
- Activities described by purpose, the Place, Persons and Items present, and recorded media during the activity.

It remains to be tested to what extent this will support reminiscence and forming episodic memories that last beyond days.

Initial feasibility analysis indicates that modern mobile phones are capable of detecting Places, Persons and Items, while prototype recording devices like the Microsoft SenseCam [27] can be used for automatic recording of images and some environmental data [12]. Persons and Items can be detected if they are tagged by Bluetooth devices, for example mobile phones. Places can be detected outdoors by using mobile phones with built-in GPS receivers and inddors by indoor positioning systems or using Bluetooth beacons. There are early results on image-based extraction of context data [21], although the processing requirements are still a barrier for their use to provide real-time advice to users.

5. ARCHITECTURE

The authors combine results from previous context-aware system studies in a tool that can assist a person with mild dementia, indoors and outdoors. The authors extend previous work in life-logging by introducing a *Review Client* which use the Reminiscence Therapy method described in Section 3, and makes it possible to visualize the life log as sets of Activities. Moreover, a main goal for the target system is reducing the need for persons with dementia and their carers to manually associate recorded media with the activities.
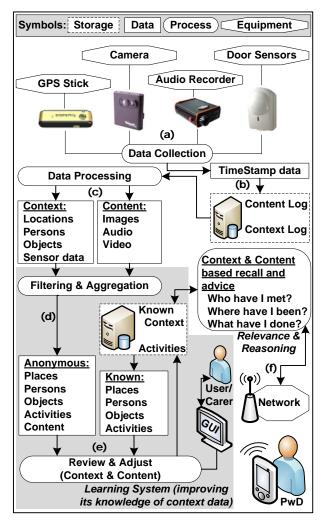

Figure 1. The MemoryLane architecture

Figure 1 shows the data and operations flow for the intended reminiscence system. Each step is indicated by a letter to clarify the sequence of the data flow. Sensor data such as Bluetooth and GPS data, and media such as images, are collected automatically by devices either carried by the person, or located in the environment (a). This step requires the user to bring the relevant equipment and have it turned on. The data will then be time-stamped and transferred to local storage in the mobile device and later in a *Home Station* (b). Time is an important parameter to automatically partition data into separate activities and associate them with sensor readings and recorded media. When data has been uploaded to the Home Station, it is processed (c) and divided into context data (persons, locations, and items) and content data (images, audio, and video). It will then be analyzed, filtered and aggregated automatically by the system (d).

After the data has been filtered and aggregated, the person with dementia together with the carer can review and adjust the context and content data (e). The carer can assist by organizing images, giving titles to Activities, naming Places (if not already named by the system), and naming Persons appearing in the activities (if not already named). At this stage, the person with dementia also has the opportunity to recall and rehearse the activities of the day, to help build lasting episodic memories. All context data is stored and used in future review sessions, and also for use in the mobile device to offer context-dependant retrieval of past and future activities. The last step in the data flow is to group logged contextual information with recorded content into activities (f), so that the person with dementia can recall activities that are similar to the current situation.

6. REVIEW CLIENT

In this section, we describe the main features of the *Review Client* and will show an early design of the user interface. The Review Client guides the person with dementia and the carer through the steps of organizing the preceding time period into Activities with a described purpose for each, annotating visited Places and present Persons, and making representative selections of recorded media for each Activity.

The MemoryLane system will mainly use the *Reminiscence Therapy* method described in Section 3 as the blueprint for designing the Review Client, although there will also be a chronological mode for doing *Life Reviews*. *Life Story Work* will not be supported in the near term, since it would require essentially a life-long log to be available to the MemoryLane system. However, recordings from Life Story Work could be attached as media to the information pages of Persons, Places, Items and Activities in the life-log.
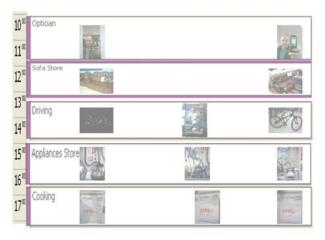

Figure 2. The reminiscence interface of the Review Client

Figure 2 presents an early design of the reminiscence interface of the *Review Client*. It present the person with dementia and the carer with a preliminary organization of the preceding time period (typically the same day) into a set of non-overlapping activities, and allows removing, adjusting, splitting and merging them.

Here the suggested activity split and titles are slightly wrong. The users should adjust the end time of the Driving activity, or split it into multiple Activities. The Appliances Store activity should be expanded to cover also the "Cooking" part of the day.

On a more detailed level shown in Figure 3, the Review Client visualises an Activity, with the detected Place, Persons and Items at the time, as well as a filtered selection of recorded media. The users can then set or change the Place, add and remove Persons, or choose what recorded media to keep.

Figure 3. The Activity review interface

In Figure 3, the larger images are the ones suggested by the system or chosen by the user as significant images to be saved. Setting the Place or adding Persons is done via easy to understand buttons.

The Review Client user interface is intended to be extremely simple and intuitive to use. It involves very few steps and offers only a few selectable options, since persons with dementia often exhibit symptoms of *apraxia* (inability to act). General decline in perception abilities of elderly persons and the prevalence of other disabilities must also be considered, applying universal design principles to get an inclusive interface.

The Review Client should also act as a limited *Configuration Client* where new Places, Persons and Items can be added and annotated, and adding auto-detection should be possible too. Planned Activities should be possible to add in a similar manner as in the Activity review interface in Figure 3.

7. DISCUSSION AND CONCLUSIONS
A number of research challenges were listed in Section 1. In this article we have addressed those challenges by surveying previous work in the area and describing a tool for reminiscence based on the findings. The result culminates in the *Review Client* which utilizes the memory entities Place, Person, Items, recorded media (e.g. pictures), and Activities which are derived from other entities and user input. Using these entities to form life-logs is supported by previous studies [19] [17] but the effectiveness of these life-log entities for building lasting episodic memory remains to be tested.

The Review Client uses the *Reminiscence Therapy* method which was introduced in dementia care over 20 years ago. It is also based on the idea of letting the person with dementia review the activities of the day together with a carer. This was deemed effective for building durable episodic memories in a study of Basset and Graham [1]. The theory is that a person with mild dementia can learn by rehearsing details about the day, and hence build lasting episodic memories. However, this remains to be properly tested. By helping persons with mild dementia build lasting episodic memory and by providing real time support through the *MemoryLane* mobile device we hope to promote independent living for persons suffering from mild dementia.

There are important privacy issues related to the use of automatic recording devices in daily life. While other persons might prefer to be given fair warning that recording of images and present Bluetooth devices is being done, persons with dementia have an equally strong need not to stand out as "ill". We intend to investigate this delicate ethical balance during field tests in 2009 and 2010. Furthermore, users of life-logging systems must have the option to turn off recording temporarily, in sensitive situations. A key challenge is how to make this explicit act easy enough to be remembered by users who usually have trouble remembering and performing procedures. It is likely that persons with more severe dementia will no longer be capable of using this option, leading to a strong requirement for ensuring confidentiality of recordings and other identifiable personal data.

In this paper, we have described our hypothesis on which memory entities are significant for building *life-logs*. We have also reviewed the evidence that reminiscence processes are relevant to persons with dementia, and the viability of creating a semi-automated tool with a simple-to-use interface for carrying out reminiscence tasks. Our challenging aim is now to develop a usable memory support system based on the reminiscence body-of-knowledge, and to perform naturalistic evaluation of our hypotheses in field tests with real users,

9. REFERENCES
[1] Bassett R., Graham J. (2007) Memorabilities: enduring relationships, memories and abilities in dementia. *Aging and Society, 27, 533-554*

[2] Bisht M., Swords D., Quigley A., Gaudin B. and Bennett M., (2007). *Context-Coded Memories: "Who, What, Where, When, Why?: Supporting Human Memory with Interactive Systems.* Workshop at the British HCI International Conference Sept 2007.

[3] Bush, V., (1945). *As We May Think*. The Atlantic Monthly, 176(1), 101-108.

[4] Butler, R. N. (1963). The life review: An interpretation of reminiscence in the aged. Psychiatry, 26, 65-76.

[5] Byrne, D., Doherty, A., Snoek, C., Jones, G., Smeaton, A., Validating the Detection of Everyday Concepts in Visual Lifelogs, in Lecture Notes in Computer Science, Vol 5392, pp 15-30, 2008.

[6] Cayton, H., (2001). *Dementia : Alzheimer's and other Dementias : The 'At Your Fingertips' Guide. London*, , GBR: Class Publishing. p 2. ISBN: 1-85959-075-6.

[7] Chung JCC. (2009) An intergenerational reminiscence program for older adults with early dementia and youth volunteers: values and challenges. *Scandinavian Journal of Caring Sciences, 23; 259-264*

[8] Clare L., Woods B. (2003) Cognitive rehabilitation and cognitive training for early-stage Alzheimer's disease and vascular dementia. Cochrane Database of Systematic Reviews 2003, Issue 4. Art. No.:CD003260.DOI:10.1002/14651858.CD003260

[9] Clarke, A.., Hanson, E.., Ross, H., (2003) Seeing the person behind the patient: enhancing the care of older people using a biographical approach. Journal of clinical Nursing 12(5), 697-706

[10] Dröes, R.M., Boelens, E.J., Bos, J., Meihuizen, L. Ettema, T.P. Gerritsen, D.L., Hoogeveen, F., de Lange, J., Schölzel-Dorenbos, C., Quality of life in dementia in perspective; an explorative study of variations in opinions among people with dementia and their professional caregivers, and in literature. *Dementia: The International Journal of Social Research and Practice* **5** (2006), pp 533-58.

[11] Gemmell, J., Bell, G., Lueder, R., Drucker, S., Wong, C., MyLifeBits: fulfilling the Memex vision, In Proceedings of the tenth ACM international conference on Multimedia, France, 2002, 235-238

[12] Gemmell, J., Williams, L., Wood, K., Lueder, R., Bell, G., Passive capture and ensuing issues for a personal lifetime store. In 1st ACM Workshop on Continuous Archival and Retrieval of Personal Experiences, pages 48–55. ACM, October 2004.

[13] Havighurst, R. J., & Glasser, R. (1972). An exploratory study of reminiscence, journal of Gerontology, 27, 235-253.

[14] HERMES project helps elderly cope with memory loss http://ec.europa.eu/research/headlines/news/article_09_01_06_en.html (22-05-2009).

[15] IBM Research Develops Technology to Aid Human Memory, http://www-03.ibm.com/press/us/en/pressrelease/24750.wss (22-05-2009).

[16] Jiang, J., Geven, A., Zhang, S., (2008). HERMES: A FP7 Funded Project towards Computer-Aided Memory Management Via Intelligent Computations. Lecture Notes in Computer Science: Springer pp249-253, ISSN: 1615-3871.

[17] Jones, G., Gurrin, C., Kelly, L., Byrne D., Chen, Y., (2008),. Information Access Tasks and Evaluation for Personal Lifelogs. In Proceedings of The Second International Workshop on Evaluating Information Access, pp 75-86

[18] Lai CKY., Chi I., Kayser-Jones J. (2004) A randomised controlled trial of a specific approach to promote the well-being of nursing home residents with dementia. *International Psycho geriatrics 16(1), 33-49*

[19] Lee, M.L., Dey, A.K., (2006). Capturing and Reviewing Context in Memory Aids. Human-Computer Interaction Institute, Carnegie Mellon University, Pittsburgh, PA. *Presented in: Workshop on Designing Technology for People with Cognitive Impairments.*

[20] Lieberman, M. A.., & Falk, J. M., (1971). The remembered past as a source of data for research on the life cycle. Human Development, 14, 132-141.

[21] McKeown, J., Clarke, A., Repper J. (2006) Life story work in health and social care: systematic literature review. *Journal of Advanced Nursing 55(2), 237-247*

[22] Moos, I., Björn, A., (2006). Use of the life story in institutional care of people with dementia: a review of intervention studies. *Aging and Society, 26, 431-454*

[23] O'Conaire, C., O'Connor, N., Smeaton, A.F., Jones, G., (2007). Organising a daily Visual Diary Using Multi-Feature Clustering. SPIE Electronic Imaging - Multimedia Content Access: Algorithms and Systems (EI121), San Jose, CA.

[24] Pollack, M., 2005. Intelligent technology for an aging population: The use of ai to assist elders with cognitive impairments, AI Magazine, 9-24.

[25] Pusey, MK., (2000) Dementia care: Intervention with people with dementia and their informal carers. *Mental Health Care, 3, 204-207*

[26] Roest, H.G., Meiland, F.J.M., Maroccini, R., Comijs, H.C., Jonker, C., Dröes, R.M., Subjective needs of people with dementia: a review of the literature. *Int Psychogeriatr.* **4** (2007), pp 1-34.

[27] Sellen et al (2007) Do Life-Logging Technologies Support Memory for the Past? An Experimental Study Using SenseCam, *CHI 2007 Proceedings*, pp 81-90

[28] Smeaton, A.F., O'Connor, N., Jones, G., Gaughan, G., Lee, H., and Gurrin, C., (2006). SenseCam Visual Diaries Generating Memories for life**.** Poster presented at the Memories for Life Colloquium 2006, British Library Conference Centre, London, U.K.

[29] Surr, CA., (2006) Preservation of self in people with dementia living in residential care: A socio-biographical approach. *Social Science and Medicine, 62, 1720-1730*

[30] Woods, B., Spector, AE., Jones, CA., Orrell, M., Davies, SP. (2005). Reminiscence therapy for dementia. *Cochrane Database of Systematic Reviews 2005, Issue 2. Art. No.: CD001 120. DOI: 10.1002/14651858.CD001120.pub 2.*