Assistive Technologies for People with Dementia: Personal Review

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Chapter 9 Daily Assistance by High Tech Interventions

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9.1 Review of High tech interventions: Various Projects

Clever Project: The mission of the Cognitive Lever (Clever) project since 1999 is to provide computationally enhanced environments to assist people with a wide range of cognitive disabilities and their support community (Carmien & Gorman, 2004).

INDEPENDENT: The aim of the Investigating Enabling Domestic Environments for People with Dementia (INDEPENDENT; 2003) project is to develop technology and design solutions to help enable people with dementia to live independently, to empower them and to improve their quality of life wherever they live. In order to avoid institutional care and facilitate early hospital discharge, the project help people within residential care settings to retain independence and autonomy and maintain contact with the outside community; increase opportunities for older people with dementia to experience enjoyment, pleasurable activities and social interaction.

Assisted Cognition: The goal of the Assisted Cognition project combines computer science research in artificial intelligence and ubiquitous computing with clinical research on patient care. Assisted Cognition systems are proactive memory and problem-solving aids that help an individual perform the tasks of day-to-day life. They are Sense aspects of an individual's location and environment, both outdoors and at home, relying on a wide range of sensors such as GPS, active badges, motion detectors, and other ubiquitous computing infrastructure. Learn to interpret patterns of everyday behavior, and recognize signs of distress, disorientation, or confusion, using techniques from state estimation, plan recognition, and machine learning. Offer help to patients through various kinds of verbal and physical interventions, and alert human caregivers in case of danger (Kautz, 2004).

Lifeline: A tool for caregivers to monitor and support clients with wireless prompting systems. This tool is closely linked to the Mobility for All and MAPS projects and it gives caregivers the ability to track and support clients who are performing activities in remote locations. Lifeline seeks to give clients greater autonomyin home, work, and travel activities and to give care givers the tools they need to assist their clients.The aim is provide clients with opportunities they might not otherwise have because of limited caregiver resources. The emphases is to harnessing caregiver support instead of replacing it with technology.

MAPS: Memory Aiding Prompting System (MAPS) is a system for providing support to persons with cognitive disabilities by guiding them through prompted tasks. The MAPS system is multimodal and uses wireless networking to adaptively respond to changes in the environment. MAPS provide adaptive prompting on a PDA platform and appropriate and useable tools for creating, maintaining, and sharing prompting scripts, with an aim to create a collaborative community around its use.

MAPS use a PDA platform to display verbal and pictorial prompts in a sequence that comprises a script. The PDA provides error correction functionality via dynamic, situated scripting and ‘panic button’ functionality. As a script is played the events and context are logged, providing information for script refinement and analysis as well as immediate alternate prompts for breakdown situations. A PC based application provides tools for script creation, modification and sharing with other users via a web-based repository of scripts. MAPS and the Lifeline project are integrated to support wireless context awareness and panic button functionality; caregivers can be notified of problems via cell phone.

CIRCA project: The CIRCA project set a goal of producing an innovatively designed reminiscence experience based on interactive multimedia and aiding communication between people with dementia and their caregivers (Alm et al., 2004). Alm et al. (2003) suggest that with the use of multimedia as a source of reminiscence, patients exhibit more control of the direction of the conversation. They developed a touch screen display to convey photographs, video or music and compared it to traditional reminiscence methods. By tapping into long-term memory to elicit communication we can come to understand that people with dementia are individuals who have life histories and personalities, they have knowledge, wisdom and humor. Reminiscence sessions enable older people to socialize, to share ‘past competencies and failures’ and encourage people to ‘value their lives (Gowans, Campbell, Alm et al., 2004).

Without an effective working memory, ordinary conversation becomes impossible. Long-term memory, however, can remain relatively well-preserved, if long term memories can be prompted. Their system, called CIRCA, stimulates long term memories with a touchscreen-based hypermedia presentation of material from the past: photos, music, video clips, graphics and text. In evaluations the system was acceptable, and positively received by both staff and people with dementia, and people with dementia were able to take more control of the interaction than they could in reminiscence sessions run in the traditional way (Alm, Astell, Gowans et al., 2009).

Evaluation of three initial virtual reality environments by a group of dementia care professionals and a group of people with a diagnosis of dementia was positive. The system captured attention and provided an engaging experience. The users with a diagnosis of dementia were able to imagine themselves in the environments, for example sitting on a bench in the botanic garden or having a pint of beer in the pub environment. We then developed a wide range of virtual activities to try out with potential users: Short video clip presentations of activities, e.g. playing with a dog; Exploring environments, e.g. the Botanical Gardens; Creative activities, e.g. painting a virtual pot; Sport activities, e.g. bowling; Fairground activities, e.g. coconut shy; Amusement arcade type games, e.g. pinball.

Music is produced by the user dragging their finger around the touch screen. Visual feedback is provided instantly during music play to help individuals with severe short-term memory loss to remain engaged while using the system.

One stated goal of CIRCA was to provide a facility to customize the system to allow users to input their own personal images e.g. family photographs. One argument against personalization relates to privacy of information, e.g. would individual personal images need to be protected in care institutions. A significant number of our subjects in tests using personal photographs often fail to recognize close relatives e.g. siblings, spouses and offspring. On many occasions they will fail to recognize themselves e.g. in their wedding photographs. This can cause great emotional upset for both the person with dementia and their close relatives (Gowans et al., 2004)

Progress of CIRCA: The combination of interactivity and the ability to provide a high-fidelity 3D visualization of places and objects offers a unique experience for users. For instance, virtual world could be used as aids in reminiscence activities, allowing users to interact with objects which are hard to obtain in the physical world (e.g. a retro car) or to provide an experience of a place which is no longer possible to access (such as a historic street from the past). The interactivity of the virtual environments could allow older people to not only be passive viewers of the objects and scenes, but also engage actively in a more playful and creative experience of reminiscence. It has also been used to provide relaxation to trigger positive emotions among older people and to provide a representation of a place from the past (e.g. a bar).

Siriaraya and Ang (2014) focus on creating a lively real time rendered 3D environment, instead of more “static” visualization such as 360 Degree Panorama. This would potentially enhance the feeling of “presence”, thus enhancing the benefit of use. Secondly, they make use of gesture-based technology (i.e. Kinect) to enhance the interaction and empower older people to interact with the system in a more natural manner. Thirdly, their design puts an emphasis on creating a virtual space for use in social interaction.

The Microsoft Kinect sensor was used to detect the user’s gestures and motions and the ZDK (Zigfu development Kit) was used as a middleware to facilitate the development of the gesture controlled system through Unity3D. A projector was used to display the virtual world. Kinect was used to map the users’ interaction to the avatars. More than 10 joints (e.g. Head, Torso, Waist, etc.) were detected and their movements mapped onto the avatar. In the second mode (seated mode), the avatar was seated in front of a table with virtual objects (a book, a magazine, a radio and a lamp) placed in front of the user. Kinect detected the movements of the upper body and the user would remain seated in the physical world. The user could pick up items on the table by moving their hands to touch the object.

In the second version, two virtual worlds were created. In the river tour, the participant was taken through a virtual river trip. The environment was created to resemble a tropical forest, with vegetation, plants and animated animals (such as elephants, rhinoceros, etc.). The user would tour around the river by doing a “rowing” motion with their arms, which would propel the boat forward along the path.

An Android-based tablet computer was used to allow the caregiver/residents to select the vegetation to plant in the virtual garden. The participant would “walk” to the empty lot using Kinect. As they came close to an empty lot, a text would be displayed on the screen, asking the participant to select the plant. Overall, almost all residents were able to see the projected screen as a place they were situated in and perceive themselves as actually performing the activity. In one case, the resident mistook the virtual environment as being the “real world”.

They are also not advocating replacing physical activities with only virtual activities. Instead, virtual world can provide interactive experiences to promote a continuing selfhood which may have been lost due to dementia and/or moving to long-term care facilities. Negative memories could be mitigated by playful design. Virtual world could also be a “place” that allows staff and residents to foster personal relationship and trust, which may improve care.

Networked Interaction Therapy: To relieve the stress of people with memory impairment and their family members, the concept of Networked Interaction Therapy was proposed for their psychological and behavioral stability in their daily life (Kuwahara, Kuwabara, Utsumi et al., 2004; Kuwahara, kuwabara, Tetsutani et al., 2005). By providing videophone intervention with multi-component stimuli, broader cognitive assistance would be possible. The stimuli include not only verbal conversation/instructions, but also photos, music, video, vibration, aroma etc. at any time of the day or night via internet. When, people are unable to relax and stay calm, the system provides them with useful instructions, together with favorite pictures and pieces of music, and enables them to talk to volunteers or family members. This project is also developing a system whereby they can receive above information, contents, and chance to talk even if they do not know how to use a computer.

When, for example, people are unable to relax and stay calm, the system provides them with useful instructions *via* the Internet, together with favorite pictures and pieces of music, and enables them to talk to volunteers or family members who are not physically present. However, at the present time, the difficulty of using a computer is seriously hampering access to these services for virtually everyone with a memory disorder. This is why we are developing a system whereby they can receive verbal instructions, pictures and music, and talk to volunteers over the Internet even if they do not know how to use a computer (Yasuda, 2007).

Since the conversation is conducted over the network using a video phone. The web contents such as old personal photos and videos (mostly a slideshow video made from the old photos) are used (Kuwabara, Kuwahara, Yasuda et al., 2006). Since a dementia patient may have difficulty in handling the browser function in the terminal, a remote controlling mechanism is included so that a conversation partner can specify which photo or video should be shown in the patient’s terminal. The remote control is realized by remote execution of a JavaScript program. Photo or video is displayed in the terminal so that the same photo is shown on the two terminals.

However, the patient and his/her family caregiver may need assistance to operate content sharing because they are usually elderly, they might not be familiar with the concept of content sharing over the network, and it is very likely that they will encounter difficulties. Therefore, remote assistance from the therapist’s terminal to operate contents is necessary, which is why we have developed a protocol between Web browsers so they can share contents with each other and operate contents from a remote Web browser (Kuwahara , Yasuda, Abe et al., 2006)..

Touching is a very intuitive sense for enabling the talking partner to recognize the patient’s interest. They provide the patients with a way to inform therapists of their interest by simply touching the object or person in the photo (5). These features are listed below In the design of the networked reminiscence system.

Reminiscence Video*:* We use reminiscence videos as video contents because the effect of the reminiscence video on dementia patients to bring them peace of mind is experimentally proven.

Remote Terminal Operation Assistance by using Web Technology*:* The photo-and video-sharing function is implemented with Web technology. There already exist some photo-sharing sites on the Internet managed by famous provider, however, these sites are designed for unimpaired people who are able to use Web browsers without the support of a remote talking partner, nor for interactive photo sharing between remote users. To implement the remote support for using a Web browser and interactive photo and video sharing, we have developed a messaging mechanism between remote Web browsers over HTTPS. Using this mechanism enables a therapist can support a patient in sharing photos and videos by sending messages on how to operate the remote Web browser on the patient’s terminal.

Multi-Modal Interface for Communication*:* Patients are required to touch the photo on the terminal display. The touched position on the photo is recorded and the corresponding position in the photo on the remote terminal is highlighted. The therapist operates the photo on the patient’s terminal remotely, for example, panning and zooming in on the object or person in question.

Panning and zooming in on the specific object or person in the photo were very effective for making patients feel much more involved when they were watching the reminiscence video. These remote content operations are also based on the messaging mechanism between remote Web browsers.

Utsumi, Kawato, & Abe (2005) discussed a system that estimates user attention to displayed content signals with temporal analysis of their exhibited behavior. In the proposed system, user behavior, including facial movements and body motions, is detected with vision-based methods. User attention to the displayed content is then estimated based on the on/off facial orientation from a display system and body motions synchronous to auditory signals. This attention monitoring mechanism design is derived from observations of actual patients. Estimated attention level can be used for content control to attract more attention of the viewers to the display system. Experimental results suggest that the content switching mechanism effectively attracts user interest.

The posture-detection system using IR cameras and IR pattern projectors detects the user's state as the 3-D appearance (posture) of him or her. In the system, human behavior is modeled as a distribution of 3-D appearances, and the results of this behavior detection are used to determine instructions to be given to the user. They address a method to display video content to people with dementia. In the method, user behavior, including facial movements and body motions, is detected with vision-based methods (Utsumi, Kanbara, Kawato et al., 2006). User attention to the displayed content is then estimated based on body motions synchronized to auditory signals. Estimated attention levels can be used for content control to attract deeper attention of viewers to the display system. Experimental results suggest that the proposed method effectively extracts user attention to musical signals (Ohara, Utsumi, Yamazoe et al., 2007).

COGKNOW: The objective of COGKNOW was to achieve a breakthrough in the development of a successful, user-validated cognitive prosthetic device with associated services for people with dementia (Final Evaluation Report, Version 3, 2009). COGKNOW uses commercial off-the-shelf stationary and mobile devices, and commercial technologies for automatic sensing and for controlling the home environment, which keeps investments and operating costs reasonably low. The ability to adjust configurations and service settings remotely enables family and professional carers to offer support also remotely which complements and extends physical presence.

The COGKNOW Day Navigator prototype consists of a touch screen in a home environment imbued with sensors and computer-mediated controls, and a mobile device for the person with dementia to bring along when going outside of their house. Both devices offer easy-to- use functions: memory support, support to manage activities of daily life. 10 persons with dementia used the prototype independently for several weeks while 32 used it for one or more days. The COGKNOW Day Navigator is perceived as useful and user-friendly by the users, with a potential to maintain more autonomy in several areas of daily living and to improve their quality of life..

The final COGKNOW Day Navigator (CDN) prototype consists of the COGKNOW Home Hub (CHH), the COGKNOW Cognitive Assistant (CCA), the COGKNOW Sensitized Home (CSH), and the COGKNOW Server (CS). Functionalities in the final prototype as follows.

Support in Reminding: Date & weekday & time indication: analogue or digital, 24-hour or am/pm.

Pop-up reminders: remotely configurable, one-time or daily, user-defined text/image/audio/repetition, Agenda & Quarter Hour Clock, Appointment Reminders, Find Mobile Device, Item Locator site tested, Forgotten Keys Warning.

Support social contact: Picture Dialing, priority, photos, landline prefix, using existing phone or voice modem with handset, Internet-based telephony (SIP).

Support daily activities: Radio/lamp control using Tynetec actuators, Radio/lamp control using X.10 actuators Music/story player, Selectable music.

Activity assistant: stepwise video or image + voice instructions for daily activities, Automatic music during lunch.

Enhance feelings of safety: Help/emergency: personalized contact/help icon, Pop-up safety warnings, doors, household appliances, Sensitized night light, Navigation when outdoors, we-centric navigation when outdoors mockup.

Reminding functionality: The reminding function was overall judged positively during the three field tests. Comments during the first field test concerned the wish for more personalization and configuration of reminders and the way of attracting attention to the reminders on the screen.

Social contact functionality: As for the picture dialing function, the majority considered it useful for keeping in touch with family and friends. After comments in the first field test, the icon for making a telephone call was removed from the screen so that the number of steps needed for performing a phone call was reduced. However, some problems with the picture-phone function remained, such as: hearing problems related to the quality of the sound of the handset and delay of the hang up function.

Summary: The technical development suffered from two main challenges, one of which was related to the technical complexity of creating a system with a highly intricate set of functionalities and secondly from the logistical complexities of the physical geography and technical/clinical communication differences.

An increased amount of effort was directed towards working in closer collaboration with non-technical partners. Although this process was not fully refined,

An increased amount of effort was directed towards addressing the logistical issues surrounding geographically distributed technical development along with increasing the testing both in the lab and at each of the sites prior to deployment within the person with dementia's homes. The process of transferring knowledge from the development environment to the technical installation environment was not perfect.

Reliable and secure home area networking systems encompassing user devices and sensors should be studied, aiming for long range, security and auto-configuration. Ideally such a new home communication infrastructure should support positioning at room resolution, and fast proximity detection. Such home networking systems should work with communication systems found in mainstream user devices like WiFi and long-range Bluetooth.

9.2 Scheduling Assistance

Assistance by Videophone (Kuwahara, Yasuda, Tetsutani et al., 2010): The schedule prompter system automatically informs patients when to start the remote reminiscence conversation. They used this schedule prompter system for managing not only remote reminiscence conversation but also the routine core of the patient's daily life at home.

Due to anterograde amnesia, individuals with dementia often forget scheduled tasks. This causes trouble, irritation, and instability. When individuals with dementia cannot remember their schedules, even using such tools as memos, diaries, and alarm-attached equipment, caregivers must constantly remind them of scheduled tasks. This places a great burden on both parties. To cope with these problems, the automatic output of scheduling contents may be useful (Yasuda et al., 2009b).

An individual with dementia, caregivers, and a memory clinic therapist determined the schedule contents to be output and a timetable, and then an engineer or a volunteer input them on the schedule prompter system. The server delivers video content by PC in which a memory clinic therapist explains and reminds patients to perform scheduled tasks (2). They prepared more than ten kinds of schedule prompter video contents (schedule contents), such as taking medicine, preparing meals, taking a bath, and so on. The length of the schedule contents was about one minute. In the initial 20 seconds, beautiful pictures and soothing/nostalgic music are output to get the attention of the individuals with dementia, to relax them, or to lure them to the PC monitor. In the remaining 40 seconds, the same explanation was repeated three times to increase the odds that the subjects had understood the task.

A five-minute automatic recording system was also installed. Since such scheduled tasks as taking medicine are crucial, the 'medicine' video content requests an individual to take her/his medicine in front of the PC. After the video presentation, the system shoots video for five minutes with the web camera to gather evidence that the individual obeyed. Then this video is sent to the server (3), so that the caregiver (who is out of the home) can check it (4). If the individual does not take her/his medicine, the caregiver or the volunteer can call the individual by IP video phone or cellular phone.

Four subjects with moderate and mild dementia participated the experiment. Several tasks were carried out every day, such as taking medicine, or output several days a week. To evaluate the effects of this video content, the caregiver was required to check whether the subject successfully fulfilled the task in periods A and B. The task completion rate afforded by the schedule prompter system, which displays a video reminder series automatically, was 52% in the study (Kuwahara et al., 2010).

The scheduling prompter was effective for subjects 1 and 3, and less effective for subjects 2 and 4. One possible explanation for the discrepancy is that both of the first two subjects were living alone, and the video contents of the schedule prompter may have eased their loneliness. In fact, subject 3 enjoyed seeing her daughter on the monitor. On the other hand, subjects 2 and 4 were living with wives or family. Since the instructions were usually given by their caregivers, the effect from the video content was less than those of subjects 1 and 3. The scheduling prompter was completely ineffective for subject 4, although, she was fascinated by the video content. She may have regarded the video content as TV commercials. Another explanation could be the difference in the severity of the dementia. The reminders worked best in the group with mild dementia, and conversation worked best in the more severe group.

Assistance by Videophone (Yasuda, Kuwahara, Kuwabara et al., 2013): The task completion rate by the schedule prompter system was 52% in Kuwahara et al. (2010). In the present study, motivational prompter videos were added to enhance the original schedule prompter system.

Individuals with Alzheimer's disease present cognitive, psychiatric, and behavioral disturbances such as agitation, poor insight, poor motivation, and depressed mood. The use of a personalized reminiscence photo video improved the concentration of individuals with dementia. The automatic output of old music improved their behavior. In addition, psychomotor exercises have also been suggested to change their mood and behavior. If these interventions are utilized, the motivation of individuals with dementia may also be sufficiently increased to accomplish scheduled tasks. Therefore, we incorporated a personalized reminiscent photo, old music, and motor exercise videos as motivational prompter videos to augment the original schedule prompter system (Kuwahara et al., 2010).

Four outpatients of the memory clinic participated in this experiment. The revised schedule prompter system included the following video reminders: navigational prompter (navigational), motivational prompter (motivational), and schedule prompter (scheduler) videos.

The navigational video was 20 s in duration and featured beautiful pictures and soothing/nostalgic music. This video was designed to capture the attention of the subject and prompt the subject to move to the PC. Three types of motivational videos were newly developed (each type of video was approximately 5 min in length): (1) old music video (three sets), (2) motor exercise video (one set), and (3) reminiscence photo videos of each subject (three sets). One type of video was randomly and evenly chosen from the three types of motivational videos. Furthermore, one set was also chosen from three sets of the old music videos and reminiscence photo videos in the same way. These motivational videos were used to inspire the subject to perform household tasks as directed by the subsequent scheduler videos.

The subjects, caregivers, and memory clinic therapist selected household tasks to be performed and their schedule. Consequently, scheduler videos for each household task were also prepared. The length of each scheduler video was approximately 30 s. In this video, a memory clinic therapist (or a family member for subject 4) explained the scheduled tasks and reminded the subject to complete them.

The server automatically delivered the following two-video reminder series. The original video series (original series) consisted of the navigational and the scheduler videos. The revised video series (revised series) consisted of the navigational, motivational, and scheduler videos.

The caregiver was required to determine whether the subject completed the scheduled tasks successfully. The subject received 1 point if the tasks were performed without any additional instructions from the caregiver, 0.5 points if additional instructions were required for the completion of the tasks, and 0 points if the task was not completed, even after additional instructions.

Compared with the average percentages of the scores obtained in session A1 (caregiver instructions), the scores of all subjects increased in session B1 (instructions given by the two-video reminder series). The average percentage of completed tasks for the four subjects was 62.6% in the two A sessions and 82.9% in the two B sessions.

Caregiver observations of the effects of the schedule prompter system: The caregivers provided information regarding the effects of the schedule prompter system on subject behavior, as follows. ***Subject 1:*** She did not write her diary. Although she had been advised to write it and knew its importance, it was difficult for her to follow the caregiver's advice. However, the advice of the therapist in the video was stronger. She began to write the tasks in her diary immediately after she performed each task.

However, writing in her diary did not persist when the video was not shown (in the B sessions). ***Subject 2:*** The PC was set in her bedroom. However, she was often in the kitchen, so the voices from the video were not heard. The timing of video output sometimes did not match her actual activities. ***Subject 3:*** When the output of the videos started, she complained about feeling as if someone was ordering her to do the task. Nevertheless, she performed the tasks as advised by the videos. Gradually, she accomplished the tasks before the videos instructed her to do so and looked forward to the start of the videos. She even became eager to complete the caregiver's household tasks. After the videos were stopped, she felt lonely because she could not see the videos anymore. Her completion rate of household tasks decreased. ***Subject 4:*** She was very glad to see her great-grandson appear on the screen and comfortably accepted his advice to "stay home", because she sometimes lost her way. After the video stopped, she left her home.

Discussion*:* In this study, motivational prompter videos were added to the original schedule prompter system. The average percentage of completed tasks for the four subjects was 82.9% (instructions provided by the revised system), compared with 52% observed in the Kuwahara et al. (2010). Although the subjects were different from those who participated in the previous study, the revised schedule prompter system may have improved their concentration, behavior, and mood and may have succeeded in motivating subjects to accomplish the scheduled household tasks.

Furthermore, the attitude of maintaining social relationships was usually preserved in individuals with mild or moderate dementia. Therefore, they tended to obey instructions from "social resources" such as therapists and doctors more frequently than they obeyed those of the caregivers. The superiority of the effect of the videos in the two B sessions can also be explained by this hypothesis, as well as the increased motivations discussed above.

Review of Other Studies on Scheduling Assistance: Skillen, Chen, Nugent et al., (2012) introduces a novel approach for providing personalized, context-aware assistance services for users in mobile environments. Central to the approach is the use of ontological user profile modeling which captures various characteristics of a user in order to create a unique set of profile information. In addition, user profiles can adapt to changing user behavior, thus enabling services to respond to evolving user needs and preferences.

This study proposes a personalized architecture with embedded user profile modeling capabilities to support person with dementia undertaking activities of daily living (ADLs) as they move from one environment to another. Current applications include the use of GPS to track users and determine their location to provide outdoor navigation support back home again (iWander). Mobile solutions have been used to deliver reminders to users to engage with various activities at scheduled times.

iWander focuses on tracking a user's location if they have wandered outside of their 'safe zone' and thereafter alerting a carer to assist the user if they are lost. This approach, however, only focuses on the aspect of a user becoming lost and does not include other personalized services such as shopping trip reminders or context-aware guidance. A novel approach to improving outdoor mobility of person with dementia through the use of a smart-phone application is proposed in this study. The solution will not only track a user when they venture outdoors, but will also aim to provide context-aware, personalized services adapted to that user at any time.

Case application scenario*: Jane is a retired, 68-year-old woman who lives by herself and has a mild form of Dementia. Due to her condition, Jane leaves the house and forgets how to find her way to the store resulting in her wandering off in the wrong direction. The phone detects this and offers navigational support to Jane to her destination through the use of GPS technology. When Jane arrives at her local supermarket, her smart phone uses the underlying user profile ontology to determine what she may want and/or need from her trip. She is presented with food items and can select if these are required or not. In the background, the personalization components will create a shopping list based on her food preferences and shopping history.*

9.3 Review of Life Logging Assistance

There are recent researches on logging the life of persons and recording it in a digital format. Furthermore, many applications have been developed in the field of smart environments especially for elderly persons and persons with mild dementia to improve their quality of life. Researchers in **Lifestyle Assistan**t aim to build a context-aware system that can be used by elderly persons and persons with mild dementia. Implementing such systems inside the home of a person will convert it into an intelligent space that observes the user and assists with daily activities. For instance, the system will remind the user to do daily activities, and it will send warning signals if necessary (forgetting the food on the stove, forgetting the door open, etc) (Kikhia, Hallberg, Synnes et al., 2009).

The ***Memex*** vision was described as "a device in which an individual stores all his books, records, and communications. This vision has already been realized, by the ***MyLifeBits*** project. 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. The ***Context-Coded Memories*** project aims at providing technological support for episodic memory to aid persons in reminiscence activities by utilizing aggregated data from a GPS logger and a digital camera. ***PENSIEVE*** is a project which utilizes lifelogging to help persons remember key facts of their life. Uses images, sounds, and recorded text, to help recall names, faces, conversations and other important information. Studies have also been using images from the innovative SenseCam device in conjunction with sensor data (Hallberg, Kikhia, Bengtsson et al., 2010).

Aiding persons with dementia generate more challenges for reminiscence processes since they often find technology difficult to understand and use. The aim of ***HERMES*** is to develop a user-friendly system that will support elderly persons. 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. (Hallberg, Kikhia, Bengtsson et al., 2010).

A ***digital photo diary*** was developed to capture information about events in daily life. The device consisted of a wearable digital camera, smart phone with Global Positioning System (GPS) and a home memory station with computer for uploading the photographs and touch screen. The aim of this study was to describe professional caregiver's perceptions on how persons with mild dementia might experience the usage of this digital photo diary from both a situation when wearing the camera and a situation when viewing the uploaded photos (Harrefors, Sävenstedt, Lundquist et al., 2012).

Memory Lane is a context-aware life-logging system for persons with mild dementia, which offers real time support (navigation, nearby person identification, current location identification, activity guide, etc) and possibilities to review previous activities and to organize future ones. It is important to collect enough data to provide sufficient material for reviewing the activities at the end of the day. This may be problematic outside the home since the system has to rely on data collected by equipment carried by the person with mild dementia. However, inside the home the system can collect data from the sensitized environment (Kikhia, Hallberg, Synnes et al., 2009).

Lisa is on her way to the medical center for her medical check-up and she is following the navigation instructions given to her by the mobile device, which is running the Memory Lane mobile client, to get there. She is grateful for this device because it helps her remember past activities, places, and name of persons. 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 review and recall past activities where Dr. Stefan has been present.

At the end of the day, the data from the portable devices is uploaded to the home station and they can start reviewing. Together they select a number of images that represent the different activities: a few images of the clinic, an image from the laundry room from when Lisa was doing her laundry, and images from the dinner Lisa had with her friends. The names of known persons which were present during the activities are automatically added by the system to reduce the effort.

Detecting the presence of known persons nearby is based on the Bluetooth ID, and the interface displays images of up to four persons if there is more than one known person nearby. Clicking on the persons' image will show the images of all nearby known persons separately as a list, making it easier for the person with mild dementia to choose any person to recall information about (Kikhia, Hallberg, Synnes et al., 2009).

Hallberg, Kikhia, Bengtsson et al., (2010) described 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 reminiscence therapy method was introduced 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. 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. (Hallberg, Kikhia, Bengtsson et al., 2010).

Wearing Assist system for recording and searching daily behavior: Information technologies to record daily behavior by wearing Video Recorder have been studied. Yasuda (2010) made a prototype system to assist recoding and searching of one-day behavior of vest-wearer on which two IC recorders and a portable video recorder are equipped. Vest-wearer records on IC recorder the key words and the time of occurrence for events which will be searched in the future. The recorded information is analyzed by a speech recognition software on personal computer. Then, by using these literally-converted information, vest-wearer can search for the specific visual scene on the video record. The operating procedures for these tools were visually presented by a note pad on the vest, and also verbally and automatically presented by another IC recorder. A patient with mild cognitive impairment wore the vest with these tools, operated them, and succeeded to record his daily behavior for 12 hours in a day. These researches suggest that various IT tools are effective to manage various symptoms of peoples with dementia. IC Recorder as automatic voice output navigator can prompt the patient’s daily activities, including reminders not to leave the house.

Huang, Matsushita, Kawagoe, and Yasuda (2014) are developing a memory vest which is equipped with portable devices including an Android smartphone, two IC audio recorders, and a digital video recorder to log the daily life of the patient. The gathered activity history database can then be used to enrich the dialogue ability of the agent and for helping the user to recall his / her own memory. It is essential to make the agent memorize not only past interactions but also the daily life of the patients, to allow them to feel that the agent is together with them. They proposed a set of recording devices (digital video recorder and an IC audio recorder) which are put in a wearable way and are operated by the patient himself / herself, the memory vest. This is used to log the user’s daily activity for memory recall of both the user and the agent after then.

They are then developing the integration with an Android smartphone into the memory vest. The current prototype recognizes the user’s moving status (walking, running, bicycle, car, or train) and location when she/he is outside home and periodically updates the user’s latest status to a server hosting the activity history database of the user. After the development of the technique to transform the log data to appropriate memory and knowledge presentation, They plan to integrate the database as the back end of the listener agent and thus allow it to engage the dialog involving the context of the user’s daily life.

They are now developing methodologies to automatically identifying remarkable events and the denotes that the user was moving by a train while red means a bus browsing interface of video log. Our next step is to extend the companion agent interface to the smartphone.

Crete-Nishihata, Baecker, Massimi et al., (2012) designed a home-based ambient display that allowed a man with AD to similarly review his past life, in combination with recent photos automatically captured by a life-logging device called SenseCam. Reviewing SenseCam images improved episodic recall for personal events depicted in the images for 4 of the 5 participants.

Two other studies followed: one utilizing life logging and semi structured interviews, and the other taking photographs from the life logging. Life logging, the recording of everything that is seen or done, includes the use of the SenseCam . The SenseCam is a wide lens wearable camera that automatically captures images based on changes in the persons’ environment.

Crete-Nishihata (2012) found that the slideshows did not improve memory, it did allow the opening of conversation about memories, and story-sharing. It aided in creating identity. They were more able to attribute emotions and memories to them, rather than if they had taken the picture themselves. There is room for expansion in this field, and the results thus far seem promising (Thompson, 2013)

Behavioral Assistance in Night: At nighttime, People with dementia (PwD) can experience aggression, restlessness and Sun downing in the forms of vocalization and shouting, physically threatening behavior, wandering, and overreaction to situations. The causes range from misunderstanding of time, irregular and excessive daytime sleeping, feeling frightened, frustration in being unable to comprehend situations, erosion of self-control and judgment through inhibitions and decreased awareness of rules about appropriate behavior. The consequences equate to higher rates of falls, propensity to other accidents and dangers, sadness and depression.

A therapy session can have a positive impact on mood as well as performance of activities for PwD during both the day and nighttime. Those therapy sessions can be influenced by carers providing information such as family pictures and appropriate music (Carswella et al, 2009).

Nighttime activity levels may be lower but this is potentially a more vulnerable period for PwD. AT has been used to assist with the regulation of sleep patterns, as excessive daytime sleeping, and Sundown syndrome contribute to the night-time problems. Sundown syndrome (sun downing) is a term that describes the onset of confusion and agitation that generally affects PwD or cognitive impairment and strikes in the late afternoon or early evening. A closely related syndrome is that of day-night reversal where PwD experience longer periods awake at night than they do during the day. This provides significant additional burden to the carer. Technology can assist people in the hours of darkness as well as during the day. While night-time specific studies identified very few papers (Carswella et al, 2009).

Monitoring*:* A monitoring system was presented for PwD using an expert system. The system tracked people and monitored their activities through use of low-cost positioning sensors. The system recorded and learned the person's movements and their whereabouts. The following data were recorded: number of times he/she got up, went back to bed, visited the toilet, and left the bedroom, and the distance covered during the night. Such analysis could give nurses warning of an increased risk of fall or a decrease in mobility and assist them in making decisions on prescribing medication or whether additional surveillance was needed (Carswella et al., 2009).

Lighting and guidance: At nighttime darkness and disorientation is a hazard. Therefore, lighting for guidance is a very important aspect of safety. Lighting can guide PwD to destinations or make them aware of other hazards. ***INDEPENDENT*** suggested that lighting significantly assisted navigation by ensuring that different areas were visually distinct and providing orientating views. Effective lighting improved recognition of spatial awareness and visual orientation (Carswella et al., 2009).

Education and treatment: A sleep education program was introduced for people with dementia to try and improve sleep patterns at home. Their program introduced the combination of sleep education, daily walking, and light exposure intervention over three weekly treatment sessions. Treatment sessions included a 30 minute daily walking exercise and a program for increasing daily light exposure via a "Sun-Ray light box", within a 3 hour window of bed time. After 6 months participants had significantly fewer awakenings per hour and were awake for less time at each awakening.

The ***Vigil system*** comprised a bed exit sensor positioned under each resident's bed sheet, and bathroom and bedroom exit monitors. Vigil alerted caregivers via a silent pager when a 'high-risk' resident exited his or her bed, bedroom, or bathroom. It was expected that the presence of an automated sensing system would reduce the number of times that nurses would have to check residents' nocturnal status. Staff commitment actually increased on average 6 minutes more per person per month, but there was a significant difference in affective disorder, with the intervention group showing improved affect.

Using an infrared sensor system 1.5m above the residents' beds, their activity along with their presence or absence from their bed was recorded over a 3 month period. The sensor system performed accurately by analyzing it against video recordings of night activity during the experiment. Thus infrared sensors have potential as an ambient technology.

Wandering is the major concern of all carers for person with dementia. Results showed subjects were less active at night, e.g. lying, sleeping and in their own rooms. Excessive wandering behavior appears to be related to activities in the environment, e.g. a quiet environment leads to less agitation and therefore less wandering.

Technology for tracking movements of individuals in residential care was discussed in using 'tagged' slippers and electric pressure mats. Six of the eight subjects were detected to have moved during the night-time period, showing various movement patterns. Understanding the pattern of movement at night time may improve the safety of PwD who are at risk of falling. Nighttime assistive success was reported where one resident required antipsychotic medication every night for episodes of screaming, when an simulation presences audiotape was used for 1 hour every evening.

Passive Infra-Red (PIR) Night Light: Two PIR dusk to dawn lights were used. One was plugged into an existing plug socket by the bed and the other was plugged into an existing plugsocket in the hallway near to the toilet door. Both lights were switched to the PIR function so that they only came on when activated by movement. The lights stayed on for approximately one minute when activated. This enabled the person to see to find their way from the bedroom to the hallway and then to locate the toilet. A simple plug in light with PIR reduce falls at night, assist orientation, reduce anxiety (Cash, 2004).

The effects of exposure to high-intensity bluish and yellowish light was assessed on behavior and circadian rhythmicity of institutionalized older person with dementia. When light intervention was used, a more normal circadian rhythm was established. Most lighting studies have been used to produce a positive impact on circadian rhythms. Person with dementia are more likely to experience disjointed patterns in their sleep and wakening patterns. By trying to regulate these patterns into a fixed normal pattern of a day/night cycle, The associated night time problems and their potential hazards could be significantly decreased. A randomized controlled trial was undertaken to determine whether the progression of cognitive and non-cognitive symptoms may be ameliorated by bright light and increased release of melatonin. Lighting, of course, is of greater relevance at nighttime, as it can assist with guidance and hence reduce the potential hazards in the dark. (Carswella et al., 2009).

Telling system in night: During the night, for example, a lighting system was activated if a patient had left the bed. On returning to bed the lights would fade off after a few minutes. However, failure to return to bed after a predefined period of time would result in the communication system telling the patient that it is nighttime, and they should go to bed. Furthermore, the system communicated to the patients when they approached an exit during the night and verbally reminded the patient to return to bed (Lauriks et al., 2010).

Electronic display board for use at night: Some people panic when they wake up during the night, unable to remember where they are, why they are there, or what time it is. One solution is to place an electronic display board on the wall, the ceiling or at the foot of the bed, so that the person will see it when he or she wakes up. It can be used to display information such as, *"I have come to spend a few days with my daughter".* We have tested this system on several people with dementia and it seems that success depends on the way in which the messages are phrased (Yasuda, 2007).

9.4 Assistance for Procedural Behaviors

Dressing Assistance: The goal of the study (Mahoney, Lczano, Ravishanka et al., 2014) is to develop a 'smart dresser' for in-home use by people with moderate memory loss. This device is designed to provide individualized audio and visual task prompting and enables people to dress while giving a respite to their caregivers. There has been insufficient attention to the stressors associated with dementia-related dressing issues. The ***DRESS*** system uniquely combines interactive context aware/skeletal movement, wrist-affective emotion sensing and fabric tag components to assess and respond to users in real time. Caregivers validated the need for tangible dressing assistance to reduce frustration from time spent in repetitive cueing and from struggles over dressing. They contributed six changes that influenced the smart dresser's conceptual stage prototype development, most notably adding a dresser top iPad to mimic a familiar "TV screen" for the audio and visual cueing.

Cooking Assistance: Forgetting to turn off the cooker can cause a fire. The control turns off the gas when the food being cooked reaches a certain temperature (ENABLE, 2004). In the early stages you could use signs to say, "remember to turn the cooker off"'. However, if this intervention failed, the cooker would be switched off. This included the use of smoke alarms, fire blankets, cooker guards and safer forms of heating such as storage heaters and oil filled radiators (At Home with AT, 2004).

Cooking is one of the most fundamental activities of humankind (CEA2015). It is not only connected with the joy of eating but also deeply affects various aspects of human life such as health, art, entertainment, and human communication. Cooking at home requires experience and knowledge. They may also need support for food-logging and menu planning for their family health. Needless to say, support for a good and enjoyable meal would improve the quality of life. Systematic cooking/eating support for elderly or physically challenged people is also significantly important. Since a cooking activity requires people to manipulate foods, watch their conditions, listen to the sounds, smell the aromas, and taste it, a cooking assistive system should also be capable of multiple sensitivities. CEA has been aiming to provide an opportunity for such research groups to discover each other, introduce their trials, and discuss their status and where they should go. Even if limiting to computer science, there are related works in multimedia, human-computer interaction, natural language processing, and artificial intelligence.

Two cognitive aids have been developed to assist aphasic users in the execution of cooking tasks. ***VERA***, which provides individually tailored visual cooking instructions, has been tested with four aphasic subjects. The most severely aphasic subjects performed best with the system, whereas those who were less impaired performed best with text-based -instructions. In contrast, ***Cook's Collage*** is a video-based reminder system that displays the previous six steps completed in the cooking task to reorient the individual to the remainder of the activity (Bharucha et al., 2008). A cooking monitor service was developed to detect problems and potential dangers during the cooking process. During evaluations the cooker monitor worked well. However, it caused some irritation to users when the cooker was turned off under false positive situations (Lauriks et al., 2010).

Among daily-living activities, kitchen tasks may profit most for ICT-based, elderly-assistive solutions: for safety; for complex and cognitively-demanding tasks; and since most home technology is found in kitchen appliances. The FOOD (Framework for optimizing the process of feeding) project, is based upon these premises, and aims at building a 'smart' kitchen environment, providing older adults with services supporting safety, motivation and fun in the kitchen, and a healthy lifestyle. FOOD utilizes a networked kitchen, in which appliances and environmental sensors communicate, both at the local and the remote level (Grossi, Bianchi, Matrella et al., 2014).

The kitchen network is also relevant to energy management and to maintenance purposes. Services could be as simple as basic safety monitoring tasks. For instance, a recipe database can be accessed through nutritional and medical 'filters'; step-by-step guidance is provided for selected recipes; automatic set-up of the cooking appliances can be connected to the desired recipe. The data stream coming from the kitchen network is also exploited for profiling the user's habits and for early detection of behavioral changes (connected to feeding and possibly suggesting health issues).

Cooking Support System (Sano, 2014): Sano (2014) have focused on cooking behaviors which are vital to living and which draw on all five senses, as a powerful means of cognitive rehabilitation with respect to people with higher brain dysfunction. In order to help people with higher brain dysfunction prepare food and cook on their own, he proposed a cooking navigation system that is tailored to the mental and physical disabilities of the patients based on multimedia cooking recipes.

The flow of a cooking rehabilitation program. Step1: The patient plans a meal, determines the dishes to create, and shops for them. Step2: The patient prepares the food, based on the cooking support system. Step3: Once the cooking is complete, the patient eats the meal while communicating with others. Step4: The patient reflects on the rehabilitation with the therapist, including shopping and cooking behaviors.

The cooking navigation system consists of multimedia cooking recipes configured of combinations of static and dynamic media, which have been converted to basic short sentences. The patients perform tasks in accordance with the recipes written into the cooking rehabilitation system. During the cooking process, a number of tasks are generally done simultaneously. For example, the boiling of water and the cutting of ingredients can occur simultaneously.

For the top-down attention behavior model, we configured it as a flow model in which a number of cooking steps are done in parallel. We show the steps for a simmered meat-and-potatoes dish, the steps for miso "soup", and the attention flow. When putting together the meat-and-potatoes dish while making the miso soup, for example, the cook starts the process for miso soup once the process for the meat-and-potatoes dish has more-or-less ended. During that time, the cook must watch the actions at hand in order to follow the miso soup step, but at the same time it is also necessary to pay attention to other things such as whether the meat-and-potatoes pan is boiling over.

For evaluating whether proposed attention indices can work well, we prepared a recipe of meat-and-potatoes dish and that of miso soup. For obtaining attention behavior evaluation index, an ideal attention allocation pattern is required. Each allocation rate (%) is normalized as the sum of the simultaneous events becomes 100%. The attention allocation rate of hands and pan is high, because the cutting and heating operations have some dangerous factors.

There is a total of 20 nodes for the meat-and-potatoes and the miso soup recipe. We arranged a video screen with rehabilitation activities at left side and located an evaluation score and comment each step at right side. When a user clicks on the step to reflect, a video is played according to the specified step. The comment was described as "You worked well!" And you watched a pan of meat-and-potatoes dish beyond necessity. You have to glance at a pan of miso soup."

We conducted cognitive rehabilitation experiments to two higher brain dysfunction patients for one month. The patient

A could perform a cooking using cooking navigation system smoothly. Because improvement was seen in how to handle kitchen knives and the way of measurement of the seasoning, this support system was effective for the patient A. As for the patient B, his awareness and aspirational utterance increased gradually. He said, "I wanted to continue this rehabilitation and I will use this system at his home".

Washing Hand Assistance: People with dementia often have difficulty completing activities of daily living (ADL). Forgetting steps in tasks such as using the toilet can become aggravating and embarrassing. Caregivers often guide patients to complete the task by giving step-by-step prompts. The development of automated prompting systems may help to alleviate some of the strain experienced by caregivers.

Mihailidis and Turgeon (2005) have had some early success with these automated prompting systems. Up to three different verbal cues were issued to the subject before a caregiver was called upon for assistance. The subjects were able to complete without assistance from a caregiver as well as a decrease in the overall number of interactions required with the caregiver when the device was introduced.

COACH: Using a video camera, hand-tracking bracelets, and machine learning algorithms, COACH monitors the progress of the hand washing activity, determines the context, and provides prerecorded verbal prompts if and when it detects a problem in task execution (e.g., forgetting to wash hands after using the soap). In a clinical trial of 10 subjects with moderate to severe dementia, COACH increased by 25% the number of hand washing steps that were correctly completed without caregiver assistance. The investigators are currently refining COACH with a new color vision hand and object tracking system that obviates the need to wear tracking bracelets, and machine learning algorithms that are capable of handling uncertainty more robustly. Moreover, a visual prompting capability is being tested in comparison with the previously developed verbal feedback methods (Bharucha et al., 2008).

Toilet Assistance System: Utsumi, Yamazoe, Abe et. (2006)'s posture-detection system using IR cameras and invisible IR pattern projectors detects the user's state as his/her 3D appearance. Human behavior is modeled as a distribution of 3D appearances using kernel density functions, and the results of this behavior detection are used to determine the instructions to be given to the user. They show a sample implementation of the system for a toilet task with voice- and CG-animation-based instructions to users.

Caregivers bear a great burden of toileting assistance for those patients with dementia. Yasuda, Okazaki, Utsumi et al. (2008) proposed a system that can help the patients to relieve themselves in the toilet activities by giving cognitive support through an appropriate voice and visual guidance, in line with their task progress. The system observes 3-D user appearances and recognizes the task progress based on his/her position and postures. They performed an evaluation experiment with 7 subjects with dementia in simulation environment.

The result showed that 5 patients had successfully fulfilled their required task in the simulated toilet activities, partly with the help of voice guidance by an experimenter from the monitor room. The cause of the failure is that their eye gazes and attentions did not correctly move from the PC screen to the target objects in the environment. In order to overcome this problem, Yasuda, Imai, Kuwahara et al. (2009) introduced an arrow and eyeball animations to direct the patient's gaze and attention. With this refinement, seven out of eight patients with mild and moderate dementia smoothly performed the required tasks. The arrow animation seemed to be more effective for eye gaze direction.

Bathing Assistance System: Onishi and Hirai (2008) had a research project of a bathroom as a ubiquitous computing environment. In order to measure bathing activities, they have studied availability of RFID equipped into bath items in a bathroom with water. From some experiments, we confirmed to be able to detect primitive actions of bathing person by picking up or putting bath items and their positions. However, meta-level bathing activities, for instance washing body or hair, are more useful than primitive actions for various applications. This paper describes three trial estimations of meta-level bathing activities from primitive activities using Hidden Markov Model (HMM). This paper also describes data of bathing activities for HMM, and a simulation using actual bath items equipped RFID.

9.5 Smart Home

Low Tech devises: Several nursing homes use environmental/spatial cues to increase functional independence in room finding for the elderly. Spatial cues can be considered as salient reference points which can help the patient to discriminate among similar places and recognize specific areas, such as corridors, stairs, room entrances. Ten persons suffering from mild to severe AD were involved, which compared the effectiveness of significant (familiar and beloved) and non-significant (unfamiliar and neutral) objects displayed outside the participants' bedroom. Some in the moderate stage relied more frequently and successfully on significant cues. The patient with an advanced stage of the disease failed drastically to use any type of orientation cues.

Another impact was evaluated for placing two external memory aids outside the bedrooms of three persons with AD. A portrait-type photograph of each participant from early childhood and a large print sign with the resident's name were both placed outside each participant's room. Results showed that there was over a 50% mean increase in participants' ability to accurately locate their own room following the intervention (Caffo, Hoogeveen, Groenendaal et al., 2013).

AT programs for reducing spatial orientation disorders have been profitably employed with persons with intellectual and visual disabilities: for example, auditory cues repeated at regular intervals to call the person toward a specific target destination were used with persons with visual impairments. Similarly, a visual orientation system based on a portable device to be worn by the participant and on light sources that marked the routes to the various destinations was employed for promoting independent indoor traveling in persons with profound developmental disabilities (Caffo, Hoogeveen, Groenendaal et al., 2013).

Recently, an AT orientation program based on verbal messages has been successfully implemented with three persons with AD. The orientation system (a) included a sound source at each of the destinations (b) provided brief verbal messages from the destinations the person was expected to reach. The verbal messages consisted of short sentences encouraging the patient to walk and find the destination. The three participants involved in the study learned to use effectively the orientation technology to reach different room destinations. In a more recent effort, the effectiveness of two AT orientation systems was compared, one involving auditory cues (i.e. verbal messages automatically presented from the destinations. There was over a 65–70% mean increase in patients' ability to travel and locate the target rooms.

High Tech Devises: The ***Gloucester Smart House*** project aimed to develop the following functions. ***Locator*** is a device to help people locate lost items such as their purse, glasses, pension book, or keys. ***Bath Monitor*** is to help stop people filling the bath to overflowing. ***Cooker Monitor*** is a device that monitors the cooker and acts to prevent dangerous situation occurring. ***Night-time Guidance*** guides the resident of a house to the toilet with gentle lighting in the middle of the night.

Helal et al., (2003) propose ***Smart House*** in which computation is embedded into physical objects (such as walls, floors, doorways, clothes, etc). The Smart House should be able to proactively change its environment to provide services that promote an independent lifestyle for the elderly. They have created a Smart Robot called ***Matilda***, which will function as a factitious AD elder. Matilda's Smart House is equipped with various sensors and devices. This environment includes J2ME smart phones as user devices, ultrasonic location sensor, X-10 controlled devices (door, mailbox, curtain, lamp, and radio), and networked devices (microwave, fridge, LCD displays on the wall, and cameras). They have developed several applications for Matilda's Smart House.

Mobile Patient Care Giver Assistant (***mPCA***) is a smart phone that interacts with a set of sensors in a smart space, in which most of the computation, decisions, and events take place. This is an attention-capturing application to help patients with moderate AD by means of reminders, orientation, and context-sensitive teaching, and monitoring. It first, attempts to capture the elder's attention. Once attention is captured, the system delivers the task to be done by the elder (e.g. the elder needs to drink water to be hydrated). The task is delivered in a form of a video clip played in one of the four flat panel monitors. The initial phase simply calls the elder's name (message played in the phone) requesting the elder to respond in a certain way (e.g. say "yes"). If attention is not secured, richer audio is attempted by playing special songs and sounds and then repeat the name calling and confirmation request. If this fails, the system actuates the vibrator on the smart phone and outputs the name calling using pre-recorded sounds of relatives and significant others (Helal et al., 2003).

General Reminder System (GRS) reminds the elder to perform critical tasks such as medication intake and doctor appointments. This application will play an audio message on the elder's smart phone whenever a medicine is due. Then the patient should use the mobile scanner attached to the phone to check if it is the right medication or not. The smart phone will send the data read by the scanner to the server, which will check how much medicine is available to order a refill whenever the quantity goes below a certain level (Helal et al., 2003).

Augmented Awareness System (AAS) is to enhance the level of awareness of the occupants by notifying them when certain events happen (mail delivery, someone at the door, water leak, etc), and also reduce the level of efforts by automating tasks (e.g. controlling appliances, lighting and doors). They have chosen voice interface to reduce the level of attention of the elder to control the environment. Appliances, lights, door latches, mailbox sensors, leak sensors, and window sensors are attached to X-10 components. Whenever mail is delivered, an event is sent in the framework. The framework delivers a voice message to the smart phone of the elder. (Helal et al., 2003).

In addition to instrumenting the home with various motion detection devices and a small wireless network consisting of three RF receivers, the person at risk for dementia and his or her caregiver wore an RF transmitting wristwatch to record the movement trajectory. the Proactive Activity Tool kit (***PROACT***) investigators also used RF technology to determine the performance characteristics of PROACT in automatically recognizing the activity of daily living (ADL) (Bharucha et al., 2008).

Intelligent sensors were described which may be used to form a monitoring and alarm system. The sensors included magnetic switches on doors for monitoring movement from room to room, thermostats which measured room temperature, appliance temperature or body temperature. Accelerometers measured loss of balance and falling. Radio Frequency Identification (RFID) tags were placed on commonly misplaced objects for retrieval while infrared motion sensors tracked presence and motion throughout the home. Microphone arrays were used to facilitate communication with the resident or to detect abnormal noises or calls for help. Grab bars were placed to aid people’s transfer on and off toilets, in and out of doors and entry and exit of baths and showers. The physical pressures exerted on grab bars could be used to identify improvement or decline in strength and balance. Pressure sensitive mats were installed under bed mattresses to monitor the rest dynamics. An array of pressure sensors, measured the positioning and posture while lying down and lying to rising transitions. Identifying these changes could lead to preventing falls injuries (Carswella, McCullagha, Augustoa et al., 2009).

The use of electronic noses can be used to recognize changes from normal smells to identify things from personal hygiene to burning food. These are very important aspects of nighttime associated care. A bathroom monitoring system was produced to provide statistical usage of bathroom appliances from showering, bathing, cleaning teeth and washing hands. However to date, evidence is not consistent as to the benefit. A Cochrane review reported a lack of empirical evidence to support or refute the use of smart home technologies within health and social care (Carswella et al., 2009).

Willow Housing and Care Beechwood Court Extra-Care scheme appears to be built specifically with dementia clients in mind, creating an environment which incorporates very helpful features. It opened in January 2012, a team Leader explains: “We have included a higher level of security at the scheme than previously; we also have flood detectors in kitchens and bathrooms and smoke detectors linked to the community alarm. We have ‘memory boards’ on individual doors and are alerted if a resident leaves their flat. Flooring is differently colored in different areas to aid way finding (Bonner & Idris, 2012).

Manor Gardens, Bolton Places for People developed this extra-care scheme in2009. Every flat has fused spurs to enable rapid installation of automatic door and window openers and motorized curtain tracks. The scheme has strengthened walls/ceilings in the bathrooms to accommodate grab rails and tracking hoists. As well as the modern call alarm system with full tele-care/tele-health capabilities, the scheme has Digital Signage and Interactive Notice boards, touch-screen video (‘Skype’) facilities and an IT Suite plus full on-site Broad band access allowing wired and wireless internet connections for each resident. Those who don’t need any assistive equipment haven’t been left with grab rails or automated mechanisms, but they can be fitted easily if they require them at a later stage (Bonner & Idris, 2012). ‘YouTube’ sessions in our IT suite were invaluable for reminiscence purposes as there are so many clips online from their earlier life. Also, our video box (which utilizes Skype), helped connect people with loved ones from around the world and this was a great source of comfort and pleasure” (Bonner & Idris, 2012).

Monitoring System in Residential Homes: Sugihara, Nakagawa, Liu et al., (2009) installed a camera system into a group home to investigate how such a device may help caregivers in responding to the behaviors of the persons with dementia. They studied how their behaviors have changed by introducing the system into the home through video recording and a series of interviews. They found that the system enables caregivers to optimize their responses to the persons with dementia depending on their degree of mobility.

Schikhop and Cordia (2012) evaluated the implementation of a new monitoring system in residential homes for people with dementia. The system supports the care professionals in their work and helps to prevent nightly incidents. The network IP-cameras were connected to a variety of sensors that respond to presence, activity, and sounds. When the sensors are activated by an event, live images and sound are sent by WiFi to the mobile Personal Digital Assistant (PDA) of the care professional on duty. The camera in the bedroom of the resident can then be steered by the carer using the PDA touch screen if necessary. Thus, the care professional can make an assessment if the resident needs immediate assistance. The care professionals said they saw only advantages to using the monitoring system. They positively evaluated working with the new system despite the fact that, when introduced to the technology, they thought it would be intimidating to work with a PDA.

9.6 Other Assistance

Almost every Alzheimer association offers a website where people with dementia and their carers can join forums, post messages or chat with fellow sufferers. Many Alzheimer associations also have a 24-h telephone support service for emotional support and information on regional support services like Alzheimer café's and meeting centers. An Internet-based application called Alzheimer's Carer Internet Support System (**ACISS**), designed to provide carers with clinical, decision-making and emotional support, was evaluated in a 6-month field trial of 42 carer/patient dyads. Preliminary results showed the system to be beneficial to carers of people with dementia (Lauriks et al., 2010).

Cognitive intervention can be presented utilizing video conference, computer based, or Internet-based systems. In comparing cognitive intervention via a video conference system with face to-face intervention, telemedicine was feasible, effective on memory, language and attention and highly accepted in people with dementia. An interactive computer -based program was performed to train people with dementia to use a touch screen and showed improved performance in computer-program tasks. To determine the usefulness of an Interactive ***Multimedia Internet-based System*** (IMIS) in people with suspected Alzheimer's disease, IMIS was compared in combination with an ***Integrated Psycho-stimulation Program*** (IPP) and pharmacological treatment to IPP combined with pharmacological treatment and pharmacological treatment alone. They found both IMIS and IPP to improve cognition and the IMIS program to provide improvement above that seen with IPP alone (Lauriks et al., 2010).

Formal and informal carers in a number of European and North-American countries utilize forms of telemedicine such as video conferencing, tele monitoring and tele care to create more capacity by reducing travel time and increase quality of care by allowing more frequent contact and quick referrals to a specialist. Several projects aimed to develop tele-care home services that enable persons with dementia to live independently and offer support to their informal carers. The European Fourth Framework Program (FP4) project ***ACTION*** (Assisting Carers using Telematics Interventions to meet Older persons Needs) focused on the empowerment of family carers to help maintain autonomy, independence and quality of life in frail elderly. Familiar electronic equipment like TV and telephone was combined with modern ICT to improve carers' coping skills in daily care and emergency interventions and to offer financial information and emotional support. A Swedish contribution to the project comprised a videophone to facilitate communication between health care providers and patients and their families. Families were quicker to request information, education and support from professional carers and valued the informal support network of family carers to share experiences (Lauriks et al., 2010).

The FP5 project ***TeleCARE*** aimed to design and develop a flexible infrastructure of remote supervision and assistance services to facilitate independent lifestyles and to improve quality of life, confidence, well-being and safety in elderly people, including people with dementia. Partial validation was achieved with field assessments involving four classes of potential users including elderly and their relatives and health care providers. However, field tests for fine tuning and acceptance of the technology still need to be carried out. Another tele care project is the "Tunstall tele-care system", which can be tailored to suit the needs of people with dementia and protect them from dangers such as wandering, fires and floods (www.tunstalltown.com)

(Lauriks et al., 2010).

Within the ***Safe-at-home*** project conducted a large-scale study into the effect of different items of assistive and tele care technology. An intervention group of people with dementia was compared to a matched control group. After intervention the two groups differed significantly in the number of services received, visits and contact hours per week, resulting in lower costs in the intervention group. The technology was found reliable and a majority of carers reported reduced feelings of concern for a person's safety. Almost half of the carers felt the project had improved the confidence of the user in their ability to look after themselves safely (Lauriks et al., 2010).

The experiences of 19 informal carers with a web-based home monitoring system, consisting of broadband Internet access, an Ethernet card, the Xanboo Smart Home Management system and a cell phone with text messaging were explored by in the ***SAFE house*** project. Carers received training on how to use the system prior to installation and were able to use the system during the intervention period of 24 weeks. Researchers reported reduced carer burden. Cellphone alerts facilitated keeping track of loved ones and as relatives called more often, relationships improved (Lauriks et al., 2010).

How to cope with them and where to find support can be found on websites of Alzheimer societies. Alzheimer Nederland also offers a 24-h telephone service for information, support and advice. The Dutch site www.hulpgids.nl offers psychiatric consultation, forum discussions and fellow patient contact. On www.vraagwijzer.nl one can get help clarifying a health care demand, get advice on adequate care and support in how to receive the desired type of care (Lauriks et al., 2010).

The Geriatric Research, Education and Clinical Centre (GRECC) of the Minneapolis Department of Veteran Affairs Medical Centre offers practical online information on a number of topics related to caring for a patient with dementia (e.g. how to handle a loved one's decline, how to cope with bowel and urinary incontinence). The US website www.alzonline.net provides Internet- and telephone-based support and education for people with Alzheimer's disease and other dementias as well as support for their carers. Utilizing training videos and downloadable information, the site offers classes to address a wide range of topics related to dementia care (e.g. medication management, dealing with the stress of caring and performing daily tasks). An initial program evaluation showed reasonable effectiveness of ***AlzOnline's Positive Caregiving Classes***. Carer self-efficacy improved and subjective carer burden was reduced but positive dimensions of the care giving experience and perceptions of time burden in providing care were unaltered. The efficacy of ***Care-giver's Friend***, an Internet-based multimedia support program designed to support family carers employed in the workforce in participants using a pre-test/post-test design. Results showed significant benefits on carer depression and anxiety and improvements in perceived stress, strain and positive aspects of care giving (Lauriks et al., 2010).

Information and emotional support for carers in coping with dementia symptoms furthermore is available through web forums and chat rooms, video training and telephone services. Though web-based interventions seem promising especially to help meeting the various needs of people with dementia and carers in an effective and less time-consuming way, instrumental ICT support for coping with behavioral and psychological changes in dementia is, however, relatively disregarded as yet. People with dementia and their carers have access to online information, support, education, and advice on coping with behavioral and psychological changes (Lauriks et al., 2010).

Until dementias can be prevented or cured, interventions that maintain or maximize cognitive and functional abilities will remain critical for healthcare and research priorities. Best practice guidelines suggest that individualized exercise programs may improve fitness, cognition, and function for people with mild to moderate dementia. Increasingly, telehealth is being used to improve the delivery and availability of healthcare services for individuals living in rural areas, including exercise. This article describes the feasibility of a telehealth-delivered exercise intervention for rural, community-dwelling individuals diagnosed with dementia and their caregivers. Participating in an exercise intervention with persons who were in similar situations was deemed beneficial. Although there are barriers to overcome, the development and evaluation of telehealth-delivered exercise interventions is a timely and important research activity that has the potential to facilitate improved healthcare services for individuals with dementia and their caregivers (Bello-Haas, O'Connell, Morgan, & Crossley, 2014).

Recently, walking exercise is becoming popular. People are able to exercise with enjoying the surrounding environment changes and the strolling around wherever they like. We believe that these enjoyments, are called wandering, are essential elements of the walking exercise. On the other hand, there are also many people exercising with a walking machine in the indoors, such as a sports gym. However, the exercise with a treadmill is tedious for users because of lack of the wandering. Takase, Yoshida, Dohi, Nakano, Sakai, & Yasuda (2016) proposed a novel support system for walking exercise with the wandering experience by using google street view. In addition, we introduce a companion agent to act as a route guide and improve the enjoyments of walking. As a result, users can stroll around the world or visit wherever they want with the agent during exercising. By means of the system, users will be able to exercise in the indoors with the similar wandering experience in case of walking in the outdoors.

9.7 References

At Home with AT: An evaluation of the practical and ethical implications of assistive technology and devices to support people with dementia and their carers. (2004). Marilyn Cash BSc (Hons) MA.

Bello-Haas, D., O'Connell, ME., Morgan, DG., & Crossley, M. (2014). Lessons learned: feasibility and acceptability of a telehealth-delivered exercise intervention for rural-dwelling individuals with dementia and their caregivers. *Rural and Remote Health* 14: 2715.

Bharucha, A. J., Anand, V., Forlizzi, J., Dew, M. A., Reynolds III, C. F., Stevens, S., Wactlar, H. (2008). Intelligent Assistive Technology Applications to Dementia Care: Current Capabilities, Limitations, and Future Challenges*Am J Geriatr Psychiatry*.

Bonner, S., & Idris, T. (2012). Assistive Technology as a Means of Supporting People with Dementia: A Review. (Ed.)Jeremy Porteus. The Housing Learning & Improvement Network.Caffo, A. O., Hoogeveen, F., Groenendaal, M., Perilli, A. V., Picucci, L., Giullo E., Lancioni, G. E. & Bosco A. (2013). Intervention strategies for spatial orientation disorders in dementia: A selective review. *Developmental Neurorehabilitation,* 1–10.

Carswella, W., McCullagha, P. J., Augustoa, J. C., Martinb, S., Mulvenna, M. D., Zhenga, H., Wanga, H.Y., Wallacea, J.G., McSorleyc, K., Taylorc. B. and Jeffersc, W.P. (2009). A review of the role of assistive technology for people with dementia in the hours of darkness. *Technology and Health Care*. 17, 1–24. Carmien, S & Gorman, A. (2004). Creating Distributed Support Systems to Enhance the Quality of Life for People with Cognitive Disabilities. CEA2015. The Seventh International Workshop on Cooking and Eating Activities. In Conjunction with The 2015 IEEE International Conference on Multiemdia and Expo Torino, Italy / July 3, 2015.

Clever Project (2004).

COGKNOW: Final Evaluation Report, Version 3(2009). (Ed.): Rose-Marie Dröes & Johan E. Bengtsson. Crete-Nishihata, M., Baecker, R. M., Massimi, M., Ptak, D., Campigotto, R., Kaufman, L. D., Brickman, A. M., Gary R. Turner, G. R., Steinerman, J. R. & Black, S. E. (2012). Reconstructing the Past: Personal Memory Technologies Are Not Just Personal and Not Just for Memory. Human Computer Interaction, 27, (1-2). 92-123, DOI: 10.1080/07370024.2012.656062.

Grossi, F., Bianchi, V., Matrella, G., DE Munari, I., Ciampolini, P. (2014). Senior-friendly kitchen activity: The FOOD Project. *Gerontechnology*, 13(2): 200; doi:10.4017/gt.2014.13.02.349.00.

Hallberg, J., Kikhia, B., Bengtsson, J. E., Sävenstedt, S., & Synnes, K. (2010).Reminiscence Processes Using Life-Log Entities for Persons with Mild Dementia.

Harrefors, C., Sävenstedt, S., Lundquist, A., Lundquist, B. & Axelsson, K. (2012). Professional Caregivers' Perceptions on how Persons with Mild Dementia Might Experience the Usage of a Digital Photo Diary. *The Open Nursing Journal*, 6, 20-29.

Hattori, F., Kuwabara, K., Kuwahara, N., Abe, S. and Yasuda, K.(2010). Socialware for people with cognitive disabilities. in Yingxu Wang, Du Zhang, and Witold Kinsner (Eds.), *Advances in Cognitive Informatics and Cognitive Computing*, Studies in Computational Intelligence, Vol. 323, pp.193-207, Springer.

Helal, S., Giraldo, C., Kaddoura, Y., Lee, C. El-Zabadani, H., & Mann, W. (2003). Smart Phone Based Cognitive Assistant. University of Florida, Gainesville, FL-32611, USA. {helal,cgiraldo, yok, chl,hme}@cise.ufl.edu, wmann@hp.ufl.edu

Huang, H. H., Matsushita, H., Kawagoe, K., & Kiyoshi Yasuda. (2014). Toward an agent framework that assists the individuals

with mild memory impairment. *International Journal on Information Science and Computational Intelligence*, 6 (1), 13pages.
Kautz, H. Assisted Cognition: Computer Systems to Aid People with Cognitive Disorders. (2004).
Kikhia, B., Hallberg, J., Synnes, K., & Sani, Z. H. (2009). Context-aware Life-Logging for Persons with Mild Dementia.
Kuwabara, K., Kuwahara, N., Yasuda, K., & Abe, S. (2006). Semantic Web Enabled User Interaction for Cognitive Prostheses.
Kuwahara, N., Yasuda, K., Abe, S., & Kuwabara, K. (2006). Networked Reminiscence Therapy for Individuals with Dementia by using Photo and Video Sharing**.** ASSET.
Kuwahara, N., Yasuda, K., Tetsutani, N., & Morimoto. K. (2010). Remote assistance for people with dementia at home using reminiscence systems and a schedule prompter.
Kawamura,T., Kono, Y., Kidode,M. (2006). Towards a Wearable Cognitive Prosthesis to Support “What” and “Who” Type Memory Activities. International Workshop on Cognitive Prostheses and Assisted Communication (CPAC 2006). In conjunction with 2006 International Conference on Intelligent User Interfaces (IUI 2006)., 2006. 4-9.
Lauriks, S., Reinersmann, A., van der Roest, H. G., Meiland, F., Davies, R., Moelaert, F., Mulvenna, M. D., Nugent, C. D., & Dröes, RM. (2010). Review of ICT-Based Services for Identified Unmet Needs in People with Dementia. M.D. Mulvenna, C.D. Nugent (eds.), *Supporting People with Dementia UsingPervasive Health Technologies*, 37-61. Springer-Verlag London Limited, 2010.
Mahoney, D.F., Lczano, B. C., Ravishanka Ä r, V., Mahoney, E.（2014）. Development of a Responsive Emotive Sensing System (DRESS) to aid persons with dementia dress independently. *Gerontechnology 2014*;13(2):259; doi:10.4017/gt.2014.13.02.020.00.
McCarthy, S., Sayers, H., Mc Kevitt, P., McTear, M., Coyle, K. (2015). Intelligently Adaptive Mobile Interfaces for Older People., DOI: 10.4018/978-1-4666-7481-3.ch003. Xhafa, Fatos, Moore, Philip, Tadros, George, (Eds). Advanced technological solutions for e-health and dementia patient monitoring. Chapter 3, ISBN 978-1-4666-7481-3, ISBN 978-1-4666-7482-0. IGI Global), Hershey, PA, USA.
McCullagh et al., (2009). NOCTURNAL, one project that is being carried out after COGKNOW, uses music, reminiscing, lighting, and mental stimulation to alleviate anxiety and the disorientation of people with dementia at night.
Mihailidis, A., Turgeon, K. L. (2005). The Efficacy of Visual Prompting Among Older Adults with Dementia. Connaught Start-up, University of Toronto.
Onishi, R., & Hirai, S. (2008). Estimation of Bathing Activities from Use of Bath Items Using HMM. Human Interface Symposium 2008, 1423.
Ohara, M., Utsumi, A., Yamazoe, H., Abe, S., & Katayama, N. (2007). Attention Monitoring for Music Contents Based on Analysis of Signal-Behavior Structures. (Ed.) Yasushi Yagi, Sing Bing Kang, In So Kweon, Hongbin Zha. Lecture Notes in Computer Science: Computer Vision-ACCV 2007: Vol. 4843, Part I, pp 292-302. DOI10.1007/978-3-540-76386-4_27. Springer Berlin Heidelberg. 2007.
Sano, M. (2014). Reflection Support System Based on an Attention Behavior Model for Cooking Cognitive Rehabilitation. Eight Asia International Conference on Mathematical Modelling and Computer Simulation, Asia Modelling Symposium 2014 .
Skillen, K. L., Chen, L., Nugent, C. D., Donnelly, M. P., & Solheim, I. (2012). A User Profile Ontology Based Approach for Assisting People with Dementia in Mobile Environments. Protégé OWL Web Ontology Editor, http://protege.stanford.edu/
Sugihara, T., Nakagawa, K., Liu, X., & Fujinami, T. (2009). The Effects of Camera System on Caregivers’ Behaviors to Persons with Dementia. Constantine Stephanidis, (Ed.). Universal Access in Human-Computer Interaction. Addressing Diversity Lecture Notes in Computer ScienceVolume 5614, 2009, pp 297-303, Springer, Berlin.
Takase, Y., Yoshida, Y., Dohi, S., Nakano, Y., Sakai, N., Yasuda. K. (2016). A System Supporting Walking Exercise through Strolling with a Companion Agent. Japanese AI conference.
Thompson, J. R. (2013). Reflection: A Literature Review of Recent Studies in Reminiscence Therapy.
Utsumi, A., Kawato, S., & Abe, S. (2005). Attention Monitoring Based on Temporal Signal-Behavior Structures. (Ed.) Nicu Sebe, Michael Lew, Thomas S. Huang. Computer Vision in Human-Computer Interaction: Lecture Notes in Computer

Science. Vol. 3766, pp100-109. Springer Berlin Heidelberg. 2005.

Utsumi, A., Yamazoe, H., Abe, S., Kanbara, D. Human Behavior Recognition for Daily Task Assistance using Sparse Range Data Observations. Control, Automation, Robotics and Vision, 2006. pp1-6. E-ISBN : 1-4214-042-1 0. DOI: 10.1109/ICARCV.2006.345317. IEEE.

Utsumi, A., Kanbara, D. Kawato, S., Abe, S., Yamauchi, H. (2006). Vision-based Behavior Detection for Monitoring and Assisting Memory-Impaired People. 2006 International Workshop on Cognitive Prostheses and Assisted Communication (CPAC 2006). In conjunction with 2006 International Conference on Intelligent User Interfaces (IUI 2006).10-15.

Yasuda, K. (2007). Rehabilitation through portable and electronic memory aids at different stages of Alzheimer's disease. *Les Cahiers De La Fondation Me'de'ric Alzheimer*, 97-107, No3, September.

Yasuda, K., Imai, Y., Kuwahara, N., & Morimoto. K. (2009). Transfer for eye gaze from screen to auter space : for dementia's toilet task support system. *The 23rd Annual Conference of the Japanese Society for artificial Intelligence, 2009.*

Yasuda, K., Kuwahara, N., & Morimoto, K. (2009). Remote reminiscence talking and scheduling prompter for individuals with dementia using video phone. 2009HCII.

Yasuda, K. (2010). Assist system for recording and searching daily behavior of people with dementia by portable video recorder and speech recognition. *The 24th Annual Conference of the Japanese Society for Artificial Intelligence*,

Yasuda, K., Kuwahara, N., Kuwabara, K., Morimoto, K., & Tetsutani, N. (2013). Daily assistance for individuals with dementia via video phone. *American Journal of Alzheimer's disease and other dementias*. 28(5), 508-516.