Mapping Memories for People with Dementia

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Abstract. Due to the demographic change and the world's ageing populations the number of people with dementia will rise dramatically in the coming years. Dementia impacts all areas of daily life and, in particular, memory and communication. Although technology provides promising means to address these challenges, few technologies have been successfully developed that empower the people with dementia instead of simply leaving them in a passive position. We aim specifically to design interactive systems that can be used by people with dementia, e.g., as part of reminiscence therapy to remember the past and communicate with others. In this paper, we present our research and design approach and exemplify the design case of the interactive Reminiscence Map. This is a tangble interface developed in collaboration with a person with early stage dementia. We present results and further developments based on field research and focus groups with care experts.

Keywords: Tangible interaction · Multimedia · Reminiscence therapy

1 Introduction

Demographic changes and longer life expectancy lead to a growing number of people with dementia. In 2014, about 36 million people worldwide had Alzheimers or a related form of dementia, the highest percentage living in Western Europe (www.alzheimers.net/resources/alzheimers-statistics/). Over the course of the disease, dementia severely impacts memory, speech and language, thinking, orientation and social behaviour. As a result people with dementia have difficulties in all areas of daily life, often become frustrated and experience lower life quality. In extreme cases such frustrations can even lead to challenging behaviours such as unrest, aggression or apathy [3]. Unfortunately, there are no medical treatments available at this point to cure the disease. Instead psychosocial interventions play an important role in order to increase the wellbeing of people with dementia. Psychosocial interventions include among others reminiscence, reality orientation or memory training, which have proven to positively and sustainably influence challenging behaviours of people with dementia [4].

Technology has recently started to play an important role in the area of care, mostly in the form of assistive systems for the home care context (AAL). Systems for people with dementia often put users in a passive role, e.g., when GPS

is used to track lost people [12]. However, "[l]iving with dementia presents a range of challenges ripe for creative applications of technology" [2]. We believe, that the currently prevailing technology-led developments miss some important values and needs of people with dementia. Design approaches involving the target group resulting in technical artefacts for people with dementia have a higher potential to address these people's needs. Especially in the area of designing for reminiscence, maintaining personhood and communication new media technologies can be utilized in supportive ways.

In the so-called NutzerWelten (English: UserWorlds, www.nutzerwelten.de) project our interdisciplinary team investigates ways in which multimedia technologies can be utilized to support and enhance the experience of reminiscence and communication for people with dementia. Until now, we conducted exploratory field research in different settings (e.g. a care home, day care and support groups) and developed a number of interactive multimedia artefacts to be deployed in these settings for observation and discussion with people with dementia and caregivers. We intend to identify design possibilities for multimedia technologies that integrate smoothly into people's daily lives.

In this paper we focus, in particular, on one design case that emerged from our field research in a local care home. We describe the development of a tangible interface called Reminiscence Map - a physical map allowing the user to select a timespan and remember places and stories from that time. The map was co-developed with a person with early-stage dementia as a personalized artefact and discussed in an interview with the person, a focus group with the caregivers in the institution and workshop with practitioners and experts in dementia care, technology and other disciplines. Especially the first focus group led to further developments, e.g. adding a digital interface allowing the caregivers to find overlap in the places and stories of care home residents.

Similar to Wallace et al., our Reminiscence Map acts "[a]s a tool of enquiry it revealed valuable spaces for design in dementia that have wider implications for interaction design" [17]. In particular, the analysis of the case surfaced themes for technology design (e.g., leaving a legacy) that had not originally been considered.

2   Background

In the following we frame our design case with the recent insights from literature that informed this research. In particular, we will first describe types of psychosocial interventions, and in specific reminiscence, for people with dementia. Next, we will outline the state-of-the-art of technologies for reminiscence, in specific the role of tangible computing.

2.1   Psychosocial Interventions for People with Dementia

Researchers investigating dementia, especially those following a person-centred perspective [9], believe that the symptoms [e.g. depression and fears] and behaviours [e.g. unrest, aggression, wandering] of demented individuals are not solely

a manifestation of the underlying disease process, but also reflect the social and environmental context, as well as the demented individuals perceptions and reactions. Psychosocial interventions can address these factors [8]. Psychosocial interventions are even more important in light of the limited success of pharmaceutical interventions for dementia. Kasl-Godley and Gatz [8] reviewed the six main psychosocial interventions for people with dementia: psychodynamic approaches, reminiscence and life review therapy, support groups, reality orientation, memory training and cognitive/behavioural approaches. Each intervention targets particular factors and addresses different goals. For instance, while psychodynamic approaches are helpful for gaining insight in the intra-psychic experiences of the individual, reminiscence and life review help with creating interpersonal connections. Behavioural approaches as well as memory training, on the other hand, are less concerned with the subjective experiences, but target specific cognitive deficits. Generally, it is recommended to involve others in these interventions in order to increase social contact, interpersonal communication and psychological health [8].

2.2 Reminiscence Therapy

As dementia progresses individuals experience memory loss, disorientation and in later stages a loss of their sense of self. As such, it becomes increasingly difficult for them to engage in meaningful activities, although this is of high importance for their quality of life [20]. It is argued that reminiscence may be particularly important for demented individuals psychological health given that the progressive deteriorating nature of the disease erodes the ability to achieve present successes and makes individuals increasingly dependent on past accomplishments for a sense of competency [8]. Since remote memory is usually spared for large parts of the dementia process, people are often able to recall events from the past. Furthermore, abilities like sensory awareness (response to stimuli like visual, audio and tactile), musical responsiveness and emotional memory (ability to experience rich emotions) are thought to persist in dementia, making reminiscence through audio-visual and tactile media possible. Even while processing memories may be compromised due to the brain damage, reminiscence can still provide structure in developing relationships or engaging with others [21].

2.3 Technologies and Reminiscence Therapy

Although contrary to our findings in field research, where caregivers used mainly non-technical objects such as images (e.g. photographs or photo books) and objects from the past (e.g. old packaging of products), as well as sensory stimulation through smells and haptics (e.g. different materials) or music, a recent literature review [10] on technologies used in reminiscence therapy points to many research projects in which ICT was used, e.g. in the form of displaying media on touch screens or projections. The purposes of using technology in reminiscence, as analyzed by Lazar et al. are two-fold: either to account for deficits such as motoric problems or memory loss or to harness strengths, such as

emotional memory. In the CIRCA project [5] researchers created a multimedia application using video, photo and music to support one-to-one reminiscence sessions. The interface was meant to be used by caregivers initiating conversations with people with dementia. The authors reported positive results from user testing. More recent work of the same research team [1] focused on multimedia for leisure. For instance, computer-generated 3D environments provided means for people with dementia to enjoy environments they once liked, but cannot visit anymore, e.g. a garden or a pub. Similarly, [15] utilized immersive 3D technology, in particular Unity3D and the Kinect, to create environments for reminiscence and meaningful activities (like gardening). However, people with progressed dementia had problems with the interaction. Lazar and colleagues [10] found that "Challenges include that many of the systems described in the study require technical expertise for setup or operation and may not be ready for independent use." We would like to address this specifically in our project by designing tangible everyday objects that hide the technology in a way that users do not need any technical expertise and even people with dementia can interact with them.

2.4   Tangible Computing and Reminiscence

Although it has already been recognized [19] that tangible computing is a way to approach a person-centered model (for designing technology for seniors), the exploration of tangible computing within the area of reminiscence is so far limited to a handful of examples that we briefly outline.

One of the early works on using tangible interfaces designed specifically for older adults to trigger reminiscence was Nostalgia [13], which consisted of an old radio and an interactive textile runner with a diamond pattern. The runner was augmented with hidden switches that could be pressed to select music and news from different timespans ranging from 1930 to 1980. A preliminary evaluation showed that people at the care home were able to interact with the device and that it triggered discussions about the old news and singing along with the music. Another medium, familiar to seniors, that was deemed suitable for broadcasting information for reminiscence to people in a care home was the television. For instance, Waller and colleagues [19] designed an extended television that extended the regular TV program with specific care home internal and personal programs. The TVs were installed in the rooms of the residents as well as the communal rooms to allow for private reflection as well as communication between residents about the programs, which showed among others, old TV series, pictures from the care home and events, and personal photographs. In the unstructured evaluations, the authors found some proof that people used the TVs and also discussed the contents. However, especially people with dementia had problems using the standard remote controls. For one such person a tangible remote in form of a photo frame was built. This could be used by the person, but was rarely approached by herself (without a caregiver).

More recent work targeted specifically to people with dementia was done by Wallace and colleagues [17,18]. In the Tales of I project [17] they designed a

system comprised of a wall cabinet holding several snow globes that encased objects relating to topics like soccer, holidays or local and a television cabinet with a mold to hold a globe. Through RFID chips in the globe the TV could read the correct topic and start the related film. Films were created from footage ranging back to the 1930s. In addition, personal content for each client could be played via a USB stick. In this project authors found that in the hospital setting where the system was installed in a common living room, it provided a sense of home for clients and visiting relatives, which was often lacking in the sterile hospital rooms. Through a sense of home and familiarity anxiety and challenging behaviors could be reduced. In addition, staff members were able to see a client more as a full person, when that person reconnected to a sense of self through the films.

In the Personhood project [18], in-depth research into the lived experiences of people with dementia was done through designing design probes with and for a couple, in which the wife suffered from dementia. Based on this research interactive jewelry was designed for reminiscence and providing a sense of self, through old media (like personal photographs in a locket) and personalized tangible artifacts (like a brooch made of old dresses).

3   Project Context

In the NutzerWelten project, researchers and designers from four disciplines (Media Technologies, Design, Electrical Engineering and Social Sciences) collaborate on solutions for people with dementia. Our research focuses on empowering people with dementia, on the one hand, through active integration in the design processes of new care technologies, and, on the other, by designing solutions adapted to their abilities, needs, and values.

While from the perspective of informal caregivers providing safety is one of the most important functionalities of technology [16], experiences from studies with people with dementia emphasized other values. For instance, communication with their surrounding, having a meaningful activity and establishing a connection with biographic aspects were identified to be of highest relevance for a good quality of life [2,14,20]. Therefore, we focus on the design of technical aids to improve communication of people with dementia and people in their surrounding, preferably through the use of biographic aspects.

3.1   Research and Design Approach

Designing for and with people with dementia is a sensitive endeavour and requires an empathic design approach [11]. Emphasizing and creating trust is a first crucial step. This is why we had a 3-months period in the beginning of the research process (Fig. 1) in which we gathered information about dementia through literature research, expert presentations and documentary films about dementia to sensitize the design team. Before visiting the field to get a first hand perspective we engaged in an activity where all design team members reflected about how
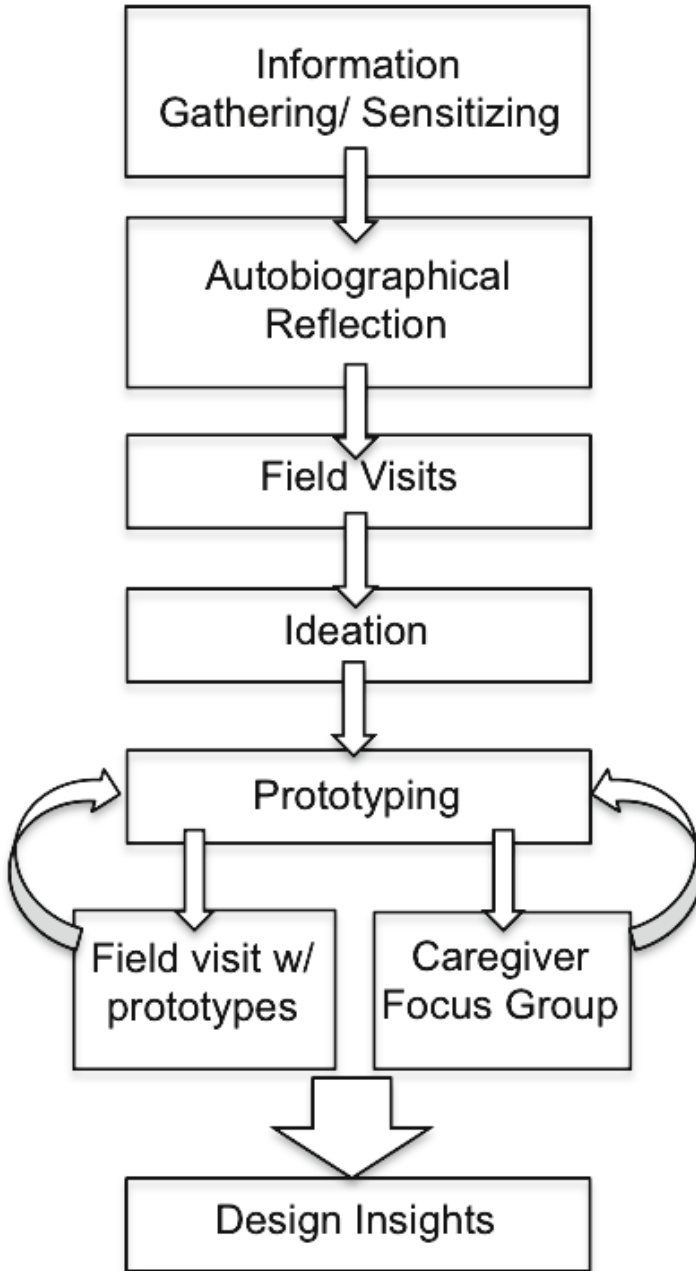
Fig. 1. Steps in the process.

they reminisce, which objects trigger memories and in what ways. First field visits were organized in close collaboration with the dementia service network in our city. We established contacts to several welfare organizations and were transferred to the key personnel in care homes (with stationary and day care) and in support groups for people with dementia. Several of our team members did (participant) observations and conducted either semi-structured interviews with caregivers or relatives or narrative interviews with people with dementia in order to elicit insights into their lived world.

In particular, these first visits were done during the course of one month and included: one visit of a day care centre with observation and an interview with a care manager, three visits to a care home including observations and interviews with five residents, several visits to three different support groups including participant observations (i.e. our team members took part in the group's program), two interviews with relatives of people with dementia in their homes, one visit to a geronto-psychiatric unit of a care home with observations as well as one interview with a caregiver and one with a resident, and, last, one interview of a person suffering from Lewy-body dementia. Observations focused mainly on the (everyday) activities people engaged in, and on the interactions between people. The interviews with caregivers focused mainly on the practical aspects of care, the communication and ways to support people in reminiscence. Interviews with relatives were similar, but focused also on the emotional aspects of dealing with the disease of their loved ones, from diagnosis and throughout the course of dementia. Interviews with people with dementia in the care homes focused on biographical aspects and life experiences.

The collected data in form of video, photos, field notes and interview transcripts were discussed with the team and used in the ideation phase, where two brainstorming sessions were held involving around 6–7 groups of ca. three people each time (mixed groups composed of students and researchers with backgrounds in design, HCI, computer sciences and media technologies). The result was a large number of ideas ranging from interactive furniture (mirrors, carpets), technology-enhanced everyday objects (stuffed animals, books) to completely newly designed artefacts. While some ideas focused more on functional aspects such as day planning, we selected a final set of ideas based on their expected potential to foster reminiscence and communication, their expected ease of use for people with dementia, their practicality to deploy in different environments and their potential to stimulate different senses.

All selected ideas contained multimedia content (video, audio, light and sound), either as original content from the past, recorded stories about the past, or recorded content from today that reminded of events or places of personal significance (e.g. videos of favourite places). Six prototypes were built in the next phase that were subsequently tested with people with dementia in the field. We also conducted a focus group with two caregivers and two care managers in the care home, where we presented all prototypes and discussed ideas for further development. Each prototype was assigned to a different caregiver in the home, who helped with the further development and provided test settings with residents. After an iteration of improving the prototypes, we presented them in an

expert workshop with 20 participants comprising caregivers, dementia support group leaders, professionals from dementia research, social workers, and technology researchers. In the 1.5-hour workshop participants first experienced all six probes in an interactive exhibition and then discussed different aspects of the prototypes in focus groups of 5 people each.

Results of this process on all six objects will be published elsewhere. In the following, we will focus on discussing one of the designs in detail to show how this interactive object gave us insights into the needs of a person with dementia and possible uses of interactive technologies in the care home. These perspectives are valuable for interaction design in this domain.

4   Design Case: Interactive Reminiscence Map

4.1   Design Concept

In one of the interviews in the first field research phase, a person suffering from mild dementia (called Mrs Smith in this paper) expressed the wish to own a world map to mark all places that she had visited to use it as a memory aid for later.

A map is a well-known visual representation of geography. While physical maps provided guidance to people in the past, people use digital maps today. In addition, a map is a good interface for memory support as combining location information with visual images [or in our case recorded stories] might allow people to better situate past activities in context [7]. In the brainstorming session the idea was developed to create an interactive map for Mrs Smith to not only support memories of places, but also have a way to situate Mrs Smith's stories in

Fig. 2. Marking places on map during interview.

time and place. While this could easily be built as, e.g., a tablet app, we decided to use a physical map, in order to create an intuitive user interface that does not require another digital device. A common representation for time is a time bar. To set a certain time span of a persons life, we therefore, used a horizontal time slider with a big handle. To indicate visited cities in the chosen time span we used LEDs placed on the map.

The stories told by Mrs Smith in the first interview were audio-recorded and could be played back for the chosen time span by pressing a physical button with a speaker icon. During the interview analysis we found that some important temporal information was missing to place all narratives onto the timeline. Therefore, a second interview was conducted to focus on the stories and missing dates and to reconstruct all events in Mrs Smiths life. Some difficulties occurred in this process due to memory deficits, but with the help of a world map and small needles (Fig. 2) most narratives could be placed in time.

4.2   Prototype Implementation

The prototype was developed as a tangible interface. The basis is a printed map of 60 × 40cm that was glued onto a corkboard (Fig. 3). The size was chosen as a balance between providing a good resolution and portability. The lightweight material allowed the map to be easily held with one hand.

The heart of the technical backend (Fig. 4) is an Arduino Uno microcontroller equipped with an audio-shield. All places were marked on the map using coloured
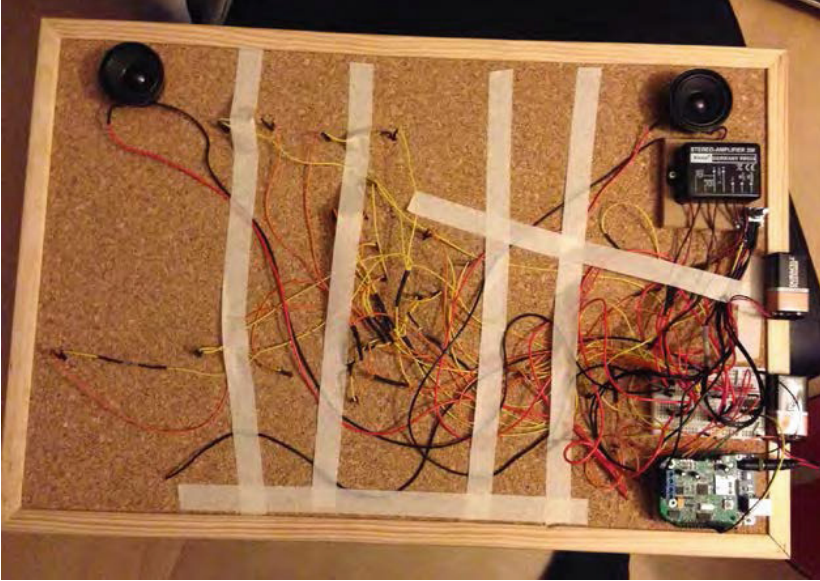

Fig. 3. Map prototype front.

Fig. 4. Map prototype back.

Fig. 5. Time slider.

3 mm LEDs to be controlled through the time slider, which was build from 6 mm cardboard (Fig. 5), a material used in advanced prototyping. We used two parallel rods on the backside of the slider, one made from copper and a plastic one wrapped with resistance wire (10). The current of 5 V sent through the wire drops depending on the position of the handle, which makes the electricity flow back through the copper rod that is connected to the analogue input of the Arduino. When a new position is retrieved, the respective LEDs are controlled via the PWM output of the Arduino (using a shift register to control several LEDs in parallel). The speaker button is implemented as a simple push button with a cardboard interface. For each time span an audio file is saved on the micro SD card inside the audio- shield. When the speaker button is pushed, the position of the time slider is used to access the particular audio file. We used two miniature speakers (1 W) hidden on the backside of the map for audio output.

4.3   Mrs Smith's Life

At the time of the interview Mrs Smith was 94 years old. She was born in 1920 in Landsberg an der Warthe, Germany, which belongs to Poland nowadays (and is called Gorzw Wielkopolski). At the age of six she moved to Berlin where she had a carefree childhood. Early on she found her calling in taking care of children and already worked for a year in a Kindergarten when she was 13. Later on, she became a paediatric nurse and worked for the Red Cross during World War II. After the war, she felt the desire to see the world. Working as a nanny for rich people this could be satisfied. Her first appointment as a nanny for a jeweller's children brought her to Italy and Switzerland, the second to the US and Denmark, and a third to Germany and France. In her stories today she refers to the children she took care of as her children. During her retirement she continued traveling including trips to Russia, Scandinavia, Spain, Singapore and Africa. Today Mrs Smith lives in the care home where she is mainly tied to her bed due to limited mobility. She suffers from mild dementia, which was hard to recognize for us in the first conversations, but became apparent due to the difficulties when placing her stories in time.

4.4   Feedback from Field Visits

Feedback from Mrs Smith. We visited Mrs Smith a third time after the prototypical interactive map was built. We did not intend to do a controlled user test, but to elicit her feedback in an unstructured interview. The following vignette (based on the first authors field notes) presents what happened.

We enter Mrs. Smiths room together with a caregiver. We greet Mrs. Smith and she immediately recognizes my colleague. I introduce myself and take a seat. Mrs. Smith asks curiously if there was already something to see. My colleague brought her a map as a gift to keep, where he marked all her visited cities. Mrs. Smith is surprised to find all the places on it. "Even Breslau is on it!" Then she says proudly, "but I was also in Africa." It seems that she had not immediately seen that Africa was also on the map. My colleague points it out to her and Mrs Smith starts telling a story about her stay in Africa.

Fig. 6. User test with Mrs Smith.

After her story is told my colleague demonstrates the interactive prototype and shows how it works by setting the slider on 1920. An LED lights up. "That's when I was born! Mrs. Smith exclaims. After the demonstration Mrs. Smith teases the caregiver in the room "That's great! Do you also have a map like this?" He says jokingly that there would not be any lamps lighting up on a map for him, because he has not seen much of the world.

"What are you going to do with the map? Will it be in an exhibition?" Mrs. Smith asks. My colleague is surprised and says that our intention was to improve the map and maybe give it to her, but Mrs Smith likes her idea of making the map and her stories publicly available. "It could be interesting to other people to hear my stories," she says. Later in the conversation Mrs. Smith suggests that we could also give the map to her GP, who seems to be dear to her, after she passed away. "Then he can remember my stories." she says her eyes filling with tears.

The conversation stops, it is quiet. Mrs. Smith looks at the marked places on the map and suddenly begins a new story about when she was crossing the border between the GDR and West Germany and was held captive at the border. A bit later, we hear another story about Mrs. Smith crossing the Atlantic Ocean by boat, to which we listen reverently.

When my colleague invites her to try out the map herself she takes it in her hand (Fig. 6). With shaky fingers she moves the slider and places it on a timespan. She presses the speaker button to start the audio, but the sound is a little low, so that she has to move the map closer. When we ask her whether it is

strange to hear her own voice telling the stories, she says that she does not care. The caregiver suggests that we take a photo together. When he lifts her bed, she starts fiddling with her t-shirt to get ready for the picture.

Throughout our visit Mrs. Smith looks at the map several times and starts telling different stories about the places marked on the map. In another conversation break, I take the initiative to learn something about Mrs. Smith. I see on the map that she has also visited Scandinavia, where I once lived. I ask her about a place there, and she tells us an exciting story about a bus trip through Scandinavia.

In many of her stories she mentions 'her children', but when I ask her about how many children she had, she says surprised "None! I took care of children of rich people." She reflects for a while and continues, "Others had families and I travelled around a lot. That's life. I made the best of mine." In this moment she looks content.

After 30 min had passed since we arrived, she seems tired and we politely say our goodbyes and tell her that we will improve the map further and show her the results again, if we may. She smiles and says "Of course, if I can be of help. You are always welcome."

We will return to different aspects from this field visit in the discussion section.

Feedback from Experts in Care and Technology. Besides discussing the map with the target user we also conducted workshops with caregivers and other experts. A focus group with four caregiver managers was held in the care home where Mrs Smith resides. In a two-hour session we first explained the goals of our research and then showcased all interactive prototypes, among these the Interactive Reminiscence Map. Each object led to discussions about its multimedia contents, the user interface and possible uses in different contexts in the care home.

In addition, we ran a workshop with 20 experts comprising caregivers, dementia support group leaders, professionals from dementia research, social workers, and technology researchers. In the 1.5-hour workshop participants first experienced all six prototypes in an interactive exhibition and then discussed different aspects of the prototypes in focus groups of 5 people each. Criticism, comments and ideas were written on post-it notes which were collected for later analysis. Focus group sessions were also audio-recorded.

The complete results on all six prototypes will be published elsewhere. Instead we focus here on the feedback that we received for the Reminiscence Map. Two aspects about the map were highlighted in the discussions: (1) its potential as a communication trigger via places, in particular, also for group sessions and (2) its appearance (virtual/physical).

Although the map was originally designed as a person-tailored object for Mrs Smith, her comment about sharing her story with others, led to a reflection that the map could be developed further in a way that could make several residents' life stories accessible to other stakeholders and in other contexts, including, for

instance, other residents, visitors, family members and caregivers in the home or even outside the context of the home in museums or online. To handle several residents the idea for a digital version (see next section) was developed. Especially the caregivers were fond of this idea since a digital version could contain extended functionality to highlight places where several people have once been, thereby providing cues for communications in groups of people with dementia.

"That sounds good, because it is often like that. I often visit places and then I usually find a conversation partner, one person was also in Austria, the other knows Mallorca, the other Southern Germany. It is great [to communicate] via the cities." (female caregiver). Another aspect is that people may have visited the same places, but at different times, which would allow for conversations about how places changed over time. "I think this is great, because it connects people. There is this outsider status that people with dementia still have that would be released a bit, because there are places where everyone has once been. Places, everyone has memories about. Even if some loose their memories slowly, there are still points that connect people. I think this is a great image." (female care manager).

Adding functionality to the map, such as finding overlap between users or showing additional media content (e.g. photos from the times people visited places) would be easier in a digital system using a screen instead of a physical map. While the caregivers were not entirely against this idea, it was mentioned that the old physical maps (that were used in geography classes in school) would also be useful, as residents would still remember them. Such old maps could serve as an inspiration, one caregiver said, even if the interface was digital. Also the option of a combination of a digital system for several residents and personalized physical representations for single residents to keep was discussed. This way two different stakeholder groups would be catered for.

During the expert workshop several advantages of a digital system were highlighted, such as the possibility to add multimedia material such as photographs or videos to the places to allow for more vivid memories. In addition, a virtual map could also show changing country borders over time, thereby allowing people with dementia to relate better to the places as they were in the past, and younger generations to learn about a country's history. Concerns of the experts about the digital system were mainly centered around collecting the data (in form of stories, photographs, etc.) and making it available through the system. Caregivers, on the other hand, were less concerned as the collection of data about residents could go hand in hand with biographical work done in most care homes.

5   Digital Prototype

Based on the feedback from caregivers to implement a version of the Reminiscence Map that can provide additional functionality suited for triggering group communication we implemented a first simple, but fully functional digital system (running in a web browser). The life stories of several people with dementia,

called narrators, can be stored in this system in form of a list of life events relating to a time and place. On the upper part of the screen a worldmap and a time slider can be found, in the lower part one or more narrators can be selected and a list of their events is displayed (see Fig. 7). The system allows a user to enter new narrators, new events for a narrator as well as delete events or narrators. When a narrator and a time span is selected the associated events are updated and the world map shows the location of the events in the form of colored circles (one color per narrator). By selecting several narrators it is possible to see on the map if two or more people visited the same place during the same time. To find out if people visited the same place, but at different times, the event list can be used. Clicking on a person or an event opens up an additional dialog giving more details about the person or the event including images and audio.

This prototype was tested in small scale usability test with six participants aged 27 years on average, who were asked to follow three scenarios (adding a narrator, deleting an event for any narrator, adding an event for the created narrator). All participants were able to finish the tasks without further instruction and participants rated the system positively. The prototype was displayed alongside the tangible map in the expert workshop described above to retrieve feedback on the idea of two different interfaces for the Reminiscence Map.
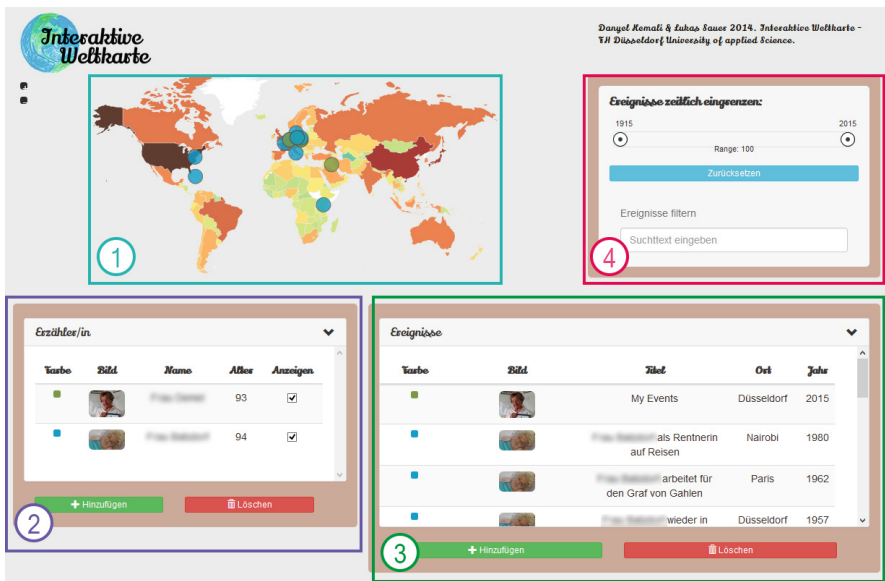
Fig. 7. Digital prototype for caregivers. (1) Map panel. (2) Narrator panel. (3) Event panel. (4) Time panel.

6   Discussion

In the following we present the themes that emerged from the field research, and, in particular, the feedback we received from Mrs Smith, the caregivers and experts on the Reminiscence Map.

6.1   Trigger of Memories

In the session with Mrs Smith we noticed that even the non-interactive world map with the marked places triggered a conversation. At least at this early stage in dementia it was easy for her to recognize the places on the map as places that were important in her life and she immediately started telling stories about them. The interactive map added the time dimension to this. When the time slider was set to a certain time period, Mrs Smith saw the places light up and referred to the time in the narratives. Given our experiences from the first two interviews with Mrs Smith, in which it was sometimes hard to match the stories to the correct timespans, the map supports remembering places and time. Similarly, Kalnikaite and colleagues [7] emphasized the value of locational information for aiding memories, and, in particular, for supporting inferences being made about past experiences.

6.2   Communication Points for Others

Equally important to the memory support for the person with dementia, we experienced ourselves the benefit of the interactive map in conversations with someone we know little about. One of the researchers who had not met Mrs Smith beforehand, could easily see on the map where Mrs Smith was born and which places she had visited at which times in her life. Especially in the case of places that the researcher had also lived in, it was easy to begin a conversation with Mrs Smith. It was also confirmed in the focus group that caregivers would use, for instance, recent holiday trips to start a conversation with residents, e.g., asking if they had been there. In this focus group, however, a wish for more advanced functionality was expressed as well. The idea of technology helping to find and visualize overlaps in several people's life stories was discussed and illustrated later on in the digital prototype.

6.3   Integration of Multimedia and Physical Artifacts

Existing multimedia systems already facilitate the sharing of stories and life events. They are, among others, available as online platforms, apps or other software. However, these are often not accessible to seniors, who are less technology savvy. Especially people with dementia have limited capacity to learn new interactions with digital user interfaces. Physical objects, however, provide at least three advantages: (1) interactions are based on familiar and basic actions (such as grabbing, moving or lifting objects), (2) they provide haptic stimulation, and (3) they often allow for shared interaction in a social setting. In our

prototype we used the strength of both tangible interaction and multimedia content to provide a rich interface to cue reminiscence and allow for active use by people with dementia. In the user session with Mrs Smith, we could not observe any hesitation to use the interface. Instead Mrs Smith was curios about the map. We also did not have to provide lengthy explanations of how to operate the map.

In addition, the caregivers highlighted in the discussion about the digital extension of the system, that the tangible aspect of the prototype is important for the people with dementia. They suggested that the map could even have a more antique look and feel to it to trigger memories about maps used by the people in the past. For themselves, however, they preferred to have a system that offers more functional support for moderating a group session, e.g. by finding overlap of life events of several group members. Tangible interfaces, however, often work best if they have few functions, which are closely tight to the properties of the object. Therefore, to implement higher level functionality such as adding narrators and life events and comparing several narrators events, a digital interface was deemed more suited.

6.4   Equal Level Communication

Places provide a good means to trigger conversations with people with dementia, not simply because many people have visited the same places in their lives, but also because places are deeply intertwined with one's life story, which (1) allows residents to share their knowledge and (2) supports their life review. Keeping in mind that "[d]espite experiencing degeneration of short-term memory function, people with dementia (including individuals who are severely impaired) can very often retain a facility for long term memory that will function strongly given appropriate stimulation" [5], communication about their past should be possible for people with dementia until the later dementia stage.

As the care manager said in the focus group, an interactive map showing several people's places and stories, allows for a communication on an equal level between residents and caregivers. While people with dementia may have difficulties in taking part in conversations about everyday happenings or recent events, talking about important stories in their lives and discussing how places changed over time allows them to feel empowered. It puts emphasis on the vast experiences and knowledge that people of high age have. The interactive artefact would support the identification of interesting conversation topics between people, who, e.g., visited the same city or country at the same time or different times.

6.5   Leaving a Legacy

Closely linked to sharing one's life story with others is the aspect of leaving a legacy. For us, as designers of technology to support everyday life for people with dementia, Mrs Smith's reaction in the try-out session was rather surprising. While we expected the Reminiscence Map to be a tool for reminiscence for Mrs Smith herself, it became clear in the conversation that Mrs Smith was more

concerned with preserving her life story for others after she cannot tell it herself anymore. Several times in the conversation she talked about placing the map in an exhibition for others to see or bequeathing it to someone she knows. She explicitly pointed out that it would be interesting for others to hear the stories, because she had travelled the world so much. While it remains unclear to us whether traveling the world was her own choice or simply a result of her life circumstances, her reflections on her life seemed to make her content and leaving her stories as a legacy beyond her own life span seemed important to her. Maybe it is especially important because she has few people left and no family of her own to continue telling her stories.

Important for the design of interactive artefacts, is to revise our assumptions of what is important for our target group and seeing the possibilities interactive technology can play in addressing their needs. While we assumed that communication in everyday life is an important need that technology should support, in this case, providing a means for casting one's experiences into an artefact that can be made accessible to others beyond one's life, surfaced as an important need, not in the first interviews, but in the session with the interactive prototype. Thus, the technology becomes a tool for a very different type of communication.

7   Limitations and Future Directions

Our work presents a single case study of how a need of a person with dementia was addressed in an interactive tangible artefact. This design case alone does not yet allow us to draw general conclusions about the role of advanced multimedia in supporting reminiscence in the large and diverse population of people with dementia. The themes, e.g. leaving a legacy, above are partially derived from data provided by a single person with dementia and it is, therefore, unclear if the same desire is present in other people. Yet, we believe this aspect is especially interesting to pursue in further research as it made us question our own design assumptions.

Arriving at a general theory on the design elements of interactive technologies for reminiscence and communication support is a longer term goal we pursue. As mentioned earlier other interactive artifacts have been developed and are being evaluated and discussed with similar sets of people in different care settings (for first results on that, see [6]). We see these artifacts more as boundary objects used to engage with stakeholders to understand their needs and discuss future possibilities. In this case, by making the idea of linking memories about life events to a time and place tangible in the two prototypes, they allowed us to explore the needs of the person deeper and discuss possibilities of advanced multimedia technologies with other stakeholders. As such the prototypes are vehicles to do research-through-design. Whether these or other designs truly have an effect on the level of reminiscence and foster communication of people with dementia needs to be studied in long-term field studies.

8   Conclusions

The work presented provides part of our larger research endeavour to design interactive multimedia artefacts for people with dementia to support their reminiscence and communication with others. In this paper we put the focus on one of the designed artefacts to show how this prototype could give us insights into the experiential world of a person with dementia and at the same time could be used in workshops and focus groups with experts as a probe triggering new ideas for designs in the care context. Especially the development of the second, digital prototype shows how the idea of linking memories to time and place was transformed and adapted to suit different stakeholders and use contexts. This way we could elicit views from different perspectives giving a more holistic picture of how the technology can support reminiscence and communication of people with dementia.

Besides this specific design case we are also field-testing several other designs (e.g. an interactive book, a virtual window to familiar places and a TV program for reminiscence). Based on the results of all evaluations, we intend to provide general guidelines for the design of interactive multimedia artefacts that support people with dementia in reminiscence and communication in different care settings. We should take into account that communication is manifold, and can also refer to communication beyond ones own life. In any case, the current case taught us to look carefully into the communication needs of people with dementia to check our own design assumptions.

References

1. Alm, N., Astell, A., Gowans, G., Dye, R., Ellis, M., Vaughan, P., Riley, P.: Engaging multimedia leisure for people with dementia. Gerontechnology **8**(4), 236–246 (2009)
2. Astell, A., Alm, N., Gowans, G., Ellis, M., Dye, R., Vaughan, P.: Involving older people with dementia and their carers in designing computer based support systems: some methodological considerations. Univ. Access Inf. Soc. **8**(1), 49–58 (2009)
3. Ferri, C.P., Ames, D.: Behavioral and psychological symptoms of dementia in developing countries. Int. Psychogeriatr. **16**(04), 441–459 (2004)
4. Gallagher-Thompson, D., Tzuang, Y.M., Au, A., Brodaty, H., Charlesworth, G., Gupta, R., Lee, S.E., Losada, A., Shyu, Y.-I.: International perspectives on non-pharmacological best practices for dementia family caregivers: a review. Clin. Gerontologist **35**(4), 316–355 (2012)

5. Gowans, G., Campbell, J., Alm, N., Dye, R., Astell, A., Ellis, M.: Designing a multimedia conversation aid for reminiscence therapy in dementia care environments. In: CHI 2004 Extended Abstracts on Human Factors in Computing Systems, pp. 825–836. ACM (2004)

6. Huldtgren, A., Mertl, F., Vormann, A., Geiger, C.: Probing the potential of multimedia artefacts to support communication of people with dementia. In: Interact – The 15th IFIP TC 13 International Conference on Human-Computer Interaction, Bamberg, IFIP. ACM, September 2015

7. Kalnikaite, V., Sellen, A., Whittaker, S., Kirk, D.: Now let me see where i was: understanding how lifelogs mediate memory. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 2045–2054. ACM (2010)

8. Kasl-Godley, J., Gatz, M.: Psychosocial interventions for individuals with dementia: an integration of theory, therapy, and a clinical understanding of dementia. Clin. Psychol. Rev. **20**(6), 755–782 (2000)

9. Kitwood, T., Bredin, K.: Towards a theory of dementia care: personhood and well-being. Ageing Soc. **12**(03), 269–287 (1992)

10. Lazar, A., Thompson, H., Demiris, G.: A systematic review of the use of technology for reminiscence therapy. Health Educ. Behav. **41**(1 suppl), 51S–61S (2014)

11. Lindsay, S., Brittain, K., Jackson, D., Ladha, C., Ladha, K., Olivier, P.: Empathy, participatory design and people with dementia. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 521–530. ACM (2012)

12. Miskelly, F.: Electronic tracking of patients with dementia and wandering using mobile phone technology. Age Ageing **34**(5), 497–498 (2005)

13. Nilsson, M., Johansson, S., Håkansson, M.: Nostalgia: an evocative tangible interface for elderly users. In: CHI 2003 Extended Abstracts on Human Factors in Computing Systems, pp. 964–965. ACM (2003)

14. Orpwood, R., Bjørneby, S., Hagen, I., Mäki, O., Faulkner, R., Topo, P.: User involvement in dementia product development. Dementia **3**(3), 263–279 (2004)

15. Siriaraya, P., Ang, C.S.: Recreating living experiences from past memories through virtual worlds for people with dementia. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 3977–3986. ACM (2014)

16. Topo, P.: Technology studies to meet the needs of people with dementia and their caregivers a literature review. J. Appl. Gerontol. **28**(1), 5–37 (2009)

17. Wallace, J., Thieme, A., Wood, G., Schofield, G., Olivier, P.: Enabling self, intimacy and a sense of home in dementia: an enquiry into design in a hospital setting. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 2629–2638. ACM (2012)

18. Wallace, J., Wright, P.C., McCarthy, J., Green, D.P., Thomas, J., Olivier, P.: A design-led inquiry into personhood in dementia. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 2617–2626. ACM (2013)

19. Waller, P.A., Östlund, B., Jönsson, B.: The extended television: using tangible computing to meet the needs of older persons at a nursing home. Gerontechnology **7**(1), 36–47 (2008)

20. Wood, W., Womack, J., Hooper, B.: Dying of boredom: an exploratory case study of time use, apparent affect, and routine activity situations on two alzheimer's special care units. Am. J. Occup. Ther. **63**(3), 337–350 (2009)

21. Woods, B., Portnoy, S., Head, D., Jones, G.: Reminiscence and life review with persons with dementia: which way forward. Care giving in dementia, pp. 137–161 (1992)