SMILE: Design of a Camera-Based System to Facilitate Person-Centered Care and Visitor Involvement in Dementia Care

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ABSTRACT
The number of people living with dementia is increasing rapidly and puts pressure on our society. Dementia care environments, providing full-time care to people living with dementia, are often hectic and complex places. Attention is focused on day-to-day care and the small events, activities and moments that build identity or social connectedness between individuals diminish, go unnoticed or 'get lost'. Thereby, family members can lose connection with the everyday lives of people living with dementia and care professionals are prevented from engaging meaningfully at a personal level with them. SMILE is a camera-based system to capture and review photos of people visiting with residents in the dementia care environment. A four-week in-context study with SMILE showed shared moments of fun, tenderness and connection that promotes and supports personhood and person-centered approaches to care for visitors and staff. SMILE was a stimulating shared experience showing that visitors and caregivers were more informed about the wellbeing of residents and the quality of conversations and connection was enhanced.

Author Keywords
Dementia; design; person-centered care; connectedness; personhood.

CSS Concepts
• Human-centered computing ~ User centered design

INTRODUCTION
With more people living in to advanced old age, the number of people with age-related conditions such as dementia is predicted to increase. The number of people with dementia, currently 47 million, is estimated to increase to 131 million by 2050 [24]. This presents a societal challenge and puts pressure on our care resources. A cure is not on the immediate horizon, and prevention strategies are stagnating [22]. Therefore, non-medical and non-clinical approaches are needed to support the wellbeing and improve the quality of life of people living with dementia. Technology and design can provide such support by facilitating shared experiences, social interaction and high-quality connections which have been shown to positively impact quality of life [11]. This paper will report on the design and evaluation of SMILE, a camera-based-system that captures photos of residents, visitors and care staff in dementia care environments to stimulate engagement, connection and record the event to allow it to be reviewed and shared (Figure 1).

Dementia is a progressive cognitive syndrome that impairs daily functioning, most often, in older adults. In early to mid-stage dementia people can often still live at home, however, in the later stages of dementia people need support in almost all everyday tasks, confining them to a specialized professional dementia care environment, with full-time care services.

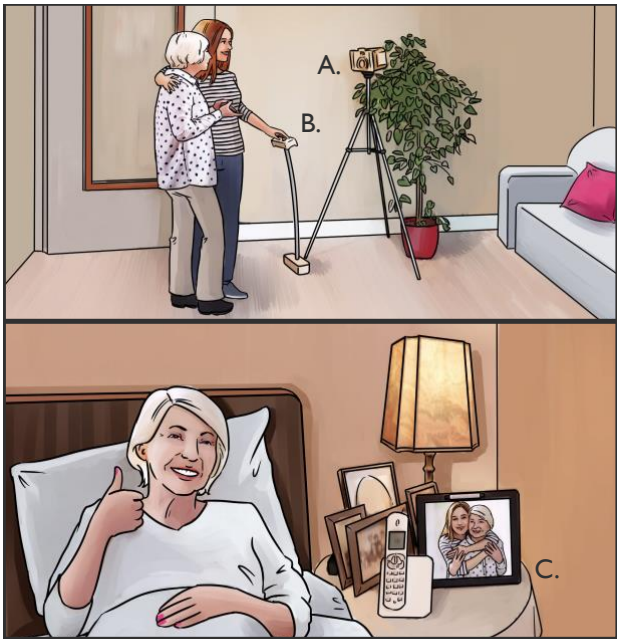

Figure 1: The SMILE system: A) a connected photo camera in the shared living room; B) a panel with buttons displaying people with dementia to send the photo to. C) the digital frame in the private room to receive the photo.

A wide range of stakeholders are affected by dementia and involved in providing care. They include informal caregivers, such as a spouse or family members, and professional caregivers, such as care staff, nurses, and doctors. The dementia care environment can be busy, complex and demanding for people living, working and visiting. Many events and activities may take place simultaneously for example, personal, clinical or medical care; friends and family visiting; and the day to day activities of cleaning the environment or preparing meals.

Informal caregivers or family members are often conflicted when a person with dementia transitions into greater dependency and is moved into a dementia care environment. While previous HCI research with older adults noted that families often have built-in routines to regularly check on their loved ones when they are living at home [26], this changes when the person with dementia is transferred to more formal care setting where formal care services are provided. In the care environment they may be unaware of how their loved one is being looked after and, not seeing the day-to-day activities or care practices can disengage family members and relatives from the care context. This can make it challenging to, for example, find a topic to talk about when visiting, as is evidenced with younger people and people with dementia [20]. As a consequence, families can lose connection with the lives of the people with dementia in the formal dementia care context.

For professional caregivers, the complexity of the care environment means they may lack clarity and not have an overview of the care provided to individuals. Consequently, the care staff may be challenged to connect socially and emotionally to people living in the dementia care environment. Those receiving care are often unable to share details about past experiences, or daily activities, because of their cognitive challenges and so professional caregivers find it hard to engage meaningfully and at a personal level. This may lead to stress and job dissatisfaction [10]. This lack of personal connection and poor social networks correlate with higher incidence of challenging behaviour in people with dementia [8], which may negatively affect their social environment, pose dangers and evoke distress for all stakeholders involved.

Thus, the dementia care environment is characterised by decreased personal attention for the person with dementia from both professional caregivers as care demand rises, and visitors because of a loss of connection and understanding of the care context. Sharing small frequent activities, events, or understandings can lead to moments of high-quality connections between people [11]. This feeling of connection promotes positive emotions and can contribute to quality of life in the moment and have an ongoing impact on resilience for both the family member and the person living with dementia [11]. Therefore, the loss of such feelings of connection and understanding can result in a decline in wellbeing and social activity for people living with dementia and their families. But by using interactive technologies we can support meaningful engagement, interaction and connection for family members and care staff, resulting in more visits, a stronger connectedness and support person-centered care.

SMILE is a camera-based system for people who are living in a specialised dementia care environment that enables them to capture photos of their activities and people who visit them (Figure 1, A). A person living with dementia can take a photo with a visitor or caregiver using the SMILE camera, which is situated in a shared living space of the dementia care environment. The photo is sent to a digital photo frame inside the private room of the person living with dementia, to support them in recognising and remembering people who visited (Figure 1, C). The SMILE camera-based system provides virtual information for visitors and professional caregivers about what activities happened throughout the day and provides a personal topic to talk about. This deepens connections, provides a meaningful actviity for people with dementia and visitors, and also contributes to person-centered care.

We conducted a four-week in-context study of the SMILE camera system with four residents with severe dementia in a dementia care environment. Qualitative data, gathered through observations and interviews, revealed three themes: 1) the photos *inform visitors and professional caregivers* about recent events and activities, the social context and wellbeing of the older adults, 2) the photos *enhance quality of conversations* by triggering new conversations with personal content, and 3) the act of taking a photo and reviewing a photo is accessible to all and creates an *exciting and stimulating experience*, through a social and shared activity. In addition, the SMILE system provides people with dementia a meaningful activity to do during their visit. It offers opportunities to shift attention away from a focus on dementia or dementia care, give compliments, have physical touch, and include humour in the visit. Therefore, SMILE overcomes the sense of unfamiliarity, lack of understanding, and lack of overview experienced by visitors and professional caregivers, by visualising the experiences and wellbeing of the residents living with dementia. As a result, SMILE enables visitors and caregivers to respond and contribute to specific wishes and needs, be connected and spend time together meaningfully.

The main objective of the study was to explore the SMILE system in -context and inform designers about its impact on the relationships between the stakeholders and the care providers. The SMILE system and in-context evaluation show how interactive technology can contribute to increasing personal connection and social cohesion in the dementia care environment for all stakeholders. The study shows how designers and researchers can support person-centred care through technology and design for identity and

connectedness among people living with dementia, visitors, and care staff in the complex dementia care environment.

PERSON-CENTERED CARE

Over the past decades, the perspective on dementia care has changed towards a more personal and person-centred care approach [14,15]. Health and dementia care have been critiqued for making care practice overly clinical and medical. In healthcare practise informal communication is often discouraged which consequently decreases the quality of life for those cared for [7]. In PCC approaches, the point of view of the person cared for, and their quality of life and wellbeing, is important. This perspective on care is widespread, has been proven effective in care practice, i.e. [10], and is being implemented in care homes globally. Person-centered care contributes to wellbeing by maintaining and building identity and personhood [14] and, through building relationships with other people and sharing experiences, helping people with dementia to reconnect with their 'self' [27]. Engagement in activities beyond routine primary care is an important indicator of quality of life in nursing homes. Having "choice of activities" and "activities that amount to something" is important for improving a sense of independence and positive self-image in nursing home residents [1]. Using these approaches caregivers get to see the client as a person and can therefore provide person-focused care. A person-centred focus in care contributes majorly to successful ageing, wellbeing and the perceived care experience of both residents and care personnel [9]. While person-centred care contributes to care, it can still be perceived as labour and time intensive impacting (?) the professional and personal life balance [28], and making it challenging to implement with the increase in numbers of people living with dementia.

RELATED WORK

In technology developments, researchers and designers often focus on the recognized symptoms of dementia and treat people living with dementia as a collective representation of the disease, rather than focusing on the person or individual behind the syndrome. In the design of technology for people with a disability, it is already critical that consideration is given to aesthetic and social-acceptance aspects, alongside usability and functionality, to avoid the stigmatization of devices for individuals that are 'ill' [25]. Fortunately, this approach is transferring to dementia research. More researchers are focusing on the lived experience of people in dementia care environments [21] and promoting equality and just inclusion in HCI research of people with dementia [16]. This thereby aims to prevent technology from being stigmatising and dehumanising while facilitating respectful engagement with people living with dementia.

Over the past years, there have been other research projects revolving around the use of photos in HCI. Photos are of emotional importance in families and within groups of close friends[19]. Reminiscence therapy (RT), for example, prompts memories of the past, using photos and music, to enhance self-esteem and wellbeing by supporting participation and 'ownership' in reciprocal communication [18]. Photos have been used as a mechanism to engage older adults (with and without dementia) in care environments. For example, the 'Photostroller' successfully engages older adults and provides a playful experience through categorised generic content on an interactive stroller [12]. Additionally, physical photos are used in the 'Portrait Pigeon' concept, to foster communication between family, staff and older adults in an assisted living environment with low-threshold interaction using a wall projection [6]. Another example uses a photo and message sharing tool to foster reciprocal communication and relationship between care managers and their aged clients who live independently in their own homes[28]. The photos and messages were used to make the aged clients cared for and care about and connect them with the outer world. These examples show that photos do engage older adults and that the depicted content is well perceived by older adults.

Related HCI research shows that such digital social sharing can contribute to the embodied experience of people living with dementia [17]. Lazar et al. use art as a mechanism, but this could be translated to the self-portraits taken with the SMILE camera which also represent a personal aspect of creation, pride and identity. The aspect of identity building is also demonstrated in lifelogging cameras, which are wearable cameras that take pictures from a first-person perspective throughout the day continuously. The tool is used to elicit memories and reflection for people living with dementia about their day [23]. Although the person with memory deficits may not recall wearing the camera, making him question the origin of the photos, the displayed photos enable richer communication than without the photos [18].

THIS STUDY

In this study, PCC underwrites our technology design, as technology can offer support for this care approach [2]. Much like person-centered care, the person-oriented focus promoted in technology development and HCI research and is also a perspective applied and developed in this study. In this study we aim to transfer the person-centered perspective into technology design and HCI research, employ a PCC approach, develop non-stigmatizing technologies and allow informal communication through technology use. The technology presented in this paper, the SMILE camera system, facilitates personal communication in the care environment through its photo taking and sharing service, and caters for an informal activity that is fun to engage in and can contribute to wellbeing. To do so, the SMILE camera uses photos as a means of communication between different stakeholders in the dementia care environment.

In the SMILE system we move from generic content to specific and personal photos. A centralized photo capturing system facilitates the person living with dementia and his visitor or caregiver to capture their own world, relationships and

experiences. This acts as a 'digital memento', technology that allows us to capture and represent memories, and has shown to facilitate personal reflection on our human experiences [3].

An important aspect of the SMILE camera-based system is the ability to send the photos taken in the living room to a photo frame in the private room of people with dementia. Through the frame, the photos can be shared with loved ones or staff members, which facilitate in this way a reference for both the people with dementia and other people visiting the room.

THIS STUDY

SMILE is a camera-based system for people who are living in a specialized dementia care environment to capture information about and review who recently visited them, as a meaningful shared activity together with visitors or caregivers (Figure 2). The system, which evolved from various co-reflections with people living with dementia and care professionals on experiential prototypes, consists of three components: 1) a photo camera to take photos together, 2) a panel with buttons to control the camera and send a photo to a resident and 3) a set of digital photo frames, in the rooms of individual people with dementia, where the photos taken are automatically sent. The person living with dementia can take a photo alone, with a visitor or caregiver through the main camera system, which is situated in the shared living space of the dementia care environment. The photo is sent to the private rooms of the person living with dementia, to support this person in recognizing people who visited and providing a topic to talk about, which facilitates a more person-centered care approach for care staff.

A prior exploratory step in the design process of SMILE conducted by the first author comparing various types of cameras provided the insight that people living with dementia are most familiar with a modern-style looking camera regarding aesthetics. Therefore, the main SMILE camera is designed to contain a viewfinder, dial, flashlight, button and lens. Objects are more recognizable and easier to interact with if they have a physicality and characteristic to them [4]. The camera is positioned on a tripod and includes a speaker for auditory voice messages and feedback. The camera is controlled using the separate panel with buttons, accompanied by text: 'To whom do you want to send the photo?'. Each button contains a photo and name of a participating older adult living with dementia (Figure 3). The digital photo frames were placed in the private rooms of participants on a cupboard or windowsill, as a part of the natural environment. The digital frames showed the captured photos of recent visitors along with the text: 'We visited you'.

Figure 2: The SMILE camera-based system in use in the dementia care environment. The camera is situated in the central living room of a care unit.

Figure 3: The panel with buttons. Each button contains the photo and name of a participating resident to whom the picture could be sent. On the bottom the interface asks: "To whom do you want to send the photo?'.

The user activates the camera by pressing the button with the photo and name of the person living with dementia who the photo would be sent to. As a response, the camera plays the following audio voice message (translated from Dutch): 'Hello, good to see you. We will take a photo. Please press once more on the same button to confirm'. The addition operation to confirm the wish to take a photo was added to avoid unintended use of the system by people in the dementia care environment. After the user presses the button for the second time, the camera explains that a picture will be taken in five seconds and counts down from five to zero and then plays a shutter sound. During the sound of the shutter, the photo is taken. Afterwards, the camera voices: 'Congratulation! The photo is sent to the digital photo frame in the private room of the receiver. A lovely memento. Thank you.' By designing the experience step-by-step the system is simple and understandable to use, and people by accident engaging with the system have multiple options to opt-out of taking a picture.

METHOD

The objective of this work is to explore the SMILE system in real-context and inform designers about its impact on the relationships between the stakeholders and the provision of care. The system does this by bringing more awareness and overview in the dementia care environment using the low-threshold, yet also enjoyable activity of taking a picture together. To explore this, a four-week in-context study was conducted with SMILE, including four residents with severe

dementia as participants. In this study qualitative data was gathered through observations, field notes taken by the researcher and interviews with different stakeholders regularly present in the dementia care environment.

Context and Participants

The study took place in a specialized dementia care environment where full-time care is provided. It was performed in one of the living communities of the care home (Figure 4). The community consisted out of seven older adults, each living with severe dementia. The residents each have private bedroom and bathroom facilities and share the living room and kitchen in the presence of 24/7 care professionals. Four older adults living with dementia volunteered to take part in the study, of whom three were female. No requirements were set to participate in the study, as we aimed to explore the system openly. The photo-camera was placed in the shared living room and was visible for everyone entering the dementia care environment (Figure 4, purple dot). The digital photo frames were situated in the private rooms of the participating senior adults living with dementia (Figure 5, personal rooms).

Ethics

As the study involved people with dementia, family members of the older adults living with dementia were involved in the consent process and asked to give permission and sign informed consent together with the residents to participate in the study. This included the display of personal photos in the semi-public space of the living room, on the interface panel in front of the camera. The care institute hosting the research requested not to record audio as they questioned whether all participates were capable of understanding what audio recording entails and preventing them to make an informed consent. Therefore, the choice was made to use notes over audio.

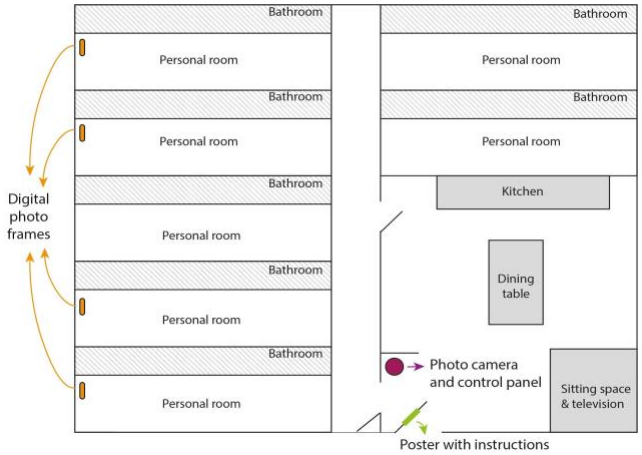

Figure 4: Schematic top-view of the dementia care environment and the location of the SMILE photo camera, control panel and poster in the common living room and digital photo frames inside the private rooms.

Figure 5: An impression of the digital photo frames located in the private rooms of the participating residents.

Participants were allowed to withdraw from the study at any moment and request deletion of captured photos. Care providers were informed about the study via an email, so they would also have an easy reference to the study if needed. Family members or friends, referred to as visitors of the residents, were not specifically informed beforehand, other than informing about the study and requesting consent. They were notified by the presence of the SMILE camera system in the living room and an informative poster put up next to the camera system. Additionally, the professional caregivers working in the care home provided additional in-person explanation if requested.

The camera informed the users about the act of capturing a photo. By actively confirming the wish to take a photo the users agreed to the capturing and display of the photo in the private room of the selected receiver. No captured photos have been displayed in public spaces to provide more privacy. In line with data protection regulations, the captured photos were anonymized for research and deleted after completion of the study.

Additionally, the study is characterized by a personal and bottom-up approach in which all stakeholders were free to use the SMILE camera system in the way they wanted, and as they saw fit. The freedom in use was a specific research consideration as we were aware that photos could both be supporting, and result in a positive experience, or be confronting for residents with regard to their mental decline, and result in a negative experience. The responses or appreciation of the SMILE system was unpredictable and may have varied from user-to-user and day-to-day. Moreover, participants, and their family were informed that they could request removal of a specific photo by contacting the researcher. However, this was not necessary as no confronting experiences were reported during the study. The study got an ethics clearance by the care home client representation board.

Data collection and analysis

The study took place over 26 days, of which 21 days featured a functioning prototype of the SMILE camera system. During the explorative design research data was gathered by the first author researcher. First observations were conducted, including rich descriptions of the context, interactions, and

conversations. After the field study, interviews (<10 minutes) were conducted with two older adults living with dementia, three caregivers and six visitors. A semi-structured approach was used to guide the research while leaving freedom to respond to captivating or unclear insights. Participants were asked to explicitly compare the before and after situation, and the impact of the design. The notes taken during the interviews were summarized at the end of the interview with the interviewee to ensure the notes were correct The interview with the older adults with dementia took place in the presence of a family member. As agreed upon in dialogue with the care institute, , keywords were noted carefully during the interview and these were written into full sentences immediately after the interview. Quote references were constructed by stating the number of the interviewed senior with dementia (S), visitor (V) and caregiver (C) and the number of the quote or observation (Obs), e.g. V2Q4 refers to visitor two quote four. The qualitative data from the field notes and interviews have been analysed using a thematic analysis [5].The quotes were analyzed in native language by a inductive approach. Themes arose based on quantity of occurrence and quality of the quotes. The quotes were translated to English for the purpose of this paper. By taking an inductive and 'analysis on the wall' approach the codes were clustered and abstracted to reach the three presented themes as presented in the paper.

FINDINGS

In total 52 photos have been taken (Week 1 had 27, week 2 had 12, week 3 had 5, and week 4 had 8), for participants one till four respectively 19, 9, 9 and 15 photos. Besides the participating residents living with dementia themselves, the pictures contained 43 distinct visitors of which five were a caregiver. Six visitors used the photo camera during multiple visits. Approximately two-thirds of the photos have been taken together with the resident.

The interviews resulted in 111 distinct quotes and the observations provided 35 field notes focusing primarily on the act of taking a photo. The thematic analysis of the qualitative data gathered from the field notes and interviews during the four-week in-context study revealed three main themes and several suggestions for design improvements.

1) The photos **inform visitors and professional caregivers** about recent events and activities, the social context and wellbeing of the older adults. 'It provides an impression of my mum's life here. Who visits [her], and how she presents herself' (V1Q16). The presented cues in the photo facilitate the visitors and professional caregivers to anticipate and tailor their contact with the older adult living with dementia. Caregivers expressed that the SMILE system is an addition to their work practice. They valued that the information about visits enable more person-centred care, as the photos inform and create awareness about social relationships, what activities took place and the possible impact of these activities on the well-being and behaviour of the person living with dementia. A caregiver explained that 'if the person talks about a topic in particular, I can maybe use the photos to trace back what made that impact' (C1Q17) supporting day-to-day care provision.

Also for visitors, the photos are a carrier of information about wellbeing and social activities and therefore relieve possible doubts and concerns about life satisfaction and possible solitude of the person living with dementia. Visiting family members feel curious who else visited. Seeing that their loved one had been visited on the photos was sometimes a positive surprise for them, as this information may not have reached them otherwise. The following comments describes this strikingly: 'Personally, I also like to see who visited. Some time ago I heard from my brother that an aunt visited her. That is special. The number of people that are faithful and visit my mother. […] But if my brother did not see her coincidentally, then we would not have known that she visited. Or just sometime after' (V6Q10). Moreover, the visitors feel happy to see pictures of the older adult together with the professional caregiver as it is proof of a good relationship and that activities are undertaken. Last, the pictures were seen as a valuable memento of the last stages of life of a person with dementia.

For the person living with dementia, there were no clear observations about the perception of the photos. It is unclear whether the photos make the person remember or recognise visits or whether seeing the photo makes the person understand and imagine that a visit took place. However, the older adult living with dementia seems to be able to recognise familiar people in the pictures and identify themselves: 'If I know the people on the photos than I can tell you who they are. That is 1-0 for me' (S1Q1) and 'The older adult points to the photo of herself. She states that her photo is different from the other pictures, the others [other residents] are looking old' (Obs14). These examples show a recognition of self in the space of a care home, and open up new perspectives.

2) The photos **enhance quality in conversations** by triggering new conversations with personal content. Instead of having small talk, the photos provide visual support to stimulate new personally oriented conversations. The display of photos triggered the senior residents to tell stories, as a caregiver explains: 'This morning I was in the room of Miss [surname] and had a glimpse at the photo frame. She noticed and immediately shared that her old neighbour had visited her that day […] And that is good as it helps to get to know more about the person' (C1Q2). Showing that the photos contributed as a memory aid for some of the residents. Another caregiver describes a case in which 'A woman asked about who that girl was with brown hair and who uses to say the word 'hello' in a funny way. So together with her, I looked at the photos on the screen to see whether it contained a photo of the person she meant.' (C3Q4) Revealing that the SMILE camera also instigated activities beyond the direct system content.

A caregiver also stated that the ease of access to the information is essential to be able to combine it with routine work. The caregiver mentioned: 'A daughter told me to take a look at it [the book with written records about activities and visits updated by the family]. However, that is not something I would do that fast. Maybe because it is so personal. [...] A photo is something I can see in one glimpse. So I can ask something about it, like who the person is on the photo' (C2Q23). Deliberating the value of the pictures as a natural part of the environment of a care home.

Visitors also used the picture as a motive for sharing information about the photographed person. One of the visitors for example explained: 'For the picture of [name grandchild] I, for example, tell how she is doing. Just the everyday information that I know. For example that she is doing her final exams' (V6Q3). Moreover, the photos created mutual understanding about the topic of conversations by providing visual context for interpretation. 'The visibility of who visited is good. You can grab the frame to talk about it. Without the photos, I would not manage to have her recall the person I am talking about' (C1Q14). Showing in a reciprocal appreciation of aiding memory through the pictures and facilitating conversation. To illustrate: 'A visitor of a resident looks at the digital screen and sees a picture of a caregiver. The visitor asks the resident: "who is that caregiver? Never seen her…". The resident is silent and then stumbles. "She is very friendly"' (Obs11).

Also, visitors and caregivers used the photos as visual proof of recent events and activities to reduce possible uncertainty and confusion experienced by the person living with dementia. Caregivers used the photos during conversations with the senior to reduce stress or tension by showing visual proof, as the following example shows: 'One of the seniors always asks when her husband will come to visit her, even if he has already come by. So at that moment I took the picture frame, but unfortunately they did not take a picture together. Otherwise, I could have easily shown her that he already visited her that day as she is wearing the same clothes as on the picture. If I just tell her, she would not believe me' (C3Q13).

Potentially, the SMILE system could also influence the quality of conversations and interaction between visitors and professional caregivers. It could trigger more contact between them, as the following visitor described: '[She] questioned whether the camera was still functioning. So we tried it together. Then I found myself smiling to a camera together with the caregiver. Afterwards, we ran to the room of my mother to see whether the picture appeared. So in that sense, the product creates new interaction with the care' (V6Q33).

3) The act of taking a photo and reviewing a photo is accessible and created an **exciting and stimulating experience, through a social and shared activity**. For visitors, the SMILE system provided them with something meaningful to do during their visit. It offered the opportunity to shift the attention, give compliments, have physical touch, and include humour in their visit. Two examples illustrate this: 'My mother is increasingly neutral in her perception. However, this is a way to shift her attention and to have an action component. It's good to stretch your legs, they are sitting a lot throughout the day' (V1Q11) and 'A senior is wandering. A staff member is weeping the floor and notices the senior. She stops her activity and states: 'we have not yet taken a picture today together, come' and she waves her hand to indicate that the senior should approach her. Together they take a picture and have a small chat about the act.' (Obs27). The interviewees revealed similar positive experiences, The SMILE system is considered, as one of the visitors described '[...] playful and creates a moment of personal attention' (V6Q36).
As a response to the act of going to take a photo, a visitor may provide some personal care by doing the hair of the senior resident or improving how the senior resident is dressed and give compliments. Like for example in the following observation: 'The visitor positions the senior resident in front of the camera and tells her to wait. The visitor walks fast-paced to the room of the senior and returns with a hairbrush. She brushes the hair of the senior and pulls her shirt down. As a response, the senior asks when the hairdresser will come' (Obs6) as well as this example: 'Before taking a photo the caregiver improves the clothing of a senior and states that it looks perfect now. The senior seems happy and says thank you to the caregiver. The senior also pulls her clothing and moves hair out of her face. The caregiver asks: Are you ready?' (Obs35). The act of taking a picture and reviewing the pictures was used to give compliments in visitor-senior and caregiver-senior conversations, contributing to the self-esteem of the senior, and an observed feeling of normality. People flourished by comments about their appearance: 'You see that Miss… [she] feels honored when you ask her to take a photo, and you say that she looks good' (C3Q9). And even made jokes about it: 'After taking a photo, a senior citizen living with dementia says: 'Oh that is nice, so now I am a photo model?!' making all involved people laugh' (Obs3).

Humor was used more often by visitors and care professionals when they used the camera by for example taking pictures with funny faces. The caregiver experienced a stimulating and joyful moment by seeing photos of colleagues who were joking and drew strange faces. The caregiver mentioned: 'It is relaxing, a moment [that is] different than the daily care activities. It caused me to smile' (C3Q3). Also, the caregiver proposed that taking a picture could function as a last activity before saying goodbye for the visitor and senior. Demonstrated by the following quote: 'We just discussed the case that a husband of a senior citizen living here does not want to leave, so he lingers at the door. In that case we can say "let's take a picture to say goodbye"' (C2Q9). Showing that the system was used for different purposes in the care environment.

In reviewing the pictures, the senior was stimulated by having a tangible display and by the automatic circulation of the photos, which grabbed their attention.

DISCUSSION

In this paper we presented and explored SMILE, a camera-based system to increase visitor involvement and person-centered care engagement by professional caregivers with people living with dementia. The system showed to contribute to the daily dementia care practice on multiple levels, by providing a shared activity in the care environment, contribute to deepened contact and conversations and proving clarity and information in the complex dementia care environment.

Improvements for the design

Besides the three themes covered in the findings above the interviews and observations resulted in several suggestions for improving the design as well. First, the person with dementia may lack understanding of the activity, the purpose, or ones role in it and therefore experience confusion while taking a photo. To illustrate: 'The resident does not understand. "Who will take it [the photo]? Someone needs to look through the lens right?"' (Obs8) and 'After the picture is taken the senior citizen asks why a picture has been taken and what she has to do now.´(Obs15). Therefore the people with dementia should be carefully involved in the activity, personal assistance is required from a caregiver or visitor. A visitor expresses the desire to have a step-based shared activity in which the pace could be adjusted to the situation. It was designed to be simple and easy, but still there are many differences between the residents. An example of experience with the current design: 'When I am explaining that we are taking a picture the device is counting down, so halfway my explanation I have to smile to the camera. My mother has no sense of what is happening at that moment' (V6Q23). This shows that the experience of taking a picture together could potentially be facilitated even stronger by the technology. Moreover, observations on the act of taking a photo showed that the older adult living with dementia looks at the place of physical activity, in this case the panel with buttons to start taking the picture (downwards). The audio message from the camera does not grab the attention, and there is no response to the audio instruction to look straight into the camera. This observation is supported by many of the captured photos showing that the people with dementia look downwards instead of straight into the camera.

Last, in reviewing the photos, some visitors experienced un-clarity due to the quality of the photo, the subject in the photo and the way of presentation. Some pictures were perceived as too dark to see the content clearly. Moreover, some photos displayed visitors of another resident as they were sent to the wrong person, due to the selection of the wrong picture on the interface. Also the automatic changing of the photos on the frames created some un-clarity. As exemplified: 'It is confusing that the photos are moving on [changing]. Image and story need to fit together' (V6Q6) and 'It confused me [a visitor] that the pictures were displayed in a random order, or at least after the last photo the first photo appears again. As a result, I have no clue about when somebody has visited. Maybe it was already weeks ago' (V1Q9). A caregiver suggested placing a photo screen in the shared living room could result in a more open information display for everyone. However, a family member noted that pictures from other seniors might not be familiar to the senior and possibly lead to confusion as well. This shows that simply displaying the pictures on a personal photo frame might not be enough on the receiving side, and potentially this display could be expanded with more information regarding time, description of the people or the occasion of the visit, to inform the residents, visitors and professional care staff more when reviewing the pictures.

Limitations

The connectivity of the system was not optimal over the entire study period. WiFi instability caused the SMILE system of dysfunction during eight dayparts spread over the four-week evaluation, leaving 21 full days with the functioning design. In case of WiFi problems the captured photos were delayed to appear on the digital photo screen of the receiver and no new photos could be captured. This limitation may have negatively influenced the user experience of people trying to take a photo, possibly preventing them from capturing a photo during following visits. However, users did not mention negative remarks and used the functionality as a motive to start a conversation about the product and express excitement about the material design and concept feeding more qualitative input.

With regard to the study set-up, during the interviews, it was noticeable that the participating people with dementia were not - or hardly - able to express themselves about the photos that were captured or the act of taking a photo. Therefore, the field notes of observations were valuable to include the first-person perspective of people with dementia in the evaluation. A subsequent study could consider performing informal interviews in the moment, during the use of the SMILE system instead of reflecting on prior usage and results post-hoc. Additionally, for two participants the digital photo screen situated in their private room was not optimally positioned due to the location of the power plugs in the corners of the room. The lowered visibility of the photo frames may have reduced the use by these two specific people with dementia and their visitors slightly, as it was not as present. Also, the number of captured photos highly depends on the number of total visitors each of the people with dementia had in their social network, and visit on regular times. Follow up research could dive deeper into the

relationship between residents and visitors, and the consequential use of the tool to capture a photo with these visitors.

Implications

While there were limitations to this study the SMILE Camera-based system revealed how technology can support the quality of life and wellbeing of different stakeholders in dementia care, including professional staff, family members or other visitors and people living with dementia. And contribute to the social and personal values in a dementia context. Over the evaluation of the SMILE system this occurred in four different ways.

1) SMILE promotes and preserves a sense of identity and personhood in people living with dementia, by means of taking and viewing of the photos.

2) SMILE increased the sense of connectedness in the preparing for and taking of the photos, by making a small event of the act itself and make these daily activities of the everyday life available to family members and care staff to review.

3) SMILE relieves the sense of guilt, lack of transparency and stress that family members could experience when their loved one enters residential dementia care environments.

4) SMILE did not foreground the technology, but used technological innovation to facilitate a series of inter-person actions and events that created and strengthened connections.

Kitwood and Bredin [14] show that identity and self-esteem are core aspects of personhood, which underlie person-centered care approaches in context of dementia [10]. The connection with the 'self' can be created from the relationships one has with his close surroundings [27]. In using the SMILE System people living with dementia were able to recognize images of themselves and differentiate themselves from others, taking pride in who they are, as exemplified earlier by the quote: 'The older adult points to the photo of herself. She states that her photo is different from the other pictures, the others [other residents] are looking old' (Obs14). This sense of identity is expanded further in the sharing of the image with family members and care staff who comment on the persons image and reflect. The photos facilitate new conversations, leading to storytelling when for example people in the photo are recognized by the person living with dementia or visitors. This could for example be seen I the example of a visitor using the picture of a grand-daughter to tell a story about exams. Similar things could happen when associations arise based on the photos display stimulating memories and recognition.

The SMILE system supported quality of life and meaningful connections, as discussed by Fredrickson [11] by making visible to visitors, often family members of close friends, the activities of everyday life when they could not be present. They were able to gain insights into who the person with dementia had engaged with throughout the day or the week. Additionally, that very act of taking a photo together, with another person present, resulted in caring connecting behaviors between visitors or care staff and people living with dementia in the care environment, such as preening, grooming, stroking and touching, as exemplified in the results.

When people living with dementia enter into greater dependency and transition to residential dementia care environments, it can be a stressful time for family members, who no longer know de details about their loved ones' life, their everyday contacts or activities. Many family members experience periods of guilt when this occurs [13]. The SMILE System was able to ease some of the concerns of family members with regard to who their loved one interacted with and what they might have done during the days. The following observation illustrated this: 'A visitor of a resident looks at the digital screen and sees a picture of a caregiver. The visitor asks the resident: "who is that caregiver? Never seen her…". The resident is silent and then stumbles. "She is very friendly"' (Obs11). This sets an opportunity for design and technology to facilitate connectedness and personhood in social and complex settings, with people with specific care needs, and increase the engagement between the stakeholders presents.

Additionally, the SMILE System used the straightforward and familiar act of taking a photo with someone, to enhance connections between people. The innovation in HCI occurred in the ongoing availability of the camera in a shared space which made it accessible to anyone and facilitated playful encounters. The automated delivery of images to digital photo frames in the rooms removed the need for manual intervention and simplified the interaction. The technology facilitated the sharing act of being photographed together, and the display of the image in a place where it could be talked about and shared. This illustrates how a simple technological concept can contribute to deepen connection and support personhood effectively in a complex context as dementia care.

CONCLUSION

The thematic analysis of the gathered data shows that the SMILE camera-based system was appreciated, and facilitated human engagement and social interaction in a specialized dementia care environment. By the use of the SMILE system, situated in the common living room and the private rooms of residents in a dementia care environment, different challenges that occur in this environment were addressed. It informs visitors and caregivers about the social environment and wellbeing of the older adult living with dementia contributing to the feelings of connectedness between the stakeholders involved. It also contributes by providing transparency and clarity in the busy and complex dementia care environment. Additionally, it enhanced the quality in conversations between people with dementia, people visiting and professional care staff, and supported in building self-esteem and personhood for people with dementia on several levels. Finally, the system provided a fun, meaningful and shared activity for both visitors and professional care staff to undertake together with the residents with dementia in the dementia care context. SMILE demonstrated how well-designed and simple technology can contribute to the quality of life and wellbeing of people living with dementia, and facilitate person-centered care in the complex dementia care environment.

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