

Closer to Nature

Interactive Installation Design for Elderly with Dementia

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Abstract: Dementia is a serious degenerative neurological condition that affects cognition and memory, often accompanied with depression and anxiety. As explicit memory deteriorates, the implicit memory remains, so sensory stimulation and tangible solutions become increasingly important to people with dementia. This paper presents the design, implementation and evaluation process of Closer to Nature, an interactive installation aiming to provide opportunities for people with dementia in care facilities to feel more connected to nature. Closer to Nature aims to do so by combining the soothing effect of nature and the animal therapy via tangible interaction with tactile stimulation. Based on the feedback we collected, we analyse the insights from the interactive installation design for seniors with dementia in their living environment and discuss the potential of utilizing tangible interaction to help facilitate the supportive environment for the elderly.

1 INTRODUCTION

Dementia a serious degenerative neurological condition that affects cognition and memory abilities and is not a natural part of aging (Alzheimer's Association, 2015). Dementia often makes living independently impossible and puts a high strain on the informal care of family members, so that many seniors suffering from dementia move into care facilities. In the Netherlands for example, 70.000 of the 260.000 people living with dementia, live in care homes (Alzheimer Nederland, 2015). Between 2011 and 2030, the number people living with dementia will increase by 70% (Deltaplan Dementie, 2014). This growing population increases the pressure on care providers. At the same time, this growth indicates the need and the opportunity to explore interventions for improving the level of care and the life quality of people living with dementia (Sharp, 2007).

Due to the cognitive degeneratoin caused by dementia, symptoms include trouble with retaining new information, memory loss, trouble with verbal communication, confusion, and paranoia (Alzheimer's Association, 2015). The increasing confusion and resulting social isolation of these symptoms lead to negative emotions like loneliness, anxiousness and depression.

However, though an individual's explicit memory disintegrates due to dementia, the individual's implicit memory, or procedural memory, is often maintained for some time (Treadaway, 2014). The implicit memory can be triggered by sensory input, thus enabling the opportunity for engaging experiences even without productive communication. This fact indicates a potential field for the researchers, not only from healthcare, but also from design and technology backgrounds, to explore the possibilities of creating interventions which can engage and stimulate people with dementia in a positive way, so as to reduce the negative impact from their symptoms.



Figure 1: Closer to Nature in Dutch Design Week 2015.

The interactive installation we present in this paper, Closer to Nature (Figure 1), is designed to create positive simulation and engaging experiences for the seniors with dementia living in a care facility. In this installation draws upon the soothing effects of

nature and the principles of animal therapy to enrich the living environment for residents of the care home by building up a remote connection with the outdoors through tangible interaction.

In the following we introduce first, related works about relevant therapies and design projects. Next, we describe the design, implementation and initial evaluation results of the installation in detail. Finally, we will discuss the insights and future work of this project.

2 RELATED WORK

2.1 Relevant Therapy for Dementia

Therapies for dementia can be divided into two main camps. The first aims to stagnate the progression of the decrease in cognitive function utilizing pharmaceuticals, arts/creativity tactile experiences, and brain training, which exercises the mind to keep it active (Alzheimer's Association, 2015). The second, focuses on remedying negative emotional side effects of dementia such as anxiety or aggression, by improving residents' mood, through nostalgia therapy, snoezeling rooms, doll therapy, music therapy or animal therapy. In this paper, we focus on the later.

Nostalgia therapy encourages residences to recall memories and communicate verbally through engaging with objects from the past (Dempsey, 2012). However, this therapy is controversial due to the risk of undesired painful memories being recalled.

Doll therapy is considered to be helpful in relieving a resident's sense of helplessness by offering the individual a chance to provide care and feel a sense of purpose. Doll therapy is also controversial because seeing a senior loved one play with dolls can leave their family feeling uncomfortable. Meanwhile, some care homes encourage residents to complete simple chores, to support a resident's sense of self and contribution (Miller, 2013). However, this can be taxing for the already busy care providers.

The snoezeling rooms, often a separate room in the care home, provide stimulating yet soothing environment. These spaces are meant to relax residents and by stimulating their senses seem to have a positive effect on the mood of many residents (Baker, 1997).

Animal therapy also addresses resident's mood through and provides for a joyful experience. Residents respond positively to animals while petting is tactile and allows for sensory stimulation

(Nordgren, 2014). As people with dementia eventually lose the ability to care for pets, residential dementia facilities enlist external organisations to bring common pets and farm animals to the care homes for animal therapy sessions. Unfortunately, though interacting with animals is widely enjoyed by residents, the cost of keeping or transporting animals and the extra burden on care providers to facilitate these visits, are often prohibitive. As a result, these happy petting sessions only occur a few times a year.

2.2 Related Designs for Dementia

Over the years, there have been many products and much research aiming to improve the quality of life and create a supportive environment for people with dementia in care facilities.

One of the major direction is design exploration on sensory stimulation through textiles and tactile interaction to help recall pleasurable memories, engage people with specific activities and facilitate communication. The **Dementia apron** is a highly personalized textile outer garment, which is created from textiles relating to the resident's personal background. When worn by the resident, it can provide tactile stimulation as the resident touch the familiar textiles (Treadaway, 2015). **Tactile Dialogs pillow** uses E-textiles to provide its users with a tactile experience to facilitate communication between residents and their loved ones through touch. This interaction is simple yet creates an implicit, sensory experience (ten Bhömer, 2013). Another pillow product, the **Discover Dementia Pillow**, allows people with dementia to play different pieces of music by simply touching the various patches of different textiles on the pillow (Brankaert, 2015).

Another direction for design is to take a more holistic approach and look into the environment of the care home, providing immersive experience with relaxation and pleasure while reducing confusion and wondering. Typical examples include the interactive lighting and sound art installation designed for elderly with dementia to explore, play and relax (Gu, 2013), as well as the interactive wall embedded in care home's living room, presenting photos from family and residents' familiar places, in order to draw residents' attention to facilitate communication and reduce wandering (Robben, 2012). In addition, the soothing effect of nature is also taken into consideration by many researchers. Grinde and Patil argued in their research on biophilia that "viewing natural landscapes provides psychological and health benefits, including a reduction in stress", and interacting with nature seems to have "positive effects

on health and wellbeing” as well (Grinde, 2009). In the context of Healing Gardens, the importance of the outside cues like time of day or season of year was emphasized, as dementia causes damage to the chiasmatic nuclei and thus a lack of these clues can lead to disrupted sleep patterns (Zeisel, 2005). Many care homes also use static images and plastic plants to mimic the outdoor spaces with a similar intention.

In this field, different strategies or therapies can be combined to achieve new products and services. **Paro**, for example, is a robot baby harp seal that responds to touch, sound, heat and movement (Grinde, 2009). Paro aims to combine the benefits of closeness to nature and other therapies, like animal therapy, and doll therapy. Care-bots of this kind inspire similar reactions from residents as real animals do, without burdening the care providers with the extra care and hassle real animals do. In this way these can be considered useful when logistic challenges prohibit therapy animal visits. However, care-bots may also propose the ethic dilemma about whether researchers and care providers deceiving residents with dementia if they allow the residents to believe the bot is a real animal (Johnston, 2014).

In summary of the mentioned therapies and design products, one important insight is that sensory stimulation plays an important role in design for people with dementia, providing pleasant experiences for them to engage with the products or environments, and stimulating the elderly to communicate, which may postpone further cognitive decline. The soothing effect of nature, appreciated by many researchers and designers, can also be considered as one approach of multi-sensory stimulation.

The other insight, however, is that though many of the mentioned therapies and design solutions help in facilitating positive feelings and communications, they also meet risks and challenges when deployed for the elderly. Among these mentioned approaches, animal therapy and being in nature seem to be widely accepted approaches with positive effects and least risks, but the impact is hindered by the heavy logistic cost. This situation indicates a potential space remained for designers and researches to investigate.

In this paper, based on specific context in local care facilities, we explored through the design process of an interactive installation for the elderly with dementia to feel more connected to nature. It is aimed to achieve an immersive experience via tactile input and tangible interaction, taking advantages of the soothing effect of nature and animal therapy.

3 DESIGN OF CLOSER TO NATURE

3.1 Context Exploration

Early investigation on local care institutions, including shadowing, observation and interviews, illustrates a situation that care givers are often fully or even over occupied with work, but the average time of care for individuals is still very limited, due to the large population of residents. There is an urgent need in care homes to help keeping the residents with dementia in a calm or relatively positive mood, as well as engaging them with some activities and reducing wandering. Since individuals’ reaction towards therapies and interventions varies according to their complex personal life backgrounds and their stages of dementia, a design with neutral, calming and constant intervention might be more appropriate and less risking to the major group of residents when dealing with multi-user context or providing products with public access to most of the residents in the care facilities. In the early investigation, a clear affection towards nature and animals expressed both by care givers and the residents with dementia indicates a potential direction for design researchers to explore: creating an engaging immersive experience to help the people who have to stay inside care facilities feel more connected with nature, improving residents’ emotions and possibly helping to reduce wandering.

The initial prototype was built and tested in 3 care facilities specially for dementia, and the refined prototype was constructed and presented in a common care home during Dutch Design Week 2015, as a field trial for embedding the installation into the daily living environment. The detailed design and evaluation process will be introduced in the following parts.

3.2 Design Concept of Closer to Nature

Based on the insights from related work and early investigations in local care facilities, the interactive installation, Closer to Nature, was designed to explore the possibilities of using tangible interaction to create supportive and responsive environment inside the care home, combining the soothing effect of nature and the principles of animal therapy to provide an opportunity for residents to feel more connected to the outdoor nature environment.

The concept includes a large high-resolution screen that continuously presents a live feed sent from a rural location or an animal therapy farm, which will

allow the residents of the care home to enjoy the green lands and lively farm life, as well as to gain the implicit information about the weather, time of day and season of the year. The installation also offers a simple tangible interaction with a tactile stimulation: pumping real water into a trough in front of the big screen with an old water pump. The pump and the trough are made of metal and in old styles which were commonly seen in residents' childhood. Since the implicit memory of touching and using these tools still remains in their mind, touching the installation, pumping water and swiping the water in the trough can give the residents a pleasant tactile stimulation with familiar feeling from the farm life they used to have, which may encourage the residents talking about their experience to others.

Furthermore, in order to enhance the connection between the indoor space and the nature spot, there is also a simulated interaction of feeding happening after water pumping: when the system of Closer to Nature detects a resident interacting with the pump, it sends a video feed of the farm animals being fed on the other side of the screen. This interaction simulates feeding animals on a farm. This caring action, may support a resident's positive self-image by fulfilling a sense of responsibility. Due to the low engaging threshold and the simple interaction, this installation is supposed to be attractive in several stages of dementia.

The whole installation is designed to provide ambient information of nature, simulate the old farming life and create immersive experience through the tangible interaction with different kinds of tactile stimulation, and building up remote connection between residents and the farm life via the feeding interaction. This is not a solution to replace the current care activities that use animal therapy and the effect of nature, but a supplementary intervention in the context where animal visits and outdoor trips into nature seldom occur due to the burden on financial and human resources of the care facilities.

3.3 Implementation of Prototypes

3.3.1 Prototype (I)

The first prototype (Figure 2) was built up with a need to be constructed and deconstructed easily, since it needed to be tested in 3 different care homes. The wood structure of the trough was made in a simple and flexible style, and a projector was used to present the farm scene instead of a big screen.



Figure 2: Set up for Prototype (I).

In addition to being easily transportable the trough also had to be short enough for the animals to feed while still tall enough for the adult residents to comfortably reach it without stooping down. When being set up and projected with the outdoor scene, the trough need to be seen as one half inside the living room and the other half outside on the farm. An antique cast-iron pump was used for people to pump, as it is common on old farms, and many of the elderly were familiar with it. The inside structures were modified in order to make pumping operation less strenuous and the installation easier to install in a care home. An infrared motion sensor was installed in the cast-iron pump to recognize if the pump was being used. An electric water pump was used to really pump water instead of the cast-iron one. It was connected to a relay which would be switched on and off by Arduino code according to movement sensed by the infrared motion sensor. Processing was used to continually play the life feed videos unless a signal from the Arduino interrupt it, then it selected a random video of farm animals being fed to play. The residents could continue to pump water without disrupting the feeding scene, since the system was designed to only listen to the new interrupt after one video playing was finished. In addition, to display smaller animals like rabbits a big-screen TV was incorporated into an authentic living enclosure. Though, the TV mainly played the non-interactive video recordings it served to enhance the immersive experience of being with nature.

3.3.2 Prototype (II)

The Prototype (II) was a refined version of Prototype (I), according to the new context and new location it needed to be embedded in, while the whole design concept and the basic interaction were kept the same (Figure 3). During Dutch Design Week 2015,

Prototype (II) was built up and exhibited inside a care home, taking up the space of a meeting room at the end of the hall way on the ground floor, and open to the public.



Figure 3: Setup for Prototype (II).

The whole meeting room was redesigned and decorated into a small common room with sofas, small tables and a fireplace. The projector used in Prototype (I) was changed into an 80" high-resolution TV screen with very high quality image. The troth was re-designed to look like a piece of furniture existing in the common room, and was rebuilt into a stable structure that could not be moved easily instead of the flexible one used before. The goal of these changes was to make the whole installation more like a window that people can look through when they have a rest in this common room. When people pumped water into the troth, the animals on the farm would come close to the window to drink the water. A fake wall was built in the similar style to the real wall's, hiding all the devices and the real windows of the room, in order to make the installation more embedded in the original environment. The electronic components and the structure inside installation were kept the same with Prototype (I). More feeding videos were added into the system and would be selected randomly to play when people pump, in order to make the simulation more like the real-time interaction.

In current stage, the real-time video stream of the remote farm was not implemented in either of the prototype, mainly due to the lack of Internet environment and constant outdoor recording tools. The real-time performance was simulated by a group of pre-recording videos.

4 EVALUATION OF CLOSER TO NATURE

The evaluation of Prototype (I) included two parts: part 1 was conducted mainly through observation and interview, aiming to examine how and to what extent

this installation would have an effect on the mood of residents in the care homes; part 2 was conducted with questionnaire and interview, to compare the difference of effect between interactive installation and non-interactive installation. Since the residents with dementia often had difficulty in verbal communication, the evaluation results heavily relied on the care givers' answers and explanation.

Prototype (II) shares the same design concept and interaction process with Prototype (I), but installed in a more open and general context, not specially for people with dementia like Prototype (I), but involving common residents and public visitors as well. The evaluation was mainly based on observation and short interviews, and the qualitative analysis can be considered as a supplementary analysis on the whole design concept. The insights from Prototype (II) was more focused on exploring the important factors in the design of this concept and the installation.

4.1 Prototype (I)

4.1.1 Experiment

In part 1 of the evaluation, the whole installation was set up in a small living room where the residents could visit the installation in small groups accompanied by one or two care providers. The care givers filled in the background information of general emotional state and stage of dementia for each resident before inviting them to the room in which the installation was set up. While the residents interacted with the installation, the care givers observed the residents' behaviour and aided in the interaction with the installation if necessary. The researchers observed and recorded their observations throughout the process interfering as little as possible, and subsequently interviewed the care givers after the experiment. In this interview the care giver's observations of the residents' reaction were discussed and the emotional state of the resident compared to the information filled before the experiment.

In part 2, the credibility/expectancy questionnaire (Deville, 2000) was used to compare the result of using the interactive installation and only watching the nature and animal life feed. There were 12 participates (3 male and 9 female, ranging in ages) who completed the survey. All of them were employed as professional care providers for people with dementia. This was a within group comparison in which all the participates saw and compared the two installations.

For the first round, each of 12 care givers was introduced to the live feed of the farm without the

interactive element of the installation, and they were allowed to ask any questions about what they were seeing. During this time, residents were also encouraged to look at the life feed, and many care givers started to engage in conversations about the life feed with the residents or their colleagues. After this, they were asked to complete the questionnaire before leaving the room. Their answers were kept anonymous. The second round followed the same process as the first one, while the interactive system was switched on, so the care givers and the residents could interact with the installation. After experiencing the installation, care givers were asked to fill in the questionnaire again. In addition, care givers were asked some open-ended questions about to what extent and in what way they envisioned the installation being used. They were also asked to describe what profile of resident they expected would benefit most from the interactive installation.

4.1.2 Result

Overall the results from observation and interviews were positive, both from the care givers and residents. The reactions of many residents were interaction without verbal feedback, since many of them did not verbally communicate well. The residents who did speak talked about the animals, such as reacting to the goats that nudge each other and naming what the rabbits were eating. They also mentioned their own farms and the animals they had had.

According to the short interviews with the care professionals after the experiment, the interaction of pumping water to feed animals could be considered pleasant for the residents. They mentioned the installation to be fun and inviting. In addition, it was considered to be appropriate for all stages of dementia. The care professionals described how people in different stages would use the installation differently. For instance, someone in an early stage of dementia might actively interact with the pump and talk to other residents or care providers, while someone whose dementia had progressed further might only sit and watch the quite farm scene or watch other residents as they interacted with the installation. Safety of using the installation was the most serious concern, including the stability of the troth if residents used it to support their weight and spilled water causing a slipping hazard.

Quantitative data, however, did not show a significant difference between the interactive installation and the non-interactive projection. The questionnaire was asked with Likert scales, 3 questions on credibility and 3 on expectancy. The

participants needed to rate each answer from 1 to 9. Credibility rating of installation without interaction was 22.92, above the middle score of 15, with a standard deviation of 2.33. The expectancy rating was 17.85, above 15 as well, with a standard deviation of 2.56. Credibility rating of the interactive installation, was 23.08, above 15, with a standard deviation of 3.62. The expectancy rating of the interactive installation was 18.18, with a standard deviation of 4.24. Although, both credibility and expectation received relatively high score, compared to the middle score 15 which meant neutral towards the questions, there seemed to be little difference in the credibility and the expectancy rating between the life feed and the life feed with interactive installation. The scores of interactive one were slightly higher than the other, but due to the lack of utilizing random order for within group experiment, the difference was not that convinced.

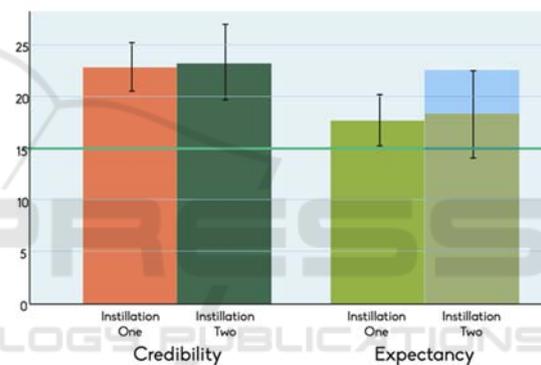


Figure 4: The result of the credibility/expectancy questionnaire.

4.2 Prototype (II)

4.2.1 Experiment

Prototype (II) was installed in a care home during an exhibition, which indicated a mixed situation that the location was not only a living environment with all the functions of a care home, but an exhibition environment with public visitors during the daytime as well. The drawback of this was that sometimes the daily routine of the residents might be interrupted by visitors, while in general the exhibition in the care home attracted more residents to come downstairs to see the installation, and brought people with different backgrounds to visit, which was helpful for us to gain more feedbacks.

The evaluation process was relatively flexible, compared to Prototype (I). Residents, care givers and other visitors explored and played with the

installation by themselves first, and they were welcomed to ask any questions about the installation. The researchers took notes for the visitors and asked them short open questions after they experienced the whole interaction process, such as which part they liked most and which part they preferred to improve if this was an installation really used in senior residents' daily life for longer period of time.

4.2.2 Result

During the exhibition (9 days from October 17th to October 25th), there were more than 220 people visiting the installation, with 198 people recorded during the observation. Among the records, there were 38 senior visitors and 13 of them could be considered as the residents of the care home according to the conversations. 44 people had backgrounds related to design, and 18 people had jobs related to elderly care, including doctors, teachers from nursing schools, care givers and the volunteers of this care home.

Most of the visitors had obvious positive reactions like laughing or exclaiming to the animals appearing after their pumping, especially when the donkeys appeared, which seemed to be treated as a surprise or bonus reward due to donkeys' bigger sizes among the farm animals. Many visitors pumped again to call the animals back when they finished drinking and left, and some visitors even tried to touch the animals on the screen like touching a pet. Meanwhile, this feeding interaction and the animals did encourage people to start talking and sharing about their own experience. Most of the elderly visitors talked about the farms they had lived on, and some middle-age visitors mentioned stories of their relatives who were suffering from dementia. The seniors with dementia who came with their caregivers also showed interest in the installation. For example, one elderly woman kept coming back during the whole week, talking about her experience of using a similar pump in old days, and another lady sat in front of the trough, keeping watching and asking the names of different animals.

The short interviews showed that the interactivity of the installation was appreciated by most of the visitors, and was expected to be enriched with multi-sensory stimulations and stronger connections with the real world changes. For example, the installation could also simulate the smells and sounds from the nature environments, and the scenes could change along with the seasons. However, most of the positive feedbacks about the interactivity were given by the people with design and health care backgrounds.

There are few elderly people specially mentioned about the interactions in their comments. Most of the senior visitors kept talking about the animals, the farm showed on screen, and their own memories of the old days. Unlike the interactivity, visitors expressed their appreciation towards the materials and the physical structures of the installation, no matter what backgrounds they had, since the cast-iron pump in old fashion and the wood trough made them feel more tangible, less technical and friendly.

5 DISCUSSION

According to the evaluation results from the two prototypes, in generally, the installation of Closer to Nature can be considered to be able to bring positive influence for the residents with dementia in care homes.

Reactions towards the nature scene with animals and tactile stimulations were observed in both prototypes' evaluations. Senior residents showed their interest and gave positive feedbacks through watching, laughing, regularly visiting, pumping, talking, and even touching the animals on the screen. The observation results indicate the potentials of this installation to create immersive soothing experience, facilitate communication and help engaging the elderly people with specific activities to possibly reduce wandering.

Although the quantitative analysis of care professionals' feedbacks did not show significant difference between interactive and non-interactive installations, the interactivity of this design was appreciated by most of the people in both qualitative evaluations. One reason leading to this quantitative result could be the short time span of the installation being presented in the care homes, so that participants had very limited periods of time to experience the interaction and compare. This indicates a need for a long-term research with real life settings to gain a convinced answer about the influence of interactivity.

In addition, most of the people who appreciated the interaction and wanted it to be enriched were the ones with design and health care backgrounds, rather than the senior residents in the care home. It still needs exploration to see whether and how the richer and more complex interactions can be understood by the elderly people and contribute to the immersive experience in their living environment.

6 CONCLUSION AND FUTURE WORK

Closer to Nature aims to offer a richer living environment to people with dementia living in a care facility, through suggesting a remote connection with nature. It is designed to provide an immersive experience, combining the natural soothing effect of nature with the principles of animal therapy through tangible interaction design. The evaluation of two prototypes indicates its potential to facilitate positive influence on residents' mood. The tactile stimulation brought by the pump and the trough, and the tangible interaction of pumping water to feed animals were appreciated by most of the participants.

In the future, further investigations, such as long-term evaluations, still need to be conducted to draw a more valid conclusion on whether and to what extent the connection with nature created through tangible interactions can contribute to a pleasant experience in the daily life of the elderly people with dementia living in care facilities.

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