

# Reducing Dementia Related Wandering Behaviour with an Interactive Wall

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**Abstract.** People suffering from dementia often have problems with way finding and feel restless. In this paper we present an interactive wall developed for decreasing the amount of wandering behaviour of people suffering from dementia. The installation aims at making these people feel more at home in the nursing homes by guiding them with a motion triggered audio path. This leads them to a wall with large windows displaying images and short movie tracks from their hometown. The results of an observation study show that the interactive wall succeeds in attracting people and thus reducing the wandering behaviour. Remarks of the elderly as well as their family and caretakers support this conclusion.

**Keywords:** Dementia, Wandering, Elderly People, Alzheimer, Interactive Wall.

## 1 Introduction

With the population of the world aging and the number of people with dementia growing exponentially [1], a predicted 65.7 million in 2050, the amount of research in the field of dementia is also gaining traction. On the one hand scientists are looking for causes of dementia [2]. On the other hand there are scientists that focus on the possibilities of reducing the effects of dementia or assisting the elderly with (interactive) technology [3]. Dementia is a degenerative condition in the brain that mostly occurs as people are getting older. It progressively reduces a person's ability to remember, think logically, communicate effectively and care for themselves. Although it is known that dementia is caused by structural and chemical changes in the brain that eventually lead to the death of brain cells, it is hard to prevent or cure dementia [4]. Studies [5,7] researching the wandering behaviour of elders with dementia show that they often feel lost and out of place. They can feel locked in their own environment and start to wander, looking for the way out or the path to their own destination, e.g. their home, work, family or spouse. 63% of all the people with dementia wanders and 70% of the caretakers see the wandering as a risk for the care of these people [5]. They have the risk of falling or getting lost or fatigued.

Multiple interventions have been described for calming the elderly including multi-sensory stimulation [12]. Though such interventions engage the elderly in an experience and reduce stress and wandering behaviour, often supervision by a caretaker or family member is necessary.

There is a need for an installation with which wandering elderly can interact independently. Can the use of such an interactive installation be effective in reducing the wandering behaviour of the elders with dementia?

In this paper we present such an interactive installation that engages the elders with dementia in a pleasant experience and distracts them from their wandering. A motion triggered sound path provides a direction or a goal for people who feel lost and are wandering through the hallways of an restricted psychogeriatric ward. The path leads them to a wall which aims at offering peace by providing a recognizable view on the world outside of the home. For evaluating the effect of the interactive installation observation studies will be performed accompanied by interviews of the caretakers and family.

## 2 Related Work

Several nursing homes in the Netherlands as well as in the UK have already build an (interactive) installation in an attempt to reduce the wandering of the elderly residents and inducing a feeling of comfort and peace. Three notable examples are the Train Wagon ('Coupé') in Delft [8], the Beach Room in Vreugdehof [9] and Millhouse in Cheshire [5]. The Train Wagon and the Beach Room provide the elderly with a room or setting in which they can relax, emerge in a experience or have social contact with their fellow travellers. The residents with dementia in both nursing homes have responded positively to the installations. There is less wandering around and especially the Train Wagon also assists the residents in their path finding, as it may be perceived as a way to reach their own destination. Whereas both installations are single rooms within a larger complex and only the Train Wagon can be operated independently by the elder, the recently developed nursing home in Cheshire [5] has been completely designed for accommodating the elderly with dementia as comfortably as possible. The doors to the rooms of elderly look like real porches, providing a sense of ownership and independence. Non-accessible doors and gates have been painted the same colour as the wall, extending skirting boards and handrails. The house aims at giving the residents a feeling of freedom and independence, while not alerting or stressing them with opportunities of leaving the premises, and thus reduce the wandering.

## 3 Product

The interactive wall consists of two main elements: direction and experience. The directive part of the installation consists of an interactive sound path that reacts to the presence of an elder and plays sounds varying between music from

the 1960's and the audio that normally comes from a living room. This path of sound, which travels along with the movement of the elder, leads the elder to the interactive wall, the experience.

As can be seen in figure 1, this wall features three interactive 'windows' that serve as a portal to the outside world. As dementia progresses the elders sense of time rewinds and they feel like they are living in their younger years, therefore all the ornaments on the wall are designed in the style of a Dutch 1960's house. On the screens movies are shown from several cities in Holland. The cities are currently chosen based on the amount of people in the institute that have resided there. Both the path and the wall emerge the elders with dementia in an experience. The sounds played are hits from their younger years and the wall acts as a possibility of looking outside and beyond the borders of the hallways of the nursing home.

### 3.1 Requirements

Studies [7,10,11] into the requirements for designing products for people with dementia provide valuable insights. Any interaction required with the product should be kept to a minimum, the installations should feel safe and secure and any experience should connect with the goals and destination of the elderly. Orpwood et al. [10] also indicate that any interaction that involves a chain or sequence of events can cause much difficulty for people with poor working memory such as those with dementia. These difficulties can often lead to withdrawal from engaging in such activities because of their experiences of repeated failure.

Furthermore interviews with the caretakers of the psychogeriatric ward in Naarderheem combined with several observations of the current situation brought to light that, although the elderly act often confused and as living in their own reality, they still act very curious. They look into every door and room and especially in the early stages of dementia can also be very suspicious and alert. In the development of the interactive audio path and wall proposed in this paper these user characteristics were taken into account. There is a balance between creating an installation that stimulates the senses while emerging the user in a relaxing experience that does not demand any additional interaction besides their presence or is too fragile to handle by the residents.

### 3.2 Implementation

The centre of the installation is a computer which connects and synchronizes all of the devices. Using digital time switches the installation automatically starts up at 10 am in the morning and shuts down at 9 pm while requiring no additional actions from the caretakers. When the installation is off, only a light bulb is on.

The audio path consists of four connected printed circuit boards with each having a passive infrared motion sensor (PIR) and a speaker with different volume settings. The sound begins when a motion is detected and then plays for ten seconds, this provides a sense of direction.

The three LCD screens are each connected to a media player and are protected by transparent plates of polycarbonate. The placement of one of the windows was optimized for viewing from a wheelchair perspective while the other two are for standing people. The movies shown on these screens are shot in a specific way, three cameras were positioned in exactly the same way as the windows on the wall so the resulting images are coherent with reality. To this end a special tripod was developed.

Both the path and wall have built-in tools and connections that enabling altering and extension of the system. Though currently not in use, the wall also features motion sensors for allowing specific actions when the elderly are approaching.

Employees of the nursing home without any specific technical knowledge can alter or replace movies and audio material. Also all systems are prepared for time and season dependent sounds and images.



**Fig. 1.** Left the interactive wall with the three ‘windows’ is displayed. On the right there is a close-up of the small fireplace which is one of the ornaments on the wall.

## 4 Experiment

The aim of the observation study was measuring the response on the interactive wall.

The interactive wall and audio path are installed in the psychogeriatric ward in healthcare centre Vivium Zorggroep Naarderheem in Naarden. The ward consists of four connected hallways around a squared courtyard, with a living room on each of the four corners. Each of the residents belongs to a living room with specific caretakers, but are free to walk on the premises. For evaluating the wall and its effect on the wandering behaviour of the elderly an observation study was conducted.

As the target group is hard to interview and often inconsistent in their answers or reactions, we primarily used the knowledge of the caretakers and family to provide us with greater insight in the usage of the installation by the residents and the experiences of these elders with the installation.

## 4.1 Observation

The number of demented people passing by were measured as well as reactions such as looking to the wall, slowing down, stopping in front of the wall, talking and smiling.

For a baseline comparison the same wall is observed, but with the interaction shut off. Because the wandering behaviour in the hallways is not continuously the same, a window of several hours was used to measure possible responses. The baseline observation was three hours and the actual observation six hours.

The number of elders that wandered past the installation were measured and any noticeable responses to the installation were listed. For standardization of the observation and analysis a observation table was used with predefined fields for (anonymous) ID of the resident, the time and any visible or audible reactions.

## 4.2 Caretakers

Besides the observation study, the caretakers of the living room closest to the wall were asked to fill out a questionnaire about the wall after each shift. The questionnaire contained both closed questions about the number of elders they spotted walking past the wall as well as room for their own remarks and suggestions. Besides this formal feedback the caretakers and family also provided informal feedback, which was taken into account.

# 5 Results and Conclusion

## 5.1 Observation

The results of the observation study can be found in table 1. The observation held when both the wall and path were turned on showed that 20 of the counted residents (N=75) looked at the new installation by turning their heads. Twelve of the observed residents actually stood still and redirected their attention from wandering to the sound and images. This in comparison to the baseline situation, where none of the passers stopped. Besides noticing the installation and stopping in front of it, also a number of smiles were observed. This indicates

**Table 1.** Results of Observation Study

|            | Baseline | Observation | Observation |
|------------|----------|-------------|-------------|
| Walking    | 25       |             | 60          |
| Wheelchair | 11       |             | 15          |
| Look       | 0        |             | 20          |
| Slow down  | 3        |             | 20          |
| Stopping   | 0        |             | 12          |
| Talking    | 0        |             | 2           |
| Smile      | 0        |             | 20          |

that the residents like the wall, which is confirmed with some of their remarks. In comparison to the baseline situation the residents showed a far greater interest in the wall and, when asked, started describing the images and relating them to their own destination and or experiences from their past: 'That's the great church of Naarden!' - 'I know that village!' - 'A wedding, those children always run around'.

## 5.2 Caretakers

The response to the questionnaires was quite low. During the first week the installation was turned on only the caretakers of one shift filled in the questionnaires, resulting in six returned questionnaires. They report an average of ten people walking past the installation of whom seven stopped in front of it. No additional feedback was given on the forms. However, interviews with the caretakers provided us with insight in the reception of the wall.

Although the first interaction with the installation was often invoked out of own interest from the wanderer, when asked by the caretakers or family additional motivation or recognition was often extracted. Some of the wanderers also tend to walk in pairs, vividly discussing the images shown on the screen or quietly singing along with the music played by the path. Many of the wanderers, when asked, started telling about their own past, the objects they recognized or responded to the presence of the new installation in the hallway.

According to the caretakers some of the noticeable quotes of the residents that stood in front of the windows of the wall were: 'I know that place, it's Heerhugowaard, I have lived there for many years' - 'It's magnificent!' - 'They even make sound, finally some action in the hallways!'.

Often family of the elder asked about the possibilities to also show video from the hometown of their father or mother or add their picture into one of the frames on the wall. This engagement of the family with the wall was an unforeseen side-effect but valued high by caretakers. The family and also the caretakers who were interviewed unanimously agreed that the new installation is a great addition to the hallways, allowing the elder to enjoy some music or talk among each other about the video images shown on the screen.

## 6 Discussion and Future Work

Overall, during the evaluation, the interactive path and wall was experienced positively by the wandering elders and the installation proved to be an improvement in attracting the elders attention compared to the old empty environment of the hallways.

However, our study has some limitations, one of which is that this study did not differentiate between people with different wandering patterns. Another one is that it is not determined yet if the wall has a similar positive effect after a longer period of time, because it might be possible that there will be a habituation effect. But this study shows that the proposed installation initially

succeeds in reducing the amount of wandering of the elders and emerges them in an experience, e.g. by bringing up childhood memories.

While the caretakers at Naarderheem provided us with valuable insight into the residents in interviews, the response rate to the questionnaires was quite low. The response rate could very well have been influenced by the workload and a lack of time. Worth mentioning is that only the caretakers operating in one of the four living rooms, the one closest to the path and wall, were asked to fill in the questionnaire. The residents of the other living rooms, further from the installation, do wander and walk by the wall but their caretakers confide to their own spaces and hallways and therefore are never observe any use of the installation.

The results from the study also provided ideas that can further improve the interactive wall. As the people have a positive response to familiar content, adding recognition of the wanderer to the wall would provide the opportunity for displaying content familiar for a specific user. For example RFID technology provide the possibility for displaying custom user content. Another added value would be a connection to the internet. If a web-server is set up on the system, family members could log on to the web-server and upload family pictures or home video's. When a resident approaches the wall, the computer reads his RFID tag and matches the appropriate content and displays it on the appropriate screen. Secondly the content displayed on the screen could be adjusted as the head of the elder moves, using eye trackers. This enables a far wider viewing angle per screen, enabling the possibilities to view a whole view in one screen. It should be noted that such an experience (image moving along) should be tested with the elders, as it might create extra confusion.

The interactive wall proves to be a successful installation in reducing dementia related wandering behaviour. An advantage to other interventions is that the wall can be approached independently by the elderly. Additionally it allows the family of the elderly to be engaged by providing personalized content.

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