

Sounds of Connection: Tactile support of family engagement in elderly memory-care residents

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This paper presents a series of interactive tangible musical quilts. These quilts were designed as part of a graduate research course, in collaboration with a local senior assisted living centre, to create a work that would better support memory-care residents and their families. Each quilt includes a variety of soft buttons that trigger age-appropriate music when pressed. While the full project will result in 5 wall-hanging quilts and include a qualitative study with the residents, the current state of this work includes one finished quilt. This project took place when the COVID-19 pandemic began and spans in-person, phone, and email interactions with our collaborators. One finding through our literature review that was emphatically confirmed by the residence director, was the importance of context and social connection in a project. The contribution of this work is the exploration of how to create context that supports a social connection between memory care residents and their families to support positive morale, as well as how the design process was able to function in a hybrid manner.

Soft circuits. Musical memory. Elderly design.

1. INTRODUCTION

Dementia affects the opportunities for many families to connect with their loved ones in the ways they used to (Brankaert 2016). Engaging activities between family members with dementia often focus on finding a common point of context: telling stories to remember history, or develop active projects to create new experiences. However, it is equally challenging for seniors to engage as their memory of their world and the people in it does not always match their experiences of the world. This project explores the development of an interactive, creative project for elderly patients residing in a memory care unit at a local assisted-living facility to have new opportunities to engage with their visiting families. This project included multiple collaborators: a graduate student civic engagement course on the topic of designing for seniors, the instructor for the course and another faculty member at our institution, and the Director of Social Services at a local senior's facility. This work began shortly before the COVID-19 pandemic put many elderly care facilities in

lockdown, so we relied heavily on the Director of Social Services to be the liaison between our design decisions and the residents and their families. Her knowledge and understanding of the residents' experiences, challenges, and tendencies were incredibly valuable in the design and implementation of this project. While our courses were also on lockdown and we were unable to fabricate materials, our students continued the design conversations to make implementation easier when possible. The stakeholders in the care facility were heavily invested in the concept for the project and actively engaged with us through the fabrication process.

Residents in memory care facilities are typically managing dementia, which has symptoms of cognitive decline such as memory loss, learning impairment, and confusion which can lead to anger and depression, and most importantly, not living and enjoying their normal life (Muller-Rakow 2017). Reconsidering quality of life is an important feature of assisted-living facilities (Brankaert 2016). This can include reconsidering levels of interaction and

care with the resident, programming social events and family involvement, re-assessing levels of care and engagement activities, or sensory environment design (Huber et al. 2019)(Jakob and Collier 2014). Care facilities are often searching for opportunities to provide new prompts for engagement for memory care residents and their visitors, in order to continue creating positive experiences that contribute to the residents' comfort and emotional well-being in these environments.

The *Sounds of Connection* project explored the development of a tangible technology work to support dementia families. We collaborated with a local assisted living facility, and in particular their memory-care unit, to devise a participatory design plan to develop multiple interactive, musical, wall-hung quilts. The context we planned to explore was based on creating a physical space for both the resident and their family to remember together. By embedding an artwork that fits the target audience's aesthetic taste into the decor of the common living space of the residence, and using tactile interaction to trigger music based on the target audience's childhood will create a safe space to remember together. However, this plan was interrupted by COVID-19, and the participatory plans were replaced by communication with the Director of Social Services as our liaison who used her eyes, ears, and email to help communicate between our designer graduate students, and residents and their families. This paper explains our hybrid design process and findings at this stage of the project, where one of five quilts has been constructed and shown to the care facility. Future work includes the completion of the additional quilts and an observational study to evaluate their impact on the target community.

2. BACKGROUND

This project began by having our class explore how technology could support seniors' creative practices, in order to develop direct and clear feedback systems that would be interesting for the senior whether they were alone or with others (Schneiderman 2002). Initially we were open to a variety of ideas around life-span/ universal design principles in functional scenarios such as Internet of Things approaches and home products. Through reading Demirek and Demirkan's work on how seniors move through entryways and door spaces, particularly while carrying items, we were able to better understand material, size, and interaction considerations for environmental design projects through a participatory process (2004). This work looks at how a senior carrying something like groceries affects their ability to get into their home, and developed a variety of speculative designs for fold-out tables to hold items, and new doorknob

designs to support a senior moving through a door while carrying items. Similar work can be seen in functional mobile applications for promoting mobility in seniors (Verhoeven et al. 2016), and with interactive media technologies for seniors by noting that clear functionality, ease of use, clear privacy descriptions, and the ability to have immediate feedback from their interactions (Kankainen and Lehtinen 2011). It was especially noted that the social use of technology was highly important, in order to create content that could be shared and further discussed or explored.

Jakob and Collier's "How to make a Sensory Room for People Living with Dementia Guide" notes the importance of context when designing sensory spaces. While random pieces of sensory fabric may be interesting for babies, without a context or connection they will not make sense to an elderly person who is used to understanding a world with reasons, intentions, and meaning. This topic is discussed less in the other literature we explored, but seems to be an important and very key concept to designing for elderly as opposed to children.

Creative projects that have explored the use of technology include Seo et al.'s work developing interactive art projects with seniors (Seo et al. 2018). This project was shown to our assisted-living facilities director, who was very interested in the potential appeal to both male and female residents who, due to their age and home locations, tend to prioritize gender roles in their activities. It was reported that this often affects who participates in what activity, because males were less likely to take part in crafting, yet there are fewer opportunities to engage in more masculine-viewed wood or building crafts in this environment. It was noted in our local care facility that a sensory board filled with hardware components was preferred by male residents, including items such as door chains, latches, hinges, and knobs.

Another artwork that was evaluated with both autistic children and seniors in an assisted living facility includes *Flora Touch* by Seo et al., that used interactive grass and plants as a way to generate light or sound through touch (Seo et al. 2015). It was found that seniors were less hesitant to engage than the children, and they stayed with the objects longer, and began discussing their gardening memories with other residents. This work suggests that having a tangible object to engage with and provoke memories, while in a social setting, can promote social engagement and connection between residents. Another project, an artificial intelligence-based digital art creation tool supported senior's creativity, by creating an initial context and helping seniors to realize their ideas as they were drawing, while also providing prompts when they seem disengaged (Leuty et al. 2013). These works

provided inspiration and guidance for how we could design a tactile social work that would engage, stimulate, and support social interaction in our assisted-living facility.

2.1 Music and Memory

There is much research exploring the connections between music and memory, particularly in older adults, and its relevance in dementia patients. While some studies focused on music therapy and dementia have found that there fewer direct findings of music supporting patient experiences compared to other positive activities (Vink et al. 2003; Baird and Samson 2015), the way in which music is presented and explored with others seems to have more conclusive results (Mcdermott et al. 2014).

Music therapy has been used especially with challenging elderly patients. Often residents with dementia can be difficult to work with, and become angry often because their memory, or lack of, does not match their current situation and it can be confusing (Gardiner et al. 2000). It is noted by Morrissey and McCarthy that music and/or media selection is very important to be transformative to social environments (2015).

McDermott et al. studied the effects of music on dementia patients residing in a care facility, and found that "all participants discussed the stimulating effect of music and how playing instruments or listening to music instantly caught the attention of many residents who often appeared less aware or disinterested in other people or activities around them" (2014). It was found that music creates emotionally meaningful experiences, memory of song lyrics connected to personal identity and history, that also brought up the important of music to build, develop, or sustain relationships with others. *The Sentic Project* explores the design of tangible interfaces for people to engage with their individual music preferences, in order to relieve stress and engage in personally meaningful activities (Thoolen et al. 2019). Another project by Müller-Rakow and Flechtner explored how to create personal music players for people with dementia by considering "how to design access to digital music platforms" while acknowledging the varying levels of physical and conceptual dexterity needed to engage with it (2017). This prompted them to explore knob shapes, page-turning shapes, and soft 3D object shapes as building blocks for musical interfaces, providing a tangible context for the user.

3. INITIAL DESIGN AND UX CONSIDERATIONS

This project developed over 20 months, through many conversations between the Director of Social Services at our local assisted living facility and our graduate student designers. The memory care unit

was identified as a place of need, due to the struggles of families to connect with their loved ones, particularly in the context of a family visit that might take place in a warm and inviting space, but could still leave residents and their familiar distraught when interactions did not go as well as planned. The director was an avid crafter and supported the residents' desires to craft as a community event with their peers and family. In our conversations this was brought up numerous times, that where words and memory might fail, creating something together and in the present moment could create a sense of accomplishment and connection. While many discussions were had around us designing community crafting sessions, these were deemed to require many regular visits from our students, and we were seeking to design something that supported the residents' experience without regular student guidance. Through our many discussions about engaging with art and crafts, we were inspired by a video shown by the Director of Social Services where small mechanical music boxes were mounted on a wall at another institution, that were a large source of engagement and joy for residents. We were never able to get a source for this video, which is why it is not referenced in this paper.

We decided to design musical quilts as the best fit for this situation, to create a conversation piece that could be visited in the common spaces of the memory care unit (see Figure 1). Other concepts included interactive sensory fidget pillows, a digitised community noteboard for sharing memories and media, and a digital video booth for capturing stories and interactions. The quilts were selected for their tactile nature, minimal maintenance or technical support needed, and the social nature of music to create a prompt for engagement in common spaces. The Director of Social Services visited our course to share research and talk with us about their needs and interests, and student designers visited the care facility prior to COVID-19 lockdowns to meet with residents and families, and see the facilities.

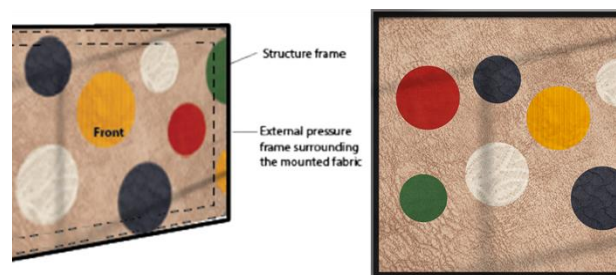


Figure 1: Mockup of Quilt Top.

Goals for the project were identified as: 1) supports the remembrance of memories, 2) supports interaction between residents and family members, 3) encourages movement, and 4) encourages vocal use in discussion and song.

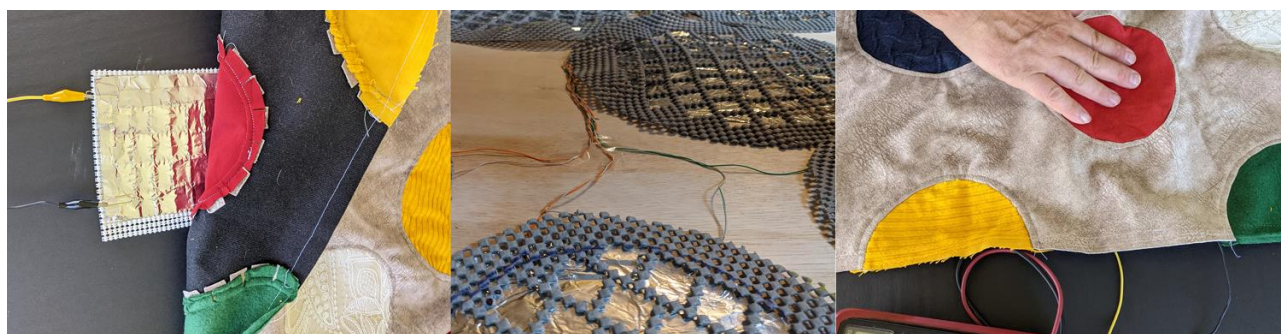


Figure 2: Stages of Fabrication.

User experiences elements focused on simple designs with basic yet clear forms of interaction, clear feedback as low latency between pushing the buttons and the audio playing, and having options in the case of mistakes to play a different song or to turn off all audio.

During lockdown, the project got as far as creating and iterating digital mockups of the designs to engage with the texture, code and electronics platforms were explored, and music was selected. Quilt designs were created to have large spaces to use as soft buttons, with contrasting fabric between discern between spaces. Color palettes were developed based on the interior design of the assisted living facility, in preparation for them to take their space as a large wall installation. Textures were specifically considered in fabric choices to create a variety of different tactile experiences. Audio selections were curated in collaboration between students and residents, mostly over email with the director soliciting music suggestions from residents and their families. Though the music selection was largely driven by the preference of the residence, reflecting on the music selected suggests a focus on the target audience's age, location of childhood, and demographics. Some of the songs that were curated through the collaboration include: You Are My Sunshine, Let Me Call You Sweetheart, Amazing Grace, How Much is That Doggie in the Window, Five Foot Two.

4. FABRICATION AND TECHNICAL DESIGN

A year later into the pandemic the residence was asking if it was possible to still receive the quilts, as the pandemic made visits more challenging, and keeping morale high was a priority. We returned to the pyAudio library largely due to ease of development. This platform provided the ability to quickly program the interaction using Python script and the board's GPIO pins and provided a built-in audio output. We wanted the quilt to be perceived as a simple interface to the sound objects. This association required designing and constructing custom buttons that reflected the visual elements in the quilt. We employed standard approaches for constructing custom soft buttons by suspending two

the fabrication process with the available students and some additional faculty support in order to construct the quilt tops, build the electronics, and compile everything together. These remaining students were passionate about seeing the project completed, and were anxious to see the results.

Within the fabrication process a variety of interaction options for how the buttons would function were explored. These included: 1) each button (built to reflect features designed in the quilt) activating sound in an associated speaker, 2) having speakers just on the top edge of the quilt, 3) each button triggering a random song from a list (so the same button does not trigger the same audio file), 4) each button having a dedicated audio file that is always triggered the same, 5) audio continuing to play when another button is triggered, and 6) stopping the current audio when another button is triggered. The final design settled on a simple interaction assuming a single interacting agent (resident with visitor) supplementing conversation and pedestrian movements. The most appropriate interactions that support the project goals were selected as: 4 speakers providing some spatial association between the sound and the position of the button but not directly implying a separate sound object. Buttons (and their visual elements) associated with single audio files affording direct selection or finding activity of preferred sound of preferred files. It was also decided to have a single button start and stop the associated sound file, and have the pressing of a new button stop the current file and start new file.

Prototypes of these design choices were developed on both the Raspberry Pi and Daisy platforms. The final project was built on the Raspberry PI 3+ using

plates of conductive material (tin foil) with a thin compressible material (foam matting) perforated to allow the conductive plates to touch when pressed. Many iterations of the buttons were explored to figure out how to have consistent connection with a variety of touches such as general light touches or more specific pokey touches. With the materials this was done by working with multiple different brands of foam matting typically used as kitchen cupboard liners which came in different thicknesses. Then

exploring the right kind of touch by cutting out different size sections that allowed for different qualities and amounts of contact until we found the right combination to always spring back while having consistent connection when touched. This construction technique allowed the buttons to be built in the shape required by remaining thin, soft, and responsive across the whole area of the associated visual element (see Figure 2).

Each quilt required 6-8 inputs per quilt, and 4 speakers. The latency and reliability of the wiring and programming was tested to ensure the touch of the quilt was associated with the resulting played sound. The panning of the output of the sound was also worked on to support this perception. The electronics are mounted on thin (skin) plywood, so the fabric can be pulled over top and fasted with velcro on the back. The fabric is washable and easily removable so it can be cleaned, and put back on. A wood frame is attached from the front, so it can be hung on the wall and help tighten up imperfections in the fabric. The mounted quilt top, over the buttons but without the frame, can be seen in Figure 3.



Figure 3: Mounted Quilt Top, Without Frame

5. CONCLUSION

This paper presents a collaborative, interactive, musical quilt design between graduate students, faculty, and the memory-care unit of an assisted living facility. This work was created in parts through the COVID-19 pandemic, which required the shift from in-person meetings, observations, or participatory design strategies to mediated email and phone discussions. While many of the design choices were able to be developed before lockdown, the prototypes were not completed until well into the pandemic. This paper presents the inspiration for this work, literature that was referenced in the development of this project, and the collaborative process to design the five musical quilts, and fabricate one of them. At the time of publishing this paper, two quilts are almost complete with the sensitivity of touch conductivity still being tweaked.

One large finding through the development process is the attention to context within the design. While options for sensory engagement were explored, this project was strongly tethered to creating a space for remembering together, combining tactile interaction with music from the target audience's childhood. We found in our interactions with our collaborators that creating a unique piece of artwork that is central to the memory care unit's decor, which is a safe space for a resident and their family to engage and remember together, would be a strong takeaway for both parties. The evaluation of how successful this design is will be carried out in future work.

5.1 Future Work

Future work will include bringing the first completed quilt to the facility to gather information on the level of engagement they receive, and how smoothly the operation works with residents. We will then be completing the fabrication of the additional quilts, with any iterations necessary. We then plan to hold multiple sessions in person, when allowable, to observe and evaluate family interaction with the musical quilts as a technology probe, as well as to gather observational and anecdotal evidence from residence staff.

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