

# Closing the gap between the collections of museums and the memories of older persons using an innovative, interactive and inclusive product.

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**Abstract** – With rising percentages of people older than sixty around the world, many older persons feel socially abandoned or excluded because of their age. This research aims to create an innovative opportunity for older persons to reconnect with their memories and stories of the past, as a way to facilitate face-to-face dialogue with family, friends or care personnel in a social context. Cultural heritage is used as a tool to trigger these locked memories, using current work on digitalized open and linked data within a participatory project carried out by the city of Ghent and five of her heritage organizations. Development is done using design thinking and participatory design methods and verified by literature review, combined with field research and multiple waves of user experience tests. The end result is an interactive, phygital experience table based on reminiscence therapy techniques that allows older persons to explore cultural heritage in a user-friendly, inclusive and stimulating way.

**Keywords** - cultural heritage, participatory design, older persons, reminiscence, phygital

## I. INTRODUCTION

### A. Social context

Growing old in the current western society brings much change for many people undergoing it. Apart from a deteriorating mental and physical health with older age [1], many older persons feel discriminated by younger generations, as they are branded frail and out of touch [2] and at times not allowed to participate in events because of their old age [3]. Even though social participation is ever so important for mental health as people start ageing [4], this type of discrimination, called ageism, has gotten more widespread over the years than sexism or racism [5]. To fight against this, WHO set out eight goals to create age-friendly cities around the world, with social factors defining three of the eight goals: (4) Social Participation, (6) Respect and Social Inclusion and (7) Civic Participation and Employment [6]. This initiative aims to support projects in working more towards inclusive places for all ages, something that will grow more important over the years as age expectancy rises throughout the world, with prospects that 34% of all European residents will be aged 60 or older by 2045 [7]. With loneliness being a major problem for large groups of older people [8], new projects must be set up that aim to rekindle social bonds between generations.

### B. Participative and mobile cultural heritage

There is a current trend of digitalizing museum heritage on the rise around the world, in a variety of forms [9]. Some museums do this to build digital exhibitions, available to the wider public. An international project by the EU, called Europeana, collects numerous of these databases into one large digital library, where users can create narratives and curate collections to their liking. A project in Belgium called Collections of Ghent is using this digitalization as a tool to explore options for mobile heritage content through participative activities that involve the citizens of the city and their stories. Research has shown that such projects, that bring art and heritage to people in a different context, can reduce stress and improve overall health [10]. Participants have shown to perceive higher levels of life satisfaction [11], improved quality of life [12], increased self-confidence [10], [13] and more social motivation in general [10]. WHO even calls for the recognition of the role of arts as a valuable partnership for the health sector [14].

However, older people are not always able to freely visit such activities, due to physical constraints or mental reservations [15]. Various cultural heritage organizations are thus offering outreach programs to mobilize parts of their collections and bring the museum to residential care centres amongst others. Handling museum artifacts can help people rediscover their sense of self [16]. Combining this trend with a social approach, focused on reconnection older persons with relatives or other generations, can offer a playful yet effective way to stimulate the mind and use heritage to spark conversations.

## II. LITERATURE REVIEW

### A. Reminiscence therapy

One of the most well-known methods to fight against ageing symptoms and diverse types of dementia is called reminiscence therapy. Reminiscence is described as “a free-flowing process of thinking or talking about one’s experiences in order to reflect on and recapture significant events of a lifetime” [17]. The main goal of reminiscence therapy is to use recollections of the past to reflect on life and find meaning in ageing [18]. Studies have shown positive improvements in older people’s health after partaking in reminiscence therapy, especially regarding improvements of mood, cognitive functioning, depression levels, social participation, quality of life, improved wellbeing,

and empowerment [15], [18]–[20]. Reminiscence is often linked with cultural heritage and object handling, since it challenges people to experience a variety of emotions and think differently about certain subjects, which are typically the same challenges that arts engagement provides [21].

### B. Designing for older persons

Before the product development process starts, it must first be acknowledged that there are ‘young’ and ‘old’ seniors, combined with differences in social background, family circumstances and mental or physical condition [4]. Some are in very good health, whilst others may not be able to perform basic activities without help of others [2]. However, old age does often come with the same broad types of challenges. Whilst the digital inequality is gradually lessening [22], many interactions with modern technological tools are still perceived as difficult for many older persons.

A number of focal points can be outlined for this. Physical and digital controls should both be spaced far enough apart to take arthritic hands into account [23]. Keyboard inputs are often more difficult to navigate than touch-based inputs input [24]. Accuracy is often a large problem however for touchscreens, which can be avoided by lowering the need for accuracy and preferring swiping operations over tapping [25]. Visual and auditory feedback on operations and active modes is of key importance for an intuitive use [25]. When developed correctly, digital tools for older persons can be built and adapted by the target group, going against the stigma that rose due to prevailing ageism. The best way to design for older persons however, is to design with older persons [4]. By adapting a participatory design methodology, which will be explained in more detail in Methods, many problems can be avoided before the first user tests.

## III. METHODS

### A. Double diamond

The thesis is split into four large phases, each consisting of both internal and external loops, with the latter going back to a previous part in a cybernetical approach with feedback and progress. These parts are based on the double diamond methodology [26], consisting of: (1) Discover phase, (2) Define phase, (3) Develop phase and (4) Deliver phase. The first step of this process is to diverge from the original problem space and find the best problem framing to solve, after which the second step requires the researcher to converge again into a precise problem definition. After this, the second diamond comes into play with an ideation to find a substantial number of solutions, within the limited time and resource framing. Finally, the best idea(s) are chosen and refined into one diverged solution [26].

### B. Participatory design

As a more specialized form of user-centred design, participatory design imposes stakeholder involvement in all stages of the project to ensure that the design meets all stakeholders’ needs and that it can be used by them [27]. To achieve a full participatory design methodology, it is good practice to involve all stakeholders, from the initial stages of the design process and designate roles that go deeper than giving feedback at the end of the project. Getting to know the stakeholders and letting them fulfil roles as co-researchers or

co-designers is mutually beneficial [28]. Because this takes a lot of time and involvement with stakeholders, this thesis is only able to pursue a half-participatory design methodology. Nevertheless, the main principles are applied and proper care is given to participants when needed, by (1) prioritizing a positive relationship over research and (2) fully understanding their point of view when things do not go as expected [29].

## IV. FIELD RESEARCH

### A. Preliminary field research

During the first month of the thesis, three discovery-oriented field research activities are attended. A hackathon organized by Collections of Ghent provided an opportunity for solution discovery by brainstorming and pitching a project that uses digitalized cultural heritage and bridges it with older people. This is done with the help of a group, with the goal of getting some first ideas for concepts and getting a feel with the digital opportunities. This digital database uses Linked Data Event Streams (LDES), a way to save metadata and links between data under CC0 licenses in an international and interoperable manner. Two informational sessions are attended with the goal of understanding how the links between objects as well as the retrieval of objects work. This is important when developing a digital application that will use the collection and its linked event streams to create an interactive experience.

### B. Day in the life of a residential care centre

The goal of this research activity is to get a general understanding of the daily life of residential care centre residents, both for people with and without dementia. In the morning, a group of 8-12 older persons in the closed department (the part of the centre where people with dementia live) is observed during breakfast and an early activity. These residents often feel lonely, away from home and without friends, and the fact that they usually cannot choose what they want to spend their time with or when they want to do things such as eating, makes this distant and lonesome feeling even more evident. During the rest of the day, the people in the closed department usually spend free time doing hobbies such as drawing, reading, or watching television. When they do other activities, they usually are guided by a person from the staff to help them.

During noon, observations turn towards a smaller group of people in the open department, whom partake in a cooking activity. This department is a lot livelier and the participants talk about their childhood and their professional lives. One person, who was a military cook when he was younger, showed the staff members how to cut a certain vegetable. Another topic that frequently comes back is children and family. It is apparent that they are waiting for the next family visit as this is one of the most preferred ways to pass time. Making a product for residents of care centres will thus greatly benefit from including and stimulating intergenerational or familial interactions.

### C. Expert interviews

Three formal and two informal qualitative expert interviews are performed with the goal of getting an in depth understanding of reminiscence, creating activities for older persons and possibilities of a bridge between older persons’ memories and museums’ collections. One interview took place at a residential care centre with an occupational therapist who

organized an activity with the Design Museum Ghent's kitchen-themed reminiscence box, whilst the second took place at a college campus with a teacher and researcher on dementia-friendly communities. The last formal interview took place at OCMW Ghent, with the interviewee being an expert on co-creation with older persons and using art and heritage as a medium to connect different generations.

The first interviewee is asked mostly about successful reminiscence therapy and the influence of cultural heritage. Museum objects are often visually striking and usually carry greater memories compared to everyday, 'grey' objects. Finding out what an unknown piece of heritage is, or letting older persons explain the purpose of something, works great in reminiscence and stimulates the mind. However, tangible object handling is confirmed to be very important, especially for people with dementia. If that is not possible, the next best thing is to pursue other tactile interactions. This is confirmed by the second interviewee, who mentions that reminiscence is about triggering multiple sensory stimuli. Participants of reminiscence activities often want to feel the materials, roughness, warmth and other properties of objects. Cultural heritage can be used as leverage to create easier topics for conversation. The final interviewee states that projects revolving around cultural heritage should be used to let older persons give new meaning to these objects in the way they want. Furthermore, they place great importance on intergenerational contact for older persons.

## V. DESIGN PROCESS

### A. Discover

To get an understanding of current projects tackling the same problem space, twelve different benchmarks are compared against each other with the help of eight criteria that are devised using the design requirements set up in the define process. The four most relevant projects (Dieper graven in het geheugen, Soulcenter, Belevenistafel, Van Eyck Senior is here!), selected based on their relevance to the problem framing and research question of this thesis, are plotted in a spider graph to see where the gaps are in the project and what the thesis can focus on. Looking at the spider graph, it is clear that most of these projects perform well on ease of use and interaction, however there is room for improvement on stimulation of memories, inclusiveness, and adaptiveness.

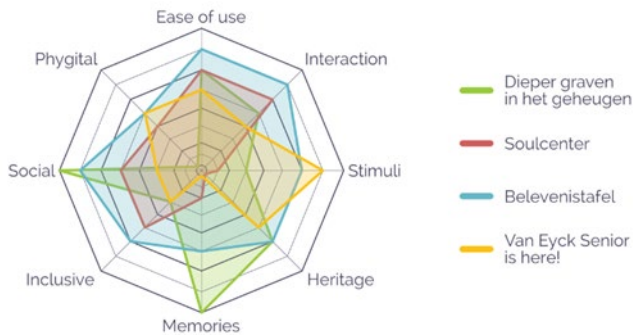


Figure 1: Comparison of the four selected benchmarks based on criteria defined through design requirements.

### B. Define

All the previously done research can be transferred to tangible design requirements and judged using a MoSCoW

analysis to arrange them in order of importance. Using the knowledge gained from the literature review, expert interviews and day in the life, a list of design requirements can be drafted in a hierarchal structure. These scores are used to create success criteria and calculate weight for each criterion. The eight main headings, under which more detailed and explanatory design requirements reside, can be viewed in Table 1.

Table 1: Eight head design requirements and their scores of importance, calculated through a MoSCoW analysis.

ID	Requirement	Feasability	Impact	Total
1.	The product is easy to use	8.1	9.0	73
2.	The product has a low usage hurdle	9.0	8.8	80
3.	The product combines digital and physical aspects	8.8	8.7	77
4.	The product bridges museums and older persons	7.5	9.3	70
5.	The product is personal / adaptive	6.0	9.0	54
6.	The product is social	7.8	8.0	62
7.	The product activates memories	9.0	9.2	83
8.	The product is interactive	8.9	8.6	77

### C. Develop

#### 1) Concept development

The first concepts are derived in two brainstorming sessions from all gained knowledge and result in eight different ideas. These are judged based on the weighted design requirements and the three best ideas, in green on Table 2, are further developed into solid concepts. These scores are assigned with the help of an occupational therapist working in a residential care centre.

Table 2: Weighted scoring to select the three best concepts.

	Weight	Reminiscence room	Collectinos swiper	Heritage match	Digital tours	Enhance storytelling	Activity tool	Game box	Linked meetings
Criterion									
Ease of use	5	3	4	5	3	4	3	4	5
Interaction	5	3	4	2	4	4	1	5	5
Stimuli	1	4	2	3	2	3	2	4	3
Heritage	6	5	4	4	3	5	3	2	4
Memories	6	4	5	2	4	5	4	2	4
Inclusive	4	3	4	4	3	2	2	3	2
Social	2	1	4	5	1	3	4	5	5
Phygital	3	3	3	2	2	4	3	3	4
Total	32	3.47	4.03	3.31	3.09	4.03	2.78	3.25	4.09

#### 2) Concept questionnaire

The winning concepts are brought to different stakeholders and users through a questionnaire that aims to select the best out of the three. Seven retired and eighteen non-retired participants with a variety of ages, backgrounds and living standards gave scores on each of the criteria for every concept.

Every concept received both positive and negative feedback and the retired participants preferred different ideas for different reasons compared to the non-retired participants. Each concept scored good on some criteria and less good on others, though the general scoring for all three is very close to each other. With the results of this questionnaire, a mix between two of the best scoring concepts is made, with their strong points combined into one.

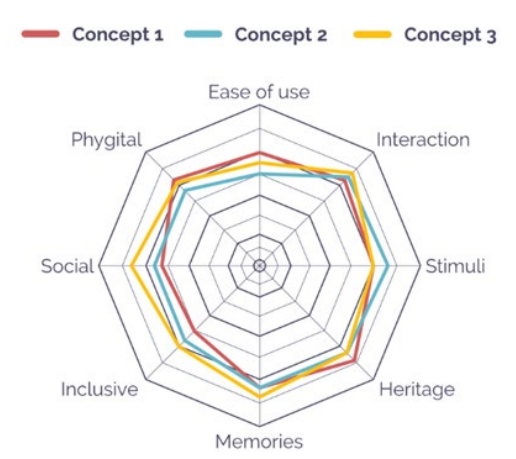


Figure 2: Comparison of the three winning concepts based on the design requirement criteria.

### 3) Prototype design

A digital prototype is made using Figma and Protopie to replicate the workings of a real app without needing to code. The first iteration focuses on using cultural heritage to tell and capture stories, with the goal of sharing these with care centres or heritage institutions. The user can swipe through the digital collection, one object at a time, and decide by swiping left or right whether they respectively dislike or like the object. This is used to group the liked objects together in folders, where the user can annotate the objects and tell their stories with audio, video, imagery or text. Figure 3 shows the design of the Figma screens before they are brought to life with Protopie.

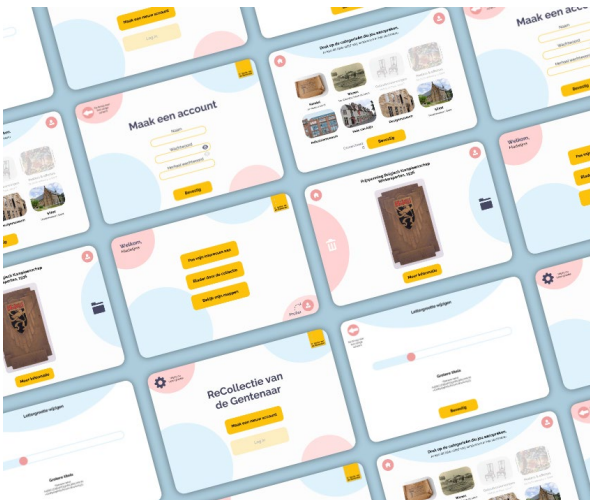


Figure 3: Static screens of the first version of the application.

This digital application will be used on an accompanying interactive physical tabletop. The goal of this physical aspect is to draw attention, easily facilitate face-to-face conversations and to make the experience of the product more interactive and user-friendly. Several concepts are created and pitched to experts, with one concept being preferred unanimously. The concept proposes a tabletop that can be placed on top of any table, made out of wood to radiate warmth. A large tablet is mounted at 60° for ergonomic readability, with speakers on each side to give auditory stimulations. There are three buttons on the tabletop to operate less frequently used functions of the application, one shaped like a hand for intuitive use. This ensures that these functions do not have to take up space in the application interface. The final aspects are a container that

holds relevant questions to trigger dialogue and stickers that explain the product.

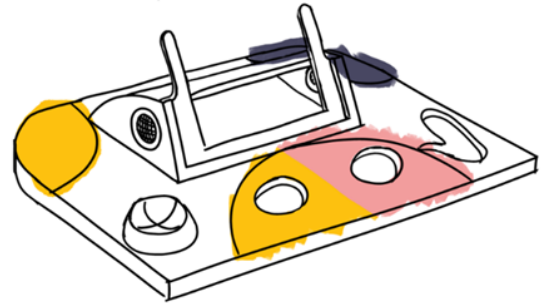


Figure 4: Sketch of the interactive tabletop

### 4) UX testing

#### Setup

Two large waves of UX testing are performed, both containing heuristic evaluations with experts and user tests. Participants for user tests are contacted through both personal and professional connections and are chosen to be as varied as possible regarding age, gender, mental well-being and technological skill level. User tests with people with dementia are accompanied by an occupational therapist in case extra care for the user is needed. After the first wave, which tested only the application, intermediate adaptations are done to the digital prototype and the physical part gets added to create a complete phygital prototype. This gets used for the second wave of UX tests. These tests include heuristic evaluations with younger people to simulate intergenerational responses, as well as experts from a design agency. When possible, family of the user is included during the user tests to further get feedback on the social and intergenerational aspects.



Figure 5: A user test of the second wave with the complete phygital prototype.

#### Results

The first wave resulted in a complete reworking of the flow of the digital application, with a larger focus on storytelling and stimulating conversations instead of capturing these memories and curations. The general perception was however still positive, and most participants are interested in the development and future final product. After initial confusion about how to use the application and how the folders work, most users found the application stimulating, both socially and mentally. Despite this general confusion about the user flow, three participants explicitly stated that the application was easy to use.

After the second wave of tests, which are accompanied by a small questionnaire to inquire about the adaptation potential in various circumstances, only smaller aspects had to be addressed



to improve the app. The main change happened to the sticker design, which is reworked to be more intuitive and complement the physical buttons better. Results from the questionnaire show that there is far more adoption potential in care centres than service centres, as can be seen in Figure 6.

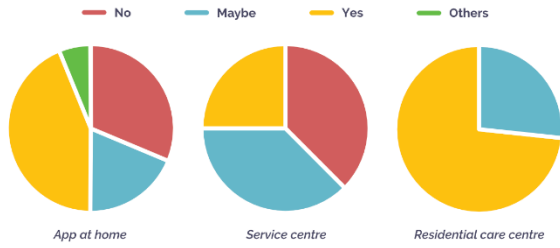


Figure 6: Comparison of adaption potential for the different user groups.

Overall, the users seem intrigued and enthusiastic about the product. According to the participants, the aesthetic and user experience invites the user to use it more and makes it an interesting tool to get people talking. Once they got used to how the app works, which usually did not take more than a couple of minutes with some pointers here and there, they could easily manoeuvre around the interface and found it fun to curate their own stories with it. Some participants used the product to gather more information about cultural heritage, using the filters to specifically search certain objects, whilst others were curious as to what they would find that they recognise or just felt like it would be an effective way to relax in a meaningful manner. Several participants tell us that active and younger retired people will be less inclined to use this product, but for the older persons (especially those living in a residential care centre) it would be remarkably interesting.

## VI. RESULTS

### A. High-fidelity prototype

A working, high-fidelity prototype is made out of poplar wood and PMMA, using an Arduino microcontroller to control the capacitive buttons and corresponding digital RGB LED strips. The code receives signals from the buttons and sends these to Protopie Connect, where it converses with the digital prototype to get a working connection between both parties. The only things that will change regarding the final product are the stickers and the shape of the tabletop.

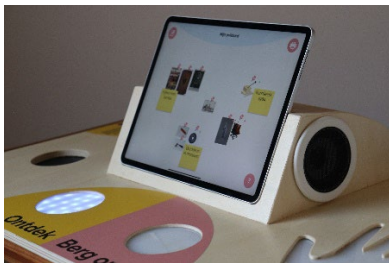


Figure 7: Final prototype that works and looks like the final product.

### B. Technical development

Using data for material properties to compare price, weight and yield strength, birch and poplar wood are chosen as suitable candidates for the final product. Both are available in 18mm FSC multiplex and are light, yet strong. PMMA and HDPE are used at the bottom of the tabletop where the electronics are and

3D-printed parts are made out of PLA. A production-ready CAD model is made with CNC milling in mind, as well as a focus on design for (dis)assembly, with most wood connections mitred and others being screwed in place.

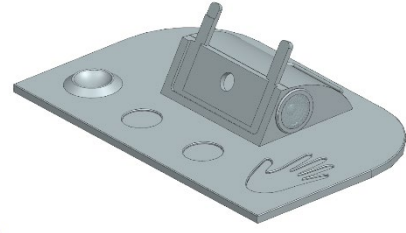


Figure 8: Production-ready CAD model.

The cost of manufacturing is calculated with the help of a detailed bill of materials and a bill of labour. With the price being relatively high, suggestions are given (1) to lower this price and (2) on which aspects to elevate to receive funding. Figure 8 shows a render of the final product, with all final adaptations made and with a handle for easier carrying.



Figure 9: Top-down render of the final interactive table.

## VII. DISCUSSION

Though the project itself is received very positively by older people and residential care centres, there are some aspects that are lacking due to the phygital nature of the interactive table. Literature reviews and expert interviews have stated that the power of tangible objects within reminiscence therapy is not to be forgotten. Being able to feel objects, estimate their weight, discover the differences in roughness, temperature, materials, and other properties can greatly improve the effectiveness of reminiscence. This is not the case when swiping through objects on a digital tablet screen. For this reason, this interactive table should not replace traditional reminiscence activities and museums' reminiscence boxes, yet rather coexist with these activities and create an intertwining interplay between digital and physical, where both sides raise the quality of one another.

## VIII. CONCLUSION

In line with WHO's eight age-friendly community goals, and the contemporary trend of digitalisation and mobilisation of cultural heritage, an interactive, innovative, and inclusive product can be made to facilitate social bonds between generations, with the help of techniques learned from reminiscence therapy. The target group for the main users consists of persons living in care centres, persons active in local service centres or retired persons at home. Secondary users include their families, friends, and elderly care workers.

With overall enthusiasm, intuitiveness and adoption potential being high with the different stakeholders, the product can be seen as possible to successfully implement. After a look at

different sustainability aspects such as C2C and SPSS, the final product proposal is done based on all stakeholder feedback during the extensive UX tests. Some parts of the product will need to be optimised before production can start, but the main workings are tested to work as intended and facilitate dialogue between users without much external incentive. The proof of concept is successful and validated as such with the success criteria. As little as possible further work is needed to produce the interactive table.

To conclude, it has been found that focusing on social interaction between generations with the help of digitalised mobile heritage and reminiscence techniques can help an innovative and interactive product to close the gap between residential care centres, their residents and museums.

## IX. FUTURE WORKS

Apart from issues with capacitive sensing, more research could be done on the use of tramping instead of tapping interactions. Overall implementation could be tested more in depth with residents, visitors and staff/volunteers in local service and residential care centres. This would not only further improve the product, but would also help to understand which aspects are important for which partners. Adding user images or other objects to the pinboard via file transfer or cable connections to the table has not been implemented into the prototype. How this would work, what the most intuitive and user-friendly way of doing this is, whilst still staying in line with the LDES structure and the addition of metadata, should be researched and tested before production. Final additions to the CAD model could include a plastic board inside the chamber that provides a place to slot in all electronics and screw them together properly and safely. An embedded charger for a tablet could also be designed to fit in the chamber.

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