Developing a user interface that enables elderly and dementia patients to access and interact with their memories

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***Abstract*—Dementia is a complex and often misunderstood condition that poses challenges still under exploration. This project investigates the challenges in designing technology with focus on a user interface for elderly and those with dementia. The technical objective of this research is to develop a usable prototype application and improve it through testing. The application's purpose is to strengthen the user's long-term memory using an interactive photo album that utilizes elaborative rehearsal through features such as image tagging and text-to-speech. The development is supported by user testing and relevant theory on how to design for patients with dementia. The project also reflects on existing technology. The result is a high-fidelity prototype and a discussion of the challenges it presented.**

Keywords: Dementia, Elaborative Rehearsal, Memory Enhancement, Interactive Application, Human-Computer Interaction

I. Introduction

Dementia is a complex and often misunderstood condition that poses challenges that are still being explored. Despite increasing awareness, more technological advancement would benefit the field. In general, the elderly are often perceived as being technologically inept [Vaportzis et al., 2017]. As a result, technological products for patients with dementia and the elderly can be difficult to develop as it requires a very specific methodological approach. The project focus investigates the challenges of developing a technical product for elderly and patients with dementia, with focus on a user-friendly interface. The focus of the application is to assist and strengthen long-term memory through elaborative rehearsal [Heerema, 2022]. The application has been developed in Unity [uni, 2023] and has been created for the usage on a tablet screen. The layout has been designed using a design guide created specifically for making interfaces for patients with dementia. The overall content and features have been designed via an iterative process and adapted with the help of user testing and interviews with people from the Danish Alzheimer community [Alzheimerforeningen, 2023]. The application consists of a photo album that uses manual image tagging to provide information of the people shown in the pictures. An external app for family and caretakers has also been developed. This app allows remote upload of pictures as well as image tagging of the people in the pictures. The concept and end-product has been validated by the Danish Alzheimer community. The application has also been developed with focus on similar products and their respective role in helping elderly and patients with dementia with technology. This project takes these existing products into consideration and investigates their limitations in order to reflect and improve the utility of this application. By exploring development of technology for elderly and patients with dementia, this project aims to investigate and improve the understanding of the current challenges.

II. Theory - Development Process

The methodologies used during the development of this project provide the project team with necessary tools to manage various complexities and challenges, while further streamlining the different development procedures. The fundamental methodology used in the conceptualization, design and development of the final prototype is based on the iterative development process, popularized by "The Agile Manifesto" by the Agile Alliance [Agile Alliance, 2001]. The iterative process is an agile development methodology focused on continuous improvement of the product by adjusting, tweeking and testing the product through multiple iterations. This procedure is repeated through an adjustment cycle, in which new functionality is incrementally added to the product until a desired result has been achieved. The steps encapsulated in each iterative cycle are planning, analysis, implementation, testing and evaluation. The iterative development process makes it possible to revise and refine the product more effectively, as the step-by-step procedure makes development more flexible. By dividing the project into tinier pieces, collaboration between team members becomes effortless as it enables a more transparent overview of the product, thereby reducing confusion and misunderstandings. Furthermore, inconsistencies and flaws in the different requirements of each iteration can more easily be spotted, making identifying risks and incorporating solutions more manageable. Finally, each iteration can be tested by the users for constructive feedback, ensuring that the product is meeting the desired requirements. Another methodology used in this project is the user-centered design (UCD) process, popularized by Donald Norman in his book "The Design of Everyday Things" [Norman, 1988]. This approach focuses on getting a deeper understanding of the product's end-users by involving them in the design and development process of the product. The main reason for this approach is to more effectively customize the requirement to

the user's needs. The process phases for UCD are firstly to identify the end-users, followed by specifying the requirements that must be met for the product to succeed. Thereafter, a design iteration will be developed with the intention of evaluating the iteration through usability testing with the users. The constructive feedback from the usability tests is used to further improve the concepts and design of the product, thereby ensuring that the features of the final product produces the desired user experience. Additionally, it allows the developers to avoid unnecessary requirements that could end up bloating the project's scope. The final methodology used in the development is Scrum [Sutherland and Schwaber, 1995]. Scrum is an agile project management framework emphasizing iterative and incremental processes, while further promoting flexibility, communication and responsibility. Scrum divides the project team into different roles, such as product owner, scrum master and developer, in order to respectively adhere to stakeholder's interests, facilitate the scrum process and work together to deliver the desired product. The scrum process entails a weekly meeting where the team shares, reviews and plans for future iterations. This methodology fits well together with the previously mentioned methodologies, as they entail a flexible, adaptable and continuous process towards delivering a high-quality product.

III. Theory - Concepts

When the development began towards building an application with the intended users being elderly and people with dementia, certain knowledge had to be acquired beforehand. Knowledge about color usage, information density, content-selection and timing had to be assessed before the development of the application. Furthermore, knowledge on how to build a tool that would work well for people with dementia, as well as elderly, had to be acquired.

A. How technology can help with dementia

A concern when development started was if the intended users would even have any use for the technology, and if they were able to use it. To address this, information was gathered on whether or not technology had any impact on elderly and those with dementia. According to the Alzheimer's Society, technology is one of the best tools for both the person with dementia, but also their relatives [Society, 2023]. Here it is mentioned that technology can help with memory problems, daily activities, keeping safe, socializing and more. As the problem focus of this project was concerning memory loss, further research would be needed in this field. The Alzheimer's Society mentioned that having pictures with notes attached to them could mitigate memory problems. According to Esther Heerema, the effects that dementia can cause on long-term memory loss can be mitigated with different techniques [Esther Heerema, 2020]. One of these techniques is known as elaborative rehearsal, which essentially is a way of memorizing information more effectively and maintaining it in your long-term memory. [Heerema, 2022]. Research has also shown that elaborative rehearsal can be helpful in the early stages of dementia [Hussey et al., 2012] [Dimitriadis et al., 2016]. Elaborative rehearsal works by connecting new information to existing knowledge or personal experiences. It enhances the user's memory by making information more meaningful and easier to remember. In the context of this project, the way of connecting this information with existing knowledge, would be to link written descriptions with images, audio files and haptic feedback. This would in theory create a more memorable experience for the person with dementia, as it stimulates different senses.

B. Developing a user interface with focus on accessibility

When it comes to developing an application for elderly and those with dementia, several factors need to be considered. Conventional design norms within user interfaces contradict the guidelines set for designing this application. Designing an easy to use and intuitive user interface is essential in this project. Not doing this would risk the intended users to avoid using the product, as the entry level requirement for the technology would be too high. Ghorbel et al. wrote the article, *Towards Accessibility Guidelines of Interaction and User Interface Design for Alzheimer's Disease Patients* [Ghorbel et al., 2017] in which they are creating a set of guidelines to follow when creating an application for Alzheimer's Disease patients. The guidelines, although created for Alzheimer's Disease patients, is still relevant for this project. The guidelines are broken down into two groups, AD[1] related changes, and age related changes. Examples of the first group would be *Memory Impairments*, where actions such as to *give feedback after every action* and *keeping consistent fonts, sizes, colors etc. throughout the application* would help mitigate this. In total, the article addresses 11 different segments of AD and age related changes, with everything being useful for this project. In addition to this article, Tanid's work *Is a big button interface enough for elderly users?* [Phiriyapokanon, 2011] also suggests guidelines for building an user interface but solely with focus on elderly. These articles have established the foundation for creating the user interface for this project, and has been referred to with almost every design choice made.

IV. Process Description of Development Work

A. Idea generation

The very first idea for the concept of this product originated during a brainstorm. Having team members prepare an idea for pitching first without direct feedback can sometimes lead to more nuanced and creative ideas. Therefore, each of the team members on the project was tasked with brainstorming three ideas each that could be pitched and discussed. A total of nine ideas were pitched and discussed. In the end it was the idea for this project that was chosen as it proved strong in concept. The original idea was a digital photo album that could map faces and show certain pictures with specific people. The application would also be able to provide a description of the people shown in the pictures. The purpose of this concept would be to

[1] Alzheimer's Disease

Fig. 1. Paper drawings of the initial interface ideas

create a photo album that could enhance memory for patients with dementia. The next part of the early development was to specify the idea and concept. The main features for the original idea included a user-friendly interface that allowed for elderly and especially patients with dementia to navigate and utilize the application. It also included facial recognition that would allow the user to easily navigate the people included in the photos. The overall concept seemed easy to approach but how these features should be implemented was still uncertain. It was also decided that some other features would be practical for the application. It was therefore decided that the application would include the initial features but in addition the family members would be able to upload pictures remotely from other devices. It was also included that the application should be used as an activity with a caretaker or family member instead of being used alone by the patient. It was decided that having the motivation to use the application with a family member would be more beneficial than expecting the patient to use it alone. Lastly, it was also decided that a feature showing a picture of a visitor should be implemented. The next step after specifying these features was to develop a paper prototype.

B. Paper prototyping

The approach for the paper prototype was for each team member to draw how they visualized the application. Each member would therefore create drawings of the application that would function as their paper prototype. The drawings were expected to be simple but also showing the defined main features in practice. This task would be done separately by each team member and then discussed afterwards. The drawings were then compared with focus on discussing the main differences between the various visualizations. The individual paper drawings can be seen on Fig 1. Here it was interesting to see how each team member perceived the main features as several differences became apparent. The drawings included the original features, but the features all looked different. The main differences between the drawings were noted to be the overall structure of the application and extra features such as a calendar, clock, and categories of picture folders. It was then quickly decided that too many features were a possibility. To mitigate this the consensus was to keep the application simple and focus on the photo album, facial recognition and the remote upload feature. It was also decided that should other

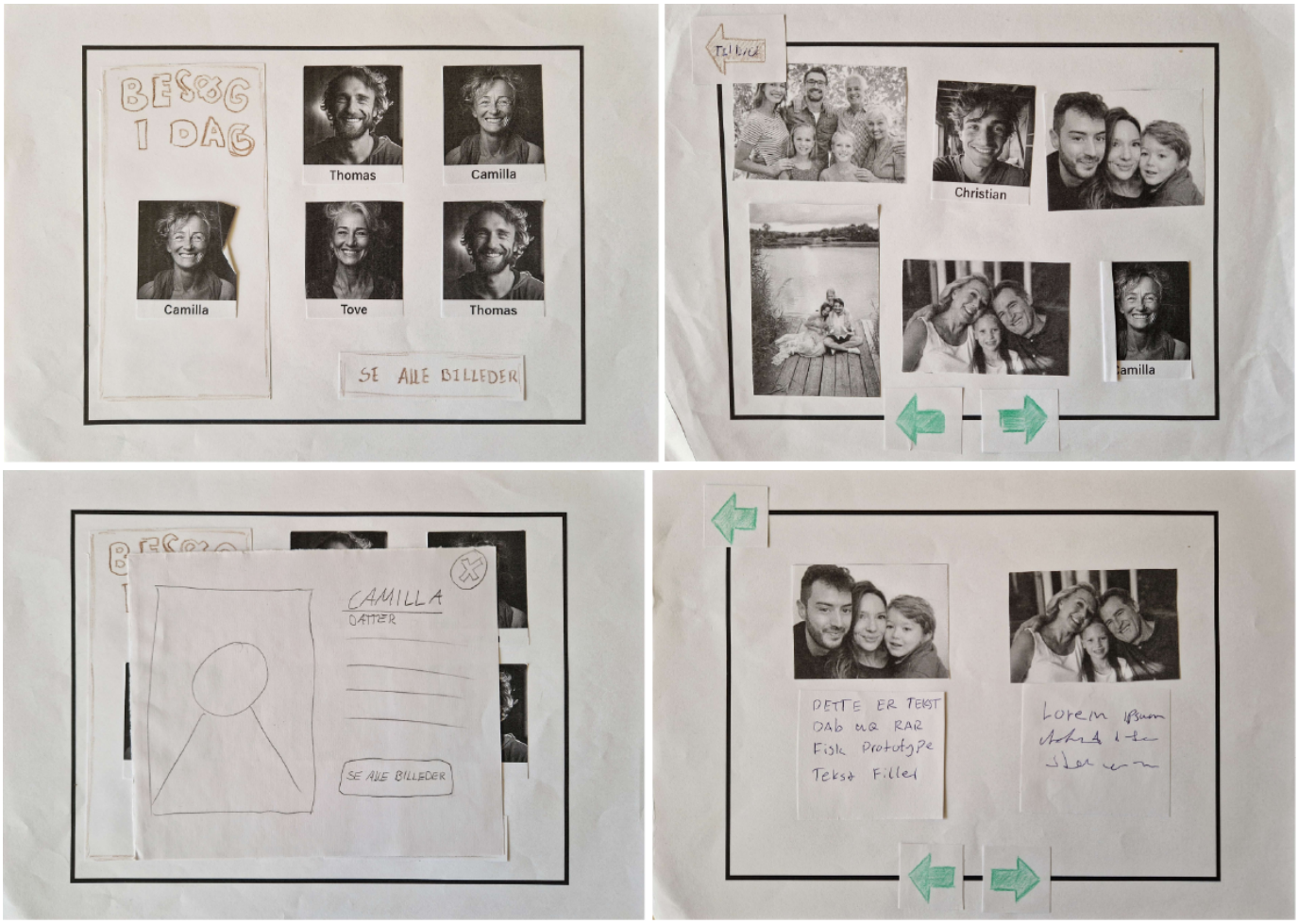

Fig. 2. Paper drawings of the different pages in the application. Top left: Front page, Top right: Photo album, Bottom left: Person profile, Bottom right: Picture descriptions

features be added it would be based on either relevant theory or feedback from testing. Too many features from the start would put the product at risk of being too complicated for the original idea. Afterwards the group made one final paper prototype. This paper prototype can be seen on Fig 2. The prototype was refined and created so that the concept could be user tested. The tester would be able to navigate different pages in the application via buttons. The final paper prototype included the pages: front page, photo album, picture descriptions and an example of a person profile. This prototype provided the possibility of user testing the concept which provided enough feedback to begin the digital and technical prototype.

V. State of the Art

During the development of the project, several existing products stood out as inspiration. These products had all been on the market for a long time, and were widely used in Denmark. This segment delves deeper into two of the different products that inspired parts of the development of the application.

A. *MoreMemo [mor,]*

In the early development of the application, a similar concept was discovered. This concept stood out among the others, because of the fact that this was encased in a picture frame with a tablet inside. This concept is MoreMemo, and has been on the Danish market for a while. MoreMemo is a plug n' play tool for people with dementia or other cognitive impairments. An image of the product can be seen on Fig 3. Where this product excels is in its ability to be a multitool. Not only is it possible for the user to see messages and pictures from their family, it is also able to tell the date, time of day as well as other features. This product is the jack of all trades in the segment of assisting technology. The inspiration taken from MoreMemo was its method of communicating information to a person with dementia. For instance, the way of conveying the time. Usually, you would encounter a digital clock displaying the time, as it is the most space-efficient option. However, MoreMemo understands its users, and their user base consists of older individuals who are likely more familiar with an analog clock. One of the aspects of MoreMemo thought to be improved on, was the user interface. Because of the many

functions of the product, the user interface could become cluttered, potentially confusing its users.

Fig. 3. Visual of the MoreMemo

B. MemoryCube [mem,]

The second point of inspiration came from the product, MemoryCube, see Fig 4. Although this product looked nothing like what was sketched for this application, the inspiration was taken from the simplicity of its controls. The MemoryCube is a tangible cube, having four sides of changeable picture frames, a turnable knob in the top and a power symbol at the bottom. The MemoryCube works by being connected wirelessly to a monitor, whereafter the user can rotate the cube to see different photo albums. E.g. turning the picture from Spain upwards, the monitor would show a slideshow with the photos from the album of that vacation. What stood out was the simplicity of the design. This product almost looked like a childrens toy, which was what inspired parts of this project. Due to the simplicity of designing a product for elderly and people with dementia, it can be compared to designing products for children.

Fig. 4. Visual of the MemoryCube

VI. Expert Interviews and User Tests

The user tests throughout this project have primarily been administered on various people with insight in the world of dementia. Furthermore, some interviews with different experts in the field of dementia have been conducted to support the project development process with valuable knowledge.

One of the initial interviews conducted for this project was with Sissel, a technology librarian working at The Dementia Community Fyn [dem,], see Fig 5. At this stage, no working prototype had been developed. The objective of the interview was therefore exclusively to obtain some initial knowledge about the topic of dementia in general. Sissel's expertise concerned the different technologies used to help people with cognitive impairments, e.g. people suffering from dementia. She emphasized the importance of making these kinds of technologies intuitive and simple, as people with impaired cognitive function generally have reduced learning abilities. The main functionality of the technology should also coincide with the needs of the patient, as there would otherwise be a disconnect between what the patient wants and what the technology can offer. She also mentioned that similar technologies in the sector apply many of the same design choices, such as utilizing touchscreens, recognizable icons and feedback-loops in the form of visual- and auditory cues. The interview ended with the promise of a follow-up interview, in which Sissel would test the finished prototype.

An early iteration of the digital prototype was developed on the grounds of the knowledge obtained during the initial interview. The next step in the development process was therefore to conduct some user tests. The subjects for these initial tests consisted of a handful of people working in the elder care sector, as their hands-on experience with elderly and people with dementia would make them more eligible to validate the technology for patient usage. The general consensus from the feedback suggested that the prototype was moving in the right direction. The concept had potential, but still needed some additional functionalities to stand out from the competition.

Fig. 5. Picture from the interview with Sissel

The next expert included in the project was Else, a Functional Manager for Dementia at the Danish Alzheimer Community. Else emphasized that repetition and positive association within the context of the technology was paramount. Additionally, she also highlighted the fact that patients suffering from dementia not only forget their memories about events, friends and family, but also who they themselves are

as individuals. The patient's ability to use technologies is also dependent on their current stage of dementia, as people in the later stages often do not have the ability or motivation to learn new digital products. With this in mind, the technology should primarily focus on a few specific requirements to avoid expanding the product's scope and reduce confusion. Lastly, Else recommended finding relevant subjects to test the prototype at a local activity center rather than at an elder care facility. However, one uncertainty concerning these user tests was the fact that the families of the patient would have to consent to the tests being conducted. In turn, Else explained that most families probably would be grateful to be included in the testing of the product.

Finally, after the prototype had been fully developed, a last interview with Sissel was conducted with the purpose of validating the product's usability and relevance. With the exception of some small potential tweaks and improvements, the overall feedback from this test came out positive. Some of her most prevalent constructive feedback included being able to implement short videos as a form of memory display, or being able to create non-human relatives, such as a family cat or dog. Aspects such as color, text, size, voice and general display of the applications matched the context perfectly. Lastly, it was mentioned that the application is not exclusively useful for elderly people with dementia, but also has potential in other demographics, such as people with other forms of cognitive disabilities or children.

VII. Documentation of Final Technical Problem

A final prototype has been created through a thorough development process, and has resulted in the production of a digital application that aims to connect patients with dementia with their memories. This application consists of two major interfaces: one for the patient to interact with their memories, and another for the relatives or caregivers to upload these memories to the patient application. Furthermore, a connection to a MongoDB [mon,] database is established in order to interlink these two interfaces, ensuring synchronization of the relevant data. A video of the two applications can be seen in the Appendix.

A. Patient Interface

The patient side of the application works as an intuitive user interface designed for patients to reconnect with their memories. It is designed for tablets as the touch screen interface is relatively user-friendly to people with varying levels of technological expertise. The interface contains different components: the login screen, the home screen, the gallery screen and a pop-up window, see Fig 6. When logged in, the patient can navigate the different relatives and friends by clicking on their icons displayed on the home screen. This will open up the pop-up window where the patient can either read a small description about the person in question or have an AI generated voice read it aloud. The patient can also click on the icon titled "My Profile" on the home screen to see information about themselves. Lastly, the patient can enter the gallery from the pop-up window by pressing the "See pictures" button. This will show all the memories in which the person in question is tagged. An additional feature for this part of the application is the ability for the patient to click on the people present in the picture, thereby opening a pop-up window with that person. This allows for the patient to always find information about a specific person while browsing their memories. To avoid getting lost in the application, the patient can always go back to the home screen by pressing the back button in the upper right corner.

B. Relative interface

The secondary part of the application is responsible for providing the memory data for the patients. This interface is dedicated to the relatives or caretakers of the patient, and allows for seamless manipulation of the data on the database. This side of the application is designed for a normal smartphone for increased availability and ease of use. The key purpose of this side of the application is to facilitate the upload and organization of the data shown on the patient interface. The graphical user interface, see Fig 7, is also constructed with a login screen where the user can either log in or create a new account. When logged in, the main screen appears, from which the user has different options available. Adding data to the database is the most essential function, and allows the user to create data regarding relatives and memories with pictures, descriptions, names, etc. Subsequently, this data will be saved on the database. With the help of the DeepVoice AI library by AiKodex [dee,], a realistic AI generated voice can be created to narrate the description for the patient. Another function of the patient interface is the ability to choose the core people of the patient, i.e. the relatives that have the closest connection to the patient, such as spouse, children or very close friends. Lastly, the user has the ability to delete data from the database if this is needed. The ability to seamlessly upload and manipulate data for the patient application is essential, because the relatives are responsible for the content shown on the patient interface.

C. Backend Database

To enable a seamless connection between the patient interface and relative interface, a MongoDB database has been integrated into the prototype. The architecture of this database serves as the center point for synchronizing, retrieving and storing the data between the two applications and ensuring that the memories are always accessible for the patient. This also enables the relatives to add more memories without having to be physically present with the patient.

MongoDB is a NoSQL database management program able to reliably store data in document-oriented structures. The final database structure of this prototype is divided into five different collections, see Fig 8. These collections are responsible for separating the different data into more readable chunks, making it easier to retrieve when needed. Methods for compressing the different data into more compact raw bytes have been implemented in order to store file formats, such

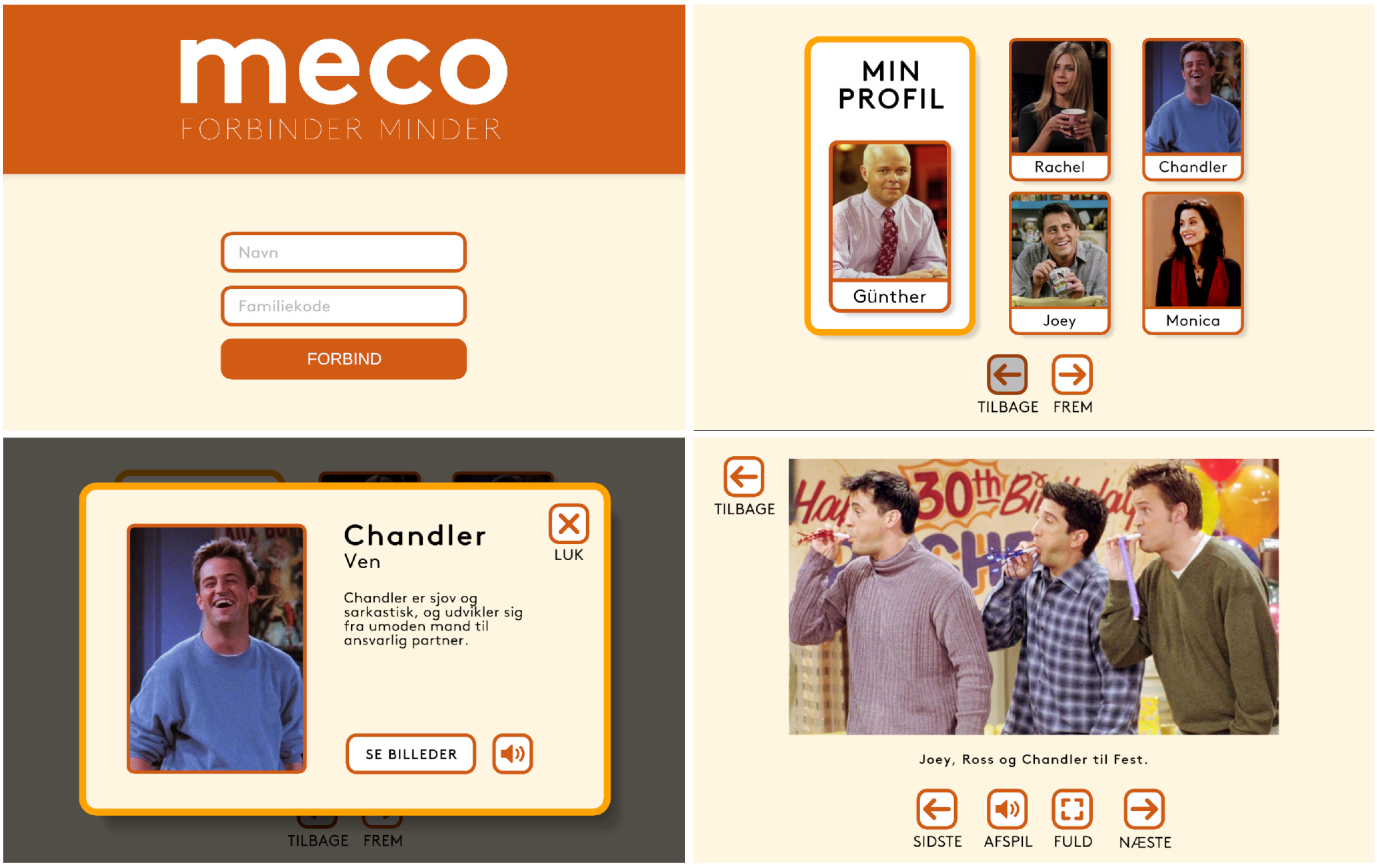

Fig. 6. User interface of the tablet/patient application. Top left: Login Screen, Top right: Home Screen, Bottom left: Pop-up window, Buttom right: Gallery Screen

as png or mp3, more efficiently. Additionally, methods for decompressing the data back into their original file format have been implemented. For a visual representation of the inner workings of the application and its individual parts, a UML diagram has been created, see Fig 9.

VIII. Discussion

A. Limitations on testing

One of the challenges faced during this project was to test the product on real patients with dementia, using real images from their own personal lives. These tests would potentially provide valuable information on whether the product would work in a real life scenario or not. It would enable real emotions when browsing the memories and reading the descriptions. The procedure for doing this would be to contact a local activity center as advised by Else, to then find willing participants among the residents. Furthermore, contact with their families would be necessary, as they needed to gather pictures to upload as well as descriptions to each. All of this would in theory be possible, however due to the current GDPR[2] rules [European Commission, 2016], precautions were taken. To test the product in a real life scenario would require much more focus on data handling, ensuring that everything would be stored in the right places, using the right encryption. This was not something set in the scope of this project, which therefore hindered further testing. However, testing the effectiveness of the application is invaluable in the development phase and should therefore not be discarded.

[2]General Data Protection Regulation

B. Optimization of data gathering

As the decision was made to make the application gather data from a database, unexpected challenges were met. Having to upload and download many large image files was the primary problem of the project. This led to extremely long loading times in the first iterations of the application. Optimization was done to prevent this, as image and audio files were saved to the device the first time they were downloaded from the database, resulting in faster retrieval for future use. Furthermore, the image and audio files were compressed to byte arrays. These actions greatly improved the performance of the loading duration. However, for this application to be fully optimal for usage of elderly and those with dementia, the application had to be faster. To further optimize data gathering, a couple of actions could be done. One of these actions would be to scale the images down before storing them in the database. This would allow for smaller image sizes, and therefore less retrieval time. However, this would also introduce the problem of the images not being as high quality

Fig. 7. User interface of the phone/relative application. From left to right; Login Screen, Home Screen, Create Relative, Selecting People, Warning before removal

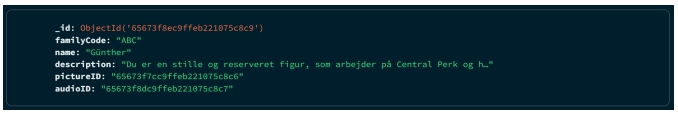

Fig. 8. Visualisation of a patient document in the MongoDB database

on the tablet application. Another way of optimizing data gathering would be the change to a SQL structured database. This would essentially allow for faster data retrieval, because of the structure of SQL.

C. User interfaces

The application was limited to being tested with stock photos from the sitcom, Friends [David Crane and Marta Kauffman, 1994]. This helped test the usability of the interface, to ensure everything was optimal for when real testing started. The results from these tests were found extremely helpful. Valuable comments and ideas for improvement were gathered from Sissel, who was able to compare it to already existing tools for patients with dementia. This helped change up small parts of the design for future testing. Overall, the results from the user interface tests showed that a successful interface had been created, with next to no confusion in the user experience. These results were to no surprise, as the interface followed strict rules set by the guidelines of Ghorbel et al., and Tanid. However, one of the flaws in the design of the tablet version was the ability to click on the people in the memories. In all of the tests, the user failed to recognise that this was a possibility. This of course meant that a change was needed to better visualize the usage of this function. It was discussed that a flashy frame around the clickable area briefly could appear, indicating that something was clickable. Another approach would be to have permanent semi-transparent frames around the clickable areas, although this might disturb the contents of the images.

D. Process description of work organization

The project has been organised and supported by a structure with the purpose to maintain the workflow consistency. The reason for this is to avoid management errors and inconsistent task completion. The framework for the general group work is based on the methodology of scrum. Scrum is a framework that works well with software development. It is also a very specific framework that requires certain factors to be upheld for it to work as intended. Some of these factors have been adapted to the project as all team members have prior experience with scrum. The team members have been comfortable adapting the framework with some specific changes. One of these changes is that the scrum master role is collective, and the tasks expected from this role are shared among the team members. This is possible because of the low number of team members. Another change is that the product owner or stakeholder is instead expected to be the testers. A product owner would normally make executive decisions, but for this project feedback is expected instead. The main method used in this project is the iterative process. Based on that methodology, the group meetings have been planned weekly with one to two meetings per week. The group would meet Thursdays to discuss the current state of the project. The format of the meetings was dialogue based with a set agenda. The agenda would consist of task updates from the members and what to do next. Afterwards, the leftover time was spent on technical work. The group would also meet Fridays. This time was designated to user testing and continuous work from the Thursday meeting. In the end most of the Friday meetups were spent user testing or interviewing representatives from the Danish Alzheimer Community. The task segmentation

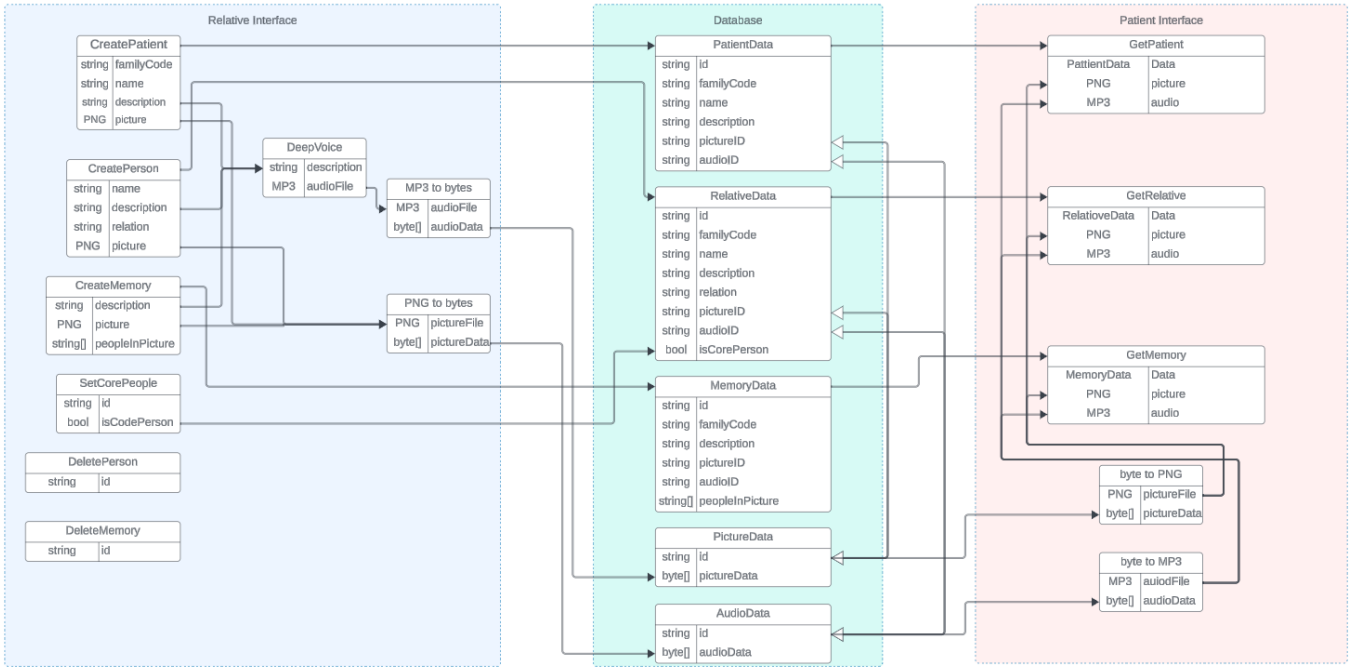

Fig. 9. Visualisation of the backend of MeCo in the form of an UML-diagram

was direct and would consist of current tasks that had to be completed followed by future tasks that were expected to occur later in the process. Each team member would be designated a task by simply choosing one. For complex tasks, the group members would complete the task together. This was done to optimise the outcome and making sure, no member would be stuck on a specific task. The framework for the project was consistent but as the product increased in fidelity, user testing required more time and the individual work on tasks decreased. This structure worked well overall, as the objective of creating a high-fidelity prototype was completed.

IX. Conclusion

The development and research efforts conducted throughout this project has resulted in a working technological prototype, named Memory Connect (MeCo), aimed at helping elderly and people with dementia with reconnecting and interacting with their old memories. The final product has been created through a careful design conceptualisation, iterative development process and multiple expert interviews. The intuitive and simple design of the final product has the desired result of improving the usability of the prototype. A dual interface allows patients to engage with their memories while enabling the patient's relatives to manage the creation of these memories. The prototype stands as an example of meaningful technologies suited for cognitively impaired individuals and their families. Furthermore, the implementation of a backend database to enable flexible and dynamic retrieval and storage of data between the two interfaces has proven effective in making interaction with the prototype seamless and intuitive. In conclusion, the journey to develop Memory Connect has been defined by delving deep into research concerning dementia and its consequences. Additionally, the continuous feedback from testers and experts in combination with the innovative ideas of the project team has shaped the prototype into the result shown in this paper. Lastly, the prototype has been verified to be an authentic and useful tool within the context of not just helping people with dementia, but also other demographics and cognitive impairments.

X. Perspectives

The project ended in the state of a high-fidelity prototype. The challenges of developing technology for elderly and patients with dementia have been investigated and the final prototype validated. However, development of the project could continue. Further development would consist of technical tweaking such as improving the structure of the backend and optimizing the image tagging feature. The backend was a big workload and took time to develop. A difficult aspect of doing so was the data transmission of pictures. This created issues with uploading and downloading pictures and was in the end fixed but with the limitation of long loading time. This also implies the issue that should a patient profile contain a lot of pictures, then the loading time would increase which would not be optimal. In addition, a comment from one of the interviews stated that being able to upload short videos would be a nice feature to have. However, the current state of the backend does not allow for this implementation. Further development of the backend would therefore allow for proper optimization of loading times, and it would also allow for more advanced features such as video uploads. Further development would also benefit the image tagging feature. Automatization

with facial recognition was tested but it proved difficult to implement with the current scope of the project. As a result, the current solution was implemented which allowed for the same function, but it required the person uploading the pictures to manually tag the faces. This is a fair solution, but an automatization of the process would be beneficial for the product. Overall, it would improve the quality of use for the people who upload pictures, which would result in a higher level of satisfaction when using the application. Automating facial recognition has been proven as a concept, but the workload of doing so requires a different project scope. One of the most important perspectives of further development is the possibility to test the application on elderly and patients with dementia. The timeframe of the project combined with European GDPR laws resulted in the product not being tested directly on the target demographic. The testing was instead focused on general usability testing as well as interviews with experts. Further development would allow for the formalities and requirements that are needed for testing on the target demographic. Doing so successfully would require contact with family members of elderly and/or patients with dementia who would be okay with participating. Then a guideline for how to use the product could help the family members use the application in peace without the project team having to be present. Here it would also be expected that relevant pictures with affection value would be uploaded instead of stock photos. These pictures would be deleted after the test. Having team members present could result in the user becoming uneasy. Team members could also be present and observe if the family is okay with it. Testing the application in practice with real photos and families would allow for inclusive data that would benefit the project and outcome excessively.

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APPENDIX

A video showcase of the this project can be seen on YouTube via the following link: https://youtu.be/gcJMnrBAiHE

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