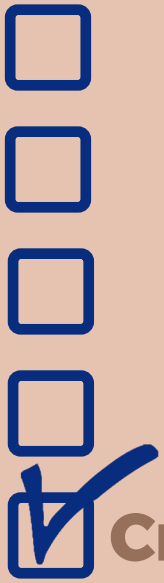

Creating a self-anamnesis platform

Saving doctors time and providing patients with an enhanced experience

Claudia Dwarkasing

Integrated Product Design, TU Delft
July, 2024

anamnesis avatar

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MASTER GRADUATION PROJECT 2023

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Master Integrated Product Design
Faculty of Industrial Design Engineering
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Claudia
2024

Abstract

The healthcare industry is increasingly looking to technological solutions to enhance the efficiency and accuracy of patient interaction and medical data collection. This study investigates the development of a self-anamnesis platform designed to streamline the medical history-taking process. The importance of this topic lies in its potential to alleviate the administrative burdens on healthcare providers, improve patient care by enabling more informed consultations, and enhance the overall patient experience through acknowledgement and reassurance.

Despite advancements in healthcare technology, there remains a gap in meeting patients' desires for longer consultations, more extensive feedback, greater empathy, and the option of receiving care from home. This often results in inefficiencies and increased workloads for healthcare providers. The Erasmus Medical Center (EMC) has expressed interest in implementing an AI avatar to address these needs but is uncertain about the design and functionality it should have. The primary research question of this study is: **How can an AI avatar-driven platform, designed to gather patients' medical histories, be developed to ensure patient acceptance?**

The research employs a combination of literature review and practical implementation to develop and test the self-anamnesis platform. Key methods include conducting user interviews and tests to investigate patient preferences for the appearance and functionality of AI-driven avatars, designing the platform to be desirable for patients, viable for healthcare professionals, and feasible for software experts. Additionally, the research examines ethical considerations and integrates comprehensive data security measures.

The core message of this research is that a well-designed self-anamnesis platform has the potential to significantly improve the efficiency of medical data collection. By addressing the challenges of integration, data security, and user accessibility, such a platform can reduce administrative workloads and facilitate better patient care. The study's findings suggest that with the right technological and user-centered design considerations, the implementation of a self-anamnesis platform is both feasible and beneficial for modern healthcare systems.

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Glossary

Anamnesis: The process of collecting a patient's medical history by healthcare providers to understand past and present health conditions.

AI (Artificial Intelligence): The simulation of human intelligence processes by computer systems, including learning, reasoning, and self-correction.

Avatar: A graphical representation of a user or a user's character, often used in virtual interactions.

Data Security: The practice of protecting digital information from unauthorized access, corruption, or theft throughout its lifecycle.

GDPR (General Data Protection Regulation): A legal framework that sets guidelines for the collection and processing of personal information from individuals who live in the European Union (EU).

Healthcare Provider: A professional or an organization that provides medical services to individuals, such as doctors, nurses, clinics, and hospitals.

Integration: The process of combining or coordinating different systems and software to function together seamlessly.

Medical Device Regulations: Rules and standards governing the design, manufacture, and use of medical devices to ensure they are safe and effective for use.

Medical History: A record of a patient's past health conditions, treatments, and any relevant family health information that can aid in current medical decision-making.

Scalability: The ability of a system, network, or process to handle a growing amount of work or its potential to be enlarged to accommodate that growth.

User Accessibility: The design of products, devices, services, or environments so that they are usable by people with the widest possible range of abilities, operating within the widest possible range of situations.

User-Centered Design: An iterative design process that focuses on the users and their needs at each phase of the design process, ensuring the final product is tailored to the user's requirements.

Context

1 Context

The first part of this report elaborates on the scope of the master's thesis and the different stakeholders and aspects involved. It will go into depth on the different aspects including information about the value of digitizing the anamnesis process, exploring topics such as AI avatars and their appearances, the preferences of the target group, and how these findings will contribute to Part 02 where the context will be defined.

1.1 Project Assignment

In collaboration with Erasmus MC, this graduation project will study the effects of different types of AI avatars on patients' acceptance to create the best-fitting AI avatar for taking off anamnesis, which is the act of retrieving a patient's medical history. This project will mainly focus on understanding which factors of the AI avatar have an impact on the level of acceptance for the patients. The end goal is to apply these factors to design and conceptualize the experience around the AI Avatar. In this project, Artificial Intelligence will be defined as "The simulation of human intelligence processes by machines, especially computer systems" (Laskowski & Tucci, 2023).

The healthcare sector keeps embracing technological advancements to enhance healthcare delivery, and the use of Artificial Intelligence (AI) in healthcare keeps increasing (PricewaterhouseCoopers, n.d.). In this specific project, AI will be used in the form of AI avatars. An AI avatar is a persona that is generated by AI which makes it a digital humanlike character. These personas are typically used to imitate the qualities and behavior of a real human person (Salminen, 2023). Currently, AI avatars are not yet being used in the healthcare sector, but as an alternative, chatbots are. Chatbots are used to answer standard and specific questions from patients, these are usually not allowed to share or react to personal medical information, they are in chat form and not linked to a type of embodiment (NOS, 2023). Possible advantages of implementing AI avatars in the healthcare environment are that it can take some of the workload from doctors and that it can help to transcribe information more accurately than humans do (Stolcke & Droppo, 2017).

The target group for this research project is patients who go to the doctor for consultations and to discuss their medical histories. The AI avatar will be adapted throughout different medical departments at Erasmus MC. The main stakeholders in this case are the doctors from Erasmus MC and the patients. The AI avatar will be used to ask the patients about their medical history, mainly after they've had surgery and are recovering at home. Retrieving the patients' medical history, also called anamnesis, consists of a set of questions about their symptoms during the aftercare of surgery or at intake consultations (Nichol et al., 2023). This is usually done by doctors through several methods such as observations, conversations, and examinations. The implementation of an AI Avatar for the anamnesis process is mostly beneficial for doctors because part of their work is being digitalized. However, it is important to identify the benefits for the patients clearly, for them to accept this new type of technology used for communicating their medical history. This project will focus on the embodiment of the AI avatar, the platform around it, and how this will have the best effect on the patients when looking at acceptance, alongside the ethics and privacy terms that come into play. Acceptance is a broad term and should be investigated in this specific context.

Research Questions

This master's thesis is a collaboration between the Erasmus Medical Centre (EMC) and Delft University of Technology (TU Delft). Erasmus MC has provided the TU Delft with the assignment to create an AI Avatar which will be used to communicate with their patients.

The objective of this master's thesis is to provide healthcare professionals and post-surgery patients with an artificial intelligence avatar experience. This AI avatar conducts an anamnesis to reduce the workload of healthcare professionals and efficiently retrieves the patient's medical history interactively.

In Figure 1 below, the main research question is shown along with the sub-research questions, which will be investigated throughout the report. Both the main research question and sub-questions will be answered through a combination of literature research, interviews and evaluation with users.

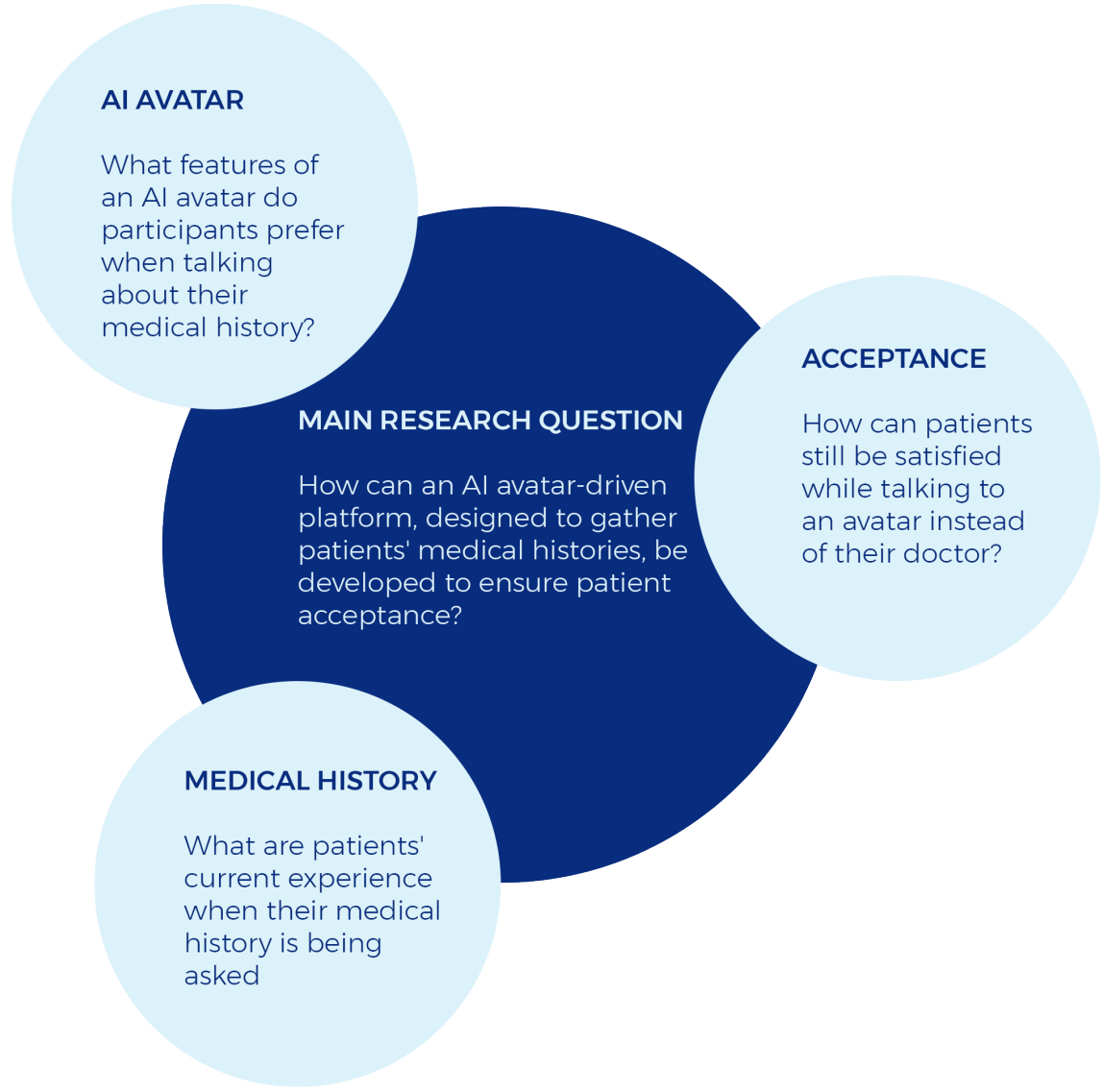


Figure 1. Research questions

1.2 Stakeholders

The Figure below (Figure 2) shows the different stakeholders involved in this research and their role or relation to the project.

Institutional Stakeholders
The client, **Erasmus MC** and the **TU Delft** are considered institutional stakeholder, given that they have the role of supporting, guiding and benefiting from the project.

Primary Stakeholders
During this project the primary stakeholders will be the **patients**, who are the target group and the **concept designer**. This category reflects the direct involvement and interest in the project's outcomes, as well as the direct impact on and benefits for the patients. As a concept designer conducting my graduation project at Erasmus MC for TU Delft, I served as the project lead and bridge among all stakeholders, ensuring that all objectives were achieved and delivering a valuable outcome.

Supportive Stakeholders
The supportive stakeholders, comprising both the **chair** and **mentor**, played a crucial role in this project from an academic perspective. They recommended relevant literature and ideas based on their expertise, and provided invaluable guidance through the planning and approach phases of the design process.

Stakeholders outside of scope
For this project the role of the **general practitioner** is mentioned in the literature research but further than that they will be outside of the scope. **Caregivers** should be considered, given that they could possibly support patients during the use of the concept, but apart from that they are also outside of the scope

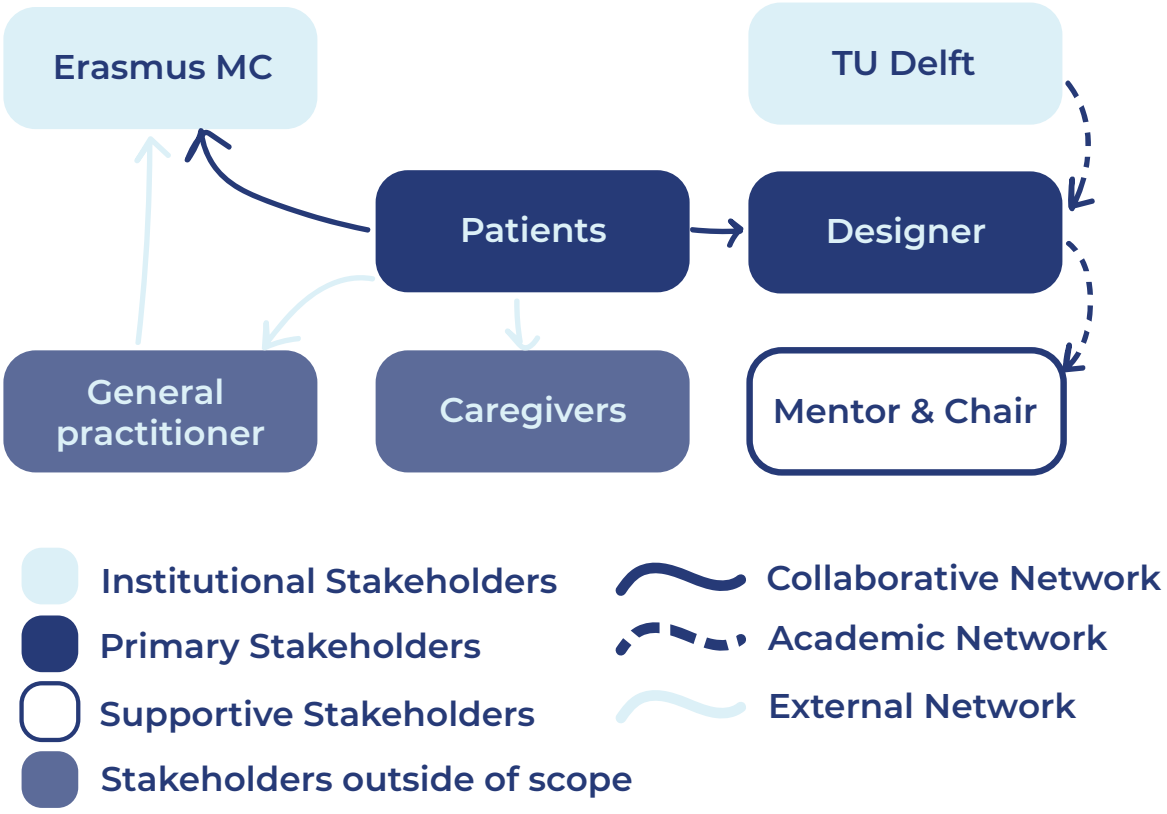


Figure 2. Stakeholder map

1.3 Project Approach

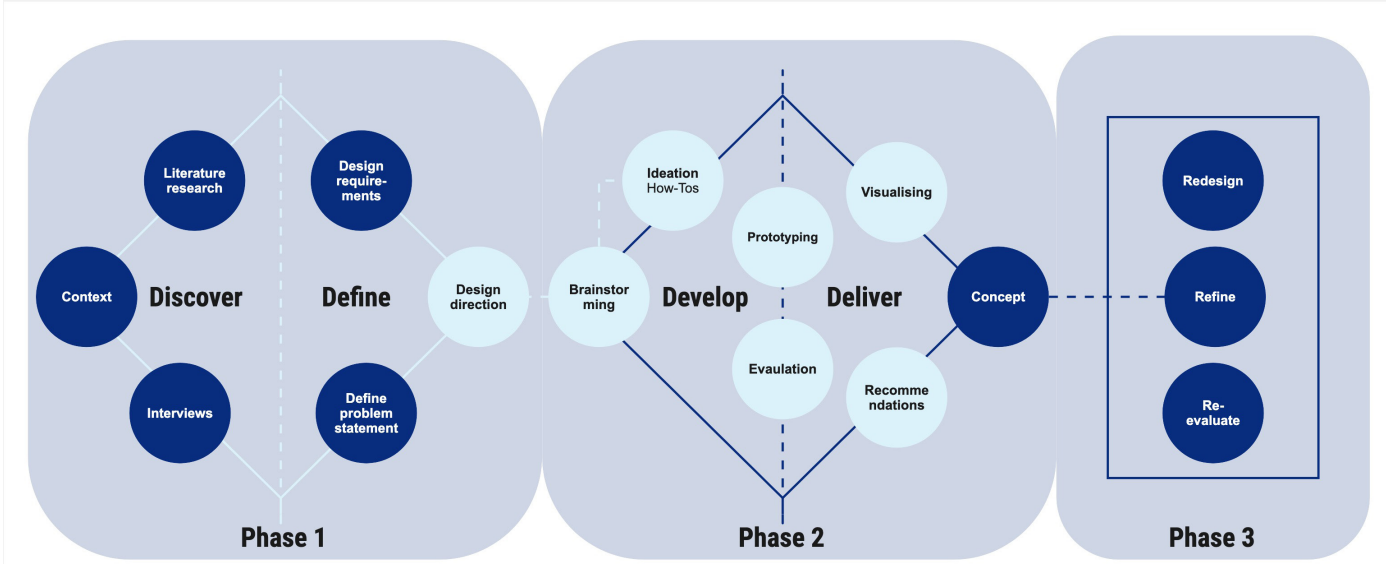


Figure 3. Double Diamond

In this section, the approach for this project will be presented (Figure 3). Since this project is focused on designing a new experience for patients in a medical setting to help doctors, it is important to involve these stakeholders in the design process. The approach that will be used during this project is the Double Diamond Method (Design Council, n.d.), this method is known for having a user-centered focus. The Double Diamond method consists of two parts which are both split into two different parts. The approach is to first discover all the different options and opportunities (diverging, which will later be defined into a clearer vision and problem definition (converging). Once the problem is redefined, the ideation process begins, allowing for the development of various ideas (divergence). These ideas are then tested and evaluated by users to arrive at a final concept (convergence). To ensure the final solution continues to meet all stakeholders' needs and adapt to any new insights, an additional "Refine" phase will be incorporated. This phase focuses on continuous improvement through iterative feedback and enhancement.

In the **discovery step**, the two research methods; desk research and interviews will be applied. With desk research through scientific papers, topics such as the patient's experiences, needs and benefits will be explored, and the outcomes from the interviews will later be used to complement and enrich the findings of the desk research and possibly show new or different results.
In the **define step**, the findings from the discovery phase will be defined into a problem statement. Along with the design requirements a more specific design direction will be created.
The second phase will start with brainstorm sessions based on the qualities in the design direction. For this ideation step, the brainstorming will be done through methods such as "How Might We's" and mindmaps. The **developing step** will end with the introduction of the created concept. In the **delivery step**, the prototype will be elaborated and the design decisions will be highlighted. Eventually the concept will be evaluated by users in order to test the desirability.
After the delivery phase, an additional phase, including the **refine step**, will be incorporated to ensure continuous improvement and adaptation of the solution. This phase addresses new insights or and the feedback from the evaluation tests. Here the iterated and refined concept will be presented. Lastly a re-evaluation will be done with the refined solution. Here different stakeholders such as healthcare professionals and software experts will be interviewd in order to adress the viability and feasibility of the concept. By incorporating the Refine phase, the project ensures the solution meets initial expectations while adapting to new challenges.

These five steps will be used to structure the chapters of this report.

Discover

2 Discover

For the research approach, two main activities will be conducted, desk research and interviews with potential patients of Erasmus MC.

2.1 Research Approach

Desk Research

For this project the discovery step will be done through literature research, and the main topics discussed in this project will be elaborated. The AI Avatar experience (Figure 4) will be split into the Human aspect and Technical aspect. In the first part, of the literature research, the context of this project will be explored by looking into the current situation and experiences during doctors' consultations. Next, the benefits for the stakeholders will be discussed and acceptance and its different factors will be explored. In the next part, the technology behind the experience will be researched. Next to these two aspects, the physical appearance of the AI Avatar will be looked at, and lastly more about the ethical side of the creation of this experience. From the desk research, the main takeaways will be mapped, to be used for comparison with the outcomes of the user interviews.

Interviews

Interviews have been conducted with the target group to explore the different factors that play a role in the acceptance of this new experience along with user preferences. The interviews focused on their current experiences with doctors' consultations by asking specific questions about the emotions they experienced during these. Next to this, the implementation of an AI Avatar was discussed and their preferences for characteristics, qualities, and physical appearance were retrieved.

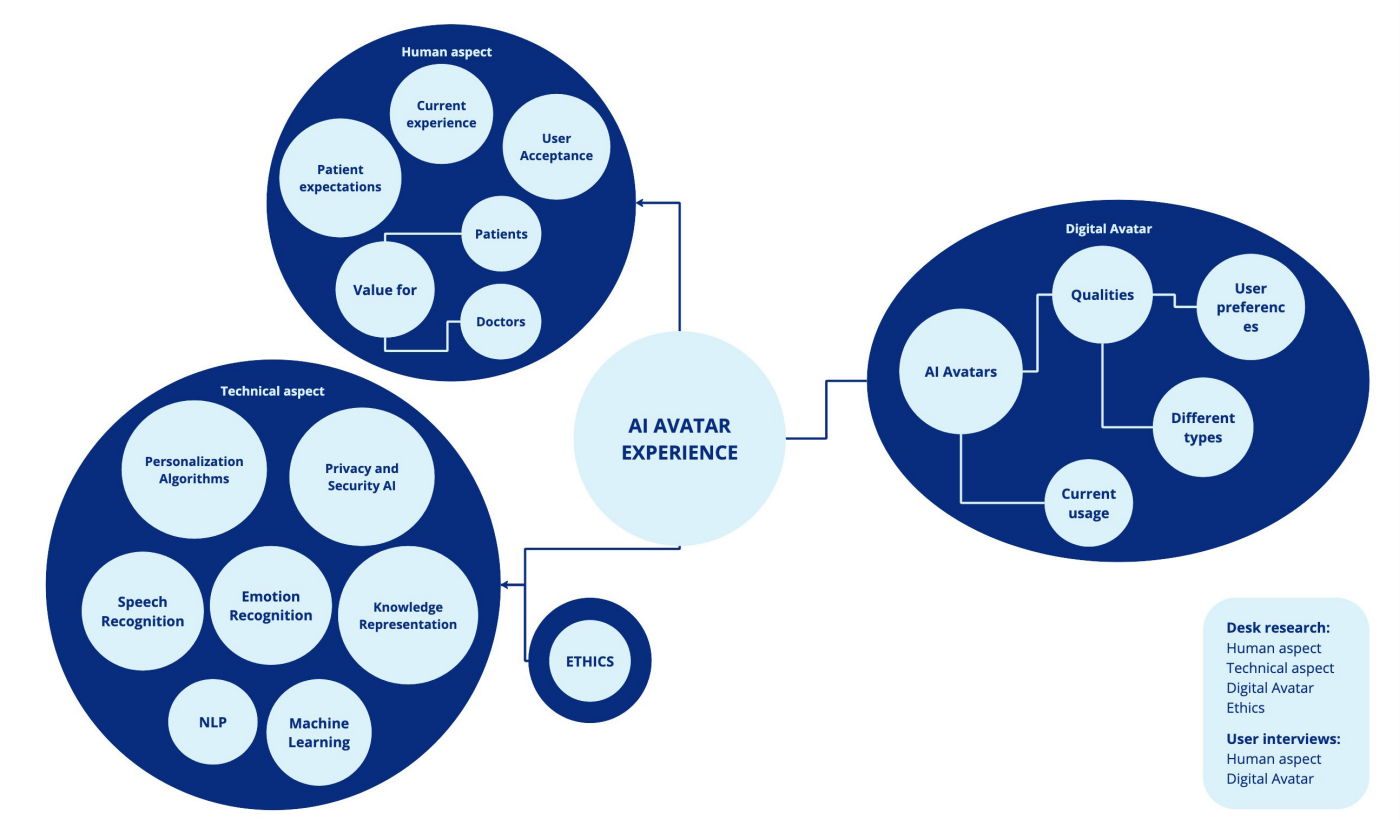


Figure 4. Research themes overview

2.1.1 Human Aspect

In this chapter, the "Human aspect" will be explored, which includes all the topics that directly relate to the user's current experiences, expectations, and needs during doctor's consultations and the interaction with their doctor. The importance of the medical history during these consultations will be highlighted and it will be discussed how consultations are being digitalized currently. For this aspect, the acceptance by patients of this new experience will be explored along with the values the implementation of an AI Avatar will have for both the doctors and patients.

Doctors' consultations

To look into the interaction between doctors and their patients, it is necessary to first mention what doctors' consultations currently look like. To gather all relevant information, it has been decided to broadly examine the interaction between medical personnel, such as general practitioners or specialist's, and their patients. A consultation model made by the Vrije Universiteit Medical Center (VUMC) breaks down how a consultation should proceed (VUMC, n.d.). According to the course given by VUMC, a consultation should consist of a structure where the patient first provides the medical professional with all the information while they try to interrupt as little as possible, but still show empathy through non-verbal actions, such as nodding and smiling. In the process of patient care, collecting their medical history plays a significant role. The first interaction between patients and doctors typically involves comprehensive inquiries into their medical background. This process uncovers chronic conditions and past illnesses that may not be actively managed but could significantly influence the patient's health. Moreover, according to Nichol, medical history serves as a cornerstone for differential diagnoses (Nichol, 2023). It does not only cover past medical issues and treatments but also the patient's lifestyle and health routines. By delving into these aspects, healthcare providers can tailor treatment plans to suit the individual needs of each patient, promoting personalized care (Het Anamnesegesprek, n.d.).

While VUMC advises medical professionals in training to not interrupt their patients when talking about their medical complaints, other research shows that interrupting the patient already early on in their explanation is not always a bad thing (Plug et al., 2022). This type of interrupt is called "cooperative interrupting", which leads to a more efficient way of interacting and helps the medical professional to understand the patient faster. Plug (2022) also found that male medical professionals more often tend to intrusively interrupt their patients, which is mostly caused by of lack of time and the time pressure they are experiencing. Time pressure often poses a challenge during consultations, as medical professionals strive to efficiently gather necessary information while providing quality care within limited timeframes. Apart from intrusively interrupting their patients, it also causes other issues such as incomplete information gathered or provided, which leads to an unsatisfied patient (Dugdale et al., 1999). Consultations are already being digitalized in order to save time.

E-consults were introduced in the late 90s (Vimalananda et al., 2015), mainly because of the time pressure, however during Covid-19 the overall use increased (Singh et al., 2022). This has a lot of advantages according to the Patiëntenfederatie Nederland. Patients are now able to contact their doctors from home and won't have to wait in a waiting room (Patiëntenfederatie Nederland, n.d.). It can also be assumed that being able to contact your doctor from home could help the less mobile people, seeing as they can have their consultations from home. However, less mobile people are often elderly, who sometimes struggle with adapting to new technologies (Iancu & Iancu, 2017). Although a different study about the adaption of new technology under elderly has found that often they are open to it but find that there is a lack of clarity through instructions and support (Vaportzis et al., 2017). This was supported by a different study which showed that seniors have a positive attitude towards technology (Nasmith & Parkinson,

2008) Next to providing the patients to speak to their own doctors online, there is also a different way of digitalizing consultations. The platform “Praatmetdedokter” gives patients the opportunity to talk to an online chatbot, which is available 24/7 and is designed in a very accessible way (PraatmetdeDokter, n.d.). The goal of “Praatmetdedokter” is to have the patients provide their own anamnesis which saves time on administration work. This creates more time for in-depth questions than when actually going to the doctor. A study in the US has shown that ChatGPT provides people with more empathetic and extensive answers than doctors do themselves (Pearl, 2023). In the Netherlands, some doctors believe that they can benefit from using ChatGPT and that it could take away a lot of workload from them. Güven Yildiz (2023), GP in The Hague, admits that sometimes they don’t provide their patients with a lot of extra information when they think that their complaints aren’t that serious (Van Noort, 2023). This decreases their stress levels which also contributes to quicker recovery (Clark, 2021). Patients usually enter a consulation with personal stress and want this to be decreased (Fryburg, 2021) and ChatGPT has been shown to provide them with extensive information in an empathetic way (Pearl, 2023) . In addition, Clark found that a decreased stress level contributes to quicker recovery (Clark, 2021), which further supports the implementation of ChatGPT/e-consults in healthcare.

In conclusion, the literature highlights the challenging dynamic in current doctor-patient consultations, where time constraints often compel doctors to manage interactions efficiently, sometimes through interruptive means. While cooperative interrupting can streamline communication and aid in quicker understanding, intrusive interruptions, especially more common among male doctors undertimepressure,riskincompleteinformation exchange and patient dissatisfaction. Patients value empathy and seek opportunities for thorough explanations tailored to their needs. Importantly, reducing patient stress levels emerges as a crucial factor for improving overall consultation experiences. Therefore, strategies that balance efficient communication with empathetic engagement could enhance patient satisfaction and contribute to more effective healthcare delivery.

Figure 5 illustrates the current patient journey, which typically begins when a patient encounters a medical issue prompting a visit to their GP. Severe cases often result in referral to a specialist (EMC), initiating an intake consult for anamnesis. Due to time constraints, a second intake may be necessary, causing delays. Eventually, patients receive diagnoses and may require follow-up appointments. Pain points identified include insufficient preparation time before intake consults, compounded by doctors’ time pressures, resulting in overall delays. Additionally, frequent visits for follow-ups or check-ups increase patients’ travel time.

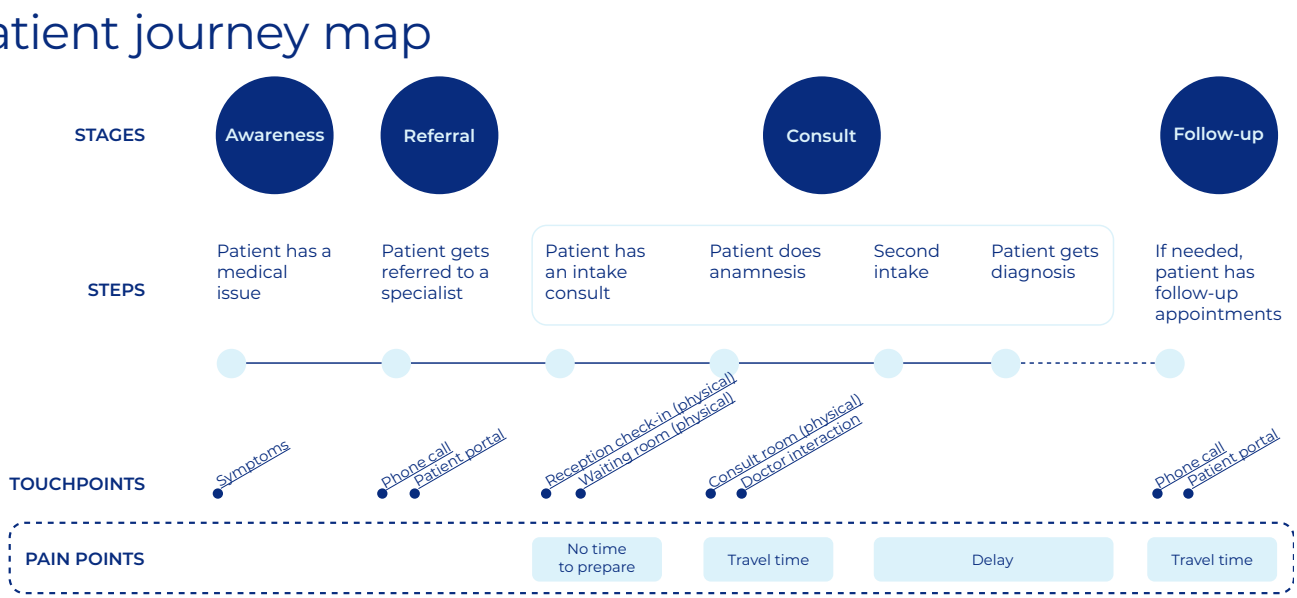


Figure 5. Patient journey map

Value of digitalisation of consultations for doctors

As mentioned before, an anamnesis is the act of asking a patient about their personal medical history, where the patient must answer questions regarding present illnesses, complaints, and disorders. They also must provide details on their current state of living. This can contain questions about whether they are smoking or not, if there are diseases present in their family. These are all needed to identify potential risk factors (German Hodgkin Study Group, 2024). This is a very important part of a patient's journey and it is currently done through a verbal consult where the doctor asks the patient all the questions. This takes a lot of time, sometimes even multiple consultations, which doctors usually do not have the time for (Porter et al., 2022, Twiddy, 2017, Nichol et al., 2023). For example, Porter found this through a study with 2500 participants in the US which shows that patients do not experience extensive care. Similarly, a study by Twiddy through a national survey released by the Physicians Foundation, observed that only 11 percent of patients and 14 percent of doctors felt their visits offered all the time needed. These findings are also in line with what Nichol found, which further highlights that obtaining a patients medical history should be detailed and not rushed. Apart from the amount of time that goes into obtaining a patients medical history, studies have also found that approximately 90 percent of doctors don't like to spend time on documentation and administration because the time pressure gives them stress (Gardner et al., 2018). They would rather spend this time on their patients (Haas, 2014, Jackson & Lemay, 2017). Another reason to digitalize the process of the anamneses, is to make sure that this important step in the diagnostic process is less prone to errors and incomplete information (Denecke et al., 2018). According to research published by Athenahealth in 2021, physicians reported dedicating an average of 13.5 hours per week to tasks unrelated to direct patient care. A good way of combatting this problem is the implementation of artificial intelligence in healthcare, which allows doctors to work smarter and not harder (N. Jessel, 2022).

In summary, digitalizing the anamnesis process stands to significantly streamline patient care by reducing the time-intensive nature of obtaining medical histories through traditional verbal consultations. This shift not only accelerates the patient's journey but also alleviates the time pressures on doctors, enabling them to allocate more focused attention to direct patient care. By leveraging artificial intelligence and digital platforms, healthcare providers can enhance efficiency and accuracy in documenting medical histories, thereby minimizing errors and ensuring comprehensive patient information. This transformation supports a more effective and patient-centered approach to healthcare delivery.

Value of digitalisation of consultations for patients

In this paragraph, the value of digitalizing the anamnesis process for the patients will be highlighted. When implementing AI to digitalize a part of a doctor's consultation, there are concerns which come up, the main one being the loss of human touch (athenahealth, 2024). But even though a part of the human interaction is being removed, there are still benefits when it comes to digitalizing a part of the doctor's consultations, such as increased healthcare efficiencies and improved accuracy of patient diagnosis (athenahealth, 2024). Seeing doctors usually don't have the time to gather a complete medical history (Nichol et al., 2023), it can be assumed that there is a possibility that important information is missing or that it is necessary to have a second consultation. When looking at the preferences of patients, especially the elderly, it was found that if the level of care at home is equivalent to that in the hospital, the majority prefer care from home (Fried et al., 2000). Yet, the absence of direct supervision could potentially affect their effectiveness (Stout et al., 2017). Lastly, as previously mentioned, a recent study did show that the AI-driven platform ChatGPT has been proven to provide patients with more empathetic conversations than actual doctors have done (Pearl, 2023, Ayers et al., 2023).

In conclusion, the digitalization of parts of the consultation process offers significant

advantages, particularly in terms of convenience and healthcare delivery efficiency. Patients, especially those with limited mobility, benefit from reduced visits to the hospital, thus enhancing their overall comfort and accessibility to care. Moreover, digital platforms can facilitate more thorough and accurate medical histories, addressing concerns about missing crucial information due to time constraints in traditional consultations. Additionally, there is evidence suggesting that AI-driven interactions, such as those facilitated by platforms like ChatGPT, may provide patients with more empathetic experiences compared to face-to-face consultations with doctors. This combination of efficiency, accuracy, and enhanced patient experience underscores the potential benefits of integrating AI technologies into healthcare practices, while acknowledging the ongoing need to balance technological advancements with maintaining human-centered care.

Patient expectations

In this paragraph the expectations of patients during a doctor's consultation will be elaborated. There are different factors at play when looking at the level of care that patients expect from their doctor's consultations. According to a study conducted with 19 general practitioners, patients all have different situations which creates different criteria for them to have a good consultation (Van Roy et al., 2013). For example, good consultations were defined by the GP's clear professional identity with specialists, structured sessions, efficient handling of complexity, noticeable progress, and a warm, trusting relationship between physician and patient. A different factor that causes these expectations to vary is the nature and severity of their conditions (Delgado et al., 2008). When gathering a medical history, the severity of the case decides the broadness of it (Medistudents, n.d.).

In short, patients' expectations during doctor's consultations are shaped by factors such as their individual circumstances and the severity of their conditions. Studies highlight that expectations include a clear professional identity from the GP, structured sessions, effective complexity management, visible treatment progress, and a warm, trusting relationship. Consequently, patients with more severe conditions have higher expectations for comprehensive and attentive care.

User Acceptance

In this section, the acceptance of implementing a new technology will be explored using the Technology Acceptance Model (TAM) (F. D. Davis, 1989). This model exists out of four variables, perceived usefulness, perceived ease of use, attitude toward using, and behavioral intention to use (Figure 6). For this research, the main focus will be on perceived usefulness and perceived ease of use. Perceived usefulness measures how much a person thinks using a system would improve their performance, while perceived ease of use assesses how effortless they believe using the system would be. Research utilizing TAM has consistently shown that perceived usefulness strongly impacts people's openness to using a new tool containing new technology, while perceived ease of use has a smaller but still noteworthy effect on behavioral intention (Moriuchi et al., 2023). In the previous paragraphs, the expectations of the patients in their current situations during doctors' consultations have already been mentioned. Next to these existing expectations, they will develop new expectations when using a new technology, seeing as the implementation of new technologies usually come with the idea of improving an experience. A consumer's need is always the most important factor to successfully creating a new product (Herbig & Day, 1992). In order to satisfy a consumer, their needs should be met.

In conclusion, the Technology Acceptance Model provides a framework to gauge patients' readiness to embrace new technological tools in healthcare. By focusing on perceived usefulness and ease of use, it becomes evident that the acceptance of new technologies hinges on their perceived benefits and their implementation. As patients develop new expectations with the introduction of such innovations, meeting these expectations becomes crucial for ensuring their adoption and enhancing overall healthcare experiences.

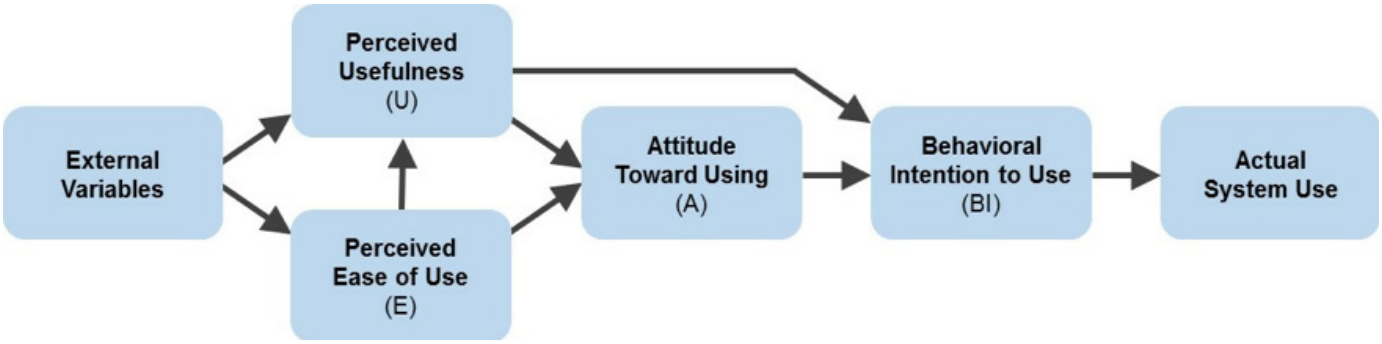


Figure 6. Technology Acceptance Model (TAM) from Davis, 1989.

2.1.2 Technical Aspect

In this chapter, the technical aspect of the platform will be discussed. First Artificial Intelligence (AI) will be looked at and more specifically, why it is being implemented in healthcare. Then the types which will be relevant for the development of the AI Avatar experience will be explained.

Artificial Intelligence

Data in healthcare is getting more and more complex, which is why the implementation of Artificial Intelligence becomes more beneficial. Artificial Intelligence is already being used in different ways in medical departments, for example, diagnosis and treatment recommendations, patient engagement and adherence, and administrative activities. With some of these tasks, especially where emotions don't play a role, Artificial Intelligence even performs as well or better than humans (Future Healthc J. 2019). From this, it can be assumed that when emotions do start playing a role, it becomes a bigger challenge to apply AI in healthcare. This is why it should be thoroughly investigated whether an AI Avatar would fulfill the role of a doctor.

The main use of AI is to automate tasks which are usually performed by humans. This does not only eliminate workload for humans but also does a more precise job because AI can process large amounts of data much faster (Laskowski & Tucci, 2023). Currently, the most used form of AI in healthcare is through large language models (LLM), a type of AI that is trained on a lot of different data, which makes it able to recognize current content and produce original material (Definition of Large Language Models (LLMS) - Gartner Information Technology Glossary, n.d.). A different type of AI used for chatbots and virtual assistance is generative AI; this form enables the generation of original answers, which could be described as human-like. Conversations become more informal, human, and organic as a result (LLM vs Generative AI: Fundamentally different but compatible, n.d.).
For this project, the type of AI which will be used is Interactive AI, which is a form of generative AI. In interactive AI, the focus is on the interaction between humans and machines in a way that the interaction feels human-like (Gilani, 2023).

To create a platform where an avatar asks patients about their medical history, several types of AI should be involved: Natural Language Processing, Speech Recognition, Machine Learning, Emotion Recognition, Knowledge Representation and Reasoning, Personalization Algorithms, and Privacy and Security AI. In the next few paragraphs, explanations will be provided for these types of AI and how they will be implemented in the platform.

Natural Language Processing
Natural Language Processing (NLP) is an automated method for extracting knowledge and insights from vast amounts of natural language text. It aims to mimic human-like understanding and interpretation of language, enabling machines to perform tasks such as parsing, resolving ambiguities, extracting information, and answering questions (Chowdhary, 2020). In this case, NLP algorithms will help the avatar understand and interpret the natural language responses of patients, allowing for more conversational interactions.

Machine Learning
Machine learning (ML) is a branch of computational algorithms that emulate human intelligence by learning from data. It's a crucial tool in the era of big data and already being applied in healthcare. In radiotherapy for cancer treatment, machine learning optimizes and automates complex processes, enhancing safety and efficacy (Naqa & Murphy, 2015). In this case ML algorithms will help the platform learn from patient interactions over time, improving its ability to ask relevant questions and provide helpful responses.

Speech Recognition
Speech recognition is a cross-disciplinary field focused on understanding and processing human speech. It enables machines to convert spoken language into text or commands by identifying and comprehending speech signals, facilitating natural voice communication. Its ultimate aim is to enable seamless communication between humans and machines. As an essential component of the IT man-machine interface, speech recognition technology is continuously evolving to enhance its accuracy and effectiveness in various applications (Meng et al., 2012). In this case, the platform also will involve spoken interaction, so speech recognition technology would be essential for transcribing and understanding what patients say to the avatar.

Emotion Recognition
Emotion recognition from speech is the study of detecting and understanding emotions expressed through spoken words. Speech Emotion Recognition (SER) has become vital in Human-computer Interaction (HCI) and other speech processing systems. SER systems extract and classify emotional features from speech signals (Wani et al., 2021, Koolagudi & Rao, 2012). In this case, emotion recognition AI can help the avatar detect and respond appropriately to the emotional state of patients, enhancing the empathetic aspect of the interaction.

Knowledge Representation and Reasoning
Knowledge representation and reasoning in AI involves symbolically representing and manipulating information to facilitate intelligent behavior. It focuses on understanding how knowledge contributes to intelligence and emphasizes studying knowledge itself rather than the entity possessing it. This field enables avatars to acquire, understand, and reason about information from their environment, supporting various tasks in AI. Using formal logic, it allows avatars to derive new information logically from existing knowledge (Brachman & Levesque, 2004, Grosan & Abraham, 2011). In this case, it could help the platform store and organize medical knowledge and reasoning capabilities to understand and respond effectively to patient inquiries and provide accurate information about their medical history.

Personalization Algorithms
Personalization algorithms customize content for individual users to enhance relevance and engagement by prioritizing specific information, influencing user encounters, but concerns arise from the lack of transparency in content ranking and its potential impact on users. Advocates stress responsible design, implementation, and use of these algorithms to ensure corporate social responsibility (Koene et al., 2017), In this case, these algorithms can tailor the interaction based on individual patient profiles and medical history, providing a more customized experience.

Privacy and Security AI
Given the sensitivity of medical data, integrating AI systems to ensure privacy and security is crucial. Privacy-preserving machine learning techniques play a vital role in safeguarding patient information by protecting sensitive data while maintaining learning performance (Jijo & Ali, 2024).

Ethics with Artificial Intelligence in healthcare

Artificial Intelligence (AI) has long been integrated into healthcare, as evidenced by various studies (Jiang et al., 2017). The ethical considerations surrounding the use of AI in healthcare have been extensively explored by organizations such as the World Health Organization. Central to these discussions is the question of how AI can be ethically implemented to prioritize patient well-being and privacy (Milutinovic & De Decker, 2016; Shahriari & Shahriari, 2017). Key ethical principles include reliability, safety, and transparency (Beljaards et al., 2023). These principles are essential for ensuring that AI technologies in healthcare operate with accountability and adherence to ethical standards.

When considering the digitalization of doctors' consultations using ChatGPT, where the doctor's role is reduced or absent, ethical concerns arise. Issues such as responsibility for erroneous information and the extent of autonomy granted to AI systems need careful consideration (Van Noort, 2023). Informed consent becomes crucial during the decision-making process between doctor and patient post-anamnesis.

Reliability is paramount in implementing new technologies in healthcare to minimize errors and enhance patient care outcomes (Sangers et al., 2022; Health Ethics & Governance (HEG), 2021; Nolan et al., 2004). Therefore, establishing reliability standards early in the prototype development phase is imperative. Patients must have confidence in the accuracy and dependability of AI-driven avatars providing them with medical information.

Privacy is another critical concern, especially concerning AI's capability to generate and process vast amounts of patient data (Beljaards et al., 2023). Adherence to legal and regulatory frameworks is essential to safeguard patient information. Transparent communication with users regarding data handling practices is equally vital to build trust and ensure compliance with privacy regulations.

In conclusion, the ethical implementation of an AI avatar for retrieving patients' medical history necessitates careful consideration of several key factors. Firstly, patient autonomy is paramount; the use of the avatar platform should always be voluntary, ensuring patients retain the option to consult their doctor directly if desired. Transparency regarding data usage is essential; patients must be clearly informed in a user-friendly manner about how their data is handled. Ultimately, building patient trust and reliance on the AI avatar hinges on maintaining high standards of accuracy and ongoing technological updates. This approach ensures that the platform not only enhances healthcare efficiency but also prioritizes patient well-being and ethical standards.

2.1.3 Digital Avatar

In this chapter, the current use and acceptance of AI Avatars will be discussed and the different qualities will be broadly explored in order to find the users' preferences. Next to the literature findings, interviews have been conducted to get a better idea of the users' needs in the specific context.

AI Avatars

In the previous chapter, we explored the phenomenon of Artificial Intelligence. In this thesis, the focus shifts to human-AI interaction through AI Avatars. These avatars are being leveraged to enhance interaction due to their human-like appearance, ability for human-like interaction, customization options, and adaptability to various contexts (Liu & Siau, 2023). Research indicates that enhancing the anthropomorphic qualities of AI Avatars can positively influence user intention to engage (Ling et al., 2021) and increase perceived usefulness, thereby enhancing user enjoyment (Rietz et al., 2019). Furthermore, the capacity of AI Avatars to emulate human-like emotions improves user experience by fostering a sense of interpersonal connection (Elyoseph et al., 2023). Users also appreciate the ability to personalize AI avatars to suit their preferences, which contributes to a more tailored interaction (Alves et al., 2020b). Lastly, the flexibility of AI Avatars to adapt their design and behavior to diverse contexts underscores their utility in varied applications (Ling et al., 2021). In this case, the context is a patient and doctor relationship during a doctor's consultation.

AI Avatars usage

Currently, AI Avatars are already being used in several different contexts. They made a first appearance in the metaverse during the 80s, also called the game world, where they were used by users to communicate with each other (Davis et al., 2009).In this case, users typically personalize the avatars to closely resemble themselves, as the avatars are used to communicate on their behalf (Ahn et al., 2011). Later, they started to be implemented as virtual assistants, mainly used for customer service. They would answer questions quicker than actual support agents which improved customer satisfaction (Runday, 2024). Eventually, AI Avatars became more capable and advanced which caused them to be implemented in more complicated industries, such as healthcare and education. In these industries they were used to assist patients with tasks such as scheduling appointments or answering general inquiries.

Challenges

However, while AI Avatars offer significant benefits, their implementation poses several critical challenges that require careful consideration. Trust issues emerge from concerns regarding the perceived goodwill, integrity, and competence of AI Avatars. Users tend to trust AI Avatars more if they perceive similarities in personality traits (Zhou et al., 2019). The potential for over-reliance on AI in critical situations, raises concerns about unintended consequences. Research emphasizes that trust in AI varies depending on its perceived reliability and the specific context of its use. For instance, users may expect higher reliability from AI in evaluative roles, reflecting different levels of trust and expectations (Appelganc et al., 2022). Moreover, as findings from Twiddy (2017) suggest that a significant portion of doctors feel overwhelmed and perceive time constraints in providing high-quality care, some express concerns about potential job displacement due to AI advancements (Bunz & Braghieri, 2021). They found that media often portrays AI as superior in healthcare, heightening concerns among doctors
From Turan's (2023) study of 20 doctors, it's evident they support AI as an assistant but emphasize retaining their authority and defining clear role limitations for liability. They advocate for manufacturers and policymakers to assume responsibility if AI fails to defer.

Doctors foresee AI and robots playing essential roles but emphasize their involvement in AI development for effective integration. They acknowledge AI's diagnostic potential but stress its role in enhancing, rather than replacing, human diagnosis to preserve the human touch in medical care.

AI Avatar qualities

A study by van Bezouw (2021) compared the use of chatbots in a medical setting with and without avatars. Results indicated that chatbots with avatars were perceived as more reliable. Avatars can vary in embodiment, being hyperrealistic (photo-realistic) (figure 7), semi-realistic (figure 8), or non-realistic (cartoon-like) (figure 9). Research on user preferences for these types of avatars has produced mixed results, varying by scenario. This chapter aims to identify key factors influencing user preferences regarding avatar appearance.

Figure 7. Hyper realistic (Dell, 2022)

Figure 8. Semi realistic (fiverr.com, n.d.)

Figure 9. Non-realistic (Virtually Human, n.d.)

For instance, van Bezouw (2021) found that users preferred photo-realistic avatars, perceiving them as more reliable, social, and safe. Seymour (2019) also found photo-realistic avatars to be more trustworthy. However, a different study by Gasch et al. (n.d.) showed that when users compared hyperrealistic and non-realistic avatars mirroring themselves, they preferred the non-realistic avatars, citing discomfort with the hyperrealistic ones (figure 10). This finding contradicts other research suggesting that users generally create avatars that closely resemble themselves (Ante, 2023). These conflicting results highlight that preference for self-resemblance in avatars may diminish when the avatars are hyper-realistic.

Figure 10. Left: Hyper realistic, Right: Non-realistic (Gasch et al., n.d.)

In another study, people were asked about their preference for different types of highly human-like avatars and whether they experienced eeriness. The results showed that hyper-realistic avatars are only preferred when they are either very close to or sufficiently different from human likeness to avoid triggering the "uncanny valley" effect (Seymour et al., 2019), this phenomenon occurs when people find that a digital avatar looks human-like but not perfect enough, which results in an eerie feeling (Palomäki et al., 2018). Features that contributed to eeriness included overly bright eyes, mismatched body proportions, and overly fluid movements, which made the avatars appear unnatural (Sharma & Vemuri, 2022). Another study found that the "uncanny valley" effect occurs only when features are significantly off from reality, not just slightly different (Seyama & Nagayama, 2007). This study also found that female characters were generally rated lower in eeriness which strengthened the finding of Sharma & Vemuri, (2022) which stated that female characters provided a more comforting feeling. Beyond physical features, other qualities such as gender cues also influence preferences (Feine et al., 2020).

Feine et al. (2020) analyzed the design of 1,375 chatbots and found that most incorporated gender cues, often leaning towards female-associated traits. These cues included feminine names, female-looking avatars, and the use of female pronouns, likely because women are perceived as more caring and empathetic (Cameron, 2000). Toader et al. (2019) indicated that gender cues are crucial for positive consumer responses. Users reported feeling more comfortable, confident, and less tense when interacting with gender-specific chatbots compared to gender-ambiguous ones (Niculescu, 2010). Additionally, Jeon (2024) found that female AI avatars generated higher levels of trust and grounding among 187 respondents.

To finalise, multiple factors influence how an avatar is perceived by users and its effect on their experience. Users generally prefer avatars that exhibit characteristics such as reliability, trustworthiness, safety, and sociability, which are often associated with photo-realistic avatars. However, the design of hyper-realistic avatars must carefully avoid the uncanny valley effect by ensuring features are realistic enough to avoid discomfort. Furthermore, while female avatars tend to enhance comfort and trust, designers should strive for inclusivity and be aware of the potential for reinforcing gender stereotypes. Overall, achieving a balance between realism, user comfort, and ethical considerations is crucial for the effective and responsible implementation of avatars in medical chatbots.

2.2 Research Goal

In order to create a fitting AI Avatar experience, the findings from the literature should be combined with the findings from the user research. In Figure 11 below it is visualized how this combination should create the eventual experience. In the first part it is shown that currently patients prefer their physical doctors, mainly because of familiarity. The goal is to have the patients prefer an AI Avatar over their physical doctor.
The second part shows that this will be done through identifying the patients' current experiences with their doctors, followed by identifying the pros and cons during these interactions.
The last part explains that the pros will be used to include in the eventual concept while the cons will be excluded.

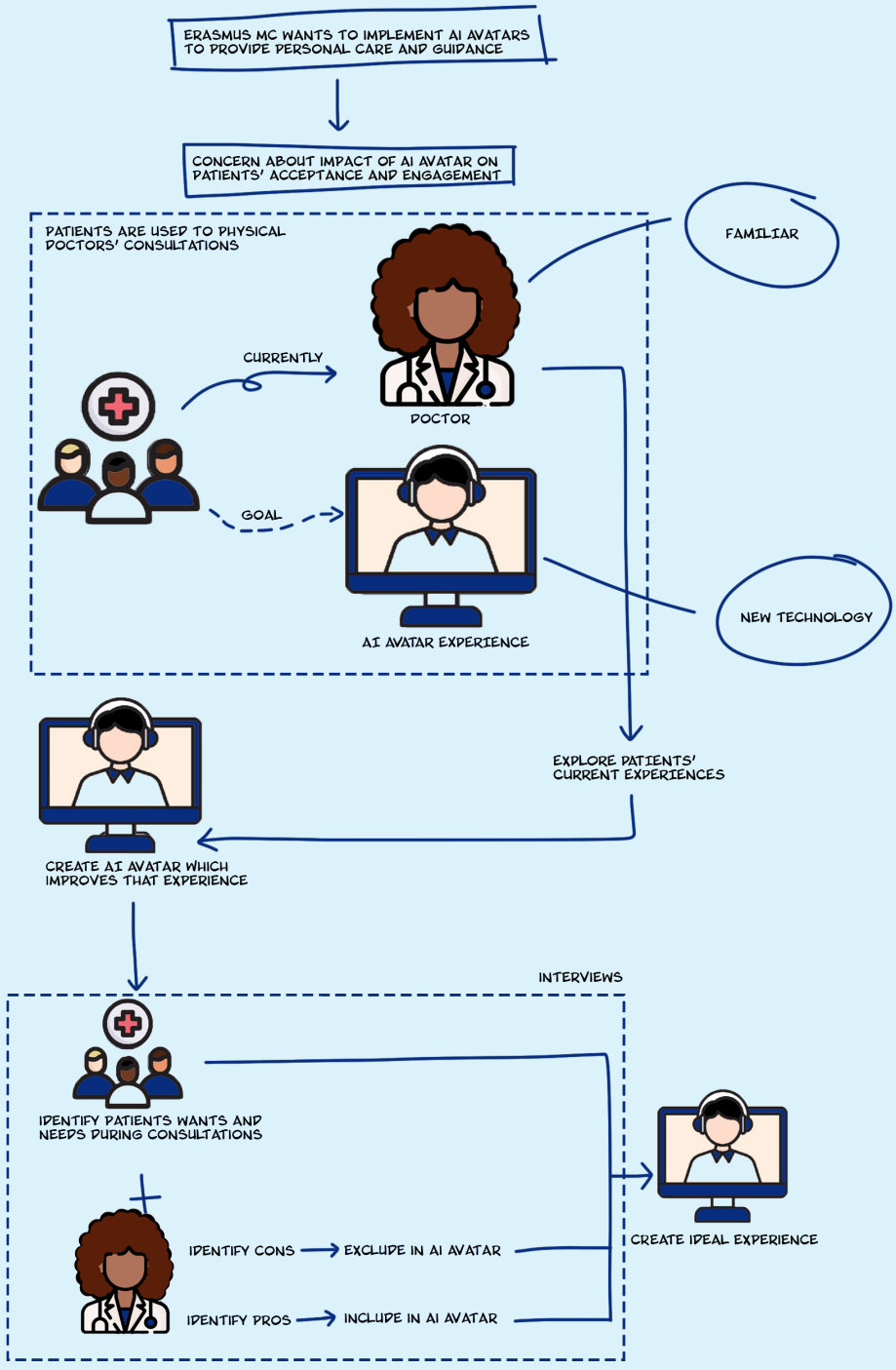


Figure 11. Goal and approach visualized

2.3 User Research

For the user research, several interviews have been conducted to get an idea of what the participants are currently experiencing when talking about their medical history during doctors' consultations. This addresses the research question: What are patients' current experiences during their doctors' consultations and through which needs could this be improved? Additionally, the interviews will be used to identify users' preferences and needs when looking at different appearances of AI avatars (Figure 12). Not only will the preferred features be identified, but it is also important to find out why the participants show these specific preferences. Since the findings of this interview will be based on the participants' experiences during real doctors' consultations, they will also strengthen the literature findings because they will now be linked to the right context. Lastly, user acceptance will be initially gauged by asking participants about their first impressions of implementing an AI avatar. This approach aims to identify and address any potential doubts early on.

Figure 12. Different avatars (Virtually human, n.d.)

Method

First the particpants were asked to read and sign the informed consent form (Appendix B).
The method chosen for this user research approach is semi-structured interviews, known for their exploratory nature in qualitative research (Cohen & Crabtree, 2004). These interviews were structured based on the Technology Acceptance Model (TAM) as a foundation, incorporating predefined yet open-ended questions to explore participants' perspectives (Burges, 1984; Cohen & Crabtree, 2004). This method is particularly suitable for gathering detailed insights into why participants make specific choices, aligning well with the study's exploratory goals. The interviews will focus on quality of insights rather than quantity, with 5 participants selected for in-depth analysis (Kuzel, 1992; Cresswell, 2007). Ethical approval has been obtained from the Human Research Ethics Committee (HREC), which can be found in Appendix C. The data will be meticulously collected through note-taking and transcription of interview recordings.

Participants

For this interview, the goal is to recruit 5 participants from different age categories and genders. For this part of the research, the recruitment won't be done through Erasmus MC, but through personal connections, such as friends, colleagues, family, and a wider network. Participants will still have to fit the criteria necessary for this study. Additionally, to ensure that the platform is accessible and effective for everyone, participants will be chosen randomly from these connections. This approach is valuable as it reflects the diversity of the general population, emphasizing that the platform should be inclusive and cater to a wide range of users. Figure 13 shows the range of gender and age. Because the participants will be recruited through personal connections, it is important that possible cognitive bias is considered. It will be made clear to the participants that there are no right or wrong answers for the outcome of this research. This way, participants will feel comfortable providing their honest opinions.

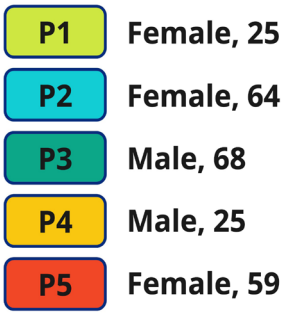


Figure 13. Participants

Procedure

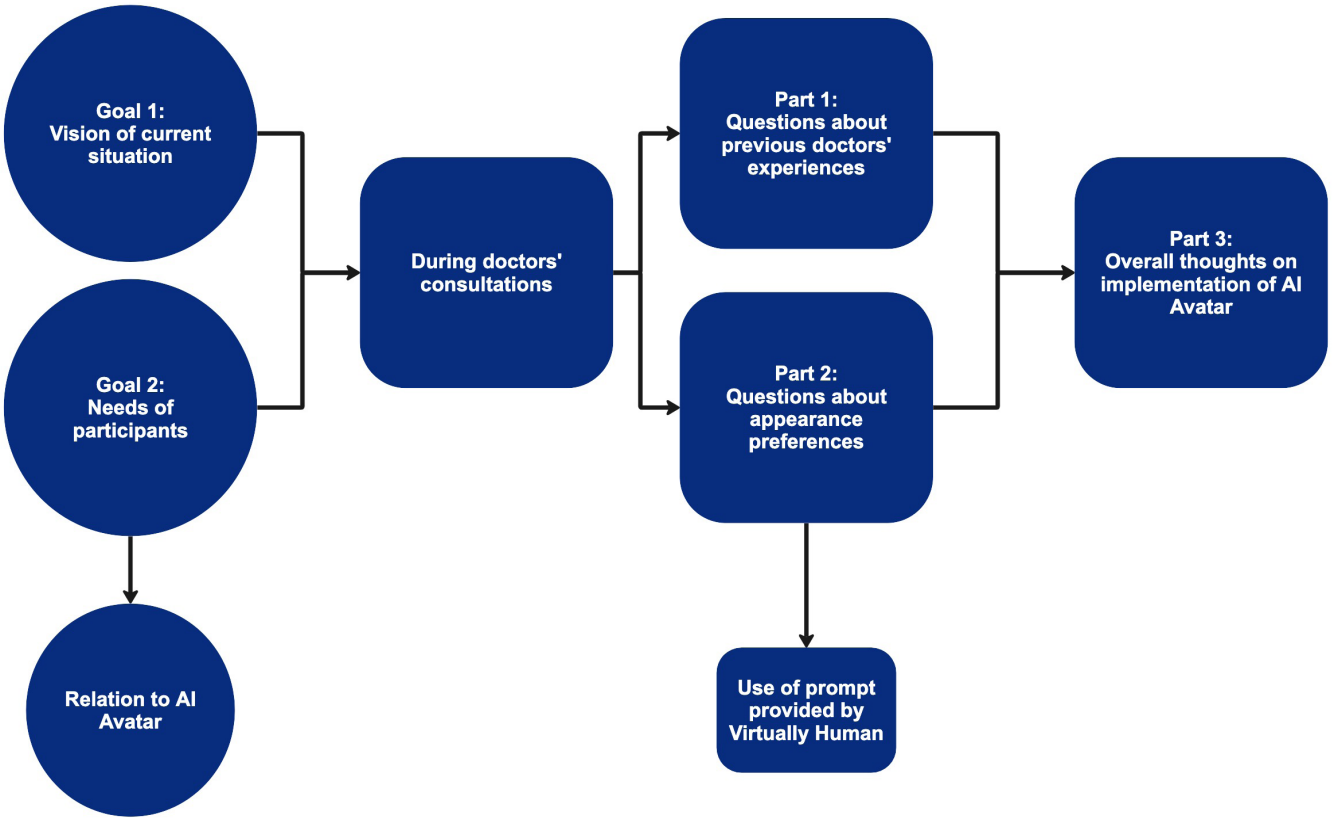


Figure 14. Interview procedure

The interview will have two main goals, which are visualized in Figure 14, getting a vision of the current situation of participants' experiences during doctors' consultations and identifying their different needs. To reach both goals, the interview will first be separated into two parts. The first part will focus on questions surrounding the participants' previous experiences by asking about their feelings while interacting with their doctor and which qualities of their doctors they liked and disliked. In the second part, the questions will be supported by the use of a prompt that displays 20 different-looking avatars (Figure 12). These specific avatars were chosen because of the broad variety of appearances. The questions will focus on the preference of the participants when interacting about their medical history. They will be asked to describe their answers based on the qualities of the avatars. Eventually the participants will be asked about their expectations and doubts of the implementation of an AI Avatar.

Data collection and analysis

The goal of analyzing the data is to identify participants' needs and determine how their current experiences can be improved by uncovering pain points. This will be achieved by selecting quotes from participants' responses and paraphrasing them to illustrate their interpretation and relevance to this research. These findings will be visualized as statement cards (Stappers, 2012) and then clustered to identify overarching themes.

The interview questions were divided into three sections: the first focused on different qualities of a doctor, the second on participants' preferences for various avatar features, and the third on their expectations and doubts of the implementation of an AI Avatar.

Participants were initially asked to describe their current experiences when visiting their doctors. Quotes from these descriptions were paraphrased to reflect their interpretation. Pain points were identified from these quotes, separating negative experiences from positive ones. These insights will be valuable in the design phase.

To expand on the first question, participants were also asked about the qualities they prefer in their doctors (e.g., empathetic, trustworthy) and those they dislike (e.g., uninterested, hurried). The responses were clustered to highlight common themes and their significance. In Figure 15 an example is shown of what these clusters looked like. From these clusters, statements were formulated to encapsulate the interpretation of the answers. These statements will be used to redefine the problem statement.

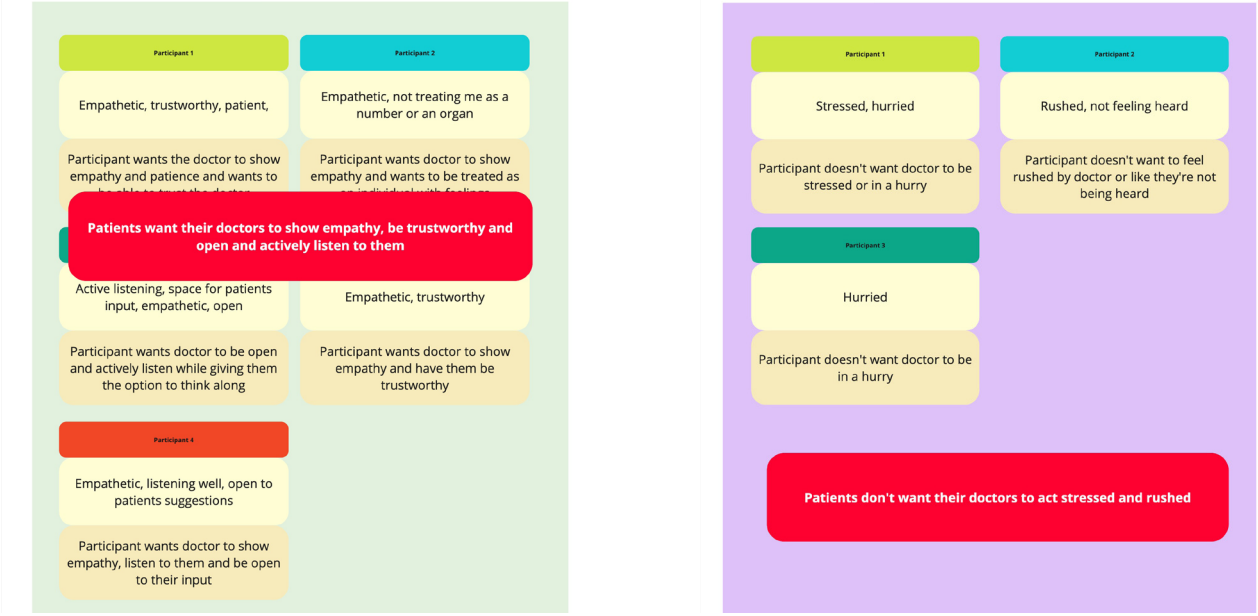


Figure 15. Clusters highlighting similarities

In the second section of the interview, participants were presented with a series of images depicting various avatars with different appearances. They were asked to identify their most and least preferred avatars, specifically considering that these avatars would be used for discussing their medical histories. Participants were encouraged to provide detailed explanations for their choices, referring to specific features that influenced their preferences. Figure 16 shows a part of what these conclusions looked like.

As participants described their preferences, they highlighted characteristics such as facial expressions, facial attributes, and overall demeanor. After collecting these detailed responses, the features identified by participants were thoroughly analyzed and interpreted to summarize the findings. This process involved identifying common themes and preferences, providing clear insights into what makes an avatar more or less suitable for medical consultations from the patient's perspective.

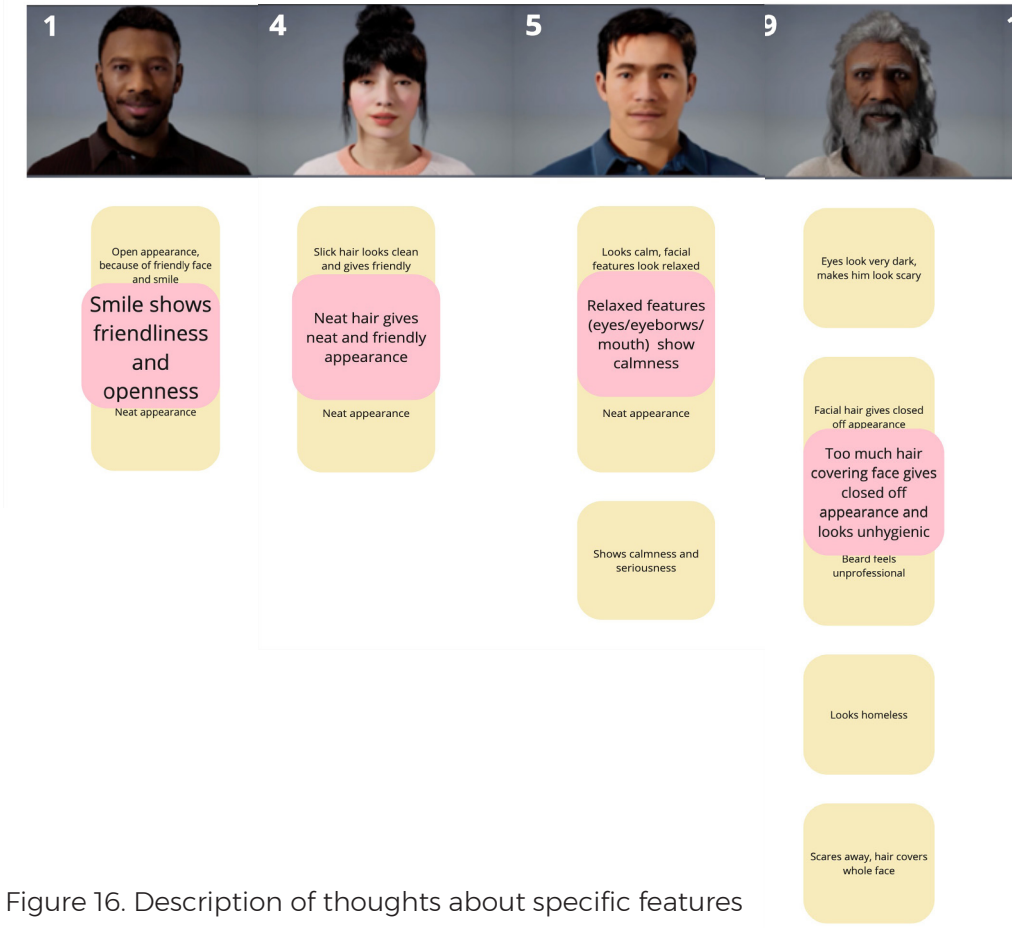


Figure 16. Description of thoughts about specific features

After these interpretations were made, the different avatars were systematically matched with participants' previously stated preferences for desired qualities. By comparing participants' preferred qualities to their chosen avatar features, several noteworthy conclusions emerged. For instance, it became evident that a clean appearance and relaxed facial features contribute to an overall sense of calmness. This calm demeanor, in turn, was associated with perceptions of empathy, patience, and trustworthiness in the avatar. In Figure 17 it can be seen how this relation was made.

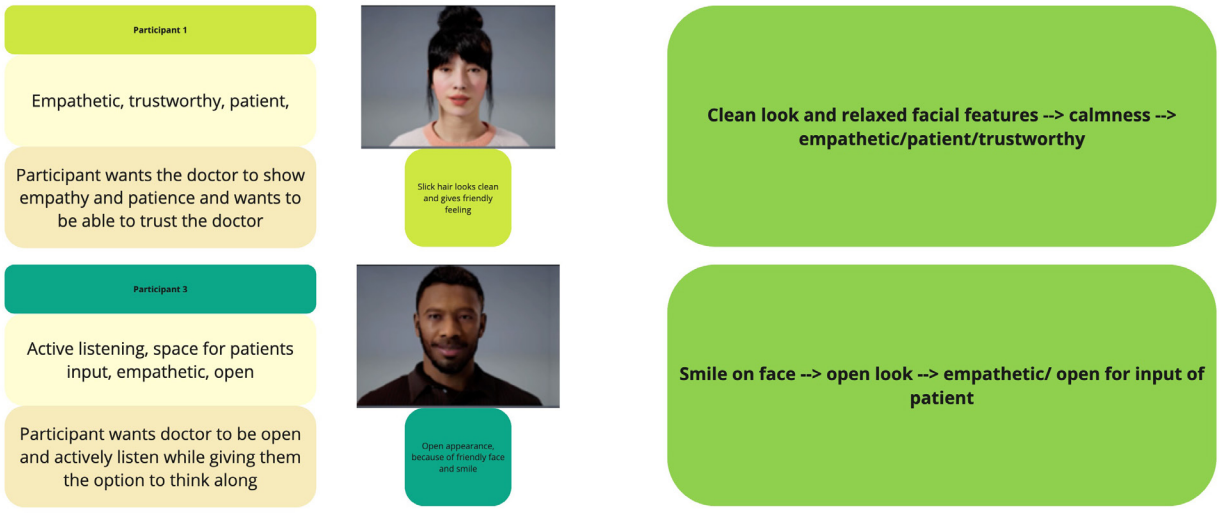


Figure 17. Example of the link made between the qualities and features

For further details and additional conclusions, refer to the Appendix (D), where the complete set of results and findings can be explored in depth.

Results and Discussion characteristics and needs

From the results there were 9 preferred qualities found, that are divided into 20 avatars. There were also 6 painpoints identified, which were the qualities which the participants would prefer not to experience.

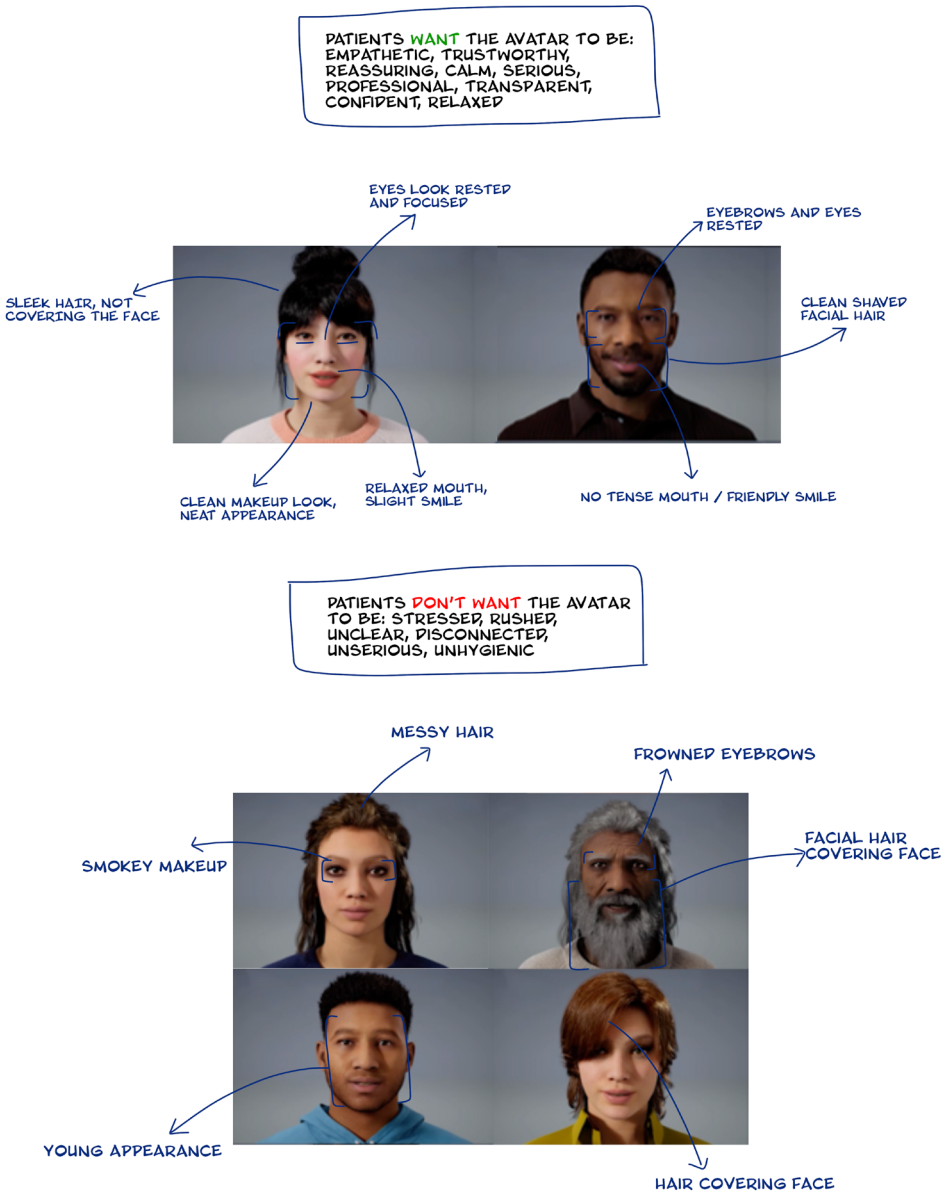


Figure 18. Preferred and non preferred qualities and features

Based on the interview findings, it is clear that patients prioritize specific qualities in the avatar design. They seek an avatar that conveys empathy, trustworthiness, reassurance, calmness, seriousness, professionalism, transparency, confidence, and relaxation. These desired attributes are closely linked to specific avatar features such as well-groomed hair, rested and focused eyes, relaxed eyebrows and mouth, clean-shaven facial hair (if applicable), a slight smile, and a clean makeup look, all contributing to a polished appearance.

Additionally, patients express strong preferences against certain characteristics they wish to avoid in the avatar. They emphasize a need for the avatar to steer clear of traits like stress, hurriedness, lack of clarity, disconnect, unseriousness, and unhygienic appearance. These negative qualities correspond to specific avatar features, including messy hair, facial hair that obscures the face, frowned eyebrows, hair covering the eyes, heavy makeup, and a youthful appearance.

The alignment between preferred qualities and avatar features underscores the importance of creating an AI avatar that embodies empathy, trustworthiness, professionalism, and comfort.

This correlation highlights the critical need for the avatar's demeanor and appearance to meet patients' expectations of reliability and clarity, thereby enhancing the overall patient experience.

Apart from identifying the preferred qualities and features of avatars (Figure 18), another objective was to uncover the pain points experienced by participants in their current interactions. These insights were instrumental in defining specific interaction requirements (Figure 19), which were synthesized alongside findings from the literature research.

In Figure 18, the needs identified through interviews are compared with those derived from literature findings. The dark blue circle represents needs identified through literature research, while the light blue circle signifies needs identified through participant interviews. The overlap between these circles highlights common needs that were identified in both sources. These overlapping requirements form the foundation for considerations during the development of the platform.

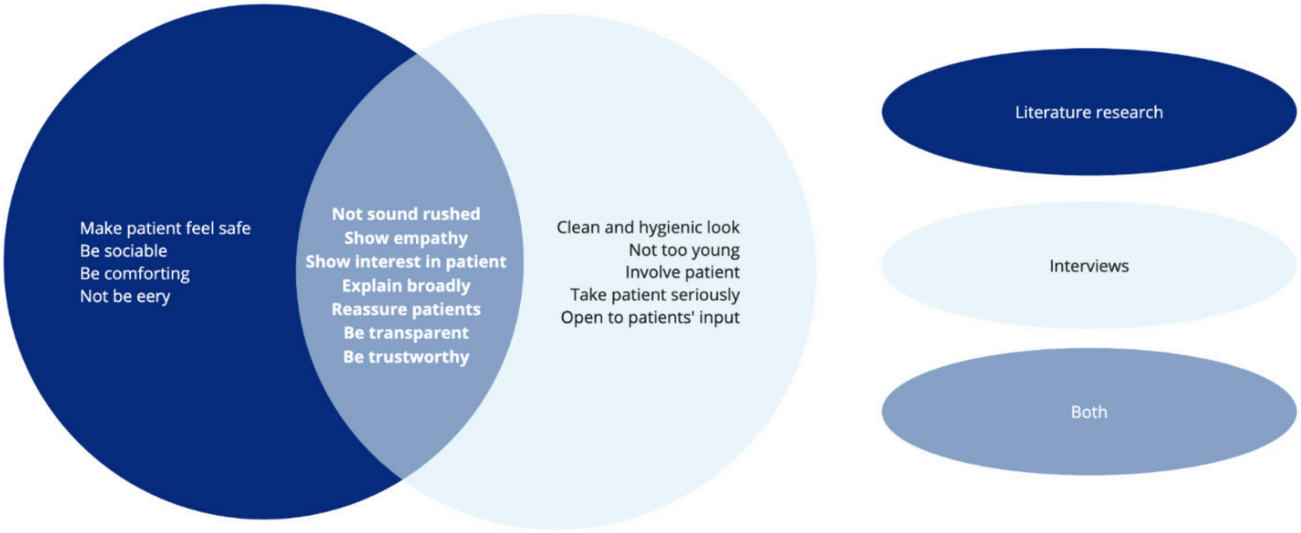


Figure 19. Identified needs

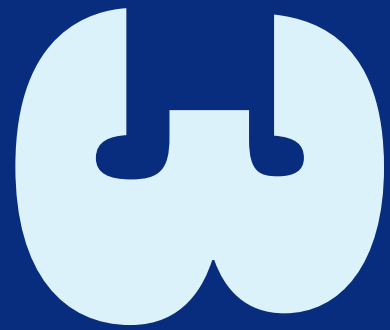
Discussion thoughts on avatar

Participants in the interviews expressed a range of perspectives regarding acceptance of AI avatars in healthcare interactions. Many anticipated benefits, such as attentive listening, efficiency in asking pertinent questions, and the potential to reassure patients quickly. They noted advantages like time savings, simultaneous assistance to multiple patients without wait times, and increased accessibility, which lowers the threshold for healthcare access. Participants also speculated that AI avatars could offer guaranteed empathy, contrasting with uncertainties about human doctors. Expectations included more extensive anamneses, enhancing diagnostic thoroughness. However, concerns about safety, potential hacking risks, and unfamiliarity with AI avatars raised doubts. Some participants expressed discomfort and distrust, fearing the absence of genuine emotions and questioning the adaptability of elderly patients to new technology. These insights highlight the complex interplay of expectations and apprehensions regarding AI avatars in healthcare settings.

Limitations

One limitation of this interview process was the use of a predefined set of 20 avatars to identify preferred qualities and features. While these avatars encompassed a wide range of ages, expressions, and ethnicities, it's important to note that AI avatars can potentially have a much broader range of appearances beyond those depicted in Figure 12. Therefore, the findings from these interviews are constrained to the specific characteristics represented by the 20 avatars used in the study.

Define



3 Define

In this chapter, the focus will be on defining the problem in order to identify the main challenges along with the requirements and qualities which should be included in the platform. At the end of this chapter, the design direction will be discussed.

3.1 Problem Statement

From the interviews several challenges have been identified regarding the current experiences between patients and their doctors during their consultations. The findings emphasize what patients want from their doctors and what they don't want, these points require attention. The findings are clustered in a way that one statement could be formulated. This is visualized in Figure 20, where the first row of statements shows the conclusions from quotes retrieved from the interviews. The second row shows how these were clustered into new statements. Lastly these statements were used to form the problem statement.

Firstly, patients want their doctors to show more empathy, especially when they have to talk about personal medical issues which makes them feel vulnerable or embarrassed. They want to be able to trust their doctor, in order to feel more open to share information without hesitation. The patient also wants to feel that their doctor is actively listening to them and that they communicate in a transparent way. lastly, they want their doctor to appear confident and relaxed, in order for them to reciprocate that feeling.

Secondly, when looking at what patients don't want from their doctors, they should not act stressed and rushed because this gives the patient a feeling of not being important. The patient does not want to feel disconnected from their doctor and want to feel comfortable giving their own input during consultations.

Figure 20. Development of problem statement

3.2 Requirements

Interaction qualities

Here the desired characteristics of the interaction between patient and platform will be described.

Reassurance
Patients seek reassurance in their medical care. They want to be assured about their current medical status, provided with comprehensive explanations about their health issues, and reminded that they are receiving genuine assistance. This reassurance not only eases their concerns but also reinforces their confidence in their healthcare providers and the treatment process.

Acknowledgement
Patients seek acknowledgement and empathy in their healthcare interactions. They want to feel heard, be taken seriously, and be actively involved in their consultations, all while sensing a genuine understanding of their concerns and emotions. This empathetic approach not only fosters trust and satisfaction but also ensures that patients feel valued and supported throughout their medical journey.

Safe & trusting environment
Establishing a safe and trusting environment is paramount when patients interact with an AI Avatar for sharing medical information. Many patients are unfamiliar with this technology and may feel hesitant about disclosing sensitive details. Therefore, it's essential for patients to feel a sense of safety while using the platform. They should be informed about how their data is handled and have confidence that their privacy is protected. When patients feel empowered with knowledge and trust in the security measures, they can confidently engage with the AI Avatar, ensuring effective communication and optimal healthcare outcomes.

Design requirements

The platform should be digital and won't have a physical component
The platform will be digitally designed, seeing as the focus in this project is on digital avatars. Therefore the design phase will focus on the digital tool.

The platform should make patients feel comfortable to talk about their medical information
It is significant to recognize the importance of giving patients the feeling of comfort. As comfort is a broad term with a subjective component to it, in this context it is about making the patient feel at ease. From the interviews it was revealed that this could be done through empathy, trust and relaxation.

The platform should give patients the sense of control
The interviews have also indicated that patients want to be able to add their thoughts, they want to maintain a feeling of control. The main use of the platform should be for the avatar to ask the patient questions, but the patients' questions or thoughts should not be neglected.

The platform should be transparent about data usage.
Patients should feel comfortable to talk about "embarrassing" topics. In order to help them to be vulnerable and feel comfortable to share their information, they should be reassured that their data is only shared with their own doctor and no third parties are involved. Apart from avoiding feelings of shame, it is also important that they trust the platform with their medical information. It should also be easy to find the option to ask for assistance, in order to not feel as if the avatar has fully replaced the doctor.

Beyond the scope

Implementation of the technical aspect
This design project will solely focus on the digital design of the platform, the technical aspects which have been mentioned in this report will not be applied. Also, the preliminary technology behind the implementation is already defined by the client.

Focus on patients
This platform will be designed with the focus on the use for the patient rather than the healthcare professional. Meaning the information accessible by the healthcare professional, the so called output will not be prioritized.

Interdisciplinary Collaboration
Involving a broader range of healthcare professionals, such as psychologists and social workers, to evaluate the platform's impact on mental health and overall patient well-being.

Longitudinal Studies
Conducting long-term studies to assess the platform's effectiveness over time, including patient outcomes, compliance, and satisfaction.

3.3 Design Direction

> Designing a **digital platform** with an **AI Avatar** for patients that enables them to do a **self anamnesis**, facilitating them with a more convenient experience while saving healthcare professionals time. The interaction with the platform should provide feelings of **acknowledgement** and **reassurance** through **trust**, **empathy** and **care**.

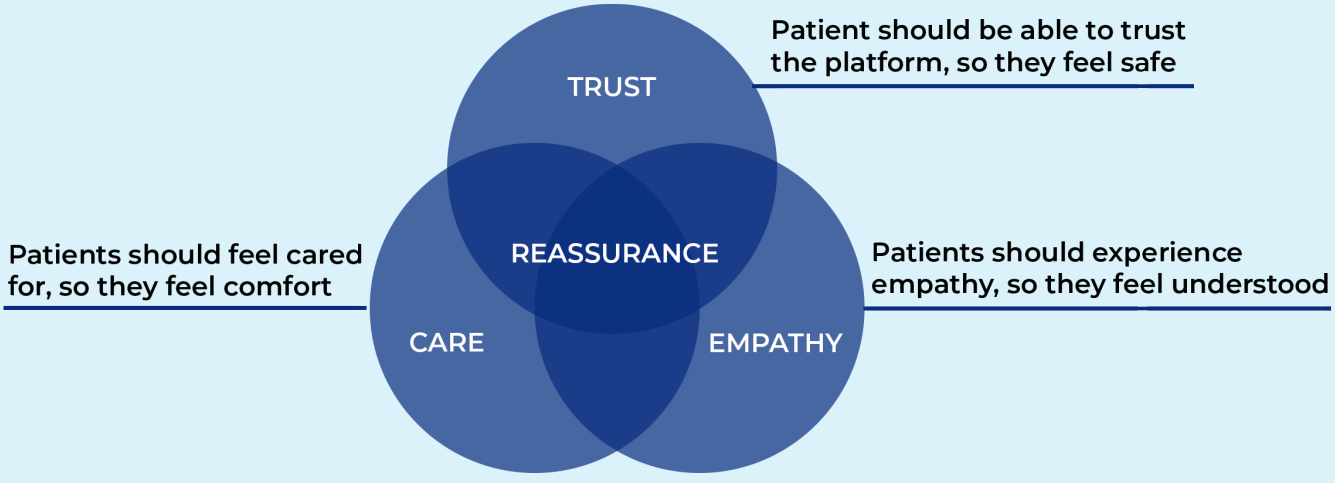
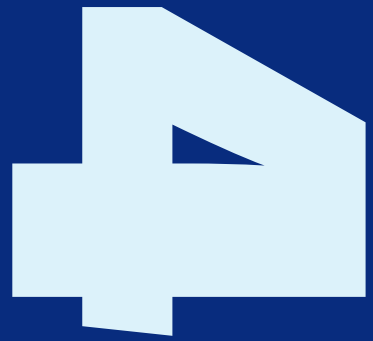


Figure 21. The overlap from care, trust and empathy contributing to reassurance.

Develop



4 Develop

In this chapter, the focus will be on the development of the digital platform. The ideation process will be explained and the steps that led to the prototype will be shown. Lastly the evaluation of the prototype will be discussed, along with the results that lead to the recommendations.

4.1 Ideation

In this chapter the ideation process will be discussed. In order to start ideating, the main method used was the “How Might We” method (Parnes, 1967), this method can also be found in the Delft design guide under “How To’s” (Delft Design Guide, n.d.). The starting point for this method was subtracting the key qualities from the findings from the interviews which were conducted. These key qualities, which also came forward in the design goal, were then used to form the How To questions which can be seen in Figure 22. The questions were answered by making use of “The Brainstorming Method”, this method is usually used to generate a large number of ideas. From these ideas a selection can be made consisting of the most promising ideas (Delft Design Guide, n.d.).

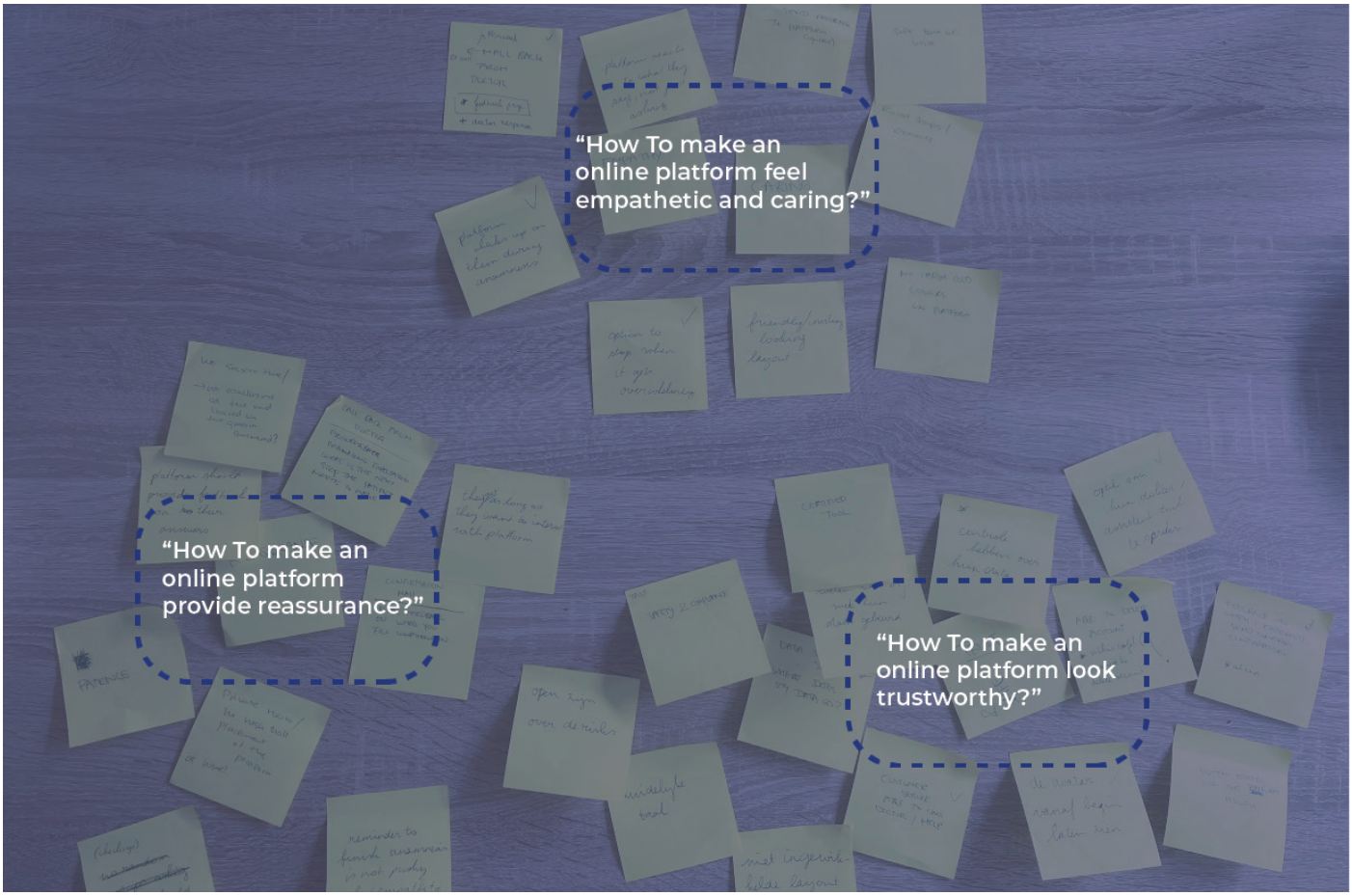


Figure 22. How To method with post its.

Figma as design medium

The design was developed using the web application Figma. Enhancing my UI design skills was a primary learning goal for this project, and I was excited to explore Figma, a tool I hadn’t used before. As an Industrial Design Engineering (IDE) student, I had some experience with Axure for UX design projects but not with Figma.

The platform’s feedback capabilities made the design process dynamic and efficient. Initially, I faced a learning curve, but transitioning from Axure to Figma was relatively smooth due to their conceptual similarities.

Using Figma, I created detailed wireframes and prototypes, leveraging its extensive library of design components and plugins. This process helped refine the visual and interactive elements of the platform, ensuring it was user-friendly and aesthetically pleasing. Overall, working with Figma not only helped achieve my learning goals but also significantly enhanced the design quality.

4.2 UX Prototyping

Wireframing Low-Fi

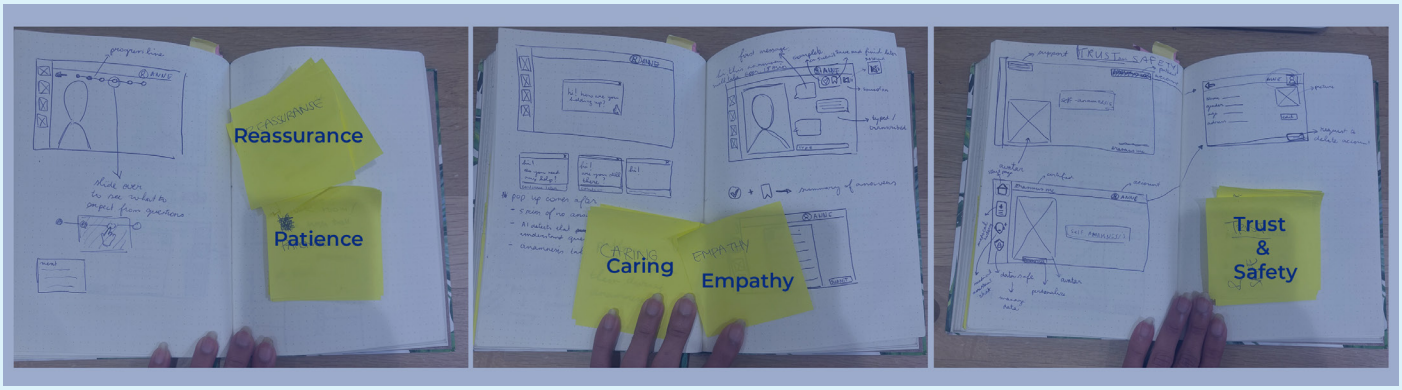


Figure 23. Low Fidelity wireframes on paper.

After the questions were answered, the next step was to transform the ideas into low-fidelity wireframes. This process began with hand-drawn sketches, where multiple design options and layouts were explored to capture the initial concepts. These sketches, which are seen in Figure 23, allowed for rapid iteration and easy adjustments, providing a flexible medium to visualize different approaches and functionalities.

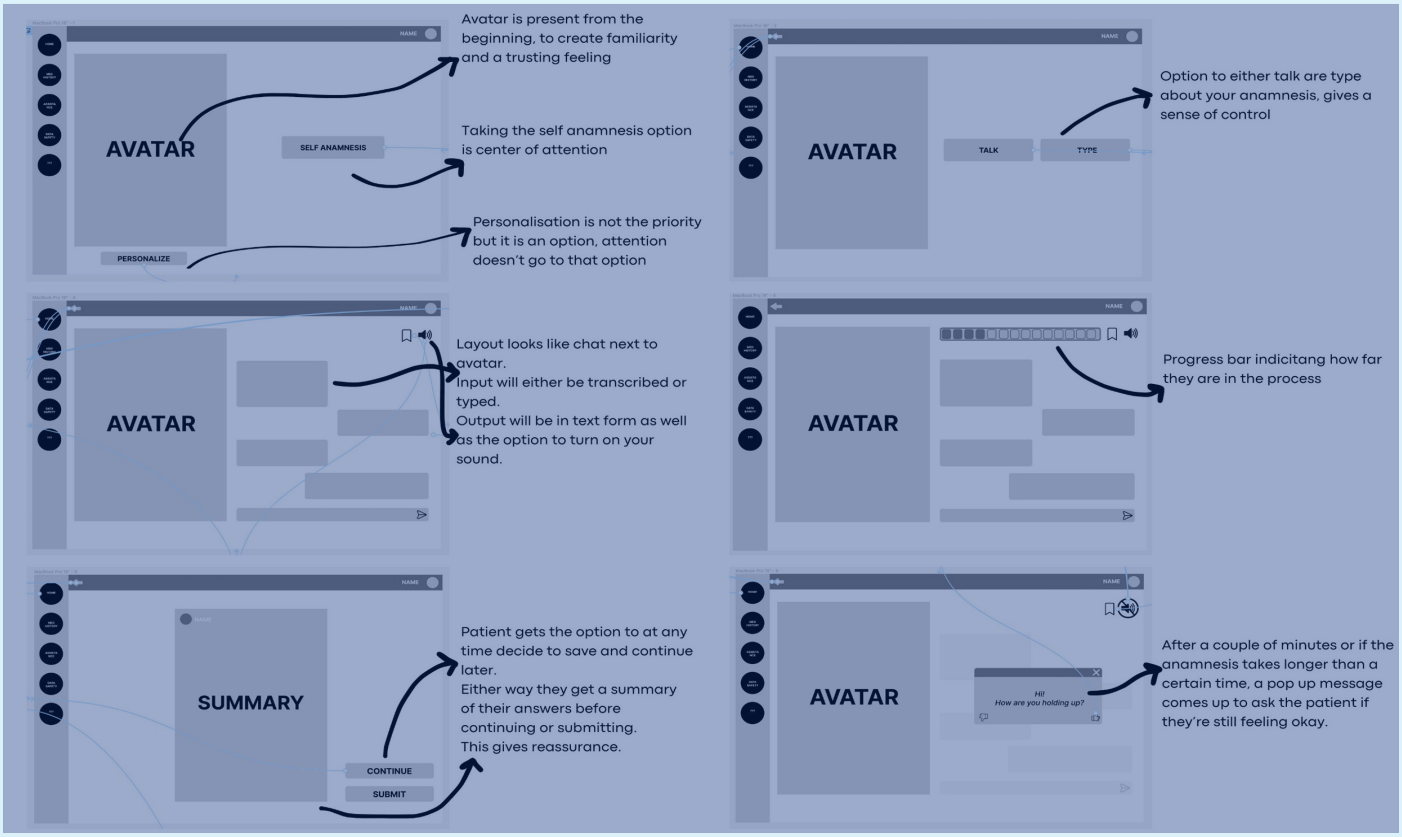


Figure 24. Low Fidelity digital wireframes made in Figma

Once a range of options was sufficiently explored on paper, the process moved to digital wireframing using Figma. This transition to Figma was crucial for creating more detailed and interactive low-fi wireframes. Figure 24 illustrates several of these digital wireframes, showcasing different considerations for the final prototype. In this stage, several options which were found through the How To method were tested in order to find what fit best. These digital wireframes maintained the simplicity of the initial sketches while adding a layer of precision and clarity, which is essential for further development and stakeholder review.

4.3 Avatar Selection

For the concept development there were two parts to consider. Apart from the development of the design of the platform, first the choice of the avatar will be elaborated.

Avatar Selection Process

The literature review revealed that people generally prefer photo-realistic avatars and find female avatars particularly comforting. Based on these findings, I selected 20 pre-made realistic-looking avatars and conducted interviews to gather more specific preferences.
The interviews indicated that participants did not have a specific avatar appearance they preferred, but they favored certain facial qualities, such as rested eyes and eyebrows, a non-tense face, a clean look, and a friendly smile. These preferences were linked to three of the 20 avatars. The figure 25 below shows two of three avatars which consisted of the most preferred qualities.

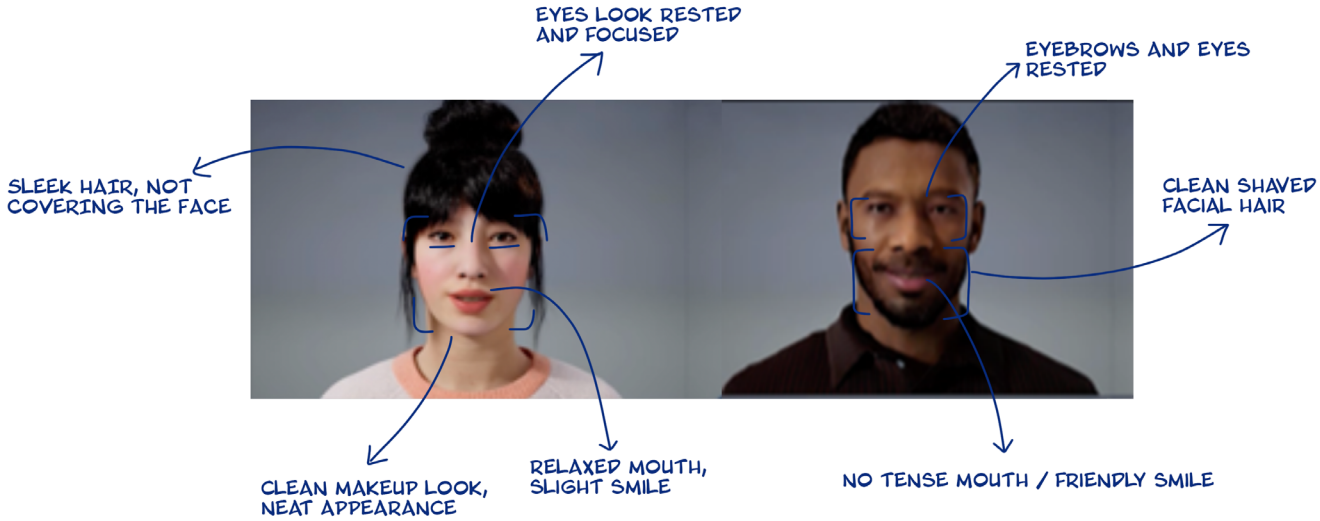


Figure 25. Avatars highlighting the preferred qualities.

Final Avatar Choice

Among the three avatars presented, I ultimately selected the female avatar. This decision was informed by insights from existing literature, which consistently indicates that female avatars are perceived as more comforting in various contexts, including healthcare settings (Cameron, 2000; Toader et al., 2019; Jeon, 2024). This choice is particularly significant for a platform designed for patient self-anamnesis, where comfort and a sense of empathy are paramount. Gender bias and its implications will be further discussed in the following paragraph.

Adressing Potential Bias

To address and mitigate potential gender and racial bias, in the future, the platform could prioritize enabling users to customize their avatars to reflect diverse gender identities and racial and ethnic backgrounds, thereby promoting inclusivity. The selection of the final avatars was influenced by their kind facial expressions, yet it is crucial to recognize and address the implications of these choices on user perception and experience. Additionally, it will continuously incorporate feedback from a diverse user base to refine avatar options and meet varied comfort and preference needs. The platform will also commit to ongoing research, regularly reviewing and updating avatar choices based on new research and user feedback to adapt to evolving preferences and norms. These steps aim to provide a comforting and user-friendly experience while actively working to avoid reinforcing gender and racial biases.

Prototyping the Avatar interaction

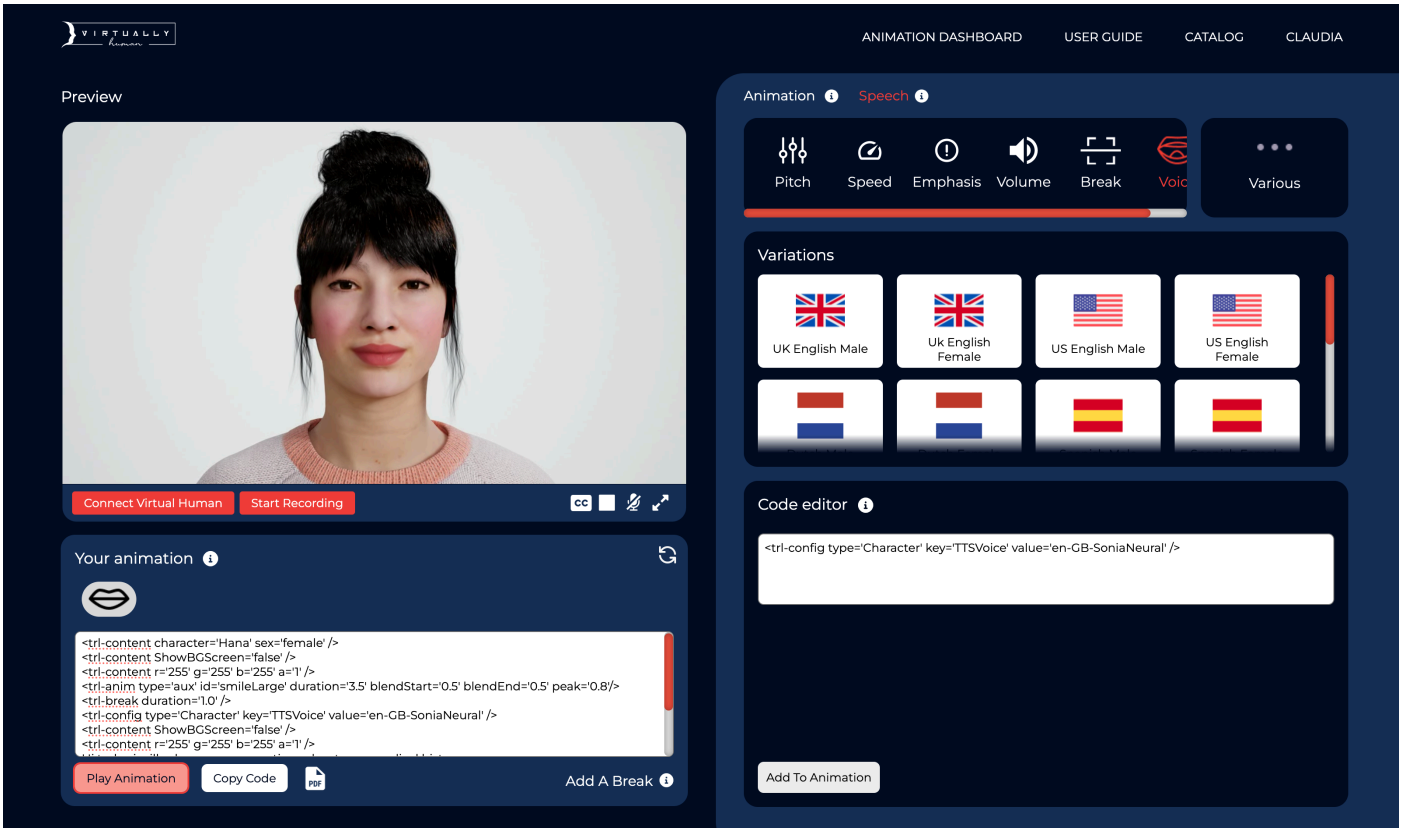


Figure 26. Design studio of Virtually Human (Virtually Human, n.d.)

The digital avatar platform offered by Virtually Human (Virtually Human, n.d.) served as the basis for prototyping the avatar's interaction (Figure 26). Within this design studio, the desired interaction was developed and coded to enable participants to engage in a scripted conversation with the avatar (Figure 27).

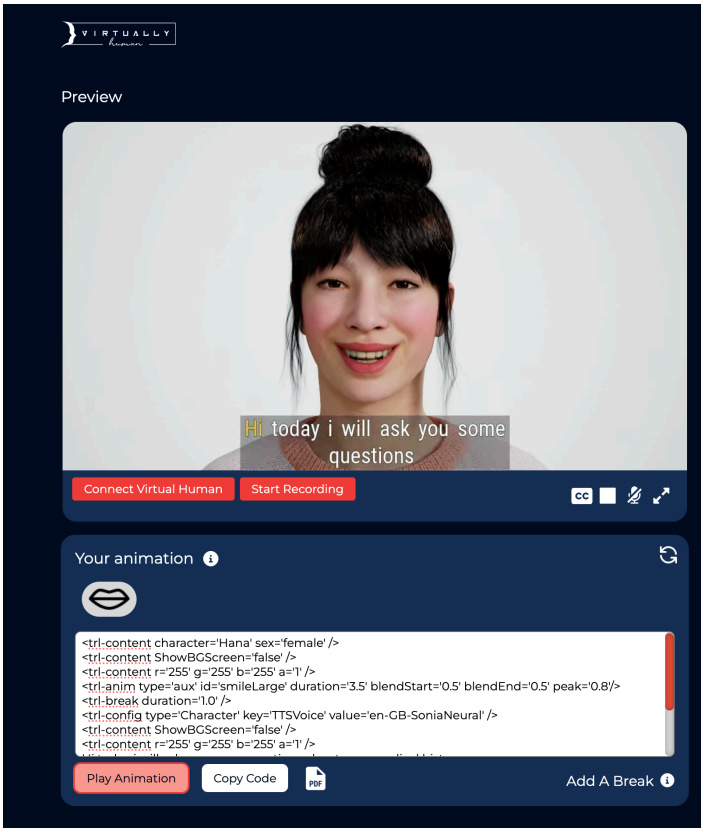


Figure 27. Text inserted in the code (Virtually Human, n.d.)

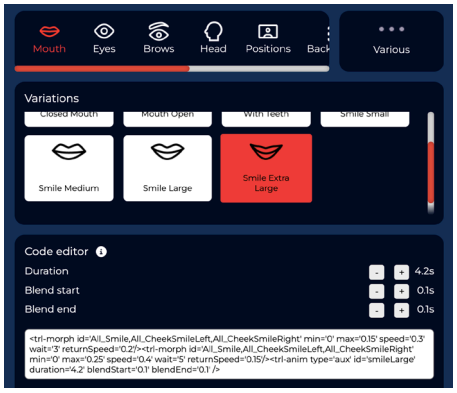


Figure 28. Implementing expressions (Virtually Human, n.d.)

The digital avatar platform functioned by utilizing a code composed of various expressions. For instance, users could initiate conversations with a big smile (Figure 28) or signal agreement with a nodding face. These expressions could also be adjusted in duration. Additionally, when entering text for the avatar to speak, users could insert pauses to ensure the code operated smoothly and maintained a natural flow.

4.4 UI Decisions

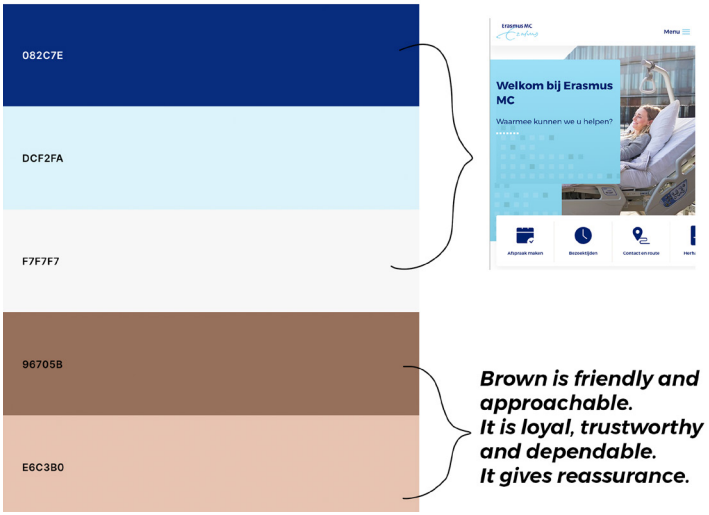


Figure 29. Explanation of the choice of the colour scheme

Colour scheme

The colour scheme which is seen in Figure 29 was made up through a combination of colours from the main website of Erasmus MC combined with two shades of brown. The colour brown was proven to be perceived approachable and friendly. It gives of loyalty, appears trustworthy and dependable while being reassuring (Harutyunyan, 2015).

Logo

For the logo first several sketches were made on paper, exploring different possibilities. The options involved avatars or screens with stethoscopes and different forms of avatars and screens. The chosen logo shown in Figure 30 was illustrated in Illustrator where the color combination was decided on based of the chosen colour scheme.

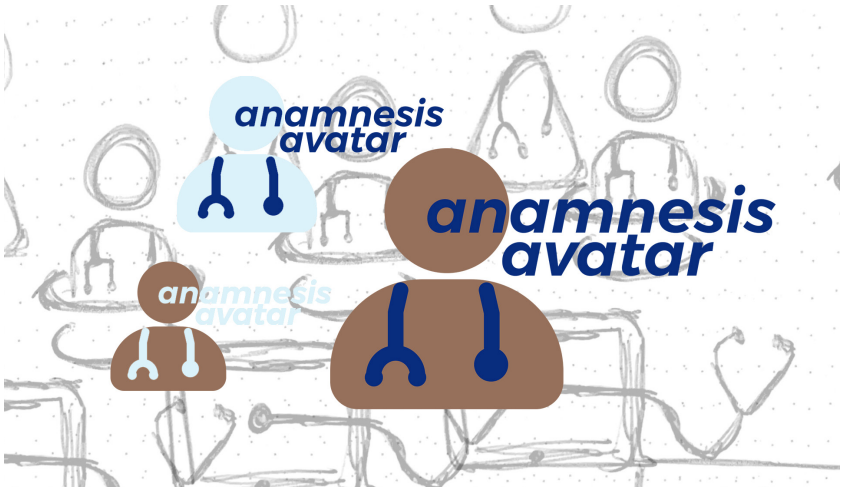


Figure 30. Development of the logo

Interface

The primary goal of the interface design was to prioritize simplicity, ensuring it is easily understandable for a diverse range of users. Additionally, the design aimed to convey empathy, trust, and care. To achieve this, not only the color combinations were carefully selected, but various types and forms were experimented with in the interface layout to enhance its visual appeal and effectiveness. In Figure 31 it is seen that all forms are rounded in a minimalistic way and combined with the type “Montserrat” which has a neat and sleek appearance.

Figure 31. Examples of the rounded forms used in the platform

4.5 Final Prototype

After the ideation phase where the wireframes were explored both on paper and digitally, the screens were transformed into a final concept. The main components are highlighted in figure 32. The different design decisions which were made will be highlighted in the Deliver chapter..

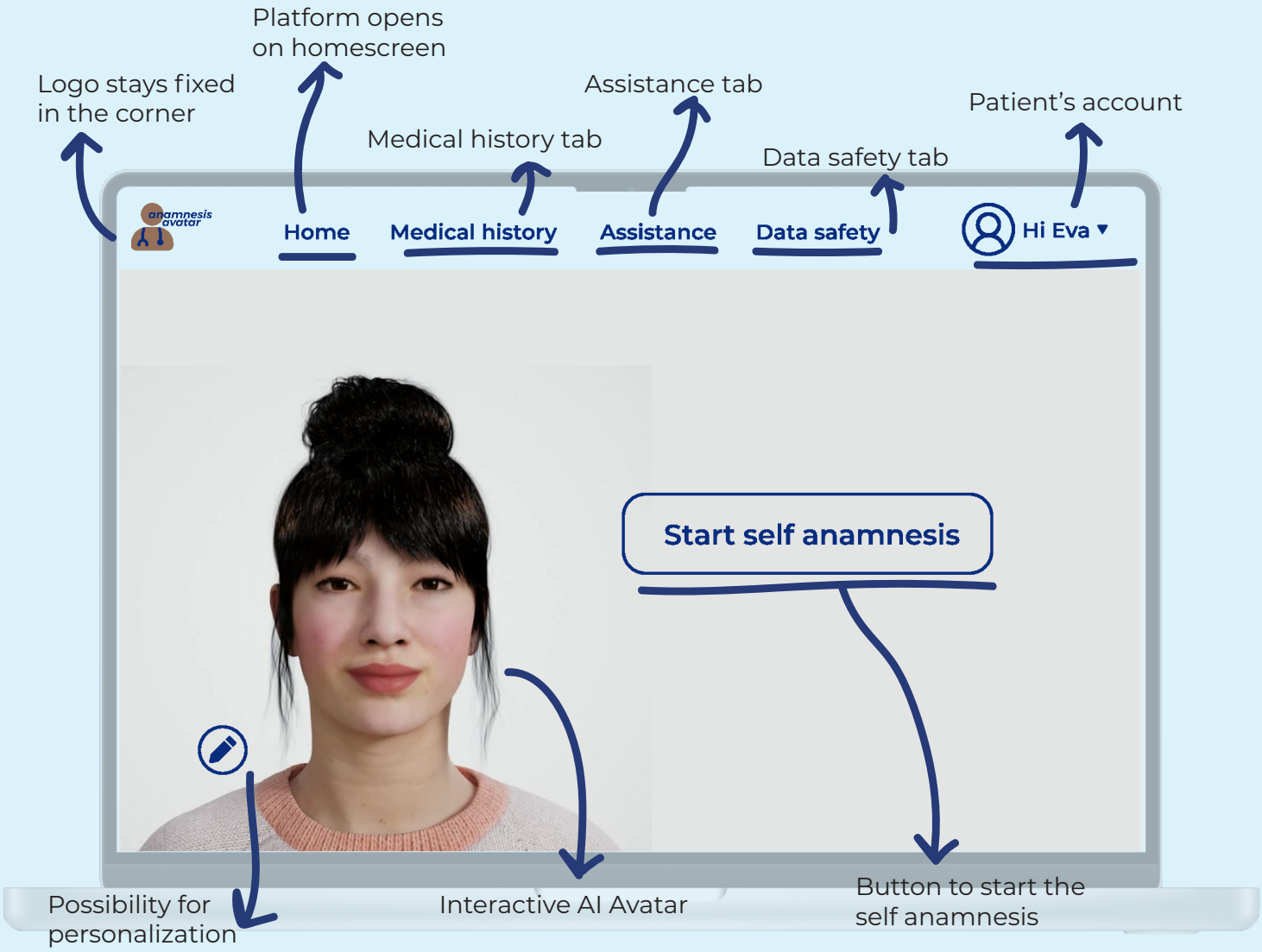
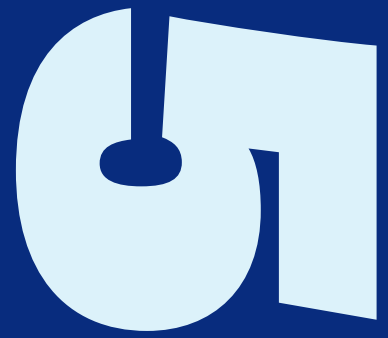


Figure 32. First impression of the prototype

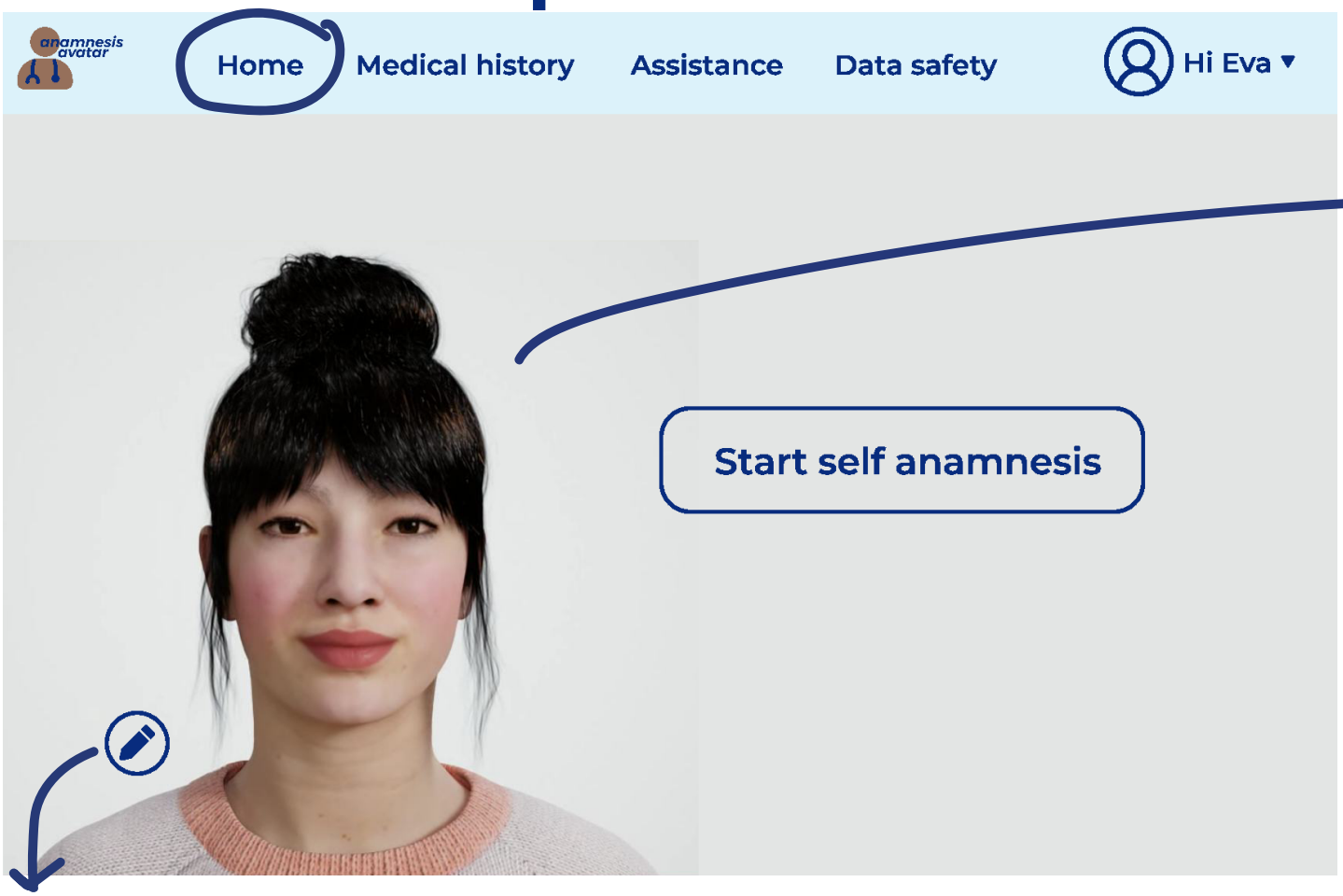
Deliver



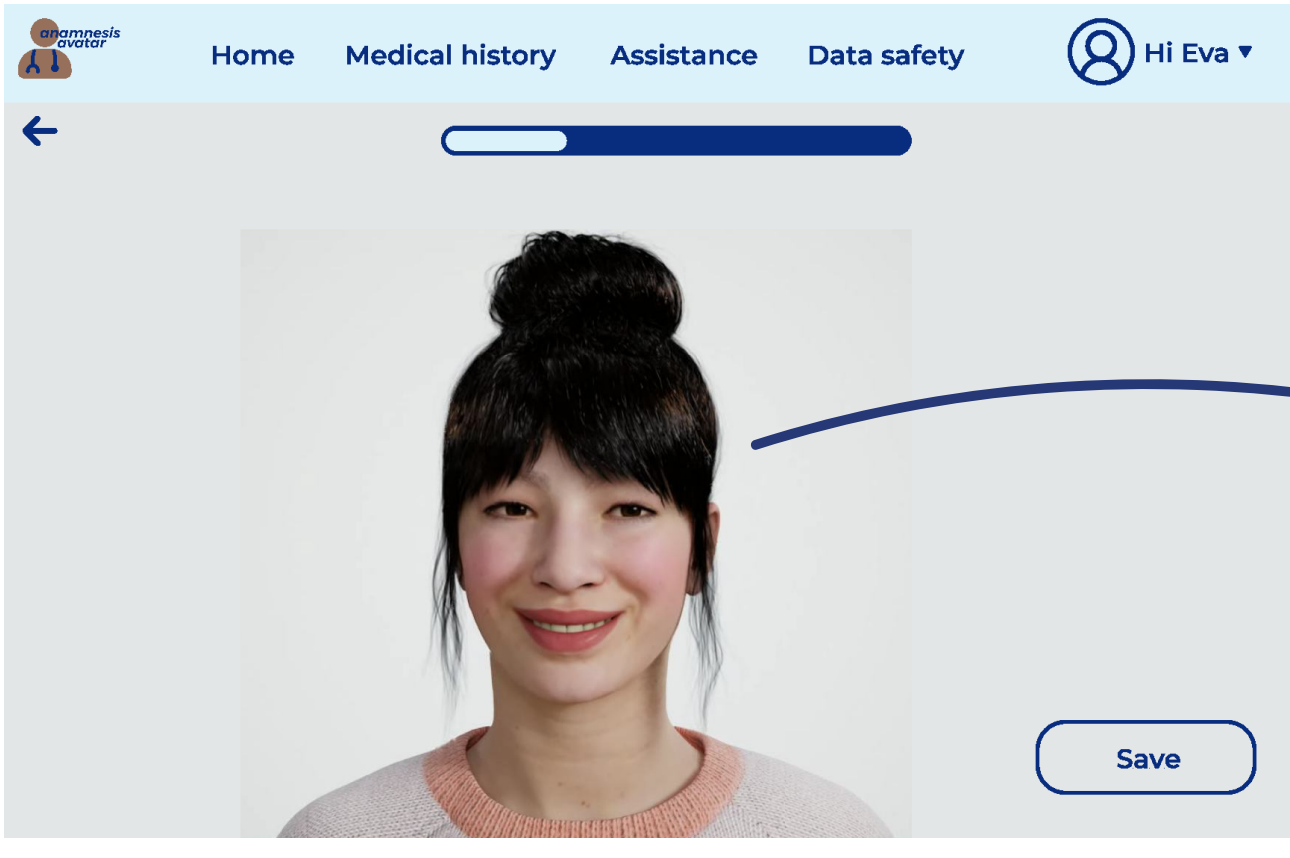
5 Deliver

This chapter provides a comprehensive overview of the platform, detailing its features and aspects. It includes an evaluation of user feedback to assess the platform's desirability. The chapter concludes with recommendations based on this evaluation, which will guide the redesign and refinement of the platform discussed in the subsequent chapter.

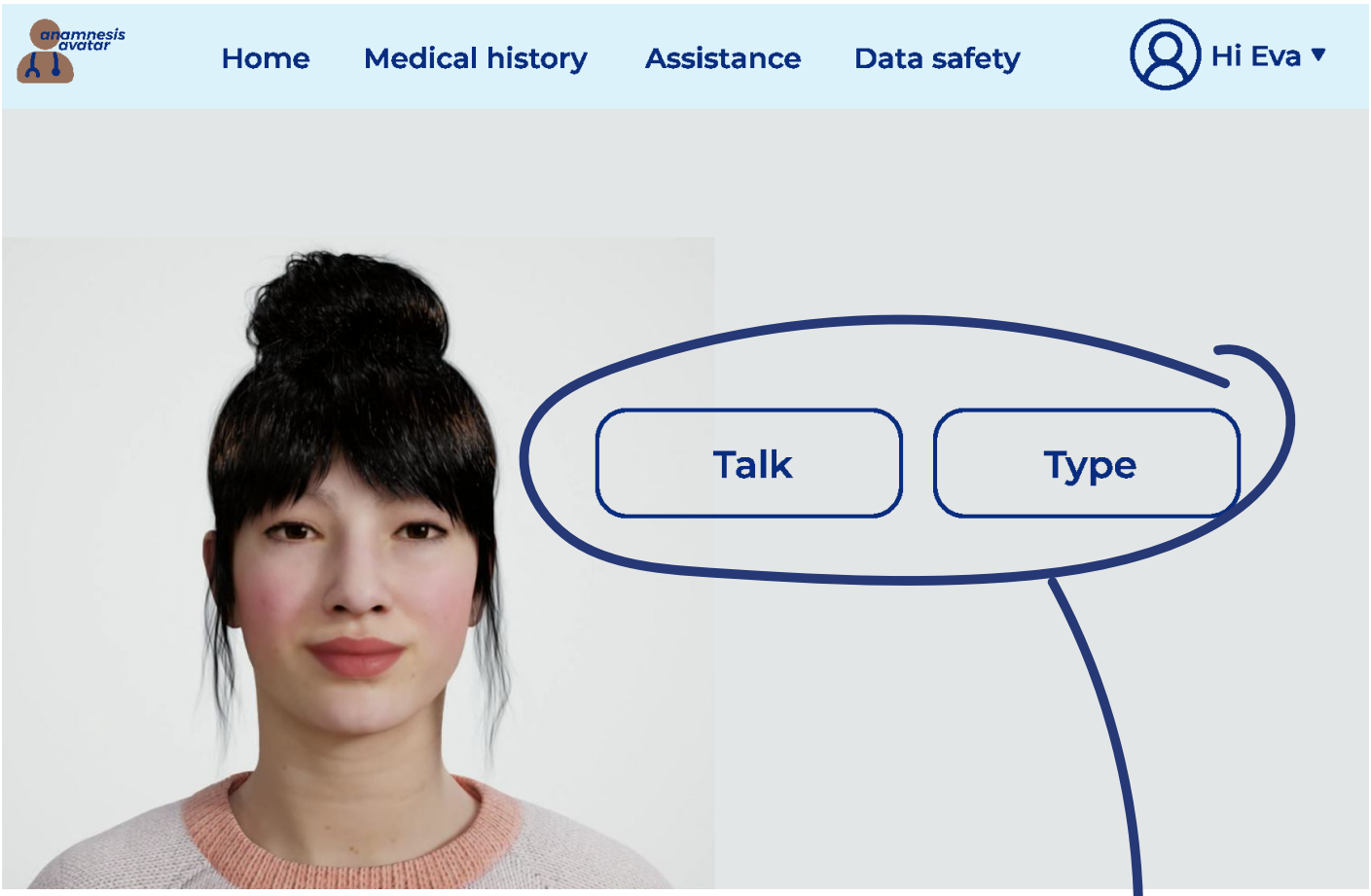
5.1 Concept



(Eventually the goal is to be able to create a personalized avatar to a certain extent. This has to be looked into further and is for now a recommendation)



In order to create a feeling of **trust** and **familiarity**, the Avatar is shown very prominently on the starting page already



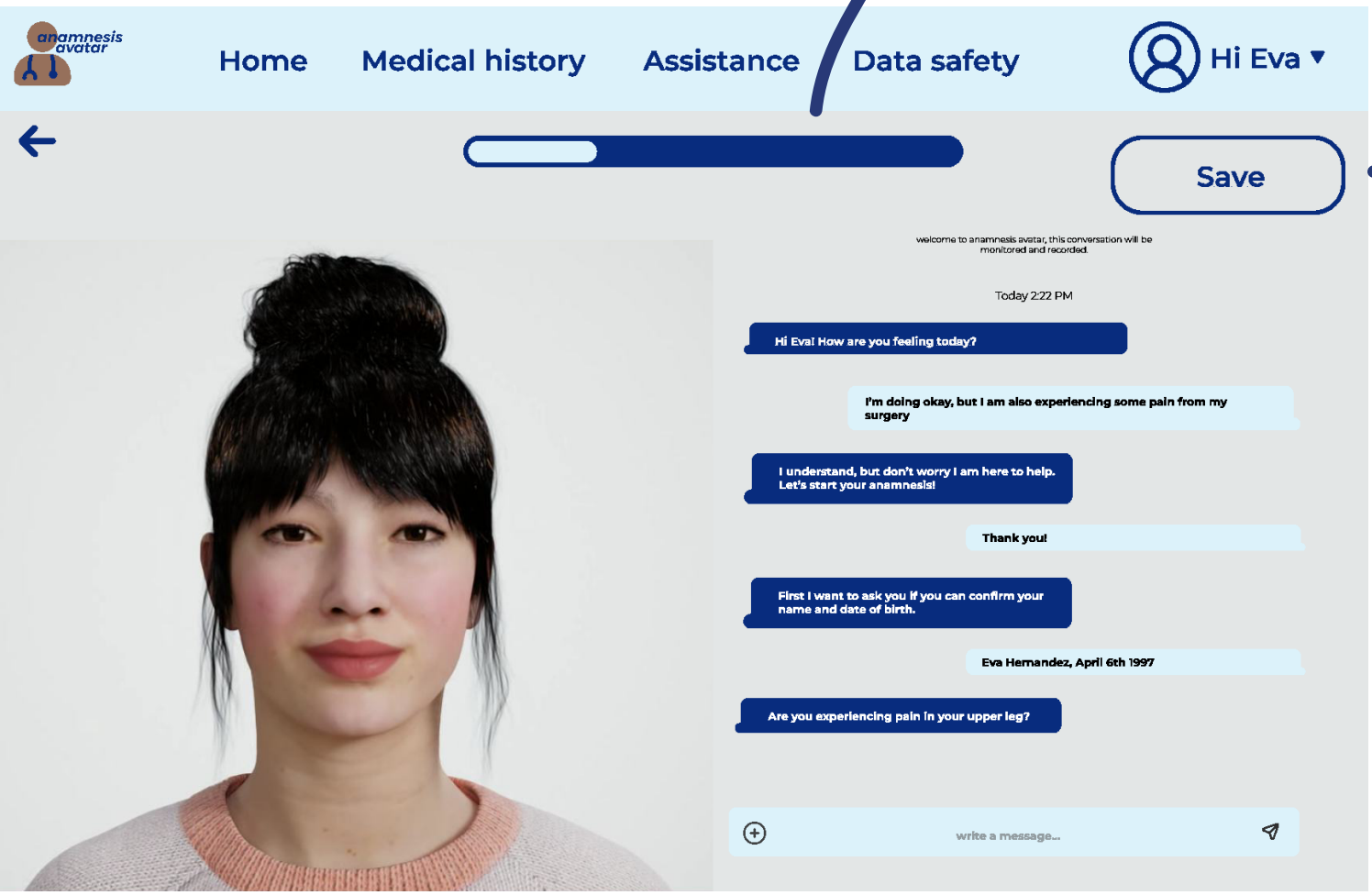
To give the user the idea that they are **not losing full control** over their anamnesis, they get the option to choose between a talking or typing consult.

This choice was also made based of **inclusivity**, some patients might not be able to speak at all or be in a fitting environment at the moment. Perhaps they are in a room with family and can not discuss personal matters.

When opening the “Talk” version, the avatar moves to the middle and is the **main focus** on the page. She starts with a big smile to create and **empathetic** feeling towards the user. The avatar will then start talking, after which the user can respond by also **talking themselves**.

Throughout the consultation, there is a progress bar present which approximately shows how far in the conversation you are. This way the user feels that they are **making progress**

The user has th
at any point, th
information giv
Apart from this
to **continue lat**



If the platform detects that the user hasn't been active in a while, a pop up message shows up in order to ask how they are holding up. This gives the user the feeling that the platform **cares** for their wellbeing

he possibility to save the conversation
is way they are **reassured** that the
ven will reach their doctor.
s, they also get the opportunity
er.

When giving a thumbs up, the platform makes sure to show that they are glad to hear that.

When giving a thumbs down, the platform makes sure to remind the user that they can also ask for extra **help at any time**.

When the user click save during or after their consultation, it immediately transfers them to the “Medical History” page, This page shows a **summary** where the user can **make sure** that the information they gave **is correct** and **if they forgot** to add certain information. This again gives the user a **sense of control.**

MEDICAL HISTORY FORM

Erasmus MC

Personal Information:

Name: [Your Name]
Date of Birth: [Your Date of Birth]
Gender: [Male/Female/Other]

Contact Information:

Address: [Your Address]
Phone Number: [Your Phone Number]
Email Address: [Your Email Address]

Medical History:

1. Current Medications:

List any medications you are currently taking, including dosage and frequency.

2. Past Medical History:

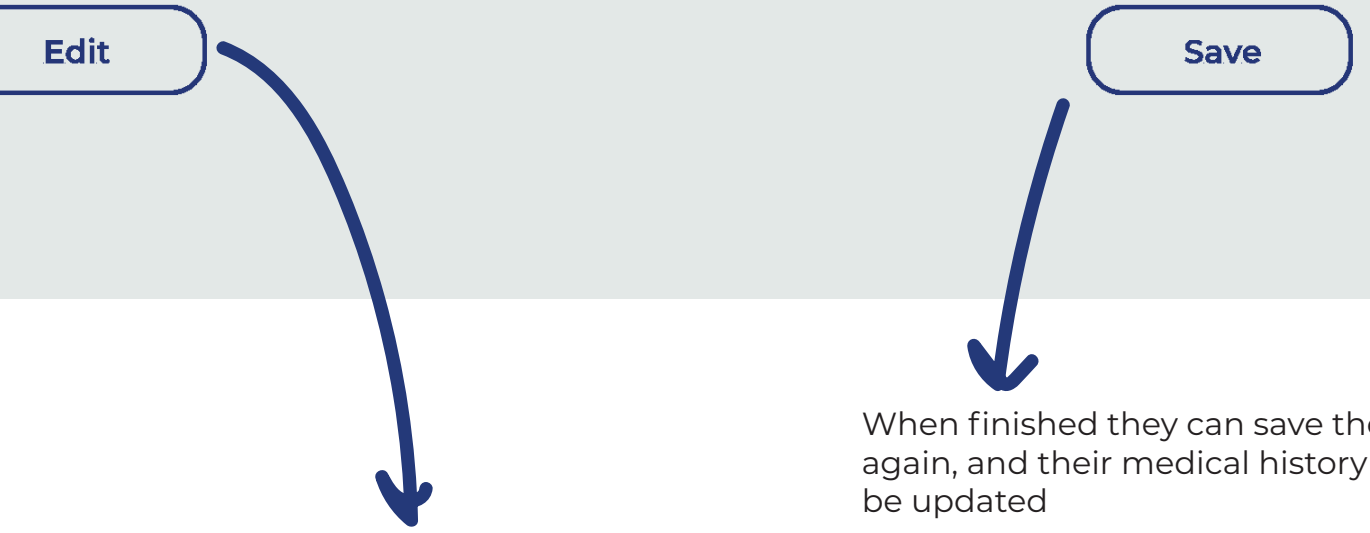
Additional Information:

Are you pregnant or planning to become pregnant? [Yes/No]

Do you have any specific concerns or symptoms you would like to discuss with your healthcare provider?

By signing below, I confirm that the information provided is accurate to the best of my knowledge.

[Your Signature]



They are able to edit the information to make sure everything is right

When finished they can save the file again, and their medical history will be updated

Request appointment

Contact information

Doctor's assistant
Erasmus MC
Phone: +31 612345678
Email: assistant@emc.nl

FAQ's

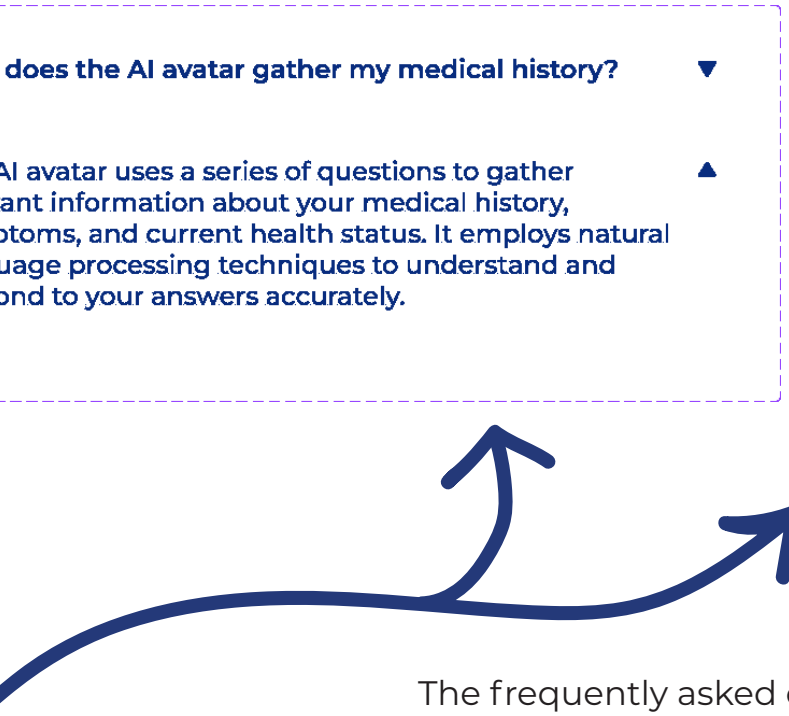
- How does the AI avatar gather my medical history?
- Is my information secure and confidential?
- Can I trust the AI avatar to provide accurate medical advice?
- How do I contact my actual doctor or assistant?
- What should I do if I experience a medical emergency?
- How do I book an appointment with my doctor?
- What languages does the AI avatar support?
- How can I provide feedback or report issues with the platform?

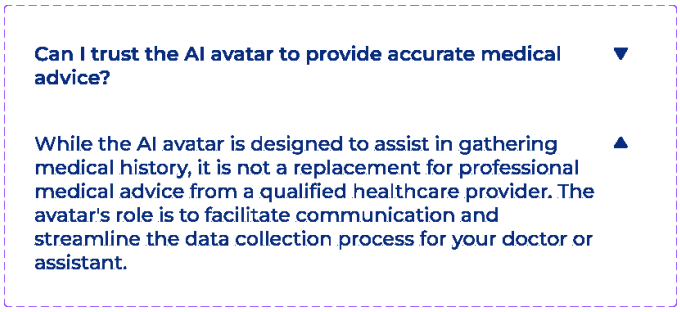
Are you happy with this platform?

> Provide your feedback here !

Erasmus MC

The user gets the chance to request an appointment if they feel like they should talk to their actual doctor. This way they are **reassured** that they still have the possibility of choosing to see their doctor and that the avatar is **not a full replacement** of their doctor.



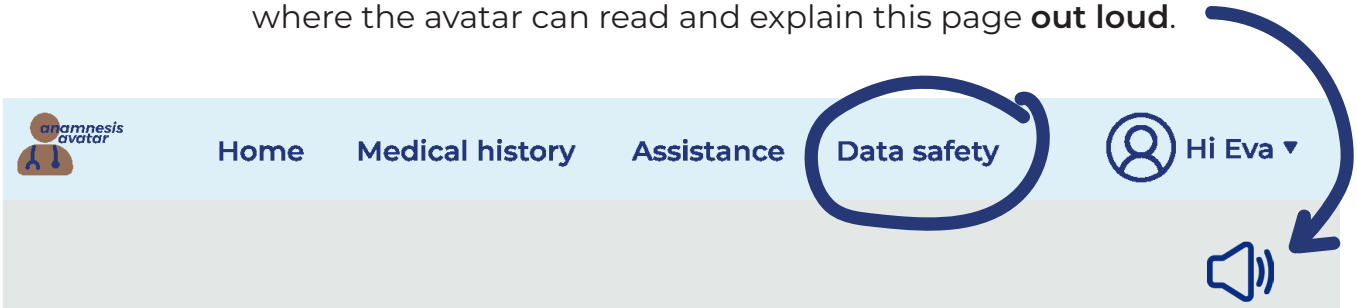


The frequently asked questions **cover as much doubts** possible in order to **build more trust** for the user. They have a slide down function where the question is as broadly answered as possible.

It is made clear that the platform **cares about the user's opinion**, in order for them to accept this new form of consultations. They can provide feedback at any time and are **reassured** that it is **valued** and will be taken into consideration.

The "Erasmus MC" watermark at the bottom of the page is crucial in order to **remind the user that this platform is linked to their trusted hospital.** By adding this, the patient can build the same **trust** for this platform as they have for their hospital.

The “Data Safety” page is designed in such a way that it is **easy readible** and **understandable** for every user.
The hirarchy created through **highlighted topics** show clearly what happens to your data. Given that this page has to cover all the user’s doubts on safety and trust, it was important that this page is **user-friendly** and **inviting** to read.
To higher the **inclusivity** in this platform, there is also an option where the avatar can read and explain this page **out loud**.



Privacy Policy

This Privacy Policy explains how Anamnesis Avatar will collect, store, use, transfer, and share personal data from you and how you can control it. When you use the this platform, you are trusting us with your personal data. Our commitment is to uphold and respect the trust you place in us, which is why we strive to maintain transparency regarding our handling of your personal data.
By signing up to our Anamnesis Avatar platform via the Erasmus MC, you acknowledge and agree that your personal data can be managed as described in this Privacy Policy.

Information We Collect

We collect the following types of information for various purposes to provide and improve our Platform:

Personal Data:
When you use our Platform, we may ask you to provide us with certain personally identifiable information, including but not limited to:

- Name
- Email address
- Date of birth
- Medical history
- Any other information you choose to provide or that is necessary for the provision of our services.

Usage Data:
We may also collect information on how the Platform is accessed and used ("Usage Data"), such as:

- Device information
- Log data
- Usage patterns

Use of Information

We use the collected data for various purposes, including but not limited to:
- Providing and maintaining our Platform
- Personalizing your experience
- Improving our services
- Communicating with you
- Compliance with legal obligations

Data Security

We are committed to protecting the security of your personal data. We implement appropriate technical and organizational measures to safeguard your information from unauthorized access, disclosure, alteration, or destruction.

Data Sharing and Disclosure

We do not sell or rent your personal data to third parties. However, we may share your information with:
- Healthcare professionals for the purpose of providing personalized health advice or treatment

We will only share your data with third parties in accordance with this Privacy Policy and applicable laws and regulations.

To n
an **i**
see
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use

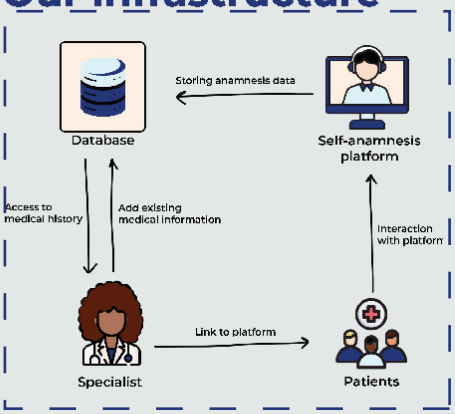
Your Rights

You have the right to:

- Access your personal data
- Correct any inaccuracies in your data
- Request the deletion of your data
- Restrict the processing of your data
- Object to the processing of your data
- Receive a copy of your data in a structured, machine-readable format

You can exercise these rights by contacting us using the information provided below.

Our Infrastructure



In this visual you can see what happens to your data. After providing your medical history data to the platform, it will be safely stored on a database of Erasmus MC which only your own doctor or specialist has access to.

Data Retention

We will retain your personal data only for as long as necessary to fulfill the purposes outlined in this Privacy Policy, unless a longer retention period is required or permitted by law.

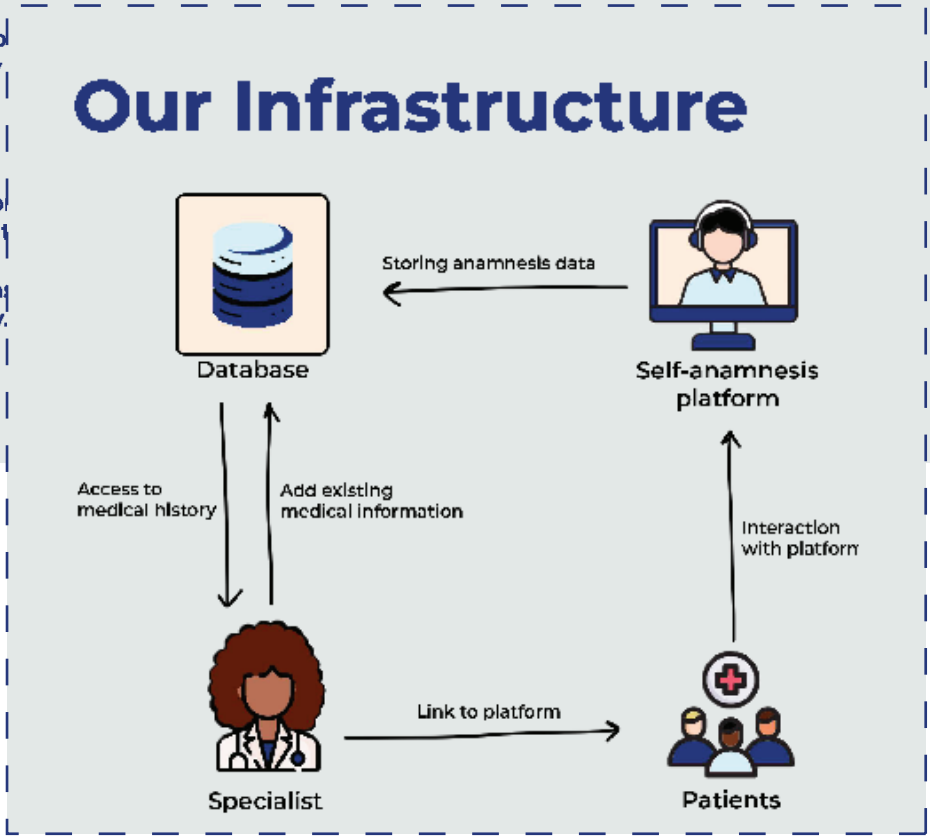
Updates to Our Privacy Policy

We may update this Privacy Po
posting the new Privacy Policy

Contact Us

If you have any questions or co
contact us at [Contact Informat

By using our Platform, you con
described in this Privacy Policy.



make this page even more **user-friendly**, **nfographic** is shown where you can clearly what happens to your data. There are no d parties involved and the data goes from r to database to the doctor.

5.2 Evaluation Test

For this evaluation test, an exploratory test will be conducted. Exploratory testing helps uncover usability and user experience issues by mimicking real user scenarios and behaviors. The usability and user experience have to be tested in order to reflect on the desirability of the concept. It involves testing various paths, inputs, and outcomes, and observing the product's reactions and responses. Additionally, this method allows you to identify and challenge assumptions and biases, explore the product's strengths and weaknesses, and generate new ideas and insights.
The purpose of this method is to assess a system's usability and allow designers to identify the root causes of usability issues early in the design process (Abowd, 1995) without involving real users (Lewis and Rieman, 1994).

The analysis focuses on two main aspects:
1. How easily a user can perform a task with minimal knowledge of the system
2. How easily the user can learn by exploring the interface.

Because the main focus for this platform is that it should be easy to use, the focus during the evaluation test will be on the second aspect.

Research question

"In what way are the preferred qualities experienced ?"

The research question should identify in what way the preferred qualities, which are seen in Figure 33 are experienced and highlight the specific features that do so.

Method

The method which will be used to conduct this exploratory test, is the Thinking Aloud method (Ericsson & Simon, 1998). During the Thinking Aloud method participants are asked to explore through the platform while verbalizing their thoughts with every step they're taking. This way quotes and statements can be subtracted from their experience. These findings will be used to improve the platform and identify recommendations. Seeing as it is not natural for most people to verbalize all of their thoughts (Nielsen, 2024), a simple warming up task will be given where the participant has to conduct a task such as picking up a bottle and opening it while describing their activities. Approval for this study has been obtained from the Human Research Ethics Committee (HREC), which ca be found in Appendix F. Data collection involved taking notes and transcribing the raw data recorded during the interviews.

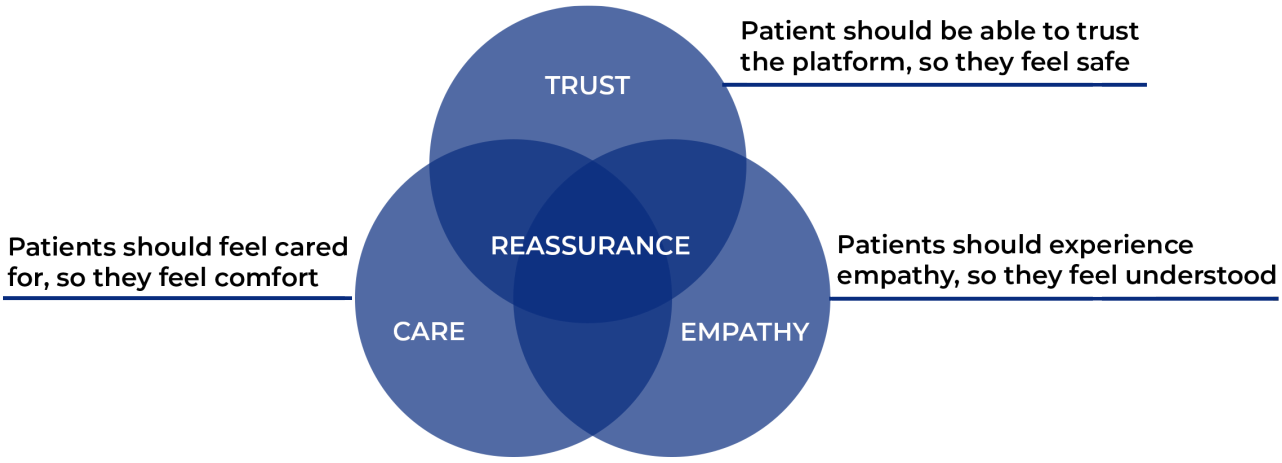


Figure 33. Preferred qualities

Participants

For this evaluation test, the goal was to recruit 6 participants from different age categories and genders. For this part of the research, the recruitment again wasn't done through Erasmus MC, but through personal connections, such as friends, colleagues, family, and a wider network. The participants all have experience with going to doctor's consulations.

P1	Male, 26
P2	Female, 24
P3	Female, 65
P4	Male, 68
P5	Female, 25
P6	Non-binary, 25

Procedure

First the particpants were asked to read and sign the informed consent form (Appendix E).
The objective was to assess the intuitiveness and user experience of the interactive prototype of the self-anamnesis tool. The duration of the full session was approximately 30 minutes.
The participants will first be instructed to imagine themselves before a doctor's consultation, interacting with the platform to answer questions about their medical history. They will not be required to answer actual medical questions during the research. Participants' consent will be obtained to use their comments for research purposes. Notes will be taken to capture feedback.
The procedure will be split up into two parts.

Part 1: Participants will be given tasks and will be encouraged to express their opinions freely, with no right or wrong answers. They will be asked to vocalize their thoughts during the activities and may ask questions at any time.

- **Task 1:** Explore a bit through the different functions without starting the self anamnesis
- **Task 2:** Start the self anamnesis, talk version and save for later
- **Task 3:** Continue self anamnesis with chat version and submit

Part 2: Participants will be asked a set of pre made questions, expressing their opinions.

Interview after test

After the evaluation test (Figure 34) was conducted, there were some open questions aimed to gather qualitative feedback on the platform. Participants were asked to describe a time when they experienced the platform as particularly caring or empathetic, along with identifying aspects of the platform that made them gain more trust, mention if something confused them, and lastly indicate any features they disliked.

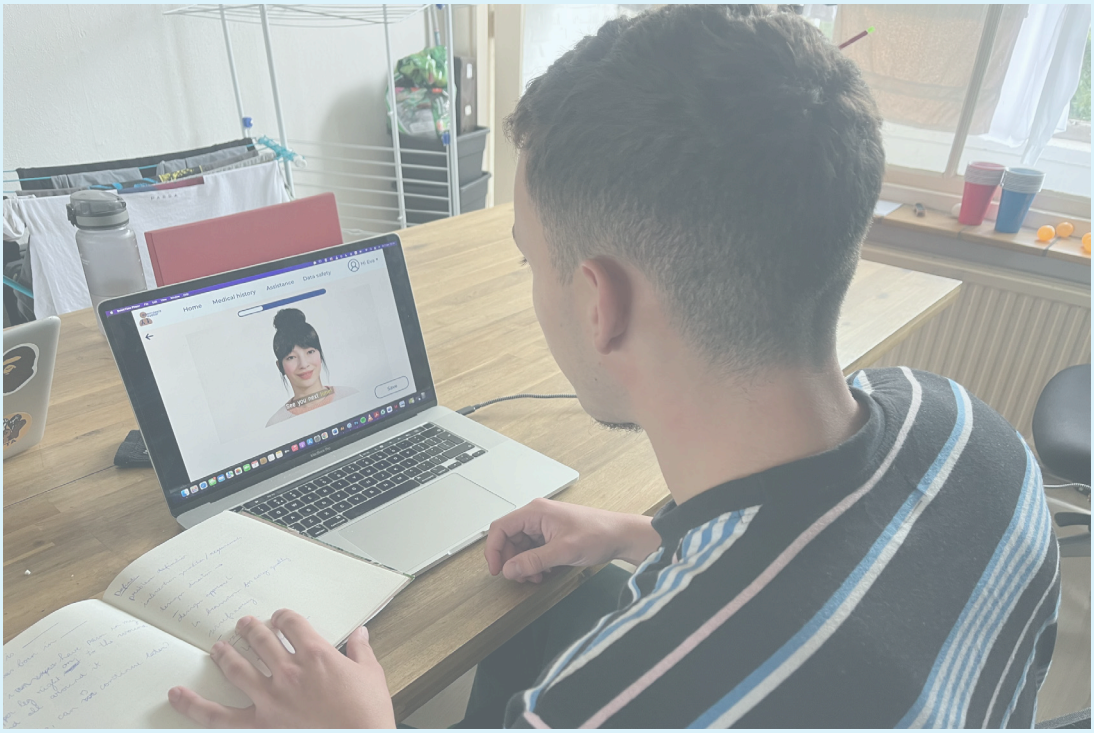


Figure 34. Participant conducting the evaluation test

Data results and analysis

The goal of analyzing the data is to first test the usability and interface. Secondly, identify in what way the qualities: care, empathy and trust are experienced by the participants. This will involve selecting quotes from participants' responses and paraphrasing them to illustrate their interpretation and relevance to this research. These insights will be visualized as statement cards (Stappers, 2012), which will be clustered to identify overarching themes. Eventually these clusters will be directly linked to the platform in order to highlight the aspects that could be improved.

The quotes concerning the usability and interface of the platform were paraphrased and then thoroughly clustered in two distinct ways to facilitate comprehensive analysis. Initially, the quotes were sorted by specific topics to organize the feedback in a coherent manner. For instance, all statements related to the home page were grouped together, as well as all comments pertaining to the medical history page. This topic-based clustering helped in identifying common themes and issues within each section of the platform.

In addition to sorting by topic, the quotes were further categorized based on the nature of the feedback. They were divided into two main categories: "Tips" and "Tops." "Tips" showed the elements that participants appreciated and found beneficial, highlighting the successful aspects of the platform. Conversely, "Tops" included the areas where participants felt improvements were necessary, pinpointing specific features or functionalities that could be enhanced.
This dual categorization allowed for a nuanced understanding of user preferences and areas for potential improvement. In Figure 35 an example is shown of the Tips and Tops for the topic "Medical history page", here it is also shown in the dark blue box that a conclusion was drawn from these answers. By employing this two-tiered clustering approach, the analysis provided a detailed insight into both the strengths and weaknesses of the platform's usability and interface.

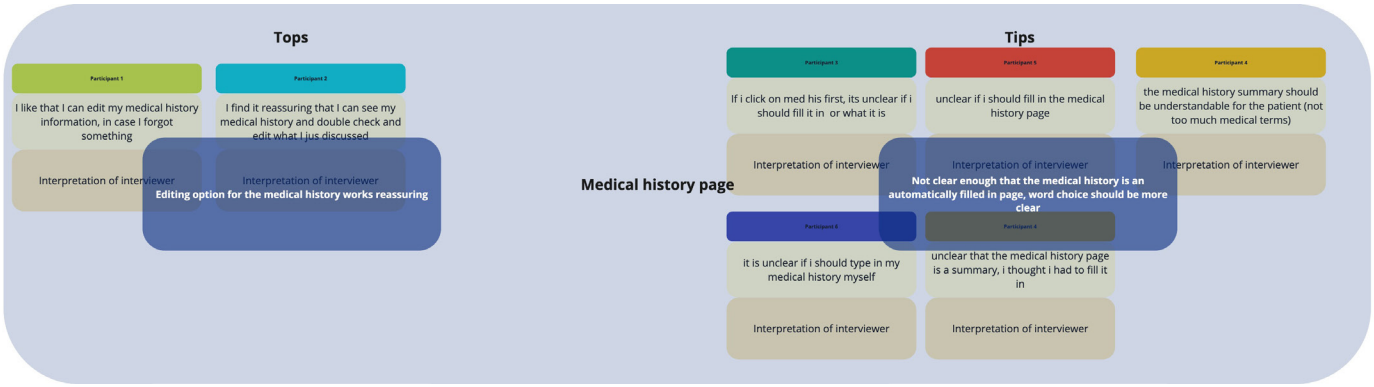


Figure 35. Example of how the tips and tops were visualized for a specific topic.

For the second part of the analysis, the qualities of care, empathy, and trust were specifically highlighted to gain deeper insights into the user experience. This process began with collecting quotes from the participants that directly mentioned these qualities, ensuring that the feedback was focused and relevant. These quotes were then transformed into statement cards, similar to the previous method, to facilitate a structured analysis.

The statement cards were clustered in two distinct ways to provide a comprehensive understanding of how these qualities were perceived across different aspects of the platform. First, the cards were grouped according to the specific quality they addressed—whether it was care, empathy, or trust. This initial clustering helped to isolate and examine the feedback related to each individual quality.

Next, within each quality category, the quotes were sorted by specific topics. These topics included the interaction with the avatar, the appearance of the avatar, and the look of the data safety page, among others. This dual-layer clustering approach allowed for a detailed analysis of how each quality was experienced in various contexts of the platform (Figure 36).

By organizing the data in this manner, it became easier to identify patterns and correlations, offering valuable insights into how the platform could better foster care, empathy, and trust among its users. This structured analysis not only highlighted areas for improvement but also pinpointed strengths that could be further leveraged to enhance the overall user experience.

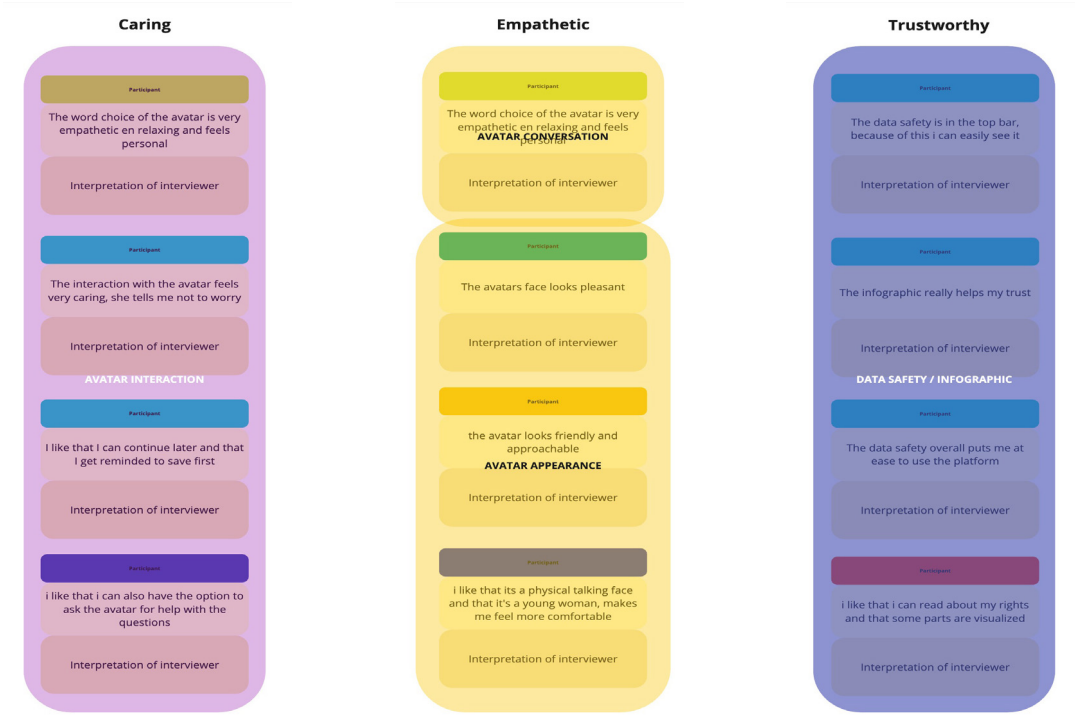


Figure 36. Examples of clusters made which show the qualities care, empathy and trust

Overview analysis

The next step was to link all the “Tips” and “Tops” to the specific pages of the platform, which can be seen on the next page in Figure 37. This approach created a detailed overview that made it easy to identify areas needing improvement at a glance. By organizing feedback in this manner, it could quickly be seen which aspects of each page were praised and which needed enhancement, providing a clear, actionable roadmap for refining the platform.

Figure 38 shows the same approach but for how the qualities of care, empathy, and trust are expressed through the design. This mapping provided a detailed view of where these qualities are effectively communicated and where improvements could be made, offering a clear visual representation of their distribution across the platform. This step was helped understanding and enhancing the overall user experience by identifying specific design elements that convey these important qualities.

Overview quotes

To get an even better idea of how the participants perceived the platform, several quotes have been highlighted which can also be found on the next page in Figure 39. For a more extensive look into the interviews refer to Appendix G.

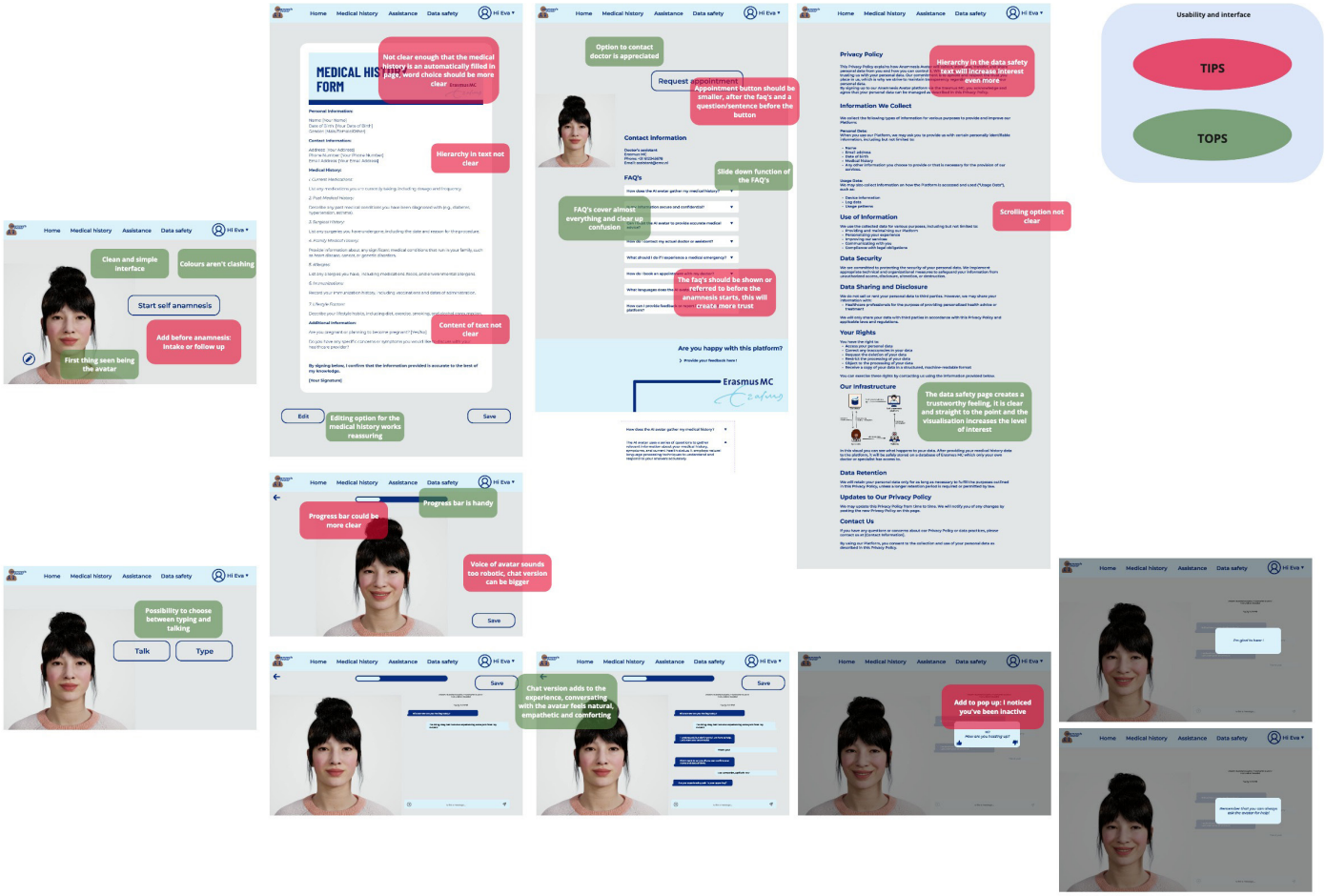


Figure 37. The tips and tops linked to the pages of the platform.

Figure 38. Overview of where the qualities care, empathy and trust were experienced

P3, F-65
"The voice was a bit *too robotic* for my liking. "

P5, F-25
" The interaction did not go as fluently as I hoped, *she interrupted me*, because I spoke a bit slower."

P5, F-25
"On the medical history page it was *not clear* to me that I did not have to fill it in myself"

P4, M-68
"It would be nice if the medical history summary is *understandable for the patients*"

P4, M-68
"The FAQ's feel really important, I think they should be *more prominent*"

P4, M-68
"The interaction felt natural, she was *empathetic and reassured me*. I do wonder what this interaction would be like if I felt bad. "

P6, NB-25
" I like that its a physical talking face and that it's a *young woman*, makes me feel *more comfortable*"

P6, NB-25
"I actually already trust the platform based of the faqs and the *EMC mark*, so I wouldn't read data safety"

P3, F-65
" I liked that the *first thing I saw was the avatar itself*"

P2, F-24
"I find it *reassuring* that I can see my medical history after submitting and that i can *edit it*. "

P1, M-26
"Every feeling of doubt I had, was *covered by the FAQ's* "

P4, M-68
"The data safety page is straight to the point, *more clear than I am used to* and the *infographic* makes it more inviting. "

P6, NB-25
"I feel reassurance from the fact that I can *physically push a save button* which leads to a summarized page."

Figure 39. Quotes directly retreived from interviews

Discussion & Recommendations

Usability

Starting page

When the user first accesses the platform, they should be prompted with a question to determine if they are starting an intake or a follow-up consultation before the anamnesis process begins. This initial question sets the stage for a more tailored experience, ensuring that the subsequent steps are relevant to the user's current needs and context.

Medical history

Users benefit greatly from the option to edit their medical history, as it provides a sense of precision and control over their personal information. However, confusion may arise because it is not immediately apparent that the medical history page is pre-filled with existing data. To mitigate this, it is essential to improve the clarity of the interface. Specifically, the language used on the medical history page should be more explicit and user-friendly, guiding users to understand that they can edit pre-existing information. Enhancing these elements will contribute to a more intuitive and reassuring experience for users.

Assistance - Appointment

The option to contact a doctor is highly valued by users, as it significantly boosts their confidence and sense of accessibility. To further enhance the user experience, the appointment button should be redesigned to be smaller and placed after the FAQs section. Additionally, including a guiding question or a brief explanatory sentence before the appointment button, such as "Do you have a question that was not answered?", can improve navigation and make it easier for users to find and use this feature effectively.

Assistance - FAQ's

The FAQs section is comprehensive and effectively resolves user queries, thereby enhancing the overall user experience. To build greater trust and ensure users feel well-informed from the outset, the FAQs should be prominently displayed or referenced before the anamnesis process begins. By doing so, users will have access to essential information right from the start, which can help alleviate any initial confusion or anxiety.

Data safety

The data safety page plays a crucial role in establishing user trust with its clear and straightforward content, complemented by an engaging visual element. To further enhance user engagement and readability, introducing a more structured text hierarchy would be beneficial. By organizing the information in a way that highlights key points and improves overall flow, users can more easily digest and appreciate the importance of data safety.

Progress bar

The progress bar is an invaluable feature that aids users in tracking their advancement through the platform. However, there is room for improvement in its design to enhance clarity and ensure users can effortlessly understand their progress. By refining the visual design and possibly adding more detailed indicators, the progress bar can become an even more effective tool in guiding users through their journey.

Avatar interaction

The chat version of the avatar significantly enhances the user experience by providing a natural and interactive way of communication. However, the usability of the chat interface could be improved by making it larger, which would facilitate easier interaction. Additionally, while the talking experience with the avatar feels empathetic and comforting, the avatar's voice currently sounds too robotic. Refining the voice to be more natural and human-like would further improve the overall user experience.

Pop- up
To further enhance the functionality of pop-up messages, it is important to address user inactivity first. Including a specific question or prompt related to inactivity can help re-engage users and ensure they remain attentive to the platform. This approach not only improves user engagement but also maintains the flow of the anamnesis process.

In conclusion, enhancing the usability of the platform involves several key improvements across different aspects. The initial question on the starting page should set a tailored experience for users. Clarity in the medical history section can be improved by making the editability of pre-filled data more explicit. The appointment button should be smaller and follow a guiding question for better accessibility, while the FAQs section should be prominently displayed to address user queries early on. The data safety page can benefit from a structured text hierarchy to highlight key points. The progress bar should be refined for better clarity, and the avatar's interaction can be improved by enlarging the chat interface and making the avatar's voice more natural. Finally, addressing user inactivity through specific prompts in pop-ups will enhance overall engagement and flow.

Qualities

Empathy
The avatar's word choice is highly empathetic and soothing, fostering a personal connection with the user. Its pleasant and approachable facial expression adds to the welcoming atmosphere, while being a physical, talking face—specifically a young woman—enhances comfort levels. The inclusion of a pop-up asking if the user is okay further demonstrates empathy, showing a genuine concern for the user's well-being. Overall, these elements create an environment that prioritizes user comfort and emotional support.

Care
The avatar's word choice is empathetic, relaxing, and feels personal, enhancing the overall sense of care during interactions. The avatar's reassurance not to worry and the option to continue later, with reminders to save progress, further contribute to a caring experience. Additionally, the ability to ask the avatar for help with questions adds another layer of support and comfort.

The ability to physically push a save button that leads to a summarized page provides a reassuring sense of control and security. The soft, well-coordinated colors contribute to a calming and caring atmosphere, further enhancing the user experience.

Trust
The clean layout of the interface instills a sense of trust, with its organized presentation enhancing user confidence. The use of blue, often associated with medical settings, contributes to a perception of trustworthiness and reliability. Additionally, the clear and well-formulated design of the elements further reinforces the sense of safety and security, ensuring users feel comfortable and assured while interacting with the platform.

The summary feature provides reassurance by confirming that the information will be forwarded to the user's doctor. This clear communication enhances trust in the platform, as users feel confident that their data is being handled responsibly and will reach the appropriate medical professional. This confirmation contributes to a sense of safety and reliability, reinforcing the platform's credibility and fostering a positive user experience.

The FAQs play a crucial role in establishing trust and safety within the platform. They provide valuable information that addresses user concerns, particularly regarding data safety. By covering a wide range of doubts and offering clear explanations, the FAQs instill confidence in the platform's

reliability and transparency. Overall, their presence and effectiveness in addressing user queries contribute significantly to building trust and ensuring user safety.

The inclusion of the Erasmus MC logo enhances trust in the platform, as users perceive a link to a reputable medical institution. This association strengthens their trust, especially considering their existing confidence in medical websites. The presence of the EMC mark further solidifies this trust, indicating a commitment to quality and credibility. Additionally, the platform's emphasis on feedback and its value reinforces a sense of transparency and user-centricity, further fostering trust in the platform's safety and reliability.
The prominent placement of the data safety information in the top bar makes it easily accessible, enhancing user confidence in the platform's commitment to privacy and security. The infographic further reinforces trust by visually presenting complex information in an easily digestible format. Overall, the attention to data safety throughout the platform instills a sense of ease and assurance, encouraging users to engage with the platform comfortably. Additionally, the inclusion of information about user rights, alongside visualizations, adds transparency and empowers users, further contributing to a trustworthy environment.

In conclusion, the platform excels in fostering empathy, care, and trust through its design and features. The avatar's empathetic and soothing communication, along with its approachable appearance and concern for user well-being, create a supportive environment. The caring experience is enhanced by the avatar's reassuring messages, save progress options, and helpful assistance, while the soft colors contribute to a calming atmosphere. Trust is built through a clean interface, the use of blue, clear communication about data handling, and the presence of the Erasmus MC logo. Comprehensive FAQs and prominent data safety information further reinforce trust and confidence in the platform's reliability and security.

Limitations

Throughout the evaluation process, feedback highlighted several areas of improvement that should be noted for the final implementation of the platform. One significant aspect raised by stakeholders and users alike was the voice of the avatar. It was mentioned that the current voice sounded robotic and less natural, which could potentially affect user engagement and satisfaction. However, it is important to note that for the final version, the platform will integrate ChatGPT 4o developed by Erasmus MC. ChatGPT 4o boasts advanced capabilities, including the ability to speak in various voices that are more empathetic and human-like (ChatGPT 4o, n.d.).

Another notable limitation identified during user interactions was the use of a prototype which closely but not perfectly resembled the eventual interaction between the user and the avatar. Given that in this phase of the project, there was no budget to build a fully functioning avatar. Because of this, a video was premade in order to test a pre-scripted interaction and the interaction could only be tested to a certain extend. The final version of the platform will feature a fully functional AI-powered avatar. This enhancement aims to provide a more dynamic and responsive interaction experience, allowing for natural dialogue that adapts to user input and context.

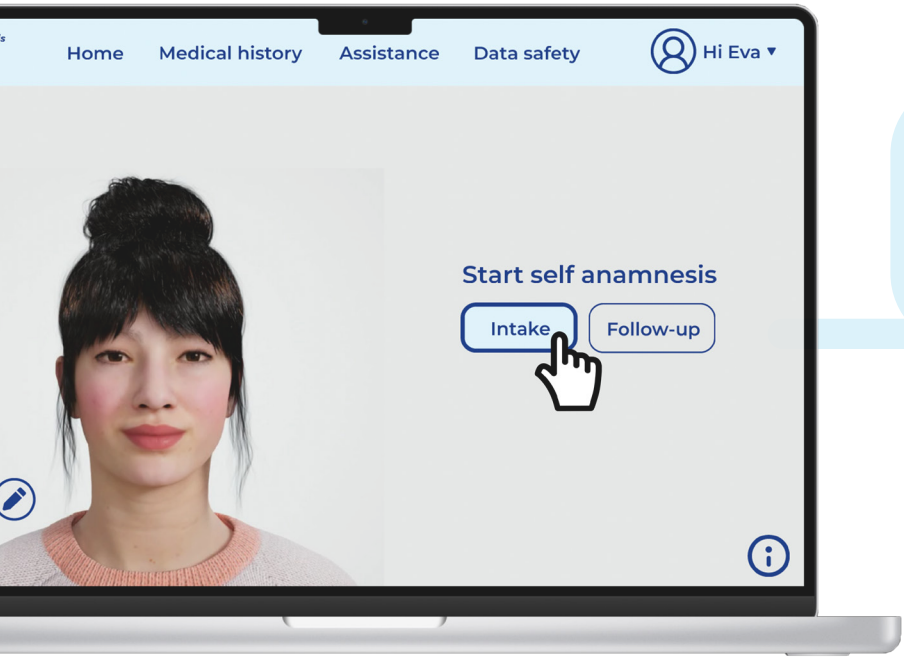
These insights underscore the importance of refining the avatar's voice and interaction capabilities to better align with user expectations and enhance overall usability. Addressing these limitations in the final implementation phase will be crucial in ensuring a more engaging and effective user experience with the platform.

Refine

6 Refine

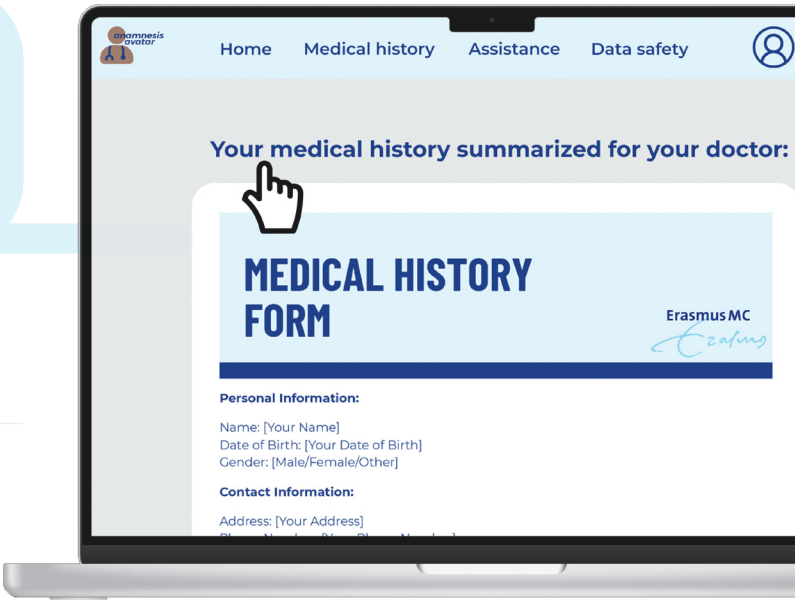
In this chapter, the findings from patient evaluation tests will be used to enhance the concept. The iterated and refined version will then be reevaluated by stakeholders to assess its viability and feasibility.

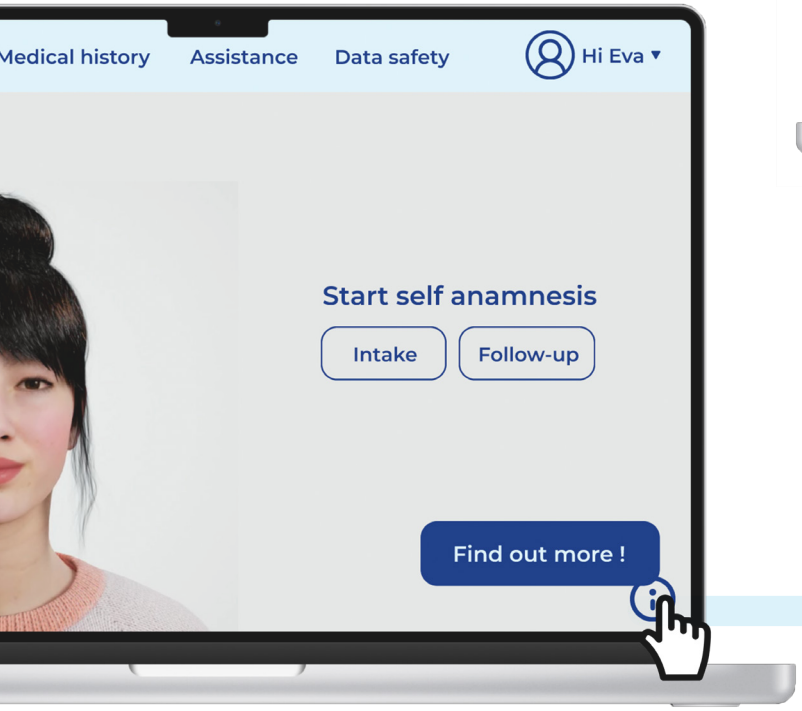
6.1 Refined Concept



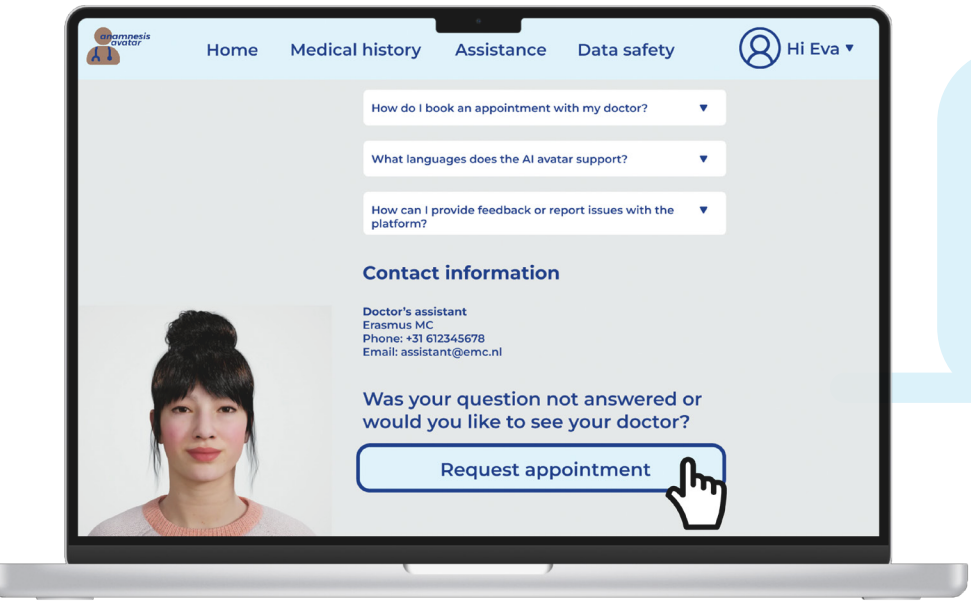
The home page now gives the options to choose between an intake or follow-up anamnesis. This makes it more clear to the user to know what they are up to.

The Medical History page has an extra header as indicator that users do not have to fill this page in seperately from the anamnesis they have conducted.

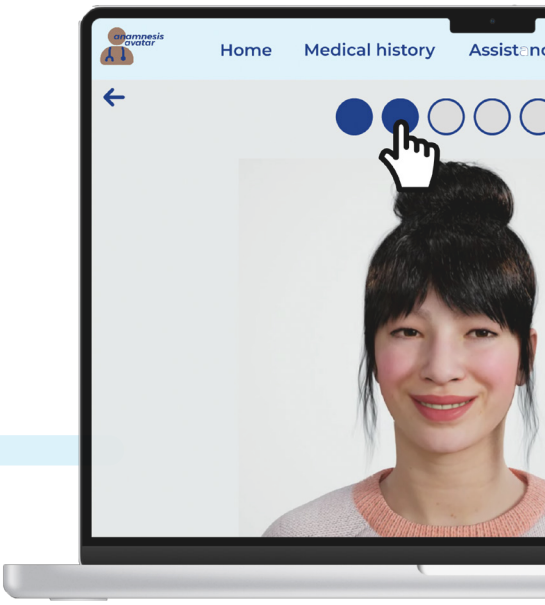




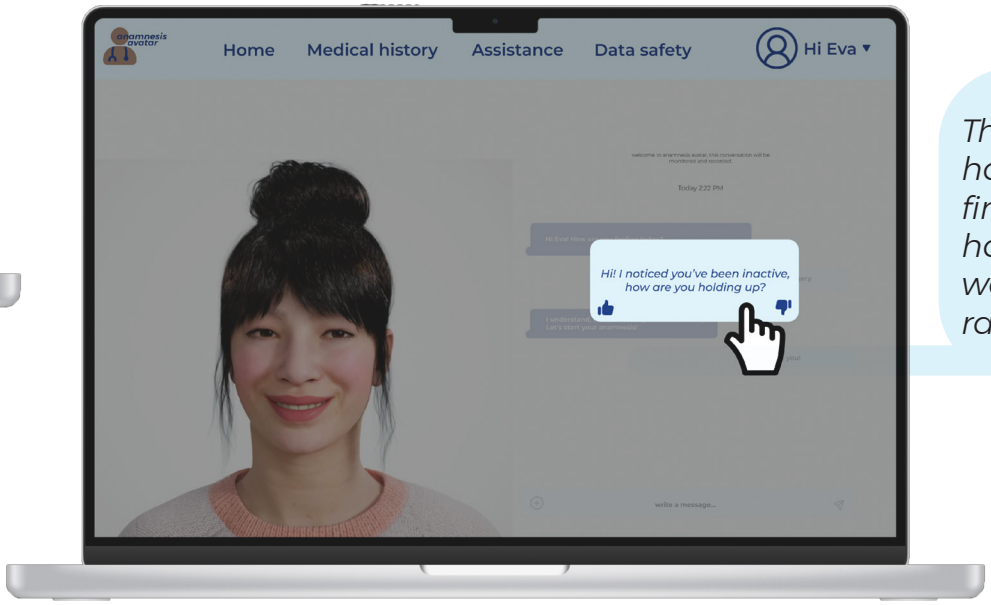
On the home page there is an extra feature which shows the phrase " Find out more" when hovering over the icon. This will directly lead the user to the FAQ's.



The option to request an appointment is now below the FAQ's, given that the FAQ's already answer most question. There is also a question added above the button which gives a better indication on what to request an appointment for.

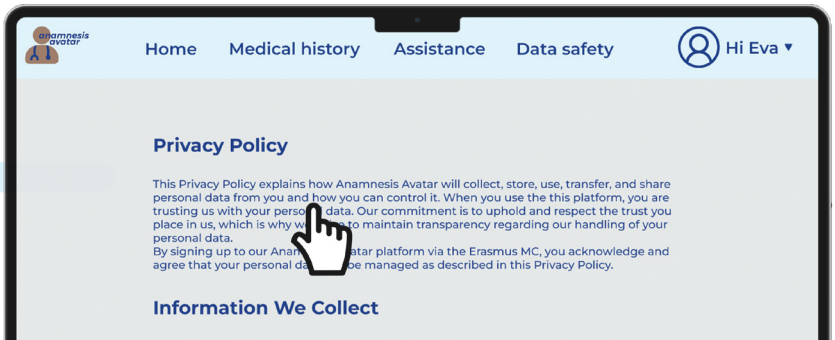


The progress bar is redesigned in a way that it is more visible to the user how far along in the process they are.



The pop-up question now has an extra phrase that first indicates that the user has been inactive, this way the message feels less random.

The data safety page shows better hierarchy because of the bigger contrasts between font sizes.



6.2 Evaluation Test

In this section the refined concept was evaluated, this time in order to evaluate the viability and feasibility of the concept. To get the most valuable insights from on both the viability and feasibility of the concept, this test was split up into two parts. First the chosen method will be ellaborated, followed by the participant choice. The data analysis will be shown along with the results and how these will be implemented into possible recommendations.

Method

For this evaluation test, a pitch-driven semi-structured interview method was used. This approach uses the combination of the clarity and engagement of a structured pitch with the depth and felixibility of a semi-structured interview. The initial pitch was crafted to clearly and concisely present the core elements of a concept, adhering to the principles recommended by Kawasaki (2004). Following this, a semi-structured interview was carried out to collect comprehensive feedback, a technique praised for its qualitative research efficacy by Kvale and Brinkmann (1996). Approval for this study has been obtained from the Human Research Ethics Committee (HREC), which can be found in Appendix F. Data collection involved taking notes and transcribing the raw data recorded during the interviews.

Viability - Participants

For this part of the study, three healthcare professionals have been interviewed. Two of them are medical residents. Medical residents, who are doctors in training, play a crucial role in patient care and bring valuable perspectives to the study due to their hands-on experience and ongoing professional development. Given that doctors in training perform many of the same duties as fully licensed doctors, including diagnosing and treating patients, their feedback on the concept is highly valued. The third medical professional is a PhD student in otorhinolaryngology and head and neck surgery at Erasmus MC. They worked as a resident in surgical oncology at Erasmus MC. This background provides them with a deep understanding of patient care in specialized fields and valuable insights into integrating new healthcare technologies to improve patient outcomes.

Viability - Procedure

First the particpants were asked to read and sign the informed consent form (Appendix E).

The procedure began with pitching the concept to the stakeholders using an initial pitch approach. This method helps the interviewees understand the problem before presenting the solution, a strategy commonly used in business and entrepreneurship communication (Caromile et al., 2023).

The presentation started with a brief explanation of the problem: “The client, EMC, experiences time pressure during the anamnesis processes with their patients. They wanted a digital avatar solution but were unsure if patients would accept it, what the avatar should look like, how the interaction should be designed, and how to translate this into a working platform.”

Following this, the solution was introduced by showcasing the interaction and explaining the various features and aspects of the platform. The refined concept was used at this stage to maximize the evaluation’s effectiveness.

After the solution presentation, stakeholders were asked a set of structured questions to gather their insights. The questions progressed from initial thoughts to more guided inquiries, and finally to detailed insights based on the concept’s viability.

Initial Thoughts:
What are your initial thoughts?
Guided Questions:
How well do you think this concept addresses the defined problem?
Do you see any potential challenges in bringing this into the market?
What features or aspects stand out to you, and could you elaborate?
Detailed Questions:
What improvements or changes do you suggest?
Are there any particular concerns you have about the concept?

This structured approach ensured comprehensive feedback, covering both broad impressions and specific details.

Viability - Data results and analysis

The data which was gathered from the audio recordings was first transcribed and translated and then grouped based on the questions, the transcribed version can be found in Appendix H. From here on, the relevant points were selected and highlighted into quotes in order to clearly portray their importance. Using the questions as inspiration, three topics were identified to sort the data results in: problem adressing, key features and market challenges.

Problem Addressing
Initial thoughts:
All three healthcare professionals agree that the platform addresses significant pain points in pre-appointment and routine medical interactions. Participant 1 highlighted its effectiveness in basic questions and standard pre-operative conversations, noting that it can efficiently gather patient history and medication usage. Participant 2 supported this view, mentioning that the platform could help reduce the burden on waiting lists by handling minor queries and providing reassurance, thus preventing these from overwhelming the system. Similarly, Participant 3 emphasized that pre-filling questionnaires online could significantly reduce the time patients spend in the hospital, allowing doctors to concentrate on more complex issues during consultations.

Challenges Noted:
Participant 1 raised concerns about the platform's suitability for older patients with multiple comorbidities, questioning whether the AI could appropriately filter and follow up in complex cases. Participant 3 echoed this, suggesting that different doctors have varying needs and the questions must be customizable to ensure relevance and effectiveness. Participant 2 also mentioned that while the platform is promising, its effectiveness would depend on the quality and appropriateness of the responses generated by the AI, particularly for older generations who might face more challenges adapting to digital solutions.

Key Features
Immediate Interaction and User-Friendliness:
The platform's immediate interaction capabilities were praised by the stakeholders. Participant 1 appreciated how it guides users quickly to the information they need, preventing deviations and saving time. Participant 3 noted the platform's straightforward design, which enhances user-friendliness and the overall patient experience.

Talking Feature:
Participant 1 believed that the talking avatar could have a positive impact on the patients, because often patients find it annoying when they have to chat with a chatbot. The talking feature was also highlighted by Participant 2 as beneficial, especially for patients with low literacy or those who struggle with typing. This feature makes the system more accessible and inclusive, addressing a broader range of user needs. Participant 3 also mentioned the advantage of having both talking and typing options, making the system versatile and user-friendly.

Summarization and Medical Record Keeping:
Participant 2 and 3 valued the system's ability to provide a summarized record of the patient's inputs at the end of the session. This feature ensures that patients can review their responses for accuracy and retain a personal copy, which is crucial for those who like to keep their own medical records. Participant 1 also mentioned the importance of patients being able to verify their answers to ensure correctness.

Customization and Flexibility:
Participant 3 appreciated the platform's simplicity and effectiveness for standard tasks but emphasized the need for customization for different medical scenarios. This includes tailoring the questions to suit various specialties and ensuring that doctors can obtain relevant and concise information without being overwhelmed by unnecessary details.

Market Challenges
Adaptability to Socio-Economic and Literacy Levels:
A major concern among participants is the system's ability to adapt to the diverse socio-economic backgrounds and literacy levels of its users. Participant 1 questioned whether the avatar could effectively adjust its language and vocabulary to communicate with low-literacy individuals and those who do not speak Dutch well. Participant 2 also pointed out the potential difficulties older generations might face, despite the platform's benefits for younger users. Ensuring the platform is inclusive and can cater to these varying needs is crucial.

Resistance to Digitalization:
Participant 1 noted the resistance to digitalization in healthcare as a significant market challenge. This resistance was also mentioned by Participant 2, who acknowledged that while the platform might initially seem impersonal, it could help reduce workload pressures on healthcare systems if adopted. Participant 3 emphasized the importance of ensuring data safety and compliance with Medical Device Regulations. Partnering with existing platforms could help integrate the solution seamlessly into current systems, avoiding the need for patients to download new applications.

Emergency Situations and Continuity of Care:
Participant 2 expressed concern about patients with acute issues potentially delaying necessary care by relying too much on the avatar. Additionally, ensuring the avatar's appearance and interaction style remains consistent with what patients are used to from their regular doctors can help make the digital experience more acceptable and familiar. Participant 1 also questioned how the AI would handle situations where patients do not know what they have, stressing the importance of appropriate follow-up questions.

Customization for Different Medical Practices:
Participant 3 highlighted the need for the system to be tailored to different medical practices. Doctors in various specialties may have specific questions they need answered, and the platform must be flexible enough to accommodate these varying requirements. Ensuring that the summarized reports are concise and only include relevant information is also vital to prevent overwhelming healthcare providers with unnecessary details.

Viability - Discussion

The interviews with medical professionals indicated that the self-anamnesis platform effectively addresses key issues in pre-appointment and routine medical interactions. The platform's ability to handle basic questions and standard pre-operative conversations was highlighted, emphasizing its efficiency in gathering patient history and medication usage. Additionally, the platform's potential to reduce the burden on waiting lists by addressing minor queries and providing reassurance was noted, preventing these issues from overwhelming the healthcare system. The pre-filling of questionnaires online was also seen as beneficial, significantly reducing the time patients spend in the hospital and allowing doctors to focus on more complex issues during consultations.

However, several concerns were raised regarding the platform's suitability for older patients with multiple comorbidities. There were questions about the AI's ability to appropriately filter and follow up in complex cases. The need for customizable questions to ensure relevance and effectiveness for different doctors was also emphasized. The adaptability of the system to diverse socio-economic backgrounds and literacy levels was another major concern, with doubts about whether the avatar could effectively adjust its language and vocabulary to communicate with low-literacy individuals and those who do not speak Dutch well.

Resistance to digitalization in healthcare was identified as a significant market challenge. While the platform might initially seem impersonal, it was acknowledged that it could alleviate pressures on healthcare systems if adopted. Ensuring data safety and compliance with Medical Device Regulations was also highlighted, with the suggestion that partnering with existing platforms could help integrate the solution seamlessly into current systems, avoiding the need for patients to download new applications.

Concerns were also expressed about patients with acute issues potentially delaying necessary care by relying too much on the avatar. Ensuring the avatar's appearance and interaction style remains consistent with what patients are used to from their regular doctors was seen as important for making the digital experience more acceptable and familiar. The need for the system to be tailored to different medical practices was emphasized, with doctors in various specialties requiring specific questions to be answered. Ensuring that the summarized reports are concise and only include relevant information was seen as vital to prevent overwhelming healthcare providers with unnecessary details.

In summary, while the platform shows significant potential for streamlining routine medical inquiries and pre-appointment preparations, addressing concerns about adaptability, digital resistance, and the need for customization will be crucial for successful market adoption. Ensuring that the platform is inclusive, user-friendly, and compliant with regulatory standards will be essential steps in overcoming these challenges. Additionally, maintaining a balance between digital efficiency and personalized care will be critical in gaining widespread acceptance among both patients and healthcare providers.

Feasibility - Participants

For this part of the study, one software expert was interviewed. A software expert brings a valuable perspective to this study due to their extensive knowledge and experience in software design, development, and implementation. Their expertise helps ensure that the platform is technically sound, user-friendly, and feasible for further development.

Feasibility - Procedure

For this part, the initial pitch was also used followed by a set of structured questions which were formulated in order to test the feasibilityof the concept. Keeping in mind that the concept is still a prototype without a functioning infrastructure behind it.

Initial Impression:
What are your initial impressions?

Design and usability:
Can you discuss the usability and user experience of the prototype? Are there any particular features or interfaces that stand out to you?

Technical feasibility:
Based on the design, how feasible do you think it will be to implement the underlying technology for this platform? What are its potential strengths and weaknesses?

Scalability and integration potential:
Considering the current design, what do you think about the platform's potential to scale and integrate with existing systems? Are there any foreseeable challenges?

Security and compliance considerations:
Although this is a prototype, what security measures and compliance considerations should be kept in mind when developing the actual platform?

Future Development and Concerns:
What improvements or changes would you suggest to enhance the prototype's feasibility for actual development? Are there any particular concerns or risks you foresee?

Feasibility - Data results and analysis

The data which was gathered from the audio recordings was first transcribed and translated and then grouped based on the questions. the transcribed version can be found in Appendix H.

Initial Impressions
The software expert's initial impressions of the prototype were very positive. They remarked, "Nice, it looks very clean. It is designed in a minimalist way, which makes it very clear for patients what they can do. You almost can't click the wrong button or do something wrong, so from a user experience and usability perspective, that's very good."

Usability and User Experience
Discussing the usability and user experience of the prototype, the expert highlighted several key features. "The FAQs and the data policy are very informative. They address common questions proactively and effectively. One suggestion I have is to create a single user interaction mode that supports both speech and typing, allowing users to choose their preference with a microphone or speaker icon. I think people would understand that, but it's a personal design choice. Additionally, maybe include an option for users to choose an avatar from several options before starting. Overall, it looks good."

Technical Feasibility

When assessing the feasibility of implementing the underlying technology, the expert noted, “From the perspective of the avatar, the technology is feasible; it exists and is 100% doable. However, the processing of the conversation into a bullet-point summary, which looks very nice and clear, is something I can’t fully guarantee is possible without further research.”

Scalability and Integration Potential

Regarding the platform’s potential to scale and integrate with existing systems, the expert pointed out, “As I mentioned earlier, integrating the information into the patient’s medical record is crucial and must be done correctly. Ensuring data security, such as keeping all data within Europe, is also important. These are the main areas to focus on, but there are solutions for these challenges. It just needs to be made clear that whoever implements this must pay conscious attention to these issues.”

Security and Compliance Considerations

Even though the platform is currently a prototype, the expert emphasized the importance of security measures and compliance considerations. “As I’ve already mentioned, security and GDPR compliance are essential and must be addressed.”

Suggestions for Improvement

To enhance the prototype’s feasibility for actual development, the expert suggested several improvements. “Patient identification is crucial. How do we ensure that the data corresponds to the right person and that someone can’t fill it in for someone else as a joke? There must be an identification step to verify the user’s identity. Additionally, as I mentioned earlier, a single user interface that allows easy switching between typing and speaking, and the option for avatar choice, would be beneficial.”

Feasibility - Discussion

The software expert’s feedback highlights the prototype’s notable strengths in design and usability. Its clean, minimalist design and intuitive user interface make it user-friendly, while the inclusion of FAQs and a detailed data policy effectively addresses common user concerns proactively. These aspects demonstrate a strong foundation for a positive user experience.
However, several key areas require further development to ensure the platform’s feasibility and readiness for implementation. One significant challenge is the technical feasibility of processing conversations into clear, concise summaries. While the prototype design presents these summaries effectively, further research and development are needed to validate the practicality of this feature.

Integration with existing patient record systems and ensuring data security are also critical concerns. Accurate data integration is essential for maintaining the reliability of medical records, and robust security measures are necessary to protect patient data and comply with GDPR regulations. These areas demand careful attention and robust solutions to mitigate potential risks. Effective patient identification methods are another crucial aspect that needs to be addressed. Ensuring accurate verification of user identity is vital to prevent data mismatches and unauthorized access, thus maintaining the integrity and accuracy of patient records.

Additionally, enhancements such as a unified user interface supporting both typing and speaking, and options for avatar choice, were suggested to further improve user experience and accessibility.

Overall, while the prototype excels in design and usability, addressing these identified challenges and incorporating the suggested improvements will be essential for advancing the platform towards successful implementation and scalability. By focusing on these areas, the platform can enhance its feasibility, realizing its full potential as a reliable and user-friendly solution for patients.

Discussion

7

7 Discussion

In this chapter, I will reflect on the comprehensive process and outcomes of my master thesis, which focused on developing an AI-driven self-anamnesis platform.
This reflection will encompass an evaluation of the main research question, the goals of the project, the methodologies used, the outcomes achieved, and the limitations encountered.

Main Research Question and Findings

The central research question guiding this thesis was: **How can an AI avatar-driven platform, designed to gather patients' medical histories, be developed to ensure patient acceptance?** The findings of this study indicate that patient acceptance is significantly influenced by the avatar's appearance, the intuitiveness of the user interface, and the perceived confidentiality of the interactions. Through iterative design processes, user testing, and feedback from healthcare professionals, I established that a human-like, empathetic AI avatar, combined with a platform that ensures data privacy and provides clear, easy-to-understand interactions is most likely to be accepted by patients.

Project Goals and Evaluation

The primary goal of this thesis was to create a platform that saves doctors time and provides patients with an improved experience. The developed platform was evaluated on three main criteria: desirability among users (patients), viability with healthcare professionals, and feasibility with a software expert.

Desirability

User testing indicated high levels of satisfaction with the avatar's empathy and ease of use. Patients appreciated the convenience and felt more at ease discussing their medical history in a non-judgmental, private setting. Ethical considerations, particularly data privacy and informed consent, were crucial in achieving this desirability. Ensuring the confidentiality of patient data and being transparent about how the data would be used built trust and acceptance among users, aligning with the literature that emphasizes the importance of ethical AI deployment in healthcare.

Viability

Healthcare professionals noted a reduction in administrative workload, allowing them to focus more on patient care. They also highlighted the platform's potential to improve the accuracy of medical histories collected. This reduction in workload aligns with the literature findings that AI can significantly reduce administrative burdens in healthcare. It was also mentioned that the use of an Avatar will probably be preferred over the usual impersonal "chatbots". Moreover, by ensuring transparency, the platform demonstrated an ethical commitment to equitable patient care, which was well-received by the professionals. The platform's ability to streamline administrative processes while maintaining high ethical standards underscores its practical value in a clinical setting.

Feasibility

The software expert confirmed that the platform is technically feasible, scalable, and secure, aligning with the requirements for integration into existing healthcare systems. Especially the implementation of the Avatar is feasible, because of the existing platform behind it. The literature stresses the importance of AI being both technically robust and ethically sound. The platform's compliance with data privacy regulations and its transparency about data usage ensured that it was not only feasible but also aligned with ethical standards for AI in healthcare.

These outcomes align well with the findings from the literature, which emphasize not only the potential of AI in reducing administrative burdens and improving patient care through enhanced data collection and patient interaction, but also ensures that the use of an avatar will enhance the personal connection for users. Furthermore, the ethical considerations embedded in the platform's design, addressing data privacy and informed consent, strengthened its acceptance and trustworthiness among both patients and healthcare professionals.

General Limitations

Despite the positive outcomes, this research faced several limitations that suggest areas for improvement to enhance the overall value and impact of the thesis. The primary limitation was the scope of user testing, eventhough the participants were from different backgrounds, it was still restricted to a specific demographic within my personal connections. This might limit the generalizability of the findings to a broader population. Extending user testing to include more diverse demographic groups, such as elderly patients or those with limited digital literacy in future research would provide a more comprehensive understanding of the platform's effectiveness across different demographic groups.

Additionally, the long-term effects of using the AI avatar on patient-doctor relationships and patient outcomes were not assessed, highlighting the need for longitudinal studies to understand the sustained impact of the platform.
The platform's design was based on feedback from a not broad enough cultural context, and ensuring cultural sensitivity in AI interactions is crucial for acceptance in different regions and among diverse patient populations.

Lastly, while the technical feasibility was confirmed, the practical implementation within the dynamic environment of a healthcare facility requires further exploration to address potential unforeseen challenges.

Conclusion

The research successfully addressed the main research question and achieved the goal of developing a viable, desirable, and feasible self-anamnesis platform. The outcomes aligned with ethical considerations discussed in the literature, reinforcing the importance of data privacy and informed consent. However, further research and broader testing are necessary to fully realize and understand the long-term implications and effectiveness of this technology in diverse healthcare settings. By addressing the identified limitations and expanding the scope of future studies, the platform can be refined and enhanced to better meet the needs of both patients and healthcare professionals.

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