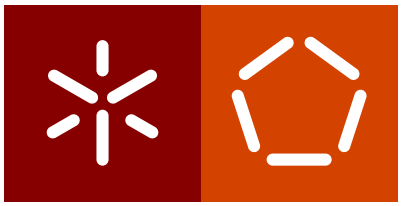

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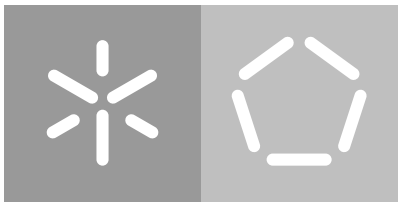

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PhobiAR, an Artefact of Augmented Reality to support the Exposure Therapy of Specific Phobias

Master dissertation
Integrated Master in Informatics Engineering

Orientador
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December 2020

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Raul Vilas Boas

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ABSTRACT

Phobia is a type of anxiety disorder defined by a persistent and excessive fear of an object or situation. Currently, exposure therapy is the most practiced method to treat phobias, although it comes with limitations. We can reduce these limitations by combining Augmented Reality techniques with exposure therapy. Its benefits are a decrease in costs, versatility of the process, and full control of the procedure by the therapist. As shown in multiple research, Augmented Reality has obtained interesting results in the therapy of psychological disorders serving as a foundation for the development of this project. The recent technological advances in the field also allowed for easier access to Augmented Reality which is accessible to use even in old smartphones. The goal of this Master's dissertation was to develop an artefact in conjunction with psychologists who treat phobic patients, to create a program to support the therapy of phobias with a gradual exposure system. Their help was essential to understand the most important features needed for the platform. The platform was deployed in the informatics department servers, which could be accessed by everyone that had internet connection. Multiple psychologists were invited to test the platform by following a user guide created and give their technical feedback in the end. The results gathered were positive, which proves the viability of this system as an extension to the current methods by providing comfort and efficiency.

Keywords: Augmented Reality, Virtual Reality, Anxiety disorder, Phobia, WebAR, Gradual Exposure, 3D Models.

RESUMO

A fobia é um tipo de transtorno de ansiedade definido por um medo persistente e excessivo de um objeto ou situação. Atualmente, o terapia de exposição é o método mais praticado para tratar fobias, embora com limitações. Estas limitações são reduzidas combinando técnicas de Realidade Aumentada com a terapia de exposição. Os seus benefícios são uma redução de custos, versatilidade do processo e controle total do procedimento pelo terapeuta. Como foi demostrado em várias pesquisas, a Realidade Aumentada obteve resultados interessantes no tratamento de distúrbios psicológicos, servindo de base para o desenvolvimento deste projeto. Os recentes avanços tecnológicos no campo permitem também um acesso fácil à Realidade Aumentada, acessível para uso mesmo em smartphones antigos. Nosso objetivo é desenvolver um artefato em conjunto com psicólogos que tratam de pacientes fóbicos, para criar um programa para apoiar o tratamento de fobias com um sistema de exposição gradual. A ajuda deles foi essencial para entender os recursos que são mais importantes para a plataforma. A plataforma foi colocada nos servidores do departamento de informática e podia ser acedida por qualquer pessoa que tivesse conexão à internet. Vários psicólogos foram convidados a testar a plataforma seguindo um guião criado e dando seu feedback técnico no final. Os resultados recolhidos foram positivos, o que comprova a viabilidade deste sistema como uma extensão dos métodos atuais providenciando conforto e eficiência.

Palavras Chave: Realidade Aumentada, Realidade Virtual, Transtorno de Ansiedade, Fobia, WebAR, Exposição Gradual, Modelos 3D

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ACRONYMS

A

AR Augmented Reality.

C

CBT Cognitive behavioral therap.

D

DI Departamento de Informática.

DSR Design Science Research.

G

GLB Graphics Library Binary.

GLTF Graphics Library Transmission Forma.

H

HRV Heart Rate Variability.

HWD Head-Worn Displays.

M

MIEI Mestrado Integrado em Engenharia Informática.

MR Mixed Reality.

S

SLAM Simultaneous Localisation and Mapping.

U

UM Universidade do Minho.

V

VR Virtual Reality.

W

WEBAR Web Based Augmented Reality.

1

INTRODUCTION

Phobia is a type of anxiety disorder that causes an individual to experience an irrational fear about a situation, living creature, place, or object (Medeiros et al., 2008). The term comes from the Greek *Phobos* which means "flight", "panic-fear", "terror". It also comes from the personification of fear in Greek mythology called *Phobos*, who provoked fear and terror in one's enemy (Marks, 1969).

Specific phobia is one of the most prevalent mental disorders in the overall population, and the 12-month community prevalence estimate to be approximately 7%-9% in the United States and 6% in European countries. This value is lower in Asian, African, and Latin American countries with 2% to 4% rates. Frequently, females are more twice more affected with specific phobias than males, although it may change depending on the type of phobia. For example, females experience more animal, natural environment, and situational specific phobias than males, although blood-injection-injury affects both genders nearly equally (Association et al., 2013).

Azuma (1997) described Augmented Reality (AR) as supplementing the real world with virtual information, such as virtual objects, texts, images, and sounds, in real-time. This technology enriches the surrounding environment without replacing it, as opposed to Virtual Reality (VR), which completely replaces the real world with a synthetic environment.

In recent years, Augmented Reality has considerably increased its accessibility and efficiency with the introduction of Augmented Reality in web browsers. This innovation allows us to use Augmented Reality in any device connected to the internet. Therefore, with the increase in the quality and quantity of cell phones, everyone is capable of experience Augmented Reality as easy as picking their phone and opening a browser on the internet.

1.1 MOTIVATION

Augmented Reality is a fascinating topic to study because it enhances the user's perception and interaction of the real world. It also connects the users to the people, locations, and objects around them, rather than immersing them in a virtual environment (Azuma, 2017).

In recent years, Augmented Reality has become a popular technology and is getting more attention in researches. Therefore, to study the current state of AR in the science community, we used the online research database Scopus to investigate the number of Augmented Reality papers released over the years. In this database, we queried “augmented reality" to search in all the articles titles, abstracts, and keywords between the years 1995 and 2019. This search was conducted on 3 January 2020, and it found 25008 documents. After analyzing the results, we created the graph shown in figure 1. In this graph, we can observe that AR documents have been steadily increasing over the years, having a sudden rise in the documents published over the last three years. This serves as an encouragement to work with Augmented Reality to explore and take advantage of this promising technology.

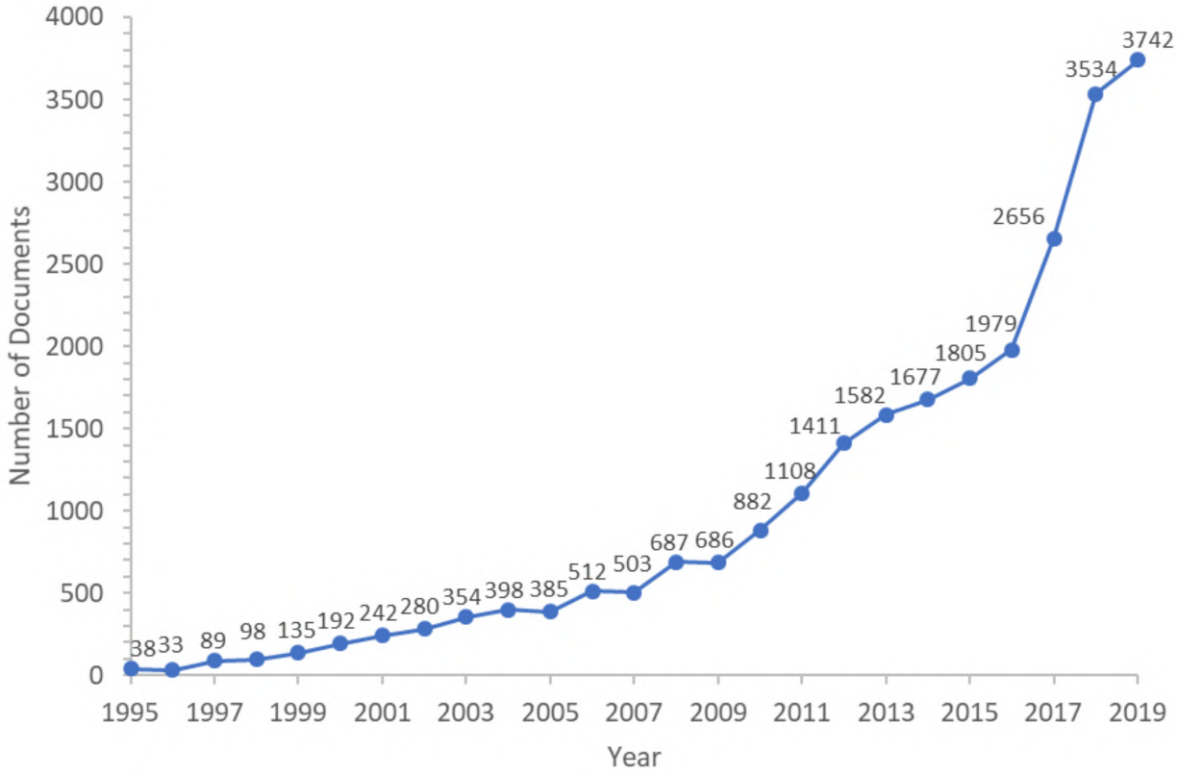

Figure 1: Publications about Augmented Reality over the years

The same method was applied to evaluate the current state of academic researches on Phobias. Therefore, we queried “phobia" to search in all the articles titles, abstracts, and keywords between the years 1995 and 2019. This search was conducted on 3 January 2020, and it produced 21928 results. The graph in figure 2 was created based on these results. Considering Phobias is not a recent topic, it had more publication than Augmented Reality in 1995. However, it was surpassed by AR in 2011. Phobias publications had a sudden increase at the beginning of 2000 and have been considered constant in the last years. These

results help us realize that Phobias still receives a substantial amount of attention in the science community, which supports our intention to improve its treatment.

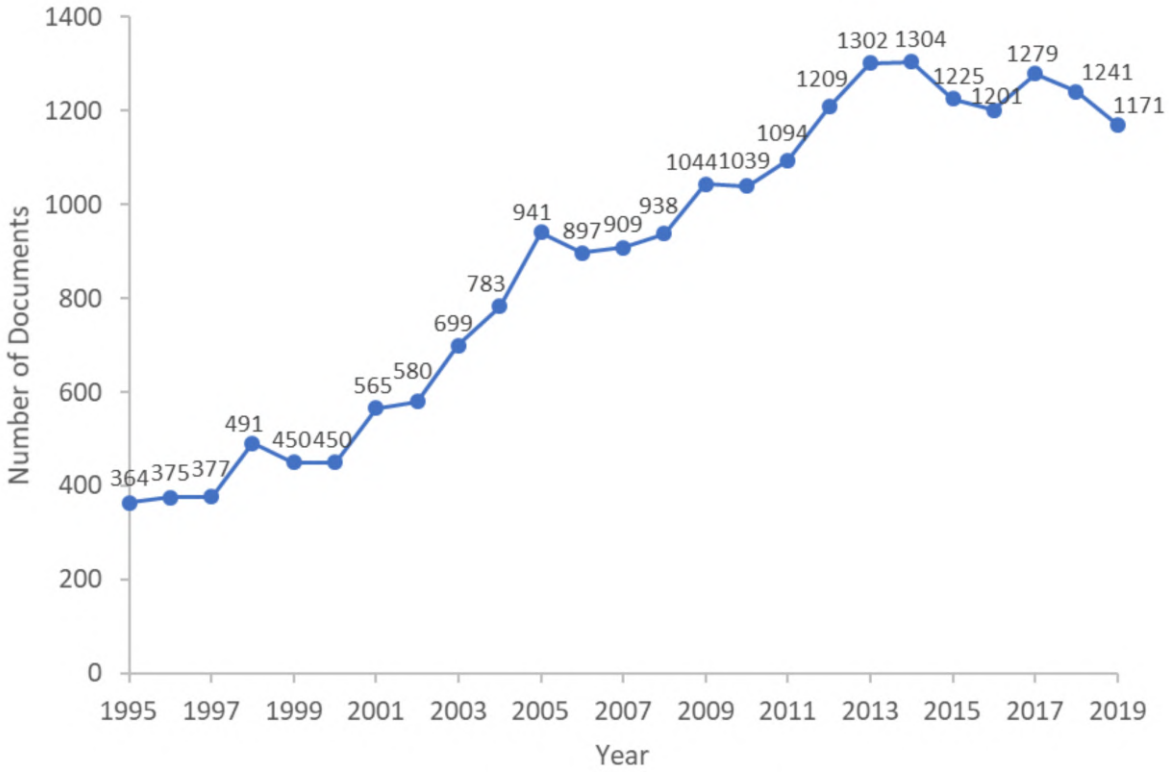

Figure 2: Publications about Phobias over the years

After evaluating the current state of the two main topics of our project, our goal with this project is to use Augmented Reality to complement the traditional methods. We will take advantage of new possible scenarios that AR presents by increasing information in the real world as virtual elements. In this context, the virtual elements would be the Phobia of the patient who seeks treatment.

We believe that AR serves as a meeting ground between the phobic not having any contact with the phobia to him having real interaction with it. Furthermore, there's the possibility to divide the procedure into small steps for the phobic to overcome, providing a more reliable growth between different levels of phobias. The likelihood of the patient to give up would also decrease since it would be less of an impact.

In this context, with the technological advancements in Augmented Reality, it emerged the motivation to create a system capable of helping with the treatment of phobias. The main focus of this project is to enhance the techniques that already exist by reducing the cost, making it more accessible, or improving the quality.

1.2 OBJECTIVES

The main goal of this master's work is to build a useful system to assist in the treatment of Specific Phobias. So the objectives are the following:

- Study the problem at hand by exploring related works to better understand what has been done about this topic to improve it. This will also provide the knowledge to identify the main problems and work on solutions;
- Assemble requirements by doing interviews in conjunction with a psychologist that has experience in treating phobic patient. This provides a more solid foundation on what the system should aim to accomplish;
- Implement the system by associating a marker to a phobia, having the possibility to have different markers that represent different stage levels of the phobia, have a preview of the existing models and the possibility for the psychologist to import new models of phobias if needed. It also must be able to create, edit and delete sessions of patients where the user can write notes about their sessions;
- Develop a system capable of detecting the user heart rate so the psychologist has more information about the patient condition;
- Verification of the system by analyzing its efficiency and collecting results from the experiments with the psychologists.

1.3 RESEARCH HYPOTHESIS

It is possible to improve the effectiveness of Phobia treatment by complementing it with Augmented Reality.

1.4 METHODOLOGY

In this project, we're going to follow the Design Science Research (DSR) methodology. As stated by Von Alan et al. (2004), the solution of a problem is accomplished by building and using an artefact designed to solve the problem. According to Van Aken (2005), the purpose of a design science is to expand the knowledge so that the professionals of the area can use it to solve the problems in their field.

To support the development of DSR, Von Alan et al. (2004) established the following guidelines:

1. **Design as an Artefact**: Creation of an useful and viable artefact.

2. **Problem Relevance**: A problem domain that the artefact will be proved useful.
3. **Design Evaluation**: The evaluation of the utility, quality and efficacy of the artefact.
4. **Research Contributions**: The implementation needs provide a clear contribution in the area by solving a unsolved problem or by solving a solved problem more effectively.
5. **Research Rigor**: The artefact upon the application must follow rigorous methods in his construction and evaluation.
6. **Design as a Search Process**: The search for an viable artefact requires using available methods and applying them in a cyclical process until the solution is effective in solving the problem.
7. **Communication of Research**: The results must be communicated effectively both to a technical audience and to managerial audience.

Considering our work is a problem-solving process, we have adapted the seven guidelines into five steps. The first step was to identify and comprehend the problem, which is supporting the exposition treatment of Specific Phobias using Augmented Reality. The next step is to define objectives that would lead to possible solutions to the problem. In this step, we will have the help of a psychologist who will provide their professional opinion of the area so the artefact as the tools needed to accomplished the goal. In the third phase, we will proceed to develop the artefact following the objectives defined in the last step. After having built a prototype of the project, it will be evaluated by the same psychologist to judge its viability. Depending on their observation we might return to step two and add or remove new objectives. The steps two, three and four will remain in a cycle until the artefact is verified by the psychologist. Afterwards, when the product is develop we will test it with multiple psychologist and gather results to prove its viability. Finally, in the last step, we will present the results obtained in the form of a scholarly publication and if possible a professional publication.

1.5 Document Organization

The structure of this document is as follow: the definition of phobias and a description of the methods used to treat them in chapter 2. In chapter 3, it's explained the concept of Augmented Reality, Virtual Reality and their differences, the types of Augmented Reality, it's application on the treatment of phobias and related works. Afterwards, in chapter 4, we will described the proposed artefact and give some examples. In chapter 5, we explain all the parts that incorporate in the development of the platform and in chapter 6 we will show an overview of the final product with an example. The results and discussion of the user

testing are in chapter 7. Lastly, in chapter 8 we conclude the project and show the proposed schedule.

2

ANXIETY DISORDER: PHOBIA

Fear is inherent and common in humans. It serves as an adaptive behavior to ensure our survival towards a dangerous situation (Barlow et al., 2017). Various anxiety disorders experience features of excessive fear, anxiety, and related behavioral disturbances. Fear is the emotional response to a real or perceived threat and is frequently correlated with a change of behavior such as fleeing or hiding. Intense fear can lead to a panic attack, which happens to people with anxiety disorders. In contrast, anxiety is the anticipation of a future threat that leads to muscle tension and alertness towards a possible danger (Association et al., 2013). When fear appears in harmless situations, it is no longer adaptable and restricts the life of the person (Barlow et al., 2017).

Marks (1969) defined phobia as a special kind of fear that is out of proportion based on the situation, cannot be explained or reasoned away, is not voluntarily controlled, and leads to avoidance of the feared situation. Although they usually recognize that their fear may be exaggerated and unrealistic, since the vast majority of people wouldn't have that problem, they are not capable of suppressing their fear. Beck et al. (2005) adds that what makes a fear into a phobia is the magnification of the amount of risk in a feared situation and the degree of harm that will come from being in that situation.

In the next sections, we will start to distinguish the categories of Phobias, study the prevalence and incidence, describe some causes and effects provoke by them, and the type of treatment used by psychologists.

2.1 CATEGORIES AND TYPES

The American Psychiatric Association identifies three categories of phobias: Agoraphobia, Social Anxiety Disorder, and Specific Phobia.

Agoraphobia is the fear of being in situations that the phobic thinks as difficult to escape or unsafe. This phobia is identified when an individual fears two or more of the following situations: using public transport, staying in open spaces, being in enclosed spaces, standing in line, being in a crowd, or being outside alone. They fear these situations because they think it might be difficult to escape or that help might be unavailable in case anything unfortunate

happens. This anxiety disorder is diagnosed only if the fear, anxiety, or avoidance is persistent, usually by lasting at least six months or more. It also needs to cause distress or impairment in the social life of the individual. Moreover, when an individual diagnosed with Agoraphobia makes contact with the situations he fears, it almost always provokes fear or anxiety. In the worst cases of Agoraphobia, the person is unable to leave their home and is dependent on others to provide help and assistance (Association et al., 2013).

Social Anxiety Disorder, also known as Social Phobia, is characterized by an intense fear of one or more social situations. This fear triggers when the individual is exposed to possible scrutiny since he fears to be negatively evaluated by others. Some examples of these situations are: having a conversation, meeting unfamiliar people, being observed, and giving a speech. An individual diagnosed with this anxiety disorder almost always suffers from fear or anxiety in those social situations. However, the type and intensity of the fear may change in different occurrences. He will also regularly avoid those situations or go through them with intense fear or anxiety. Moreover, this condition will limit the individual's usual routine reducing his quality of life (Association et al., 2013).

Specific Phobia is characterized as fear or anxiety of a specific object or situation. In this anxiety disorder, it is common to have multiple Specific Phobias. Roughly 75% of individuals fear more than one situation or object. Any contact with the phobic object or situations almost always provokes immediate fear or anxiety in the individual. If he is only occasionally anxious about those situations, he would not be diagnosed with Specific Phobia. However, as well as in Social Anxiety Disorder, the intensity of the fear may vary depending on other causes, such as the presence of others, duration of exposure, and dangerous elements. Association et al. (2013)

Just until the beginning of the early 1990s, Specific Phobias were called Simple Phobia until it was changed and subdivided into five types. Following the Association et al. (2013) these five types are:

- **Animal** (fear of spiders, insects, dogs)
- **Natural Environment** (fear of heights, storms, water)
- **Blood-injection-injury** (fear of needles, invasive medical procedures)
- **Situational** (aeroplane, elevators, enclosed places)
- **Other** (circumstances that may lead to choking or vomiting, loud sounds or costumed characters)

2.2 Prevalence and incidence of Specific Phobias

In Eaton et al. (2018) literature search, they gathered information about the prevalence of specific phobias in adults between 1984 and 2016. The median lifetime prevalence value they got was 7.2%, although these values vary considerably in different countries. For example, in Florence, the value is 1.5%, and in Oslo, Norway is 14.4%. Additionally, low-income countries have a lower prevalence than others.

Figure 3 shows the first occurrence of a Specific Phobia around different ages. We can see that females have a more tendency to have a Specific Phobia and that the age where it mostly occurs is during childhood, and they persist for several years. Moreover, they could also result in the appearance of other mental disorders, such as anxiety, mood, and substance-use disorders (Eaton et al., 2018). Therefore, understanding how they appear and how to treat them is essential to prevent the manifestation of other disorders

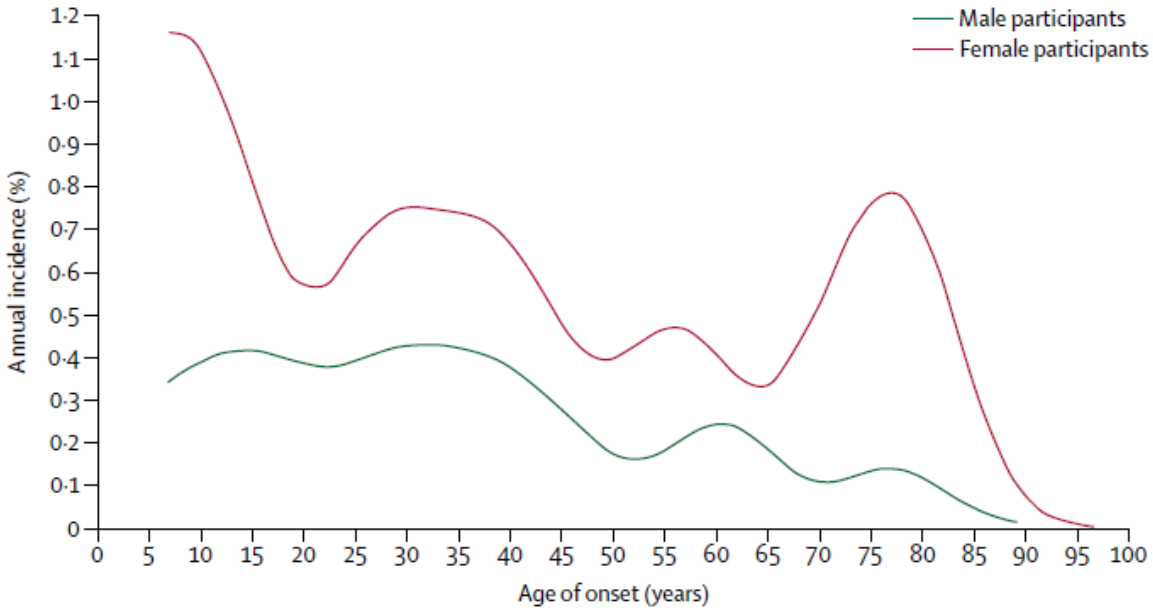

Figure 3: Incidence of Specific Phobia by age of first onset (Eaton et al., 2018)

2.3 Causes and effects

The development of a phobia may occur after a traumatic event that resulted in an unpleasant or harmful experience. For example, if a person is involved in a car accident, he may develop vehophobia, which is the fear of driving. These phobias are usually easier to date since it's from a specific traumatic event of the person's life. Other phobias may come from childhood fears the person didn't outgrow, typical examples are the fear of being alone in the dark

or being lost. One possible reason that leads to the person not being able to outgrow the fear, unlike most children, is that the child was able to avoid the feared situation (Beck et al., 2005).

Beck et al. (2005) defined three characteristics that occur when a person faces the cause of his fear. The first one is suffering from an unpleasant level of anxiety that leads to symptoms such as a pounding heart, racing pulse, nausea, dizziness, and faintness. The second one is escaping or avoiding the source of the phobia. If he is unable to avoid it, he may overcome the situation or develop chronic anxiety. Finally, the third characteristic is the ability to understand that the fear is excessive, but despite this, he is still incapable to overcome the fear.

This understanding that leads the phobic to seek treatment is an important step for them to outgrow the fear. However, the efficiency of the treatment is also as important

2.4 TREATMENT

Generally, the people affected by phobias seek treatment because they either realize they suffer in a situation that doesn't affect others or because they can no longer endure the effects and the restrictions inflicted by the phobia in their life. Although, people who are phobic about certain situations are completely relaxed in other circumstances that provide distress in others. To an observer, the situation may seem harmless, although for the phobic it may be life-threatening (Beck et al., 2005).

Exposure therapy is an efficient method to treat specific phobias. In this approach, the psychologist exposes the patient to situations that increase his anxiety levels. This procedure should be performed multiple times and gradually to reduce the phobic responses, through learning processes about what is feared (Sánchez et al., 2019). Using this approach comes with a lot of limitations since it's not always possible to control, prolong, or repeat the exposure to the fear. Depending on the type of treatment this could also cause moving costs, the discomfort of the patient, and loss of time on the process (Wauke et al., 2004).

Among the various ways to put exposure therapy into practice, technology can be used to assist in the treatment by improving quality and safety. Therefore, we can enhance the therapeutic process by simulating this phobic object in a controlled and safe environment (Sánchez et al., 2019). These limitations could decrease if we used virtual tools, such as Augmented Reality since there would not be a need for transportation of the patient and the therapist. Applying this technology also allows the therapist to have full control of the virtual objects and how many times he wants the process to be simulated, without any increase in the cost (Medeiros et al., 2008).

Alternatively, there is also another effective treatment for specific phobias called Cognitive behavioral therapy (CBT). This technique, combined with others, helps to change the way

the phobic patient views the feared object or situation. CBT accentuates learning to grow a sense of mastery and confidence with your thoughts and feelings as opposed to feeling overwhelmed by them. Therefore by changing unhelpful thoughts, beliefs, and attitudes, it improves their emotional regulation(Beck and Beck, 1995).

After having a better comprehension of phobias, we have to study Augmented Reality to understand how we can efficiently use it to treat phobias. Therefore, in the next chapter, we will focus on what is AR, what types exist, and how we can apply it in the treatment.

3

AUGMENTED REALITY

It's possible to use Augmented Reality to assist in the treatment of phobias. Therefore, in this chapter, we intend to explore the concepts and main definitions of the topics related to the research, such as Augmented Reality and virtual reality. Also, we will compare Augmented Reality with virtual reality to identify their differences applications in the treatment of phobias. Lastly, there will be a comparison between using Augmented Reality and traditional methods.

The development of VR started in the 1950s and 60' because of several inventions that occurred at that time. For instance, the invention of the Sensorama by Morton Heilig aimed to engage all of the user's senses via specific components, which provided a complete multi-sensory experience. In 1961, the Philco Corporation invented the first head-mounted displays that incorporated motion tracking and dual monitor displays called Headsight (Maples-Keller et al., 2017).

In 1966, Ivan Sutherland created the first Augmented Reality device called "Sword of Damocles". The origin of its name came from an ancient Greek story of Damocles because the equipment was suspended on top of the user's head (Tabusca and Garais, 2017). Although, the concept of virtual reality was only formalized in 1989 by Jaron Lanier where it began to get more attention in researches and psychiatric treatments. In later years, it was even proved effective in the treatment of acrophobia, which leads to more studies on its use to treat anxiety disorders and other psychiatric conditions Maples-Keller et al. (2017). In Figure, 5 is a chronological about the evolution of AR adapted from Qiao et al. (2019).

3.1 AUGMENTED REALITY AND VIRTUAL REALITY

As defined by Azuma (1997), Augmented Reality is an interactive experience where it combines the real world with virtual elements that supplement reality, rather than completely replacing it. Since the user is not immersed and so can see the real world, this gives more feeling of presence and allows them to use their own hands to interact resulting in a more real experience. The ideal scenario for AR would be if it looked like the virtual elements and the real object coexisted in the real world, without the user knowing which one is real.

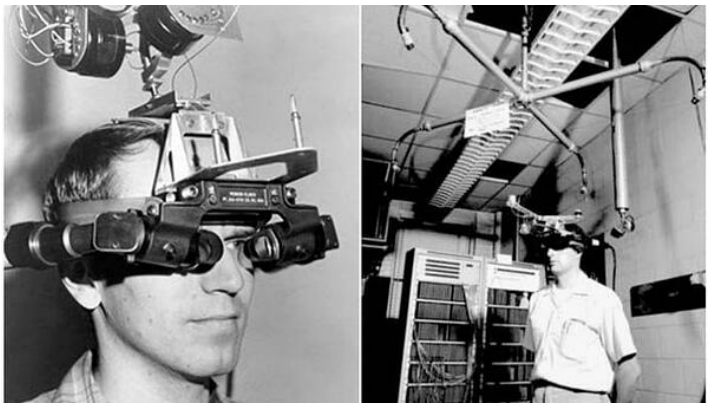

Figure 4: Ivan Sutherland, a Harvard professor and computer scientist, created the first head-mounted display called 'The Sword of Damocles.

Besides vision, Augmented Reality could even be extended to other senses such as sound, achieving a bigger immersion with the environment.

Azuma (1997) also defined three characteristics that AR has to follow. Those characteristics are:

- Combines real and virtual
- Interactive in real time
- Registered in 3-D

In contrast, in Virtual Reality, the user can't see the real world because he is completely immersed in a synthetic environment Azuma (1997). To understand the differences between Augmented Reality and Virtual Reality, Milgram et al. (1994) created a reality-virtuality continuum, as observed in Figure 6, that separates the two concepts. The Augmented Reality is closer to the real environment as it adds information to the real world with visual elements. AR is considered to be Mixed Reality (MR) since it incorporates elements from both realities. VR appears on the right side of the continuum since it's completely a Virtual Environment. There's also a variant o VR called Augmented Virtuality, which combines elements from the real world into the virtual environment this is also considered a Mixed Reality.

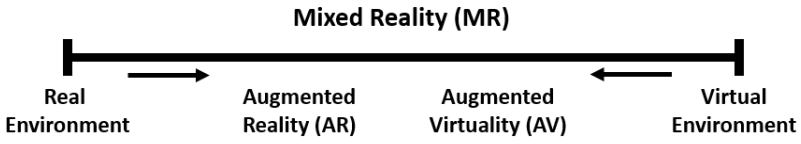

Figure 6: Reality-Virtuality (RV) Continuum adapted from (Milgram et al., 1994).

Although similar, VR and AR are better for different kinds of psychological treatments being that VA would be more suitable for treatments that consist of using their hands and

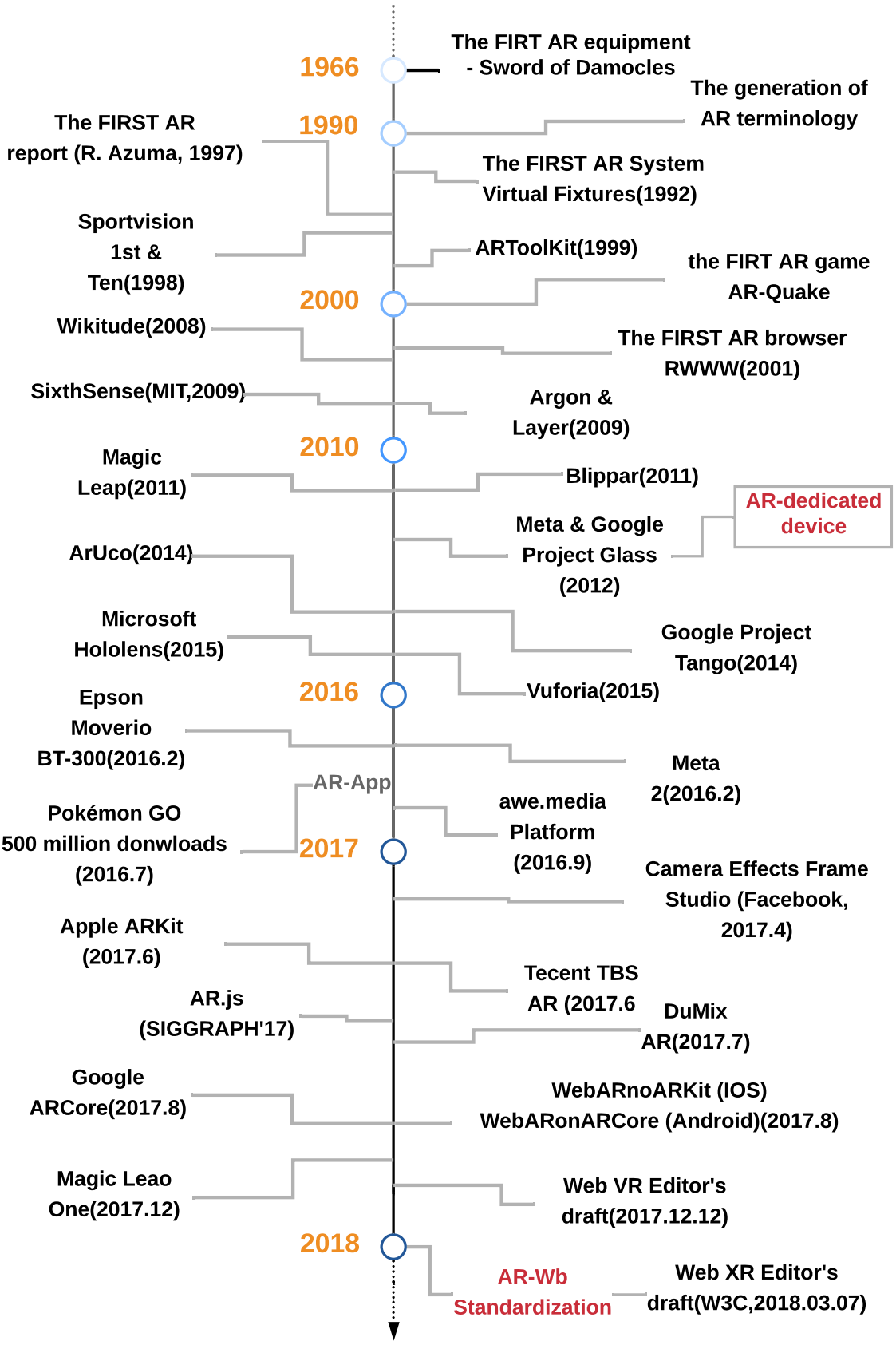

Figure 5: Historical evolution of AR adapted from Qiao et al. (2019).

feet to interact with the phobia, otherwise VR might be a better option. In this case, the type of phobia will determine the type of technology to use Juan et al. (2005).

One study compared the effect of AR and VR on inducing anxiety made by Tsai et al. (2018) by comparing the heart rate of both methods. In this study, the phobia focused was Claustrophobia, which is characterized by the fear of enclosed spaces. Their results showed that the heart rate variability (HRV) generated better results using AR than VR because the patients felt a more natural presence by becoming more engaged with the experiment. They also made anxiety questionnaires to the patients, which resulted in a contraction with the HRV test since they felt more anxiety during VR than VA. Although, this could have been caused by the stimuli that the VR provides.

Augmented Reality and Virtual Reality can be displayed in multiple ways, each with its strengths and weakness. Therefore, in the next section, we will describe the different types of AR available.

3.2 TYPES OF AUGMENTED REALITY

As stated by Azuma et al. (2001), Augmented Reality can be classified depending on the display used for viewing the virtual elements in the real world. Therefore, they are divided into the following categories: head worn, handheld and projective.

Head-Worn Displays (HWD). In this type of display, the user mounts the equipment in their heads providing the image in front of their eyes. There are two types of head-worn displays: optical see-through and video see-through. The first one produces the virtual elements through the transparent display, and the other uses the video, captured from the camera on the head-worn, as background for the AR overlay. The video and the virtual elements are then shown on an opaque display. Multiple optical see-through displays were produced recently, such as the Meta 2 display, Microsoft's HoloLens, and DAQRI's Smart Helmet specifically designed to be used for Augmented Reality (Azuma, 2017). Among the two types, optical see-through is getting more attention since it covers two problems of the video see-through. First, since the user is in a direct view of the real world it avoids distorting or reducing the user's view of the real environment. Second, if the power is cut off, in the video-through display the user is effectively blind since the equipment covers his eyes this doesn't happen in the optical see-through displays since the user has a clear view of the real world. (Azuma, 1997)

Handheld. Some types of AR systems can use handheld displays that use a camera attached to it that provides video see-through with the virtual information. There are two types of systems that can provide AR display which is: cell phones and Tablets. All these devices provide a fair trade-off between size, weight, computing power, and cost (Wagner and Schmalstieg, 2006).

Figure 7: Example of a Head-worn display (Microsoft's HoloLens 2).

Projection. In this method, the virtual elements are projected directly into the environment. This could be achieved using a projector without the need for special eyewear. This type of display allows for a highly precise tracking technology since it's within a controlled environment and a better resolution can be provided. (Stork and Bimber, 2002). In this type of display, the user cannot carry any devices which can disturb them. Another option is to incorporate the projector with a head-worn who will project the images along the viewer's line of sight (Azuma et al., 2001).

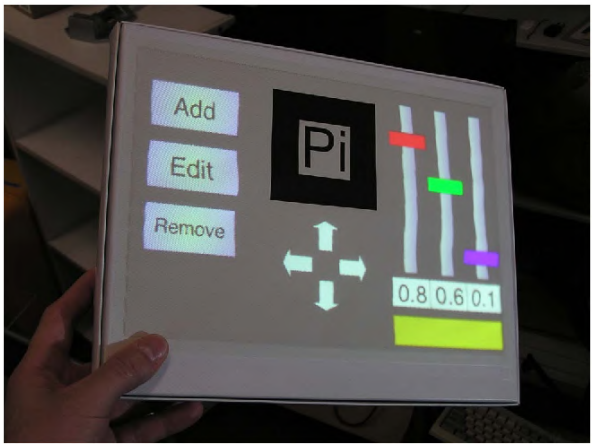

Figure 8: Projecting the control parameters in a Panel (Ehnes et al., 2004)

Tracking is one of the most important techniques in AR technologies that is responsible for displaying the 3D and adapt it if there's any change in the viewer's position. However, it is still difficult to obtain low-latency tracking with high precision and accuracy (Kim et al., 2018).

Zhou et al. (2008) categorized the tracking techniques into three categories that were later expanded by Kim et al. (2018). These categories are Sensor-Based tracking, Vision-Based

tracking, Simultaneous Localisation and Mapping, and Hybrid tracking, as shown in figure 9.

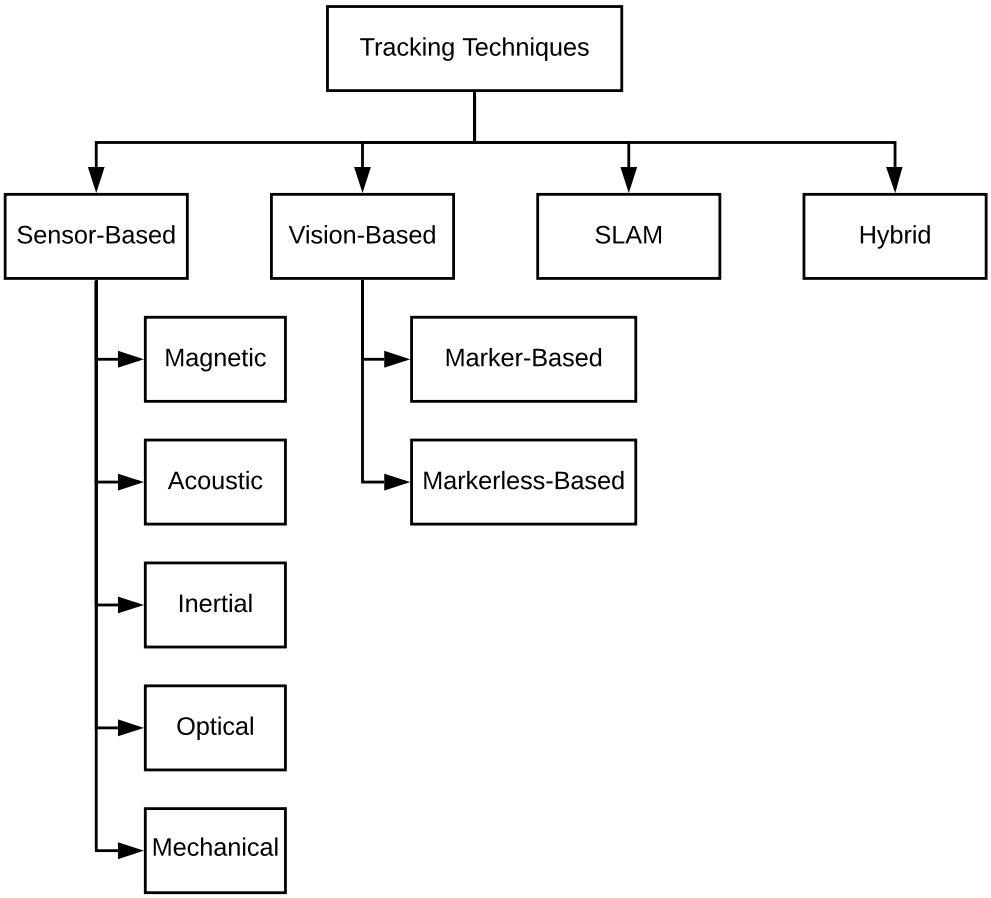

Figure 9: Augmented Reality tracking techniques

Sensor-Based Tracking Techniques consist of using sensors, such as magnetic, acoustic, inertial, optical, and mechanical sensors. These methods have their advantages and disadvantages, therefore researchers are exploring different ways to combine the different types of sensors to provide better tracking techniques (Zhou et al., 2008). One example of a Sensor-Based system is *The Bat* created by Newman et al. (2001) that uses ultrasonic sensors to provide wide-area indoor tracking.

Vision-Based tracking uses image processing techniques to calculate the position of the camera relative to real-world objects. This type of tracking can be divided into two categories: Marker-Based and Markerless (Afif et al., 2013).

Marker-Based uses a marker, for example, a QR code, to recognize the pattern and overlay the virtual elements on the marker. Markers are simple images that are used to place the

virtual assets when the camera detects it. They are mostly black and white, as we can see in figure 10.

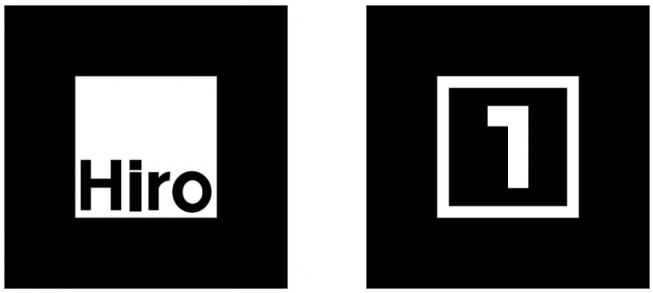

Figure 10: Markers examples

The Markerless tracking aims to recognize natural elements in the real world, such as human faces or arms, and place the virtual object in that position.

Simultaneous Localisation and Mapping (SLAM) is another tracking technique used in Augmented Reality. SLAM denotes the computational method of building or updating a map of an unknown space while simultaneously keeping track of an agent's location in it. This technique has the advantage of not needing any prior information, such as reference images or 3D models. The limitations of SLAM are a high computational cost to deal with tracking and mapping simultaneously and tracking loss caused by camera movement. However, it has overcome some of these limitations and has improved the tracking over the past ten years (Kim et al., 2018).

Finally, we have Hybrid tracking, which consists of combining multiple techniques to improve tracking quality. This method is a good alternative because there are situations where a single tracking method is not enough to provide reliable tracking for AR. For example, sensor-based methods may not produce good results, and vision-based techniques struggle in texture-less surroundings. Hybrid tracking is specifically beneficial in mobile platforms since they are inherently equipped with multiple sensors used for tracking techniques (Kim et al., 2018).

After classifying all types of Augmented Reality, it is important to understand and compare the differences between the use of AR versus the traditional methods in the treatment of Phobias. Therefore, the next section will focus on this topic.

3.3 Traditional Methods and AR/VR Treatment

As stated by Juan et al. (2005) Virtual Reality and Augmented Reality share some benefits in comparison with the traditional methods as shown in table 1. They contribute to a safer

environment for the patient allowing him to feel less anxious and decreasing the possibilities of him giving up on the treatment.

In the case of Zoophobia, which is the Specific Phobia to particular animals, the therapist cannot control them. For example, if the patient fears dogs, there is always the possibility that he is attacked by them. This situation could lead to an increased level of phobia. However, using AR ou VR this problem does not happen because the elements are virtual, and therefore they can't hurt the patient. In another scenario, if the patient fears flying by plane, there is a need for him to travel by one to surpass the phobia. This leads to an increase in cost since traveling by plane is not cheap and also in longer sessions. In AR or VR, the virtual elements appear whenever the therapist wants and also can control when it starts and stops. Additionally, the procedure can be performed multiple times without any increase in the cost. In this type of phobia, there is also the possibility that the patient suffers from discomfort during the session since it requires to do it in a public space. This does not occur with AR or Vr because the therapist can decide where the sessions take place.

Table 1: Comparison between the traditional methods and Augmented and Virtual Reality for the treatment of phobias by Juan et al. (2005)

Traditional Methods	**AR and VR Treatment**
The elements that the patient fear are real and cannot be controlled by the therapist	The elements feared are virtual therefore they can be controlled
Depending on the type of phobia it may require moving costs and longer sessions	The therapist has full control when the virtual objects appear. Also, he can start/stop the program at any time
The stimuli produced in are not controlled by the therapist	The therapist can simulate the process multiple times without increasing the cost of the procedure
There's no assurance of the safety of the patient during the treatment	There is no real threat to the patient since the elements are not real
If the treatment requires a public place the patient may suffer discomfort during the session	The therapist can choose where the sessions take place

After comparing AR with VR, we also need to study some related projects that used these technologies, so we have a better understating of what's been done and how we can proceed to improve it.

3.4 Related projects

Medeiros (2006) proposed a collection of Virtual Reality systems to treat phobias such as the fear of tunnels, subways, airplanes, elevators, and buses. Although these types of phobias are not the main focus of our project, understanding how he proceeded and implemented

Figure 11: Images of Medeiros (2006) systems to treat tunnel phobia (left image) and buses phobia (right image)

this project is beneficial to our project, as we can always take some ideas out of it. Figure 11 it shows two different systems that help the treatment of phobias using VR, one for the fear of tunnels and the other for the phobia of riding a bus. In the first one, virtual cars and people are crossing the street during the path the user takes, making it more realistic. Additionally, inside the tunnel, there is a truck crash at the end to increase the notion of the danger of the patient. In the other image, the person starts by waiting for the bus and then rides on it until it archives his destination.

Juan and collaborators Juan et al. (2004) developed a system to treat the fear of cockroaches using marker-based Augmented Reality. They created their 3D model of a cockroach with a modeling tool, and then using ARToolkit 2.65, they created the system seen in Figure 12.

Figure 12: Image of (Juan et al., 2004) work

The system was capable of:

- **Appearance of cockroaches:** when only one cockroach is selected it appears in the center of the marker, but when there are multiple cockroaches they appear randomly;
- **Cockroaches movement:** cockroaches can move from the starting position, but their movement is repetitive, and it is different for each cockroach;
- **Increase/reduce size:** the cockroaches can have different sizes by zooming in and out.

Figure 13: Image of (Lima et al., 2012) system

During the treatment, the patient had to use a Head-worn display to see the virtual element, but he still had the presence of the real world. This way, he treats his phobia without having direct contact with a real one. The conclusions that Juan et al. (2004) took were that the system was capable of activating the patient's anxiety and claims that AR is effective to treat phobias of animals of small sizes. Although this project was successful, it had some disadvantages, there was no gradual evolution of the models, and it requires the use of a head-worn display.

Another interesting project is a system to treat arachnophobia created by (Lima et al., 2012) that eliminated some of the disadvantages found in Juan et al. (2004) project. He also used marker base Augmented Reality with the possibility to use a head-worn display. For this, he used Papervision and Flartoolkit to develop his AR application on the internet. Although, to executed it was necessary to install a Flash plugin.

The functionalities of Lima et al. (2012) system were:

- Registering the information of the patient such as name, birthday, address, complements, and his treatment history;
- View and manipulate the virtual spiders using different markers;
- Interact with the spiders with the system interface, making it possible to change 3D models and include animations;
- Having a gradual evolution of the models by having different realism levels.

In figure 13 shows the user choosing the model to be used by selecting the bottoms on the right side, and the left side shows the webcam. In case the marker is positioned in the view of the camera, the 3D model would appear. Besides this, his system could also be used with AR glasses with direct vision.

Although this system was an upgrade from the (Juan et al., 2004), we still could improve it by making it accessible to all the devices without any installation by using the internet. Moreover, we could discard the use of a head-worn device making it more comfortable for the patient and retain its portability by using a smartphone. Therefore using this knowledge, in the next chapter, we present the artefact proposal of what we intend to develop to support the treatment of Specific Phobias using Augmented Reality.

4

PHOBIAR: PROPOSAL

After studying the state of the art of Phobias and Augmented Reality, this chapter shows a proposal of the artefact that we intend to develop based on all the research done. Additionally, it is also presented an example of using a prototype developed using AR with marker-based tracking.

4.1 ARTEFACT DESCRIPTION

In this project, we are following the Design Science Research methodology, which consists of creating an artefact to solve a problem (Von Alan et al. (2004)). In this context, the problem is to improve the treatment of specific phobias by using Augmented Reality. Therefore, our goal is to develop an artefact capable of providing support for the treatment of phobias using this technology. To accomplish this, we will work in conjunction with a psychologist who treated phobic patients to define which requirements are needed for the artefact to be viable and intuitive. Considering the final product is aimed for them to use during the treatment, their approval is essential for the success of this artefact.

Lima et al. (Lima et al. (2012)) in their work applied a gradual exposition method for the treatment of arachnophobia. Their system had eight different levels of spiders. As each level progressed, the level of realism of the spider would also increase. They start with a model that doesn't resemble a spider and then add features such as textures and animations. This approach encompasses different states in which patients experience different levels of fear. Moreover, it allows for a gradual exposition, which adds small steps to overcome during the treatment, decreasing the possibility of the patient to give up on the treatment. Therefore, we will implement a similar approach to our system.

The artefact will use libraries of WebAR, which consist of using Augmented Reality in the browser. This option allows for greater accessibility and an intuitive approach. Furthermore, there is also the option to use Marker-based and Markless options.

The schema in Figure 14 was developed to describe the intended result with this project. The schema is divided into two phases: the development and the operation. The first phase is dedicated to the preparation of the session. The psychologist will have access to the

information of the patient in previous sessions. He will also be able to choose which 3D model he wants to load. Additionally, there will be the possibility to import other models if necessary. Other options that he can choose will be the level of realism of the 3D model and the tracking method. After this, the AR artefact is created and is ready to be used in the operation phase.

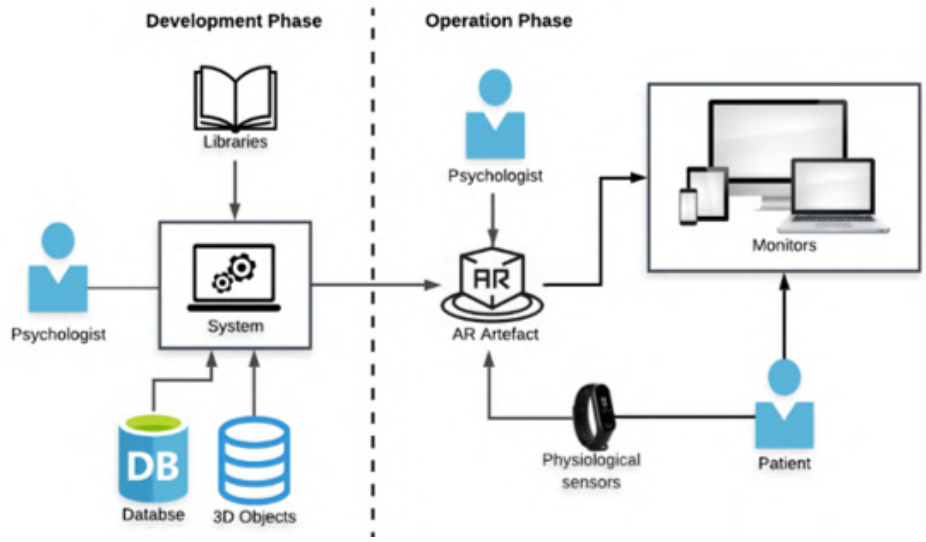

Figure 14: Schema proposal

In this phase, the psychologist chooses the equipment that he wants to use. The only requirements needed for the device are a camera and an internet connection. The camera is used to recognize the marker and to provide video. The internet enables access to the artefact. Additionally, the psychologist can add a simple physiological sensor to measure the heart rate of the patient to obtain more information.

4.2 EXAMPLES

In this section, we will demonstrate some examples used using a prototype. These examples will focus on different types of phobias, such as the fear of spiders, cockroaches, rhinoceros beetle, snakes, blood, and syringes. These examples were performed with a laptop in a Web browser.

In figure 15, the camera recognizes the HIRO marker and overlays the 3D object of the spider on it. This example was used to cover arachnophobia, which is the fear of a spider.

To expand coverage of phobias, we also used a rhinoceros beetle and cockroach models shown in figure 16. These examples were created with the purpose to help the treatment of entomophobia, which is the fear of insects. Both of them follow the same procedure as the spider, although we used a different marker on the cockroach example.

Figure 15: Example of Augmented Reality using Marker-based tracking

Figure 16: Example a rhinoceros beetle (left) and a cockroaches (right)

Other examples of phobias that are not from an animal but are still common are hemophobia, which is the fear of blood, and aichmophobia, which is the fear of sharp things. Figure 17 was used to cover these phobias. On the left side, we overlay an image of a pool of blood above the marker, and on the right side, it is a 3D model of a syringe.

In figure 18, we present three different levels of snakes from left to right. The first level resembles more a snake toy than a real snake so that the patient understands what it is but without causing any strong reaction. After the psychologist analyses the outcome of the patient interaction with this example, he can then progress the patient towards the next level. In the second level, the snake model already looks like a real snake, but it is small and slim. In both of these examples, the patient can see the marker, which helps him realize that the models are not real. Finally, in level three, the model matches a real rattlesnake, and a square is covering the marker. Both these elements increase the difficulty of this level because the patient can easily associate the 3D model with a real snake and the absence of the marker hinders his perception that it is not a real snake. With this, we can simulate a

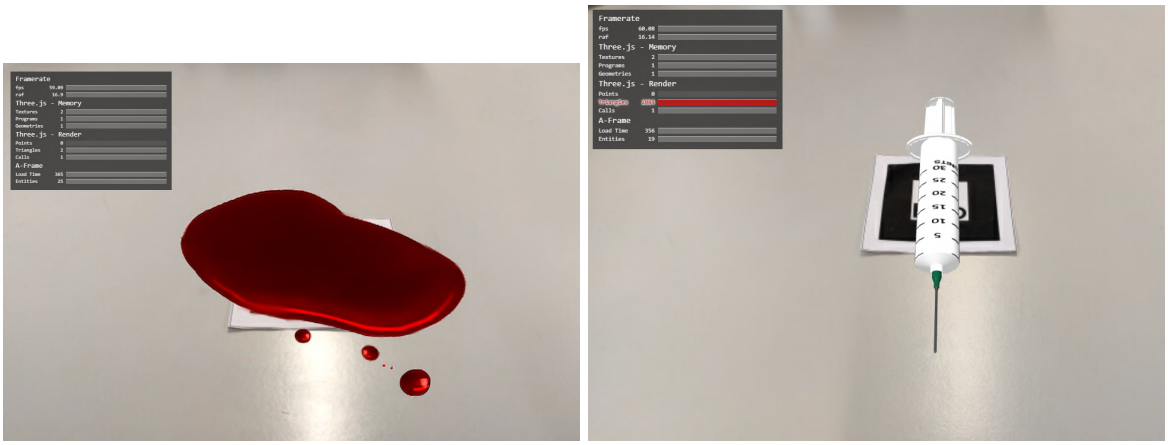

Figure 17: Example blood and a syringe

possible progression on the treatment of this type of phobia, where the patient would start on level one and would progress to level three. There are more options that we could add to further expand the levels such as animations and movement.

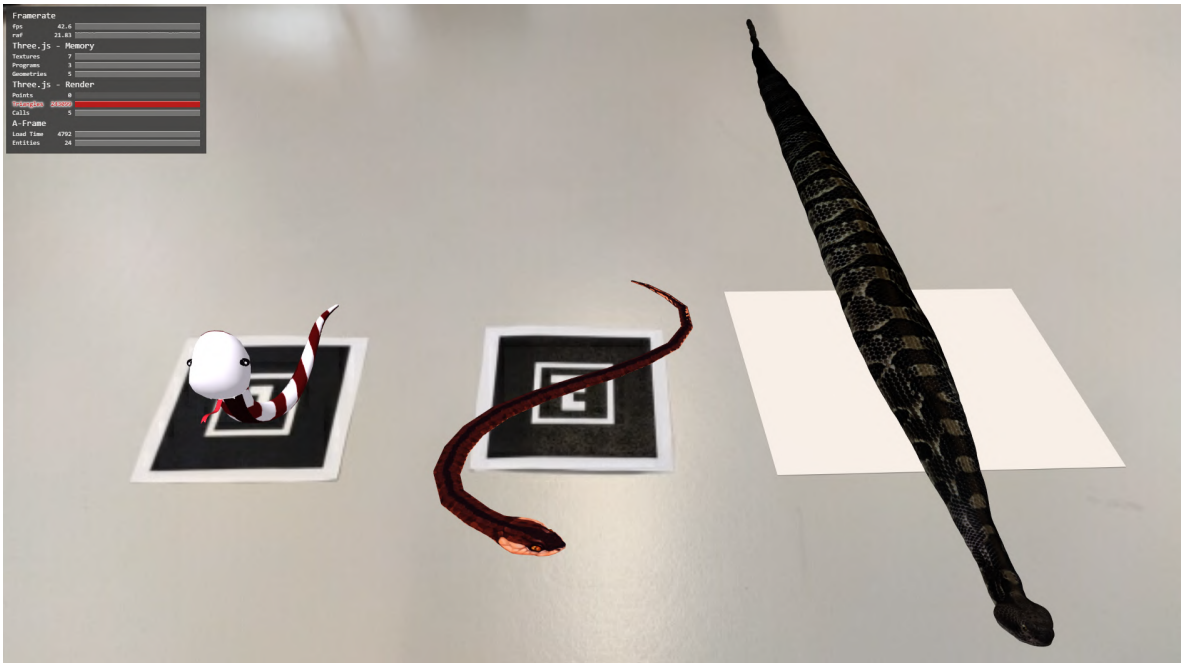

Figure 18: Diferent levels of snakes

After deciding the intended result with this project and having a working example we started to develop a complete system with all the necessary features. Therefore, in the next chapter, we are going through every step took explaining what was done to achieve the end result.

5

PHOBIAR: IMPLEMENTATION

The central goal of this project is the development of a system capable of helping the treatment of Specific Phobias. As discussed in the last chapter, we created a prototype of the system we intended to build. Therefore, in this chapter, we are going to show the steps and decisions took to progress from the prototype seen towards the final system.

5.1 TECHNOLOGY APPROACH

In Figure 19, we present a proposal for the architecture of the web platform. The three main components in this architecture are the frontend, the backend, and the database. The frontend presents a dynamic interface to the user, so he can easily access the information or fill forms. The framework chosen was *Vue*, for the page and interface, and we also use *Vuetify* for the page design. The back end is responsible for processing requests sent from the front end and respond. The framework used was *Node.js*. The backend will also incorporate an AR library, *AR.js*, which is used for the Marker tracking technique. The communication between the frontend and backend is made through HTTP requests and responses. To process these requests, the back end connects to the database and accesses, inserts, updates, or deletes data. *MongoDB* is used to store user accounts, sessions, markers, and phobias.

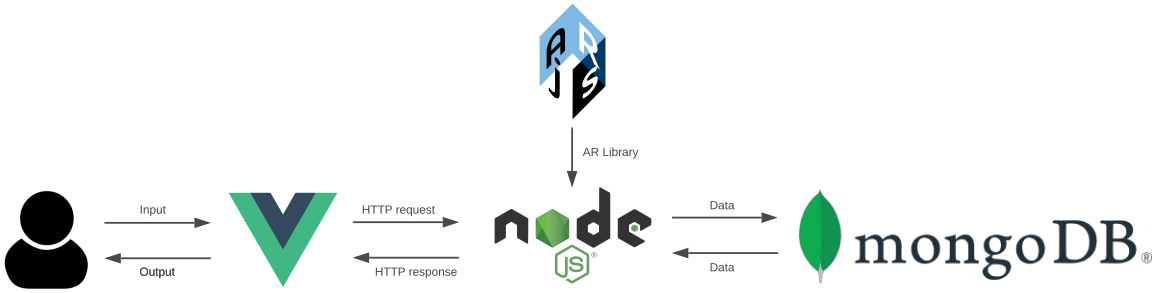

Figure 19: System proposed architecture

5.2 AR.js, Augmented Reality library on the Web

AR.js is a lightweight open-source library for Augmented Reality on the Web, which supports features such as Image Tracking, Location-based AR, and Marker tracking (AR.js). It is essentially a JavaScript framework acting as a port of ARToolkit while adding other packages like a-frame and three.js. Their goal is to be able to use AR on web browsers without losing performance.

The advantages of using this technology are:

- **Fast** : It runs efficiently even on old phonesM
- **Web-based** : It run on the web so it does not require any installation and it is full javascript based on three.js + A-Frame + jsartoolkit5;
- **Open Source** : It is open source and free to use;
- **Standards** : It works on any phone with webgl and webrtc.

Although this library is constantly being updated there are some restrictions that should be taken into consideration when using it. For example, for it to work it needs to have *webgl* and *webrtc*, which are methods of generating dynamic 3D graphics using JavaScript, accelerated through hardware and of accessing external device data (such as a webcam video stream), respectively. In tables 2 and 3 it shows the supported versions for both the methods for Desktop and mobile browsers. It also does not support IOS when using Google Chrome because it does not have access to the camera. Lastly, the deployment needs to be done under https because of the browser restrictions since it does not allow access to the camera under an http server.

Table 2: WebGL and Webrtc supported versions for Desktop browsers (WebGL)

	Desktop					
	IE	Edge	Firefox	Chrome	Safari	Opera
WebGL	11	79-81,83	4+	8+	5.1+	12+
Webrtc	X	12-81,83	36+	53+	11+	40+

Table 3: WebGL and Webrtc supported versions for Mobile browsers (WebRTC)

	Mobile							
	Chrome	Firefox	UC Browser	Samsung Internet	IOS Safari	Opera Mobile	Baidu	KaiOS
WebGL	81	68	12.12	12	8+	46	7.12	2.5
Webrtc	81	68	12.12	12	13.5	46	X	X

5.3 3D FILE FORMAT

The file format chosen for the 3D objects was glTF (Graphics Library Transmission Format) developed by The Khronos Group (KhronosGroup). This format follows a JSON standard and is an efficient, interoperable format with minimum file size and reduced processing time needed to unpack and use those assets. There is also Graphics Library Binary (GLB), which is the binary file format representation of 3D models saved in the glTF. This format avoids the issue of increased file format that happens in glTF resulting in compact file sizes, fast loading, complete 3D scene representation, and extensibility for further development GLB.

In comparison with older formats like *OBJ*, which supports only vertices, normals, texture coordinates, and basic materials. The glTF includes more features such as (aframe-gltf)

- Hierarchical objects
- Scene information
- Skeletal structure and animation
- More robust materials and shaders

Therefore, with all the advantages that *glTF* format provides since it is more interoperable with web technologies, it was the best choice for this project.

5.4 BLENDER AND 3D MODELS

After deciding what type of 3D format to use, we proceeded to create/gather models of different phobias. For this, we used multiple approaches while keeping in mind that our goal is to have a gradual evolution of the models. We first decided to create simple models that do not resemble the actual phobia and then proceed to more complex models. To achieve this goal, we used Blender© (Blender), which is a free and open-source 3D computer graphics software toolset for modeling, animation, texturing, compositing, rendering, video editing, and creating interactive 3D applications. This tool also supports a variety of 3D formats, such as glTF format, with the inclusion of an extension that we will need. Therefore, using this tool, we started to create various levels for the first model of a spider that we called aranha_evolucao. The first level consisted of only using three spheres to make the body and the eyes, as can be seen in figure 20.

After that, we added cylinders to the model to create the spider legs. First, we only added four legs to the model, so it still does not represent a spider creating level two. Then, with the inclusion of four more legs, we formed level 3, already resembling a spider (Figure 21).

For the next levels, which we wanted them to be more realistic, we did not have the necessary skills and time to create multiple realistic 3D models. For that reason, we choose

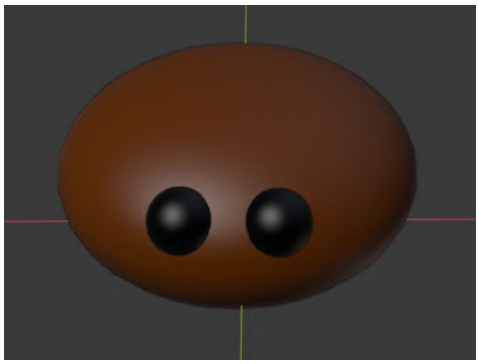

Figure 20: Level 1 of the spider

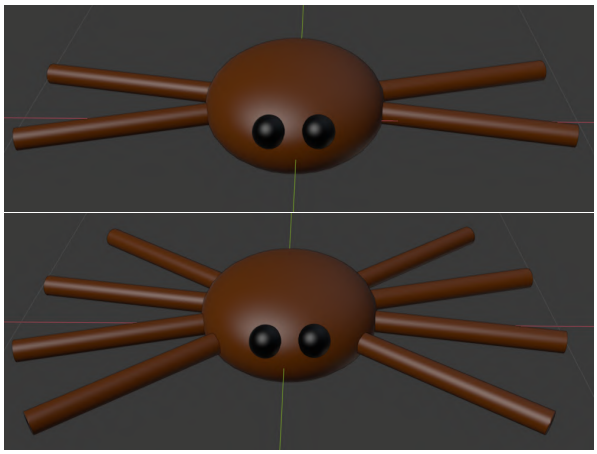

Figure 21: Level 2 and 3 of the spider

to download free to use models from the internet to help us complete the last two levels. After some changes in the downloaded model, such as reducing the number of triangles, it became level five of the model. Level four was created by removing some key features of the last level. For example, we removed the spider abdomen and the pedipalp, as shown in figure 22. For other phobias, we applied the same approach to create multiple models and their levels. The more complex models, besides arachnophobia already described, are for ophidiophobia and aichmophobia (Figure 44). They both have five levels and evolve gradually with an increased amount of features as the level progresses.

Figure 22: Level 4 and 5 of the spider

In table 4, we gathered some information about the models' file size and the number of triangles. Most of them have small file sizes (lower than 100 kb), which make them faster to load., as the exception of the most realistic ones (abelha_real and baratas).

Table 4: File size and number of triangles of different models

Phobia	Model	Level	File Size (kb)	Triangles
aichmophobia	seringa_evolucao	1	14	248
aichmophobia	seringa_evolucao	2	27	532
aichmophobia	seringa_evolucao	3	179	1369
aichmophobia	seringa_evolucao	4	31	696
aichmophobia	seringa_evolucao	5	204	2084
apiphobia	abelha_real	1	9567	69279
Arachnophobia	aranha_evolucao	1	62	2880
Arachnophobia	aranha_evolucao	2	73	3128
Arachnophobia	aranha_evolucao	3	83	3376
Arachnophobia	aranha_evolucao	4	1628	10034
Arachnophobia	aranha_evolucao	5	2192	14120
entomophobia	baratas	1	8299	69279
ophidiophobia	cobra_evolucao	1	385	12800
ophidiophobia	cobra_evolucao	2	212	11558
ophidiophobia	cobra_evolucao	3	240	13148
ophidiophobia	cobra_evolucao	4	343	13148
ophidiophobia	cobra_evolucao	5	751	668

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Figure 24: Hiro marker patt filer

5.5 MARKERS

After having created the 3D models, the next thing we needed was the markers. They are responsible for displaying the 3D model when the camera recognizes it. The most famous ones used are the Hiro and the Kanji markers seen in Figure Figure 23. We already had used them on the project prototype, but now we wanted to create our custom markers.

Figure 23: Hiro and Kanji marker

For this, we need two files, the image of the marker and the corresponding pattern that the AR.js library needs so the camera can identify it. The first step to create a custom marker is to use an image manipulation program and create an image of it. This image should be simple because otherwise, it's difficult for the camera to identify it. After that, we upload the image to AR.js Marker Training program, which transforms the image into a patt file. This file describes the marker image with a set of numbers between 0 and 255. Figure 24 shows the patt file of the Hiro marker.

In total, we decided to create five custom markers based on levels (see Figure 25) because we also had five levels in some of the models. In our platform, these five markers act as a combination called 'niveis' as opposed to the Hiro and kanji markers that are individual. Therefore, when the user chooses this marker, it will automatically associate it to the corresponding model level.

Figure 25: Level base Markers

5.6 MONGODB STORAGE

MongoDB is a NoSQL document database, storing data in JSON-like documents (MongoDB). MongoDB is used to store all the information available allowing a high degree of flexibility and faster access. The information included in the database are sessions, markers, phobias, and feedback

The user saved sessions saved in MongoDB have the following parameters:

- **Session Date**: The date of the session;
- **Patient**: The name of the patient;
- **Session Notes**: The notes taken about the session;
- **Phobia**: The phobia that the patient suffers;
- **Model**: The model was chosen based on the phobia;
- **Level**: The level of the model;
- **Marker**: The marker chosen to show the 3D model;

The information contained in the markers collection is:

- **Marker**: The name of the marker;
- **Image**: The name of the image file of the marker;
- **Patt**: The name of the patt file of the marker;

The Phobias collection has the information about all the phobias available, their models and levels.

- **Phobia**: The name of the phobia;
- **Models**: An array with the all the models of the phobia;
  - **Model Name**: The name of the model;
  - **Levels**: An array with all the levels of the model;

5.7 BACKEND

The frameworks used are Node.js (Node.js) and Express (Express). Next it is shown a simplified definition of the backend API divided as sessions, markers, phobias.

Sessions

GET `/api/sessions/`
Returns the list of the sessions

POST `/api/sessions/upload`
Creates a new session

DELETE `api/sessions/:session_date/:patient`
Deletes a session

PUT `api/sessions/:session_date/:patient`
Changes the information of a session

Markers

GET `/api/markers/:marker/download`
Download a marker

Phobias

GET `/api/phobias`
Returns the list of the phobias

GET `/api/phobias/:phobia`
Returns the models of a phobia

GET `/api/phobias/:phobia/:model`
Returns the levels available of the model

Aside from these routes, we also create two routes that will render the sessions. When the user wants to open a session previously created by him, these are the routes used. They received all the information needed, such as the phobia, the model, the level, and the marker. This information is then passed into a Pug file that is rendered using the Ar.js library.

The first one is used when the marker that was chosen is a single marker, such as the Hiro marker. The other one is used when the marker 'niveis' is selected since this one includes five different markers.

GET `/:phobia/:model/:level/:marker` Generate the session based on the information received
GET `/:phobia/:model/:level/niveis` Generate the session based on the information received for the marker 'niveis'

5.8 FRONTEND

The frontend goal is to have an intuitive user interface capable of providing an easy way for the therapist to use the platform. This way, psychologists that are not very used to using these types of technology have an easier time learning it.

Vue (Vue) and Vuetify (Vuetify) are the frameworks used to develop PhobiAR frontend. Vue is a JavaScript framework for the development of reactive web frontends. Vuetify is a JavaScript and CSS framework developed for Vue that adds new components with many possible configurations. Additionally, due to the responsive nature of Vue, it allows us to easily adapt the platform to smaller screens with small changes to the original code.

The frontend is divided into seven views which are: `home.vue`, `createSession.vue`, `sessions.vue`, `models.vue`, `markers.vue`, `feedback.vue` and `about.vue` and, each of these views represent a page on the platform. Overall, all the operation available are:

- Sessions list and management (Create, Delete, Edit);
- Sessions search by patient;
- Generate the session;
- View the available models;
- View and download markers;
- Sending feedback;

The most simple views are the `home.vue` and `about.vue`, which are informative pages about the platform and the team, respectively. Then we have the `createSession.vue`, this view handles the creation of a session by receiving the necessary information and then sending a post request to the backend to save the session into the database. In this view, the order of the information is picked is important, therefore some bottoms are disabled until the condition is verified. For example, the user cannot choose the level of the model before choosing the model.

The next one is the `sessions.vue`. This view receives all the available sessions from the backend with a get request. Afterward, we process this information so that we can group the sessions by the patient and storing it in an expansion panel. We also created a text field that searches for a patient and filters the sessions by it. For each session, we can generate it redirecting the user to the backend page that renders the sessions and creates it. There is also another alternative to generate the session that is by using a QR code that has the information of the backend URL that renders the session. To create this QR Code we used an API (qrc) that generates it by sending a request to their page with the information that we want in the QR Code in the URL. This was made so the user can easily change from using the computer to the phone. Additionally, we can edit by sending a put request to change the information or delete a session by sending a delete request to the backend.

The `models.vue` is responsible for showing the available models to the user. First, we send a get request to the backend to receive a JSON array with all the information that we need, such as the phobias available, their models, and levels. Then we create an expansion panel with this information and a button that when clicked it renders the chosen level of the model. For viewing it we used a GitHub library (vue-3d-model) created by the user Hujiulong lets you view 3D models in vue. It also allows you to rotate and move the camera so you can see the model from different perspectives and angles.

Following after `models.vue`, we have the `markers.vue`. In this view, we show the available markers and give the possibility to download any of them. When pressing the download bottom, the user is redirected to a backend page where it prompts the user to where he wants to save the file of the chosen marker. After accepting or declining it, the pages automatically closes.

Finally, we have the `feedback.vue` that is responsible for sending any feedback that the user want to send about the platform. This feedback is saved in a collection on the database so we can later analyze it.

Finally, we have the `feedback.vue` that is responsible for sending any feedback that the user wants to send about the platform. This feedback is saved in a collection on the database so we can later analyze it.

In this chapter, we explained all the necessary components of our system. Next, we will show the result with an overview of the PhobiAR website, a working example of the platform, and a comparison between our system and other systems discussed in chapter 3.4

6

PHOBIAR: ARTEFACT OF AR TO TREAT PHOBIAS

In this chapter, we are going to show the final result of the Platform PhobiAR by going through every page and explaining what it does. Afterward, we will demonstrate a simple example of the necessary steps to follow to use this tool to its full capacity.

6.1 PHOBIAR OVERVIEW

The PhobiAR website is hosted in https://phobiar-fe.epl.di.uminho.pt/ and the first page that is showed to the user is the home page (see Figure 48 or Figure 55a). On this page we have a brief description of what it is and what it does and, next to it we have a set of images that alternate between them, one is the phobiAR logo and the others are examples of the tool. Additionally, there is a top bar (see Figure 26) that is persistent on every page and allows the user to navigate between the different pages. The available pages are:

- Home (with the PhobiAR logo)
- Criar Sessão (Create Session)
- Sessões (Session)
- Modelos (Models)
- Marcadores (Markers)
- Feedback
- About

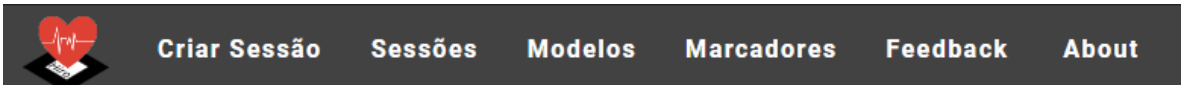


Figure 26: Navigation bar of PhobiAR

Following the order on the navigation bar, after the home page, we have the "Criar Sessão" (Create Session) page (see Figure 49 and Figure 55b). On this page, the user creates the session by filling out the form with all the necessary information. The first step is to write the name of the patient and choose the date in the fields seen in Figure 27. When clicking on the date, it opens a calendar, making it easier to pick a date.

Figure 27: Fill with a name and a date

The next step is to choose what we want to show in the session and what marker we want to use. There are some conditions when filling this part of the page. The first one is the order required to choose the phobia, the model, and the level because the model is dependent on the phobia and the level is dependent on the model. As we can see in Figure 28, the boxes to choose the model and the level is disabled (The line is dashed) until we pick a phobia. We can only show the available models after knowing the phobia that the user wants, and the same is applied for the level. The other condition is that in case the psychologist picks the marker "niveis" he does not have to choose the model level because that is done automatically. All the model levels will be available when generating the session.

Figure 28: Choose a phobia, a model, a level and a marker

Finally, we have a text area where the user can write anything he wants about the session (see Figure 29). Afterward, the user can also edit by adding more content or removing. This is the only field that is not mandatory, all the other boxes must be filled for the save bottom to be active.

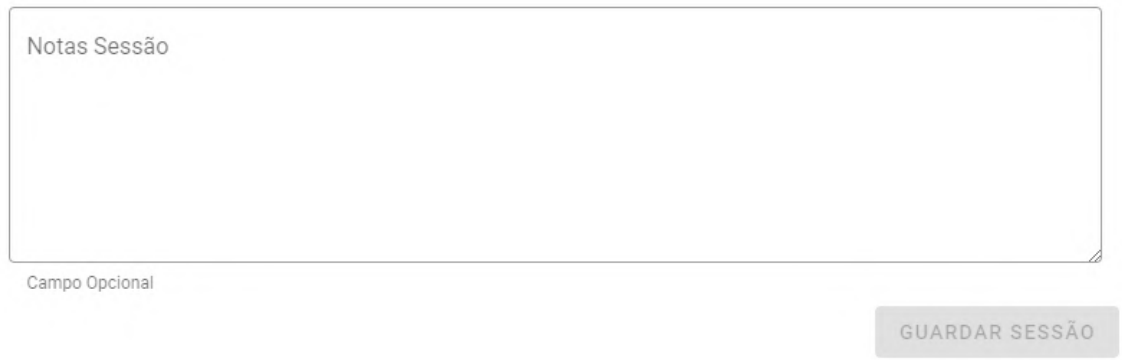


Figure 29: Notes and save session bottom

The third page available is the Sessões (Sessions) page (see Figure 50 and 56a). This page shows all the patients. When we clicked on them, it expands and shows all their sessions. In Figure 30, we can see a session of a specific patient. Each session has the information of the patient name, date, phobia, model, level, and marker. It also shows the patient notes if it has any. For each session, there are four bottoms that we are going to explain what they do from left to right. First, we have the 'Gerar' (Generate) bottom that creates this specific session and redirects the user to another page, where, if he shows the marker to the camera, the 3D model will appear above it. Next, we have the bottom that generates the QR Code of the session. Has it was described before in chapter 5.8, the QR Code has the link of the session, and then read the user can navigate to that page. The reason why we decided to make two different ways to generate the sessions is when the psychologist wants to create the session on the computer but wants to use the phone for it. This situation may occur because the computer is better to create the session, but the phone has a better camera and is more portable. Therefore, with the QR Code, the therapist can easily use his phone to read it and generate the session on the phone instead. The QR Code returns the link to the compiled session. The last two bottoms are the edit and delete bottom. The edit bottom lets the user change any field he wants, for example, he can change the model or add notes. The delete bottom deletes the chosen section since there is no way to retrieve the sessions the user is prompt with a warning to see if he wants to delete it. Additionally, we also have a bottom that lets the user create a new session for the selected patient with some fields already filled. Finally, we have a search bar that filters the sessions by a patient.

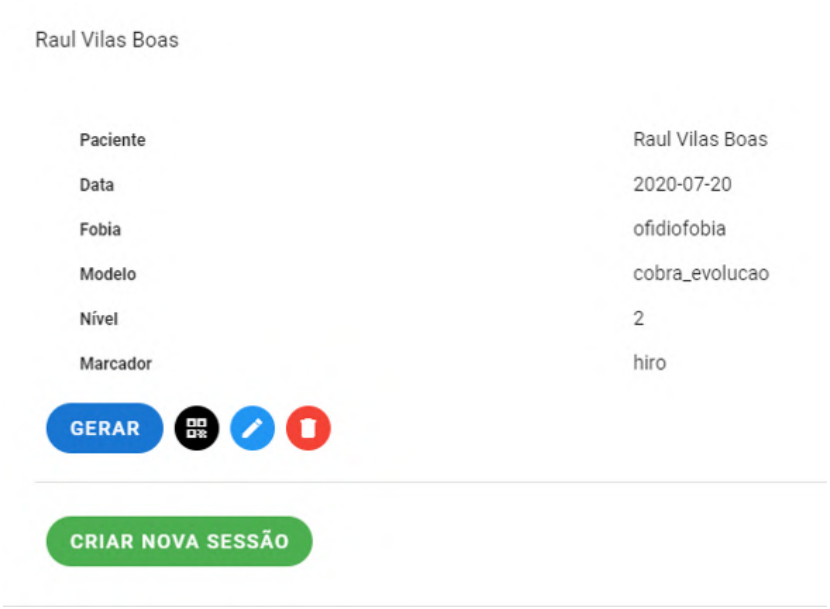


Figure 30: Session of a patient

The following page is "Modelos" (Models) (see Figure 51 and 56b). The goal of this page to have an easy way to view all the available models on the platform. This way, the therapist can identify which model is best suited for the treatment of a specific patient. The page starts by showing an accordion of the phobias, that when expanded, displays the models. In the same way, the models are also an accordion, that when opened, shows the model levels. Afterward, the user can choose which level of the model he wants to see.

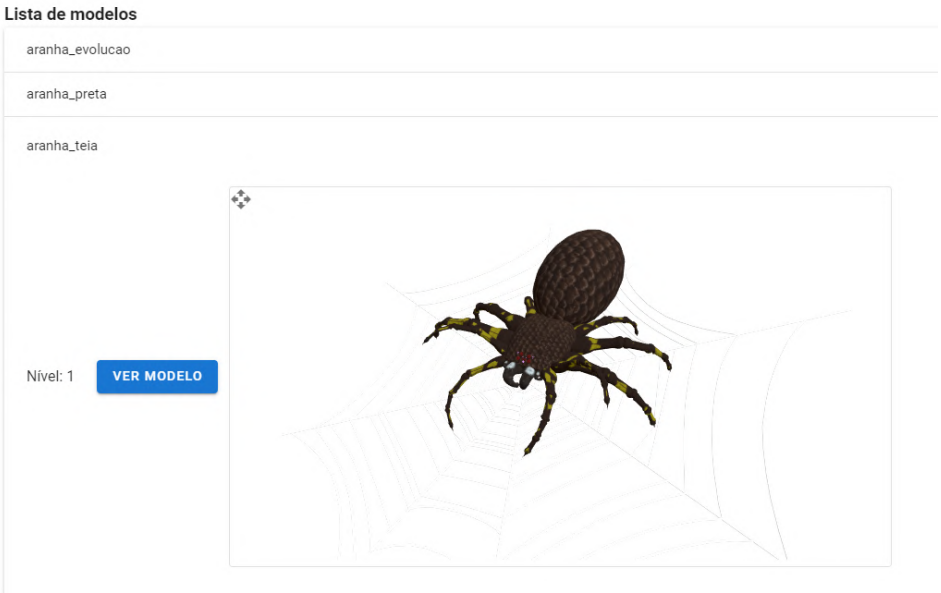


Figure 31: Viewing a spider model

In Figure 31, we can see view level one of the models "aranha_teia" and in Figure 52 it shows level five of the model "seringa_evolução". After loading, the user can zoom in/out and rotate the object allowing him to freely view the model.

The next page is the "Marcadores" (Markers) page (See Figure 53 and 57a). This page shows the user the available markers (Hiro, Kanji, and "Niveis"). Considering the marker "Niveis" is a group of five different markers, we divided them on this page so the user can differentiate between them. Additionally, we can also download any of these markers. This way, it enables the option to print out the marker, making it is easier to use in the paper during the therapy. Alternatively, if the user is using his phone, he can always open this page on another device and point the camera towards the markers.

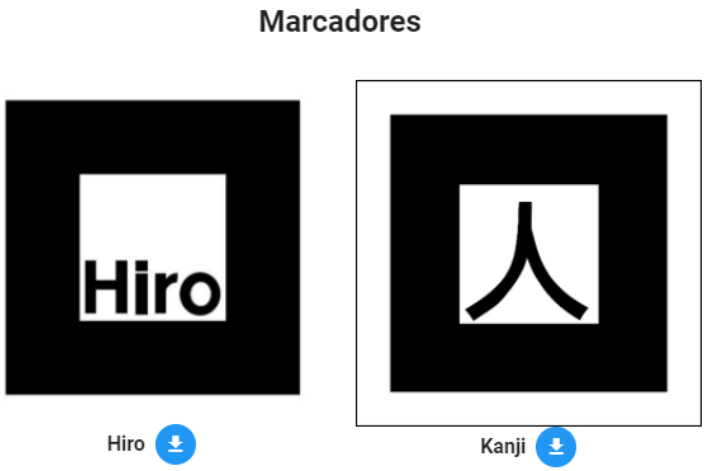


Figure 32: Markers Examples

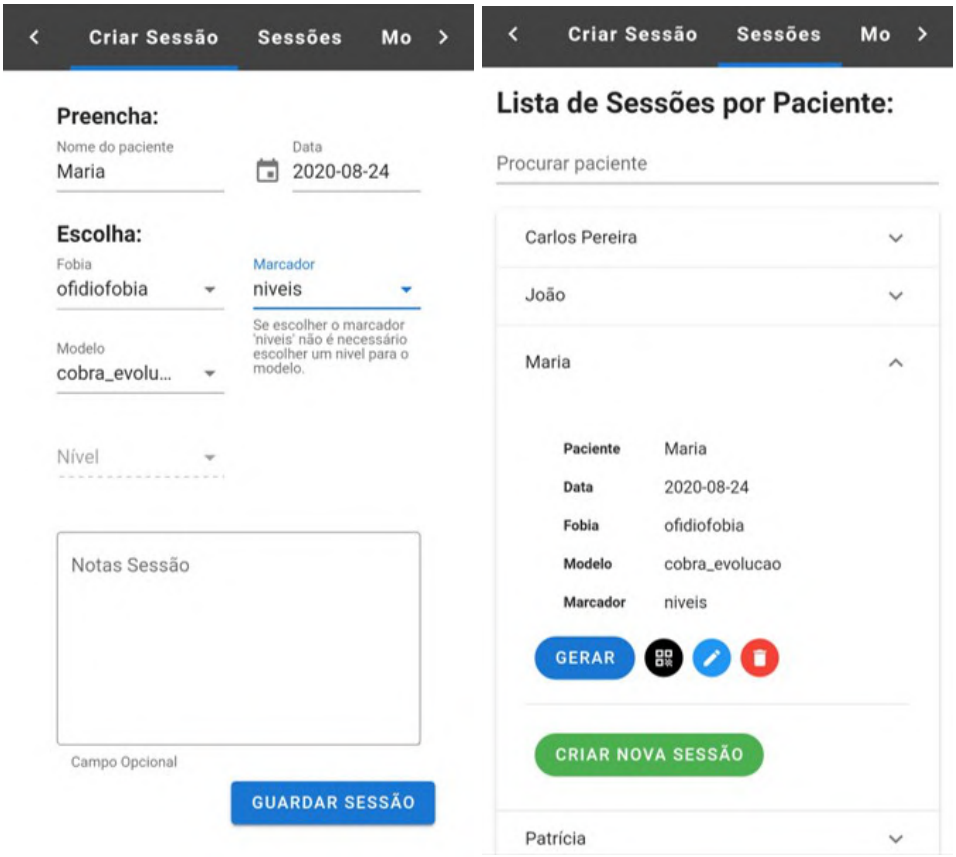
Finally, we have the Feedback page (see Figure 54 and 57b). The objective of this page is to provide an easy way for the user to give us feedback about the platform. The information that is important to us is any ideas or suggestions, any bugs found, and an overall rating of the platform from one to ten.

6.2 DEMONSTRATION

In this section, we will demonstrate the procedure for a therapist to use this platform efficiently, imagining a scenario where we are treating a patient named Maria that is afraid of snakes (Ophidiophobia). The first step is to have a better understanding of the models provided so the user can choose the best for his needs. Therefore observing all the snake models on the models' page is advantageous to have great results. Assuming the therapist picked the model "cobra_evolucao" (see Figure 45 because it is the model that has the most gradual evolution of snakes. Additionally, knowing what markers are available is also

essential to use this tool. Therefore, he then proceeds to the markers page to decide which marker he wants to use. After deciding on using the "niveis" marker (see Figure 47) because he can have one for each level of the model, he prints them out. This way, they are always available, and it is easier to use.

After all these preparations, the psychologist then needs to create a session for his patient. In figure 33a, he creates a session for the patient Maria, which as ophidiophobia, by choosing a model and a marker. Considering he chooses the marker 'niveis' we do not have to select a level. Finally, he saves the session. Moving on to the next step, he navigates to the sessions page (See figure 33b) and finds the session he created.



(a) Creating a session

(b) Finding the session

Figure 33: Creating and finding the session

He then generates the session by clicking on the button and accepts the permission for the use of the camera. After loading the page, he only has to point the camera to the chosen marker, and the 3D model will appear as seen in figure 34 Afterward, he has the total liberty to do what they want in their therapy using the platform.

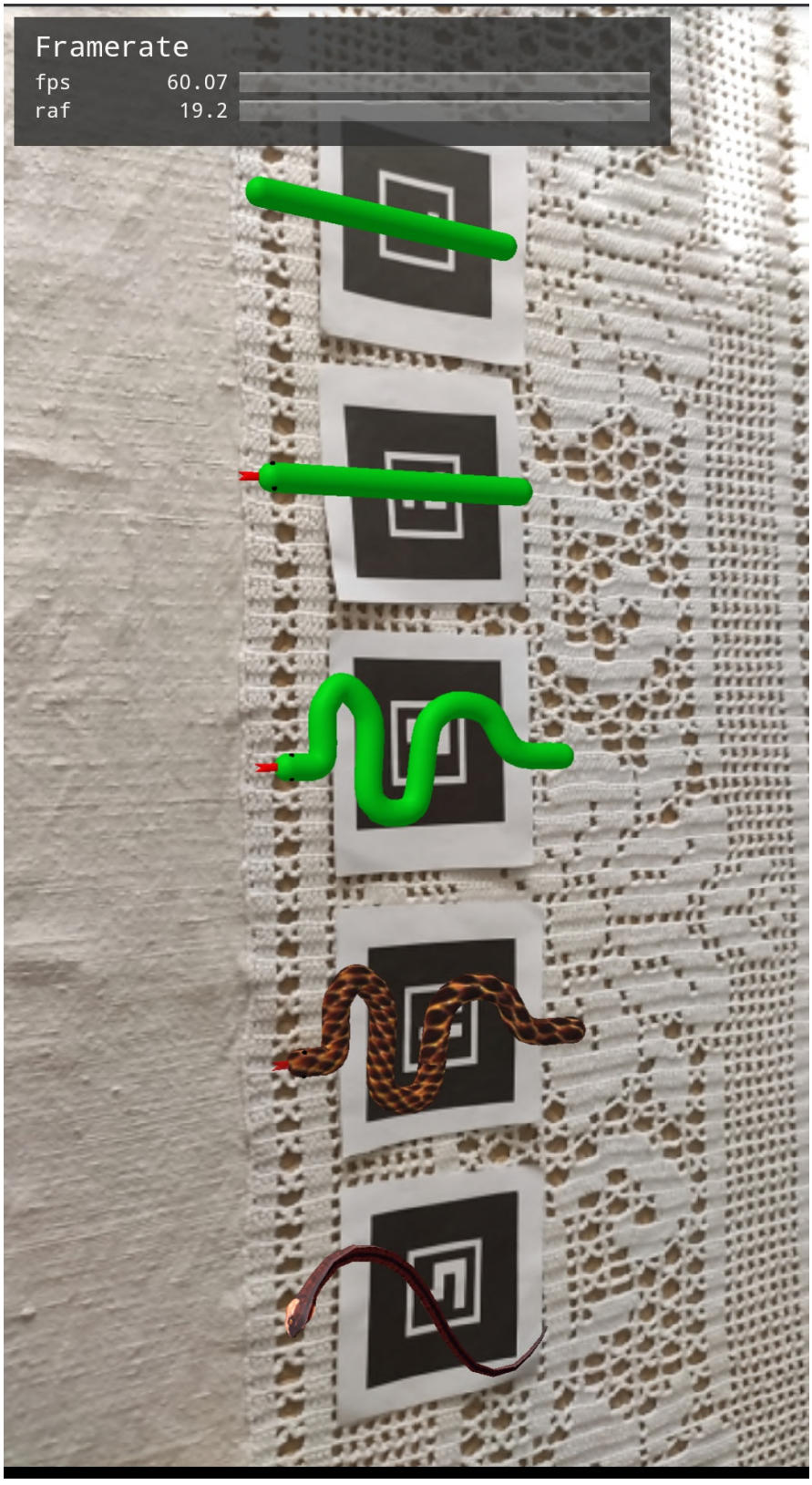


Figure 34: Generated session

6.3 COMPARISON BETWEEN DIFFERENT SYSTEMS

In chapter 3.4, we discussed some related works from Juan et al. (2004) and Lima et al. (2012). Therefore, in this section, we are going to compare their systems with ours, as seen in table 35.

Firstly, we compared if the systems were multiplatform, and all of them had this property, although with some key differences. The Juan et al. (2004) system required the installation of an application, and the Lima et al. (2012) system, although it was on the internet, it also required a flash plugin. As opposed to our platform, that does not require any installation. Moreover, it can easily be used in a smartphone as access to the internet. Therefore, making our system more accessible to be used.

The next one is if the system has a gradual evolution of the models, and only Juan (Juan et al., 2004) did not present this feature. In her system, there was only one model of the cockroach, but it could appear multiple times. Alternatively, both our and Lazaro platforms have different realism levels for a model. As for having different phobias, only our system had this feature since the other's were only for katsaridaphobia and arachnophobia.

The session management feature was included in PhobiAR and in Lima et al. (2012) system, where the user could create a session with the information of the patient.

The other two features that are exclusive to PhobiAR is simultaneous marker recognition, where we can have up to five markers with five different levels of a model, as seen in Figure 34 in chapter 6.2. Along with the possibility to preview the models.

Figure 35: Comparison between different systems

Related Work	Multi platform	Gradual Evolution	Different Phobias	Simultaneous Markers	Session Management	Models Preview
Juan et al. (2004)	Yes	No	No	No	No	No
Lima et al. (2012)	Yes	Yes	No	No	Yes	No
PhobiAR	Yes	Yes	Yes	Yes	Yes	Yes

After achieving the final result with PhobiAR, it was necessary to meet psychologists to test our platform to prove its viability. Therefore, in the next chapter, we are going to explain our approach towards this goal and the results obtained.

7

EXPERIMENT AND DISCUSSION

One of our objectives in chapter 1.2 was verifying the viability of this project. For this, we tested our platform with various psychologists and collected their technical feedback on the matter. Although with the COVID-19 outbreak, it hindered our ability to gather an extensive group of testers and to test with them personally. However, we still came up with solutions for this problem by sending emails to psychologists that were our acquaintances, and asking them to enroll in this experiment. It was also requested, if possible, to pass the message to others psychologists so they could also participate. This method leads us to assembled some results that help on proving the viability of this dissertation.

7.1 EXPERIMENT DESIGN

The first step in our approach was to create a user guide of PhobiAR (see appendix E) to facilitate the psychologists when using the platform. We divided this guide into multiple parts. We first give a brief description of what the platform is and our goal with this project to motivate the therapist to complete the required tasks. Since some maybe be using AR for the first time, we wanted it to be very intuitive so they would not give up. Following the introduction, we have the requirements needed, which is a browser and internet connection, and the definition of the concepts used throughout the guide. Next, we we do a summary of each page explaining what they do for them to have a better understanding of the capacities of the platform. Finally, we have a list of procedures that the psychologists have to follow to complete the experiment. These steps consist of going through the platform, first to see the available models and the markers, and then to create a new session. Afterward, they have to generate the session and point the marker to the camera to see the virtual object.

Lastly, they have to fill a form considering it is an important role to collect the intended results. Therefore, using Google forms, we created an easy to follow survey (see appendix F) for this purpose. The form is divided into three sections. The first one asks information about the person and if they have already used AR technologies and if they treated any phobic patient. The second one is about the platform we want to know if they found it easy to use if it's useful and has applicability in the treatment of phobias. The last one is about

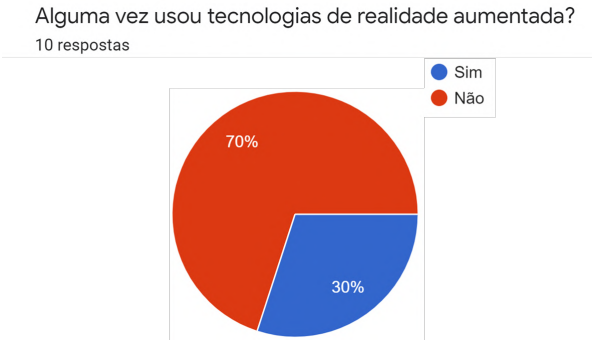


Figure 36: Pie Chart of question number 4 of appendix F

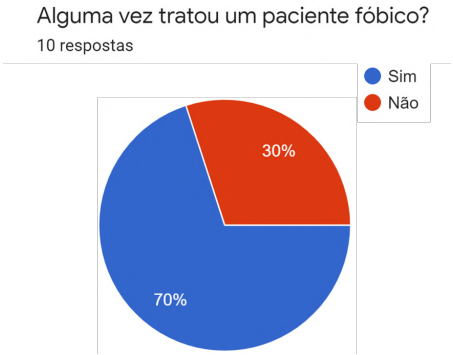


Figure 37: Pie Chart of question number 5 of appendix F

the 3D models. In these sections, we ask if the gradual evolution in some models is suitable for the treatment and if the most realistic models are closed to reality. We also ask if level one of the models is useful in the treatment of more severe cases.

7.2 User Experiment Results

After having contact with multiple therapists, we gathered seven that tested the platform and filled the form. We sent them a version of the PhobiAR guide that they read and followed the instructions. The results of the forms are going to be shown in this section.

As stated in the last section, the first part of the form was to know basic information about the users. They were mostly female (80%) from the age of 26 to 46, with an average age of 37. The main area of study of most of them was clinical psychology, with the exclusion of three from education. As seen in Figure 36, the vast majority of the users did not have any contact with Augmented Reality beforehand, which could pose some difficulties in using the platform. Additionally, seven out of ten had the experience of treating a phobic patient, which increases the value of our results (see Figure 37).

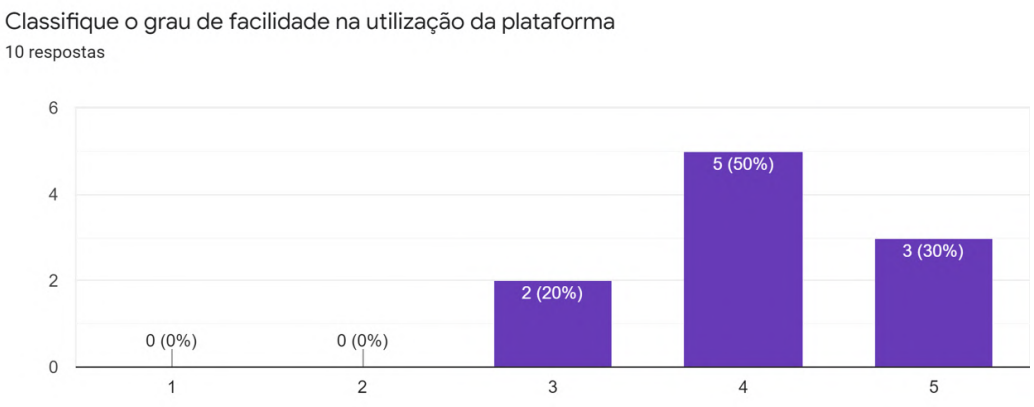


Figure 38: Bar chart of question number 6 of appendix F

In the next part, we asked questions related to the platform. Here we asked three questions to know if PhobiAR was easy to use if it would be useful and if it is applicable. These three questions are essential, and they all need to have positive answers to prove the viability of our project. For example, the system could be useful to the treatment of phobias, but if it is not easy to use, the psychologist would refuse to use it. Additionally, the system can be useful but not applicable. For example, if it required expensive equipment that the psychologist does not have.

From the results of the first question (see Figure 38), we conclude that even without the majority using AR beforehand, they still had no difficulties using the platform as the response was mainly positive.

In Figure 39, we have the results of the second question of this group relative to the usefulness of the application. The responses were slightly different by having more positive classifications but also having some negatives ones. However, overall the responses were very positive, helping to prove the viability of the system.

The last question of this part of the form was to understand if the system was applicable in the treatment of phobias. This is because if psychologists had difficulties using the platform, it would limit the use of the tool during the session. The results of this response were also positive.

Finally, in the last part of the form, we ask questions about the 3D models. The first question is to understand if the lowest levels of the models are appropriate for the worst cases of phobias or if they are still too similar to the phobia. The results of these questions are in Figure 41. This result was also positive as the majority claimed that it was applicable. However, we could maybe improve it by decreasing the complexity of the first level of the models to distinguish them more from the real phobia.

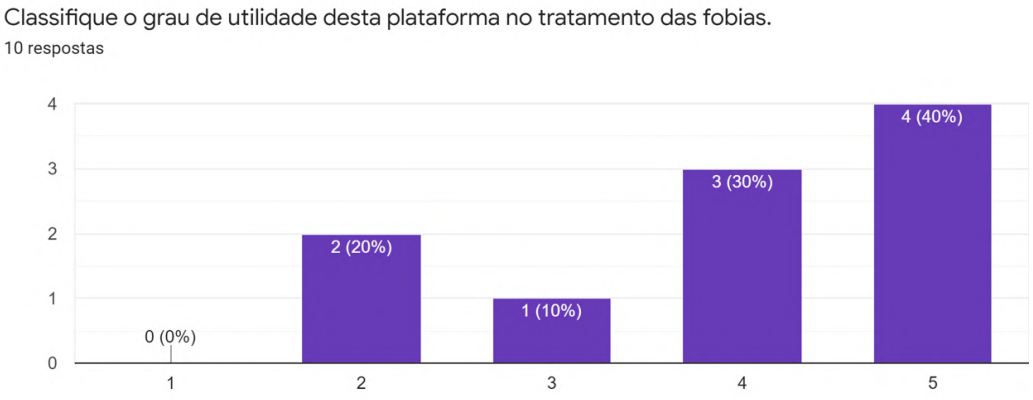


Figure 39: Bar chart of question number 7 of appendix F

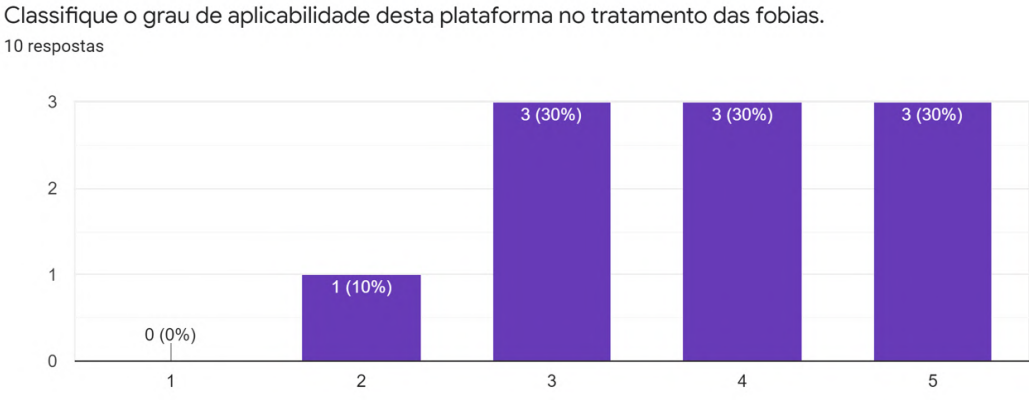


Figure 40: Bar chart of question number 8 of appendix F

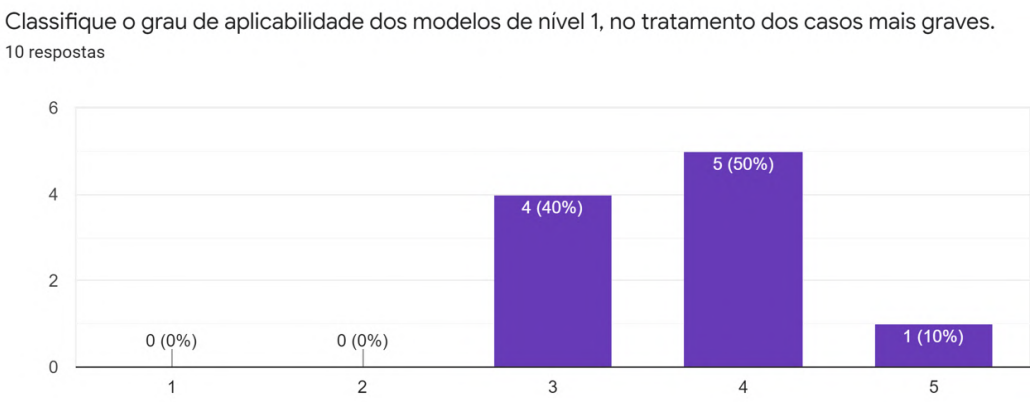


Figure 41: Bar chart of question number 9 of appendix F

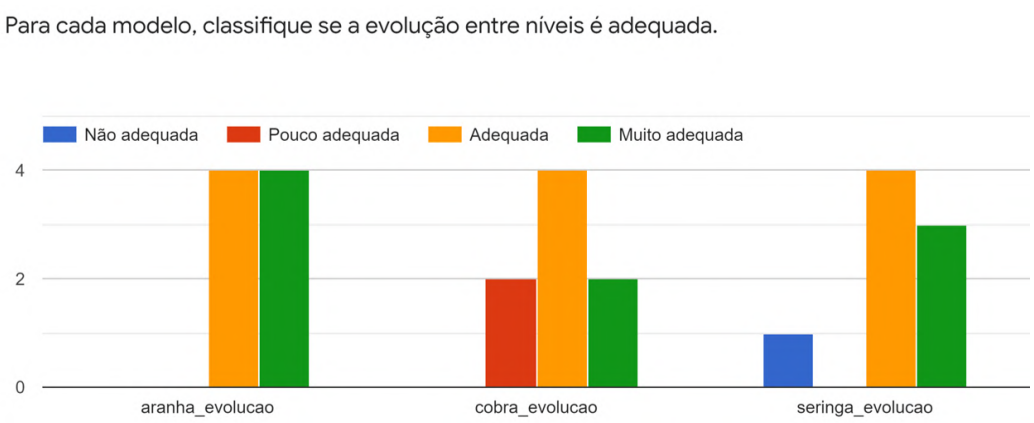


Figure 42: Grouped bar chart of question number 10 of appendix F

The next question is related to the gradual evolution of the models since this is one of the most important requirements of this project. For this, we asked the tester to evaluate the levels progression of three different models ('aranha_evolucao, cobra_evolucao, and seringa_evolucao). From the answers, we can conclude that the differences between the levels were appropriate.

Finally, the last question we asked if the highest level of the models were close to reality. In this one, we got some negative responses on the aranha_evolucao and cobra_evolucao thus we could add as future work to improve these models.

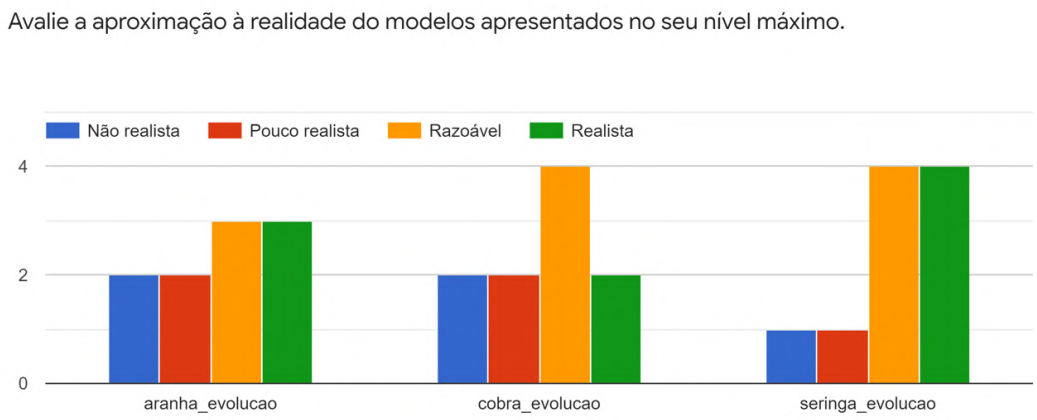


Figure 43: Grouped bar chart of question number 11 of appendix F

7.3 PHOBIAR FEEDBACK

In the form and the platform, there was a place where the users could write some feedback about anything they thought interesting. In this subsection, we are going to discuss some of the suggestions and ideas gathered from this feedback. All the answers are in the appendix G.

The most common suggestion was to improve level 5, making it more realistic. This would be hard to achieve because the more realistic the models are the more complex they are and end up consuming more resources. Therefore, we had to decide on a balance between realism and resource consumption, so it would still be able to run in smartphones. Moreover, creating realistic 3D models take a long time to create, and we did not have any experience with 3D modeling before. Another suggestion related to the models was dividing them into more levels having an increased gradual evolution.

Other suggestions focused on ways to keep track of the patient information related to the history of the origin of his phobia, the type of fear, and a description of the physical and psychological reactions of the patient. Although the platform does not support this, the psychologist is free to write what he thinks is essential in the session notes. Lastly, one person suggested the possibility to incorporate a way to count the pulsations of the patient. This would required extra equipment that would go against the focus of this project to be easy and accessible. Although, it would be a great feature to be included.

In general, the feedback was insightful and positive, showing that they understood the objective of the platform and approved its viability.

8

CONCLUSION

The current chapter closes this dissertation by providing a summary of everything discussed, a validation of the objectives, and a critical view of this work. It discusses what has been achieved with the resulting platform and how it compares to similar projects. Finally, it proposes some new ideas on how this project or others can be continued and improved in the future.

8.1 WORK SUMMARY

Phobia is a type of anxiety disorder and is one of the most prevalent mental disorders. There are various different methods to treat this disorder, but the most successful is exposure therapy. Although this approach is effective it comes with some restrictions. Augmented Reality can be a powerful tool to support the exposition treatment of phobias. This technique can provide multiple benefits and decrease some of the limitations of exposure therapy. There is also an increasing amount of researches on Augmented Reality, which served as an encouragement to explore it.

This dissertation proposal was submitted at the WorldCIST'20 conference in form of a short paper. It was accepted and published in Springer in a book called Trends and Innovations in Information Systems and Technologies (Boas et al., 2020) that consisted of all the papers accepted in that conference. This helped to prove and consolidate our motivation to progress with this thesis.

The state of the art of this dissertation consisted of a study of Phobias and Augmented Reality. An investigation of the categories and types of phobias concluded that our work should focus only on Specific Phobias as it was the only category that would work efficiently with Augmented Reality. We also explored the prevalence and incidence to understand how much of the population is affected by this disorder. The causes, effects, and treatment choices helped to comprehend how a phobia occurs and which treatment method is the most effective for us to replicate using AR. Following this research, it was also studied the difference between Virtual Reality and Augmented Reality that reinforced our decision to use

the chosen technology. An extensive investigation of the AR types helped to decide which type would be the most effective to implement with the treatment of phobias. Moreover, a comparison between traditional methods and AR/VR was done to strengthen our motivation to use this technology as it would bring various benefits. Finally, the state of art closes with a summary of related projects previously done that helped to understand what are the features that the project must include. Furthermore, some requirements for this system were discussed by doing interviews with a psychologist with experience in treating people with phobias, so we have another expert opinion.

To understand the viability of the project, we also create a schema of the system. In this schema, we separate the system into two phases: the development and the operation. One describes the preparation of the session and the other the use of the artefact. Besides, we also built a prototype of the system with some phobias. The examples focused were the most common types of phobias which are the fear of spiders, snakes, blood, and others. As for the implementation of the platform, a system architecture helped to decide which technologies would be used to achieve the intended result. Additionally, throughout this chapter, every component is explained as well as some decisions taken during the project.

The resulting platform is called PhobiAR and was deployed on a server at the University of Minho, allowing everyone who had access to the internet to use it. An overview of the platform is done, explaining every page and its available services. Additionally, a demonstration of the platform is presented, showing how a therapist would use this platform in an imaginary scenery. Afterward, there is also a comparison between the PhobiAR system and the related projects shown beforehand.

Verifying the viability of this project is an important step in this dissertation. For this, various psychologists tested and evaluated our platform and provided their technical feedback by responding to a survey. Although the outbreak of COVID-19 hindered the possibility of gathering an extensive group of testers, it was still possible to test the platform with ten psychologists. Based on the very satisfactory results obtained in terms of utility, viability, and applicability we can prove the viability this project as a system that can help the treatment of Specific Phobias.

This dissertation proposed various objectives that would be essential to build a beneficial system to support the treatment of Specific Phobias. The first objective was to do a study of the problem by exploring related projects to understand how it could be improved. This way, we would identify the main problems of the treatment of phobias and work on solutions with the use of AR. This was achieved in the chapter related to the state of art. The second objective was to do interviews with a psychologist that had experience in treating phobic patients. For this, we planned multiple sessions where progress was shown to the psychologist on the team, and feedback was provided to add or remove requirements. The next one was implementing multiple functionalities in the system. Most of these features

were implemented, such as associating a marker to a phobia, having the possibility to have different markers that represent different stage levels of the phobia have a preview of the existing model. Additionally, it also has session management functionalities being like to create, edit, and delete a session of the patient and add notes about the sessions. However, the possibility for the psychologist to import new models were not implemented because it would be difficult for them to do. This because it must follow be in a specific file format, and the models need to be resized before to be in decent sizes. Another objective that was not achieved was to a developed system capable of detecting the user heart rate. The reason for this was because it would difficult to implement and associate with the platform. Furthermore, it would go against the idea of the proposed system of not needing any additional equipment to work except for a smartphone and internet connection. Finally, the last objective was to validate the systems by analyzing its efficiency and collecting results from the experiments with the psychologists. This verification was done, and the results obtained were mostly positive, as said beforehand.

Besides doing this dissertation, there was also another contribution done together with members of the Language Processing laboratory. The full paper was about "OntoJogo: An Ontology for Game Classification" and was published in SeGAH 2020 (Teixeira et al., 2020). This initiative was important to strengthen our team spirit in the laboratory and to gain knowledge in another topic different from the dissertation.

8.2 FUTURE WORK

With this project's conclusion, this section presents a few ideas of possible future additions to the platform proposed. These new ideas appear from the feedback collected from the platform, but also from other specialists from different areas of knowledge. Additionally, Augmented Reality is also an expanding technology that can lead to creating new features. Therefore, future studies could focus on improving the realism level of the last levels. These improvements could help to reach phobic patients that have lighter levels of phobias that the 3D models of PhobiAR would not trigger their anxiety. The gradual evolution of the models could also be improved by having more levels and fewer differences between the models. For example, the first level could be an optical illusion of the phobias. This addiction would further expand the possibilities of the gradual evolution and would allow for more comfortable development of the patient between the models, without taking the risk of having a big evolution in levels.

Due to the fact that a system to detect the heart rate of the patients was not developed, it could be an interesting new feature to include in a future project. Moreover, if after the session the therapist could see the evolution of the heart rate it would be an amazing tool to understand the progress of the patient.

Other features that could be included in the platform could be adding the possibility to add music to the models. This because AR can be not only focused on visual elements but also on other senses like hearing. Changing the perception that the phobic patient has of the phobia may help him overcome this fear, and music is a great way to achieve this. Lastly, the platform could support multiple languages so it can increase the number of therapists that can use the platform.

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A

3D MODELS

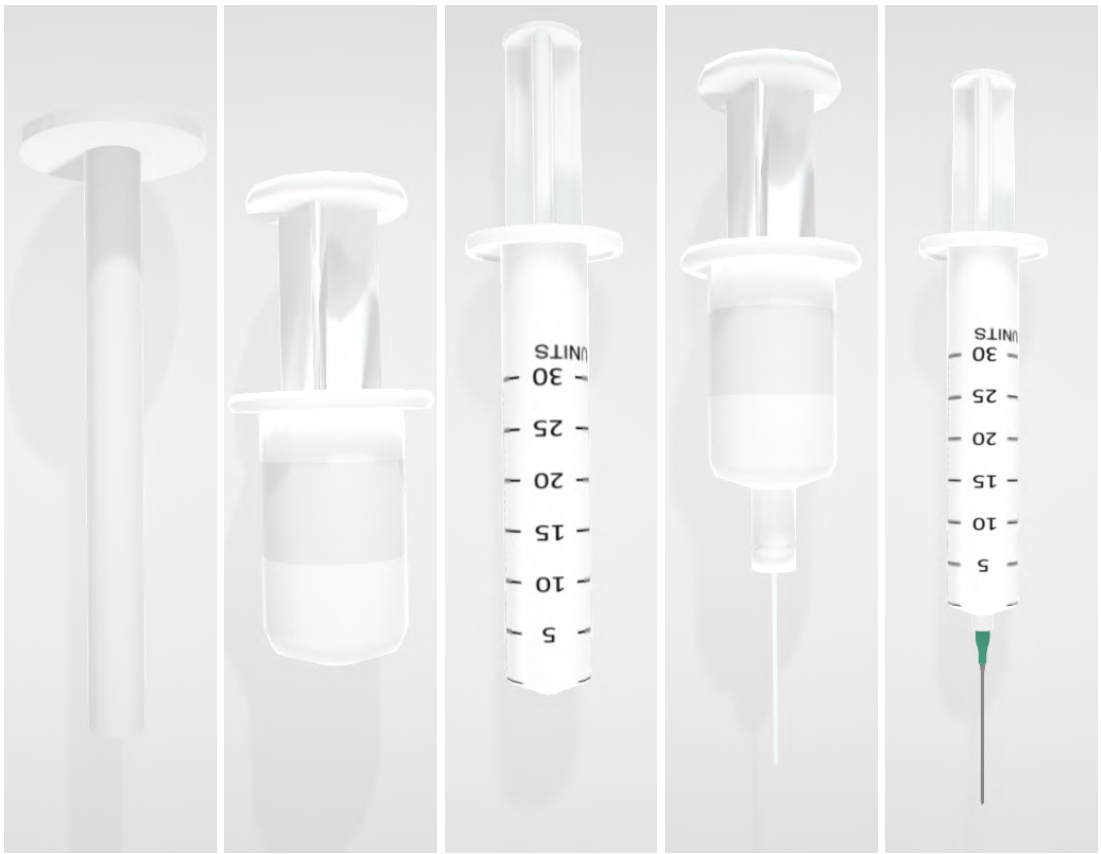


Figure 44: Model serinha_evolucao with five levels

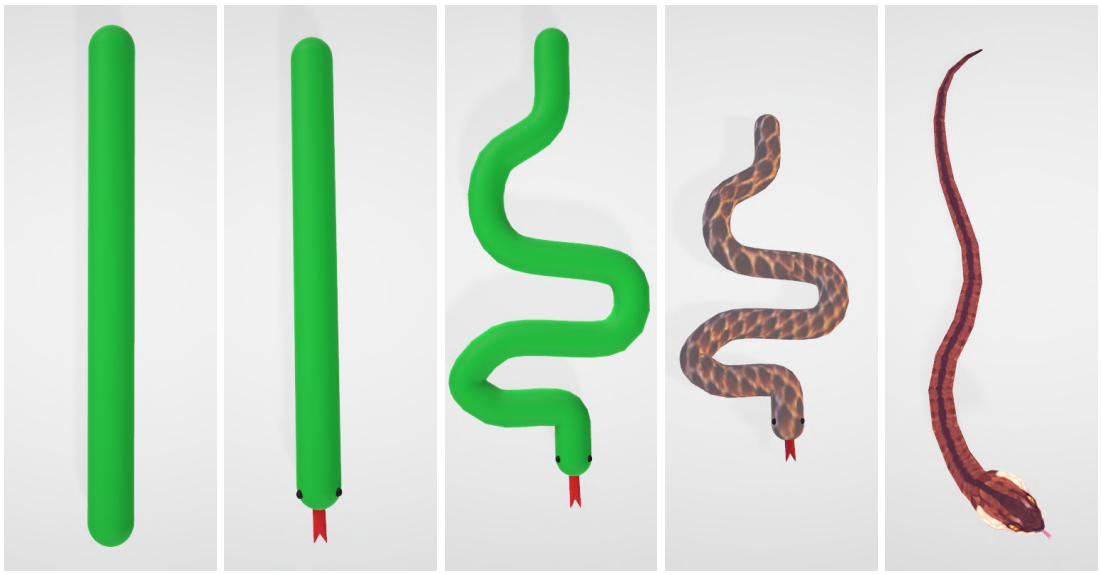
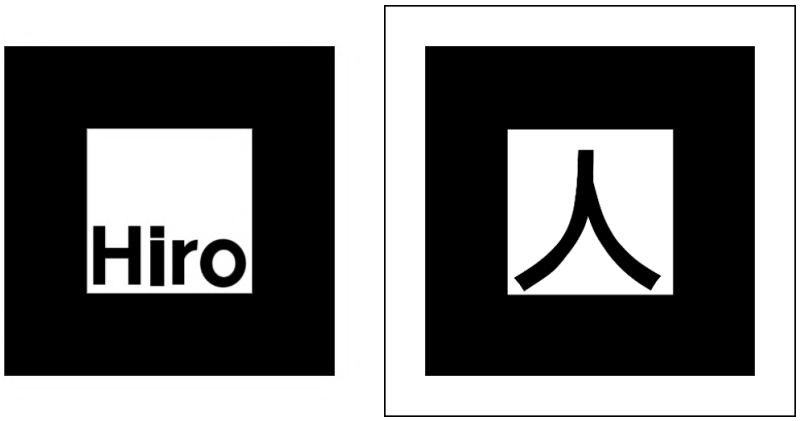


Figure 45: Model cobra_evolucao with five levels

B

MARKERS



(a) Hiro (b) kanji

Figure 46: Hiro and Kanji markers

(a) Level 1 (b) Level 2 (c) Level 2 (d) Level 2 (e) Level 2

Figure 47: "Niveis" Marker

C

PHOBIAR SCREENSHOTS (DESKTOP)

Figure 48: PhobiAR home page

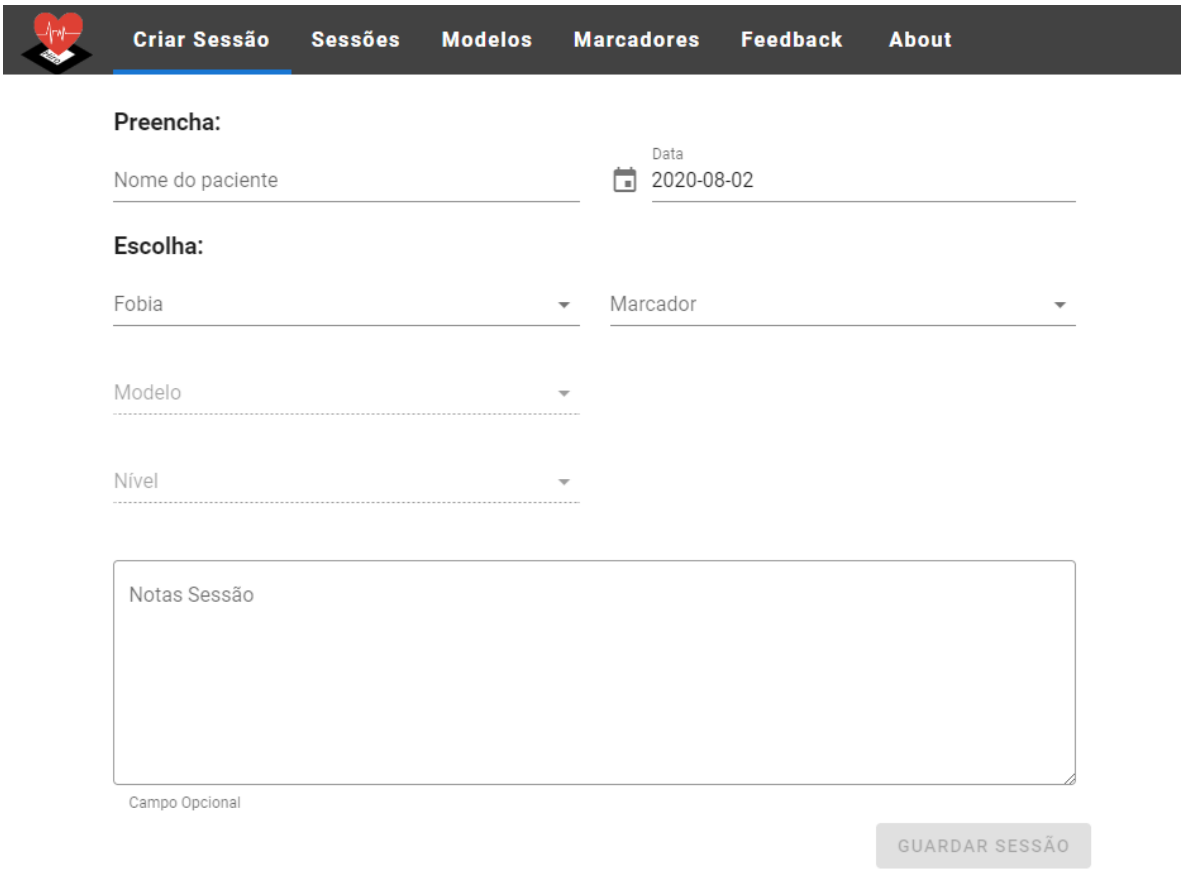


Figure 49: Create Session page

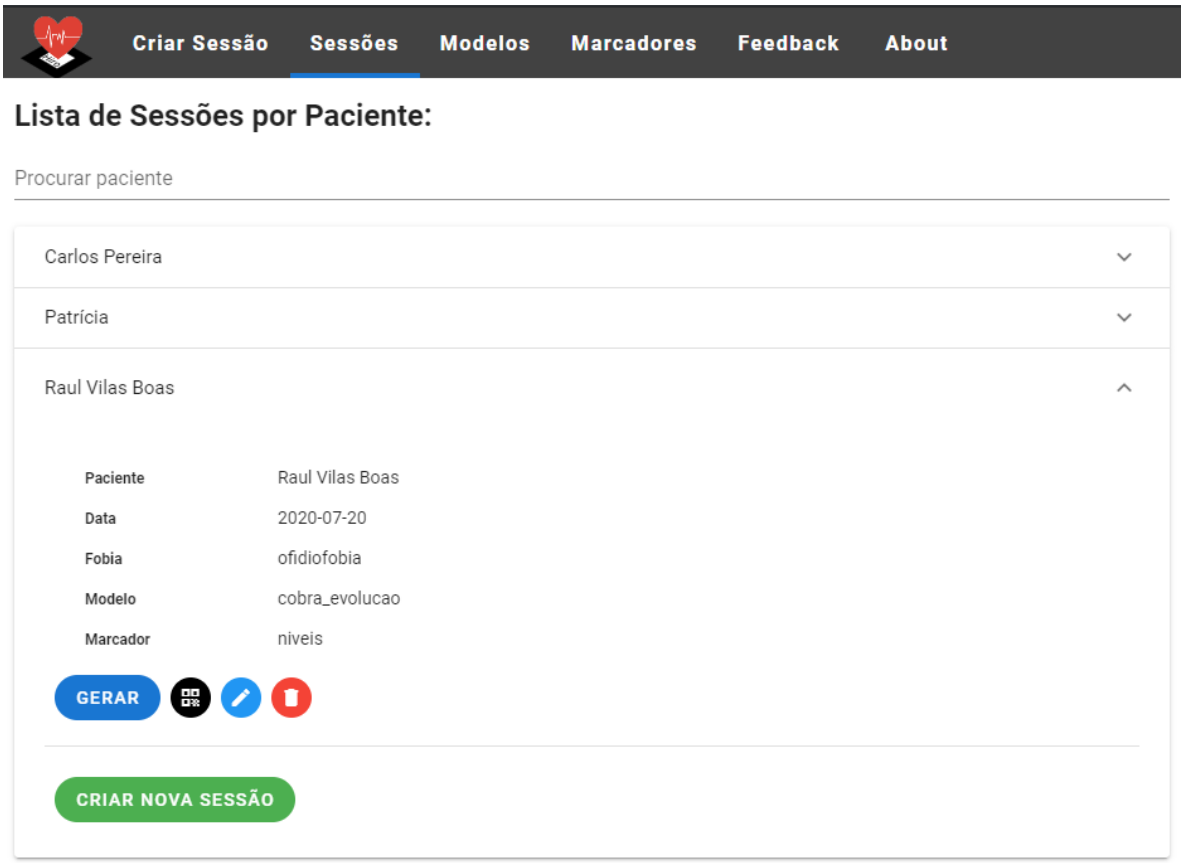


Figure 50: Sessions page

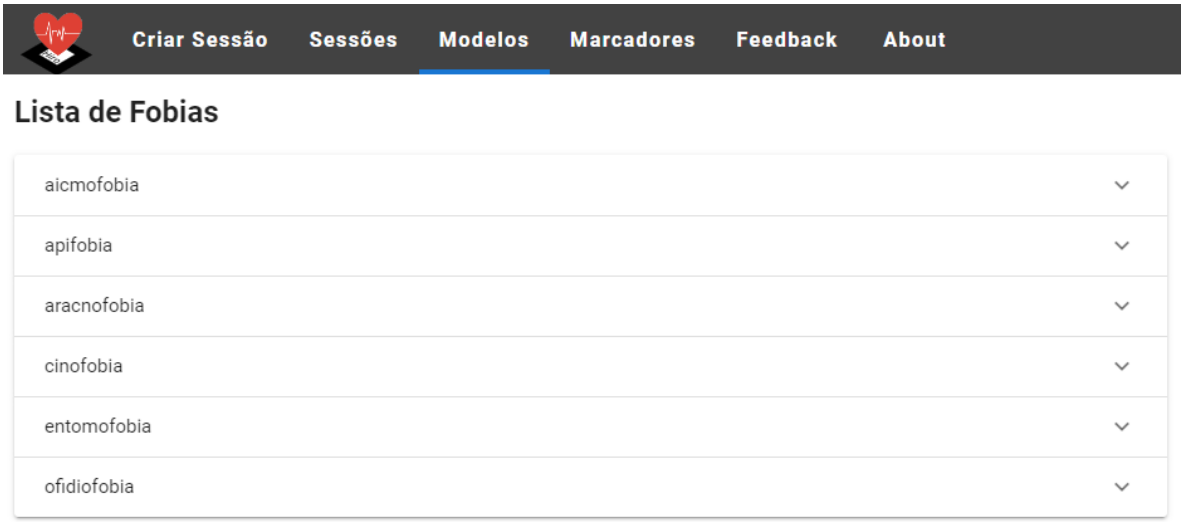


Figure 51: Models page

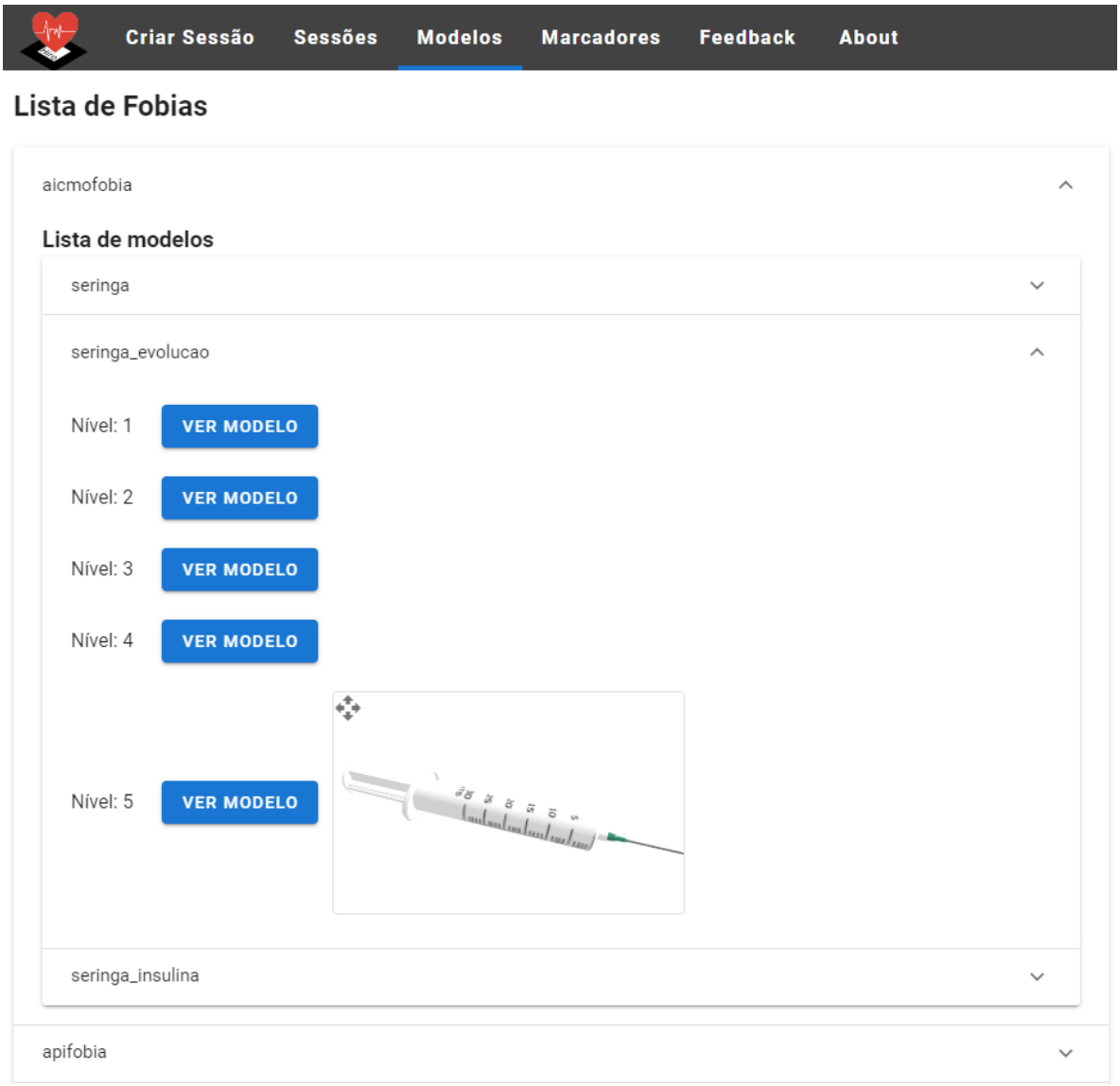


Figure 52: Models page expanded

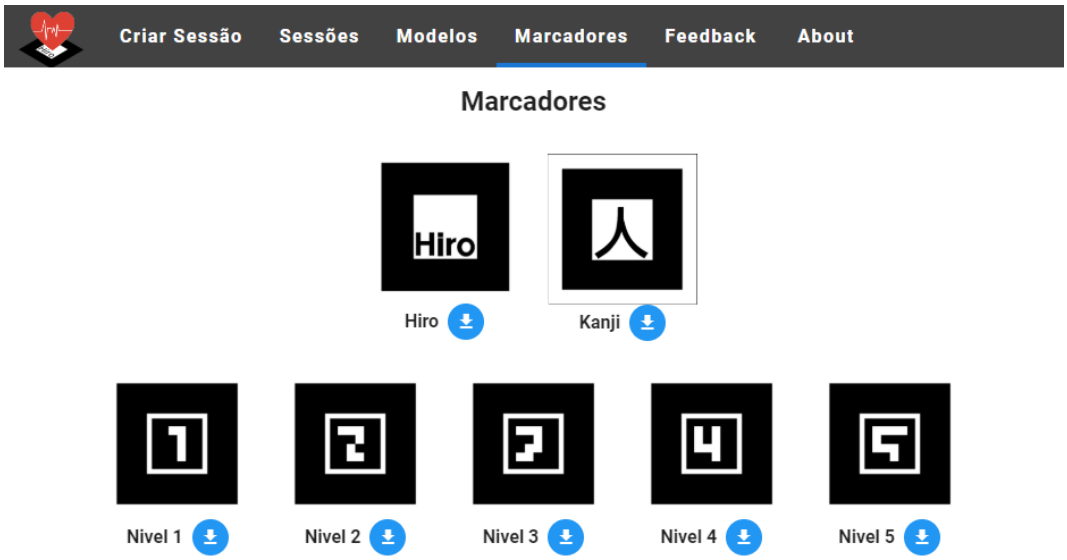


Figure 53: Markers page

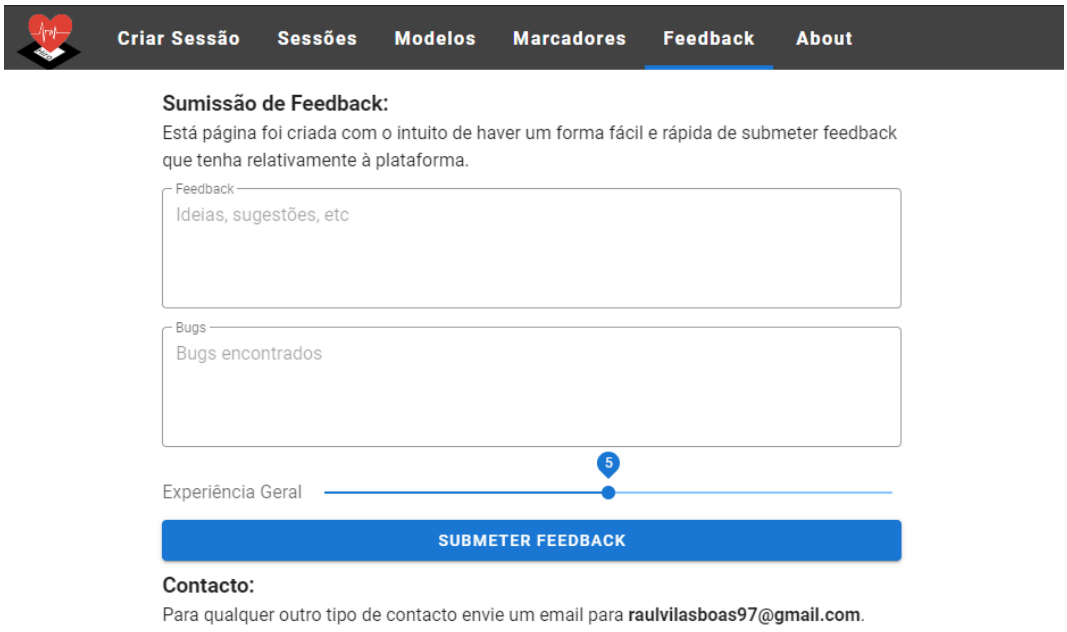
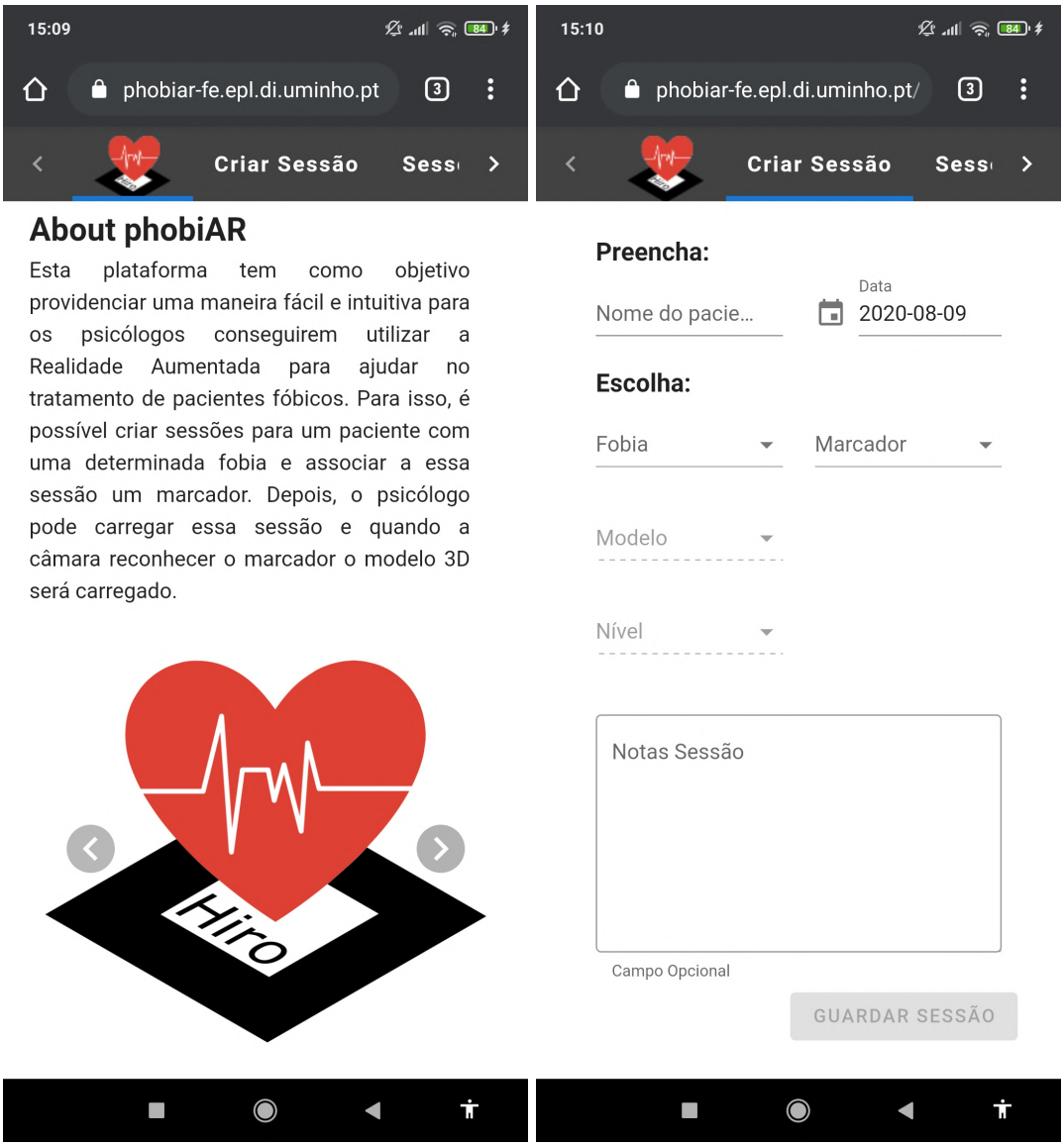


Figure 54: Feedback page

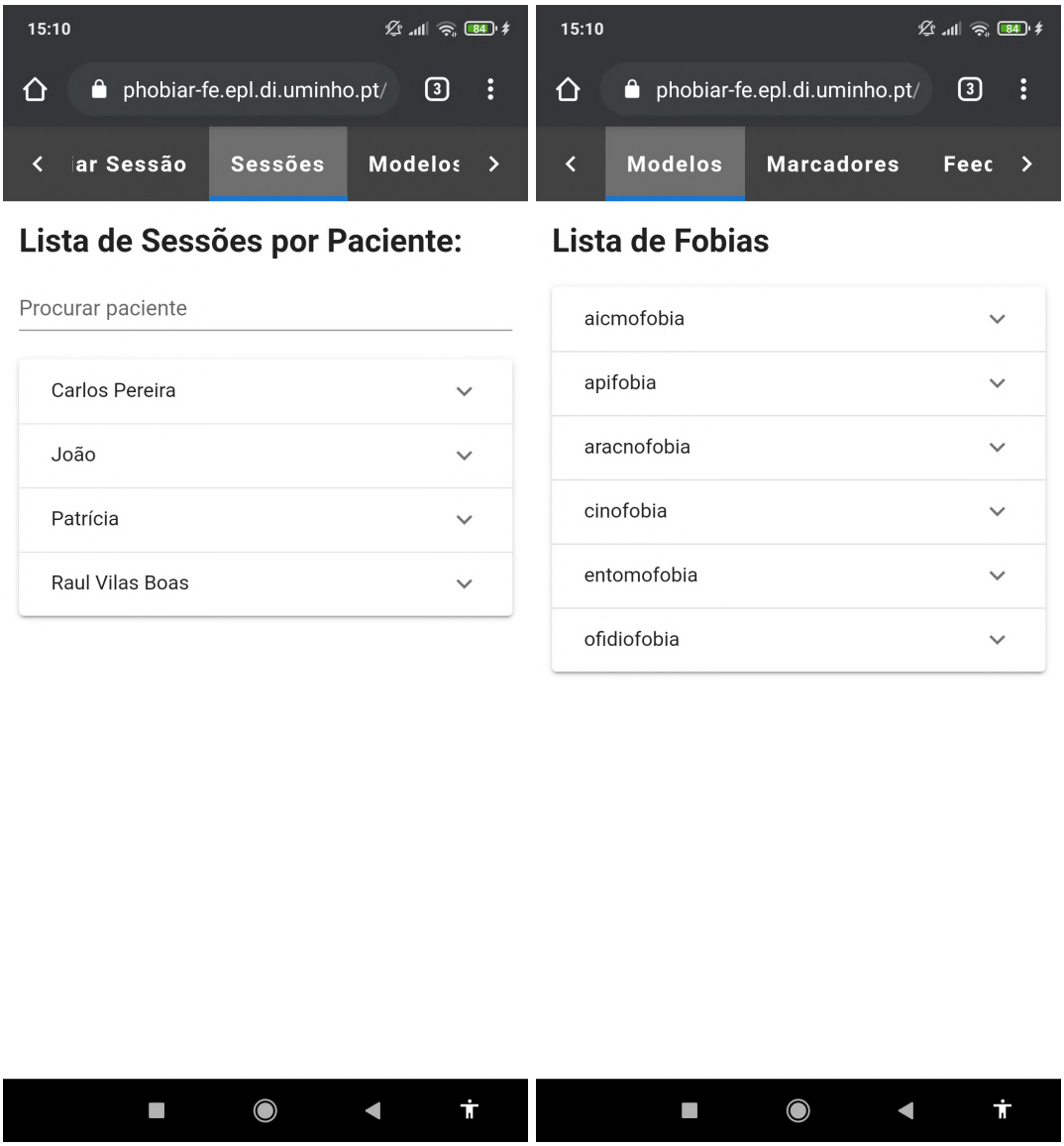
D

PHOBIAR SCREENSHOTS (PHONE)



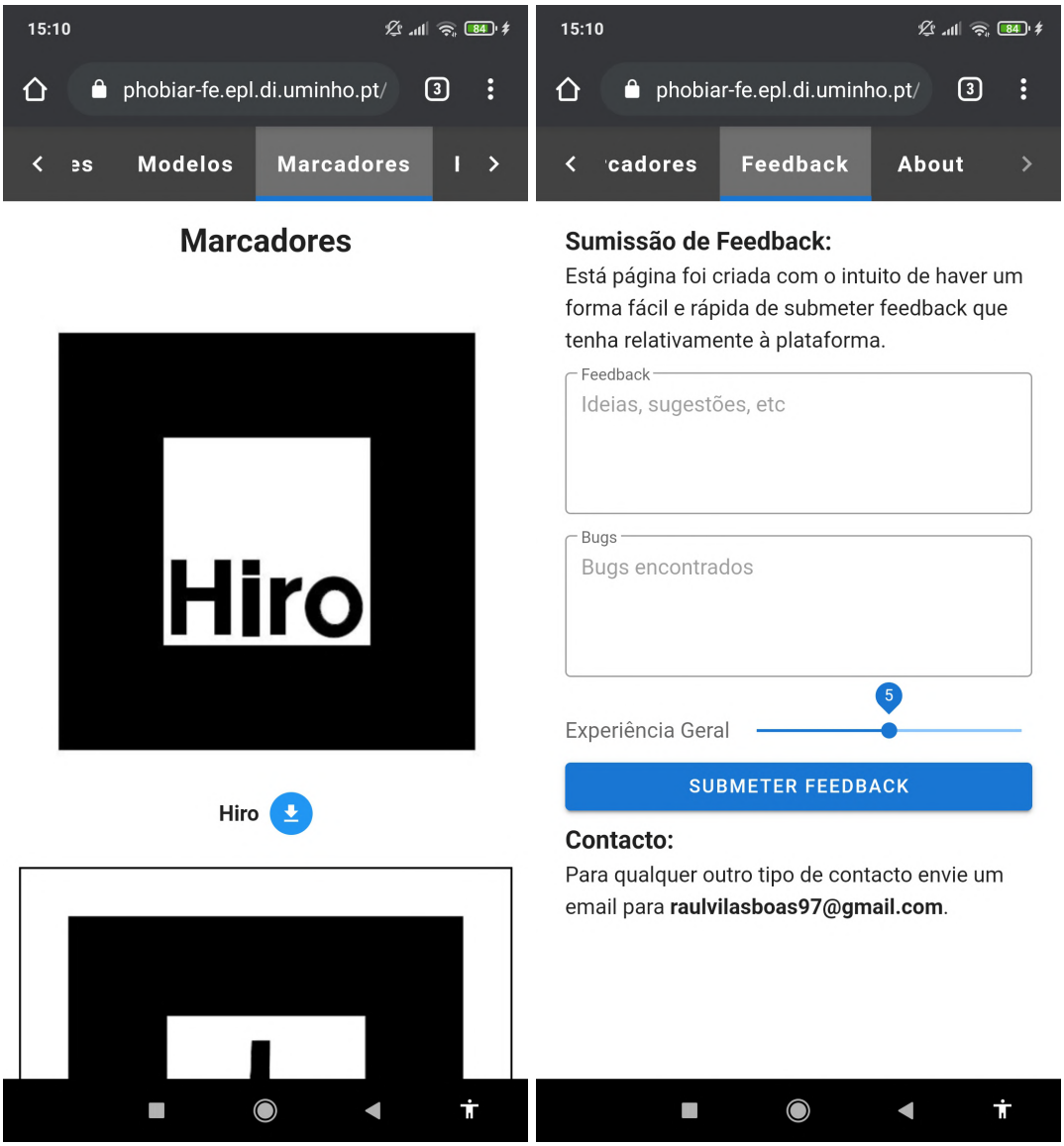
(a) Home (b) Create Session

Figure 55: Home and create session page



(a) Sessions (b) Models

Figure 56: Sessions and models page



(a) Markers (b) Feedback

Figure 57: Sessions and models page

E

PHOBIAR USER GUIDE

The user guide of PhobiAR shared with psychologists explains the platform by going through what every page does, and the procedures that need to be followed during the use of the platform.

Guião de utilização da plataforma PhobiAR

Descrição Geral:

Esta plataforma está a ser elaborada no âmbito de uma tese de mestrado na Universidade do Minho em Engenharia Informática. O tema da tese é *Design an Artefact of Augmented Reality to support the Exposure Therapy of Specific Phobias* e incide sobre a utilização da Realidade Aumentada para ajudar no tratamento de fobias específicas. Deste modo, a plataforma tem como objetivo providenciar uma forma fácil e intuitiva para os psicólogos conseguirem utilizar a Realidade Aumentada no tratamento de pacientes fóbicos. Não tem como objetivo substituir o tratamento tradicional, mas sim complementá-lo expandindo as suas possibilidades.

Com este guião, pretende-se que os psicólogos experimentem a plataforma (na ausência de pacientes) e respondam a um questionário com os seguintes objetivos:

- Verificar a utilidade deste projeto no tratamento de fobias;
- Avaliar a aplicabilidade da plataforma;
- Analisar as dificuldades sentidas na utilização da plataforma;

Exemplos:

Requisitos:

Navegador: Chrome (Computador/Android) ou Safari (IOS)

Acesso ao website https://phobiar-fe.epl.di.uminho.pt/

Equipamento necessário: telemóvel ou computador

Conceitos:

Realidade Aumentada: tecnologia que permite sobrepor elementos virtuais à nossa visão da realidade.

Modelo: objeto 3D que representa uma fobia.

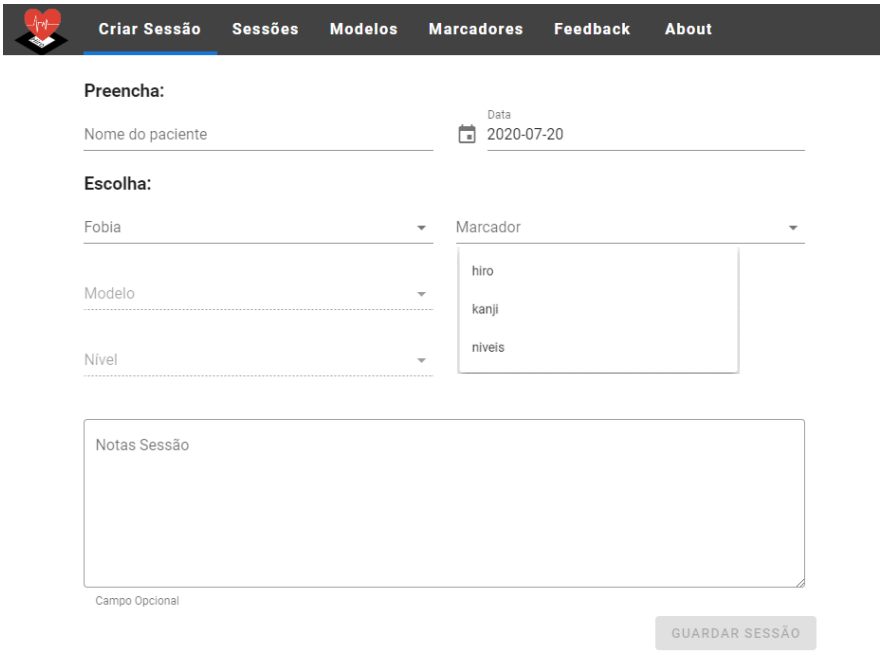
Nível: uma fase na evolução do modelo

Marcador: imagem reconhecida pela câmara que permite sobrepor o objeto 3D no marcador.

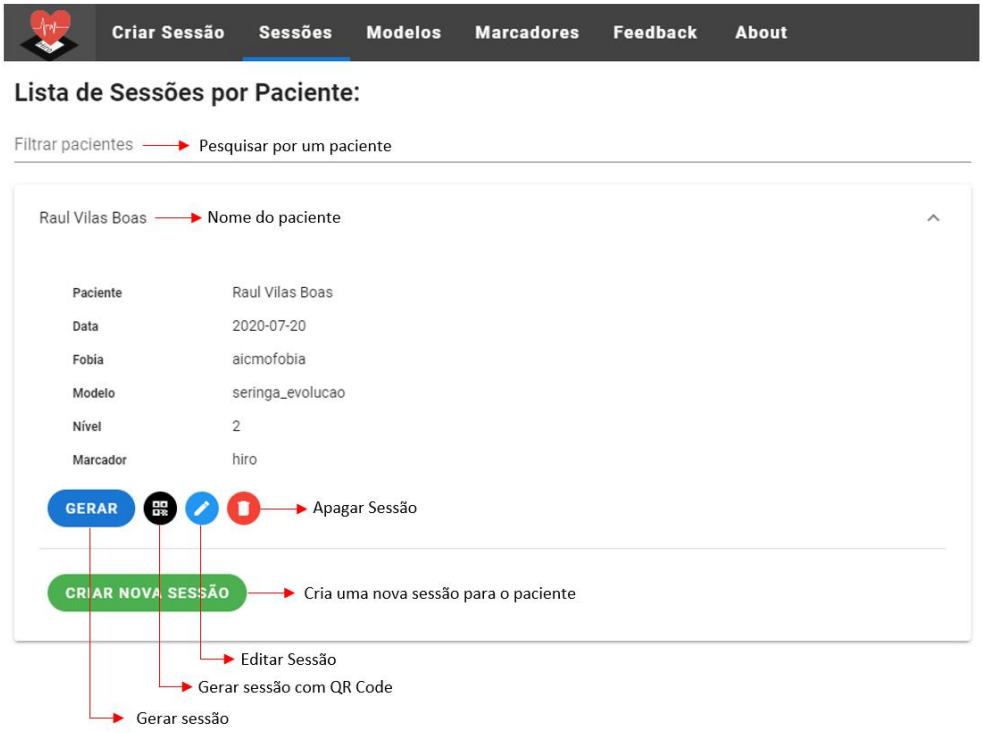
Descrição das funcionalidades da plataforma:

Criar Sessão: Permite criar uma sessão para um paciente associando-lhe uma fobia, modelo, nível e marcador.

Na opção do marcador existem 3 hipóteses: ‘hiro’, ‘kanji’ e ‘niveis’. A escolha de ‘hiro’ e ‘kanji’ obriga à definição do nível pretendido. A escolha da opção ‘niveis’ desativa o campo ‘Nivel’ pois este é atribuído automaticamente conforme o número que consta no marcador (1,2,3,4,5).



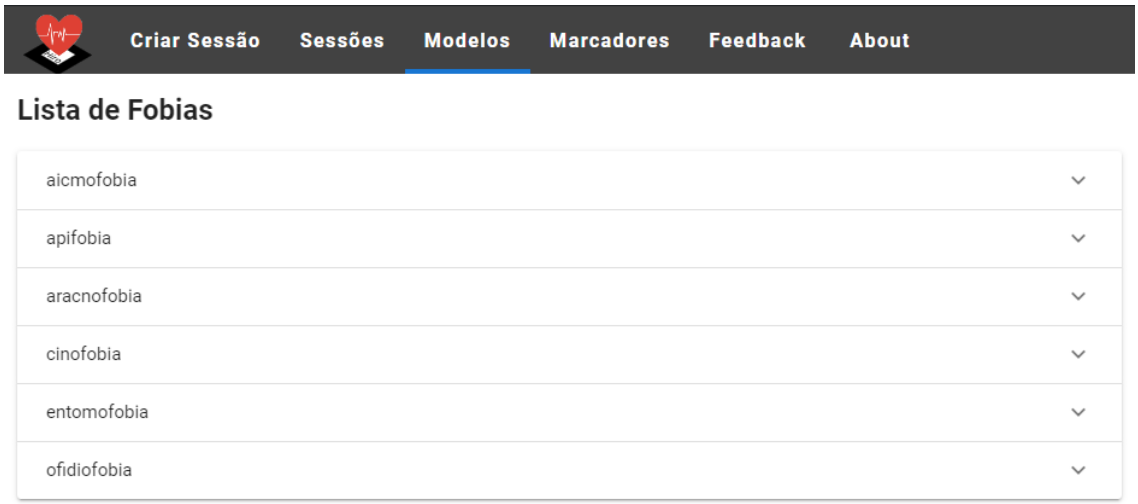
Sessões: Apresenta a lista de sessões agrupadas por paciente. Permite gerar a sessão utilizando o botão ou lendo um QR Code, criar uma nova sessão para o paciente, editar e apagar.



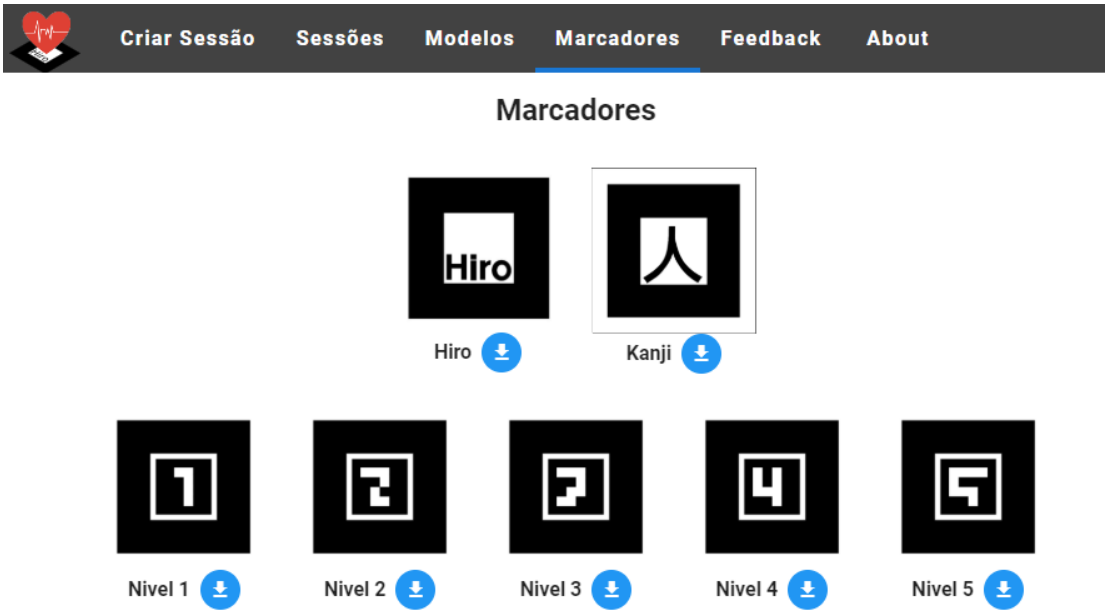
Modelos: Permite visualizar os modelos 3D disponíveis na plataforma, bem como movimentar e fazer zoom.

Foram criados vários modelos exemplificativos, contudo, face aos objetivos pretendidos, apenas 3 modelos possuem 5 níveis de evolução (aranha_evolucao, cobra_evolucao e seringa_evolucao).

Alguns modelos são bastantes pesados, por isso podem demorar mais tempo a carregar.



Marcadores: Permite visualizar e transferir os marcadores disponíveis na plataforma.



Perguntas Frequentes:

- É necessário instalar alguma aplicação?
  Não, o acesso à plataforma não requer nenhuma instalação estando disponível online.

- É necessário imprimir os marcadores?
  Não é necessário, mas aconselha-se, pois, facilita o procedimento pelo facto de ser mais fácil apontar a câmara ao marcador. Em alternativa, aponte a câmara do telemóvel aos marcadores existentes em https://phobiar-fe.epl.di.uminho.pt/marcadores .

- Devo imprimir todos os marcadores?
  Não, apenas é necessário imprimir os marcadores que pretende usar.

Notas:

- A plataforma como está em desenvolvimento poderá ter bugs, se encontrar algum por favor descreva-o em https://phobiar-fe.epl.di.uminho.pt/feedback

Procedimentos:

1. Consultar os modelos 3D existentes na plataforma.
   1.1. Ir para a página dos 'Modelos' (https://phobiar-fe.epl.di.uminho.pt/modelos);
   1.2. Escolher a fobia aicmofobia;
   1.3. Escolher o modelo seringa_evolucao;
   1.4. Carregar no botão 'Ver modelo' para cada nível e observar o objeto 3D;
   1.5. Repetir os procedimentos 1.2 a 1.4 para a fobia/modelo aracnofobia/aranha_evolucao e ofidiofobia/cobra_evolucao;
   1.6. Ver outros modelos.
2. Consultar os marcadores existentes na plataforma.
   2.1. Ir para a página 'Marcadores' (https://phobiar-fe.epl.di.uminho.pt/marcadores);
   2.2. Ver os marcadores disponíveis;
   2.3. Descarregar e imprimir um marcador **(Opcional)**.
3. Criar uma sessão para um paciente.
   3.1. Ir para a página de 'Criar Sessão' (https://phobiar-fe.epl.di.uminho.pt/criarsessao);
   3.2. Criar uma sessão preenchendo as informações necessárias;
   3.3. Guardar a sessão.
4. Gerar a sessão para o paciente;
   4.1. Ir para a página das 'Sessões' (https://phobiar-fe.epl.di.uminho.pt/sessoes);
   4.2. Procurar a sessão do paciente anteriormente criada;
   4.3. Carregar na sessão do paciente;
   4.4. Carregar no botão de 'Gerar sessão';(*)
   4.5. Aceitar permissões de acesso à câmara;
   4.6. Apontar a Câmara para o marcador escolhido para a sessão (marcador impresso ou disponível na página 'Marcadores'.
5. Utilizar a plataforma livremente.
6. Preencher o formulário em https://forms.gle/8ySCQ86KqmHdegcCA

(*) Nota: existe a possibilidade de passar a utilizar o telemóvel nesta etapa, procedendo à leitura do QR Code para gerar a sessão.

Antecipadamente grato pela colaboração prestada.

Raul Vilas Boas

Nota: Para qualquer informação adicional envie email para raulvilasboas97@gmail.com

F

PHOBIAR FORM

The feedback form that the psychologists were asked to fill in order to gather the results of the platform. The form is divided into 3 parts. The first part is basic information about the user. The second is questions about the platform, and finally, the last part questions about the 3D models.

Feedback

Este questionário está a ser elaborado no âmbito de uma tese de mestrado, e pretende reunir feedback sobre a aplicabilidade e utilidade da plataforma. Assim, a sua colaboração é fundamental na recolha de informações.
*Obrigatório

Informações

1. Género *

   Marcar apenas uma oval.

   - ◯ Feminino
   - ◯ Masculino
   - ◯ Indiferenciado

2. Idade *

   _____

3. Área de especialização *

   _____

   _____

   _____

   _____

   _____

4. Alguma vez usou tecnologias de realidade aumentada? *

   Marcar apenas uma oval.

   - ◯ Sim
   - ◯ Não

5. Alguma vez tratou um paciente fóbico? *

Marcar apenas uma oval.

- ◯ Sim
- ◯ Não

Características da Plataforma

Perguntas gerais sobre a plataforma.

6. Classifique o grau de facilidade na utilização da plataforma *

Marcar apenas uma oval.

	1	2	3	4	5	
Difícil	◯	◯	◯	◯	◯	Muito fácil

7. Classifique o grau de utilidade desta plataforma no tratamento das fobias. *

Marcar apenas uma oval.

	1	2	3	4	5	
Nada útil	◯	◯	◯	◯	◯	Muito útil

8. Classifique o grau de aplicabilidade desta plataforma no tratamento das fobias. *

Marcar apenas uma oval.

	1	2	3	4	5	
Nada aplicável	◯	◯	◯	◯	◯	Muito aplicável

Modelos 3D

Tendo em conta os modelos aranha_evolucao, cobra_evolucao e seringa_evolucao, responda às seguintes questões.
(poderá visualizar estes modelos na página "Modelos" na plataforma: Link: https://phobiar-fe.epl.di.uminho.pt/modelos)

9. Classifique o grau de aplicabilidade dos modelos de nível 1, no tratamento dos casos mais graves. *

Marcar apenas uma oval.

	1	2	3	4	5	
Não aplicável	◯	◯	◯	◯	◯	Muito aplicável

10. Para cada modelo, classifique se a evolução entre níveis é adequada. *

Marcar apenas uma oval por linha.

	Não adequada	Pouco adequada	Adequada	Muito adequada
aranha_evolucao	◯	◯	◯	◯
cobra_evolucao	◯	◯	◯	◯
seringa_evolucao	◯	◯	◯	◯

11. Avalie a aproximação à realidade do modelos apresentados no seu nível máximo. *

Marcar apenas uma oval por linha.

	Não realista	Pouco realista	Razoável	Realista
aranha_evolucao	◯	◯	◯	◯
cobra_evolucao	◯	◯	◯	◯
seringa_evolucao	◯	◯	◯	◯

12. Classifique a probabilidade de usar este tipo de plataforma. *

Marcar apenas uma oval.

	1	2	3	4	5	
Pouco provável	◯	◯	◯	◯	◯	Muito provável

13. Sugestões

G

PHOBIAR FEEDBACK

Other feedback receive on the platform from the users.

Feedback

Feedback 1

Parabéns pelo trabalho! É uma ótima ferramenta que poderá ser utilizada também nos contextos educativos (por exemplo explicar o movimento das placas tectónicas). A minha área não é clínica, pelo que na minha prática não utilizarei muito, mas se adaptada ao contexto educativo pode ser interessante.

Na minha opinião é mais fácil utilizar a partir do telemóvel ou tablet, contudo pelo menos eu não consegui ver a cobra numa rotação 360º nem aumentar o zoom como consegui ao explorar os modelos (a experiência foi mais intensa e real ao explorar o modelo no nível 5). Está uma ideia fantástica, a plataforma é intuitiva, mas sugeria a par da descrição dos procedimentos criar um vídeo a explicar como utilizar a plataforma.

Continuação de um bom trabalho!

Feedback 2

No meu entender, esta plataforma pode ser utilizada no estudo do tratamento de fobias, sendo uma ferramenta de diagnóstico complementar no contexto clínico, no entanto, acrescentaria os seguintes itens:

- Poder anotar-se na 1ª sessão, o histórico da origem da sua fobia onde consta-se várias questões para melhor perceber se a sua fobia está associada a outros fatores ou outros estados emotivos, como identificar como perceciona o medo e como o vivencia;
- Também integrar se trata de medo (por vezes está relacionado com uma distorção do processo cognitivo e associado ao perigo) ou ansiedade (a resposta emocional é o de aversão);
- Estar um item em que se possa anotar, se apresenta um medo recativo (quando apresentam o medo por uma situação ameaçadora real) ou medo cognitivo (só de pensar);
- Descrição das reações físicas/psicológicas do paciente;
- As imagens apresentadas deveriam ser o mais real possível;
- Possibilidade de contabilizar as pulsações (ritmo cardíaco), para poder obter o grau de intensidade (1- nem um pouco, 2- um pouco, 3- moderadamente, 4- bastante e 5- extremamente) da ansiedade/medo, porque ajudaria a medir a ativação do sistema nervoso e no final poder obter um gráfico da evolução do tratamento;

Em conclusão, esta plataforma pode contribuir para a identificação dos principais antecedentes e consequentes do medo/Ansiedade e a sua aplicação pode oferecer informações pertinentes sobre como o indivíduo vivencia o seu medo e orientar para estratégias de resolução da fobia.

Feedback 3

O programa parece simples de usar e bastante fácil de armazenar informação. No entanto, acho que o look digital de alguns dos objetos poderá não ter efeito em pessoas que apresentem algumas fobias mais "ligeiras". Pergunto-me qual seria a diferença entre ver esta imagem utilizando AR ou uma simples imagem 3D. A minha dúvida vem principalmente do facto de não ser possível "manipular" o objeto no espaço. Sim, é possível pegar na imagem impressa e colocar na mão do paciente e pedir para que este olhe para a imagem como se fosse o objeto na sua mão. Em casos mais intensos isto poderá ser o primeiro passo até conseguir transitar para algo mais "real". Acho o conceito bastante interessante e com possibilidade de ter grande utilidade para tratamento em casos severos. Penso só que o grafismo poderá ter que ser tornado mais realista em alguns casos e talvez ser acrescentado algum tipo de animação para que não sejam objetos estáticos.

Feedback 4

Pensar em ter mais níveis dentro de cada dimensão e procurar ter modelos mais realistas, inclusive modelos reais, dado que em determinados casos, o "desenho" não despoleta a desregulação emocional e/ou o mal-estar. Bom trabalho e boa iniciativa! ^_^

Feedback 5

Adorei conhecer este projeto! Acho que é efetivamente daquelas respostas que em muito enriquece o terreno da intervenção! Fiquei fã deste trabalho e ponderaria investir nesta ferramenta uma vez ficando disponível! Não desista deste trabalho por favor, é uma necessidade para os técnicos!

Feedback 6

Aplicabilidade da ferramenta é muito boa. Agrega ao trabalho realizado pelo profissional e contribui com a exposição de forma segura durante o tratamento. Sugiro aprimorar cada vez mais o nível de realismo, bem como adicionar novos objetos fóbicos.