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Virtual Reality in Depressive and Anxiety Symptomatology – Contributions to REVIDA project from a mobile app mapping

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Abstract

The worldwide prevalence of mental health diseases is alarming. 792 million individuals have a mental disorder such as anxiety or depression. Treatment varies among the types of illness. They can be expensive and, in order to be effective, must address a combination of psychotherapy and medications. The drugs used for treating symptoms present a risk of negative side effects. Studies have shown the benefits of other co-therapies such as physical exercise. In this case, the ability to simulate reality can strongly increase the introduction of other psychological therapies and treatment results can be improved through new immersive experiences. Virtual Reality Exposure Therapy has demonstrated its effectiveness by allowing patients to gradually face fearful stimuli or stressful situations. Recent studies showed that the use of Virtual Reality is effective and safe for mental health. Particularly, in the scenario of how Virtual Reality simulation could increase empathy and behaviour change. This article presents a preliminary study of the REVIDA project: It aims to investigate through Benchmarking and SWOT Analysis the possible integration of Virtual Reality in mental illness monitoring in Portugal. Results show that there exist several new opportunities for using Virtual Reality technology in mental health and wellbeing.

Keywords: Benchmarking; Design Process; Mental Health; SWOT Analysis; Virtual Reality

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1. Introduction

Mental health disorders are rising all over the world (Ferrari et al., 2013). It is estimated that 792 million individuals worldwide have a mental health disorder, with anxiety and depression being the more common ones (Our World in Data, 2021). Thus, more than one in ten people globally live with a mental disorder. Anxiety is the most common mental illness in the world (Thibaut, 2017), affecting 284 million people whereas 264 million are estimated to have depression (Our World in Data, 2021). People with an anxiety disorder may present constant worry, fear, and stress (APA, 2013; Thibaut, 2017). As regards people with depression, continuing low mood, fatigue, and profound sadness are usually present (APA, 2013). In both cases, there is an important interference in one's everyday life (Thibaut, 2017; Our World in Data, 2021).

The prevalence of these mental health diseases is alarming, showing that a large part of the population lives in great suffering. Thus, it is essential to get effective treatment so that fewer people are experiencing pain. However, much work is still needed to achieve effective treatments. In fact, many studies are still needed to understand the etiology of the disease, which will clearly have repercussions on the effectiveness of treatments. At the present moment, it is known that mental health treatment varies among the types of mental disorders. Treatments can be expensive (Chisholm et al., 2016) and, in order to be effective, must address a combination of psychotherapy (especially cognitive behavioral therapy) and medications (APA - Division 12, n.d.). However, as with most medications, the drugs used for treating symptoms of anxiety and depression have a risk of negative side effects including drowsiness, fatigue, headaches, dry mouth, nausea, and tremor, among others (Bandelow et al., 2017; Osuch & Marais, 2021; Thibaut, 2017). Moreover, recently, studies have shown the benefits of other co-therapies such as physical exercise (Stubbs, Koyanagi, et al., 2017; Stubbs, Vancampfort, et al., 2017).

The introduction of other psychological therapies, such as new immersive experiences, is strongly increasing in mental health because of the ability to simulate reality (Riva & Serino, 2020; Serino, 2020). An example of that is Virtual Reality Exposure Therapy (VRET), which has demonstrated its effectiveness by allowing patients to gradually face fearful stimuli or stressful situations, where psychological and physiological reactions can be controlled and assessed by the health professional (Cipresso et al., 2018). A recent study (Gillespie et al., 2021) revealed that the use of Virtual Reality (VR) is effective and safe for mental health (Ferrari et al., 2013). It is estimated that 792 million individuals worldwide have a mental health disorder, with anxiety and depression being the more common ones (Our World in Data, 2021). Thus, mental health, particularly in scenario showed how VR simulation could increase empathy, which also helps to improve attitudes and behaviors for the betterment of patients. A recent study was conducted with 206 health professionals, and it showed that this context is still needed to be explored with the intention to change behavior based on the social determinants of health (Gillespie et al., 2021; Liao et al., 2018).

Thus, the aim of the present study is 1) to investigate, map (quantitatively) and compare existing mobile apps (qualitatively), through Benchmarking and SWOT analysis methodologies and to investigate how mental illness monitoring could be improved with the use of VR technology; 2) to understand how the Design Process is able to contribute to the junction of the two core areas of this project, which are mental health and VR technology. Here the Map of Perception (Kumar 2013) methodology will be applied. The Design Process is a way of figuring out what is needed to do (Kumar 2013) and as seen in figure 1, this study is a preliminary stage of a project which is a part of the master's degree REVIDA project[†]. After all, methodologies have been applied, the Design process is completed and the results are presented, it is intended to create a proof of concept, and possibly a mobile application, with the possibility to create an environment or an immersive meditative experience with VR glasses for people with anxiety and depression. It may be possible to integrate a conversation exercise with the health professional or to be used isolated.

[†] This is an ongoing project developed by a student from the master's degree in Design for Health and Wellbeing from ESAD.CR – School of Arts and Design of Polytechnic of Leiria, Portugal. The student is a Multimedia Designer, and the supervisors are experts in Design for Health and Wellbeing and Clinical and Health Psychology.

This document is divided into 5 sections: first, the Introduction, where a summary of the context is given. The second is Literature Review about how VR, mental health and wellbeing are getting together; the third, the Methods and Materials section, sets out the search strategy adopted through two different phases: (1) Benchmarking and (2) SWOT analysis. Fourth, Results, where the global outcomes are shown. In this section, the selected studies are analyzed using a narrative methodology; finally, the Discussion and Conclusion, with implications for further research.

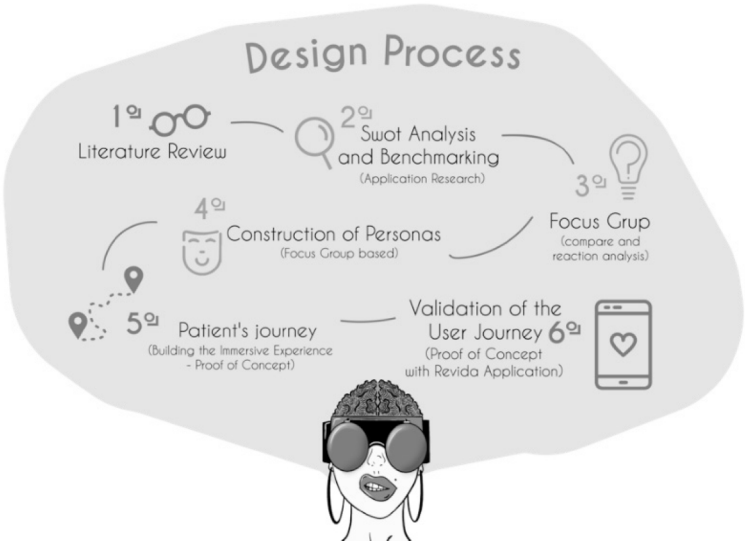

Fig. 1. - REVIDA Design Process Infographics

2. Virtual reality, mental health and wellbeing – How are they getting together?

In the last three years, the so-called second wave of VR has brought a vast number of new displays and input devices. Not only has the new hardware entered the consumer market by providing affordable models, but also new technologies are being designed and developed. In addition, new problem-handling concepts are constantly being introduced to existing problems on the hardware and software side of VR technology (Anthes et al., 2016). This development of software and hardware is mainly led by enthusiasts interested in the domain of VR, as opposed to the established scientific community, which already makes partial use of the newly available technology. Besides head-mounted displays (HMDs), either cable-based or mobile, other devices such as haptic devices, controllers, waistcoats, omnidirectional treadmills, tracking technologies as well as optical scanners for gesture-based interaction are gaining importance in the field of commodity VR. Most of these technologies are already accurate and robust enough to be used in professional operations and scientific experiments (Anthes et al., 2016). The use of VR as an exposure therapy has generated curiosity about what its benefits might be (Anderson & Molloy, 2020). Considering the mental health and wellbeing context, and to the best of our knowledge, no VR system has ever been created for the Portuguese population.

Literature reveals that some clinical problems such as the fear of something in particular – e.g., specific phobias – can be reduced by exposing patients to that specific phobic object through VR. According to Chung and colleagues (2022), the acceptability of this technology by patients is generally satisfactory, although some applications do not meet clearly their expectations. Still, for healthcare professionals (such as doctors), this technology is still new, and thus more studies are needed as well as education in relation to what this technology can bring, exploring good and bad people's quality of life. A particular study showed what is happening in an Australian mental Health Services regarding their knowledge, attitudes and the implementation of barriers to therapeutic VR. This was a study on changes related to knowledge, attitudes and changes in the behaviours of health professionals, after an experience with VR where professionals can experience some life circumstances and past events with the patients. Given the ability and

impracticality of conducting live training with current providers at their side, virtual VR may be considered the next best option.

Since VR permits people to be present in a virtual environment (Riva, 2022) and experience different situations, VR systems could be a powerful tool for behavioural change (Riva et al., 201). Figure 2 presents the statistical data regarding the state of mental health in Portugal. This country is the 2nd in Europe with the most psychiatric illness and the 5th with higher consumption of antidepressants. Considering the increasing percentages of mental health problems, the costs of treatments as well as the possible side effects of medication, it is important that other adjunctive therapies are considered. Therefore, the REVIDA project arises with the intention to create an app to help the Portuguese population with depressive and anxious symptoms, through an immersive experience with VR glasses – mental illness monitoring.

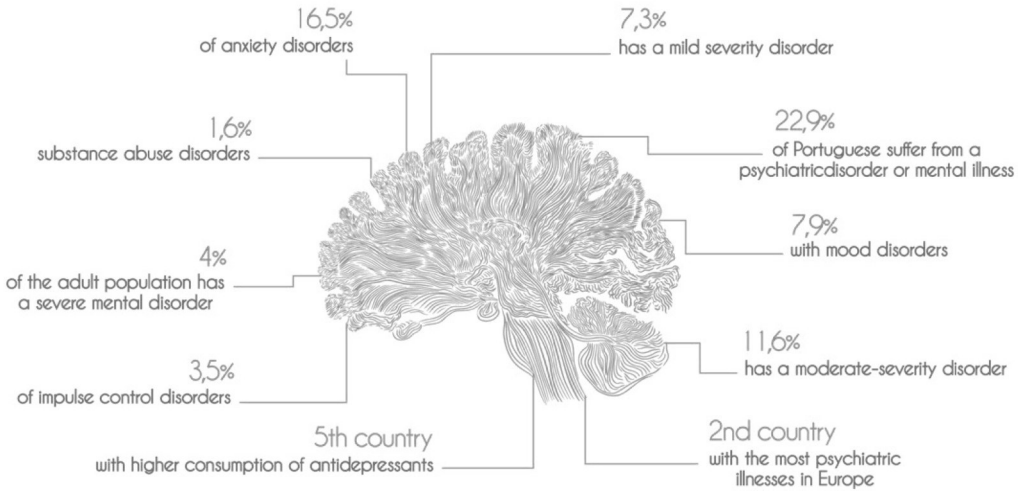

Fig. 2 - Statistical data on the state of mental health in Portugal (Teixeira, 2016)

3. Methods & Materials

3.1. Benchmarking and SWOT Analysis

The preliminary study presented in the article includes two methods: a Benchmarking and a SWOT Analysis. Benchmarking (Stapenhurst, 2009) method was selected because it serves as a standard to measure whose performance is against others in the industry field. The proposed method was carried out by mapping the Portuguese mobile apps. The three main goals were: (1) to understand how many mobile apps are available to the citizens regarding mental health; (2) if there were any related apps with VR; (3) to analyze the mapped solutions considering the research question "Could results of Benchmarking method be useful to guide the REVIDA project?"; (4) to identify which are the selected systems that offer the most suitable solution for the user target (i.e., people with depressive and anxiety symptomology). SWOT analysis is a method that maps the perception of benefits and challenges of something through four dimensions: strength, weaknesses, opportunities, and threats (Panagiotou, 2003). This method was applied after concluding Benchmarking methodology to evaluate where those systems are standing and moving forward with opportunities for the REVIDA project.

3.2 Strategy adopted

The design of the REVIDA project started in December of 2021 A previous literature review helped to comprehend the potential of VR in mental illness monitoring. Relevant contributions of what was discovered are

presented in section 2 – Virtual reality, mental health and wellbeing – How are they getting together? – following a narrative approach.

The initial phase of the Design Process, in which Benchmarking and SWOT analysis are included, started on Abril, 8th of 2022 and finished on June, 10th of the same year. It was conducted by the master's degree student and the supervisors. Based on the main research question of this study phase *"Could Benchmarking results be useful in the Design Process helping REVIDA to make robust decisions"* a strategy was defined: First, search in the IOS App store following these keywords: Meditation; VR Health; Health; VR Mental health; Mental health; Mood diary; Calm anxiety and stress. After that, the master's degree student searched in Google using another group of words: APP for mental health; APP glasses VR for mental health; VR in depression and anxiety apps.

Benchmarking started with two phases. In the beginning, it was decided by the group to collected Brand image; Name of the mobile app; Store description; Goals; Downloads, Reviews, Rating; Category; Last update; Link Store (App Store or website associated with the application); If it is from Android or IOS; Compatibility with Apple Watch or another smartwatch; Compatibility with VR Glasses; If it is focusing on Depression or Anxiety; If it is about Meditation and Relaxation; Mobile and Compatibility; Compatibility; Country Availability (Portugal); If it is free or with paid features; If it is totally paid; Language; Company or Author; if it is considered a Game; Keywords that led to the application. After mapping all the mobile apps, a second phase started with a selection followed by creating a colour principles pattern to help us in exploring insights and identify opportunities for the REVIDA project. This methodology (Kumar, 2013) associates colour principles with a meaning: (a) Green – Positive; (b) Blue – Important; (c) Red – Negative; (d) Yellow – Corresponding research goal (Kumar, 2013). At the end of this process, the final score counted how many greens, blues, reds and yellows each mobile app achieved, thus giving a value which is the final score. The applications with characteristics in red would be a negative point, that is, an application to not consider for the REVIDA project. Those with more yellows would be ideal, as they represented correspondence with the concept or with the characteristics to be developed in the future. The applications chosen were the ones that scored highest because they corresponded most to the concept of the future intended application and that had identical or similar points, characteristics and functionalities to those previously thought in the SWOT analysis.

Subsequently, a third phase happened. Using Miro online tool, the master's degree student listed the criteria those systems should meet (Table I) and the type of competitor (indirect if it is a mobile app that does not correspond exactly to the goal of the application to be developed; similar if it is an application that is similar to it). To complement this third phase, the corresponding features were selected with an icon under what would be relevant to be considered. The goal was to understand which mobile apps were the most valuable for this analysis. To close this third phase, the diagrammatic technique Perceptual Map (Kumar 2013) was followed to visualize the perceptions about price and quality from the selected mobile apps.

Table I – Criteria list for apps analysis

a.	Video consultation in real-time with VR glasses
b.	VR glasses available with the application
c.	Medical monitoring from the application
d.	Treatment guide
e.	Monitoring
f.	Learn the techniques of meditation or breathing
g.	Videos and guided meditation
h.	Appointments with health insurers or clinics
i.	Being part of the National Health Service
j.	Accessible to as many people as possible
l.	Possibility to talk to other people with the same diagnosis

In the last phase, the selected mobile apps were installed and tested without any specific guidelines or corresponding usability tests. The Trello online tool was used to describe them following these topics: how they

worked; how to open the app for the first time; how to use it; how it received us as a user. The goal of this phase, very relevant to the student, helped regarding what should and should not be included in REVIDA project.

4. Results

The results of the Benchmarking revealed that there are several mobile apps related to mental health. Table II (See online) shows the 30 apps found. Several results collected will serve as a guide to the REVIDA project. This first phase of the research showed us that from the group of 30 those that reveal, in the online store, higher ratings were: Cingulo – 5.0; Mooda – 5.0; P5_Saúde Mental – 5.0; P5_Avaliador de Sintomas – 5.0. The maximum value is 5.0 starts. Another interesting issue discovery is related to the keywords which identified the area that those mobile apps are developed for. From these 30 mobile apps, 10 are identified as Meditation (Provata VR; 5 Minutos; Atma; Cíngulo; Zen; Calm; Sattva; Insight Timer); 4 as Mental Health (Wakeout! – Movement Therapy; Self-Help for the mind; P5 – Saúde Mental; Knok); 1 as VR Mental Health (Medita App); 1 as VR Glasses for Mental Health; 1 as VR for depression and anxiety (Social UP3D).

Table II – Results of the Benchmarking second phase

						
	Insight timer - meditation	Xrhealth mobile app	Rootd - relief from anxiety	Socialup3d	p5 - Saúde mental	Knok - Vídeo consultas
Video Consultation in real-time with VR glasses	👎	👍	👎	👍	👎	👎
VR glasses available with the application	👎	👍	👎	👍	👎	👎
Medical monitoring from the application	👎	👍	👎	👍	👎	👍
Treatment guide	👍	👍	👍	👍	👍	👍
Monitoring	👎	👍	👎	👎	👎	👎
Learn the techniques of meditation or breathing	👍	👎	👍	👎	👎	👎
Videos and guided meditation	👍	👍	👎	👎	👍	👎
Appointments with health insurers or clinics	👎	👍	👎	👎	👎	👍
Being part of the National Health Service	👎	👎	👎	👎	👎	👎
Accessible to as many people as possible	👍	👎	👍	👍	👍	👍
Possibility to talk to other people with the same diagnosis	👍	👎	👎	👎	👎	👎
RESULTS	**5**	**7**	**3**	**5**	**3**	**4**

The second phase of the Benchmarking consisted in selecting those mobile apps following the strategy explain in 3. Methods & Material, considering the criteria defined in Table I. From the 30, only 6 achieved the second phase (Table II). Of those 6 mobile apps, there is one that almost reached all those 10 criteria: Xrhealth mobile with 7. Regarding the competitive analysis, only 3 are considered similar competitors (Xrhealth mobile; SocialupP3D; P5 – Saúde Mental) because they have treatment guides, and two of them are using VR glasses (Table II).

To evaluate the price and quality of those 6 mobile apps a Perception Map – Fig. 3 was created. This interesting result revealed that the apps which are in the sweet spot of the chart, in terms of price/quality are compensatory. This is where P5 - Mental Health, Knok - Video consultations and Insight Timer – Meditation.

The last phase was a SWOT analysis that come together several results considering the REVIDA project: There are already applications with video call appointments associated with health insurance; Virtual Reality glasses are still expensive; Maybe possible side effects discovered over time should be considered.

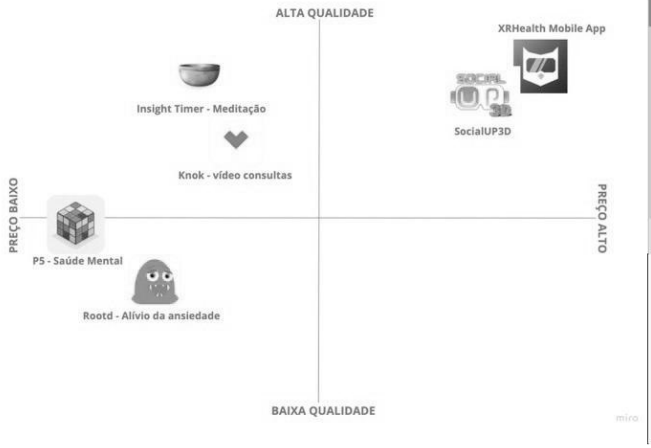

Fig. 3 – Map of Perception (Kumar 2013)

SWOT ANALYSIS	
Strengths	**Weaknesses**
Free mobile app; Virtual Reality app and goggles available; Emotion diary (to facilitate the diagnosis); Monitoring from virtual reality goggles and mobile app; Meditation guide and videos (wellness); Patient data shared with the physician; Appointment through virtual reality goggles (digital appointment); Talk with the doctor through message; Real-time therapy (treatment).	Virtual reality goggles are expensive; Depending on the Portuguese national health service; You will have access to the application and glasses only during treatment; Application will work only on mobile and tablet.
Threats and Challenges	**Opportunities**
Free mobile app; Virtual Reality app and goggles available; Emotion diary (to facilitate the diagnosis); Monitoring from virtual reality goggles and mobile app; Meditation guide and videos (wellness); Patient data shared with the physician; Appointment through virtual reality goggles (digital appointment); Talk with the doctor through message; Real-time therapy (treatment).	Therapy at home; More assertive diagnosis; Agreement with the National Health Service; Better medical follow-up; Agreement with health insurance; Decrease of medication, depending on the severity of the problem; Best mental health service in Portugal; Agreements with virtual reality companies that can provide support or sponsorship.

Fig. 4 – SWOT Analysis

5. Discussion and future work

Benchmarking showed us that most apps are free, but with paid features, i.e., free contents are still scarce, and the available contents are few. There are already apps for mental health and its assessment (regarding mood). None of the collected data can be used to diagnose or treat any disease. These are apps with mobile and tablet access. According to the results of all processes, some features were listed to consider for the REVIDA project and mapped in a SWOT (Fig.4). First, it is essential to have a video call appointment with a doctor from the national health service or with a service from a private hospital. Second, develop real-time access to appointments through VR glasses within the scope of treatments for depressive or anxious symptoms. Third, monitoring and a diary of emotions will also be critical for a more assertive diagnosis; lastly, VR glasses will have to be included during the treatment sessions.

IOS or Android for mobile should be requested (for the use of the VR glasses) and tablet (only for the use of the app overall and video call consultations). The REVIDA should be free, whether from a private hospital or the national health service. There is also the great goal of having agreements with health insurances (in case it is through the private service) and the availability of the language to be in Portuguese and English. Guided Meditation through the VR glasses will be one of the essential features of the application, together with the possibility of chatting with a health professional and having a telephone or video SOS number for emergency cases. Thanks to this project we expect to be able to improve the treatment of depressive and anxiety symptomatology. Since treatment is usually expensive and needs a combination of methods and health professionals, the REVIDA project will help improve symptomatology as well as the quality of life of those suffering from some of the most prevalent psychiatric symptomatology. Moreover, it may also be important to consider that, at the present time, we are living in times of uncertainty due to the COVID-

19 pandemic. Thus, in times when it may be difficult to meet with health professionals in the healthcare context, VR may be an important help by allowing patients to continue treatment without leaving their homes.

6. Acknowledgements

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