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Interactive multiplatform software to mitigate arachnophobia through augmented reality

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Abstract

Augmented Reality (RA) is a technology that mixes physical reality with virtual elements, resulting in mixed reality in real time. He is currently widely accepted for his ease of adaptation in human activities. Superimposing data and digital information in a real environment for educational, commercial, social, therapeutic, industrial, among others. The objective of this research is to develop an interactive software to mitigate arachnophobia by using the engine and graphic editor of Unity Games, focusing on augmented reality. In this project the agile scrum methodology was used. Because it is based on incremental development. Enabling application requirements and development to be flexible for patients and developers. Obtained as a result of a sample of 16 people, that 93.19% improved equal or greater than 50% in their level of anxiety and fear according to their score obtained in the test FSQ after using the proposed application. While 6.81% obtained a percentage lower than 50% because the use of the application was carried out in times less than 20 minutes per day, causing no significant changes.

Keywords: Software interactive, arachnophobia, augmented reality, unity, vuforia, blender, fear of spider questionary.

1. Introduction

Approximately 5% of the population suffers from animal phobias such as arachnophobia (fear of spiders). Although phobias can be managed and cured, among 60 and 80 % of victims of phobia do not try to cure this disease [1].

There are several way to treat phobias [2]. They are directly related to the fear and anxiety that they generate to those who suffer. For the treatment of these disorders, we have demonstrated that exposure-based on therapies are more appropriate and effective than other ones [3–11]. Allowing patients to overcome their phobias in a progressive way. Increasing their stimulation levels [2].

Exposure therapy treatment consists on live exposure or image exposure (visualization), there are limitations on live exposure, they do not have control on real-life circumstances and the cost is a bit expensive [12].

To overcome limitations in physical exposure therapy and use Augmented Reality technologies. Interactions that allow to have an effective therapeutic effect on patients [13].

The objective of this research is to develop an interactive software to mitigate arachnophobia by using the "Unity" motor and graphic game editor, focusing on Augmented Reality. It should be noted that it was used as a SCRUM development methodology because it is flexible requirements and they are not fully defined at the beginning of this research. Its implementation is based on incremental development. Allowing each interaction or sprint to have its own schedule and its corresponding deliverable. In addition, it is necessary to mention that ISO / IEC 9126 was applied, which is a quality model focused on the software taking into consideration three aspects: internal quality, external quality and quality of use; this standard classifies the quality of the software in a structured set of characteristics and sub characteristics as functionality, reliability, usability, efficiency, maintainability and transportability [14, 15].

The application developed in this research benefits patients and therapists in the following ways: (a) It allows to increase the communication among the involved ones.

(b) It promotes an interaction in a more natural, intuitive, fluid and simple way, independent of the level of severity of the arachnophobia. (c) Allows sure working environments. (d) Promotes the disappearance of the patient's consciousness from the mediation of his therapist. (e) It allows the perception of the therapeutic scenario as real. (f) Improves commitment of participants in established therapy. (g) Reduces anxiety and fear of arachnophobia. (h) Generates a highly motivating environment for being interactive and attractive for those involved in therapies.

The article has been organized as follows: Section 2 describes the background and related work that underlies this research, section 3 presents the schematic of the software to be used, section 4, shows the assembly and interactive software, the section 5, establishes the technical functioning of the application, in section 6, details the implementation of the application, section 7, establishes the results and discussions and finally, section 8, determines the conclusions on the basis of the results obtained and describes future work.

2. Background and Related Work

2.1. Vuforia

Software Development Toolkit (created by the company Qual-comm), which allows us to create RA applications in conjunction with Unity3D [16]. This software generates a bookmark by importing the required packages required in "Unity" for the development of Frame Makers and Image Targets. Allowing the visualization of the different objects proposed at each of the levels of the application. The target image is necessary for the camera of the different devices to recognize the data and digital information superimposed on the real environment.

2.2. Blender

Free distribution program for modeling, animating and creating three-dimensional objects [17]. This tool allows 3D modeling and it is possible to import to Unity (Unity Extension) from different generated entities allowing to superimpose these images in the corresponding marker (created in the tool of development Vuforia). Configuring and incorporating the preview camera option and the directional light that makes it easy to see the 3D image and texturize it giving a better appearance to the modeling.

2.3. Microsoft Visual Studio

It is an integrated development environment for desktop devices or applications, whether for the web or in the cloud. It allows Coding for iOS, Android and Windows in the same IDE [18]. Tool that allows the design of interfaces and their interaction when developing an application focused on Augmented Reality while maintaining the integration between the Microsoft Visual Studio C # programming language and the 3D unity editor.

2.4. Unity3D

Graphics engine for creating multiplatform games developed for windows and OSX (mac). Its propagation in the world of video game developers is extensive, it is due to its set of intuitive tools that are integrated into a simple interface, fast and with a high

image quality [19]. This program configures the correlation of the objects generated in Blender, facilitating the extrusion of images. Improving and correcting errors.

2.5. Android Studio

Integrated development environment for creating applications on all Android devices [20]. It allows to the generated project in Unity 3D to become an.APK. We can do this, using the Build Settings option only, adding the corresponding scene using the Add Current option, finally, choose and generate the platform to which it will be created through the Build option.

2.6. Aptoide

Play Store for Android devices that works alternately to the Official Google Play Store. It is similar to Google Play or Amazon Appstore, there are thousands of free applications to download and install directly to your Android item, with the advantage that a previous registration is not necessary [21].

2.7. Augmented reality

Expression used to define the integration of digital content in ICT that relates those objects that are tangible in real time. Allowing users to recognize enhanced or enhanced representations in the world around them. Depending on users' interaction users can vary its content and its form. It ranges from simple applications to complex systems. [22].

2.8. Related Jobs

This section provides a brief description of the work related to the subject matter proposed in this research and its respective perspectives. There are some works related to the treatment of people who suffer from arachnophobia or other types of phobia to small animals. Using exposure therapy and virtual reality (VR) or augmented Reality (AR) [23.24, 25, 26]. Some of the relevant works are: The first experiment carried out in the Human Interface Technology Laboratory of the University of Washington. That allowed patients to reduce the fear of spiders. Coming to interact with true spiders in a manageable way. Improving their quality of life [27]. The treatment of spider

and cockroach phobias by using visible markers with augmented reality. Reducing the fear in patients with spiders and cockroaches. Being able to kill the real spiders or cockroaches.

The treatment of spider phobias using true spiders has the disadvantage of not being able to control the behavior, the proximity and the size of the same [28]. They also harm therapy, because exists the mediation with the therapist. Which is reflected in people's consciousness. Confronting the patient with inadequate therapeutic scenarios that impede the promotion of natural interaction. Affecting their level of anxiety and clinical outcome [1, 29].

The use of computer games in the homes of patients who have different phobias, allow to get to have a self-exposure of their fears, reducing their anxiety. Due to high interactivity and appealing way to confront virtual animals (feared animals) in a real environment [1].

The evaluation of arachnophobia through questionnaires is a way to measure the severity level of the arachnophobia that patients have. Being the safest and most reliable questionnaire the FSQ (Fear of Spider Questionary) for owning 0.92 percent of internal consistency in its psychometric properties [30]. It is also shown that it is advisable to perform pre-treatment tests [31]. For being more assertive than the SPQ (Spider Phobia Questionary) at the time of discriminating between phobic and not phobic [32, 33].

All these works show that exposure therapy that uses virtual reality (VR) or augmented Reality (AR) is highly effective. And that regardless of whether they are virtual reality applications (VR) or augmented Reality (AR), they use specialized devices to be able to be used. Reason why it justifies the development of interactive multi-platform software that allows mitigating the arachnophobia through augmented reality.

3. Schematic of the software to be used

For the construction of the software proposed in this research, a schematic of the software is used, focusing on the development of applications that use Augmented Reality, as it is shown in Fig.1. Using eight components, everyone with its specific purpose: (1) Vuforia Marker Builder, (2) 3D Modeling and Textured Blender, (3) Microsoft Visual Studio Development Environment, (4) Unity Development Platform, (5) IDE Android Studio, (6) Aptoide Application Server, (7) Mobile Application and (8) Users.

1. Vuforia Marker: The purpose of the component is to generate a marker that serves as a point of launch of the application and allows to work with the environment that is developed in Unity, in which it provides the patient, the sensation of being in augmented reality through of the generation of the proposed scene in the environment.

2. Modeling and Textured 3D Blender: The purpose of this component is to model spiders that interact with the patient, facilitating the creation of their skeleton and textured, using the system of quadrant modeling, allowing a more dynamic manipulation of spiders, resulting a better finish at the time of exporting them to Unity.

3. Microsoft Visual Studio development environment: The purpose of this component is to facilitate the creation of scripts (coding) that control the GUI (Graphic User's Interface) and its interaction in the treatment of arachnophobia, by using the four levels of stimulation proposed in this research. In addition, it reduces development time because it has a direct connection with Unity, it simplifies copying and pasting scripts generated or modified from one place to another, since these are in a folder of the project.

4. Unity development platform: The purpose of this component is to interrelate the objects generated in the different IDE's (Integrated Development Environments). Allowing to improve and correct errors of both animation and texture. Obtaining a cohesion of quality that guarantees that the developed application is multiplatform.

5. IDE Android Studio: The purpose of this component is to generate a compatible apk with all types of mobile devices that have Android as an operating system.

6. Application Server Aptoide: The purpose of this component is to share the application with people who have arachnophobia, generating social support and improving the future quality of the application, from the patients' point of view, allowing improvements or changes.

7. Mobile Application: The purpose of this component is to download the application (apk) for mobile devices, Application Server.

8. Users: The purpose of this component is that the application allows patients to treat their phobia without excessive spending of resources.
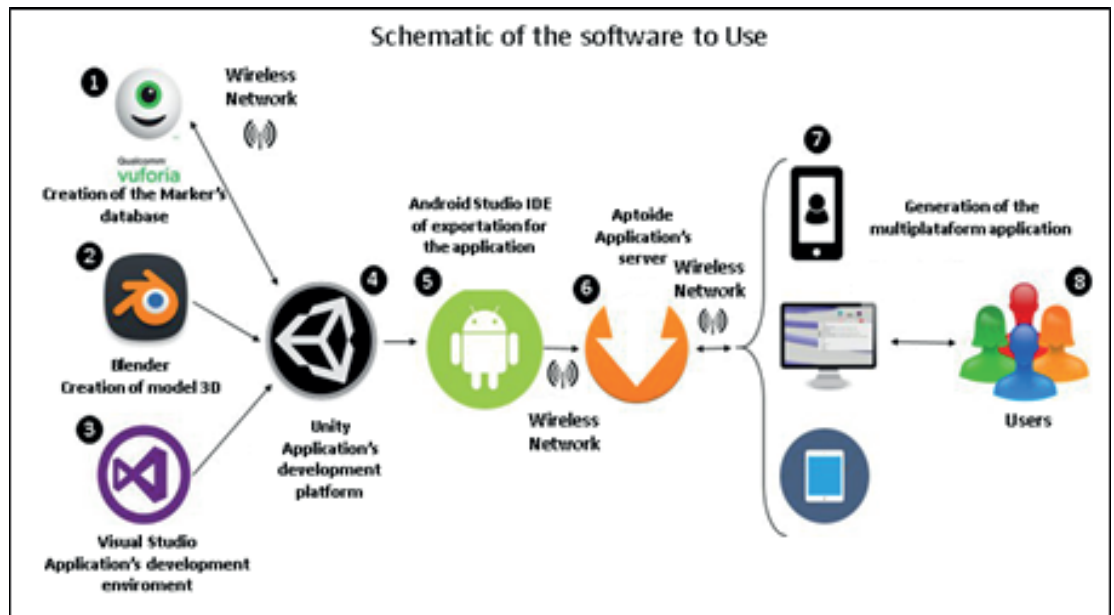
Figura 1: Software software scheme to use for the development of Multipltaforma Interactive software through augmented reality.

4. Assembling and Interactive Animation

The process of assembling and animating the application starts by exporting the following assets to Unity: 1) Vuforia Marker: a model where a database is created and used as a launch point for each Stage of the application, patient feeling actually augmented and 2) Modeling and Textured 3D Blender: model where spiders are exported with their respective skeletons, textured and animations. Once both components are within Unity, the interaction of the software proposed in this research is performed according to the level required based on the degree of stimulation required, as shown in Fig.2, which consists of the following steps:

A. Unity Animator: At this stage animation on frames are done, which allows to modify existing animations, create new animations or correct errors.

B. Unity State Machine: Stage in which each of the spider animation sequences is produced, with its corresponding repetition cycles, or static sequences, depending on the interaction required for each level of the application.

C. Unity Codification: Stage where the coding of the application is developed, working with C # because it is compatible with the platform of Unity. Here the execution functions in the interface and the movement of the spiders are created by the surroundings of the corresponding scene.

D. Application in Execution: Final stage where it is executed in the editor itself to verify errors, and correction of scenarios, proceeding finally to the creation of APK.
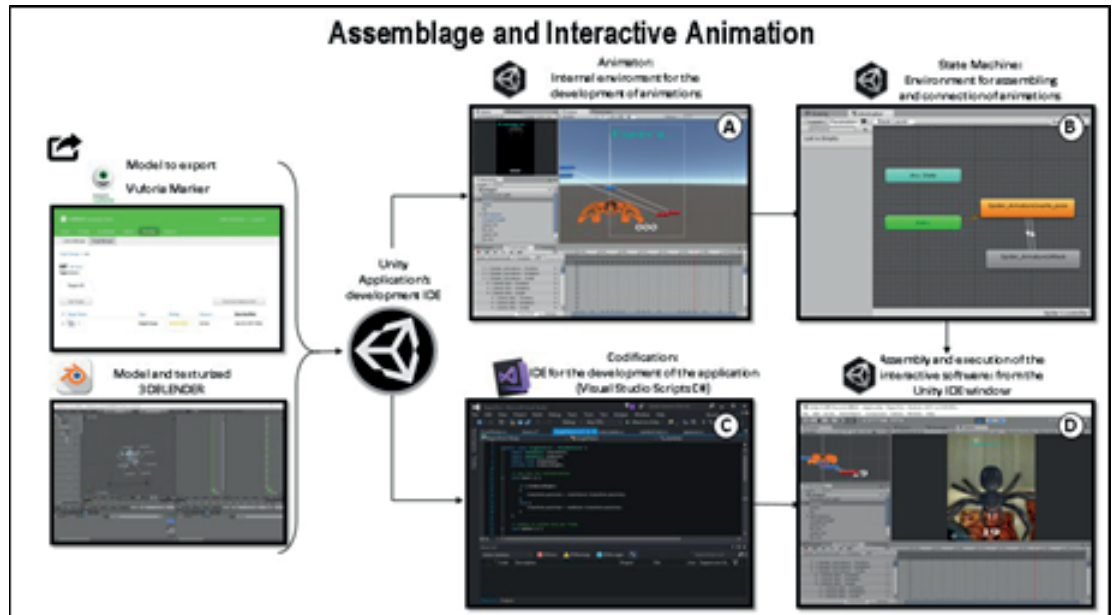

Figura 2: Assembly and interactive software through Augmented Reality.

5. Reference Architecture

This section describes the components that conform the reference architecture that was taken as the basis for the development of the proposed application in this research. This architecture arises from the analysis of the eighteen architectures, more representative of augmented reality software systems. Grouping the common components [34.35]. As you can look at the Fig 3. Consisting of six elements, each with its specific task: (a) Application, (b) Tracking, (c) Control, (d) Presentation, (e) Context y (f) Model¿s Word.

a. Application: handles the content and the logical and specific programming of the application.

b. Tracking: Determines the position of users and objects by using the Target Manager, which is captured by the device camera and subsequently rendered.

c. Control: It allows processing of user interaction inputs.

d. Presentation: It allows to display the graphical interface of the system and the rendering captured by the camera.

e. Context: It processes the information of the tracking and distributes it to the other modules considering only one component. f.Model's World: Stores the generated Target and the render to be launched once the application is executed, which includes the virtual objects and graphical representations.
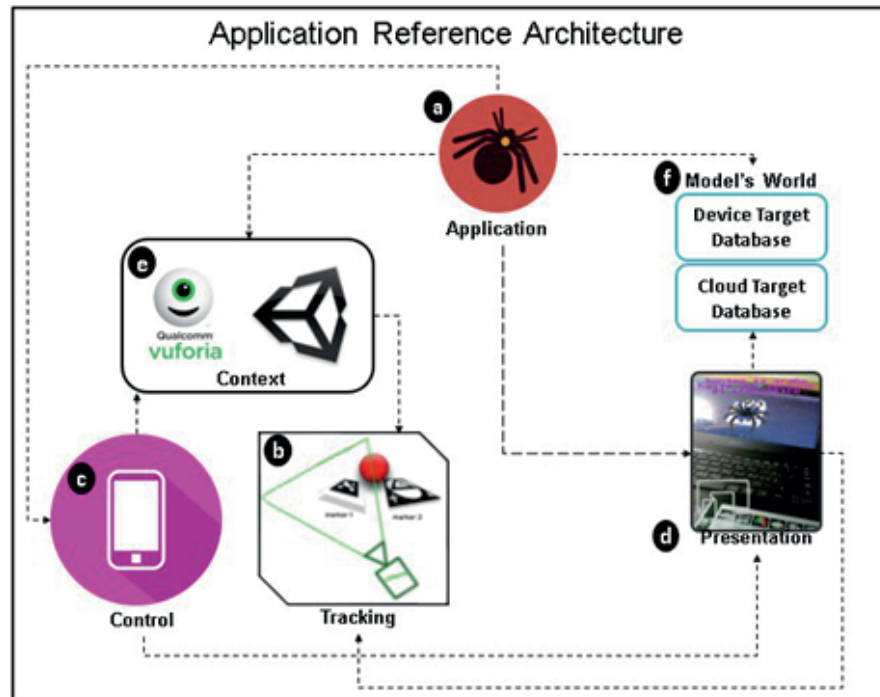

Figura 3: Application reference architecture developed with augmented reality.

6. Application Execution

Next, the execution of multiplatform interactive software to mitigate arachnophobia through augmented reality will be exemplified. In Fig.4 the application consists of a menu that allows interacting with patients, admitting to touch with their hands one of the two main options (Instructions-Start) giving the sensation that they are in the air.

When user access the Start option from the application menu, as shown in Fig. 5, four stages are presented for the treatment of patients, they are according to the level of phobia reached in the evaluation of arachnophobia (Fear of Spider Questionary). Performed prior to the patients (pre-treatment tests). Respecting the clinical protocols established by the spider fear questionnaire (FSC) it allows to identify the fear of the phobia that presents each patient and its corresponding treatment (Stage -Application) as described in Table 1.
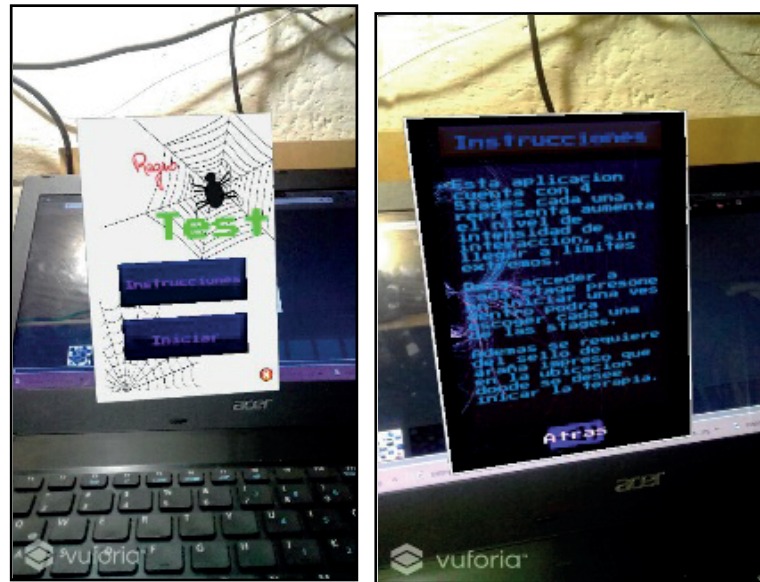
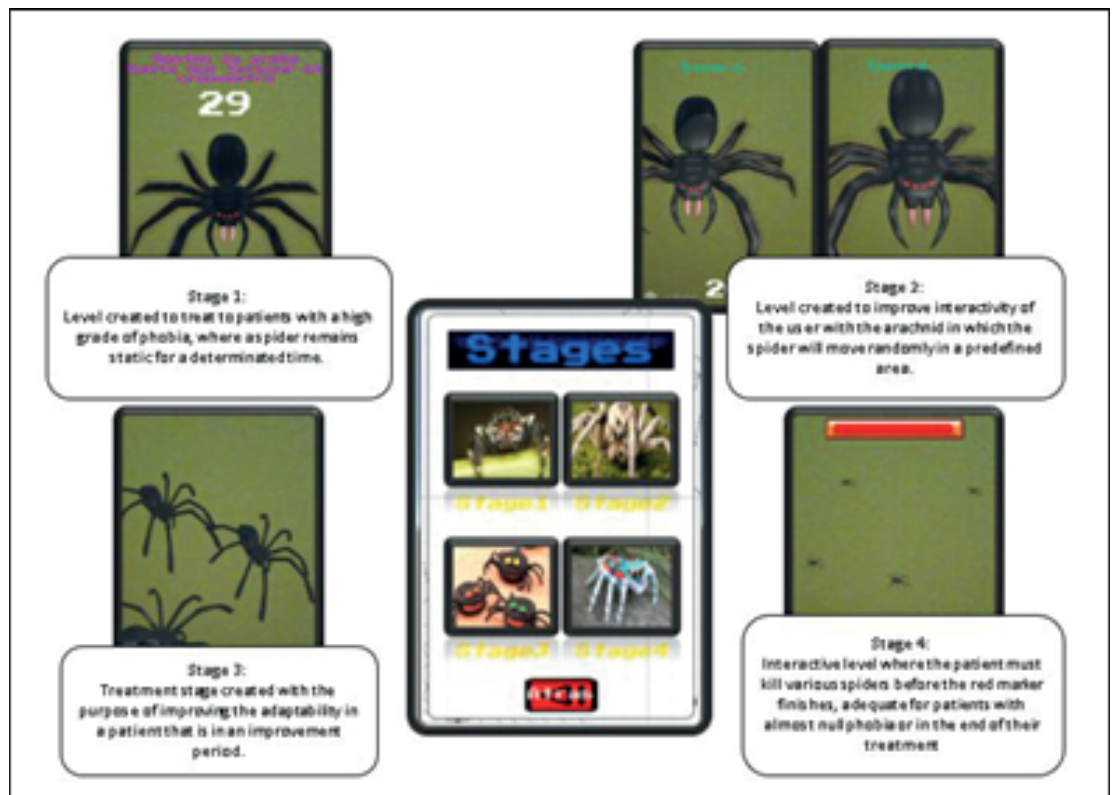**Figura** 4: Interactive menu of the application using augmented reality.

Figura 5: Stages of the interactive software through the Augmented Reality according to the level of phobia reached in FSQ(Fear of Spider Questionary).

As shown in Fig. 6, the therapy treatment session begins, accessing the stage that corresponds to the patient according to the score obtained in the FSQ. It allows the patient to choose the degree of virtual stimulation required, accessing from the multiplatform application to each of the following levels:

Tᴀʙʟᴀ 1: Delimited score in Fear of Spider Questionnaire (FSQ) to determine the phobia present in each patient and its corresponding treatment (Stage -Application).

LEVEL	PHOBIA FEAR	SCORE (FSQ)	TREATMENT STAGE
5	High	109-129	1
4	Particular	91-108	2
3	Intermediate.	73-90	3
2	Diffuse.	37-72	4
1	Normal.	19-36	4
0	Null.	0-18	Anyone

Level 1: Patient watches a static spider (set time).Level 2: Patient watches a moving spider (configured time).Level 3: Patient watches several spiders in motion (configured time).Level 4: Patient watches many spiders in motion (configured time).
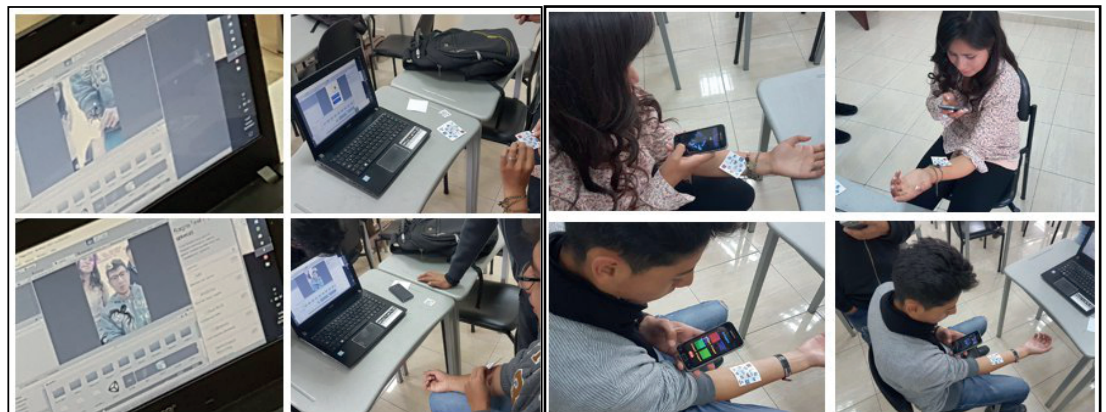

Figura 6: Patients perform a therapy session according to the level of phobia reached in FSQ from a laptop and a mobile device (android).

7. Results and discussions

As a simulacrum and validation of interactive cross-platform software, tests were performed in a group of 16 patients aged 18 to 20 years. By subjecting the patient group to fill the Fear of Spider Questionary (FSQ) in this way, it was possible to determine a diagnosis of people suffering from spider phobia and their level of fear. Each patient was then assigned a stage in the application according to the results obtained in the test (pre-treatment). Every patient autonomously performed a daily treatment session, for a full month. Allowing each person to control the time of use of the assigned stage. At the end of the patients' follow-up, the FSQ test was taken again in order to determine if there were any changes in the scoring level of the individuals evaluated.

As shown in Fig. 7, of the sample of 16 patients, 10 patients (patient 1, patient 2, patient 4, patient 5, patient 6, patient 7, patient 13, patient 14, patient 15) representing 93.19% achieved an improvement equal or greater than 50% in their level of anxiety and fear according to their FSQ score obtained after using the application, while the remaining six patients (patient8, patient9, patient10, patient11, patient12, patient16) the 6.81% lens obtained a percentage lower than 50%, because their time recording per session showed that the 6 patients used the application in shorter times at 20 minutes per day, causing no significant changes (decreased anxiety and fear).
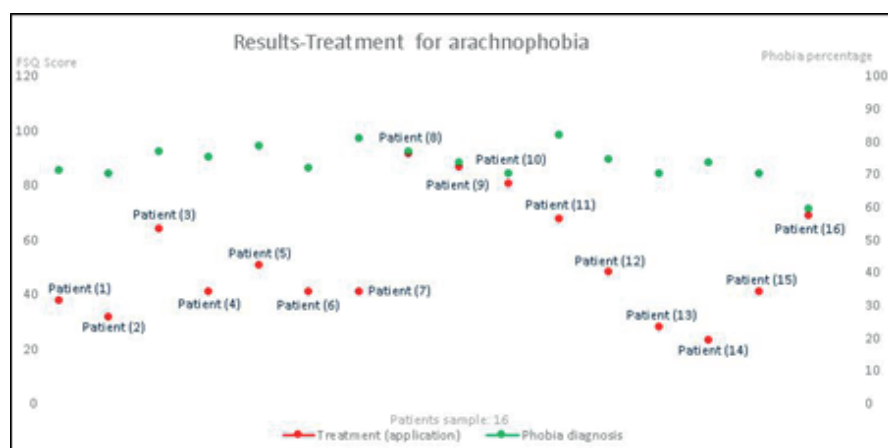

Figura 7: Results of FSQ Scores before and after treatment of patients in the application.

As shown in Fig. 8, a patient (woman) is followed for a full month (4 weeks) divided into periods of 2 treatment sessions (60 minutes) per week. Denoting that in the first session improved 7%, in the second session improved 10%, in the third session 12%, in the fourth session 4%, in the fifth session 20%, in the sixth session a 10 %, in the seventh session a 27% and in the eighth session a 30%. Having better results in the last week where it was evidenced that her level of anxiety and fear according to the score obtained in FSQ test after having used the application. Because the application usage time log increases from 20 minutes to 50 minutes.

As shown in Fig. 9, a patient (man) is followed for a full month (4 weeks) divided into periods of 2 treatment sessions (60 minutes) per week. In the first session, it improved 41%, in the second session improved 38%, in the third session 19%, in the fourth session 6%, in the fifth session 19%, in the sixth session a 15% %, in the seventh session a 0% and in the eighth session a 56%. Having better results in the second session of the last week showing that his level of anxiety and fear according to the score obtained in FSQ test after having used the application, allows him to move to the next level of treatment and the worst result in the first session of the last week. Because the session was not performed.
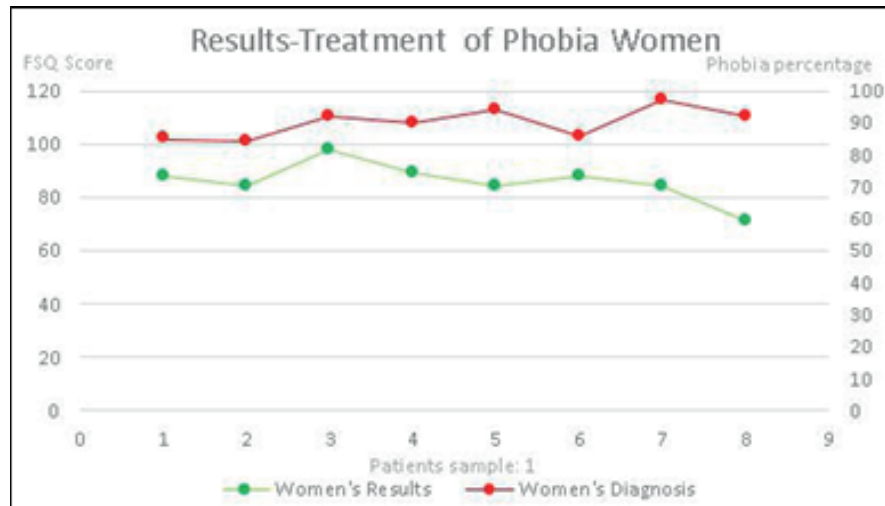
Figura 8: Results of FSQ Scores before and after treatment of a patient (woman) in the application for a full month (8 sessions).
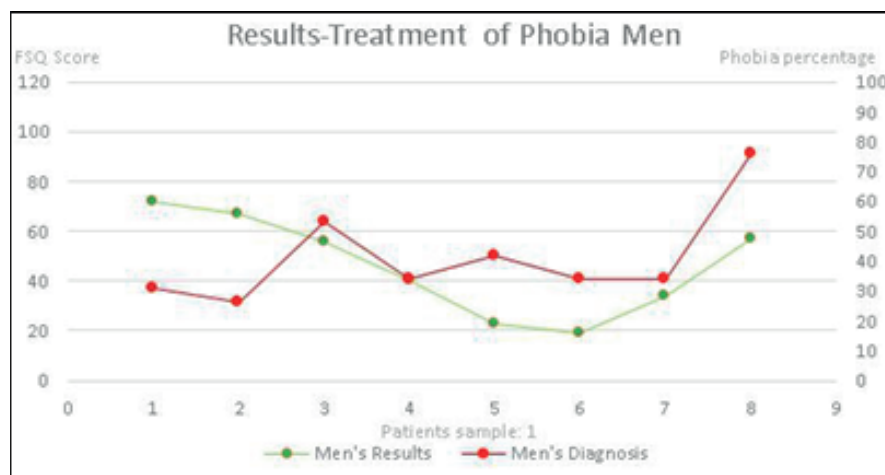

Figura 9: Results of FSQ Scores before and after treatment of a patient (man) in the application for a full month (8 sessions).

8. Conclusions and Future Work

The multiplatform interactive software proposed in this research, allowed to treat the fear and anxiety that the spiders cause to the patients. Demonstrating that therapies based on exposure and using Augmented Reality, promotes natural interaction, mediation with the therapist disappears from the patient's consciousness. What is appropriate and beneficial at the time of curing arachnophobia in a progressive way, through the use of stimulation levels. Reducing the need to go to a specialist.

The dedication of time that patients invest in each session is of utmost importance in order to satisfactorily fulfill the treatment according to the level of phobia that each one possesses.

The use of graphical interfaces and the insertion of augmented reality in the interaction of the application, allowed the patients a clear understanding and a facility in its use (suitable usability). Based on the efficiency of the application in the handing and use of the functions Unity's own.

The Vuforia SDK allowed to improve patient-application interactivity. Obtaining a controlled environment for patients. Keeping them safe and keeping their mental state healthy.

As future work, it seeks to integrate intelligence of area recognition so that the mobility of spiders is more natural, being able to scan the area where the treatment is to be performed.

In addition, it is planned to improve the design and animation of the spiders to improve the level of realism, integrating them with self-learning, improving the quality of the application, and therefore obtaining better results when it is applied.Another future work is to replace the Vuforia SDK with another of its own authorship, opening us to a new field of research, where user-application interactivity is improved.

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