

# Use of Virtual Reality Systems and Augmented Reality for Visualizing Acrophobic Environments

Gianfranco Preciado Cossío, Giacomo Preciado Cossío

**Abstract - This investigation will allow to develop a new use of the Virtual Reality (VR) and Augmented reality (AR), Since the combination of these systems will permit the treatment of psychological disorders, especially the acrophobia disorder. The acrophobia is an intense fear of heights, which carries the avoidance of situations related to the height. In this work systems have been evaluated for the visualization of acrophobic environments based on different technologies as they are the VR and the AR. They have also been used and compared different devices of visualization. The traditional treatment for acrophobia is the "in vivo "exposition, in which the patient is exposed to a series of stimulus that leads to anxiety. However, the exposition therapy by VR or AR provides a series of advantages in regards to the traditional therapy. If a virtual environment can produce fear and activate the structures that cause anxiety, the exposition therapy by VR can work as an alternative way to induce exposition. Several studies have shown that acrophobia can be treated successfully thought out exposition therapy based on VR. As to the AR, recent researches raise the possibility of inducing exposition by AR. There have been developed a total of 2 researches with users without phobia, for whom it has been necessary to create 4 acrophobic environments, two based on AR and VR. On the first research "photo browser ", used AR's system, combined with immerse photography techniques. The system has different height levels, from a first floor to a parking lot's roof of an Eighth Floor. The results show that the users feel very present in the developed environment (even though not so much like in the real environment). In the second research "the hole room, VR vs. AR", there were used two applications that simulate the situation in which several holes are shown in the room's floor in where the user is. An VR's application (Panoweaver) was used, while the second one was based on AR (ARToolKit). In this case, the research compares the user's levels of anxiety and presence while using both systems. The results state that the developed environments have provoked presence and anxiety in the users, a significant correlation being observed between the above mentioned variables. The levels of presence and anxiety obtained are very similar in both systems. Finally, it is necessary to ask about the developed environments therapeutic possible use. As it has already been said, acrophobia can be treated successfully by therapy exposition based on VR. Also, AR shows a series of extra advantages which makes it more attractive for the therapy, such as when the user can use real elements to interact with the system, such as when the user can use real elements to interact with the system, for example like their hands or feet and when it can be reproduced or use a real environment and reproduce noise at the same time.**

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**On the other hand, the environments created in this investigation (AR and VR), have caused a certain level of presence and anxiety in users without phobia. Therefore, these results and the precedents in therapy of exhibition by VR and AR seem to indicate that those systems might be effective in the treatment of acrophobia.**

**Index Terms - Augmented Reality, Virtual Reality, Acrophobia, Anxiety.**

## I. CONCEPTUAL AND METHODOLOGICAL BASES

This investigation hopes to develop and evaluate systems for the visualization of acrophobic environments, based on different technologies, as they are the Virtual Reality (VR) and the Augmented Reality (AR). Also different devices of visualization will be used.

The acrophobia is an intense fear of the high places. The 'Manual of diagnosis and statistics of the mental disorders' [1] the DSM-IV classifies it inside the disorders of anxiety as an specific phobia. In other words is an intense and specific fear to particular situations and objects. First, the person who suffers acrophobia has a strong, persistence, excessive and illogical fear which leads to the avoidance of any situation that involves height, their greatest fear is to fall. Secondly, the exposition of these heights provokes almost invariably an immediate response of anxiety, which can adopt the form of a panic attack. Finally, the person recognizes that's it's fear is excessive, interfering in its regular life routine [2].

A VR system is that one in which all the elements that compose it are synthetic and allow a real time interaction, whereas in the AR's systems the real world prospers with the incorporation of virtual elements. These virtual elements are generated by the computer and coexist with the real world in the same space. Besides combining virtual and real objects in a real environment, the AR executes interactively and at a real time, setting the virtual elements in a suitable way in the real environment [3].

Traditionally, the phobia treatments and other physiological disorders include the patient's gradual exposition in front of stimulus that causes anxiety. Those stimulus can be made by the patient's imagination," exposition in imagination "or getting them directly from reality "exposition in vivo" [4]. The most common treatment for acrophobia is the gradual exposition " in vivo " in which breaks the avoidance behavior, exposing the patient to a series of stimulus organized in a hierarchically Way

However, both the VR and the AR appear as interesting technologies for the therapy since it is possible to design the

situation according to the key elements of a certain problem, generating in the person the same reactions and emotions that those that it would experience in a similar situation in the real world.

Different environments can be generated (objects, places or situations) where the patient feel rejection but, since they are generated by the computer, it will avoid the need have to move to those same places at times, in occasions, of difficult access, or having to wait for those problematic situations to happen in reality that normally are not easily reproducible. On the other hand, the consultation of the psychologist will turn into a place where the patient's confidentiality will not be put in risk. Also, in these environments the therapist has great control and can manipulate them to a certain extent.

Additionally, this control from the psychologist will allow having a progressive exhibition, advancing little by little, from easy situations where the patient does not feel anxiety up to the most complicated situations, where the psychologist verifies the capacity of the patient to the stimulus and modifies these in major or minor degree.

The virtual objects will be able to do all the specific works, as to say, it can get authentic therapeutic context, environment and object with aspects or conditions directly related with phobia or disorders to treat and which include vital information for the patient and it's therapy. It might even be specified up to the point of adapting them to the specific characteristics of a patient.

On having always available the environment and the objects, the therapy can be experienced by the patients as many times as the psychologist suggests to the pace and level of difficulty that he considers. This circumstance will allow to the patient to experience and to feel several times the implications and consequences of these problematic situations, to the point of losing the fear and to be able to confront them. This reiteration will reverberate to the degree of control that the patient will experience, whose increase will generate expectations personal efficiency which will lead to an important involution of the treatment's efficiency.

In addition, full advantages can be taken from the capacities of storage of information technology (IT) system, allowing to save in the application, if it was necessary, information that is being used related to the attitudes and behaviors that the patient has experienced during the therapy. These methods, faced up to the traditional ones, facilitate, speed up and improve significantly the later labors of study, the analysis and personalized evaluation of the patients, which is done by the psychologist.

Additionally both VR and AR give the next extra series of advantages:

- Stimulate several sensory modalities
- Let the therapist know in each moment what the patient is watching and therefore know with better precision which stimuli is provoking the answer.
  - They offer a degree of exposition in those people who denies having this type of technique (exposition to a determined situation) because it is very it is very hard for them

- They provide a higher level of confidentiality, since the treatment is done in the consultation
- They allow to design made-to-measure the hierarchy of exhibition.
- They are safe, since the (patient) person and the therapist control at all times what happens in the environment.
- The exposition can be repeated to a situation every time it's necessary

Since the 90's decade, it's been added the VR to the campus the phobia treatments and other physiological disorders. It has been demonstrated that the exposition by VR can be as or more effective than the traditional "in vivo" exposition [5][9].

If a virtual environment can cause fear and activate the structures that provoke anxiety, the therapy of exhibition by VR can work as an alternative way of inducing exposition. At the same time, it raises the possibility of inducing exposition by AR, is a line of a new investigation where we have based on the work developed for [6]. In summary, the use of the new technologies can help to increase the clinical utility of some of the therapeutic technologies that we use nowadays. As it has already been said, in this research we pretend to develop and valid systems for the visualization of the acrophobic environments, this is how it's shown two research in which for it had been necessary develop two different applications. If this systems are able to provoke enough presence and anxiety levels is users without phobia, then they can be useful on the acrophobia treatment.

In the first one of the above mentioned studies, the "navigable browser", develops a AR system combined with immerse photography techniques for the acrophobic environment visualization. This system is the first one that combines the immersive photography with the AR for the purpose. The system has different height levels, from a first floor to a thirteenth floor roof. The research compares the levels of presence for the systems showing a stairs scene to a certain height and the real environment in where those stairs are.

In the second research, they develop two applications for the visualization of the acrophobic environments, which simulate the situation in which a hole appears in the floor of the room where the user is. An application has been developed just using VR's technology, while the second one is based on AR. In this case a study has been done by users without phobia to compare the levels of presence and anxiety of these during the utilization of both systems. It is the first work in which there are compared and validate similar AR and VR systems for the visualization of acrophobic environments.

## II. METHODOLOGIES

### Scientific Research Methods

- Interview to leader users.
- Compilation of field information.
- Workflow analysis.
- Compilation of historic information.

### Extreme Programming Development Methodology

XP (Extreme Programming) it is a new discipline for software development that has recently interrupt with great commotion in the sea of methods, techniques and existing methodologies. Specifying more, it is about a "light" methodology, in comparison to "heavy" methodologies such as; Metrics.

Extreme Programming is a software development methodology that is based on simplicity, communication and feedback or reuse of development code (code recycling). Relies on only 6 year life, but with a great support on large companies side such as; Ford, DaimlerChrysler, First Union National Bank - USA, etc., what they are looking for, in short, is cost price reductions.

#### Project Contribution to Thematic Area

- The system for acrophobic environments that puts it together with VR and AV allows generating images that shows a 3D environment.
- The system will allow a new union conception between images for generating 3D effect.
- Improves pictures processing.
- Camera effects simulation.
- Fitting together 3D images in flat images.

### III. CONCLUSIONS

- The VR and the AR share advantages related to the traditional "in vivo" exposition. One of those advantages is that both realities give control about the situations to what the patient is afraid of [4]. Additionally, the systems based on AR show a great advantage about the VR systems, they give greater versatility in the matter of that the environment is real, unlike the other VR systems, they give greater versatility in the matter of that the environment is real, unlike the other VR systems everything has to be molt and included. Therefore, in AR's system, the real environment can be any place, however, if the psychologist needs the same virtual environment as the real one, it would be necessary it's complete model, which implies certain temporary and economic cost. In this way, AR's system can be used in any real environment, with a lower cost than a VR's system.

- The AR's system "Photo Browser", developed for the first study caused high levels of presence, however, they were not as good as the ones obtained for the real environment that represented, existing significant statistical evidences that corroborate that.

- In case of the Systems (Room with Hole with VR and AR) that represented a hole on room's floor, both (VR and AR) produce similar effects on the users in what concerns presence, not being found statistical significant differences that allow to affirm that one of two systems provokes greater level of presence than the other one. Even though, in what concerns to anxiety levels, there has been found statistical significant differences that allow to affirm that AR's system provokes major anxiety in the subjects. Therefore it is possible to end up by affirming that the first hypothesis of this work, an AR's system for the visualization of acrophobic environments will lead to equal or major

feeling of presence and anxiety than a system of similar VR, it is fulfilled, as it demonstrates the study.

- On the other hand, it is necessary to ask on the possible therapeutic use of the developed systems. As they have demonstrated different cases of research, the acrophobia can be treated successfully by an exposition therapy based on VR [7][5]. Also there has been demonstrated the exposition's therapeutics potentiality based on AR, for the treatment of other specific phobias [6][8].

- Additionally, the AR shows a series of additional advantages, which make it more attractive for therapy, when the user can interact with real elements, as its hands or its feet, and when it is possible to reproduce or use a real environment [6]

- Definitively the systems and computerized software's offer a potential and powerful contribution to the human sciences and to raise the standard of living of the people who submit to a therapy, offering exceptional advantages for the therapist or clinical that uses these modern systems.

- It will be very valuable and interesting that the computerized system investigators continue researching about this topic and develop systems that can give qualitative advantages, quantitative and introduce the systems in other sciences that can improve the quality and efficiency in the health professionals.

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