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General Article

Augmented Reality Systems for the treatment of phobia of Cockroaches and Spiders

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Abstract

Use of technology has been very helpful in the field of psychology. Virtual reality is somewhat established for the treatment of phobias. Augmented Reality due to its advantages over traditional therapy and virtual reality has been introduced for treatment. In this paper we study two systems that use augmented realty to treat phobia of cockroaches and spiders. First is Visible Marker Based Augmented Reality System in which the patient is able to view the marker during treatment, and the second is Invisible Marker Based Augmented Reality System in which the marker is invisible to the patient undergoing therapy. We have compared both the Systems for its advantages over each other. Finally in the paper we conclude that Invisible Marker Based Augmented reality system is better, because the patient has more surprise element and anxiety levels, which are necessary for therapy than in Visible marker Based System.

Keywords: *Augmented Reality, Visible Marker Based Augmented Reality System (VMARS), Invisible Marker Based Augmented reality System (IMARS), Phobia, Therapy.*

1. Introduction

Technology has widely found its applications in the field of healthcare including treatment of phobias like Acrophobia, Demo phobia, Felinophobia, Arachnophobia, Katsaridaphobia etc. Virtual Reality has been greatly established for the treatment of phobias. Recently, Augmented Reality has been tried into the field as it gives greater sense of presence and reality-like experience to the patient.

Experiments have been conducted to see the effectiveness of AG based therapy to treat the phobia of spiders and cockroaches. The results have demonstrated that the therapeutic alliance between the patient and the therapist were the same in both the technology-mediated therapeutic sessions and the non-mediated-by-technology therapeutic sessions (Maja Wrzesien, Juana Bretón-López, Cristina Botella, Jean-Marie Burkhardt, Mariano Alcañiz, María Ángeles Pérez-Ara, and Antonio Riera del Amo, 2013). Hence Augmented Reality(AG) does not harm the alliance between the therapist and the patient but obviously gives advantages to Virtual Reality and Traditional therapy, so Augmented Reality has a great scope in treatment of phobias.

Experiments that are conducted to see the effectiveness of AG mainly in the treatment of Arachnophobia(fear of spiders) and Katsaridaphobia(fear of cockroaches). Different setups have been proposed and used for the purpose. These setups are mainly of two types, first is Visible Marker Augmented Reality System(VMARS), that was initially developed and the other is Invisible Marker Based Augmented Reality System(IMARS).

The paper considers a setup of each type and gives its technical characteristics i.e of the VMARS and IMARS. In the next section of the paper these systems are compared depending upon the experience of the person under therapy and the hardware.

2. Visible Marker Based Augmented Reality System (VMARS)

The Sysem designed by M. Carmen Juan, Mariano Alcañiz, Carlos Monserrat, Cristina Botella, Rosa M. Baños and Belen Guerrero uses a marker i.e a white square with a black border containing symbols or letters and a USB or FireWire camera. It uses a Creative NX-Ultra camera in the patient exposure sessions and Logitech QuickCam Pro 4000. The camera is attached to a headmounted display (HMD) worn by the patient so the camera focuses where the patient looks, as Fig 1 shows. The therapist watches the treatment on the monitor, viewing the same scene as the patient (M. Carmen Juan, Mariano Alcañiz,Carlos Monserrat,Cristina Botella,Rosa M. Baños, and Belen Guerrero, 2005).

The system used Visual C++ version 6.0 as the development environment and was programmed in C. It used ARToolKit 2.656 with Virtual Reality Modeling Language (VRML) support to incorporate AR options. The one cockroaches and three types of spiders in the system are virtual elements. The cockroach and spider models and their movement were created using Autodesk 3ds Max. The models were then exported to VRML

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format and VRML Pad was used to edit the objects and modify some characteristics. The graphic user interface was developed using the OpenGL Utility Toolkit (GLUT)-based user interface library (GLUI) ((M. Carmen Juan, Mariano Alcañiz,Carlos Monserrat,Cristina Botella,Rosa M. Baños, and Belen Guerrero, 2005).

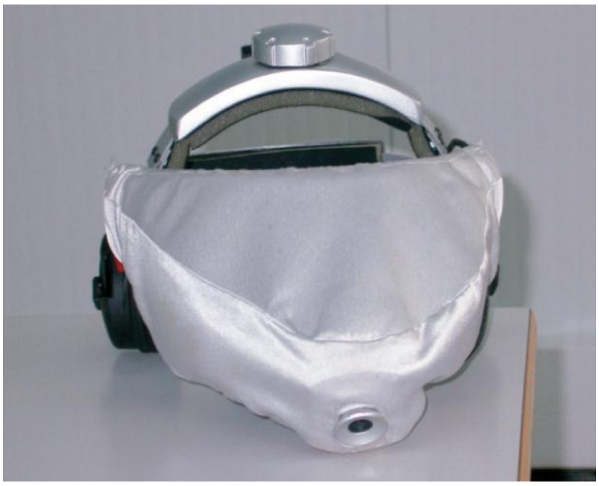

Fig. 1: Capture and Visualization System for Visible Marker Based Augmented Reality system.

The system first loads the files related to the markers and the camera, and performs the required initializations. Then, captures a frame of the video entry searches and recognizes the markers in the captured frame. The system can identify four types of markers- animal marker, insecticide killer marker, flyswatter marker, and dustpan marker. It then finds the related transformation matrix. The virtual cockroaches and spiders are drawn on the markers next. This procedure is repeated for each frame and the video entry is closed (M. Carmen Juan, Mariano Alcañiz,Carlos Monserrat,Cristina Botella,Rosa M. Baños, and Belen Guerrero, 2005).

Users can make one animal appear, three animals appear or disappear, or 20 animals appear or disappear by choosing from five menu options or keys. If only one animal is selected, the image appears in the centre of the marker. The number of animals in the system are increased or reduced in increments of three or 20, depending on the option selected. If several animals are selected, they are divided into three groups, depending on the distance relative to the marker. The first group is on or near the marker, the second group is halfway between the established maximum distance and the animal marker, and the last group is at the distance as far as possible. As animals appear, the first animal goes into the first group, the next goes into the second group, and the third goes into the third group, then the entire round is repeated until the system reaches the maximum number of allowed animals i.e. 60. This distribution is done to ensure that the marker always has animals near it. But, to provide the necessary randomness, every time the system executes, a random value is assigned to the first group of animals, then this value is used to rotate the group. Thus the animals have a different orientation at each time, as the second and third groups is always oriented toward the marker. The static or dynamic model of the cockroaches and spiders is selected based on if the user requires movement or not. If movement is selected, it is repetitive. For instance, if a spider or a cockroach is near the marker and its orientation faces outward from the image, the image starts the movement toward the outside of the image, traces the established distance, then goes back to its initial position (the distance isn’t the same for all animals).But, if the spider or cockroach is at the farthest distance possible, its movement will be toward the marker, after moving the specified distance the animal returns to its initial position. In case the animal’s movement is stopped by the user, the dynamic animal is replaced with a static animal by the system. The static model remains where it was stopped. Now, if the user again selects movement, the movement of the animal is resumed from its current position (M. Carmen Juan, Mariano Alcañiz,Carlos Monserrat,Cristina Botella,Rosa M. Baños, and Belen Guerrero, 2005).

3. Invisible Marker Based Augmented Reality system (IMARS)

The System designed by Juan, M.C, Joele, D. , Baños, R., Botella, C., Alcañiz, M., van der Mast, Ch is a invisible marker system. It uses an infrared (IR) camera, which comes in a 2.5 inches long tube and has a diameter of 0.8125 inches. The camera has diagonal FOV of 92 degrees. Image sensor of the system is 1/3” CCD with 290,000 CCIR pixels, which is capable of delivering a video stream of frame rate of 30 fps in several image formats. A composite video signal is the output of the camera. Proper operation of the system requires a regulated 12 VDC power supply. The video composite signal is converted into a USB 2.0 signal using USB2.0 Video Grabber, which gives frames at a rate of up to 30 fps and resolution of a resolution of 640x480. The device is completed with DirectShow, which is a colour, Dragonfly camera.The Dragonfly camera has 63.5x50.8 mm dimensions. The camera has a Sony 1/3” progressive scan CCD sensor, that provides images of a resolution of 640x480 with uncompressed 24-bit true colour and a maximum frame rate of 30 fps. A 6-pin IEEE-1394 interface, makes the computer connection. Camera parameters are changeable through image acquisition software, providing it a horizontal field of view (FOV) and a vertical FOV of 42.2 degrees and 32 degrees respectively. That makes to a diagonal FOV of 52 degrees (Juan, M.C., Joele, D., Baños, R., Botella, C., Alcañiz, M., van der Mast, C.,2006). The system’s Head Mounted Display is shown in Fig 2.

The system is programmed using the development environment as Microsoft Visual Studio C++ version 6.0. It uses Virtual Reality Modeling Language (VRML) support with ARToolKit [8] version 2.65 to incorporate AR options. The three-dimensional models are made using Autodesk 3D Studio Max, 5.0 version. The models are edited with VRMLPad, version 1.2 and exported to VRML format. The OpenGL Utility ToolKit (GLUT) was used to create graphical user interface. OpenAL sound library provides sound support. The system has three spiders and one cockroach. The marker border is drawn with a special ink, that has limited durability of only one week (Juan, M.C., Joele, D., Baños, R., Botella, C., Alcañiz, M., van der Mast, C.,2006).

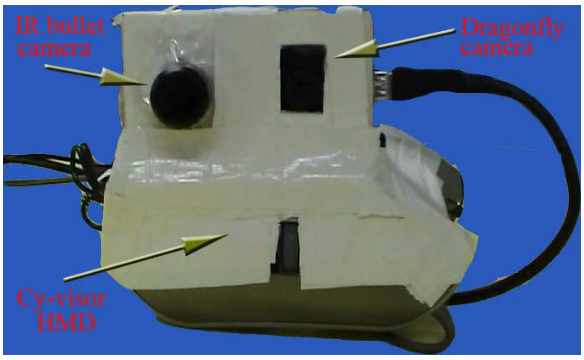

Fig. 2: Capture and Visualization System for Invisible Marker Based Augmented Reality system.

The system produces a sound similar to that of a real animal being killed when the animals are killed in the system. The system includes two sounds: a squishing sound similar to that of a real cockroach or spider being crushed and a squirting sound similar to the sound of a real can of insecticide (Juan, M.C., Joele, D., Baños, R., Botella, C., Alcañiz, M., van der Mast, C.,2006).

The system uses a video see-through HMD with one infrared camera and one colour camera so that a scene can be viewed concurrently. The markers are not detected in by the coloured camera but infrared camera capture the marker images. ARToolKit is used to establish the position and orientation of the infrared camera with respect to the marker and the infrared camera video is treated by the system. Using the relationship between the infrared camera and the colour camera, the position and orientation of the invisible marker in the video of the colour camera can be determined. Hence, the virtual element are placed where the invisible marker is situated. Thus, the virtual element appears in the right position and orientation but the user cannot see the marker. The resulting image is finally displayed on the microdisplays of the HMD (Juan, M.C., Joele, D., Baños, R., Botella, C., Alcañiz, M., van der Mast, C.,2006).

4. The Comparative Study

Initially, VMARS was developed when Augmented reality was just introduced for the treatment of Phobias. The developed version of the same system is IMARS. We have performed a comparative study on both the systems on mainly two points- Hardware and experience of the Patient.

4.1 Hardware of the systems

The ink that is used to make the marker for IMARS is a special ink that last only a week and has to be redrawn after a week. This is an added responsibility on the person managing the hardware. Whereas this is not the case in VMARS.

The VMARS uses only one color camera whereas the IMARS has additional cost of Infrared Camera along with Color Camera, as it has to detect that special ink that is not visible in the color camera.

Hence seeing the additional cost of hardware for IMARS in terms of the marker ink and the infrared Camera, VMARS becomes slightly cheaper than IMARS.

4.2 Experience of the patient

Initially phobias in patients was treated using actual exposure, next Virtual Reality was well established in the field. But because using Augmented Reality the patient can feel more connected to the actual world it has started being used. This is called as the sense of presence. Experimentally it has been proved that IMARS give a greater sense of presence than VMARS (M. Carmen Juana, Dennis Joeleb, 2011).

In VMARS when the patient sees through the HMD, he can see the marker. So, even though the spider or the cockroach has not yet appeared the patient knows the area where it will appear. This removes the sense of surprise from the therapy that is absolutely necessary. In IMARS the patient cannot see the marker hence does not know where to expect the creature. So IMARS gives higher level of surprise and anxiety in the patient than the VMARS.

Thus the treatment of a patient can be performed in a much better and effective way using the IMARS.

Conclusion

Augmented Reality has tremendous scope in the field of treatment of phobia. Though Invisible Marker Based Augmented Reality System is costly as compared to Visible Marker Based Augmented Reality, but it provides a greater sense of presence and more anxiety to the patient. Therefore therapy is better using IMARS. But cost being some constraint, future research must be conducted in the field to reduce the cost of Invisible Marker Based Augmented Reality Systems. Also, the system can only work if the entire marker is in view of the camera. Future Studies should be in the direction to overcome this disadvantage.

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