Use of Virtual Environments and Selection of Measurement Parameters For the Application in the Phobia Treatment

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Abstract— The level of the phobia condition and its progress is done by the assessment that the medical doctor does of the patient, whit out having a certain control over the measurement variables that shows a certain indication of the patient's stages. The possibility of detecting some variables that could be measured and that allows us to show these stages would be such a great idea to detect the sickness, while we can assess the patient's evolution or his follow up under a treatment.

The current paperwork talks about the efforts to carry out a research with the goal of measuring vital signs on people who are placed in relaxed environment and then compare them with vital sign measured under condition of a artificially environment. At the end of this research we are trying to determine if the virtual environment has any influence in the person's psychological change seen through the changes of the controlled vital signs.

Key Words — measurement, phobia, virtual reality, vital signs.

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I. Introduction

With the levels of stress that involve the everyday activities of human being, the number of phobias and the people who suffer of these phobias has increased. The phobia treatments by direct exposure used by the psychologists have shown to be effective, but in many cases they can be a danger for the physical and psychological health [2]. In some Cases a worst trauma or physical damage could be caused as a result of a wrong control of the treatment; so, thinking about dropping the traumas caused by direct exposure treatment, a new technology know as virtual reality has been used [11].

Using virtual reality has been a constant in the technological field [8]. With the introduction of this technique in the treatment of phobias, we expect to create virtual reality situations for the patient and his virtual direct exposure to different environment, where the patient can suffer a specific phobia (claustrophobia; scare of heights, fears of driving a car…) but in a safeties environment created by the computer in a virtual way; trying to get a better control of this environment, giving the patient the chance to swap to a relaxed environment, very easy way, under possible psychological reaction [7].

There are some possible questions to ask about this new technology. For instance if it's really true that it can create the

conditions that can make the patient fell the same effects of the real life [4] and secondly, if this new technique might be a useful tool for the phobia treatment; talking into account, that there are not valid method of his effects on the patient, out of the subjective assessment the doctor does, based on the patient perception, witch it's a traditional diagnosis of the kind of disease.

Just doing a simple assessment of the technique, it would be dangerous if the evaluation were done in wrong way specially to determine the progress on the patient's treatment before and after the end of it, where his psychological and physical health could be affected in a real environment.

To produce the virtual environment, some equipments of virtual reality are going to be used, like, infrared tracking and Head Mounted Display [9] (figure 1). The methods used nowadays to measure the effectiveness of the treatment are the survey, [2] so that's why we are thinking about using a quantitative assessment that allow us to measure in a determined scale, the treatment development and his use as a tool of assessment, if the variables are measured in a right way in a formal treatment [3].

An answer to this consideration could be found in the vital sign. It has been prove by medical specialist methods, that the vital sign are affected with some changes in his stress level. The idea carried out in the current research is based on the identification and measurement of specific vital signs of a person in a real relaxed environment, doing subsequently measurement of the same vital sign in a virtual environment, that shows situations of possible dangers or phobia that the person is exposed, and looking for a right procedure that allow us to determine if this environment exerts any influence over the patient. The vital signs identified and used in the research are the cardiac frequency and corporal temperature.

Figure 1. *Virtual reality equipment.*

Another additional element to take into account is the fundamental frequency of the voice in witch free software for voice processing is used [10]

We expected to prove with this research, that using these parameters would have a guarantee quantitative measurement of the patients feeling and emotions out of personal criteria. The phobias chosen to develop this project are claustrophobia (fear of being locked) and acrophobia (fear of heights).

II. Argumentation of the Method

In every research project, where the results have a direct influence with the medicine and the possible effects on the

people who are under these test, some requirements have to be met to comply some special considerations like ethical and safety methods of working for the people who are going to be expose to the studies.

So thinking about the medical implications some working sessions were made with medical team experts in vital sign who made a deep analysis of the research and they conclude that:

- If was mandatory to avoid epilepsy attack in the patients by photosensitivity or a reaction to some stimulation patters of light with a final wrong ECG result. That's why they limited the time to less than 3 minutes thinking about dropping the head tracker reaction and to check out the movement of the images.
- The initial survey we asked about the treated phobias different from the previous ones to have a special care with these patients.
- The patient has to read carefully and understand that these tests do not represent any body or mental risk and it is a volunteer participation in it. The patient has to sign at the end of it.

Doing an examination of the some elements like the heart rate frequency, the cardiac variability and the temperature, likewise the fundamental frequency of the voice, we expect to have a quantitative scale of assessment, especially for the medical doctors to know the stress regulation of the patient and of course, the treatment progress or evolution of the phobias in closed spaces and heights.

The selection of the vital sign was determined by the facility in the measurement methods and the changes show on the stress levels. On the other hand, there are no studies that show the bigger changes on the other vital signs.

Situation of Stress and Regulation of Temperature

When a patient is under strong treatment, he feels hard changes in his emotions and feelings due to a high stress effects, it causes a bad regulation of heater system of the human body. These changes are more remarkable in some body places where capillary irrigation is higher, for example, the hands.

The physical cause of this reaction is the hormone segregation potentially constrictor vessel elements, the muscles spasms of the walls of the arteries, the rusting that damage the red cellular membranes making them thicker and the clots formation because of the platelets [1].

The temperature of the thermograph tests in the hand shows a percentage little higher in increase. The correlation of the temperature in the different environments is high which does not allow to differentiate the groups in the rest environments, closed space and height (figure 2)

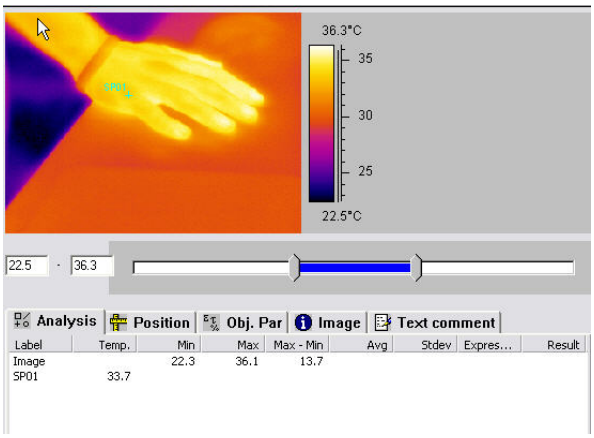

Figure 2. *Termographic data.*
Heart Rate variability

It refers to arrhythmia or rhythm not symmetrical of sinusal node, which is the one that works as heart's pacemaker [6]. It happened at the breathing phase. It is an easy influenced parameter by emotional changes of the persons [5]

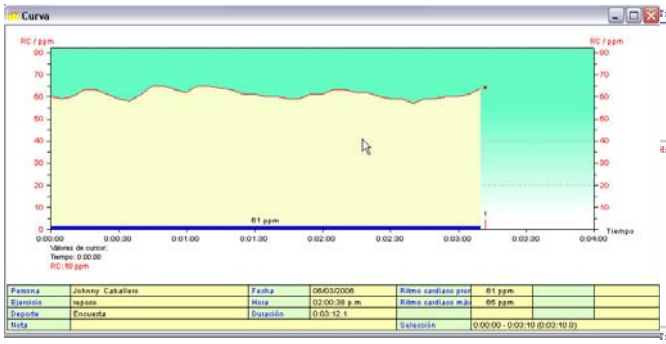

Figure 3. *Cardiac frequency on rest environment.*

If the heart rate variability is studied instead of the cardiac frequency (figure 3), it shows a drop in the measure in both virtual environments with a big difference that allows us to identify the virtual environment

Fundamental frequency of the voice

The muscles of the human body vibrate at a determined frequency and it includes the vocal chords. In some stress situations, the muscular vibration changes and so the frequency changes too.

Some different techniques can be used on the vocal chords behaviors. One of these is the fundamental frequency of the voice. It consists in obtain the frequency of the sound produced by the vocal chords which is highly correlated with the intonation and stress levels.

A decrement is showed in fundamental frequency of the voice, the correlation of the average values of the fundamental frequency in the two environments show that there is a difference, allowing us to distinguish the two environments [9]. The duration of the voice goes down but in the same way of the voice energy, they do not present any significant change so they are not a right parameter to determine the influence of the virtual reality (figure 4).

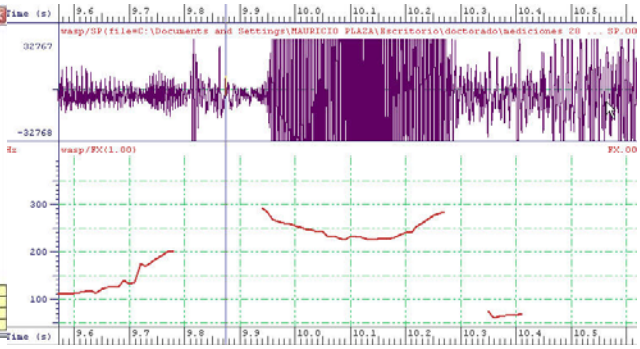

Figure 4. *Voice register, fundamental frequency and energy.*

III. Experimental procedure

Beginning from the previous analysis the experimental work will consist in creating, first of all, virtual environments of height and closes spaces for the people who voluntary accept to be part of the analysis. It will allow us to measure the vital signs identified as in a real relaxed state with out any level of stress like in virtual environment made, to contrast the results and to determine if the virtual reality has any influence in the patients.

The main achievement is to determinate with this experimental test and with some virtual reality tools, if the synthetic environment produce similar effects to the real ones and the possibility of using these results as a tool of the phobias treatment.

Working with a experimental design, we went on to make the selection of a sample for the research; beginning with some engineering students from Universidad

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Libre, Bogotá, Colombia (ULC). In order to have a starting point to determine the size of the sample, we use statistical procedure. The result of the analysis offered the necessity of making studies over total of 308 students between 1350 students at the ULC.

Some steps were chosen as a working procedure as followed:

1. First of all, the people were informed about all the process and they all were trained on how to use the virtual reality equipments.
2. Once training is finished, we ask the person to fill a simple survey, during the survey, the vital sign data is recorder.
3. The next steps are to undergo the person to virtual environments of height and closed spaces and register the same vital sign parameters. Afterwards a contrasting information data is done under the different conditions to find some differences that allow us to valid the method to this purpose.

At the end of this test as survey is done again. The patient is asked about his feeling or impression of the experiment and the generated stress level. This information will be correlated with the vital signs data.

IV. Result of the Research

The information data found in the previous test show that there are some parameters that present some changes within the environments. Some other parameters do not suffer any changes so they cannot be user to determine the effectiveness of the virtual reality for phobia treatment

Other result can determine that there is a possibility to distinguish the type of phobia with the statistical data.

V. Conclusion

Figure 5. *Virtual reality center for the research.*

The virtual reality is a tool used for the phobia treatment by some medical centers [12] (figure 5). Due to the necessity of having a tool to measure a quantitative way the effectiveness of the treatment and the patient evolution, the present research, based on medical studies about the influence of the stress in the vital sign, is trying to determine the effectiveness of the virtual reality and establish a range or a scale that can be used by the medical doctors in the treatments.

With vital signs an the fundamental frequency of the voice found and checked, we can conclude that there are some parameters like the average cardiac frequency witch does not allow us to distinguish the reaction of the person in virtual and rest environment. Some other parameter like the temperature, cardiac variability let us distinguish the estate of rest and virtual environment.

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