EFFECT OF AUGMENTED REALITY AND VIRTUAL REALITY ON INDUCED ANXIETY

SEMINAR REPORT

submitted by

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(TLY16CS034)

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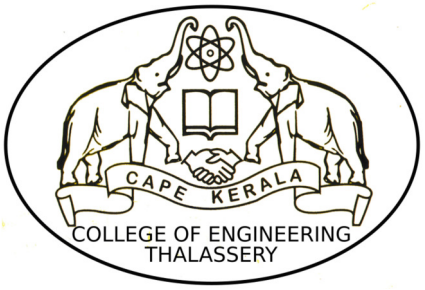

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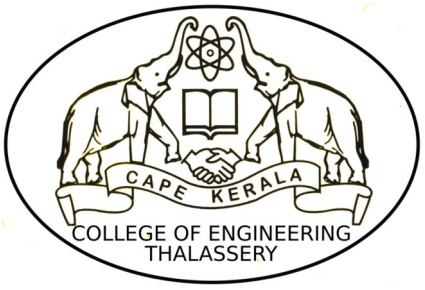

CERTIFICATE

This is to certify that the report entitled **EFFECT OF AUGMENTED REALITY AND VIRTUAL REALITY ON INDUCED ANXIETY** is a bonafide record of the seminar report presented by **NAZIM VK (TLY16CS034)** in partial fulfillment of the requirements for the award of the Degree of **Bachelor of Technology** in **Computer Science & Engineering** of APJ Abdul Kalam Technological University

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DECLARATION

I undersigned hereby declare that the seminar report **"EFFECT OF AUGMENTED REALITY AND VIRTUAL REALITY ON INDUCED ANXIETY"** , submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of **Prof.SNEHA B K** . This submission represents my ideas in my own words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

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ABSTRACT

To explore the effects of virtual reality (VR) and augmented reality (AR) in the treatment of claustrophobia, the potential effects of VR and AR on induced anxiety were investigated in the current study. During the experiment, 34 subjects were randomly selected and distributed in AR and VR scenes in sequence. The skin conductance and heart rates of the subjects were measured throughout the entire process, and the anxiety scale was used to assess the subjective anxiety when the task in each scene was completed. The results showed the following. (1) AR and VR scenes led to feelings of discomfort, but the subjective anxiety scores obtained in the two scenes were not significantly different. (2) The skin conductance level of the subjects significantly increased from the baseline when the subjects entered the experimental scene but remained active in the two scenes without showing significant difference between the scenes. (3) The heart rate index significantly increased from the baseline after the subjects entered the scene and then gradually decreased. The heart rates of the subjects significantly increased again when the anxiety-induced event was triggered. However, No significant difference was observed between AR and VR scenes. AR and VR induced obvious anxiety, which was reflected in the subjective and objective physiological indicators. However, no significant difference was found in the effects of AR and VR on induced anxiety. Considering the cost of building two scenes and other factors, AR was more suitable for the treatment of claustrophobia than VR..

Contents

ABBREVIATIONS

VR	Virtual Reality
AR	Augmented Reality

Chapter 1

INTRODUCTION

1.1 Phobia and Its Main Treatment Methods

Phobia is attributed to the anxiety disorders spectrum in DSM-5. The current main treatment methods for phobia include drug and psychological treatments. Several studies have reported that in drug treatment of phobia, tricyclic antidepressants, especially monoamine oxidase inhibitors, are more effective than placebos against social anxiety . Paroxetine has been approved by the US Food and Drug Administration for social anxiety disorder . Psychotherapy is more widely used for most phobias. Cognitive behavioral therapies for anxiety disorder mainly include exposure therapy (EX), cognition process therapy, systematic desensitization, and cognitive therapy .

Studies have shown that 5–7 percent of the world's population suffer from claustrophobia, but most of them do not actively seek treatment Several studies have achieved the treatment of some phobias using VR . Several researchers have speculated that AR may be used to treat phobia . However, studies on claustrophobia remain limited. Different from other phobias, claustrophobia is a kind of anxiety in a closed space. The closed space can be a variety of places, such as engine rooms, elevators, and closed rooms. This kind of anxiety comes mainly from imagining possible events in the claustrophobic space. Therefore, great differences may exist in establishing experimental scenarios for claustrophobia. This specificity requires experimental studies that are specifically conducted to address the anxiety-inducing condition of the phobia.

1.2 Application of VR in Phobia Treatment

VR is a type of advanced human–computer interface that allows users to interact with computers in real time and immerse themselves in the environment created by computers. In psychological treatment, VR technology can present audio-visual experiences more realistically than traditional therapy technology and provides a safe and controllable environment where patients can be treated.

1.3 Application of AR in Phobia Treatmen

Another EX was gradually developed, namely, augmented reality exposure treatment (ARET). Azuma reported that AR must satisfy the following conditions: (1) combined real and virtual objects in real environments, (2) interactive and real-time implementation, and (3) associated real and virtual objects. One of the purposes of virtual elements is to deepen user experience and knowledge.

We believe that augmented reality (AR) could also be used to treat some psychological disorders. AR and VR share some advantages over traditional treatments. However, AR gives a greater feeling of presence (the sensation of being there) and reality judgment (judging an experience as real) than VR because the environment and the elements the patient uses to interact with the application are real. Moreover, in AR users see their own hands, feet, and so on, whereas VR only simulates this experience. With these differences in mind, the question arises as to the kinds of psychological treatments AR and VR are most suited for. AR could be suitable when the following two premises are met:

1) when patients can use real elements to interact with the application, such as their hands and feet; and

2) when it's possible to use or reproduce the real environment (with little cost or time) or to use an alternative environment.

If both premises aren't satisfied, VR might be preferable. Because neither AR nor VR are a panacea, the phobia type will determine the most appropriate technology to use. We have developed an AR system for treating phobias to spiders and cockroaches. In our system, patients see their own hands touching a table, holding a marker with a dead spider or cockroach, and picking up a flyswatter, a can of insecticide, or a dustpan.

1.4 Statement of the Problem

A review of related literature reveals that ARET may be as effective as VR EX for treating phobias. However, studies on the two therapies for treating claustrophobia are limited. This preliminary research on the effectiveness of the scenario aims to study the anxiety induced by the scenario in a healthy population. On this basis, researchers can further speculate whether this scenario is suitable for fear inducement in phobia patients. Cheng Fang conducted a related preliminary study and discovered that the scenarios established through AR and VR can cause physiological changes in the subjects, with AR bringing

about changes. The Technology Acceptance Model (TAM) and self-made anxiety scales show that the anxiety of the subject in VR is significantly higher than that in AR. However, experimental control has several problems. The present study showed that the effect of AR is better than that of VR in the physiological index because different experiment environments were used, namely, a realistic environment for AR and an office environment for VR. A standing test was adopted in AR, whereas a sitting posture was adopted in VR. These differences affected the physical experience of the subjects. The subjective report result of VR was better than that of AR because the subjective reporting of subjects are conducted after the completion of all experiments, which may cause memory confusion. The deficiency of these controls may directly lead to error bias in the experimental results. Therefore, the differences between AR and VR should be studied further.

Several researchers have designed and evaluated scenarios for treating claustrophobia. Their results showed that complex scenarios are highly likely to cause anxiety in individual. This finding provides valuable information for the design of the current research. The elevator scenarios used in previous studies are monotonous. Bringing the subject into a closed-room scenario to which tasks are added may have an improved immersion effect.

Chapter 2

EXPERIMENTAL STUDY

2.1 Subjects

A total of 43 subjects, which include 18 male students and 31 female students, with an average age of 23.3 years (± 4.12) and normal vision or normal corrected visual acuity, were recruited through the Internet. The data of nine subjects were removed from the data possessing because the system encountered unexpected termination during testing, and part of the data was lost. Finally, valid data from 34 persons (11 males and 23 females) were obtained. Six of the subjects used a VR device.

2.2 System design

2.2.1 System Architecture

VR hardware device: The VR device was equipped with HTC Vive. The device has a screen refresh rate of 90 Hz and two wireless controllers.

AR hardware device: For controlling variables, we directly modified HTC Vive with an added camera in 1080 P. Thus, the modified HTC Vive with the corresponding function of AR was used as the AR device in our experiment. Scenario development: Unity3D5.3.x was used to implement VA and AR scenarios. The visual differences between AR and VR were minimized with an existing graphics technique in that AR and VR scenes look consistent and equivalent. The data acquisition system was integrated with the VR/AR

Figure 2.1: Scenario of VR diagram

Figure 2.2: Scenario of AR diagram

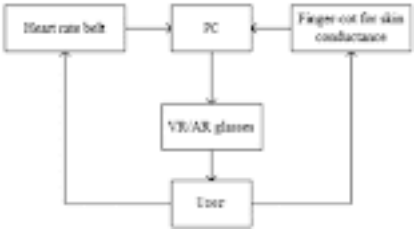

Figure 2.3: system architecture

device to build the following system. The subject wears these devices, which constitute the entire system: heart rate belt, finger-cot for skin conductance, and VR/AR glasses.

The Grove-GSR skin current induction sensor kit developed by Seeed Studio was used to collect skin conductance information, and arduino-1.16.13 and Matlab coding were used to receive the data. A Polar H7 heart rate belt sensor was used to measure the heart rate. Windows' BluetoothGattHeartRate CPP sample and Python coding were used to receive the data. The experimental environment, temperature, light, postures of subjects, helmet weight, and additional variables were controlled in the experiment.

2.2.2 Scenario Design

With reference to a previous study , two virtual scenarios designed as safe environments form physiological and psychological perspectives. The scenarios adopted different technologies but were the same, that is, a small closed room. The purpose of the experiment was concealed before the experiment and was only divulged at the end to obtain the true emotional feedback of the subject. First, a psychological experiment scenario was simulated at the beginning of the experiment. The subject sits in the room and completes a classic Stroop task facing the computer. This is a pseudo task. The computer stops running after a period. A leakage fire occurs in the room, and events in the scenario would occur in turn with time. The events in the two scenarios occur at the beginning of the game in a fixed order. The trigger time of events in the two scenarios are consistent.

Figure 2.4: process of events in the scenario

Figure 2.5: Fire scene in AR

2.3 Research procedure design

The design was a single-factor within-subject design. Its independent variables referred to the experimental situations: VR and AR. Its dependent variables referred to the scores of the subject in two anxiety scales: SUDS and State Trait Anxiety Inventory (STAI) The design was a single-factor within-subject design. Its independent variables referred to the experimental situations: VR and AR. Its dependent variables referred to the scores of the subject in two anxiety scales: SUDS and State Trait Anxiety Inventory (STAI) [19], which were subjective indicators; and skin conductance and heart rate in the experiment, which were objective indicators., which were subjective indicators; and skin conductance and heart rate in the experiment, which were objective indicators.

Figure 2.6: Fire scene in VR

Figure 2.7: Research procedure

2.4 Data recording and processing method

2.4.1 Data Recording

The whole system recorded the following information. User's basic information included number, age, gender, and scenario.The scale information included the scores of the SUDS and STAI-SAI scales. The psychological information included skin conductance and heart rate during the entire course of the scenario.

2.4.2 Data Processing

The following approaches were adopted in processing the scale and psychological data. For the scale data, the questionnaire was given and answered via an iPad, and the results were uploaded to the Questionnaire Star Website. All the data were downloaded for processing using Excel 2016 after data collection was completed. For the psychological data, Matlab R2016a software was adopted after data collection was completed for data screening, data merging, filtering and noise reduction, and obtaining the peak value. The data were analyzed using SPSS Version 20 for the paired T-test.

2.5 LIMITATIONS OF FORMER METHODS

In the above mentioned methods even though they have positive results there are some limitations.They include the lack of attention.Because , hearing lectures and watching videos or images becomes boring after some time.Another drawback is that the one who are getting awareness doesnot feel that they are going to affect these issues because the videos or photos we shows exist inside the monitor.These are some old fashions,so people doesnt want these.

Chapter 3

ANALYSIS OF RESULTS

The obtained results were analyzed in terms of subjective and objective indicators. After generating the descriptive statistics of the data, a paired t-test was conducted for the data results to determine the differences among the obtained means.

3.1 Analysis on subjective indicators of anxiety

the subjects were asked to fill in a subjective scale. The scale score of each subject in each scenario was obtained, and the means of the two scale scores and the differences between them were added.

3.2 Analysis on objective indicators of anxiety

The results of the physiological data were divided into three parts. The first part is the baseline data ($B_SCL), which were obtained by measuring the 15 min resting time from the beginning of$

stable for 100 s before the experiment were obtained manually owing to the differences among subjects. The second part was obtained from the first scenario (AR/VR). The software was used to obtain the time points of the different events, which matched the psychological data. The third part was obtained in the second scenario (AR/VR).. It was divided into two parts in each scenario. The first part is the pseudo psychology experiment (EXP), and the second part is the anxiety-induced scene (SCENE), which was accounted for at the end of the psychological experiment.

3.2.1 Skin conductance data

The skin conductance data of subjects were collected during the whole experiment. Therefore, the mean value of the skin conductance of the subjects in different periods was obtained to generate the statistics The baseline data were used in the paired data to test the differences in skin conductance in different periods and the resting status among subjects

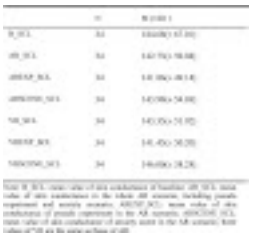

Figure 3.1: Skin conductance data

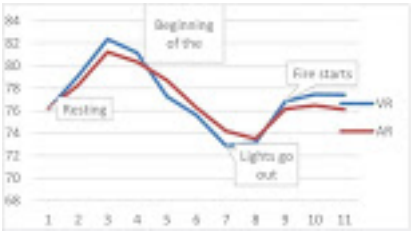

Figure 3.2: Changes in value of AR and VR

to determine whether the scenario processing can lead to a change in the skin conductance of the subjects, A significant difference in skin conductance existed between the experimental treatment and the baseline data. The difference in skin conductance between the baseline and AR.

The data obtained from the scenarios were used in a paired t-test to test the difference in skin conductance change caused by the AR and VR scenarios . No difference in skin conductance existed between AR and VR in the overall and partial scenarios.

3.2.2 Heart rate data

The heart rate data of the subjects were collected during the entire experiment. Therefore, the mean value of the heart rates of the subjects in different periods was obtained to generate the statistics.The baseline data were used in a paired t-test with other data to obtain the differences in heart rates in different periods and the resting status among subjects to determine whether the scenario processing led to a change in the heart rate of subjects.

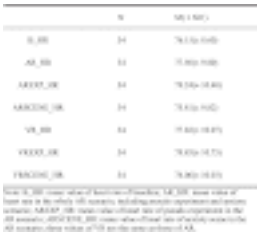

Figure 3.3: Heart rate data

to test the difference in heart rate changes caused by the AR and VR scenarios, the heart rate data obtained from the scenarios were used in a paired t-test . The two experimental treatments did not have a significant effect on the heart rate.the data of heart rate is shown in figure 3.3

Chapter 4

DISCUSSION

4.1 Comparison of AR and VR: Subjective indicators

A. Comparison of AR and VR: Subjective indicators The subjective scale data indicate that the subjects experience a certain degree of anxiety in the AR and VR scenarios . However, the comparison of the scores of the two scales in two scenarios shows no significant difference. The results of a previous study showed that the effect of VR is better than that of AR in the psychological indicators. Further comparison showed that the TAM and customized anxiety scales for the experimental scene were used in previous studies. Moreover, existing studies adopted SUDS and SAI. After the experiment, several subjects recounted that they did not see their legs as they bowed their heads in the VR, and thus, they knew they were in a built scene.

The score of VR was higher than that of AR in the TAM scale. Previous studies have adopted the self-made anxiety scale, but the general scale was used in this study. A great difference exists between the two in terms of questioning and wording. The previous scale was self-made and thus closer to questioning in the experimental scene. The scales adopted in this research focused on the current anxiety status. Several subjects felt nervous but did not believe they were anxious. This phenomenon also shows the effects of questioning and wording on the results obtained by the scales. The fire in the AR scenario was relatively direct with insufficient logic due to technical reasons, and the fire moved along with the head. However, the subjects were immersed in the real background scenes. Many subjects feared the two scenarios but speculated that these were simulations. This cognitive adjustment indicates the overall tension tendency of the subjects in the experiment when they entered the scenario, followed by gradual relaxation.

4.2 Comparison of AR and VR: Objective indicators

The skin conductance of the subjects greatly changed after entering the scenario. This change is constant and significant in the statistical result. The experimental treatment led to a psychological change in the subjects, and the reaction to this change is sensitive. The

change in skin conductance is explained from the angle of sweat secretion [21]. When the subjects enter the experiment, their hands start to secrete sweat, and the sweat secretion is maintained throughout the experiment. A slight decrease occurs after resting, but the change is not obvious. Sweat secretion increases slightly after entering the second scenario. No significant difference exists between the heart rates of the subject in the resting state and in the experimental status, but a significant difference exists between the heart rates in the resting state and in the pseudo experiment. The heart rates of the subjects as they entered the scenario and in the pseudo experiment increase significantly possibly because this was the first time that most of the subjects wore helmets. No difference is found in subjects' heart rate. Therefore, we further analyzed and calculated the mean value of heart rates of the subject in all time points in the scenario. The subject experienced an increase in heart rate twice during the experiment. Moreover, the heart rate declined before the second heart rate increased, and the peak value of the second increase reached the mean value of the resting state. This discovery may be the reason that the mean heart rate did not increase.

Chapter 5

CONCLUSION

The study indicated that the proposed AR and VR systems effectively induced anxiety in subjects. Moreover, by measuring the subjective scale scores, skin conductance, and heart rate, no significant difference was found between the proposed AR and VR systems in terms of inducing anxiety. Future research will further quantify the contribution of each type of stimulus from human perceptions (visual, auditory, haptic, or smell) and investigate whether AR or VR system is more effective in inducing anxiety.

Chapter 6

Referance

1. M. R. Liebowitz et al., "Phenelzine vs atenolol in social phobia: A placebo-controlled comparison", Psychopharmacol. Bull., vol. 49, no. 4, pp. 290-300, 1992

2. M. B. Stein, M. R. Liebowitz, R. B. Lydiard, C. D. Pitts, W. Bushnell, I. Gergel, "Paroxetine treatment of generalized social phobia (social anxiety disorder): A randomized controlled trial", JAMA, vol. 280, no. 8, pp. 708-713, 1998.

3. E. B. Foa, T. M. Keane, Effective Treatments for PTSD, London, U.K.:Guilford Press, 2010.

4. R. L. Leahy, "Phobias: A handbook of theory research and treatment", J. Cogn. Psychotherapy, vol. 14, no. 1, pp. 115-117, 2000.

5. P. Anderson, B. O. Rothbaum, L. F. Hodges, "Virtual reality exposure in the treatment of social anxiety", Cogn. Behav. Pract., vol. 10, no. 3, pp. 240-247, 2003.

6. C. Botella, R. M. Baños, H. Villa, C. Perpiñá, A. García-Palacios, "Virtual reality in the treatment of claustrophobic fear: A controlled multiple-baseline design", Behav. Therapy, vol. 31, no. 3, pp. 583-595, 2000.

8. A. Garcia-Palacios, H. Hoffman, A. Carlin, T. A. Furness, C. Botella, "Virtual reality in the treatment of spider phobia: A controlled study", Behav. Res. Therapy, vol. 40, no. 9, pp. 983-993, 2002.

9. M. Kahan, J. Tanzer, D. Darvin, F. Borer, "Virtual reality-assisted cognitive-behavioral treatment for fear of flying: Acute treatment and follow-up", Cyberpsychol. Behav., vol. 3, no. 3, pp. 387-392, 2000.

10. C. Botella, M. C. Juan, R. M. Basños, M. Alcañiz, V. Guillén, B. Rey, "Mixing realities? An application of augmented reality for the treatment of cockroach phobia", Cyberpsychol. Behav., vol. 8, no. 2, pp. 162-171, 2005.

11. C. Botella, J. Bretón-López, S. Quero, R. Baños, A. García-Palacios, "Treating cockroach phobia with augmented reality", Behav. Therapy, vol. 41, no. 3, pp. 401-413, 2010.

12. M. Wrzesien, J.-M. Burkhardt, M. Alcañiz, C. Botella, " How technology influences the therapeutic process: A comparative field evaluation of augmented reality and in vivo exposure therapy for phobia of small animals ", IFIP Tc 13 Int. Conf. Hum.-Comput. Interaction, pp. 523-540, 2011.

13. C. Botella, R. M. Baños, C. Perpiñá, H. Villa, M. Alcañiz, A. Rey, "Virtual reality treatment of claustrophobia: A case report", Behav. Res. Therapy, vol. 36, no. 2, pp. 239-246, 1998.

14. M. Bruce, H. Regenbrecht, "A virtual reality claustrophobia therapy system—Implementation and test", Proc. IEEE Virtual Reality Conf., pp. 179-182, Mar. 2009.

15. R. Azuma, Y. Baillot, R. Behringer, S. Feiner, S. Julier, B. MacIntyre, "Recent advances in augmented reality", IEEE Comput. Graph. Appl., vol. 21, no. 6, pp. 34-47, Nov. 2001.

16. D. R. Berryman, "Augmented reality: A review", Med. Ref. Services Quart., vol. 31, no. 2, pp. 212-218, 2012.

17. Y. Cheng-Fang, "Comparison between VR and AR: Application of virtual elevator in claustrophobia", pp. 1-67, 2012.

18. M. Christofi, D. Michael, "Designing and evaluating virtual environments for the treatment of claustrophobia", Cyprus Workshop Signal Process. Inform, pp. 1, 2016.

19. C. D. Spielberger, R. Gorsuch, E. L. Richard, P. R. Vagg, G. A. Jacobs, Manual for the state-trait anxiety inventory (form Y1—Y2), 1983.

20. J. R. Stroop, "Studies of interference in serial verbal reactions", J. Exp. Psychol., vol. 18, no. 6, pp. 643, 1935.

21. Z. Wang, Y.-Y. Yao, H.-J. Zhang, H. Jiang, "Design and research of the electrical skin resistance in college students", Res. Med. Educ., vol. 4, no. 3, pp. 144-150, 2005.

22. The Distress Thermometer—Subjective Units of Distress Scale (SUDS), Mar. 2018, [online] Available: http://at-ease.dva.gov.au/professionals/files/2012/12/SUDS.pdf.

23. Measures of Anxiety, Mar. 2018, [online] Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PM