

Another day at the office: Visuohaptic schizophrenia VR simulation

George Michalakos Michail Pavlou Giannis Gerogiannis Vasilis Liapis Ioanna Terzi
Apostolos Tsagarakis Raphailia Asimakopoulou Dimitris Bitzas Konstantinos Moustakas*

University of Patras
Department of Electrical and Computer Engineering†

ABSTRACT

This paper presents Virtual Reality 3D interaction and simulation techniques in the context of the 2020 3DUI contest of the IEEE VR conference. This paper discusses the design and development of a scenario-based mental disorder simulation, aiming to empathize the end-user with the symptoms that a schizophrenic person faces. These techniques are integrated in the context of a virtual reality environment which serves as the medium to immerse the user to experience a vast number of schizophrenia symptoms, mainly focusing on the positive ones, such as mind delusions and auditory, visual, haptic hallucinations. The paper concludes with a discussion on the extensibility and translational application of the approaches in practical problem solving.

Index Terms: Human-centered computing—Human computer interaction (HCI)—Interaction paradigms—Virtual reality; Behavioral sciences—Psychiatry—Mental disorder;

1 INTRODUCTION

Over the recent years, virtual reality applications are gaining traction, mostly in the consumer market due to their ability to provide novel-immersive experiences to end-users and the affordable prices of the respective consumer-grade devices. This results to the focus of the research community on improving the virtual reality user experience with realistic graphics and practical 3D interfaces [1].

To this end, the 3DUI contest, following previous practice [2], [4], centers on the design and development of creative and innovative solution to challenging 3DUI problems. The 3DUI 2020 contest is focused on developing an environment that can lead the user to feel the issues that people with differences (e.g, physical disabilities, mental disabilities, social disorders, or impairments) could feel.

The proposed interactive virtual reality system attempts to approach the aforementioned functionality by presenting a mental disorder based scenario, in which the user will experience some of the common symptoms of schizophrenia. The simulation focuses on empathizing the user with the difficulties of this mental disorder and reduce stigma and fear of society towards mental diseases.

2 DESIGN

Research on perception of schizophrenia proves that public awareness of schizophrenia leads to discrimination and stigmatization of the patients [3]. Previous literature has proven that VR based simulations are more efficient in terms of empathizing the user than classic methods [6].

The choice of a mental disorder simulation inside a virtual reality environment is based on the fact that the user, in order to experience the symptoms that a person with a mental disorder faces, must be fully immersed in a reality different than the actual one.

Further to the above mentioned, the necessity of a virtual reality environment for the display of symptoms such as visual and acoustic hallucinations, is obvious.

People with schizophrenia tend to have visual, auditory, tactile, olfactory and gustatory hallucinations. The first three were chosen to be presented. As mentioned before, auditory and visual hallucinations can be experienced by designing visual and acoustic effects and taking advantage of the virtual reality hardware used. As for the tactile hallucinations, a custom haptic vest was designed, to increase the sense of embodiment. Although this part of symptoms is important for the increase of empathy of the user, the intensity of the effects has to be carefully designed to prevent dizziness and VR sickness.

Aside from hallucinations, people with schizophrenia are affected by false beliefs of reality facing different kinds of delusions. The kind of delusion chosen was the persecutory delusion. A gamification approach was rejected through the design, to prevent the user from feeling like playing a horror game and having some tasks and goals to achieve. Instead of this, the delusion is being augmented through a scenario of the user being at his office with some escalating events happening to build the feel of persecution.

The sense of embodiment seems to be one the most important factors in a virtual reality application, especially when it focuses on the increase of empathy. The user must feel self located inside the virtual environment, perceive feedback from the environment as it was from his own sensations and recognizes himself as the cause of the actions and movements of his virtual body [7].

3 SCHIZOPHRENIA VR SIMULATION

The software is designed using Unity real-time development platform and the hardware used is the Oculus Rift HMD. As a VR application demands realistic models and textures rendering in high frame rate, a great majority of the environment and its surroundings required to be modelled from scratch. In order to face these challenges, 3D modelling, sculpting, UV unwrapping and texturing techniques were implemented in Blender. Figure 1 illustrates some screenshots from the environment.



Figure 1: From left to right: Personal office view, office with NPCs view

The need of immersion and realism were the main factors while considering the animations for each character. These ought not to be limited in body movements but should also include facial motion, in order to provide lifelike interaction with the NPCs. A variety of characters was designed to emulate a realistic office-environment workforce, with custom animations and facial motions, implemented

*e-mail:moustakas@upatras.gr

†http://www.vvr.ece.upatras.gr

by a custom Motion-Capture technique using Blender and a make-up sharpies.

Scenario: As a starting point, the user's avatar is placed into a semi-open VR world, a corporate's office environment. The story begins with the user trying to search his treatment pills and noticing the pill case is empty. Next, he/she will receive certain simple objectives/tasks to accomplish via realistic 3d interactions with the surroundings. As time passes, the end-user will experience the effects of the lack of medication in a patient suffering from schizophrenia. These effects will be experienced during user's interactions with objects, 3D avatars, surrounding environment and will be dynamically generated regardless of the user choosing to follow the objectives of the scenario or wandering around. Also, the NPCs representing the user's colleagues and boss are designed to escalate their behaviour concurrently with the progression of the simulation so that they provoke a feeling of persecution to the user.

Visual Hallucinations: As visual hallucinations may vary, different kinds of visual effects are displayed in the present work, such as lights appearing in different spots of the environment, changes on object textures and semi-transparent shadows on the peripheral view of the user. These effects are designed to escalate properly, avoiding the cause of dizziness during the simulation and attempting to keep the user immersed through the whole experience.

Auditory Hallucinations: Auditory hallucinations, is one of the most prevalent symptoms of schizophrenia, reported by as many as 75% of patients [5]. As the simulation escalates, the user will hear a single ore multiple voices, who speak in turn or all at the same time, saying inaccurate things or giving commands. The position of the voices will vary using spatialized audio. Figure 2 illustrates an example of a hallucination and a delusion.



Figure 2: From left to right: Delusion showing the boss being angry, Hallucination with a weird crature inside the coffee

Tactile Hallucinations: This kind of hallucinations includes small touches in the user's body implying that someone is touching or a small animal walks on the user's body. To achieve this, a custom haptic vest was designed. The vest consists of 6 vibration motors spread-out in different positions of its surface. The vibration motors are driven by an Arduino with a Bluetooth module attached, so that the vest is connected wirelessly with the designed Unity software. Finally, the motors are triggered by the progression of the simulation giving the user tactile feedback in his chest and shoulders. Figure 3 illustrates the front and back view of the custom haptic vest.



Figure 3: Front and back view of the custom haptic vest

4 DISCUSSION - CONCLUSIONS

This paper presents a virtual reality 3DUI interaction system that addresses the 3DUI 2020 contest objectives. The main technical contributions are the use of an interactive scenario, simulating hallucinations and delusions caused by a mental disorder, in first person and the design of a custom low-cost haptic vest to provide tactile feedback to the user and improve the sense of embodiment. One of the challenges faced was, primarily, the design process of both the environment and effects in order to provide an immersive realistic experience of suffering from a mental disorder and do not cause any negative effects in a mental healthy user simultaneously. We strongly believe that these implementations are promising great results and a wide variety of applications, due to their facilitation of a disorder embodiment.

REFERENCES

- [1] D. A. Bowman, E. Kruijff, J. J. LaViola, and I. Poupyrev. *3D User Interfaces: Theory and Practice*. Addison Wesley Longman Publishing Co., Inc., Redwood City, CA, USA, 2004.
- [2] P. Figueroa, R. Guo, K. Takashima, and B. Weyers. Escape room in mixed reality: 10th annual 3dUI contest. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 1407–1408, March 2019. doi: 10.1109/VR.2019.8798285
- [3] R. Graves, J. Cassisi, and D. Penn. Psychophysiological evaluation of stigma towards schizophrenia. *Schizophrenia research*, 76:317–27, 08 2005. doi: 10.1016/j.schres.2005.02.003
- [4] R. Guo, R. McMahan, and B. Weyers. 3dUI-league: 9th annual 3dUI contest. pp. 1–1, 03 2018. doi: 10.1109/VR.2018.8446389
- [5] J.-K. Heo, S.-O. Seo, M.-Y. Hong, J. S. Lee, Y. S. Shin, J. Ku, S. Kim, and J.-J. Kim. The effect of simulated auditory hallucinations on daily activities in schizophrenia patients. *Psychopathology*, 45:352–60, 07 2012. doi: 10.1159/000337264
- [6] S. Kalyanaraman, D. Penn, J. Ivory, and A. Judge. The virtual doppelganger effects of a virtual reality simulator on perceptions of schizophrenia. *The Journal of nervous and mental disease*, 198:437–43, 06 2010. doi: 10.1097/NMD.0b013e3181e07d66
- [7] K. Kiltner, R. Groten, and M. Slater. The sense of embodiment in virtual reality. *Presence Teleoperators and Virtual Environments*, 21, 11 2012. doi: 10.1162/PRES.a.00124