Simulation of world perception in psychotic disorders

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Abstract—After the successful application of virtual reality (VR) in supporting cognitive-behavioral therapy based on exposure and psychoeducational interventions for various mental disorders, this technology emerges as a promising tool in the treatment of psychotic disorders, especially schizophrenia. This article describes the concept of creating a customized simulation in a CAVE environment dedicated to understanding the perspective of individuals suffering from schizophrenia. The simulation aims to serve as a tool for better comprehension of this disorder by their loved ones and for raising awareness in society at large.

During initial practical tests following development, the level of engagement and empathy in healthy participants was assessed. The research showed that the simulation effectively contributes to a better understanding of the perspective of individuals with schizophrenia. However, certain disrupting factors were identified, such as potential feelings of disorientation or difficulties in grasping simulated experiences due to a low level of immersion.

This work lays the foundation for an innovative application concept that not only helps close ones understand the world of individuals with schizophrenia but also plays a crucial role in social education about this disorder. To fully harness the potential of this concept, further scientific research and technical refinement of both the simulation and hardware are necessary.

Index Terms—simulation, I3DVL, VR, CAVE, psychotic disorder

I. INTRODUCTION

The growing popularity of various virtual and augmented reality technologies finds applications in various areas of life. This is also true in the field of psychology, where this technology serves as a supportive tool in cognitive-behavioral therapy for treating post-traumatic stress disorder, phobias, eating disorders, and addictions. It enables easy immersion of the patient into a simulated environment and controlled exposure to a specific stimulus.

However, simulations can benefit not only the patients but also their families and close associates, particularly in the case of illnesses surrounded by pervasive myths, such as schizophrenia. According to the World Health Organization (WHO), individuals with schizophrenia often experience stigmatization, discrimination, and violations of human rights. In Gerlinger's study, 64% out of 5871 participants reported experiencing stigmatization [1], while another study found that 79% of participants felt a sense of alienation citeb2. Such behaviors can lead individuals to avoid seeking help for their mental health issues due to feelings of shame or fear 2nd Mikołaj Trylewicz Gdansk University of Technology Department of Inteligent Interactive Systems Gdansk, Poland s171582@student.pg.edu.pl

of rejection [3]. To prevent these situations, it is essential to foster an empathetic mindset within the population.

In the cognitive and affective realms, empathy encompasses an individual's capacity to step into another person's shoes, discern, comprehend, and acknowledge their behavior. This involves understanding their viewpoint, expressions, and how they respond to various situations [4] [5]. Research indicates that one of the most effective methods for fostering empathy involves practicing perspective-taking. This approach enables individuals to grasp and personally experience the internal states guiding the person for whom empathy is being cultivated [6]. However, it's worth noting that this technique may demand significant cognitive effort, potentially leading users to shy away from engaging in the activity [7].

Due to its positive impact on social relationships, scientists are exploring new ways to enhance empathy, including techniques like perspective-taking. Existing methods of perspective-taking include role-playing, mental simulations, narrative constructions, and video games [8]. Video games provide visual, auditory, and sometimes tactile sensory stimuli, and their interactive nature significantly engages users. When combined with the features of virtual storytelling, especially those utilizing virtual reality (VR), video games are considered an effective means of promoting empathy [9]. In comparison to traditional methods, VR has an additional advantage - users don't have to imagine a different perspective but can focus on experiencing the sensations of the simulation.

Crucial in simulations designed to foster empathetic attitudes in users is a high level of immersion in the experience. Various VR technology environments vary in the achievable level of immersion. Among them, the CAVE environment stands out as one of the most sophisticated devices for immersive virtual reality [10].

This study aims to investigate the impact of virtual reality simulations in the CAVE environment on knowledge, empathy, and attitudes towards individuals with psychotic disorders, particularly schizophrenia.

II. MATERIALS AND METHODS

A. Exposure scenario

The simulation scenario used in the study was created by a group of psychology students and subsequently validated by



Fig. 1. CAVE environment in Gdańsk University of Technology.

a Ph.D. in psychology. The scenario unfolds in the home of an individual suffering from schizophrenia, depicting a typical "day in the life." Participants are tasked with performing daily household activities such as

- doing laundry
- arranging cosmetics on the shelf
- putting groceries into the fridge
- listening to the radio news
- drawing the curtains
- contact with friends listening to messages from an automated secretary
- following the designated tasks written on the list

During the activities, the participant experiences symptoms of psychotic disorders such as

- washing machine sounds to signal the end of the wash they appear irregularly causing confusion
- sounds of knocking at the door, banging, shouting behind the door, knocking on windows - auditory hallucinations suggesting the presence of a burglar, arouse fear and anxiety
- whispers when listening to others blame the participant for events beyond their control
- hallucinatory facial expressions utterances that make no sense and are unrelated to the situation cause confusion in the participant

The scenario focuses on auditory hallucinations and presents them in an escalating manner to emphasize the difference between a state of remission and actual episodes. This design also aims to make it challenging for the person in the simulation to predict upcoming sounds. Visual hallucinations are less prevalent in the scenario.

B. Development

The simulation was fully implemented in the Unity game engine, version 2022.3.16f1. The models used were created using Blender 3.3. To ensure the best possible graphics, highresolution textures and Physically Based Rendering (PBR)



Fig. 2. Fragment of a simulation scene.

materials were applied whenever possible. Voices serving as the narrator were recorded for the simulation.

The intended application is designed for the CAVE environment at the Gdansk University of Technology Immersive 3D Visualization Laboratory (I3DVL). Achieving a highly realistic simulation for such an environment requires a substantial amount of work. Therefore, an initial prototype of the application has been developed for desktop computers in the first instance.



Fig. 3. Another fragment of a simulation scene.

C. Functionality tests

Test version of the application was presented to several individuals not involved in the study to assess the overall level of immersion and realism of presented symptoms of psychotic disorders. The results were collected through interviews and did not meet the anticipated expectations. Users indicated:

- Narrative errors at times, it was challenging to distinguish whether a particular line was a hint for a task or represented auditory hallucinations.
- Low quality of the narrator's voice the provided recordings were of insufficient quality, and the tone of the voice was not well-suited for the simulation environment.
- Physics engine errors many user actions in the simulation involve interacting with objects, and collision errors occurred, such as objects penetrating each other on the scene, leading to user distraction or hindering task continuation.

Despite noticeable errors, users were able to identify some of the simulated symptoms of psychotic disorders. Their knowledge on the subject deepened, and they expressed a willingness to further enhance their understanding of individuals suffering from schizophrenia and the disorder itself.

A decision has been made to continue working on improving the quality of the simulation before delivering the final version to the CAVE environment.

III. RESULTS AND DISCUSSION

Due to the study's progress, the analysis of results was only possible based on the preliminary simulation test outcomes.

The participants had difficulty identifying all the symptoms present in the simulation. Due to the insufficient quality of the application, some of the simulated symptoms were mistakenly classified as occurring errors. This could negatively impact the level of immersion and, consequently, the level of engagement of individuals in the simulation, which is essential for effectively building an empathetic attitude.

Among the participants, there was noted an increased knowledge about the symptoms present in individuals with psychotic disorders, along with a desire to further deepen this understanding.

The conducted simulation represents a promising technique for cultivating empathetic attitudes towards individuals with schizophrenia. However, to conduct a comprehensive study, it is imperative to refine and enhance the overall quality of the simulation.

IV. CONCLUSION

The research clearly indicates that virtual reality can serve as a valuable educational tool. Through simulations conducted within them, it is possible to effectively cultivate empathetic attitudes, which are crucial for interpersonal relationships and, as demonstrated in previous studies, are associated with an increase in positive attitudes and, consequently, prosocial behaviors. This technique represents a promising form of social awareness and counteraction to the stigma faced by individuals with schizophrenia. However, for broader application, it requires a well-constructed and refined simulation allowing for a high level of immersion, as well as further research on the effectiveness of this method.

In the context of the presented project, this implies continued efforts to improve the implemented simulation, enhance the interactivity of the virtual environment, and overall elevate its quality.

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