

Virtual Reality Therapist Game for Mental Health Rehabilitation

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Abstract—VR-Therapist-Virtual-Mental-Health-Experience (VR-TVMHE) represents a groundbreaking approach to mental health rehabilitation, integrating Virtual Reality (VR) technology with the capabilities of Large Language Models (LLMs) to simulate therapeutic interactions. Against the backdrop of a global mental health crisis, characterized by limited access to traditional mental health services, innovative solutions are imperative to address the escalating demand for care. The VR-TVMHE leverages AI-driven chatbots to provide personalized and accessible support, simulating traditional psychotherapy sessions, thus filling the gap between those in need and efficient mental health services. Code available on GitHub

Rehabilitation — Large Language Models, Unity, Virtual Reality

I. INTRODUCTION

In recent decades, mental health has increasingly gained recognition as an integral component of overall well-being, profoundly influencing various aspects of daily life, including cognition, emotion regulation, interpersonal relationships, and decision-making processes. The World Health Organization (WHO) has identified mental health as a key contributor to the global burden of disease, underscoring the critical importance of maintaining mental wellness. Despite this acknowledgment, traditional mental health services often face significant challenges, including underfunding, limited accessibility, stigma, and disparities in care provision, leaving many individuals without adequate support.

The advent of modern technologies has heralded a new era in mental health care, offering promising ways to address the gaps and challenges within the field. From the digitalization of health records to the development of innovative interventions, technology has revolutionized how healthcare is delivered and accessed. Notably, the integration of Artificial Intelligence (AI) and Virtual Reality (VR) has begun to shift ways of diagnosing and treating various health conditions, including mental health disorders.

Artificial Intelligence (AI) has brought about significant advancements in mental health care, introducing technologies that allow machines to perceive, comprehend, act, and learn. These innovations include diagnostic algorithms, therapeutic bots, and chatbots, all of which offer novel solutions for addressing mental health challenges. Furthermore, chatbots driven by AI have become accessible and cost-effective resources for mental health support, providing users with personalized interventions and real-time assistance, ultimately improving engagement and treatment adherence. In parallel, Virtual Reality (VR) technology has emerged as a powerful tool for immersive therapeutic experiences.

This paper introduces a novel approach to mental health rehabilitation called the VR-Therapist-Virtual-Mental-Health-Experience. This research simulates therapeutic interactions between patients and virtual therapists by utilizing the power of Large Language Models (LLMs) and Virtual Reality (VR) technology.

II. LITERATURE REVIEW

A. Virtual Reality in Mental Health

Virtual reality (VR) stands as a transformative tool in the aspect of mental health care, offering unparalleled potential to aid individuals in overcoming the challenges posed by various psychological disorders. Central to many mental health issues are difficulties interacting with the world—be it the crippling anxiety experienced near spiders in arachnophobia, the haunting flashbacks triggered by reminders of past trauma in post-traumatic stress disorder (PTSD), or the constant fear of attack in persecutory delusions. Recovery from such conditions often hinges on reshaping thoughts, reactions, and behaviors in these triggering situations. VR therapy emerges as a promising avenue for achieving such transformative change, allowing individuals to immerse themselves in simulated environments and receive guidance in navigating these challenging scenarios based on the best theoretical understanding of their specific disorder. The effectiveness of VR interventions lies in their ability to replicate real-world situations with remarkable fidelity, allowing for graded exposure and repeated experiences until the desired learning outcomes are achieved. Unlike traditional therapeutic approaches, VR affords the unique advantage of accessing problematic scenarios at the touch of a button, eliminating the logistical challenges associated with finding and creating such environments in the real world. Crucially, despite the awareness of being in a computer-generated environment, individuals' minds and bodies respond as if the experiences were genuine, facilitating greater acceptance and experimentation with new therapeutic strategies. This process of experiential learning in VR can then seamlessly transfer to real-world settings, empowering individuals to confront and navigate challenging situations with newfound confidence and resilience. Beyond its applications in exposure therapy, VR holds immense promise across a spectrum of mental health care functions. Originally conceived to aid in symptom assessment, identification of markers or correlates, and prediction of disorders, VR technology has evolved to offer insights into the causal factors underlying mental health conditions. By pinpointing environmental characteristics that may contribute to adverse psychological reactions, VR has

the potential to deepen our understanding of disorder etiology and individual differences. Moreover, VR-based assessments could revolutionize traditional diagnostic practices by offering real-time evaluations that mitigate the subjectivity and fallibility inherent in retrospective recall methods. The bulk of evidence supports the effectiveness of VR exposure therapy in anxiety disorders and PTSD. Studies have demonstrated the utility of VR in facilitating exposure-based interventions, leading to symptom reduction and improved outcomes for individuals with these conditions. However, limited evidence exists for the efficacy of VR therapy in generalized anxiety disorder and obsessive-compulsive disorder [1]. VR-based interventions have shown promise in addiction and eating disorders, with cue exposure therapy yielding positive results. Additionally, studies exploring the use of VR therapy in psychosis, autism spectrum disorder, and attention deficit hyperactivity disorder (ADHD) have shown encouraging outcomes [1].

B. AI in Mental Health

In recent years, advancements in artificial intelligence, particularly in the form of large language models (LLMs) like OpenAI's GPT-3 and -4 and Google's PaLM, have opened up new possibilities to transform mental healthcare delivery. These LLMs possess a diverse range of capabilities, from generating text to diagnosing illnesses, holding promise to enhance psychotherapy practices and address the limitations of traditional mental health systems.

While older forms of AI, such as natural language processing (NLP), have been utilized in behavioral healthcare for decades, the integration of LLMs into patient-facing applications is relatively new. Existing mental health chatbots, like Woebot and Tessa, primarily rely on rule-based systems and struggle to handle unanticipated user responses effectively. However, LLMs offer the potential to bridge these gaps by generating context-dependent responses and providing real-time feedback on therapy worksheets and homework assignments.

Several patient-facing applications incorporating LLMs have been explored, including research-based dialogue generation for therapeutic counseling and industry-based mental health chatbots like Youper. These applications signify a shift towards more autonomous clinical care, where patients engage with chatbots for psychotherapy sessions or receive real-time support between sessions.

In the context of our project for rehabilitation engineering, which focuses on developing exposure therapy for mental health disorders using virtual reality and LLMs, these findings highlight the potential synergies between advanced AI technologies and immersive therapeutic interventions. By integrating LLMs into virtual reality-based exposure therapy, we aim to enhance treatment effectiveness, improve accessibility, and bridge the gap between therapy sessions. Our approach aligns with emerging trends towards fully autonomous clinical care, where standardized assessment approaches and evidence-based therapy protocols can be

leveraged to deliver personalized and scalable mental healthcare solutions.

III. METHODS

In this section, we delineate the methodology employed in the development of the Virtual Reality (VR) Therapist, an AI-guided VR experience for interactive and immersive therapy. The methodology encompasses the conceptualization, design, and technical implementation of the system to address the identified needs for accessible and cost-effective mental health support.

A. Conceptualization and Motivation

The project was conceived in response to the challenges faced by individuals seeking mental health support, particularly during times when traditional therapist availability is limited. The motivation stems from the necessity to provide a solution for patients who may struggle with accessing therapy due to factors such as cost, scheduling conflicts, or social discomfort. The Virtual Reality (VR) Therapist aims to offer a supportive environment that complements traditional therapy by providing an immersive and interactive experience.

B. Design Principles

To ensure an effective therapeutic experience, the design principles of place illusion and plausibility illusion were employed. Place illusion is achieved through the creation of a virtual therapist clinic room within the VR environment, fostering a sense of presence and immersion for the patient. Plausibility illusion is facilitated by integrating interactive elements such as the therapist's head movements synchronized with the patient's position, lip-syncing during the conversation, and blinking eyes to enhance the realism of the interaction.

C. Technology Stack

The technical implementation of the VR Therapist leverages cutting-edge technologies to realize its functionality. The system is powered by GPT3.5 Turbo, a state-of-the-art large language model renowned for its natural language understanding and generation capabilities. Additionally, the system utilizes the POE Free API to interface with the GPT3.5 Turbo Engine, enabling seamless integration of AI-driven conversational features.

D. Implementation Workflow

The implementation workflow begins with the patient donning the VR headset and initiating a therapy session. Within the virtual environment, the patient assumes a reclined position on a chaise longue while the virtual therapist occupies a chair. As the patient interacts within the VR environment, the therapist's responses are dynamically generated based on the conversation flow.

Upon selecting the option to record the conversation, the patient's voice input is captured using the VR controller. The recorded audio is then processed by a C# script in Unity, which sends a post request to a Python server implemented

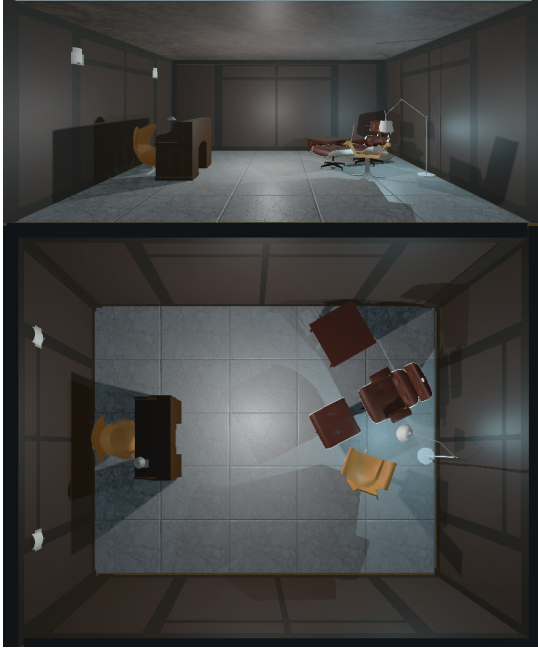


Fig. 1: Side and Top view of the environment



Fig. 2: 3D view of the environment

using Flask. The Python server utilizes Google Speech to Text to convert the audio into text format.

Subsequently, utilizing prompt engineering, the text input is passed to the GPT3.5 Turbo Engine via the POE API to generate a response from the virtual therapist. Post-processing techniques are applied to refine the generated text, followed by utilizing AWS Polly to synthesize the response into voice format. The synthesized voice response is then played within the VR environment, synchronized with the virtual therapist's lip movements.

Finally, the conversation data is saved to prevent redundancy and facilitate continuity in subsequent sessions,

ensuring a cohesive and personalized therapeutic experience for the patient.

This comprehensive methodology encompasses the conceptualization, design, and technical implementation of the VR Therapist, thereby offering a novel approach to accessible and immersive mental health support.

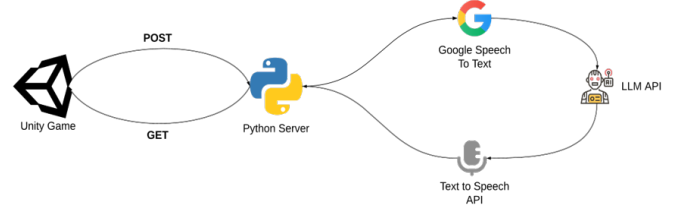


Fig. 3: System Diagram



Fig. 4: Plausibility: Patient Tracking



Fig. 5: Plausibility: Therapist Lip Sync

IV. RESULTS

V. EXPERIMENTS

We conducted a series of controlled trials to evaluate the responsiveness of various Large Language Models (LLMs) to messages indicative of anxiety, depression, or other mental health concerns. These trials simulated user interactions, where messages conveyed symptoms or feelings commonly associated with these conditions.

The methodology involved:

- **Series of Controlled Trials:** Establishing a structured framework to consistently assess LLM behavior.
- **Evaluating Responsiveness:** Measuring how effectively LLMs detect and respond to messages expressing mental health symptoms.

- **Simulating User Interactions:** Designing prompts that mimic real-world user experiences, making the interactions appear authentic and relatable.
- **Expressing Symptoms or Feelings:** Focusing on messages that clearly articulate mental health issues, ensuring relevance to the context of virtual therapy.

VI. RESULTS

The experiments yielded notable responses from different LLMs. Here are examples of interactions and responses:

Message: “I feel like I don’t exist and my body is not my own, like if I’m somebody else observing me, what could be this disorder?”

Response from GPT-3.5 (using Poe API):

“Now, I’d like to understand more about your experience. When did these feelings start? Have you noticed any triggers or patterns associated with them? It sounds like you’re experiencing a sense of detachment from yourself as if you’re disconnected from your own body and identity. This can be distressing and confusing. While I can’t provide a diagnosis without a proper evaluation, what you’re describing might be related to a condition called depersonalization-derealization disorder. It’s characterized by feelings of unreality or detachment from oneself or the surroundings. However, it’s important to remember that only a qualified mental health professional can accurately diagnose any disorder.”

Response from LLaMA-3-8B-Chat-Psychotherapist (using Hugging Face):

“You’re describing a phenomenon called depersonalization. It’s a common symptom of anxiety disorders, post-traumatic stress disorder (PTSD), and other mental health conditions. Depersonalization can make you feel like you’re observing yourself from the outside, like you’re watching a movie or reading a book about yourself. You might also feel like you’re not in control of your body or that you’re just a puppet. This feeling can be very distressing and can make you wonder if you’re even alive. It’s a very disorienting and unsettling experience. If you’re experiencing depersonalization, it’s important to seek help from a mental health professional. They can help you identify the underlying causes of your feelings and develop coping strategies to manage them.”

VII. DISCUSSION

The trials effectively simulated user interactions involving messages that expressed symptoms of anxiety, depression, and other mental health conditions. The results demonstrate the capability of LLMs, such as GPT-3.5 and LLaMA-3-8B-Chat-Psychotherapist, to identify potential mental health issues from user messages. The LLM responses not only

exhibited empathy but also provided informative explanations regarding the user’s potential condition, underscoring the importance of seeking professional help.

VIII. CONCLUSION AND FUTURE WORK

A. Conclusion

The Virtual Reality (VR) Therapist Game presents a novel approach to mental health support. Users engage with a virtual therapist through a VR headset, where the therapist, powered by LLMs trained on psychological data, listens and provides guidance. While VR therapy may not suit everyone, it offers a convenient and accessible alternative, particularly for those who find traditional therapy intimidating.

Our findings validate this approach from multiple perspectives:

- **VR Perspective:** As highlighted in the literature review, VR therapy shows promise in treating social anxiety disorder and demonstrates results comparable to traditional exposure therapy.
- **AI Perspective:** Advancements in AI, from early chatbots like ELIZA to modern LLMs, highlight the potential of AI-powered therapy. These LLMs can understand complex language and personalize interventions, making them a valuable tool in mental health treatment.

Together, VR and AI technologies open exciting possibilities for expanding access to effective mental health treatments.

B. Future Work

Future work will focus on enhancing the functionality, effectiveness, and user experience of the Virtual Reality Therapist Game. Key areas of development include:

- **Fine-Tuning Large Language Models (LLMs) for Deployment:**
 - **Objective:** Refine LLMs to optimize their performance for virtual therapy applications.
 - **Approach:** Implement advanced fine-tuning techniques tailored to therapeutic contexts, ensuring the generation of accurate and contextually appropriate responses in real-time scenarios.
- **Integration of Retrieval-Augmented Generation (RAG):**
 - **Objective:** Enhance the relevance and specificity of responses by incorporating real-time information retrieval mechanisms.
 - **Approach:** Combine LLMs with retrieval systems to dynamically access and integrate up-to-date and pertinent information during therapy sessions, thereby increasing the depth and accuracy of the interactions.
- **Expansion of Therapy Modules:**
 - **Objective:** Broaden the therapeutic capabilities by introducing diverse psychological treatment approaches.
 - **Approach:** Develop and integrate additional modules covering various therapeutic methodologies,

allowing for a more comprehensive and adaptable virtual therapy experience.

- **Creation of Diverse Virtual Environments:**

- **Objective:** Enhance the therapy experience through varied and immersive virtual settings tailored to individual therapeutic needs.
- **Approach:** Design and implement a range of customizable virtual environments to facilitate different therapeutic modalities and user preferences, thereby improving engagement and effectiveness.

- **Customization of Virtual Therapist Design:**

- **Objective:** Personalize the virtual therapist to better match user preferences and increase comfort and engagement.
- **Approach:** Develop features allowing users to customize the therapist's appearance, voice, and mannerisms, creating a more relatable and personalized therapeutic interaction.

- **Patient History Management and Analysis:**

- **Objective:** Facilitate personalized therapy by maintaining and analyzing user interaction data.
- **Approach:** Implement secure systems for recording, storing, and analyzing patient history and interactions, enabling continuous adaptation and improvement of therapeutic interventions based on individual user profiles and progress.

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