XR Cognitive Training for Early Dementia & Alzheimer's
Games, Simulated Activities, and Holographic Telepresence

Christina Chrysanthopoulou
School of Film, Aristotle University of Thessaloniki, Thessaloniki, Greece
chryschris@film.auth.gr

Olga Chatzifoti
Department of Informatics & Telecommunications, National and Kapodistrian University of Athens, Athens, Greece
olchatz@di.uoa.gr

Stamatis Poulimenos
Research and Development Maggioli Spa, Santarcangelo di Romagna, Italy
stamatis.poulimenos@maggioli.gr

Nikoletta Geronikola
Alzheimer Athens Association, Markou Mousourou, Athens, Greece,
ngeronikola@alzheimerathens.gr

Introduction

Eligence is a web-based platform which offers cognitive training games co-designed with psychologists to support individuals at risk of dementia or Alzheimer's across seven (7) cognitive areas.

Eligence XR is an experimental extension to the deployed platform focusing on physical aspects and spatial memory cognitive training.

ELICT combines Eligence XR with holographic telepresence – harnessing the offerings of the SPIRIT platfrorm.

(1) Eligence 2D game for cognitive exercise

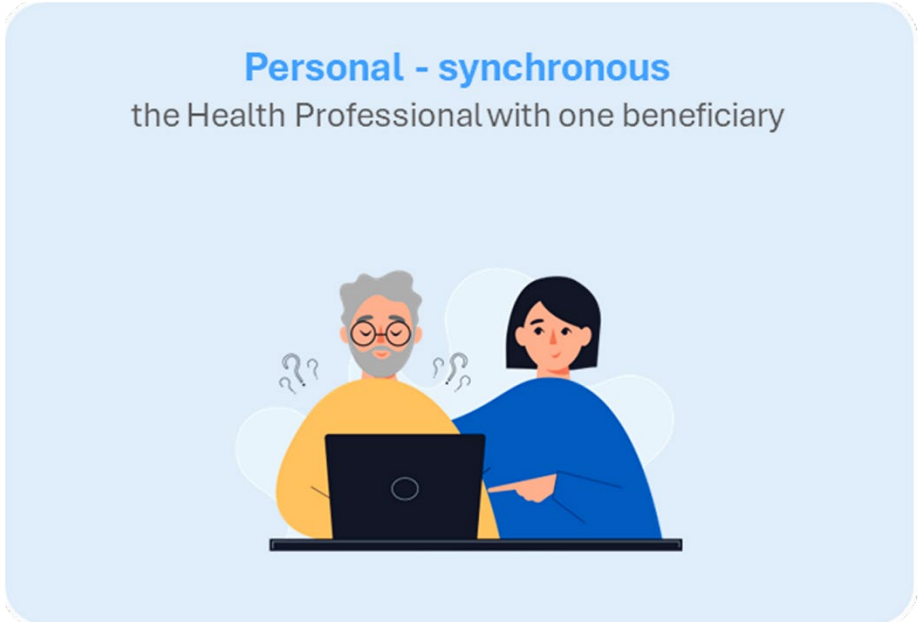
(2) Eligence XR counterpart of 2D game including body movement

Motivation

As standard practice, health professionals monitor beneficiaries through in-person sessions to review progress and provide direct support during game engagement with the 2D Eligence games. Extending to immersive environments brings the challenge of allowing proper monitoring and guidance without breaking immersion.

User(s) requirements

- HP should offer:
  - Guidance (pro-active action)
  - Assistance (reactive action)
  - Moral support
- HP should be able to monitor user performance
- HP should be able to remotely adjust training settings
- HP cannot be in immersion for practical and operational reasons.
- HP and beneficiary should maintain a personal relationship
- HP and beneficiary should have high-quality human-human communication, therefore paralinguistic communication traits, like gesturing and facial expressions, are important.



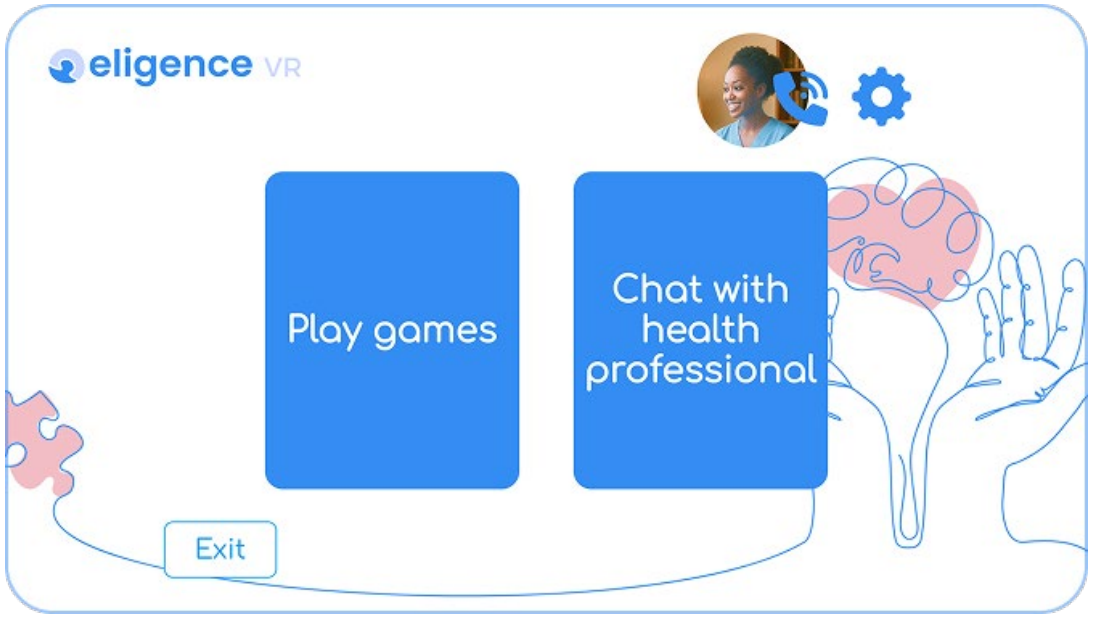
Design approach

To that end, this project investigates implementing:

1. Assisted XR cognitive training – where the health professionals have access and can change in real-time the settings of the games used in cognitive training sessions
2. Holographic telepresence of the health professional within the immersive environment - provided by the **SPIRIT research project**.

For evaluation, will support two immersive environments: 1) a dedicated space for remote sessions between beneficiary and HP for consultation purposes, and 2) selected cognitive games with HP co-presence for monitoring and guidance purposes.

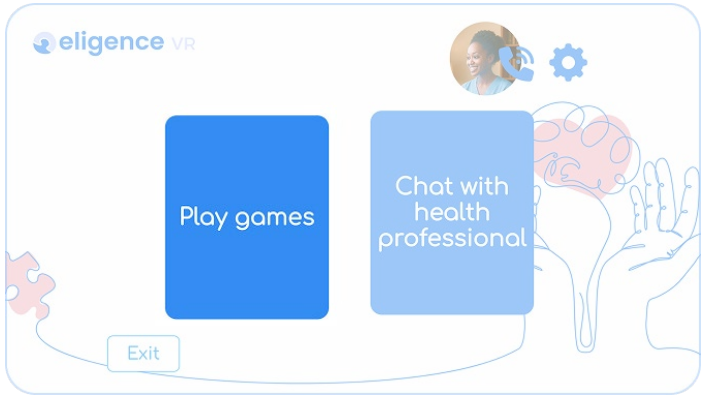
(1) Assisted cognitive training



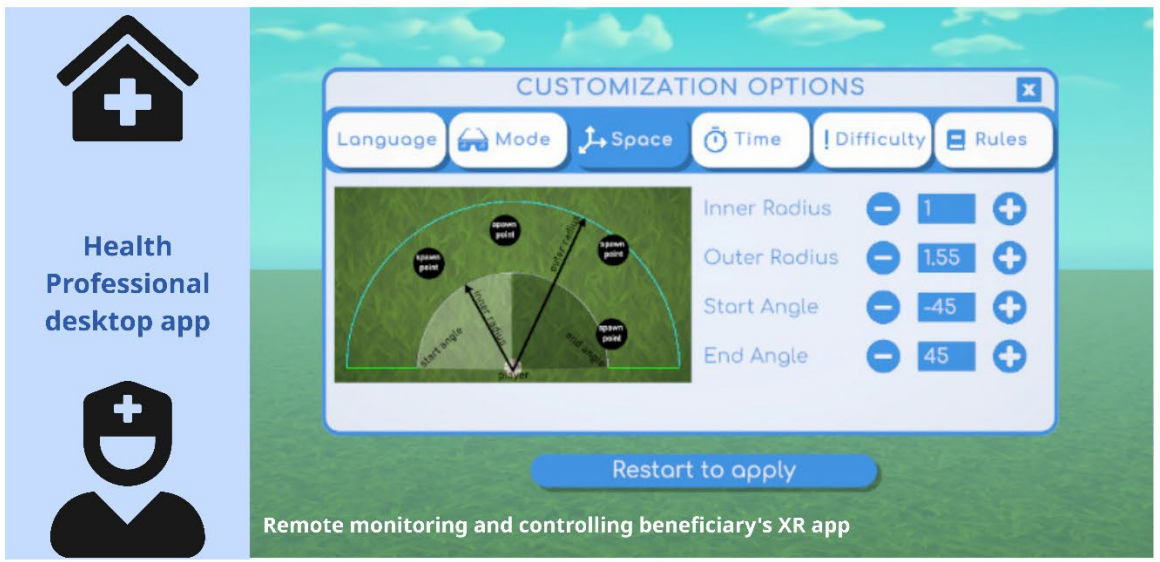
(2) Remote sessions with HP

Assisted cognitive XR training

Health professionals have access to all the game settings, to tackle in real-time any issue that might create difficulties for the beneficiaries, such as standing or sitting mode, speed, complexity of the assignment etc.
In some cases, it is useful to implement the exact opposite changes, challenging the more adept players by raising the difficulty.



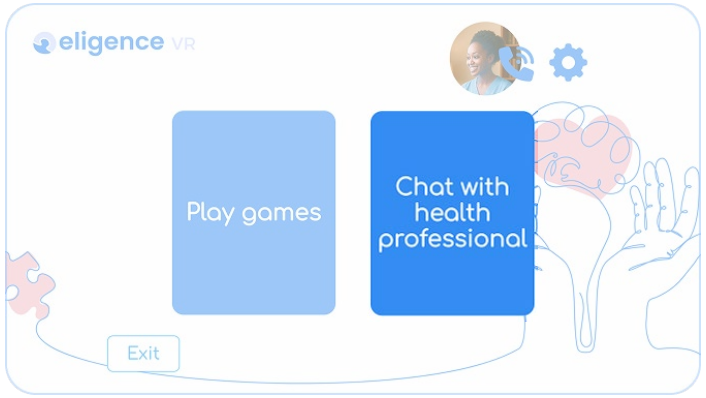
Component #1



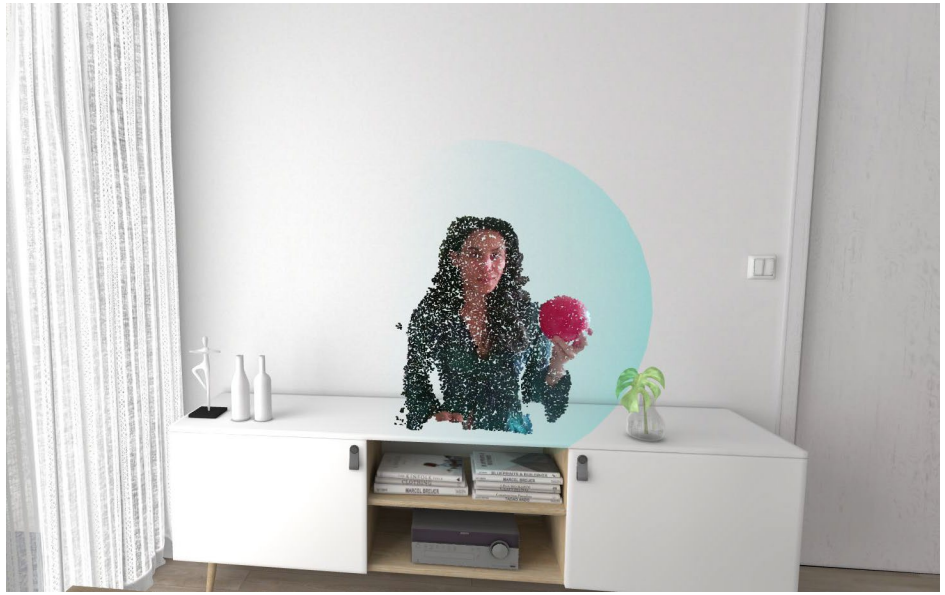
Component #2

Holographic telepresence

The SPIRIT platform, which powers our holographic system, enables real-time streaming of the HP's volumetric representation into the virtual space. This creates a co-present experience that includes voice, facial expressions, and gestures, aiming to enhance the user's sense of safety, and attentiveness, while offering guidance,
assistance, and moral support.



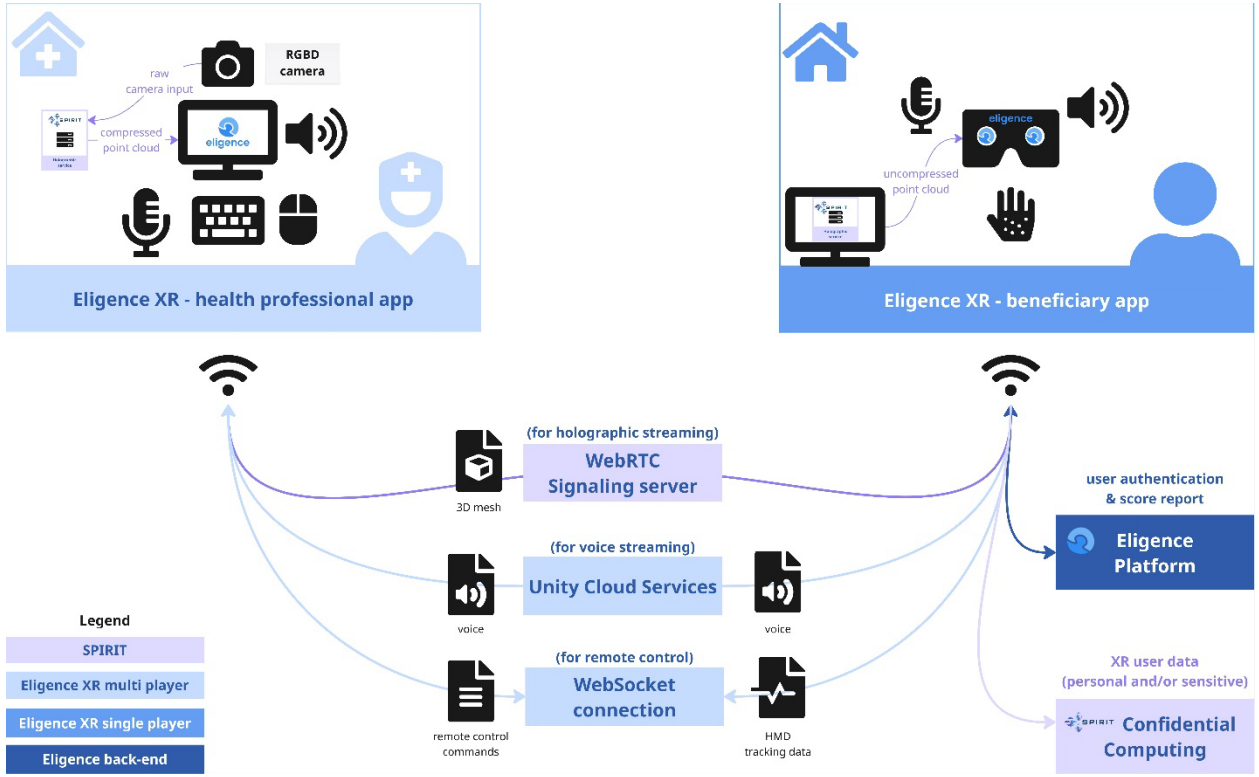
(1) ELICT's consultation environment with a placeholder avatar



(1) ELICT's consultation environment with holographic streaming

Technical implementation

To technically implement this experiment, a custom software solution has been developed. The base software system is comprised of a monitor-based application for the HP and an immersive application for the beneficiary. SPIRIT's holographic streaming module is integrated in the system, as shown in the high-level architectural diagram below:



High-level system architecture

Experiment protocol

A user study will be conducted in collaboration with the Alzheimer's Athens Association to determine whether the holographic telepresence is helpful to the beneficiaries and facilitates the XR gaming sessions, and whether the XR games are welcomed by the beneficiaries, or even preferred compared to the 2D.
Research questions will include:

- How much did the health professional's presence in the game help you?
- Which of the following statements best describes the presence of the professional as a hologram in the game:
  - I felt confident that I wasn't alone and that I understood the exercise well.
  - I felt safe that someone was constantly with me and helping when needed.
  - The hologram's presence confused me more than helped.
  - None of the above (please describe your own experience in free text)
- What is the perceived enjoyment and usability of the XR games?
- Do physical movement and spatial engagement enhance cognitive stimulation?
- Which modality—2D or VR—is preferred, and why?

Test group
(30+ participants)

- holographic telepresence
- XR game

Participants will be asked to complete questionnaires, one of which is based on the System Usability Scale (SUS), whereas the others are covering technical performance, motion tracking fidelity, visual comfort, ease of navigation, and perceived mental effort. Open-ended responses further capture engagement, sense of presence, and willingness to continue training with immersive tools. Preliminary findings show encouraging responses around motivation and perceived realism, though technical limitations such as motion sickness and controller precision remain areas of active refinement.

Thank you!