

Connecting the Elderly Using VR

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An innovative approach for creating a social virtual reality (VR) platform that seamlessly blends art, technology, artificial intelligence (AI), and VR. Developed as part of a European project, the methodology is designed to safeguard and improve neurological, cognitive, and emotional functions, with a particular emphasis on promoting mental health.

Keywords: AI ; art ; VR ; architecture

1. Introduction

Challenges posed by demographics are an important point of debate for our future. According to the 2020 report of the United Nations “World Population Ageing” ^[1], the number of persons over 65 in 2020 was estimated to be around 727 million worldwide. This number is predicted to double by 2050, reaching over 1.5 billion. The percentage of older people in the global population is expected to increase from 9.3% in 2020 to 16.0% in 2050, revealing that by mid-century, one in six people globally will be over 65 years old. Moreover, the number of persons over 80 years is probable to increase, rising from 137 million to 425 million on a global scale (reference period: 2017–2050). Among other consequences, as individuals will generally wish to stay in their homes for as long as possible, as they grow older and older, meaning that the home becomes a place where older people spend most of their time, their social activity will be undoubtedly affected. Consequently, the necessity to increase the social capital—the value that social networks and the types of reciprocity associated with them have—for the elderly becomes crucial ^[2]. A plethora of studies investigate the psychological impact of social isolation, stating that the anxiety levels of elderly people increase due to the lack of social interaction. As a result, they become lonely, bored, exhausted, and distressed, which increases their depression levels ^{[3][4]}. VR stands out as an emerging technology capable of instilling a sense of presence in a virtual environment, achieved through responsive visual and auditory cues that adapt to user actions, overcoming limitations of time and space ^[5]. Its versatile applications extend to various domains, including sports activities, simulations, and surgical techniques ^[6]. Notably, VR has found utility in rehabilitation efforts for individuals with diverse health conditions, such as post-stroke rehabilitation ^{[7][8]} and addressing cerebral palsy ^[9]. The application of VR in health contexts has garnered increased attention due to the time, space, and financial constraints associated with traditional rehabilitation methods conducted in healthcare facilities, often requiring the involvement of healthcare professionals ^[10]. For example, VR applications and headsets are being integrated into care homes to aid older individuals, particularly those dealing with Alzheimer's, aiming to enhance overall mental health and evoke recollections ^{[11][12][13]}.

Art offers the capability to imagine futures that do not just reflect the current consensus in mathematics, logic, and engineering but also set into motion new ways of seeing, hearing, touching, feeling, transforming, and experiencing spaces, places, and community. Regarding older people, more importantly, we needed to consider the overall symbolic experience by associating historical facts and memory recoveries to the experience, in order for them to be more emotionally connected due to the harmonization of their values and identity. For instance, the objects that are present in their homes may be more valuable to them because of the cultural, life events, and family memories they are associated with. This was taken into account in the design process of the private spaces provided in our virtual village.

Another important point in creating experiences through art and technology is by generating well-being for older people with strategies of “Interactive Art”—since in the co-creation procedures, the users are themselves actors who perform and create, beginning with a blank canvas, along with artists, architects, and software engineers—to stimulate their curiosity and self-expression and support their identity ^{[14][15][16][17]}. From the recent past, the *Tunnel under the Atlantic* ^[18] was an art installation that was completed in 1995. The tele-virtual project linked the Pompidou Centre in Paris and the Museum of Contemporary Art in Montreal. This project was more than just a technical performance; it was an intercontinental virtual reality artwork, referred to as “tele-virtuality” by Philippe Quéau in 1994. This installation was a unique example of what Maurice Benayoun calls “reactive architecture of communication”, and it was another way to explore the limits of communication after *Hole in Space* by Kit Galloway and Sherrie Rabinowitz ^[19]. In addition, over the last thirty years, numerous works of art have showcased the potential of VR as an expressive medium. Opting for VR as a form of artistic creation not only offers boundless creativity but also expands the scope of artistic interaction ^[20].

In general, there has been ample attention paid to the interaction of cognitive and emotional aspects of engaging with arts. During the last several decades, many studies have shown that experiencing and making art have many positive

effects on individual well-being ^[21]. As art addresses the quest of purpose and meaning, experiencing art may forge social bonds. The positive effects of art experiences are produced by various mechanisms, such as being “carried away” by the art or being prompted to question worldviews and values ^[21]. Many studies point to positive neurological and physiological changes, such as lower levels of cortisol, a stress hormone, or galvanic skin response ^[22]. In addition, psychological competencies may improve, such as increased creativity or adaptation to circumstances ^{[23][24]} while other studies point out an increased self-reported (subjective) well-being.

Additionally, there are a plethora of studies that advocate how active engagement and physical involvement in a virtual environment (VE) contribute to improved long-term memory abilities, aligning with the enactment effect observed in various memory studies ^[25]. More specifically, the enactment effect suggests that individuals who physically engage in an action are more likely to remember the corresponding event compared to those who merely listen to verbal descriptions or observe someone else performing the task ^[26]. This phenomenon extends to various scenarios, such as actively rotating objects versus passively observing their rotation, resulting in a faster recognition speed ^[27]. Additionally, studies indicate that virtually manipulating body parts, as opposed to observing another individual performing the manipulation, enhances anatomical memory, especially benefiting individuals with lower spatial abilities at baseline ^[28].

When talking about the elderly, actively encoding information during virtual navigation ^[29] or engaging in physical activities like walking ^[30] and actively controlling VR navigation by deciding the itinerary ^{[31][32]} have been found to enhance distinctive memory traces, boost source memory, and improve episodic memory. Participating in such exercises that simulate daily life activities has been associated with improvements in visual memory, attention, and cognitive flexibility among older adults ^[33]. Additionally, even seemingly simple but enjoyable tasks have been linked to increased hippocampal gray volume in both older and younger adults ^{[34][35]}.

2. Connecting the Elderly Using VR

A variety of VR experiences designed for the elderly have been explored in the literature. For instance, in ^[36], the authors assessed the effectiveness of 360° immersive VR interventions on the well-being of older adults with and without cognitive impairment. The review of 10 articles found that VR 360° video interventions were feasible, safe, and enjoyable for older adults in community or residential care settings.

In another study ^[37], researchers explored the use of head-mounted display (HMD) VR with individuals suffering from dementia. The evaluation involved interviews and reports, revealing that users were excited about the application and experienced increased pleasure during and after VR sessions compared to before exposure. Matsangidou et al. ^[38] proposed an experimental design to investigate the feasibility of using VR for rehabilitating patients with moderate to severe dementia. The authors reported the challenges faced during the design, development, and implementation of the experiment. Furthermore, in ^[39], authors presented a VR-based approach to address social isolation among elderly users.

Regarding VR technology acceptance among older adults, a study ^[40] investigated the use of VR as a tool for active aging. Thirty older adults used selected VR applications twice a week for six weeks and completed a questionnaire assessing their acceptance of VR technology. The results indicated that perceived usefulness, perceived ease of use, social norms, and perceived enjoyment significantly influenced their intention to use VR. The study concluded that older adults had positive perceptions of VR, considering it useful, easy to use, and enjoyable for active aging. Another study ^[41] explored the use of VR in engaging older adults residing in care facilities. The study involved residents and staff members who evaluated a VR system for two weeks, utilizing interviews, research notes, and video recordings. The study revealed that interactive VR technology's usability was affected by the abilities of aged care residents, particularly those with dementia. Additionally, it identified that VR technology could engage older residents who might otherwise isolate themselves. Overall, the study emphasized the potential benefits of using VR in aged care while highlighting the need for design improvements to ensure effective utilization with older adults.

Furthermore, regarding the social aspect of VR, authors in ^[42] evaluated a novel social VR platform that connected older adults from different locations, enabling them to engage in virtual travel and activities together. The study suggested that VR social applications could facilitate social engagement among older adults.

On the commercial side, there is Rendeever ^[43], a VR application that allows elderly individuals to immerse themselves in and explore virtual worlds using customized VR hardware and 360-degree videos. The acceptance of Rendeever demonstrates the potential of VR for the elderly community, while also emphasizing the need to study and develop evaluation methodologies that best meet the needs of the elderly.

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