# THE APPLICATION OF VIRTUAL REALITY TO CEREBRAL PALSY

## HOW A VIRTUAL REALITY ARCHITECTURAL EXPERIENCE COULD IMPROVE THE WELL-BEING OF INDIVIDUALS LIVING WITH CEREBRAL PALSY

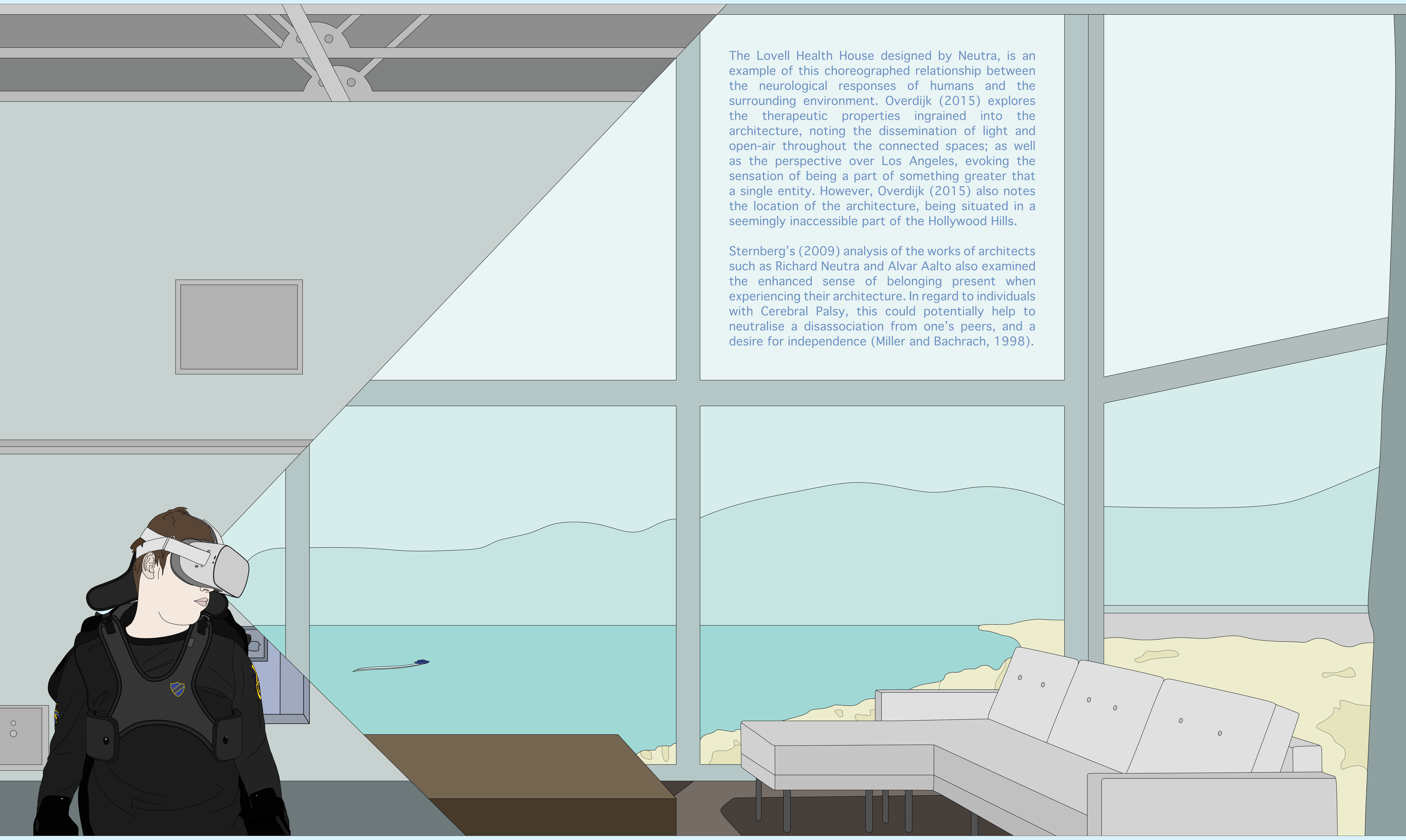
Cerebral Palsy is a group of conditions that demand individuals to overcome new and recurring challenges every day. This study explores the application of virtual reality to these individuals, investigating the properties that architecture offers and the subsequent improvement to the well-being and quality of life that can occur as a result of this.

Architecture's ability to invoke these well-being properties are explored throughout this dissertation, as Sternberg's (2009) analysis of the healing characteristics that exist within a space, and how one subsequently accesses them, is reviewed. This was achieved by examining how the brain and its sensory systems perceive the surrounding environment, investigating the thoughts of Pallasmaa (2012) in regard to the collaboration of senses when experiencing the works of architects such as Richard Neutra or Alvar Aalto. Exploration into the neurological processes that are undergone when experiencing such architecture is also discussed, with reference to Mallgrave's (2010) explanation of how one's brain validates an authentic architectural encounter.

Virtual reality has the potential to become the primary method of experiencing architecture remotely, combining the portability of photography with the immersion of reality. However, prior to discussing the benefits of enabling individuals with Cerebral Palsy (CP) to experience architecture through virtual reality, it is worth noting that this form of technology would not be suitable for all individuals. 35% of those with CP also have some form of epilepsy (Centers for Disease Control and Prevention, 2018), such as photosensitive epilepsy (PSE). The incorporation of visual stimuli such as flashing lights or interchanging patterns has the potential to trigger a seizure. Special care must therefore be taken when utilising virtual reality technology. Despite this, not all VR would necessarily be a trigger for those with PSE, and the continuing development of VR technology may still allow for a greater range of individuals to use it.

OXFORD BROOKES UNIVERSITY

SAMUEL BEASLEY - BA ARCHITECTURE



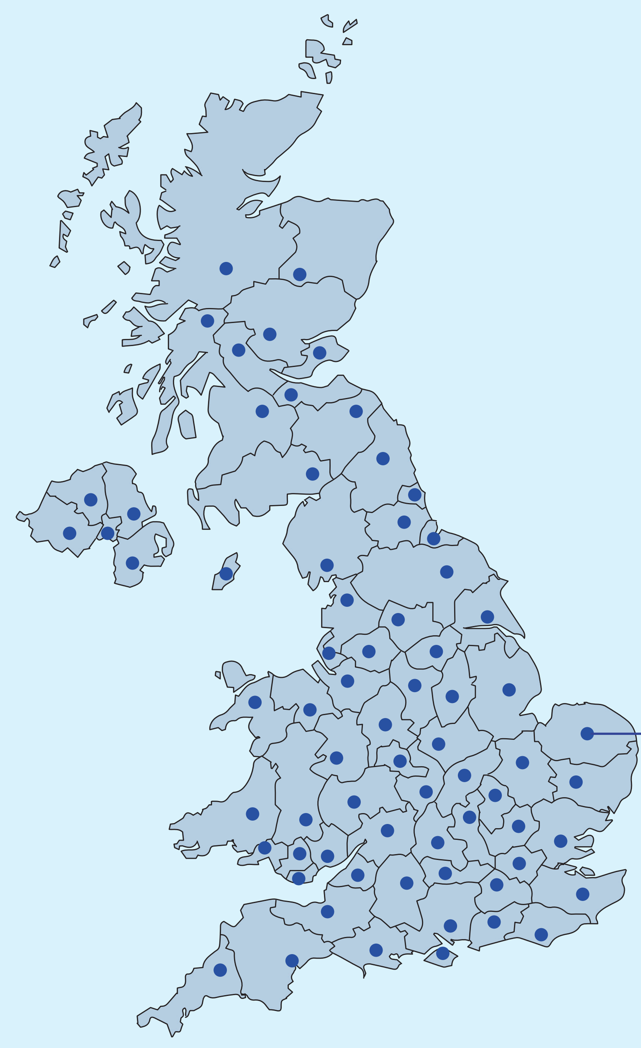
The Lovell Health House designed by Neutra, is an example of this choreographed relationship between the neurological responses of humans and the surrounding environment. Overdijk (2015) explores the therapeutic properties ingrained into the architecture, noting the dissemination of light and open-air throughout the connected spaces; as well as the perspective over Los Angeles, evoking the sensation of being a part of something greater that a single entity. However, Overdijk (2015) also notes the location of the architecture, being situated in a seemingly inaccessible part of the Hollywood Hills.

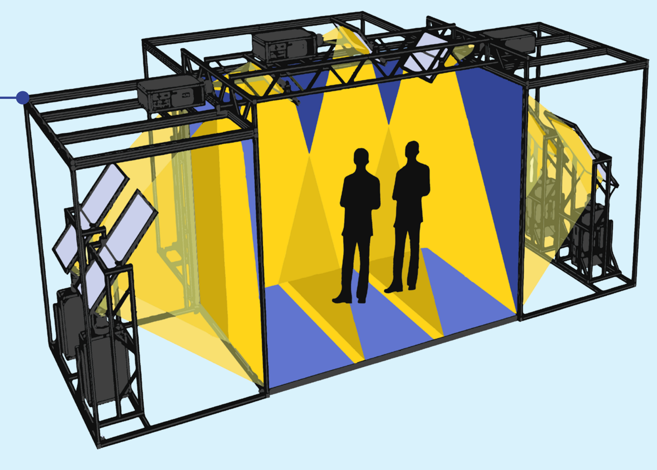
Sternberg's (2009) analysis of the works of architects such as Richard Neutra and Alvar Aalto also examined the enhanced sense of belonging present when experiencing their architecture. In regard to individuals with Cerebral Palsy, this could potentially help to neutralise a disassociation from one's peers, and a desire for independence (Miller and Bachrach, 1998).

In order to compare some existing VR architectural experiences, an individual who has Cerebral Palsy experienced two VR systems and scenarios with slightly contrasting interfaces, to then answer some questions regarding their preferences, criticisms and overall experience.

When interviewing the individual with CP about their opinion of each scene, it was noted that although the first experience immersed the viewer in a more architecturally interesting space, potentially due to the properties explored by Sternberg (2009) and the potential for free movement, the resulting view was that the space was more difficult to navigate. As was previously investigated through testing the Architecture VR (2019) application on Oculus' store, all experiences which enable free-roam capability, result in an encounter from which difficulties in progressing to various marked locations may arise, in this case the blue place-markers. The prolonged stabilisation of the head that is required to enable relocation to the desired spot is demanding for an individual who has complete control of their motor movement, therefore it is even more challenging, and nigh impossible for an individual who does not have such control. Subsequently, as hypothesised earlier, an experience which fuses the freedom and intriguing architecture offered by Matterport VR (2019), with the easier navigational properties exhibited in The Daily 360 (2019), then a more inclusive experience could be produced.

Further questioning of the individual's preferences, as well as any potential advancements, highlighted how the service proposed in this dissertation may be improved by the utilisation of a more intuitive navigation system within the experience, or the opportunity for multiple users to interact in the same environment. The former, was previously discussed when exploring the potential of the inclusion of Eyegaze technology, which serves the primary use amongst individuals with CP, of a supportive communication aid (Eyegaze, 2017). This technology relies on the tracking of retinal movements to select different options from a screen (Ruhland et al., 2015). The second of the suggested improvements, the incorporation of a multiple user option, is one of the most exclusive properties of the CAVE Automatic Virtual Environment, or CAVE (Cruz-Neira, Sandin and DeFanti, 1993). Overall, the individual who took part in this investigation, profoundly expressed their enjoyment of the experience; highlighting the ability to become fully immersed in a new location without the need of travel as impressive. A subsequent immediate improvement to their temperament was also noted during the experience; perhaps due to the architectural properties that affect the psychological state which are explored throughout this study.





After consulting with experts within the field of Neuroscience (Dr Sanjay Kumar) and Occupational Therapy (Mrs Sheena Hardwick) regarding the psychological and physiological impacts of such a service, as well as the aforementioned case study; the evaluation of the Google Cardboard, Oculus Go and VisCube™ C4-T3X (CAVE) deduced that the latter two provided the user with the required auditory immersion and hapticity stressed by Stinson and Bowman (2014).

Through further investigation of how such a service would be implemented, and reviewing the economic cost of each strategy, the optimal solution would be a mediation of the C4-T3X and the Go, as ones' benefits neutralise the others' drawbacks. However, with this technology currently being unavailable, it was summarised that a network of the CAVE systems may be deployed in each of the UK's counties, as this satisfied more of the requirements addressed by Mallgrave (2010), Blesser and Salter (2009) and Barbara and Perliss (2006).

References:

Architecture VR. (2019). Madrid: FFrenders.
Barbara, A. and Perliss, A. (2006). Invisible Architecture: Experiencing Places through the Sense of Smell. London: Thames and Hudson, p.13-15, 19-24.
Blesser, B. and Salter, L-R. (2009). Spaces speak, are you listening?. Cambridge: The MIT Press, pp.2-4, 6-7.
Centers for Disease Control and Prevention, (2018) Data and Statistics for Cerebral Palsy. [online] Available at: https://www.cdc.gov/ncbddd/cp/data.html [Accessed 14 Oct. 2018].
Cruz-Neira, C., Sandin, D. and DeFanti, T. (1993). Surround-screen projection-based virtual reality: the design and implementation of the CAVE. In: Proceedings of the 20th annual conference on Computer graphics and interactive techniques. [online] New York: ACM, pp. 135-142. Available at: http://www8.cs.umu.se/kurser/TDBD13/VT00/extra/p135-cruz-neira.pdf [Accessed 02 Jan. 2019].
Eyegaze, (2017). Cerebral Palsy, [online] Available at: https://eyegaze.com/users/cerebral-palsy/ [Accessed 02 Jan. 2018].
Mallgrave, H. (2010). The Architect's Brain. Oxford: Wiley-Blackwell, pp. 98-108, 132-138, 159-165, 188-195.
Matterport VR. (2019). London: Matterport.
Miller, F. and Bachrach, S. (1998). Cerebral Palsy. London: Johns Hopkins University Press, pp. 4-5.
Overdijk, M. (2015). Richard Neutra's Therapeutic Architecture. [online] Failed Architecture. Available at: https://failedarchitecture.com/richard-neutras-therapeutic-architecture/ [Accessed 03 Jan. 2019].
Pallasmaa, J. (2012). The eyes of the skin: architecture and the senses. Chichester: Wiley, pp. 10-14, 28-33, 44-49, 77-78.
Sherman, B. and Judkins, P. (1992). Glimpses of Heaven, Visions of Hell: Virtual Reality and its implications. London: Hodder and Stoughton, pp. 6-10.
Sternberg, E. (2009). Healing Spaces: The Science of Place and Well-being. Cambridge: Belknap Press of Harvard University Press, pp. 1-2, 4-13, 22-25, 174-186, 192-193, 215-221.
Stinson, C. and Bowman, D. (2014). Feasibility of Training Athletes for High-Pressure Situations Using Virtual Reality. IEEE Transactions on Visualization and Computer Graphics, [online] Volume 20(4), pp. 606-615. Available at: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6777452 [Accessed 02 Dec. 2019].
The Daily 360. (2019). New York: The New York Times Company.