Research Topic:

To investigate how virtual reality can influence motor responses via deception of the sensory nervous system and aid navigation around a virtual plane.

Introduction:

Virtual reality is a new-wave medium, which at present provides visual experiences via optical immersion. For the future, it has a copious range of potential applications within i.e. the education, gaming and medical industries. Through analysis of participant estimation both within a real and virtual environment, I intend to discover how virtual reality can influence motor responses via deception of the sensory nervous system and aid navigation around a virtual plane.

Evidently monetary barriers to virtual reality depreciate as cost of its hardware decreases, this suggests an increase in potential consumers. Yet, the emancipatory confounds of VR restrict exploration and varied motion, which in turn breaks the illusion of walking around a real domain. This problem has been addressed with add-on hardware such as the Virtuix Omni. However two key obstacles face a 3rd party hardware solution (such as the Omni). Metaphorically its integration with developed software and literally its potential size.

Aim:

To investigate the extent to which a users perception of motion can be deceived within virtual reality.

Objectives:

Understand how perception can influence a human’s motion.

- This research will be a crucial asset when constructing a system and scenario that targets the primary aim. Information will be discovered through research of academic journals and books relating to VR and cognitive science.

Design a scenario, which forces a participant to rely on a sensory system to achieve a given goal.

- A scenario presents a task and prompts the user's to achieve a goal. A given task will to be very simple, i.e. walking in a straight line towards a point. Simple tasks will enable a clear and concise way to gather evaluative data. The scenario will be displayed within a virtual environment; therefore technological possibilities and limitations have to be considered.

Design a VR system, which appropriately meets the needs of the scenario design.

- The system design will be prepared by analying requirements from the scenario.

- Hardware and software requirements will be considered in order to outline realistic capabilities of the system.

Develop a VR system, which accurately follows its design schematic, and appropriately presents the scenario.

- The system will adhere to all scenario requirements using the Unity 5 Game engine to create the virtual environment. A HTC Vive will be utilised to display the scenario and track the user within a virtual plane.

Construct one or a set of experiments, which utilise the system to gather participant results.

- A given experiment will evaluate the performance of a user using the VR system.

Evaluate future applications of the VR system or later evolutions of the developed technology.

Literature Review

From a high level, visual input contributes greatly to sensory information. Utilization of VR's visual component to simulate scenarios and gather results seems logical and is evident in a vast amount of research.

Research, which uses visual stimuli to convey presence in a virtual environment, provides a coherent foundation that the project aim is achievable. Umeki and Doi (1997) suggest distance estimation in a virtual room is similar to that of in a real room. The 1997 experiment was conducted using a single 21-inch monitor to display virtual scenes. Yet, their research alone presents how a virtual environment can be perceived in a similar way to the real world. This indicates deception of the sensory nervous system can be achieved using basic hardware. Utilising of current technology (Unity 5 the HTC Vive) may produce results, which indicate a greater influence on a users perception.

Heydariana explores the performance of office space activities in both real and virtual environments. Even with increased complexity over distance estimation, results indicate differences in performance to be non significant. In terms of the project this means created tasks will be manageable for all participants , especially with the likely tasks being relatively less complex than those in Heydariana’s experiment. This also suggests the future capabilities of VR for rehabilitation, skill training and performance testing.

This re-enforces the idea of presence within VR. However participants described unrealistic navigation within their virtual environment.

Navigation seems like a theme within VR, which limits a higher sense of presence within VR. Vection, according to Bernhard E.Riecke can ’significantly enhance self-motion perception’ within VR. His study suggests the illusion of self-motion can be facilitated via the use of low cost locomotive interfaces, without psychical walking or complex motion. However Grechkin suggests a rotate and walk technique. In his study, if a user is attempting to reach an out of bounds target ‘t’ the user is then prompted to go to a sub target ‘I’. As they walk to ‘I’ the world rotates to encompass the t again. Both studies deceive participants ‘visual’ sensory information to enhance the feeling within a virtual space. A combination of both physical and virtual locomotion could be attempted in the virtual scenario in order to address the navigational limitations within VR.

Other research such has attempted to facilitate the illusion of locomotion. Turchet argues that the rendering of a virtual body has to be consistent with the user's body. Prior research has demonstrated the possibility of identifying a walker’s gender (Li et al, 1991) and emotions (Bresin R, 2006) based solely on auditory data. As a result, auditory input of a participant's anthropomorphic appearance could play a key part in simulating presence and locomotion within a virtual environment.

Scenario Design

The scenario design will require steady thought, and will take influence from the information gathered from the previous task. It will not take a long time to complete however will need to clear and target the project's aim.

Experiment Design

Design of the experiment will directly follow scenario design. This task will decide how data is collected by participant engaging with the VR system.

Documentation

Documentation (Physical Dissertation) will be constructed throughout the whole project.

System Requirements/Design

The system design will be prepared by analysing requirements from the scenario. Hardware and software requirements will be specified.

System Development

From the system design the system will first be developed in small incremental stages.

System Testing

Functional and Non-functional requirements will be tested, in order to make sure

Academic literature

* https://www.ncbi.nlm.nih.gov/pubmed/25450453 - manipulating the speed of visual flow in VR.
* http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0016128   Fat belly illusion
* http://jov.arvojournals.org/article.aspx?articleid=2213267 Self motion - Vection - Environment moving instead of using a physical tool, like an omni
* http://ieeexplore.ieee.org/document/7504714/ walking model for enhancing redirection in VR
* http://ieeexplore.ieee.org.proxy.library.lincoln.ac.uk/xpls/icp.jsp?arnumber=7223357 - Reorientation techniques for VR (space utilisation)
* <http://content.ebscohost.com/ContentServer.asp?EbscoContent=dGJyMNHX8kSep7M4zdnyOLCmr06ep69Ss6e4TLOWxWXS&ContentCustomer=dGJyMPGqtlGzrbFMuePfgeyx43zx1%2B6B&T=P&P=AN&S=R&D=a9h&K=13507573> sensation of motion in a virtual space
* <http://content.ebscohost.com/ContentServer.asp?EbscoContent=dGJyMNHr7ESep7Q4zdnyOLCmr06ep7JSsKa4TbWWxWXS&ContentCustomer=dGJyMPGqtlGzrbFMuePfgeyx43zx1%2B6B&T=P&P=AN&S=R&D=a9h&K=16621967>
* http://www.sciencedirect.com.proxy.library.lincoln.ac.uk/science/article/pii/S0165027012002506?np=y

http://www.sciencedirect.com.proxy.library.lincoln.ac.uk/science/article/pii/S0926580515000606?np=y

http://content.ebscohost.com/ContentServer.asp?EbscoContent=dGJyMNLr40Sep7Y4zdnyOLCmr06ep7VSsq%2B4SbaWxWXS&ContentCustomer=dGJyMPGqtlGzrbFMuePfgeyx43zx1%2B6B&T=P&P=AN&S=R&D=s3h&K=70860692

http://link.springer.com.proxy.library.lincoln.ac.uk/article/10.1007%2Fs10055-015-0267-3