The Reduction of Motion Sickness in Virtual Reality Applications

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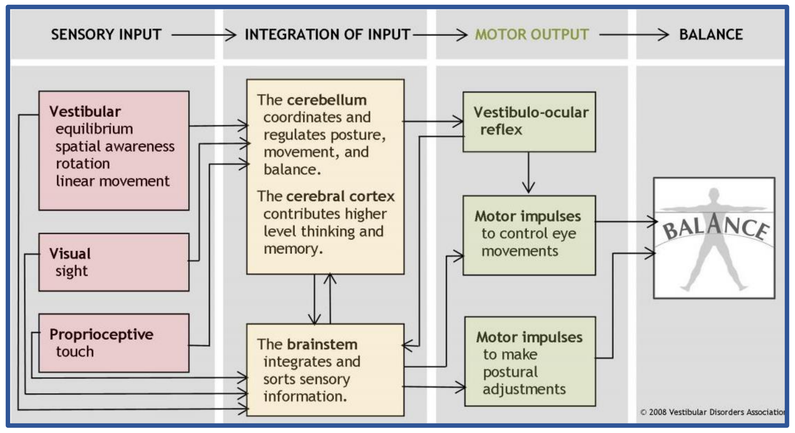
Introduction

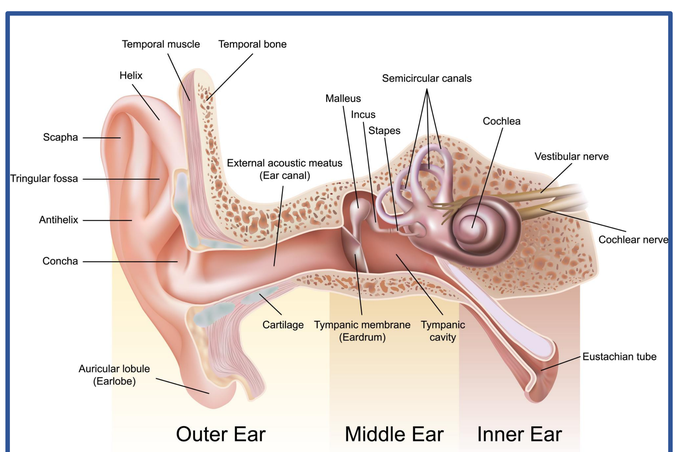
With the recent advent of 3 DOF (degrees of freedom) and 6 DOF movement in Virtual Space, VR devices and applications have become more immersive than ever before. But the largest limitation is that the user is restricted to a virtual space the size of the room they occupy. To combat this many applications introduce a system of locomotion typically controlled through joysticks or touchpads. But this method of control has its own drawbacks, the most troublesome being simulator sickness. We will be exploring the ways in which this locomotion is directly linked to simulator sickness in VR.

The Body's Equilibrium



Simulator Sickness

- VR applications visually and auditorily trick the mind into believing it is in an non-existent environment
- VR fails to stimulate other parts of the brain primarily responsible for motor functions
  - The eyes perceive that it is within a space that the body's muscles, joints, and vestibular system have no perception of
  - This disconnect between the visual and motor function of the body bring about Motion Sickness
  - This sickness if referred to Simulator Sickness in relation to VR
- This ruins a persons inherent sense of equilibrium and can greatly prohibit the usability of VR for many people



Solutions to VR Motion Sickness

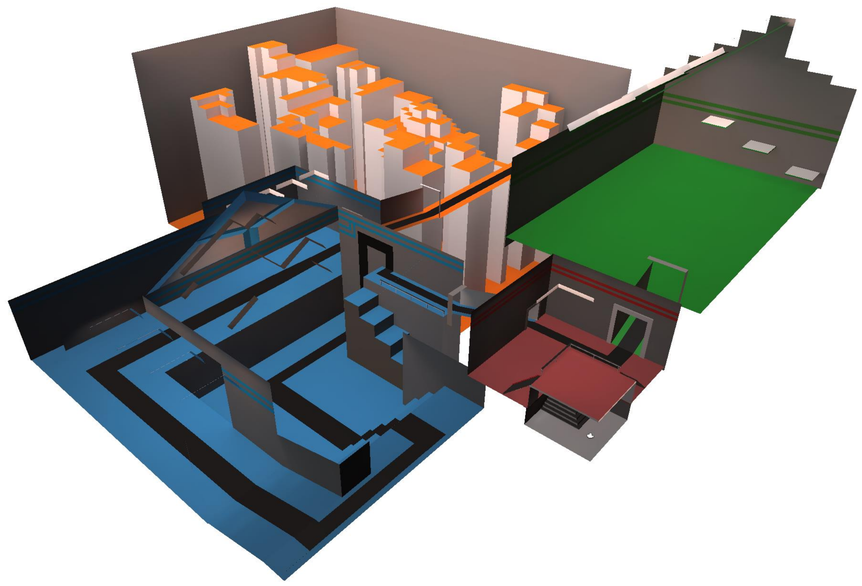
- Home Remedies
  - Limit Playing Time
  - Change user's stance while playing
  - Play games where to camera's location is fixed
  - Get prescribed motion sickness medication
- In-Application Methods
  - Minimize Latency (20ms or less)
  - Minimize the duration and frequency of acceleration
    - These types of movements are most responsible for the conflict with
    - If acceleration occurs the motion being controlled by the player will make it slightly more comfortable
    - Keep Velocity to about the same as the average persons walking speed (1.4 m/s)

Future Research : Methodology

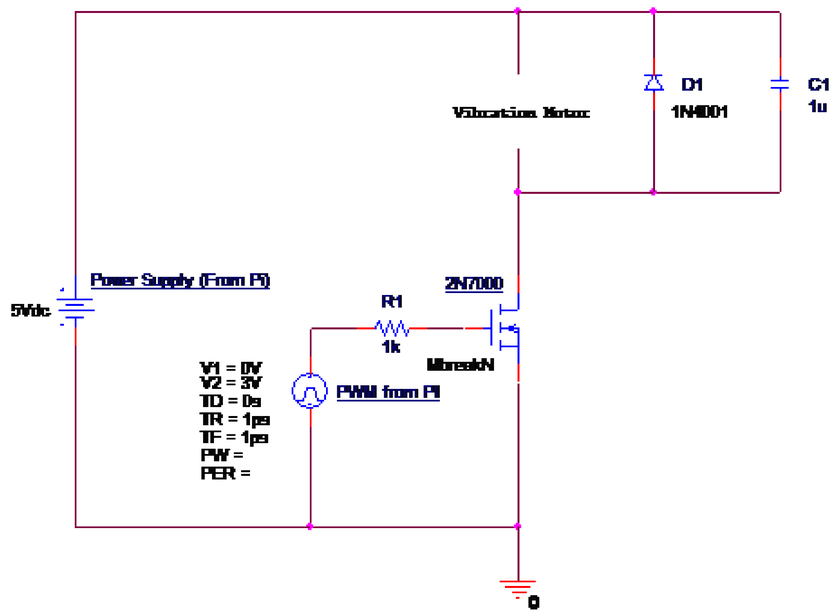
- Software
  - Unity 3D – Application Development Engine
- Hardware
  - Samsung Gear VR / Oculus Rift
  - Samsung Galaxy s6 Edge+
  - Raspberry Pi
    - Rumble pads connected to Pi will be attached to subjects wrists and ankles
    - The pads will then vibrate in time with actions performed in game
- Testing Methodology
  - Simulator Sickness Questionnaire (SSQ)
    - Created by the US Navy in 1993 for use with flight simulator sickness
    - Currently the standard for measuring simulation sickness
    - List of 27 symptoms which are commonly experienced by users of Virtual Reality systems
    - Each item is rated from a scale of none, slight, moderate, severe
    - Administered Post-Simulation
  - Fast Motion Sickness Score (FMS)
    - Created in 2011 for testing during simulation
    - Ask subject every minute to rate experience on a scale of 0 to 20
      - 0 being no sickness
      - 20 being extreme sickness
  - Run simulation for 10 minutes without haptic feedback
    - Administer FMS and SSQ
  - Run simulation for 10 minutes with haptic feedback
    - Administer FMS and SSQ

Future Research: Current Progress

Application Test Build



Rumble Pack Circuit Schematic



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