AR Therapy for Lateropulsion

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OBJECTIVES

DEVELOP A GEAR VR APP FOR LATEROPULSION THERAPY
AR RATHER THAN VR
LOW COST EASY TO USE SOLUTION
- HIGH AVAILABILITY
- LOW COST IN TERMS OF SPACE AND EXPENSE
CLIENT

DR. DAVID PUTRINO & DR. JEAN COPPOLA (PACE U. MENTOR)

- RESEARCHER FOR BURKE MEDICAL RESEARCH INSTITUTE
- EXPLORING INNOVATIVE TECHNOLOGIES TO LEVERAGE MEDICAL REHABILITATION PROCESS, SPECIFICALLY POST-STROKE
- REQUESTED RESEARCH INTO PASSTHROUGH CAMERA APP TO TREAT SYMPTOMS
Medical Background
LATEROPULSION PHYSIOLOGY

What Is It?

● Post Stroke Condition

● Skewed Vision/Proprioception
  ○ Patient Unaware And Still Perceive The World Normally
  ○ Imbalance Causes High Risk Of Falling

● Treatable With Physical Therapy Rehabilitation
  ○ 5-10% (40,000-80,000 US) Of Stroke Survivors At Risk For Pusher Syndrome
LATEROPULSION PHYSIOLOGY cont.

Diagram showing subjective postural vertical, Earth-vertical axis, and Earth-horizontal axis under different conditions: (A) Eyes occluded with a 17.9° angle and (B) Viewing the surroundings with a 0.9° angle.
Application Toolset Overview
VR & AR

Virtual Reality (VR)

- Simulated virtual world that immerses the user within its environment
- Artificaly fabricated

Augmented Reality (AR)

- Real World environment integrated with virtual enhancements
- Overlay of computer elements
WHY AR?

Uses The Passthrough Camera

Lets The Patient See A Real World Environment

- Attempt To Minimize Motion Sickness

Comfort For VR Late Majority And Laggards

Gamification

Build Upon Existing Rehab Techniques
CAMERA TILT

ADJUST THE TILT BASED ON PATIENT’S OWN PERCEPTION

- Adjustable to nearest 10th degree
- Therapist Inputs tilt before patient uses the app
  - Can be adjusted based on progress
- Viewed from the phone’s built in camera
DEVELOPMENT TOOLSET

Unity

Android SDK

Google Cardboard SDK

Explored Vuforia, Kudan, Wikitude SDK, Samsung Gear SDK, Natcam Asset
WHY UNITY?

Game Engine

Current Builds Focus On Ar And Vr Integration

Abstracts The Complexity For Faster Development

Third Party Plugins
DEVELOPMENT HARDWARE

Samsung Gear VR

Any Google Cardboard Headset
  - Economical
  - High Availability

Android Phone Device
## AR SDKs

### Vuforia

**Pros**
- Most robust
- Integrated AR tool/gamification

**Cons**
- Black Box
- Unable to access hardware level camera properties

### Google Cardboard

**Pros**
- Large community support
- Can be used with any headset

**Cons**
- Geared towards VR not AR
- Field of View
TESTING PROCEDURE

We Use a Physical Target

- Test Behavior of camera
- Test Mobile Capabilities
- Make sure app doesn’t crash (memory leak)

Adjust Code in Unity to get best User Experience

RESEARCH, DEVELOP, AND RETEST
INITIAL RESULTS

First Prototype: Camera With Static 3d Cube

Testing Vuforia

- Tilt Did Not Affect Pass Through
- Cube Shifted

Follow Up Builds:

- Ruled Out Wikitude: Built To One Eye
- Ruled Out Kudan: Didn’t Build
- Eventually Ruled Out Vuforia: Black Box
RESULTS
Our Developmental Verdict & Why

Google Cardboard SDK with Unity WebCamTexture API

- Accessible on all Android devices including target device
- Lacks proprietary restrictions which hinder AR/VR customizability
- WebCamTexture included in Unity’s default Scripting Library
- No API keys required, therefore can be developed openly with little setup
CAMERA VS CARDBOARD
UX Design

Just Tap the Screen!
Resulting Tilt
Conclusions

- AR toolsets are in the fetal stages
- Dynamic tilting of the passthrough camera was achieved
- Met client’s specifications/requirements
- Can use any cardboard based headset
- Cross platform compatibility possible
- Modularity achieved, scalable for future research projects
Thank You