Modulating Dorsiflexion with Exergaming during Overground Walking

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Introduction

- Children with spastic diplegia, a form of cerebral palsy, suffer with neurological impairments resulting in limited walking ability and muscle weakness
- Some children have trouble with ankle control and generating enough dorsiflexion to perform a heel strike during the stance phase of the gait cycle
- Visual feedback training has been performed to test its effectiveness on improving gait function of children with diplegic/hemiplegic cerebral palsy, yet this current research does not test visual feedback during active ankle dorsiflexion training while walking
- Exercise Gaming (Exergaming) can be beneficial for maintaining engagement of children during ankle dorsiflexion training and a motivational activity to improve their gait

Methodology

- An exergame was developed using Unity, a 3-D game engine
- Microsoft HoloLens 2 was used to deploy the Unity game onto the hologram displayed in the real environment
- Participants are instructed to position their foot in order to collect each coin displayed on the hologram
- HTC Vive trackers are placed on top of the participant's shoes and are used to collect coins in the game environment
- Participants can see the number of coins collected by each foot while playing the game

Methodology

Fig. 1: Design Flow Chart

unity

- Design augmented environment
- Create user interface
- Add collectible game objects
- Add packages for feet tracking

Build

Visual Studio

Universal Windows Platform

- Develop C# code
- Build Unity 3-D project that is compatible for deployment

- Computing platform used to target the Microsoft HoloLens for game deployment

Deploy

- A hollow circle represents a coin that was collected by the left foot
- The participant is able to see their score change as they collect more coins

Fig. 2: Participant wearing equipment

Results

Fig. 3a: Participant demonstrating coin collection with the left foot

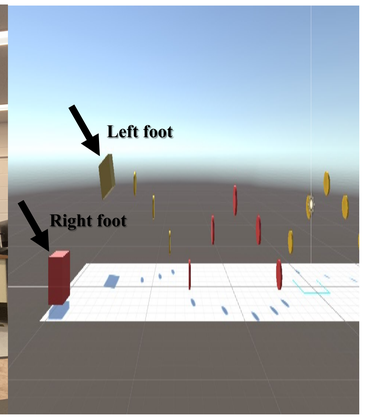

Fig. 3b: Virtual representation of coin collection in real time

Conclusion and Future Work

- Through this pilot study, methodology was developed to train participants to increase their ankle dorsiflexion through overground walking rather than with an inactive seated task
- Data collected for position and orientation of the feet gives a quantitative measurement of how participants are performing in real time
- A censored walkway can be used to track how much participants are improving in real time by assessing gait parameters such as stride width, stride velocity, stride length, and cadence
- Future work with healthy participants will look at performing a baseline test of maximum ankle range of motion while walking and having coins appear at a 10% greater angle than their maximum range of motion
- Children with spastic diplegia will be included in testing to help them reach a normal amount of ankle dorsiflexion during the gait cycle

References
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