Can Playing a Video-Game Designed for Drop Foot Rehabilitation Translate into Functional Changes in Gait?

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Innovation Hub

Introduction

One of the main obstacle for effective rehabilitation is adherence to a program. Brown et al. (2019) suggests that incorporating technology into the home rehabilitation program can improve adherence.

Purpose

The purpose of our study is to assess whether a custom designed video-game controller can be used in gait rehabilitation for patients suffering from drop foot. Drop foot is a condition that causes difficulty dorsiflexing the ankle (lifting the front of the foot) and is common after stroke.

Methods

-Participants will be recruited and separated into 2 groups to determine the order in which they will be exposed to the experimental condition.

-The following data will be collected pre and post intervention: preferred walking speed, peak ankle dorsiflexion during gait, time on timed up and go test, peak ankle dorsiflexion seated, number of consecutive reps above threshold and ratio of neuromuscular activation between the tibialis anterior and soleus longus during seated dorsiflexion and gait.

-Participants will be asked to play the game 3-5 times a week. During the game, participants complete a calibration trial to establish the max range of motion. The threshold value represents 50% of the max value for that session. Participant plays solitaire until they want to stop, or they cannot lift their ankle to the threshold value twice in a row.

Design of a Custom Controller

The custom foot controller is designed like a pedal. The foot rests on the surface. The heel is affixed to the back using a velcro strap. The controller records the distance of the ball of the foot from its starting position, as the participant dorsiflexes at the ankle. This movement of the foot, controls the image on the screen.

Data collection and storage is possible with an Arduino Nano and the time-of-flight sensor VL53L0X. The time-of-flight sensor uses a laser to read the distance from the module to the participant's foot.

The location of the sensor is adjustable along the rail slots to accommodate varying foot sizes. The custom controller was designed using Autodesk Inventor The controller was built with a 3D printer using polylactic acid filaments
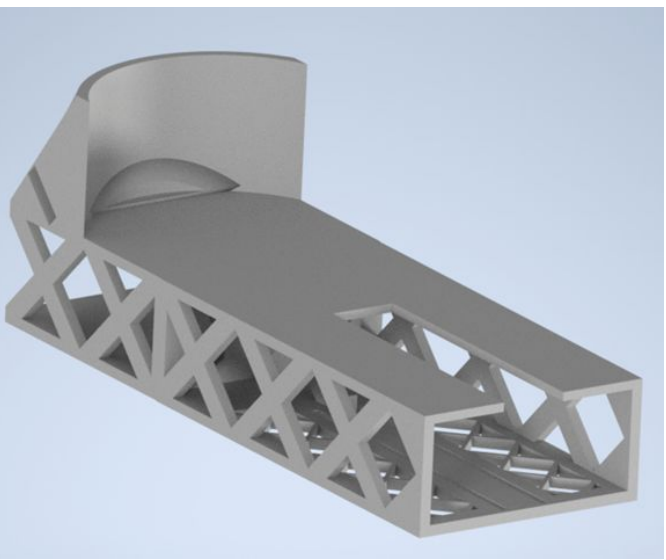
Design of the Game

The game selected for the rehabilitation program is solitaire. Solitaire was chosen because it has no timing elements and can be grasped quickly. The game was developed using Unity software. The playing card assets were open source.

The game is designed to read input from the custom controller to draw cards once a threshold value is reached. Data on the number of repetitions, and average range of motion is recorded and stored for offline analysis. Once the suggested number of repetitions have been reached, or an attempted repetition takes too long, the game will enable mouse/ touch controls to avoid exhaustion or frustration.
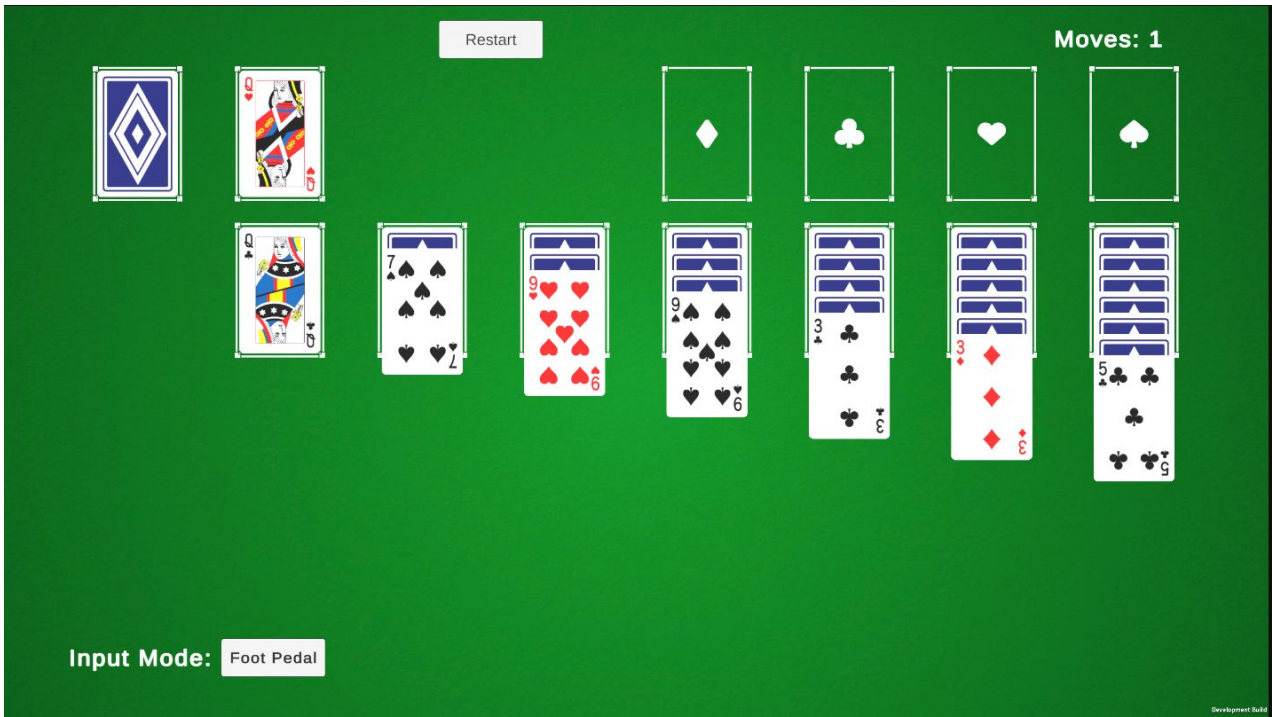
Expected Outcome

We expect the intervention to improve participants' peak ankle dorsiflexion seated, number of repetition and peak ankle dorsiflexion during gait and improvement in the Timed Up and Go test (Ciou et al., 2017). We are expecting improvement for walking speed and ratio of neuromuscular activation between the tibialis anterior and soleus longus during seated dorsiflexion and gait.

References

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