Hardware and Software System for At-Home Stereognosis Training

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Technology description

Sensory loss of the hand (including impaired proprioception, stereognosis, and tactile sensation) is common after peripheral nerve damage, stroke, spinal cord injury, multiple sclerosis (MS), and other neurological conditions. While sensory retraining therapy has shown some benefits, there is no established method to restore tactile sensation following stroke. Recent studies indicate that vagus nerve stimulation (VNS) paired with motor rehabilitation can enhance neural plasticity in patients – significantly improving their motor recovery. Recognizing the need for effective tactile retraining therapy, researchers have created a mobile system that establishes the first working model towards enhancing sensory recovery.

The University of Texas at Dallas presents a system for tactile training in patients with severe sensory impairment after nerve damage - which may be paired with VNS (in clinical settings) - for enhanced recovery of sensory function. The system integrates hardware and software to provide a reliable, quantitative system to provide challenging tactile tasks and monitor progress without the need for a therapist. The system may be used for training either in clinical or at-home settings – the software guides the user through training and/or provides patient progress to remote medical providers for monitoring.

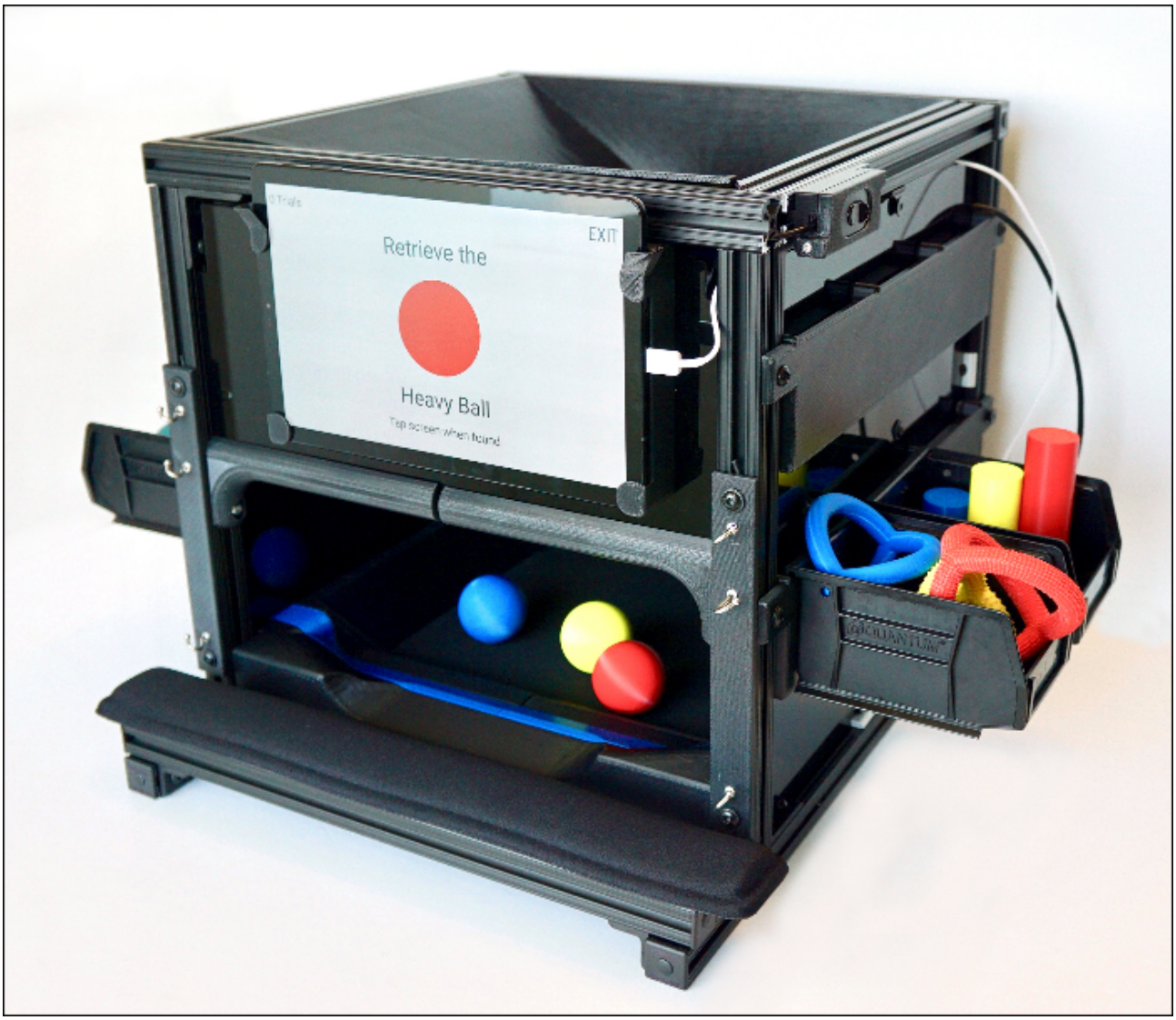

Figure 1:Prototype of hardware and software system for stereognosis training.

Technical Summary:

The system hardware is designed to provide enough room for active haptic exploration, while still fitting on a desktop. The user explores obscured ‘object sets’ within the system, which are designed to require tactile judgment of a single feature or combination of features (as in everyday objects). Objects may be tailored to have upward-facing handles and/or putty-like consistency to enable severely impaired individuals to grasp them.

The system software may be implemented as a smartphone application - it is able to record the user’s training time, attempts versus successes, and recommend changes to the object set to adjust task difficulty. Beyond tracking user progress over time, the software can even provide verbal encouragement or trigger VNS based on task performance – serving as an at-home rehabilitation coach.

Value Proposition:

The presented stereognosis training system may be tailored for use in nearly any setting, clinical or at-home, to provide accessible and effective tactile retraining therapy for patients with nerve damage-related sensory loss of the hand. By further implementing object sets of scalable difficulty, software

that provides user feedback and encouragement, and a cost-effective design – this system sets the gold standard for the first commercial product to address haptic training.
Publication:
Kilgard, Michael P., and Robert L. Rennaker. "Vagus Nerve Stimulation Paired with Tactile Training Improved Sensory Function in a Chronic Stroke Patient." NeuroRehabilitation, vol. 42, no. 2, 12 Mar. 2018, pp. 159–165., doi:10.3233/nre-172273.

Application area

Telemedicine– Complete system for remote, progressive stereognosis training that may also record and transmit patient results for clinical review
Tactile Training– Establishes modus operandi for haptic training; first system to train tactile sensation, stereognosis, and proprioception
First-in-class– Establishes framework for determining a method to restore tactile sensation, no other products are yet to provide effective haptic training

Advantages

Cost-Effective– Allows for at-home tactile training; eliminates need for clinician; uses low-cost materials in a simple design (box, object sets, software app)
Adjustable Difficulty– Object sets vary across individual (length, curvature, texture, weight) and combined dimensions; system recommends object sets based on user progress
Mobile– Small-footprint hardware is lightweight and easy to setup, software application works with smartphones or tablets
Ease of Use– Readily-available, guided tactile therapy system reduces patient inactivity and contracture by using motivational encouragement and reminders

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