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3D Unity based Saccadic Training software for Brain-Injured Patients with Hemianopia

Background:

A full visual field allows us to appreciate the world around us without moving our eyes or head. Visual field deficits, for example hemianopia, are common functional impairments after acquired brain injury. With a homonymous hemianopsia, there is a loss of one half of the visual field on the same side in both eyes. These patients no longer can pick up objects to the impaired side without moving the head and/or eyes to that side. Though early recovery is expected in around half of cases within the first 3 months after injury, patients with hemianopia are often disabled in several activities of daily living as reading, walking or driving. This occurs, together with the visual field loss, because of the uncontrolled and small saccadic eye movements. Saccades refer to the eye's ability to quickly and accurately shift from one target to another. Rehabilitative approaches generally target eye movement training which are needed to build upon compensatory strategies to improve explorative saccades. Multiple studies have shown the benefit of training exploratory saccadic eye movements.

A pilot version of a computer based saccadic training application has been developed in our group. The training consists of saccadic eye movement tasks which is based on a compensation strategy. The ability to make compensatory saccades differs among hemianoptic patients. Some patients adapt quickly, demonstrate adequate saccades, and function well in everyday life activities while other continue to struggle long after the event. We would now like to move the pilot version to a complete setup to be deployed in the hospitals and patient homes.

Aim: Our aim is to develop and evaluate a reliable computer based training tool for patients with homonymous hemianopia based on a visual search paradigm that is portable, inexpensive, and easy to deploy. We hypothesize that the training will improve the efficiency of eye movements and enable patients to realize controlled eye movements

Materials and Methods: The saccadic program consists of three parts: the patient application, therapist application and the data server. The patient and therapist applications will be developed as Unity 3D standalone clients, compatible over different platforms (MAC, Windows, Linux). The therapist application consists of a user management module and a exercise management module. The patient application consists of eye movement training tasks. These tasks will comprise of randomly positioned target and distractor element on different backgrounds. Both static images and dyamic videos will be used as background. An expedient order of difficulty adjustment (reaction time limit, stimulus size, range of distribution, background difficulty) will be incorporated. The patient has to detect a specific target and differentiate it from a distractor using the keys. Visual exploration behavior will be recorded using an eye tracking setup.

Nature of the Thesis:
Development: 70%
Evaluation study: 20%
Data analysis and documentation: 10%

Requirements:
Background in Biomedical Engineering or Computer Science
Good programming skills
Basic knowledge in Unity 3D is preferable

Supervisors:
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Figure 1- A screenshot of the saccadic training program

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