

A Wearable Device to Overcome Post-Stroke Learned Non-Use; The Rehabilitation Gaming System for wearables: Methodology, Design and Usability

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Abstract : After a stroke, a great number of patients experience persistent motor impairments such as hemiparesis or weakness in one entire side of the body. As a result, the lack of use of the paretic limb might be one of the main contributors to functional loss after clinical discharge. We aim to reverse this cycle by promoting the use of the paretic limb during activities of daily living (ADLs). To do so, we describe the key components of a system that is composed of a wearable bracelet (i.e., a smartwatch) and a mobile phone, designed to bring a set of neurorehabilitation principles that promote acquisition, retention and generalization of skills to the home of the patient. A fundamental question is whether the loss in motor function derived from learned-non-use may emerge as a consequence of decision-making processes for motor optimization. Our system is based on well-established rehabilitation strategies that aim to reverse this behaviour by increasing the reward associated with action execution as well as implicitly reducing the expected cost associated with the use of the paretic limb, following the notion of the reinforcement-induced movement therapy (RIMT). Here we validate an accelerometer-based measure of arm use, and its capacity to discriminate different activities that require increasing movement of the arm. We also show how the system can act as a personalized assistant by providing specific goals and adjusting them depending on the performance of the patients. The usability and acceptance of the device as a rehabilitation tool is tested using a battery of self-reported and objective measurements obtained from acute/subacute patients and healthy controls. We believe that an extension of these technologies will allow for the deployment of unsupervised rehabilitation paradigms during and beyond the hospitalization time.

Keywords : stroke, wearables, learned non use, hemiparesis, ADLs

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