Design of Smart Portable Rehabilitation Exoskeletal Device for Upper Limb

Authors

Do Yeon Kim[1] , Jong-Hoon Kim[2] , Mangai Prabakar[2] , YoungJin Jung[3]

[1]University of Illinois at Urbana-Champaign, [2]Florida International University, [3]Dongseo University

Abstract

Due to raised incidences of stroke, paralysis, or other diseases along with dramatic increment of life expectancy, the number of patients with movement disability has been increasing continuously. Repetitive and intensive voluntary movements in physical therapy are important factors that facilitate significant improvement for motor-impaired patients. The emergence of rehabilitation robotic devices has stimulated the development of physical therapy. However, most of current robotic devices for upper limb are poor in user-friendly interface and bulky as well as assisting only limited part(s) of arm.

We proposed Smart Portable Rehabilitation Exoskeletal Device (SPRED), which is a portable, tele-operatable, and effective exoskeleton type of upper limb rehabilitation robotic device controlled by multimodal signals with smart interfaces for both patients and therapists. The SPRED system supports full range of joint movements and assists disabled arms more naturally through highly accurate, adaptable, and fast responses based on muscle strength, brain activity, and motion tracking technology. The compact size and wireless device allows patients to carry the device during their daily activities so that they can naturally lengthen the training duration and conclude more effective clinical results eventually. We believe that the research will contribute to development a new generation of exoskeleton type of rehabilitation robotic device for upper limb.

As a first step towards the proposed system, this paper presents the design of SPRED and the mirroring motion based self-tuning concept is illustrated. Its simulation result demonstrates its potential in upper limb rehabilitation.

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