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Editorial

Rehabilitation Robotics

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Rehabilitation robotics has produced exciting new ideas and novel human assistive devices in the growing field of biomedical robotics. The successful research and development of such rehabilitation robotics requires a thorough understanding of not only mechanical, electrical, and software components, but also the related physiology, biology, neuroscience, and brain science. The science and technology of rehabilitation robotics will progress through the collaboration among robotic researchers, medical doctors, and patients. This special issue focuses on the most recent advances in modeling, design, analysis, implementation, and therapeutic testing of the human assistive rehabilitation robotics.

The paper entitled "*Lower-limb robotic rehabilitation: literature review and challenges*" of this special issue presents a survey of existing robotic systems for lower-limb rehabilitation. This paper presents an overview of all lower-limb robotic rehabilitation systems to date, including information about their commercialization as well as their clinical use, but only presenting a short description of each system. The paper entitled "*Gait rehabilitation device in central nervous system disease: a review*" presents outlines of spinal cord injury and cerebrovascular disease as two of the major causes of gait disturbance and introduces gait rehabilitation for central nervous system disorders as well as the gait rehabilitation orthoses currently being studied. These two papers will be a very valuable source of information on lower-limb and gait robotic rehabilitation systems. The paper entitled "*Mina: a sensorimotor robotic orthosis for mobility assistance*" describes the initial concept, design goals, and methods of a wearable over-ground robotic mobility device called Paralyzed, which uses compliant actuation to power the hip and knee joints. An initiated sensory substitution feedback mechanism is used to augment the user's sensory perception of his or her lower extremities.

The paper entitled "*Mechanical performance of actuators in an active orthosis for the upper extremities*" presents a lightweight, portable, active orthosis for the upper limbs. This paper focuses on the actuators for the support of the elbow function and the internal rotation, adduction, and anteversion of the shoulder and the inflatable shell structure. The paper entitled "*Stroke rehabilitation in frail elderly with the robotic training device ACRE: a randomized controlled trial and cost-effectiveness study*" reports an active rehabilitation robotic device called ACRE that was developed to enhance therapeutic treatment of upper limbs after stroke. The aim of this study was to assess the effects and costs of ACRE training for frail elderly patients and to establish whether ACRE can be a valuable addition to standard therapy in nursing home rehabilitation. The paper entitled "*Two-fingered haptic device for robot hand teleoperation*" presents a two-fingered haptic device called ExoPhalanx for robot hand teleoperation. The device provides reaction force on the distal phalange and proximal phalange to the remote operator. The effectiveness of the proposed system for teleoperation applications was verified through preliminary experiments. The paper entitled "*Finger rehabilitation support system using a multifingered haptic interface controlled by a surface electromyogram*" presents a new type of finger rehabilitation system using a multifingered haptic interface that is controlled by the patient though a surface electromyogram. The multi-fingered haptic interface robot called HIRO III can give 3-directional forces to 5 fingertips. The proposed system provides active hand rehabilitation using the surface electromyogram.

The paper entitled "*Single-switch user interface for robot arm to help disabled people using RT-middleware*" presents the construction of the user interface system using RT-Middleware. To support disabled people, especially those with less muscle strength such as muscular dystrophy patients, a single switch and scanning menu panel are introduced as the input device for the manual control of the robot arm. Patients with muscular dystrophy tested and evaluated the user interface. The paper entitled "*Toward monitoring and increasing exercise adherence in older adults by robotic intervention: a proof of concept study*" presents a proof of concept study aimed at increasing adherence for elderly adults using a small humanoid robot. The robot physically demonstrates exercises for the user to follow and monitors the user's progress using a vision-processing unit that detects face and hand movements. Socially assistive robots have the potential to improve the quality of life of elderly adults by encouraging and guiding their performance of rehabilitation exercises while offering cognitive stimulation and companionship.

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