Dual Mode Soft Wrist-Fingers Exoskeleton for Hand Rehabilitation and Assistance: Novel Soft Wrists, Optimized Soft Fingers, Multi-functional Rehabilitation

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Rehabilitation needs of hemiplegic patients have gained great concern all over the world. According to disadvantages of current rigid or soft hand rehabilitation devices, a novel dual mode soft wrist-fingers exoskeleton (SoWFsLeton) for hand rehabilitation and assistance was designed and fabricated, which was suitable for separate or collaborative rehabilitation training of fingers and wrist, assisting to pinch dexterously with two/three fingers, grasp and move objects with hand by electromyogram (EMG) gesture recognition and switch control modes. Its advantages include compatible deformation with hand, better rehabilitation effect, lighter, safer, dexterous, cheaper. SoWFsLeton mainly consists of five optimized segmented multi-airbag soft fingers, one novel differential dual-direction upper soft wrist, one novel parallel-series dual-direction lower soft wrist with soft elastomer and textile materials, EMG bracelet and switches. Filling air, with dual mode control, rehabilitation training, dexterous pinching and grasping actions were realized. Wearing exoskeleton, when air pressure was 130kPa for fingers and 100kPa for wrists, maximum bending angles of four soft fingers, thumb, lower wrist reached 100°, 110°, 30°, respectively, and maximum deflecting angles of upper soft wrist reached 15°. Compared with requirements of weight, grasping force and rehabilitation training (0.5kg, 10N, 8 times/minute), exoskeleton weight was reduced by 20%, grasping force was increased by 6%, bending/deflecting-stretching times of soft fingers, thumb, upper wrist and lower wrist were up to 50%, 125%, 12.5%, 12.5% improvements, respectively. The project has great research and application value, especially in medical field (hand dysfunction caused by spinal cord injury, stroke, brain injury).

Awards Won:
First Award of $5,000