Ergonomic Finger Exoskeleton for Hand Muscle Rehabilitation and Protection: Four-Bar Linkage, Finger-Length Personalized, Low Cost

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Strokes are the fifth-highest cause of death around the world. Even if one is to survive a stroke, the malady can leave behind many irritating symptoms including numbness or weakness of body parts such as the arm or leg. Reflecting on previous studies, this research focuses on developing an exoskeleton for optimal treatment of hand muscle atrophies and hemiplegia caused by stroke, cerebral palsy, or other common diseases. Four-bar linkage and personalization according to the length of phalanges were applied to the novel three-finger rehabilitative exoskeleton to reduce the damage done to finger muscles. Other advantages of the device include portable batteries and dual control modes implanted to suit any usage scenario, an ergonomic fastening approach to improve users' long-term wearing experience, and the utilization of cheap and reusable materials that are friendly to both users and the environment. The device itself is comprised of two parts. The first consists of three segmented resin bases with soft fasteners, which satisfy the maximum bending range of human fingers and are powered by nine independently controlled servos capable of 2.3 kg/cm of force in order to allow a range of degree of freedom (DOF) wider than that of the human finger. Secondly, an acrylic plate is attached to the forearm and is embedded with the central command system of sensors, an Arduino board, and a breadboard connecting the other components. Qualitative data regarding the efficacy of the product was collected on the researcher and evaluated. Results show the ability of the exoskeleton to relieve tense finger muscles through the training mode of the device, indicating the study's great research and application value, especially in the realm of biomedical engineering and related devices.