Smart Exoskeleton Glove

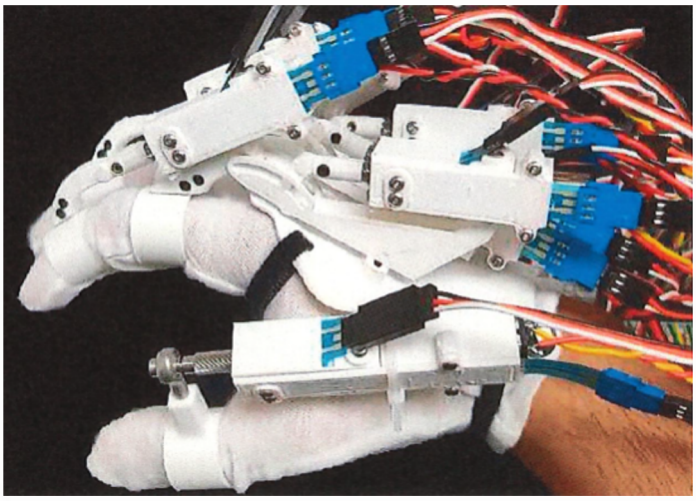
VTIP 20-054: “Intelligent Hand Exoskeleton with Grasping Assistance”

THE CHALLENGE

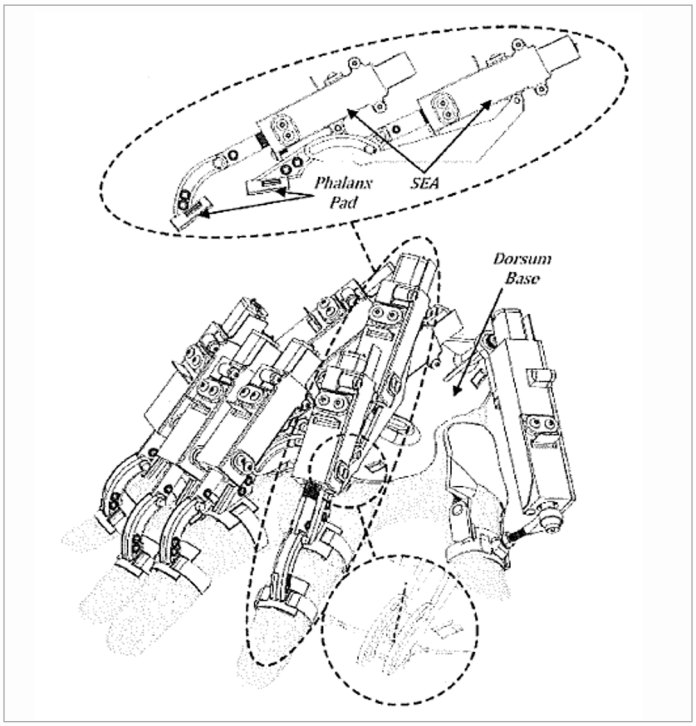
A number of ailments can adversely affect the mobility of the human hand including stroke, brachial plexus injury, arthritis, or carpal tunnel syndrome. In the United States, at least 1.1 million people report difficulty performing ordinary grasping operations; this heavily reduces their earning potential. In some cases, such as stroke, rehabilitation and return of mobility and strength is possible through repetitive motion. Unfortunately, there are other situations, including injury to the brachial plexus, in which manual functionality cannot be fully restored even with surgical intervention. In these types of cases, continual assistance is needed to restore mobility to the hand.

OUR SOLUTION

Oumar Barry and his team of researchers from the Virginia Tech Department of Mechanical Engineering have developed an exoskeleton glove with nine degrees of freedom that is capable of reproducing all grasping tasks present in ordinary activity. The device is easily modifiable to fit individuals with varied hand sizes. The series elastic actuators used to move the finger joints allow for compliance while the structure of the glove incorporates the finger as a part of the mechanism. Both of these design choices heavily increase the comfort, and therefore attractiveness, of the exoskeleton. The user-driven control scheme requires no additional hardware such as cameras or EMG sensors, but relies on the movements—even weak movements—of the user leading to intuitive naturalistic operation. Comfort and usability are further enhanced by the intelligent assistance that prevents uncomfortable motion beyond the natural range of motion of the fingers while reacting very quickly to the user's physical input as a result. The device provides enhanced operation and comfort over other state of the art exoskeleton gloves while reducing the amount of effort required for grasping.



Prototype exoskeleton glove being tested by a lab volunteer.



Detailed schematic diagram of the pieces included in the exoskeleton's finger mechanism.

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