tendo
for people, not symptoms

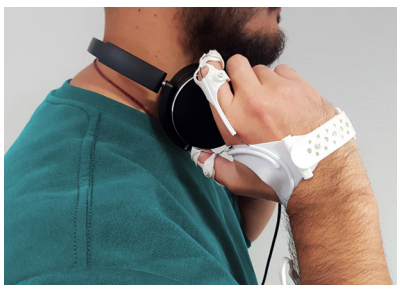
A Robotic Glove with a Fine Touch

By Peter Berlin

Tendo is a soft robotic exoskeleton. Everybody knows what a robot is, but what about an *exo*-skeleton? Broadly speaking, it refers to the shell (the "outside" skeleton) that supports and protects the body of animals such as lobsters, crabs, snails, grasshoppers and cockroaches. In contrast, birds, fish, and mammals like human beings are built around *endo*skeletons (i.e. "internal" skeletons).

Now imagine an exoskeleton in the form of a robotic glove, which strengthens your grip if weakened due to e.g. injury, arthritis, stroke or spinal cord injury. It is estimated that 5 percent of all people in the world suffer from some form of reduced hand and finger movement which hampers their ability to carry out everyday chores independently. The Tendo glove is designed to help restore the independence of these people as they go about their daily lives.

The glove covers the thumb, index finger and forearm. It is equipped with soft artificial tendons and smart sensors which detect the



muscle movements in your forearm when you are getting ready to grasp an object, and applies the requested strength to your fingers via external tendons. The actuator of the tendons is strapped to your forearm and includes the motion sensors as well as the battery-driven power supply.

In other words, Tendo is an intelligent, motorized exoskeleton that assists a person to grip, hold and release objects by pulling artificial tendons, somewhat like a puppeteer. The fingertips are left exposed so that the wearer can feel the object at hand and temper the assisted finger pressure accordingly.

Looking back in history, the first true powered exoskeleton – in the sense of being a mobile machine integrated with human movements – was co-developed by General Electric and the United States Armed Forces in the 1960s. The suit was named Hardiman and made lifting 110 kilograms (250 lb) feel like lifting 4.5 kilograms (10 lb). Powered by hydraulics and electricity, the suit allowed the wearer to amplify his strength by a factor of 25, so that lifting 25 kilograms was as easy as lifting one kilogram without the suit. A feature dubbed "force feedback" enabled the wearer to feel the forces and objects being manipulated. Its main drawback was that it weighed 680 kg (1,500 lb), which was one of the reasons why it never went into production. Since that time, many powered exoskeletons have been developed primarily for military and medical applications. The Tendo robotic glove represents state-of-the-art exoskeletal technology in terms of miniaturization.

Tendo AB was founded in 2016 by Sofie Woge, an entrepreneur and designer with a great passion for usability, design and robotics. She is also the present CEO of the company and is supported by a handful of experts in the relevant design and engineering fields. She obtained the idea for Tendo while working at NASA in the US. The company has offices in Lund's Ideon Science Park and is working in partnership with Odense Robotics in Denmark to develop prototypes. So far, the Tendo robotic glove has completed two development and testing phases.

"We recently had a test where a man was able to drink by himself for the first time in 20 years," says Sofie. "It truly gives meaning to what we do." A third prototype is currently in preparation to refine the glove's design, performance and reliability. It is expected to become available on the open market in 2020.

All photos courtesy: Tendo AB