



Psyonic's Ability Hand offers 32 different grips. It weighs around the same as an average adult hand.

STARTUP

Haptic Hand Gives Amputees Sense of Touch

Psyonic's prosthesis vibrates to provide feedback

BY JOANNA GOODRICH

ON A VISIT to Pakistan with his parents, 7-year-old Aadeel Akhtar met a girl his age who was missing her right leg. That was the first time he had met a person with a limb difference. The girl's family could not afford the cost of getting her a prosthetic leg, so she used a tree branch as a crutch to help her walk. From that encounter, Akhtar decided that one day he would develop affordable artificial limbs.

Twenty-one years later, in 2015, the IEEE member founded Psyonic, which designs and builds advanced, affordable

artificial limbs. Akhtar is the CEO. The startup, headquartered in Champaign, Ill., released its first product—the Ability Hand—in September 2021. It is the fastest bionic hand on the market and the only one with touch feedback.

The prosthesis uses pressure sensors to mimic the sensation of touch through vibrations. It functions almost like a regular hand. All five fingers on the lightweight prosthesis flex and extend. It offers 32 different grips.

“The most important thing for us is to give people a functioning, robust

prosthesis that allows them to do things they never thought they would be able to do again,” Akhtar says.

Making prosthetic limbs accessible

Akhtar originally wanted to work with people with amputations as a physician. He earned a bachelor's degree in biology in 2007 from Loyola University in Chicago. But while pursuing his degree, he took a computer science course and fell in love with the subject.

“I loved everything about engineering, programming, and building things,” he says. “I wanted to figure out a way to combine my interests in both engineering and medicine.”

He went on to earn a master's degree in computer science in 2008, also from Loyola. Two years later he was accepted into the Medical Scholars Program at the University of Illinois at Urbana-Champaign. The program allows students to earn both an M.D. and a Ph.D. in tandem. Akhtar earned an additional master's degree in electrical and computer engineering and a doctorate in neuroscience in 2016.

His research for his doctorate focused on developing what eventually became the Ability Hand.

In 2014 he and another graduate student, Mary Nguyen, partnered with the Range of Motion Project, a nonprofit that provides prosthetic devices to people around the world who can't afford them. Akhtar and Nguyen flew to Quito, Ecuador, to test their product on Juan Suquillo, who lost his left hand in 1979.

Using the prototype, Suquillo was able to pinch together his thumb and index finger for the first time in 35 years. He reported that he felt as though a part of him had come back thanks to the prosthesis. That feedback inspired Akhtar to found Psyonic when he returned from his trip.

To get some advice about how to run the company and possibly win some money, he entered the Cozad New Venture Challenge at the University of Illinois. The competition provides mentoring to teams, as well as workshops on topics such as pitching skills and customer development.

Psyonic placed first and received a US \$10,000 prize. Since then, Psyonic has received funding from the University of Illinois Technology Entrepreneur Center, the iVenture Accelerator, and the U.S. National Science Foundation.

The startup has 23 employees including engineers, public health experts, social workers, and doctors.

Developing the Ability Hand

Psyonic's artificial hand weighs 500 grams, around the weight of an average adult hand. Most prosthetic hands weigh about 20 percent more, Akhtar says. The Ability Hand contains six motors housed in a carbon fiber casing. It has silicone fingers, a battery pack, and muscle sensors that are placed over the patient's residual limb.

If the patient has an amputation below the elbow, for example, two muscle sensors would be placed over the intact forearm muscle. The patient could then use those sensors to control the hand's movement and grip.

The Ability Hand is connected by Bluetooth to a smartphone app, which provides users another way

to configure and control the hand's movements. The hand's software is automatically updated through the app. Its battery recharges in an hour, the company says.

While talking with patients who used prosthetic hands, Akhtar says, he learned they had issues such as a lack of sensation and frequent breakage.

To give patients a sense of touch, the Ability Hand contains pressure sensors on the index finger, pinky, and thumb. When patients touch an item, they will feel vibrations on their skin that mimic the sensation of touch.

The prosthesis uses those vibrations to alert users when they touch an object as well as indicate how hard they have grabbed it and when they have let go.

The reason most prosthetic limbs break, Akhtar says, is because they are made of rigid materials such as plastic, wood, or metal, which can't bend when they hit a hard surface. Psyonic uses rubber and silicone to make the fingers, which are flexible and can withstand a great deal of force, he says.

"Everything we do has the patient in mind," Akhtar says. "We want to

improve the quality of life for people with limb differences as much as possible. Seeing the effect the Ability Hand has already had on people in such a short time span motivates us to keep going."

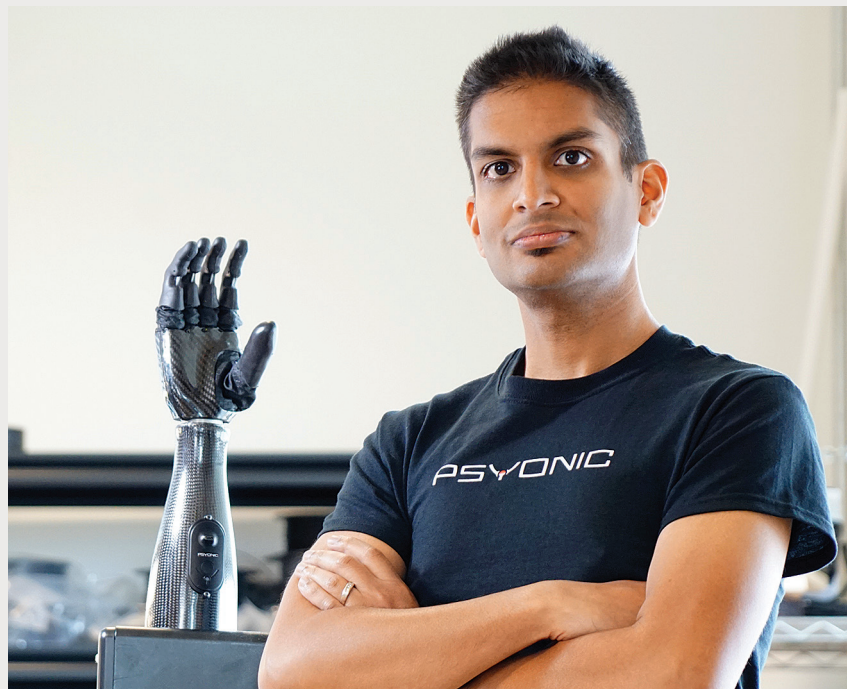
Psyonic and its partners are researching how to improve the artificial hand. Akhtar says some of the partners, including the Ryan AbilityLab in Chicago and the University of Pittsburgh, are developing brain and spinal-cord implants that could help patients control the prosthesis.

Positive feedback

Akhtar joined IEEE in 2010 when he was a doctoral student.

IEEE provides a great "ecosystem," he says, on prosthetic limbs and robotics, and "it's amazing to be part of that community."

He adds that having access to IEEE's community of scholars and professionals, some of whom are pioneers in the field, has helped the company gain important feedback on how it can improve the hand, as well as help in the development of legs in the future. ■



The startup's founder, Aadeel Akhtar, was inspired to develop artificial limbs during a trip to Pakistan when he was 7 years old.