

START-UPS & ENTREPRENEURS

Roceso Technologies makes non-metallic robotic gloves for neuro rehabilitation

BY JEFFREY TAN

Jane Wang's desire to help people made her think about becoming a doctor. However, that ambition changed when she was offered a scholarship to study engineering at Nanyang Technological University. "I chose [to major in] mechanical engineering and mechatronics because I thought building robots was cool," Wang, who is originally from China, tells *The Edge Singapore* in an interview. Her love for mathematics and physics rather than biology and chemistry was the other key motivating factor, she adds.

Today, Wang is in the fast-growing medical technology industry and co-founder and CEO of Roceso Technologies. The three-year-old start-up designs and manufactures robotic gloves that are used to help stroke or spinal cord injury patients regain function in their hands through neurological and muscle rehabilitation.

Called EsoGlove, the device assists patients in conducting various repetitive tasks. The patient wears the glove, made from fabric and embedded with actuators, and moves as directed by simulations on a screen. This includes performing everyday functions such as holding a spoon or pouring water from a bottle. The speed and duration of these exercises and the pressure exerted by the robotic glove can be altered, depending on the severity of the patient's condition.

Wang says the aim of these repetitive tasks is to rewire functions from the damaged areas of the brain to the undamaged ones. This process is known as neuroplasticity. "Often times, when one part of the brain dies, we [try] to teach other parts of the brain to compensate as well as to relearn lost skills," says Rachel Ho, a physiotherapist at Tan Tock Seng Hospital.

Patients are encouraged to complete the tasks by themselves. The EsoGlove can detect whether patients are moving their hands by themselves via an electromyography sensor that detects electrical activity in their muscles. In fact, some patients may retain some degree of functioning ability in their hands. "[The gloves] give a little bit of support," says Wang.

As with any medical device, regulatory approval is a crucial component for success. The EsoGlove received clearance from the US Food and Drug Administration (FDA) last December. This has allowed Roceso to market its robotic gloves in the US.

The company is expecting to receive the European CE marking in 2H2019, says Wang. This certification mark indicates that the robotic gloves conform to the health, safety and environmental protection standards for products sold within the European Economic Area. The company also expects to receive approval from Singapore's Health Sciences Authority in 2H2019, Wang adds.

Meanwhile, the initial response from healthcare practitioners has been positive. The Barrow Neurological Institute, the



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world's largest neuro rehabilitative centre based in the US, has expressed its interest in trying out the EsoGlove, according to Wang. "They have been waiting for us to get FDA approval [as] they want to try [it out] and give feedback," she says. Other interested clinical partners include St Joseph's Hospital and Medical Center in Phoenix, Arizona, as well as Hospital Seberang Jaya and Hospital Pulau Pinang, in Malaysia. On home ground, the National University Hospital (NUH) is also testing the robotic gloves.

Soft robotics

Roceso had its beginnings in a classroom at the National University of Singapore in 2014. Wang, who had worked for several MNCs for almost a decade, returned to school to acquire a master's degree in engineering. It was there that she met Raye Yeow and Yap Hong Kai. Yeow is Roceso's scientific adviser and an NUS assistant professor, while Yap is Roceso's chief technology officer. He was a PhD student and classmate of Wang's.

During class, students were required to showcase their inventions and commercialisation plans. At one session, Yap presented an early version of EsoGlove, which caught Wang's attention. Immediately after the class ended, Wang told Yap that she wanted to be part of the team to commercialise the robotic gloves. Yeow, who was teaching the class to postgraduate students, also expressed interest to be part of the venture. The trio pooled their money and registered Roceso as a company.

Wang says the robotic gloves were unlike anything she had seen previously. This is because the gloves use soft robotics, a new area of robotics technology developed by researchers at Harvard University in the last few years. Essentially, soft robot are constructed from highly compliant materials — such as fabric — and devoid of any metal components used by conventional robots.

The applications of soft robotics are manifold, says Wang. Apart from its uses

in the medical sector, it can be employed in industry automation or even farming. However, after extensive market research, Wang felt that soft robotics would have the biggest impact on the healthcare industry. "We interviewed many therapists and doctors from St Luke's Hospital, Tan Tock Seng Hospital, NUH and Orange Valley Nursing Home. Many of these people have given us feedback," she says. "We think the medical field has the biggest potential and [market] gap and it is our passion to help patients."

The use of soft robotics enables EsoGlove to differentiate itself from competitors in the rehabilitation space such as Rehab-Robotics, Saebo and Gloreha. Wang says many of the other robotic gloves are heavy and bulky because they employ conventional robotics. As a result, they would also cost more.

Wang says other robotic glove manufacturers could eventually use soft robotics in their products, but the challenge lies in mass manufacturing. Roceso has discovered the right fabric materials and manufacturing methods to scale up production. The company has also secured patents for the design of its robotic gloves' soft actuator and soft robotics device, which are licensed by NUS. The licences have a perpetual lifespan, however the patents are valid for only 20 years. The company has filed for a device patent for EsoGlove.

B2B model

Robotic gloves are far too expensive for patients to buy off the shelf, so Wang says the company will adopt a B2B, or business-to-business, model. Most robotic gloves, including EsoGlove, are priced in the five-figure range, she explains. The company intends to sell EsoGlove to hospitals, neuro rehabilitation centres and nursing homes, which would in turn let the patients use the robotic gloves.

Roceso could also adopt a rental model for the gloves. Wang says this might be a viable alternative, as the robotic gloves are typically used regularly for only a limited period of time. "If patients start

therapy early and their condition is not too severe, they can recover [quickly]. So, after six months, they may not need the device anymore," she explains.

Wang says Roceso is ready to take orders from the US. The company will showcase the EsoGlove at a booth at this year's WearAcon 19 conference in the US, says Wang. This global annual event presents the latest demonstrations and research on wearable robotic devices. It is usually attended by robotics professionals and entrepreneurs, including healthcare professionals.

If business booms, Wang says Roceso has plans to monetise the software used to run the EsoGlove. The company could introduce new kinds of exercises in the form of games, which can be sold as subscriptions to users for a recurring fee, she says.

Roceso had raised seed funding of \$920,000 from several angel investors. The company is now seeking to raise \$2 million

for its Series A round. Last month, Wang made a pitch to a room filled with angel investors from AngelCentral, a community of angel investors. Some of them have expressed interest in the company, but none have made a financial commitment yet. "Investments take some time to close," Wang says.

Beyond EsoGlove, Roceso has plans to introduce a robotic sock called ESock. Just like the gloves, the sock will employ soft robotics technology. The ESock's purpose is to increase blood circulation in a patient's lower leg. This is because many people who are bedridden develop deep vein thrombosis, or blood clots, owing to immobility. This usually leads to further health complications and even death. The ESock also helps the wearer avoid muscle contraction in the leg.

Roceso may introduce more rehabilitative devices in the future. Ultimately, Wang has high hopes for Roceso to become the market leader in rehabilitative medical technology. "Hopefully, we can change how rehabilitation works because soft robotics is [revolutionary]."

For Wang, she has come full circle. "As it turns out, I am doing medical devices," she says. "[Helping people] is still my passion. It won't change. You just turn one round and then you come back." ■



NOTICE INVITING TENDER

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The tender document with all details is available on the Air India website www.airindia.in

The completed sealed tender document (in English) along with all support documents should be forwarded to the address specified in the tender document by **28th March, 2019**.

All bidders are advised to check the website at regular intervals till the last date. There could be changes to the bid document.