

# GIVING SURGEONS A HELPING HAND

DENSO Corporation partnered with two universities and medical professionals to devise a revolutionary motorless surgical support robot called the iArmS that reduces the tremors from arm strain and fatigue surgeons experience as they perform procedures.



The motorless iArmS curtails hand tremors by 70 percent—a lifesaving improvement for patients undergoing microsurgery

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## TAMI KAWASAKI

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**T**HE iArmS is a surgical support robot that reduces the fatigue and slight arm tremors of surgeons while they are performing operations. In addition, the robot helps surgeons assume unusual stances during procedures, especially for fine work like microsurgery, which involves suturing blood vessels and other tissue structures smaller than one millimeter in size while looking through a microscope.

DENSO Corporation—which developed the device in cooperation with Shinshu University and Tokyo Women’s Medical University—is a major producer of automotive components and a leader in the Japanese manufacturing industry, boasting connections to overseas automakers and pursuing the development and manufacture of small industrial robots as well.

“We began this project with the goal of using DENSO’s strengths as a reputable provider of technology to develop a service robot and promptly bring it to market as a finished product,” says Toshihiko Koyama, head of the company’s healthcare business, who notes that surgical robots had begun to appear in the United States and were making quick inroads. “Robots were garnering praise in the medical sector, and we could see a new market taking shape. We felt this was a chance to use our existing expertise, so we set about developing this new device.”

Even so, these engineering experts were rank beginners when it came to the world of medicine. “We were told it was too late to enter that market, and since we lacked any connections we decided to contact famous doctors directly via e-mail. Despite the fact that this approach was

highly unorthodox in the realm of traditional Japanese business practices, doctors responded favorably,” Koyama reflects.

“Although there were already robots being developed through partnerships between medicine and engineering, those projects were all long term, and none had come to fruition yet,” says Koyama. “We treated creating a practical robot as our absolute mission, and sought the most flexible and optimal solution to this engineering challenge in the context of the pressing needs of medicine. I think that really resonated with surgeons.”

DENSO representatives then met with Jun Okamoto of Tokyo Women’s Medical University, who had the concept for a motorless medical robot designed to reduce the fatigue and hand tremors surgeons experienced. As soon as they saw the demo unit, Koyama says, they knew “this was the way we could leverage our technology.” A system using motors requires significant development time to achieve safety guarantees, as well as time and effort to pass reliability verification tests. Opting for a fully motorless design that utilizes a system of weighted balance and friction alone to follow a surgeon’s movements exactly, they created a robot that curtailed hand tremors by 70 percent. Surgeons place their arms on platforms, and experience no resistance or heaviness; their arms move freely. Upon trying the iArmS for the first time, doctors could not believe the device had no motor. Their arms felt strangely weightless, they reported, and did not tire.

The robot emerged in an astonishingly short span of three years after further refinements were made in maneuverability, safety and practical use in a clinical context. The appearance of the motorless passive robot shocked the industry, but as Koyama adds with a grin, “It surprised us, too.”

With the collaboration of over one hundred stakeholders, the device later incorporated further improvements based on feedback from the operating room.

“When one of the surgeons we tested it with turned around to look at us during an operation, I tensed up, thinking he’d found a defect,” Koyama recalls. “But



Surgeons place their arms on the device’s mobile platform, which moves smoothly as they do

he just said, ‘I like it!’ For an engineer, that’s a thrilling moment—the pinnacle of your efforts.”

Since April 2015 when DENSO began taking orders for iArmS, the device has garnered praise in clinical contexts such as neurosurgery and endoscopic procedures in otolaryngology, with orders even coming in from abroad. Koyama is enthusiastic about the overseas market. “There’s a strong latent demand in the surgical world for this kind of product,” he states. “Surgeons feel they would be able to achieve even more precise results if they can limit hand tremors. We hope to find overseas sales partners and bring the product to a wider user base so that it can serve the real-world needs of surgeons everywhere.” 



Toshihiko Koyama heads DENSO Corporation’s healthcare business