IKEA-Building Robot Conquers Touchy-Feely Challenge

The Swedish furniture has become something of a benchmark for robotics engineers

By <u>Larry Greenemeier</u> on April 18, 2018

Credit: <u>Artystarty</u> Getty Images

Anyone who has spent an afternoon puzzling over an IKEA furniture kit will appreciate how tempting it would be to turn the project over to a robot. Fortunately the store's complex self-assembly kits are something of a benchmark for roboticists who have toiled for years at building automatons smart and dexterous enough to fit screws and wooden pegs into their

corresponding holes. Progress has been steady, but it will likely be awhile before robots can build a STUVA loft bed combo in your bedroom while you sip coffee in the kitchen.

A STEFAN chair kit is clearly within reach, however, according to engineers at Nanyang Technological University in Singapore. In this week's *Science Robotics* they report having assembled a STEFAN using a two-armed robot, whose sensors and programming enable it to fit most of the pieces together without human help. The machine's arms, parallel grippers, sensors and 3-D camera completed the chair's frame (not including the seat and stabilizing screws), covering more than 50 steps in about 20 minutes.

Just as noteworthy: each of the robot's parts was the generic, off-the-shelf kind—a key step toward making such machines mass-producible. The components that did the assembly work "are already mass-produced, so the technology we developed here can be deployed in actual factories in [the] very near future," says Pham Quang-Cuong, an assistant professor of mechanical and aerospace engineering who built the robot with fellow Nanyang researchers Francisco Suárez-Ruiz and Xian Zhou.

The engineers programmed the robot using computer code, rather than training the device to assemble parts via machine-learning and other artificial intelligence techniques crucial to the future of robotics. "In this work we were interested in achieving the low-level capabilities such as perception, planning and control, rather than in the high-level reasoning," Quang-Cuong says. "Those low-level capabilities are crucial for, and can be adapted to, the assembly of other objects or to other industrial tasks such as handling, drilling, glue dispensing, assembly and inspection. We are also planning to integrate AI methods in our future work to automate [more abstract] high-level reasoning."

The Nanyang robot arms' movements may look slow and tedious but their ability to fit pegs into holes tackles "a superhard problem in robotics," says Ross Knepper, an assistant computer science professor at Cornell University who was not involved in the Nanyang research. Knepper would know—he was part of a Massachusetts Institute of Technology team that in 2013 built the "IKEABot" system of autonomous robots capable of assembling LACK side tables. The MIT project debuted the same year as another LACK-building bot developed by researchers at the University of Massachusetts Amherst, Willow Garage robotics research lab and elsewhere (pdf).

The MIT IKEABot was an automated system that coordinated two robots with specialized tools to perform the assembly. This system applied reasoning about the geometry of individual parts in order to figure out how they fit together. "Whereas my work used a visual perception modality— using vision to solve the peg-in-a-hole problem—the Nanyang researchers are doing it through tactile feedback, feeling whether or not the peg went into the hole," Knepper says. "The applications are both for IKEA furniture, but the contributions to robotics are very different."

The Singapore-based researchers' technology promises to be versatile, able to be reprogrammed for different tasks—maybe even assembling other kinds of furniture. "Many people, especially many Americans, have this intimate experience with struggling and maybe failing to build IKEA furniture," Knepper says. "The dream is still to have one robot system that can assemble IKEA's entire catalogue—but we're not there yet.