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Semi-autonomous robot assembles IKEA chair frame in 20 minutes

ABC Science

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Each robotic arm is equipped with parallel grippers to pick up objects and has force sensors to determine how strongly the "fingers" are gripping.

(Supplied: Nanyang Technological University)

When it comes to robots stealing our jobs, there's one task that plenty of people would be happy to relinquish: assembling flat-pack furniture.

Key points:

- A Singapore team programmed a pair of robotic arms to construct a flat-pack chair frame in 20 minutes
- Such dexterous manipulation requires skills such as vision, motion planning and force control
- If paired with advanced artificial intelligence, the robots could one day be fully autonomous

The day we can handball that job off is a step closer.

In **Science Robotics** today, a trio of roboticists from Nanyang Technological University in Singapore unveiled a semi-autonomous pair of robotic arms that can put together the frame of an IKEA chair.

Made from off-the-shelf gear, their invention can look at chair parts scattered around, grasp and lift the right bit, carefully insert wooden pins in pre-drilled holes and slot the pieces together.

And while the robot's repertoire of furniture-building skills is limited — it can't yet screw in metal screws, for instance — the technology could soon be ready for jobs that require human-like dexterity, such as electronics and aircraft manufacturing.

Building a builder takes time

The seemingly simple task of putting together a few pieces of wood involved around three years of work, said Quang-Cuong Pham, who is one of the robot's creators.

"Simply programming the robot to pop a pin into a hole took a year."

This is because even though the robotic arms are equipped with 3D cameras, the image resolution isn't quite good enough for the robotic fingers to pop the pin in on the first try all the time.

"The camera is good to around 2 or 3 millimetres, but that's not precise enough for the snug-fitting wooden pins.

"So that's why the pin lands on the surface of the wood block, then moves around to search for the hole."

Sensors on the robotic "wrists" detected if a pin successfully slid into the hole.

All up, the robotic arms took about 20 minutes to put a chair frame together, spending about 11 minutes planning their motions and nine minutes executing them.

The next step, Dr Pham said, is to fully automate the furniture-building process by incorporating advanced artificial intelligence.

"It's not full autonomy [yet] in the sense that the set of instructions still has to be given by us," he said.

"Put the pin here, move the wood block there, transport it from one place to another place."

Besides, the lab is rarely like the real world. A flat pack might be missing a piece, or a pin might not fit in a hole.

Robots are good at recognising an object and its position and orientation, but they're not yet "reasoning", according to Juxi Leitner, a roboticist at Queensland University of Technology who wasn't involved in the work.

So artificial intelligence will allow robots to deal with these problems as they arise.

"How does the robot reason with, 'OK, I tried to put in one of the small pegs and it didn't go in all the way'," Dr Leitner said.

"'Do I need to put it in further or is it OK because I'm going to press it down on the other part anyway?'"

Despite advances in artificial intelligence and engineering, a fully autonomous furniture-building robot is still a long way off, he added.

So those who get frustrated assembling flat-pack furniture will have to grit their teeth and persevere — at least for the next few years.

What's with IKEA and robotics research?

The furniture giant's ubiquity means its products are found in robotics laboratories around the globe to benchmark and compare systems.

"If we used something from [a local chain] then it might be different elsewhere," Dr Leitner said.

"But IKEA furniture is basically the same in every country in the world."

Dr Leitner and his colleagues will use IKEA objects when they hold the first "Tidy Up My Room" challenge in May this year.

Teams will let robots loose in a messy room — set up like an IKEA showroom — to carry out a variety of tasks, such as picking objects off the floor and popping them neatly on a shelf.

Despite advances in robotics, humans are still able to construct a chair faster if pitted against the IKEA-builder robot.

"The most important reason for that is not so much in the computation, but more in the 'human hardware'," Dr Pham said.

"If you think about it, human arms are very flexible, whereas the robot arms are very rigid and it's easier for us to manipulate things.

"Human hardware really is fantastic, both in terms of skills and versatility."