Engineers develop soft robotic gripper

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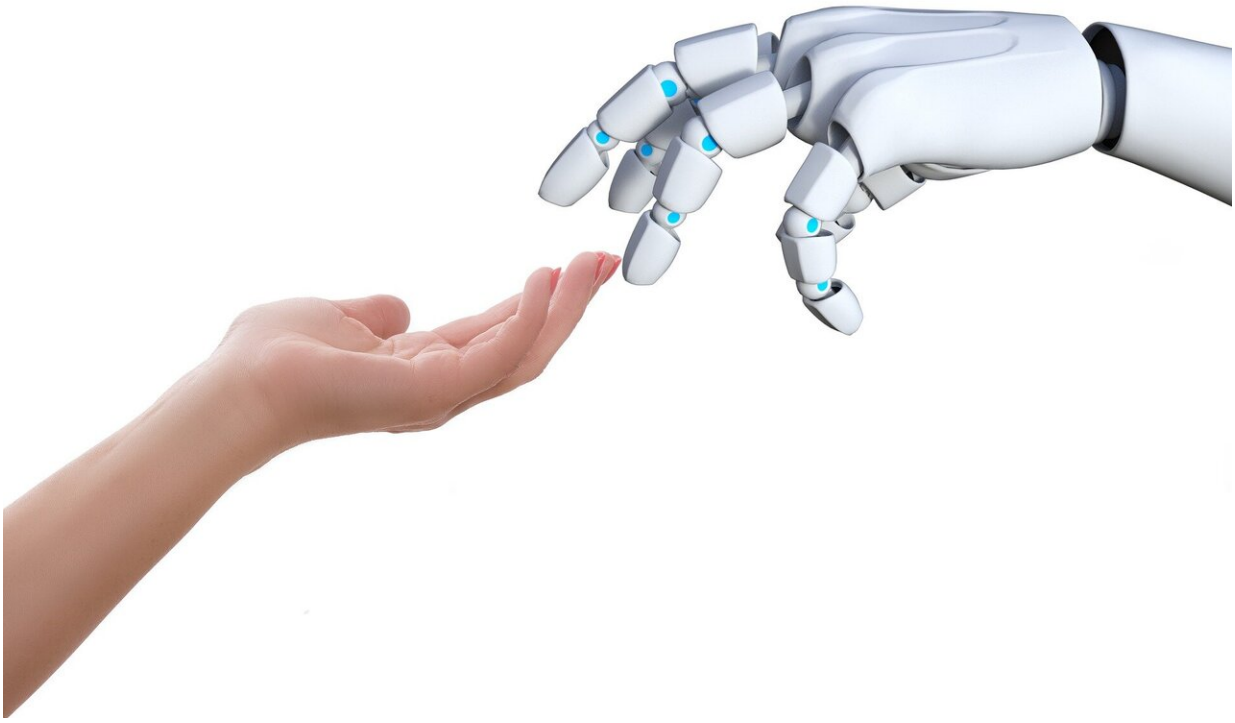

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Scientists often look to nature for cues when designing robots—some robots mimic human hands while others simulate the actions of octopus arms or inchworms. Now, researchers in the University of Georgia College of Engineering have designed a new soft robotic gripper that draws inspiration from an unusual source: pole beans.

While pole beans and other twining plants use their touch-sensitive shoots to wrap themselves around supports like ropes and rods to grow upward, the UGA team's robot is designed to firmly but gently grasp objects as small as 1 millimeter in diameter.

"We had tried different designs but we were not happy with the results, then I recalled the pole beans I grew in our garden few years ago," said Mable Fok, an associate professor and the study's lead author. "This plant can hold onto other plants or rope so tightly. So, I did some research on twining plants and thought it was a good design from nature for us to explore."

In a new study published in the journal *Optics Express*, the researchers say their soft robotic spiral gripper offers several advantages over existing robotic devices.

"Our robot's twining action only requires a single pneumatic control, which greatly simplifies its operation by eliminating the need for complex coordination between multiple pneumatic controls," said Fok. "Since we use a unique twining motion, the soft robotic gripper works well in confined areas and needs only a small operational space."

The UGA device offers another advancement over many existing robotics: an embedded sensor to provide critical real-time feedback.

"We have embedded a fiber optic sensor in the middle of the robot's elastic spine that can sense the twining angle, the physical parameters of the target, and any external disturbances that might cause the target to come loose," said Fok.

The researchers believe their soft robotic gripper—a little more than 3 inches long and fashioned from silicone—could be useful in many settings, including agriculture, medicine and research. Applications

might include selecting and packaging agricultural products that require a soft touch such as plants and flowers, surgical robotics, or selecting and holding research samples in fragile glass tubes during experiments.

In their study, the research team says the spiral gripper proved effective in gripping objects such as pencils and paintbrushes—even an item as small as the thin wire of a straightened paperclip. The device also demonstrated excellent repeatability, high twining sensing accuracy and precise external disturbance detection.

In addition to Fok, the research team includes Mei Yang and Ning Liu, both Ph.D. candidates in engineering; Liam Paul Cooper, an undergraduate studying computer systems engineering; and Xianqiao Wang, an associate professor in the College of Engineering.

The team plans to continue its work with an eye on improving the automatic feedback control based on the readings of the fiber optic sensor. They also want to explore miniaturizing the design to serve as the foundation of a biomedical robot.

"This twining soft robot with its embedded fiber optic sensor forms a building block for a more comprehensive soft robot. Having a simpler design and control is definitely an advantage," said Fok.

More information: Mei Yang et al, Twining plant inspired pneumatic soft robotic spiral gripper with a fiber optic twisting sensor, *Optics Express* (2020). DOI: 10.1364/OE.408910

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