Octopus-inspired robot arm can grab and lift a toy shark using suction

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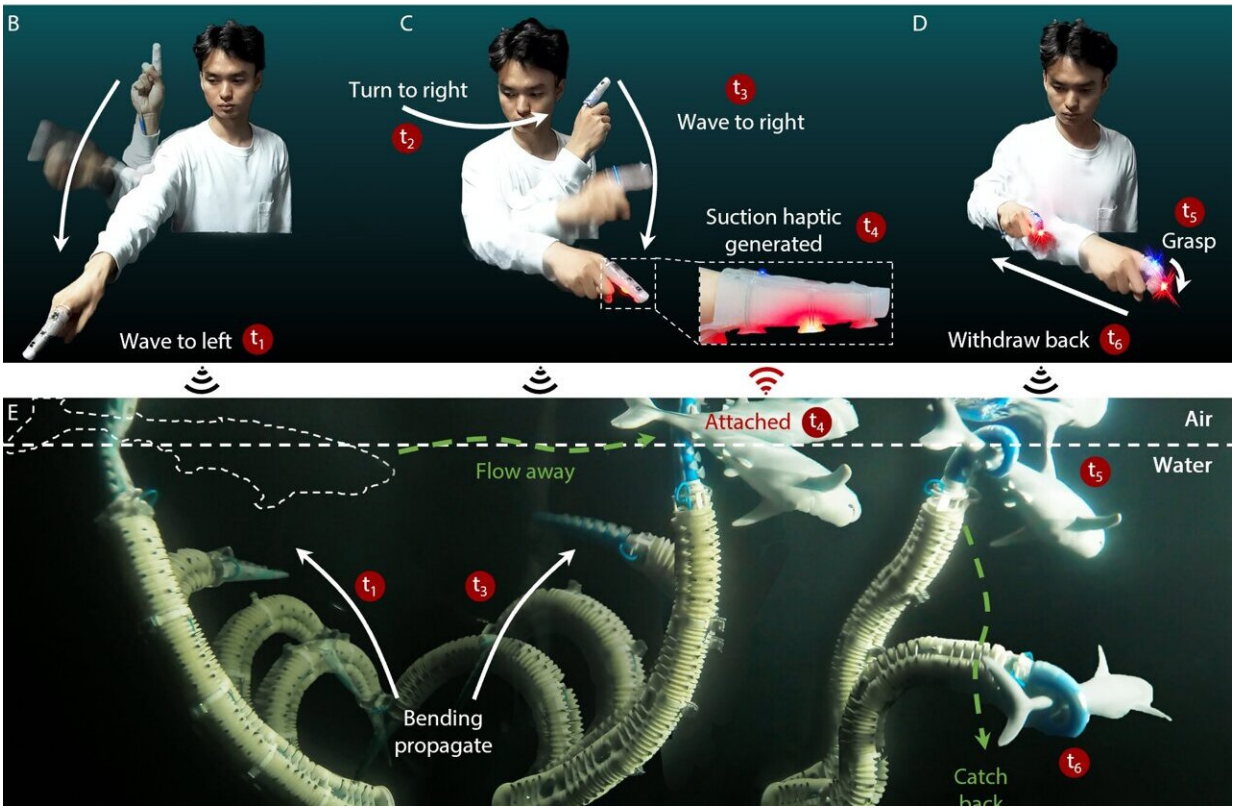

Composition of the electronic-integrated soft octopus arm. Credit: Li Wen, Beihang University

A team of engineers at Beihang University, working with a colleague from Tsinghua University, both in China, has designed, built and tested a

haptically controlled octopus robot arm that is capable of grasping, lifting and carrying objects on land and underwater. In an article published in the journal *Science Robotics*, the group describes how they built their robot, how it works and how well it performed when tested under a variety of scenarios.

For many years, scientists have studied the behavior of octopi—its many species have evolved a host of ways to use extensible arms with suction cups along the underlying surface to pick up objects, defend themselves and scurry about on the sea floor. Researchers have sought to develop robots with similar capabilities. In this new effort, the team in China has found a way to create a robot arm that faithfully replicates the behavior of an octopus's arm.

The robot the team built looks very much like the real thing. It is shaped like a tentacle and can furl, stretch and unfurl on demand. It can also apply vacuum pressure inside the cups on its underside, which it can use to grab objects. And it does so by first curling around them.

The research team explains that they got their tentacle to curl by programming mathematical propagation of its five segments. Together, the segments and their insides form a network that mimics the nervous system of an octopus arm. Electrical messages are sent using liquid metal wires to allow for maximum flexibility.

The tips have both suction cups and temperature sensors. Operation of the robot is controlled wirelessly, using the flip of a finger sequestered inside a glove. The approach allows for not only controlling the curling of the arm, but also pitch, roll and acceleration.

To allow for precise control, the researchers also added a sensory feedback system, which allows the operator to feel what the robot arm is touching with its sucker tips. Sensations are provided to the controller

via tiny suction cups embedded inside the glove. Testing showed that such feedback was accurate enough to allow the operator to find and grab objects such as toy sharks and balls with their eyes covered.

The research team notes that their octopus arm works equally well in both wet and dry environments.

More information: Zhexin Xie et al, Octopus-inspired sensorized soft arm for environmental interaction, *Science Robotics* (2023). DOI: 10.1126/scirobotics.adh7852