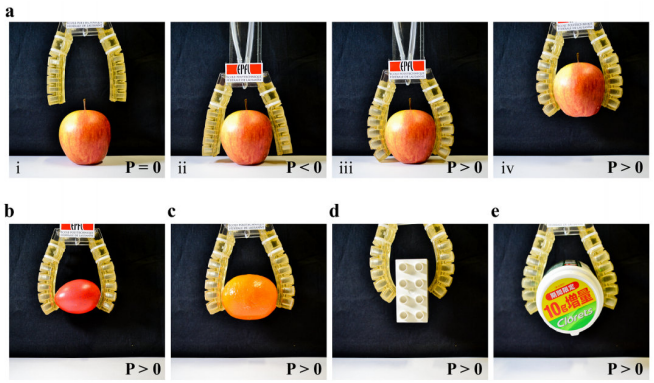
EPFL researchers show edible actuator at IROS 2017

9 October 2017, by Nancy Owano



Gripper grasping test. P stands for the gauge pressure. (a-i) The gripper is placed above the object, here an apple mass of 95.6 g. (a-ii) The device approaches the object. (a-iii) Applying pressure conforms the adaptation of the fingers. (a-iv) The actuated force of the gripper makes it possible to picked up the object. The gripper demonstrated handling of other objects: (b) a boiled egg (47.7 g), (c) an orange (104.8 g), (e) A LEGO brick (25.7 g), and (f) A bottle of chewing gums (153.1 g). Credit: arXiv:1703.01423 [cs.RO]

(Tech Xplore)—Edible what? Swiss researchers from Switzerland's École Polytechnique Fédérale de Lausanne (EPFL) have come up with a fully edible soft pneumatic actuator. So what is the takeaway?

Factory workers using assembly tools and then eating them for lunch? Kids' toys?

Not at all. It could function inside the body, for nutrition or healing purposes.

Evan Ackerman, *IEEE Spectrum*, said, "What's been missing so far has been the thing that makes a robot distinct from a computing system, and that's an edible actuator that would allow an ingestible robot to actually do something useful once you've swallowed it."

The authors themselves pointed out a "(still missing) availability of edible actuators" and these, they wrote, "could pave the way to fully edible robots."

The authors can imagine components of such robots could be mixed with "nutrient or pharmaceutical components for digestion and metabolization."

Ackerman had further details. "The actuator is made from a mix of gelatin, glycerin, and water that's poured into a mold. The overall design is a standard one for pneumatic actuators (and the performance is similar); the structure causes it to bend when inflated and straighten out again when pressure is reduced."

The actuator is 90 mm in length, 20 mm in width, and 17 mm in thickness.

As per the researchers' abstract on arXiv, the actuator exhibits "a bending angle of 170.3 {deg} and a blocked force of 0.34 N at applied pressure of 25 kPa."

Two actuators were integrated to form a gripper and the "researchers conducted a gripper grasping test, adjusting the actuated force to allow the gripper to handle objects of different sizes and shapes," said Ackerman.

IEEE Spectrum posted a video earlier this month that showed the gelatin-based gripper in action picking up an apple.

Aric Jenkins, *Fortune*, said "researchers are closing in on the creation of an ingestible robot that can perform a variety of functions from within the human body."

Meanwhile, James Vincent in *The Verge* took a look at their efforts and made note that they actually had thoughts about a number of ways this could be used.

Vincent wrote that the researchers "imagine digestible bots being put to a number of uses—from exploring our bodies (before being disposed of by our guts) to 'food transportation where the robot does not require additional payload because the robot *is* the food.' (Our emphasis.)"

The scientists worked with "entirely edible gelatin and glycerin materials," said Mike Murphy in *Quartz*. "Everything, from the gripping fingers, through to the sensors, batteries, and transistors, is digestible."

The team's paper is titled "Soft Pneumatic Gelatin Actuator for Edible Robotics," by Jun Shintake, Harshal Sonar, Egor Piskarev, Jamie Paik, and Dario Floreano from EPFL, and *IEEE Spectrum* said it was presented at the International Conference on Intelligent Robots and Systems (IROS) 2017.

Ackerman said they presented a prototype there of the actuator made of gelatin—"biodegradable, biocompatible, and environmentally sustainable."

The Laboratory of Intelligent Systems said, "Soft robots can continuously change their shape, withstand strong mechanical forces, and passively adapt to their environment. The 'softness' makes these robots safer and potentially more robust and versatile than their counterparts made of bolts and metal. Examples include soft grippers that manipulate complex shapes without complex software."

Murphy in *Quartz* said, "it does promise a future where we could swallow smaller bots that could repair us from the inside."

Actually, *TechCrunch* had a look at the team's research interests on this back in March. Brian Heater reported.

"The creation of the actuators is part of the team's ongoing research into soft robotics, a sub-field of robotics inspired by nature that make for components that better comply with their environment. Notable applications for the technology include robotic grippers capable of conforming to a wide variety of different shapes."

More information: Soft Pneumatic Gelatin Actuator for Edible Robotics, arXiv:1703.01423 [cs.RO] arxiv.org/abs/1703.01423

Abstract
We present a fully edible pneumatic actuator based on gelatin-glycerol composite. The actuator is monolithic, fabricated via a molding process, and measures 90 mm in length, 20 mm in width, and 17 mm in thickness. Thanks to the composite mechanical characteristics similar to those of silicone elastomers, the actuator exhibits a bending angle of 170.3 {deg} and a blocked force of 0.34 N at the applied pressure of 25 kPa. These values are comparable to elastomer based pneumatic actuators. As a validation example, two actuators are integrated to form a gripper capable of handling various objects, highlighting the high performance and applicability of the edible actuator. These edible actuators, combined with other recent edible materials and electronics, could lay the foundation for a new type of edible robots.