# *Stanford Develops an Electronic Glove that Gives Robots a Sense of Touch*

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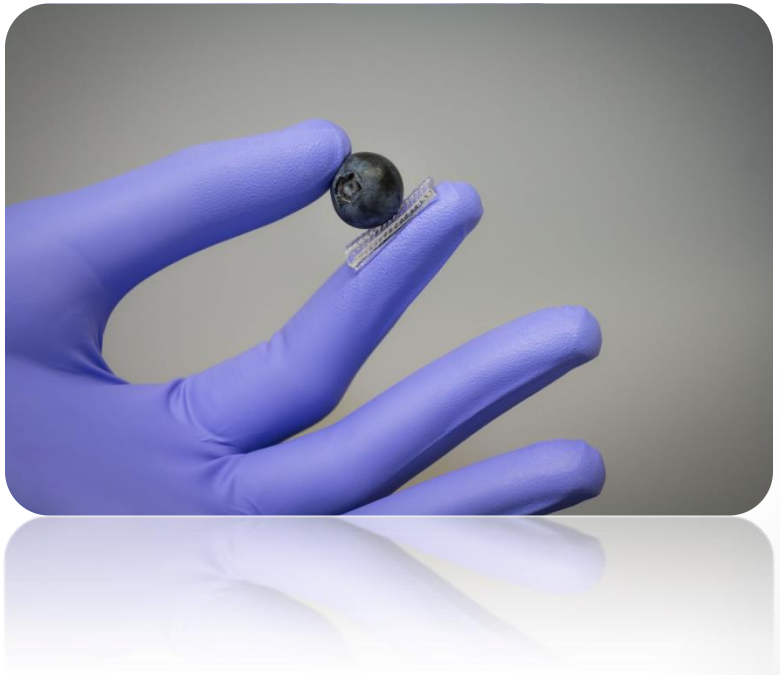
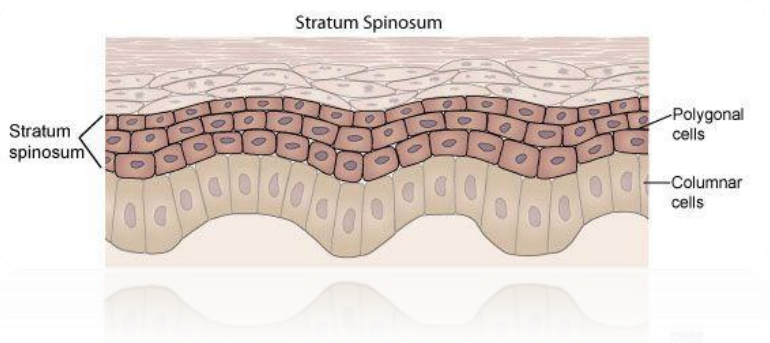
# Introduction

The sensors in the fingertips of the glove measure simultaneously pressure and direction; this has allowed a robot to have enough control such that when it is handling an egg between a “thumb” and “forefinger”, it neither crushes it nor allows it to slip and fall.



# Mechanical Analogue

The premise of the sensors is quite close in mechanics to that of a human fingertip. Our outer layer of skin works in conjunction with a sublayer known as the spinosum, a microscopic bumpy terrain on hills and valleys. When contact occurs, the pressure from outside forces the outer layers of skin to contact the spinosum, and the ridges and valleys within the spinosum help determine direction of the force.



# Implementation

The robotic sensors work in a similar manner: each sensor is comprised of three flexible layers; the top and bottom layers being electrically active. The inner facing sides of the outer two layers have lines of electrical lines; the lines on one face are perpendicular to its complementing face, creating a grid.

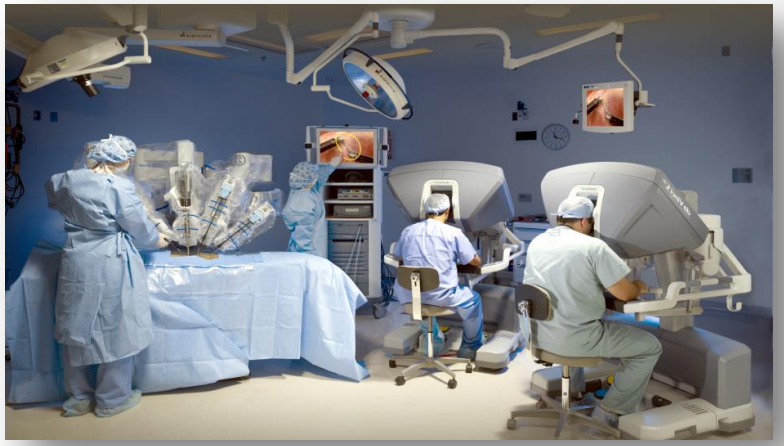
# Implementation (cont.)

The bottommost layer is also comprised of microscopic ridges and valleys, much in the same manner as the spinosum. The central layer is a rubber insulator that keeps the electrically active layers separated. The separating is critical: electrodes that are close but do not connect are able to store energy. As the outer layer is pressed down, the distance between the electrodes decrease and hence, the stored electrical energy increases, mimicking pressure. The bumps on the bottommost layer then help to map intensity and direction of pressure to certain points on the electrical grid.

# Possible Applications

Current possible applications of the technology are already diverse: a robotic hand with sensors equipped can be programmed to perform a repetitive, yet delicate task. This can be applied in factories or in the food industry, performing tasks such as lifting eggs off a conveyer belt and placing them in cartons, preparing them for consumption.

The technology can also currently find application a cutting edge field: robotic surgery, where precision is a must. Precise detection of force and pressure is crucial in an environment where a single mistake can cost the life of a patient.



# The Future?

Unfortunately, the touch sensors are not at a point where it can automatically handle an object at the correct pressure without prior programming. Put succinctly in the words of the team lead Zhenan Bao: “We can program a robotic hand to touch a raspberry without crushing it, but we’re a long way from being able to touch and detect that it is raspberry and enable the robot to pick it up.” Bao has stated that her ultimate goal is to develop a version of the touch sensors that can accomplish just that.