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Four-fingered robot can replace flashlight batteries

Bioengineers get a step closer to producing a robotic hand as dexterous as a human's.

Larry Greenemeier

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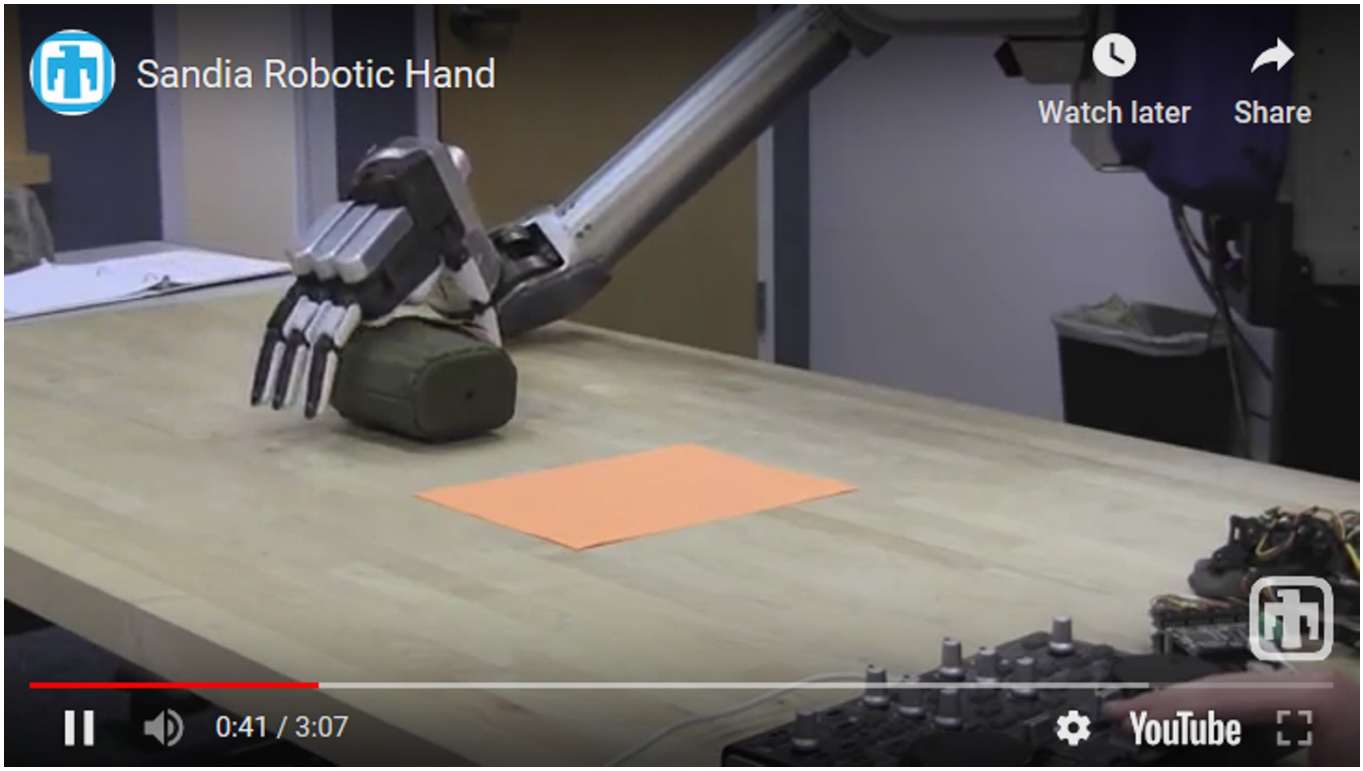

An article from Scientific American.

A robot that can reproduce the dexterity of the human hand remains a dream of the bioengineering profession. One new approach to achieving this goal avoids trying to replicate the intricacy of the bones, joints and ligaments that produce our most basic gestures.

A Sandia National Laboratories research team has adopted just such a strategy by designing a modular, plastic proto-hand whose electronics system is largely made from parts found in cell phones. The Sandia Hand can still perform with a high level of finesse for a robot, and is even capable of replacing the batteries in a small flashlight. It is expected to cost about $10,000, a fraction of the $250,000 price tag for a state-of-the-art robot hand today.

The researchers were able to scrimp in a number of clever ways. “One was scouring the globe for the least expensive, highest-performing components like motors, gears, etcetera,” says Curt Salisbury, the project’s principal investigator. “Another was to build the entire electronics system from commodity parts, especially those found in cell phones. We also moved from metal structural elements to plastic, being careful to design the structures so plastic would provide adequate strength.”

The Sandia Hand’s fingers are modular and affixed to the hand frame via magnets. This gives the researchers the flexibility to design interchangeable appendages tipped with screwdrivers, flashlights, cameras and other tools. The fingers are also designed to detach automatically to avoid damage if the hand hits a wall or other solid object too hard. The researchers say the hand can even be manipulated to retrieve and reattach a fallen finger.

The Hand’s current incarnation has only four fingers, including the equivalent of an opposable thumb. “It turns out that for a wide range of manipulation tasks that humans do, four fingers is enough,” Salisbury says. Still, future iterations of the Hand could have any number of fingers and any arrangement of those fingers without adding much cost or complexity, he adds.

Although the Hand might someday be programmed to operate autonomously, for now a human controls the device using either a

sensor-laden glove or a basic control panel. The glove is a custom design that reads a person's hand posture and attempts to replicate that with the robot hand, Salisbury says. The communication protocol right now is a USB cable, but could be upgraded to include any wireless communications approach, he adds. The team's goal is to develop a glove that costs about $1,000.

At such a low cost, and with the Defense Advanced Research Projects Agency (DARPA) funding the project, the Hand might be a welcome addition to mobile robots involved in disarming and disposing of improvised explosive devices (IEDs). The U.S. military has deployed thousands of unmanned ground robots worth hundreds of millions of dollars to disarm IEDs used against troops in Afghanistan and Iraq over the past decade. Many of these devices, such as iRobot's PackBot, are driven by remote control into dangerous areas where they use clamp-like metal claws to search for and dispose of bombs. A significant amount of the money spent on these battle bots goes toward spare parts to replace those damaged in the field. One of Sandia's goals is to offer greater proficiency at disarming (rather than detonating) bombs.

Sandia researchers are experimenting with upgrades to the Hand, including a palm with two embedded cameras that convey stereo images to a human operator during a grasping sequence. "After that," Salisbury says, "we hope this technology will move to field tests."

In the video above, the Sandia Hand demonstrates a number of capabilities, including lifting a suitcase, picking up a telephone handset and, perhaps most impressively, dropping a AA battery into a flashlight.

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