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This Camera Is Like an Eye

New method for making curved sensors advances hopes for artificial retina

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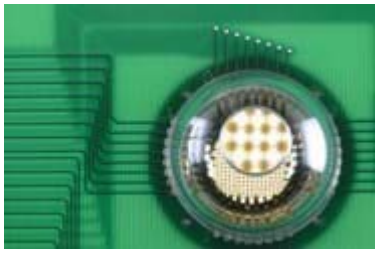
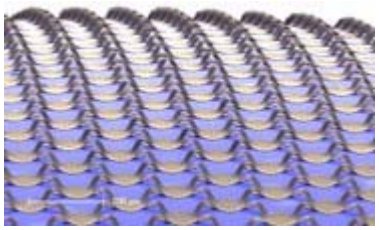
WHERE DISCOVERIES BEGIN

Biology teachers have been telling students "the eye is like a camera" ever since there were cameras. And while there are many similarities between the two, the camera, alas, is not like an eye. The human eye is a deceptively simple biological organ made of wet, squishy materials that efficiently and rapidly manipulate and process light waves under a diversity of conditions. A camera—even modern digital ones—not so much. They are hard, and flat and brittle.



A new 256-pixel electronic-eye camera has the same size, shape and layout as a human eye. (Beckman Institute, University of Illinois)



Silicon photo-detector pixels and electronics interconnected by arc-shaped ribbons allow the "seeing" surface to be shaped into a curve similar to a human retina. (Beckman Institute,

But new research reported this week brings mechanical imaging devices ever closer to the real thing and may lead the way toward the first bio-electronic prosthetic eyeball. That may be good news for many of the estimated 10 million blind or visually impaired people in the United States.

"We believe that some of the most compelling areas of future application involve the intimate integration of electronics with the human body," said John Rogers, a physical chemist at the University of Illinois at Urbana-Champaign, who helped develop the device.

Even though it's based on the same materials, this bionic orb is a radical departure from the hard, flat silicon sensing wafers now used in digital cameras and other imaging devices, and a very long way from the complex system of multiple lenses and mirrors used in older film cameras.

"The advantages of curved-detector surface imaging have been understood by optics designers for a long time, and by

University of Illinois)

biologists for an even longer time," said co-developer Yonggang Huang of Northwestern University in Evanston, Ill. "That's how the human eye works—using the curved surface at the back of the eye to capture an image."

This device is made of a flexible light sensor consisting of an array of 256 pixels linked by a stretchy mesh of tiny wires, which the researchers form into a shallow cup and attach to a curved-glass substrate to keep its shape. The mesh allows the sensor array to withstand up to 40 percent stretching, bending and twisting—about like folding a digital camera nearly in half.

Connecting a lens to focus light entry and external electronics to translate the signals completes the assembly, which has the same size, shape and layout as a human eye.

For now, Rogers and his research team are content to call the device a camera, but the invention also foreshadows adaptations for use as a human body part. Such spherical shapes, for example, are "much better suited for use as retinal implants than flat detectors," Rogers said. "The ability to wrap high-quality silicon devices onto complex surfaces and biological tissues adds very interesting and powerful capabilities to electronic and optoelectronic device design, with many new application possibilities." The team announced their findings Aug. 7, 2008, in the journal *Nature*.

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—By Leslie Fink/NSF

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