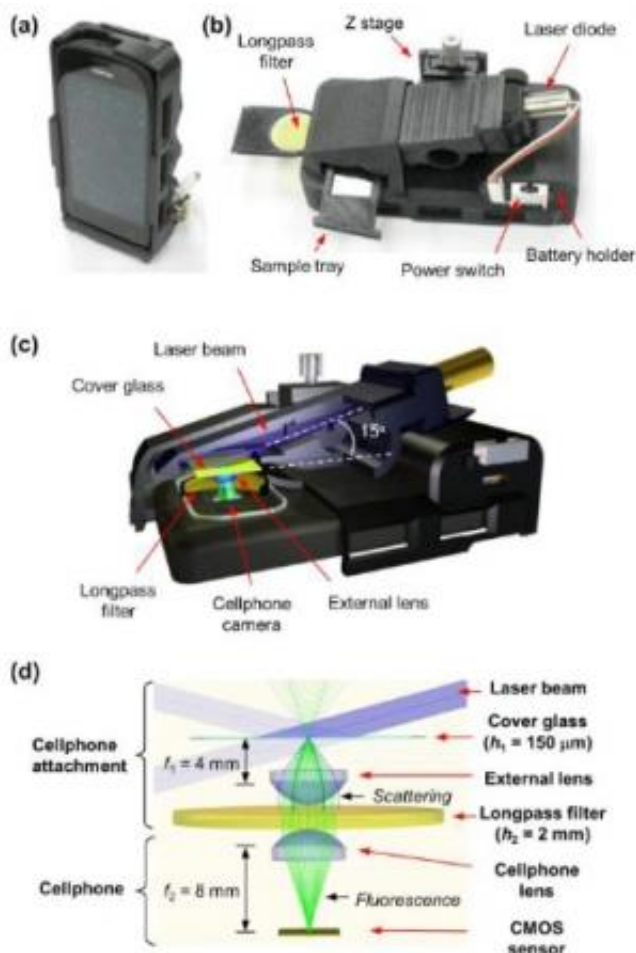


# Researchers' smartphone 'microscope' can detect a single virus, nanoparticles

17 September 2013, by Bill Kisiuk



(Phys.org) —Your smartphone now can see what the naked eye cannot: A single virus and bits of material less than one-thousandth of the width of a human hair.

Aydogan Ozcan, a professor of electrical engineering and bioengineering at the UCLA Henry Samueli School of Engineering and Applied Science, and his team have created a portable smartphone attachment that can be used to perform sophisticated field testing to detect [viruses](#)

[and bacteria](#) without the need for bulky and expensive microscopes and lab equipment. The device weighs less than half a pound.

"This cellphone-based imaging platform could be used for specific and sensitive detection of sub-wavelength objects, including bacteria and viruses and therefore could enable the practice of nanotechnology and biomedical testing in field settings and even in remote and resource-limited environments," Ozcan said. "These results also constitute the first time that single nanoparticles and viruses have been detected using a cellphone-based, field-portable imaging system."

The new research, published on Sept. 9 in the American Chemical Society's journal *ACS Nano*, comes on the heels of Ozcan's other recent inventions, including a cellphone camera-enabled sensor for allergens in food products and a smart phone attachment that can conduct common kidney tests.

Capturing clear images of objects as tiny as a single virus or a nanoparticle is difficult because the [optical signal](#) strength and contrast are very low for objects that are smaller than the [wavelength of light](#)

In the *ACS Nano* paper, Ozcan details a [fluorescent microscope](#) device fabricated by a 3-D printer that contains a [color filter](#), an external lens and a [laser diode](#). The diode illuminates fluid or solid samples at a steep angle of roughly 75 degrees. This oblique illumination avoids detection of [scattered light](#) that would otherwise interfere with the intended fluorescent image.

Using this device, which attaches directly to the camera module on a smartphone, Ozcan's team was able to detect single human cytomegalovirus (HCMV) particles. HCMV is a common virus that can cause birth defects such as deafness and brain damage and can hasten the death of adults who

have received organ implants, who are infected with the HIV virus or whose immune systems otherwise have been weakened. A single HCMV particle measures about 150–300 nanometers; a human hair is roughly 100,000 nanometers thick.

In a separate experiment, Ozcan's team also detected [nanoparticles](#)—specially marked fluorescent beads made of polystyrene—as small as 90–100 nanometers.

To verify these results, researchers in Ozcan's lab used other imaging devices, including a scanning electron microscope and a photon-counting confocal microscope. These experiments confirmed the findings made using the new cellphone-based imaging device.

**More information:**

[pubs.acs.org/doi/pdfplus/10.1021/nn4037706](https://pubs.acs.org/doi/pdfplus/10.1021/nn4037706)

Provided by University of California, Los Angeles

APA citation: Researchers' smartphone 'microscope' can detect a single virus, nanoparticles (2013, September 17) retrieved 23 September 2019 from <https://phys.org/news/2013-09-smartphone-microscope-virus-nanoparticles.html>

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