Engineer invents world's smallest, lightest telemedicine microscope

22 April 2010, By Jennifer Marcus and Mike Rodewald

Prototype for Ozcan's lensless microscope

Aydogan Ozcan, whose invention of a novel lensless imaging technology for use in telemedicine could radically transform global health care, has now taken his work a step further -- or tinier: The UCLA engineer has created a miniature microscope, the world's smallest and lightest for telemedicine applications.

The microscope, unveiled in a paper published online in the journal Lab on a Chip, builds on imaging technology known as LUCAS (Lensless Ultra-wide-field Cell Monitoring Array platform based on Shadow imaging), which was developed by Ozcan, an assistant professor of electrical engineering at the UCLA Henry Samueli School of Engineering and Applied Science and a researcher at UCLA's California NanoSystems Institute.

Instead of using a lens to magnify objects, LUCAS generates holographic images of microparticles or cells by employing a light-emitting diode to illuminate the objects and a digital sensor array to capture their images. The technology can be used to image blood samples or other fluids, even in Third World countries.

"This is a very capable and yet cost-effective microscope, shrunk into a very small package," Ozcan said. "Our goal with this project was to develop a device that can be used to improve health outcomes in resource-limited settings."

The lensless microscope, in addition to being far more compact and lightweight than conventional microscopes, also obviates the need for a trained technicians to analyze the images produced ? images are analyzed by computer so that results are available instantaneously.

Weighing 46 grams ? approximately as much as a large egg ? the microscope is a self-contained imaging device. The only external attachments necessary are a USB connection to a smart-phone, PDA or computer, which supplies the microscope with power and allows images to be uploaded for conversion into results and then sent to a hospital.

Samples are loaded using a small chip that can be filled with saliva or a blood smear for health monitoring. With blood smears, the lensless microscope is capable of accurately identifying cells and particles, including red blood cells, white blood cells and platelets. The technology has the potential to help monitor diseases like malaria, HIV and tuberculosis in areas where there are great distances between people in need of health care and the facilities capable of providing it, Ozcan said. It can even be used to test water quality in the field following a disaster like a hurricane or earthquake.

Using a couple of inexpensive add-on parts, the lensless microscope can also be converted into a differential interference contrast (DIC) microscope, also known as a Nomarski microscope. DIC microscopes are used to gain information on the density of a sample, giving the appearance of a 3-D image by putting lines and edges in stark contrast. The additional parts for conversion to a DIC microscope cost approximately $1 to $2.

A number of design elements lead Ozcan to believe his lensless microscope will be a useful medical tool in resource-limited settings, such as some countries in Africa. Two key requirements for such settings are ease of use and durability. The microscope requires minimal training; because of its large imaging field of view, the sample does not need to be scanned or perfectly aligned in the microscope. And operating the microscope is as simple as filling a chip with a sample and sliding the chip into a slot on the side of the microscope. Because of its large aperture, the lensless microscope is also resistant to problems caused by debris clogging the light source. In addition, there are few moving parts, making the microscope fairly robust.

The lensless microscope is also an example of a type of medicine known as telemedicine. In resource-limited settings, tools that are portable enough to do medical tests in the field are vital. Tools like the lensless microscope could be digitally integrated as part of a telemedicine network that connects various mobile health-care providers to a central lab or hospital, filling gaps in physical infrastructure with mobile tools. The transmission connections for such networks already exist in cellular networks, which have penetrated even the most remote corners of the globe.

"Making things user-friendly is what I love about being an engineer," Ozcan said. "It is very rewarding to create something that to the end-user is very simple, when in reality years of research and work went into the technology and product development."

Provided by University of California Los Angeles
APA citation: Engineer invents world's smallest, lightest telemedicine microscope (2010, April 22) retrieved 20 October 2019 from https://phys.org/news/2010-04-world-smallest-lightest-telemedicine-microscope.html