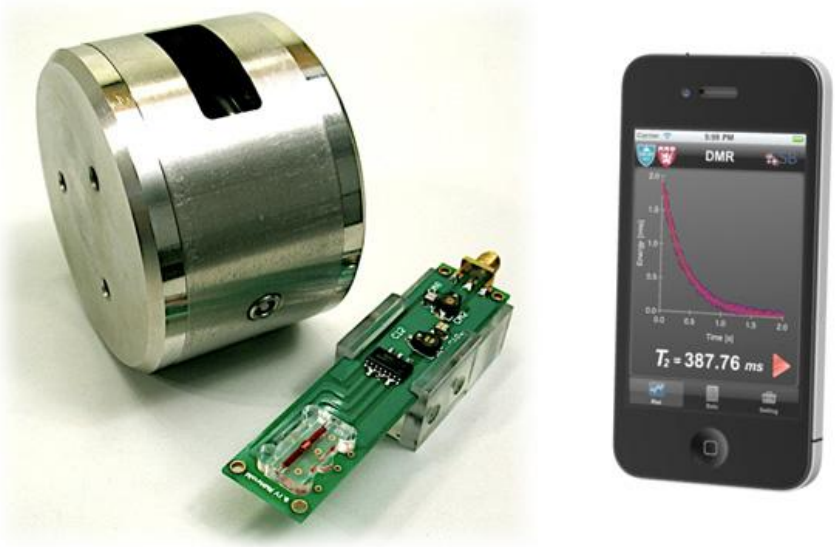
Researchers Use Smartphones to Detect Cancers

By Charles Q. Choi, TechNewsDaily Contributor
23 February 2011 4:16 PM ET



A portable NMR system for bed-side diagnostics. The system features a miniaturized NMR probe for the capability of single-cell detection and a user-friendly smart phone interface. Credit: C. Min, H. Lee, R. Weissleder

Smartphones equipped with what are essentially hand-held MRI scanners can accurately diagnose life-threatening tumors, researchers say.

The miniature scanner could diagnose cancer faster, more accurately and less expensively than the current gold standard technique used in the field. Improvements in diagnosis could lead to matching improvements in therapies, the inventors added.

Nuclear magnetic resonance or NMR scanners immerse samples in magnetic fields and then hits them with radio waves, encouraging atoms to emit signals that shed light on the composition of the molecules they are in. NMR was renamed magnetic resonance imaging or MRI in medicine so as to not scare people with the word "nuclear."

MRI and nuclear magnetic resonance (NMR) scanners typically use large, powerful magnets, but that is unnecessary when the samples being scanned are very small — say, just one-millionth of a liter of fluid, which is all that is needed for an accurate detection of cancer cells.

Researchers now have developed a device "that, even including the magnet, can fit in the palm of

your hand," researcher Jered Haun, a medical engineer at Harvard Medical School in Boston, told TechNewsDaily.

The device requires only a 0.5 tesla magnet, less powerful than the magnet in a typical loudspeaker. (A full-body MRI system is about 10 tesla in strength.)

For their study, detailed online in this week's issue of the journal Science Translational Medicine, researchers said they used antibodies bound to magnetic iron oxide particles only 30 nanometers (billionths of a meter) wide. The antibodies latch onto whatever specific compounds they are designed to look for — in this case, cancer-linked molecules — while the magnetic nanoparticles enhance the image of the target compounds.

The researchers took specks of tissue from patients, prepared them with the antibody-nanoparticle combos, and scanned them with the device. The scanner was attached to a chip that in turn could be connected to a smartphone, which physicians could use to read and operate the gadget.

At Massachusetts General Hospital, researchers analyzed small portions of biopsies from 50 patients who had a variety of cancers. After scanning tissue for the presence of nine key proteins — ones that can predict the likelihood that a cancer will grow and spread to other tissues in the body — the gadget identified 44 patients harboring malignant tumors, and each diagnosis was verified by standard techniques.

By homing in on four of the nine proteins, the researchers were able to boost the diagnostic accuracy of the micro-NMR chip to 96 percent, surpassing the 84 percent accuracy of immunohistochemistry, the current gold standard in diagnosing cancer. The machine also was able to generate results in under an hour, compared with a typical three-day turnaround.

"We were most surprised by just how well the device worked, obtaining that level of molecular information from such small, crude, minimally processed samples," Haun said.

The scientists found the tumors could look very different on a molecular level depending on which areas were sampled. This means patients probably will have to be jabbed with needles several times to obtain multiple samples that provide a complete picture of a cancer, "but those are more like pokes, the kinds of injections you get with a local anesthetic, than a core biopsy, where you're actually cutting away tissue and which is much more painful and can lead to complications," Haun said.

Besides cancer diagnosis, the researchers are experimenting to see how well their scanner works on diagnosing diseases such as tuberculosis. "There are plans to bring this to Africa, where its portability really lends itself to performing in the field," Haun said.

"The phone part of a smartphone could also then prove useful in sending results to specialists to examine."

Currently no company is working on commercializing this device, Haun added.

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