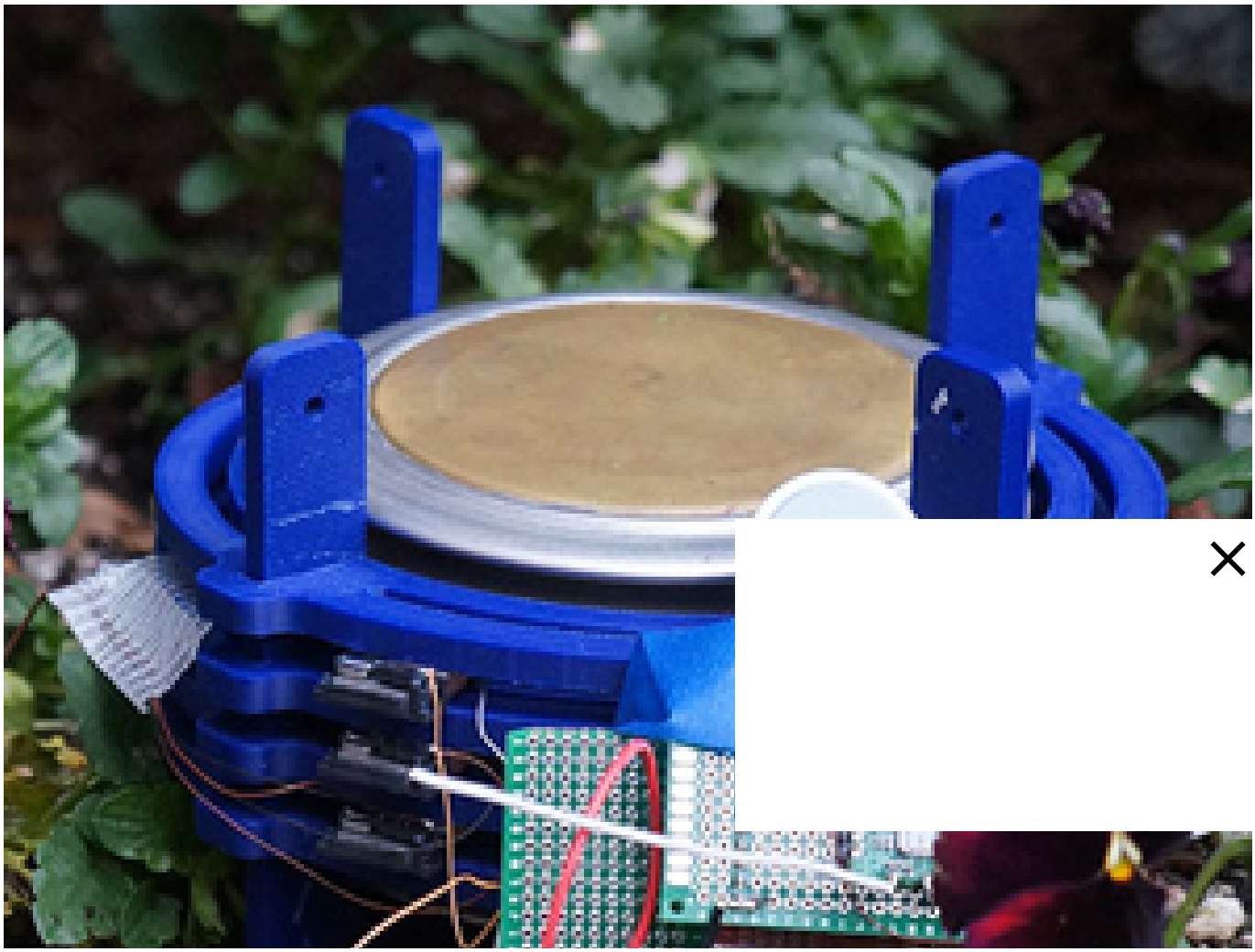
MIT Technology Review

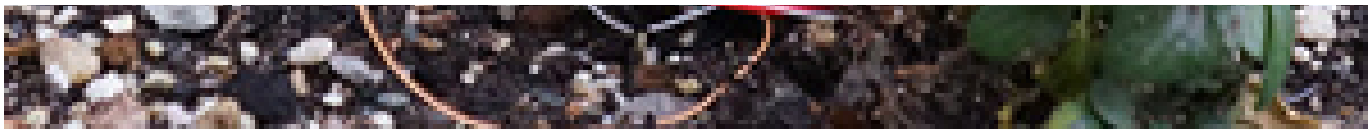
Can Electronic Devices Harvest Energy on Their Own?

Clever approaches to gathering ambient energy could lead to new applications.

by **Kristin Majcher** Oct 29, 2014

The usefulness of the "Internet of things" will depend on small sensors put just about anywhere to capture data about the environment or track products and people. To have the greatest impact, such sensors will need to work even without being plugged in or depending on batteries that have to be recharged or replaced. That's why engineers are developing sensors that can get by with energy harvested from ambient sources, such as light, changes in temperature, and radio waves. Here are some examples.





University of Washington researchers developed a new sensor that harvests power from gradual temperature changes and could be used to detect problems like leaks or cracks in buildings.

Backscatter

The University of Washington's Shyam Gollakota and his team have created a way of connecting devices to the Internet that consumes very little power and does not require batteries. The devices capture radio-frequency energy that is all around us from radio, TV, and cell phone networks. Gollakota and colleagues are not the first to harvest radio-frequency energy, but their technology goes a step further because it also can facilitate communications over Wi-Fi—which normally would require much more power than can be captured from ambient radio waves. They do this with technology they call Wi-Fi backscatter. They have developed tags with antennas that switch between reflecting and absorbing the ambient radio waves. In absorbing mode they gather power; in reflecting mode they can scatter the radio-frequency energy in ways that a nearby Wi-Fi router can detect. The tag uses fewer than 10 microwatts of power to communicate via these reflections, compared to the watt of power it could take to actually transmit Wi-Fi signals. Today, the tag can communicate over a range of two meters, but researchers hope to extend that to 20 meters. The researchers demonstrate the technology in this video and explain it in this paper.

Sensing Change

Another group of University of Washington researchers has developed a sensing device that takes advantage of the gradual temperature changes in the environment. The sensors could monitor water leaks or structural issues in buildings and send wireless alerts. The key to making this technology work is an accordion-like bellows inside the device filled with a gas that expands or contracts based on the temperature; this movement is converted into electricity. The researchers demonstrated that a temperature change of just 0.25 °C is enough to power a sensor node, transmit data to a receiver more than five meters away, and update an e-ink display showing the temperature. The sensor is described in the paper "Powering Wireless Sensor Nodes with Ambient Temperature Changes" and shown in this video.

Antenna on Chip

Researchers from Stanford and the University of California, Be
size of an ant. Its antenna harvests enough power from an inco
embedded in it. At a cost of only a few pennies to make, these
way to connect almost any type of device to the Internet. The c
the 2014 Symposium on VLSI Circuits.

Nanogenerator

power themselves to detect motion, vibrations, leaks, or explosions. Research on the generators has been described in several papers, including an article in *Nature Communications* in March that explains how the generator can charge electronics. Lin Wang explains the "triboelectric effect" produced by two different materials in this video.

The Takeaway:

Eventually, we might be able to run phones and tablets on harvested ambient energy, after such devices get reworked to require dramatically less power. But for now, energy harvesting is promising for only small sensors and radios. Today's versions of the cell phones and laptops we use every day require orders of magnitude more power.

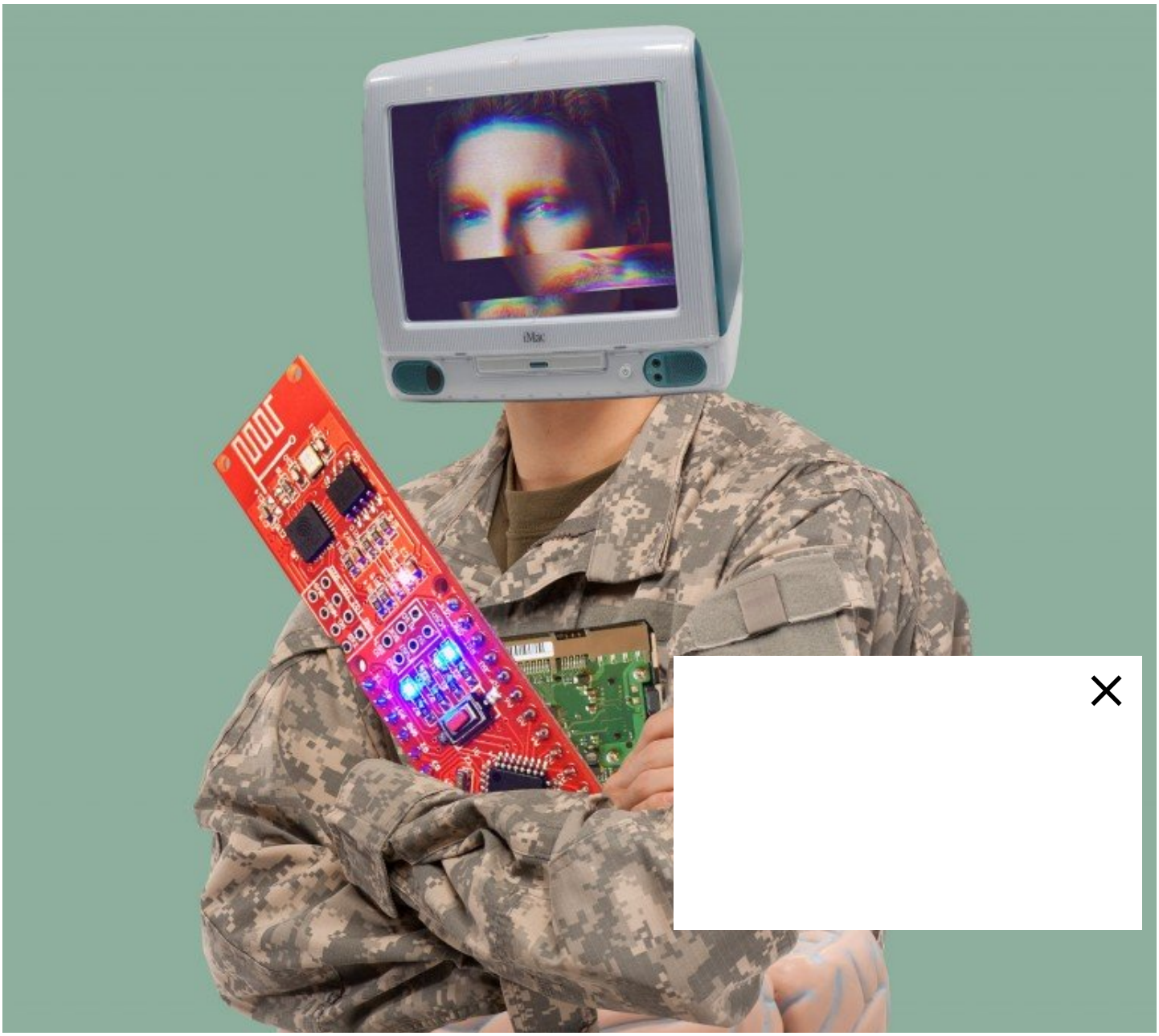
Do you have a big question? Send suggestions to questionoftheweek@technologyreview.com.

What makes a city great? A new way to look at urban data will give us clues.

Special issue: war and peace

The US military wants super-soldiers to control drones with their minds

A new DARPA research program is developing brain-computer interfaces that could control ""swarms of drones, operating at the speed of thought". What if it succeeds?



Silicon Valley 57m

Twitter's policy on what it will let Trump tweet is completely toothless

The news: Twitter has used a blog post to set out exactly what President Donald Trump would need to do to be suspended or banned from the platform. He'd have to promote terrorism, post someone's...

Expand

Humans and Technology 59m

The US military wants super-soldiers to minds

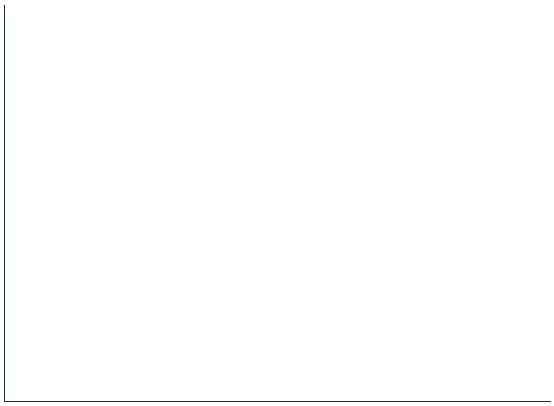
A new DARPA research program is developing brain-computer int operating at the speed of thought". What if it succeeds?

Smart Cities 2h

Deep learning

This robot hand taught itself to solve a Rubik's cube

Researchers at OpenAI have developed a new method for transferring complex manipulation skills from simulated to physical environments.



SpaceX News Oct 15

SpaceX just filed a request to run 30,000 more Starlink satellites in orbit

The company wants permission to turn its proposed mega-constellation into a behemoth in low Earth orbit. But its motives are unclear.

Read more

Blockchain Oct 15

Telegram might be forced to put its global cryptocurrency plans on ice

The US Securities and Exchange Commission (SEC) has just halted Telegram's massive—and massively hyped—$2 billion digital token sale....

Expand

Astronomy Oct 15

A galaxy cluster has been used as a magnifying glass to view the ancient universe

Astronomers have spotted a toddler dwarf galaxy 9.4 billion light-years away by turning a cluster of other galaxies into a magnifying glass for x-rays, according to a new paper published in Nature...

Expand

Climate Change Oct 15

The UK just got more power from renewables than fossil fuels for the first time

The news: In the third quarter of this year 40% of the UK's electricity came from renewables like wind, biomass, and solar, while fossil fuels—virtually all gas in the UK's case—made up 39%, according...

Expand

How a new class of startups are working to solve the grid storage puzzle

California's shutting off power to prevent fires. Here are some better options.