

SCIENCE AND TECHNOLOGY NEWS | THE WEEK'S BEST IDEAS | US JOBS IN SCIENCE

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Your beautiful forgetful mind

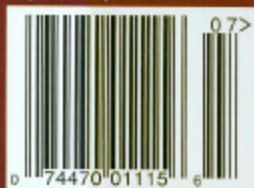


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All charged up and raring to go...

IT GIVES a whole new meaning to "power walking". Strap on a pair of leg braces and with a little extra effort you can generate enough electricity while you walk or run to charge up your cellphone or laptop, or perhaps even a prosthetic arm.

The brace, built by Max Donelan and colleagues at Simon Fraser University in Burnaby, Canada, harvests around 5 watts of power from the motion of a walking pair of legs – enough to power 10 cellphones. A gear on the brace twists as you stride along, causing an attached electricity generator to spin and generate power (tinyurl.com/34ytlh).

In 2005 Larry Rome of the University of Pennsylvania in Philadelphia and colleagues developed a power-generating backpack (*Science*, vol 309, p 1726). Designed for people who were already used to carrying a heavy load, such as soldiers, it harnesses

POWER FROM THE PEOPLE

The ordinary motion of our bodies could power electrical gadgets

Backpack

Power out: 7 watts

The up-and-down motion of our hips and shoulders as we walk, bounces the backpack

Piezoelectric clothing

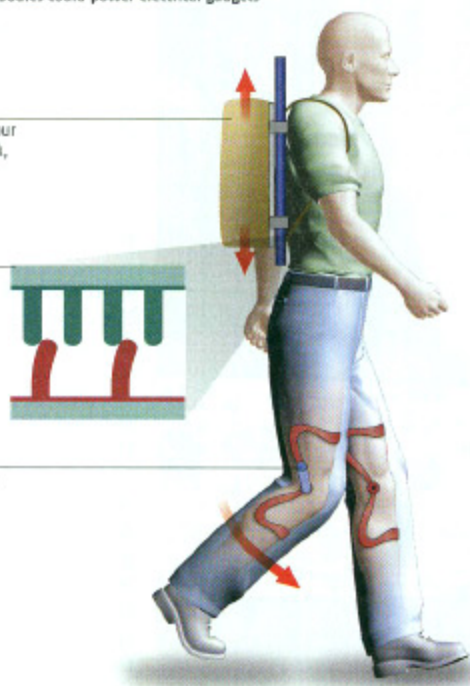
Power out: 80 milliwatts

The fibres of the piezoelectric fabric produce a voltage as they are brushed together through natural movement

Leg brace

Power out: 5 watts

As the leg moves, the gears in the brace turn, spinning an electric generator



the loping up-and-down motion of the wearer's hips and shoulders as they walk. But you have to carry a 38-kilogram backpack to generate 7 watts of power.

The leg braces weigh 1.6 kilograms and extend from mid-thigh to mid-calf. "It's a device that a healthy, normal human can strap on and generate a significant amount of power

during walking and running," says Hugh Herr, a biomechanics researcher and prosthetics expert at the Massachusetts Institute of Technology. Although walking with the two braces uses up 20 per cent more metabolic energy than walking normally, Donelan hopes to make the leg brace lighter in future.

To figure out how to use the

brace most efficiently, Donelan's team got volunteers to run on a treadmill while wearing a brace on each leg. A person walking repeats a cycle in which they bend each leg to lift it off the ground and then extend it outwards before it hits the ground.

In some tests, the researchers programmed the braces so that the gears engaged with the electricity generator for the whole process of leg extension, using a sensor that detects leg position. They also tried programming the gears so that

"A human can generate a significant amount of power while walking"

they only engaged during the end part of each leg extension.

When the generator spun only during the end of the extension, it generated slightly less power, but also required less effort, making it more efficient overall than when the brace generated power throughout the entire leg extension process (*Science*, DOI: 10.1126/science.1149860).

The researchers say this is because at the end of the extension, muscles expend effort to decelerate or "brake" before the foot hits the ground. Because the brace adds resistance to leg movement, it helps with this braking process. "You can think of walking like stop-and-go driving," says Donelan. "Muscles spend about the same amount of time working as brakes as they do working as motors."

Hybrid and electric cars work in a similar way, boosting efficiency by generating electricity from energy expended during braking.

Donelan has founded a company called Bionic Power to develop the brace into a product that will suit soldiers, hikers and emergency rescue teams. Herr says the knee brace could eventually be used to power motors in prosthetic arms. But Rome says that for people to use the leg brace, it must feel "like it's not even there". **Mason Inman** ●

T SHIRT POWER

Big, obvious body motions such as walking can generate large amounts of power. Useful dribbles of power can also be harvested from subtler motions, including a piezoelectric fabric that generates power through the bending of its component threads.

Last year, Zhong Lin Wang, a materials scientist at the Georgia Institute of Technology in Atlanta, developed a generator composed of a forest of piezoelectric zinc oxide nanowires topped by a flat conductive plate (*New Scientist*, 25 August 2007, p 30). When the plate is pushed down, the wires bend, producing a voltage that induces a current to flow into the plate.

Now Wang has turned this idea into an electricity-generating thread, which he plans to weave into a fabric. His team figured out how to grow the nanowires on a strand of Kevlar fibre instead of a flat surface, so that the wires stick out from the fibre like bristles on a pipe-cleaner. When two bristly fibres rub against one another, the nanowires deform, causing a current to flow through a thin layer of metal coating on one of the fibres.

In tests with just two short fibres, Wang's team was able to generate a few picowatts of power, but they found that the power output increased 50-fold when three pairs of fibres are

twined together into a yarn, increasing the area of contact (*Nature*, DOI: 10.1038/nature06601).

Wang estimates that the fabric should be capable of generating about 80 milliwatts of electricity per square metre, enough to charge a cellphone battery or other personal electronics from the ordinary motions of a shirt or a curtain blowing in the wind.

A fabric woven from such coated fibres shouldn't ultimately be too expensive, because the nanowires can be grown in bulk. With the fibres just 40 micrometres in diameter, bristles and all, they will be too small to give the wearer a prickly feeling. **Bob Holmes**