Researchers Develop Power-Producing Backpack

Energetic Walking May Give One Day's Juice to Your Mobile Electronics

By PAUL ENG

Sept. 8, 2005 —

Relief workers wandering through the hurricane-damaged areas of the Gulf Coast carry a heavy burden -- literally.

In addition to food, potable water, medical supplies, flashlights, radios and other electronic gear such as GPS satellite receivers, some crews -- rescue teams and National Guard soldiers, for example -- must carry other weighty tools while on duty.

Researchers say shouldering that load may someday be helpful in another way: To help produce electricity to run the workers' high-tech gear or to provide power in areas where there is none.

Researchers at the University of Pennsylvania have developed a new type of backpack that actually generates electricity as a load-bearer walks. Lawrence C. Rome, a professor at the university's Department of Biology and the lead researcher of the project, says the concept behind the device is pure simplicity.

"When you walk, your hips move about five to seven centimeters [about two to three inches] vertically," says Rome. "That's because you have a straight leg, that when you plant it on the ground, it's actually lifting you -- sort of like when a pole-vaulter plants his pole and then is lifted up -- in an arc as you move forward."

Most people don't notice those tiny up-and-down motions while walking. But Rome did and he set out with his research team -- Louis Flynn, an engineer, and postdoctoral fellows Evan M. Goldman and Taeseung D. Yoo -- to turn those small oscillations into pure electrical energy.

Jump for Juice

The team's prototype Suspended-load Backpack looks similar to any rigid-frame pack commonly used by campers, hikers and soldiers.

But as the name implies, the portion of the backpack that actually carries the wearer's cargo is suspended on a "load plate." The plate itself is connected to the frame by a series of vertical springs, allowing it to slide freely. Also on the plate is a "rack," or small row of teeth, which mates to a gear attached to a tiny generator mounted on the rigid frame.

The plate bounces vertically in reaction to every step taken by the wearer. And as the plate moves, the "rack-and-pinion" setup turns the generator to create electricity.
Tests conducted by Rome's team show that the backpack not only works as predicted, but delivers another interesting feature.

"Electricity generation is proportional to the load you carry and the speed you walk," says Rome. "By either increasing the speed or the load, you can generate much more electricity."

Their results, published in the current issue of Science magazine, show that a person carrying about 40 pounds in the pack at the quick pace of approximately 3 mph can generate about 0.8 Watts, or 800 milliwatts, of power. But double the load and increase the speed to 4 mph and the pack will generate a whopping amount of juice: 7.4 watts.

"A cell phone uses 250 to 260 milliwatts of power, an LED flashlight, about 600 milliwatts, and a GPS receiver about 800 milliwatts," says Rome. "This is generating more electricity than a person is capable of using."

**A Pack for Power Rangers?**

Rome says the power-generation backpack may sound fishy -- especially since it's designed by a biologist rather than a mechanical engineer. But the idea comes from solid studies conducted for and funded by the U.S. Navy's Office of Naval Research and the National Institute of Health.

"My typical research involves understanding how muscles are designed to do different things -- how frogs jump and fish swim," says Rome. And "the Navy has always wanted to duplicate the maneuverability of a fish … to help them build a submersible [vessel] that can turn on a dime."

But while researching for that project, he says he became intrigued by another challenge facing ONR: How to reduce the weight of batteries used by soldiers?

"The Marines and SEALs go into combat with 80 pounds [of gear] on their back," says Rome. "Now with GPS, satellite communication gear, night vision goggles, laser sights … They have to take about 20 pounds of batteries to ensure they can fight for weeks at a time. How can we save that weight? That was a big issue during the Afghanistan war."

That's why most of the research done by Rome's team has been based on using such heavy burdens. The hope is that the backpack could generate enough power for all of a soldier's electronic gear just from marching into battle with a full combat load.

**The Rough and Tumble**

But before the U.S. military sees any real "power rangers" soon, Rome admits that much more work and research needs to be done.

For one, the prototype is a bit bulky and heavy for use in harsh battlefield conditions. All the extra parts add about four to six pounds to a standard military pack. Rome hopes to cut the weight in half without sacrificing durability.

"What we have now is a prototype that is very strong but also very heavy," says Rome. "The generator weighs about a pound [but] we think we can get that down to half a pound and waterproof it. I personally think that it
[the pack] is a doable option, but we have to go through a lot of testing [by the military]."

Rome and his team have started up a commercial company called Lightning Packs to expand the technology, hopefully out of the labs and into the real world.

**Consumer Caution**

So, could a consumer version soon make its way onto the shoulders of mobile workers and commuters with computers soon? Not likely.

As Rome admits, the team hasn't tested the pack with less than 40 pounds, so they aren't sure that lighter loads - coupled with slower walking paces -- would generate enough juice to satisfy common mobile consumer needs.

And like the military version, the consumer pack can't be much heavier -- or more costly -- than the other options available today.

"From a commercial viewpoint, what consumer would be willing to pay more and have a slightly heavier pack to have electricity?" asks Rome. "For explorers or weekend backpackers, they might appreciate generating their own power since they're lugging all that camping gear anyway. But for a commuter where it may or may not generate power?"

As such, Rome believes the radical packs might find more commercial acceptance for their ergonomics rather than their electronics.

"When people walk with Suspended-load Backpacks, they walk more efficiently than with a regular backpack because it moves with you," says Rome. "Certainly, these packs have a coolness factor."

Copyright © 2014 ABC News Internet Ventures