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Finding the Power to Run All Those Portable Electronics

Gary Breed
Editorial Director

We are becoming increasingly dependent on electronic devices in our daily lives, but all of them require at least a small amount of electric power. Better batteries are part of the solution to providing that power, but with so many potential future applications being explored, breakthroughs in power generation and management are needed.

Of course, personal communications and entertainment products are responsible for much of the growth in portable electronics, but there is much more. In the medical arena, prosthetic devices are becoming more capable, there is amazing work underway in artificial organs, along with continued development of supporting devices like pacemakers and automatic dosage drug injectors. Safety and security devices such as child monitors, implanted medical history microchips, and RFID-based building access and financial transaction "cards" will become common before too long.

Some of these things need very little power, but a few need a lot. Nearly all require their source of power to be highly reliable. Our engineering colleagues specializing in power management are working on some difficult, but fascinating challenges! Where is their work heading?

Conservation—The easiest, cheapest power is the power you don't use. But there are limits. At some point, a particular system just cannot operate effectively with less power. Its the same with gas mileage in vehicles and insulation in an energy-conserving building—much can be saved, but some amount of energy input will always be needed. In the case of devices that must deliver power, such as motorized prosthetic limbs or a wireless transmitter, the required power is significant.

Energy storage—Batteries have improved dramatically in response to growth in portable electronics. Fuel cell technology is getting a lot of development effort. High-value capacitors enable much-improved handling of high peak loads. These, and other technologies yet to be developed, will be a significant part of the energy source solution.

Energy harvesting—This is the process of extracting energy from ordinary activities and the environment. Wind and solar power are the most common examples of energy harvesting, but you should also include bat-

teryless wind-up emergency radios and shake-to-charge flashlights that are available. (Hmmm... I suppose there is a message here for health clubs—why are those treadmills taking power *out* of the wall socket?)

More subtle, but currently-used energy harvesting techniques include dynamic braking in hybrid vehicles that helps recharge the batteries, and the long-time practice of extracting excess heat from industrial operations to provide steam or hot water to nearby buildings, or even to generate electricity.

The Army is leading the way in the development of energy harvesting at the personal level. With a major effort underway to equip every soldier with advanced communications, positioning, sensor, computing and weapons technology, the issue of power is at the forefront. Energy harvesting has the potential to greatly extend the time that a soldier can operate without needing to turn off some systems, or stop to recharge batteries.

Among the more interesting techniques is integrating electrical generation and storage into the fabric of clothing. Electroactive polymers that contract when electricity is applied (artificial muscles) have been developed; now the search is underway for similar materials that efficiently convert motion into electricity. When woven into the fabric of clothing, these materials can generate electricity from the motion of ordinary human activities. That energy can be stored in woven capacitors, another developing technology. Without the bulk of canister-type construction, a high-value capacitor can also be woven into clothing or embedded in the composite materials of an airframe or vehicle body.

Although a multi-faceted energy harvesting system would be complex, it's not hard to imagine how it might capture energy from many sources—solar, wind, body motion and even nearby AC power fields, ambient RF and static electricity voltage gradients.

It's fun to imagine the future, especially when you can see that it can actually happen. These are some of the ideas I'll be watching with great interest!

Get Out and Vote on November 7!

To our U.S. readers: We have important issues to consider at the local, state and national level. Do your part by voting for the people you think will do the best job handling our country's economic, social and security issues—not just for today, but for the future.

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