by William Van Winkle

Power Gets Under Your Skin

Thermoelectric technology from Biophan may soon be able to power implantable electronics by harnessing the temperature delta between the inside of your body and just under your skin.

In the outer solar system, our sun is little brighter than the millions of stars comprising its backdrop, and deriving power for a spacecraft via solar cells is impossible. Instead, NASA equips its ships with a thermoelectric thin film with one side pointed toward the Sun and the other toward deep space. The slight temperature delta between the two is just enough to let the power system convert the thermal differential into a bit of electricity—a phenomenon known as the thermocoupling effect.

Biophan Technologies recently acquired a patented approach to take this thermoelectric technology and adapt it for use inside the human body. In many places in the body, there is a 2- to 3-degree (Celsius) difference between the temperature just under the skin and deeper inside. Using sensors the size of one or two postage stamps, Biophan can generate about 50 milliwatts of power, enough to power a pacemaker or trickle-charge a defibrillator battery. With more and larger sensors, the system can generate more power.

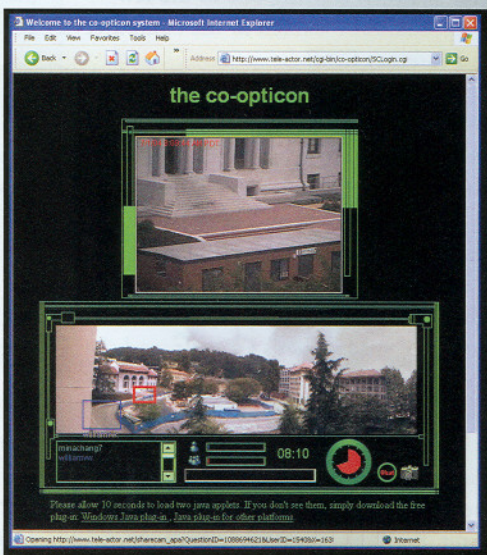
"An artificial heart needs like 10W," says Biophan CEO Michael Weiner, "and while a person generates that much heat across his entire body, capturing it all isn't something we're thinking about. Our target is all the miniature devices going into the body: sensors, drug pumps, pacemakers, neurostimulators, and future things. You'll see more and more diagnostics in the body, some of which will be therapeutic. One company has a device in development that has a GPS built in so that if the person has a heart attack, they know where he or she is. But that will obviously have greater power demands."

Interestingly, Biophan was careful to make sure that its technology would work in most any environment.

"There's a circuit that measures polarity and temperature change," says Weiner. "So, if you went from an air conditioned office out to 108 degrees outside, like you're laying out by the pool in southern Texas, it would change so that the flow would change direction. Instead of 98 degrees on the surface of the skin and 101 on the inside, it might go to 101 on the inside to 105 on the skin. The polarity switches and keeps providing power."

According to Weiner, biothermal power is something that gets installed as part of a new implant, not something you retrofit into existing implants. Although Weiner is reluctant to speculate about applications beyond the medical field, many expect certain low-power devices moving from being worn externally to being implanted subcutaneously. Biothermal-power technology might be the key that enables such a transition.

Weiner expects Biophan's biothermal technology to reach the market in various products within two to three years. ▲



Say we have one electronic eyeball among us but want to look in different places. Software being developed at UC Berkeley will help make sure we all stay satisfied.

10,000 People, One Eye

The day is coming when remotely controllable, motorized Web cameras will be widely available to the public. But if you want the camera to look one way while your counterpart across the country wants it to look somewhere else, you have a problem.

"For a while, we've been looking at people sharing resources, whether that's a camera, a robot, or some experimental apparatus," says Ken Goldberg, UC Berkeley engineering professor. "The problem is when a lot of people want to use them at the same time. The naive thing to do is just take an average of all the viewer requests. But if a bunch of people want to look at the left and a bunch at the right, the camera would look in the middle—a very bad solution. You need to be more sophisticated. We characterize it as an optimization problem, and we've developed a series of algorithms to solve for that."

You can play with the test bed for Goldberg's work at www.tele-actor.net/co-opticon. The co-opticon camera overlooks a section of the Berkeley campus. Remote users see a wide-angle panorama of the camera's possible field of vision within a Java-based browser interface. They then use a mouse to click and drag on an area where they want the camera to focus. Part of the interface displays indicators for your request satisfaction, plus all users' satisfaction.

"We've found that people like to watch people walking around," says Goldberg, "so viewers tend to focus on the foot traffic corridors. Then there's a lot of interest in the construction going on. In fact, we've found that our biggest user is the manager of the construction site. He uses it every day to check in on his workers. At night, users tend to look in the windows because then you can see in them."

Voyeurs, pause there. The co-opticon's resolution isn't sufficient for making out small-scale details, although the project just received a new camera from Panasonic, which is interested in licensing the group's software. Major funding has come from Intel and the National Science Foundation. ▲