SILICON VALLEY biz ink
TECHNOLOGY · FINANCE · REAL ESTATE · LIFESTYLES
THE VOICE OF THE VALLEY ECONOMY

AUGUST 22 - 28, 2003

Tiny technology hasn't hit the big time -- yet

Once they overcome infrastructure limitations, networks of tiny wireless sensors may begin popping up everywhere

Published: Friday, August 22, 2003

Everywhere -- invisible to the naked eye -- millions of sensors collect data. Two Berkeley researchers working on tiny sensor technology believe this is the sort of fabrication best left to Hollywood. Tiny wireless sensor technology is still too rudimentary to formulate a vast global database that can contain all information gleaned from the real world.

Although tiny sensors, or motes, are proving to be valuable in industry and environmental studies, they must still overcome the limitations of inadequate research infrastructure -- such as low bandwidth and energy constraints -- before the technology can find its way out of research labs and become adopted by industry.

Samuel Madden, a researcher at the University of California Berkeley, and Wei Hong, a researcher at the Intel Research Laboratory at UC Berkeley, are co-developing TinyDB technology, which obtains information from a network of tiny wireless sensors. They shared their passion for incorporating this technology into real-world applications with Biz Ink reporter Radhika Kaushik.

What are some real-world applications of your technology?

Hong: Wireless sensor networks can be used to predict equipment malfunction. They can be deployed at assisted-living homes to monitor health statistics and prompt users to take medication. Intel just made a large donation to the Alzheimer's Association to fund these types of applications. There are obviously endless possibilities for the military from monitoring of individual soldiers' health to enemy surveillance.

Madden: An interesting application is in environment and habitat monitoring. Recently, we collaborated with biologists to deploy a network of sensors in a redwood grove. [The devices installed on redwood trees measure light, temperature and humidity.] One of the big advantages of TinyDB [software used for tiny sensors] is that we can easily ask the sensors to report new kinds of readings, change the rates at which they produce data, or ask them to combine data in interesting new ways.

Is your work with these tiny motes -- or sensors -- relevant to the nanotech industry?

Hong: Yes, both motes and nano-devices are pushing computing to a scale where it becomes invisible for humans. High-level infrastructures, like our TinyDB, that allow people to interact with entire networks of devices as a whole are crucial.

Madden: I like to think of motes as a prototype for nano-devices built from

off-the-shelf technology that's available today; in 10 years, motes will be nano-scale devices. The programming model we have developed will only get more useful and important as motes get smaller and more numerous.

The programming behind these tiny sensors is approached as a database problem. What possible lessons can big database companies learn from this?

Hong: Having worked in a big database company before, I think companies can learn that data doesn't just reside on disks. Tons of data available in the physical world can be sampled via sensor networks. There is a clear need for database software in sensor networks and a lot of work still needs to be done simply because sensor networks require network integration on a vast scale.

Madden: The biggest lesson for database vendors is that there is a huge amount of data in the real world that their systems are currently not built to deal with. Conventional database systems demand too many resources, like power and CPUs, to work in the weakly connected, power-constrained environment found in sensor networks.

We now have tiny wireless sensors capable of building a network. What are your thoughts on a futuristic global wireless database?

Hong: I don't think wireless will make wired technology obsolete. It makes more sense for wireless networks to only be deployed at the edges of the Internet. I do believe a publicly shared, globally distributed database with a combination of sensor networks and traditional databases will be extremely valuable. But such a global database will remain a fantasy until we solve the privacy and security problems inevitable in such a system.

Madden: We need to be careful about privacy issues. Even if every individual network is not designed specifically to violate privacy, the combination of data from many such networks may reveal personal activities or whereabouts, and that's scary.

What are some of the challenges facing network sensors?

Hong: It all boils down to power consumption. We need a cheap, renewable energy source. Because of energy constraints, sensor motes have to deal with low bandwidth, possibly intermittent communication links. This makes them much more challenging than traditional networks since sensor motes must sleep most of the time to conserve energy.

Madden: One issue we have begun to address deals with disconnection. Because sensors are often deployed in very remote environments, we expect that these networks will not have a persistent connection to the outside world.

How can the installation of sensor systems become more widely adopted, say in homes?

Hong: We have been focusing on creating do-it-yourself kits at the Intel Berkeley Laboratory. We envision such kits will be sold at Home Depot or Fry's in the future.

Madden: Adoption in homes has to do with finding compelling applications for everyday users. One example might be using sensor nets to reduce home owners electricity bills -- sensor-equipped power outlets could report the amount of energy used by every appliance in the house, so that people can get a sense of where their electric bill is going every month.

In your opinion, what is the most pressing database issue today?

Hong: The database industry should focus on the integration of real-time data that will begin streaming in as we deploy more sensor networks across enterprises and natural habitats.

Madden: One of the biggest challenges is trying to make sense of data coming out from the real world.

You can reach Samuel Madden at madden@cs.berkeley.edu, Wei Hong at whong@intel-research.net and Radhika Kaushik at rkaushik@svbizink.com.