Cellphones for Science

Scientists want to put sensors into everyone's hands

ENVIRONMENTAL SENSOR: Cellphones could broaden scientists' ability to collect data. PHOTO: TIM ROBERTS/GETTY IMAGES

Being at the right place with a camera phone can make anyone an amateur reporter nowadays. How about turning cellphone users into amateur scientists? Cellphones can take pictures, record sounds, reveal location, and even measure temperature and sense light. And they are everywhere—there are more than 260 million subscribers in the United States alone. So cellphones seem an ideal tool for collecting research data, according to Eric Paulos, assistant professor at Carnegie Mellon University's Human-Computer Interaction Institute, in Pittsburgh.

Paulos has lofty goals. He wants to incorporate various environment sensors into cellphones. Everyday cellphone users would then become "citizen scientists," measuring temperature, wind speed, pollen count, or air pollution levels and sharing the data with researchers. He will be presenting his ideas next month at the ETech 2009 conference in San Jose, Calif.

Environment sensing is usually done using a few reading stations spread around cities. Cellphones would give researchers thousands of mobile sensors gathering rich sets of local data at almost no cost. "Scientists would love more data, even if it's not as high quality, just to have [it] for modeling and for understanding a lot of phenomena," Paulos says.

Meanwhile, the compilation of measurements taken at every city block would give people more-accurate, up-to-date readings on weather conditions like temperature or humidity near their offices rather than for the city as a whole. Allergy or asthma sufferers could figure out which areas to avoid. Plus, says Paulos, the average cellphone user would become more aware of science and the environment: "This digital object people carry around can suddenly participate in helping them view their world in a very different way."

A test run in Accra, Ghana, proved the idea could work. Paulos's team gave portable air pollution sensor packs to taxicab drivers and students for two weeks. The resulting model showed microclimates and block-to-block variations, giving a much more nuanced view than the overall city air-quality index. What surprised the researchers was the participants' response. People started exchanging pollution information with friends, Paulos says, and the data prompted one cab driver to take his car in for an emissions inspection.

Paulos and investigators at Intel Research are performing a similar study using sensors that sample the air and send data to a person's cellphone via a Bluetooth link. The cellphone then text-messages the data, along with coordinates from the cellphone's GPS unit, to a central server.

A cellphone's GPS unit on its own can make for valuable data, other researchers have found. Alexandre Bayen, a civil engineering professor at the University of California, Berkeley, is using GPS signals for real-time traffic monitoring in the San Francisco Bay Area. People who have downloaded Bayen's software onto their cellphones automatically send their coordinates to a central server. The data is fused with information from speed sensors and traffic-light sensors deployed by the transportation department. The reconstructed traffic flow is then sent back to cellphones. "On your phone you see a map of wherever you are with a color map on top of it representing a level of traffic exactly like you would see on the Traffic.com Web site," Bayen says—except it would be more accurate, up-to-the-minute, and sent to you automatically so you can plan your route as you drive.

New York City start-up Sense Networks, meanwhile, is combining GPS location data with sophisticated machine-learning algorithms to predict consumer and social behavior. The software pools data about where people are, where they go and when, and the distances they travel. This could help financial services firms predict how retailers are doing or tell shop owners where to put their next store, says cofounder Tony Jebara, a computer science professor at Columbia University, in New York City.

Paulos believes that many new applications for cellphones might open up. The time is just right, he says, because of the collision of sophisticated technology with "people and culture being more participatory."

—Prachi Patel-Predd