

Reality Mining

Sandy Pentland is using data gathered by cell phones to learn more about human behavior and social interactions.

By Kate Greene

Every time you use your cell phone, you leave behind a few bits of information. The phone pings the nearest cell-phone towers, revealing its location. Your service provider records the duration of your call and the number dialed.

Some people are nervous about trailing digital bread crumbs behind them. Sandy Pentland, however, revels in it. In fact, the MIT professor of media arts and sciences would like to see phones collect even more information about their users, recording everything from their physical activity to their conversational cadences. With the aid of some algorithms, he posits, that information could help us identify things to do or new people to meet. It could also make devices easier to use—for instance, by automatically determining security settings. More significant, cell-phone data could shed light on workplace dynamics and on the well-being of communities. It could even help project the course of disease outbreaks and provide clues about individuals' health. Pentland, who has been sifting data gleaned from mobile devices for a decade, calls the practice “reality mining.”

Reality mining, he says, “is all about paying attention to patterns in life and using that information to help [with] things like setting privacy patterns, sharing things with people, notifying people—basically, to help you live your life.”

Researchers have been mining data from the physical world for years, says Alex Kass, a researcher who leads reality-mining projects at Accenture, a consulting and technology services firm. Sensors in manufacturing plants tell operators when equipment is faulty, and cameras on highways monitor traffic flow. But now, he says, “reality mining is getting personal.”

Within the next few years, Pentland predicts, reality mining will become more common, thanks in part to the proliferation and increasing sophistication of cell phones. Many handheld devices now have the processing power of low-end desktop computers, and they can also collect more varied data, thanks to devices such as GPS chips that track location. And researchers such as Pentland are getting better at making sense of all that information.

WHO

Sandy Pentland, MIT

DEFINITION

Personal reality mining infers human relationships and behavior by applying data-mining algorithms to information collected by cell-phone sensors that can measure location, physical activity, and more.

IMPACT

Models generated by analyzing data from both individuals and groups could enable automated security settings, smart personal assistants, and monitoring of personal and community health.

CONTEXT

Cell phones are now sophisticated enough to collect and analyze data on personal behavior, and researchers are developing techniques that allow them to effectively sort through such information.

To create an accurate model of a person's social network, for example, Pentland's team combines a phone's call logs with information about its proximity to other people's devices, which is continuously collected by Bluetooth sensors. With the help of factor analysis, a statistical technique commonly used in the social sciences to explain correlations among multiple variables, the team identifies patterns in the data and translates them into maps of social relationships. Such maps could be used, for instance, to accurately categorize the people in your address book as friends, family members, acquaintances, or coworkers. In turn, this information could be used to automatically establish privacy settings—for instance, allowing only your family to view your schedule. With location data added in, the phone could predict when you would be near someone in your network. In a paper published last May, Pentland and his group showed that cell-phone data enabled them to accurately model the social networks of about 100 MIT students and professors. They could also precisely predict where subjects would meet with members of their networks on any given day of the week.

This relationship information could have much broader implications. Earlier this year, Nathan Eagle, a former MIT grad student who had led the reality-mining research in Pentland's lab, moved to the Santa Fe Institute in New Mexico. There, he plans to use cell-phone data to improve existing computational models of how diseases like SARS spread. Most epidemiology models don't back up their predictions with detailed data on where and with whom people spend their time, Eagle says. The addition of relationship and proximity data would make these models more accurate. "What's interesting is that you can see that a disease spreads based on who is infected first," Eagle says.

Taking advantage of other sensors in cell phones, such as the microphone or the accelerometers built into newer devices like Apple's iPhone, could even extend the benefits of reality mining into personal health care, Pentland says. For example, clues to diagnosing depression could be found in the way a person talks: depressed people may speak more slowly, a change that speech analysis software on a phone might recognize more readily than friends or family do. Monitoring a phone's motion sensors might reveal slight changes in gait, which could be an early indicator of ailments such as Parkinson's disease.

While the promise of reality mining is great, the idea of collecting so much personal information naturally raises many questions about privacy, Pentland admits. He says it's crucial that behavior-logging technology not be forced on anyone. But legal statutes are lagging behind our data collection abilities, he says, which makes it all the more important to begin discussing how the technology will be used.

For now, though, Pentland is excited about the potential of reality mining to simplify people's lives. "All of the devices that we have are completely ignorant of the things that matter most," he says. "They may know all sorts of stuff about Web pages and phone numbers. But at the end of the day, we live to interact with other people. Now, with reality mining, you can see how that happens ... it's an interesting God's-eye view."

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