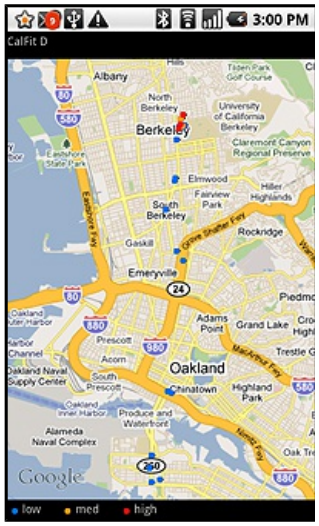
Smartphone technology makes exposure assessment more personal

By Nancy Lamontagne

In a new study, partially funded by NIEHS, the CalFit smartphone application developed at the University of California (UC), Berkeley improved air pollution exposure assessment, by providing personal data on time-location patterns and physical activity. Smartphone applications offer an inexpensive and easy-to-use way to gather personal exposure data.

"Having personalized information about where and when people are exposed to pollution raises questions about trade-offs that we haven't been able to think about before," said NIEHS grantee Michael Jerrett, *(http://ehs.sph.berkeley.edu/people/jerrett.htm)* Ph.D., of the UC Berkeley School of Public Health. "For example, if we encourage people to use public transit or to increase their physical activity by walking or biking, are we increasing their exposure to air pollution?"

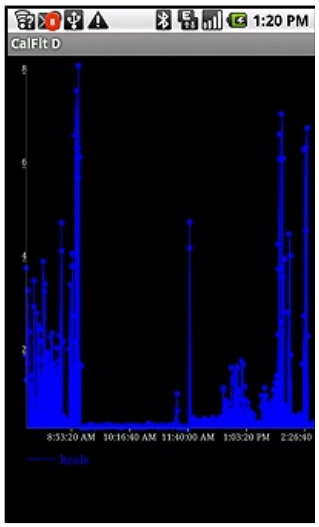


This CalFit screenshot shows the GPS capability for tracing where a person spends time during the day. (Photo courtesy of Edmund Seto)

Research-grade data

Developed by Edmund Seto, *(http://ehs.sph.berkeley.edu/people/seto.htm)* Ph.D., at UC Berkeley, who jointly serves as lead researcher on the study with Jerrett, CalFit runs on Android smartphones, using the phone's accelerometer to collect data on the user's energy expenditure associated with physical activity, and its global positioning system (GPS) to pinpoint geographic location. The researchers previously demonstrated that CalFit provides research-grade information that matches the accuracy of gold standard GPS and accelerometry instruments.

In the new study, *(http://www.ncbi.nlm.nih.gov/pubmed/23416743)* 36 people in Barcelona, Spain used CalFit to track their activity and location, and then the researchers linked the phone data with pollution maps. One key finding was that, on average, travel accounted for only six percent of the study participants' time, but this short time period accounted for 24 percent of their daily-inhaled nitrogen dioxide (NO_2). NO_2 is found in vehicle emissions and can cause respiratory problems, especially for people with asthma.



The application can also track the relative levels of energy expenditure for a person during the day. (Photo courtesy of Edmund Seto)

Although scientists know that pollution is higher during times when most people commute, typical air pollution assessment methods don't provide data on when, and for how long, a person is in an area with high levels of air pollution. Most studies use fixed-site pollution monitoring stations, or home addresses and pollution dispersion models to estimate exposure. Tracking physical activity is also key for determining a person's actual inhalation of air pollution, since a person can inhale up to seven times more air pollution on a bike than when in a car, for example.

Adding more personal information

In an NIEHS-funded follow-up study, the researchers are adding ecological momentary assessment to the CalFit information, to gain additional mood and behavior information from users. Five to seven times a day, a survey screen appears on the user's phone. The survey includes a wide range of questions aimed at gathering information, such as whether the user is aware of exposures, why the person was exercising at that time, and how the user felt while exposed to air pollution.

In other NIEHS-funded work, the researchers are collaborating with a research team at the University of Cambridge to develop a portable pollution monitor that will run alongside the CalFit software. Jerrett said that the UC Berkeley team is also designing its own air pollution sensors, to maximize battery life, be portable, and link directly with CalFit.

A long-term goal for scientists, developing cell phone-based exposure monitoring technology, is to one day have a large group of volunteers whose exposure-related data is gathered via their cell phones, sent to a server in real time, and then displayed on the Internet without personally identifiable information.

"This information could be used to better understand aspects of population exposure, such as how many people are active when pollution levels are high," Jerrett said. "It could also be used to alert sensitive groups, such as people with asthma, that pollution levels are currently high in a certain area."

Citation: de Nazelle A, Seto E, Donaire-Gonzalez D, Mendez M, Matamala J, Nieuwenhuijsen MJ, Jerrett M. *(http://www.ncbi.nlm.nih.gov/pubmed/23416743)* 2013. Improving estimates of air pollution exposure through ubiquitous sensing technologies. Environ Pollut 176:92-99.

(Nancy Lamontagne is a science writer with MDB Inc., a contractor for the NIEHS Division of Extramural Research and Training.)
