Citizen Science: How Smartphones Can Aid Scientific Research

Is your smartphone reaching its full potential? You may use your phone to text, Twitter and geo-tag photographs, but your phone can collect data for so much more than your social networks. A number of researchers are working on software applications that would enable smartphone users to help scientists gather data for research. Here are three projects that look to make citizens with smartphones into data collectors for science.

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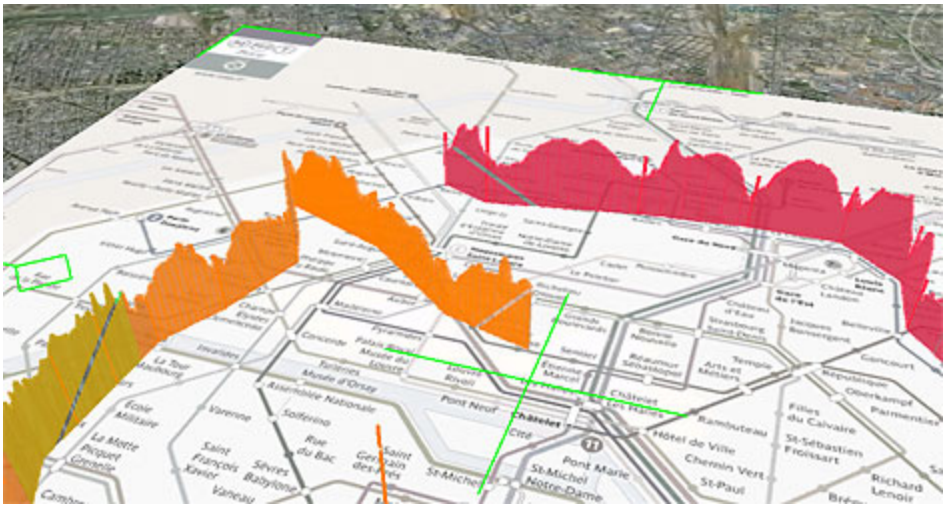

A smartphone-generated noise map of Paris. (Photo By N. Maisonneuve, Sony Computer Science Laboratory.)

Gathering geographic and time-sensitive data from large populations can be difficult, complicated and extraordinarily expensive for researchers. But collecting massive amounts of sensitive information may be as easy—and cheap—as writing an iPhone app. When combined with a GPS signal and a Wi-Fi or 3G connection, mobile phones can gather data, organize it and send it to a server to be analyzed. These large amounts of cheaply gathered data come at the cost of the control and reliability enjoyed in a laboratory setting—a problem that has come to light in recent years with scientific research that has relied on the processing power of everyday home computers and gaming consoles. With smartphone-based research, participants lose their phones, batteries fail and phones moving in and out of people's pockets and handbags can obscure data collection. Even so, having people constantly collect real-word data with existing technology is appealing to researchers on a budget. With simple software and consent from smartphone users, researchers can save money while getting more data, follow individuals in real time and gather data in places out of sensor or satellite range. Here are three projects that look to make citizens with smartphones into data collectors for science.

Measuring Air Quality

Eric Paulos, a researcher at Carnegie Mellon University's Human-Computer Interaction Institute, has used GPS-equipped Bluetooth phones to monitor carbon monoxide (CO) and nitrogen dioxide (NO_2) in San Francisco. Paulos was able to integrate a carbon-monoxide sensor into the phones' hardware and to install software that would send him readings and phone location information. He and his collaborators at Intel Research Berkeley then distributed the phones to city street sweepers. The results from preliminary trials of this system suggest the existence of microclimates—localized pockets with different mixtures of CO and NO_2—within sections of the city areas that the Bay Area's air-quality agency monitors. Maintaining measurement stations across the city would cost millions of dollars and wouldn't deliver the kind of detail researchers could get from citizens' mobile phones, says Paulos. The sensors he designed for his experiment cost only about $60 each.

Watching Workouts

Peter Capone-Newton, a public health researcher specializing in preventative medicine at University of California—Los Angeles would like to use smartphones to collect data on how, when and where people exercise, which could help researchers evaluate trends in health conditions such as asthma and obesity. Deborah Estrin, a researcher at UCLA's Center for Embedded Networked Sensing, has developed a software application for this exact purpose and hopes to start testing it within the year. Capone-Newton says that while other studies have quantified people's exercise habits, the advantage of using smartphones' accelerometers to collect data is that measurements can be taken outside of the lab, and in greater quantity. Plus, using a device people own means researchers can get data from more subjects for less money. "We have pretty good existing measures of how sedentary or not we are as a population," Capone-Newton says, "but studies using smartphones could give researchers a large-scale [data set] and could let you follow people's activity long-term in a nonintrusive way."

Listening for Hazardous Noise

Several cities in western Europe and the U.S. have attempted to identify the most hazardous areas decibel-wise by creating city-wide noise maps. They were motivated by studies indicating chronic noise exposure can lead to a host of nonhearing-related health problems, including cardiac events in adults and learning deficits in children. But blanketing a city with noise sensors is cost-prohibitive, which means most city noise maps rely heavily on computer models. Researchers at the Sony Computer Science Laboratory in Paris have been working on a software application that uses smartphones' microphones to measure noise and then maps the data on Google Earth. The French team's project, called NoiseTube, is a collaboration with the official noise-monitoring agency in Paris, the idea being to bolster the existing methods for data collection, not replace them.

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