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Instrumenting Our World, Ourselves, and Our Livestock

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This quarter's contributors to our Reddit site include posts about the many different ways we instrument our world, ourselves, and our stuff. Along with these topics come the inevitable discussions of privacy, power, and, of course, sheep. We also received more posts about drones—including drones for sheep.

INSTRUMENTING OUR STUFF

Smartphones continue to accrue sensors both inside and out. When on the outside, perhaps we can call such sensors "smart barnacles." We also need easier ways to recharge our sensor-hosting phones.

Acoustic Accoutrements

The most intriguing contribution this quarter is a collaboration between Disney Research Pittsburgh and Carnegie Mellon University called "Acoustruments." These are inexpensive plastic devices that you attach on or around your phone to provide new kinds of interactive control through acoustic manipulation (see Figure 1). Acoustruments take audio input from the phone's speaker at one end of a tube or cavity and feed it back into the phone's microphone at the other end. Along the way, you can alter the sound by changing various physical elements, such as the size and shape of the cavity, the continuity of the channel, and the number and placement of holes—much the way wind instruments manipulate sound.

The authors provide building blocks that allow for interaction controlled by touch, grip, sliders, rotators, and more, with high accuracy. The devices require no batteries or power sources—just acoustic input (see www.disneyresearch.com/publication/acoustruments for more information and a video).[1] However, you might end up with a clunky look and feel with phones such as the Moto X, which positions its microphone ports on the phone's display surface and back surface.

Turning Air Pressure into Gold

Barometric sensors made their way into phones just a little over three years ago (and only recently into the iPhone), but PressureNet was there at the beginning, with its vision of building the largest network of such sensors. Barometric phone sensors were intended to improve altitude measurements for GPS locations and elevation readings. With its strong crowdsourced sensing community, PressureNet now has over a billion atmospheric readings, and the collection is growing by about 5 million readings a day. This has become great material for improving weather forecasts, and PressureNet is now working on selling the data as a service to researchers and forecasters.

This is another example of crowdsourced sensing becoming profitable. To read more about PressureNet and its plans and tools, and how it is addressing privacy concerns, see www.pressurenet.io/blog/to-users-community-update.[2]

Powering Our Stuff

The more we rely on our phones, the more we require convenient charging. One member of our subreddit contributed a link to Ikea's new scheme for recharging mobile devices. As reported by Gizmodo's Adam Clark Estes (http://gizmodo.com/ikea-just-made-it-crazy-easy-to-add-wireless-charging-t-1698047498),[3] Ikea will sell furniture with built-in wireless charging. If you don't want new furniture, they will sell you a special drill bit that allows you to make the appropriate hole in almost any existing piece of furniture in which you'd like to install their new inductive charging device. If you don't want to drill any holes, they offer a cute wireless

JOIN OUR SUBREDDIT

This column offers a summary of interesting news and research in pervasive and mobile computing, with content drawn from submissions to a shared community on the social news site Reddit, at www.reddit.com/r/pervasivecomputing. We encourage you to join our subreddit and spread the news of this site to others, so that together we can build a sustainable online community for all aspects of pervasive and ubiquitous computing.
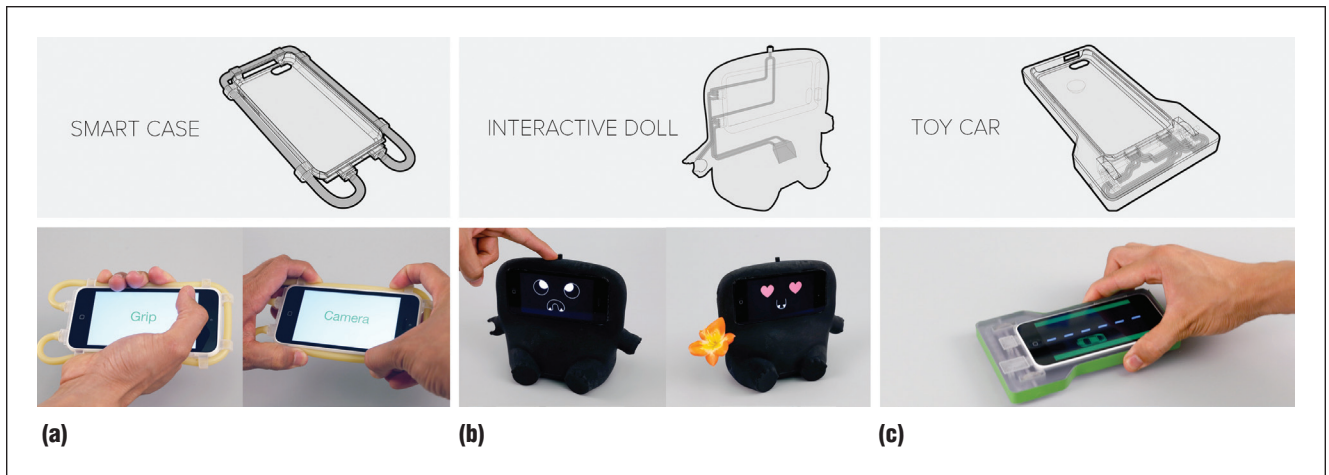   —*Mary Baker and Justin Manweiler*

Figure 1. Acoustruments take audio input from the phone's speaker at one end of a tube or cavity and feed it back into the phone's microphone at the other end. You can alter the sound by manipulating various physical elements along the path. Via these acoustic controls, you can create interfaces and devices. Examples include a (a) case, (b) doll, and (c) car. (Source: Disney Research, Pittsburgh; used with permission.)

charging pad you can slap down wherever you'd like to recharge your device. And if your phone isn't already equipped with Qi inductive charging capabilities, they even offer phone cases that will bring that functionality to your phone. One way or another, you'll be able to recharge that phone wirelessly!

INSTRUMENTING OUR ENVIRONMENT

Beyond sensing on phones, contributors this quarter posted information about instrumenting our environments with a variety of sensors and actuators.

Paying Local Experts

While crowdsourcing things like weather readings benefits from a passionate community, finding that community for some tasks can be very difficult. Online labor markets such as Mechanical Turk (www.mturk.com) work best for unskilled, relatively low-paid work. What if you need a community of experts? In the case of the Umati Project from UC Berkeley, the answer is to bring the work physically to the expert community in the form of kiosks, and then offer a convincing incentive.

The Umati Project's Community-Sourcing Vending Machine (see Figure 2)

dispenses candy as the very desirable payment for grading endless introductory-level CS exams via its touchscreen interface. Grad school, of course, is not survivable without candy. For more explanation, photos, and a video, check out http://represent.berkeley.edu/umati.[4]

Turning Buttons into Gold

Amazon is trying out several ways of instrumenting the home environment to make it easier for consumers to purchase products as soon as the thought crosses their minds. We mentioned Amazon's Echo in a past column (www.amazon.com/oc/echo). Another approach, the Dash Button, is a small device consumers attach to a surface near where they use things like detergents, lotions, and coffee. When running out of the product, the consumer just presses the button to order more.

Removing friction from the buying process might help Amazon grab a larger share of the consumables market. How much friction does the button remove compared to ordering by phone? Results remain to be seen, but as Adrienne LaFrance points out in *The Atlantic*, (www.theatlantic.com/technology/archive/2015/03/the-amazon-button-is-real/389234),[5] "People don't always want to pull out their smartphone right after using the last paper towel on the

roll." For Amazon's video about the Dash Button, see www.youtube.com/watch?v=NMacTuHPWFI. Might our future refrigerators be covered with re-ordering buttons instead of kids' photos and drawings?

Industrial Instrumentation

Aside from home environments, there are many compelling reasons to instrument industrial environments. The French commercial creativity services company, Sid Lee, offers a delightful dashboard showing the current status of the many items they have instrumented in their office (http://dashboard.sidlee.com). If you don't see a readout moving as you'd expect, remember the time zone of the instrumented office—it could be everyone is at home sleeping.

Another company, SeeControl, has helped many commercial customers save money and reduce energy consumption, including a leading US manufacturer of carpets. Energy prices that vary hourly at the carpet manufacturer's Western US plants caused financial losses. Furthermore, the company wanted to predict when machines on the production floor would give out. Using eGauge's electrical submeters and SeeControl's IoT cloud service and tools, the company was able to meter

and visualize their energy consumption. After one month, the company had a full shop-floor enterprise-scale energy management system. See http://startupfocus.saphana.com/introducing-seecontrol-the-first-turnkey-iot-solution-for-enterprise-customers for more information about this use case.[6]

Shepherds of Progress

But what if the environment you want to instrument consists of sheep in the hills and fields of Wales? If you have not already viewed the viral video of Extreme Shepherding from the "Baaa-Studs" (www.youtube.com/watch?v=D2FX9rviEhw), it's well worth watching. Sheep and sheepdogs instrumented with Samsung's Smart LED technology make for illuminating outdoor farm art. For behind-the-scenes information about how they did it and how much of it was real (almost all, apparently, with the "very able" sheepdogs doing most of the work) see www.youtube.com/watch?v=FxedtAM2j7g.

INSTRUMENTING OURSELVES

Readers continue to post items about wearable technology. Interestingly, the only post about Apple's new watch touched on the company's retail strategies to ensure that returned watches have as much gold in them as when they were purchased. Instead, we cover more fitness clothing and a Google Glass app.

My Clothes Are Smarter than I Am

One contributor shared *CNN Money*'s article positing that the biggest growth area for fitness devices will be smart clothing (http://money.cnn.com/2015/03/20/technology/fitness-wearables-smart-clothes/index.html).[7] The article mentions three brands. First, Indian startup Lechal's smart shoe was originally designed to help the visually impaired navigate via haptic feedback telling the user which way to turn. Lechal now offers both shoes and insoles instrumented to measure distance, calories, and steps. The shoes store the results, and you can download the data via an
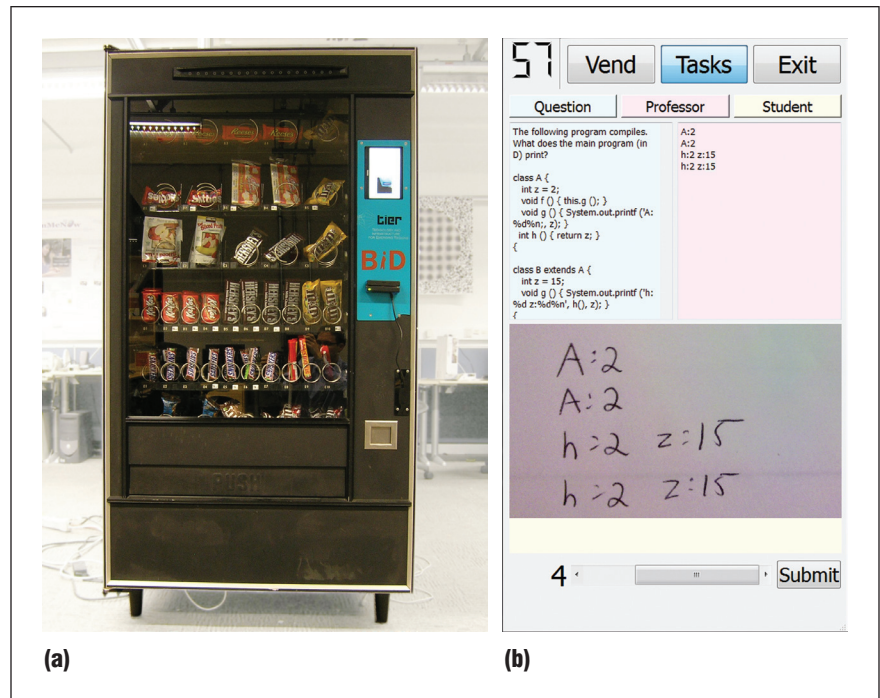

Figure 2. The Umati Project's vending machine and exam-grading touch interface. (Source: The Umati Project; used with permission.)
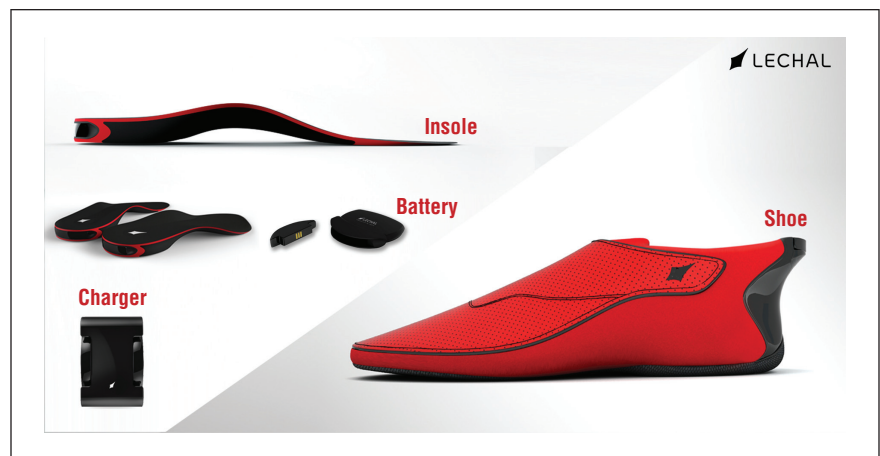

Figure 3. Lechal's smart shoe, which can measure distances walked, calories burned, and steps taken. (Source: Lechal, http://lechal.com; used with permission.)

app when you're done exercising (see Figure 3). Building step sensing directly into the shoes might help avoid some of the inaccuracies found with devices that don't sense the user actually putting his or her weight into the step.

The second company, Glofaster, offers a jacket for runners that senses speed and heart rate and can flash lights along the sleeve if you're not exercising hard enough.

The third company is Sports Performance Tracking, whose vest contains a GPS unit to measure speed and distance. This vest is oriented toward teams and can tell you how well each player is doing in a game. It can also tell you if a player is working so hard that a potential injury

is possible. The latter feature sounds very useful, but we wonder if the former feature could cause individual anxieties that reduce the sense of teamwork.

My Accessories Are Better Speakers than I Am

Another post on wearables covers Rhema, an application that uses Google Glass to provide feedback to speakers about their pace and volume. The researchers evaluated a variety of ways to display the feedback to speakers via the glasses, including color-coded warnings, words, and graphs. They experimented with both continuous and occasional feedback but settled on providing feedback every 20 seconds in the form of the words "louder" or "slower" as needed. They tested the system on 30 native English speakers and also used Mechanical Turk workers as audience members to judge whether video-taped speakers behaved differently when wearing the glasses in terms of using filler words, making eye contact, appearing stiff or uncomfortable, or seeming distracted. Find out more about this University of Rochester research at http://phys.org/news/2015-03-wearable-technology.html.[8]

The reported results are encouraging, although we believe there is a class of speakers that will feel even more foolish if they're caught wearing smart glasses while giving a talk. Also, we're not sure how the system adapts to different spaces with differing volume requirements. We're reminded that worried public speakers are often prompted to find comfort through pretending their audience is not wearing clothes. I've never understood why that wouldn't make the speaker even more worried, but if it actually works for anyone, then there's a clear augmented reality application for smart glasses for public speaking.

THE NEW WORLD ORDER

This quarter several community members contributed posts concerning privacy issues and how the future is shaping up regarding our increasing use of technology and smart devices.

Barbie Hears Everything

The most popular post this quarter flags privacy issues behind Mattel's new "Hello Barbie" doll. Caitlin Hu's article for *Quartz* tells us that while Barbie can finally hold a conversation (a long-standing request from children), the Wi-Fi-connected toy also sends everything Barbie's playmate says back to the company (http://qz.com/362891/new-hello-barbie-records-kids-voices-and-sends-the-intel-back-to-mattel).[9] If the child playing with Barbie presses a button on the doll's belt, Barbie will ask a question and record the child's response and send it to the cloud. In the cloud, ToyTalk's software processes the audio for its content. This content helps trigger an appropriate response from Barbie.

ToyTalk uses these recordings over time to learn children's names, interests, and conversational styles. The company will also use these recordings "for other research and development or internal purposes" and may also "share extracted data and transcripts … from which any personal information has been removed" with third parties.[9] Mattel says this information will not be used to target advertising to children, but some parents remain concerned about the privacy implications of this new functionality for the famous doll. On the other hand, maybe adaptive conversation will prove more acceptable than pre-programming Barbie to say "math class is tough!" (www.youtube.com/watch?v=NO0cvqT1tAE).

A View into 2017

According to *Parks and Recreation*'s final season, future (2017) technology companies are still using people's personal data in uncomfortable ways, and they're still forcing U2 music onto people's personal devices. Sean O'Kane's article in *The Verge* extracts the show's key predictions of our technological future (www.theverge.com/2015/2/25/8095109/parks-and-recreation-series-finale-future-tech-vision).[10] Personal devices become clear glass displays, wearables are rare but

goofy, everyone uses cumbersome gestures to interact with devices, and drone delivery exists but seems a bit frightening. Also, Ron Swanson shoots a drone out of the sky, but that probably isn't too surprising to fans of the show.

Comparing Two Lives

Another reddit member posted a short documentary by Ivan Cash (via an article in *The Atlantic*, www.theatlantic.com/video/index/386579/how-do-you-function-without-a-cellphone)[11] about our dependence on smartphones. This topic often seems trite, although this documentary is rather sweet. It compares the lives of a San Francisco designer who has never owned a smartphone and a teenage girl who hasn't gone a day without hers since she received it. The video is called "How Do You Function Without a Cellphone?" The designer is happy to be without a phone, although he believes he might eventually need one due to the devices' great utility. The teenager wonders whether cell phone use prevents her and others from living physically enough in the moment. She knows that time is passing her by quickly.

These all seem like valid points, although the minutes spent showing the differences in the two walking might be pushing the matter a bit. The walking designer always looks happy and engaged with his surroundings, while the teenager is always head-down and furiously texting while walking. Such matters are rarely so cut and dry.

THE SKIES ARE ALIVE WITH COPTERS

Even if *Parks and Recreation* does not fully endorse drone delivery, our community continues to be fascinated by the topic.

The Ultimate Selfie

Instead of taking a photo of yourself before and after you skateboard down the mountain or run up it, you can have a complete video of the event to show the world. 3DR's IRIS+ or new Solo

Figure 4. 3DR's Solo quadcopter. (Source: 3DR, www.3drobotics.com; used with permission.)

quadcopters can automatically follow you and film you while you go—almost like having your own mobile aerial film crew. You can also fly the devices manually with a controller or from a wearable or mobile device, and you can draw a path on a map and the drone will follow that path making it great for mapping applications.

The IRIS+ gives you 15 to 20 minutes or more of flight/filming time and is available for well under US$1,000. The new Solo, available for pre-order at US$1,000, makes it even easier for ordinary people to get high-quality footage right out of the box (see Figure 4). Check out the posted video at www.youtube.com/watch?v=_yOCTgVqmeQ or look for more information at 3DR's website (www.3drobotics.com).

Fewer Nasty Letters

In a recent column, we covered new regulations from the FAA regarding the safe and legal flight of drones. *Bloomberg Business* also reports that the FAA is trying to take a kinder and more forgiving approach to ensuring the safety of our airspaces (www.bloomberg.com/news/articles/2015-04-14/drone-home-videos-on-youtube-no-longer-provoke-faa-wrath).[12] While doing dangerous, illegal things will still get you in trouble, the FAA hopes to encourage voluntary compliance through educating

individual drone operators about safety issues and current laws and regulations. Apparently, they will no longer hunt down authors of YouTube drone videos to send them harsh letters or scare them into removing the videos. So, be safe and do the right thing, but go ahead and post that nice aerial video of your personal speed boating record.

And Finally, More Sheep

In his video (https://youtu.be/yD9KUB7QqZI), Paul Brennan introduces Shep, the world's first drone sheepdog. The video shows the view from the drone as it moves a herd of sheep through a narrow passage from one field to another in Carlow, Ireland. Maybe the next iteration of farm LED art from the "Baaa-studs" will use a swarm of drones instead of actual sheepdogs to move sheep in ever more artistic patterns. ℗

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