Drones, More Wearables, and New Things to See and Feel

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Thank you for reading this quarter's edition of Notes from the Community. Recent contributions to our subreddit community include the ever-popular topic of wearables, as well as new topics including drones and novel interactions enabled through holographic displays and haptics.

WEAVING WEARABLES INTO OUR LIVES

Wearables remain at the top of our subreddit's billboard. This quarter, we see a kid's wearable device for health and safety, two types of wearable clothing for sports and workouts, more smart glasses, and a useful reminder that many people have been wearing assistive smart devices for ages in the form of hearing aids.

No Privacy for Safe Kids

The Miiya is a wrist wearable device targeted toward children ages four to 10 to encourage increased physical activity, help keep them safe, and give them something to talk about with their parents. In other words, the goal is healthier kids who won't go missing and who won't say "nothing" when asked about what they did all day. It sounds great, right? But maybe not from the kid's perspective: the tracking of kids and other dependents remains controversial.

The device includes GPS and activity tracking to send a daily activity report to parents. Now the conversation might be "I see you didn't do any running today. No dessert for you." It also includes a Bluetooth geofencing system so the parent can receive alerts if the kid moves too far away. Given that range detection using Bluetooth varies greatly in its behavior,[1] this may cause a lot of false alarms. The inventors argue this is a less invasive kind of tracking, because it doesn't give a location but merely a relative distance from the parents. Miiya's last feature is the ability for a kid to "tag" a location, so they can remember to tell their parents about something they did during the day. So the final topic at dinner can be, "Why didn't you tag any locations for us to discuss today?" The kid can then reply, "Because I really didn't do anything today." Read more about this controversial wearable, whose Indiegogo campaign ended short of its fundraising target, at http://techcrunch.com/2015/01/10/miiya.[2]

Smart Clothing

Readers submitted articles about two workout-related wearables this quarter as well as about a beautiful but frightening dress. The first workout wearable is from Athos (see Figure 1) and embeds the following into body-conforming workout shirts and shorts: electromyography (EMG) sensors (to measure muscle activity), heart rate sensors, and breathing sensors. Their system gathers data from the sensors, and an app on your phone tells you how hard you're working and what you're doing wrong—such as whether your right leg is pushing as much weight as your left. *TechCrunch* covers the clothing at http://techcrunch.com/2014/12/04/gearing-up-for-the-future-of-connected-workout-clothes-with-athos,[3] and Athos provides more details at www.liveathos.com/apparel/gear.

The second contribution is specifically for women, again covered by *TechCrunch* at http://techcrunch.com/2014/11/25/victorias-secret-heart-rate-sports-bra.[4] Victoria's Secret now sells a sports bra with embedded electrodes to which you can connect a heart rate monitor. The hope is that these more discreet sensors provided by smart clothing will appeal to a broader market than the more obvious fitness bands and clunky chest straps.

As fashion statements go, the Spider Dress is a dramatic one. This 3D-printed sensor-based dress has a heart-shaped skeletal cut-away front with spider-like mechanical limbs near the shoulders that respond to external stimuli. The dress uses proximity sensors as well as a respiration sensor to understand and protect the personal space of the wearer. If you approach the wearer aggressively, the limbs move up to an attack position. If you approach nicely, under calmer circumstances, the limbs might give you a suggestive "come-hither" gesture instead. Although spooky, the dress is beautiful. You can find a poorly edited video at https://vimeo.com/114828162. One reddit commenter says, "lame edit, nice dress."

Glasses for Academics

JINS MEME is a pair of eyeglasses that can measure eye movements and head motion. Researchers at Tohoku University, Keio University, Shibaura University, and elsewhere have already used this electro-ocular information for an exciting variety of purposes including detecting "dry eye" from blinking patterns and mental attention and focus problems. The glasses look normal, with most of the electronics tucked behind each ear. This is also a consumer device, but special kits containing the same devices are available for academic researchers. Read more at http://academic.jins.com/en.

Don't Forget the Ears

With all the publicity over smart glasses, it's easy to forget about one of the oldest and most useful wearable smart devices: hearing aids. *The Atlantic* brings us a nice article written by Ryan Budish of the Berkman Center for Internet & Society at Harvard University.[5] Budish has worn hearing aids since he was a kid and has experienced firsthand 30 years of improvements brought by smaller, lower-power sensors and electronics. This gives him some insight into what "sensory-enhancing wearables—like hearing aids, and unlike data-recording wearables like pedometers—could someday become." He

Figure 1. Workout clothing with embedded sensors from Athos. (Source: Athos; used with permission.)

gives a list of requirements, such as the need for wearables to justify their place on our bodies, and predicts that wearables will eventually be ruled by algorithms so they can understand and adapt to their context to provide the best possible service. Budish reminds us that wearables are not just novelties but also indispensable tools, and we should take them seriously. Check out his further comments at www.theatlantic.com/technology/archive/2015/02/what-my-hearing-aid-taught-me-about-the-future-of-wearables/385145.

DRONES FOR EVERYTHING, INCLUDING CONGRESS

Drones are a newly popular topic for our subreddit. Drones now let us do things we couldn't do before, or do things for orders of magnitude less money, or in orders of magnitude less time. They also fail during congressional demos, and now that they have become so affordable, many are worried we'll see a lot of unsafe behavior from new, inexperienced drone hobbyists.

Drone-Enabled Mapping for Everything

One contributor submitted a link to Andrew Rosenblum's *Popular Science* article (www.popsci.com/rise-drone-mapper) on new, or less expensive, aerial mapping applications that drones have enabled.[6] Aerial imagery has long been used for military purposes, but it used to cost a lot and require a plane and a pilot to fly through potentially hostile airspaces. Now, ordinary citizens can send drones up to take pictures and then can use apps like Maps Made Easy to stitch them together to create a map cross-referenced with location information. Geologists such as Larry Hulbert use aerial photography for searching for mineral deposits, and now he no longer needs to gather these images by helicopter. Hulbert says "Drone technology is really changing the industry I work in… but anyone can buy a drone and take pictures—it's putting them all together that's the breakthrough technology."

Drone technology (see Figure 2) is also aiding wildlife conservation, especially

Figure 2. Cameras and other sensors attached to a researcher's drone. (Source: Justin Manweiler; used with permission.)

antipoaching efforts, and disaster relief because it's now affordable for rangers and humanitarians. An entirely new application is cemetery management. This used to require surveyors on foot to match the location of all the graves with cemetery records, but new drone mapping technologies have made this much faster—only two hours, down from 100 hours, for a 12-acre cemetery.

When Demos Go Wrong
Failed demos can be fun to observe if nobody gets hurt, and there have been lots of these with drones. One community member submitted a link to this video footage in the *National Journal* of a drone demo at a US congressional hearing (www.nationaljournal.com/tech/watch-a-drone-fly-around-and-crash-during-a-congressional-hearing-20150121).[7] As Dustin Volz writes, congressional hearings are not usually this exciting, but the topic is timely as the US Congress has asked the Federal Aviation Administration to ready our airspaces for commercial drones. Even news agencies such as CNN have received permission to use drone systems to gather news, and lots more commercial use is expected.

Trying to Avoid Real Disasters
But of course not all drone failures are so benign. In the past, drones were hard to come by and expensive for hobbyists, who largely paid attention to safety needs and regulations through things like the National Model Aircraft Safety Code (see www.modelaircraft.org/files/105.PDF). Some of these rules should be obvious, such as don't fly your drone over 400 feet high or by an airport. But with the influx of affordable drones, we see many new and less experienced pilots who don't understand the harm they can cause. This started to scare people, which was interfering with deployment of new commercial uses of drones.

To enable these new uses, the Federal Aviation Administration has just proposed a new set of regulations (www.faa.gov/regulations_policies/rulemaking/recently_published/media/2120-AJ60_NPRM_2-15-2015_joint_signature.pdf) for commercial "small, unmanned aircraft."[8] (Hobbyist use is still permitted.) Of course, there's controversy over the new rules, and many feel they're too bureaucratic and will severely limit new drone-based commerce (https://hbr.org/2015/03/whats-wrong-with-the-faas-new-drone-rules).[9] Enjoy reading about these aerial arguments.

NEW DIMENSIONS OF COMMUNICATION
Community members are always intrigued by new ways for humans to interact with technology. This quarter, we see two approaches to holographic displays and new users for haptic communications.

Creating Your Own Holographic World
One community member posted a promotional video about Microsoft's HoloLens work (https://www.youtube.com/watch?v=aThCr0PsyuA). As is the case with many promotional videos, it's hard to tell what's real, and there's no technical information. The longer video of a live demonstration of HoloLens and HoloStudio (https://www.youtube.com/watch?v=b6sL_5Wgvrg), however, is worth watching. HoloLens is a set of augmented reality glasses through which you can see and manipulate what appear to be real 3D objects added to your environment. You can walk around in that environment freely because HoloLens is fully untethered. With high-definition lenses, spatial sound, no need for markers or external cameras, and the inclusion of the HoloStudio toolkit for creating and manipulating your own holograms in real-time, this augmented reality demonstration is very exciting and convincing.

Unfortunately, we have also just heard very sad news that a project designer, Mike Ey, was killed in a hit-and-run car crash.[10] Researchers everywhere in augmented reality pay tribute to him; beyond his 3D dreams to change the world, he improved the lives of everyone around him. This is a painful reminder of how dependent technology advances are on the humans who make them possible. We send thoughts of comfort and community to his family, friends, and coworkers.
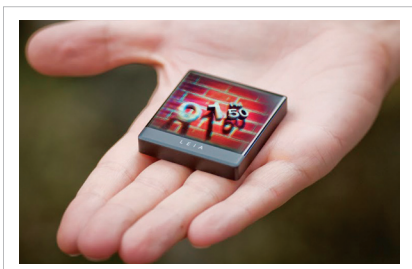
Figure 3. Leia provides holographic displays in a range of sizes. (Source: Leia Inc., www.leiainc.com; used with permission.)

The Princess Leia Display

Startup Leia takes a different approach to holographic displays (see Figure 3). They offer a display technology that can present full-color holographic images right above the screen. Recent work lets them do this even with conventional liquid crystal displays (LCDs) for easier commercialization. Those who enjoyed Princess Leia's holographic message in Star Wars might be excited to see the same possibilities from their smartphone or wearable. Read more about this work at www.technologyreview.com/news/535376/new-display-technology-lets-lcds-produce-princess-leia-style-holograms.[11]

Talking about Haptics

One very interesting topic this quarter is about new uses of haptic communication. *Wired*'s Clive Thompson writes about how finer-controlled buzzes and vibrations can enable new communication paths through our skin (www.wired.com/2014/12/haptic-technology).[12] Many wearables already incorporate a haptic motor that gives a discreet buzz to alert you to events such as an upcoming meeting or a low battery. Seungyon Claire Lee, a wearables designer at Google, has tested a wristband with three small buzzers in it. Using 24 different vibration patterns, she found that her test subjects could tell the difference between the patterns with 99 percent accuracy after only 40 minutes of training. As the technology improves and we discover more about the density of information people can distinguish through

this medium, more complex kinds of communication become possible.

An app called Mumble! (available at Google's Play Store) uses patterns of vibration to provide information about incoming texts. After a few weeks, users develop the ability to recognize the authors of a text or the text's relative urgency without the need to pull out their phones. This technique is also potentially useful for emergency alerts: General Motors uses it in drivers' seats, where a vibration in a certain direction notifies the driver of a coming collision in that direction. This is reminiscent of Ferscha and Zia's Life-Belt work,[13] which provides directional assistance to guide the wearer to a safe exit to escape a disaster scene in which it's too dark or smoke-filled to see and too noisy to hear. As Thompson points out, though, one reason this medium is so popular is that it's a way of removing some of the technological distractions of constant communication through other means (sound, graphics, and so forth). If we offload too much to haptics, it might no longer provide this benefit. ℙ

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