Wearable Technology

Scenario

Adele, a graduate student in environmental science, is spending her summer testing wearable technology along a coastal waterway in a national park. The wearable device, resident in an ear clip, can "hear," analyze, and record the environmental biophony—all the sounds made by animals other than humans. When it is ready for market, the device will operate as a field guide to area wildlife. The device hears and parses sound far more effectively than the average human ear. Once it recognizes a bird, mammal, reptile, amphibian, or insect, the device plays the sound into the ear of the wearer. It verbally identifies the creature and helps the user distinguish that "voice" from others in the ambient sound.

Adele's specialty is estuary avian life, and she is helping build the mobile database of bird species that this wearable device uses. Her job is to listen to a bird sound when the device plays it in her ear and to confirm any identification the program provides. If no identification is offered, she flags the sound file and attempts to offer an identification. In this latter task, she is aided by a helmet-mounted telescopic lens that folds down to enhance her vision and function as a camera viewfinder for snapshots.

Today Adele is testing another phase of the project. One of her colleagues has developed a database of bird images. Once the wearable device identifies a sound, it sends a signal to an app on Adele's smart phone that displays an image for visual ID.

For the last 20 minutes of her work, she re-tunes the device to analyze the complete biophony of the forest so that she can enjoy all the sounds of life around her. When she reaches the exit, she is stopped by a ranger, who wants to be kept apprised of the work on her project. He believes the wearable device would enhance visitor appreciation of area wildlife, educate students, and raise awareness of the importance of the interconnected life of an estuary ecosystem.

1 What is it?

The distinctions between computers and everyday items is blurring as **IT becomes a component of things that are primarily designed for other purposes: cars, buildings, appliances, and, increasingly, things we wear**. For the purposes of this brief, an Internet-connected smart watch or a pair of running shoes with sensors in them are "wearable technology," whereas a smartphone or a tablet is simply "mobile." Wearables can be networked or might store data that can be transferred later to other devices. In many cases, the technology need not be activated; it simply functions as part of the item. Wearables can *gather* data—from the body of the wearer or from the environment—or *provide* information, or both. Wearable technology could, for example, locate a lost child, manage the wearer's phone messages, alert medical help, or provide the user with information based on the user's location.

2 How does it work?

Some examples of wearable technology, such as Google Glass, are complex, multifunction systems, but most wearable devices focus on a narrower range of purpose with a limited set of features. These functions might be as simple as notifying the wearer of messages received via phone or social media, or they may perform complex services, such as a device for diabetics that monitors glucose levels and administers insulin as needed. Some wristbands track fitness data such as steps taken, calories burned, and sleep patterns and send those data to the wearer's mobile device. In some cases, heart rate sensors are woven into tank tops or tees and can share that data with exercise equipment. These devices offer a type of computer-boosted self-awareness for the wearer, a quantified self who can employ information from multiple sensors to determine health, fitness, or peak performance.

3 Who's doing it?

In higher education, the use of wearables remains largely experimental. At the Wexner Medical Center at Ohio State University, a surgeon transmitted live video of an operation to remote students via Google Glass while collaborating with a colleague at a third location. A study at Northeastern University uses wearables to monitor the movements and

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physiological states of individuals with autism; data from these devices allow caregivers to better understand the needs of those who have difficulty communicating in an upsetting or stressful situation. A wearable device developed at Georgia Tech University's College of Computing can retrieve data from the web, present it on an eyeglass display, and connect the user with a distant colleague for consultation. The Contextual Computing Group at Georgia Tech is developing complex apps for this wearable, including a tracking device that can record the wearer's usual daily path and provide phone messages such as "Bill is currently teaching a class but will be available if you'd like to call back in an hour."

4 Why is it significant?

Wearables represent an evolution in our relationship with computing and hint at a future of ubiquitous connectivity where the furnishings of our everyday life are imbued with sensors, processors, and information displays. Wearables that monitor users' physical state might enable timely intervention in medical conditions. Devices such as the GoPro cam provide a video record of events. Such tools could allow real-time exploration of a crime scene narrated by a detective during a criminology class. For those consuming data, the display of information a few millimeters from the eyes can offer learning support through augmented reality. Learners attempting to espalier a fruit tree, for example, can view text or video instructions in their goggles or eyeglasses right beside the problem to be solved. Similarly, a visitor to a 12th-century castle can read a data overlay that explains the site's significance, provides dates of associated historical events, and lists the hours when the venue is open to the public.

5 What are the downsides?

The connectivity that makes wearable devices useful raises questions of privacy, security, and informed consent. Anything that can send and receive data can be hacked, and wearable cameras can infringe on privacy. Despite the attention on wearables, a recent survey found that only 9 percent of consumers were eager to own a wearable device. As the market evolves, developers may find themselves struggling to re-size content for a wide variety of display sizes and shapes, and attempting to make a wearable computer comfortable—much less fashionable—is another challenge. In addition, the power needed to run complex wearable devices usually means heavier batteries and increased heat. The cost of yet another computing device in a learning environment could be burdensome to many students, and the presence of wearables in class could raise concerns about cheating and unauthorized recordings of lectures.

6 Where is it going?

Emerging developments may remove the challenges of battery life, including the weight, heat, and need to recharge. Engineers at the University of Washington have created wireless communication devices that interact without batteries by using a technique called "ambient backscatter," which powers communication by reflecting transmissions of TV and cellular devices. Researchers at the University of Illinois at Urbana-Champaign have created batteries a few millimeters in size that offer 2,000 times the power of comparable batteries. Wearables might incorporate haptic feedback, such as discrete tactile alerts to messages or upcoming appointments. Devices may combine touch with location-based notification, so that our own shirtsleeves tug us toward our next destination. Biometrics combined with wearables may offer more effective security options. The Nymi wristband by Bionym can unlock a laptop, smart phone, tablet, or bank account. The wristband confirms identity by checking for the wearer's unique heartbeat.

7 What are the implications for teaching and learning?

Inconspicuous wearable devices could change the landscape of educational computing. Wearable cameras, for instance, allow a learner to engage simultaneously as observer, reporter, and participant, enabling more detailed life-blogging and providing a subjective point of view for digital storytelling. The data-gathering potential in biometrics and environmental conditions could support research, providing information collected without human interaction and thus with less risk of contamination. In turn, such affordances for research may require new mechanisms for informed consent and re-examination of ethical practices regarding use of personal data. Finally, **these devices might offer powerful assistance to those with visual, auditory, or physical disabilities**. Experts can monitor students with learning disabilities remotely and recommend interventions, and students struggling with language issues can access immediate translation. As the things we own and wear acquire sensors, process data, and connect us beyond ourselves, they open new opportunities for us to see further, hear differently, and touch things we have never been able to reach, enabling a new self-awareness and an enhanced perception of the world around us.