Physiological monitoring was once squarely in the realm of medicine, but has since broken out to personal, sports, and military training and improvement. More significantly, miniaturized sensors, the Internet, and smartphones have been combined to create an “Internet of You” in which physiological data across populations is being analyzed for both health and economic applications.

“There are three things extremely hard: steel, a diamond, and to know one’s self.”
—Benjamin Franklin, Poor Richard’s Almanack, 1750

Physiological monitoring is the measuring of the human body to understand health and disease, optimize physical and mental performance, and enhance learning and entertainment. Over the last two centuries, the technology of physiological monitoring has progressed from primitive to pervasive, enabling applications that span from necessary to narcissistic.

Physiological monitoring was once squarely in the realm of medicine, but has since broken out to personal, sports, and military training and improvement. More significantly, miniaturized sensors, the Internet, and smartphones have been combined to create an “Internet of You” in which physiological data across populations is being analyzed for both health and economic applications.

To achieve this paradigm shift, entrepreneurs and established firms are leveraging a confluence of enabling technologies and consumer trends: better sensors, more data processing power and memory in smaller, lighter packages, more power density, the ubiquity of smartphones and inter-device wireless communications (like Bluetooth), app ecosystems, the advent of the Cloud, and the ubiquity of GPS. A significant part of the paradigm shift is the confluence of physiological sensors with social media. The networking of physiological monitors allows users to share health status data in real time; couch potatoes can’t hide their sloth from their friends unless they take off the sensor. Similarly, networking facilitates competition between friends, or even with strangers known only through the shared customer community (the so-called “gamification” of fitness).

A clear example of all of these advancements combined in a single package is Basis, a wristwatch-like sensor package launched in 2012 that measures temperature, sweat (via skin conductivity), blood oxygen content (via an infrared sensor), and body motion and orientation (via three-axis accelerometry). Data are transmitted from the wrist device to a user’s smartphone via...
Bluetooth, and relayed (along with GPS information) by the phone to Basis applications in the Cloud. Raw data from the sensors are combined with user-provided data (like age and weight) and analyzed at each level (wrist, phone, and cloud) to further calculate calories burned, sleep quality, and other parameters. All of this information is provided as feedback in applications that help the user maintain a healthy lifestyle, train for a particular sport, or compete with friends who also own Basis devices.

Again, these applications were once dominated by medical device companies; however, the increasingly broad adoption of networked physiological sensors by consumers is driving down costs, as is typically the case with breakout technologies. That said, Basis does not intend to reach profitability solely on the sale of goods and services to consumers. The company offered its device at launch for $199, and customers can dress up the devices with interexchangeable watchbands and other accessories. Customer data analysis is being provided on the freemium model, with access to advanced applications for additional fees.

If Basis (and its competitors) will not provide the desired return to investors by selling devices, apps, and accessories alone, what is the value proposition? The intended study of such companies is their customer base, and the main product will be insights into consumer behavior. (Or to paraphrase my colleague Sri Chandrasekar, “If the technology is inexpensive, then you are the payment!”) Want to pick a location for the athletic shoe store you’re opening? Companies like Basis will tell you where to find the 18 to 24-year-old runners who log more than 20 miles per week. Selling motivational programs? Pay up and learn which customers are not keeping up with fitness goals. Where will healthcare resources need to be deployed? Networked sensor companies know the general health state of their customers, where they are, and how their health is trending over time.

Which applications in this space will interest the IQT customer community? Beyond optimizing fitness and training, some firms are designing products to wear under protective gear during operations, providing a means to both track and monitor personnel working in harm’s way. The ability to assess the health of populations can give early warning of pandemic infectious disease. Other, more targeted applications are apparent, but some adopters will need to balance operational requirements with potential legal constraints governing medical privacy. As wearable physiological sensors gather and process more and more data, the operational opportunities and regulatory challenges will grow at the same pace.

**The increasingly broad adoption of networked physiological sensors by consumers is driving down costs, as is typically the case with breakout technologies.**

---

**Dr. Kevin P. O’Connell** is Vice President with IQT’s Physical and Biological Technologies Practice. He has been with In-Q-Tel since 2007. His 28-year career began in applications of molecular microbiology to problems in agriculture, and progressed to research and development projects in biological defense. He was a scientist and principal investigator with a Department of Defense laboratory for 10 years, where he focused on pathogen detection and genetic characterization. He is the author of over 50 peer-reviewed journal articles, book chapters, and other publications, edited a recent book on biological defense, and holds eight patents. O’Connell holds a B.S. degree in Life Sciences from MIT and an M.S. and Ph.D. in Bacteriology from the University of Wisconsin-Madison.